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Ethnobotanical study and characterization of medicinal plants used by populations of Kisantu and Mbanza-Ngungu territories, Kongo-Central Province (DR Congo)

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Pathy Kibungu Kembelo

« We have been blessed with an invaluable wealth of medicinal plants from nature, which we must safeguard and maintain for the posterity. Achieving this noble objective needs a deep understanding of plants and their natural habitat, as well as adequate measures to conserve the ecosystems that support their growth. »

Rosemary Gladstar

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Acronyms and abbreviations

AcOEt	Ethyl acetate
APG	Angiosperm Phylogeny Group
ATTC	Appui Technique aux Tradipraticiens des Cataractes (Technical support for Traditional Cataract Practitioners)
CAID	Cellule d'Analyses des Indicateurs de Développement (Development Indicators Analysis Unit)
CPP	Consensus for Plant Part
CRISP	Centre de Recherche et d'Information Socio-Politiques
DCM	Dichloromethane
DR Congo or DRC	Democratic Republic of Congo
DSRP	Document stratégique de la Réduction de la Pauvreté (Poverty Reduction Strategy Document)
IAR	Informant Agreement Ratio
ICF	Informant Consensus Factor
INERA:	Institut National d'Etudes et Recherches Agronomiques (National Institute of Agronomic Studies and Research)
IPNI	International Plant Names Index
masl	meter above sea level
MeOH	Methanol
MSP	Ministère (congolais) de Santé Publique (Congolese Ministry of Public Health)
m/z	mass-to-charge ratio
N°	Number
n-BuOH	*n*-Butanol
PHARMEL	Pharmacopoea from Traditional Medicinal Plants
PNMT-PM	National Programme for the Promotion of Traditional Medicine and Medicinal Plants
ppm	parts per million
SPSS	Statistical Package for the Social Sciences
STP	Species Therapeutic Potential

UN-REDD	United Nations program of Reducing Emissions from Deforestation and Forest Degradation
UPLC-ESI-QTOF-MS	Ultra-performance liquid chromatography with electrospray ionization Quadruple time-of-flight mass spectrometry
USD	American Dollars
UV	Medicinal Use Values
VLIR-UOS	*Vlaamse Interuniversitaire Raad* (Flemish Interuniversities Council) - *Universitaire Ontwikkelingssamenwerking* (University Development Co-operation)
WHO	World Health Organization

Abstract

The pharmacopoeia of the Democratic Republic of Congo (DRC) contains monographs on various medicinal plants with pharmacological properties, whose knowledge and use is rapidly eroding. To document the remaining knowledge, we conducted an ethnobotanical survey in the territories of Kisantu and Mbanza-Ngungu in Kongo-Central Province, on the most important medicinal plants and diseases treated with them, as well as plants supposedly containing bioactive substances. We also assessed the cultural similarity in medicinal plant knowledge between the two territories and how knowledge about Kongo medicinal plants differs between different sociological categories. To complete our study, we conducted an ecofloristic survey to assess the vegetation composition and dynamics, as well as the distribution and availability of the most important medicinal plants in their harvesting areas. We further performed a phytochemical profiling of species supposedly containing bioactive substances, a first step in the search for a scientific basis for their traditional use.

From june 2017 until february 2018 and from february 2019 until april 2019, we conducted a survey with 188 phytotherapists, selected and surveyed using the snowball method and semi-structured interviews, respectively. Voucher specimens of inventoried plants were collected for identification. Ethnobotanical data were analyzed using medicinal use value (UV), informant agreement ratio (IAR), informant consensus factor (ICF), and species therapeutic potential (STP). Rahman's similarity index was used for ethno-cultural comparison of medicinal plant knowledge between the two communities. Medicinal knowledge between different sociological categories was analyzed using non-parametric Mann-Whitney and Kruskal-Wallis tests, as well as Poisson regression.

A total of 227 botanical species, representing 192 genera and 79 families were reportedly used to treat 103 diseases. Most abundant taxa were reported for the Fabaceae family (including 11.9% of species and 10.9% of genera) and from anthropized areas (45.0%). Leaves (39.4%), herbs (36.4%), decoction (41.7%), and oral administration (71.7%) were the most frequently cited plant part, plant botanical form, and remedies preparation and administration methods, respectively. Four of all inventoried species showed high UV (> 0.05), whereas eight had an IAR of 1.

According to ICF, 31 diseases were mentioned. Highest ICF (≥ 0.4) were observed for hemorrhoids (0.44), amoebiasis (0.43), and itchy rash (0.42). Based on species presenting a UV > 0.05 or IAR > 0.2, which are used to treat diseases with an ICF > 0.2, a total of 35 plants species were identified and considered as supposedly containing bioactive substances. A literature overview of the 35 selected species showed that 33 were chemically well-known. Only two native species namely *Commelina africana* L. and *Kalaharia uncinata* (Schinz) Moldenke, showed no relevant phytochemical information. Thus, we focused on these two species for the phytochemical profiling.

Low ethno-cultural similarity in medicinal knowledge (RSI = 16.7%) was found between the two territories. Analysis of the *Kongo* medicinal plant knowledge showed that the mean number of reported species and diseases varies considerably with gender, type and residence of therapists ($P < 0.05$).

The ecofloristic study was conducted in the Mbanza-Ngungu region, using ecofloristic plots to assess the vegetation composition and dynamics of different plant formations that constitute the landscape, as well as species distribution and abundance, with a focus on medicinal plant species. Ecofloristic plots were established and surveyed using ecofloristic approaches over two periods. The first period covered the months of june to august 2019, representing the dry season in Kongo-Central, while the second period extended from november 2020 to february 2021, corresponding to the rainy season. The vegetation composition was analyzed and 709 botanical species were identified, including 113 families and 446 genera. Of the total number of species inventoried, 35 % were reported as medicinal.

The vegetation was dominated by Fabaceae taxa (14.8%), herbs (47.4%), species possessing sarcochores diaspores (39.2%), and pantropical species (28.9%). Phanerophytes were the most abundant life form (50.8%), while species with mesophilic leaves accounted for 49.1% of the vegetation. The dryland forests (46 ± 12) and anthropized formations (44 ± 11) exhibited the highest species richness. They were distinguished from other plant formations by the proportion of their characteristic species (i.e. 39.5% and 58.8% for dryland forest and anthropized formations, respectively), which are considered as representative for these types of ecosystems. Savannahs and swamp forests presented both the highest percentage of constant species (i.e. 6.3% and 5.2%, respectively), suggesting that these ecosystems have the capacity to maintain their structure and functions in the face of disturbance. However, further research and analysis are needed to fully understand the dynamics of these ecosystems and their long-term stability.

The majority of inventoried species (445 species, i.e. 62.3 %) had a very limited ecological niche, restricted to a single type of vegetation, while 16 (2.2 %) exhibited a very wide distribution. The highest Sorensen and Jaccard similarity indices were observed, in descending order, between dryland forests and swamp forests (KS: 71.1; JC: 26.2), savannahs and dryland forests (KS: 52.7; JC: 20.9), anthropized formations and dryland forests (KS: 46.2; JC: 18.8), and between anthropized formations and savannahs (KS: 41.9; JC: 17.3), meaning that plant formations follow each other in the natural succession defined by vegetation dynamics, from the pioneer to the climax stage.

The lowest Whittaker's dissimilarity indices were observed in dryland forests (18%) and savannahs (19%), suggesting that ecofloristic plots inventoried in these plant formations have more similar ecological and floristic characteristics, and belong to the same plant formation. Field observations and ecofloristic data showed that most medicinal plants exhibited a very low frequency rate, suggesting that most areas where medicinal plants are harvested are degraded and availability of medicinal plants is decreasing.

Regarding phytochemical analyses, leaf extracts of *C. africana* and *K. uncinata* including AcOEt, MeOH 90%, *n*-hexane, dichloromethane (DCM), *n*-BuOH extracts and the residual fraction were analyzed by UPLC-ESI-QTOF-MS in positive and negative ionization modes, together with a set of 26 reference compounds. The negative ionization mode proved to be more sensitive and exhibited the most abundant and well-separated peaks compared to the positive ionization mode. It allowed to a tentative identification of 22 compounds from *C. africana*, representing mainly flavonoids (14), followed by hydroxycinnamic acid amides (3), phenolic acids (3) and lignanamides (2). Most of these identified compounds are well known and documented for their antioxidant, antifungal and anti-inflammatory properties, which could possibly explain the use of *C. africana* against skin disorders in traditional *Kongo* medicine. For *K. uncinata*, 24 compounds including mainly flavonoids (14), followed by phenylethanoid glycosides (7), phenolic acids (2) and an iridoid glycoside (1) were tentatively identified. These compounds are known and documented to have antiviral and anti-inflammatory properties, which could possibly be related to the use of *K. uncinata* against upper respiratory tract infections, such as laryngitis, cough, etc. in *Kongo* traditional medicine.

Our results prove that *Kongo* traditional medicine is rich and contains a number of important medicinal plant species with interesting active compounds. However, their availability in the wild is decreasing and some of them are reported to be threatened according to IUCN red list data. To promote and ensure the sustainable supply of communities who depend on these resources, it is essential to develop protection and adapted conservation measures, including *in* and *ex situ* methods, with a sustained focus on threatened species. Further studies would be required to elucidate exact structures of tentatively identified compounds, as well as to assess their effectiveness against the diseases for which they are used. Furthermore, a comprehensive phytosociological study, incorporating a sigmatist approach, is recommended to confirm the availability and rarity of species, enabling the development of well-adapted measures to ensure their conservation.

Samenvatting

De farmacopee van de Democratische Republiek Congo (DRC) omvat monografieën van medicinale planten met farmacologische eigenschappen, waarvan de kennis en het gebruik snel eroderen. Om de overblijvende kennis te documenteren, werd een ethnobotanisch onderzoek uitgevoerd in de gebieden Kisantu en Mbanza-Ngungu van de Centrale Provincie van Congo, naar de belangrijkste geneeskrachtige planten, de aandoeningen die ermee behandeld worden, en plantensoorten die vermoedelijk actieve bestanddelen bevatten. Ook werd de culturele gelijkenissen in medicinale plantenkennis in de beide gebieden onderzocht, evenals de verschillen die optreden tussen de verschillende sociologische categorieën. Om de studie te vervolledigen, werd een ecofloristisch onderzoek uitgevoerd naar de vegetatiesamenstelling en -dynamiek, en naar de verspreiding en het voorkomen van de belangrijkste soorten in de gebieden waar ze worden geoogst. Verder werd een fytochemische profilering uitgevoerd van soorten die vermoedelijk biologisch actieve stoffen bevatten. Dit is een eerste stap bij het vinden van een wetenschappelijke basis voor hun traditioneel medicinaal gebruik.

Tussen juni 2017 en februari 2018, en tussen februari en april 2019 werd een onderzoek uitgevoerd bij 188 fytotherapeuten, geselecteerd met de "sneeuwbal methode" en bevraagd door middel van semi-gestructureerde interviews. Voucher specimens van de geïnventariseerde planten werden verzameld ter identificatie. Ethnobotanische gegevens werden geanalyseerd met behulp van de "*medicinal use value*" (UV), de "*informant agreement ratio*" (IAR), de "*informant consensus factor*" (ICF), en de "*species therapeutic potential*" (STP). De similariteitsindex van Rahman werd gebruikt voor ethno-culturele vergelijking tussen de twee gemeenschappen van medicinale plantenkennis. Voor het vergelijken van verschillende sociologische categorieën werden niet-parametrische Mann-Whitney en Kruskal-Wallis tests en Poisson regressie gebruikt.

In het totaal werden 227 botanische soorten gerapporteerd, behorend tot 192 genera en 79 families, die werden gebruikt tegen 103 aandoeningen. De meest voorkomende taxa behoorden tot de Fabaceae familie (11,9% van de soorten en 10,9% van de genera) en kwamen voor in geantropiseerde gebieden (45,0%). Bladeren (39.4%), kruiden (36.4%), afkooksels (41.7%), en orale toediening (71.7,0%) waren respectievelijk de meest voorkomende plantendelen, botanische vormen, bereidingswijzen en toedieningswijzen. Vier van de geïnventariseerde soorten vertoonden een hoge UV score (> 0,05), terwijl 8 soorten een IAR van 1 hadden.

Op basis van de de ICF werden 31 aandoeningen vermeld. De hoogste ICF (≥ 0,4) werd waargenomen voor aambeien (0,44), amoebiasis (0,43), en jeukende huiduitslag (0,42). Uitgaande van soorten met een UV > 0,05 of IAR > 0,2, gebruikt om ziekten te behandelen met een ICF > 0,2, werden in het totaal 35 plantensoorten geïdentificeerd die vermoedelijk biologisch actieve stoffen bevatten. Een literatuurstudie toonde aan dat 33 hiervan fytochemisch goed gekend waren. Enkel voor 2 inheemse soorten, *Commelina africana* L. en *Kalaharia uncinata* (Schinz) Moldenke, werd geen relevante fytochemische informatie gevonden. Daarom werd op deze 2 soorten gefocust voor de fytochemische profilering.

Er werd een lage ethno-culturele gelijkenis (RSI = 16.7%) in medicinale plantenkennis vastgesteld tussen beide gebieden. Het gemiddeld aantal gerapporteerde soorten en aandoeningen varieerde aanzienlijk met geslacht, type van de woonplaats en van therapeut ($P < 0.05$).

In Mbanza-Ngungu werd bovendien een ecofloristische studie uitgevoerd, gebruik makend van ecofloristische plots om de samenstelling van de vegetatie en de dynamiek van de verschillende landschapsbepalende plantenformaties te onderzoeken, evenals de verspreiding en het voorkomen van soorten, met een focus op medicinale plantensoorten. Ecofloristische plots werden opgesteld en onderzocht in twee periodes: van juni tot augustus 2019, wat overeenkomt met het droge seizoen in Kongo-Centraal, en van november 2020 tot februari 2021, wat overeenkomt met het regenseizoen. De vegetatiesamenstelling werd geanalyseerd, en 709 plantensoorten werden aangetroffen, behorende tot 113 families en 446 genera. Van het totale aantal geïnventariseerde soorten werd 35 % gemeld als medicinaal.

De vegetatie werd gedomineerd door Fabaceae taxa (14,8%), kruiden (47,4%), soorten met sarcochore diasporen (39,2%), en pantropische soorten (28,9%). Fanerofyten waren de meest voorkomende vorm (50,8%), terwijl soorten met mesofiele bladeren 49,1% van de vegetatie uitmaakten. Droge bossen (46 ± 12) en geantropiseerde formaties (44 ± 11) vertoonden de grootste rijkdom aan soorten. Deze konden onderscheiden worden van andere plantenformaties door de verhouding tussen hun karakteristieke soorten (respectievelijk 39,5% en 58,8% voor droge bossen en geantropiseerde formaties), die beschouwd worden als representatief voor deze soort ecosystemen. Savannes en moerasbossen vertoonden het hoogste percentage aan constante soorten (6,3% en 5,2%, respectievelijk). Dit suggereert dat deze ecosystemen in staat zijn om hun structuur en functies te behouden bij verstoring. Er is echter verder onderzoek en analyse nodig om de dynamiek van deze ecosystemen en hun stabiliteit op lange termijn volledig te begrijpen.

De meeste geïnventariseerde soorten (445 of 62,3 %) had een erg beperkte ecologische niche, beperkt tot één vegetatietype, terwijl 16 soorten (2,2%) sterk verspreid waren. De hoogste Sorensen en Jaccard similariteitsindices werden vastgesteld, in dalende volgorde, tussen droge bossen en moerasbossen (KS: 71,1; JC: 26,2), savannes en droge bossen (KS: 52,7; JC: 20,9), geantropiseerde formaties en droge bossen (KS: 46,2; JC: 18,8), en tussen geantropiseerde formaties en savannes (KS: 41,9; JC: 17,3), wat betekent dat plantenformaties elkaar natuurlijk opvolgen in de vegetatiedynamiek, van het pionier- tot het climaxstadium.

De laagste Whittaker dissimilariteitsindices werden vastgesteld voor droge bossen (18%) en savannes (19%), wat suggereert dat de ecofloristische plots opgesteld voor deze plantenformaties meer gelijkaardige ecologische en floristische karakteristieken vertoonden, en behoorden tot dezelfde plantenformaties. Veldobservaties en ecologische gegevens toonden aan dat de meeste medicinale planten relatief weinig voorkwamen, wat suggereerde dat de meeste gebieden waar ze gewonnen worden gedegradeerd zijn en dat hun beschikbaarheid afneemt.

Voor de fytochemische analyses werden bladextracten van *C. africana* en *K. uncinata* gemaakt met AcOEt, MeOH 90%, *n*-hexaan, dichloromethaan (DCM), *n*-BuOH extracten. De residuele fractie werd geanalyseerd met UPLC-ESI-QTOF-MS in positieve en negatieve ionisatie modus, samen met een set van 26 referentieproducten. De negatieve ionisatie modus bleek meer gevoelig te zijn, en vertoonde de meest voorkomende en goed gescheiden pieken, in vergelijking met positieve ionisatie. Op deze manier werd de tentatieve identificatie uitgevoerd van 22 componenten van *C. africana*, voornamelijk flavonoiden (14), gevolgd door hydroxykaneelzuuramiden (3), fenolzuren (3) en lignaanamiden (2). De meeste van deze producten zijn goed gekend, en hun antioxidatieve, antifungale en anti-inflammatoire eigenschappen goed gedocumenteerd, wat mogelijk het gebruik van *C. africana* bij huidziekten in de traditionele geneeskunde van Congo kan verklaren. In *K. uncinata* werden 24 inhoudsstoffen tentatief geïdentificeerd, voornamelijk flavonoiden (14), gevolgd door fenylethaan glycosiden (7), fenolzuren (2) en een iridoid glycoside (1). Deze producten zijn gekend en hebben gedocumenteerde antivirale en anti-inflammatoire eigenschappen, wat mogelijk verband houdt met het gebruik van *K. uncinata* in de traditionele geneeskunde van de Kongo-provincie tegen infecties van de hogere luchtwegen, zoals laryngitis en hoest.

Onze resultaten tonen aan dat de traditionele geneeskunde in de Kongo-provincie zeer rijk is en een aantal belangrijke medicinale plantensoorten omvat met interessante actieve stoffen. Hun voorkomen in het wild neemt echter af, en enkele worden in de rode lijst van de IUCN gerapporteerd als bedreigd. Om een duurzame aanvoer ervan voor de gemeenschappen die van deze planten afhankelijk zijn te verzekeren en te bevorderen, is het essentieel om beschermings- en conserveringsmaatregelen te nemen, zowel met *in* als *ex situ* methoden, met een focus op bedreigde soorten. Verder onderzoek is nodig om de volledige structuur van de tentatief geïdentificeerde fytochemische componenten op te helderen, en hun doeltreffendheid tegen de aandoeningen waarbij ze gebruikt worden te onderzoeken. Verder is ook een uitgebreide sigmatisch fytosociologische studie aanbevolen om de beschikbaarheid of zeldzaamheid van bepaalde soorten te bevestigen, zodat gepaste maatregelen kunnen genomen worden om hun voortbestaan te verzekeren.

Résumé

La pharmacopée de la République Démocratique du Congo (RDC) contient des monographies sur diverses plantes médicinales aux propriétés pharmacologiques remarquables, mais dont les connaissances et l'utilisation s'érodent rapidement. Afin de documenter les connaissances restantes, nous avons mené une enquête ethnobotanique dans les territoires de Kisantu et Mbanza-Ngungu, situés dans la Province du Kongo-Central. Cette enquête visait à répertorier les plantes médicinales les plus importantes ainsi que les maladies traitées par ces plantes, tout en identifiant celles supposées renfermer des substances bioactives d'intérêt. Nous avons également évalué la similarité culturelle des connaissances sur les plantes médicinales entre ces deux territoires et avons ensuite analysé les variations des connaissances médicinales sur ces plantes au sein de différentes catégories sociologiques étudiées. Pour compléter notre étude, nous avons réalisé une étude écofloristique afin de déterminer la composition et la dynamique de la végétation, ainsi que la distribution et la disponibilité des plantes médicinales les plus importantes dans leurs milieux naturels où elles sont récoltées. De plus, nous avons effectué un profilage phytochimique des espèces importantes, présumées contenir des substances bioactives intéressantes ; une première étape dans la quête d'une base scientifique de leur utilisation traditionnelle.

De juin 2017 à février 2018 et de février 2019 à avril 2019, nous avons mené une enquête auprès de 188 phytothérapeutes, sélectionnés et interrogés à l'aide de la méthode de la boule de neige et d'entretiens semi-structurés, respectivement. Des échantillons de plantes inventoriées ont été collectés pour identification. Les données ethnobotaniques ont été analysées à l'aide des paramètres tels que la valeur d'utilisation médicinale (UV), le ratio d'accord des informateurs (IAR), le facteur de consensus des informateurs (ICF) et le potentiel thérapeutique des espèces (STP). L'indice de similarité de Rahman a été utilisé pour la comparaison ethnoculturelle des connaissances sur les plantes médicinales entre les deux communautés. Les connaissances médicinales entre les différentes catégories sociologiques ont été analysées à l'aide de tests non paramétriques de Mann-Whitney et de Kruskal-Wallis, ainsi que d'une régression de Poisson.

Au total, 227 espèces botaniques, représentant 192 genres et 79 familles, ont été identifiées pour traiter 103 maladies. Les espèces les plus abondantes appartenaient à la famille de Fabaceae (comprenant 11,9 % des espèces et 10,9 % des genres) et provenaient de zones de végétations anthropisées (45,0 %). Les feuilles (39,4 %), les herbes (36,4 %), la décoction (41,7 %) et l'administration orale (71,7 %), représentaient respectivement la partie de plante, la forme botanique, et les méthodes de préparation et d'administration de remèdes les plus fréquemment citées. Quatre des espèces inventoriées présentaient une valeur d'utilisation médicinale élevée (UV > 0,05), tandis que huit avaient un IAR de 1.

S'agissant de l'ICF, 31 maladies ont été mentionnées. Les maladies à ICF les plus élevés (≥ 0,4) ont été observés pour les hémorroïdes (0,44), l'amibiase (0,43) et les éruptions cutanées (0,42). Sur la base des espèces présentant une UV > 0,05 ou un IAR > 0,2, utilisées pour traiter des maladies avec un ICF > 0,2, un total de 35 espèces végétales ont été identifiées et supposées contenir des substances bioactives intéressantes. Une revue de la littérature de ces 35 espèces a montré que 33 étaient chimiquement bien connues. Seules deux espèces locales, à savoir *Commelina africana* L. et *Kalaharia uncinata* (Schinz) Moldenke, ne présentaient aucune information phytochimique pertinente. Ainsi, nous nous sommes concentrés sur ces deux espèces pour le profilage phytochimique.

Une faible similarité ethnoculturelle dans les connaissances médicinales (RSI = 16,7 %) a été observée entre les deux territoires. L'analyse des connaissances sur les plantes médicinales *Kongo* a montré que le nombre moyen d'espèces et de maladies enregistrées varie considérablement en fonction du genre, de la catégorie des phytothérapeutes, ainsi que de leur lieu de résidence (P < 0,05).

L'étude écofloristique a été réalisée à Mbanza-Ngungu, en utilisant des parcelles écofloristiques, pour étudier la composition et la dynamique de la végétation de différentes formations végétales qui constituent le paysage, ainsi que la distribution et l'abondance des espèces, en mettant un accent particulier sur les plantes médicinales. Ces parcelles ont été établies et enquêtées à l'aide d'approches écofloristiques sur deux périodes. La première période couvrait les mois de juin à août 2019, représentant la saison sèche au Kongo-Central, tandis que la deuxième période s'étendait de novembre 2020 à février 2021, correspondant à la saison des pluies. L'analyse de la composition de la végétation a révélé la présence de 709 espèces botaniques réparties en 113 familles et 446 genres, parmi lesquelles environ 35 % sont signalées comme étant utilisées à des fins thérapeutiques.

La végétation de la région était dominée par les espèces de la famille de Fabaceae (14,8 %), les herbes (47,4 %), les espèces possédant des diaspores sarcochores (39,2 %) et les espèces pantropicales (28,9 %). Les phanerophytes étaient la forme biologique la plus abondante (50,8 %), tandis que les espèces aux feuilles mésophiles représentaient 49,1 % de la végétation. Les forêts sur terre ferme (46 ± 12) et les formations anthropisées (44 ± 11) ont présenté la plus grande richesse spécifique. Elles se sont distinguées des autres formations végétales par la proportion de leurs espèces caractéristiques (c'est-à-dire 39,5% et 58,8 % pour les forêts sur terre ferme et les formations anthropisées, respectivement), considérées comme représentatives de ces types d'écosystèmes. Les savanes et les forêts marécageuses présentaient le pourcentage le plus élevé d'espèces constantes (soit 6,2 % et 5,2 %, respectivement), suggérant que ces écosystèmes ont la capacité de maintenir leur structure et leurs fonctions face aux perturbations. Cependant, des recherches et analyses supplémentaires sont nécessaires pour comprendre pleinement la dynamique de ces écosystèmes et leur stabilité à long terme.

La majorité des espèces inventoriées (445 espèces, soit 62,3 %) occupaient une niche écologique très restreinte, limitée à un seul type de végétation, tandis que 16 (2,2 %) présentaient une distribution très large. Les indices de similarité de Sorensen et Jaccard les plus élevés ont été observés, dans l'ordre décroissant, entre les forêts sur terre ferme et les forêts marécageuses (KS : 71,1 ; JC : 26,2), les savanes et les forêts sur terre ferme (KS : 52,7 ; JC : 20,9), les formations anthropisées et les forêts sur terre ferme (KS : 46,2 ; JC : 18,8), et entre les formations anthropisées et les savanes (KS : 41,9 ; JC : 17,3), signifiant que ces formations végétales se succèdent dans l’ordre de succession naturelle normale définie par la dynamique de la végétation, du stade pionnier au stade climax.

Les indices de dissimilarité de Whittaker les plus bas ont été observés dans les forêts sur terre ferme (18 %) et les savanes (19 %). Ceci suggere que les parcelles écofloristiques inventoriées dans ces formations végétales ont des caractéristiques écologiques et floristiques similaires et appartiennent à la même formation végétale. Les observations sur le terrain et les données écofloristiques ont montré que la plupart des plantes médicinales présentaient un taux de fréquence très faible, ce qui suggère que les zones de récolte des plantes médicinales sont largement dégradées et que la disponibilité de ces plantes diminue.

En ce qui concerne les analyses phytochimiques, les extraits de feuilles de *C. africana* et *K. uncinata*, comprenant les fractions d'EtOAc, de MeOH à 90 %, de *n*-hexane, de dichlorométhane (DCM), de *n*-BuOH et la fraction résiduelle, ont été analysés par UPLC-ESI-QTOF-MS en mode d'ionisation positive et négative, en même temps qu'un ensemble de 26 composés de référence. Le mode d'ionisation négatif s'est avéré plus sensible et a montré des pics plus abondants et bien séparés par rapport au mode d'ionisation positif. Il a permis d'identifier de manière provisoire 22 composés pour *C. africana*, principalement des flavonoïdes (14), suivis d'amides d'acide hydroxycinnamique (3), d'acides phénoliques (3) et de lignanamides (2). La plupart de ces composés identifiés sont bien connus et documentés pour leurs propriétés antioxydantes, antifongiques et anti-inflammatoires, ce qui pourrait expliquer l'utilisation de *C. africana* contre les troubles cutanés en médecine traditionnelle *Kongo*. S'agissant de *K. uncinata*, 24 composés, comprenant principalement des flavonoïdes (14), suivis de glycosides de phényléthanoides (7), d'acides phénoliques (2) et d'un glycoside d'iridoïde (1), ont été identifiés. Ces composés sont connus et documentés pour leurs propriétés antivirales et anti-inflammatoires, ce qui pourrait expliquer l'utilisation de *K. uncinata* contre les infections des voies respiratoires supérieures, telles que la laryngite, la toux, etc., en médecine traditionnelle *Kongo*.

Nos résultats démontrent que la médecine traditionnelle *Kongo* est riche et contient un certain nombre d'espèces végétales médicinales importantes avec des composés actifs intéressants. Cependant, leur disponibilité dans la nature diminue et certaines d'entre elles sont signalées comme menacées selon les données de la liste rouge de l'UICN. Pour promouvoir et assurer l'approvisionnement durable des communautés qui dépendent de ces ressources, il est essentiel de développer des mesures de protection et de conservation adaptées, comprenant des méthodes de concervation *in situ* et *ex situ*, en mettant l'accent sur les espèces menacées.

Cependant, des études supplémentaires sont essentielles afin d'élucider les structures exactes des composés identifiés et d'évaluer leur efficacité contre les maladies pour lesquelles ils sont utilisés. En outres, une étude phytosociologique approfondie, intégrant une approche sigmatiste, est préconisée pour authentifier la disponibilité et la rareté des espèces, facilitant ainsi la mise en place de mesures appropriées en vue de leur préservation.

Introduction

1. Context and general issues

Since time immemorial, humans have relied from nature to meet their basic needs for food, medicine, shelter, firewood, etc. (Karunamoorthi *et al.*, 2013; Schippmann *et al.*, 2006). However, in all cultures of the world, medicinal plants played an important role in the human health (Qureshi *et al.*, 2016; Voeks, 2004), and herbal medicine proved to be an essential method for treating a variety of illnesses, whether of natural or presumed mysterious origin, known or unknown to modern medicine (Tahri *et al.*, 2012; Voeks and Leony, 2004). Today, interest in medicinal plants continues, especially in modern medicine and the pharmaceutical sector, which is searching for new drug discoveries (De Natale and Pollio, 2007; Nasim *et al.*, 2022; Rivera *et al.*, 2005; Wangchuk, 2018).

Despite advances in medical science, a significant proportion of the world's population, estimated at around 80%, continues to practice herbal medicine (Demeke *et al*., 2022; Ullah *et al*., 2010). In many African societies, as in most underdeveloped countries, the practice of traditional medicine is an ongoing experiment which embedded into national health systems (Mutombo *et al.*, 2023). Extreme and widespread poverty in these countries is one of the main constraints limiting people's access to quality health care or modern medicine, forcing them to resort to herbal medicine (Bajin ba Ndob *et al.*, 2016; Kouadio *et al.*, 2016).

The phytotherapeutic knowledge of the *Kongo* people originates from the ancient *Kongo* kingdom (1350-1880). This historical kingdom extended from present-day Angola, where its capital (*Mbanza Kongo*) was situated, through the Democratic Republic of Congo, and Congo- Brazzaville, and then further north into Gabon (Amadou, 2021; Hendrickx, 2021; Randles, 2002). Rooted in their rich traditions, the *Kongo* people are very attached to their customs (Martin, 2009). They have a deep connection to herbal medicine, a practice that is ingrained in their culture and transcends all social categories, regardless of age, gender, education or geographical location.

Despite efforts to preserve ancestral *Kongo* cultures and rituals (Lautenschläger *et al*., 2018), the reliance on traditional medicine among the *Kongo* people in the Kongo-Central Province, as well as in other regions of DRC, is attributed to extreme and widespread poverty. A provincial study on poverty reduction strategies, outlined in the Provincial Poverty Reduction Strategy Document (DSRP, 2007), revealed that 69.81% of the population in the aforementioned Province is poor, living on approximately US$ 0.39 per person per day. This

economic challenge severely limits their access to primary healthcare and their ability to afford basic pharmaceutical or allopathic products due to their high cost compared to the low income of the beneficiaries. Beyond economic factors, other elements contribute to the persistent use of traditional medicinal practices. These include the belief in diseases with presumed mystical origins or those unknown to modern medicine. In recent decades, enhanced sexual performance for both men and women is increasingly searched for, adding another layer to the reasons behind the continued popularity of traditional medicine in the region (Kabena *et al.*, 2015; Kibungu, 2010; Van Andel and Van't Klooster, 2007).

The practice of traditional medicine constitutes a cultural treasure, deeply rooted in a community's identity and transmitted from generation to generation. Fundamentally linked to the wise use of potent plants and powerful remedies, the sustainability of these ancient traditions is closely linked to the quality, availability and accessibility of natural resources, especially of specific medicinal plants, as well as the acceptance of traditional healthcare services (Srithi *et al*., 2009). This ancestral heritage, a true cultural treasure of the *Kongo* people, is currently in decline. This progressive decline is a direct result of the reduction and, in some cases, disappearance of plant species. The decline is being orchestrated by excessive and abusive resource exploitation, as well as by inappropriate agricultural practices, intensive tree cutting for firewood and charcoal production for the city of Kinshasa, and bush fires set by the local community of the study area (Nzuki *et al.*, 2013, 2016). The current ecological crisis resulting from this situation is exerting considerable pressure on the preservation of traditional medicinal knowledge, thereby jeopardizing the future transmission of this cultural heritage (Lanata *et al*., 2013).

The territories of Kisantu and Mbanza-Ngungu (DRC), inheritors of exceptional cultural and environmental wealth, contain profound traditional knowledge related to herbal medicine (Kibungu, 2010). However, this ancestral wisdom is increasingly threatened by a number of factors, including resource overexploitation, habitat degradation, globalization and the growing disinterest of younger generations in traditional medicine (Nzuki *et al*., 2013). At the heart of these challenges is a unique botanical biodiversity of medicinal plant species with potent pharmacological properties that form the essential basis of traditional *Kongo* medicine (Kibungu *et al.*, 2021).

Located in the Guinean-Congo phytogeographic region (Compère, 1970; Dubiez *et al.*, 2014), the Kisantu and Mbanza-Ngungu vegetation is in decline, with an exponential loss of species in favor of savannahs and degraded forest areas (Boulogne *et al*, 2013). The once imposing forests have given way to herbaceous or shrubby savannahs (Wamuini *et al.,* 2010) and a few isolated patches of forest (Bamba *et al.,* 2008). These include former village sites known as "Voka di mfinda" or "Sangi" and heavily exploited or degraded forest recruitment areas, commonly called "Nkunku" (Nsimundele *et al*., 2010; Nzuki *et al*, 2016). The degradation of these forest areas not only leads to biodiversity loss but also poses a risk of extinction for potent medicinal plants and powerful remedies (Kibungu *et al.*, 2021).

Many authors highlighted the decline or extinction of medicinal plant species in the study area. For instance, *Erythrophleum suaveolens* (Guill. & Perr.) Brenan, formerly an integral part of the *Kongo* people's practice of trial by poison, has disappeared, revealing its former role in identifying the culprit behind diseases of supposed mystical origin (Daeleman and Pauwels, 1983; De Meyer, 2023; Delaude and Breyne, 1971). The species is traditionally used to treat rheumatism and gynaecological problems (Kibungu *et al*., 2021). In addition, *Mondia whitei* (Hook.f.), *Garcinia kola* Heckel and *Dorstenia laurentii* De Wild., which are used in the region to treat sexual impotence, abdominal pain and intestinal amoebiasis, respectively, are also reported to become rare in their natural habitat in the study area (Kibungu, 2010; Makumbelo *et al.*, 2008). More recently, *Lannea antiscorbutica* (Hiern) Engl., *M. whitei*, *Monodora myristica* (Gaertn.) Dunal, *Pseudospondias microcarpa* (A. Rich.) Engl. and *Annona senegalensis* subsp. *oulotricha* Le Thomas were reported to be the most vulnerable medicinal plant species in the region (Nzuki *et al.*, 2013).

An ethnobotanical study conducted by Kibungu *et al.* (2021), highlighted growing concerns about the overexploitation of traditionally important medicinal plants and its impact on species rarity and the erosion of traditional knowledge. Despite the expansion of research into remote forest areas of Kisantu and Mbanza-Ngungu territories, most important medicinal plants believed to contain potent bioactive compounds have become increasingly rare in their natural habitats. Traditional medicinal knowledge and expertise about rare or extinct species are mainly held by older people, while, younger people were less informed, unaware or ignorant of most information about these disappearing plants. The authors showed that older people exhibited greater expertise and deeper knowledge of medicinal plants than their younger counterparts. Under these circumstances, the extent of medicinal plant decline, which is closely linked to the survival of traditional medicinal knowledge, underscores the crucial importance

of conserving these natural resources and highlights the urgent need to implement initiatives for the conservation and sustainable management of biodiversity, particularly of key medicinal plants. Faced with the threat of species extinction and its impact on traditional knowledge, it is imperative to implement measures for the preservation and sustainable management of medicinal plants to ensure the survival of these vital resources. Thus, the need to safeguard traditional phytotherapeutic knowledge before it is irreversibly lost becomes paramount.

Indigenous knowledge of plants and their use has largely contributed to the development of numerous pharmaceutical products. For instance, thanks to the traditional use of species like *Digitalis purpurea* L., *Cinchona* spp. or *Podophyllum peltatum* L., the following medicines were respectively developed: digoxine to treat certain heart problems, quinine to treat malaria, a mosquito-borne infectious disease caused by *Plasmodium parasites*; and podophyllotoxin to treat certain forms of cancer (Fabricant and Farnsworth, 2001). In DRC, medico-traditional knowledge has largely contributed to the development of improved traditional medicines which are still used for addressing several ailments. Examples include (i) Manadiar, an antidiarrheal medicine based on decocted leaves of *Cajanus cajan* (L.) Huth, *Psidium guajava* L. and the bark of *Mangifera indica* L.; (ii) Manalaria, an antimalarial medicine containing an extract of *Nauclea latifolia* Sm. and *Senna occidentalis* (L.) Link; (iii) Meyamycine used against intestinal parasitosis and food poisoning which is made from the extract of *Citrus aurantium* L., *Elaeis guineensis* Jacq., *Allium sativum* L. and *Chamaesyce hirta* (L.) Lillsp. (Pousset, 2006).

Despite these achievements, many traditional practitioners in traditional African societies still lack a scientific basis for their methods. Although they believe in the results of their practices, they do not understand how these results are achieved (Bagwana, 2015). This lack of scientific understanding can sometimes lead to the discrediting of their practices, some of which are reported to be based on mysticism and/or superstition, with no scientific basis for the way in which this knowledge was acquired, such as through dreams or contact with ancestral spirits (Quittel, 1983; Sobiecki, 2014). It is therefore essential to provide explanations based on scientific evidence to support the use of plants in *Kongo* phytomedicine. This evidence could not only increase confidence in traditional *Kongo* medicine, but also help to promote and preserve this ancestral cultural heritage.

Confronted with these challenges, how can we assess and reconcile the preservation of traditional medicinal knowledge, which is deeply ingrained in the cultural heritage of *Kongo* community, with the need to ensure the survival of medicinal plants and the effective remedies on which it is based? This balance must take into account the challenges posed by the loss of biodiversity and natural habitats for medicinal plants, as well as changes in environmental conditions. Additionally, how can we promote sustainable harvesting practices to ensure the continuity of this ancestral knowledge while preserving the ecological balance? How to establish a scientific foundation to support the use of plants in *Kongo* traditional medicine to increase user confidence and, consequently, contribute to the preservation of this orally accumulated knowledge for centuries?

A comprehensive and multidisciplinary approach is essential in addressing these challenges. Through ethnobotanical studies, we aim to gain insights into the *Kongo* phytotherapeutic knowledge, systematically document traditional knowledge and its dynamics, and identify key species and individuals that form the basis of this knowledge. This approach aims to (i) assess and document plant-based ethnomedicinal practices and traditional knowledge on the use of plants to treat disease, in order to establish a database of medicinal plants and their traditional uses; (ii) analyse the documented data using quantitative ethnobotanical indices to identify key plant species thought to contain potentially active compounds; (iii) assess the cultural similarities between the two territories and evaluate how sociological parameters influence traditional medical knowledge, in order to identify the true guardians of traditional *Kongo* medical knowledge who could serve as key informants for future studies in the region.

On the other hand, ecofloristic studies which aim to gain insights into the composition, dynamics, distribution, and availability of plants in their harvesting areas, with a primary focus on medicinal plants can serve as a strategy and play a central role in identifying the most vulnerable medicinal plants, and can thus make a significant contribution to the safeguarding of traditional *Kongo* knowledge.

Furthermore, phytochemical profiling of the most important medicinal plants can help assess the chemical compounds that may be responsible for their therapeutic effects, thereby providing a scientific basis to support their use in traditional *Kongo* medicine.

A comprehensive study addressing these challenges associated with the decline of *Kongo* phytomedicinal knowledge in the territories of Kisantu and Mbanza-Ngungu is currently lacking. Therefore, there is a critical need to conduct interdisciplinary research to study and

document traditional *Kongo* medicine. This research is essential to increase the credibility of traditional *Kongo* medicine and contribute to its preservation and protection. The imperative for this research is driven by the future well-being of rural communities, as their livelihoods and socio-cultural foundations heavily depend on medicinal plants and the conservation status of surrounding ecosystems. The documentation of this knowledge is crucial for the sustainable management of natural resources and the continued well-being of these communities.

2. Research assumptions

Our research is based on the assumptions that:

- *Kongo* phytotherapeutic knowledge includes insights into important local medicinal plant species, many of which are believed to contain potent pharmacological properties. This provides a compelling basis for their integration into herbal medicine practices. However, the gradual loss of oral knowledge highlights the urgent need for documentation. We argue that documenting this knowledge not only safeguards cultural and medicinal heritage, but also opens up new avenues for pharmaceutical research.
- accessibility and availability of plants, as well as the acceptance of traditional healthcare services, significantly influence the use of traditional medicines. We believe that studying vegetation is a crucial step in wise nature management, respecting natural balances. This approach has the potential to mitigate the effects of human overexploitation of vegetation and plays a key role in preventing the extinction of traditional medicinal knowledge. The preservation of such knowledge is closely linked to the accessibility and availability of medicinal plants. Furthermore, providing scientific basis for the use of medicinal plants could lead to a deeper understanding of their therapeutic properties and mechanisms of action, bolstering their credibility in traditional medicine. This scientific validation could enhance confidence among healthcare practitioners and patients, paving the way for the integration of medicinal plants into conventional treatment regimes.
- traditional medicinal knowledge and expertise within the two communities studied is expected to show similarities due to their shared cultural background. However, it is recognized that this knowledge is influenced by various sociological parameters, including factors such as age, gender, marital status, education, experience, type of occupation and geographical location of respondents. A thorough assessment of this information has the potential to provide valuable insights into the individuals who form the basis of *Kongo* traditional medicinal knowledge.

3. Research questions

To verify our assumptions, following research questions need to be considered:

- what are the key medicinal plant species and individuals of *Kongo* traditional medicine that form the fundamental cornerstones of this traditional medicinal practice, and how can their identification and documentation contribute to the preservation and sustainable use of *Kongo* traditional medicinal knowledge?
- how does the cultural coherence in medicinal plant knowledge among respondents from Kisantu and Mbanza-Ngungu vary across diverse sociological categories such as age, gender, marital status, education, experience, profession, and location, and what insights can be gained from these variations to enhance our understanding of traditional medicinal practices in the region?
- what is the current vegetation composition and status in Mbanza-Ngungu, and what is the conservation status of key medicinal plant species in their natural habitats? Are these species still abundant, or have they become rare?
- what is the scientific basis underlying the utilization of key *Kongo* medicinal plant species, and how do the biological effects of tentatively identified compounds, as reported in the literature, corroborate the traditional use of these plants, thus providing the scientific basis to support their use in traditional *Kongo* medicine?

4. Objectives

Considering the above, beyond the general objective of documenting the remaining *Kongo* ethnomedicinal knowledge and expertise across different sociological categories, our study aims to:

- identify and document the most important medicinal plant species using quantitative ethnobotanical parameters, and determine key individuals in *Kongo* traditional medicine that form the fundamental cornerstones of the *Kongo* medical practice in Kisantu and Mbanza-Ngungu;
- investigate the cultural coherence of medicinal plant knowledge among respondents from Kisantu and Mbanza-Ngungu across different sociological categories, including age, gender, marital status, education, experience, profesion and location;
- understand and document the significance of variance between different sociological groups and the insights that can be drawn from these variations to improve our understanding of traditional medicinal practices in the region;

- assess the present vegetation composition and condition in Mbanza-Ngungu and to determine its dynamics, as well as the availability of plants and their conservation status, with a focus on key medicinal plant species in their native environments. The study will investigate whether these species remain abundant or if they have experienced a decline in their populations.
- perform a phytochemical analysis of key *Kongo* medicinal plant species with the goal of identifying their biochemical compounds, thus providing a basis for their traditional use. Furthermore, the research aims to investigate the pharmacological effects of tentatively identified compounds from these plants using existing literature data. Ultimately, the study seeks to provide scientific evidence to support the traditional use of these plants in *Kongo* traditional medicine.

5. Rationale of the study

The traditional *Kongo* medicine holds valuable information about significant local medicinal species, most of which are supposedly containing effective pharmacological properties. According to Lanata *et al.*(2013), anthropogenic disturbances of ecosystems in the Kongo-Central Province are mainly related to shifting cultivation techniques and unsustainable exploitation of forest resources. These activities significantly impact the quality of life and well-being of local populations.

Natural resources that traditionally played an important role in the daily lives of thousands of people have become very scarce, and the knowledge regarding their appropriate utilization is rapidly decreasing. Moreover, the forces of globalization and the lack of interest among younger generations, who dismiss traditional medicine as rooted in spiritualism and superstition rather than scientific evidence, further accelerate the decline of traditional medicinal knowledge (Kibungu *et al.,* 2021).

This lack of interest among young people can be illustrated by certain practices associated with traditional treatment. For instance, the traditional method of treating fractures involves applying a traditional tourniquet to the patient. The success of this treatment depends entirely on the fate of a chicken whose leg is deliberately broken and treated similarly to the patient's, symbolizing the recovery of both. (Ackerknecht, 1947; Ezeanya-Esiobu, 2019). Another example involves tapping a man's genitals three times on the chest of his wife, suffering from mastitis, believed to aid her recovery (Kibungu, 2010).

Furthermore, if tradional hearlers believe in the results of their practices, they do not know how these results are achieved (Bagwana, 2015). These mysteries contribute to the doubt and mistrust about *Kongo* herbal medicine among today's young generation. The extinction or rarefaction of many species once precious to the health and well-being, despite efforts to extend research to remote regions, reveals a concerning trend.This results in a systematic loss of many potent plants and their powerful remedies, which remain unknown to younger generations. Furthermore, there is currently no study on the current state of the study area vegetation, the degradation of which threatens not only biodiversity but also important medicinal plant species and the traditional knowledge derived from them.

Faced with this situation, it is imperative to conduct this study to preserve the *Kongo* medicinal cultural heritage from inevitable erosion. The ultimate goal is to document the indigenous medicinal knowledge of the *Kongo* people, while at the same time making young people aware of the risk of losing this part of the *Kongo* cultural heritage. It also aims to restore young people's confidence in traditional medicine and to contribute to the conservation of the biodiversity of Kisantu and Mbaza-Ngungu regions on which the *Kongo* traditional medicine depends.

This study contributes not only to science by providing data on most important medicinal plants and phytochemical composition of selected medicinal plant species but also at the local level by sustainably preserving traditional medicinal knowledge. Additionally, our study contributes to guide decision-makers and the *Kongo* community regarding key medicinal species, suitable habitats, and strategies for the rational management of nature to preserve both resources and the associated medicinal knowledge.

6. Interests of the study

The interests of this study lie in addressing several crucial aspects related to the traditional phytotherapeutic knowledge of the *Kongo* people:

- documentation and preservation of the *Kongo* cultural heritage: by assessing medicinal plants and diseases they treat, this study aims to make a significant contribution to the documentation and preservation of the cultural heritage of the *Kongo* people. This effort will ensure the protection of cultural heritage and increase the understanding of medicinal plant diversity and its role in the traditional *Kongo* medicine.
- identification of key informants: exploring sociological parameters influencing traditional medicinal knowledge will help identify key informants who serve as

guardians of *Kongo* traditional medicinal knowledge. This identification is crucial for future studies and knowledge transmission.

- providing new data for science: the ethnobotanical research introduced a new ethnobotanical parameter to science, Species Therapeutic Potential (section 2.4.2.3). This innovative parameter was developed to facilitate advancing selection of important medicinal plant species within a region and to provide a robust basis for comprehensive phytochemical studies of selected species, due to its simplicity, safety and methodological rigour based on a consensus regarding the plant use in the treatment of specific diseases. The phytochemical analysis of *C. africana* and *K. uncinata*, provides science with relevant data including, tentatively identified compounds and their related biological effect to support their traditional use. Data on abundance, availability and rarity of key medicinal species revealed a concerning trend about their conservation status. This information could be of considerable interest to the scientific community and lead to further in-depth research. Once the status of these species is confirmed, they can be proposed as endangered to the IUCN Red List of threatened species for the Province of Kongo-Central (DRC), to ensure their conservation.
- scientific validation of traditional practice: by providing a scientific basis to support the use of medicinal plants in traditional medicine, this scientific validation could enhance confidence (especially among the younger generation) in traditional medicine and contribute to its continued preservation.
- guiding conservation efforts: the study recognizes the importance of a healthy environment for the sustainability of traditional medicinal knowledge. By assessing the ecological consequences of overexploitation and degradation, the research aims to actively contribute to environmental conservation efforts. The identification of key medicinal plants, coupled with an assessment of their conservation status within their natural habitats, serves as a means of raising awareness among the *Kongo* people of the importance of these plants. At the same time, it highlights the potential risk associated with their disappearance and emphasizes the importance of preserving traditional medicinal knowledge accumulated over centuries. In addition, this information can provide valuable guidance to decision-makers in formulating and implementing appropriate and effective conservation measures. Such measures are essential to ensure the conservation of habitats and the sustainable supply of these important resources to the communities dependent on these valuable resources.

7. General outline

Apart from the introduction, this study is subdivided into five chapters outlined as follows:

- **Chapter 1. General information**

  Tthis chapter provides a brief review of the history of the traditional medicine in DRC, categories of herbal practitioners within the study area and a short presentation of the study area.

- **Chapter 2. Ethnobotanical characterization of medicinal plants used in Kisantu and Mbanza-Ngungu territories, Kongo-Central Province in DR Congo**

  This chapter aims to assess and document the expertise and traditional medicinal knowledge of *Kongo* people. The study focuses on identifying the most important medicinal plants with effective pharmacological properties and diseases treated with them. It also focuses on assessing the cultural similarities between respondents from Kisantu and Mbanza-Ngungu and how different sociological parameters influence the *Kongo* traditional medicinal knowledge.

- **Chapter 3. Ecofloristic characterization of the vegetation of Mbanza-Ngungu territory in the Kongo-Central Province, DRC**

  The objective of the ecofloristic analysis is to provide a comprehensive overview of the vegetation of Mbanza-Ngungu, shedding light on its species composition, dynamics, distribution and accessibility, with a particular focus on medicinal plants. The study uses frequency indices to identify the most endangered medicinal plants, providing valuable insights for decision-makers and users.

- **Chapter 4. Phytochemical profiling by UPLC-ESI-QTOF-MS of *Commelina africana* L. and *Kalaharia uncinata* (Schinz) Moldenke**

  This chapter aims to identify phytochemical constituents from leaf extracts of *C. africana* and *K. uncinata*, which is a first step towards understanding the scientific basis for their traditional use. Furthermore, this chapter also discusses the potential bioactivity of tentatively identified compounds from previous studies reported in the literature to support the traditional use of CA and KU in *Kongo* traditional medicine, specifically against skin disorders and upper respiratory tract infections, respectively.

- **Chapter 5. General conclusion**

  This chapter focuses on the study strengths, weaknesses, achievements and recommandations.

Chapter 1. Introduction to traditional medicine in DRC

1.1. Brief historical overview of traditional medicine in DRC

The World Health Organization (WHO) considers traditional medicine as the total amount of knowledge, competences and practices based on theories, beliefs and indigenous experiences of different cultures that are used to maintain health as well as to prevent, diagnose, improve or treat physical and mental diseases.

Traditional medicine has been practised for centuries by ancestors to solve health problems in their communities (Manzo *et al*., 2017). However, medico-traditional knowledge was and still is transmitted by word of mouth, from generations to generations, from old to young (Ashforth, 2008; Mokgobi, 2014; Sofowora, 2010).

Traditional *Kongo* medicine is analogous to that of the rest of Black Africa. In traditional *Kongo* society, medicinal knowledge was reserved and transmitted to the eldest brother of the family or, failing that, to the most courageous, the most talented of the children or to whoever paid the greatest attention to their father's art (Gessler *et al.,* 1995).

This transfer of knowledge was most often done by initiation and in a ritualistic atmosphere (Kouassi, 2008). The aim was to instil in the initiate certain behavioural norms and attitudes of the society, and to put him in contact with and under the influence of ancestors, under the assumption that they possess knowledge that a natural man would not have (Gessler *et al.,* 1995; Godfraind, 2010; Monteillet 2001; Ozioma and Nwamaka, 2019).

The new initiate was therefore subject to certain prohibitions, the non-respect of which would undermine his power to heal or his relationship with the ancestors (Adjaye, 2001; Hammond-Tooke, 1989; Van der Veen, 1994).

In fact, in the traditional African context, a man consists of himself and nature (Makhubu, 1978). An illness or a misfortune in a community is therefore attributed to a possible imbalance between man and nature, or to the anger of an ancestor towards the one who has broken a rule (Iroegbu, 2005; Okpako, 2006; Rigouzzo-Weiller, 2002; Westerlund, 2006). Thus to restore this balance, the patient should resort to a practitioner of traditional medicine (Mavi *et al.,* 1983).

It should be noted, however, as reported by Ahluwalia and Méchin (1980) and White (2015), that in traditional African societies, a disease is not always and in all cases considered to be caused solely by unnatural causes. It is considered unnatural if it occurs under problematic circumstances or if it displays certain peculiarities during its development, such as an abnormal degree of severity, a resistance to treatment, a certain chronicity or the occurrence of unusual symptoms.

As reported by Quittel (1983), the treatment of diseases consisted in most cases of diagnosing the patient's apparent symptoms and treating the immediate effects. The patient considered himself cured when the outward signs of pain were no longer visible.

Moreover, the patient could consult a modern doctor if the disease seemed very serious or if he had not been successful with the traditional healer. For minor ailments, the patient could either treat himself or turn to his relatives, who would find him the plant species close to the village, that would provide rapid relief (Staner & Boutique, 1937).

It is therefore in this holistic and ambivalent atmosphere, centred on the phytotherapists, considered as the cornerstone of the traditional health system, that traditional indigenous medicine was organized (Bibeau, 2013; Omonzejele, 2008; Yeboah, 2008).

The arrival of white people changed things. They discouraged the use of traditional medicine, which they considered in its empirical form as opposed to Christian values (Mabika, 1967; Quittel, 1983; Segal and Ulin, 1980).

From around 1980 in DRC, the work of western doctors and nurses took the place of that of traditional healers (Janzen *et al.*, 1995). Over time, for example in urban areas, traditional medicine was systematically banned by the Belgian colonial administration in favour of conventional medicine (Bibeau, 2013). This was imposed by the decree of 19 March 1952 on the art of healing (Tshibinda, 2010) and the ordinance n° 27 bis/hygiene of 15 March 1933 on pharmacy (Okond'ahoka, 2013).

However, despite the advantages of modern medicine - its drugs, surgery, and hospital health care recognized by the indigenous people, traditional healers and phytomedicinal consultations did not, against all odds, disappear with the introduction of modern medicine (Janzen *et al.,* 1995). They continued to flourish because traditional healers successfully healed a wide range of illness (Kinkela *et al.,* 1977). Thus, a real *modus vivendi* developed in the minds of the natives, according to which the two forms of medicine were complementary rather than competitive (Bayona, 1978, 1988; Lomomba, 1997).

Traditional medicine has regained importance in DRC (formerly Zaïre) thanks to the authenticity policy introduced by President Mobutu in 1974 (Bibeau, 1984; Kizito, 1997; Quittel, 1983).

However, its especially with the recognition by WHO in 1976 and 1978 of the precariousness and failure of the formal health system in rural areas, and the role played by phytotherapy that traditional medicine in DRC was finally freed from the colonial yoke and officially recognized (Rukangira, 2001; Ministère Congolais de Santé et de la Population [MSP], 2006; Sanogo, 2014).

In addition, various international conventions, including that of the African Union at its 5th session in 1968, also contributed to its expansion. Nowadays, traditional medicine has expanded in both urban and rural settings, with an increasing number of traditional practitioners and traditional health centers (Sara *et al.*, 2017).

Traditional medicine is now recognised as a method of health care delivery in the DRC through legislative and regulatory texts. These include the Constitution of the Republic, the framework law on health and ministerial orders issued by the Minister of Public Health. The DRC's constitution deals with the organisation of the profession of practitioner of traditional medicine.

The ministerial decrees, from their side aim to create of a National Programme for the Promotion of Traditional Medicine and Medicinal Plants (PNMT-PM), which has one of missions to integrate traditional medicine into the national healthcare system (Mavungu *et al.*, 2017). The most recent ministerial decree is the Law No. 18/035 of 13th of December 2018, which establishes the basic principles for the organisation of public health.

1.2. Typology of identified phytotherapists

According to the Central African law on traditional medicine from 2002, a traditional doctor is a person recognized by the community as competent to provide healthcare, by using plant, animal or mineral products as well as certain methods based on socio-cultural and religious knowledge, attitudes and beliefs that prevail in the community with regard to physical, mental and social well-being and the causes of illness and disability (Bozize, 2002).

In DRC, information on traditional practitioners is very limited. In 2002, the Ministry of Health published a decree on the organisation of the practice of traditional medicine. Unfortunately, the proposed categories of phytotherapists do not seem to reflect the reality on the field.

According to a Kinshasa daily newspaper *Le Phare* (2013) cited by Brunner *et al.* (2019), the National Programme for the Promotion of Traditional Medicine and Medicinal Plants of the Ministry of Public Health conducted a census of traditional practitioners in 2013, but did not communicate the results to the public.

During our fieldwork, we identified three prominent categories of phytotherapists in the study area. These individuals are acknowledged for their profound knowledge of local plant properties and enjoy a notable reputation among the public. Their distinctions lie in their specialized fields of expertise, their unique perspectives on diseases, and their individual approaches of curing (Shalukoma *et al.*, 2016). We classified them as:

- **Herbalists**

  According to Hammond-Tooke (1972) cited by Van Rensburg *et al.* (1992), herbalists are people who possess knowledge of plants and marginal techniques for therapeutic purposes. They generally consider a disease to be of natural origin, and diagnose and prescribe medicines for common ailments. Based on our field observations, herbalists are often associated with alternative and complementary medicine approaches, and they are primarily focused on using plants to treat various ailments. These healers are not necessarily trained in the same way as traditional practitioners. Rather, they are people who propose traditional treatments on the basis of their own personal experience, or on the basis of their own treatments and/or information gathered from others. In other words, they acquire their knowledge from personal sources or information gathered from other people, rather than through formal training or initiation.

- **Curing healers**

  Also called locally "*Nganga buka*", Curing healers are according to Asch (1983), healers who use plant, animal and mineral organs, also certain representations, and mainly resort to religious rites or supernatural practices to cure. According to our observations in the field, curing healers primarily base their diagnosis and treatment on a holistic view of the patient and the patient's symptoms, simultaneously providing physical and psycho-spiritual care. They more frequently specialize in diseases believed by the community to be of non-natural origin or influenced by an evil spell affecting mental or physical well-being, such as madness, epilepsy, Buruli ulcer, and Fournier's gangrene. These healers employ rituals and incantations in their healing practices.

- **Traditional practitioners**

  According to the DRC's law on herbal medicine, traditional practitioners are defined as phytotherapists who provide healthcare by the use of medecines derived plants or herbs, animal and mineral substances (MSP, 2002; Tata Paul, n.d). They have a natural conception or not of a disease, and are specialized in the treatment of many diseases in their respective communities. Based on our field observations, traditional practitioners are initiated individuals who claim to be in permanent contact with ancestors, receiving appropriate traditional treatments through dreams and visions. They are the authentic practitioners of traditional medicine, relying on methods transmitted orally, often based on ancient practices. Their approach combines knowledge of medicinal plants, physical manipulation (like consultation) and other techniques designed to promote health. Deeply rooted in cultural traditions, they attach particular importance to preserving the customs, beliefs and practices accumulated from generation to generation within their communities. These professionals draw on a heritage of methods and knowledge inherited from generation to generation. This category is the most common, influential and best organized. They practise either at home or in medicinal care centers for the more affluent. A peculiarity observed among some traditional practitioners in Kisantu and Mbanza-Ngungu is that they sometimes refer to results of medical examinations and/or diagnoses from modern medicine, in addition to their own diagnoses, to gain a better understanding of the patient's illness and to formulate an appropriate traditional treatment. In turn, they refer their patients to modern doctors (for medical examinations) to confirm or ensure progress in the healing process.

1.3. Brief presentation of the research area

Our study research field was located in the territories of Kisantu (also known as Inkisi) and Mbanza-Ngungu, in the Province of Kongo-Central, in the Democratic Republic of Congo (Figure 1.1). These territories are respectively located at about 120 km and 150 km southwest from Kinshasa and are directly accessible by the National Road N°1, on the section linking Kinshasa to Matadi.

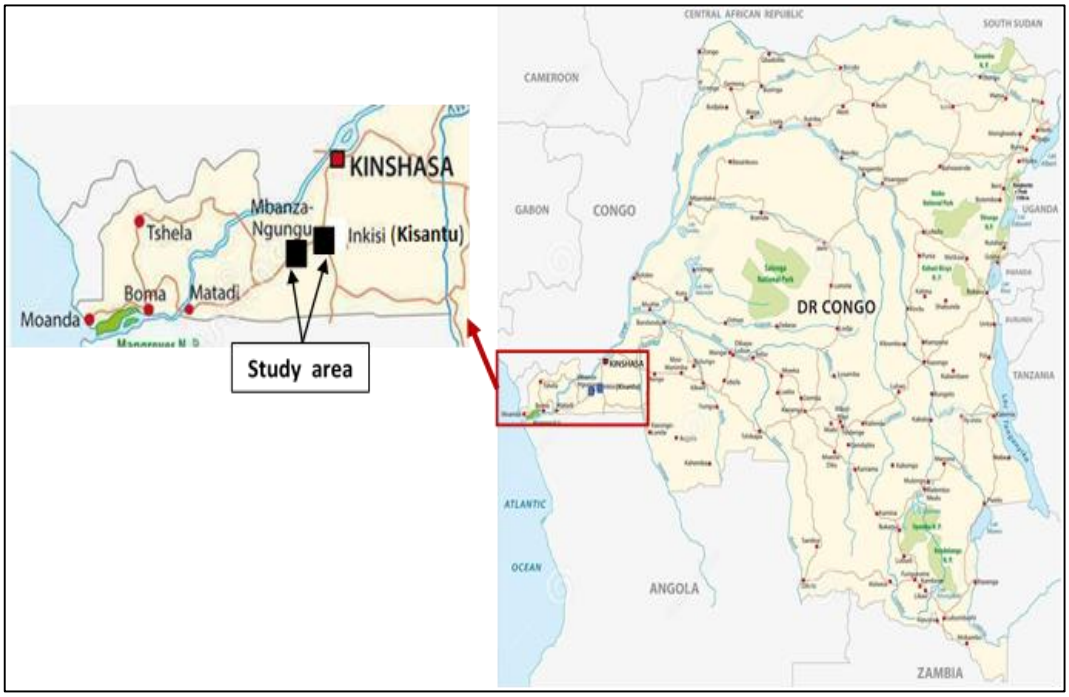

Figure 1.1. Study area location inside DRC, adapted from Rainer Lesniewski (n.d.)

Kisantu and Mbanza-Ngungu are mainly inhabited by *Ntându* and *Ndibu* ethnic groups, respectively. They are neighbours and are both part of the *Kongo* people, who stretch from Congo-Brazzaville to Angola (Martin, 2009). They share the same culture inherited from the former Kongo kingdom and the use of medicinal plants is well anchored in their customs and habits (CAID, 2017). They influence each other and share almost the same socio-economic and cultural realities (Kibungu *et al.*, 2021). They are located in a Province where poverty is general and widespread. The health indicators for this Province show a very worrying situation. According to DSRP (2007), about 90% of the population in fact experiences absolute poverty, with an estimated annual income of $138.6 USD (equivalent to $11.55 USD per month or $0.39 USD per day), whereas the provincial poverty index is 69.8%.

In the Kongo-Central Province, the sanitary situation in general is alarming. It is marked by dilapidated health infrastructures, most of which was built during the colonial period and shortly after independence.

According to DSRP (2007), this Province is characterized by low coverage and precarious health system, with only one general referral hospital for every 126.700 inhabitants, one doctor for every 17.356 inhabitants, one pharmacist for every 131.069 inhabitants, and one bed for every 514 inhabitants. Additionally, there is only one referral health center for every 50.013 inhabitants, and the use of health services for curative care is only about 49 %.

The DSRP estimates that approximately 40 to 50 % of the entire Congolese population (and about 72 % living in rural areas) lack access to basic healthcare. So, it is not surprising that in view of the above, a population that can neither have access to primary healthcare nor obtain basic pharmaceutical products because of their high cost (considering its low income), turns to traditional medicine.

1.3.1. The territory of Kisantu

Kisantu is in Madimba Territory in Lukaya District. It is bordered to the north by the Sonabata grouping, to the south by the city of Ngidinga, to the east by the city of Nselo and to the west by the Sector of Boko (Figure 1.2). It is located at latitude between 4°57' and 6°41'S and at longitude between 14° 53' and 15°36' E (Deceuninck, 1952). Its mean altitude is estimated at 530 m above sea level (masl) (Pauwels, 1972). It is characterized by a tropical Köppen AW_4 climate (Drachoussoff, 1947; Bultot, 1954) with as for the whole Kongo-Central Province, an average annual rainfall oscillating around 1600 mm and an annual average temperature of 25°C (Dubiez *et al.,* 2014).

Located in the Inkisi basin, Kisantu is mainly crossed by the Inkisi River, with its tributaries, the Nianga and the Ngufu. Its soil is sandy-clayey in places and sandy-clayey from the Plio-Pleistocene overlay (Cailteux *et al.,* 2015). The underlying bedrock (Figure 1.3) consists of schisto-limestone rocks. In the eastern region, it is represented by the Bangu stage, characterized by the prevalence of magnesian limestone and dolomite. In the western region, it is composed of the Lukunga stage, which includes schists, limestone, sandstone, and dolomite (Cailteux *et al.*, 2015). The topography is characterized by low hills, valleys, and plateaus (Ladmirant, 1971).

The research area's vegetation is of the Guinean-congo type and is very disturbed (Dubiez *et al.,* 2014). It is mainly occupied by herb or shrubby savannahs and a few isolated forest scraps, among which can be distinguished sites of old preserved villages (*Voka di mfinda, Sangi*) and forest fallows localy named "*Nkunku*" (Nsimundele *et al.,* 2010). The Kisantu botanical garden, covering an area of 225 hectares, is home to a diverse collection of 3500 local

and exotic plant species and serves as the only forested area in the region, sandwiched between three large cities (Kintanu, Nkandu and Gare) with galloping demography. The vegetation of Kisantu is very degraded. Its distribution curve and the evolution of areas by vegetation type between 1995 and 2012 (Figure 1.4) shows the situation presented for the year 2012, which corroborates the current state of the landscape.

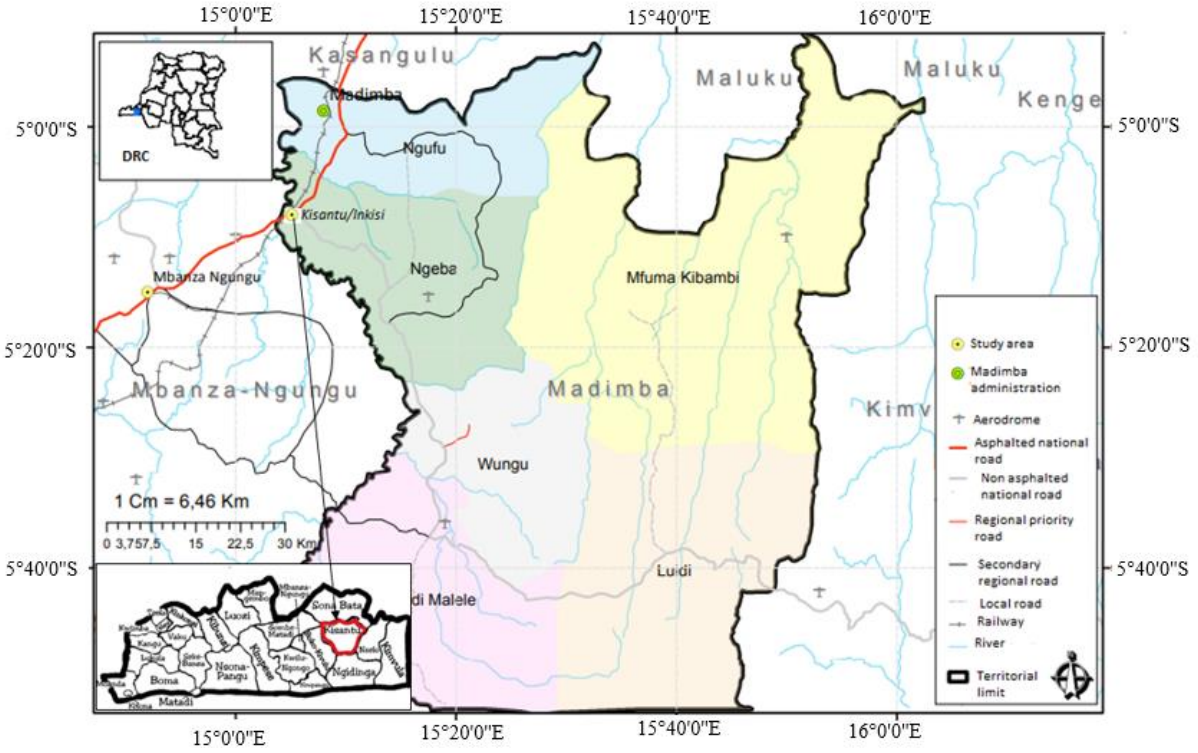

Figure 1.2. Administrative division map of Kongo Central with the location of Kisantu in the territory of Madimba *(adapted from CAID,* 2017)

Kisantu is mainly inhabited by the "*Ba Ntându*" people who represent around 65% of the active population of this region. *Ntându* culture is based on *Kongo* customs and practices, with an emphasis on respect for elders and ancestors (CAID, 2017). However, contact with Westerners and Christianity onwards 15th century, and especially the influence of the proximity of Kinshasa has from our point of view, strongly influenced the ancestral cultural achievements (Nzembele, 2015). The expression "*Muntându Mundedi*" which means in English *Ntându* is a white man, shows clearly this western acculturation.

Economic activities of Kisantu people are essentially focusing on subsistence agriculture (mainly cassava production), small livestock and trading. Agriculture is still of the subsistence type, meaning slash and burn and with a long fallow (Péroches *et al.*, 2019). Charcoal production for trade towards Kinshasa and the fabrication of wood-fired clay bricks

are becoming increasingly important and are often described as the main causes of deforestation (Tchatchou *et al.*, 2015; UN-REDD, 2012).

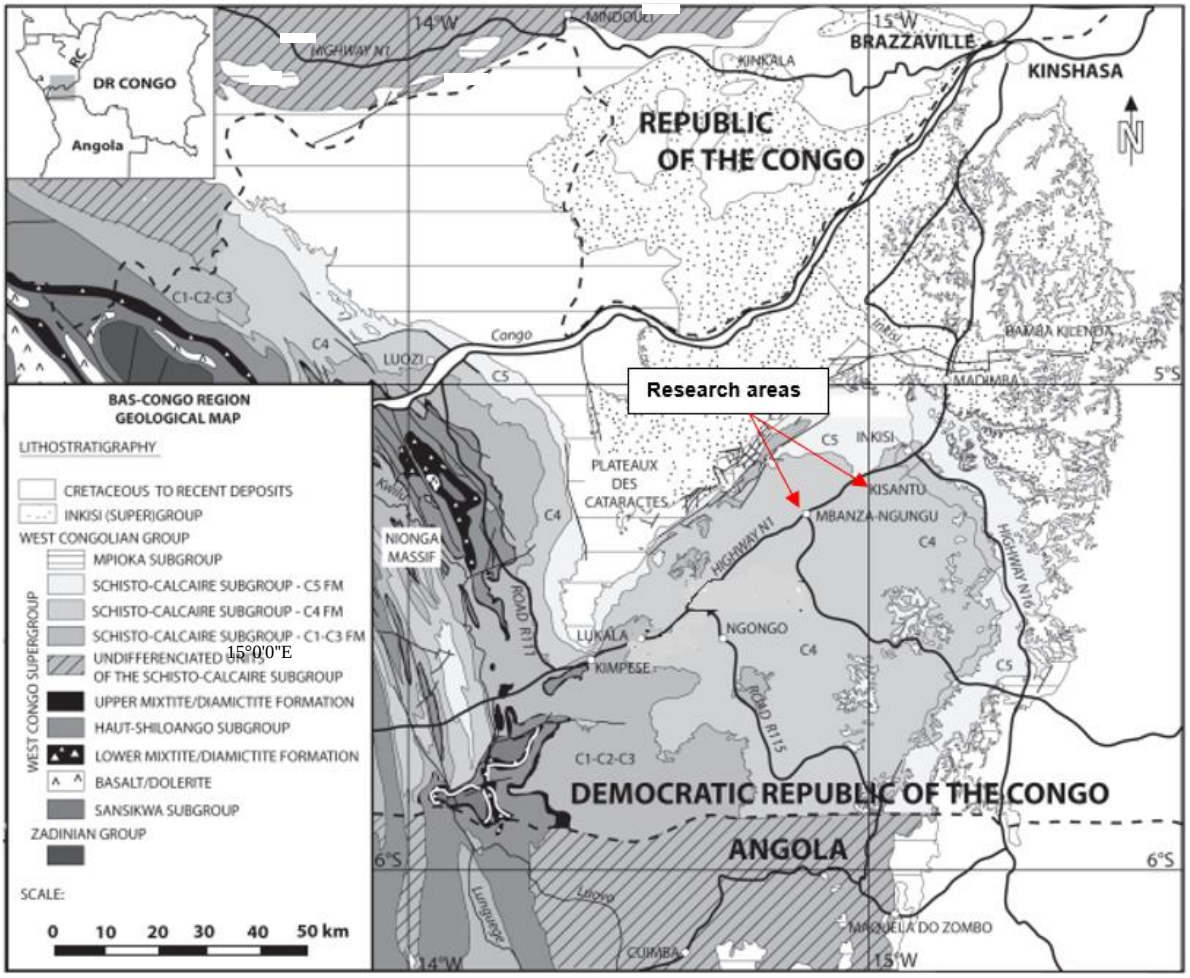

Figure 1.3. Geological map of Kisantu and Mbanza-Ngungu, adapted from Cailteux et al. (2015)

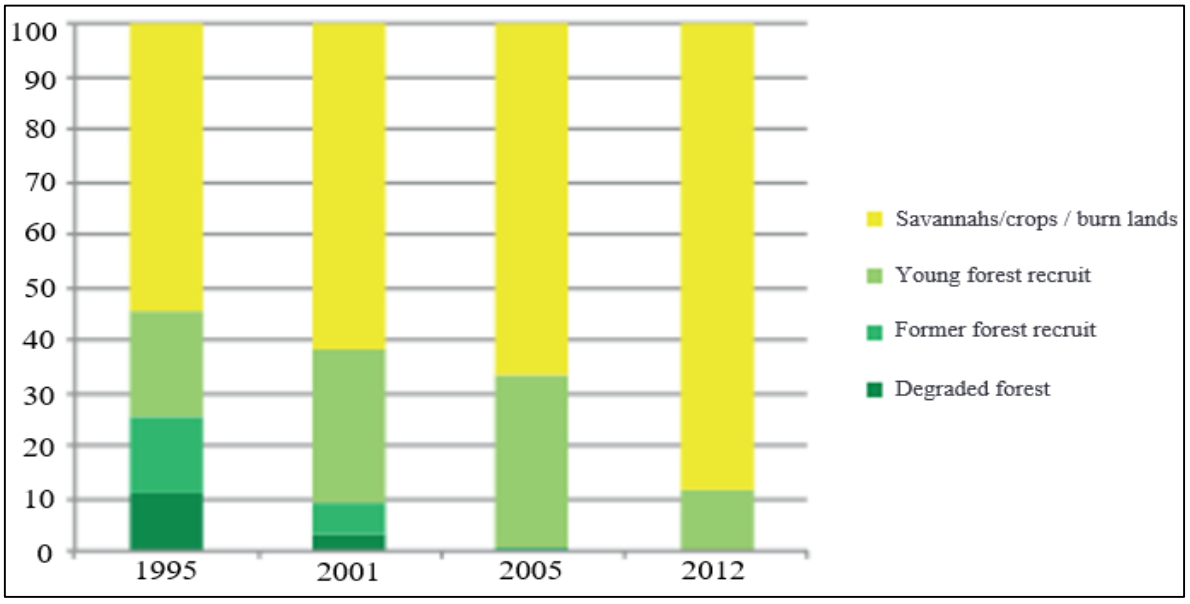

Figure 1.4. P*ercentage change in vegetation cover in the Kisantu region from 1995 to 2012*, based on *satellite images (Boulogne et al., 2013)*

1.3.2. The territory of Mbanza-Ngungu

Mbanza-Ngungu is located in Cataracts District. This territory is bordered from East to West by the territories of Madimba and Songololo, and from North to South by Republics of Congo and Angola, respectively. Mbanza-Ngungu lies between latitude 5° 16' S and longitude 14° 5' E. Its altitude ranges 500 - 750 masl (CAID, 2017).

The town of Mbanza-Ngungu is sandwiched between Gombe-Matadi Sector to the north, Kwilu-Ngongo Sector to the south and west, and Boko-Kivulu Sector to the east (Figure 1.5).

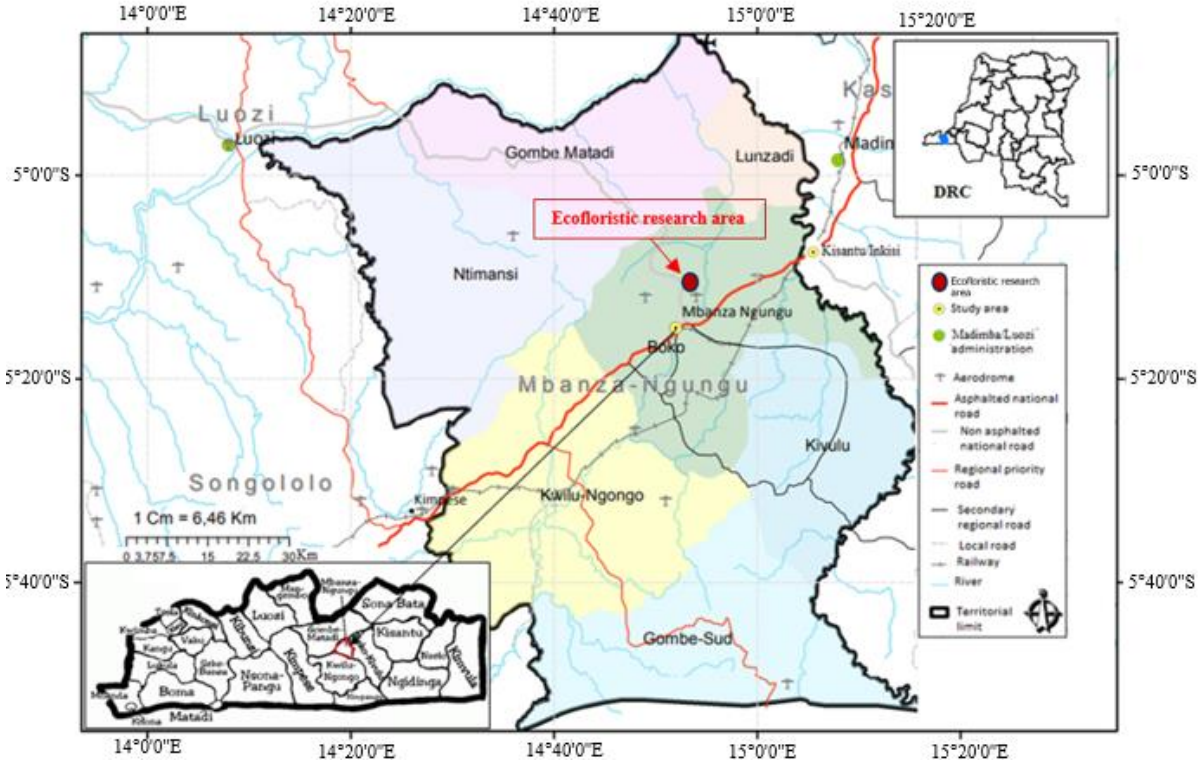

Figure 1.5. Administrative division map of Kongo *Central* with the location of the town of Mbanza-Ngungu and the ecofloristic research are in the territory of Mbanza-Ngungu (Map adapted from CAID, 2017)

Mbanza-Ngungu enjoys a tropical Köppen AW_4 climate and benefits from an average annual rainfall ranging 1100 - 1600 mm, with an average annual temperature estimated at around 25°C (CAID, 2017).

Mbanza-Ngungu is crossed by the Congo river to the north, the Inkisi river to the east and several other rivers in the center, the most important of which are Kwilu-Ngongo, Mpoika, Luasi, Luidi, Luzandi, Noa and Luyaka (CAID, 2017).

The vegetation of this region is highly anthropized and is characterized by shrubby savannahs, dominated by *Hymenocardia acida* Tul., *Annona senegalensis* Pers., *Crossopteryx febrifuga* (Afzel. ex G. Don) Benth. and *Nauclea latifolia* Sm., while in the grassy savannahs species of the genus *Hyparrhenia, Panicum* and *Andropogon* dominate (Pauwels, 1993). Between the hollows of the mountains or around the wetlands, still some fragments of forest dominated by *H. acida* (Wamuini *et al.*, 2010). Some forest fallows, remnants of old secondary forests, can also be found (Bamba *et al.*, 2008).

The soil consists of silt, sand, soft sandstone and sandy-clay found generally at the bottom of valleys and low terraces. This Mesozoic and Cenozoic soil rests on a bedrock of schisto-limestone formations of the Bangu stage, characterised by the presence of magnesian limestone, dolomite and schist (Cahen, 1954).

Mbanza-Ngungu is largely inhabited by the *Ndibu* tribe, representing 57% of the active population (CAID, 2017). As for the *Ntându* people, *Ndibu* culture is also based on *Kongo* customs and habits. However, *Ndibu* are considered, as reported by CRISP (1960) and Procès (2009), the best guardians of *Kongo* culture because of their resistance to the western acculturation in the region since the 15th century (Nzuki, 2016). Their main economic activities are subsistence agriculture, small livestock production and trading. Mbanza-Ngungu is particularly renowned for market gardening (*Phaseolus vulgaris* L., *Solanum lycopersicum* L., tomato, *Allium* L., *A. fistulosum* L., *cepa Brassica oleracea* L., *Capsicum annuum* L., *C. frutescens* L., *Solanum melongena* L., *Ipomoea batatas* (L.) Lam., *Daucus carota* L., etc.). Various other food crops and even plant-based medicinal drugs are supplied directly from the outlying villages to the market of Mbanza-Ngungu where commercial exchanges take place.

Chapter 2. Ethnobotanical characterization of medicinal plants used in Kisantu and Mbanza-Ngungu territories, Kongo-Central Province in DR Congo

From published paper by:

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2.1. Context

Kisantu and Mbanza-Ngungu (DRC) territories, heirs to exceptional cultural and environmental wealth, are home to profound traditional knowledge related to phytotherapy (Kibungu, 2010). However, this ancestral wisdom is under increasing threat from a number of factors, including overexploitation of resources, habitat degradation, globalization and a growing disinterest in traditional medicine among younger generations (Nzuki *et al*., 2013). At the heart of these challenges is a unique botanical biodiversity of potentially medicinal plant species, supposedly containing pharmacological properties, that form the essential foundation of the *Kongo* traditional medicine (Kibungu *et al.*, 2021).

The urgency of preserving traditional phytotherapeutic knowledge before it is lost permanently is undeniable in the current context. The proposed research is designed as a strategic response to this imminent threat. It aims to explore and document the current repertoire of medicinal species still present in the *Kongo* cultural fabric, thus, providing a solid basis for the conservation of this precious heritage.

Through an integrated approach, the research aims to address crucial questions such as which are the most important medicinal plant species of the *Kongo* traditional medicine, that are supposedly containaing effective pharmacological properties, and how these plants can help to maintain traditional medicine in the contemporary context. Emphasis is placed on the identification of key medicinal species, supported by ethnobotanical studies, to provide a sustainable solution for preserving traditional knowledge.

By shedding light on the criteria for selecting important medicinal plants and exploring the sociological factors influencing this traditional knowledge, the research aspires to offer valuable insights into the perception of phytotherapy within *Kongo* communities. Ultimately, this research seeks not only to document and conserve the *Kongo* medicinal heritage

of the DRC but also to illuminate the way toward an informed and sustainable use of this precious knowledge, ensuring its transmission to future generations.

2.2. Introduction

Since time immemorial and throughout annals of history, medicinal plants have been a cornerstone of healing in different civilizations around the world (Qureshi *et al*., 2016; Voeks, 2004). In the contemporary era, the allure of medicinal plants persists, particularly in modern medicine and the pharmaceutical sector, which seeks novel drug discoveries (De Natale and Pollio, 2007; Rivera *et al*., 2005). Despite advances in medical science, approximately 80 % of the global population continues to practice phytotherapy (Demeke *et al.*, 2022; Ullah *et al.*, 2010). In Africa, as in most underdeveloped countries, extreme and widespread poverty limits people's access to quality health care or modern medicine (MA *et al*., 1997), forcing them to rely on herbal medicine (Kouadio *et al.*, 2016).

Several studies have raised the issue of loss or risk of extinction of traditional knowledge and skills in medicinal plant use. Factors such as overexploitation of natural ressources, habitat degradation or deterioration and disinterest of young people to traditional culture due to westernization, acculturation and education, contribute to the disappearance of medicinal plant species and knowledge, respectively (Voeks and Leony, 2004; Yineger *et al.*, 2008). This challenge is notably pronounced in Kongo-Central Province, with reports of the disappearance of *Erythrophleum suaveolens* (Guill. & Perr.) Brenan, a species formerly used in the practice of trial by poison by the *Kongo* people, which allowed to identify the culprit behind a disease of supposedly mystical origin (Daeleman and Pauwels, 1983). In herbal medicine, this species was and is still used against rheumatism and gynaecological problems.

Studies by Makumbelo *et al*. (2008) and Kibungu (2010), point to the increasing rarity of native wild medicinal plant species in Kongo-Central Province, including *Mondia whitei* (Hook. f.) Skeels, *Garcinia kola* Heckel, and *Dorstenia laurentii* De Wild., used to address sexual impotence, abdominal pain, and intestinal amoebiasis, respectively.

A recent vulnerability study in Mbanza-Ngungu by Nzuki *et al.* (2013), highlights *Lannea antiscorbutica* (Hiern) Engl., *Mondia whitei* (Hook. f.) Skeels, *Monodora myristica* (Gaertn.) Dunal, *Pseudospondias microcarpa* (A. Rich.) Engl. and *Annona senegalensis* subsp. *oulotricha* Le Thomas as - according to their vulnerability indices (Iv) - the most vulnerable species in *Kongo* herbal medicine.

The use of medicinal plants and the preservation of traditional phytotherapeutic practices are integral to local culture and tradition, constituting a rich cultural heritage that requires safeguarding (Léger, 2008). In Kisantu and Mbanza-Ngungu territories, ancestral knowledge and skills regarding medicinal plants are orally transmitted, making them vulnerable to erosion and extinction. A gradual decline is currently underway, highlighting the urgent need for research and documentation of medicinal plants in the area to preserve this valuable medicinal heritage before its depletion (Kibungu, 2010).

Our ethnobotanical research is based on the assumption that *Kongo* phytomedicinal knowledge contains valuable information about important local medicinal plant species, most of which are believed to contain potent pharmacological properties that could rationalize their use in *Kongo* herbal medicine. However, the erosion of orally transmitted knowledge highlights the urgent need for documentation. We believe that documenting this knowledge not only helps to preserve the *Kongo* cultural and medicinal heritage, but also opens up new avenues for pharmaceutical research.

To address this pressing need, our research questions focused on the most effective methods of accessing and documenting these important medicinal plant species within *Kongo* phytomedicinal knowledge, and identifying the most knowledgeable custodians of this indigenous wisdom. Furthermore, we expect that the establishment of essential criteria as a basis for identifying these key plants with therapeutic potential will improve precision and guide our conservation and exploration efforts more effectively.

Expanding upon the findings of Nzuki *et al.* (2013), the most important medicinal plants are those distinguished by their medicinal use value (UV) or informant agreement ratio (IAR). They should be prioritized for both cultivation and conservation to prevent their disappearance. However, Heinrich *et al*. (1998) and Lautenschläger *et al.* (2018), suggested that the informant consensus factor (ICF) is a good indicator for the selection of plant species that are best adapted to pharmacological needs and should be subjected to phytochemical analysis.

To respond effectively to this challenge, a global strategy involving ethnobotanical studies is needed to (1) assess and document plant-based ethnomedicinal practices and traditional knowledge on the use of plants to treat diseases, in order to establish a database of medicinal plants and their traditional uses. (2) Analyze documented data using quantitative ethnobotanical indices to identify key medicinal plant species supposedly containing

pharmacologically active substances. (3) assess the cultural similarities between the two groups studied and to evaluate how sociological parameters influence traditional medicinal knowledge.

Our approach involves a holistic assessment of *Kongo* herbal medicine knowledge, including the identification of the most important medicinal plants species and their uses, as well as those believed to contain pharmacologically active substances. In addition, our methodology includes the analysis of ethno-cultural similarities in the knowledge of medicinal plant use between the two territories. We also intend to compare the knowledge of medicinal plants, taking into account (factors such as) the number of species cited and that of diseases treated. This comparative analysis will extend to different social groups, differentiated by gender, age, marital status, level of education, experience, type and residence of the respondents.

The integration of these approaches goals not only to deepen our understanding of *Kongo* herbal medicine, but also to provide valuable insights into the ethno-cultural dynamics that shape the *Kongo* medicinal plant knowledge. Through this study, we intend to provide a valuable basis for further phytochemical and phytopharmacological research aimed at providing a scientific basis for the traditional use of these plants. We hope to make a significant contribution to the *ex situ* and *in situ* conservation of key medicinal plants, to sustainable resource management and to improving the quality of life of the local communities that depend on these resources. By documenting the traditional knowledge and practices associated with these plant resources, we believe that this study will play a key role in an overall strategy aimed at achieving the above objectives and, consequently, slowing down or even halting the erosion of traditional knowledge accumulated over the centuries in the Kisantu and Mbaza-Ngungu territories.

2.3. Study area

For proper organisation and to avoid any data confusion, ethnobotanical surveys were initially conducted in the town of Kisantu among respondents from its four main settlements, namely Nkandu, Kintanu, Gare and Kikonka, where the use of herbal medicine is widespread. Then, we focused on the town of Mbanza-Ngungu and its neigboring villages that are conveniently accessible by road and also exhibit a prevalence of herbal medicine practice. For this purpose, respondents from towns of Mbanza-Ngungu and Kisantu were classified as urban informants, while those from the neighbouring villages of Mbanza-ngungu were categorized as village informants. Peripheral villages of Mbanza-Ngungu included Boko,

Buenze, Gombe-Matadi, Kola, Kinzau, Kolo-Fuma, Kumbi, Kwilu-Ngongo, Luvaka, Mbamba, Mavuma, Muala-Kinsende and Tumba.

2.4. Methods

2.4.1. Data collection

During our investigations, we identified three distinct types of herbal therapists according to their attitude: (1) traditional health practitioners; (2) herbalists and (3) curing healers. We defined them according to the Congolese (MSP, 2002) and Central African (Bozize, 2002) law on herbal medicine, as well as our own observation of their expertise in the field. These herbal therapists are reputed to have in-depth knowledge on local plant properties and enjoy a certain notoriety among the public. However, all herbal therapists have their own area of expertise, do not necessarily use the same plants to treat diseases and are distinguished in the art of curing diseases (Pretorius, 1999).

Ethnobotanical surveys were conducted between june 2017 to february 2018 and february to april 2019. A total of 188 informants, including herbalists, traditional health practitioners and curing healers were interviewed. They were selected using the snowball method (Cochran, 1977; Martin, 1995; Nzuki *et al.*, 2013) and surveyed using semi-structured interviews (Appendix 1). The snowball sampling of informants was based on the identification of a number of informants that we considered to be key informants within the target population, who in turn identified their peers and invited them to participate to the study (Scherrer *et al.*, 2005; Johnston and Sabin, 2010; Johnson, 2014). This method is recommended when researching groups are difficult to locate or approach, like herbal therapists. However, this mode of sampling could according to Erickson (1979), produce biased samples because respondents with large social networks can provide researchers with a great proportion of other respondents who are more likely to have the same characteristics as the initial subject. To eliminate this bias, and after identification of key respondents, we proceeded as proposed by Heckathorn (1997), to the recruitment of peers by peers, and to the limitation of the number of informant to be appointed. In the context of our study, in order to streamline the process, we chosed to limit the number of informants to three persons. We also included informants met at random or in traditional health centers, and informants identified through testimonials or referrals from patients to their healing practitioners.

The semi-structured interview however, is a qualitative data collection strategy in which the researcher poses a series of predetermined yet open-ended questions to the informants. The method provides a flexible and in-depth approach to qualitative data collection (Nzuki, 2016).

Following Thomas *et al.* (2007), plant photos were used to complete interviews (Appendix 2) and to check the respondents' ability to recognize plants they use. We also used photos depicted in Pauwels *et al.* (n.d.), as well as own photos taken during preparatory field visits in the study area.

Information on age, gender, marital status, education level, experience, socio-professional category, diseases treated, plants and plant organs used, medicinal pant growth location, preparation and administration methods were collected during interviews. Following Silva *et al*., (2014), visits in the wild were carried out, accompanied by healers to the places where they harvest medicinal plants. Plant identification was done with the help of phytotheurapists or botanical guides (refering to the most experienced people in the area who know their forests well and are highly regarded by the locals for their ability to identify and recognize plants) and by consulting studies from Gillet and Pâque (1910), Nsimundele (1968), Daeleman and Pauwels (1983), Ludiongo (1984), Mukoko (1991), Pauwels (1993), Malaisse (1997), Kibungu (2010), Nzuki (2016), Latham and Konda (2016) and Nzenze and Disengomoka, (2018). Voucher specimens of each species were collected (Figure 2.1) and compared with species at the herbarium of Kisantu botanical garden or at the National Institute for Agronomic Studies and Research (INERA) at Kinshasa University (UNIKIN). Scientific names, in accordance with the APG (Angiosperm Phylogeny Group) IV system were verified using websites such as Tela-Botanica (www.tela-botanica.org), IPNI (International Plant Name Index: www.ipni.org) or plant of the word online (http://powo.science.kew.org/).

Figure 2.1. *Collect and preparation of voucher specimen in the field*
(Picture from Kibungu, July, 2019)

2.4.2. Parameters calculated

2.4.2.1. Local importance of medicinal plants

Relative importance attached to a given medicinal plant species in *Kongo* traditonal medicine was calculated using UV (medicinal use value) parameter by the formula of Phillips & Gentry (1993), modified and used by Thomas *et al.* (2007) :

$$\mathbf{UV} = \frac{\sum_{\mathbf{i=1}}^{\mathbf{n}} \mathbf{UIs}}{\mathbf{ns}}$$

in which "UV" is the use value of a given species s; "Uis" is the number of uses of species s mentioned by informant I, and "ns" is the total number of informants.

As the latter parameter does not reflect the consensus of informants on medicinal plant use, we also calculated for each species, Informant Agreement Ratio (IAR) following Nzuki *et al*. (2013), Thomas *et al.* (2007), and Trotter and Logan (1986).

$$\boldsymbol{IAR} = \frac{\boldsymbol{Nr-Na}}{\boldsymbol{Nr-1}}$$

in which "Nr" is the total number of citations of the species, and "Na" is the number of diseases treated by the species as mentioned by the respondents.

2.4.2.2. Homogeneity of informants' knowledge

For each plant use, we calculated the Informant Consensus Factor (ICF), which enabled us to verify informant's agreement of a given plant species in the treatment of a particular disease. This method allowed us to identify species with promising therapeutic potential for further phytochemical studies (Giday *et al.* 2007; Hassan *et al.*, 2018; Lautenschläger *et al.*, 2018). ICF was computed following Trotter & Logan (1998) and Houéhanou *et al.* (2016).

$$\mathbf{ICF} = \frac{\mathbf{Nuc - Nt}}{\mathbf{Nuc - 1}}$$

in which "Nuc" is, the number of citations of a particular disease; "Nt" is the number of species used for the treatment of that disease.

2.4.2.3. Species therapeutic potential

After documenting local uses, we further selected species believed to contain effective substances against diseases for which they are used, for phytochemical studies. For this purpose, following Heinrich (2000), we considered species cited more than once for the treatment of a mentioned disease as potentially effective. To enable selection of such potentially effective species, we defined and used the parameter that we named Species Therapeutic Potential (STP) following the formula:

$$\boldsymbol{STP}\ (\%) = \frac{\boldsymbol{Ni - 1}}{\boldsymbol{Nti}}\ \text{x } 100$$

in which "Ni" is the number of informants who mentioned the use of a species for the treatment of a given disease, and "Nti" is the total number of informants who mentioned any species for the treatment of that disease. The subtraction of one (-1) in the formula is necessary because we require consensus from at least two respondents.

The STP parameter allows the selection of the most frequently cited plants for the treatment of a given disease, whereas it allows plants cited only once to be discarded (Table 2.1).

Table 2.1. Illustration of the calculation of STP for species used against amoebiasis (ICF=0.43), cited by 22 respondents during the survey

Species	Number of respondents citing the species	STP (%)
Chamaesyce hirta (L.) Millsp.	5	18
Allium sativum L.	4	14
Elaeis guineensis Jacq.	3	9
Catharanthus roseus (L.) G. Don	1	0
Lygodium microphyllum (Cav.) R.Br.	1	0
Phyllanthus niruri L.	1	0
Cissus rubiginosa (Welw. ex Baker) Planch.	1	0
Psidium cattleianum Afzel. ex Sabine	1	0
Sida rhombifolia L.	1	0
Chenopodium ambrosioides L	1	0
Carica papaya L.	1	0
Ocimum basilicum L.	1	0
Manihot esculenta Crantz.	1	0

Following Table 2.1, a total of 13 species were cited by 22 informants for the treatment of amoebiasis. Among them, *Chamaesyce hirta* (L.) Millsp, *Allium sativum* L. *and Elaeis guineensis* Jacq., were distinguished by their STP different from zero. Hence, these species were believed to have an interesting therapeutic potential for the treatment of amoebiasis. Other species have zero STP value because there was no consensus on their use against amoebiasis among informants.

2.4.2.4. Cultural similarity index

For ethnocultural comparison between Kisantu (inhabited mainly by the *Ntându* ethnic group) and Mbanza-Ngungu (inhabited mainly by the *Ndibu* ethnic group) and between urban and rural respondents, we used the Rahman similarity index (RSI), which indicates the similarity of species used for the treatment of the same diseases (Rahman *et al.*, 2019).

$$\boldsymbol{RSI}\ (\%) = \frac{d}{a+b+c-d}\ \text{x}\ 100$$

in which "a" is the number of unique species in community A, "b" is the number of unique species in community B, "c" is the number of common species in both A and B communities, and "d" is the number of common species in both A and B communities that are used to treat the same disease; a and b $\neq 0$ *and c and d* ≥ 0.

2.4.2.5. Consensus value for the part of the plant used (CPPx)

CPPx index was calculated to measure the degree of approval among informants, concerning the most used plant organ, according to the formula of Monteiro *et al*. (2006). In the context of our work, we have only calculated this parameter for species believed to have therapeutic potential.

$$\mathbf{CPP}\boldsymbol{x} = \frac{\mathbf{P}\boldsymbol{x}}{\mathbf{Pt}}$$

in which "Px" is the number of citations of an organ of a plant for the treatment of a particular disease, and "Pt" is the total number of citations of all organs of plant x.

2.4.3. Data analysis and processing

MS Excel and MS Access 2013 were used to process ethnobotanical data. A synoptic table of inventoried medicinal plants and their use in Kisantu and Mbanza-Ngungu territories is presented in Appendix 3. Differences in traditional medicinal knowledge between *Kongo* sociological parameters were analysed using SPSS 25. Mann-Whitney and Kruskal-Wallis non-parametric tests as well as Poisson regression were employed to analyze difference in disease and medicinal plant knowledge between the different sociological categories considered (distinguished according to gender, age, experience, education, marital status, socio-professional status and geographical origin). Results of Poisson regression, Mann-Whitney and Kruskal-Wallis tests were considered as statistically significant for p-values < 0.05. Two communities (Kisantu versus Mbanza-Ngungu, or rural versus urban) were considered as culturally closer if they share many common species to treat similar diseases or if they have a high cultural similarity index.

The median UV and IAR value of 0.05 and 0.5, were respectively considered as references to assess the local importance of a medicinal plant species of the study area. Medicinal plant species with UV values greater than or equal to 0.05 ($UV \geq 0.05$) or IAR values greater than or equal to 0.5 ($IAR \geq 0.5$), were thus considered as the most important medicinal plants of Kisantu and Mbanza-Ngungu phytotherapy.

Furthermore, we identified plant species believed to contain effective substances, particularly those with non-zero STP values. To determine these species, we focused on diseases with ICF median value of 0.2, which allowed us to select the most significant diseases based on the consensus among respondents. We compiled a list of all species mentioned for the treatment of these diseases and then prioritized species that were consistently cited by more

than one respondent (or species with STP values different from zero). These selected species were believed to contain potential active constituents and were further recommended for chemical studies. For these species, we also defined and considered the part of the plant most commonly used in the preparation of a remedy as the specific plant organ that holds the highest medicinal value for a particular species.

2.5. Results and discussions

2.5.1. Informant sociological profiles

The analysis of the informant profile data involved the classification of respondents into seven distinct categories, as presented in Table 2.2. The results consistently revealed notable trends among the participants. A majority of the respondents, accounting for 57.4% of the total sample, was identified as male. Furthermore, 81.9% of the respondents were health practitioners, indicating a strong representation of this professional status in the study.

Regarding age distribution, 72.3% of respondents were adults (26-50 years old), highlighting the prevalence of mature individuals within the study population. Additionally, a significant portion of participants, comprising 23.4 % of the total, fell into the elderly category (> 50 years old), suggesting a significant representation of older adults in the study.

The distribution of respondents across the study area displayed noticeable disparities among the three different locations. The urban area of Mbanza-Ngungu exhibited the lowest number of respondents, accounting for 20.7 % of the total, while the majority of participants (43.1 %) were from Kisantu. The rural area of Mbanza-Ngungu showed the second-highest representation, with 36.2 % of the respondents.

Furthermore, a substantial proportion of respondents had received formal education, with the majority having received an education limited to primary school (33%) and others limited to secondary school (41.5%). This indicates that a considerable number of participants possessed a basic to intermediate level of educational background.

Married individuals constituted the majority of the respondents, accounting for 70.2 % of the total participants. This suggests a significant representation of married individuals in the study.

Moreover, participants exhibited a considerable level of experience with phytomedicine, with 78.7 % of them reporting more than 10 years of experience in this field. This indicates a high level of expertise and familiarity among the respondents regarding the use and application of herbal medicine.

The data analysis also uncovered interesting patterns concerning the average number of cited plant species and diseases among different respondent groups. Several groups, including men, respondents with 5 to 10 years of experience, older individuals (> 50 years old), married respondents, those that have completed a secondary level of education, curing healers, and respondents residing in the urban area of Mbanza-Ngungu, exhibited a relatively high average number of cited plant species and diseases. These findings suggest that these groups possess a rich understanding, extensive experience, and accumulated knowledge in the field of phytomedicine in the study area.

Table 2.2. Informant sociological profiles and average (± SD) number of reported species and diseases

Factors	Category	No	%	No. of species	No. of disease
Gender	Female	80	42.6	3.3±3.2	1.4±1.5
	Male	108	57.4	4.8±3.9	1.9±1.9
Age	Young (18-25 years old)	8	4.3	3±1.9	2±2,8
	Adult (26-50 years old)	136	72.3	4.0±3.6	1.6±1.7
	Old (>50 years old)	44	23.4	4.8±4.2	2.1±1.9
School level	Illiterate	28	14.9	3.6±3.5	1.5±1.4
	Primary	62	33.0	4.2±3.5	1.5±1.4
	Secondary	78	41.5	4.7±4.1	2.1±2.2
	Tertiary	20	10.6	2.7±2.0	1.4±1.8
Year of experience	< 5 years	12	6.4	2.5±1.6	1
	5-10 years	28	14.9	4.6±4.4	1.9±1.9
	> 10 years	148	78.7	4.2±3.6	1.8±1.9
Professional status	Herbalist	13	6.9	1.9±1.5	1
	Curing healer	21	11.2	6.7±5.6	3.1±2.6
	Traditional health practitioner	154	81.9	4±3.3	1.6±1.7
Marital status	Single	19	10.1	2.6±1.9	1.4±1.8
	Married	132	70.2	4.6±3.9	1.8±1.9
	Widower	37	19.7	3.5±2.8	1.6±1.5
Location	Kisantu	81	43.1	4.7±4,2	1,9±1.9
	Mbanza-Ngungu urban area	39	20.7	5,2±4.4	2.5±2.6
	Mbanza-Ngungu rural area	68	36.2	2.9±1.8	1.0±0.1
	Total	188	100.0	4.2±3.7	1.7±1.8

Our findings are consistent with those reported by Nzuki (2016), who previously observed that *Kongo* phytotherapists (in Mbanza-Ngungu) were predominantly male, married, adult (48-55 years), educated, experienced, and living in urban areas. In comparison with results from other countries, our findings are consistent with those of (1) Ladoh-Yemeda *et al.* (2016) in Cameroon who find the predominance of adults (31-50 years old) and respondents with more than 10 years of experience; (2) Bahassan *et al.* (2014) in Yemen, Kisangau *et al.* (2007) in Tanzania, and Gbary *et al.* (1996) in Burkina Faso, who also observed the predominance of older phytotherapists (over 50 years old), while Lautenschläger *et al.* (2018) in Angola and Tumoro & Melesse, (2016) in Ethiopia, highlighted the predominance of respondents under 40

years old; (3) Ndjouondo *et al.* (2015) in Cameroon and Amujoyegbe *et al.* (2016) in Nigeria who like us, observed a predominance of informants of secondary school level. Conversely, Treasure *et al.* (2020), in Nigeria; Polat (2019), in Turkey and Razafindraibe *et al.* (2013), in Madagascar observed the predominance of respondents with only primary school level; (4) Tumoro & Melesse (2016) in Ghana, and Lulekal *et al.* (2013) in Ethiopia who observed as we did, a high proportion of literate respondents among phytotherapists. By contrast, Hassam *et al.* (2017), in Pakistan; Rajalakshmi *et al.* (2019), in India; Lee *et al.* (2019), in Vietnam and Chaachouay *et al.* (2019), in Morocco observed unlike us that illiterate respondents were the predominant group among phytotherapists; (5) Salim *et al.* (2019) and Rehman *et al.* (2017) in Pakistan, as well as Wanjohi *et al.* (2020) in Kenya observed like us, a predominance of men among respondent they interviewed. Conversely, Estrada-Castillón *et al.* (2012) in Mexico and Appiah *et al.* (2018) in Ghana, observed unlike us, after using the same research approach, the predominance of women among the respondents; (6) our results agree with those of Rehman *et al.* (2017) for the predominance of phytotherapists with 5-10 years of experience and with Benkhnigue *et al.* (2010) for the predominance of married people among respondents; (7) Reimers *et al.* (2019) for the predominance of informants from urban areas. On the other hand, our results differ from those of Malik *et al.* (2019) who found the predominance of respondents from rural areas.

In view of all these observations, it seems therefore impossible to accurately predict gender, average age, experience or education level of phytotherapists that prevail in any region or culture's traditional medicine. In accordance with Heckler (2002), Philander *et al*. (2011) and Phumthum *et al.* (2018), we agree that each area or culture has its own characteristics and unique ethnomedicinal knowledge. However, across civilizations, it is widely recognized that in traditional societies, knowledge and healing abilities are typically acquired with a certain level of maturity and after a long period of apprenticeship. They increase, develop and consolidate with age and life experience (Anyinam, 1995; Estomba *et al.,* 2006). This could partly explain the predominance of adults, elderly and experienced respondents among participants. The predominance of elders could also be due to (1) the disinterest of younger people in traditional medicine (Yineger *et al.*, 2008); (2) influence of Western culture and schooling (Reyes-Garcia, 2003; Yineger et *al.,* 2008; Amouzou, 2009) ; and (3) young people's denigration of and contempt for traditional practices due to the emergence of revivalist churches, which consider them to be contrary to Christian values (Somé, 2001; Lougbegnon *et al.,* 2018).

The predominance of men in traditional medicine, especially in Africa, is probably due to the fact that in African traditional societies, knowledge is generally primarily transmitted to men, more specifically to the elder brother of the family (Gessler *et al.*, 1995). This provides him with a certain power within the family and a notoriety in society (Pfeiffer, 2005). Women, on the contrary, are generally considered as "unable to keep secrets". Once married, it is assumed that they are able of passing on to their husbands, even secret medicinal knowledge from their families. Consequently, very few women have benefited from the knowledge of healing. However, it was challenging to find that women played a pivotal role in the indigenous healing domain. The reasons for this underrepresentation may include societal and cultural norms that have limited women's access to education and opportunities in traditional healing practices (Mji, 2019).

Furthermore, beyond the many taboos around women handling traditional medicines (Moteetee and Van Wyk, 2011), there is a prevailing traditional belief that women should primarily focus on their domestic responsibilities, such as taking care of their families, including children and the elderly (Mbala and Fao, 2007). Consequently, this cultural perspective often restricts women from actively participating in healing practices and limits their involvement in the field of traditional medicine. Despite the predominance of men, the contribution of women to traditional medicine should not be ignored. Due to the societal role assigned to her, the *Kongo* woman, similar to her counterparts across Africa, plays a crucial role in the dynamics of household life. Without being the head of the family, she has a significant influence and contributes greatly to the well-being, survival and expansion of the family unit through her responsibilities as a mother (Sow, 1995). As such, she has extensive knowledge about postnatal care and provides first aid, especially to children (Mbala and Fao, 2007).

However, men and women living as a couple have the advantage of sharing their respective families' knowledge of herbal medicine, even if it is secret (Pourchez, 2011), in order to solve health problems that affect the household before resorting to the doctor of modern medecine (Staner and Boutique, 1937). This allows them, to a certain extent, to avoid or minimize the financial expenses that comes with consulting doctors or pharmacists (Benkhnigue *et al.*, 2010).

Furthermore, women's knowledge of nature, generally related to the anthropogenic landscapes (cultivated areas) they frequent, making them more knowledgeable than men about medicinal herbs (Amorozo, 2013), whereas men who work most often in forests, have more

knowledge of medicinal forest species (Pasa *et al.*, 2017 cited by Pasa *et al.*, 2019). Consequently, by combining their knowledge, both genders contribute a wealth of medicinal knowledge, making them important resource persons in the field of ethnobotany. This collaboration between men and women amplifies the collective understanding of medicinal plants, fostering a comprehensive understanding of their uses and applications.

The predominance of married or phytotherapists living as a couple could also be linked to the consideration, opportunities and social benefits that this marital status confers in Congolese society. Once married, both spouses acquire a new, more valuable and honorary status. A married person is perceived by Congolese society as being responsible, serious, respectful, capable, enable to assume the functions of responsibility and a safeguard against immoral or inappropriate behaviour such as premarital sex (Mpilambo *et al.*, 2017).

With regard to educational level, the predominance of respondents having completed at least primary education can be understood by the fact that Kongo-Central Province is one of the country's Provinces where the level of education is very high (Mokonzi, 2009). As an example, data from 2005 reveals that in Kongo-Central Province, 74 % of the population had attained at least a primary education level, while the percentage for secondary education stood at 32 % (Bashir, 2005). These statistics provide interesting trend in terms of gender distribution. Specifically, a higher proportion of men (81 % for primary level and 39 % for secondary level) were reported compared to women (68 % for primary level and 24 % for secondary level).

The predominance of urban respondents could be linked to the proliferation of so-called phytotherapists who came to settle in urban areas in search of a better future (Auzias and Labourdette, 2015). Indeed, living conditions have become so precarious in rural areas that in recent years there was a mass exodus of populations from villages to towns (DSRP, 2007). Confronted with the misery of the slums and shantytowns that host them in urban areas (Lagrange, 2015; Santos, 1961), the latter have developed survival strategies by improvising themselves as phytotherapists (Baya, 2019). They make false claims about their competence and take advantage of naive patients who are often destitute and in desperate search of medical treatment (Les observateurs, 2010). Driven by profit, these so-called phytotherapists often prescribe medicinal plant treatments that do not correspond to accurate ancestral knowledge (Nonguierma, 2005).

2.5.2. Taxonomic diversity

From a total of 231 inventoried plants, 227 botanical species could be identified and classified in 192 genera and 79 families. Families with the highest number of species were Fabaceae (27, i.e. 11.9 %), Euphorbiaceae (13, i.e. 5.7 %), Rubiaceae (12, i.e. 5.3 %), Asteraceae and Lamiaceae (each with 11, i.e. 4.8 %), and Solanaceae (10, i.e. 4.4 %). The other 73 families were represented by less than 10 species (Table 2.3).

*Table 2.*3. *Taxonomic diversity of medicinal plants in the study area*

Family	Number of reported species	Share of reported species (%)	Number of genera	Share of genera (%)
Fabaceae	27	11.9	21	10.9
Euphorbiaceae	13	5.7	12	6.3
Rubiaceae	12	5.3	10	5.2
Asteraceae	11	4.8	11	5.7
Lamiaceae	11	4.8	6	3.1
Solanaceae	10	4.4	7	3.6
Poaceae	8	3.5	8	4.2
Apocynaceae	7	3.1	6	3.1
Malvaceae	7	3.1	7	3.6
Cucurbitaceae	5	2.2	5	2.6
Anacardiaceae	5	2.2	4	2.1
Moraceae	5	2.2	4	2.1
Zingiberaceae	5	2.2	4	2.1
Annonaceae	4	1.8	3	1.6
Araceae	4	1.8	4	2.1
Myrtaceae	4	1.8	3	1.6
Amaryllidaceae	3	1.3	1	0.5
Arecaceae	3	1.3	3	2.1
Cyperaceae	3	1.3	2	1.0
Dioscoreaceae	3	1.3	1	0.5
Phyllanthaceae	3	1.3	3	1.6
Other families (< 3 species)	74	32.6	67	34.9
Total	227	100.0	192	100.0

Out of the 231 medicinal plant species documented in the ethnobotanical study, 135 were previously identified in ethnomedicinal studies from Nzuki (2016), 170 from Kibungu (2010) and 70 from Nsimundele (1968) in the same Kongo-Central Province. Across the country, Lejoly (1997) identified, based on the PHARMEL database, 291 medicinal species, while Konda *et al.* (2015) inventoried 452 species, grouped into 327 genera and representing 96 families. These results not only confirm the richness and diversity of the *Kongo* medicinal plants but also suggest that much work remains to be done in order to develop a comprehensive list of medicinal plants of the Kongo-Central Province and of the whole country.

Predominance of species of the Fabaceae family in the Congolese medicinal plants has been also observed by Mpiana *et al.* (2010) and Ilumbe *et al.* (2014). In other areas, our results match those of Ngene *et al.* (2015) in Cameroon, Gnagne *et al.* (2017) in the Ivory Coast, Chukwuma *et al.*(2019) and Anywar *et al.* (2020) in Uganda, Amujoyegbe *et al.* (2016) in Nigeria, Ribeiro *et al.* (2017) in Brazil, and Ong & Kim (2020) in India and Bangladesh. The relative high medicinal use of Fabaceae species could be explained by the wide range of bioactive elements they contain, including tannins, alkaloids, coumarins, steroids, saponosides, flavonoids and isoflavonoids (Ratiba, 2017). These bioactive elements are known for their interesting pharmacological roles such as antioxidant and anti-free radical (Ngene *et al.*, 2015), and for cardiovascular (Mpondo *et al.*, 2012), neuronal (Chen *et al.*, 2008), antimicrobial (Ulanowska *et al.*, 2006) uses, etc.

2.5.3. Medicinal plant use

We identified a total of 337 plant medicine recipes of which 203 were composed of at least two species, for the treatment of 103 ailments. Diseases most commonly treated by traditional medicine in the study area are haemorrhoids, hernias, and sexual weakness or impotence (Figure 2.2).

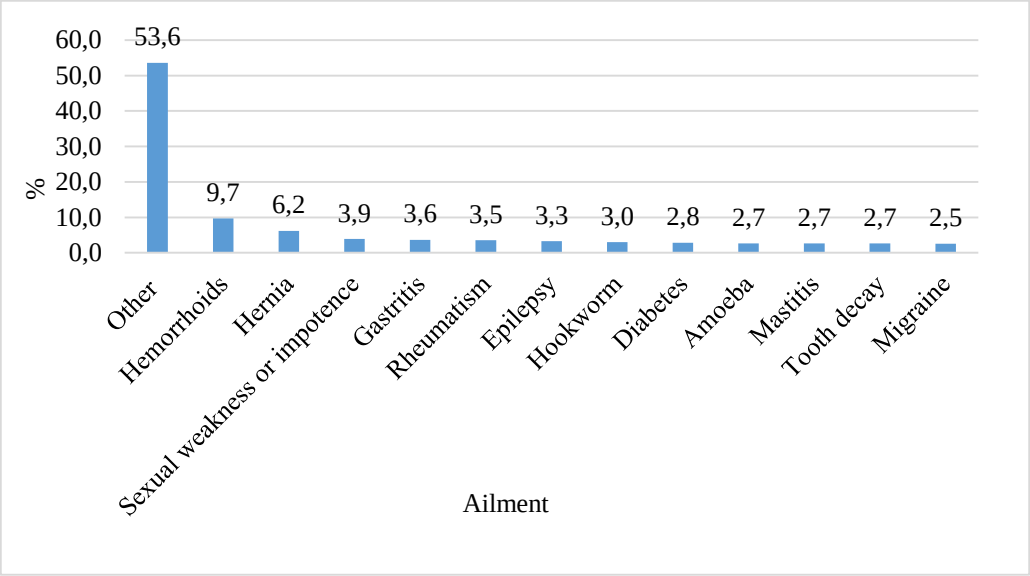


Figure 2.2. Share (%) in use reports of ailments commonly cited

The prevalence of haemorrhoidal diseases among the most-treated diseases by phytotherapy in DRC is widespread (Ilumbe, 2010; Kalanda and Ilumbe, 1993; Nzuki *et al.*, 2013). It could be due and favoured by poor eating habits (hard, dry and overly spicy foods), intense physical effort, sedentary lifestyle or occupations that involve prolonged sitting and limited opportunity for movement (Siproudhi and Vilotte, 1996).

These factors generally lead to frequent problems of constipation and abnormal dilatation of recto-anal veins, both precursors of haemorrhoids (Chautems *et al.,* 2005; Sun and Migaly, 2016). These problems usually manifest themselves by low back pain, anal bleeding, burning and heaviness when defecating, anal itching, repeated farts and libido disorders (Tshimpi *et al.,* 2016).

The leaf (39.4 %) was the most commonly used organ (Figure 2.3a), while decoction (41.7 %) and oral administration (71.7 %) were the most common methods of preparation (Figure 2.3b) and administration (Figure 2.3c), respectively. The predominance of leaves, decoction and oral administration are reported in medicinal plant studies as the most-used medicinal plant part, preparation and administration methods, respectively by several authors (Balamurugan *et al.,* 2019; Malik *et al.,* 2020; Rahayu *et al.,* 2020; Tugume *et al.,* 2016). The widespread medicinal use of leaves is probably due to the fact that they are easily and conveniently harvested (Bhattarai *et al.,* 2006), but also because they are the site par excellence of biosynthesis and storage of secondary metabolites, responsible for biological plant properties (Kumar and Lalramnghinglova, 2011; Srithi *et al.,* 2009). It has been suggested that a high frequency of use of a particular plant part can be a threat to the plant itself (Krog *et al.,* 2006). However, removing up to 50 % of leaves does not appear to have a significant impact on the survival of a tree (De Wet *et al.,* 2013; Poffenberger *et al.,* 1992), whereas excessive removal of roots or barks, for example, is detrimental to the survival of the plant because it affects its physiological balance compared to what happens with leaf removal (Deleké, 2005; Deleké *et al.,* 2009; Jain, 2003; Kefalew *et al.,* 2015; Yapi *et al.,* 2015). The common practice of decoction as a medicinal plant preparation method can be explained by the fact that it is an easy way to collect the medicinally active compounds and to mitigate or eliminate toxic substances in certain medicinal plants (Dougnon *et al.* 2016; Lazli *et al.,* 2019; Salhi *et al.,* 2010). According to Lahsissene *et al.,* (2009) and (Tahri *et al.* (2012), decoction heat and disinfect the body.

Benlamdini *et al.* (2014) and Labiad *et al.* (2020), on the other hand, estimated that decoction would destroy certain active principles of species, while Stachowiak-Wencek and Prądzyński (2013) observed that the concentration of volatile compounds can increase with temperature. Based on the above, we agree with Dextreit (1984), that there is no best method of traditional drug preparation. The best method of using a plant would be that which preserves all its properties while allowing a high and concentred extract during extraction process, and a good assimilation of the active principles.

The frequent use of oral administration can be linked to the fact that it is fast and provides a large effective surface area for absorption of any drug's active components (Hillery *et al.*, 2001). Once absorbed, the drug passes through the intestinal wall and liver before being transported to the target site by the bloodstream (Jean-François, 2004; Azman *et al.*, 2022).

Regarding biological forms and areas where medicinal plants are harvested, our findings show that herbs (36.4 %) are the most widespread, while anthropized areas such as fields, roadsides and homegardens (45.0 %) are the most common places where inventoried medicinal plants are found (Figure 2.4a and Figure 2.4b).

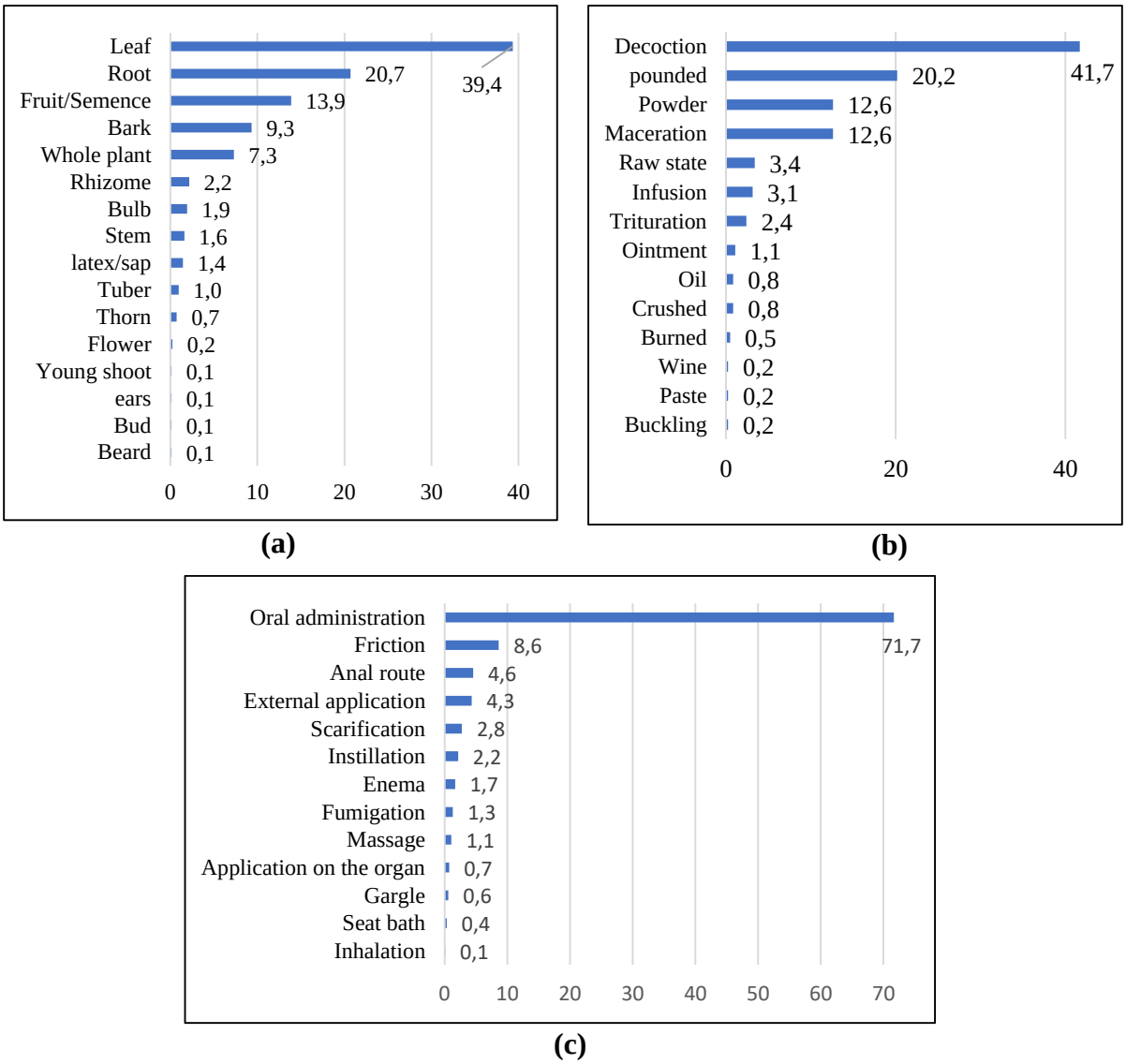


Figure 2.3. Share (%) in use reports of organs harvested (a), preparation (b) and administration (c) methods of medicinal plants

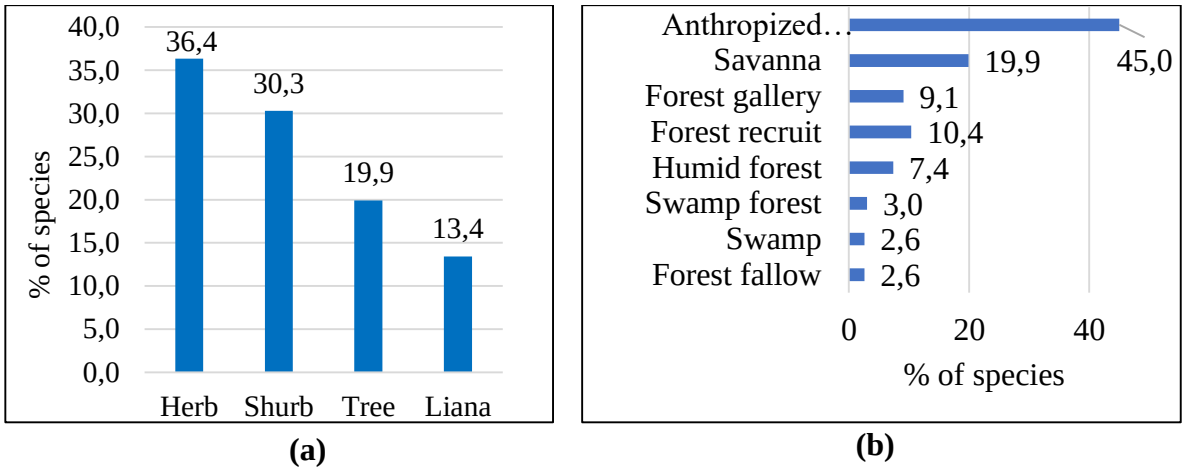


Figure 2.4. Share (%) in medicinal plant use reports of biological forms (a) and plant locations (b)

The predominant use of herbs and plants harvested from anthropized areas in traditional medicine, were also reported in Brazil (Avila *et al.*, 2015), the Philippines (Tantengco *et al.*, 2018) and Cameroon (Maffo *et al.* 2019). This predominance could be due to the easy availability and intrinsic medicinal value of herbaceous species, as well as the increasing scarcity of forests in the study area (Voeks, 1996). Because of the fact that the vegetation of the region is severely disturbed by human activities, people are forced to resort to resources provided by abandoned fields and disturbed areas. These areas are rapidly colonized by grasses, to the detriment of forests and savannahs, which require a long transition period to regenerate (Betti, 2001). The predominant use of herbaceous plants could also be due (as mentioned by most respondents) to the depletion of medicinal trees in the region and the forest degradation which makes medicinal plants harvesting difficult and complicated. Faced with this constraint, they are obliged to rely the surrounding herbaceous species that are easily accessible to them (Benoît, 2008; Giday *et al.*, 2003).

2.5.4. Ethnobotanical parameters calculated

2.5.4.1. Relative importance of a given plant (UV, IAR)

Medicinal plant use values ranged 0.01 to 0.14. *Elaeis guineensis* Jacq. (0.14), *Mondia whitei* (Hook. f.) Skeels (0.10), *Ocimum gratissimum* L. (0.08) and *Pentadiplandra brazzeana* Baillon (0.06) were the most-important species in the traditional *Kongo* pharmacopoeia, with UV > 0.05 (Figure 2.5).

Informant agreement on plant use ranged 0.1 to 1. *Dioscorea smilacifolia* De Wild. et T. Durand, *Abelmoschus esculentus* (L.) Moench, *Corymbia citriodora* (Hook.) K. D. Hill & L.A.S. Johnson, *Garcinia kola* Heckel, *Musanga cecropioides* R. Br., *Steganotaenia araliacea* Hochst., *Strychnos pungens* Soler. and *Datura stramonium* L., had the maximum

IAR-value of 1 (Figure 2.6). They represented the species with the highest level of consensus for their use as a remedy for diabetes, coughs, epilepsy, laryngitis, hernia, elephantiasis, hair yellowing and tooth decay, respectively.

Based on the informant agreement ratio (IAR) and the medicinal use value (UV) of plants, twenty species (Figure 2.5), representing 8.7%, and twelve species (Figure 2.6), representing 5.2% of all inventoried medicinal plants, were classified as most important. Among these species and with comparison to the literature, *Elaeis guineensis* Jacq, *Mondia whitei* (Hook. f.) Skeels, *Brillantaisia patula* T. Anderson, *Chamaesyce hirta* (L.) Millsp, *Aframomum melegueta* (Roscoe) K. Schum, *Zingiber officinale* Roscoe, *Allium sativum* L. and *Coffea* spp. were previously identified as the most important medicinal plant species of the traditional *Kongo* medicine of Mbanza-Ngungu (Nzuki *et al*., 2013).

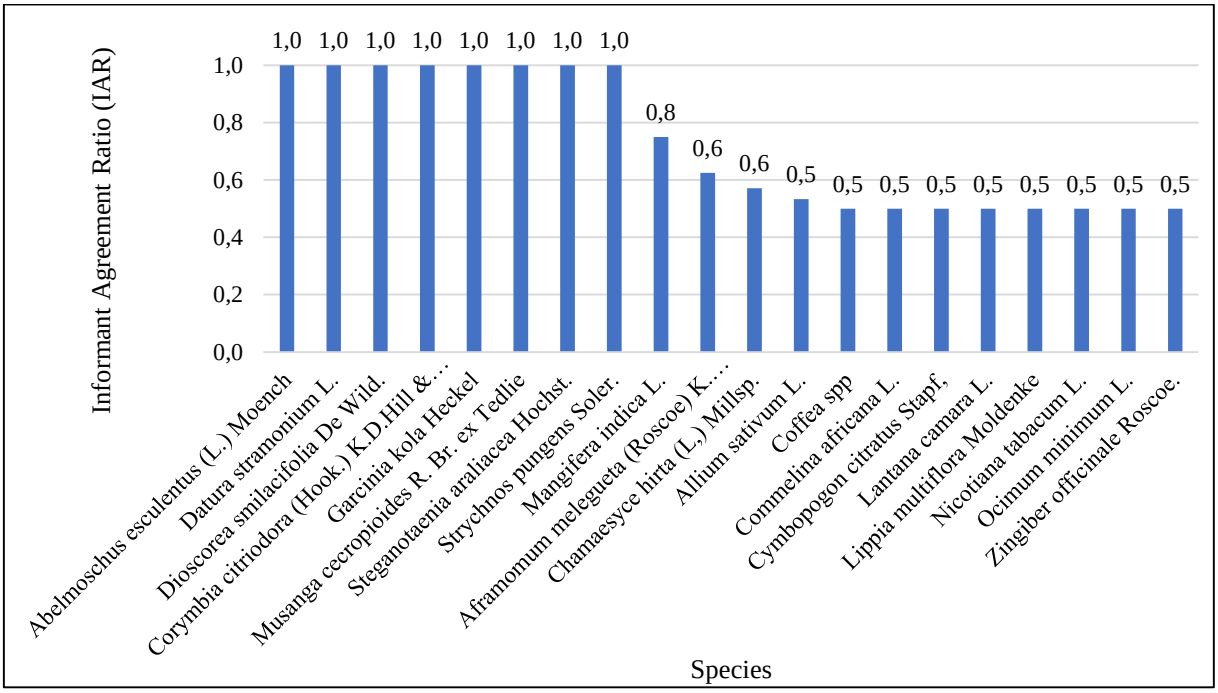


Figure 2.5. Ranking of most important medicinal plant species according to their IAR

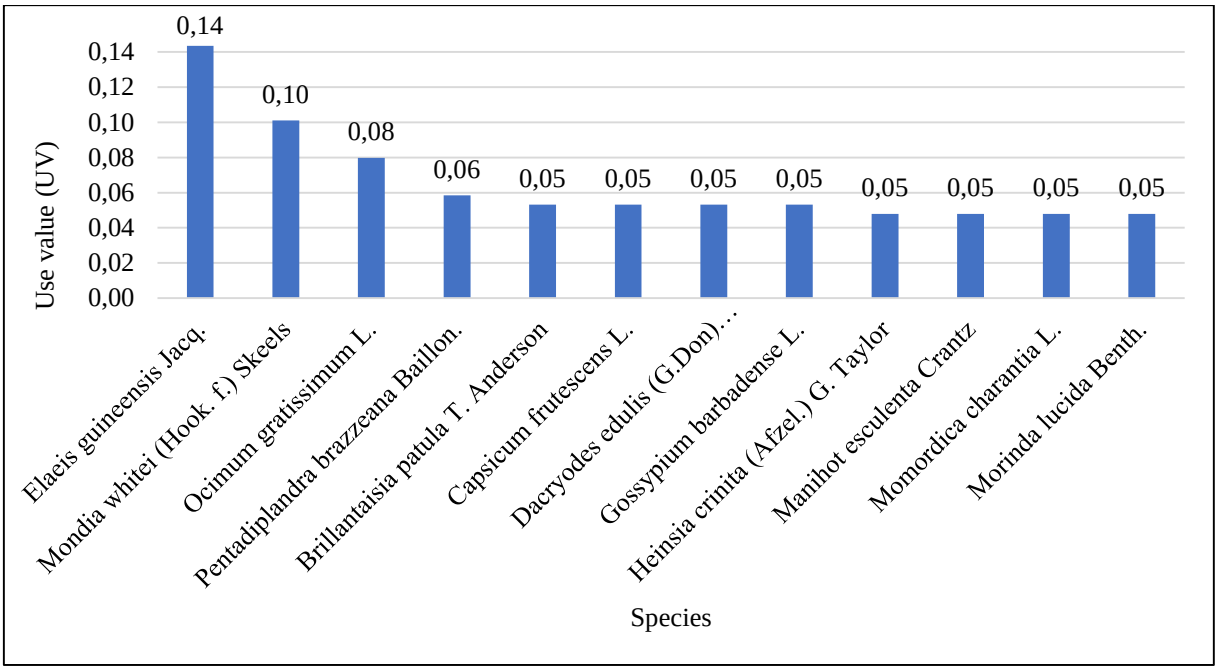


Figure 2.6. Ranking of most important medicinal plant species according to their UV

2.5.4.2. Informant Consensus Factor (ICF), Species Therapeutic Potential (STP) and Consensus on the Plant Parts used (CPP)

ICF ranged 0.05 to 0.44 and a total of 31 diseases was highlighted. Diseases with high ICF-values (ICF ≥ 0.20) include haemorrhoids (0.44), amoebiasis (0.43), itchy rash (0.42), poliomyelitis (0.36), intestinal parasitosis (0.33), sexual weakness or impotence (0.32), splenomegaly (0.29), laryngitis (0.27), rheumatism (0.25), otitis, (0.25), hernia (0.2) and coughing (0.2) (Table 2.4). For each reported disease, we identified species with the highest STP (STP ≠ 0). Thus, a total of 54 plant species was defined as supposedly containing pharmacologically active substances (Table 2.4). Hernia was the disease with the highest number of reported medicinal plant remedies. *Elaeis guineensis* Jacq. was the plant species used to treat a high number of diseases including amoebiasis, dental caries, migraine, sciatic neuralgia, splenomegaly and rheumatism. The common medicinal use of *Elaeis guineensis* Jacq., could be linked to the diverse set of products that are obtained from it, including oil, wine and salt (palm inflorescence reduced to ashes), which are respectively used as (1) an excipient for the preparation of vegetable ointments; (2) a liquid maceration to enhance the action of certain drugs with aphrodisiac and galactogenic properties; and (3) an addition in many preparations to facilitate the absorption of the drug, or to reduce and preserve certain preparations in powder form (Sillans, 1951). According to Raymond-Hamet (1933), the extensive use of *E. guineensis* in traditional medicine may be attributed to its ash salts, which

are used by indigenous in various preparations to extract alkaloids from the plants for a wide range of medicinal purposes.

The agreement between informants on the most-used plant organ among species believed to contain pharmacologically active substances against diseases ranged 0.05 to 1, whereby the leaf was the most used organ for many preparations (Table 2.4).

Table 2.4. Plant use consensus and species with high therapeutic potential associated with their most used organs

Diseases	ICF	Species with therapeutic potential (STP)	Organ	CPPx
Amoebiasis	**0.43**	*Allium sativum* L.	B	0.50
		Chamaesyce hirta (L.) Millsp.	PE	0.60
		Elaeis guineensis Jacq.	FS	0.66
Anemia	0.1	*Ochna afzelii* R. Br. ex Oliv.	E	1.00
Hookworm	0.17	*Allium cepa* L.	B	1.00
		Allium sativum L.	B	1.00
		Piper nigrum L.	FS	1.00
Asthma	0.09	*Imperata cylindrica* (L.) P. Beauv	RH	1.00
Dental caries	0.14	*Datura stramonium* L.	FS	1.00
		Elaeis guineensis Jacq.	FS	1.00
Headache	0.18	*Brillantaisia patula* T. Anderson	F	1.00
		Ocimum gratissimum L.	F	1.00
Diabetes	0.05	*Abelmoschus esculentus* (L.) Moench	FS	1.00
Chest or intercostal pain	0.1	*Eleusine africana* Kenn.-O'Byrne	F, PE	0.50
Premature ejaculation	0.14	*Zingiber officinale* Roscoe	RH	1.00
Elephantiasis and yellowing of the hair	0.17	*Strychnos pungens* Soler.	F, FS	0.50
Epilepsy	0.19	*Aframomum melegueta* (Roscoe) K. Schum.	FS	1.00
		Allium cepa L.	B, FS	0.50
		Garcinia kola Heckel	FS	1.00
		Lippia multiflora Moldenke	F	1.00
		Mucuna pruriens (L.) DC.	F	1.00
Itchy skin rash	**0.42**	*Brillantaisia patula* T. Anderson	F	1.00
		Clerodendrum formicarum Gürke	F	1.00
		Commelina africana L.	F	1.00
		Mondia whitei (Hook. f.) Skeels	R, PE	0.50
		Nymphaea lotus L.	PE	1.00
Sexual weakness or impotence	**0.32**	*Mondia whitei* (Hook. f.) Skeels	R	1.00
		Newbouldia laevis (P. Beauv.) Seem. ex Bureau	R	1.00
		Heinsia crinita (Afzel.) G.Taylor	R	1.00
		Gardenia ternifolia subsp. *jovis-tonantis* (Welw.) Verdc..	R	1.00
		Hymenocardia acida Tul.	R	1.00
		Coffea sp.	FS	1.00
		Dioscorea smilacifolia De Wild. et T.Durand	R	1.00
Madness	0.07	*Brillantaisia patula* T. Anderson	F, R	0.50
Chronic scabies with itching and stench	0.1	*Gossypium barbadense* L.	F	1.00
Gastritis	0.14	*Allium cepa* L.	B	1.00
		Brillantaisia patula T. Anderson	F	1.00
		Citrus limon (L.) Burm.f.	FS	1.00
		Jatropha curcas L.	F, LS	0.50
Hemorrhoids	**0.44**	*Aframomum melegueta* (Roscoe) K.bSchum.	FS	1.00
		Capsicum frutescens L.	F	0.66

Table 2.4. Plant use consensus and species with high therapeutic potential associated with their most used organs

Diseases	ICF	Species with therapeutic potential (STP)	Organ	CPPx
		Mangifera indica L.	E	0.71
		Monodora angolensis Welw.	FG	1.00
		Piper nigrum L.	FS	1.00
		Zingiber officinale Roscoe	Rh	1.00
Hernia	**0.2**	*Desmodium mauritianum* (Willd.) DC.	R, F	0.50
		Gardenia ternifolia subsp. *jovis-tonantis* (Welw.) Verdc	R	1.00
		Hallea stipulosa (DC.) J.-F. Leroy	E	1.00
		Pentadiplandra brazzeana Baillon	R	0.66
		Nauclea latifolia Sm.	R	1.00
		Nauclea pobeguinii (Pobég.) Merr.	R	1.00
		Steganotaenia araliacea Hochst.	R	1.00
		Xylopia aethiopica (Dunal) A. Rich.	E, F	0.50
Laryngitis	**0.27**	*Bridelia ferruginea* Benth.	R	1.00
		Kalaharia uncinata (Schinz) Moldenke	R	1.00
		Musanga cecropioides R. Br.	E	1.00
		Pentadiplandra brazzeana Baillon	R	1.00
Malaria	0.17	*Artemisia annua* L.	F	1.00
Mastitis	0.05	*Momordica charantia* L.	F, PE	0.50
Microfilariate	0.1	*Momordica charantia* L.	F, PE	0.50
Migraine	0.15	*Elaeis guineensis* Jacq.	FS	1.00
		Eleusine africana Kenn.-O'Byrne	PE	1.00
		Ocimum minimum L.	F	1.00
Sciatic neuralgia	0.15	*Elaeis guineensis* Jacq.	FS	1.00
		Ocimum gratissimum L.	F	1.00
Otitis	**0.25**	*Ocimum gratissimum* L.	F	1.00
Poliomyelitis	**0.36**	*Aframomum melegueta* (Roscoe) K.Schum.	F, FS	0.50
		Cymbopogon citratus (DC.) Stapf	F	1.00
		Cyperus articulatus L.	R	1.00
		Securidaca longepedunculata Fresen.	F, R	0.50
Prostate	0.13	*Zea mays* L.	Ba, F	0.50
Splenomegaly	**0.29**	*Elaeis guineensis* Jacq.	FS	1.00
		Eleusine africana Kenn.-O'Byrne	R, PE	0.50
Rheumatism	**0.25**	*Aframomum melegueta* (Roscoe) K.Schum.	FS, F	0.50
		Capsicum frutescens L.	F	1.00
		Elaeis guineensis Jacq.	FS	1.00
		Musa x paradisiaca L.	E, FS	0.50
		Ocimum gratissimum L.	F	1.00
		Securidaca longipedunculata Fresen.	F	0.66
Cough	**0.2**	*Cymbopogon citratus* (DC.) Stapf	F	1.00
		Corymbia citriodora (Hook.) K.D. Hill & L.A.S. Johnson	F	1.00
		Lantana camara L.	F	1.00
Intestinal parasitosis	**0.33**	*Zingiber officinale* Roscoe	Rh	1.00

Legends: B (Bulb), Ba (Beard), E (Bark), F (Leaf), FS (Fruit or Seed), LS (Latex or Sap), PE (Whole Plant), R (Root), Rh (Rhizome), ICF (Informant Consensus Factor), STP (Species Therapeutic Potential), Org (Most Used Organ), CPP (Consensus value for plant part).

ICF values (≥0.2) for the twelve most important diseases of our study area were low compared to those reported for the same diseases by other authors who conducted ethnobotanical studies on the same *Kongo* people in other regions. This is the case for example of sexual weakness (ICF: 0.71) reported in Kinshasa by Ngbolua *et al.* (2019); intestinal parasitosis (ICF: 0.48), rheumatism (ICF: 0.47) and otitis (ICF: 0.4) reported in Uíge Province, northern Angola by Lautenschläger *et al.*, (2018).

The low ICF-value could be explained by the tendency of phytotherapists to keep their knowledge secret from each other (Lulekal *et al.*, 2013; Pfeiffer, 2005). It could also be attributed to the idiosyncratic nature of some phytotherapists who possess unique knowledge about plants and may disagree with others on the medicinal uses of these plants. Similar behaviors of secrecy among herbalists have been reported in Bolivia (Vandebroek, 2010) and Ethiopia (Eshetu *et al.*, 2015; van Avveldonk and Lams, 2020), where many interviewees express a strong intention to keep their knowledge confidential and not to share it with others, either freely or based on incentives.

Consequently, suspicion and caution have emerged among herbalists, extending even to researchers they encounter (Bourdarias and Lepalec, 1995). Field observations revealed that a significant number of informants expressed concerns about being spied up, believing that revealing their secrets to others would jeopardize their future. They consider any transfer or sharing of knowledge, especially to a stranger, as a loss of inherited ancestral treasure to others. This is why the majority of respondents admit that they only share their knowledge with a trusted family member or which they have themselves reached. The secrecy may also be due to the fact that most herbalists consider their knowledge, compared to that of modern medicine, to be a professional secret and therefore to be jealously guarded for themselves, at the risk of sharing it with others (Lejoly *et al.*, 1996).

However, there are instances where some informants are open to the idea of monetizing the sharing of their knowledge. Nevertheless, they remain cautious about revealing crucial details of their remedies. They understand the value of their expertise and are prepared to share it under specific conditions, while preserving certain aspects of the remedy. This behavior is primarily observed in urban areas where traditional medicine has thrived and adapted well to the new environment.

An example illustrating this mistrust is the story of Esther Ambuya from Chaminikire village in Zimbabwe, as reported by Frommer (2003). Scientists from the University of Zimbabwe approached her to inquire about various types of *Mishonga* (traditional remedies). As they were fellow Zimbabweans, she shared some of her traditional medicinal knowledge with them. However, she later discovered that they were planning to produce medicinal capsules using those *Mishonga*. This revelation shocked her, as she perceived this behavior as a direct exploitation of their profession. As a result, she made a firm decision to never share her valuable knowledge with anyone in the future.

Like Esther Ambuya, most phytotherapists have now become skeptical about sharing their knowledge. They have developed strategies to protect their knowledge by introducing confusion, such as including inappropriate herbs in the mixture or in the remedy lists to share. According to Almeida *et al.* (2006), this mistrust consequently contributes to the lack of consensus on the use of certain plants for various diseases.

In light of the aforementioned observations, it becomes evident that the practice of keeping medicinal knowledge secret among herbalists contributes to a lack of consensus among informants regarding plant usage. This not only hinders and limits the comprehensive search for new drugs but also fails to benefit the progress of scientific understanding. It is essential to recognize that sharing knowledge about medicinal plants is important not only for the progress of science, but also for our survival and the preservation of plant species (Hodgson-Ruetz, 2011). By keeping their medicinal knowledge secret, many powerfull and effective herbs and remedies risk being lost to future generations (Mudimba and Streiffeler, 1999).

To address this challenge, we propose implementing collaborative initiatives and platforms that foster the exchange of knowledge between herbalists, researchers, and communities. Additionally, we suggest like Demeke *et al.* (2022), exploring ways to safeguard the intellectual property of phytotherapists. These initiatives should encourage an environment of trust, where herbalists feel respected, acknowledged, and fairly compensated for their expertise. Promoting dialogue and partnerships can facilitate the documentation and preservation of traditional medicinal knowledge, ensuring its accessibility for scientific research and the development of innovative healthcare solutions. By actively involving herbalists and communities in the knowledge-sharing process, we can collectively contribute to the advancement of both traditional and modern medicine, benefiting humanity as a whole.

2.5.5. Informant knowledge analyses

2.5.5.1. Ethnomedicinal cultural similarity

Results from the comparison based on cultural similarity of knowledge on the use of medicinal plants between the two territories (Table 2.5), showed that the two ethno-linguistic groups share 105 similar species and 40 diseases treated by medicinal plants (with 58 species and 31 diseases specific to Kisantu and 68 species and 32 diseases specific to Mbanza-Ngungu). Despite the large number of similar species and diseases reported in the two territories, a low ethno-cultural similarity (16.7%) was evidenced between respondents from Kisantu and that of Mbanza-Ngungu (rural and urban areas).

According to the comparison between urban versus rural respondents, it appears that (1) 74 species and 32 diseases are reported by respondents from both Kisantu and Mbanza-Ngungu urban areas; (b) 77 species and 27 diseases are reported by respondent from both Kisantu and Mbanza-Ngungu rural areas; and (c) 51 species and 23 diseases are reported by respondents from both Mbanza-Ngungu urban and Mbanza-Ngungu rural areas. The highest cultural similarity index was observed in the use of common species for similar diseases between respondents from Kisantu and those of Mbanza-Ngungu rural areas (RSI = 15.8 %), followed by similarity between respondents of Mbanza-Ngungu urban and rural areas, respectively (RSI= 8.1 %). Ethnocultural similarity of medicinal plant knowledge was lowest (RSI = 5.7 %) between respondents from Kisantu and those from Mbanza-Ngungu urban areas.

The high number of common species and diseases reported in both Kisantu and Mbanza-Ngungu (including its nearby villages), could be linked to the fact that the two territories belong to the same Guinean-congo phytogeographic region (Compère, 1970), and share almost the same ecoclimatic and edaphic conditions (Nzuki, 2016). Low similarity indices are often linked to a high diversity of ethnic groups in a certain area (Kimpouni *et al.*, 2019), acculturation (Leonti *et al.*, 2013), the use of the same species for a wide variety of diseases or to the limited cultural exchanges between the ethnolinguistic groups studied (Jafarirad and Rasoulpour, 2019).

Table 2.5. Ethnomedicinal cultural similarity between Kisantu and Mbanza-Ngungu territories

Ethnic groups/regions	Parameters	Kisantu	Mbanza-Ngungu (Urban area)	Mbanza-Ngungu (Rural area)
Kisantu	a	-	60	13
	b	-	89	86
	c	-	74	77
	d	-	12	24
	e	-	32	27
	RSI	-	5.7%	15.8%
Mbanza-Ngungu (urban & rural areas)	a	58	-	-
	b	68	-	-
	c	105	-	-
	d	33	-	-
	e	40	-	-
	RSI	16.7%	-	-
Mbanza-Ngungu (urban area)	a	89	-	39
	b	60	-	83
	c	74	-	51
	d	12	-	13
	e	32	-	23
	RSI	5.7%	-	8.1%
Mbanza-Ngungu (rural area)	a	86	83	-
	b	13	39	-
	c	77	51	-
	d	24	13	-
	e	27	23	-
	RSI	15.8%	8.1%	-

Legend: a (number of unique species in community A), b (number of unique species in community B), c (number of common species in both A and B communities), d (number of common species used for the same diseases in both A and B communities), e (number of common diseases reported in both A and B communities. This parameter was not directly involved in calculating the RSI, but was used to determine the "d" parameter, hence its inclusion in the table for information purposes) and RSI (Rahman similarity index).

2.5.5.2. Traditional medicinal knowledge among sociological groups

Based on Mann-Whitney and Kruskal-Wallis significance tests examining medical knowledge across different social factors (Table 2.6), traditional Kongo medicinal knowledge-specifically the number of medicinal plant species and diseases reported-was found to be independent on age, education, experience and marital status of respondents ($p > 0.05$). However, it was found to be dependent on gender, residence location and professional status ($p < 0.05$).

Table 2.6. Mann-Whitney and Kruskal-Wallis significance tests of medical knowledge between social factors.

Dependent variables	Factors	Test	p-value
Number of species	Gender	Mann-Whitney U test	0.005*
	Age	Kruskal-Wallis Test	0.734
	Residence location	Kruskal-Wallis Test	0.029*
	School level	Kruskal-Wallis Test	0.129
	Experience (year)	Kruskal-Wallis Test	0.299
	Professional status	Kruskal-Wallis Test	0.002*
	Marital status	Kruskal-Wallis Test	0.095
Number of diseases	Gender	Mann-Whitney U Test	0.003*
	Age	Kruskal-Wallis Test	0.150
	Residence location	Kruskal-Wallis Test	0.000*
	School level	Kruskal-Wallis Test	0.058
	Experience (year)	Kruskal-Wallis Test	0.055
	Professional status	Kruskal-Wallis Test	0.000*
	Marital status	Kruskal-Wallis Test	0.115

* *Significant difference at the 0.05 level*

The mean number of species cited was found to be significantly ($p < 0.05$) different between (1) curing healers, herbalists and traditional health practitioners; with curing healers citing 1.47 times more species ($b = 0.38$; S.E = 0.106, $p = 0.000$) than traditional health practitioners, and traditional health practitioners citing 0.44 times more species than herbalists ($b = -0.81$; S.E = 0.217; $p = 0.000$); (2) informants from cities (in both Kisantu and Mbanza-Ngungu) and those from villages, with informants from Kisantu and Mbanza-Ngungu significantly citing 1.53 times ($b = 0.43$; S.E = 0.098; $p = 0.000$) and 1.76 times ($b = 0.57$; S.E = 0.099; $p = 0.000$) more species, respectively, than informants from villages near Mbanza-Ngungu; and (3) men and women, with men citing 0.75 times more species than women ($b = -0.29$; S.E = 0.076; $p = 0.00$) (Table 2.7).

Concerning their knowledge of diseases, there was a significant difference ($p < 0.05$) in the number of diseases cited between curing healers and traditional health practitioners. Curing healers significantly mentioned 1.77 times more diseases than traditional health practitioners ($b = 0.57$, S.E = 0.160, $p = 0.00$). However, traditional health practitioners cited more diseases than herbalists (0.63 times more), although this difference ($p > 0.05$) did not reach statistical significance ($b = -0.47$, S.E = 0.301, $p = 0.12$).

The mean number of cited diseases was significantly different for informant residence ($p < 0.05$). Informants from Kisantu ($b = 0.52$; S.E = 0.162; $p = 0.001$) and Mbanza-Ngungu urban area ($b = 0.87$; S.E = 0.158; $p = 0.000$) significantly cited respectively 1.68 and 2.40 times more diseases than informants from villages near Mbanza-Ngungu.

To conclude, the mean number of cited diseases was also significantly different between men and women ($p < 0.05$), with men citing 0.76 times more diseases ($b = -0.28$; S.E = 0.118; $p = 0.018$), than women (Table 2.7).

Table 2.7. Poisson regression model of the average number of species and diseases cited by different sociological groups

Dependent	Factor	B (estimated coefficient)	Standard Error	P-value.	Exp(B) (exponentiated values)
Number of species	(Constant)	1.191	0.0769	.000	3.289
	Female	-0.29	0.0764	.000	0.749
	Male	0[a]	.	.	1
	Kisantu (urban)	0.426	0.0977	.000	1.53
	Mbanza-Ngungu urban	0.565	0.0999	.000	1.76
	Mbanza-Ngungu rural	0[a]	.	.	1
	Herbalists	-0.812	0.2165	.000	0.444
	Curing healer	0.383	0.1056	.000	1.467
	Traditional health practitioners	0[a]	.		1
	(scale)	1[b]			
Number of diseases	(Constant)	0.132	0.1288	0.304	1.142
	Female	-0.279	0.1181	0.018	0.756
	Male	0[a]	.	.	1
	Kisantu (urban)	0,52	0.1616	0.001	1.682
	Mbanza-Ngungu urban	0.874	0.1576	.000	2.397
	Mbanza-Ngungu rural	0[a]	.	.	1
	Herbalists	-0.467	0.3005	0.12	0.627
	Curing healer	0.574	0.1595	.000	1.774
	Traditional health practitioners	0[a]	.	.	
	(scale)	1[b]			

[a] explanatory variable, [b] fixed display value

Descriptive statistics (Table 2.2), showed that curing healers, male therapists, adults and the elderly, married, educated (with secondary education) and urban respondents reported a higher average number of species and diseases than other respondent categories. These findings are consistent with those of Dapar *et al.* (2020) in the Phillipines for men, adults and elderly, married and secondary-school-educated therapists as well as with Sangare (2011) in Ivory Coast for therapists living in urban areas. Nzuki (2016), however, found opposite results with rural therapists being more knowledgeable than urbans. The discrepancy with Nzuki's findings could be attributed to the fact that Nzuki's study focused on comparing urban and rural healers who utilize more than 10 medicinal plants, rather than comparing the average number of plants used by healers in both categories.

Based on analytical statistics, our results are consistent with those of Sharma *et al.* (2019) and Albuquerque *et al.* (2011) for gender, with men's knowledge being higher than that of women. Opposite results were found by Schunko *et al.* (2012) and Ong & Kim (2014), whereas Merétika *et al.* (2010) and Silva *et al.* (2011) found no significant difference with gender. As previously mentioned, the difference in favor of men in our study may be attributed to the preferential advantage given to men in the initiation and transmission of phytotherapeutic knowledge, compared to women (Gessler *et al.*, 1995), and also to the naturally closer relationship of men with the forest (Hanazaki *et al.*, 2000).

For residence, our results coincide with those of Avila *et al.* (2015), who similarly reported higher traditional knowledge among respondents from urban areas. Conversely, Pieroni and Vandebroek (2009) found contrasting results in favor of respondents from rural areas, while Case *et al.* (2005) did not find any significant difference based on respondents' residence. As mentioned above, the high medicinal knowledge of urban phytotherapists could probably be linked to the cultural diversity of all these ethnic groups in urban areas, to socio-environmental factors prevailing in urban areas and also to the false claims of urban phytotherapists about their presumed competence, which do not always correspond to precise ancestral knowledge (Les observateurs, 2010; Rogers and Ehrlich, 2008; Saslis-Lagoudakis *et al.*, 2014).

Regarding respondent categories, our findings match those of Lulekal *et al.* (2013), despite the different respondent categories studied. The high medicinal knowledge of curing healers may be associated to the use of medicinal plants for both physical and mental health problems (Asch, 1983). The use of certain plants may concern the treatment of illnesses, while others intervene rater in the rituals that accompany the treatment (Bongango, 2012; Mélon, 2017).

In relation to age, educational level, and marital status, our findings align with those of Mathez-Stiefel & Vandebroek (2012) and Wassie *et al.* (2015), who also found no significant influence of these social parameters on respondents' medicinal knowledge. However, contrasting results were reported by Mokgobi (2014), who found that respondents with a higher number of years of experience exhibited greater medicinal knowledge.

Based on these findings, although our study did not find significant differences for age, educational level, marital status, and residence, it should be noted that the global trend indicates that adults and older individuals generally possess more knowledge about medicinal plants compared to younger generations (Merétika *et al.* 2010). This is probably due to the accumulation of experience and exposure to traditional knowledge over time. Furthermore, married individuals may have higher levels of knowledge due to the sharing and transfer of knowledge between spouses (Voeks and Leony, 2004).

However, it is important to recognize that the acquisition of traditional knowledge about plants can occur at a young age. When knowledge is actively transmitted to younger generations through participatory approaches, such as community-based programs or intergenerational learning, it is possible for the younger generation to have a better understanding of medicinal plants than their older counterparts (Jiménez-Balam *et al.*, 2019). Therefore, differences in knowledge cannot be solely attributed to age or life experience, but may also be influenced by other socio-economic factors.

It is essential to consider that adulthood does not necessarily guarantee a greater accumulation of experience or ethnobotanical knowledge over time. Factors such as access to education, cultural context, socioeconomic status, and exposure to traditional practices all play significant roles in shaping an individual's knowledge about medicinal plants (Weckmüller *et al.*, 2019). Therefore, a comprehensive understanding of medicinal plant knowledge requires a broader exploration of these socio-economic factors, in addition to age and other demographic characteristics.

2.6. Conclusion

This chapter aimed to document the remaining knowledge of *Kongo* herbal medicine, which is at risk of disappearing. The aims were to identify the most important medicinal plants and their uses in *Kongo* phytotherapy, to assess the ethno-cultural similarity of medicinal plant expertise between the two territories, and evaluate how sociological parameters influence traditional medical knowledge.

Ethnobotanical studies using semi-structured interviews were successfully employed to access the extensive knowledge on *Kongo* herbal medicine. Informants were selected and interviewed using snowball sampling and semi-structured interviews to ensure comprehensive understanding. Quantitative ethnobotanical parameters, including UV (medicinal Use Value), IAR (Informant Agreement Ratio), RSI (Rahman Similarity Index), ICF (Informant Consensus Factor), STP (Species Therapeutic Potential), etc., were calculated. Additionally, statistical analyses such as Poisson regression, Mann-Whitney, and Kruskal-Wallis tests were conducted to derive meaningful insights from the gathered data.

Results proved that the *Kongo* phytotherapy is characterized by a remarkable diversity of medicinal plant species, many of which have significant medicinal value, while others are believed to contain promising therapeutic potential for certain diseases. *Kongo* herbal medicine is widespread, well-established, and deeply ingrained in the local culture, transcending all social categories, including age, education, location, etc. Unfortunately, this medicinal knowledge suffers from a lack of consensus about its use, orchestrated by the fear that traditional practitioners will be spied on and thereby deprived of their knowledge, hence the secrecy surrounding this knowledge. We believe that establishing a regulatory framework to guarantee the intellectual property of their knowledge could address this secrecy. Indeed, if these knowledge were to disappear, it would be potent plants and effective remedies that would be lost, making the maintenance of secrecy useless.

The identification of key medicinal plants, specifically those believed to contain effective potential compounds, was assessed using a combination of approaches involving UV, IAR, and ICF, which allowed for the definition of the new STP parameter. The result of this discovery highlights the "Species Therapeutic Potential" (STP) parameter as an exceptional tool for accurately identifying species that have gained consensus among informants regarding their use in the treatment of specific diseases.

This innovative parameter, which considers the consensus of at least two individuals, constitutes a significant contribution to science by revealing the most important medicinal plant species of a region or culture, supposedly containing effective pharmacological properties. It provides a solid foundation for in-depth phytochemical studies. This parameter has already been embraced in research, particularly by local researchers such as Kyolo *et al*. (2022), who successfully employed STP to identify species with the greatest therapeutic potential in treating mental disorders in Goma (DRC). The adoption of STP underscores its utility and relevance at the international level for the targeted selection of plant species with exceptional medicinal properties.

By highlighting differences between social groups, our study provided nuanced perspectives that can inform targeted conservation and education initiatives. Ultimately, this research enabled to contribute not only to heritage conservation, but also to the wider field of ethnobotanical knowledge, promoting sustainable practices for the benefit of present and future generations.

Due to the significance of *Kongo* medicinal plants and concerns expressed by respondents regarding their rarity or decline, the preservation and cultivation of these species are imperative. A thorough investigation into the vegetation of the region becomes essential. Such a study holds the potential to provide crucial insights into the current status of these plants in their natural habitat, their availability, especially where they are harvested, and the dynamics of the region's vegetation.

This information is crucial for making informed decisions concerning the conservation of suitable habitats and the safeguarding of plants to ensure their long-term survival, particularly those used in traditional medicine. Conservation efforts can be achieved both *ex situ*, involving cultivation in fields, home gardens, or plantations, and *in situ*, through the maintenance and protection of their natural ecosystems.

Furthermore, medicinal plants believed to contain active substances should be subjected to phytochemical analysis to provide more evidence of their true medicinal value, which could form the basis for their use in traditional *Kongo* medicine. Such validation would bolster the *Kongo* people's confidence in herbal medicine, enabling them to fully harness the social and economic benefits derived from their knowledge.

Chapter 3. Ecofloristic characterization of the vegetation of Mbanza-Ngungu Territory in the Kongo-Central Province, DRC

3.1. Context

The *Kongo* traditional medicinal knowledge faces imminent risk of extinction due to the unsustainable exploitation of natural resources. The rapid decline of key medicinal plant species not only threatens biodiversity, but also directly endangers the survival of associated traditional knowledge. Addressing this urgent challenge requires a comprehensive strategy that integrates biodiversity conservation and floristic studies, offering a solution for the sustainable preservation of traditional medicinal knowledge. By conducting ecofloristic studies, we tried to gain insights into the composition, dynamics, distribution, and availability of plants in their harvesting areas, with a primary focus on medicinal plants. These comprehensive studies play a central role in identifying the most vulnerable medicinal plant species, making a significant contribution to the safeguarding of the *Kongo* traditional medicinal knowledge. Field observations and frequency data indicate an alarming degradation rate of natural areas where medicinal plants are harvested, resulting in a decline in the latter plants' availability. Of all identified species (medicinal and non-medicinal), 62.04 % exhibit a very restricted ecological niche, underscoring the vulnerability of these plants. To safeguard traditional *Kongo* knowledge, it is imperative to know the current plant conservation status in order to implement adequate conservation measures, both *in situ* and *ex situ*, so that a sustainable supply of medicinal plants to communities can be ensured. This research highlights the urgency of balancing plant harvest and use with conservation efforts to protect both biodiversity and the invaluable traditional medicinal knowledge of the *Kongo* people in the Mbanza-Ngungu Territory.

3.2. Introduction

The practice of traditional medicine is an ongoing experiment that has been part of the national health systems of many African societies for many years (Mutombo *et al.*, 2023). This practice represents a cultural jewel of a people, transmitted orally from generation to generation. Fundamentally rooted in the judicious use of plants and powerful remedies, the continuity of these age-old practices is closely linked to the quality, availability and accessibility of natural resources, particularly specific medicinal plants (Srithi *et al.*, 2009).

This ancestral heritage, a true cultural treasure, is currently disappearing in the Mbanza-Ngungu region. A decline is taking place, as a direct result of the reduction and even disappearance of plant species. This is being orchestrated by the excessive and abusive exploitation of resources, as well as bush fire by the Mbanza-Ngungu communities. The current ecological crisis resulting from this situation exerts significant pressure on the survival of traditional medicinal knowledge, thereby compromising the future transmission of this cultural heritage.

The Mbanza-Ngungu area, which is part of the Guinean-Congo phytogeographic region (Compère, 1970; Dubiez *et al.*, 2014), is experiencing a decline in vegetation, with an exponential loss of species in favor of savannas and degraded forest areas (Boulogne *et al.*, 2013). The once imposing forests have given way to herbaceous or shrubby savannahs (Wamuini *et al.*, 2010) and a few isolated forest patches (Bamba *et al*., 2008). These include former village sites known as "Voka di mfinda or Sangi" and heavily exploited or degraded forest recruitment areas, commonly known as "Nkunku" (Nsimundele *et al.*, 2010; Nzuki *et al.*, 2016). The degradation of these forest areas not only leads to biodiversity loss, but also, as previously reported, threatens the extinction of plants and potent medicinal remedies (Kibungu *et al.*, 2021).

Overexploitation of plants in this region resulted in disappearance of species, particularly those with traditional medicinal uses (Lanata *et al.*, 2013). Studies carried out by Nzuki *et al*. (2013, 2016), already highlighted the vulnerability of some important medicinal species in the region, such as *Lannea antiscorbutica* (Hiern) Engl, *Mondia whitei* (Hook. f.) Skeels, *Monodora myristica* (Gaertn.) Dunal, *Pseudospondias microcarpa* (A. Rich.) Engl and *Annona senegalensis* subsp. *oulotricha* Le Thomas. These species were found to be highly vulnerable.

More recently, the ethnobotanical study conducted by Kibungu *et al*. (2021), confirmed the growing trend of overexploitation of traditionally important medicinal plants. These plants, most of which are believed to contain bioactive compounds, are becoming increasingly rare in their natural habitats, despite the expansion of research into the remote forest areas of Mbanza-Ngungu.

Based on interviews with local communities, especially traditional healers, researchers found that the holders of traditional medicinal knowledge about rare or extinct species were mainly older people. Young people, on the other hand, are often unaware or

ignorant of much information about extinct plants. These observations were corroborated by the analysis of the level of medicinal knowledge in the region, where the elderly people showed greater expertise and more in-depth knowledge of medicinal plants than younger people, hence confirming the statement that "in Africa an old man who dies, it is a whole library which burns".

The extent of the decline of medicinal plants diversity, which could be linked to the survival of traditional medicinal knowledge, highlights the critical importance of conserving these natural resources and underlines the urgent need to implement initiatives for conservation and sustainable management of biodiversity, particularly, medicinal plant species.

Given this situation, how can we reconcile the preservation of traditional medicinal knowledge, which is deeply rooted in the cultural heritage of a community, with the need to ensure the survival of potent plants and effective remedies on which it is based? This balance must take into account challenges posed by biodiversity decline, conservation of medicinal plant's natural habitats and environmental conditions that are currently being degraded. Sustainable harvesting practices for medicinal plants should be promoted to ensure the continuity of this ancestral knowledge while preserving the ecological balance.

Ecofloristic studies are essential for addressing the challenge of preserving biodiversity and fragile ecosystems, as they offer the opportunity to identify the most endangered plants. This information can help preserve traditional knowledge and contribute to the development of targeted conservation strategies. These studies also enable the detection and anticipation of changes in natural plant composition, which is crucial for implementing appropriate measures to protect biodiversity and fragile ecosystems (Su *et al.*, 2022; Wani *et al*., 2022)

Our study is based on the assumption that studying vegetation is an essential step towards managing nature in a rational way that respects natural balances. This approach can mitigate consequences of human overexploitation of vegetation. It can also help to prevent the extinction of traditional medicinal knowledge, which is closely linked to the accessibility and availability of medicinal plants.

To the best of our knowledge, no ecofloristic studies have been performed in Mbanza-Ngungu before. This study intends to inventory the vegetation of the region in order to assess its composition, distribution, and plant availability (Chhetri and Shrestha, 2019; Gul *et al*., 2018; Magray *et al*., 2022; Watts *et al*., 2022).

The study also focuses exclusively on the availability of the region's most important medicinal plants, with the aim of determining their current conservation status in the natural environment where they are harvested.

Despite their laborious nature, ecofloristic studies are an effective and straightforward means of obtaining valuable data on the vegetation of Mbanza-Ngungu, particularly on the essential medicinal plants upon which the viability of traditional knowledge in the region depends.

By conducting this research, we aim to provide a better understanding and gather valuable data on the vegetation of Mbanza-Ngungu. Our study goes beyond simply monitoring species of the Mbanza-Ngungu vegetation and their conservation status in the wild. It also encompasses an advocacy and educational dimension, aiming to make users aware of the threats posed by the disappearance of species and the traditional knowledge associated with them. The study holds the potential to raise collective awareness of the urgency to address these issues. Simultaneously, it could offer crucial information to guide decision-makers in adopting appropriate and effective protection measures in favor of habitat preservation and conservation, guaranteeing a sustainable supply for the communities that depend on these resources.

3.3. Study area and mathods

3.3.1. Study area

Ecofloristic studies were conducted in the area around Mbanza-Ngungu, on the Gombe-Matadi road. Ecofloristic plots were established on the western side of the N12 road, along an axis of approximately 10 km towards the area between the villages of Kimaza, Buenze and Kingo. Located in altitudes between 500 to 750 masl, these areas benefit from a humid tropical Köppen AW_4 climate with an average annual rainfall of 1100 to 1600 mm and an average annual temperature estimated to 25 °C (CAID, 2017). The vegetation is dominated by patches of swamp forests, as well as fallow lands, remnants of an old secondary forest (Bamba *et al.,* 2008). The rare savannah and forest formations in Kisantu, however, exhibited a very degraded landscape. They showed that the latter would have almost the same characteristics as those of Mbanza-Ngungu, if only they were not heavily reworked, since they are both located in the same Guinean-Congo phytogeographic region (Compère, 1970; Dubiez *et al.*, 2014). This could justify the choice of our ecofloristic study area in Mbanza-Ngungu.

3.3.2. Data collection

Ecofloristic surveys using ecofloristic approaches, were carried out from june to august 2019 and from november 2020 to february 2021, corresponding to the dry and the rain season in the study area, respectively. This method was also used by Kikufi & Lukoki (2008) and Lassa *et al.* (2019) in Kongo-Central Province for Guinean-Congo phytogeographic region. The method is widely used to classify and describe plant communities, understand their ecological characteristics, and investigate patterns of vegetation distribution and dynamics in relation to their ecological context (Chhetri and Shrestha, 2019; Magray *et al.*, 2022; Watts *et al.*, 2022).

Google Health, Google Maps and field visits allowed to identify the main vegetation formations, including swamp forests (comprising permanent and periodically flooded forests), herbaceous formations (savannah), and dryland forests (comprising recruit forests), as well as anthropized formations. The latter included wastelands, abandoned fields, ruderal vegetation, post-cultural and trampled areas.

For each plant formation, plots were established on the basis of physiognomic, floristic and ecological homogeneity of the vegetation (De Foucault, 1979; Delpech and Géhu, 1988). Their dimension were adapted following surface areas proposed by Belesi (2009) for Guinean-Congo phytogeographic region. i.e., 10 - 25 m² for anthropized formations, 100 m² for savannahs and 500 - 600 m² for swamps and dryland forests. Following De Foucault (1979), plots were spaced by 500 m in savannah and forest formations, and 100 m in anthropized formations, to avoid redundancy. This approach allowed to capture the heterogeneity and diversity of plant species within specific vegetation types, as well as the influence of spatial scale on the representation of plant communities.

For each plot, the vegetation composition, as well as geographical coordinates, including latitude and longitude (Table 3.1), were recorded. Plant species were first tentatively identified in the field using local botanical guides, as well as floristic guides (Belesi, 2009; Kibungu, 2010; Latham and Konda, 2014; Malaisse, 1997; Pauwels, 1993). To ensure the identification, voucher specimens were collected and compared with reference specimens from the herbarium of Kisantu Botanical Garden or that of the National Institute for Agronomic Studies and Research (INERA) at the University of Kinshasa (UNIKIN). Scientific names, in accordance with the APG IV system, were verified using websites such as Tela Botanica (www.tela-botanica.org), IPNI (International Plant Name Index: www.ipni.org) or plants of the

world online (https://powo.science.kew.org/). The list of all inventoried species is presented in appendix 4.

Table 3.1. Geographical coordinates of ecofloristic plots

(AT: anthropized area, JA: dryland forest, MA: swamp forest and S: savannah)

Plot label	Latitude S (DMS)	Longitude E (DMS)
AT1	5°6'38"	14°50'7"
AT2	5°7'15"	14°50'18"
AT3	5°6'28"	14°50'45"
AT4	5°6'41"	14°50'16"
AT5	5°6'28"	14°50'5"
AT6	5° 7'24"	14°50'23"
AT7	5°7'35,3"	14°50'23,8"
AT8	5°4'21"	14°50'31"
AT9	5°4'25"	14°50'27"
AT10	5°5'17,2"	14°50-40,9"
AT11	5°5'18"	14°50'44,2"
AT12	5°5'17"	14°50'40"
AT13	5°7'40"	14°49'11"
AT14	5°7'38"	14°49'17"
AT15	5°7'34"	14°49'24"
AT16	5°5'27"	14°50'38"
AT17	5°5'53"	14°50'31"
AT18	5°5'56"	14°50'33"
AT19	5°5'6	14°50'36"
AT20	5°5'60"	14°50'29"
AT21	5°5'06"	14°51'11"
AT22	5°5'28"	14°50'46"
AT23	5°5'52"	14°51'24"
AT24	5°5'10"	14°51'5"
JA1	5°5'50"	14°51'21"
JA2	5°5'40"	14°51'23"
JA3	5°5'12"	14°51'8,48"
JA4	5°6'31"	14°49'53"
JA5	5°6'49"	14°49'42"
JA6	5°5'22"	14°50'41"
JA7	5°6'48"	14°50'25"
JA8	5°7'28"	14°50'9"
JA9	5°7'17"	14°50'29"
JA10	5°7'37	14°50'30"
JA11	5°7'57"	14°50'2"
JA12	5°7'54,8"	14°50'45,4"
JA13	5°7'9,4"	14°50'8"
JA14	5°8'8"	14°50'37"
JA15	5°8'20"	14°50'7"

Plot label	Latitude S (DMS)	Longitude E (DMS)
JA16	5°8'22"	14°49'42"
JA17	5°8'09"	14°49'23"
JA18	5°6'15"	14°51'12"
JA19	5°6'35"	14°50'42"
JA20	5°6'21"	14°50'22"
JA21	5°7'16"	14°49'45"
JA22	5°7'40"	14°48'52"
JA23	5°8'47"	14°49'20"
JA24	5°7'01"	14°50'31"
JA25	5°7'05"	14°52'5"
JA26	5°6'43"	14°52'36"
JA27	5°7'42"	14°51'14"
JA28	5°7'45"	14°52'3"
JA29	5° 8'17"	14°51'21"
JA30	5°7'38"	14°52'55"
JA31	5°7'3"	14°53'6"
JA32	5°6'56"	14°53'30"
JA33	5°6'25,07"	14°53'34.9"
JA34	5°5'42"	14°53'28"
JA35	5°4'28"	14°50'31"
JA36	5°4'51"	14°53'05"
JA37	5°5'14"	14°52'46"
JA38	5°5'20"	14°53'23"
JA39	5° 8'27"	14°48'51"
JA40	5°8'04"	14°50'19"
JA41	5° 5'50"	14°50'40"
JA42	5°5'32"	14°50'49"
JA43	5°6'45"	14°50'7"
JA45	5°5'9"	14°50'57"
JA46	5°5'23"	14°51'13"
JA47	5°7'37"	14°50'51"
JA44	5° 5'22"	14°51'14"
JA48	5° 8'3"	14°51'39"
JA49	5° 8'4"	14°51'14"
MA1	5°5'50"	14°50'31"
MA2	5°6'01"	14°50'5"
MA3	5°6'17"	14°50'4"
MA4	5°5'59"	14°50'17"
MA5	5°6'33"	14°50'6"

Plot label	Latitude S (DMS)	Longitude E (DMS)
MA6	5°7'0,8"	14°50'20"
MA7	5°6'20"	14°50'51"
MA8	5°6'03"	14°50'44"
MA9	5°7'22"	14°49'50"
MA10	5°4'33"	14°51'34"
MA11	5°4'43"	14°50'39"
MA12	5°5'17"	14°50'54"
MA13	5°5'56"	14°51'24"
MA14	5°5'50"	14°51'28"
S1	5°4'39"	14°50'57"
S2	5°4'55,4"	14°50'55"
S3	5°4'21"	14°51'20"
S4	5°5'33"	14°50'39"
S5	5°5'40"	14°50'52"
S6	5°5'29"	14°51'25"
S7	5°5'02"	14°51'40"
S8	5°5'30"	14°51'46"
S9	5°5'16"	14°52'16"
S10	5°4'49"	14°52'9"
S11	5°4'49"	14°51'18"
S12	5°4'43"	14°51'30"
S13	5°5'48"	14°51'13"
S14	5°6'21"	14°51'31"
S15	5°5'47"	14°51'45"
S16	5°5'38"	14°52'2"
S17	5°5'36"	14°52'32"
S18	5°5'15"	14°50'41"
S19	5°5'39"	14°50'22"
S20	5°6'5"	14°50'15"
S21	5°6'13"	14°50'0,48"
S22	5°6'27"	14°50'26"
S23	5°6'35"	14°50'28"
S24	5°4'24"	14°50'33"
S26	5°3'59"	14°50'39"
S27	5°4'46"	14°50'35"
S28	5°4'41"	14°50'32"
S29	5°5'08"	14°51'00,2"
S30	5°5'00,42"	14°50'33"
S31	5°5'28"	14°51'5"

Floristic parameters such as species richness, species diversity and frequency (F*i*), Jaccard (Jc), Sorensen (Ks) and Whittaker (β) indices were measured.

The specific richness relates to the total or average number of species encountered in a plot or a plant formation (Ramade, 2009). It is calculated from the specific index or quotient using the formula of Szymkiewicz (1936), also employed by Belesi (2009).

$$\mathbf{Qs = Sp / G}$$

in which "Sp" is the total number of species inventoried and "G" is the total number of genera.

The local frequency of a species (F*i*) is determined by the number of surveyed plots where the species is present relative to the total number of surveyed plots (Lamotte, 1962). This was calculated using the formula by Ousmane *et al.* (2013).

$$Fi\ (\%) = (\mathrm{N}i/\mathrm{N}t)\ \mathrm{x}\ 100$$

In which "Ni" is the number of plots (or plant formation) in which a species is present and Nt total number of plots (or plant formations)

We further calculated similarity indices of Jaccard (1901) and Sorensen (1948). Since it is easier to demonstrate the presence of a species than to prove its absence, we opted for Jaccard and Sorensen's similarity indices. These indices enabled to assess the degree of affinity (Kimpouni *et al.*, 2012) or floristic similarity (Ousmane *et al.*, 2013) between the different plots or plant formations. The choice of these indices is justified by the fact that, unlike with other indices, they favour presence rather than absence (Magurran, 2004).

The double calculation of Jaccard and Sorensen's similarity coefficients is based on the value attributed to the presence or absence of species. For example, Sorensen's index gives more weight to the presence of a species than to its absence, while Jaccard's index gives twice as much weight to the presence of a species than to its absence (Legendre & Legendre, 1984).

$$Jaccard\ (Jc) = (\mathrm{nc}\ \mathrm{x}\ 100)/(\mathrm{na} + \mathrm{nb} + \mathrm{nc})$$

$$Sorensen\ (Ks) = (2\mathrm{nc}\ \mathrm{x}\ 100)/(\mathrm{na} + \mathrm{nb})$$

in which "na" is the number of species unique to the first survey, "nb" is the number of species specific to the second survey, and "nc" is the number of species common to both surveys.

To conclude with, we calculated the Whittaker dissimilarity index (Whittaker, 1972). This index is a valuable metric for assessing the degree of species dissimilarity between ecofloristic plots within a plant formation. The index provides insight into ecological relationships within plant formations, offering a quantitative measure of species composition and helps to visualize plot similarities or differences.

A high index value indicates a lower number of common species, suggesting that each plot has a unique set of species specific to its environment. On the contrary, a low index value signifies a higher number of common species, implying that plots share similar environmental conditions leading to the development of the same species. Furthermore, when comparing two plots within similar plant formations, changes in the Whittaker Index highlight their distance or proximity in terms of shared or distinct species. This information can be visually represented through hierarchical clustering diagrams, illustrating distances based on the common species composition between ecofloristic plots. Plots with a higher abundance of common species would tend to cluster closer together, while those with a more diverse species composition would be further apart. The dissimilarity index was calculated using the formulas used by Landeau (2008).

$$\beta = \gamma 1/\alpha 1.\,\mathrm{TotNRel}$$

in which "β" represents the dissimilarity index, "γ1" is the total number of species encountered in a given plant formation, "α1" is the average number of species per plot and "TotNRel" is the total number of plots per plant formation.

Autoecological characteristics express the behaviour of each plant species in relation to its environment. They include geographical distribution, biological form, dissemination mode of diaspores, leaf size and phytosociological status. These characteristics were determined on the basis of criteria established by Lubini (2001) and Belesi (2009), for the vegetation of Bas-Kasaï, which is located in the same Guinean-Congo phytogeographic region as Mbanza-Ngungu, thus making these criteria applicable to our study area.

Some examples of corresponding species, concerning biological form, leaf size, and diaspore dissemination mode, were derived from our direct observations of species in their natural habitat, while others were sourced from existing literature (Belesi, 2009; Kami *et al.*, 2019; Kayumba *et al*., 2015; Kikufi *et al.*, 2017; Lubini, 1997, 2009; Miabangana *et al.*, 2017).

Concerning the geographical distribution, data of inventoried species are presented as follows:

A. Species with wide distribution: species distributed in several parts of the world. Among them are:

- Cosmopolitan (**cosm**): species found in both tropical and temperate regions. e.g. *Chenopodium ambrosioides* L., *Zea mays* L., *Allium fistulosum* L., *A. cepa* L.
- Pantropical (**Pan**): species widespread in the intertropical regions, including Africa, America, Asia and Australia; e.g. *Mucuna pruriens* (L.) DC., *Elaeis guineensis* Jacq.
- African-American or African-Tropical (**AnT**): species occurring both in tropical Africa and America; e.g. *Schwenckia americana* L., *Harungana madagascariensis* Lam. Ex Poir.
- Paleo-tropical (**Pal**): species found in tropical Africa and tropical Asia, as well as in Madagascar and Australia; e.g. *Cajanus cajan* (L.) Huth, *Nymphaea lotus* L.

B. African species with a wide distribution other than regional species: are species that are widespread in several phytogeographic regions of the African continent. They include:

- Continental Afro-tropical (**AT**): species found in several areas of continental tropical Africa. They are Guinean-Sudano-Zambezian species; e.g. *Mondia whitei* (Hook.f.) Skeels, *Zingiber officinale* Rosc.
- Afro-Malagasy (**AFM)**: species distributed in Africa, Madagascar and neighbouring islands; e.g. *Desmodium mauritianum* (Willd.) DC.
- Eastern and southern Africa (**AOA**): species occupying all of eastern and southern Africa; e.g. *Corymbia citriodora* (Hook.) K.D. Hill & L.A.S. Johnson.

C. Regional species that are confined to a single phytogeographic region

This category include:

- Guinean-Congo (**GC**): species found in the Guinean-Congo region; e.g. *Garcinia kola* Heckel, *Pentadiplandra brazzeana* Baill.
- Central Guinean-Congo (**CGC**): these are Central Guinean-Congo species that do not reach the upper Guinean domain; e.g. *Piper guineense* Schumach. & Thonn, *Erythrococca atrovirens* (Pax) Prain.
- Guinean (**G**): these are species found throughout the area of dense African rainforest from southern Senegal to the DRC; e.g. *Rungia congoensis* C.B. Clarke
- Lower Guinean-Congo (**BGC**): species known only from Atlantic Equatorial Africa (Cameroon, Gabon, Equatorial Guinea and the islands of the Gulf of Guinea) and also

existing in Angolan and RDC; e.g. *Crossopteryx febrifuga* (Afz. ex G. Don) Benth., *Bridelia ferruginea* Benth.

D. Species distributed in regional transition areas

These include:

- Guinean-Congo-Zambezian (**GC-Z**): species found in the regional center of Guinean-Congo endemism and in the Zambezian part; e.g. *Ficus thonningii* Blume.

Regarding biological forms, the following appear in this work:

A. Phanerophytes (Ph): plants whose stem system has visible persistent buds more than 50 cm from the ground. Based on height, the following categories have been identified:

- Megaphanerophytes (**Mgph**): large trees over 30 m high; e.g. *Canarium schweinfurthii* Engl., *Pentaclethra eetveldeana* De Wild. et T. Durand.
- Mesophanerophytes (**Msph**): medium trees from 10 to 30 m high; e.g. *Mangifera indica* L.
- Microphanerophytes (**Mcph**): shrubs from 2 to 8 m high; e.g. *Leptactinia pynaertii* De Wild.
- Nanophanerophytes (**Nph**): under shrubs from 0.5 to 2 m high; e.g. *Tephrosia vogelii* Hook.f.
- Climbing Phanerophytes (**Phgr**): lianas, climbing and non-woody phanerophytes; e.g. *Abrus precatorius* L.

B. Chamaephytes (**Ch**): plants whose buds or tips of perennial shoots (which remain alive all year round) are located close to the ground, on creeping or erect twigs (branches) and are protected by litter. These include:

- succulent chamaephytess (**Chssuc**): with succulent fatty leaves; e.g. *Bryophyllum pinnatum* Kurz*;*
- erected chamaephytess (**Chd**): with erected thatch; e.g. *Ocimum gratissimum* L.
- Climbing chamaephytess (**Chgr**): climbing plants; e.g. *Mucuna pruriens (L.) DC, Phaseolus vulgaris* L.
- Prostrate chamaephytess (**Chp**): with stems lying on the ground; e.g. *Boerhavia diffusa* L.
- creeping chamaephytess (**Chr**): spread diffusely, by their creeping stems on the ground, taking root at the level of the nodes; e.g. *Commelina africana* L.
- cespitous chamaephytess (**Chces**): with dense tufted shoots that develop from a rhizome; e.g. *Cenchrus purpureus* (Schumach.) Morrone.

- epiphytic chamaephytess (**Cheph**): often parasite; e.g. *Tapinanthus globifer* (A. Rich.) Tiegh.

C. Hemicryptophytes (**He**): plants characterized by an aerial vegetative system which dries up completely during the dry season and whose persistent buds are located at the level of the crown or at ground level. Among them, we recognize:

- cespitous hemicryptophytes (**Hc**): forming compact tufts developing from numerous rhizomes, short and tight against each other; e.g. *Melinis minutiflora* P. Beauv., *Cymbopogon citratus* (DC.) Stapf.

D. Geophytes (**Ge**): plants with buds and young shoots in the substrate. We distinguish:

- rhizomatous geophytes (**Grh**): the perennial organs are rhizomes; e.g. *Imperata cylindrica* (L.) P. Beauv., *Zingiber officinale* Roscoe, *Dorstenia laurentii* De Wild.
- bulbous geophytes (**Gb**): the perennial organs are bulbs. e.g. *Allium fistulosum* L.
- tuberous geophytes (**Gt**): the perennial organs are tubers; e.g. *Manihot esculenta* Crantz
- mega-geophytes (**mG**): the bud is generally large in size and buried in the soil; e.g. *Anchomanes difformis* Engl., *Musa x paradisiaca* L.

E. Hydrophytes (**Hydr**)**:** include aquatic plants whose regeneration buds are located at the bottom of the water; e.g. *Nymphaea lotus* L., *Ottelia ulvifolia* (Planch.) Walp.

F. Therophytes (**Th**): plants whose regeneration bud is included in the seed itself. We have:

- erect therophytes (**Thd**): the aerial vegetative apparatus is formed by an erect stem; e.g. *Chenopodium ambrosioides* L., *Celosia trigyna* L. Moench.
- climbing or crawling therophytes (**Thg**); e.g. *Citrullus lanatus*(Thunb.) Matsum. & Nakai, *Momordica charantia* L.
- Cespitous therophytes (**Thc**); e.g. *Setaria barbata* (Lam.) Kunth.

Regarding types of diaspores, we can recognize the following species:

A. Autochorous species: diaspores do not show obvious adaptations to any external dispersal agent. In this category, we distinguish:

- ballochores (**Bal**): diaspores expelled (ejected) by the plant itself; e.g. *Pentaclethra eetveldeana* De Wild. et T. Durand, *Millettia versicolor* Welw. ex Baker.

B. **Barochores species** (**Bar**): non-fleshy, heavy diaspores. They are characterized by their weight and the absence of other dispersal-related characteristics; e.g. *Garcinia huillensis* Welw. ex Oliv.

C. Anemochores species: diaspores are dispersed by the wind. Among them, the following categories can be distinguished:

- sclerochores (**scler**): tiny, light diasporas, without any particular characteristics and whose mass is < 1 g; e.g. *Cyperus articulatus* L., *Eleusine indica* (L.) Gaertn.
- pogonochores (**pogo**): diaspora with feathery or silky appendages, or crested hairs; e.g. *Ceiba pentandra* (L.) Gaertn., *Imperata cylindrica* (L.) P. Beauv.
- pterochores (**pter**): diaspores with aliform appendages (wing-shaped diaspores); e.g. *Hymenocardia acida* Tul.

D. Zoochorous species: diaspores disseminated by animals. They include the following categories:

- desmochores (**desm**): adhesive, thorny or sticky diaspores; e.g. *Bidens pilosa* L., *Mimosa pudica* L., *Acanthospernum hispidum* DC.
- sarcochores (**sar**): totally or partially fleshy diaspores (with soft, fleshy outer layers); e.g. *Strychnos cocculoides* Baker, *Crossopteryx febrifuga* (Afzel. ex G. Don) Benth.

E. Pleiochore species (**Pleo**): diasporas with a flotation device (aerenchyma tissues); e.g. *Nymphaea lotus*. Seeds of this plant species possess air-filled chambers that enable them to float effortlessly, aiding in its dispersal by water.

Regarding the foliar type, we have identified the following categories:

- Aphylla (**aph**): plants without leaves; e.g. *Rhipsalis baccifera* (J.S. Muell.) Stearn;
- leptophylls sized-leaf (**Lepto**): leaf or leaflet surface less than 0.2 cm^2; e.g. *Phyllanthus amarus* Schumach. & Thonn., *Albizia adianthifolia var. adianthifolia* W. Wight.
- nanophylls sized-leaf (**nano**): leaf or leaflet surface between 0.2 cm^2- 2 cm^2. e.g. *Chamaesyce hirta* (L.) Millsp, *Arachis hypogaea* L.
- microphylls sized-leaf (**micro**): leaf or leaflet surface between 2 cm^2-20 cm^2; e.g. *Maprounea africana* Müll.Arg, *Sesamum indicum* L.
- mesophylls sized-leaf (**meso**): leaf or leaflet surface between 20 cm^2-200cm^2; e.g. *Mangifera indica* L., *Cola acuminata* (P. Beauv.) Schott & Endl.
- macrophylls sized-leaf (**macro**): leaf or leaflet surface between 2-20 dm^2; e.g. *Renealmia africana* Benth., *Hallea stipulosa* (DC.) J.-F.Leroy, *Caladium bicolor* (Aiton) Vent.
- megaphylls sized-leaf (**Mega**): Leaf or leaflet area up than 20 dm^2; e.g. *Musa x paradisiaca* L., *Colocasia esculenta* (L.) Schott, *Megaphrynium macrostachyum* (K. Schum.) Milne-Redh.

Regarding the biological form, we distinguished:

- trees (**A**): woody plants more than 10 m high; e.g. *Mangifera indica* L.
- shrubs (**B**): woody plants from 0.5 to 8 m high; e.g. *Bridelia ferruginea* Benth.
- herb (**H**): herbaceous plants; e.g. *Sida rhombifolia* L.
- liana (**L**): woody or herbaceous creeping or climbing plants; e.g. *Landolphia owariensis* P. Beauv.

Regarding the phytosociological status, we distinguished the following ecological groups, described by Belesi (2009, 2016)**:**

- Phragmitetea (**P**): semi-aquatic vegetation species. e.g. *Scleria racemose* Bojer
- Soncho-Bidentetea (**SB**): ruderal species of hydromorphic and dried hydromorphic environments, dominated by the association of *Sonchus* spp and *Bidens pilosa* L. e.g. *Bidens pilosa* L., *Tridax procumbens* L. *Sida acuta* L., *Urena lobate* L.
- Halleetea (**Ha**): species of ecosystems related to wetlands and riparian zones, dominated by *Hallea stipulosa* (DC.). J.-F. Leroy. e.g. *Eulophia bouliawongo* (Rchb.f.) J. Raynal, *Nauclea pobeguinii* (Pobég.) Merr., *Lasimorpha senegalensis* Schott
- Hyparrhenietea (**Hy**): species of dry herbaceous formations in the Guinean-Congo region. *Hyparrhenia diplandra* (Hack.) Stapf, *Helichrysum mechowianum* Klatt, *Cotus spectabilis* (Fenzl) K. Schum.
- Ruderali-Manihotetea (**RM**): Species of synanthropic vegetation. e.g. *Schwenckia americana* L. *Acanthospermum hispidum* DC.
- Cultivated (**Cu**): Crop species, introduced exotic species adapted to local climatic conditions and naturalized. e.g. *Zingiber ofinanale* Rocoe, *Cinnamomum verum* J. Presl, *Cymbopogon citratus* Stapf
- Erythrophloetea africani (**Ea**): shrub savanna species dominated by *Erythopheum suaveolens* (Guill. & Perr.) Brenan. e.g. *Hymenocardia acida* Tul., *Bridelia ferruginea* benth.
- Musango-Terminalietea (**MT**): species of secondary forests, typically disturbed by humans and characteristics of the association *Musanga cecropioides* R. Br. ex Tedlie and *Terminalia superba* Engl. & Diels. e.g. *Myrianthus arboreus* P. Beauv., *Musanga cecropioides* R. Br. ex Tedlie

- Strombosio-Parinarietea (**Sp**): species of semi-evergreen Guinean-Congo dryland rainforests dominated by the association of *Strombosia schefflera* Engl. *and Parinari excelsa* Sabine. e.g. *Ficus lutea* Vahl., *Gnetum africanum* Welw.
- Ruderali-Manihotetea and post-cultura (**RMP**): ruderal and post-cultivation species considered as characteristics of *Manihot esculenta* Crantz. e.g. *Chamaesyce hirta* (L.) Millsp., *Mitracarpus hirtus* (L.) DC
- Potamotea (**Po**): herbaceous species specifically associated with aquatic vegetation or stagnant waters (ponds, marshes), e.g. *Nyphaea lotus* L.
- Oncobo-Tremion (**CT**): species of forest recruit, characterized by the association *Oncoba welwitschii* Oliv. and *Trema orientale Blume*. e.g. *Voacanga africana* Stapf., *Senna hirsuta* (L.) H.S. Irwin & Barneby
- Symphonion-Globuliferea (**SG)**: species of the vegetation of humid or hydromorphic soils which are sometimes degraded by human activities. e.g. *Polygala acicularis* Oliv.

3.3.3. Data process and analysis

MS Excel 2013 and SPSS 25 were used to process and analyse data, as well as drawing graphs. To evaluate the distribution, ecological range, availability, and conservation status of species, we analyzed the specific frequency of each species. Concerning the distribution and availability of plant species, we defined four categories using an adapted classification system of that proposed by Du Rietz *et al*. (1920), Dajoz (1982) and Benchiha *et al.* (2014). This classification is based, as previously reported, on the percentage of plots where a species was present. Brief descriptions of these categories are presented in Appendix 5.

For species distribution, we classified them as constant species ($75\% \leq Fi \leq 100\%$), regular species ($50\% \leq Fi < 75\%$), accidental ($25\% \leq Fi < 50\%$), and relatively rare species ($Fi < 25\%$).

In terms of availability, we categorized species as relatively rare (1) with a local frequency of less than 25% ($Fi < 25\%$), accidental or opportunistic (2) with a local frequency between 25% and 50% ($25\% \leq Fi < 50\%$), regular (3) with a local frequency between 50% and 75% ($50\% \leq Fi < 75\%$), and abundant (4) with a local frequency greater than 75% ($75\% \leq Fi \leq 100\%$).

Concerning the ecological amplitude of species, we considered three categories, including ubiquitous species (present in all plant formations, i.e., $Fi = 4$), transgressive species (present in two or three plant formations; i.e., $2 \leq Fi \leq 3$), and characteristic species (restricted

to only one plant formation; i.e., F*i* = 1). Following Belesi (2009) and Gillet (2000), we considered two plant formations with Ks or Jc more than 50% as similar. With reference to Landeau (2008), plots were considered to belong to the same vegetation type when β (Whittaker Index) was less than 50% (β < 50%). Furthermore, following Belesi (2009), the plant formation with the highest species diversity was considered floristically rich.

3.4. Results and discussions

3.4.1. Plot repartition in the studied area

A total of 117 ecofloristic plots were established over an area of approximately 600 hectares, and studied in the four inventoried plant formations, including anthropized formations (24 plots), swamp forests (14 plots), savannahs (30 plots) and dryland forests (49 plots).

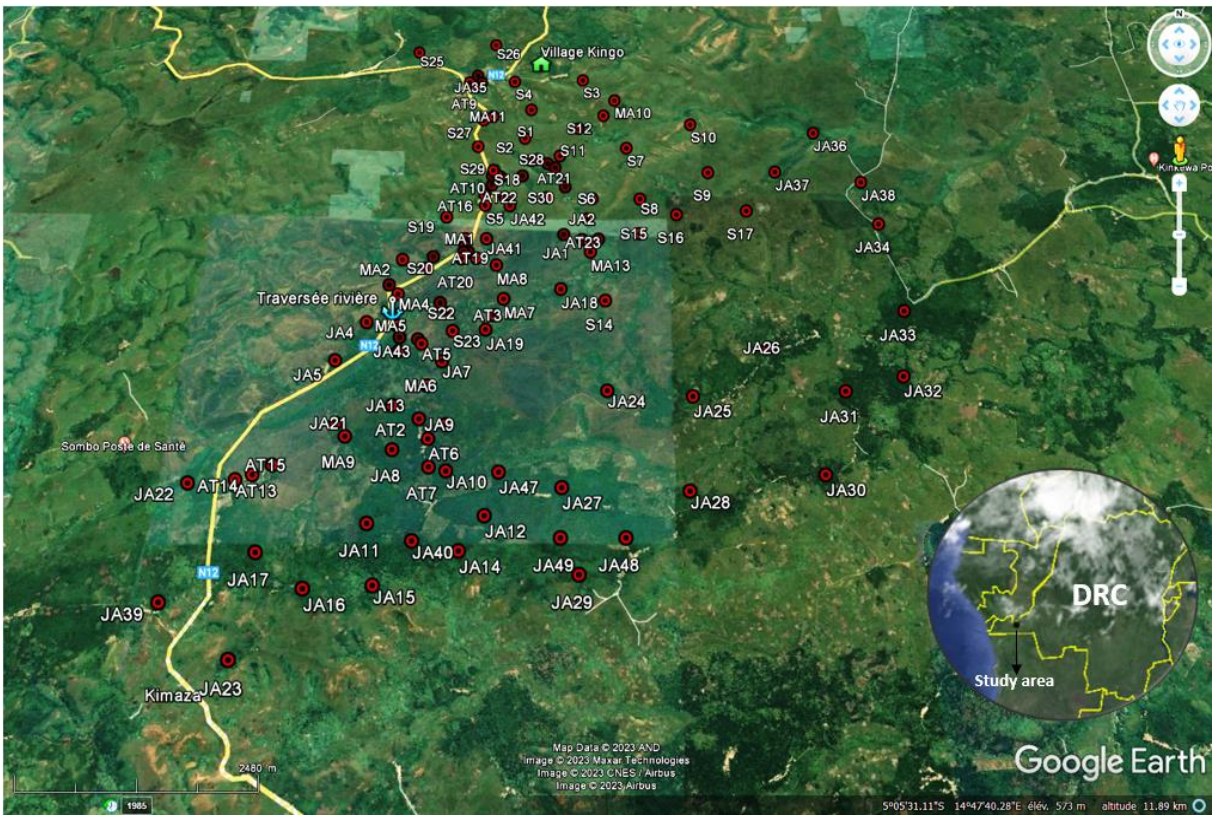


Figure 3.1. Location of ecofloristic plots within the study area (adapted from DRC map from google Earth, 08/12/2021) (AT: anthropized formation, MA: swamp forest, S: savannah and JA: dryland forest)

3.4.2. Taxonomic diversity

In total, 709 out of the 714 species inventoried, were successfully identified and grouped into 113 families and 446 genera (Appendix 4). Of the total number of species inventoried, 248 (35 %) were reported as medicinal.The most prevalent families among the studied vegetation were Fabaceae, comprising 105 species (14.8 %), followed by Poaceae with

46 species (6.5 %), Asteraceae with 46 species (6.5 %), Rubiaceae with 41 species (5.8 %), and Malvaceae with 28 species (3.9%) (Figure 3.2a).

The identification of the top five plant families aligns with findings of Kikufi *et al.* (2017) and Lassa *et al.* (2019) in the same Kongo-Central Province, and Belesi (2009) in Bas-Kasai areas, located in the same Guinean-Congo phytogeographic region as Mbanza-Ngungu. The latter authors further also ranked these five families among the best-represented of the whole DRC. Predominance of Fabaceae was also observed in all plant formations (Figures 3.2-3.6). High frequency of Fabaceae species among the five biggest families in the world may be related to their adaptation to harsh ecological or environmental conditions, as well as to their efficient diaspore dispersion strategies (Centeno-González *et al*., 2021). Fabaceae exhibits a wide range of adaptations such as nitrogen fixation, symbiotic relationships with soil bacteria, and diverse seed dispersal mechanisms, including pod bursts and interactions with animals (Shavanov, 2021; Shrivastava *et al.*, 2021). These characteristics contribute to the success and prevalence of Fabaceae species globally.

The three most predominent genera were *Solanum* (13 species, 1.8 %), *Cyperus* (12 species, 1.7 %), and *Ficus* (10 species, 1.4 %) (Figure 3.2b). The predominance of these genera was also reported from Kikwit vegetations (DRC) (Masens, 1997). This predominance could be linked to the large number of species they contain (Belesi, 2009). *Solanum* species are often characterized by their ability to tolerate a wide range of environmental conditions and their adaptability to various habitats (Nakazato *et al.*, 2010; Nosenko *et al*., 2016). They can be found in diverse ecosystems, from forests to herbaceous or anthropized formations (Formozis *et al.*, 2021). *Cyperus* is a genus of the Cyperaceae family, commonly known as sedges. Many species of *Cyperus* are adapted to wet habitats, such as marshes, swamps, and seasonally flooded areas (Parmentier *et al.,* 2005). They have adapted to survive in waterlogged soils and are often dominant components of wetland vegetation. They are also found in wasteland, trampled areas and as field weeds in the intertropical zone (Barrett, 2013; Mishra *et al.*, 2015). The widespread dispersal of Cyperaceae species could be related to their ability to colonize diverse habitats, as well as the various adaptation mechanisms (Larridon *et al*., 2021). The combination of wind, water, animal dispersal, rhizomatous growth, ecological versatility, and seed dormancy collectively enhances their ecological success and distribution (Allessio Leck and Schütz, 2005; Żukowski *et a*l., 2010). Wind dispersal allows for long-distance dispersal of lightweight seeds (Lye, 2016), while water dispersal facilitates transportation across water bodies (Király *et al.*, 2013). Some species have developed adaptations for dispersal by animals, either through seed

adherence or interactions with specific seed dispersers like birds (Barrett, 2013; Everson, 2022). Additionally, the rhizomatous growth habit of many Cyperaceae species promotes vegetative propagation and expansion into neighbouring areas, further enhancing their colonization potential, particularly in areas that are constantly being reworked, as the rhizomes can quickly regenerate and establish new individuals (Shi *et al*., 2021). *Ficus* is a genus within the Moraceae family, which includes fig trees. *Ficus* species exhibit a remarkable adaptability to different environmental conditions, allowing them to colonize a wide range of habitats, from forests to disturbed areas. They can tolerate various light levels, soil types, and moisture conditions, enhancing their ability to disperse and establish in diverse ecosystems (Negash, 2021). The interaction between *Ficus* species and their seed-dispersing animals, known as zoochory, also plays a significant role in the widespread dispersion and establishment of *Ficus* populations (Lomáscolo *et al*., 2010). Animals, such as monkeys, bats, and other mammals, are attracted to the sweet fruits of *Ficus* trees and consume them. The seeds are either ingested and dispersed through their feces or dropped during feeding, promoting dispersal to new locations (Qian *et al*., 2022).

Within plant formation, species from the genus *Solanum* (Figure 3.3b) dominated the anthropized area (3.3 %), while those of *Ficus* (Figure 3.4b), *Dalbergia* (Figure 3.5b) and *Vernonia* (Figure 3.6b) dominated in swamp forests (3.5 %), dryland forests (2.0 %) and savannahs (4.9 %), respectively. Their dominance in their respective plant formation, as reported above, can be attributed to the richness of species they host (Belesi, 2009) and most probably to the environments in which they develop. These environments are likely to provide optimal conditions for their growth and ecological success (Cano-Ortiz *et al.*, 2020; Chen *et al*., 2023).

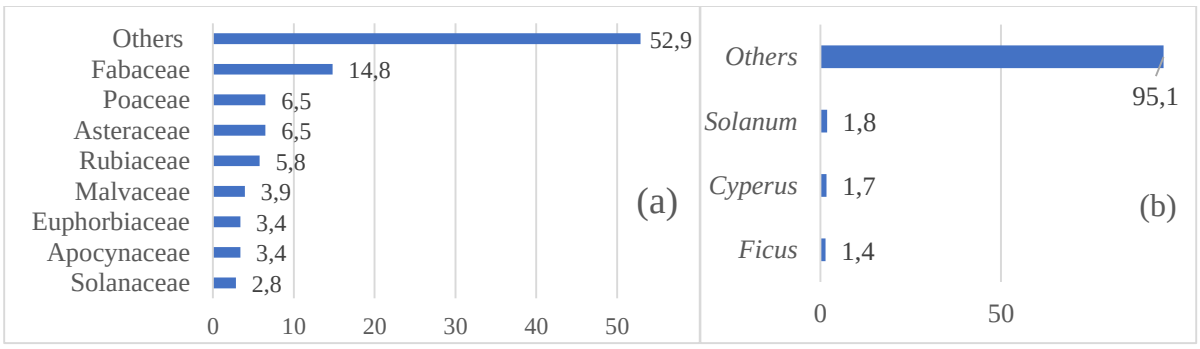


Figure 3.2. Share (%) of families (a) and genera (b) according to number of species

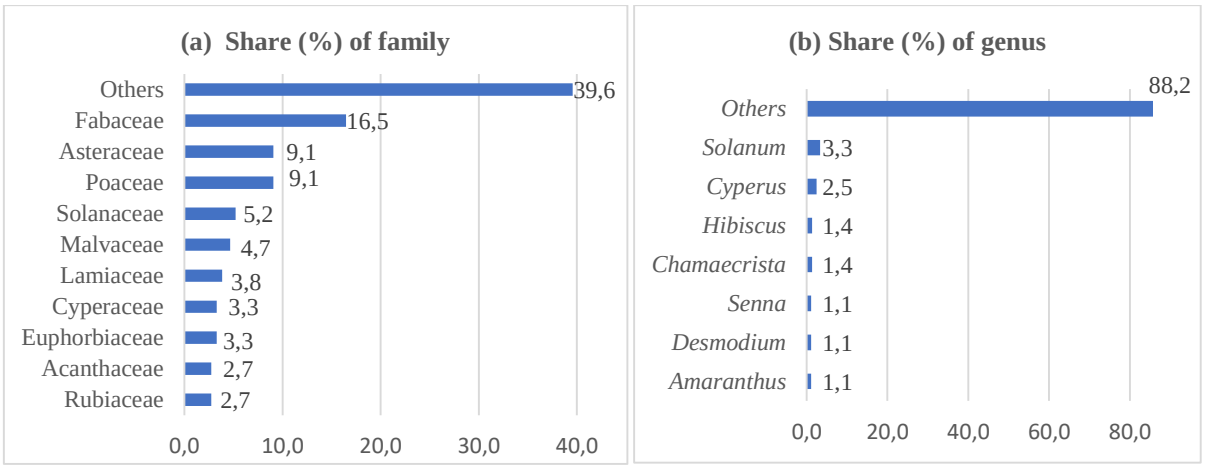


Figure 3.3. Share (%) of families (a) and genera (b) in anthropized formations

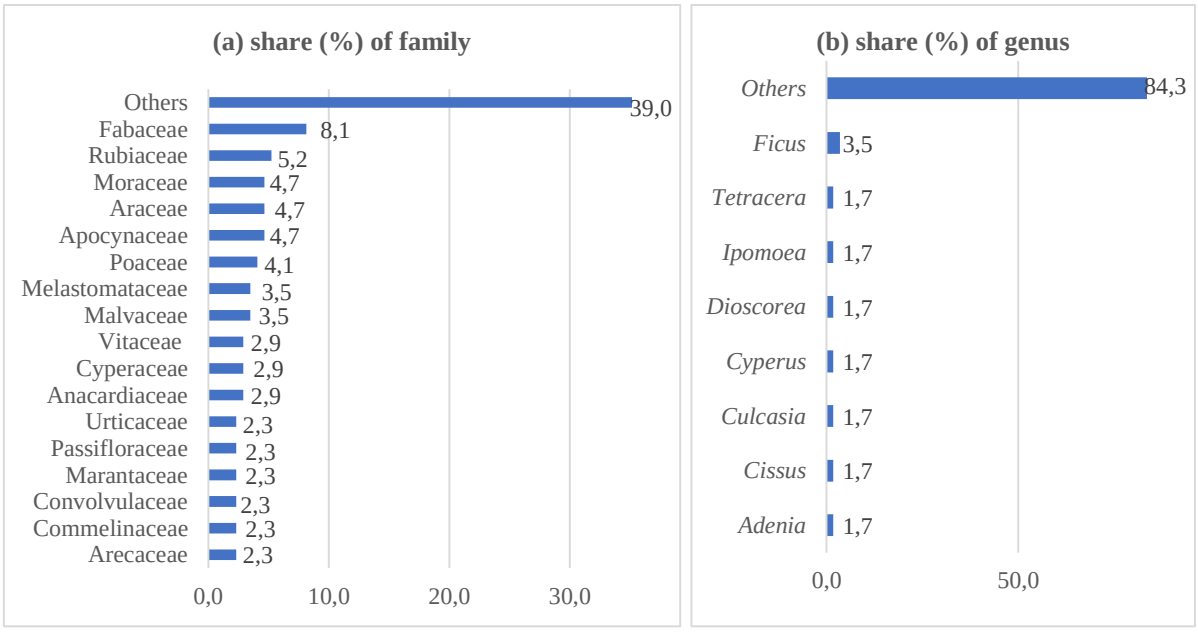


Figure 3.4. Share (%) of families (a) and genera (b) in swamp forests

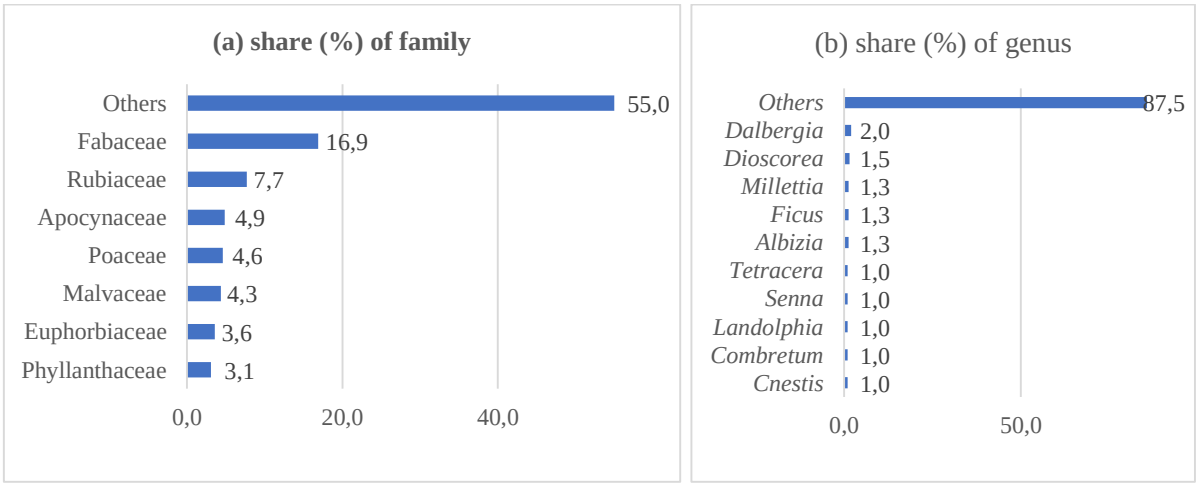


Figure 3.5. Share (%) of families (a) and genera (b) in dryland forests

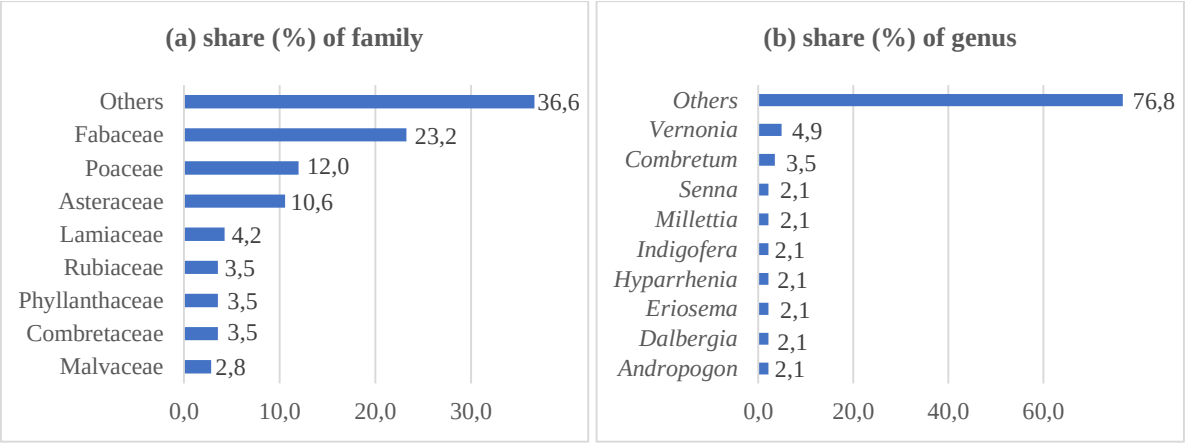


Figure 3.6. Share (%) of families (a) and genera (b) in herbaceous formations

3.4.3. Ecofloristic characteristic of the studied vegetation

3.4.3.1. Floristic richness of plant formations

The number of species in the different plant formations ranged 144 to 395. Dryland forests, as well as anthropized formations, are the formations with the highest number of species, genera and botanical families. They differed from other types of vegetation by the high proportion of characteristic species. Herbaceous formations (savannahs) and swamp forests had the high proportion of constant species (Table 3.2).

Table 3.2. Floristic richness by plant formation

	Anthropized vegetation (AT)	Swamp forests (MA)	Savannah (S)	Dryland forests (JA)	Global
Number of plots	24	14	30	49	117
Number of species	364	173	144	395	714
Number of genera	256	130	105	271	446
Number of families	74	59	44	82	113
Number of characteristic species	214	50	25	156	445
% of characteristic species	58.8	28.9	17.4	39.5	62.3
Average number of species per plot	44 ± 11	37 ± 8	25 ± 7	46 ± 12	-
Number of constant species	1	9	9	3	22
Proportion (%) of constant species	0.3	5.2	6.3	0.8	3.1

Dryland forests vegetation showed high plant diversity than that of swamp forests and anthropized formations, as well as that of herbaceous formations, despite that herbaceous formations having much more open areas. The decrease in diversity of swamp forests could be linked to the waterlogged conditions of these forest types, which often limit the development of woody species (Belesi, 2009). The few species encountered have morphological structures that allow them to adapt to waterlogged conditions.

On the other hand, the low number of species in savannahs and anthropized formations could be linked to the rough, poor and incrusted soils on which these ecosystems develop (Belesi, 2009; Masens, 1997). Additionally, the low number of species could be attributed to recurring bush fires and continual disturbances in these plant formations, both of which exert a substantial impact on their vegetation (Sheuyange *et al.*, 2005).

The richness of dryland forests may be linked to the specific eco-edaphic conditions of forest soils as well as to the microclimate under the forest canopy, which creates favorable conditions for plant development (Cicuzza and Mammides, 2022).

3.4.3.2. Sampling effort

The sampling effort was evaluated by analyzing species accumulation curves, aiming to determine if the sampling was sufficient to yield a more comprehensive estimate of the specific diversity of the inventoried plant formations.

Accumulation curves provide valuable insights into species distribution and occurrence within each plant formation, allowing for a visual representation of detected species diversity and an estimation of potential species richness within plant communities (Figure 3.7). The first plots closest to the origin of the graph refer to those that were sampled first.

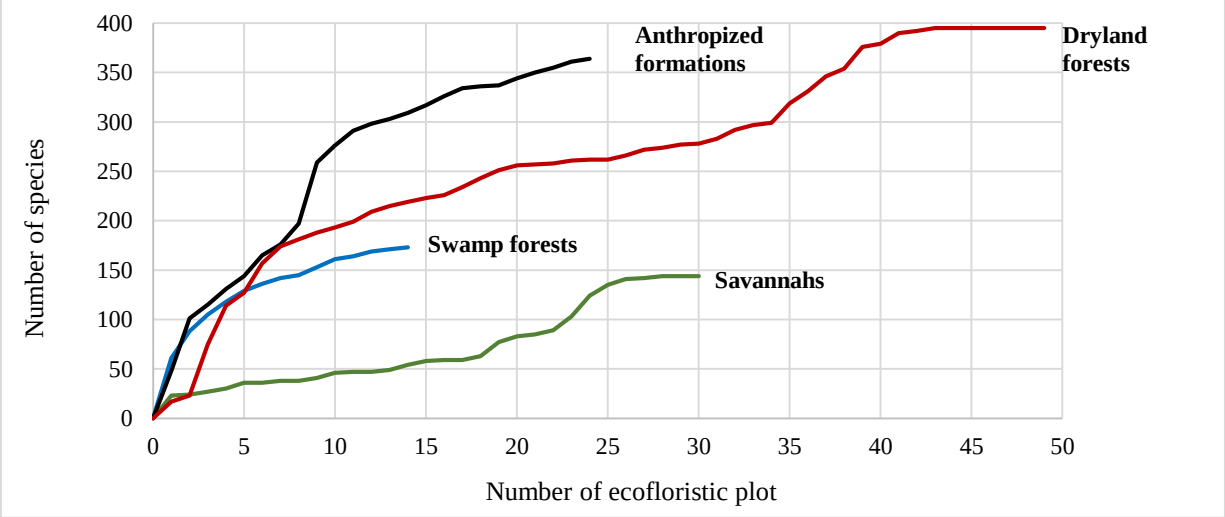


Figure 3.7. Accumulation curves estimating the number of species sampled as a function of sampling effort in different plant formations

The curves show a consistent pattern across the different formations, characterized by an initial rapid increase in species discoveries during early sampling, followed by a gradual flattening as effort increases, reaching a plateau. This pattern holds for dryland forests, swamp forests and savannahs, with the exception of savannahs, which show a slower initial rise in the

curve and a faster late increase. This divergence in savannahs may be due to their expansive and open spaces, which presents a challenge to early species detection due to potentially less visible and discrete species. For most plant formations, the plateau of the curves suggests that most species have been sampled and that additional effort is unlikely to substantially increase the observed diversity. Conversely, anthropized formations showed a distinct continuous increase pattern, suggesting a higher potential for undiscovered species without reaching a saturation point. The tendency for the accumulation curve to rise indicates the need for additional sampling to obtain a more complete estimate of diversity.

Regarding species distribution, the observed distribution patterns reveal a homogeneous and uneven species distribution in anthropized formations, swamp forests, and dryland forests, characterized by a dominance of common and abundant species identified early in the sampling process. Herbaceous formations, however, exhibit a more heterogeneous and balanced distribution, with a gradual discovery of less frequent species during sampling.

Concerning species diversity, the general tendency of curves confirms the high species richness in dryland forests, followed by anthropized formations, swamp forests, and savannahs. However, anthropized formations exhibited a higher rate of species discovery with increasing sampling effort compared to other plant formations.

These results highlight the effectiveness of sampling efforts within different plant formations. They underline the importance of adapting sampling efforts across plant formations to gain a more comprehensive understanding of species diversity and distribution.

3.4.3.3. Species frequencies of the studied vegetation

Species frequency analyses showed high proportion of relatively rare species, followed by opportunist species, regulars and constant species (Figure 3.8). Dryland forests exhibited a high proportion of relatively rare (87.9 %) and regular (5.3 %) species, whereas swamp forests (13.3 %) and savannahs (6.3 %) showed high proportions of accidental and constant species, respectively. Most-abundant constant species included *Andropogon chinensis* (Nees) Merr (100%), *Hymenocardia acida* Tul. (93.3 %), *Annona senegalensis* Pers. (93.3 %), *Hyparrhenia familiaris* (Steud.) Stapf (90 %), *Maprounea africana* Müll. Arg. (86.7 %), *Vitex madiensis* Oliv. (83.3 %), *Andropogon africanus* Franch. (83.3 %), *Costus spectabilis* (Fenzl) K. Schum. (83.3 %) and *Helichrysum mechowianum* Klatt (76.7 %) in savannahs. Dryland forests most-abundant constant species included *Millettia drastica* Welw. ex Baker (77.6 %), *Sapium cornutum* Pax (77.6 %) and *Rauvolfia vomitoria* Wennberg (75.5 %). Most abundant

constant species from anthropized formations included *Urena lobata* L. (75 %), whereas swamp forest species included *Alchornea cordifolia* (Schumach.) Müll. Arg. (100 %), *Elaeis guineensis* Jacq. (92.9 %), *Musanga cecropioides* R. Br. ex Tedlie (92.9 %), *Costus lucanusianus* J. Braun & K. Schum. (92.9 %), *Vitex doniana* Sweet (85.7 %), *Macaranga schweinfurthii* Pax (85.7%), *Thelypteris gongylodes* (Schkuhr) Small (85.7 %), *Hallea stipulosa* (DC.) J.-F. Leroy (85.7%) and *Lasimorpha senegalensis* Schott (85.7 %) (Appendix 4).

The prevalence of rare species compared to common species has been recognized since the 1940s and supported by different studies and authors, and was observed in many species across different classes and regions (Darwin *et al*., 2008; Enquist *et al.*, 2019; McCabe and Weber, 1994; McGill *et al.*, 2007; ter Steege *et al.*, 2013; Yoccoz, 2022). The underlying causes contributing to the abundance of rare species are likely to be neutral and diverse (Flather and Sieg, 2007; Hubbell, 2001; Jeliazkov *et al.*, 2022). Leitão *et al.* (2016), suggested that rare species exhibit higher sensitivity to natural and anthropogenic disturbances, such as overexploitation, habitat loss, and global environmental change, when compared to abundant and widespread (common) species. Rare species abundance could be due to the fact that these species possess ecological advantages that require minimal energy expenditure. In contrast, common species exhibit higher energy requirements due to their greater phenotypic plasticity, referring to the ability of species to change their phenotype or behavior in response to variations in the environment. Common species also have a wider ecological niche and the ability to exploit a variety of resources, as opposed to species that specialize in fewer but more efficient resources. Additionally, common species are reported to display higher reproductive and dispersal capacities (Dostál *et al.*, 2016; McNichol and Russo, 2023). Few species are able to allocate energy to multiple adaptations, making them less competitive. This may explain the prevalence of rare species relative to common species.

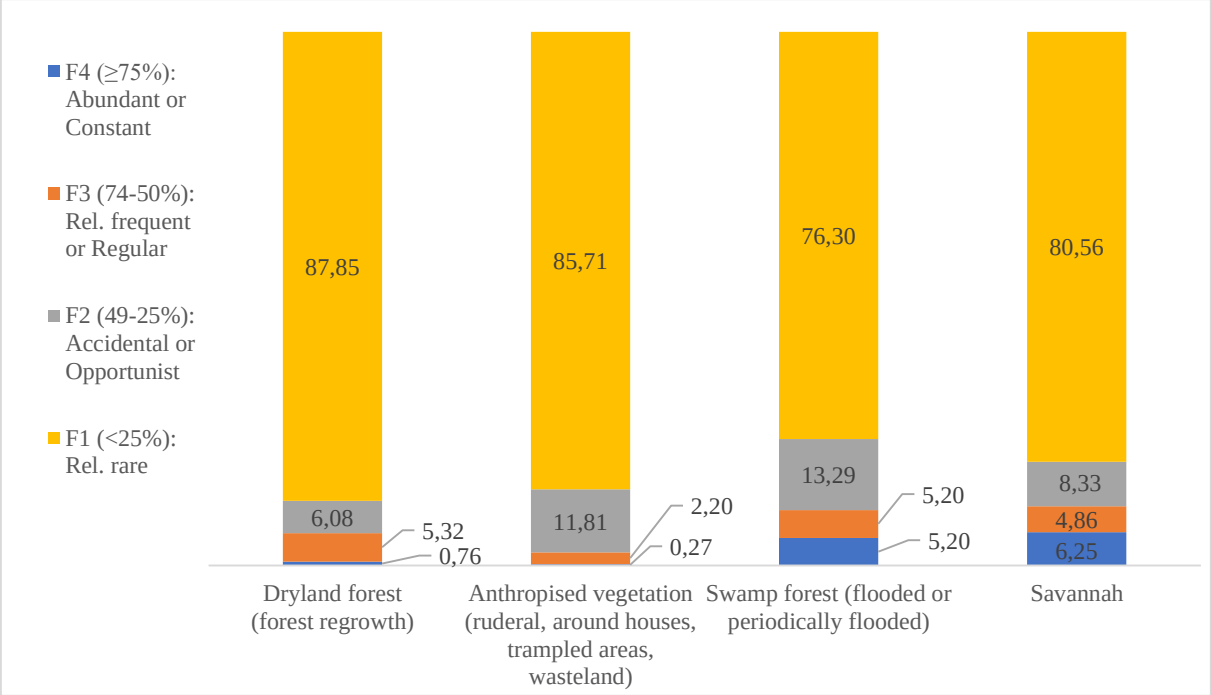


Figure 3.8. Share (%) of species frequency in different plant formations

3.4.3.4. Species distribution

According to the species' ecological amplitude within the landscape, 16 species (2.24%) showed a wide distribution or ecological amplitude (Table 3.3). These species can be considered as ubiquitous or eurybionts, as they can be found in different types of vegetation (Farzalieva & Esyunin, 2014). They are well adapted to thrive in all environmental conditions within the intertropical zone, where they reach their ecological optimum. In addition, these species show a remarkable ability to tolerate environmental fluctuations, demonstrating their resilience to various ecological challenges (Belesi, 2009).

On the other hand, 445 species (62.03%) were found to be restricted to a single plant formation, categorized as characteristic or stenobiont species. This is the case, for example, of (1) *Aframomum sanguineaum* K.Schum., *Nauclea pobeguinii* (Pobég.) Merr., *Lasimorpha senegalensis* Schott (in swamp forests); (2) *Chenopodium ambrosioides* L., *Chamaesyce hirta* (L.) Millsp., *Boerhavia diffusa* L. (in anthropized areas); (3) *Costus spectabilis* (Fenzl) K.Schum., *Tacca leontopetaloides* (L.) Kuntze (in savannahs) and (4) *Gaertnera paniculata Benth*, *Vernonia brazzavillensis* Aubrév. ex Compère, *Sapium cornutum* Pax (in dryland forests). These species are well adapted to their original ecological niche, where they can fully grow and develop. They demonstrate a high degree of acclimatization to their environment but also exhibit limited adaptability to the conditions prevailing in other types of plant formations (Behroozian *et al*., 2020), where they are usually scarce. For example,

Eulophia bouliawongo (Rchb.f.) J.Raynal and *Hallea stipulosa* (DC.) J.-F.Leroy are characteristic of swamp ecosystems, where they are well represented. However, they are also found in dryland forests, where they have specific adaptations, but are still very scarce in these environments compared to their natural habitat. Similarly, *Helichrysum mechowianum* Klatt, a characteristic savannah species, of which rare isolated specimens were found in neighboring anthropogenic environments. Additionally, species such as *Hymenocardia ulmoides* Oliv and *Chaetocarpus africanus* Pax, characteristic of dryland forests, have very few occurrences found in the savannah. This example illustrates how species restricted to a single habitat show limited adaptability to other plant formations, emphasizing the importance of preserving their specific ecological niches for their continued survival.

Other species are classified as ecological transition species. Typically associated with two or three plant formations, they accounted for 35.43% of the total number of species inventoried. These species are characterized by their ability to expand beyond their natural geographical range. They are considered characteristic species in their original habitat, but can colonize and thrive in other plant formations. In general, these species target plant formations that are closely related in the natural order of vegetation succession. This applies to species like *Lannea welwitschii* (Hiern) Engl. and *Macaranga monandra* Müll. Arg., typically found in wetland forests, were also well represented in woodland forests, indicating their ability to transition and thrive in different habitats compared to their natural habitat. Similarly, *Musanga cecropioides* R.Br. ex Teldie and *Myrianthus arboreus* P. Beauv. showed a high preference for wetland forests, suggesting their adaptation to these environments. They also exhibited the ability to thrive in dryland forests, reflecting their capacity to overlap between the two ecosystems. This ability to transition and thrive in different habitats is a key characteristic of ecological transition species, allowing them to expand beyond their natural range and adapt to new environments.

Table 3.3. Share (%) of species distribution in the study area

Species distribution by plant formation	1	2	3	4
Number of species	445	192	61	16
Percentage	62.32	26.89	8.54	2.24

Species with a wide distribution in Mbanza-Ngungu, as shown in Table 3.4, are those that were observed in all plant formations, albeit with different frequencies. Detailed species distribution and frequencies are presented in Appendix 4. In the light of these data, it appears that a species can occur in various plant formations. However, the plant formation where a species exhibits a higher frequency can be considered its most suitable habitat,

indicating favorable conditions for its growth and development. Conversely, in other plant formations, species display specific adaptations, resulting in a lower distribution (frequency) within those plant formations. *Milletia versicolor* Welw. ex Baker is an illustrative case of a species with a wide distribution in the Mbanza-Ngungu region. The species is well adapted to dryland forests, where it occupies 53% of its distribution. In contrast, it has a modest presence in savannahs (7%) and a more significant presence in anthropized environments (38%). Despite its adaptations to thrive in both swamp forests and anthropized environments, dryland forests appear to be the most conducive to its ecological optimum and robust development. This suggests that conservation efforts for *M. versicolor* should focus on protecting dryland forests as the most appropriate and beneficial approach.

Similarly *Commelina africana* L. is another example of a species with a wide distribution, despite being limited to pockets of very restricted habitats and becoming rare in the Mbanza-Ngungu region. The species is well adapted to humid and shady environments, where it occupies a significant portion of its distribution. In contrast, the plant species is sparsely distributed in dry forests and anthropized environments, mainly in lowland areas, particularly in former cultivation sites, where only a few isolated plants were found under the tree canopy. Despite its potential adaptability to dryland and anthropized formations, possibly associated with humid and shady microenvironments in these ecosystems, swamp or humid environments remain the most conducive for the species. Therefore, sustained conservation efforts directed towards the protection of these environments are crucial for ensuring the longevity of *C. africana*, and by extension, the associated medicinal knowledge.

Table 3.4. Share (%) of the 16 widely distributed species by plant formation
(AT: Anthropized formation, MA: swamp forest, JA: dryland forest, S: savannah or herbaceous formation)

Species	Frequency (%)			
	MA	AT	JA	S
Abrus precatorius L.	7.1	8.3	28.6	3.3
Alchornea cordifolia (Schumach.) Müll. Arg.	100	16.7	67.3	20.0
Chromolaena odorata (L.) R. M. King et H. Rob.	21.4	58.3	61.2	26.7
Cissus rubiginosa (Welw. ex Baker) Planch.	7.1	12.5	16.3	16.7
Dalbergia lactea Vatke	14.3	4.2	40.8	3.3
Dioscorea cayenensis Lam.	35.7	8.3	55.1	3.3
Dissotis brazzae Cogn.	7.1	8.3	20.4	26.7
Elaeis guineensis Jacq.	92.9	4.2	57.1	6.7
Ficus exasperata Vahl.	21.4	4.2	8.2	3.3
Lannea antiscorbutica (Hiern) Engl.	7.1	4.2	28.6	3.3
Millettia versicolor Welw. ex Baker	21.4	37.5	53.1	6.7
Mimosa pigra L.	14.3	8.3	2.0	3.3
Mucuna pruriens (L.) DC.	42.9	16.7	20.4	3.3
Psidium guineense Sw.	7.1	8.3	12.2	26.7
Rauvolfia vomitoria Wennberg	42.9	20.8	75.5	10.0
Smilax anceps Willd.	7.1	37.5	34.7	33.3

3.4.3.5.Vegetation dynamics

Vegetation dynamics were investigated using similarity (Table 3.5a-b) and dissimilarity (Table 3.5c) indices. The similarity rate (%) between different plant formations ranged 17 to 71.1 for Sorensen index (Table 3.5a), while Jaccard's varied from 7.8 to 26.2 (Table 3.5b). The highest similarity indices were found in descending order, between (1) dryland and swamp forests (KS: 71.1; JC: 26.2); (2) savannahs and dryland forests (KS: 52.7; JC=20.9); (3) anthropized formations and dryland forests (KS=46.2; JC=18.8) and between (4) anthropized formations and savannahs (KS=41.9; JC=17.3). Low similarity indices were observed between swamp forests and savannahs (KS = 17.9; JC = 8.9) and between anthropized formations and swamp forests (KS = 17; JC = 7.8). The Whittaker dissimilarity index ranged from 18% to 35% (Table 3.5c). The highest indices were observed in anthropized formations (Ws: 35%) and swamp forest (Ws: 33%). The lowest values were observed in savannah (Ws: 19%) and dryland forest (Ws: 18%).

Table 3.5. Sorensen (a), Jaccard (b) and Whittaker (c) indices of plant formations

Sorensen index	Dryland forest	Savannah	Swamp forest	Anthropized vegetation
Dryland forest	-	52.7	71.1	46.2
Savannah	52.7	-	17.9	41.9
Swamp forest	71.1	17.9	-	17
Anthropized vegetation	46.2	41.9	17	-

(a) Sorensen index

Jaccard index	Dryland forest	Savannah	Swamp forest	Anthropized vegetation
Dryland forest	-	20.9	26.2	18.8
Savannah	20.9	-	8.9	17.3
Swamp forest	26.2	8.9	-	7.8
Anthropized vegetation	18.8	17.3	7.8	-

(b) Jaccard index

Plant formation	Whittaker's index of dissimilarity
Dryland forest	18
Anthropized vegetation	35
Swamp forest	33
Savannah	19

(c) Whittaker's index

The examination of similarity between different plant formations revealed the closest relationship between anthropized and herbaceous (savannahs) formations, followed by the similarity between savannahs and forest formations (swamps or drylands). Based on these findings, the most pronounced similarities were observed among plant formations that follow each other in the natural succession defined by vegetation dynamics, progressing from the pioneer to the climax stage (Lebrun, 1954). The weak similarities, however, appeared between

two increasingly distant plant formations in the chain of the natural evolutionary dynamics of the vegetation (Ganglo, 2005).

The greatest similarity between swamp and dryland forests may arise from the overlap of plant species between the two plant formations, allowing them to thrive and coexist in both ecosystems (Liu *et al.*, 2023). This overlap is due to the proximity of these habitats, which creates an ecotone where species from both environments coexist. This ecotone, characterized by species overlap, enhances the similarity between the two ecosystems by promoting the coexistence of species from both habitats. The ecotone mitigates some of the unfavorable environmental conditions of swamps and dryland forests, facilitating the coexistence of species (Chytrý *et al.*, 2022; Kent *et al.*, 1997). Furthermore, this high similarity between the swamp and dryland forests may also be linked to hydrological connectivity. This connectivity provides a means of transportation for seeds and other biological materials, creating opportunities for colonization and dispersion of species and promoting a similar species composition when ecological changes occur between neighboring habitats (Liu *et al.*, 2022; Wu *et al*., 2023). This connectivity allows for the exchange of resources and genetic material between the two ecosystems, contributing to the similarity in species composition and ecological processes.

Regarding Whittaker's indices, they were generally low (Ws < 50 %) for all plant formations. This indicates that the surveyed plots of each plant formation are similar in terms of species composition. However, the highest indices of 35 % and of 33 % observed in anthropized formations and swamp forests, respectively, indicate a low species similarity between the surveyed plots of each plant formation. This means in other words that the inventoried plots do not necessarily have the same species composition or do not exhibit more similar species, even if they belong to the same type of vegetation.

We posit that the observed situation could be due to competition driven by anthropogenic activities, which tend to favor the proliferation of opportunistic species. Furthermore, the character or type of anthropized vegetations under examination could significantly influence its species composition. For instance, plots within anthropized vegetation, like abandoned fields, may not have similar species to those in ruderal, wasteland or trampled areas. This disparity is likely due to the variable eco-environmental conditions that prevail in each type of anthropized formation. These conditions of variability are likely to favor the emergence and prevalence of generalist, opportunist, or transgressive species. In essence,

the complex interplay of competition, the nature of anthropized vegetation, and environmental conditions collectively contribute to the observed differences in species composition.

With regard to swamp forests, this vegetation community includes both permanently flooded and periodically flooded forests. Thus, plant adaptations to different flooding regimes certainly contribute to the observed diversity and specific dissimilarity within this vegetation community. Indeed, plants in permanently flooded forests seem to have evolved to survive in permanently flooded conditions with adapted root structures. Those in periodically flooded forests, on the other hand, have adapted to survive prolonged flooding, but need critical periods of drought to develop. This factor can lead to significant differences observed.

The low levels of dissimilarity recorded in both dryland forests (18%) and savannahs (19%) indicate the prevalence of a significant proportion of species that are either similar or consistently present across the plots surveyed. Based on our results, this observation could be linked to the high proportion of constant species within their vegetation.

The affinity in terms of species composition between different plots of studied plant formations can be effectively illustrated by dendrograms of classification (Figures 3.9 - 3.12). These dendrograms allow for the visualization of affinity or the distance in terms of species composition among different ecofloristic plots within a given plant formation. The vertical axis (Y) of dendrograms represents clusters, and the height of the branches indicates the dissimilarity between these clusters, while the horizontal axis (X) represents the distance (proximity) between the studied floristic plots. Thus, from left to right, ecofloristic plots that exhibit more similar species (indicating lesser dissimilarity) to each other are closer. Conversely, those with less common species are more distant. Dissimilarity coefficients between plots to facilitate understanding of dendrograms are given in Appendix 6. A low coefficient indicates a high degree of species similarity and proximity between plots, while a high coefficient indicates a high degree of dissimilarity and distance between plots.

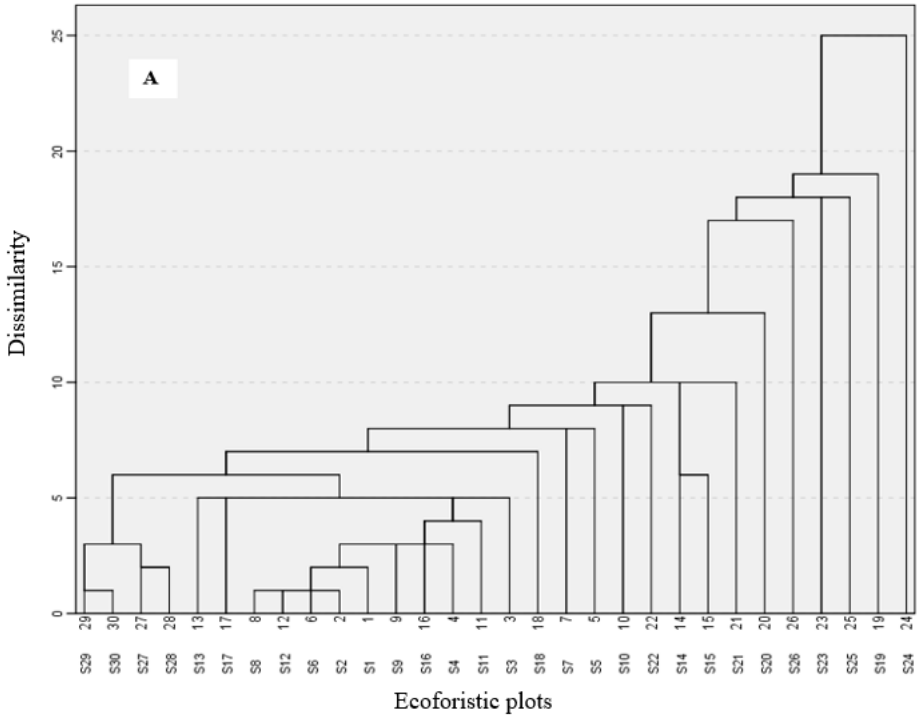


Figure 3.9. Dendrogram of classification of plots based on species composition in savannahs

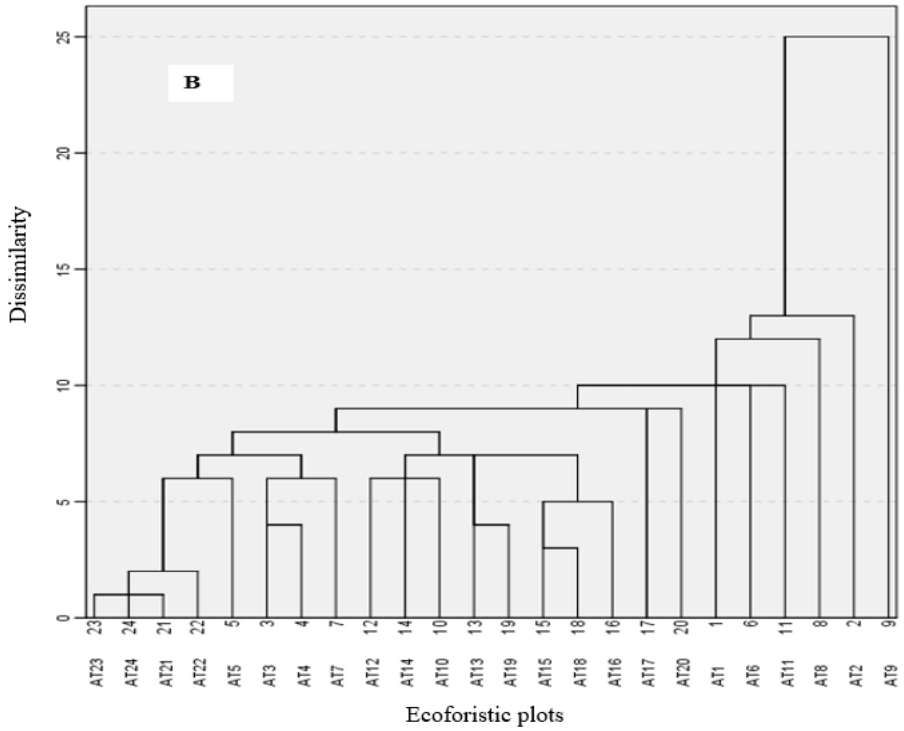


Figure 3.10. Dendrogram of classification of plots based on species composition in anthropized formations

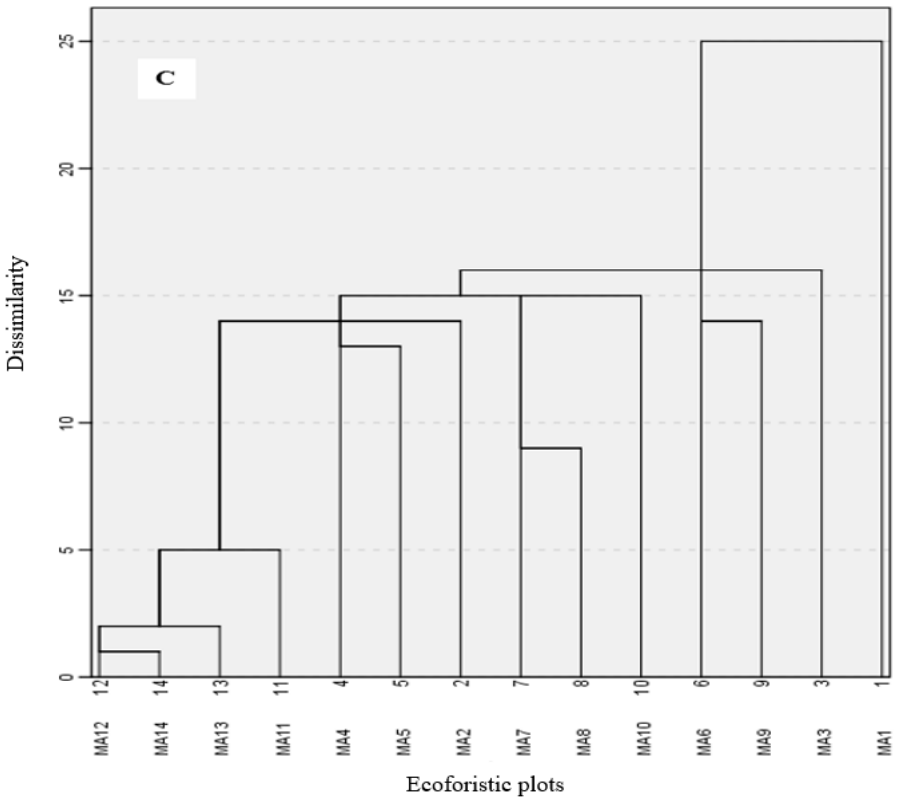


*Figure 3.*11. *Dendrogram of classification of plots based on species composition in swamp forests*

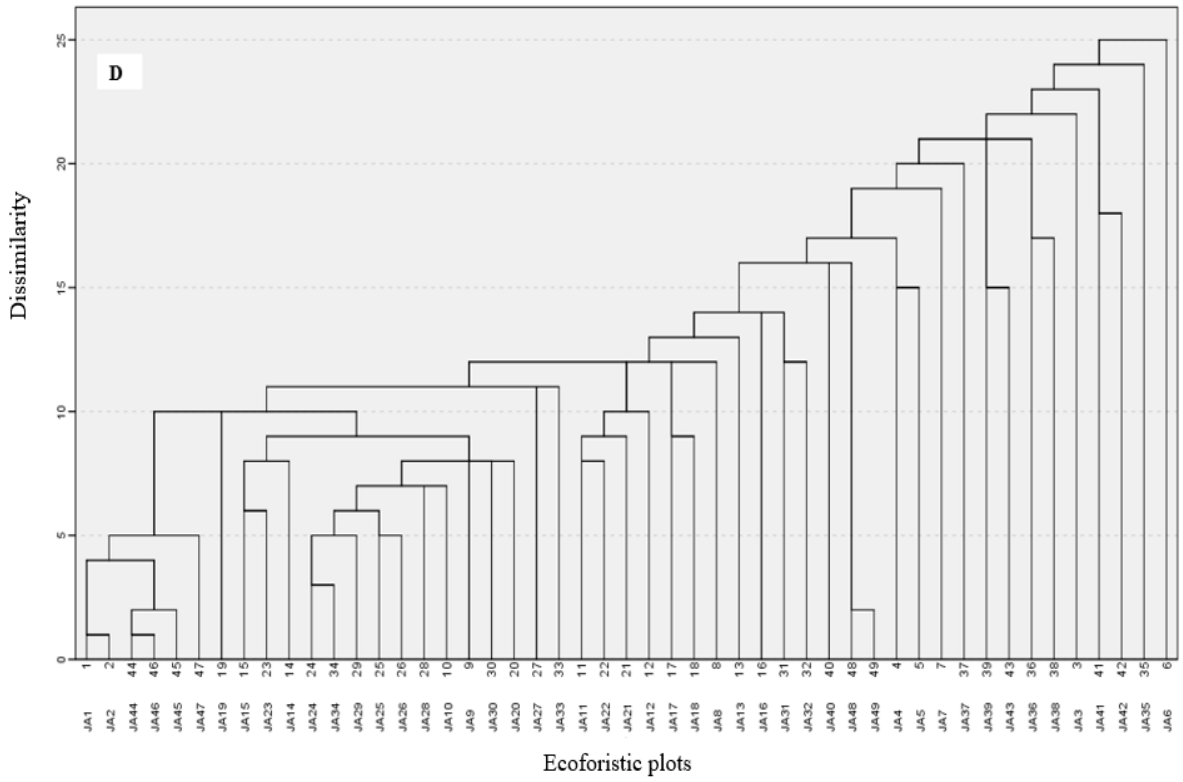
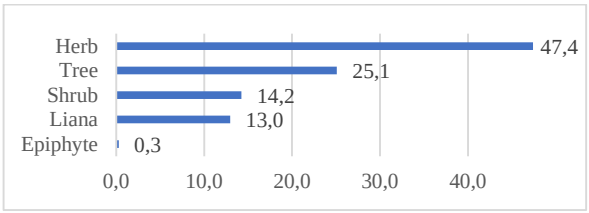


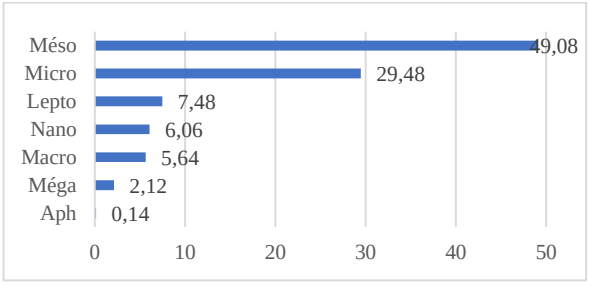
*Figure 3.*12. *Dendrogram of classification of plots based on species composition in dryland forests*

3.4.3.6. Autoecological characteristics of the vegetation

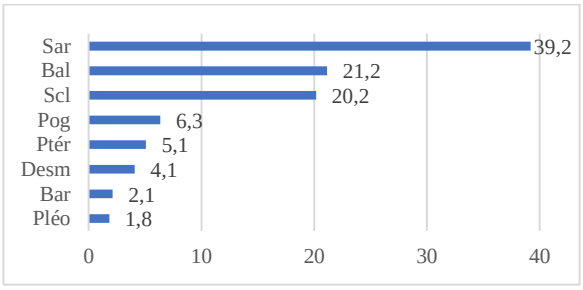
The studied vegetation revealed that the landscape was dominated by herbs (47.4%), species with mesophyll-sized leaves (Meso: 49.08%), sarcochores diaspores (Sar: 39.2%) and phanerophytes (Ph: 50.8%). The most common species were pantropical (Pan: 28.9%) and those belonging to the *Musango-Terminalietea* (MT: 28.2 %) phytosociological group (Figure 3.13).



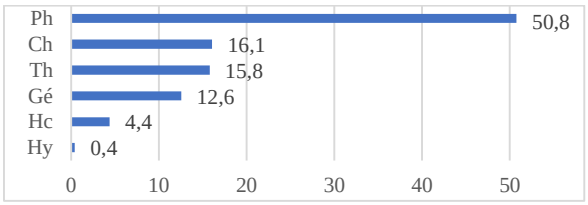
(a) Share (%) of morphologic type of inventoried species



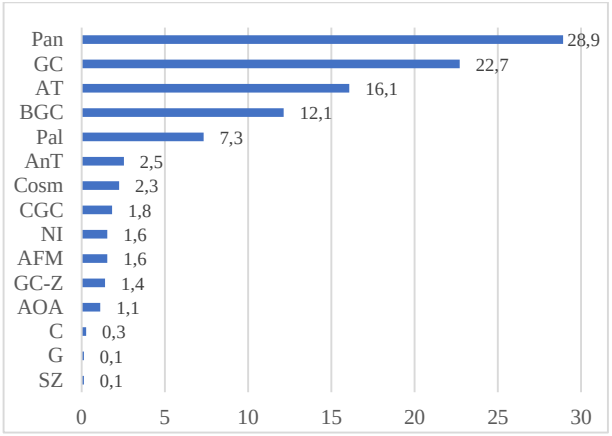
(b) Share (%) of leaf type of inventoried species



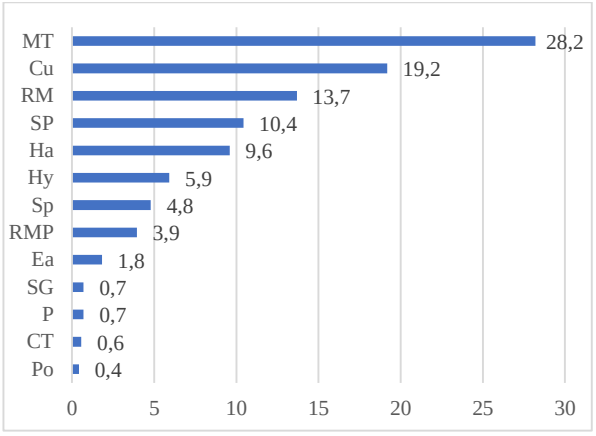
(c) Share (%) of diaspore type of inventoried species



(d) Share (%) of biological type of inventoried species



(e) Share (%) of phytogeographic distribution of inventoried species



(f) Share (%) of phytosociological status of inventoried species

Legend: *Bal: ballochore, Bar: barochore, Desm: desmochore, Pleo: pleochore, Pog: pogonochore, Ptér: pterochore, Sar: sarcochore, Scl: sclerochore, Mega: megaphyll, Macro: macrophyll, Meso: mesophyll, Micro: microphyll, Nano: nanophyll, Lepto: leptophyll, Aph: aphylla, Ch: chamaephytes, Gé: geophyte, Hc: cespitous hemicryptophyte, Ph: phanerophyte, Th: therophyte, Hy: hydrophytes, AFM: Afro-Malagasy, AnT: African-American or African-Tropical, AOA: Eastern and Southern Africa, AT: Afrotropical, BGC: Lower-Guinean-Congo, C: Congolese, CGC: Central Guinean-Congo, Cosm: Cosmopolitan, G: Guinean, GC: Guinean-Congo, GC-Z: Guinean-Congo-Zambezian, Pal: Paleo-tropical, Pan: Pan-tropical, SZ: Sudano-Zambesian, P: Phragmitetea, SB: Soncho-Bidentetea, Ha: Halleetea, Hy: Hyparrhenietea; RM: Ruderali-Manihotetea, Cu: Cultivated; Ea: Erythrophloetea africani, MT: Musango-Terminalietea, Sp: Strombosio-Parinarietea, RMP: Ruderali-Manihotetea and post-cultura, SG: Symphonion globuliferea, Po: Potamotea, CT: Oncobo-Tremion, NI: Not identified*

Figure 3.13. Autoecological characteristics of the studied vegetation

Autoecological profiles of different plant formations (Tables 3.6 – 3.12) showed that anthropized and herbaceous (savannahs) formations were mainly colonized by Pantropical (45.6 % and 26.8 %, respectively) and Afro-tropical species (16.2 % and 25.4 %, respectively). However, swamp forests were dominated by Guinean-Congo (32.0%) and Afro-tropical (18.6%) species. In dryland forests, Guinean-Congo (32.0%) and both Pantropical (17.0%) and Lower-Guinean-Congo (17%) species were the most widespread (Table 3.6). Predominance of Pantropical and that of regional Guinean-Congo species in the Kongo-Central Province were also reported by Lassa *et al.* (2019) and Kikufi *et al.* (2017). Pantropical species include trees, shrubs and herbs. They are generally species of secondary forests, clearings or grassy fallows in forest environments or of anthropized areas (Belesi, 2009; Lubini, 1997). In most cases, they are ubiquitous species, adapted to all types of habitats and ecoclimates. Their abundance could be linked to significant changes in the environmental conditions that have favored species with very high ecological amplitude. Their penetration and expansion are facilitated by cultural clearances and constant reshuffling of the soil (Lubini, 1997).

Table 3.6. Share (%) of geographic distribution of identified species by plant formation

Plant formation ---------- **Spatial distribution**	**AT**		**MA**		**JA**		**S**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
AFM	4	1,1	4	2.3	5	1.3	2	1.4
AnT	13	3.6	4	2.3	9	2.0	3	2.1
AOA	1	0.3	2	1.2	6	2.0	0	0.0
AT	59	16.2	32	18.6	61	16.0	36	25.4
BGC	24	6.6	28	16.3	68	17.0	21	14.8
C	0	0.0	2	1.2	1	0.3	0	0.0
CGC	2	0.5	2	1.2	10	2.8	4	2.8
Cosm	15	4.1	1	0.6	2	0.5	2	1.4
G	1	0.3	0	0.0	1	0.3	0	0.0
GC	30	8.3	55	32.0	12.5	32.0	22	15.5
GC-Z	2	0.5	2	1.2	8	2.0	4	2.8
Not identified	7	1.9	5	2.9	3	0.8	1	0.7
Pal	39	10.7	11	6.4	24	6.0	9	6.3
Pan	166	45.6	24	14.0	68	17.0	38	26.8
SZ	1	0.3	0	0.0	0	0.0	0	0.0
Total	364	100.0	172	100.0	391	100.0	142	100.0

(AT: Anthropized vegetation, MA: swamp forest, JA: dryland forest, S: savannah or herbaceous formation, AFM: Afro-Malagasy, AnT: African-American or African-Tropical, AOA: Eastern and Southern Africa, AT: Afrotropical, BGC: Lower-Guinean-Congo, C: Congolese, CGC: Central Guinean-Congo, Cosm: Cosmopolitan, G: Guinean, GC: Guinean-Congo, GC-Z: Guinean-Congo-Zambezian, Pal: Paleo-tropical, Pan: Pantropical, SZ: Sudano-Zambezian)

Herbs were the dominant biological form in all plant formations (64.3% for anthropized formations; 38.2% for swamp forests and 41.5% for savannahs), except for dryland forests where trees (37.6%) predominated. Furthermore, the trio including trees, shrubs and lianas together, were the most dominant in both woodland and herbaceous

formations (Table 3.7). Dominance of herbs could be related to the large open spaces of herbaceous formations that dominate the landscape (Belesi, 2009). The dominance of herbaceous species could also be attributed to the colonization of disturbed (anthropized) formations by herbaceous plants after continuous reworking. This process increases competition and creates favorable conditions for the emergence and development of plant species, especially spontaneous species that have been dormant for a long time (Cheng *et al.*, 2022). Plants, including ruderal species, weeds and adventives, have a great capacity for colonization (Bews, 1920). These plants often have herbaceous characteristics and spread rapidly due to prolific seed production or efficient revegetation processes (Betti, 2001). This ability to establish and spread rapidly may explain the wide distribution and abundance of these plant species.

*Table 3.*7. Share (%) of morphological types of identified species by plant formation

Plant formation ---------- **Biologic form**	**AT**		**MA**		**JA**		**S**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
A	62	17,0	52	30.2	147	37.6	35	24.6
B	46	12.6	17	10.0	59	15.1	28	19.7
Eph	0	0.0	1	0.6	2	0.5	0	0.0
H	234	64.3	66	38.2	109	27.9	59	41.5
L	22	6.0	36	21.0	74	18.9	20	14.2
Total	364	100.0	172	100.0	391	100.0	142	100.0

(AT: Anthropized vegetation, MA: swamp forest, JA: dryland forest, S: savannah or herbaceous formation, , A: tree, B: shrub, H: herb, L: liana, Eph: epiphytic).

Plants with mesophyll and microphyll-sized leaves dominated in anthropized formations (38.5% and 37.1%, respectively), as well as in swamps (57% and 22.6%, respectively) and dryland forests (59.8 and 22.4%, respectively). The opposite was observed in savannahs, where plant with microphyll-sized leaves (43.7%) outnumbered those with mesophyll-sized leaves (37.3%) (Table 3.8). The predominance of mesophyll-sized leaves as the most-representative foliar trait within the studied vegetation, followed by microphyll-sized leaves, is consistent with findings of Lassa *et al.* (2019), in the Kimvula forest, in Kongo-Central Province. Leaf area is determined by air humidity which is higher at the bottom than at the top of the forest canopy. As a result, plants reduce their leaf surface area at the top of the canopy in order to reduce transpiration (Hovenden *et al.,* 2012). Thus, forest vegetation, which is specifically dominated by large trees of which leaves occupy the upper forest layer, generally have medium-sized leaves due to the low air humidity at the top of the forest canopy, compared to shrubs and herbs under the canopy, which have larger leaf sizes. The high air humidity under the canopy favors the accumulation of water and the increase in leaf size of some species (with microphyll and macrophyll-sized leaves) under forest conditions. In

savannas and disturbed environments, however, where species with microphyll sized-leaves dominate, plants are exposed to much lower levels of atmospheric humidity. As a result, plants have a reduced leaf surface area to prevent water loss (Devi *et al.,* 2022).

Table 3.8. Share (%) of leaf size of identified species by plant formation

Plant formation / Leaf size	AT		MA		JA		S	
	Number	%	Number	%	Number	%	Number	%
Aph	1	0.3	0	0.0	0	0.0	0	0.0
Lepto	33	9.1	8	4.7	26	6.6	15	10.6
Macro	15	4.1	17	9.9	22	5.6	3	2.1
Méga	10	2.7	5	2.9	4	1.0	0	0.0
Méso	140	38.5	98	57.0	234	59.8	53	37.3
Micro	135	37.1	39	22.6	88	22.7	62	43.7
Nano	30	8.2	5	2.9	17	4.3	9	6.3
Total	364	100.0	172	100.0	391	100.0	142	100.0

(AT: Anthropized vegetation, MA: swamp forest, JA: dryland forest, S: savannah or herbaceous formation, Mega: megaphyll, Macro: macrophyll, Meso: mesophyll, Micro: microphyll, Nano: nanophyll, Lepto: leptophyll, Aph: aphylla).

Sarcochores was the most widespread diaspora (29.1% in anthropized formations; 51.7% in swamp forests; 46.8% in dryland forests and 29.6% in savannahs) (S9). Apart from sarcochores, also ballochores (25.3% in anthropized formations; 21.5% in dryland forests and 23.2% in savannahs) and sclerochores (25% in anthropized formation and 20.3% in swamp forests) were well represented (Table 3.9). The predominance of sarcochores and ballochores in the studied flora can be attributed to the fact that it belongs to the Guinean-Congo flora, which is characterized by an abundance of sarcochore and ballochore plant species. In addition, the presence of insects and animals plays an important role in the dispersal of these types of diaspora, contributing to their prevalence. These animals actively contribute to the transport and dispersal of seeds, thereby promoting the expansion and distribution of sarcochores and ballochores throughout the region (Belesi, 2009; Fonu Anahendo, 2022; Kikufi *et al.,* 2017; Kimpouni *et al.,* 2013; Lassa *et al.,* 2019; Miabangana *et al.,* 2017; Shutsha *et al.,* 2017; Yangakola *et al.,* 2004). Plants exhibiting a sarcochorous mode of dispersion rely on animals such as rodents, birds, monkeys or other animals for seed dissemination. This interaction plays a crucial role in the wide distribution of these species, either through the animals' consumption and subsequent excretion of the seeds or through their active transport from one location to another. Additionally, the explosive nature of the fruits of ballochore species contributes to efficient local seed dispersal, as the ripe fruits often dry out and burst, violently ejecting the seeds from the parent plant (El-Khalafy *et al.,* 2021). Once on the ground, some seeds can be further dispersed through entomochory (by insects), especially ants

(myrmecochory) or by rodents (zoochory), which carry them from one point to another, thereby increasing their secondary dispersal (Li Vigni and Melati, 1999; Xiao, 2022).

Table 3.9. Share (%) of dissemination modes of identified species by plant formation

Plant formation ---------- **Diaspore types**	AT		MA		JA		S	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Bal	92	25.3	17	9.9	84	21.5	33	23.2
Bar	7	1.9	1	0.6	10	2.6	3	2.1
Desm	28	7.7	5	2.9	9	2.3	6	4.2
Pléo	5	1.4	8	4.7	6	1.5	3	2.1
Pog	25	6.9	7	4.1	16	4.1	15	10.6
Ptér	10	2.7	10	5.8	30	7.7	14	9.9
Sar	106	29.1	89	51.7	183	46.8	42	29.6
Scl	91	25.0	35	20.3	53	13.6	26	18.3
Total	364	100.0	172	100,0	391	100.0	142	100.0

(AT: Anthropized vegetation, MA: swamp forest, JA: dryland forest, S: savannah or herbaceous formation, Bal: ballochore, Bar: barochore, Desm: desmochore, Pleo: pleochore, Pog: pogonochore, Ptér: pterochore, Sar: sarcochore, Scler: sclerochore).

The phytosociological status of species within the different plant formations (Table 3.10) showed a predominance of the *Cultivated* (Cu) and *Ruderali-Manihotetea* group (RM) in anthropized formations (33.2 and 23.1 %, respectively) and *Musango-Terminalietea* group (MT) in savannahs (32.4 %), as well as in swamp (43 %) and dryland forests (45.3 %). A high proportion (29.1 %) of species belonging to the *Halleetea* (Ha) group was also observed in swamp forests (Table 3.10). The predominance of the *Musango-Terminalietea* phytosociological group may be linked to the degraded intertropical forest physiognomy of the studied vegetation, which is generally dominated by species from this phytosociological group (Belesi, 2009; Lubini, 2001). In anthropized areas, however, uncontrolled and unintended human action could lead to a high proportion of cultivated species, most of which are ornamentals, weeds and crops (Lubini, 2001). It may also be related to the influence and spread of exotic plants, particularly those introduced from Kisantu Botanical Garden, which have greatly influenced the area's vegetation.

Phanerophytes (Table 3.11), mainly mesophanerophytes (Table 3.12), were dominant in all plant formations (35.3% and 14.8 % in anthropized formations; 60.5% and 27.9% in swamp forests; 68.5% and 34.5% in dryland forests; 52.2% and 26.1% in savannahs). They were followed by chamaephytes, with a majority of erected chamaephytes, in both dryland forests (12.4 and 4.1 %, respectively) and savannahs (20.4 and 11.3 %, respectively). Also therophytes (25%, with mostly erected therophytes: 17.9%) and geophytes (17.5%, with mostly rhizomatous geophytes: 9.9%), were observed in both anthropized

formations and swamp forests. The dominance of phanerophytes is an indication of (or could be due to) the forest physiognomy of the studied flora (Lassa *et al.*, 2019; Shutsha *et al.*, 2017).

The high frequency of therophytes in anthropized areas could be related to high anthropic pressure and the difficult environmental conditions in which they develop (Floret *et al.*, 1992). These areas include roadsides, house edges, and wastelands (Habib *et al.*, 2020), which are regularly trampled, reworked, and have poor soil conditions (Belesi, 2009). These areas are generally colonized by therophytes, which are plants that complete their life cycle in a short period of time, usually within a year, and are adapted to disturbed environments (Lundholm, 2011).

Table 3.10. Share (%) of phytosociological status of identified species by plant formation

Plant formation ---------- **Phytosociological status**	AT		MA		JA		S	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
CT	1	0.3	1	0.6	4	1.0	0	0.0
Cu	121	33.2	5	2.9	30	7.6	2	1.4
Ea	7	1.9	0	0.0	12	3.1	12	8.5
Ha	11	3	50	29.1	36	9.2	6	4.2
Hy	20	5.5	5	2.9	14	3.6	32	22.5
MT	55	15.1	74	43.0	177	45.3	46	32.4
P	2	0.5	4	2.2	2	0.5	1	0.7
Po	0	0	3	1.8	0	0	0	0
RM	84	23.1	7	4.0	25	6.4	11	7.7
RMP	24	6.6	1	0.6	7	1.8	6	4.2
SB	29	8	5	2.9	16	4.1	13	9.2
SG	1	0.3	1	0.6	3	0.8	4	2.8
Sp	9	2.5	16	9.4	65	16.6	9	6.4
Total	364	100	172	100.0	391	100.0	142	100.0

(AT: Anthropized vegetation, MA: swamp forest, JA: dryland forest, S: savannah or herbaceous formation, P: Phragmitetea, SB: Soncho-Bidentetea, Ha: Halleetea, Hy: Hyparrhenietea; RM: Ruderali-Manihotetea, Cu: Cultivated; Ea: Erythrophloetea africani, MT: Musango-Terminalietea, Sp: Strombosio-Parinarietea, RMP: Ruderali- Manihotetea and post-cultura, Po: Potamotea, CT : Oncobo-Tremion, SG : Symphonion globuliferea).

Table 3.11. Share (%) of biological types of identified species by plant formation

Plant formation ---------- **Biological types**	AT	MA	JA	S
Ch	22.0	11.6	12.4	20.4
G	11.4	17.5	10.0	8.4
Th	25.0	7.0	6.3	10.5
Hc	6.3	1.7	2.8	8.5
Hy	0.0	1.7	0.0	0.0
Ph	35.3	60.5	68.5	52,2
Total	100.0	100.0	100.0	100.0

(AT: Anthropized vegetation, MA: swamp forest, JA: dryland forest, S: savannah or herbaceous formation, Ch: chamaephytes, G: geophyte, Th: therophyte, Hc: cespitous hemicryptophyte, Hydr: hydrophyte, Ph: phanerophyte)

Table 3.12. Share (%) of detailed biological types of identified plants by plant formation

Plant formation ---------- Biological types	AT		MA		JA		S	
	Number	%	Number	%	Number	%	Number	%
Ch	19	5.3	3	1.7	9	2.3	6	4.2
Chces	0	0.0	1	0.6	1	0.3	0	0.0
Chd	33	9.1	5	2.9	15	4.1	15	10.6
Cheph	0	0.0	1	0.6	2	0.5	0	0
Chgr	7	1.9	3	1.7	7	1.8	2	1.4
Chp	13	3.6	5	2.9	9	2.3	1	0.7
Chr	6	1.6	2	1.2	3	0.8	4	2.8
Chsuc	2	0.5	0	0.0	1	0.3	0	0
Gb	7	1.9	1	0.6	2	0.5	1	0.7
Ge	2	0.5	0	0.0	1	0.3	0	0.0
Ggr	0	0.0	0	0.0	2	0.5	0	0.0
Grh	20	5.5	17	9.9	23	5.9	8	5.6
Gt	7	1.9	5	2.9	4	1.0	3	2.1
Hc	23	6.3	3	1.7	11	2.8	12	8.5
Hydr	0	0.0	3	1.7	0	0.0	0	0.0
Lph	0	0.0	0	0.0	3	0.8	0	0.0
McPh	23	6.3	8	4.7	27	6.9	10	7.0
mG	2	0.5	2	1.2	1	0.3	0	0.0
MgPh	2	0.5	4	2.3	10	2.6	0	0.0
mGrh	4	1.1	5	2.9	6	1.5	1	0.7
MsPh	53	14.8	48	27.9	136	34.5	37	26.1
NPh	32	8.8	7	4.1	24	6.1	11	7.7
Phgr	18	4.9	37	21.5	69	17.6	16	11.4
Th	13	3.6	1	0.6	0	0.0	4	2.8
Thc	1	0.3	0	0.0	1	0.3	0	0.0
Thd	65	17.9	9	5.2	18	4.6	10	7.0
Thgr	6	1.6	1	0.6	3	0.8	0	0.0
Thpr	6	1.6	1	0.6	2	0.6	1	0.7
Total	364	100.0	172	100.0	391	100.0	142	100.0

(AT: Anthropized vegetation, MA: swamp forest, JA: dryland forest, S: savannah or herbaceous formation, Ch: chamaephytes, Chces : cespitous chamaephytes, Chd: erect chamaephytes, Chgr: climbing chamaephytes, Chp: prostrate chamaephytes, Chr: creeping chamaephytes, Cheph: epiphyte chamaephytes, Chsuc: succulent chamaephytes, Gb: bulbous geophyte, Ge: geophyte, Gt: tuberous geophyte, Grh: rhizornate geophyte, Hc: cespitous hemicryptophyte, Lph: lianeous phanerophyte, mG: megageophyte, MgPh: megaphanerophyte, MsPh: mesophanerophyte: McPh: microphanerophyte, NPh: nanophanerophyte, Th: therophyte, Thd: erect therophyte, Thgr: climbing therophyte, Thpr: prostrate therophyte, Thc: cespitous therophytes, Hydr: hydrophytes).

3.4.3.7. Species availability

The analysis of species availability was conducted based on their local frequency. As previously mentioned, species with high frequency indices were mainly observed in savannahs and swamp forests (Appendix 4). They are species that are specific to these types of plant formation, where they are relatively widespread, and are considered as constant species. However, in the present work, we considered species availability in terms of the number of plots where a species was recorded (based on presence/absence) and not in terms of species abundance or dominance. Thus, the presence of these species in these plant formations may indicate that they are in their native habitats, where they can reach their ecological optimum, and find and enjoy the favorable conditions they need to thrive. The species commonly reported in savannahs are consistent with those documented by Pauwels (1993) as being the most common and widespread in the Kinshasa-Brazzaville regions. Notable examples include *Hymenocardia acida* Tul., *Annona senegalensis* Pers., *Maprounea africana* Müll. Arg., and *Vitex madiensis* Oliv.

In swamp forests, dominant species such as *Hallea stipulosa* (DC.) J.-F. Leroy and *Lasimorpha senegalensis* Schott, match with findings by Belesi (2009) and Lubini (2001) in Bas-Kasaï region, as prevalent species. Additionally, *Macaranga schweinfurthii* Pax, *Vitex doniana* Sweet, and *Alchornea cordifolia* (Schumach.) Müll. Arg, were reported as the most common species in these ecosystems (Pauwels 1993). Out of the 22 constant species recorded in all surveyed plant formations, 17 were reported as medicinal by Kibungu *et al.* (2021) and could be considered as readily available.

Regular species are less common. They are adapted to the environments in which they develop and may become, over time, more and more constant. The most important are *Leersia hexandra* Sw., *Pseudospondias microcarpa* (A. Rich.) Engl. and *Scleria verrucosa* Willd., each with a frequency of 64 % in swamp forests. In dryland forests, however, most important species include *Caloncoba welwitschii* (Oliv.) Gilg, *Chaetocarpus africanus* Pax, *Alchornea cordifolia* (Schumach.) Müll. Arg, *Leptactina leopoldi-secundi* Büttner, *Hymenocardia ulmoides* Oliv, *Chromolaena odorata* (L) M. King et H. Rob, *Cnestis ferruginea* Vahl. ex D. C, *Gaertnera paniculata* Benth, *Markhamia tomentosa* (Benth.) K. Schum. ex Engl. and *Millettia laurentii* De Wild. In herbaceous formations, the most common regular species include *Psorospermum febrifugum* Spach, *Syzygium* guineense var. *macrocarpum* Engl, *Nauclea latifolius* Sm., *Murdannia simplex* (Vahl) Brenan, *Crossopteryx febrifuga* (Afzel. ex G. Don) Benth, and *Bridelia ferruginea* Benth. In anthropized formations,

the most common include *Commelina diffusa* Burm.f., *Sida acuta* Burm.f., *Phyllanthus amarus* Schumach. & Thonn, *Ageratum conyzoïdes* L. and *Cleome rutidosperma* DC. Almost half (24) of the 44 regular species recorded, are reported as medicinal (Kibungu *et al*., 2021).

Accidental species are alien to a plant formation. They have low distribution and very low frequency. They are opportunistic species that probably take advantage of a particular situation to colonize an area. They are much more frequent in swamp forests, probably favored by hydrological connectivity or episodic drainage of these ecosystems, especially in dry periods, which create favorable weather conditions for their development. Anthropized areas also presented a high number of accidental species. Their presence can be temporary or permanent, depending on the nature or prevailing site conditions (rubbish dumps, surroundings of the house, sanitary areas, fields, roadsides, etc.). High amount of accidental species was also observed in savannahs. They development could be favored by bush fires. Fire can break seed dormancy and which can then germinate under satisfactory moisture conditions (Keeley, 1981). In dryland forests, overexploitation, habitat loss or human activities can lead to environmental changes (Siyum, 2020) which benefit opportunistic species (Malcolm *et al.*, 2002). Out of the 94 opportunistic species recorded, 47 were inventoried as medicinal in the region (Kibungu *et al.*, 2021) and are relatively available despite their low abundance.

The analysis of the studied vegetation revealed a high proportion of rare species throughout the landscape, characterized by a very low frequency. In addition to reasons discussed in detail in Section 3.4.3.3, the dominance of certain plant species could also be due to the presence of cultivated or introduced species in different plant formations, or their accidental occurrence in places where they should not naturally occur. For example, the introduction from Kisantu botanic garden (Nsimundele, 2006), of species such as *Annona muricata* L., *Inga edulis* Mart., *Cinnamomum verum* J.Presl, *Garcinia mangostana* L., *Talinum triangulare* (Jacq.) Willd., *Oxalis corniculata* L. or *Nephelium lappaceum* L., into the region increases the risk of unintentional introduction of species into the wild, which could lead to a high incidence of low frequency species.

When considering the availability of medicinal plants among the inventoried species, most of them exhibited an exceptionally low frequency, reaching a point that can be classified as approaching extreme rarity. Some of them are local species that have been reported as having disappeared from the wild, or with only a few isolated wild specimens

remaining. The overexploitation associated with their use, constant disturbance and bush fires are the most likely reasons for their low frequency in the natural area.

These local medicinal plant species can be divided into seven categories, based on their local abundance or rarity observed in the field.

The first category encompasses species found at a very low frequency in their natural habitat but are commonly found in and around villages. These species could accidentally be described as rare. This is the case with e.g. *Croton mubango* Müll.Arg., *Cyperus articulatus* L., *Cymbopogon densiflorus* (Steud.) Stapf., *Lippia multiflora* Moldenke, *Aframomum melegueta* (Roscoe) K. Schum, *Mondia whitei* (Hook. f.) Skeels, *Phytolacca dodecandra* L'Hér., *Pachira glabra* Pasq., and *Erythrina abyssinica* Lam. They are cultivated in the village to ensure their sustainability, availability, and protection from disappearance.

The second category includes very isolated clumpy species, with a low frequency, limited to pockets of very restricted habitats on which their survival depends. They can be considered as stenooecious species (Gégout, 1995). They are common in a very narrow range of environments and absent elsewhere (Chihab *et al.,* 2018). Their disappearance has been linked by local communities to habitat destruction and bush fires. They include *Kalaharia uncinata* (Schinz) Moldenke, *Anisophyllea quangensis* Engl. ex Henriq and *Commelina africana* L. These species require sustained attention to ensure their perpetuity.

The third category includes species that are limited to a few isolated individuals in the wild and are becoming increasingly rare, probably as a result of overexploitation. According to local people, this is the main reason for their very low abundance in their natural habitat. This group includes species such as *Heinsia crinita* (Wennberg) G. Taylor, *Securidaca longepedunculata* Fresen, *Dorstenia laurentii De Wild., Polygala acicularis* Oliv., *Rungia congoensis* C. B. Clarke, *Garcinia huillensis* Welw. ex Oliv, *Garcinia kola* Heckel, , *Gardenia ternifolia* subsp. *jovis-tonantis* (Welw.) Verdc., *Renealmia africana* Benth, *Scorodophloeus zenkeri* Harms., *Symphonia globulifera* L.f., *Xylopia aethiopica* (Dunal) A. Rich., *Gnetum africanum* Welw., etc.

The fourth category includes very rare species that are limited to one to two isolated specimens. They are considered by local communities to be extremely rare or even extinct in the study area. These include *Ottelia ulvifolia* (Planch.) Walp. and *Erythrophleum suaveolens* (Guill. & Perr.) Brenan. During our research we struggled to find even a single specimen of

each species and most people, especially the younger generation, seem to be unfamiliar with them.

The fifth category concerns declining medicinal traditional food species. This is the case for *Vigna subterranea* (L.) Verdc., and *Capsicum baccatum* L. (described by De Wildeman, 1920), two traditional food species locally known as "Nguba zi nsamba" and "Matubulu", respectively. These species have become increasingly rare and difficult to find in recent times, as they are no longer part of current eating habits.

The sixth category concerns potentially extinct species. The most known is *Salacia pynaertii* De Wild, a species reported in the region for its medicinal properties, but no specimens were found during our investigations, indicating that it is most likely completely extinct. The extinction of this species could be related to overexploitation and habitat destruction.

Finally, there is a potentially misclassified extinct species, *Monodora angolensis* Welw. Unfortunately, no specimens of this species were observed during our surveys, although paradoxically its seeds are still available on local drug markets in Mbanza-Ngungu. This species could be mistakenly considered extinct, while it is likely still present elsewhere, outside our study area. Its absence in the study area could most probably due to anthropic activities and habitat destruction. The majority of local respondents claimed that the seeds sold on the local markets in Mbanza-Ngungu appeared to come from very distant regions (Mayumbe, Angola, etc.), since the tree has disappeared in their area. Neverless, the species was reported to be vulnerable in Mbanza-Ngungu (Nzuki *et al*, 2013).

This rarity categorization of medicinal plant species and the ambiguities surrounding their disappearance indicate the necessity for more comprehensive and large-scale studies to address uncertainties regarding their availability and rarity. Phytosociological studies, especially when using the sigmatist (or Braun-Blanquet) method, which involves detailed field surveys to record plant species along with their cover or abundance and the degree of association between species (Guemou *et al.*, 2023; Kouadja *et al.*, 2021), could be crucial tools in gaining a clearer and more comprehensive understanding of the conservation status of species within the flora of a region. This approach provides greater clarity and precision, thus offering more evidence and certainty regarding species conservation status within an ecosystem.

Although our current method provides a comprehensive description or overview of the studied vegetation, it still does not allow for the definitive determination of the conservation status of inventoried species. The adoption of the sigmatist approach appears to be the most relevant, as it helps eliminate ambiguities concerning the rarity or abundance of a species.

Among the 35 important medicinal plant species supposedly containing interesting pharmacological properties, some native species including *Commelina africana* L., *Gardenia ternifolia* Schumach. & Thonn. Subsp., *Heinsia crinita* (Afzel.) G.Taylor, *Kalaharia uncinata* (Schinz) Moldenke, *Mondia whitei* (Hook. f.) Skeels, *Pentadiplandra brazzeana* Baillon, *Nauclea pobeguinii* (Pobég.) Merr., *Securidaca longepedunculata* Fresen., and *Xylopia aethiopica* (Dunal) A. Rich., were recorded with a very low frequency in the wild and could be considered as on the verge of extinction. This is why these species should deserve particular attention.

Based to the IUCN website database, some inventoried species are reported becoming globally rare and require more attention by researchers and for conservation. This is the case for *Alstonia congensis* Engl., whose population was reported as declining (IUCN, 2019), *Anchomanes difformis* (Blume) Engl., reported to be potentially threatened (IUCN, 2009), *Ceiba pentandra* (L.) Gaertn, reported to be threatened in the Dominican Republic (IUCN, 2017), *Cola acuminata* (P. Beauv.) Schott & Endl., reported to be overexploited (IUCN, 2018a), *Cyperus papyrus* L., reported to be threatened in Egypt (IUCN, 2008a), *Dracaena mannii* Baker, whose global population is reported to decline (BGCI, 2018), *Garcinia kola* Heckel, reported to be overexploited (BGCI, 2019; IUCN, 2004), *Gnetum africanum* Welw., reported to be nearly threatened (IUCN, 2008b), *Hallea stipulosa* (DC.) J.-F.Leroy, reported to be threatened (IUCN, 1998a), *Lannea antiscorbutica* (Hiern) Engl., threatened in Swaziland (Linda Loffler, n.d.), *Milicia excelsa* (Welw.) C. C. Berg, reported to be threatened (IUCN, 1998b), *Mondia whitei* (Hook. F.) Skeels, reported to become increasingly rare in DRC (Aremu *et al.*, 2011), *Psorospermum febrifugum* Spach, reported to be threatened in Malawi, Namibia and Zimbabwe (IUCN, 2018b), *Pterocarpus angolensis* DC, reported to be threatened (IUCN, 2018b) and *Raphia textilis* Welw., whose habitats are declared to be lost (IUCN, 2016). Most of these species were found at a very low frequency in the wild during our investigations. Their status in the IUCN Red List is a strong signal of their threat. Therefore, it is important to carry out further studies, to confirm their status and to define appropriate conservation measures in our study area.

3.5. Conclusion

Ecofloristic studies showed to be an effective way to describe and understand the plant composition and dynamics of the vegetation of Mbanza-Ngungu, particularly the distribution and availability of key medicinal plants in their natural harvesting areas. This vegetation proved to be rich and diverse, and classified into four plant formation types according to the general landscape physiognomy. Of the total number of plant species inventoried, 248 (35%) were reported to be used for therapeutic purposes. Some of them were found to be available due to their relatively high frequency, while others were found to be threatened with extinction due to their rarity in their natural environments. Since the practice of herbal medicine relies on the presence and accessibility of specific plant species, the extinction of these plants implies the loss of associated traditional medicinal knowledge. Therefore, the integration of targeted floristic studies with a concern for biodiversity conservation appears to be a promising strategy for the long-term conservation of traditional medicinal knowledge in the Mbanza-Ngungu region. This method allowed the identification of the most endangered plants that require continued attention, with a significant impact on conservation efforts and, consequently, the preservation of traditional medicinal knowledge.

We believe that our study goes beyond a simple inventory of the vegetation of Mbanza-Ngungu. Above all, it aims to make the people of Mbanza-Ngungu aware of the consequences of the disappearance of medicinal plants and the traditional knowledge associated with them. This information will serve as a basis for informed decisions on how to better manage nature, taking into account natural balances, in order to combat the loss and extinction of species.

By raising the community awareness, we hope to contribute to biodiversity and traditional knowledge conservation, which are essential for the health and well-being of the population. Due to the local importance of medicinal plants in the region, it is necessary to promote *in situ* conservation of available species. Species that have become rare may require sustained attention, possibly through conservation methods such as *ex situ* conservation followed by reintroduction into the wild. The disappearance of these species not only threatens the endogenous knowledge accumulated over centuries, but also endangers many powerful and effective plants and remedies that are crucial to science and human development. Nevertheless, comprehensive research, including the sigmatist approach is essential to provide more evidence and certainty about the abundance and rarity of plant species in Mbanza-Ngungu, since it involves the degree of species cover, abundance and dominance.

Chapter 4. Phytochemical profiling by UPLC-ESI-QTOF-MS of *Commelina africana* L. and *Kalaharia uncinata* (Schinz) Moldenke

From published papers by:

Pathy Kibungu Kembelo, Emmy Tuenter, Wouter Vanhove, Honoré Belesi Katula, Patrick Van Damme and Luc Pieters

1. Phytochemical profiling by UPLC-ESI-QTOF-MS of *Commelina africana* L., widely used in traditional medicine in DR Congo
   South African Journal of Botany 157, 325-334
   https://doi.org/10.1016/j.sajb.2023.04.010

2. Phytochemical profiling by UPLC-ESI-QTOF-MS of *Kalaharia uncinata* (Schinz) Moldenke, widely used in traditional medicine in DR Congo
   Chemistry and Biodiversity 20(9), e202300826
   https://doi.org/10.1002/cbdv.202300826

4.1. Context

For centuries, herbal and natural products have been widely used and represent a growing industry in today's society due to their reported ability to alleviate and/or cure various ailments and diseases (Amit Koparde *et al.*, 2019; Lahlou, 2013). However, many practitioners of traditional medicine still lack a scientific basis for their methods. Although they believe in the results of their practices, they do not know how these results are achieved (Bagwana, 2015). Faced with this situation, we performed a literature search on the most important medicinal plants from Kisantu and Mbanza-Ngungu to better understand what might be behind their use in traditional *Kongo* medicine and provide a scientific basis to support their use. By providing a scientific basis for the use of medicinal plants in traditional medicine, this scientific validation could increase confidence in traditional medicine and help to interest younger generations in its preservation.

Our study is based on the assumption that in traditional medicine, the widespread use of a particular species, coupled with consensus among respondents about its use in treating a particular condition, is likely due to the chemical compounds it contains that may have a pharmacological effect against the specified condition.

A previously conducted ethnobotanical survey highlighted 54 species supposedly containing pharmacologically active substances (Table 2.4, section 2.5.4.2). Considering the extensive list of species to be analyzed, we focused exclusively on plant species with a UV score equal or over 0.05 or an IAR score equal or surpassing 0.2 (due to the consensus of at

least two individuals), which are traditionally used to treat diseases with an ICF value greater than 0.2. The resulting list comprised 35 species.

A literature overview of selected species using academic database or browsers, including Google Scholar, ScienceDirect, Scopus, PubMed, PubChem, Web of Science, SciFinder, and others, were systematically employed to gather in-depth phytochemical information on these species, using different key words. e.g. for *C. africana*, keyword combinations such as "*Commelina africana* phytochemistry", "*Commelina africana* chemical constituents", "*Commelina africana* pharmacological properties", "*Commelina africana* health benefits", "*Commelina africana* phytochemical analysis ", "*Commelina africana* biological activities", "*Commelina africana* bioactive compounds", "*Commelina africana* ethnobotanical uses", "*Commelina africana* antioxidant activity", "*Commelina africana* anti-inflammatory effects", "*Commelina africana* antifungal effect", and "*Commelina africana* anti-viral effect", were employed. This comprehensive approach aimed to assess relevant data from literature available in these reputable sources. Findings indicate that 33 of these species are chemically well-known. These species are listed in Appendix 7.

However, two native species namely *Commelina africana* L. and *Kalaharia uncinata* (Schinz) Moldenke, showed no relevant phytochemical information. Thus, we focused on these two medicinal plants for the phytochemical profiling to understand the nature of these plant species and the basis of their medicinal properties. Subsequently, we tried to establish a connection between the documented biological effects of the tentatively identified compounds and the conditions for which these plants are used in traditional *Kongo* medicine. This approach is the first step in the search for scientific evidence to support the use of these plant species in *Kongo* herbal medicine.

4.2. Introduction

The *Kongo* herbal medicine contains a significant number of medicinal plant species with pharmacological properties. A previously conducted ethnobotanical study, followed by a brief literature review, revealed that 33 out of 35 key species were chemically well known. Since no relevant phytochemical information was available for the native species *Commelina africa* L. and *Kalaharia uncinata* (Schinz) Moldenke, these two plant species were selected for phytochemical characterization.

C. africana (CA) is a perennial herbaceous plant of the Commelinaceae family. It is according to IPNI database (https://www.ipni.org/), endemic to West Africa (Gulf of Guinea), Central Africa, East Africa, and South Africa, including the Middle East (Figure.4.1). In DR Congo, where it is native, the species is generally found in the undergrowth of damp or wooded forests and sometimes in anthropized vegetations. In Mbaza-Ngungu, the species was found to flourishe in the undergrowth of humid forests, where it spreads rapidly. In traditional *Kongo* medicine, the macerate of its leaves is widely used against skin disorders, such as dermatitis, itchy skin rashes, burns, skin aging, stings, etc.(Kibungu, 2010; Kibungu *et al.*, 2021).

On the other hand, *K. uncinata* (KU) is a tropical erect bushy shrub, or subshrub belonging to the Lamiaceae family. The species is endemic to sub-Saharan Africa and generally thrives on disturbed land along the savannah roads in DRC (Bamps, 2013; Kibungu *et al*., 2021), where it is native (Figure. 4.2). The decoction of its roots is widely used in traditional *Kongo* medicine to treat upper respiratory tract infections (Kibungu *et al.*, 2021).

High-performance liquid chromatography with electrospray ionization quadrupole time-of-flight mass spectrometry (UPLC-ESI-QTOF-MS) was used for the profiling and identification of the major phytochemical constituents of leaf extracts (MeOH 90%, DCM, AcOEt, *n*-BuOH, *n*-hexane, and residues) of both CA and KU plant species. Although this approach is labor-intensive, it guarantees a high quality output of tentatively identified compounds. It offers, according to Gu *et al.* (2012), a powerful advantage in identifying and characterizing complex mixtures of extracts without the need for isolation and purification, and allows for the identification of a wide range of compounds. Due to its high sensitivity and resolution, making it particularly effective for analyzing natural product extracts, the UPLC high-resolution mass spectrometer provides information about accurate mass, fragment ions and elemental composition, which greatly aids in the elucidation of compounds.

According to literature, skin infections can be caused by a range of microorganisms, including viruses, bacteria, fungi, and parasites (Aly, 1996). Most skin damage is caused by an interaction of genetic, environmental, and immunological factors, which include exposure to ultraviolet radiation, oxidative stress, and free radicals (Agathokleous *et al.*, 2022; Bickers and Athar, 2006; Chen *et al.*, 2021; Ji and Li, 2016; Nakai and Tsuruta, 2021; Rinnerthaler *et al*., 2015; Zhou *et al.*, 2009).

Oxidative stress results in the generation of reactive oxygen species (ROS), which are the product of incomplete reduction of oxygen molecules (Michalak, 2022). ROS mediate important cellular processes, such us growth proliferation, differentiation and apoptosis (Devasagayam *et al.*, 2004; Michalak, 2022). High levels of free-radicals exert destructive effects on cell components, and cause damage to nucleic acids and macromolecules, such as lipids and proteins (Cannavò *et al.,* 2019; Elsayed Azab *et al.,* 2019; Halliwell, 2007; Valko *et al.,* 2007).

Upper respiratory tract infections are caused by an acute infection that affects the upper respiratory tract, including the nose, sinuses, pharynx, larynx and/or trachea. It usually results in nasal congestion, sore throat, tonsillitis, pharyngitis, laryngitis, sinusitis, sneezing, coughing and common cold (Calderaro *et al.,* 2022; Thomas and Bomar, 2022). The most common causes of respiratory tract infections are viruses and less frequently, bacteria or atypical pathogens (Helou *et al.,* 2022; Suzuki *et al.,* 2020).

An upper respiratory tract infection occurs when viruses trapped in the mucus lining the nose, destroy the epithelial cells and overcome this first barrier and defense mechanism, and then progress into the airways by endocytosis or membrane fusion (Eugenia *et al.,* 2013; Tosta, 2021). They attack the alveoli and release the viral content. Once inside the host cell, infectivity and/or replication of certain RNA and DNA viruses begins (Eugenia *et al.,* 2013). This is where the leucocytes come in to fight off the unwanted organisms. The ensuing host inflammatory response causes vasodilation and increased vascular permeability, resulting in the first characteristic symptoms of the disease (Parasher, 2021; Troy and Bosco, 2016).

Several documented biological experiments have shown the importance of natural substances against skin disorders and upper respiratory tract infections. Phenolic compounds, such as flavonoids, hydroxycinnamic acids, phenolic acids and lignanamides have been reported to alleviate the symptoms and inhibit the development of various skin disorders (Contardi *et al.,* 2021; Godić *et al.*, 2020; Kaurinovic and Vastag, 2019; Leonard *et al.*, 2021). Similarly, flavonoids (Somerville *et al.,* 2016), phenolic acids (Kowalczyk *et al.,* 2021), phenylethanoid glycosides (Song *et al.*, 2016), and iridoid glycosides (Guo *et al., 2020;* Zhang *et al.*, 2017) have been found to play an important role in reducing the incidence and symptoms of upper respiratory tract infections.

As previously mentioned, the use of CA and KU in *Kongo* traditional medicine to treat skin disorders and upper respiratory tract infections, respectively, is widespread. These plant species may contain substances with antioxidant, antiviral and/or anti-inflammatory effects, which may possibly be the rationale behind their use. Only very few studies on the biological activity and/or on the phytochemical composition of *C. africana* were conducted. These studies mainly focus on the phytochemical groups present in the plant species and/or on the biological activities of its derived extracts. However, they do not investigate the biological activities specifically associated with individual compounds or their identification, thus providing incomplete phytochemical information.

Therefore, the current work describes the phytochemical characterization and tentative identification of the main phytochemical constituents from leaf extracts of CA and KU, a first step in the search for a scientific basis for their traditional use. Furthermore, we linked and discussed these compounds and their bioactivities based to previous studies reported in the literature.

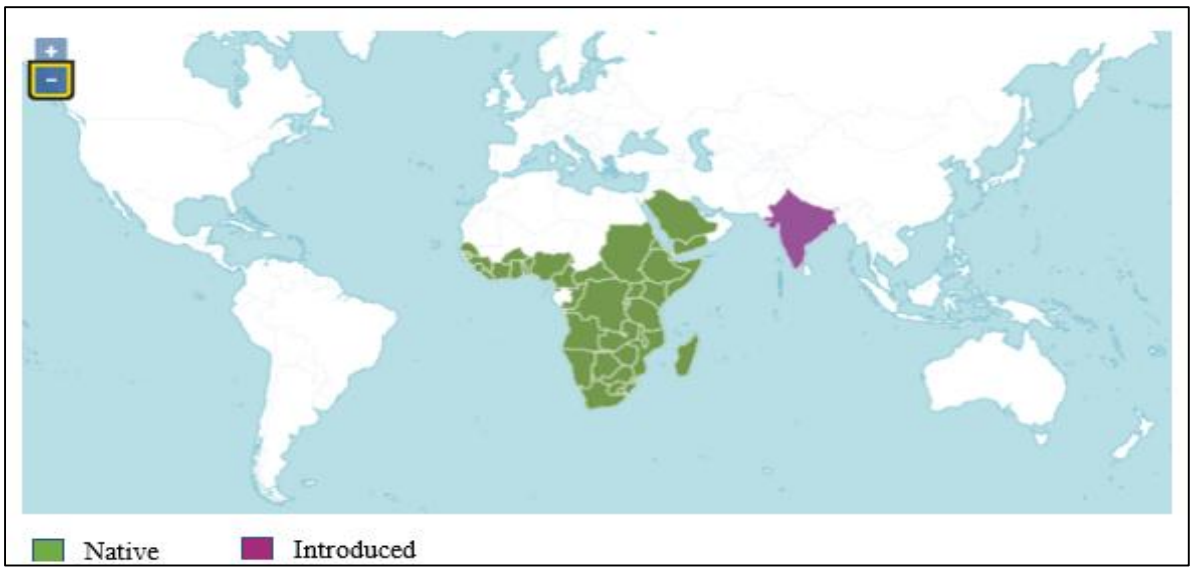


*Figure 4.*1. *Worldwide distribution of* C.africana *(from https://www.ipni.org/)*

Figure 4.2. Worldwide distribution of K.uncinata *(from https://www.ipni.org/)*

4.3. Methods

4.3.1. Chemicals and solvents

All solvents used for the phytochemical profiling including MeOH, AcOEt, *n*-hexane, *n*-BuOH, and dichloromethane (DCM), were obtained from Acros Organics (Geel, Belgium) or Fisher Scientific (Leicestershire, UK). UPLC grade acetonitrile and methanol were purchased from Biosolve (Valkenswaard, The Netherlands). Formic acid, hydrochloric acid, and ammonium hydroxide were purchased from Acros Organics (Geel, Belgium) or Biosolve Chimie (Deuz, France). Analytical standards were obtained from Extrasynthese (Lyon, France), Sigma-Aldrich (Bornem, Belgium), Santa Cruz Biotechnology (Heidelberg, Germany), or Carl Roth (Karlsruhe, Germany). Ultrapure water with a resistivity of 18.2 MΩ cm at 25 °C was dispensed from the Direct Pure UP system from Rephile Bioscience (Boston, MA, USA).

Reference standard compounds were provided by NatuRAPT laboratory (Natural Products & Food Research and Analysis - Pharmaceutical Technology, University of Antwerp, Belgium). This set of 26 reference standards was chosen because its composition represents compounds of different phytochemical classes commonly found in plants, making it an effective starting point for identification when the exact composition of the plant under study is not (fully) known. By using these standards as a reference, it was possible to compare the compounds extracted from the plant with those already identified, thus facilitating the recognition of common compounds and the determination of compounds specific to the plant under study.

4.3.2. Plant materials and extraction

Fresh leaves of CA (Commelinaceae), and KU (Lamiaceae), were harvested in the Kisantu botanical garden in DRC at the beginning of September 2021, during the flowering phase. Plant materials were cleaned and dried at room temperature. Herbarium specimens (PK-Jkis-183b/2021 for CA and PK-Jkis-367b/2021 for KU) were collected and compared to the Kisantu and Kinshasa university herbaria reference specimens by Guy Lundoloka Mafuta, Pathy Kibungu Kembelo and Honoré Belesi Katula for identification. From 72 g and 430 g of powdered leaves of CA and KU, respectively, 65 g (for CA) and 400 g (for KU), were defatted with *n*-hexane (to eliminate interfering substances such as waxes, chlorophyll and other lipids and nonpolar compounds), followed by extraction with MeOH 80% (5 times, ratio 1:10 m/V, to maximise the yield of the extract) by ultrasonication for 60 min. The obtained extracts were filtered and dried under reduced pressure, with nitrogen gas and/or by lyophilization. Crude MeOH 80% CA and KU extracts, obtained in a yield of 3.21 g and 79 g, respectively, were subjected to a classical liquid/liquid partitioning scheme (Figure 4.3).

For liquid/liquid partitioning, crude extract plant material (3 g for CA and 75 g for KU) was resuspended in MeOH/H_2O (50:50 v/v) (150 mL for CA and 3000mL) and a small amount of HCl 0.2 N was progressively added to the hydromethanolic extract to lower the pH of the solution below 3. The hydromethanolic extract (150 mL for CA and 3000 mL for KU) was then transferred to a separatory funnel for liquid/liquid partition. For the DCM (dichloromethane) separation, the same volume of DCM (150 mL for CA and 3000 mL for KU) was added to the funnel. After unmixing for one hour, the mixture was separated.

On the one hand, the DCM fraction, which was dried with nitrogen (yielding DCM1: 0.54 g for CA and 5.78 g for KU) was subjected to further partitioning with *n*-hexane and MeOH 90%. For CA, 0.5 g of the extract was dissolved in 25 mL of MeOH 90% and placed in a separatory funnel, followed by 150 mL of a mixture of MeOH 90% and *n*-hexane (50:50 v/v). The mixture was allowed to unmix for one hour and then separated into MeOH 90% and *n*-hexane fractions, which were dried and weighed. For KU, 4 g of the extract was dissolved in 100 mL of MeOH 90% and placed in a separatory funnel, followed by 1000 mL of a mixture of MeOH 90% and *n*-hexane (50:50 v/v). The mixture was allowed to unmix for one hour and then separated into MeOH 90% and *n*-hexane fractions, which were dried and weighed.

On the other hand, the remaining hydromethanolic fraction, adjusted with NH_4OH to a pH above 9, was subjected to DCM, MeOH 80% and *n*-BuOH partition. For each fraction, a volume equivalent to that of the hydromethanolic extract solution (150 mL for CA and 3000 mL for KU) was added to the separatory funnel and left to unmix for approximately one hour. The mixture was then separated by setting aside the corresponding fraction, which was dried and weighed. The remaining hydromethanolic extract was then mixed with the next fraction (ratio 50 : 50 v/v), left to unmixt, separated, dried and so on until the last fraction was obtained. The last remaining hydromethanolic solution was then dried and weighed.

The liquid/liquid partitioning yielded the following extracts for CA: 0.11 g AcOEt, 0.24 g MeOH 90 %, 0.11g *n*-hexane, 0.02 g (DCM), 0.51 g *n*-BuOH and 1.19 g residue. For *KU*, the following extracts were obtained: 5.46 g AcOEt, 2.60 g MeOH 90%, 0.64 g *n*-hexane, 5.78 g DCM1, 0.73 g DCM2, 20.12 g *n*-BuOH and 1.68 g residue. For each extract, samples/fractions of 100 µg/mL in methanol 80% were prepared for UPLC-ESI-QTOF-MS analyses. Fractionation enables enrichment of specific compounds in certain fractions. It also aids in reducing the complexity of the sample, making the identification and characterization of compounds more easy and simple (Abubakar and Haque, 2020; Hossain *et al.*, 2014). This fractionation allows for a more in-depth analysis of the individual compounds present in the extract.

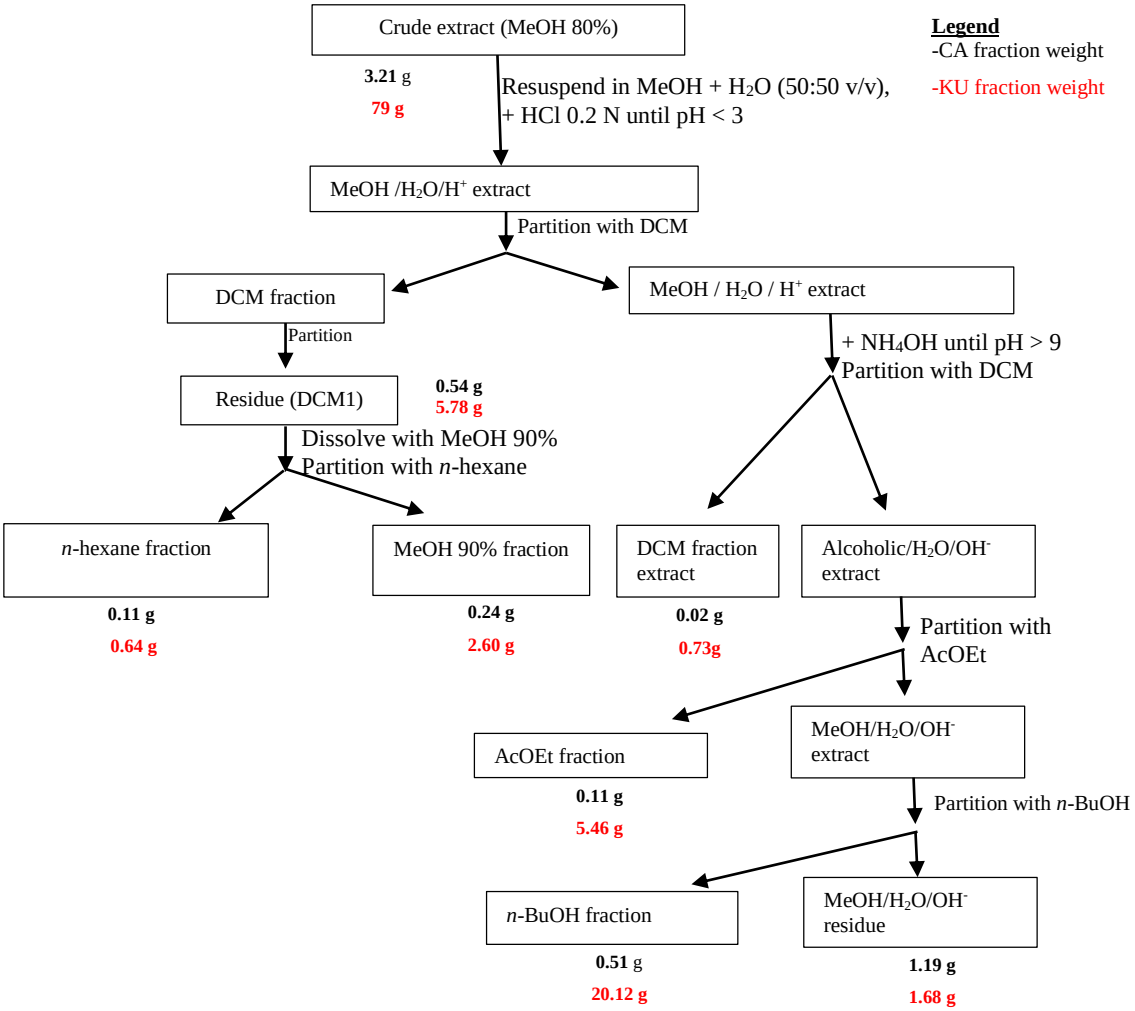


Figure 4.3. Partitioning scheme and weight of different fractions of CA *and* KU

4.3.3. UPLC-ESI-QTOF-MS analysis and data processing

The chemical profiling of both CA and KU leaf extracts was performed using Acquity UPLC and XEVO G2-XS QTOF (quadrupole time-of-flight) MS systems. The chromatographic separation was achieved on a Waters Acquity HSS T3 column (2.1 × 100 mm, 1.8 µm) kept at 40 °C. The mobile phase comprised (A) Milli-Q water with 0.1% formic acid and (B) acetonitrile with 0.1% formic acid at a flow rate of 0.4 mL/min. The injection volume applied was 5µL. The gradient elution was programmed as follows: 0-1 min. 3% (B), 17-19 min. 100% (B) and 21-25 min. 3% B. Mass spectra were recorded in the range of *m/z* 50-1500 using a capillary voltage of 0.8KV for the positive and 1KV for the negative ionization mode, a cone voltage of 40 V and flow rates of desolvation gas (N_2) and cone gas (N_2) of 1000 and 50 L/h, respectively. The instrument was run in MSe mode, thus, obtaining MS and mass fragmentation data simultaneously.

Desolvation gas temperature and the ion source temperature were set at 550 and 120 °C, respectively. Mass lynx 4.1 software was employed to process data and a ppm deviation less than or equal to five ppm between the theoretical and the observed mass, and 10 ppm for fragment ions, were set as limits. The identification of some compounds was confirmed by comparison with 26 authentic reference compounds (Table 4.1), which were run in parallel. Others were tentatively identified by comparison of molecular ions and fragment ions of a given compound with those provided in literature.

The identification of compounds was focused mainly on the MeOH 90% and AcOEt fractions for CA and the AcOEt fraction for KU. These fractions showed the most abundant and well separated peaks. Some compounds could be identified in more than one fraction, most probably due to the fact that the partitioning was not exhaustive. Thus other fractions in which the identified compounds were detected are also reported. In order to present results in a logical way, we grouped first compounds identified by comparison with authentic references, followed by those tentatively identified by comparison with data provided in the literature. The chemical profiling and identification process is summarized in the graphical abstract in Figure 4.4. UPLC-ESI-MS/MS spectra of the tentatively identified compounds are presented in Appendices 8 and 9 for CA and KU, respectively.

Identification confidence levels (Table 4.2), were reported according to Schymanski *et al.* (2014). Appendix 10 shows an example of how a selected compound (e.g. KU-compound **18**, luteolin) was identified by comparison to the reference substance. The fragment ions and retention time of the identified compound were highly consistent with the reference substance. Appendix 11 shows how a comparison of mass spectra between a sample and literature data resulted in a direct match for identification. Appendices 12-15 show how we attempted to identify a compound by its mass spectral data generated by a peak at a certain retention time Rt and by characteristic fragment ions observed.

Table 4.1. LC-MS data of 26 reference substances

N°	Compound	Standard reference	Molecular formula	Rt (min)	Monoiso-topic mass	$[M-H]^-$	$[M+H]^+$
1	Benzoic acid	RC2695	C_6H_5COOH	4.47	122.0368	121.0289	123.0447
2	*p*-Hydroxybenzoic acid	-	$C_7H_6O_3$	3.67	138.0317	137.0238	139.0396
3	Salicylic acid	RC 2601	$C_7H_6O_3$	5.09	138.0317	137.0238	139.0396
4	Coumarin	RC2485	$C_9H_6O_2$	5.73	146.0368	145.0289	147.0447
5	Cinnamic acid	RC2936	$C_9H_8O_2$	6.94	148.0524	147.0445	149.0603
6	Protocatechuic acid	RC2953	$C_7H_6O_4$	3.01	154.0266	153.0187	155.0345
7	*p*-Coumaric acid	RC2246	$C_9H_8O_3$	4.92	164.0473	163.0394	165.0552
8	Vanillic acid	RC2937	$C_8H_8O_4$	4.22	168.0423	167.0344	169.0502
9	Gallic acid	RC2150	$C_7H_6O_5$	1.90	170.0215	169.0136	171.0294
10	Caffeic acid	RC2244	$C_9H_8O_4$	3.35	180.0423	179.0344	181.0502
11	Ferulic acid	RC2274	$C_{10}H_{10}O_4$	5.27	194.0579	193.05	195.0658
12	Syringic acid	RC3015	$C_9H_{10}O_5$	4.37	198.0528	197.0449	199.0607
13	Sinapic acid	RC2932	$C_{11}H_{12}O_5$	5.28	224.0685	223.0606	225.0764
14	Apigenin	RC3041	$C_{15}H_{10}O_5$	7.60	270.0528	269.0449	271.0607
15	Naringenin	RC2715	$C_{15}H_{12}O_5$	7.55	272.0685	271.0606	273.0764
16	Luteolin	RC2621	$C_{15}H_{10}O_6$	6.87	286.0477	285.0398	287.0556
17	Catechin	RC2729	$C_{15}H_{14}O_6$	3.84	290.0790	289.0711	291.0869
18	Epicatechin	RC2490	$C_{15}H_{14}O_6$	4.31	290.0790	289.0711	291.0869
19	Quercetin	RC2838	$C_{15}H_{10}O_7$	6.89	302.0427	301.0348	303.0506
20	Isorhamnetin	RC 396	$C_{16}H_{12}O_7$	7.91	316.0583	315.0504	317.0662
21	Chlorogenic acid	RC2734	$C_{16}H_{18}O_9$	3.84	354.0951	353.0872	355.1030
22	Quercitrin	RC2307	$C_{21}H_{20}O_{11}$	5.63	448.1006	447.0927	449.1085
23	β-Sitosterol	RC2187	$C_{29}H_{50}O$	-	414.3862	413.3783	415.3941
24	Procyanidin B2	RC2987	$C_{30}H_{26}O_{12}$	4.06	578.1424	577.1345	579.1503
25	Rutin	RC608	$C_{27}H_{30}O_{16}$	5.02	610.1534	609.1455	611.1613
26	Theophylline	RC 2861	$C_7H_8N4O_2$	3.35	180.0647	179.0568	181.0726

Table 4.2. Identification confidence levels according to Schymanski *et al.*, 2014

Level	Identification confidence	Minimum data requirements
1	Confirmed structure by reference standard	MS, MS2, Rt, reference standard
2	Probable structure by library spectrum match and/or diagnostic evidence	MS, MS2, bibliographic MS2
3	Tentative candidates(s)	MS, MS2, Experimental data
4	Unequivocal molecular formula	MS isotope/adduct

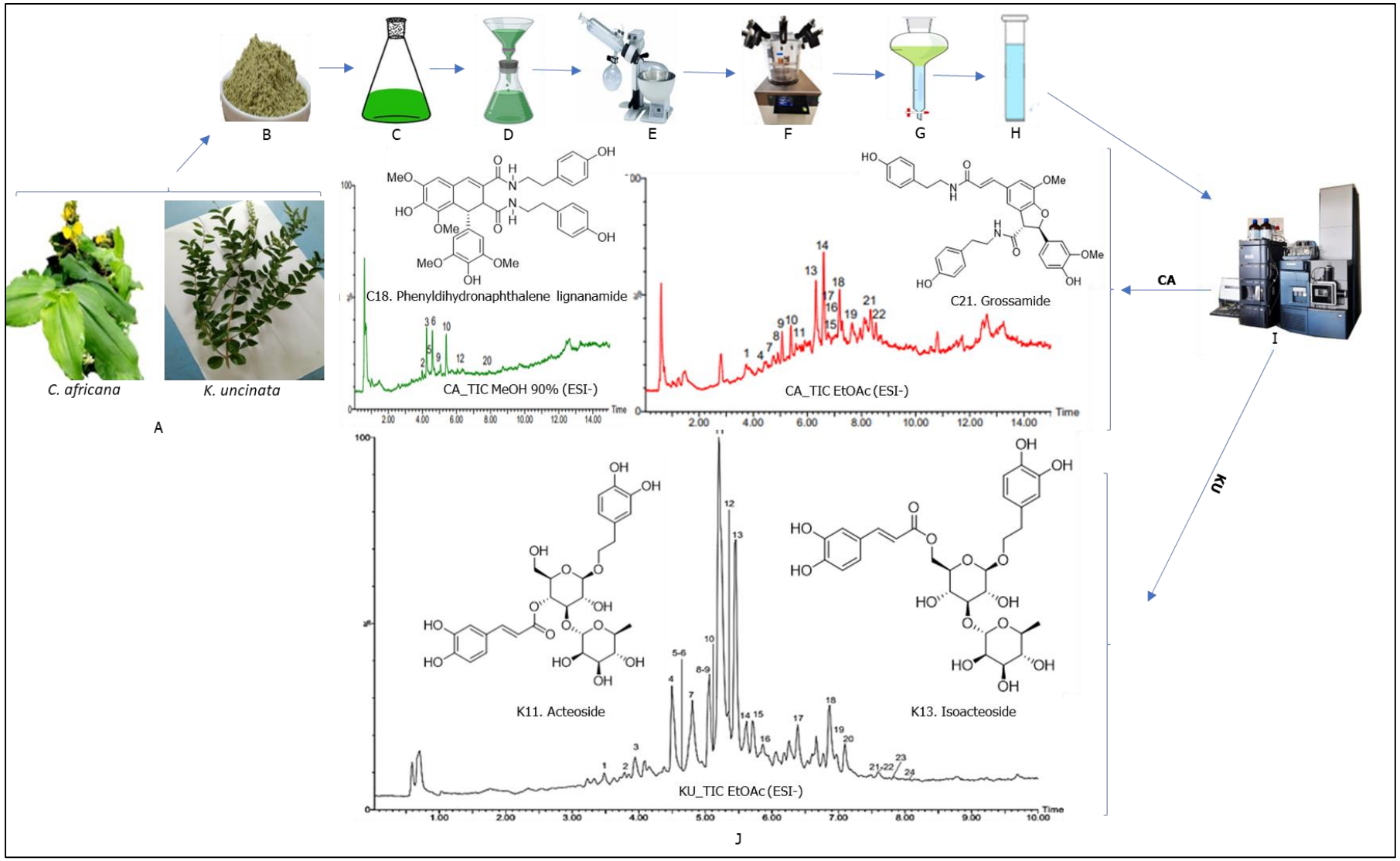


Figure 4.4. Graphical presentation of CA *and* KU *chemical profiling and compound identification process*

4.4. Results

4.4.1. Tentative identification of leaf extract compounds of *Commelina africana*

Analysis of subfractions of the crude extract of *C. africana*, including AcOEt, MeOH 90%, *n*-hexane, DCM, *n*-BuOH and residual fractions were analyzed by UPLC-ESI-QTOF-MS in both positive and negative ionization modes, together with a set of 26 reference compounds. The identification of compounds focused mainly on the MeOH 90% and AcOEt fractions in the ESI^- mode, which showed the most abundant and well-separated peaks (Figure 4.5). A total of 22 compounds eluting between Rt 3.84 and Rt 8.53 minutes were thus tentatively identified (Table 4.3).

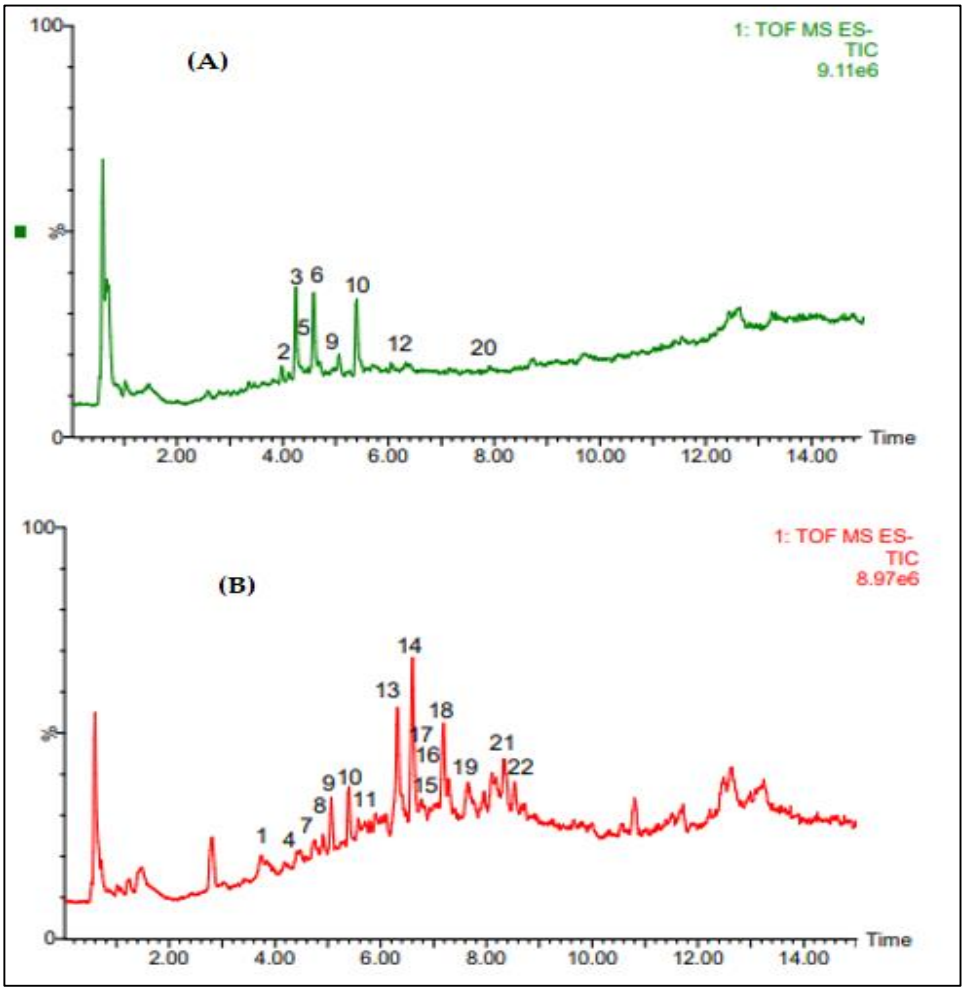


Figure 4.5. UPLC-QTOF-MS chromatograms of the AcOEt (A) and MeOH 90% (B) fractions of C. africana *leaves in ESI^- mode*

Compounds **C1** (MeOH 90%), **C16** (crude extract, MeOH 90% and *n*-hexane fractions), **C17** (crude extract), **C19** (crude extract, DCM, MeOH 90% fractions) and **C20** (*n*-hexane fraction), eluted at Rt 3.84, 6.85, 6.88, 7.59 and 7.90 min, respectively, and were identified as chlorogenic acid, luteolin, quercetin, apigenin and isorhamnetin by comparison to authentic reference compounds.

Compounds **C2** (detected in all fractions, except *n*-hexane, at *m/z* 609.1456 $[M-H]^-$/*m/z* 611.1612 $[M+H]^+$), **C3** (detected in all fractions, except *n*-hexane, at *m/z* 593.1507 $[M-H]^-$ /*m/z* 595.1663 $[M+H]^+$), **C5** (detected in MeOH 90% and AcOEt fraction, at *m/z* 579.1350 $[M-H]^-$/*m/z* 581.1506 $[M+H]^+$) and **C6** (detected in all fractions, at *m/z* 563.1401 $[M-H]^-$/*m/z* 565.1557 $[M+H]^+$), which correspond to $C_{27}H_{30}O_{16}$, $C_{27}H_{30}O_{15}$, $C_{26}H_{28}O_{15}$ and $C_{26}H_{28}O_{14}$, eluted at Rt 3.97, 4.24, 4.32 and 4.58 min, respectively. In ESI^- mode, they displayed characteristic fragment ions at *m/z* $[M-H-90]^-$, *m/z* $[M-H-120]^-$ (compounds **C2**, **C3**, **C6**) and *m/z* $[M-H-60]^-$ (compound **C5**), which according to Becchi & Fraisse (1989) and Li & Claeys (1994), refer to symmetrical and dissymmetrical 6,8-di-*C*-hexosyl flavonoids, respectively. Compound **C2** was detected in the AcOEt fraction in the ESI^- mode. It was suggested to be a di-*C*-hexoside flavonoid with luteolin or kaempferol as aglycone moiety, after the consecutive losses of 162 Da $[M-H-162-162]^-$, which resulted in a fragment ion with *m/z* 285 Da. Characteristic fragment ions at *m/z* 489 $[M-H-120]^-$ and *m/z* 519 $[M-H-90]^-$ suggest as mentioned above, a 6,8-di-*C*-hexosyl flavonoid. In addition, typical fragment ions at *m/z* 399 and *m/z* 369, which were previously observed and defined as 286 [aglycone + 113] and 286 [aglycone + 83] by Elsadig Karar & Kuhnert (2016); Ferreres *et al.* (2008, 2012); Kim *et al.* (2016); and Ravisankar *et al.* (2018), suggested an aglycone with molecular weight of 286 Da, which fits with luteolin or kaempferol. Indeed, the presence of characteristic fragment ions at *m/z* 286 [aglycone + 113] or *m/z* 286 [aglycone + 83] and *m/z* ($[M-H-90]^-$ / $[M-H-120]^-$) indicates according to Ferreres *et al.* (2012) a di-*C*-hexosyl flavone with luteolin as the aglycone moiety, and the loss of 162 Da as typical for a hexoside sugar. These characteristic fragmentation patterns of *C*-linked flavone diglycosides are presented in Appendix 16. Similar fragment ions were previously reported for luteolin 6,8-di-*C*-hexoside (Elsadig Karar & Kuhnert, 2016; Gouveia & Castilho, 2010; Sun *et al.,* 2009). However, LC-MS/MS analysis alone did not allow to specify with certainty the nature of the aglycone (luteolin or kaempferol), nor the nature of the sugar involved. Hence, we assigned the generic term tetrahydroxyflavone and hexose to designate the aglycone and the sugar moiety, respectively. Thus, compound **C2** was identified as **6, 8-di-*C*-hexosyl tetrahydroxyflavone**.

The MS spectrum of compound **C3**, detected in the AcOEt fraction in ESI^- mode exhibited typical fragment ions at *m/z* 383 and *m/z* 353. These ions were previously observed as 270 [aglycone + 113] and 270 [aglycone + 83], respectively, and suggested apigenin as the aglycone (Ferreres *et al.,* 2012; Kim *et al.,* 2016; Liu *et al.,* 2010; Ravisankar *et al.,* 2018). Fragment ions at *m/z* 593/503/473/383/353 are similar to those previously reported for apigenin 6,8-di-*C*-hexoside (Benayad *et al.,* 2014; Ferreres *et al.,* 2003; Kim *et al.,* 2016), also

identified in *Commelina erecta* by Cavichi *et al*. (2023). Since LC-MS/MS analysis alone cannot provide conclusive proof for the presence of apigenin and glucose as the involved aglycone and sugar moiety, respectively, compound **C3** was identified as **trihydroxyflavone-6, 8-di-*C*-hexoside**.

Compound **C4** eluted at Rt 4.27 min in the MeOH 90% fraction. The mass spectrum recorded in ESI^- mode, exhibited an abundant signal at *m/z* 353.0679 and a characteristic fragment ion at *m/z* 191 $[M-H-162]^-$, corresponding to quinic acid, after the loss of a caffeoyl moiety (Gouveia and Castilho, 2010). Thus, compound **C4** could be identified as a **caffeoylquinic acid**.

The mass spectrum of compound **C5**, observed in the AcOEt fraction in ESI^- mode exhibited a molecular ion at *m/z* 579.1350 $[M-H]^-$. The successive losses of 162 Da and 132 Da suggested a *C*-hexoside-*C*-pentoside compound, whereas the fragment ion at *m/z* 285, could correspond to luteolin or kaempferol as the aglycone. The two most abundant fragment ions were observed at *m/z* 459 $[M-H-120]^-$ and *m/z* 489 $[M-H-90]^-$, and a less intense ion was found at *m/z* 519 $[M-H-60]^-$. The relatively intense peak at *m/z* 459, indicates according to Elsadig Karar and Kuhnert (2016) and Ferreres *et al.* (2012), the 6-position of the glycoside moiety, while the ion at *m/z* 489 refers to a pentose at the 8^{th} position. Other fragment ions were observed at *m/z* 399 (also 286 [aglycone + 113]) and *m/z* 369 (also 286 [aglycone + 83]), indicating according to Ferreres *et al.* (2012), luteolin as the aglycone. With comparison to literature, our findings fit with those of Ferreres *et al.* (2012) for luteolin 6-*C*-hexoside-8-*C*-pentoside, also identified in *Commelina erecta* by Cavichi *et al*. (2023) and with those of Llorent-Martínez *et al.* (2015) and Zengin *et al.* (2021), for luteolin-*C*-hexoside-*C*-pentoside. Based on all available data, compound **C5** was tentatively identified as **tetrahydroxyflavone-6-*C*-hexoside-8-*C*-pentoside**.

Compound **C6** was detected in the AcOEt fraction in ESI^- mode, and showed a molecular ion at *m/z* 563.1401 $[M-H]^-$. Successive losses of 162 Da and 132 Da from the molecular ion resulting in a fragment ion with *m/z* 269, could correspond to *C*-hexosyl-*C*-pentosyl apigenin. The fragment ion at *m/z* 353 $[M-H-120-90]^-$ was the most abundant, and may suggest two *C*-linked monosaccharides at both positions 6 and 8, which could be a hexoside and a pentoside, respectively. Other signals were observed at *m/z* 443 $[(M-H)-120]^-$, *m/z* 473 $[(M-H)-90]^-$, which refer according to Elsadig Karar and Kuhnert (2016) and Ferreres *et al.* (2012), to 6-*C*-hexoside and 8-*C*-pentoside, respectively. Characteristic fragment ions at *m/z* 383 and *m/z* 353 were also observed and could be defined as 383 (270 [aglycone + 113]) and 353 (270 [aglycone + 83]) indicating probably, as mentioned earlier,

apigenin as the aglycone. Comparing these results with published data (Deseo *et al.,* 2020; Ferreres *et al*., 2003; Gouveia and Castilho, 2013; Llorent-Martínez *et al.,* 2015; Patel *et al.*, 2018), compound **C6** is in agreement with MS data of apigenin-6-*C*-hexoside-8-*C*-pentoside, also identified in *Commelina erecta* by Cavichi *et al*. (2023). Thus, based on the LC-MS/MS data, compound **C6** was tentatively identified as **trihydroxyflavone-6-*C*-hexoside-8-*C*-pentoside**.

Compounds **C7** (crude extract, MeOH 90%, DCM and AcOEt fractions) and **C8** (Crude extract, MeOH 90% and *n*-BuOH fractions), which eluted at Rt 4.65 and 4.76 min, respectively, displayed similar molecular ions at *m/z* 447.0927 $[M-H]^-$ and *m/z* 449.1084 $[M+H]^+$, corresponding to $C_{21}H_{20}O_{11}$. They were characterised in ESI^- mode as a mono *C*-hexosyl flavonoid due to the loss of 162 Da to give a fragment ion at *m/z* 286, corresponding to luteolin or kaempferol as the aglycone. The ESI^- mass spectrum of the two compounds (**C7** and **C8**) from the MeOH 90% fraction, exhibited similar characteristic fragment ions at *m/z* 357 $[M-H-90]^-$, which could also be defined according to Ferreres *et al.* (2012), as 286 [aglycone + 71]$^-$ and at *m/z* 327 $[M-H-120]^-$ as 286 [aglycone + 41]$^-$. These characteristic fragmentation patterns of *C*-linked flavone monoglycosides are presented in Appendix 17. According to Ferreres *et al.* (2012), the high abundance of the ion corresponding to *m/z* 357 (286 [aglycone + 71]), refers to 6-*C*-glycosylation, while that corresponding to *m/z* 327 (286 [aglycone + 41]), refers to 8-*C*-glycosylation. The abundant signal referring to 8-*C*-glycosylation was observed at *m/z* 327 for compound **C8**. However, compound **7** exhibited an abundant signal at *m/z* 357, which refers to 6-*C*-glycosylation. Comparing these results with published data, compound **C7** corroborates with luteolin-6-*C*-glycoside (isoorientin) (Olennikov *et al.*, 2018), while compound **C8** matches with luteolin-8-*C*-glucoside (orientin) (Ravisankar et al., 2018). Thus, based on LC-MS/MS data, compounds **C7** and **C8** were identified as **tetrahydroxyflavone-6-*C*-hexoside** and **tetrahydroxyflavone-8-*C*-hexoside,** respectively.

Compounds **C9** (detected in all fractions, at *m/z* 431.0978 $[M-H]^-$/*m/z* 433.1135 $[M+H]^+$) and **C10** (detected in all fractions, except in the residual fraction, at *m/z* 445.1135 $[M-H]^-$ / *m/z* 447.1291 $[M+H]^+$), corresponding to $C_{21}H_{20}O_{10}$ and $C_{22}H_{22}O_{10,}$ eluted at Rt 5.06 and 5.40 min, respectively. Compound **C9** was suggested to be a mono-*C*-hexosyl flavonoid, possibly with apigenin as the aglycone, due to the loss of 162 Da to give a fragment ion with *m/z* 269 in ESI^- mode**.** The mass spectrum from the MeOH 90% fraction in ESI^- mode, exhibited a molecular ion at *m/z* 431.0978 $[M-H]^-$, which yielded an abundant fragment ion at

m/z 311 $[M-H-120]^-$. This fragment ion could also be defined as 270 [aglycone + 41], suggesting, as mentioned earlier, an 8-*C*-hexosyl-flavonoid (Ferreres *et al.,* 2012). Another characteristic fragment ion at *m/z* 341 $[M-H-90]^-$, also defined according to Ferreres *et al.* (2012), as 270 [aglycone + 71], was less abundant compared to the fragment ion at *m/z* 311. The observed fragment ions at *m/z* 431/341/311 are in agreement with those reported by Ferreres *et al.* (2012) for apigenin-8-*C*-glucoside (vitexin). Thus, compound **C9** was tentatively identified as **trihydroxyflavone-8-*C*-hexoside**.

The mass spectrum of compound **C10,** present in the AcOEt fraction, exhibited several fragment ions in both positive (*m/z* 447, 411, 381, 327 and 297) and negative (*m/z* 445, 385, 325, 297 and 269) ionization modes which were in agreement with those reported for swertisin (Colombo *et al.,* 2009; Sun *et al.,* 2009; Vermeulen *et al.,* 2020). This compound was previously reported in the *Commelina* genus (Vermeulen *et al.,* 2020; Zhang *et al.,* 2018). Thus, compound **C10** most possibly corresponds to **swertisin** (6-*C*-glucosyl-7-*O*-methylapigenin) (Figure 4. 6).

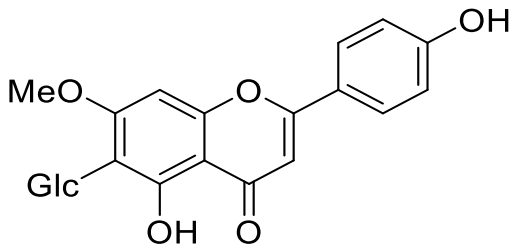


*Figure 4.6. Chemical structure of compound **C10** (swertisin)*

Compound **C11** eluted at Rt 5.57 min and exhibited in ESI^- mode a molecular ion at *m/z* 447.0951 $[M-H]^-$ in the crude extract, MeOH 90% and *n*-hexane fractions, corresponding to molecular formula $C_{21}H_{20}O_{11}$. The spectrum recorded from the crude extract, showed a characteristic and abundant fragment ion at *m/z* 284 $[M-H-163]^-$, but not at *m/z* 285 $[M-H-162]^-$. Other fragment ions were found at *m/z* 447, 255 and 227. According to Hvattum and Ekeberg (2003) and Li *et al.* (2016), the highly abundant peak at *m/z* 284, corresponds to the radical aglycone ion [Y0-H]°, after the homolytic loss of a hexose moiety (162 Da). The presence of this ion is indicative for the 3-*O*-position of glycosylation. In contrast, an intense signal at *m/z* 285, corresponding to $[Y_0]^-$, is indicative for the heterolytic loss of a sugar moiety and indicates position 7 of the hexoside moiety. The 7-*O* and 3-*O*- positions of glycosylation of kaempferol (*m/z* 447 $[M-H]^-$) were well-explained by March *et al.* (2006). In our case, the fragment ion at *m/z* 284, which corresponded to the homolytic loss of the sugar moiety with kaempferol as the aglycone, was more abundant than the ion at *m/z* 285, suggesting 3-*O*-

glucosyl kaempferol. The fragment ions at *m/z* 447/284 and *m/z* 255 were also observed by Peeters *et al.* (2020) for astragalin or kaempferol-3-*O*-glucoside**.** Thus, based on LC-MS/MS data, compound **C11** was tentatively identified as **tetrahydroxyflavone-3-*O*-hexoside**. The fragmentation pattern of kaempferol-3-*O*-glycoside (March *et al.,* 2006) and the ESI^- mass spectra of 3-*O*- (from our work) and 7-*O*- (from March *et al.,* 2006) glycosylation of kaempferol (tetrahydroxyflavone) are presented in Appendices 18 and 19 (A and B), respectively.

Compound **C12**, which corresponds to molecular formula $C_{28}H_{32}O_{15}$, eluted at Rt 5.68 min in the crude extract, AcOEt, DCM, and *n*-BuOH fractions, and displayed molecular ions at *m/z* 607.1663 $[M-H]^-$ and *m/z* 609.1819 $[M + H]^+$. The mass spectrum of compound **C12** in ESI^- mode in the AcOEt fraction, exhibited a fragment ion at *m/z* 299 $[M-H-308]^-$, resulting from the cleavage of a deoxyhexose (146 Da) and a hexose (162 Da) moiety, which could correspond to methylkaempferol or methyl luteolin as aglycone moieties ($C_{16}H_{12}O_6$). Upon fragmentation, a characteristic fragment ion at *m/z* 284 $[M-H-323]^-$ could result from successive losses of 308 Da (deoxyhexosylhexoside group) and 15 Da, which are in agreement with the presence of methylkaempferol or methyl luteolin as the aglycone. Based on this fragment ion, which corresponds to the homolytic (*m/z* 284) fission of the glycosidic bond, the cleavage of a hexosyl and a deoxyhexosyl was hypothesized to have occurred at the 3-position. Hence, compound **C12** was tentatively identified as **trihydroxy-methoxyflavone-3-*O*-deoxyhexosylhexoside**. Previously, flavocommelinin A was reported from *Commelina communis* L. (Zhang *et al.,* 2018), corresponding to the same molecular formula. However, given the fact that the reported fragment ions differ from the ones observed in the current work, compound **C12** does not seem to correspond to flavocommelinin A.

Compounds **C13** and **C14 (**detected in the MeOH 90% fraction), eluted at 6.33 and 6.62 min and displayed molecular ions at *m/z* 312.1236 $[M-H]^-$ and *m/z* 314.1392 $[M+H]^+$, respectively, corresponding to $C_{18}H_{19}NO_4$. The mass spectra recorded from the MeOH 90% fraction in ESI^+ mode for the two compounds exhibited a fragment ion at *m/z* 177 $[M+H-137]^+$, possibly indicating the loss of a tyramine moiety (Geng *et al.,* 2017). Other fragment ions at *m/z* 145 and *m/z* 117 were reported by Al-Taweel *et al.* (2012); Ayanlowo *et al.* (2020); and Li *et al.* (2016) as characteristic for amides of ferulic acid. Hence, these findings match with ***N*-feruloyl-tyramine** (Al-Taweel *et al.,* 2012; Ayanlowo *et al.,* 2020). Comparing these results with literature (Forino *et al.,* 2016; Raimundo e Silva *et al.,* 2020), compound **C13** eluted first and could be identified as ***N*-*trans*-feruloyl-tyramine**, while compound **C14,**

which eluted second**,** could be identified as ***N*-*cis*-feruloyl-tyramine**. Compound **C13** (*N*-*trans*-feruloyl-tyramine) was also identified in *C. diffusa* (Vu *et al*., 2023), another species within the *Commelina* genus. This finding serves to validate the presence of this compound in *Commelina* species.

Compound **C15** (MeOH 90% fraction**)** eluted at Rt 6.77 min and displayed molecular ions at *m/z* 342.1342 $[M-H]^-$ and *m/z* 344.1497 $[M+H]^+$, suggesting a molecular formula of $C_{19}H_{21}NO_5$. It yielded in ESI^+ mode, in the MeOH 90% fraction, a highly abundant ion at *m/z* 177 $[M+H-167]^-$ resulting from a loss of 167 Da, which possibly corresponds to a methoxytyramine or a methyldopamine moiety (Geng *et al.,* 2017; Kang *et al.,* 2018; Ozturk *et al.,* 2022). Other fragment ions at *m/z* 145 and *m/z* 117 indicated the presence of a feruloyl moiety (Nikolić *et al.,* 2012). Thus based on data reported above and in agreement with literature (Kang *et al.,* 2018; Ozturk *et al.,* 2022), compound **C15** could be identified as ***N*-feruloyl-methoxytyramine** or ***N*-feruloyl-*O*-methyldopamine**. To the best of our knowledge, this compound is reported for the first time in genus *Commelina*.

Compound **C18** (all fractions, except the residual fraction) eluted at Rt 7.19 min and displayed molecular ions at *m/z* 683.2605 $[M-H]^-$ and *m/z* 685.2761 $[M + H]^+$, suggesting $C_{38}H_{40}N_2O_{10}$ as a molecular formula. The mass spectrum recorded in the crude extract, in ESI^- mode, showed fragment ions at *m/z* 623, 521, 520, 504, 460 and 352. Fragment ions at *m/z* 520/504 and 352 matched with those previously reported for commelinin B from *Commelina communis* (Zhang *et al.,* 2018). A recent study by Vu *et al*.(2023), reported from *C. diffusa* at *m/z* 683.2 $[M-H]^-$, a compound identified as 1,2-dihydro-6,8-dimethoxy-7-hydroxy-1-(3,5-dimethoxy-4-hydroxyphenyl)-N1,N2-bis-[2-(4-hydroxyphenyl)ethyl]-2,3-naphthalene dicarboxamide, which could probably match our finding. In ESI^+ mode, the mass spectrum recorded in the MeOH 90% fraction exhibited characteristic fragment ions at *m/z* 685, 548, 520, which match with phenyldihydronaphthalene lignanamide, a podophyllotoxin-type of lignan, which was previously reported (Figure 4.7) (Chaves and Roque, 1997). No chemical structure was previously reported for commelinin B. Based on our experimental data and a comparison with the literature and the structure reported by Vu *et al.* (2023), this compound could possibly be a phenyldihydronaphthalene lignanamide, more specifically 1,2-dihydro-6,8-dimethoxy-7-hydroxy-1-(3,5-dimethoxy-4-hydroxyphenyl)-N1,N2-bis-[2-(4-hydroxy-phenyl) ethyl]-2,3-naphthalene. However, this could not be confirmed. Thus, compound **C18** was tentatively identified as a **phenyldihydronaphthalene lignanamide**.

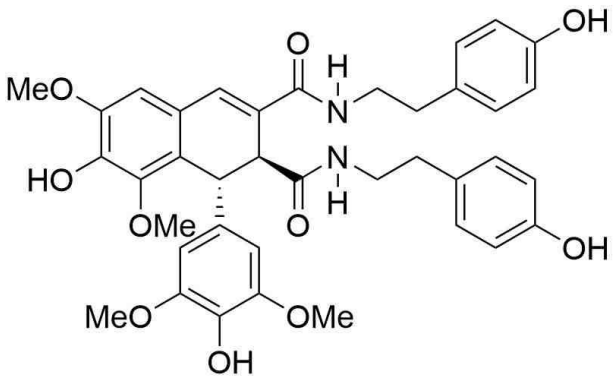


*Figure 4.7.Tentative chemical structure of compound **C18** (phenyldihydronaphthalene lignanamides)*

Compound **C21** (MeOH 90%) eluted at Rt 8.35 min and displayed molecular ions at *m/z* 623.2394 $[M-H]^-$ and *m/z* 625.2550 $[M+H]^+$ which corresponds to a molecular formula of $C_{36}H_{36}N_2O_8$. The fragmentation spectrum recorded in ESI^+ mode in the MeOH 90% fraction exhibited a fragment ion at *m/z* 351 $[M+H-274]^+$, corresponding to $C_{20}H_{14}O_6$ and was previously suggested to correspond to grossamide, after the consecutive loss of two tyramine moieties (137 Da +137 Da = 274 Da) (Bolleddula et al., 2012). Other fragment ions observed at *m/z* 488, 462, 325, 307 and 293 match with **grossamide** (Figure 4. 8), a lignanamide, previously reported (Bolleddula *et al.*, 2012; King and Calhoun, 2005; Zhang *et al.*, 2015; Zhuang *et al.*, 2021).

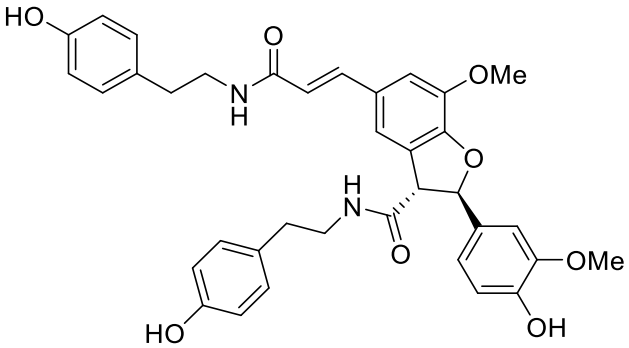


*Figure 4.8. Chemical structure of compound **C21** (grossamide)*

Compound **C22** (MeOH 90%)displayed molecular ions at *m/z* 343.0454 $[M-H]^-$ and *m/z* 345.0610 $[M+H]^+$ and eluted at Rt 8.53 min, suggesting molecular formula $C_{17}H_{12}O_8$. The spectrum recorded in ESI^- mode in the MeOH 90% fraction exhibited fragment ions at *m/z* 328, 312, 297, 285 and 269, which matched with **tri-*O*-methyl ellagic acid**, as reported previously (Kumar *et al.*, 2017; Manurung *et al.*, 2021). To the best of our knowledge, compounds **C21** and **C22** are reported for the first time in genus *Commelina*.

Table 4.3. Tentative identification of compounds of C. africana by UPLC-ESI-QTOF-MS

Compound	Rt (min)	Formula	Tentative identification	Ion	Theor. mass (m/z)	Exp. mass (m/z)	Mass error (ppm)	Fraction	Fragments ESI^- (m/z)	Fragments ESI^+ (m/z)	Class of compound	Identification confidence level	References
C1	3.84	$C_{16}H_{18}O_9$	Chlorogenic acid	$[M-H]^-$	353.0872	353.0866	-1.7	MeOH 90%	191.0545, 179.0349	-	Phenolic acids	1	(Peeters *et al*., 2020; Rini Vijayan and Raghu, 2019)
C2	3.97	$C_{27}H_{30}O_{16}$	6,8-di-*C*-hexosyl tetrahydroxyflavone	$[M-H]^-$ $[M+H]^+$	609.1456 611.1612	609.1438 611.1606	-3.0 -1.0	AcOEt	609.1473, 519.1158 489.1050, 399.0703 369.0607	-	Flavonoids	3	(Kim *et al*., 2016)
C3	4.24	$C_{27}H_{30}O_{15}$	Trihydroxyflavone-6,8-di-*C*-hexoside (vicenin-2)	$[M-H]^-$ $[M+H]^+$	593.1507 595.1663	593.1506 595.1655	-0.2 -1.3	AcOEt	593.1533, 503.1213 473.1106, 383.0775 353.0667, 297.0750	-	Flavonoids	3	(Kim *et al*., 2016)
C4	4.27	$C_{16}H_{18}O_9$	Caffeoylquinic acid	$[M-H]^-$	353.0872	353.0884	3.4	MeOH 90%	353.0679, 191.0546	-	Phenolic acids	3	(Gouveia and Castilho, 2010)
C5	4.32	$C_{26}H_{28}O_{15}$	Tetrahydroxyflavone-6-*C*-hexoside-*8*-*C*-pentoside	$[M-H]^-$ $[M+H]^+$	579.1350 581.1506	579.1329 581.1498	-3.6 -1.4	AcOEt	579.1356, 459.0933 489.1028, 399.0710 369.0591	-	Flavonoids	3	(Elsadig Karar and Kuhnert, 2016; Zengin *et al*., 2021)
C6	4.58	$C_{26}H_{28}O_{14}$	Trihydroxyflavone-*6*-*C*-hexoside-8-*C*-pentoside	$[M-H]^-$ $[M+H]^+$	563.1401 565.1557	563.1415 565.1542	2.5 -2.7	AcOEt	563.1413, 503.1198 473.1096, 443.0987 383.0786, 353.0662 297.7889	565.1572, 574.1466 511.1252, 475.1045 445.0989, 427.1022 409.0931, 397.0821 379.0821, 349.0716 337.0719, 325.0718 295.0616	Flavonoids	3	
C7	4.65	$C_{21}H_{20}O_{11}$	Tetrahydroxyflavone-6-*C*-hexoside	$[M-H]^-$ $[M+H]^+$	447.0927 449.1084	447.0934 449.1081	1.6 -0.7	MeOH 90%	357.0633, 327.0530	353.0662, 329.0663 299.0547	Flavonoids	3	
C8	4.76	$C_{21}H_{20}O_{11}$	Tetrahydroxyflavone-8-*C*-hexoside	$[M-H]^-$ $[M+H]^+$	447.0927 449.1084	447.0930 449.1077	0.7 -1.6	MeOH 90%	447.0937, 358.0639 357.0623, 327.0502 315.0084, 279.0307	431.0968, 413.0870 329.0650, 353.0639 299.0650	Flavonoids	3	

Table 4.3. Tentative identification of compounds of C. africana by UPLC-ESI-QTOF-MS

Compound	Rt (min)	Formula	Tentative identification	Ion	Theor. mass (m/z)	Exp. mass (m/z)	Mass error (ppm)	Fraction	Fragments ESI^- (m/z)	Fragments ESI^+ (m/z)	Class of compound	Identification confidence level	References
C9	5.06	$C_{22}H_{22}O_{10}$	Trihydrohyflavone-8-*C*-hexoside	$[M-H]^-$ $[M+H]^+$	431.0978 433.1135	431.0977 433.1141	-0.2 1.4	MeOH 90%	431.1005, 386.9392 341.0672, 323.0555 311.0566, 312.0598 283.0613, 269.0465	433.1130, 313.0709 415.1030, 397.0925 379.0819, 367.0816 351.0857, 337.0708 283.0608	Flavonoids	3	
C10	5.40	$C_{22}H_{22}O_{10}$	Swertisin	$[M-H]^-$ $[M+H]^+$	445.1135 447.1291	445.1142 447.1299	1.6 1.8	AcOEt	445.1137 385.0912 325.0717, 326.0750 297.0406, 282.0528 231.0278, 269.0457 231.0278	299.0552, 327.0864 381.0049, 447.1287	Flavonoids	3	(Colombo *et al.*, 2009; Sun *et al.*, 2009)
C11	5.57	$C_{21}H_{20}O_{11}$	Tetrahydroxyflavone-3-*O*-hexoside	$[M-H]^-$	447.0927	447.0939	2.7	MeOH 90%	255.0401, 284.0326 285.0401, 447.0953 227.0329	-	Flavonoids	3	
C12	5.68	$C_{28}H_{32}O_{15}$	Trihydroxy-methoxyflavone-3-*O*-deoxyhexosylhexoside	$[M-H]^-$ $[M+H]^+$	607.1663 609.1819	607.1644 609.1818	-3.1 -0.2	AcOEt	299.0547, 284.0296	301.0719, 302.0758 286.0475	Flavonoids	3	
C13	6.31	$C_{18}H_{19}NO_4$	*N*-trans-feruloyl tyramine	$[M-H]^-$ $[M+H]^+$	312.1236 314.1392	312.1233 314.1394	-1.0 0.6	MeOH 90%	312.1239, 297.0997 289.9373, 287.9408 237.9467, 191.054, 190.0491, 178.0493 176.0328	314.1394, 177.0552 145.0290, 117.0317	Hydroxy-cinnamic acid amide	2	(Al-Taweel *et al.*, 2012; Ayanlowo *et al.*, 2020)
C14	6.60	$C_{18}H_{19}NO_4$	*N-cis*-feruloyl tyramine	$[M-H]^-$ $[M+H]^+$	312.1236 314.1392	312.1235 314.1390	-0.3 -0.6	MeOH 90%	297.1008, 253.0862 208.0606, 190.0497 178.0509, 176.0336	314.1386, 177.0553 145.0289, 117.0335	Hydroxy-cinnamic acid amide	2	(Ayanlowo *et al.*, 2020)
C15	6.77	$C_{19}H_{21}NO_5$	*N*-feruloyl-*O*-methyldopamine	$[M-H]^-$ $[M+H]^+$	342.1342 344.1498	342.1339 344.1497	-0.9 -0.3	MeOH 90%	342.1343, 327.1140 293.0451	344.1494, 177.0554 145.0283, 117.0284	Hydroxy-cinnamic acid amide	2	(Kang *et al.*, 2018; Ozturk *et al.*, 2022)
C16	6.85	$C_{15}H_{10}O_6$	Luteolin	$[M-H]^-$ $[M+H]^+$	285.0398 287.0555	285.0384 287.0565	-2.5 3.5	MeOH 90%	285.0394, 217.0492 199.0371, 175.0361 151.0027	287.0561, 229.0507 153.0189	Flavonoids	1	(Lv *et al.*, 2015; Peeters *et al.*, 2020; Rittà *et al.*, 2020; Sliwka-Kaszyńska *et al.*, 2022;

Table 4.3. Tentative identification of compounds of C. africana by UPLC-ESI-QTOF-MS

Compound	Rt (min)	Formula	Tentative identification	Ion	Theor. mass (m/z)	Exp. mass (m/z)	Mass error (ppm)	Fraction	Fragments ESI^- (m/z)	Fragments ESI^+ (m/z)	Class of compound	Identification confidence level	References
													Zengin *et al.*, 2021)
C17	6.88	$C_{15}H_{10}0_7$	Quercetin	$[M-H]^-$ $[M+H]^+$	301.0348 303.0505	301.0335 303.0506	-4.3 0.3	Crude extract	301.0352, 285.0404 217.0392, 199.0387 175.0378, 151.0022	287.0549, 257.0456 229.0497, 201.0500 162.0181, 153.0182	Flavonoids	1	(Peeters *et al.*, 2020; Zhang *et al.*, 2018)
C18	7.19	$C_{38}H_{40}N_2O_{10}$	Phenyldihydronaphthalene lignanamide	$[M-H]^-$ $[M+H]^+$	683.2605 685.2761	683.2593 685.2752	-1.8 -1.3	Crude extract	683.2619, 623.2406 521.1984, 520.1998 504.1683, 460.1736 352.1172	685.2740, 645.2279 550.3438, 549.1944 548.1931, 520.1981 509.2495, 488.1696 460.1764, 394.1284 383.1124, 351.0863 231.0653	Lignanamides	2	(Chaves and Roque, 1997; Zhang *et al.*, 2015)
C19	7.59	$C_{15}H_{10}O_5$	Apigenin	$[M-H]^-$ $[M+H]^+$	269.045 271.0606	269.0451 271.0608	0.4 0.7	MeOH 90%	269.0443, 225.0540 151.0023	271.0617, 153.0190	Flavonoids	1	(S. Li *et al.*, 2019; Peeters *et al.*, 2020; Zengin *et al.* 2021)
C20	7.90	$C_{16}H_{12}O_7$	Isorhamnetin	$[M-H]^-$ $[M+H]^+$	315.0504 317.0661	315.0503 317.0644	-0.3 -5.4	*n*-hexane	315.0507, 300.0269 371.0240, 255.0288 151.0080	317.0665, 302.0430 285.0400, 274.0477 229.0503, 153.0187	Flavonoids	1	(Kramberger *et al.*, 2020; Peeters *et al.* 2020; Rini Vijayan and Raghu, 2019)
C21	8.35	$C_{36}H_{36}N_2O_8$	*N-cis (or trans)*-grossamide	$[M-H]^-$ $[M+H]^+$	623.2394 625.2550	623.2388 625.2555	-1.0 0.8	MeOH 90%	623.2415, 576.0546 461.1813, 460.1782 327.2179, 297.1134 288.0222	488.1708, 462.1916 352.0905, 351.0866 307.0967, 293.0804	Lignanamides	3	(Bolleddula *et al.*, 2012; King and Calhoun, 2005; Zhang *et al.*, 2015; Zhuang *et al.*, 2021)
C22	8.53	$C_{17}H_{12}O_8$	Tri-*O*-methylellagic acid	$[M-H]^-$ $[M+H]^+$	343.0454 345.0610	343.0461 345.0617	2.0 2.0	MeOH 90%	345.0453, 328.0236 312.9994, 297.9758 285.0035, 269.9802	330.0376, 315.0150 313.0352, 285.0405	Phenolic acids	3	(Kumar *et al.*, 2017; Manurung *et al.*, 2021)

4.4.2. Tentative identification of compounds of leaf extracts of *Kalaharia uncinata*

The tentative identification compounds of leaf extracts of *K. uncinata* focused mainly on the AcOEt fraction in the ESI$^-$ mode. This fraction exhibited the most abundant and well-separated peaks in the ESI$^-$ mode (Figure 4.9), making it suitable for the tentative identification of most of the KU phytochemicals. Therefore, it was preferred instead of the *n*-BuOH fraction, despite the latter being present in a larger amount (Figure 4.3). A total of 24 compounds eluting between Rt 3.49 and Rt 7.91 minutes were tentatively identified and an identification confidence level was also assigned (Table 4.4).

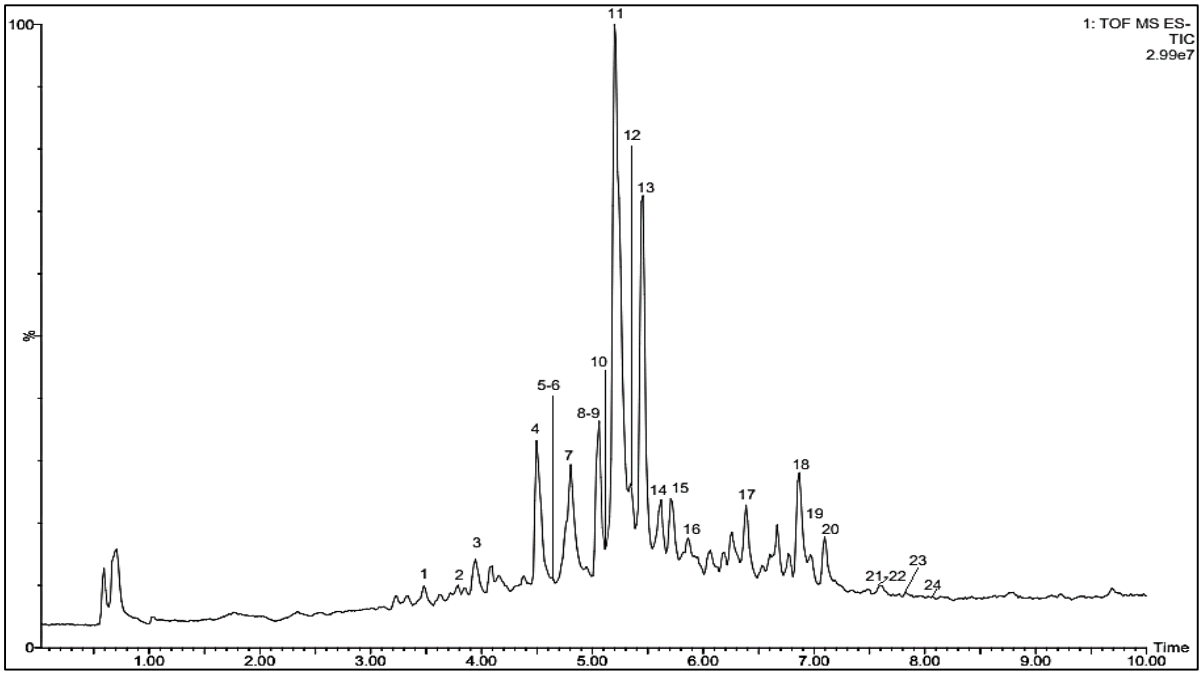


Figure 4.9. UPLC-ESI-QTOF-MS chromatogram of the AcOEt fraction of K. uncinata leaves recorded in the negative ionization mode

Compound **K1** (crude, AcOEt, *n*-BuOH extracts and residue) eluted at Rt 3.48 min and displayed a molecular ion at *m/z* 487.1452 [M-H]$^-$, suggesting a molecular formula of $C_{21}H_{28}O_{13}$. The mass spectrum observed in the AcOEt fraction exhibited an abundant ion at *m/z* 179 [M-H-308]$^-$, corresponding to $C_9H_8O_4$ (caffeic acid), after the loss of 308 Da (rutinoside or deoxyhexosylhexoside moiety) and fits with Xiang *et al.* (2021), for caffeic acid-*O*-rutinoside. Thus, based on LC-MS data, compound **K1** was tentatively identified as **caffeic acid-*O*-deoxyhexosylhexoside**.

Compounds **K2** (crude, AcOEt and MeOH 90% extracts), **K18** (crude, DCM1, AcOEt, MeOH 90%, *n*-BuOH, *n*-hexane extracts and residue), **K19** (crude and DCM2 extracts), **K21** (crude, DCM1, DCM2, AcOEt, MeOH 90% and *n*-hexane extracts) and **K 24**

(crude extract), eluted at Rt 3.84, 6.87, 6.89, 7.60 and 7.91 min, respectively, and were identified as chlorogenic acid, luteolin, quercetin, apigenin and isorhamnetin by comparison to authentic references. Similar compounds were also previously identified in *C. africa*na.

Compound **K3** (*m/z* 373.1135 $[M-H]^-$) detected in all extracts, eluted at Rt 3.94 and corresponded to a molecular formula of $C_{16}H_{22}O_{10}$. It was characterized by losses of H_2O (18 Da), CO_2 (44 Da) and cleavage of a hexose (hex) moiety (162 Da), corresponding to the fragmentation behaviour of iridoids (Gao *et al.*, 2022; Li *et al.*, 2015; Zhou *et al.*, 2010) (Appendix 20). The mass spectrum observed in the AcOEt fraction exhibited fragment ions at *m/z* 193 $[M-H-hex-H_2O]^-$ and 149 $[M-H-hex-H_2O-CO_2]^-$, that matched with geniposidic acid or secologanic acid (Guo *et al.*, 2014; Li *et al.*, 2015; Ye *et al.*, 2014; Zou *et al.*, 2015). The high intensity of the ion at *m/z* 193 and the lack of a signal at *m/z* 211 observed upon fragmentation, most likely indicates **secologanic acid** (Li *et al.*, 2015) (Figure 4.8).

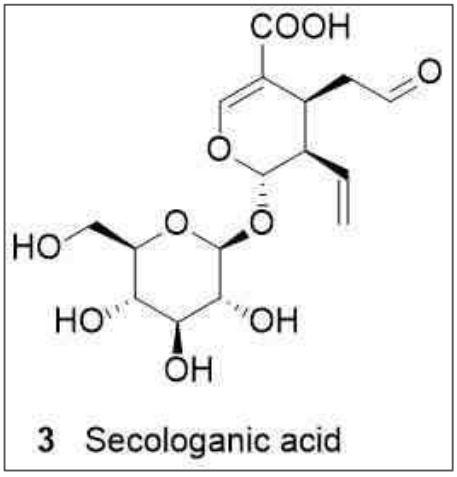


*Figure 4.*10. *Chemical structures of compound **K3** (secologanic acid)*

Compounds **K4** (all fractions, except DCM1, DCM2) and **K7** (AcOEt, *n*-BuoH) eluted at Rt 4.50 and 4.80 min, respectively. They displayed a similar molecular ion at *m/z* 639.1925 $[M-H]^-$, suggesting $C_{29}H_{36}O_{16}$ as molecular formula. They were characterized as phenylethanoid glycosides, indicated by typical loss of caffeoyl or hexose (162 Da), 152 Da, 146 Da and 134 Da, and losses of 42 and 18 Da (Gao *et al.*, 2022; Guo *et al.*, 2007; Li et al., 2008; Wang *et al.*, 2019). The mass spectrum of both compounds **K4** and **K7** observed in the AcOEt fraction in ESI^- mode, exhibited an abundant fragment ion at *m/z* 621 after the loss of 18 Da. Other characteristic signals were observed at *m/z* 529, 487, 459 (loss of caffeoyl/hexose/162 Da from *m/z* 621), 179 (after consecutive losses of deoxyhexose = 146 Da and hexose = 162 Da, from *m/z* 487), 161 (after a loss of H_2O = 18 Da, from *m/z* 179) and 151 (after consecutive losses of hexose/caffeoyl = 162 Da, and deoxyhexose = 146 Da, from

m/z 459). The presence of a fragment ion at *m/z* 477 (after the loss of hexose or caffeoyl = 162 Da, from *m/z* 639) could be consistent with **β-hydroxyacteoside** (Li *et al.*, 2015) being compound **K4** and the absence of this fragment ion could indicate **suspensaside** (Cui *et al.*, 2010; Han *et al.*, 2007a; Li *et al.*, 2015; Martakos *et al.*, 2021; Zhou *et al.*, 2017) being compound **K7.** Their structures are presented in Figure 4.11.

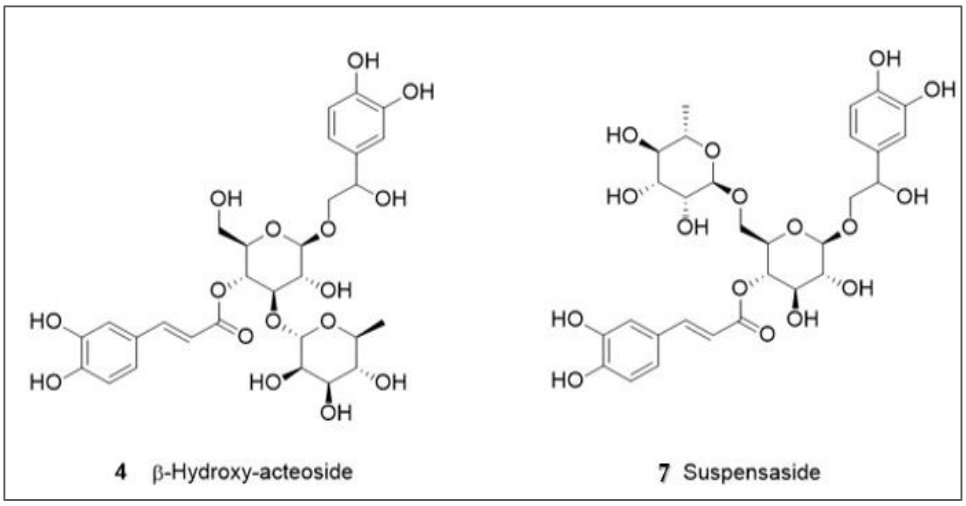


*Figure 4.*11. *Chemical structures of compounds **K4** (β-hydroxy-acteoside) and **K7** (suspensaside)*

Compounds **K5 and K10** eluted at Rt 4.76 and 5.14 min, respectively. They displayed similar molecular ions at *m/z* 463.0877 $[M-H]^-$ and *m/z* 465.1033 $[M+H]^+$, corresponding to a molecular formula of $C_{21}H_{20}O_{12}$. They were detected in all fractions (crude, DCM1, DCM2, AcOEt, MeOH 90%, *n*-hexane, *n*-BuOH extracts and residue), except for compound **5** which was not observed in the *n*-hexane extract, and compound **K10**, which was not observed in the DCM2 extract. The mass spectrum of compounds **K5** and **K10** observed in ESI^- mode, in the AcOEt fraction, exhibited characteristic fragment ions at *m/z* 301 $[M-H-162]^-$ and *m/z* 300 $[M-H-163]^-$, suggesting a molecular formula of $C_{15}H_{10}O_7$, which refers to pentahydroxyflavone. The highly abundant peak at *m/z* 301 (Compound **5**), corresponds to the aglycone ion $[Y_0]^-$ after the heterolytic loss of a hexose moiety (162 Da) (Hvattum and Ekeberg, 2003; Li *et al.*, 2016; Waridel *et al.*, 2001). The presence of this ion is, according to the same authors, an indication of the 7-*O* position of glycosylation. In contrast, an intense signal at *m/z* 300 (compound **K10**), corresponding to the radical aglycone [Y0-H]°, is indicative for the homolytic loss of a hexose moiety and indicates position 3 of the hexoside moiety (Hvattum & Ekeberg, 2003; Li *et al.*, 2016; Waridel *et al.*, 2001). Thus, compounds **K5** and **K10** were tentatively identified as **pentahydroxyflavone-7-*O*-hexoside** and **pentahydroxyflavone-3-*O*-hexoside**, respectively.

Compounds **K6** (crude, AcOEt, *n*-BuOH extracts and residue) and **K22** (DCM2 extract) eluted at Rt 4.78 and 7.62 min, respectively. They displayed similar molecular ions at *m/z* 609.1455 $[M-H]^-$ and *m/z* 611.1612 $[M+H]^+$, suggesting a molecular formula of $C_{27}H_{30}O_{16}$. The mass spectrum of compound **K6** observed in ESI^- mode, in the *n*-BuOH fraction, displayed characteristic fragment ions at *m/z* 463, 301 and 300. The abundant fragment ion at *m/z* 301 $[M-H-308]^-$, corresponded based on LC-MS data to pentahydroxyflavone ($C_{15}H_{10}O_7$), after successive losses of 146 Da (deoxyhexose) at *m/z* 463 and 162 Da at *m/z* 301 (hexose) to give a total neutral loss of 308 Da (deoxyhexosylhexoside). The highly intense peak at *m/z* 301 instead of *m/z* 300, indicates as mentioned above, the 7-position of glycosylation. Thus, based on these data, compound **K6** was identified as **pentahydroxyflavone-7-*O*-deoxyhexosylhexoside**. The mass spectrum of compound **K22** present in the DCM2 fraction, in ESI^- mode, exhibited an abundant fragment ion at *m/z* 357 $[M-H-162-90]^-$, which could be rationalized as 286 (aglycon) + 71 Da, suggesting according to Ferreres *et al.* (2012), a mono 6-*C*- hexosyl-*O*-hexoside flavone, with tetrahydroxyflavone as the aglycone. Thus, based on this data, compound **K22** was tentatively identified as **tetrahydroxy-flavone-6-*C*-hexosyl-*O*-hexoside**.

Compound **K8** (detected in all fractions) eluted at Rt 5.06 min and displayed a molecular ion at *m/z* 653.2082 $[M-H]^-$, suggesting $C_{30}H_{38}O_{16}$ as the molecular formula. Fragment ions observed in the AcOEt fraction at *m/z* 621 (after the loss of MeOH = 32 Da, from *m/z* 653), 487 (loss of 134 Da from *m/z* 621), 469 (loss of H_2O = 18 Da, from *m/z* 487), 459 (loss of caffeoyl/hexose/162 Da from *m/z* 621), 179 (after loss of deoxyhexose = 146 Da and hexose = 162 Da from *m/z* 487) and 151 (after consecutive losses of hexose or caffeoyl = 162 Da and deoxyhexose = 146 Da from *m/z* 459), correspond and match with typical losses of **suspensaside methyl ether** (Guo *et al.*, 2007), presented in Appendix 21**.**

Compounds **K9** (AcOEt and MeOH 90% extracts) and **K15** (crude, DCM1, DCM2, AcOEt, MeOH 90%, *n*-hexane, *n*-BuOH extracts and residue), eluted at Rt 5.08 and 5.72 min, respectively. They displayed similar molecular ions at *m/z* 431.0978 $[M-H]^-$ and *m/z* 433.1135 $[M+H]^+$, suggesting a molecular formula of $C_{21}H_{20}O_{10}$**.** The mass spectrum of compound **K9** in the AcOEt fraction in ESI^- mode, exhibited a molecular ion at *m/z* 431.0978 $[M-H]^-$, which yielded an abundant fragment ion at *m/z* 311 $[M-H-120]^-$. This fragment ion could be rationalized as 270 (aglycone) + 41 Da, suggesting an 8-*C*-hexosyl-flavonoid, with apigenin as the aglycon (Ferreres et al., 2012). Another characteristic fragment ion at *m/z* 341 $[M-H-90]^-$, also defined according to Ferreres *et al.* (2012), as 270 (aglycone) + 71 Da, was

less abundant compared to the fragment ion at *m/z* 311 and confirmed to be the mono-*C*-glycosylation (Xu *et al.,* 2007). Characteristic fragmentation patterns of *C*-linked flavone monoglycosides are presented in Appendix 17. The observed fragment ions at *m/z* 431/341/311 are in agreement with those reported by Ferreres *et al.* (2012) for apigenin-8-*C*-glucoside (vitexin). Thus, compound **K9** was tentatively identified as **trihydroxyflavone-8-*C*-hexoside**. The mass spectrum of compound **K15** in the AcOEt fraction in ESI^- mode, exhibited characteristic fragment ions at *m/z* 431, 268 and 269. The abundant fragment ion at *m/z* 268 $[M-H-163]^-$, corresponded to $C_{15}H_{10}O_5$, after the homolytic loss of a hexose moiety, indicating that the aglycone could be a trihydroxyflavone. The highly abundant peak at *m/z* 268 instead of *m/z* 269 indicates according Li *et al.* (2016), the 3-*O*-position of the hexose moiety. Thus, compound **K15** was tentatively identified as **trihydroxyflavone-*3*-*O*-hexoside**.

Compounds **K11** (detected in all extracts) and **K13** (all extracts, except for the MeOH 90% and *n*-hexane extracts) eluted at Rt 5.20 and 5.46 min, respectively. They displayed similar molecular ions at *m/z* 623.1976 $[M-H]^-$ and *m/z* 625.2132 $[M+H]^+$, suggesting a molecular formula of $C_{29}H_{36}O_{15}$. The mass spectra of compounds **K11** and **K13** observed in the AcOEt fraction in ESI^- mode, exhibited fragment ions at *m/z* 461 (after the loss of 162 Da or hexose or caffeoyl) and *m/z* 161 [caffeic acid-H-$H_2O]^-$, that matched with finding of a number of studies (Attia *et al.*, 2018, 2018; Cui *et al.*, 2016; Darwish *et al.*, 2022; Gao *et al.*, 2022; Kritikou *et al.*, 2020; Li *et al.*, 2019; Li *et al.*, 2021; Peng *et al.*, 2022; Qian *et al.*, 2018; Zhao *et al.*, 2020) for acteoside (verbascoside) and for iso-acteoside (isoverbascoside) (Figure 4.12). The fragmentation patterns of acteoside (Gao *et al.*, 2022; Qian *et al.*, 2018; Zhao *et al.*, 2020) and verbascoside (Attia *et al*., 2018) are presented in Appendix 22. According to their different Rt and references (Gao *et al.*, 2022; Wang *et al.*, 2016), compound **K11** which eluted first was identified as **acteoside** and compound **K13** which eluted second as **isoverbascoside**.

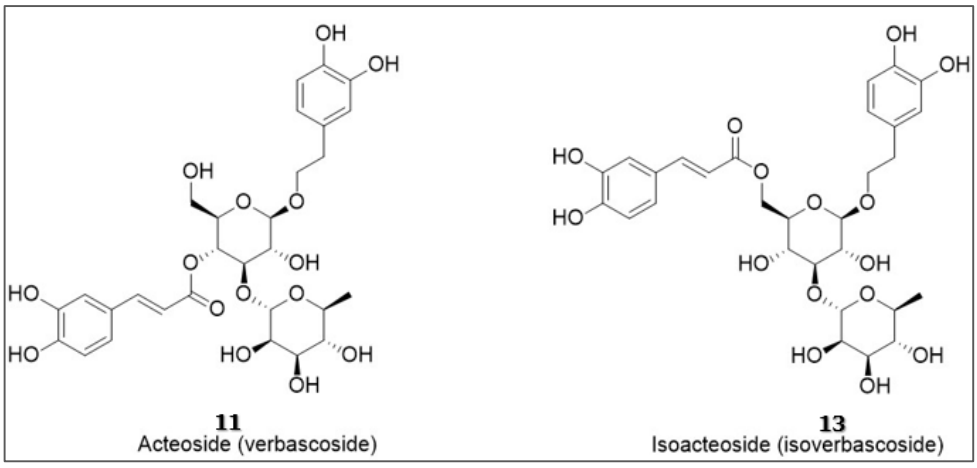


*Figure 4.*12. *structures of compounds* ***K11*** *(acteoside/verbascoside) and* ***K13*** *(isoacteoside/isoverbascoside)*

Compound **K12** (crude, DCM1, DCM2, AcOEt, MeOH 90%, *n*-BuOH and *n*-hexane extracts) eluted at Rt 5.24 min. It displayed molecular ions at *m/z* 447.0927 $[M-H]^-$ and *m/z* 449.1084 $[M+H]^+$, suggesting $C_{21}H_{20}O_{11}$. The mass spectrum observed in the AcOEt fraction in ESI^- mode, exhibited a fragment ion at *m/z* 285 $[M-H-162]^-$, suggesting $C_{15}H_{10}O_6$ as molecular formula, after the loss of a hexose moiety. This aglycone could possibly correspond to kaempferol; however, this could not be confirmed. The intense signal at *m/z* 285 is indicative of the 7-*O*-position of glycosylation (Li *et al.*, 2016). Thus, compound **K12** was identified as **tetrahydroxyflavone-7-*O*-hexoside**.

Compound **K14** (all fractions, except *n*-hexane and the residual fraction) which eluted at Rt 5.62 min, displayed a molecular ion at *m/z* 629.2657 $[M-H]^-$, corresponding to $C_{26}H_{46}O_{17}$. The mass spectrum of compound **K14** exhibited an abundant fragment ion at *m/z* 583. Other signals observed at *m/z* 477, 421, 314, 315 and 179 could indicate the loss of hexose or caffeoyl (162 Da) and hydroxytyrosol (152 Da) moieties, which most probably correspond to phenylethanoid glycosides typical fragmentations ions as reported by Gao *et al.* (2022), Li *et al.* (2008) and Wang *et al.* (2019). The observed fragmentation ions do not correspond with those provided in literature. Therefore, compound **K14** could not be identified.

Compound **K16** (crude extract, AcOEt, DCM1 and *n*-BuOH fractions) eluted at Rt 5.87 min. It displayed a molecular ion at *m/z* 637.2133 $[M-H]^-$ that corresponded to $C_{30}H_{38}O_{15}$. The mass spectrum observed in the AcOEt fraction exhibited fragment ions at *m/z* 509, 491, 461 and 347 which could indicate the loss of deoxyhexose (146 Da) and feruloyl (176 Da) moieties, matching most probably with typical fragmentation of phenylethanoid glycosides. Thus compound **K16** could be a phenylethanoid glycoside compound. However, no structure could be proposed for this compound.

Compound **K17** (DCM2, AcOEt, MeOH 90%, *n*-BuOH, *n*-hexane extracts and residue), eluted at 6.36 min and displayed molecular ions at *m/z* 315.0504 $[M-H]^-$ and *m/z* 317.0661 $[M+H]^+$, suggesting a molecular formula of $C_{16}H_{12}O_7$. The mass spectrum of compound **K17** present in the AcOEt fraction, exhibited in ESI^- mode, an abundant fragment ion at *m/z* 300 $[M-H-15]^-$, after the loss of 15 Da (may be a methyl group). Other fragment ions are reported in Table 1, which is consistent with Gu *et al.* (2012) for methyl-quercetin. Based on LC-MS data, compound **K17** was tentatively identified as a **tetrahydroxy-methoxyflavone**.

Compounds **K20** (crude, DCM1, DCM2, AcOEt, MeOH 90%, *n*-BuOH, *n*-hexane extracts and residue) and **K23 (**DCM1, DCM2, MeOH 90% and *n*-hexane extracts), eluted at 7.10 and 7.80 min, respectively. They exhibited similar molecular ions at *m/z* 299.0556 $[M-H]^-$ and *m/z* 301.0712 $[M+H]^+$, suggesting the molecular formula of $C_{16}H_{12}O_6$. The mass spectra of both compounds **K20** and **K23** observed in the AcOEt and the MeOH 90% fractions, respectively, exhibited in ESI^- mode an abundant fragment ion at *m/z* 284 $[M-H-15]^-$, after the loss of 15 Da (most probably a methyl group) and fit with Jia *et al.* (2020), Jiang *et al.* (2017), Song *et al.* (2006), Zhang *et al.* (2020) for kaempferide and Zhang *et al.* (2018) for diosmetin. Thus, based on LC-MS data, compounds **K20** and **K23** are most probably **trihydroxy-methoxyflavone**s.

Table 4.4. Tentative identification of compounds of K. uncinata by UPLC-ESI-QTOF-MS

Compound	Rt	Formula	Tentative identification	Ion	Theor. mass (m/z)	Exp. mass (m/z)	Mass error (ppm)	Fraction	Fragments (ESI^- mode)	Fragments (ESI^+ mode)	Class of compound	Identification confidence level	References
K1	3.49	$C_{21}H_{28}O_{13}$	Caffeic acid-*O*-deoxyhexosylhexoside	$[M-H]^-$	487.1452	487.1447	-1.0	AcOEt	368.0981, 179.0334	-	Phenolic acids	3	(Xiang *et al.*, 2021)
K2	3.84	$C_{16}H_{18}O_9$	Chlorogenic acid	$[M-H]^-$	353.0872	353.0867	-1.4	AcOEt	191.0540	-	Phenolic acids	1	(Peeters *et al.*, 2020; Rini Vijayan and Raghu, 2019)
K3	3.94	$C_{16}H_{22}O_{10}$	Secologanic acid	$[M-H]^-$	373.1135	373.1145	-1.9	AcOEt	193.0491, 149.0588	-	Iridoid glycosides	3	(Gao *et al.*, 2022; Guo *et al.*, 2014; Li *et al.*, 2015; Ye *et al.*, 2014)
K4	4.50	$C_{29}H_{36}O_{16}$	β-hydroxy-acteoside	$[M-H]^-$	639.1925	639.1918	-1.1	AcOEt	639.1947, 621.1851 529.1593, 487.1477 477.1629, 469.1368 459.1528, 325.0930 179.0332, 161.0224 151.0383	-	Phenylethanoid glycosides	2	(Y. Li *et al.*, 2015)
K5	4.76	$C_{21}H_{20}O_{12}$	Pentahydroxyflavone - 7-*O*-hexoside	$[M-H]^-$ $[M+H]^+$	463.0877 465.1033	463.0869 465.1040	-1.7 1.5	AcOEt	463.0894, 301.0350 300.0273, 302.0385 303.0390	465.1035, 356.9703 305.0563, 304.0541 303.0508, 285.0399	Flavonoids	3	
K6	4.78	$C_{27}H_{30}O_{16}$	Pentahydroxyflavone-7-*O*-deoxyhexosylhexoside	$[M-H]^-$ $[M+H]^+$	609.1455 611.1612	609.1442 611.1592	-2.1 -3.3	*n*-BuOH	609.1469, 463.0897 323.0768, 302.0390 301.0356, 300.0279	565.1043, 549.0868 533.0967, 449.1078 304.0534,303.0509	Flavonoids	3	
K7	4.80	$C_{29}H_{36}O_{16}$	Suspensaside	$[M-H]^-$	639.1925	639.1921	-0.6	AcOEt	639.1950, 621.1850 529.1588, 487.1480 459.1527, 323.0778 251.0560, 179.0335 161.0222	-	Phenylethanoid glycosides	2	(Cui *et al.*, 2010; Guo *et al.*, 2007; Han *et al.*, 2007a; Y. Li *et al.*, 2015; Martakos *et al.*, 2021; Zhou *et al.*, 2017)
K8	5.06	$C_{30}H_{38}O_{16}$	Suspensaside methyl ether	$[M-H]^-$	653.2082	653.2078	-0.3	AcOEt	653.2120, 621.1863 487.1490, 469.1393 459.1542, 179.0339 161.0225, 151.0375	-	Phenylethanoid glucoside	2	(Guo *et al.*, 2007)

K9	5.08	$C_{21}H_{20}O_{10}$	Trihydroxyflavone-8-*C*-hexoside	$[M-H]^-$ $[M-H]^+$	431.0978 433.1135	431.0989 433.1152	2.6 3.9	AcOEt	341.0698, 311.0568 283.0608	313.0712, 283.0616	Flavonoids	3	
K10	5.14	$C_{21}H_{20}O_{12}$	Pentahydroxyflavone-3-*O*-hexoside	$[M-H]^-$ $[M+H]^+$	463.0877 465.1033	463.0883 456.1045	1.3 2.6	AcOEt	463.0900, 300.0276 271.0241, 255.0288	465.1036, 356.9704 303.0510, 229.0496 201.0513	Flavonoids	3	
K11	5.20	$C_{29}H_{36}O_{15}$	Acteoside or verbascoside	$[M-H]^-$ $[M+H]^+$	623.1976 625.2132	623.1977 625.2136	0.2 0.6	AcOEt	623.2009, 461.1684 179.0331, 161.0224 133.0239	-	Phenylethanoid glycosides	3	(Attia *et al.*, 2018; Cui *et al.*, 2016; Darwish *et al.*, 2022; Gao *et al.* 2022; W.-L. Li *et al.*, 2019; Li *et al.*, 2021; Peng *et al.*, 2022; Qian *et al.*, 2018; Zhao *et al.*, 2020)
K12	5.24	$C_{21}H_{20}O_{11}$	Tetrahydroxyflavone (kaempferol)-7-*O*-hexoside	$[M-H]^-$ $[M+H]^+$	447.0927 449.1084	447.0941 449.1088	3.1 2.0	AcOEt	447.0976, 327.0516 285.0417,286.0439 284.0329	449.1092, 87.0562 288.0595, 89.0608 153.0189	Flavonoids	3	
K13	5.46	$C_{29}H_{36}O_{15}$	Isoacteoside or isoverbascoside	$[M-H]^-$ $[M+H]^+$	623.1976 625.2132	623.1992 625.2133	2.6 0.2	AcOEt	623.2031, 461.1696 161.0226	-	Phenylethanoid glucoside	3	(Cui *et al.*, 2016; Darwish *et al.*, 2022; Gao *et al.*, 2022; W.-L. Li *et al.*, 2019; Li *et al.*, 2021; Peng *et al.*, 2022; Qian *et al.*, 2018; Zhao *et al.*, 2020)
K14	5.62	$C_{26}H_{46}O_{17}$	ND	$[M-H]^-$	629.2657	629.2647	-1.6	AcOEt	583.2644, 421.2105 477.1054, 315.0501 314.0433 179.0336	-	Phenylethanoid glycosides	4	
K15	5.72	$C_{21}H_{20}O_{10}$	Trihydroxy flavone-3-*O*-hexoside	$[M-H]^-$ $[M+H]^+$	431.0978 433.1135	431.0981 433.1135	0.7 0.0	AcOEt	431.1010, 311.0563 268.0381, 269.0453	433.1137, 271.0610 153.0184	Flavonoids	3	
K16	5.86	$C_{30}H_{38}O_{15}$	ND	$[M-H]^-$	637.2133	637.2120	-2.0	AcOEt	509.2421, 491.1244 461.1131, 347.1883	-	Phenylethanoid glycosides	4	
K17	6.36	$C_{16}H_{12}O7$	Tetrahydroxy-methoxyflavone (methyl quercetin)	$[M-H]^-$ $[M+H]^+$	315.0504 317.0661	315.0504 317.0661	0.0 0.0	AcOEt	315.0516, 300.0288 193.0492, 175.0387 160.0135	317.0667, 302.0432 177.0554, 117.0244	Flavonoids	3	

K18	6.87	$C_{15}H_{10}O_6$	Luteolin	$[M-H]^-$ $[M+H]^+$	285.0398 287.0555	285.0388 287.0558	-3.5 -1.0	AcOEt	285.0403, 199.0383 175.0381	287.0565, 269.0450 241.0502, 153.0191	Flavonoids	1	(Lv *et al.*, 2015; Peeters *et al.*, 2020; Rittà *et al.* 2020; Sliwka-Kaszyńska *et al.* 2022; Zengin *et al.*, 2021)
K19	6.89	$C_{15}H_{10}O7$	Quercetin	$[M-H]^-$	301.0348	301.0345	-1.0	Crude extract	285.0405, 199.0397 175.9544, 151.0020		Flavonoids	1	(Peeters *et al.*, 2020; Zhang *et al.*, 2018)
K20	7.10	$C_{16}H_{12}O_6$	Trihydroxy-methoxyflavone (kaempferide)	$[M-H]^-$ $[M+H]^+$	299.0556 301.0712	299.0551 301.0715	-1.7 1.0	AcOEt	284.0332, 265.0981 256.0344, 255.0289 227.0338, 212.0463	301.0717, 286.0483 267.1147, 171.0926 168.0062, 154.0660	Flavonoids	3	(Jia *et al.*, 2020; Jiang *et al.*, 2017; Song *et al.*, 2006; Zhang *et al.*, 2020)
K21	7.60	$C_{15}H_{10}O_5$	Apigenin	$[M-H]^-$ $[M+H]^+$	269.0450 271.0606	269.0443 271.0608	-2.6 0.7	Crude extract	269.0452, 225.0540 201.0538, 183.0440 149.0221	271.0602, 153.0174	Flavonoids	1	(S. Li *et al.*, 2019; Peeters *et al.*, 2020; Zengin *et al.*, 2021)
K22	7.62	$C_{27}H_{30}O_{16}$	Tetrahydroxy-flavone-6-*C*-hexosyl-*O*-hexoside	$[M-H]^-$ $[M+H]^+$	609.1455 611.1612	609.1455 611.1611	-3.1 -0.2	DCM2	609.1404, 608.1430 598.1160, 564.1534 562.1367, 357.1566 269.0449, 227.0320 225.0550, 223.0322 187.0183	533.2217, 421.0963 534.2243, 413.1790 335.0070, 303.0684 271.0606, 243.0491 171.0297, 153.0181	Flavonoids	3	
K23	7.80	$C_{16}H_{12}O_6$	Trihydroxy-methoxyflavone or diosmetin	$[M-H]^-$ $[M+H]^+$	299.0556 301.0712	299.0553 301.0712	-1.0	MeOH 90%	284.0333, 256.0372 227.0359	286.0484, 258.0530 229.0503	Flavonoids	3	
K24	7.91	$C_{16}H_{12}O_7$	Isorhamnetin	$[M-H]^-$ $[M+H]^+$	315.0504 317.0661	315.0501 317.0659	-1.0 -0.6	Crude extract	300.0279	317.0663, 302.0426 177.0553	Flavonoids	1	(Brito *et al.*, 2014; Lech *et al.*, 2014; Otłowska *et al.*, 2018; Zhang *et al.*, 2018)

4.5. Discussions

4.5.1. About *C. africana*

Most tentatively identified compounds in CA were phenolic compounds, including several flavonoids (14 of 22) and some non-flavonoid compounds (hydroxycinnamic acids, phenolic acids and lignanamides). It is well-known that naturally occurring phenolic compounds show a wide range of biological activities (Działo *et al*., 2016). Antioxidant, anti-inflammatory, antimicrobial and antifungal activities may be potential mechanisms of action against various skin disorders (Działo *et al.*, 2016; Kaurinovic and Vastag, 2019; Zillich *et al.*, 2015). The antioxidant defense by phenolic compounds plays an important role in protecting the skin from oxidative damage (Pandel *et al.*, 2013). The mechanism of action of antioxidants on skin disorders could probably be due to the restoration of the skin barrier function by fighting inflammation through the scavenging of free radicals and the interruption of radical reactions (Godić *et al.*, 2020). This accelerates the healing process by promoting efficient skin cell renewal (Boo, 2019).

Naturally occurring phenolic compounds, such as flavonoids, hydroxycinnamic acids, phenolic acids and lignanamides are reported to alleviate symptoms and inhibit the development of various skin disorders (Contardi *et al.*, 2021; Godić *et al.*, 2020; Kaurinovic and Vastag, 2019; Leonard *et al.*, 2021). Due to their mechanism of action, we hypothesized that the combination of the identified compounds and their biological effects could play an important role in the treatment of skin disorders.

Identified compounds, such as **C1** (chlorogenic acid) (Contardi *et al*., 2021; Girsang *et al.*, 2021; Lee *et al.*, 2021; Zhou *et al.*, 2023), **C16** (luteolin) (Gendrisch *et al.*, 2021; Jeon *et al.*, 2014; Rivera-Yañez *et al.*, 2021; and Shaik *et al.*, 2018), **C17** (quercetin) (Azeem *et al*., 2022; Beken *et al*., 2020; Caddeo *et al*., 2014; Čižmárová *et al*., 2023; Dwivedi et al., 2021; Gębka et al., 2022; Jafarinia et al., 2020; Karuppagounder *et al.*, 2015; Lee *et al*., 2017; Maramaldi *et al.*, 2016)**, C19** (apigenin) (Ali *et al.*, 2017; Hou *et al.*, 2013; Ma *et al.*, 2021; and Park *et al.*, 2020), and **C20** (isorhamnetin) (Gong *et al.*, 2020; Han *et al.*, 2015; Kim *et al.*, 2014; and Kim *et al.*, 2011) were reported to have antioxidant, antifungal and ani-inflammatory properties which could be related to their use against skin disorders.

Several publications have demonstrated the effectivity of most identified compounds against skin infections. Hou *et al.* (2013), reported that apigenin (**C19**) improved epidermal permeability barrier function by stimulating epidermal differentiation, lipid synthesis and secretion, as well as cutaneous antimicrobial peptide production.

Karuppagounder *et al.* (2015), reported that quercetin (**C17**) reduced hyperkeratosis, parakeratosis, spongiosis, mast cell and inflammatory cell infiltration in the skin. Quercetin (**C17**) is also reported to address tissue damage, with a noticeable attenuation of edema and leukocyte infiltration (Caddeo *et al*., 2014). Furthermore, it scavenges free radicals and protects human keratinocytes against hydrogen peroxide damage (Jafarinia *et al.*, *2*020) whereas it also exerts an antiproliferative effect on inflammatory cells (Gębka *et al.*, 2022).

In the tropics, many skin disorders are caused by fungi (Taborda *et al.*, 2022). Quercetin (**C17**) is reported to act against fungi by inhibiting their growth and viability (Al Aboody and Mickymaray, 2020). It disrupts the integrity of the fungal cell membrane, interferes with cellular functions, or induces oxidative stress, leading to damage or death of fungal cells. Indeed, research has demonstrated that quercetin **(C17)** has the ability to inhibit the production of crucial components constituting the fungal cell wall. Additionally, it inhibits the activity of fatty acid synthase (FAS) in yeast and mycobacterial cells by down-regulating the expression of genes linked to this metabolic pathway (Gębka *et al*., 2022). These findings not only indicate promising antifungal properties of quercetin, but also underscore its potential in addressing skin disorders.

Kim *et al.* (2014), reported that isorhamnetin (**C20**) improves the skin barrier function through activation of peroxisome proliferator-activated receptors and suppression of inflammatory cytokines. Isorhamnetin (**C20**) is also reported to effectively increase melanogenesis by targeting serotonergic synapses and arachidonic acid metabolism (Gong et al., 2020), to suppress skin cancer, reduce tumor growth and COX (cyclooxygenase)-2 expression (Kim *et al.*, 2011), and to protect human keratinocytes against ultraviolet B-induced cell damage and death (Han *et al.*, 2015).

Gendrisch *et al.* (2021), reported that luteolin (**C16**) reduced ultraviolet-induced proinflammatory cytokine release from keratinocytes and fibroblasts, and also reduced the amounts of ROS (e.g. hydrogen peroxide) in the skin or the release of proinflammatory cytokines from ROS-activated keratinocytes. Luteolin (**C16**) was also reported to promote

lipid raft generation and decreased fatty acid β-oxidation, methionine sulfoxide, and oxidized glutathione levels in cells and decreased mRNA expression of keratinocyte cell lines (Rivera-Yañez *et al.*, 2021).

Girsang *et al.* (2021), reported that chlorogenic acid (**C1**) has potential as protective agent against inflammation and aging by reducing ROS, pro-inflammatory cytokines, apoptosis, and necrosis. It is also reported that chlorogenic acid (**C1**) induced upregulation of cellular antioxidant enzymes and suppressed ROS, activator protein-1 (AP-1) and mitogen-activated protein kinase and suppressed also the generation of pro-inflammatory cytokines (Contardi *et al.*, 2021).

In their study, Rocha da Silva *et al*., (2022) investigated the *in vitro* antifungal potential of chlorogenic acid (**C1**) against fluconazole-resistant strains of *Candida* spp., a fungi species commonly implicated in skin infections (Calheiros *et al.*, 2023). The results revealed that chlorogenic acid (**C1**) demonstrated notable *in vitro* antifungal activity against the tested strains. This activity was characterized by a decrease in cell viability, higher potential for mitochondrial depolarization, increased production of reactive oxygen species, DNA fragmentation, and phosphatidylserine externalization. These observed effects collectively suggest the induction of an apoptotic process of fungal cells.

Tyramine-derived hydroxycinnamic acid amides, such as *N-trans*-feruloyl-tyramine (**C13**), were reported to have a strong ability to neutralize free radicals and reactive oxygen species and thus to possess strong antioxidant and anti-inflammatory properties, which could combat skin disorders (Al-Taweel *et al.*, 2012; Gao *et al.*, 2015; Leonard *et al.*, 2022).

Concurrently, lignanamides have also been reported to demonstrate strong antioxidant effects and free-radical scavenging activities, which could be effective in the treatment of skin infections (Leonard *et al.*, 2021; Zhuang *et al.*, 2021).

Based on documented data on the genus *Commelina*, several studies underline the antioxidant, antifungal, antibacterial, and anti-inflammatory effects of *Commelina* plant extracts. In their study, Kudumela *et al.* (2018) highlighted these effects for the acetone extracts of *C. africana*. Although the authors did not identify compounds responsible for these effects, their findings are consistent with the biological effects reported in our investigation on *C. africana,* reinforcing thus the connection between reported and observed biological activities.

Nasrim *et al.* (2019), Mensah *et al.* (2014) and Khan *et al.* (2011) found similar effects using biological tests on different extracts of *C. diffusa*, providing scientific support for its traditional use for skin problems. This supports our findings with *C. africana* and provides a link between the effects observed in other *Commelina* species and the similar documented effects reported in our study.

Suganya and Jothi (2014) demonstrated through phytochemical screening and biological assays of chloroform, acetone and ethanol extracts of *C. nudiflora* that this *Commelina* species may contain sterols, tannins, saponins and flavonoids, which could be responsible for its antioxidant and antimicrobial effects. These results confirm the biological potential of *Commelina* species and emphasize the link between our findings on *C. africana* and the general biological activities observed in other *Commelina* species.

Cavichi *et al*. (2023) performed HPLC-DAD-ESI/MS analysis on hexanoic, ethyl acetate and ethanolic extracts of *C. erecta*. Their identified mostly tentatively compounds similar to those in our study, such as apigenin (**C19**), luteolin (**C16**), quercetin (**C17**), apigenin-6,8-di-*C*-hexoside (**C3**), luteolin-6-*C*-hexosyl-8-*C*-pentoside (**C5**), and apigenin-6-*C*-hexosyl-8-*C*-pentoside (**C6**). Biological activity determination of extracts from *C. erecta* demonstrated anti-inflammatory, antibacterial, antifungal, and antioxidant properties. These findings are consistent with the results reported in our study and suggest that these different *Commelina* species probably contain similar chemical compounds with comparable biological effects.

Orni *et al*. (2018) conducted a comprehensive review on *C. benghalensis*, a plant that is also used in Indian folk medicine for the treatment of skin disorders. Reviewing existing literature on the biological activities of *C. benghalensis*, the authors reported remarkable antioxidant, anti-inflammatory, antibacterial, and antiviral activities associated with extracts of *C. benghalensis*.

Also, a recent study by Manhas and Kaul (2023), highlited the presence of kaempferol and apigenin in *C. benghalensis*, that they associated with antioxidant properties and function of this plant species, in scavenging free radicals. These findings reinforce the potential efficacy of *Commelina* species in addressing skin disorders and establish a link between our study on *C. africana* and the common biological activities reported in other *Commelina* species.

Based on the above, we can consider that the use of CA against skin disorders in traditional *Kongo* medicine could possibly be attributed to the antioxidant, antifungal and anti-inflammatory properties of tentatively identified constituents.

4.5.2. Regarding *K. uncinata*

It appears that most of the tentatively identified compounds in KU leaf extracts are flavonoids (14), followed by phenylethanoid glycosides (7), phenolic acids (2), and one iridoid glycoside (1). Several previous studies, as reported by Çalış and Başer (2021), have already confirmed the presence of the tentative identified compounds in the Lamiaceae family, highlighting the chemical diversity and the potential biological and pharmacological activities of plants within this family. These compounds are known to provide a wide range of biological effects, including antiviral, anti-inflammatory, cytotoxic, antimicrobial, antiallergic and antioxidant activities (Chathuranga *et al.*, 2019; González-Gallego *et al.*, 2010).

The antiviral activity of some identified compounds such as flavonoids has been documented to play an important role in reducing the incidence and symptoms of upper respiratory tract infections. They act against the infectivity and/or replication of certain RNA and DNA viruses (Kaul *et al.*, 1985; Sánchez *et al.*, 2000; Somerville *et al.*, 2016; Yao *et al.*, 2022) and regulate cell apoptosis (Zakaryan *et al.*, 2017).

The mechanism of action of flavonoids on upper respiratory tract infections was investigated by Dayem *et al.* (2015), who found that hydroxy and methoxy substitution of flavonoids (i.e. quercetin, kaempferol, and isorhamnetin) may contribute to their antiviral potency against upper respiratory infection viruses.

Phenolic acids are known to inhibit the multiplication of viruses at different stages of the viral life cycle (i.e. entry, replication, assembly and maturation, and release) and to affect biochemical processes in the host cell that viruses use for their own benefit (Ding *et al.*, 2017; Kowalczyk *et al.*, 2021). Ding *et al.* (2017), showed in an experiment with mice infected with influenza that chlorogenic acid (**K2**) suppressed viral mRNA transcription and subsequent protein translation during infection. Chlorogenic acid (**K2**) also protected cells from viral infection and reduced the viral production. According to Ikeda *et al.* (2011), the free carboxyl group could be responsible for the antiviral activity of chlorogenic acid (**K2**).

Phenylethanoid glycosides such as acteoside (verbascoside) (**K11**), are known to be effective against a wide range of respiratory tract infections (Song *et al.*, 2016). Chathuranga *et al*. (2019), reported the antiviral activity of acteoside by inhibiting intracellular viral RNA transcription, viral gene expression and preventing virus-induced cells death (apoptosis).

Concurrently, iridoid glycosides were also reported to possess potent antiviral properties against respiratory tract infections. They inhibit the transcription and replication of genes of respiratory pathogenic viruses and alleviate acute lung injury and cell damages induced by the virus (Guo *et al.*,2020). Zhang *et al.* (2017), investigated mice with upper respiratory infections and found that treatment with geniposide (an iridoid glucoside) significantly restored body weight, reduced mortality and attenuated viral titres and virus-induced lung damage. Geniposide also significantly inhibited virus-induced alveolar wall changes, alveolar haemorrhage and neutrophilic infiltration of lung tissue. Levels of inflammatory mediators, including tumour necrosis factor, were also significantly altered after treatment with geniposide.

These examples of documented research provide confirmation of the antiviral and anti-inflammatory effects of certain compounds identified in our study, specifically in relation to their efficacy against upper respiratory tract infections. Consequently, it is plausible to attribute the use of KU in traditional *Kongo* medicine for treating upper respiratory tract infections to the antiviral and anti-inflammatory properties exhibited by these constituents.

In the available literature on *K. uncinata*, Dorsaz *et al*. (1985) highlighted the presence of uncinatone, an antifungal hydroquinone diterpenoid. However, in the absence of additional bibliographic data, it is not possible to comment on its biological potential in relation to diseases of the upper respiratory tract. Another publication by Watt and Breyer-Brandwijk (1962) documented the Bemba tribe's (Zambia) use of a decoction of *K. uncinata* roots as a gargle to alleviate sore throat discomfort, a common symptom associated with upper respiratory tract infections. This traditional use of root decoction for gargling suggests a historical application for relieving symptoms related to infections affecting the upper respiratory tract, particularly the throat. The rationale behind this practice may be related to the beneficial biological effects associated with KU, particularly in the treatment of infections or discomfort associated with upper respiratory tract infections. Unfortunately, the lack of relevant phytochemical and bioactivity data prevented a closer link between the reported information and our findings.

Furthermore, the decision to use KU leaf extracts rather than root extracts, as used in *Kongo* traditional medicine, for phytochemical analysis is based on our commitment to sustainable harvesting of medicinal plants, which is particularly important given the increasing rarity of the plant species in the region. This approach aims to ensure the long-term availability of medicinal plants and prevent the overexploitation of species. Harvesting roots has the potential to disrupt the plant's physiology and jeopardize its survival. Prioritizing leaves is a strategic approach aimed at minimizing the impact on the viability of the species.

However, we contend that opting for leaves does not significantly compromise the results, considering the substantial variability in the production and diversity of compounds between roots and leaves across different plant species. Research by Weinhold *et al*. (2022), Dermane *et al*. (2020) and Rui *et al.* (2020), have demonstrated that the composition and quantity of compounds produced by different parts of a plant can be influenced by various factors, including the specific plant species, environmental conditions, and the physiological state of the plant. In some cases, roots may contain basically the same compounds, but that the quantitative composition may be different. For instance, roots may store distinct bioactive compounds, while leaves play a central role in photosynthesis and contain a diverse range of compounds associated with this process.

The rationale behind the use of an hydromethanolic solvent mixture (MeOH 80%) for the extraction of *C. africana* or *K. Uncinata* leaf extract, instead of maceration or decoction like it is done in the *Kongo* traditional preparation of the plant material, lies in the ability of MeOH 80% to optimize the extraction efficiency of plant constituents, and to produce a concentrated extract compared to traditional decoction or maceration methods (Plaskova and Mlcek, 2023, Rasul, 2018; Sik *et al.*, 2020 Thouri *et al.*, 2017, Tourabi *et al*., 2023). Moreover, scientific literature indicates that a hydroalcoholic mixture, yields a higher quantity of bioactive components with a remarkable concentration compared to decoction or maceration. Traditional decoction or maceration extraction methods are known for theirs limitations, including lower extraction selectivity and longer extraction times (Thouri *et al.*, 2017; Rasul, 2018; Sik *et al.*, 2020). The use of MeOH 80% not only overcomes these drawbacks but also ensures a more efficient extraction process, ultimately resulting in a more concentrated and potent extract.

4.6. Conclusion

We performed a phytochemical study to unveil the chemical compounds responsible for the therapeutic effects observed in these plants, aiming to provide a scientific basis for their use in traditional *Kongo* medicine. A comprehensive phytochemical analysis of leaf extracts from CA and KU was successfully performed using UPLC-ESI-QTOF-MS. All compounds identified are known (from other plant sources), and for most of them the biological activities related to the traditional use have extensively been investigated before. Therefore, and because our work was focused on phytochemical profiling of the extracts and not on isolating pure compounds, we have based the discussion of the biological activity on published data, rather than repeating activity testing and confirming known information. Reported activities nicely support the traditional use. We think that repeating activity testing would not add any novelty to the study. The results obtained further reinforce our conclusion that these plants exhibit promising potential in the treatment of specific diseases, supporting the relevance of their integration into traditional medical practices.

For CA, the presence of 22 compounds, mainly flavonoids, confirms its traditional application in treating skin disorders. Notable constituents such as apigenin (**C19**) and quercetin (**C17**) exhibit antioxidant, anti-inflammatory and antifungal properties, suggesting a potential mechanism for relieving skin-related symptoms.

Regarding KU, the analysis revealed 24 compounds, most of which are flavonoids and phenylethanoid glycosides, aligning with its traditional use for upper respiratory tract infections. Compounds like quercetin (**K19**), Chlorogenic acid (**K2**) and acteoside (**K11**), known for their antiviral and anti-inflammatory effects, provide a plausible explanation for the efficacy of KU in respiratory conditions.

Although the LC-MS analysis method we used was effective, it did not allow us to identify with more certainty the exact compounds involved, nor their structure. Therefore, we recommend the isolation and quantification of individual compounds as essential steps to elucidate the structures of tentatively identified compounds and understand the complex interaction of these compounds. Advanced analytical techniques such as nuclear magnetic resonance (NMR) spectroscopy can provide valuable information about the chemical structure of compounds present in an extract. NMR spectroscopy enables precise insights into the constituents of the extract, allowing to accurately identify and characterize individual molecules within the extract. This capability facilitates literature searches for data on the

bioactivity or activity testing of these compounds. Thus, the combination of compounds with complementary effects, when isolated and quantified, can lead to additive and synergistic effects, enhancing the potency and efficacy of the extract. Moreover, a meticulous analysis of the concentration of each compound will provide a precise understanding of their individual contributions to the overall therapeutic effect.

The emergence of additive and synergistic effects, supported by rigorous isolation and quantification, can result in increased potency, improved therapeutic efficacy, and potentially reduced side effects compared to the use of each compound individually (Basavegowda and Baek, 2022; Caesar and Cech, 2019; Vaou *et al.*, 2022). Therefore, a thorough investigation involving the isolation, quantification, and characterization of these interactions is crucial. This approach will not only contribute to a more nuanced understanding of the plant's pharmacological potential but will also pave the way for identifying optimal combinations for safe and effective use. Rigorous isolation and quantification methods will add precision to our study, increasing its scientific rigor and value.

However, further research and clinical studies are essential to fully understand the specific mechanisms of action and validate the efficacy of these plants in treating the diseases for which they are used.

Based on the IUCN Red List database, no relevant information exist regarding the global conservation status of CA and KU. Nevertheless, the conducted ecofloristic research revealed a concerning trend for the specific region of Mbanza-Ngungu, showing that these two species are becoming increasingly rare in their harvesting areas within the Mbanza-Ngungu region, due to their naturally low abundance. Given their local importance and the scientific basis supporting their use in the traditional *Kongo* medicine, it is imperative that these two species deserve sustained attention and concerted conservation efforts. This may involve *ex situ* conservation, followed by reintroduction into the wild, to ensure their continued existence.

Chapter 5. GENERAL CONCLUSION, SUGGESTIONS AND PERSPECTIVES

Our study aimed to assess and document the expertise and traditional medicinal knowledge of *Kongo* people, with a specific focus on identifying the most important medicinal plants with effective pharmacological properties, as well as the key people who hold this knowledge, which is currently threatened by erosion. Additionally, the study sought to explore the vegetation of the Mbanza-ngungu region, which is still relatively unknown to the general public, by studying its composition and dynamics, and assessing the state of conservation and availability of plants, particularly important medicinal plants, in their natural environments, where they are harvested. Furthermore, the phytochemical composition of selected key medicinal species was studied to provide a scientific basis for their traditional use in *Kongo* phytotherapy, with the hope of generating interest and confidence in the younger generation towards traditional medicine.

5.1. Ethnobotanical characterization

5.1.1. *Kongo* medicinal plant and knowledge

Ethnobotanical studies showed that *Kongo* herbal medicine is widespread, well-established, and deeply ingrained in the local culture, transcending all social categories, including age, gender, education, location, etc. Quantitative ethnobotanical parameters, including UV (Use Value) and IAR (Index of Agreement Ratio) enabled the identification of the most important medicinal plants in the area under study. Combination of these parameters with ICF (Informant Consensus Factor) allowed the definition of a new parameter "Species Therapeutic Potential" (STP). This parameter proved to be an excellent tool for accurately identifying and selecting species for which at least two people agreed on their use for a particular disease, as potentially effective key species for further phytochemical studies.

Study on ethomedicinal expertise exhibited low ethnocultural similarity between the two territories, despite the large number of common species and diseases reported in both areas. Furthermore, the *Kongo* ethnomedicinal knowledge and expertise showed to be dependent on gender, location, and categories of phytotherapists; with men, respondents from the urban area of Mbanza-Ngungu and, curing healers exhibiting a more advanced medicinal expertise compared to women, respondents from rural areas of Mbanza-Ngungu, and traditional health practitioners.

5.1.2. Strengths and weaknesses

Ethnobotanical surveys, conducted through semi-structured interviews, proved to be a comprehensive approach, covering various aspects of the research question, delving into the most crucial medicinal plants and key respondents who form the bedrock of *Kongo* traditional medicine of Kisantu and Mbanza-Ngungu . This method provides crucial guidance for the planning and implementation of targeted ethnobotanical surveys in these specific regions. It successfully enabled the identification, collection, and documention of *Kongo* medicinal plant species and their related knowledge in Kisantu and Mbanza-Ngungu. Ethnobotanical surveys yielded a comprehensive overview of the most useful plants and the level of medicinal expertise among respondents, offering a valuable guide. This guide is intended not only to inform decision-makers about the most important medicinal plant species and the conservation strategies to be promoted, but also to help select the most competent participants with this knowledge for future ethnobotanical surveys in the study region or elsewere.

Unfortunately, despite the wealth of traditional knowledge accumulated over centuries, the *Kongo* medicinal knowledge still suffers from a lack of sharing. This is exacerbated by the general tendency of phytotherapists to keep their knowledge secret. This reluctance to share information not only limits access to this knowledge for science and posterity, but also contributes to the extinction of plants and the loss of their related medicinal use.

5.1.3. Achievements and recommendations

This thesis is a repository of traditional *Kongo* medicinal knowledge, ensuring its survival for present and future generations. It also serves as a methodological guide and reference for students and researchers interested in the initiation or continuation of ethnobotanical studies in the region or elsewhere.

The innovative Specific Therapeutic Potential (STP) parameter we defined represents a significant scientific advance, making it possible to identify and select the most important medicinal species in a given region or cultural context. Its simplicity and methodological rigor, based on a consensus on the use of a plant to treat a particular disease, represent a significant contribution to the field of ethnobotany and provide a solid basis for comprehensive phytochemical studies. This parameter has already found an echo in academic work, as evidenced in particular by its inclusion in research projects, such as that of Kyolo *et*

al. (2022). The successful use of STP to identify plant species with greater therapeutic potential for the treatment of mental disorders in Goma (DRC) highlights the effectiveness and applicability of this innovative parameter. The use of STP in this research illustrates its usefulness and relevance on a global scale, particularly for the careful selection of plant species with exceptional medicinal properties.

Regarding reluctance of informants to share ethnomedical information, it would be a serious mistake to continue to keep this knowledge secret, because when medicinal plants and their users disappear, knowledge is lost and secrecy becomes useless. To remedy this situation, it is imperative to promote a culture of knowledge sharing within the community of *Kongo* phytotherapists. This initiative could not only strengthen the transmission of traditional knowledge, but also contribute to the conservation of medicinal plant species and their sustainable use in a medicinal context by encouraging this open communication. It would also be desirable for the Congolese government to provide a regulatory framework that preserves and guarantees the intellectual property rights of phytotherapists. Recognition and legal protection for phytotherapists and their valuable knowledge would encourage them to become more actively involved in sharing their expertise with researchers. This collaboration would encourage a mutually beneficial exchange of traditional medicinal knowledge and results of scientific research. Furthermore, granting rights to herbalists over their medicinal knowledge can help protect traditional knowledge against misappropriation and unauthorized use.

5.2. Characterization of the vegetation of Mbanza-Ngungu and the state of conservation and availability of associated medicinal plants in their natural habitat

The floristic study, based on a comprehensive ecofloristic approach, proved to be an effective and rapid strategy for understanding the composition and dynamics of the vegetation of Mbanza-Ngungu. It also allowed an analysis of the distribution and accessibility of plants that constitute the vegetation, with a particular focus on medicinal plants, in their natural habitat where they are harvested. Through the use of frequency indices, this study successfully identified the most endangered plants, focasing mainly on medicinal plant species. The aim of this identification is to provide valuable and detailed information that can guide decision makers and users. The ultimate goal of this guidance is to implement conservation strategies aimed at significantly ensuring the survival of these plants, thereby contributing to the preservation of the knowledge associated with their use in traditional *Kongo* medicine.

5.2.1. Floristic composition and vegetation characteristics

The ecofloristic study revealed a rich and diverse vegetation, which can be grouped, on the basis of the physiognomy of the landscape, into four plant formations, including savannah, anthropized formation, swamp and dryland forests. The analysis of the floristic composition enabled identification of 709 botanical species, 113 families and 446 genera. However, their availability in nature varies, with some being relatively common while others are rare or very rare. Nevertheless, the study showed that rare species predominated over common species (Figure 3.8).

The vegetation of the studied region exhibited the general characteristics of a degraded Guinean-Congo flora in the intertropical zone, characterized by the dominance of species from the Fabaceae family, phanerophytes, herbs, species with mesophyll-sized leaves, sarcochores and ballochores, pantropical and species belonging to the *Musango-Terminalietea* phytosociological group.

The analysis of similarities between plant formations showed that the closest resemblances are found between plant formations that are close to each other in the natural vegetation succession process. The Whittaker dissimilarity analysis on the other hand, showed low indices within dryland forests and savannahs, indicating a significant overlap in the floristic composition of the studied ecofloristic plots, characterized by a prominent presence of constant species.

Regarding species distribution and availability, most of them showed a restrictive ecological niche and exhibited a low frequency of occurrence. Furthermore, during our study, a notable trend emerged regarding numerous local species, particularly those with medicinal properties, who seem to display a significant decline in their natural habitats. As a consequence, these species can tentatively be categorized as rare or endangered within the investigated region. Interestingly, a few individuals of these rare species were found intentionally cultivated near human settlements, indicating a conscious effort to conserve them in order to ensure their sustainability and availability. This is the case for *Croton mubango* Müll.Arg., *Cymbopogon densiflorus* (Steud.) Stapf., *Cyperus articulatus* L., *Mondia whitei* (Hook. f.) Skeels, etc. Conversely, alarming reports indicate the complete disappearance of certain species from the region. Despite thorough inventories and surveys, no specimens or evidence of their existence could be found. This worrying situation highlights a severe decline in their populations, raising concerns about their potential extinction within the studied area.

The most well-known cases concerned *Salacia pynaertii* De Wild and *Monodora angolensis* Welw., medicinal plant species used locally against diabetes and haemorrhoids, sexual impotence, abdominal colic, vaginal retraction and hernia, respectively (Kibungu *et al.*, 2021).

5.2.2. Strengths and achievements

The ecofloristic analysis of the vegetation of Mbanza-Ngungu using an ecofloristic approach provided an overview of the vegetation of the region, which is relatively unknown to the general public. This study allowed to understand the evolution of the local vegetation and the threats it faces due to the disappearance of certain species, with particular emphasis on the most important medicinal plants of the region. The survival of these plants is closely linked to the preservation of the indigenous knowledge and practices associated with them. This research is of paramount importance as it has a direct impact on the future well-being of rural communities, whose livelihoods and socio-cultural sustainability are closely linked to the state of conservation of the surrounding ecosystems.

Consideration of the frequency of species provides an overall understanding of their relative abundance, their distribution and the most suitable habitat for their development. This method enabled to tentatively determine the conservation status of plants, especially key medicinal plant species. Thanks to this analysis, we can identify the most widespread medicinal plants and those that become rare, localized or in danger of extinction, as well as their most suitable natural habitats. Common species can play a key role in the structure and functioning of the ecosystem (by contributing significantly to maintaining ecological balance, supporting biodiversity, and influencing interactions within the ecosystem), while rare species can serve as indicators of specific environmental conditions or specific habitats. This information could be essential for effective environmental management and biodiversity conservation, as well as for making informed decision regarding the planning and preservation of natural habitats and resources they contain. Taking the example of CA and KU, whose significance in traditional *Kongo* medicine has been demonstrated (Kibungu *et al.,* 2023a; 2023b), it is observed that these species showed a concerning trend due to their increasing rarity in their original natural habitat. Although CA showed some adaptability to disturbed environments and dryland forests, it clearly prefers the understory of humid forests or wet areas, where its development and flourishing are optimal. Therefore, to preserve this species, it is crucial to focus conservation efforts specifically in these locations. On the other hand, KU thrives in trampled environments, particularly along roads crossing savannas. Testimonies from local communities indicate that this plant is severely affected by the constant harvesting

of its roots and by bush fires in the region, leading to a significant reduction in its population. Consequently, promoting soustainable plant harvesting, preserving these specific habitats, as well as combating bush fires could significantly contribute to the conservation of the species and thus, the preservation of the associated traditional medical knowledge.

By accessing accurate and comprehensive information regarding the conservation status of species, including factors such as dissemination mode, abundance, dynamics, and distribution of plants within a specific environment, we can facilitate various critical initiatives, including effective biodiversity conservation, ecosystem management support, guidance for environmental impact assessments, assistance in ecosystem restoration, and contribution to climate change research. The availability of such information could play an essential role in enabling informed decision-making processes, sustainable land use planning, preservation and management of ecosystems and their services, and ultimately ensuring a harmonious coexistence between humans and nature. These data serve as essential tools for understanding and addressing the complex relationships within ecosystems, promoting the conservation of endangered species, and safeguarding the integrity and resilience of natural habitats.

Studying plant succession patterns allows us to observe how different species colonize and become established in response to changing environmental conditions, with each plant community creating conditions that allow other plant communities to thrive. For example, early colonisers such as grasses could add nutrients to the soil, while later colonisers such as shrubs and trees might provide shelter and shade.Through this understanding, we can gain insight into the ecological processes that drive the transition from one plant formation to another and predict the future evolution of plant formations. Furthermore, this analysis also helps to identify key indicator species that are particularly well-suited to different stages of succession. Characteristic species can serve as key indicators for monitoring and assessing the health and status of ecosystems (Siddig *et al.,* 2016). These species can provide valuable information about the environmental conditions and ecological interactions within a particular plant formation. However, it is essential to consider the complex and dynamic nature of succession, which can be influenced by various factors, and to interpret the results of such comparisons with caution. For instance, in this study, a species such as *L. senegalensis* was identified as an indicator species for swamp forests due to their high frequency or presence in this ecosystem, while *H. mechowianum* or *C. spectabilis* were identified as indicator species for savannahs in the study area. A decrease in the population of these species could indicate a

decline in swamp forest or savannah health, which may be caused by factors such as habitat loss, fragmentation, degradation or changes in environmental conditions. Furthermore, being characteristic species for this ecosystems, they can also serve as pioneers for reforestation process. This example demonstrates how the identification of indicator species can provide valuable insights into the health and dynamics of specific ecosystems at different stages of succession.

Studying patterns of plant succession and understanding the environmental factors that influence plant community dynamics also allows to make informed predictions about the potential changes that will occur if a particular plant formation is left undisturbed over time. This knowledge has significant implications for ecosystem management, restoration efforts, and conservation strategies. It can inform decisions about land-use planning, habitat restoration projects, and biodiversity conservation options.

Understanding the adaptive traits and ecological functions of different species within plant formations enables the development of strategies to improve the resilience and promote the long-term stability of natural habitats. In the context of our study, the analysis of plant succession patterns following the disturbance of forest recruits enabled us for example, to understand the potential changes in species composition and community structure over time. The advanced degradation of these ecosystems resulted in shrub savannas, with a high degree of similar species, but also the loss and arrival of other accompanying species that become established over time. This information can be used to inform forest management practices, including the development of strategies to promote species recovery and the restoration of ecosystem functions. The knowledge gained from these studies can be directly applied to make informed decisions about ecosystem management, restoration efforts and conservation strategies.

Ultimately, our research not only documents the vegetation of Mbanza-Ngungu, but also aims to raise awareness and inform the local community of the potential repercussions associated with the loss of medicinal plants and traditional knowledge. By adopting this approach, we intend to establish a basis for informed decision-making in relation to the management of natural resources while taking into consideration the ecological balance to mitigate species loss and extinction.

By raising community awareness, we aim to make a significant contribution to the conservation of biodiversity and the preservation of traditional knowledge, which is integral to the health and well-being of local people. The disappearance of these species threatens not only ancient indigenous knowledge accumulated over centuries, but also many powerful and effective plants and remedies that are essential to scientific progress and human development.

5.2.3. Weaknesses and recommendations

The categorization of medicinal plant species based on their observed (state of) rarety in the field revealed some ambiguity regarding their disappearance, highlighting the need for more comprehensive and large-scale studies to address uncertainties regarding their availability and rarity. Phytosociological studies, particularly those including the sigmatist (or Braun-Blanquet) approach, involve detailed field surveys that record plant species along with their cover or abundance and the degree of association between species are recommended. These studies can be crucial tools in gaining a clearer and more comprehensive understanding of the conservation status of plant species within the studied region. This approach provides greater clarity and precision, offering more robust evidence and certainty regarding the conservation status of species within an ecosystem.

Although our method is rigorous and provides a comprehensive view of the studied vegetation, it seems not to precisely reveal the true conservation status of the identified plant species or dispel the ambiguity surrounding the disappearance of certain species. This is because it is often easier to prove the presence of a species than its absence. That's why we recommend and believe that the adoption of the sigmatist phytosociological approach which involves detailed field surveys to record plant species with their cover, abundance and dominance, seems to be the most relevant, as it helps eliminate ambiguities regarding the rarity or abundance of a species.

Furthermore, *Kongo* medicinal species (i.e. *M. whitei*, *M. angolensis*, *E. suaveolens*, *O. ulvifolia*, *D. laurentii*, *S. pynaertii*, *C. africana*, *S. longepedunculata*, *K. uncinata*, *C. articulatus*, *C. densiflorus*, etc.) that showed a worrying trend or were found to be extinct or on the verge of extinction due to their low abundance (frequency), availability, rarity and disappearance, could be subjected to in-depth research to determine their true conservation status in the study area. Once this is achieved, they can be considered for inclusion in the UICN Red List of Threatened Species for the Province of Kongo-Central (RDC).

5.3. Phytochemical profiling of *Kongo* medicinal plants, a first step in the search for a scientific basis for their traditional use

This chapter focused to a phytochemical profiling of *Commelina africana* (CA) and *Kalaharia uncinata* (KU), widely used in *Kongo* traditional medicine for addressing skin conditions and upper respiratory tract infections, respectively. Despite their extensive traditional use, there is a lack of documented relevant phytochemical information for these plant species. To address this issue, UPLC-ESI-QTOF-MS analysis was performed and successfully assessed the main phytochemical constituents from leaf extracts of CA and KU, a first step in the search for a scientific basis for their traditional use. We therefore focused solely on compound identification, to determine the rationale behind their use and to provide a scientific basis to support their traditional medicinal applications. Tentatively identified compounds and the documented biological effects associated with them provided evidence of the traditional use of these plants in traditional *Kongo* traditional medicine.

5.3.1. Strengths and achievements

Naturally occurring phenolic compounds tentatively identified from leaf extracts of CA, such as flavonoids, hydroxycinnamic acids, phenolic acids, and lignanamides, are reported to exert a wide range of biological activities against skin disorders. These activities include antioxidant, anti-inflammatory, antimicrobial, and antifungal effects, that exhibit potential mechanisms of action to alleviate symptoms and inhibit the development of various skin disorders. On the other hand, phytochemical compounds like flavonoids, phenylethanoid glycosides, phenolic acids, and iridoid glycosides from KU leaf extracts are recognized for delivering a variety of biological effects. These effects include antiviral, anti-inflammatory, cytotoxic, antimicrobial, antiallergic, and antioxidant activities, that could play a crucial role in reducing the incidence and symptoms of upper respiratory tract infections. They are reported to inhibit viral multiplication, act against the transcription and replication of viral genes, alleviate pulmonary lesions, regulate cell apoptosis and reduce inflammation.

Documented data from literature corroborate these findings and therefore support the traditional use of these species in the *Kongo* traditional medicine. These findings are a noble contribution to science by providing information on the phytochemical composition of these two species, information that did not exist before. Our results represent a valuable contribution to science, not only by providing previously unavailable information on the phytochemical composition of these two species, but also by paving the way for more in-depth scientific studies (chemical, biological and clinical) that can enhance our understanding of these plant species, particularly their constituents and associated pharmacological capabilities.

5.3.2. Weaknesses and recommendations

In the current study a classical data analysis for tentative identification of compounds by UHPLC-HRMS was performed. This approach is labor-intensive, but guarantees a high quality output of tentatively identified compounds. Although the LC-MS analysis method used was effective, it did not allow us to identify with more certainty the exact compounds involved, nor their structure.

To further advance the understanding and use of these compounds, we suggest (1) to conduct in-depth characterization of the identified compounds to elucidate their chemical structures, properties, and mechanisms of action. Advanced analytical techniques, such as nuclear magnetic resonance (NMR) spectroscopy can provide valuable insights into the structural characterization of tentatively identified compounds and hence, their therapeutic potential. As reported before, by providing valuable information about the chemical structure of compounds present in an extract, NMR spectroscopy can provide precise insights into the constituents, allowing identification and characterization of individual molecules within the extract accurately, thus facilitating searches on the bioactivity of these compounds.

(2) to conduct comprehensive bioactivity studies, including *in vitro* and *in vivo* assays, to evaluate the efficacy and safety of the identified compounds against specific skin disorders and respiratory tract infections, as well as to assess their antioxidant, anti-inflammatory, antiviral, and other relevant properties.

(3) to explore the development of formulations such as improved traditional medicines, incorporating well characterized extracts. Topical creams can be used for skin disorders, optimizing delivery and therapeutic efficacy. For respiratory tract infections, inhalation formulations or nasal sprays can be considered to improve drug efficacy. These

approaches optimize the stability, bioavailability and targeted delivery of active compounds, offering new opportunities to improve medical treatments.

(4) to conduct well-designed clinical trials to assess the safety and efficacy of CA extracts or formulations containing the identified compounds for the treatment of skin disorders. Similarly, to evaluate the efficacy and safety of KU extracts or formulations for the treatment of respiratory tract infections. These trials should involve a diverse patient population, assess relevant clinical endpoints, and compare treatment outcomes with standard therapies. The results of these trials will provide valuable evidence regarding the effectiveness and potential benefits of these preparations in clinical practice.

(5) in parallel with clinical trials, comprehensive safety and toxicity assessments should be performed to evaluate the long-term effects and potential adverse reactions of the identified compounds and formulations. This is crucial for ensuring the safety and well-being of patients using these treatments.

(6) encouraging collaboration between researchers, pharmaceutical companies, dermatologists, and traditional medicine practitioners can foster knowledge exchange and accelerate the development of novel and innovative treatments. Sharing findings, expertise and resources can lead to synergistic efforts and ultimately benefit patients suffering from skin disorders or respiratory tract infections.

(7) exploring the integration of traditional medicine practices, such as the use of CA or KU in *Kongo* medicine, with modern scientific approaches can provide valuable insights and potentially uncover new treatment modalities. Collaborating with traditional medicine practitioners and incorporating their knowledge and experience can enrich the research and development process.

By implementing these suggestions and recommendations, a deeper understanding of the identified compounds can be achieved, leading to the potential development of formulations incorporating these extracts and compounds. Additionally, conducting rigorous clinical trials will provide essential evidence of their efficacy in treating skin disorders or upper respiratory tract infections. These types of research projects could have the potential to significantly advance the field of dermatology or respiratory tract infections and thus contribute to the development of innovative and effective therapies.

5.4. In conclusion

Our study focused on the decline of *Kongo* traditional medicinal knowledge in Kisantu and Mbanza-Ngungu territories, employing an interdisciplinary approach that integrated ethnobotany, ecology, and phytochemistry to address this issue. The decline of *Kongo* traditional medicine, characterized by the disappearance of plant species, habitats loss and the waning interest of younger generations, was a key concern. The study aimed to identify key species and custodians of traditional knowledge, understand the state of plants in their natural environment, and unveil the rationale behind the use of plants in *Kongo* traditional medicine.

The ethnobotanical study documented essential medicinal plant species, their uses, and key informants who serve as guardians of this *Kongo* cultural heritage. The introduction of the new approach, called " Species Therapeutic Potential " (STP), allowed the selection of species with crucial pharmacological properties, which was well-received in the scientific community, representing a significant contribution to ethnobotany.

The ecofloristic study provided crucial information on the current state of plants in Mbanza-Ngungu, focusing on the availability of key medicinal plant species in their natural habitats. This information is vital for guiding necessary actions to protect these plants, which are essential for traditional *Kongo* medicinal knowledge and the health and well-being of the *Kongo* community. Phytosociological studies, including the sigmatist or Braun-Blanquet approach, can provide valuable information on the abundance-dominance of species and their coverage in nature, which is crucial for accurately determining the conservation status of species. However, it is important to note that the conservation status of a plant species is influenced by various factors, including habitat loss, fragmentation, degradation, and overexploitation. Therefore, in addition to phytosociological studies, it is recommended to conduct comprehensive assessments of the threats to the species and their habitats, as well as to develop and implement effective conservation strategies to mitigate these threats.

The identification of phytochemical compounds in certain plants enhanced our understanding of the rationale behind their use and contributed to the phytochemical knowledge on these species. These scientific findings support the traditional use of these plant species, with the hope of restoring confidence in traditional medicine among younger generations and promoting in-depth research on *Kongo* phytotherapy.

In summary, the study of traditional medicinal plants plays a crucial role in preserving ancestral knowledge about plant biodiversity and its therapeutic applications. It helps document and valorize the cultural heritage of local communities while offering significant insights for biological and medical research. Moreover, it contributes to the conservation of fragile ecosystems by raising awareness about the importance of biodiversity preservation and promoting sustainable practices in natural resource utilization.

Our study provides valuable insights into the *Kongo* cultural heritage related to traditional medicine, allowing the *Kongo* people, researchers, and anyone interested in traditional *Kongo* medicine to directly immerse themselves in the knowledge of this cultural heritage, its use, its know-how, and its importance for both science and well-being.

By conducting this research, we offer valuable guidance for local communities and decision-makers, aiming to preserve essential species of *Kongo* traditional medicine, ensuring their continuity and sustainability.

Documenting and promoting *Kongo* traditional medicinal knowledge can have several potential benefits. Firstly, it can help preserve traditional knowledge for future generations and prevent the loss of valuable information. Secondly, it can provide basic data for further research and conservation, leading to the development of new medicines and treatments. Thirdly, it can promote the fair and equitable distribution of benefits from the commercialization of traditional medicine, ensuring that traditional knowledge holders receive appropriate compensation for their contributions. Fourthly, it can help protect traditional knowledge from misappropriation and exploitation by unauthorized parties. Finally, it has the potential to instill confidence in traditional medicine among younger generations and foster extensive research into *Kong*o traditional medicine practices.

References

Abdo, B.M., 2019. Physico-Chemical Profile and Antioxidant Activities of *Eucalyptus globulus* Labill and *Eucalyptus citriodora* Essential Oils in Ethiopia. J. Med. Aromat. Plants 8(2), 1000332. https://doi.org/10.35248/2167-0412.19.8.332

Abdullah, S., Chong, K., Ng, S., 2013. Phytochemical Constituents From Leaves of *Elaies Guineensis* and Their Antioxidants and Antimicrobial Activities. International Journal of Pharmacy and Pharmaceutical Sciences 5 (Suppl 4), 137–140.

Abubakar, A., Haque, M., 2020. Preparation of medicinal plants: Basic extraction and fractionation procedures for experimental purposes. J. Pharm. Bioallied. Sci. 12(1), 1–10. https://doi.org/10.4103/jpbs.JPBS_175_19

Acidri, R., Sawai, Y., Sugimoto, Y., Handa, T., Sasagawa, D., Masunaga, T., Yamamoto, S., Nishihara, E., 2020. Phytochemical Profile and Antioxidant Capacity of Coffee Plant Organs Compared to Green and Roasted Coffee Beans. Antioxidants 9(2), 93. https://doi.org/10.3390/antiox9020093

Ackerknecht, E.H., 1947. PRIMITIVE SURGERY*. American Anthropologist 49(1), 25–45. https://doi.org/10.1525/aa.1947.49.1.02a00030

Adewole, DR.E., Basiru, A., Idris, O., Ojo, O., Onikanni, S., Oluwafemi, O., FD, A., 2013. Phytochemical, Antimicrobial and Gc-Ms of African Nutmeg (*Monodora myristica*). Int. J. Pharm. Sci. Invent 2(5), 25–32.

Adigun, N.S., Oladiji, A.T., Ajiboye, T.O., 2016. Antioxidant and anti-hyperlipidemic activity of hydroethanolic seed extract of *Aframomum melegueta* K. Schum in Triton X-100 induced hyperlipidemic rats. South African Journal of Botany 105, 324–332. https://doi.org/10.1016/j.sajb.2016.03.015

Adjaye, J.K., 2001. The Performativity of Akan Libations: An Ethnopoetic Construction of Reality. Ghana Studies 4, 107–138.

Affonso, R.C.L., Voytena, A.P.L., Fanan, S., Pitz, H., Coelho, D.S., Horstmann, A.L., Pereira, A., Uarrota, V.G., Hillmann, M.C., Varela, L.A.C., Ribeiro-do-Valle, R.M., Maraschin, M., 2016. Phytochemical Composition, Antioxidant Activity, and the Effect of the Aqueous Extract of Coffee (*Coffea arabica* L.) Bean Residual Press Cake on the Skin Wound Healing. Oxidative Medicine and Cellular Longevity 2016, 1–10. https://doi.org/10.1155/2016/1923754

Agathokleous, S., Saitanis, C.J., Savvides, C., Sicard, P., Agathokleous, E., De Marco, A., 2022. Spatiotemporal variations of ozone exposure and its risks to vegetation and human health in Cyprus: an analysis across a gradient of altitudes. Journal of forestry research 34(3), 579-594. https://doi.org/10.1007/s11676-022-01520-2

Agbodjento, E., Klotoé, J.R., Dramane, G., Dougnon, T.V., Ategbo, J.M., 2019. *Gardenia ternifolia* Schumach. & Thonn.: revue sur les aspects ethnobotanique, ethnopharmacologique, phytochimique et toxicologique. Int. J. Biol. Chem. Sci 12 (6), 2922–2932. https://doi.org/10.4314/ijbcs.v12i6.34

Agim, C., Ci, N., Chukwuma, A., Okechukwu, A., 2017. Evaluation of the phytochemical and GC-MS analysis of the aqueous seed extract of *Aframomum melegueta*. J. Pharmacogn. Phytochem. 6(2), 101–104.

Agiriga, A.N., Siwela, M., 2018. Effects of Thermal Processing on the Nutritional, Antinutrient, and In Vitro Antioxidant Profile of *Monodora myristica* (Gaertn.) Dunal Seeds. Preventive Nutrition and Food Science 23(3), 235–244. https://doi.org/10.3746/pnf.2018.23.3.235

Agunbiade, O., Ojezele, O., Ojezele, J., Ajayi, A., 2012. Hypoglycaemic activity of *Commelina africana* and *Ageratum conyzoides* in relation to their mineral composition. Afr. Health Sci. 12, 198–203. https://doi.org/10.4314/ahs.v12i2.19

Aguoru, C., Pilla, C., Olasan, J., 2016. Phytochemical screening of Xylopia aethiopica with emphasis on its medicinally active principles. Journal of medicinal plant research 10(22), 306-309

Ahluwalia, R. and Méchin, B., 1980. Traditional Medicine in Zaire: Present and potential contribution to the health services. Edited by International Development Research Centre. Ottawa: IDRC (IDRC-137e). pp. 39. ISBN 978-0-88936-222-2

Ahmed, I., Khalid, N., 2014. Comparison of antimicrobial activity, phytochemical profile and minerals composition of garlic *Allium sativum* and *Allium tuberosum*. Journal of the Korean Society for Applied Biological Chemistry 57 (3), 311−317.

Ahmed, O.M., Abd El-Twab, S.M., Al-Muzafar, H.M., Adel Amin, K., Abdel Aziz, S.M., Abdel-Gabbar, M., 2020. *Musa paradisiaca* L. leaf and fruit peel hydroethanolic extracts improved the lipid profile, glycemic index and oxidative stress in nicotinamide/streptozotocin-induced diabetic rats. Vet. Med. Sci. 00, 1-12. https://doi.org/10.1002/vms3.389

Ahmed, Z., Shaiq Ali, M., Adhikari, A., Imran Ali, M., Ngoupayo, J., Malik, I., 2017. Formiside and seco-formiside: lignin glycosides from leaves of *Clerodendrum formicarum* Gürke (Lamiaceae) from Cameroon. Zeitschrift für Naturforschung B 72, 17–21. https://doi.org/10.1515/znb-2016-0114

Al Aboody, M.S., Mickymaray, S., 2020. Anti-Fungal Efficacy and Mechanisms of Flavonoids. Antibiotics 9(2), 45. https://doi.org/10.3390/antibiotics9020045

Alagbe, J.O., Shittu, M. D, Bamigboye Samson. O, Oluwatobi, A.O, 2020. Proximate and mineral composition of P*entadiplandra brazzeana* stem bark. International Journal on Integrated Education 3(11), 114–118. https://doi.org/10.31149/ijie.v3i11.844

Alexandra Pazmiño-Durán, E., Giusti, M.M., Wrolstad, R.E., Glória, M.B.A., 2001. Anthocyanins from banana bracts (*Musa X paradisiaca*) as potential food colorants. Food Chemistry 73(3), 327–332. https://doi.org/10.1016/S0308-8146(00)00305-8

Alfred Maroyi, 2020. *Gardenia ternifolia* Schum. & Thonn. (Rubiaceae): Review of medicinal uses, phytochemistry and biological activities. International Journal of Research in Pharmaceutical Sciences 11(4), 5876–5885. https://doi.org/10.26452/ijrps.v11i4.3238

Ali, F., Rahul, Naz, F., Jyoti, S., Siddique, Y.H., 2017. Health functionality of apigenin: A review. International Journal of Food Properties 20(6), 1197–1238. https://doi.org/10.1080/10942912.2016.1207188

Ali, M., Ibrahim, I.S., 2019. Phytochemical Screening and Proximate Analysis of Garlic (*Allium Sativum*). An Archive of Organic and Inorganic Chemical Sciences 4 (1), 1–5. https://doi.org/10.32474/AOICS.2019.04.000180

Ali, M.S., Ahmed, Z., Ali, M.I., Ngoupayo, J., 2010a. Two new aromatic acids from *Clerodendrum formicarum* Gürke (Lamiaceae) of Cameroon. Journal of Asian Natural Products Research 12(10), 894–898. https://doi.org/10.1080/10286020.2010.509718

Ali, M.S., Ahmed, Z., Ngoupayo, J., Ali, M.I., 2010b. Terpenoids from *Clerodendrum formicarum* Gürke (Lamiaceae) of Cameroon. Zeitschrift für Naturforschung B 65(4), 521–524. https://doi.org/10.1515/znb-2010-0414

Allessio Leck, M., Schütz, W., 2005. Regeneration of Cyperaceae, with particular reference to seed ecology and seed banks. Perspectives in Plant Ecology, Evolution and Systematics 7(2), 95–133. https://doi.org/10.1016/j.ppees.2005.05.001

Almeida, C., de Amorim, E., de Albuquerque, U., Maia, M., 2006. Medicinal Plants Popularly Used in the Xingó Region - A Semi-Arid Location in Northeastern Brazil. Journal of Ethnobiology and Ethnomedicine 2, 15. https://doi.org/10.1186/1746-4269-2-15

Al-Snafi, P.D.A.E., 2017. Pharmacology and therapeutic potential of *Euphorbia hirta* (Syn: *Euphorbia pilulifera*)- A review. IOSR Journal Of Pharmacy 7(3), 7–20. https://doi.org/10.9790/3013-0703010720

Al-Taweel, A.M., Perveen, S., El-Shafae, A.M., Fawzy, G.A., Malik, A., Afza, N., Iqbal, L., Latif, M., 2012. Bioactive Phenolic Amides from *Celtis africana*. Molecules 17(3), 2675–2682. https://doi.org/10.3390/molecules17032675

Aly, R., 1996. Microbial Infections of Skin and Nails, in: Baron, S. (4th ed.), Medical Microbiology. University of Texas Medical Branch at Galveston, Galveston (TX). Chapter 98. PMID: 21413322. https://www.ncbi.nlm.nih.gov/books/NBK8301/

Amadi, S.W., Zhang, Y., Wu, G., 2016. Research progress in phytochemistry and biology of *Aframomum* species. Pharmaceutical Biology 54(11), 2761–2770. https://doi.org/10.3109/13880209.2016.1173068

Amadou, B., 2021. Le Kongo, 1350-1880: plus qu'un royaume, un très vaste empire au coeur de l'Afrique centrale. Éditions AB Alkebulan, Ontario. pp. 80. ISBN 978-1-77774-283-6

Amit Koparde, A., Chandrashekar Doijad, R., Shripal Magdum, C., 2019. Natural Products in Drug Discovery, in: Perveen, S., Al-Taweel, A. (Eds.), Pharmacognosy - Medicinal Plants. IntechOpen, pp. 19. https://doi.org/10.5772/intechopen.82860

Amoa, O.P., Ntie-Kang, F., Lifongo, L., Ndom, J., Sippl, W., Mbaze, L., 2013. The potential of anti-malarial compounds derived from African medicinal plants, part I: a pharmacological evaluation of alkaloids and terpenoids. Malaria Journal 12(1), 449. https://doi.org/10.1186/1475-2875-12-449

Amorozo, MDM., 2013. Sistemas agrícolas de pequena escala e a manutenção da agrobiodiversidade–uma revisão e contribuições. Rio Claro, SP: Edição do autor. pp. 120. ISBN 978-85-902432-2-9

Amouzou, E., 2009. L'impact de la culture occidentale sur les cultures africaines. Editions L'Harmattan. pp. 193. ISBN 978-2-296-21701-0

Amujoyegbe, O.O., Idu, M., Agbedahunsi, J.M., Erhabor, J.O., 2016. Ethnomedicinal survey of medicinal plants used in the management of sickle cell disorder in Southern Nigeria. Journal of Ethnopharmacology 185, 347–360. https://doi.org/10.1016/j.jep.2016.03.042

Anyinam, C., 1995. Ecology and ethnomedicine: Exploring links between current environmental crisis and indigenous medical practices. Social Science & Medicine 40, 321–329. https://doi.org/10.1016/0277-9536(94)E0098-D

Anywar, G., Kakudidi, E., Byamukama, R., Mukonzo, J., Schubert, A., Oryem-Origa, H., 2020. Indigenous traditional knowledge of medicinal plants used by herbalists in treating opportunistic infections among people living with HIV/AIDS in Uganda. Journal of Ethnopharmacology 246, 112205. https://doi.org/10.1016/j.jep.2019.112205

Appiah, K., Oppong, C., Mardani, H., Omari, R., Kpabitey, S., Amoatey, C., Onwona-Agyeman, S., Oikawa, Y., Katsura, K., Fujii, Y., 2018. Medicinal Plants Used in the Ejisu-Juaben Municipality, Southern Ghana: An Ethnobotanical Study. Medicines 6, 1-27. https://doi.org/10.3390/medicines6010001

Aremu, A.O., Cheesman, L., Finnie, J.F., Van Staden, J., 2011. *Mondia whitei* (Apocynaceae): A review of its biological activities, conservation strategies and economic potential. South African Journal of Botany 77, 960–971. https://doi.org/10.1016/j.sajb.2011.06.010

Asai, T., Hirayama, Y., Fujimoto, Y., 2012. Epi-α-bisabolol 6-deoxy-β-d-gulopyranoside from the glandular trichome exudate of *Brillantaisia owariensis*. Phytochemistry Letters 5, 376–378. https://doi.org/10.1016/j.phytol.2012.03.006

Asch, S., 1983. L'Eglise du prophète Kimbangu: de ses origines à son rôle actuel au Zaïre, 1921-1981, Hommes et sociétés. Editions Karthala, Paris. pp. 342. ISBN 978-2-86537-069-6

Ashforth, A., 2008. Muthi, Medicine and Witchcraft: Regulating 'African Science' in Post-Apartheid South Africa? Social Dynamics 31(2), 211-242. https://doi.org/10.1080/02533950508628714

Attia, Y.M., El-Kersh, D.M., Wagdy, H.A., Elmazar, M.M., 2018. Verbascoside: Identification, Quantification, and Potential Sensitization of Colorectal Cancer Cells to 5-FU by Targeting PI3K/AKT Pathway. Sci. Rep. 8, 16939. https://doi.org/10.1038/s41598-018-35083-2

Auzias, D., Labourdette, J.-P., 2015. Congo Rdc. Country Guides. Petit Futé. pp. 528, ISBN 978-2746987203

Avila, J.V. da C., Zank, S., Valadares, K.M. de O., Maragno, J.M., Hanazaki, N., 2015. The Traditional Knowledge of Quilombola About Plants: Does urbanization matter? Ethnobotany Research and Applications 14, 453–462.

Avolio, M.L., Forrestel, E.J., Chang, C.C., La Pierre, K.J., Burghardt, K.T., Smith, M.D., 2019. Demystifying dominant species. New Phytologist 223, 1106–1126. https://doi.org/10.1111/nph.15789

Avoseh, O., Oyedeji, O., Rungqu, P., Nkeh-Chungag, B., Oyedeji, A., 2015. Cymbopogon Species; Ethnopharmacology, Phytochemistry and the Pharmacological Importance. Molecules 20, 7438–7453. https://doi.org/10.3390/molecules20057438

Avula, B.W., YH; Wang, M; Ali, Z; Smillie, TJ; Zweigenbaum, J; Khan, IA, 2012. Structural characterization of steroidal saponins from Dioscorea species using UHPLC-QTOF-MS. Planta Med. 78(11), PI385. https://doi.org/10.1055/s-0032-1321072

Awas, E., L.k, O., J.o, M., A, N., J, M., 2016. Antioxidant Activities of Flavonoid Aglycones from Kenyan Gardenia ternifolia Schum and Thonn. IOSR Journal of Pharmacy and Biological Sciences 11(3), 136-141 https://www.researchgate.net/publication/305114259_Antioxidant_Activities_of_Flavonoid_Aglycones_from_Kenyan_Gardenia_ternifolia_Schum_and_Thonn

Ayanlowo, A.G., Garádi, Z., Boldizsár, I., Darcsi, A., Nedves, A.N., Varjas, B., Simon, A., Alberti, Á., Riethmüller, E., 2020. UHPLC-DPPH method reveals antioxidant tyramine and octopamine derivatives in *Celtis occidentalis*. Journal of Pharmaceutical and Biomedical Analysis 191, 113612. https://doi.org/10.1016/j.jpba.2020.113612

Ayinde, B., Onwukaeme, D., Omogbai, E.K.I., 2007. Isolation and characterization of two phenolic compounds from the stem bark of *Musanga cecropioides* R. Brown (Moraceae). Acta poloniae pharmaceutica 64(2), 183–185.

Azeem, M., Hanif, M., Mahmood, K., Ameer, N., Chughtai, F.R.S., Abid, U., 2022. An insight into anticancer, antioxidant, antimicrobial, antidiabetic and anti-inflammatory effects of quercetin: a review. Polym. Bull. 80(1):241-262. https://doi.org/10.1007/s00289-022-04091-8

Azman, Maisarah, Akmal H. Sabri, Qonita Kurnia Anjani, Mohd Faiz Mustaffa, and Khuriah Abdul Hamid., 2022. Intestinal Absorption Study: Challenges and Absorption Enhancement Strategies in Improving Oral Drug Delivery'. Pharmaceuticals 15(8), 975. https://doi.org/10.3390/ph15080975.

Azzaz, N., El-Khateeb, A., Farag, A., 2014. Chemical composition and biological activity of the essential oil of *Cyperus articulatus*. International Journal of Academic Research Part A; 2014; 6(5), 265-269. https://doi.org/10.7813/2075-4124.2014/6-5/A.37

Bagwana, P., 2015. Indigenous knowledge of traditional medicine: Answering the question of knowledge acquisition and transmission among the traditional health practitioners in Uganda. Antropoloji 0(30), 13–32. https://doi.org/10.1501/antro_0000000318

Bahassan, A., Zidane, L., El Yacoubi, H., Rochdi, A., 2014. Ethnobotanique et taxonomie des plantes médicinales utilisées pour le traitement des pathologies du système digestif à Hadramaout (Yémen). Phytothérapie 12, 399–416. https://doi.org/10.1007/s10298-014-0897-8

Bajin ba Ndob, I., Mengome, L.E., Bourobou Bourobou, H.-P., Lossangoye Banfora, Y., Bivigou, F., 2016. Ethnobotanical survey of medicinal plants used as anthelmintic remedies in Gabon. Journal of Ethnopharmacology 191, 360–371. https://doi.org/10.1016/j.jep.2016.06.026

Balamurugan, G., Karthick, A., Sasikumar, K., 2019. Herbal plants for children diseases' cure in Perambalur, Tamil Nadu, India. Indian Journal of Traditional Knowledge 18(4), 758-768.

Bamba, I., Mama, A., Neuba, D.F., Koffi, K.J., Traore, D., Visser, M., Sinsin, B., Lejoly, J., Bogaert, J., 2008. Influence des actions anthropiques sur la dynamique spatio-temporelle de l\'occupation du sol dans la province du Bas-Congo (R.D. Congo). Sciences & Nature 5(1), 49–60. https://doi.org/10.4314/scinat.v5i1.42151

Bamps, P., 2013. A new species of *Kalaharia* (Lamiaceae) from Central Africa. Plant Ecology and Evolution 146(1), 134–137. https://doi.org/10.5091/plecevo.2013.746

Barrett, R.L., 2013. Ecological importance of sedges: a survey of the Australasian Cyperaceae genus *Lepidosperma*. Annals of Botany 111(4), 499–529. https://doi.org/10.1093/aob/mct008

Basavegowda, N., Baek, K.-H., 2022. Combination Strategies of Different Antimicrobials: An Efficient and Alternative Tool for Pathogen Inactivation. Biomedicines 10(9), 2219. https://doi.org/10.3390/biomedicines10092219

Bashir, S., 2005. Le systeme educatif de la republique democratique du Congo : Priorites et alternatives (No. 32814). The World Bank. pp. 184. [WWW Document]. URL: https://documents1.worldbank.org/curated/fr/244781468026664848/pdf/328140DRC0Systeme0educatif0AFHDno68.pdf (accessed 29.05.2020).

Bashir, S., Jabeen, K., Iqbal, S., Javed, S., Naeem, A., 2019. *Lantana camara*: Phytochemical Analysis and Antifungal Prospective. Planta daninha 37, e019193526. https://doi.org/10.1590/s0100-83582019370100137

Batiha, G., Beshbishy, A., Wasef, L., Elewa, Y., Al-Sagan, A., El-Hack, M., Taha, A., Abd-Elhakim, Y., Devkota, H., 2020. Chemical Constituents and Pharmacological Activities of Garlic (*Allium sativum* L.): A Review. Nutrients. 12, 872 https://doi.org/10.3390/nu12030872

Baya, C., 2019. Pourquoi je ne crois pas à la médecine traditionnelle ? [WWW Document]. Habari RDC. URL https://habarirdc.net/medecine-traditionnelle-tradipratien-moderne-charlatan/ (accessed 5.30.20).

Bayona, B.M.K, 1978. L'aspect juridique de la médecine des guérisseurs. Revue juridique du Zaïre: droit écrit et droit coutumier 54(1-3), 10–20.

Bayona B.M.K. 1988. L'aspect Juridique de la Médecine Traditionnelle." *Muntu : Revue Scientifique Et Culturelle Du Ciciba* 8, 102-116.

Becchi, M., Fraisse, D., 1989. Fast atom bombardment and fast atom bombardment collision-activated dissociation/mass-analysed ion kinetic energy analysis of *C*-glycosidic flavonoids. Biol. Mass. Spectrom. 18, 122–130. https://doi.org/10.1002/bms.1200180207

Behiry, S.I., Okla, M.K., Alamri, S.A., EL-Hefny, M., Salem, M.Z.M., Alaraidh, I.A., Ali, H.M., Al-Ghtani, S.M., Monroy, J.C., Salem, A.Z.M., 2019. Antifungal and Antibacterial Activities of Wood Treated with *Musa paradisiaca* L. Peel Extract: HPLC Analysis of Phenolic and Flavonoid Contents. Processes 7(4), 215. https://doi.org/10.3390/pr7040215

Behroozian, M., Ejtehadi, H., Memariani, F., Pierce, S., & Mesdaghi, M.. (2020). Are endemic species necessarily ecological specialists? Functional variability and niche differentiation of two threatened Dianthus species in the montane steppes of northeastern Iran. Scientific Reports, 10(1), 11774. https://doi.org/10.1038/s41598-020-68618-7

Beken, B., Serttas, R., Yazicioglu, M., Turkekul, K., Erdogan, S., 2020. Quercetin Improves Inflammation, Oxidative Stress, and Impaired Wound Healing in Atopic Dermatitis Model of Human Keratinocytes. Pediatric Allergy, Immunology, and Pulmonology 33, 69–79. https://doi.org/10.1089/ped.2019.1137

Belesi, K.H., 2016. Etude floristique, phytogeographique et phytosociologique de la vegetation du parc national de la salonga (Bas-Kasai – RDC) (synthese). International Journal of Innovation and Applied Studies 14(3), 709-720

Belesi, K.H., 2009. Etude Floristique, Phytogéographique et Phytosociologique de La Végétation Du Bas-Kasai en République Démocratique du Congo. Thèse de doctorat. ULB, Bruxelles. pp. 565.

Benayad, Z., Gómez-Cordovés, C., Es-Safi, N., 2014. Characterization of Flavonoid Glycosides from Fenugreek (*Trigonella foenum-graecum*) Crude Seeds by HPLC–DAD–ESI/MS Analysis. International Journal of Molecular Sciences 15(11), 20668–20685. https://doi.org/10.3390/ijms151120668

Benchiha, Walid & Samira, Mahroug & Bennaoum, Zineb & Bouterfas, Karim., 2014. Characterization of Habitat of *Rhamnus alaternus* L. at the Jebel Tessala (North-Western Algeria). J. Chem. Chem. Eng. 8, 1036-1048. https://doi.org/10.17265/1934-7375/2014.11.004.

Benkhnigue, O., Zidane, L., Fadli, M., Elyacoubi, H., Rochdi, A., Douira, A., 2010. Etude ethnobotanique des plantes médicinales dans la région de Mechraâ Bel Ksiri (Région du Gharb du Maroc). Acta botánica barcinonensia 53, 191–216. https://raco.cat/index.php/ActaBotanica/article/view/252920/339658 (accessed 28.02.2020)

Benlamdini, N., Elhafian, M., Rochdi, A., Zidane, L., 2014. Étude floristique et ethnobotanique de la flore médicinale du Haut Atlas oriental (Haute Moulouya). J. App. Bioscience. 78(1), 6771. https://doi.org/10.4314/jab.v78i1.17

Benoît, É., 2008. Les changements climatiques : vulnérabilité, impacts et adaptation dans le monde de la médecine traditionnelle au Burkina Faso. Vertigo 8(1), 1-13 https://doi.org/10.4000/vertigo.1467

Betti, J.L., 2001. Vulnerabilite des plantes utilisees comme antipaludiques dans l'arrondissement de Mintom au sud de la reserve de biosphere du Dja (Cameroun). Systematics and Geography of Plants 71(2), 661-678. https://doi.org/10.2307/3668709

Bews, J.W., 1920. Plant Succession and Plant Distribution in South Africa. Annals of Botany 34(134), 287–297. [WWW Document] https://www.jstor.org/stable/43236879

(BGCI), 2018. IUCN Red List of Threatened Species: *Dracaena mannii* [WWW Document]. IUCN Red List of Threatened Species. URL https://www.iucnredlist.org/en (accessed 6.1.20).

Bhat, S., Rajanna, L., 2017. Preliminary Phytochemical Analysis and in vitro antioxidant Potential of Fruit Stalk of *Capsicum annuum* var. *glabriusculum* (Dunal) Heiser & Pickersgill - ProQuest. J. Pharm. Sci. & Res 9, 1283–1287.

Bhattarai, S., Chaudhary, R.P., Taylor, R.S., 2006. Ethnomedicinal plants used by the people of Manang district, central Nepal. J. Ethnobiol. Ethnomed. 2, 41. https://doi.org/10.1186/1746-4269-2-41

Bhavani, T., Mohan, R.R., Mounica, C., Nyamisha, J., Krishna, A.G., Raja, D.R.R., Baba, D.K.H., 2019. Phytochemical screening & antimicrobial activity of *Ocimum gratissimum* review. Journal of Pharmacognosy and Phytochemistry 8(2), 76–79.

Bibeau, G., 2013. Un hôpital en forme de village: Au temps de la politique mobutiste de l'« authenticité » (1972-1977). Anthropologie et Sociétés 37(3), 25–43. https://doi.org/10.7202/1024077ar

Bibeau, G., 1984. Authenticité et ambiguïté d'une implication dans un institut africain de recherche. Anthropologie et Sociétés 8(3), 95-115. https://doi.org/10.7202/006220ar

Bickers, D.R., Athar, M., 2006. Oxidative Stress in the Pathogenesis of Skin Disease. Journal of Investigative Dermatology 126(12), 2565–2575. https://doi.org/10.1038/sj.jid.5700340

Bolaji, O., John, O., Toluwani, F., Adisa, L., 2018. Evaluation of Phytochemical Constituents and Antimicrobial Activity of Leaves and Stem Bark Extracts of *Sarcocephalus latifolius*. Microbiology Research Journal International 24(2), 1–10. https://doi.org/10.9734/MRJI/2018/41887

Bolleddula, J., Fitch, W., Vareed, S.K., Nair, M.G., 2012. Identification of metabolites in *Withania sominfera* fruits by liquid chromatography and high-resolution mass spectrometry: Metabolites of *Withania* fruits. Rapid Commun. Mass Spectrom. 26(11), 1277–1290. https://doi.org/10.1002/rcm.6221

Bongango, J., 2012. L'Étude des interdits chez les Mongo: La rencontre entre l'éthique Bantu et la morale chrétienne. Editions Publibook. pp. 520. ISBN 978-2-7483-7576-3

Boo, Y.C., 2019. Can Plant Phenolic Compounds Protect the Skin from Airborne Particulate Matter? Antioxidants 8(9), 379. https://doi.org/10.3390/antiox8090379

Boukhatem, M.N., Ferhat, M.A., Kameli, A., Saidi, F., Kebir, H.T., 2014. Lemon grass (*Cymbopogon citratus*) essential oil as a potent anti-inflammatory and antifungal drugs. Libyan Journal of Medicine 9(1), 25431. https://doi.org/10.3402/ljm.v9.25431

Boulogne, M.P., A., P., Dubiez, E., M., G., Péroches, A., J., L., J., R., Proces, P., R., P., J-N, M., Gond, V., 2013. Evolution du couvert végétal et des stocks de carbone dans le bassin d'approvisionnement de Kinshasa, in: Marien, J.-N., Dubiez, Emilein, Louppe, D., Larzillière, A. (Eds.), Quand La Ville Mange La Forêt, Les Défis Du Bois-Énergie En Afrique Centrale, Matière à Débattre & Décider. Editions Quae, Versailles, pp. 238. ISBN 978-2-7592-1980-3

Bourdarias, F., Lepalec, A., 1995. Guérisseurs et médecins, interactions et stratégies. A propos du colloque «Médecine traditionnelle et sida ». Journal des anthropologues 60(1), 51–61. https://doi.org/10.3406/jda.1995.1896

Bozize, F., 2002. LOI N° 72.002. portant organisation de l'exercice de la pharmacopée et de la médecine traditionnelle en République Centrafricaine. Décret présidentiel, RCA, 2002. pp. 7 [WWW Document]. URL https://www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/LOI-SUR-LA-MTR.pdf

Brito, A., Ramirez, J., Areche, C., Sepúlveda, B., Simirgiotis, M., 2014. HPLC-UV-MS Profiles of Phenolic Compounds and Antioxidant Activity of Fruits from Three *Citrus* Species Consumed in Northern Chile. Molecules 19, 17400–17421. https://doi.org/10.3390/molecules191117400

Brunner, B.M., Combet, V., Callahan, S., Holtz, J., Mangone, E., Barnes, J., Clarence, A., Gober, S., 2019. The Role of the Private Sector in Improving the Performance of the Health System in the Democratic Republic of Congo (No. 131045). The World Bank. pp. 135. [WWW Document]. URL http://documents.worldbank.org/curated/en/335191548260500149/The-Role-of-the-

Private-Sector-in-Improving-the-Performance-of-the-Health-System-in-the-Democratic-Republic-of-Congo (accessed 23.01.2019).
Buckle, J., 2015. Basic Plant Taxonomy, Basic Essential Oil Chemistry, Extraction, Biosynthesis, and Analysis, in: Buckle, J. (Ed.), Clinical Aromatherapy (Third Edition). Churchill Livingstone, St. Louis, pp. 37–72. https://doi.org/10.1016/B978-0-7020-5440-2.00003-6
Bultot, F., 1954. Saisons et périodes sèches et pluvieuses au Congo Belge et au RwandaUrundi (Comm.n° 9 du Bureau climatologique). Publ. INEAC., (1954), 25-30., Communication. Institut National pour l'Étude Agronomique du Congo Belge. [WWW Document]. URL. https://books.google.be/books?id=TQdKHAAACAAJ
Butt, Masood Sadiq, Sultan, M.T., Butt, Mehmood S., Iqbal, J., 2009. Garlic: Nature's Protection Against Physiological Threats. Critical Reviews in Food Science and Nutrition 49, 538–551. https://doi.org/10.1080/10408390802145344
Caddeo, C., Díez-Sales, O., Pons, R., Fernàndez-Busquets, X., Fadda, A.M., Manconi, M., 2014. Topical anti-inflammatory potential of quercetin in lipid-based nanosystems: in vivo and in vitro evaluation. Pharm. Res 31, 959–968. https://doi.org/10.1007/s11095-013-1215-0
Caesar, L.K., Cech, N.B., 2019. Synergy and antagonism in natural product extracts: when 1 + 1 does not equal 2. Nat. Prod. Rep. 36, 869–888. https://doi.org/10.1039/C9NP00011A
Cahen, L., 1954. Géologie du Congo Belge. Liège : H. Vaillant-Carmanne SA., Liège. 1 vol. (XIII-577 p.-17 p. de pl.)
CAID, 2017. Cellule d'Analyses des Indicateurs de Développement [WWW Document]. URL https://www.caid.cd/ (accessed 04.12.20).
Cailteux, J., R.a. Delpomdor, F., Ndobani, J.-P.N., 2015. The Neoproterozoic West-Congo "Schisto-Calcaire" sedimentary succession from the Bas-Congo region (Democratic Republic of the Congo) in the frame of regional tentative correlations. Geologica Belgica 18 (2-4), 126-146.
Calderaro, A., Buttrini, M., Farina, B., Montecchini, S., De Conto, F., Chezzi, C., 2022. Respiratory Tract Infections and Laboratory Diagnostic Methods: A Review with A Focus on Syndromic Panel-Based Assays. Microorganisms 10(9), 1856. https://doi.org/10.3390/microorganisms10091856
Calheiros, D., Dias, M.I., Calhelha, R.C., Barros, L., Ferreira, I.C.F.R., Fernandes, C., Gonçalves, T., 2023. Antifungal Activity of Spent Coffee Ground Extracts. Microorganisms 11(2), 242. https://doi.org/10.3390/microorganisms11020242
Çalış, İ., Başer, K.H.C., 2021. Review of Studies on *Phlomis* and *Eremostachys* Species (Lamiaceae) with Emphasis on Iridoids, Phenylethanoid Glycosides, and Essential Oils. Planta. Med. 87, 1128–1151. https://doi.org/10.1055/a-1527-4238
Cannavò, S.P., Tonacci, A., Bertino, L., Casciaro, M., Borgia, F., Gangemi, S., 2019. The role of oxidative stress in the biology of melanoma: A systematic review. Pathology - Research and Practice 215, 21–28. https://doi.org/10.1016/j.prp.2018.11.020
Cano-Ortiz, A., Musarella, C.M., Piñar Fuentes, J.C., Pinto Gomes, C.J., Quinto-Canas, R., Del Río, S., Cano, E., 2020. Indicative Value of the Dominant Plant Species for a Rapid Evaluation of the Nutritional Value of Soils. Agronomy 11, 1. https://doi.org/10.3390/agronomy11010001
Capistrano, I.R., Wouters, A., Foubert, K., Baldé, A.M., Apers, S., Lardon, F., Pieters, L., Exarchou, V., 2015. Phytochemical characterisation of a cytotoxic stem bark extract of *Steganotaenia araliacea* and identification of a protoflavanone by LC–SPE–NMR. Phytochemistry Letters 12, 119–124. https://doi.org/10.1016/j.phytol.2015.03.008

Case, R.J., Pauli, G.F., Soejarto, D.D., 2005. Factors in Maintaining Indigenous Knowledge Among Ethnic Communities of Manus island. Economic Botany 59, 356–365. https://doi.org/10.1663/0013-0001(2005)059[0356:FIMIKA]2.0.CO;2

Centeno-González, N.K., Martínez-Cabrera, H.I., Porras-Múzquiz, H., Estrada-Ruiz, E., 2021. Late Campanian fossil of a legume fruit supports Mexico as a center of Fabaceae radiation. Commun. Biol. 4, 41. https://doi.org/10.1038/s42003-020-01533-9

Chaachouay, N., Benkhnigue, O., Fadli, M., El Ibaoui, H., Zidane, L., 2019. Ethnobotanical and ethnopharmacological studies of medicinal and aromatic plants used in the treatment of metabolic diseases in the Moroccan Rif. Heliyon 5(10), e02191. https://doi.org/10.1016/j.heliyon.2019.e02191

Chathuranga, K., Kim, M.S., Lee, H.-C., Kim, T.-H., Kim, J.-H., Gayan Chathuranga, W.A., Ekanayaka, P., Wijerathne, H.M.S.M., Cho, W.-K., Kim, H.I., Ma, J.Y., Lee, J.-S., 2019. Anti-Respiratory Syncytial Virus Activity of *Plantago asiatica* and *Clerodendrum trichotomum* Extracts In Vitro and In Vivo. Viruses 11(7), 604. https://doi.org/10.3390/v11070604

Chautems, R., Zufferey, G., Roche, B., 2005. Pathologie hémorroïdaire: approche diagnostique et thérapeutique à l'usage du praticien. Swiss Med. Forum 5(35), 869-874. https://doi.org/10.4414/smf.2005.05626

Chaves, M.H., Roque, N.F., 1997. Amides and lignanamides from *Porcelia macrocarpa*. Phytochemistry 46(5), 879–881. https://doi.org/10.1016/S0031-9422(97)00364-6

Chen, H.-Q., Jin, Z.-Y., Wang, X.-J., Xu, X.-M., Deng, L., Zhao, J.-W., 2008. Luteolin protects dopaminergic neurons from inflammation-induced injury through inhibition of microglial activation. Neuroscience Letters 448, 175–179. https://doi.org/10.1016/j.neulet.2008.10.046

Chen, J., Liu, Y., Zhao, Z., Qiu, J., 2021. Oxidative stress in the skin: Impact and related protection. Intern. J. Cosmetic. Sci. 43, 495–509. https://doi.org/10.1111/ics.12728

Chen, J., Liu, Z., Cui, H., Song, H., Wang, J., Gao, H., Chen, S., Liu, K., Yang, Z., Wang, Y., Wang, X., Yang, X., Meng, L., An, L., Xiao, S., Le Bagousse-Pinguet, Y., 2023. Direct and indirect effects of dominant plants on ecosystem multifunctionality. Front. Plant Sci. 14, 1117903. https://doi.org/10.3389/fpls.2023.1117903

Cheng, X.-L., Padullés Cubino, J., Balfour, K., Zhu, Z.-X., Wang, H.-F., 2022. Drivers of spontaneous and cultivated species diversity in the tropical city of Zhanjiang, China. Urban Forestry & Urban Greening 67, 127428. https://doi.org/10.1016/j.ufug.2021.127428

Chhetri, N.B.K., Shrestha, K.K., 2019. Floristic Diversity and Important Value Indices of Tree Species in Lower Kanchenjunga Singhalila Ridge Eastern Nepal. American Journal of Plant Sciences 10(1), 248–263. https://doi.org/10.4236/ajps.2019.101019

Chihab, M., Bouzidi, M.A., Latreche, A., Dif, M.M., Boubakr, S., 2018. Caractérisation de l'habitat naturel d'une espèce de géophyte menacée (*Tulipa sylvestris* L.) dans la fôret de Bouhriz (ouest Algérien). Acta Botanica Malacitana 43, 71–81. https://doi.org/10.24310/abm.v43i0.3957

Choudhary, R., 2008. Benificial effect of *Allium sativum* and *Allium tuberosum* on experimental hyperlipidemia and atherosclerosis. Pakistan Journal of Physiology 4(2), 7–10. http://www.pps.org.pk/PJP/4-2/Raghuveer.pdf

Chukwuma, C.I., Matsabisa, M.G., Ibrahim, M.A., Erukainure, O.L., Chabalala, M.H., Islam, Md.S., 2019. Medicinal plants with concomitant anti-diabetic and anti-hypertensive effects as potential sources of dual acting therapies against diabetes and hypertension: A review. Journal of Ethnopharmacology 235, 329–360. https://doi.org/10.1016/j.jep.2019.02.024

Chytrý, K., Prokešová, H., Duchoň, M., Klinkovská, K., Novák, P., Chytrý, M., Divíšek, J., 2022. Ecotones in Central European forest–steppe: Edge effect occurs on hard rocks but not on loess. J. Vegetation Science 33, e13149. https://doi.org/10.1111/jvs.13149

Cicuzza, D., Mammides, C., 2022. Soil, Topography and Forest Structure Shape the Abundance, Richness and Composition of Fern Species in the Fragmented Tropical Landscape of Xishuangbanna, Yunnan, China. Forests 13(9), 1453. https://doi.org/10.3390/f13091453

Čižmárová, B., Hubková, B., Tomečková, V., Birková, A., 2023. Flavonoids as Promising Natural Compounds in the Prevention and Treatment of Selected Skin Diseases. International Journal of Molecular Sciences 24 (7), 6324. https://doi.org/10.3390/ijms24076324

Cochran, W.G., 1977. Sampling techniques, 3d ed. ed, Wiley series in probability and mathematical statistics. Wiley, New York. pp. 428. ISBN 978-0-471-16240-7

Colombo, R., Yariwake, J.H., Queiroz, E.F., Ndjoko, K., Hostettmann, K., 2009. On-line identification of minor flavones from sugarcane juice by LC/UV/MS and post-column derivatization. J. Braz. Chem. Soc. 20, 1574–1579. https://doi.org/10.1590/S0103-50532009000900003

Compère, P., 1970. La Carte Des Sols et de La Végétation Du Congo Belge et Du Ruanda-Urundi: 25. Bas-Congo. Notice Explicative. Bruxelles: Publications de l'Institut National Pour l'Etude Agronomique Du Congo Belge (INEAC). pp. 35.

Condori Penaloza, E., Casanova, L., Leal, I., Aguiar, P., Costa, S., 2018. Metabolite Fingerprinting and Profiling of the Medicinal Grass Eleusine indica Based on HPLC-DAD, UPLC-DAD-MS/MS and NMR Analyses. Journal of the Brazilian Chemical Society 0(0), 1-13. http://dx.doi.org/10.21577/0103-5053.20180131

Contardi, M., Lenzuni, M., Fiorentini, F., Summa, M., Bertorelli, R., Suarato, G., Athanassiou, A., 2021. Hydroxycinnamic Acids and Derivatives Formulations for Skin Damages and Disorders: A Review. Pharmaceutics 13(7), 999. https://doi.org/10.3390/pharmaceutics13070999

CRISP, 1960. Problèmes du Bas-Congo (I). Courrier hebdomadaire du CRISP 59(13), 1-23. https://doi.org/10.3917/cris.059.0001

Cui, Q., Pan, Y., Xu, X., Zhang, W., Wu, X., Qu, S., Liu, X., 2016. The metabolic profile of acteoside produced by human or rat intestinal bacteria or intestinal enzyme in vitro employed UPLC-Q-TOF-MS. Fitoterapia 109, 67–74. https://doi.org/10.1016/j.fitote.2015.12.011

Cui, Y., Wang, Q., Shi, X., Zhang, X., Sheng, X., Zhang, L., 2010. Simultaneous quantification of 14 bioactive constituents in *Forsythia Suspensa* by liquid chromatography-electrospray ionisation-mass spectrometry: Simultaneous Quantifi cation of Bioactive Constituents in *Forsythia Suspensa*. Phytochem. Anal. 21, 253–260. https://doi.org/10.1002/pca.1194

da Cruz, R.M.S., Alberton, O., da Silva Lorencete, M., da Cruz, G.L.S., Gasparotto-Junior, A., Cardozo-Filho, L., de Souza, S.G.H., 2020. Phytochemistry of *Cymbopogon citratus* (D.C.) Stapf inoculated with arbuscular mycorrhizal fungi and plant growth promoting bacteria. Industrial Crops and Products 149, 112340. https://doi.org/10.1016/j.indcrop.2020.112340

Daeleman, J., Pauwels, L., 1983. Notes d'ethnobotanique ntándu (Kongo) - Principales plantes de la région de Kisaántu : Noms ntándu et noms scientifiques. Africana Linguistica 9(1), 149–255. https://doi.org/10.3406/aflin.1983.920

Dajoz, R., 1982. Accurate Ecology. Gauthier Villars, Scientific Research Publishing, Paris, pp. 503

Dapar, M.L.G., Alejandro, G.J.D., Meve, U., Liede-Schumann, S., 2020. Quantitative ethnopharmacological documentation and molecular confirmation of medicinal plants used by the Manobo tribe of Agusan del Sur, Philippines. Journal of Ethnobiology and Ethnomedicine 16, 14. https://doi.org/10.1186/s13002-020-00363-7

Darwin, C., Becquemont, D., Barbier, E., Drouin, J.-M., 2008. L'origine des espèces au moyen de la sélection naturelle ou La préservation des races favorisées dans la lutte pour la vie., Éd. mise à jour en 2008. ed, GF. Flammarion, Paris. pp. 624. ISBN 978-2-08-122107-9. https://www.docdroid.net/zhDCqmv/darwin-lorigine-des-especes-pdf

Darwish, R.S., El-Banna, A.A., Ghareeb, D.A., El-Hosseny, M.F., Seadawy, M.G., Dawood, H.M., 2022. Chemical profiling and unraveling of anti-COVID-19 biomarkers of red sage (*Lantana camara* L.) cultivars using UPLC-MS/MS coupled to chemometric analysis, in vitro study and molecular docking. J. Ethnopharmacol. 291, 115038. https://doi.org/10.1016/j.jep.2022.115038

Dayem, A.A., Choi, H.Y., Kim, Y.B., Cho, S.-G., 2015. Antiviral Effect of Methylated Flavonol Isorhamnetin against Influenza. PLoS ONE 10, e0121610. https://doi.org/10.1371/journal.pone.0121610

de Albuquerque, U.P., Soldati, G.T., Sieber, S.S., Ramos, M.A., de Sá, J.C., de Souza, L.C., 2011. The use of plants in the medical system of the Fulni-ô people (NE Brazil): A perspective on age and gender. Journal of Ethnopharmacology 133, 866–873. https://doi.org/10.1016/j.jep.2010.11.021

De Foucault, B., 1979. Eléments pour une théorie statistique du tableau phytosociologique homogène. Vegetatio, 40 (3), 163-174.

De Meyer, E., 2023. The Spiritual Valuation of *Erythrophleum suaveolens*, a Cultural Keystone Species in the Democratic Republic of Congo. Econ. Bot. 77, 103–109. https://doi.org/10.1007/s12231-023-09566-x

De Natale, A., Pollio, A., 2007. Plants species in the folk medicine of Montecorvino Rovella (inland Campania, Italy). Journal of Ethnopharmacology 109, 295–303. https://doi.org/10.1016/j.jep.2006.07.038

De Nicola, G.R., Nyegue, M., Montaut, S., Iori, R., Menut, C., Tatibouët, A., Rollin, P., Ndoyé, C., Zollo, P.-H.A., 2012. Profile and quantification of glucosinolates in *Pentadiplandra brazzeana* Baillon. Phytochemistry 73, 51–56. https://doi.org/10.1016/j.phytochem.2011.09.006

De Wet, H., Nciki, S., van Vuuren, S.F., 2013. Medicinal plants used for the treatment of various skin disorders by a rural community in northern Maputaland, South Africa. J Ethnobiol. Ethnomed. 9, 51. https://doi.org/10.1186/1746-4269-9-51

De Wildeman, E., 1920. Additions a la Flore du Congo. Bulletin du Jardin botanique de l'État a Bruxelles 7, 1. https://doi.org/10.2307/3666519

Deceuninck, V., 1952. La pêche et la pisciculture au Bas-Congo. Publication de la direction de l'agriculture, des forêts et de l'élevage, Bruxelles, pp. 64

Delaude, C., Breyne, H., 1971. Plantes médicinales et ingrédients magiques du grand marché de Kinshasa. in Africa - Tervuren 17, 93 - 103. [WWW Document]. URL http://www.ethnopharmacologia.org/prelude2020/pdf/biblio-hd-06-delaude.pdf (accessed 04.12.2023)

Deleké, I., 2005.Utilisation des plantes médicinales contre les maladies et troubles gynécologiques dans les terroirs autour de la zone cynégétique de la Pendjari (ZCP) du Bénin : compréhension, inventaire et perspectives pour leur conservation. Mémoire d'Ingénieur Agronome, Université d'Abomey-Calavi, Bénin, pp.70.

Deleké, K. I., Djego J., Hounzangbe-Adote, M. S., Sinsin, B., 2009. Etude ethnobotanique des plantes galactogènes et emménagogues utilisées dans les terroirs riverains à la

Zone Cynégétique de la Pendjari. Int. J. Biol. Chem. Sci. 3(6), 1226-1237. https://www.ajol.info/index.php/ijbcs/article/view/53138/41725

Delpech, R., Géhu, J.M., 1988. Intérêt de la phytosociologie actuelle pour la typologie, l'évaluation et la gestion des écosystèmes. In: « La gestion des systèmes écologiques: des progrès de la recherche au développement des techniques », 4e colloque national de l'AFIE & Société d'écologie, Bordeaux, 14-16 mai 1987, 39-52. Paris] (26 rue Montmartre, 75001).

Demeke, H., Hasen, G., Sosengo, T., Siraj, J., Tatiparthi, R., Suleman, S., 2022. Evaluation of Policy Governing Herbal Medicines Regulation and Its Implementation in Ethiopia. Journal of Multidisciplinary Healthcare 15, 1383–1394. https://doi.org/10.2147/JMDH.S366166

Demoz, M.S., Gachoki, K.P., Mungai, K.J., Negusse, B.G., 2014. GC-MS Analysis of the Essential Oil and Methanol Extract of the Seeds of Steganotaenia araliacea Hochst. American Journal of Plant Sciences 5(26), 3752–3760. https://doi.org/10.4236/ajps.2014.526392

Dermane, A., Kpegba, K., Eloh, K., Osei-Safo, D., Amewu, R.K., Caboni, P., 2020. Differential constituents in roots, stems and leaves of *Newbouldia laevis* Thunb. screened by LC/ESI-Q-TOF-MS. Results in Chemistry 2, 100052. https://doi.org/10.1016/j.rechem.2020.100052

Deseo, M.A., Elkins, A., Rochfort, S., Kitchen, B., 2020. Antioxidant activity and polyphenol composition of sugarcane molasses extract. Food Chemistry 314, 126180. https://doi.org/10.1016/j.foodchem.2020.126180

Devasagayam, T.P.A., Tilak, J.C., Boloor, K.K., Sane, K.S., Ghaskadbi, S.S., Lele, R.D., 2004. Free radicals and antioxidants in human health: current status and future prospects. The Journal of the Association of Physicians of India 52, 794–804. PMID 15909857

Devi, M.J., Reddy, V.R., Timlin, D., 2022. Drought-Induced Responses in Maize under Different Vapor Pressure Deficit Conditions. Plants 11, 2771. https://doi.org/10.3390/plants11202771

Dextreit, R., 1984. La cure végétale, Toutes les plantes pour se guérir. Vivre en harmonie, 3ème ed, pp. 118

Dhooghe, L., Mesia, K., Kohtala, E., Tona, L., Pieters, L., Vlietinck, A., Apers, S., 2008. Development and validation of an HPLC-method for the determination of alkaloids in the stem bark extract of Nauclea pobeguinii. Talanta 76, 462–468. https://doi.org/10.1016/j.talanta.2008.03.036

Ding, Y., Cao, Z., Cao, L., Ding, G., Wang, Z., Xiao, W., 2017. Antiviral activity of chlorogenic acid against influenza A (H1N1/H3N2) virus and its inhibition of neuraminidase. Sci. Rep. 7, 45723. https://doi.org/10.1038/srep45723

Dongmo, A.B., Kamanyi, A., Franck, U., Wagner, H., 2002. Vasodilating Properties of Extracts from the Leaves of *Musanga cecropioides* (R. Brown). Phytother. Res. 16, 6–9. https://doi.org/10.1002/ptr.1012

Dorsaz, A., Marston, A., Stoeckli-Evans, H., Msonthi, J.D., Hostettmann, K., 1985. Uncinatone, a New Antifungal Hydroquinone Diterpenoid from *Clerodendrum uncinatum* S CHINZ. Helvetica Chimica Acta 68, 1605–1610. https://doi.org/10.1002/hlca.19850680612

Dostál, P., Fischer, M., Prati, D., 2016. Phenotypic plasticity is a negative, though weak, predictor of the commonness of 105 grassland species: Phenotypic plasticity and commonness of grassland herbs. Global Ecology and Biogeography 25, 464–474. https://doi.org/10.1111/geb.12429

Dougnon, V., Attakpa, E., Bankolé, H., Hounmanou, Y., R., D., Agbankpe, J., M., de, Fabiyi, K., Gbaguidi, F., Baba-Moussa, L., 2016. Etude ethnobotanique des plantes médicinales utilisées contre une maladie cutanée contagieuse : La gale humaine au Sud-Bénin Ethnobotany study of medicinal plants used against a contagious skin disease: Human scabies in South Benin. Revue CAMES – Série Pharmacopée et Médecine Traditionnelle Africaine 18(1), 16–22.

Drachoussoff, V., 1947. Essai sur l'agriculture indigène du Bas-Congo : Bulletin Agricole du Congo Belge, 38(3 et 4), 474-880.

DSRP, B.-C., 2007. Document Provincial De Strategie De Reduction De La Pauvrete (DSRP Provincial): Province Du Bas-Congo. pp. 137 [WWW Document]. URL https://www.capac.ulg.ac.be/Data/DSRP/DSRPBasCongo.pdf (accessed 05.02.20).

Du Rietz, G.E., Fries, Th.C.E., Osvald, H., Tenwall, T.A., 1920. Du Rietz, G. E., Fries, Th. C. E., Osvald, H. & Tengwall, T. A., 1920. Gesetze der Konstitution nattirlicher Pflanzengesell- schaften. Vetensk. Prakt. Unders. Lappland. Flora och Fau- na 7: 1-47. Uppsala/Stockholm. Almqvist & Wiksells Boktryckeri-A.-B.

Dubiez, E., Yamba Yamba, T., Mvolo, B., Freycon, V., 2014. Perception locale des sols et de leur évolution dans des terroirs en cours de savanisation des populations Batandu en République démocratique du Congo. Bois. for. trop. 319(1), 19-29. https://doi.org/10.19182/bft2014.319.a20549

Dwivedi, D., Pandey, S., Asif, S., Awasthi, V., Kaur, G., Nimisha, N., 2021. Investigating the potential of Quercetin enthused nano lipoidal system for the management of dermatitis. RJPT 6516–6526. https://doi.org/10.52711/0974-360X.2021.01127

Działo, M., Mierziak, J., Korzun, U., Preisner, M., Szopa, J., Kulma, A., 2016. The Potential of Plant Phenolics in Prevention and Therapy of Skin Disorders. IJMS 17, 160. https://doi.org/10.3390/ijms17020160

Ebong, Igile, G.O., Mgbeje, B., I, I., Odongo, Onofiok, Oso, 2014. Hypoglycemic, Hepatoprotective and Nephroprotective Effects of Methanolic Leaf Extract of *Heinsia crinita* (Rubiaceae) in Alloxan-induced Diabetic Albino Wistar Rats. IOSR Journal of Pharmacy 4(1), 37–43

Ekalu, A., Ayo, R.G.-O., James, H.D., Hamisu, I., 2019. A Mini-Review on the Phytochemistry and Biological Activities of Selected Apocynaceae Plants (preprint). CHEMISTRY. https://doi.org/10.20944/preprints201906.0219.v1

Ekpenyong, C.E., Akpan, E., Nyoh, A., 2015. Ethnopharmacology, phytochemistry, and biological activities of *Cymbopogon citratus* (DC.) Stapf extracts. Chinese Journal of Natural Medicines 13, 321–337. https://doi.org/10.1016/S1875-5364(15)30023-6

El-Khalafy, M.M., AL-Sodany, Yassim.M., Shaltout, Kamal.H., Haroun, Soliman.A., Ahmed, DAlia.A., Salim, Mohamed.A., 2021. Authentication, Micromorphology and Ultrastructure of Pollen Grains and Seeds of Endemic Taxa in Saint Katherine Protectorate, South Sinai, Egypt. International Journal of Agriculture and Biology 26, 359–370. https://doi.org/10.17957/IJAB/15.1844

Elsadig Karar, M.G., Kuhnert, N., 2016. UPLC-ESI-Q-TOF-MS/MS Characterization of Phenolics from *Crataegus monogyna* and *Crataegus laevigata* (Hawthorn) Leaves, Fruits and their Herbal Derived Drops (Crataegutt Tropfen). J. Chem. Biol. Ther. 1(1). https://doi.org/10.4172/2572-0406.1000102

Elsayed Azab, A., A Adwas, A., Ibrahim Elsayed, A.S., A Adwas, A., Ibrahim Elsayed, A.S., Quwaydir, F.A., 2019. Oxidative stress and antioxidant mechanisms in human body. Journal of Applied Biotechnology & Bioengineering 6, 43–47. https://doi.org/10.15406/jabb.2019.06.00173

Enquist, B.J., Feng, X., Boyle, B., Maitner, B., Newman, E.A., Jørgensen, P.M., Roehrdanz, P.R., Thiers, B.M., Burger, J.R., Corlett, R.T., Couvreur, T.L.P., Dauby, G.,

Donoghue, J.C., Foden, W., Lovett, J.C., Marquet, P.A., Merow, C., Midgley, G., Morueta-Holme, N., Neves, D.M., Oliveira-Filho, A.T., Kraft, N.J.B., Park, D.S., Peet, R.K., Pillet, M., Serra-Diaz, J.M., Sandel, B., Schildhauer, M., Šímová, I., Violle, C., Wieringa, J.J., Wiser, S.K., Hannah, L., Svenning, J.-C., McGill, B.J., 2019. The commonness of rarity: Global and future distribution of rarity across land plants. Sci. Adv. 5, eaaz0414. https://doi.org/10.1126/sciadv.aaz0414

Erickson, B.H., 1979. Some Problems of Inference from Chain Data. Sociological Methodology 10, 276–302. https://doi.org/10.2307/270774

Eshetu, G.R., Dejene, T.A., Telila, L.B., Bekele, D.F., 2015. Ethnoveterinary medicinal plants: Preparation and application methods by traditional healers in selected districts of southern Ethiopia. Vet. World 8, 674–684. https://doi.org/10.14202/vetworld.2015.674-684

Esievo, K., Anthony, S., Fatokun, O., Kunle, O., 2018. Pharmacognostic studies of the leaves and roots of *Mondia whitei* (hook.f.). Int. J. Pharm. Biol. Sci. 8, 253–258.

Estomba, D., Ladio, A., Lozada, M., 2006. Medicinal wild plant knowledge and gathering patterns in a Mapuche community from North-western Patagonia. Journal of Ethnopharmacology 103, 109–119. https://doi.org/10.1016/j.jep.2005.07.015

Estrada-Castillón, E., Soto-Mata, B., Garza-López, M., Villarreal-Quintanilla, J., Jiménez-Pérez, J., Pando-Moreno, M., Sánchez-Salas, J., Scott-Morales, L., Cotera-Correa, M., 2012. Medicinal plants in the southern region of the State of Nuevo León, México. J. Ethnobiol. Ethnomed. 8, 45. https://doi.org/10.1186/1746-4269-8-45

Ettebong, E., Obot, D., 2020. A Systematic review on *Eleucine indica* (L.) Gaertn.): From ethnomedicinal uses to pharmacological activities. Journal of Medicinal Plants Studies 8(4), 262–274.

Eugenia, Ma., Patricia, D., Horacio, L., Ocadiz-Delgado, R., Cabello-Gutierrez, C., 2013. Pathogenesis of Viral Respiratory Infection, in: Vats, M. (Ed.), Respiratory Disease and Infection - A New Insight. InTech. pp. 1-17. https://doi.org/10.5772/54287

European Food Safety Authority (EFSA), 2020. Technical Report on the notification of infusion from coffee leaves (*Coffea arabica* L. and/or *Coffea canephora* Pierre ex A. Froehner) as a traditional food from a third country pursuant to Article 14 of Regulation (EU) 2015/2283. EFS3 17. https://doi.org/10.2903/sp.efsa.2020.EN-1783

Everson, L., 2022. USC Plant Profile - Cyperaceae, *Cyperus polystachyos* - University of the Sunshine Coast, Queensland. [WWW Document]. URL https://research.usc.edu.au/esploro/outputs/assignment/USC-Plant-Profile---Cyperaceae-Cyperus/99708 797502621 (accessed 06.07.2023).

Ezeanya-Esiobu, C., 2019. The Case of Traditional Bonesetting and Orthopaedic Medical Curriculum, in: Indigenous Knowledge and Education in Africa, Frontiers in African Business Research. Springer Singapore, Singapore, pp. 81–95. https://doi.org/10.1007/978-981-13-6635-2_6

Fabricant, D.S., Farnsworth, N.R., 2001. The value of plants used in traditional medicine for drug discovery. Environmental Health Perspectives 109, 69. https://doi.org/10.1289/ehp.01109s169

Fadiji, A., 2019. Phytochemical screening and antibacterial potentials of the garlic (*Allium sativum*) extracts against clinical isolates. Journal of Pharmacology and Toxicology 3, 14–18.

Faparusi, F., Bello-Akin, M.M., Oyede, R.T., Adewole, A., Bankole, P.O., Ali, F.F., 2012. Phytochemical Screening and Antibacterial Activity of *Brillantaisia patula* Leaf. Research Journal of Phytochemistry 6, 9–16. https://doi.org/10.3923/rjphyto.2012.9.16

Farah, A., Donangelo, C.M., 2006. Phenolic compounds in coffee. Braz. J. Plant Physiol. 18, 23–36. https://doi.org/10.1590/S1677-04202006000100003

Farzalieva, Gyulli & Esyunin, Sergei., 2014. The structure and seasonal dynamics of myriapods (Chilopoda and Diplopoda) in the southern taiga of the Perm Cis-Urals Region. Entomological Review. 94 (4), 498-513. https://doi.org/10.1134/S0013873814040058.

Ferreres, F., Andrade, P.B., Valentão, P., Gil-Izquierdo, A., 2008. Further knowledge on barley (*Hordeum vulgare* L.) leaves *O*-glycosyl-*C*-glycosyl flavones by liquid chromatography-UV diode-array detection-electrospray ionisation mass spectrometry. Journal of Chromatography A 1182, 56–64. https://doi.org/10.1016/j.chroma.2007.12.070

Ferreres, F., Gonçalves, R.F., Gil-Izquierdo, A., Valentão, P., Silva, A.M.S., Silva, J.B., Santos, D., Andrade, P.B., 2012. Further Knowledge on the Phenolic Profile of *Colocasia esculenta* (L.) Shott. J. Agric. Food Chem. 60, 7005–7015. https://doi.org/10.1021/jf301739q

Ferreres, F., Silva, B.M., Andrade, P.B., Seabra, R.M., Ferreira, M.A., 2003. Approach to the study of *C*-glycosyl flavones by ion trap HPLC-PAD-ESI/MS/MS: application to seeds of quince (*Cydonia oblonga*). Phytochem. Anal. 14, 352–359. https://doi.org/10.1002/pca.727

Fetse, J., Kofie, W., Adosraku, R., 2016. Ethnopharmacological Importance of *Xylopia aethiopica* (DUNAL) A. RICH (Annonaceae) - A Review. British Journal of Pharmaceutical Research 11, 1–21. https://doi.org/10.9734/BJPR/2016/24746

Flather, C., Sieg, C., 2007. Species rarity: definition, causes, and classification, in: Raphael, M.G., Molina, R. (Eds.), Conservation of Rare or Little-Known Species: Biological, Social, and Economic Considerations. Island Press, Washington, pp. 40–66. https://www.fs.usda.gov/rm/pubs_other/rmrs_2007_flather_c002.pdf. ISBN 978-1-59726-165-4.

Floret, C., Galan, M.J., Floc'h, E., Romane, F., 1992. Dynamics of holm oak (*Quercus ilex* L.) coppices after clearcutting in southern France: Flora and life cycles changes. Vegetatio 99, 97–105. https://doi.org/10.1007/BF00118214

Foning Tebou, P.L., Ngnokam, D., Harakat, D., Voutquenne-Nazabadioko, L., 2018. Three new iridolactone derivatives from the whole plant of *Brillantaisia owariensis* P. Beauv. Phytochemistry Letters 25, 171–174. https://doi.org/10.1016/j.phytol.2018.04.015

Fonu Anahendo, J., 2022. Contribution à l'étude des forets sacrées du secteur Lukumbe en République Démocratique du Congo. Mouvements et Enjeux Sociaux 122, 94–101. https://nbn-resolving.org/urn:nbn:de:0168-ssoar-78801-0

Forino, M., Tartaglione, L., Dell'Aversano, C., Ciminiello, P., 2016. NMR-based identification of the phenolic profile of fruits of Lycium barbarum (goji berries). Isolation and structural determination of a novel *N*-feruloyl tyramine dimer as the most abundant antioxidant polyphenol of goji berries. Food Chemistry 194, 1254–1259. https://doi.org/10.1016/j.foodchem.2015.08.129

Formozis, G., Tsakaldimi, M., Ganatsas, P., 2021. Are Mediterranean forest ecosystems under the threat of invasive species *Solanum elaeagnifolium*? iForest 14, 236–241. https://doi.org/10.3832/ifor3706-014

Frommer, C., 2003. Protecting Traditional Medicinal knowledge in Zimbabwe [WWW Document]. URL https://www.culturalsurvival.org/publications/cultural-survival-quarterly/protecting-traditional-medicinal-knowledge-zimbabwe (accessed 6.3.20).

Galindo, L.A., de Moraes Pultrini, A., Costa, M., 2010. Biological effects of Ocimum gratissimum L. are due to synergic action among multiple compounds present in essential oil. J. Nat. Med. 64, 436–441. https://doi.org/10.1007/s11418-010-0429-2

Ganglo, J., 2005. Les groupements végétaux à *Chromolaena odorata* dans les plantations forestières du sud Bénin: Caractéristiques structurelles et valeurs indicatrices écologique et sylvicole. Systematics and Geography of Plants 75, 179–194. https://doi.org/10.2307/3668575

Gao, H., Liu, Z., Song, F., Xing, J., Zheng, Z., Liu, S., 2022. A Strategy for Identification and Structural Characterization of Compounds from *Plantago asiatica* L. by Liquid Chromatography-Mass Spectrometry Combined with Ion Mobility Spectrometry. Molecules 27, 4302. https://doi.org/10.3390/molecules27134302

Gao, K., Ma, D., Cheng, Y., Tian, X., Lu, Y., Du, X., Tang, H., Chen, J., 2015. Three New Dimers and Two Monomers of Phenolic Amides from the Fruits of *Lycium barbarum* and Their Antioxidant Activities. J. Agric. Food. Chem. 63, 1067–1075. https://doi.org/10.1021/jf5049222

Gbary, A.R., Sombié, I., Guiguemdé, R., IP, G., 1996. Connaissances et pratiques des tradipraticiens en matière de paludisme en milieu urbain de Ouagadougou et de Bobo-Dioulasso, Burkina Faso, Afrique de l'Ouest. Santé Publique 8, 249–260.

Gebashe, F., Aremu, A.O., Gruz, J., Finnie, J.F., Van Staden, J., 2020. Phytochemical Profiles and Antioxidant Activity of Grasses Used in South African Traditional Medicine. Plants 9, 371. https://doi.org/10.3390/plants9030371

Gębka, N., Adamczyk, J., Gębka-Kępińska, B., Mizgała-Izworska, E., 2022. The role of flavonoids in prevention and treatment of selected skin diseases. J. Pre-Clin. Clin. Res. 16, 99–107. https://doi.org/10.26444/jpccr/152551

Gégout, J.-C., 1995. Soil mineral resources-forest vegetation relationships in the vosges mountains. Université Henri Poincaré - Nancy 1. pp. 352. [WWW Document] URL https://hal.univ-lorraine.fr/tel-01747514 (accessed 08.02.2023).

Gendrisch, F., Esser, P.R., Schempp, C.M., Wölfle, U., 2021. Luteolin as a modulator of skin aging and inflammation. BioFactors 47, 170–180. https://doi.org/10.1002/biof.1699

Geng, P., Harnly, J.M., Sun, J., Zhang, M., Chen, P., 2017. Feruloyl dopamine-*O*-hexosides are efficient marker compounds as orthogonal validation for authentication of black cohosh (*Actaea racemos*a)—an UHPLC-HRAM-MS chemometrics study. Anal. Bioanal. Chem. 409, 2591–2600. https://doi.org/10.1007/s00216-017-0205-1

Gessler, M., De, M., Mh, N., A, S., M, H., M, T., 1995. Traditional Healers in Tanzania: Sociocultural Profile and Three Short Portraits. Journal of ethnopharmacology 48 (3), 145-160. https://doi.org/10.1016/0378-8741(95)01295-o

Ghosh, P., Ghosh, C., Das, S., Das, C., Mandal, S., Chatterjee, S., 2019. Botanical Description, Phytochemical Constituents and Pharmacological Properties of *Euphorbia hirta* Linn: A Review 9, 273–286.

Giday, M., Asfaw, Z., Elmqvist, T., Woldu, Z., 2003. An ethnobotanical study of medicinal plants used by the Zay people in Ethiopia. Journal of Ethnopharmacology 85, 43–52. https://doi.org/10.1016/S0378-8741(02)00359-8

Giday, M., Teklehaymanot, T., Animut, A., Mekonnen, Y., 2007. Medicinal plants of the Shinasha, Agew-awi and Amhara peoples in northwest Ethiopia. Journal of Ethnopharmacology 110, 516–525. https://doi.org/10.1016/j.jep.2006.10.011

Gillet, F., 2000. La Phytosociologie synusiale intégrée. Guide méthodologique. Laboratoire d'écologie végétale et de phytosociologie. Neuchâtel. pp. 69. [WWW Document] URL https://www.researchgate.net/publication/233773247_La_Phytosociologie_synusiale_integree_Guide_methodologique/citation/download

Gillet, J., Pâque, E., 1910. Plantes principales de la région de Kisantu: leur nom indigène, leur nom scientifique, leurs usages. Ministère des Colonies, Bruxelles. Notes botaniques sur la région du Bas- et Moyen-Congo, fasc. 1.; Annales du Musée du Congo belge : Botanique, sér. 5. pp. 134. [WWW Document] URL https://bibdigital.rjb.csic.es/medias/d7/3a/17/37/d73a1737-c525-460d-b868-f4116a7e4afc/files/P0540_Ser5_04_01.pdf

Girsang, E., Ginting, C.N., Lister, I.N.E., Gunawan, K. yashfa, Widowati, W., 2021. Anti-inflammatory and antiaging properties of chlorogenic acid on UV-induced fibroblast cell. PeerJ 9, e11419. https://doi.org/10.7717/peerj.11419

Gnagne, A.S., Camara, D., Fofie, N.B.Y., Bene, K., Zirihi, G.N., 2017. Étude ethnobotanique des plantes médicinales utilisées dans le traitement du diabète dans le Département de Zouénoula (Côte d'Ivoire). J. Appl. Biosci. 113, 11257. https://doi.org/10.4314/jab.v113i1.14

Godfraind, T., 2010. À propos des médecines traditionnelles en Afrique Centrale. Rev. Quest. Sci. 181(3), 341-371.

Godić, A., Pojšak, B., Adamič, M., Dahmane, R.G., 2020. The Role of Antioxidants in Skin Cancer Prevention and Treatment. Oxidative Medicine and Cellular Longevity, *2014*, 1–6. https://doi.org/10.1155/2014/860479

Gong, G., Guan, Y.-Y., Zhang, Z.-L., Rahman, K., Wang, S.-J., Zhou, S., Luan, X., Zhang, H., 2020. Isorhamnetin: A review of pharmacological effects. Biomedicine & Pharmacotherapy 128, 110301. https://doi.org/10.1016/j.biopha.2020.110301

González-Gallego, J., García-Mediavilla, M.V., Sánchez-Campos, S., Tuñón, M.J., 2010. Fruit polyphenols, immunity and inflammation. Br. J. Nutr. 104, S15-27. https://doi.org/10.1017/S0007114510003910

Gorai, D., 2016. Ethnopharmacological, phytochemical, pharmacological and toxicological aspects of *Lantana camara* L.: A comprehensive review. Adv. Biomed. Pharma. 03, 328–357. https://doi.org/10.19046/abp.v03i05.07

Gouveia, S.C., Castilho, P.C., 2013. *Artemisia annua* L.: Essential oil and acetone extract composition and antioxidant capacity. Industrial Crops and Products 45, 170–181. https://doi.org/10.1016/j.indcrop.2012.12.022

Gouveia, S.C., Castilho, P.C., 2010. Characterization of phenolic compounds in *Helichrysum melaleucum* by high-performance liquid chromatography with on-line ultraviolet and mass spectrometry detection: Phenolic compounds in *Helichrysum melaleucum*. Rapid Commun. Mass Spectrom. 24, 1851–1868. https://doi.org/10.1002/rcm.4585

Gu, D., Yang, Y., Abdulla, R., Aisa, H.A., 2012. Characterization and identification of chemical compositions in the extract of *Artemisia rupestris* L. by liquid chromatography coupled to quadrupole time-of-flight tandem mass spectrometry: Characterization of *Artemisia rupestris* L. by LC/MS/MS. Rapid Commun. Mass Spectrom. 26, 83–100. https://doi.org/10.1002/rcm.5289

Guemou, L., Fellah, S., Mairif, M., Chouhim, K.M.L., Moussaoui, B., Bouzemarene, I.N., Boubekeur, C., 2023. Floristic diversity of the steppe area of Tissemsilt, Northwest of Algeria. Biodiversitas 24(4), 2483-2491. https://doi.org/10.13057/biodiv/d240464

Gul, B., Ahmad, I., Khan, H., Zeb, U., Ullah, H., 2018. Floristic inventory of wild plants of Peshawar university campus. Acta Ecologica Sinica 38, 375–380. https://doi.org/10.1016/j.chnaes.2018.04.005

Guo, H., Liu, A.-H., Ye, M., Yang, M., Guo, D.-A., 2007. Characterization of phenolic compounds in the fruits ofForsythia suspensa by high-performance liquid chromatography coupled with electrospray ionization tandem mass spectrometry. Rapid Commun. Mass Spectrom. 21, 715–729. https://doi.org/10.1002/rcm.2875

Guo, M., Zhao, B., Liu, H., Zhang, L., Peng, L., Qin, L., Zhang, Z., Li, J., Cai, C., Gao, X., 2014. A Metabolomic Strategy to Screen the Prototype Components and Metabolites of *Shuang-Huang-Lian Injection* in Human Serum by Ultra Performance Liquid Chromatography Coupled with Quadrupole Time-of-Flight Mass Spectrometry. J. Anal. Methods Chem. 2014, 1–12. https://doi.org/10.1155/2014/241505

Guo, S., Bao, L., Li, C., Sun, J., Zhao, R., Cui, X., 2020. Antiviral activity of iridoid glycosides extracted from *Fructus gardeniae* against influenza A virus by PACT-dependent suppression of viral RNA replication. Sci. Rep. 10, 1897. https://doi.org/10.1038/s41598-020-58443-3

Habib, N., Regagba, Z., Miara, M.D., Hammou, M.A., Snorek, J., 2020. Floristic diversity of steppe vegetation in the region of Djelfa, North-West Algeria. Acta Botanica Malacitana 45, 37–46. https://doi.org/10.24310/abm.v45i.7987

Halliwell, B., 2007. Biochemistry of oxidative stress. Biochem. Soc. Trans. 35, 1147–1150. https://doi.org/10.1042/BST0351147

Hammond-Tooke, W.D., 1989. Rituals and medicines : indigenous healing in South Africa. Johannesburg : Ad. Donker, 166p. ISBN: 978-0-86852-110-7.

Hammond-Tooke, W.D., 1972. The Structuring of Chaos: Anthropological Approaches to the Human Mind : Inaugural Lecture. Witwatersrand University Press. pp. 42. ISBN: 978-0-85494-127-8.

Han, J., Ye, M., Guo, H., Yang, M., Wang, B., Guo, D., 2007a. Analysis of multiple constituents in a Chinese herbal preparation Shuang-Huang-Lian oral liquid by HPLC-DAD-ESI-MSn. J. Pharm. Biomed. Anal. 44, 430–438. https://doi.org/10.1016/j.jpba.2007.02.023

Han, J., Ye, M., Xu, M., Sun, J., Wang, B., Guo, D., 2007b. Characterization of flavonoids in the traditional Chinese herbal medicine-Huangqin by liquid chromatography coupled with electrospray ionization mass spectrometry. J. Chromatogr. B. 848, 355–362. https://doi.org/10.1016/j.jchromb.2006.10.061

Han, X., Piao, M.J., Kim, K.C., Hewage, S.R.K.M., Yoo, E.S., Koh, Y.S., Kang, H.K., Shin, J.H., Park, Y., Yoo, S.J., Chae, S., Hyun, J.W., 2015. Isorhamnetin Protects Human Keratinocytes against Ultraviolet B-Induced Cell Damage. Biomolecules & Therapeutics 23, 357–366. https://doi.org/10.4062/biomolther.2015.005

Hanazaki, N., Tamashiro, J.Y., Leitão-Filho, H.F., Begossi, A., 2000. Factors affecting the use of medicinal plants by migrants from rural areas of Brazilian Northeast after moving to a metropolitan region in Southeast of Brazil. Biodiversity and Conservation 9, 597–615. https://doi.org/10.1023/A:1008920301824

Hao, B., Caulfield, J.C., Hamilton, M.L., Pickett, J.A., Midega, C.A.O., Khan, Z.R., Wang, J.R., Hooper, A.M., 2015. The biosynthesis of allelopathic di-*C*-glycosylflavones from the roots of *Desmodium incanum* (G. Mey.) DC. Org. Biomol. Chem. 13, 11663–11673. https://doi.org/10.1039/C5OB01926E

Hassam, N., Mohammad Nisar, Saeed Ur Rehman Kakar, Faiz Ul, Zhong, Z., Mohammad Ijaz Khan, Mohammad, S., Deli, W., 2017. Determination of Informant Consensus Factor of Medicinal Plants Used as Therapy in District Dir Lower Pakistan. Journal of Medicinal Plant Studies 5 (4): 183–88.

Haudecoeur, R., Peuchmaur, M., Pérès, B., Rome, M., Taïwe, G.S., Boumendjel, A., Boucherle, B., 2018. Traditional uses, phytochemistry and pharmacological properties of African *Nauclea* species: A review. Journal of Ethnopharmacology 212, 106–136. https://doi.org/10.1016/j.jep.2017.10.011

Heckathorn, D.D., 1997. Respondent-Driven Sampling: A New Approach to the Study of Hidden Populations. Social Problems 44, 174–199. https://doi.org/10.2307/3096941

Heinrich, M., 2000. Ethnobotany and its role in drug development. Phytother. Res. 14, 479–488. https://doi.org/10.1002/1099-1573(200011)14:7<479::aid-ptr958>3.0.co;2-2

Heinrich, M., Ankli, A., Frei, B., Weimann, C., Sticher, O., 1998. Medicinal plants in Mexico: healers' consensus and cultural importance. Social Science & Medicine 47, 1859–1871. https://doi.org/10.1016/S0277-9536(98)00181-6

Helen, P.M., Aswathy, M.R., Rathi, K.D.R.M., Joseph, J.J., Sree, S.J., 2013. Phytochemical analysis and anticancer activity of leaf extract of *Mangifera indica* (Kotttukonam Varika). International Journal of Pharmaceutical Sciences and Research 4(2), 819-824.

Helou, M., Mahdi, A., Daoud, Z., Mokhbat, J., Farra, A., Nassar, E., Nehme, R., Abboud, E., Masri, K., Husni, R., 2022. Epidemiology of Community-Acquired Respiratory Tract Infections in Patients Admitted at the Emergency Departments. Trop. Med. Infect. Dis. 7, 233. https://doi.org/10.3390/tropicalmed7090233

Hendrickx, B., 2021. Kimpa Vita (Dona Beatriz) and "Afro-Catholicism": reexamining controversies and unsolved problems. Pharos Journal of Theology 102(1). https://doi.org/10.46222/pharosjot.102.14

Herrera-Calderon, O., Santiváñez-Acosta, R., Pari-Olarte, B., Enciso-Roca, E., Campos Montes, V.M., Luis Arroyo Acevedo, J., 2018. Anticonvulsant effect of ethanolic extract of *Cyperus articulatus* L. leaves on pentylenetetrazol induced seizure in mice. Journal of Traditional and Complementary Medicine 8, 95–99. https://doi.org/10.1016/j.jtcme.2017.03.001

Hillery, A.M., Lloyd, A.W., Swarbrick, J. (Eds.), 2001. Drug delivery and targeting for pharmacists and pharmaceutical scientists. Taylor & Francis, London. pp. 475. ISBN 978-0-415-27197-4; 978-0-415-27198-1

Hodgson-Ruetz, D., 2011. Do All Bugs Need Drugs?: Conventional and Herbal Treatments of Common Ailments. iUniverse. pp. 147. ISBN 978-1-4502-6827-1

Hooper, A.M., Caulfield, J.C., Hao, B., Pickett, J.A., Midega, C.A.O., Khan, Z.R., 2015. Isolation and identification of *Desmodium* root exudates from drought tolerant species used as intercrops against Striga hermonthica. Phytochemistry 117, 380–387. https://doi.org/10.1016/j.phytochem.2015.06.026

Hossain, M.A., Al-Hdhrami, S.S., Weli, A.M., Al-Riyami, Q., Al-Sabahi, J.N., 2014. Isolation, fractionation and identification of chemical constituents from the leaves crude extracts of *Mentha piperita* L grown in Sultanate of Oman. Asian Pac. J. Trop. Biomed. 4, S368-372. https://doi.org/10.12980/APJTB.4.2014C1051

Hou, M., Sun, R., Hupe, M., Kim, P.L., Park, K., Crumrine, D., Lin, T.-K., Santiago, J.L., Mauro, T.M., Elias, P.M., Man, M.-Q., 2013. Topical apigenin improves epidermal permeability barrier homoeostasis in normal murine skin by divergent mechanisms. Exp. Dermatol. 22, 210–215. https://doi.org/10.1111/exd.12102

Houehanou, T., Assogbadjo, A., Chadare, F.J., Zanvo, S., Sinsin, B., 2016. Approches méthodologiques synthétisées des études d'ethnobotanique quantitative en milieu tropical. Annales des Sciences Agronomiques 20, 187–205.

Hovenden, M.J., Vander Schoor, J.K., Osanai, Y., 2012. Relative humidity has dramatic impacts on leaf morphology but little effect on stomatal index or density in *Nothofagus cunninghamii* (Nothofagaceae). Aust. J. Bot. 60, 700. https://doi.org/10.1071/BT12110

Hubbell, S.P., 2001. The unified neutral theory of biodiversity and biogeography, Monographs in population biology. Princeton University Press, Princeton. pp. 375. ISBN 978-0-691-02129-4; 978-0-691-02128-7

Hvattum, E., Ekeberg, D., 2003. Study of the collision-induced radical cleavage of flavonoid glycosides using negative electrospray ionization tandem quadrupole mass spectrometry. J. Mass Spectrom. 38, 43–49. https://doi.org/10.1002/jms.398

Ibitoye, S., Ukpo, G., Rabiu, A., 2020. Qualitative phytochemical screening and antimicrobial evaluation of the total alkaloids of the hydroalcoholic extracts of the leaves and stem bark of *Musanga cercropoides* (Urticaceae). Annals of Health Research 6(1), 74–84. https://doi.org/10.30442/ahr.0601-09-69

Idayat, T.G., Sherifat, A.A., 2016. Essential oil constituents and in vitro antimicrobial activity of the root of *Mondia whitei* (Hook. F.) Skeels (Periplocaceae). Journal of Pharmacognosy and Phytotherapy 8(8), 163–167. https://doi.org/10.5897/JPP2016.0392

Ikeda, K., Tsujimoto, K., Uozaki, M., Nishide, M., Suzuki, Y., Koyama, A.H., Yamasaki, H., 2011. Inhibition of multiplication of herpes simplex virus by caffeic acid. Int. J. Mol. Med. 28, 595–598. https://doi.org/10.3892/ijmm.2011.739

Ikpefan, E.O., Ayinde, B.A., Adedokun, A., 2014. Comparative phytochemical, cytototic and growth inhibitory effects of the leaf and root barks of *Sarcocephalus latifolius* (J.E. Smith) E.A. Bruce (Rubiaceae). Int. J. Biosci. 4, 162–169. https://doi.org/10.12692/ijb/4.4.162-169

Ilic, N., Schmidt, B.M., Poulev, A., Raskin, I., 2010. Toxicological evaluation of Grains of Paradise (*Aframomum melegueta*) [Roscoe] K. Schum. Journal of Ethnopharmacology 127, 352–356. https://doi.org/10.1016/j.jep.2009.10.031

Ilumbe, B.G., 2010. Utilisation des plantes en médecine traditionnelle par les Pygmées (Ba-Twa) et les Bantous (Ba-Oto) du territoire de Bikoro, Province de l'Equateur en République Démocratique du Congo. Université libre de Bruxelles, Bruxelles. pp. 253. https://api.semanticscholar.org/CorpusID:191016076

Ilumbe, B.G., Van Damme, P., Lukoki Luyeye, F., Joiris, V., Visser, M., Lejoly, J., 2014. Contribution à l'étude des plantes médecinales dans le traitement des hémorroïdes par les pygmées Twa et leur voisin Oto de Bikoro, en RDC. Congo Sciences 2, 46–54.

Insuan, W., Chahomchuen, T., 2020. Chemical Composition and Antimicrobial Activity of Essential Oil Extracted from *Eucalyptus citriodora* Leaf. Microbiology and Biotechnology Letters 48, 148–157. https://doi.org/10.4014/mbl.1912.12016

International (BGCI)), R.H. (Botanic G.C., 2019. IUCN Red List of Threatened Species: Ordeal Tree [WWW Document]. IUCN Red List of Threatened Species. URL https://www.iucnredlist.org/en (accessed 6.1.20).

Iroegbu, P.E., 2005. Healing insanity: skills and expert knowledge of Igbo healers. Africa Development 30(3), 78-92. https://doi.org/10.4314/ad.v30i3.22231

IUCN, 2019. *Alstonia congensis*: Hills, R.: The IUCN Red List of Threatened Species 2019: e.T60760828A60760831. https://doi.org/10.2305/IUCN.UK.2019-3.RLTS.T60760828A60760831.en

IUCN, 2018a. *Cola acuminata*: Cheek, M. & Lawrence, P.: The IUCN Red List of Threatened Species 2019: e.T111376285A111449137. https://doi.org/10.2305/IUCN.UK.2019-1.RLTS.T111376285A111449137.en

IUCN, 2018b. *Pterocarpus angolensis*: Barstow, M. & Timberlake, J.: The IUCN Red List of Threatened Species 2018: e.T33190A67802808. https://doi.org/10.2305/IUCN.UK.2018-1.RLTS.T33190A67802808.en

IUCN, 2017. *Ceiba pentandra*: Rivers, M.C. & Mark, J.: The IUCN Red List of Threatened Species 2017: e.T61782438A61782442. https://doi.org/10.2305/IUCN.UK.2017-3.RLTS.T61782438A61782442.en

IUCN, 2016. *Raphia textilis*: Cosiaux, A., Gardiner, L.M. & Couvreur, T.L.P.: The IUCN Red List of Threatened Species 2018: e.T95366796A95366800. https://doi.org/10.2305/IUCN.UK.2018-2.RLTS.T95366796A95366800.en

IUCN, 2009. IUCN Red List of Threatened Species: Anchomanes difformis [WWW Document]. IUCN Red List of Threatened Species. URL https://www.iucnredlist.org/en (accessed 6.1.20).
IUCN, 2008a. IUCN Red List of Threatened Species: Papyrus Sedge [WWW Document]. IUCN Red List of Threatened Species. URL https://www.iucnredlist.org/en (accessed 6.1.20).
IUCN, 2008b. *Gnetum africanum*: Lakeman Fraser, P. & Bachman, S.: The IUCN Red List of Threatened Species 2013: e.T194958A8928340. https://doi.org/10.2305/IUCN.UK.2011-1.RLTS.T194958A8928340.en
IUCN, 2004. *Garcinia kola*: Cheek, M.: The IUCN Red List of Threatened Species 2004: e.T34715A9884648. https://doi.org/10.2305/IUCN.UK.2004.RLTS.T34715A9884648.en
IUCN, 1998a. *Mitragyna stipulosa*: World Conservation Monitoring Centre: The IUCN Red List of Threatened Species 1998: e.T33913A9819072. https://doi.org/10.2305/IUCN.UK.1998.RLTS.T33913A9819072.en
IUCN, 1998b. *Milicia excelsa*: World Conservation Monitoring Centre: The IUCN Red List of Threatened Species 1998: e.T33903A9817388. https://doi.org/10.2305/IUCN.UK.1998.RLTS.T33903A9817388.en
Iwara, A., Ebong, P.E., Mgbang, J., Igile, G.O., 2017. Phytochemical profiling, oral glucose tolerance, body weight changes and insulin response of methanol fraction of *Hensia crinita* extract on Wistar Rats. Research Journal of Pharmacology and Pharmacy 1: 3. https://www.researchgate.net/publication/326243844_Phyto-chemical_profiling_oral_glucose_tolerance_body_weight_changes_and_insulin_response_of_methanol_fraction_of_Hensia_crinita_extract_on_Wistar_Rats
Iwu, I.C., Okere, M.C., Linda, O.U., Uchegbu, R., 2018. GC-MS, Phytochemical and Antimicrobial Analysis of the Leaf of *Newbouldia Laevis* (P.Beav). International Journal of Innovative Research and Development 7(7), 242-250. https://doi.org/10.24940/ijird/2018/v7/i7/JUL18053
Jaccard, P., 1901. Étude comparative de la distribution florale dans une portion des Alpes et du Jura, in: Roux, F. (Ed.), Bulletin de La Société Vaudoise Des Sciences Naturelles 37(142), 547-580. Imprimerie Corbaz & Comp., Lausane. https://doi.org/10.5169/seals-266450
Jafarinia, M., Sadat Hosseini, M., kasiri, N., Fazel, N., Fathi, F., Ganjalikhani Hakemi, M., Eskandari, N., 2020. Quercetin with the potential effect on allergic diseases. Allergy, Asthma & Clinical Immunology 16(1), 36. https://doi.org/10.1186/s13223-020-00434-0
Jafarirad, S., Rasoulpour, I., 2019. Pharmaceutical ethnobotany in the Mahabad (West Azerbaijan) biosphere reserve: ethno-pharmaceutical formulations, nutraceutical uses and quantitative aspects. Braz. J. Pharm. Sci. 55, e18133. https://doi.org/10.1590/s2175-97902019000118133
Jain, S.K., 2003. Notable foreign medicinal uses for some plants of Indian tradition. Indian Journal of Traditional Knowledge 2(4), 321-332
Janzen, J.M., 1995. La quête de la thérapie au Bas-Zaïre., Collection hommes et sociétés. Karthala, Paris. pp. 287. ISBN 978-2-86537-513-4
Jean-François, J., 2004. Synthèse et évaluation in vivo de microparticules d'hydrogel. Thèse de doctora. Montréal, Canada. pp. 279. [WWW Document]. URL https://archipel.uqam.ca/794/ (accessed 31.05.2020)
Jeliazkov, A., Gavish, Y., Marsh, C.J., Geschke, J., Brummitt, N., Rocchini, D., Haase, P., Kunin, W.E., Henle, K., 2022. Sampling and modelling rare species: Conceptual

guidelines for the neglected majority. Global Change Biology 28, 3754–3777. https://doi.org/10.1111/gcb.16114

Jeon, I., Kim, H., Kang, H., Lee, H.-S., Jeong, S., Kim, S., Jang, S., 2014. Anti-Inflammatory and Antipruritic Effects of Luteolin from Perilla (*P. frutescens* L.) Leaves. Molecules 19, 6941–6951. https://doi.org/10.3390/molecules19066941

Ji, H., Li, X.-K., 2016. Oxidative Stress in Atopic Dermatitis. Oxidative Medicine and Cellular Longevity 2016, 1–8. https://doi.org/10.1155/2016/2721469

Jia, X., Du, Y., Xu, J., Dong, Y., 2020. Comparative pharmacokinetic study of five flavonoids in normal rats and rats with gastric ulcer following oral administration of Mongolian medicine, Shudage - 4 by UPLC – ESI – MS/MS. Trop. J. Pharm. Res. 19, 651–659. https://doi.org/10.4314/tjpr.v19i3.28

Jiang, Z., Wang, J., Chen, X., Wang, X., Wang, T., Zhu, Z., Pan, J., 2017. Simultaneous Determination of Kaempferide, Kaempferol and Isorhamnetin in Rat Plasma by Ultra-High Performance Liquid Chromatography-Tandem Mass Spectrometry and its Application to a Pharmacokinetic Study. J. Braz. Chem. Soc. 29, 535–542. https://doi.org/10.21577/0103-5053.20170166

Jiménez-Balam, D., Alcalá, L., Salgado, D., 2019. Maya children's medicinal plant knowledge: Initiative and agency in their learning process. Learning, Culture and Social Interaction 22, 100333. https://doi.org/10.1016/j.lcsi.2019.100333

Johnson, T.P., 2014. Snowball Sampling: Introduction, in: Balakrishnan, N., Colton, T., Everitt, B., Piegorsch, W., Ruggeri, F., Teugels, J.L. (Eds.), Wiley StatsRef: Statistics Reference Online. John Wiley & Sons, Ltd, Chichester, UK. https://doi.org/10.1002/9781118445112.stat05720

Johnston, L.G., Sabin, K., 2010. Sampling Hard-to-Reach Populations with Respondent Driven Sampling. Methodological Innovations Online 5 (2), 38-48. https://doi.org/10.4256/mio.2010.0017

Kabena, N., Ngombe, K., Ngbolua, K., Kikufi, B., Lassa, L., Mboloko, E., Mpiana, P., Lukoki, L., 2015. Etudes ethnobotanique et écologique des plantes d'hygiène intime féminine utilisées à Kinshasa (République Démocratique du Congo). Int. J. Bio. Chem. Sci 8(6), 2626-2642. https://doi.org/10.4314/ijbcs.v8i6.23

Kalanda, K., Ilumbe, B., 1993. Kalanda, K., and G. Ilumbe. 1993. Contribution à La Connaissance Des Plantes Médicinales Du Haut-Zaïre. Plantes Anti Hémorroïdaires de Kisangani. Rev. Méd. et Pharma. Afric. 9(1), 51–58.

Kalu, E.C., N. Onyeike, E., C. Ikewuchi, C., 2019. Phytochemical Composition and Biochemical Studies of the Aqueous Leaf Extracts of *Brillantaisia guianensis* P. beauv on Alloxan Treated Wistar Albino Rats. International Journal of Biochemistry Research & Review 27(4), 1–13. https://doi.org/10.9734/ijbcrr/2019/v27i430129

Kami, T.J.V., Moutsambote, J., Nzobadila, E.K., Atencia, R., 2019. Analyse floristique et phytogéographique de la végétation à l'Est du Parc National Conkouati-Douli (République du Congo). International Journal of Innovation and Applied Studies, 27(1), 122-132.

Kang, C., Zhao, D., Kang, L., Wang, S., Lv, C., Zhou, L., Jiang, J.-Y., Yang, W., Li, J., Huang, L.-Q., Guo, L., 2018. Elucidation of Characteristic Sulfur-Fumigated Markers and Chemical Transformation Mechanism for Quality Control of Achyranthes bidentate Blume Using Metabolome and Sulfur Dioxide Residue Analysis. Front. Plant Sci. 9, 790. https://doi.org/10.3389/fpls.2018.00790

Karunamoorthi, K., Jegajeevanram, K., Vijayalakshmi, J., Mengistie, E., 2013. Traditional Medicinal Plants: A Source of Phytotherapeutic Modality in Resource-Constrained Health Care Settings. J. Evid.-Based Complement. Altern. Med. 18, 67–74. https://doi.org/10.1177/2156587212460241

Karuppagounder, V., Arumugam, S., Thandavarayan, R.A., Pitchaimani, V., Sreedhar, R., Afrin, R., Harima, M., Suzuki, H., Nomoto, M., Miyashita, S., Suzuki, K., Nakamura, M., Watanabe, K., 2015. Modulation of HMGB1 translocation and RAGE/NFκB cascade by quercetin treatment mitigates atopic dermatitis in NC/Nga transgenic mice. Exp. Dermatol. 24, 418–423. https://doi.org/10.1111/exd.12685

Kaul, T.N., Middleton, E., Ogra, P.L., 1985. Antiviral effect of flavonoids on human viruses. J. Med. Virol. 15, 71–79. https://doi.org/10.1002/jmv.1890150110

Kaurinovic, B., Vastag, D., 2019. Flavonoids and Phenolic Acids as Potential Natural Antioxidants, in: Shalaby, E. (Ed.), Antioxidants. pp. 1-21. IntechOpen. https://doi.org/10.5772/intechopen.83731

Kausar, J., Muthumani, D., Hedina, A., S, S., Anand, V., 2016. Review of the phytochemical and pharmacological activities of *Euphorbia hirta* Linn. Pharmacognosy Journal 8(4), 310–313. https://doi.org/10.5530/pj.2016.4.2

Kayumba, M., Lubini, A.C., Kidikwadi, T.E., Habari, J., 2015. Floristic study of the mature formation of Bombo-Lumene Domain and Reserve (Kinshasa / RD Congo). International Journal of Innovation and Applied Studies 11(3), 716-727.

Keeley, J.E., 1981. Reproductive cycles and fire regimes (Federal Government Series No. WO-26), General Technical Report. U.S. Forest Service. pp. 231-277. [WWW Document]. URL https://pubs.usgs.gov/publication/2002128.

Kefalew, A., Asfaw, Z., Kelbessa, E., 2015. Ethnobotany of medicinal plants in Ada'a District, East Shewa Zone of Oromia Regional State, Ethiopia. Journal of Ethnobiology and Ethnomedicine 11, 25. https://doi.org/10.1186/s13002-015-0014-6

Kent, M., Gill, W.J., Weaver, R.E., Armitage, R.P., 1997. Landscape and plant community boundaries in biogeography. Progress in Physical Geography: Earth and Environment 21, 315–353. https://doi.org/10.1177/030913339702100301

Khan, M., Srivastava, S.K., Syamasundar, K.V., Singh, M., Naqvi, A.A., 2002. Chemical composition of leaf and flower essential oil of *Lantana camara* from India. Flavour Fragr. J. 17, 75–77. https://doi.org/10.1002/ffj.1047

Kibria, A.A., Kamrunnessa, Rahman, Md.M., Kar, A., 2019. Extraction and Evaluation of Phytochemicals from Banana Peels (*Musa sapientum*) and Banana Plants (*Musa paradisiaca*). Malaysian Journal of Halal Research 2, 22–26. https://doi.org/10.2478/mjhr-2019-0005

Kibungu, kembelo, 2010. Quelques Plantes Medecinales du Bas-Congo et leurs Usages. Biodiversity, Natural resources, Tourism. pp. 195. [WWW Document]. URL http://www.nzenzeflowerspauwels.be/Plantes_medicinales_Kibungu.pdf (accessed 5.2.20).

Kibungu, K.P., Flavien, N.B., Honoré, B.K., Vanhove, W., Van Damme, P., 2021. Ethnobotanical characterization of medicinal plants used in Kisantu and Mbanza-Ngungu territories, Kongo-Central Province in DR Congo. J. Ethnobiol. Ethnomed. 17, 5. https://doi.org/10.1186/s13002-020-00428-7

Kibungu, K.P., Tuenter, E., Vanhove, W., Katula, H.B., Van Damme, P., Pieters, L., 2023a. Phytochemical profiling by UPLC-ESI-QTOF-MS of *Commelina africana*, widely used in traditional medicine in DR Congo. South African Journal of Botany 157, 325–334. https://doi.org/10.1016/j.sajb.2023.04.010

Kibungu, K.P., Tuenter, E., Vanhove, W., Belesi Katula, H., Van Damme, P., Pieters, L., 2023. Phytochemical Profiling by UPLC-ESI-QTOF-MS of *Kalaharia uncinata* (Schinz) Moldenke, Widely Used in Traditional Medicine in DR Congo. Chemistry & Biodiversity 20, e202300826. https://doi.org/10.1002/cbdv.202300826

Kikufi, A., Lejoly, J., Lukoki, F., 2017. État actuel de la biodiversité végétale du territoire de Kimvula au sud-ouest de la République Démocratique du Congo/Plant biodiversity

status of Kimvula territory in the South-West of DR Congo . International Journal of Innovation and Applied Studies 19 (4), 929-943.
Kikufi, A., Lukoki, F., 2008. Etude floristique et écologique des marais de Masina. Revue Congolaise des Sciences Nucléaires 23, 1–20.
Kim, B., Choi, Y.-E., Kim, H.-S., 2014. *Eruca sativa* and its Flavonoid Components, Quercetin and Isorhamnetin, Improve Skin Barrier Function by Activation of Peroxisome Proliferator-Activated Receptor (PPAR)-α and Suppression of Inflammatory Cytokines: *Eruca sativa* and its flavonoids improve skin barrier function. Phytother. Res. 28, 1359–1366. https://doi.org/10.1002/ptr.5138
Kim, J.-E., Lee, D.-E., Lee, K.W., Son, J.E., Seo, S.K., Li, J., Jung, S.K., Heo, Y.-S., Mottamal, M., Bode, A.M., Dong, Z., Lee, H.J., 2011. Isorhamnetin Suppresses Skin Cancer through Direct Inhibition of MEK1 and PI3-K. Cancer Prevention Research 4, 582–591. https://doi.org/10.1158/1940-6207.CAPR-11-0032
Kim, M.K., Yun, K.J., Lim, D.H., Kim, J., Jang, Y.P., 2016. Anti-Inflammatory Properties of Flavone di-C-Glycosides as Active Principles of *Camellia Mistletoe, Korthalsella japonica*. Biomolecules & Therapeutics 24, 630–637. https://doi.org/10.4062/biomolther.2016.019
Kimpouni, V., Apani, E., Motom, M., 2013. Analyse Phytoécologique de la Flore Ligneuse de la Haute Sangha (République du Congo). Adansonia 35, 107–134. https://doi.org/10.5252/a2013n1a9
Kimpouni, V., Apani, E., Motom, V.K. et M., 2012. Variation de la composition floristique des fruitiers traditionnels après abandon en zone de savane. Acta Botanica Gallica 159, 53–65. https://doi.org/10.1080/12538078.2012.671643
Kimpouni, V., Mamboueni, J.C., Tsoungould, F.G.M., Mikoko, E.N., 2019. Ethnobotanical and phytotherapeutic study from Kouni community of the sub-prefecture of Kayes (Bouenza – Congo). Heliyon 5. e02007. https://doi.org/10.1016/j.heliyon.2019.e02007
King, R.R., Calhoun, L.A., 2005. Characterization of cross-linked hydroxycinnamic acid amides isolated from potato common scab lesions. Phytochemistry 66, 2468–2473. https://doi.org/10.1016/j.phytochem.2005.07.014
Kinkela, N., Bibeau, G., Corin, E., 1977. Vers un nouveau plan de santé au Zaïre. Médecine traditionnelle au Zaïre et en Afrique 3, 5-47.
Király, G., Bidló, A., Takács, G., Eliáš, P., Melečková, Z., Dítě, D., 2013. Remote locality of the littoral *Carex extensa* (Cyperaceae) in Hungary — long distance dispersal from coastal to inland salt marshes. Biologia 68, 872–878. https://doi.org/10.2478/s11756-013-0219-x
Kisangau, D.P., Lyaruu, H.V., Hosea, K.M., Joseph, C.C., 2007. Use of traditional medicines in the management of HIV/AIDS opportunistic infections in Tanzania: a case in the Bukoba rural district. J. Ethnobiol. Ethnomed. 3, 29. https://doi.org/10.1186/1746-4269-3-29
Kitamura, S., Morisseau, C., Inceoglu, B., Kamita, S.G., De Nicola, G.R., Nyegue, M., Hammock, B.D., 2015. Potent Natural Soluble Epoxide Hydrolase Inhibitors from Pentadiplandra brazzeana Baillon: Synthesis, Quantification, and Measurement of Biological Activities In Vitro and In Vivo. PLoS ONE 10, e0117438. https://doi.org/10.1371/journal.pone.0117438
Kizito, N.B., 1997. Au-delà de la régulation étatique : la gouvernance du marché informel de la santé : cas des médicaments au Zaïre. United Nations Research Institute for Social Development. Geneva, Switzerland. pp. 44. [WWW Document]. URL http://hdl.handle.net/20.500.12424/179529 (accessed 25.06.2022).

Koffi-Nevry, R., Kouassi, K.C., Nanga, Z.Y., Koussémon, M., Loukou, G.Y., 2012. Antibacterial Activity of Two Bell Pepper Extracts: *Capsicum annuum* L. and *Capsicum frutescens*. International Journal of Food Properties 15, 961–971. https://doi.org/10.1080/10942912.2010.509896

Konda, ku M., Ngoma, B., Latham, P., Mafuta, M., Konda, K.M.R., Dumu, L., Kelela, B., Itufa, Y., Kodondi, K., 2015. Plantes medicinales de traditions de la R.D. Congo: donnees preliminaires, 1st ed. Institut de Recherche en Sciences de la Santé (I.R.S.S.), Kinshsa, DR Congo. p. 438. ISBN 978-0-9928986-4-9. [WWW Document]. URL: http://www.nzenzeflowerspauwels.be/Plantes_medicinales_RDC.pdf

Kouadio, B., Djeneb, C., Yvette, F.N.B., Basile, Y.A., Cynthia, Y.Y., Alain, A.S., Noël, Z.G., 2016. Étude ethnobotanique des plantes médicinales utilisées dans le Département de Transua, District du Zanzan (Côte d'Ivoire). Journal of Animal & Plant Sciences 27 (2), 4230-4250.

Kouadja, G.S., Kouamé, A.C., Kouadio, K.E., Kouao, B.J., Kouassi, N.C., 2021. Phytosociological Surveys and Monitoring of the Bromatological Parameters According to the Age of Regrowth of Savannah Pastures Perfectly Reconstituted in the Central Zone of Côte d'Ivoire. European Journal of Nutrition & Food Safety 13(3), 54–61. https://doi.org/10.9734/ejnfs/2021/v13i330390

Kouassi, N.M., 2008. Les modes de transmission du savoir technique en Afrique. Revue Ivoirienne de Philosophie et de Culture, LE KORE 2008(40), 45-60. https://www.dptphilosophie-univfhb.org/lekore/2008-40-4-Les_modes_Kouassi.pdf

Kowalczyk, M., Golonko, A., Świsłocka, R., Kalinowska, M., Parcheta, M., Swiergiel, A., Lewandowski, W., 2021. Drug Design Strategies for the Treatment of Viral Disease. Plant Phenolic Compounds and Their Derivatives. Front. Pharmacol. 12, 709104. https://doi.org/10.3389/fphar.2021.709104

Kramberger, K., Barlič-Maganja, D., Bandelj, D., Baruca Arbeiter, A., Peeters, K., Miklavčič Višnjevec, A., Jenko Pražnikar, Z., 2020. HPLC-DAD-ESI-QTOF-MS Determination of Bioactive Compounds and Antioxidant Activity Comparison of the Hydroalcoholic and Water Extracts from Two Helichrysum italicum Species. Metabolites 10, 403. https://doi.org/10.3390/metabo10100403

Kritikou, E., Kalogiouri, N.P., Kolyvira, L., Thomaidis, N.S., 2020. Target and Suspect HRMS Metabolomics for the Determination of Functional Ingredients in 13 Varieties of Olive Leaves and Drupes from Greece. Molecules 25, 4889. https://doi.org/10.3390/molecules25214889

Krog, M.P., Falcâo, M.P., Olsen, C.S., 2006. Medicinal plant markets and trade in Maputo, Mozambique. Forest & Landscape Working Papers no. 16-2006. Danish Centre for Forest, Landscape and Planning, KVL., Denmark. pp. 50. ISBN 10: 87-7903-279-6. ISBN 13: 978 87-7903-279-6

Kudumela, R.G., McGaw, L.J., Masoko, P., 2018. Antibacterial interactions, anti-inflammatory and cytotoxic effects of four medicinal plant species. BMC Complement. Altern. Med. 18, 199. https://doi.org/10.1186/s12906-018-2264-z

Kumar, R.P., Lalramnghinglova, H., 2011. Ethnomedicinal Plants of India with Special Reference to an Indo-Burma Hotspot Region: An overview. Ethnobot. Res. App. 9, 379–420. https://doi.org/10.17348/era.9.0.379-420

Kumar, S., Singh, A., Kumar, B., 2017. Identification and characterization of phenolics and terpenoids from ethanolic extracts of *Phyllanthus* species by HPLC-ESI-QTOF-MS/MS. Journal of Pharmaceutical Analysis 7, 214–222. https://doi.org/10.1016/j.jpha.2017.01.005

Kyolo, S.K., Katuura, E., Bbosa, G., Mwebaza, N., Kibendelwa, Z.T., Nakasujja, N., 2022. Medicinal Plants Used in Management of Various Mental Illnesses in Goma City,

Democratic Republic of Congo. Neuroscience and Medicine 13(1), 17–42. https://doi.org/10.4236/nm.2022.131002
Labiad, H., Et-tahir, A., Ghanmi, M., Satrani, B., Aljaiyash, A., Chaouch, A., Fadli, M., 2020. Ethnopharmacological survey of aromatic and medicinal plants of the pharmacopoeia of northern Morocco. Ethnobotany Research and Applications 19, 1–16.
Ladmirant, H., 1971. Notice Explicative De La Feuille Inkisi: Carte Géologique à L'échelle Du 1/200.000 (degré Carré S6/15 - SB33.10). 2e éd., rev. Kinshasa: Service géologique. pp. 46
Ladoh-Yemeda, C., Vandi, T., Dibong, S., Mpondo Mpondo, E., Wansi, J., Betti, J., Choula, F., Ndongo, D., Tomedi Eyango, M., 2016. Étude ethnobotanique des plantes médicinales commercialisées dans les marchés de la ville de Douala, Cameroun. J. App. Bioscience. 99, 9450-9466. https://doi.org/10.4314/jab.v99i1.11
Lagrange, H., 2015. L'épreuve des inégalités. Presses Universitaires de France. pp. 315. ISBN 978-2-13-073922-7
Lahlou, M., 2013. The Success of Natural Products in Drug Discovery. Pharmacology & Pharmacy 4, 17–31. https://doi.org/10.4236/pp.2013.43A003
Lahsissene, H., Kahouadji, A., Tijane, M., Hseini, S., 2009. Catalogue des plantes médicinales utilisées dans la Région de Zaër (Maroc occidental). Lejeunia, Revue de Botanique, N° 186, pp. 30. [WWW Document].URL : https://popups.uliege.be/0457-4184/index.php?id=710. 186 (accessed 30.05.2020).
Lamotte, M., 1962. Initiation aux méthodes statistiques en biologie, in: Sutter, J. (Ed.), Population, 15 ème Année, N°3. 2ème Ed. ed. Masson, Paris, pp. 144
Lanata, F., Dessein, S., Nsimundele, L., 2013. The Role of Kisantu Botanical Garden in Biodiversity Conservation. BGjournal 10(2), 8–11. https://www.jstor.org/stable/24811307 (accessed 12/01/2024)
Landeau, R., 2008. Comparaison de la diversité intra et inter habitat et observation sur la distribution des taxons le long des gradiens environnementaux. Chambery SAVOIE, France. pp. 21. [WWW Document].URL: https://www.jardinalpindulautaret.fr/sites/sajf/files/pdf/Rapport_Remi_Landeau_rapport.pdf (accessed 24.05.2020).
Lanhers, M.C., Nicola, J.P., Fleurentin, J., Weniger, B., 2005. *Euphorbia hirta* L. Ethnopharmacologia 36, 9–23.
Lanzotti, V., 2006. The analysis of onion and garlic. Journal of Chromatography A 1112, 3–22. https://doi.org/10.1016/j.chroma.2005.12.016
Larridon, I., Spalink, D., Jiménez-Mejías, P., Márquez-Corro, J.I., Martín-Bravo, S., Muasya, M., Escudero, M., 2021. The evolutionary history of sedges (Cyperaceae) in Madagascar. J. Biogeogr. 48, 917–932. https://doi.org/10.1111/jbi.14048
Laskey, H., Crook, E.D., Kimball, S., 2020. Analysis of Rare Plant Occurrence Data for Monitoring Prioritization. Diversity 12, 427. https://doi.org/10.3390/d12110427
Lassa, K.L., Kikufi, B.A., Ilumbe Bayeu, G., Biloso, M.A., Masens, D.M., Habari, M.J.P., Lukoki Luyeye, F., 2019. Etude Floristique, Ecologique et Phytogeographique des Especes Utiles du Territoire de Kimvula, R.D. Congo. Congo Sciences 7(2), 91–101.
Latham, P., Konda ku Mbuta, A., 2016. Useful plants of Bas-Congo Province, Democratic Republic of Congo. Vol. 1, 3. ed. ed. Salvation Army. Scotland, UK. pp. 301. ISBN 978-0-9554208-7-0. http://www.nzenzeflowerspauwels.be/Useful-vol-1.pdf
Latham, P., Konda ku Mbuta, A.,2014. Plantes utiles du Bas-Congo, République Democratique du Congo. 3. ed. ed. Salvation Army. Scotland, UK. p.407. ISBN 978-0-9928986-0-1
Lautenschläger, T., Monizi, M., Pedro, M., Mandombe, J.L., Bránquima, M.F., Heinze, C., Neinhuis, C., 2018. First large-scale ethnobotanical survey in the province of Uíge,

northern Angola. J. Ethnobiol. Ethnomed. 14, 51. https://doi.org/10.1186/s13002-018-0238-3
Lavanya, N., Beaulah, A., Vani, G., 2016. *Musa paradisiaca* – A review on phytochemistry and pharmacology. World Journal of Pharmaceutical and Medical Research 2(6), 163–173.
Lazli, A., Beldi, M., Ghouri, L., Nouri, N.E.H., 2019. Étude ethnobotanique et inventaire des plantes médicinales dans la région de Bougous: (Parc National d'El Kala,- Nord-est algérien). Bulletin de la Société Royale des Sciences de Liège 88, 22 - 43 https://doi.org/10.25518/0037-9565.8429
Lebot, V., Faloye, B., Okon, E., Gueye, B., 2019. Simultaneous quantification of allantoin and steroidal saponins in yam (Dioscorea spp.) powders. Journal of Applied Research on Medicinal and Aromatic Plants 13, 100200. https://doi.org/10.1016/j.jarmap.2019.02.001
Lebrun, J.P.A., 1954. Une classification écologique des forêts du Congo. Série Scientifique Numéro 63. Institut national pour l'étude agronomique du Congo Belge. pp. 89.
Lech, K., Witkoś, K., Jarosz, M., 2014. HPLC–UV–ESI MS/MS identification of the color constituents of sawwort (*Serratula tinctoria* L.). Anal. Bioanal. Chem. 406, 3703–3708. https://doi.org/10.1007/s00216-013-7589-3
Lee, C., Kim, S.-Y., Eum, S., Paik, J.-H., Bach, T.T., Darshetkar, A.M., Choudhary, R.K., Hai, D.V., Quang, B.H., Thanh, N.T., Choi, S., 2019. Ethnobotanical study on medicinal plants used by local Van Kieu ethnic people of Bac Huong Hoa nature reserve, Vietnam. Journal of Ethnopharmacology 231, 283–294. https://doi.org/10.1016/j.jep.2018.11.006
Lee, H.N., Shin, S.A., Choo, G.S., Kim, H.J., Park, Y.S., Kim, B.S., Kim, S.K., Cho, S.D., Nam, J.S., Choi, C.S., Che, J.H., Park, B.K., Jung, J.Y., 2017. Anti-inflammatory effect of quercetin and galangin in LPS-stimulated RAW264.7 macrophages and DNCB-induced atopic dermatitis animal models. Int. J. Mol. Med. 41, 488-498. https://doi.org/10.3892/ijmm.2017.3296
Lee, K.-H., Do, H.-K., Kim, D.-Y., Kim, W., 2021. Impact of chlorogenic acid on modulation of significant genes in dermal fibroblasts and epidermal keratinocytes. Biochemical and Biophysical Research Communications 583, 22–28. https://doi.org/10.1016/j.bbrc.2021.10.057
Legendre, L., Legendre, P., 1984. Ecologie numérique. 2e éd., rev.Augm. Paris, New York: Masson ; Presses de l'Université du Québec, Montréal. pp. 260. ISBN 978-2-225-80132-7
Léger, A., 2008. Biodiversité des plantes médicinales québécoises et dispositifs de protection de la biodiversité et de l'environnement. Montréal (Québec, Canada), pp. 197. [WWW Document]. URL https://archipel.uqam.ca/967/ (accessed 05.02.20).
Leitão, R.P., Zuanon, J., Villéger, S., Williams, S.E., Baraloto, C., Fortunel, C., Mendonça, F.P., Mouillot, D., 2016. Rare species contribute disproportionately to the functional structure of species assemblages. Proc. R. Soc. B. 283, 20160084. https://doi.org/10.1098/rspb.2016.0084
Lejoly, J., 1997. La banque de données ethnobotaniques PHARMEL sur les plantes médicinales africaines, in: D. Barreteau, R. Dognin, and C. von Graffenried, eds., L'Homme et le milieu végétal dans le bassin du Lac Tchad: Séminaire du Réseau Méga-Tchad, Sèvres, du 18 au 20 Septembre 1991 = Man and vegetation in the Lake Chad Basin, 383-92. Collection Colloques et séminaires. Paris: Editions de l'Orstom. ISBN 978-2-7099-1372-0
Lejoly, J., Polygeris-Bindeko, M.J., Maes, F., 1996. Herbal Medicine, In: In P. G. Janssens, M. Kivits, & J. Vuylsteke (Éds.), Health in Central Africa Since 1885 : Past, Present

and Future (Vol. 1, p. 459-486). King Baudouin Foundation. ISBN 978-2-87212-214-1. https://books.google.be/books?id=akw1xwEACAAJ

Leonard, W., Zhang, P., Ying, D., Fang, Z., 2022. Tyramine-derived hydroxycinnamic acid amides in plant foods: sources, synthesis, health effects and potential applications in food industry. Critical Reviews in Food Science and Nutrition 62, 1608–1625. https://doi.org/10.1080/10408398.2020.1845603

Leonard, W., Zhang, P., Ying, D., Fang, Z., 2021. Lignanamides: sources, biosynthesis and potential health benefits – a minireview. Critical Reviews in Food Science and Nutrition 61, 1404–1414. https://doi.org/10.1080/10408398.2020.1759025

Leonti, M., Cabras, S., Eugenia Castellanos, M., Challenger, A., Gertsch, J., Casu, L., 2013. Bioprospecting: Evolutionary implications from a post-olmec pharmacopoeia and the relevance of widespread taxa. Journal of Ethnopharmacology 147, 92–107. https://doi.org/10.1016/j.jep.2013.02.012

Les observateurs, 2010. Les tradipraticiens, entre médecine traditionnelle et charlatanisme [WWW Document]. Les Observateurs de France 24. URL https://observers.france24.com/fr/20100603-tradipraticiens-medecine-traditionnelle-charlatans-congo-sante-plantes-kisangani (accessed 05.30.20).

Li, L., Tsao, R., Yang, R., Liu, C., Young, J.C., Zhu, H., 2008. Isolation and purification of phenylethanoid glycosides from Cistanche deserticola by high-speed counter-current chromatography. Food Chem. 108, 702–710. https://doi.org/10.1016/j.foodchem.2007.10.082

Li, L., Wang, Z., Peng, Y., Fu, X., Wang, Y., Xiao, W., Song, S., 2015. Screening and Identification of Multi-Components in Re Du Ning Injections Using LC/TOF-MS Coupled with UV-Irradiation. J. Chromatogr. Sci. 53, 778–786. https://doi.org/10.1093/chromsci/bmu125

Li, Q.M., Claeys, M., 1994. Characterization and differentiation of diglycosyl flavonoids by positive ion fast atom bombardment and tandem mass spectrometry. Biol. Mass Spectrom. 23, 406–416. https://doi.org/10.1002/bms.1200230705

Li, S., Wu, B., Fu, W., Reddivari, L., 2019. The Anti-inflammatory Effects of Dietary Anthocyanins against Ulcerative Colitis. Int. J. Mol. Sci. 20 (10), 2588. https://doi.org/10.3390/ijms20102588

Li, W.-L., Ding, J.-X., Bai, J., Hu, Y., Song, H., Sun, X.-M., Ji, Y.-B., 2019. Research on correlation of compositions with oestrogenic activity of Cistanche based on LC/Q-TOF-MS/MS technology. Open Chem. 17, 1–12. https://doi.org/10.1515/chem-2019-0001

Li, Y., Liu, Y., Liu, R., Liu, S., Zhang, X., Wang, Z., Zhang, J., Lu, J., 2015. HPLC-LTQ-orbitrap MS ^{n} profiling method to comprehensively characterize multiple chemical constituents in xiao-er-qing-jie granules. Anal. Methods 7, 7511–7526. https://doi.org/10.1039/C5AY00420A

Li, Z., Ryenchindorj, L., Liu, B., Shi, J., Zhang, C., Hua, Y., Liu, P., Shan, G., Jia, T., 2021. Chemical profiles and metabolite study of raw and processed Cistanche deserticola in rats by UPLC-Q-TOF-MSE. Chin. Med. 16, 95. https://doi.org/10.1186/s13020-021-00508-0

Li, Z.-H., Guo, H., Xu, W.-B., Ge, J., Li, X., Alimu, M., He, D.-J., 2016. Rapid Identification of Flavonoid Constituents Directly from PTP1B Inhibitive Extract of Raspberry (Rubus idaeus L.) Leaves by HPLC–ESI–QTOF–MS-MS. J. Chromatogr. Sci. 54, 805–810. https://doi.org/10.1093/chromsci/bmw016

Likibi, B.N., Mabika, A.B.M., Tsiba, G., Moutsambote, J., Nsikabaka, S., Ouamba, J., 2020. Cristal de l'huile essentielle de *Mondia whiteï* (Hook. F.) Skeels : isomere de la

vanilline (2-hydroxy-4-methoxy-benzaldehyde). International Journal of Innovation and Applied Studies 28(2), 567–574.
Linda Loffler, n.d. Base de données sur la flore du Swaziland [WWW Document]. URL http://www.sntc.org.sz/backup/flora/speciesinfo.asp?spid=1742 (accessed 06.01.20).
Liu, C., Chen, Y., Fang, G., Zhou, H., Huang, W., Liu, Y., Wang, X., Li, Z., 2022. Hydrological Connectivity Improves the Water-Related Environment in a Typical Arid Inland River Basin in Xinjiang, China. Remote Sensing 14(19), 4977. https://doi.org/10.3390/rs14194977
Liu, L., Xia, H., Quan, X., Wang, Y., 2023. Plant trait-based life strategies of overlapping species vary in different succession stages of subtropical forests, Eastern China. Front. Ecol. Evol. 10, 1103937. https://doi.org/10.3389/fevo.2022.1103937
Liu, Q., Qiu, Y., Beta, T., 2010. Comparison of Antioxidant Activities of Different Colored Wheat Grains and Analysis of Phenolic Compounds. J. Agric. Food Chem. 58, 9235–9241. https://doi.org/10.1021/jf101700s
Li Vigni, I., Melati, M.R., 1999. Examples of seed dispersal by entomochory. Acta Bot. Gallica 146, 145–156. https://doi.org/10.1080/12538078.1999.10515813
Llorent-Martínez, E.J., Gouveia, S., Castilho, P.C., 2015. Analysis of phenolic compounds in leaves from endemic trees from Madeira Island. A contribution to the chemotaxonomy of Laurisilva forest species. Industrial Crops and Products 64, 135–151. https://doi.org/10.1016/j.indcrop.2014.10.068
Lomáscolo, S.B., Levey, D.J., Kimball, R.T., Bolker, B.M., Alborn, H.T., 2010. Dispersers shape fruit diversity in *Ficus* (Moraceae). Proceedings of the National Academy of Sciences 107(33), 14668–14672. https://doi.org/10.1073/pnas.1008773107
Lomomba, E., 1997. L'entre-traditions comme épreuve du nœud. Interculture, 30(2), 3-67.
Lontsi, D., Sondengam, B.L., Martin, M.T., Bodo, B., 1998. Cecropioic acid, a pentacyclic triterpene from *Musanga cecropioides*. Phytochemistry 48(1), 171–174. https://doi.org/10.1016/S0031-9422(97)00789-9
Lougbegnon, T.O., Gbesso, F., Logbo, J., Tente, B., Codjia, J.T.C., 2018. Ethnobotanical study of plants with therapeutic value in the commune of Glazoué in Benin (West Africa). International Journal of Innovation and Applied Studies 24(2), 644–655.
Lubini, A., 2001. Analyse phytogéographique de la flore forestière du secteur Kasai au Congo Kinshasa, In: Comptes rendus de la XVI ème réunion pleinière de l'AETFAT vol. 72 n° 2, Bull. Jard. Bot. Nat. Belg. Bruxelles, pp. 859–872.
Lubini, A., 1997. La végétation de la Réserve de biosphère de Luki au Mayombe (Zaïre). Jardin botanique national de Belgique, Meise. Opera botanica Belgica, Vol. 5, pp. 155. ISBN 978-90-72619-33-4
Ludiongo, N., 1984. Nkisi mi bakulu. Afrique et développement. Vol. 29. Kinshasa: Université Catholique du Congo. Afrique et développement, Vol. 29, pp. 172. [WWW Document]. URL: https://books.google.be/books?id=qSgyrgEACAAJ.
Lulekal, E., Asfaw, Z., Kelbessa, E., Van Damme, P., 2013. Ethnomedicinal study of plants used for human ailments in Ankober District, North Shewa Zone, Amhara Region, Ethiopia. J. Ethnobiol. Ethnomed. 9, 63. https://doi.org/10.1186/1746-4269-9-63
Lundholm, J. (2011). Vegetation of urban hard surfaces. In J. Niemelä (Ed.), Urban ecology: Patterns, processes, and applications (pp. 93–102). New York: Oxford University Press. [WWW Document]. URL https://www.researchgate.net/profile/Jeremy-Lundholm/publication/284225074_Vegetation_of_Urban_Hard_Surfaces/links/56700fe308aecdcd23588d1a/Vegetation-of-Urban-Hard-Surfaces.pdf (Accessed 02.01.2024).

Lv, H.-P., Zhu, Y., Tan, J.-F., Guo, L., Dai, W.-D., Lin, Z., 2015. Bioactive compounds from Pu-erh tea with therapy for hyperlipidaemia. J. Funct. Foods 19, 194–203. https://doi.org/10.1016/j.jff.2015.09.047

Lye, K.A., 2016. Chemistry of fruit wall and seed in Cyperaceae tribe Trilepideae. South African Journal of Botany 106, 104–109. https://doi.org/10.1016/j.sajb.2016.06.003

MA, W.G., TAN, R.X., Fuzzati, N., LI, Q.S., Wolfender, J.-L., Hostettmann, K., 1997. Natural occurring and synthetic polyyne glycosides. Phytochemistry, 45(2), 411- 415.

Ma, X., Lin, Y., Liu, yingying, Li, W., He, J., Fang, M., Lin, D., 2021. Effects of Apigenin Treatment on Random Skin Flap Survival in Rats. Front. Pharmacol. 12, 625733. https://doi.org/10.3389/fphar.2021.625733

Mabika, K., 1967. La remise en question, base de la décolonisation mentale. Études congolaises, No 14, Bruxelles: Éditions Remarques africaines. pp. 205. http://ark.bnf.fr/ark:/12148/cb34997022b (accessed 25.02.2021)

Maffo, M.N.L., Ntsomboh-Ntsefong, G., Zapfack, L., Siefried Dibong, D., Feukeng Kenfack, S.S., Tchatchouang Ngansop, E., Youmbi, E., 2019. Ethnopharmacological study of medicinal plants used in Douala City (Littoral region), Cameroon. International network for natural sciences - research journal 15, 23–40.

Magray, J.A., Wani, B.A., Islam, T., Ganie, A.H., Nawchoo, I.A., 2022. Phyto-ecological analysis of *Phytolacca acinosa* Roxb. assemblages in Kashmir Himalaya, India. Front. For. Glob. Change 5, 976902. https://doi.org/10.3389/ffgc.2022.976902

Magurran, A.E., 2004. Measuring biological diversity. Blackwell Pub, Malden, Ma. 256p. ISBN 978-0-632-05633-0

Mahamat, A., Gbaweng, A.J.Y., Tagatsing Fotsing, M., Talla, E., Fekam, F.B., Henoumont, C., Sophie, L., Mbafor, J.T., 2021. Two new flavones glycosides with antimicrobial activities from *Clerodendrum formicarum* Gürke (Lamiaceae). Natural Product Research 35, 951–959. https://doi.org/10.1080/14786419.2019.1613397

Mahmood, A., Ngah, N., Omar, M., 2011. Phytochemicals Constituent and Antioxidant Activities in Musa x Paradisiaca Flower. European Journal of Scientific Research 66(2), 311-318.

Makhubu, L., 1978. The traditional healer. University of Botswana and Swaziland. Kwaluseni, Swaziland. pp. 86. ISBN 9780797803541

Makumbelo, E., Lukoki, L., Sj. Paulus, J.J., Luyindula, N., 2008. Stratégie de valorisation des espèces ressources des produits non ligneux de la savane des environs de Kinshasa: II. Enquête ethnobotanique (aspects médicinaux). Tropicultura 26, 129-134.

Malaisse, F., 1997. Se nourrir en forêt claire africaine: approche écologique et nutritionnelle. Presses Agronomiques de Gembloux, pp. 405, ISBN 978-2-87016-045-9

Malcolm, J.R., Markhan, A., Neilson, R.P., Garaci, M., 2002. Special Paper: Estimated Migration Rates under Scenarios of Global Climate Change. Journal of Biogeography 29, 835–849.

Malik, K., Ahmad, M., Zafar, M., Sultana, S., Tariq, A., Rashid, N., 2020. Medicinal Plants Used for Treatment of Prevalent Diseases in Northern Pakistan of Western Himalayas, in: Abdul Rasool Hassan, B. (Ed.), Medicinal Plants - Use in Prevention and Treatment of Diseases. IntechOpen. https://doi.org/10.5772/intechopen.89932

Malik, K., Ahmad, M., Zafar, M., Ullah, R., Mahmood, H.M., Parveen, B., Rashid, N., Sultana, S., Shah, S.N., Lubna, 2019. An ethnobotanical study of medicinal plants used to treat skin diseases in northern Pakistan. BMC Complement. Altern. Med. 19, 210. https://doi.org/10.1186/s12906-019-2605-6

Manhas, A., Kaul, V., 2023. Preliminary Phytochemical Analysis and Quantification of Antioxidant Phenolics in Commelina benghalensis Using HPLC. Natl. Acad. Sci. Lett. 46(4), 305–310. https://doi.org/10.1007/s40009-023-01257-4

Manika, N., Mishra, P., Kumar, N., Chanotiya, C., Bagchi, G.D., 2012. Effect of season on yield and composition of the essential oil of *Eucalyptus citriodora* Hook. leaf grown in sub-tropical conditions of North India. Journal of medicinal plant research 6, 2875–2879. https://doi.org/10.5897/JMPR011.1611

Manurung, J., Kappen, J., Schnitzler, J., Frolov, A., Wessjohann, L.A., Agusta, A., Muellner-Riehl, A.N., Franke, K., 2021. Analysis of Unusual Sulfated Constituents and Anti-infective Properties of Two Indonesian Mangroves, *Lumnitzera littorea* and *Lumnitzera racemosa* (Combretaceae). Separations 8(6), 82. https://doi.org/10.3390/separations8060082

Manzo, L.M., Idrissa Moussa, Ikhiri, K., 2017. Les Plantes Médicinales Utilisées Dans Le Traitement Des Diarrhées Au Niger. Etude Ethnobotanique. Algerian Journal of Natural Products 5 (2), 475-482. https://doi.org/10.5281/ZENODO.1069669

Maramaldi, G., Togni, S., Pagin, I., Giacomelli, L., Cattaneo, R., Burastero, S., Eggenhoffner, R., 2016. Soothing and anti-itch effect of quercetin phytosome in human subjects: a single-blind study. Clinical, Cosmetic and Investigational Dermatology 2016:9 55–62. https://doi.org/10.2147/CCID.S98890

March, R.E., Lewars, E.G., Stadey, C.J., Miao, X.-S., Zhao, X., Metcalfe, C.D., 2006. A comparison of flavonoid glycosides by electrospray tandem mass spectrometry. International Journal of Mass Spectrometry 248, 61–85. https://doi.org/10.1016/j.ijms.2005.09.011

Martakos, I., Katsianou, P., Koulis, G., Efstratiou, E., Nastou, E., Nikas, S., Dasenaki, M., Pentogennis, M., Thomaidis, N., 2021. Development of Analytical Strategies for the Determination of Olive Fruit Bioactive Compounds Using UPLC-HRMS and HPLC-DAD. Chemical Characterization of Kolovi Lesvos Variety as a Case Study. Molecules 26, 7182. https://doi.org/10.3390/molecules26237182

Martin, D., 2009. Bakongo, in: Encyclopedia of African Religion. In: Asante, M. K., & Mazama, A. (Eds.). Encyclopedia of African religion (pp. 90). SAGE Publications, Inc. https://doi.org/10.4135/9781412964623

Martin, G.J., 1995. Ethnobotany: a methods manual, 1st ed. ed, "People and plants" conservation manuals (pp. 268). Chapman & Hall, London ; New York.. https://doi.org/10.1007/978-1-4615-2496-0

Masens, D.-M.Y.B., 1997. Etude phytosociologique de la région de Kikwit (Bandundu, rép. dém. du Congo). Université libre de Bruxelles, Bruxelles- Belgique. pp. 470. [WWW Document]. URL: https://difusion.ulb.ac.be/vufind/Record/ULB-DIPOT:oai:dipot.ulb.ac.be:2013/212168/Holdings (accessed 06.05.2020).

Mathew, N.S., Negi, P.S., 2017. Traditional uses, phytochemistry and pharmacology of wild banana (Musa acuminata Colla): A review. Journal of Ethnopharmacology 196, 124–140. https://doi.org/10.1016/j.jep.2016.12.009

Mathez-Stiefel, S.-L., Vandebroek, I., 2012. Distribution and Transmission of Medicinal Plant Knowledge in the Andean Highlands: A Case Study from Peru and Bolivia. Evidence-Based Complementary and Alternative Medicine 2012, 1–18. https://doi.org/10.1155/2012/959285

Mavi, s, Fa, O., M, G., 1983. The Aetiology of Illness as Determined by Divination and Methods of Treatment by Zimbabwean N'anga. Review of 100 consultations with Township N'anga [WWW Document]. The Central African journal of medicine. URL https://pubmed.ncbi.nlm.nih.gov/6861200/ (accessed 05.02.20).

Mavungu, L.D.J., Mbuyi Kaluka Tshibanda, J., Dasnoy, C., Gretry, L., Mikobi Mikobi, C., Kayembe, J.M., Longo Mbenza, B., Marini Djang'Eing'A, R., Hubert, P., Reginster, J.-Y., Michel, B., Manzambi Kuwekita, J., Jansen, O., Frederich, M., 2017. Processus d'intégration de la Médecine traditionnelle dans le système national de soins de la

République Démocratique du Congo : Cas de trois zones de santé de Kinshasa. https://hdl.handle.net/2268/225728
Mbala, M.S., Fao, R. (Italy) D. des P. et des I.F. fre, 2007. Integrer les questions de genre dans le secteur forestier en Afrique: Republique Democratique du Congo. FAO. pp. 65. https://www.fao.org/3/k0821f/k0821f00.pdf (accessed 28.05.2020)
McCabe, T.L., Weber, C.N., 1994. The robber flies (Diptera: *Asilidae*) of the Albany pinebush. Great Lakes Entomologist. 27, 157–159.
McGill, B.J., Etienne, R.S., Gray, J.S., Alonso, D., Anderson, M.J., Benecha, H.K., Dornelas, M., Enquist, B.J., Green, J.L., He, F., Hurlbert, A.H., Magurran, A.E., Marquet, P.A., Maurer, B.A., Ostling, A., Soykan, C.U., Ugland, K.I., White, E.P., 2007. Species abundance distributions: moving beyond single prediction theories to integration within an ecological framework. Ecol. Letters 10, 995–1015. https://doi.org/10.1111/j.1461-0248.2007.01094.x
McNichol, B.H., Russo, S.E., 2023. Plant Species' Capacity for Range Shifts at the Habitat and Geographic Scales: A Trade-Off-Based Framework. Plants 12, 1248. https://doi.org/10.3390/plants12061248
Medeiros, L., Rocha, M., Rocha, S., de Lima, S., De, G., Júnior, S., Das, A., Citó, A.M.G.L., Da, D., Lopes, J., Moura, D., Saffi, J., Mobin, M., Costa, J.G., 2012. Chemical constituents and evaluation of cytotoxic and antifungal activity of *Lantana camara* essential oils. Revista Brasileira de Farmacognosia 22, 1259–1267. https://doi.org/10.1590/S0102-695X2012005000098
Mélon, M.-E., 2017. La démarche photographique de Clément Delaude. Bulletin des Musées de la Ville de Liège, hors-série n°53. pp. 12. [WWW Document].URL: https://orbi.uliege.be/bitstream/2268/226291/1/Cl%c3%a9ment%20Delaude%20-%20Txt001.pdf (accessed 07.06.2020).
Merétika, A.H.C., Peroni, N., Hanazaki, N., 2010. Local knowledge of medicinal plants in three artisanal fishing communities (Itapoá, Southern Brazil), according to gender, age, and urbanization. Acta Bot. Bras. 24, 386–394. https://doi.org/10.1590/S0102-33062010000200009
Mesia, K., Cimanga, R.K., Dhooghe, L., Cos, P., Apers, S., Totté, J., Tona, G.L., Pieters, L., Vlietinck, A.J., Maes, L., 2010. Antimalarial activity and toxicity evaluation of a quantified Nauclea pobeguinii extract. Journal of Ethnopharmacology 131, 10–16. https://doi.org/10.1016/j.jep.2010.05.008
Meyer, J.J.M., Rakuambo, N.C., Hussein, A.A., 2008. Novel xanthones from Securidaca longepedunculata with activity against erectile dysfunction. Journal of Ethnopharmacology 119, 599–603. https://doi.org/10.1016/j.jep.2008.06.018
Mgbeje, B., Asenye, E., I, I., Ebong, P., 2019. Evaluation of phytochemical composition of n-hexane fractions of *Heinsia crinita* crude leave extracts using gas chromatography - mass spectroscopy (GC-MS). World Journal of Pharmacy and Pharmaceutical Sciences 5 (9), 98–107. https://doi.org/10.20959/wjpps20169-7326
Mgbeje, B.I.A., Abu, C., 2020. Chemical Fingerprinting of Nauclea latifolia, an Antidiabetic Plant, Using GC-MS. Journal of Complementary and Alternative Medical Research 9(4), 25–34. https://doi.org/10.9734/jocamr/2020/v9i430148
Miabangana, E.S., Nsongola, G., Orban, B., van Rooyen, M., van Rooyen, N., Gaugris, J., 2017. Analyse floristique et phytogéographique de la végétation du littoral et sublittoral dans le Kouilou (République du Congo)/Floristic and phytogeographycal analysis of coastal and subcoastal vegetation in the Kouilou Department (Republic of Congo). International Journal of Innovation and Applied Studies, 19(1), 206-217.
Michalak, M., 2022. Plant-Derived Antioxidants: Significance in Skin Health and the Ageing Process. Int. J. Mol. Sci. 23, 585. https://doi.org/10.3390/ijms23020585

Mishra, S., Tripathi, A., Tripathi, D.K., Chauhan, D.K., 2015. Role of sedges (Cyperaceae) in wetlands, environmental cleaning and as food material: Possibilities and future perspectives, in: Azooz, M.M., Ahmad, P. (Eds.), Plant-Environment Interaction. John Wiley & Sons, Ltd, Chichester, UK, pp. 327–338. https://doi.org/10.1002/9781119081005.ch18

Mitaine-Offer, A.-C., Pénez, N., Miyamoto, T., Delaude, C., Mirjolet, J.-F., Duchamp, O., Lacaille-Dubois, M.-A., 2010. Acylated triterpene saponins from the roots of *Securidaca longepedunculata*. Phytochemistry 71, 90–94. https://doi.org/10.1016/j.phytochem.2009.09.022

Mji, G., 2019, Women as healers and indigenous knowledge systems and its holders: An intertwined epistemological and ontological struggle for recognition. In G. Mji (ed.), *The walk without limbs: Searching for indigenous health knowledge in a rural context in South Africa*, pp. 73–108, AOSIS, Cape Town. https://doi.org/10.4102/aosis.2019.BK98.03

Mokgobi, M. G., 2014. Understanding traditional African healing. African journal for physical health education, recreation, and dance 20 (Suppl 2), 24-34. PMID 26594664

Mokgobi, M.G., 2014. Western-trained health care practitioners' knowledge of and experiences with traditional healing. Afr. J. Phys. Health Educ. Recreat. Dance 2014 (Suppl 2), 1–13. PMID 26753180

Mokonzi, B.G., 2009. République démocratique du Congo: fourniture efficace de Services dans le domaine de l'enseignement public. Open Society Initiative for Southern Africa, Johannesburg, pp.14. ISBN 978-1-920355-13-5

Mongalo, N.I., McGaw, L.J., Finnie, J.F., Staden, J.V., 2015. Securidaca longipedunculata Fresen (Polygalaceae): A review of its ethnomedicinal uses, phytochemistry, pharmacological properties and toxicology. Journal of Ethnopharmacology 165, 215–226. https://doi.org/10.1016/j.jep.2015.02.041

Monteillet, N., 2001. Tradition orale, utilisation des généalogies et nouvelles entités politiques, Nanga Eboko, Cameroun. jafr 71, 95–112. https://doi.org/10.3406/jafr.2001.1271

Monteiro, J.M., Albuquerque, U.P. de, Lins-Neto, E.M. de F., Araújo, E.L. de, Amorim, E.L.C. de, 2006. Use patterns and knowledge of medicinal species among two rural communities in Brazil's semi-arid northeastern region. Journal of Ethnopharmacology 105, 173–186. https://doi.org/10.1016/j.jep.2005.10.016

Morah, F., Ashipu, L., 2017. Chemical composition and antimicrobial activity of essential oil from Heinsia crinita leaf. american journal of essential oils and natural products 23, 23–28.

Moteetee, A., Van Wyk, B.E., 2011. The medical ethnobotany of Lesotho: a review. Bothalia 41, 209–228. https://doi.org/10.4102/abc.v41i1.52

Mpiana, P.T., Makelele, L.K., Oleko, R.W., Bokota, M.T., Tshibangu, D.S.T., Ngbolua, K.N., Mbala, M.B., Atibu, E.K., Nshimba, S.M., 2010. Antisickling Activity of Medicinal Plants Used in the Management of Sickle Cell Disease in the Tshopo District, DR Congo. Australian Journal of Medical Herbalism 22, 132.

Mpilambo, J.E., Appunni, S.S., Kanayo, O., Stiegler, N., 2017. Determinants of Early Marriage among Young Women in Democratic Republic of Congo. Journal of Social Sciences 52, 82–91. https://doi.org/10.1080/09718923.2017.1322393

Mpondo, M.E., Dibong, S.D., Ladoh Yemeda, F., Priso, R.J., Ngoye, A., 2012. Les plantes à phénols utilisées par les populations de la ville de Douala. Journal of Animal and Plant Sciences. Volume 15(1), 2083 - 2098.

MSP, M.C. de la santé publique, 2002. Arrêté n°1250/CAB/MIN/S/CJ/KIZ/62/2002 du 25/10/2002 portant organisation de l'exercice de la médecine traditionnelle. MSP, pp.

8. [WWW Document]. URL http://www.leganet.cd/Legislation/Droit%20Public/SANTE/AM.1250.25.10.2002.pdf (accessed 12.10.2020)
Mudimba, M., Streiffeler, F., 1999. Secteur informel au Congo-Kinshasa: stratégies pour un développement endogène : (Zamba epeli moto, nyama iboyi kokima). Editions universitaires africaines, pp. 223
Mukoko, M., 1991. Plantes Médecinales et leurs Usages. Ed. Centre de Vulgarisation Agricole, Kinshasa, R.D.C. pp. 55
Muriithi, K.E., Midiwo, J.O., Wanjohi, J.M., Mathiu, M.P., Kiama, S.G., 2017. Chemical Composition of crude extract of the tubers of *Cyperus articulatus* L. From Meru in Kenya. International Journal of Scientific & Engineering Research, 8 (7), 1575-1586
Mutombo, P.N., Kasilo, O.M.J., James, P.B., Wardle, J., Kunle, O., Katerere, D., Wambebe, C., Matsabisa, M.G., Rahmatullah, M., Nikiema, J.-B., Mukankubito, I., Sheridan, R., Sanogo, R., Nissapatorn, V., Sivakorn, C., Tripathy, S., Goyal, R., Dhobi, M., 2023. Experiences and challenges of African traditional medicine: lessons from COVID-19 pandemic. BMJ Global Health 8(8), e010813. https://doi.org/10.1136/bmjgh-2022-010813
Nakai, K., Tsuruta, D., 2021. What Are Reactive Oxygen Species, Free Radicals, and Oxidative Stress in Skin Diseases? Int. J. Mol. Sci. 22(19), 10799. https://doi.org/10.3390/ijms221910799
Nakazato, T., Warren, D.L., Moyle, L.C., 2010. Ecological and geographic modes of species divergence in wild tomatoes. American Journal of Botany 97, 680–693. https://doi.org/10.3732/ajb.0900216
Nascimento, P., Nascimento, T., Ramos, N., Silva, G., Gomes, J., Falcão, R., Moreira, K., Porto, A., Silva, T., 2014. Quantification, Antioxidant and Antimicrobial Activity of Phenolics Isolated from Different Extracts of *Capsicum frutescens* (*Pimenta Malagueta*). Molecules 19, 5434–5447. https://doi.org/10.3390/molecules19045434
Nasim, N., Sandeep, I.S., Mohanty, S., 2022. Plant-derived natural products for drug discovery: current approaches and prospects. Nucleus 65, 399–411. https://doi.org/10.1007/s13237-022-00405-3
Nazir, I., Chauhan, R.S., 2019. Qualitative phytochemical analysis of Allium sativum (Garlic) and Curcuma longa (Turmeric). J. Entomol. Zool. Stud. 7, 545–547.
Ndjouondo, G.P., Ngene, J.-P., Ngoule, C.C., Kidik Pouka, M.-C., Dibong, S.D., Mpondo Mpondo, E., 2015. Inventaire et Caractérisation Des Plantes Médicinales Des Sous Bassins Versants Kambo et Longmayagui (Douala, Cameroun). Journal of Animal et Plant Sciences 25(3), 3898–3916.
Ndoye Foe, F.M.-C., Tchinang, T.F.K., Nyegue, A.M., Abdou, J.-P., Yaya, A.J.G., Tchinda, A.T., Essame, J.-L.O., Etoa, F.-X., 2016. Chemical composition, in vitro antioxidant and anti-inflammatory properties of essential oils of four dietary and medicinal plants from Cameroon. BMC Complementary and Alternative Medicine 16(1), 117. https://doi.org/10.1186/s12906-016-1096-y
Negash, L., 2021. A Selection of African Native Trees: Biology, Uses, Propagation and Restoration Techniques. Addis Ababa, Ethiopia. pp. 621. ISBN 978-99944-3-086-4
Ngbolua, K.N., Liyongo, C.I., Bongo, G.N.,Lufuluabo, L.G., Nsimba, N.K., Ashande, C.M., Mutanda, S.K.,Gbolo, B.Z., Tshilanda, D.D., Mpiana, P.T., 2018a. Microscopy features, Phytochemistry and Bioactivity of *Mondia whitei* L. (Hook F.) (Apocynaceae): A mini-review. Discovery Phytomedicine 5(3), 34-42 https://doi.org/10.15562/phytomedicine.2018.67
Ngbolua, K.-T.-N., Kongobi, N.N., Nzewe, T.C., Masengo A.C., Inkoto, L.C., Lufulwabo, L.G., Bongo, N.G., Konga, W.D., 2018b. *Pentadiplandra brazzeana* Baill.

(Pentadiplandraceae): Chemical screening assessment and a mini-review on its bioactivity and phytochemistry, DR Congo. Journal of Advancement in Medical and Life Sciences 6(4), 1-5. https://doi.org/10.5281/ZENODO.1250435

Ngbolua, K.-N., Inkoto, C.L., Mongo, N.L., Ashande, C.M., Masens, Y.B.D.-M., Mpiana, P.T., 2019. Étude ethnobotanique et floristique de quelques plantes médicinales commercialisées à Kinshasa, République Démocratique du Congo. Rev. Mar. Sci. Agron. Vét. 7 (1): 118-128

Ngene, J.-P., Ngoule, C., Pouka Kidik, C.-M., Mvogo Ottou, P., Dibong, S., Mpondo Mpondo, E., 2015. Importance dans la pharmacopée traditionnelle des plantes à flavonoïdes vendues dans les marchés de Douala est (Cameroun). Journal of Applied Biosciences 88, 8194– 8210. https://doi.org/10.4314/jab.v88i1.6

Nguessan, K., Kadja, B., Zirihi, G., Traoré, D., Aké-Assi, L., 2009. Screening phytochimique de quelques plantes médicinales ivoiriennes utilisées en pays Krobou (Agboville, Côte-d'Ivoire). Sciences & Nature 6(1), 1-15. https://doi.org/10.4314/scinat.v6i1.48575

Nicolas, J.-P., 2012. Plantes médicinales du Nord de Madagascar ethnobotanique antakarana et informations scientifiques. Ed. Jardins du monde. Brasparts, Antsiranana (Madagascar). pp. 150. ISBN 978-2-9543726-0-0

Nikolić, D., Gödecke, T., Chen, S.-N., White, J., Lankin, D.C., Pauli, G.F., van Breemen, R.B., 2012. Mass spectrometric dereplication of nitrogen-containing constituents of black cohosh (*Cimicifuga racemosa* L.). Fitoterapia 83, 441–460. https://doi.org/10.1016/j.fitote.2011.12.006

Nkunya, M.H.H., Makangara, J.J., Jonker, S.A., 2004. Prenylindoles from Tanzanian *Monodora* and *Isolona* Species. Natural Product Research 18, 253–258. https://doi.org/10.1080/14786410310001620529

Nonguierma, J., 2005. Pharmacopée et médecine moderne : La nécessaire collaboration au profit de la santé. Le Faso.net, l'actualité au Burkina Faso. Magazine le Faso.net.. https://lefaso.net/spip.php?article8236 (accessed 30.05.2020).

Nosenko, T., Böndel, K.B., Kumpfmüller, G., Stephan, W., 2016. Adaptation to low temperatures in the wild tomato species *Solanum chilense*. Mol. Ecol. 25, 2853–2869. https://doi.org/10.1111/mec.13637

Nsimundele, L., 1968. Banque de données Prélude - Parcourir par référence - HN 36. Musée Royal de l'Afrique Centrale - Tervuren - Belgique. [WWW Document]. URL https://www.africamuseum.be/fr/research/collections_libraries/biology/prelude/view_reference?ri=HN%2036 (accessed 05.03.2020).

Nsimundele, L.K., 2006. Catalogue de l'herbarium du Jardin Botanique de Kisantu. pp. 318. [WWW Document]. URL: http://www.nzenzeflowerspauwels.be/Invent_Herb_JBK.pdf (accessed 05.01.2022)

Nsimundele, N.L., Diansambu Makanua, I., Dubiez, E., Proces, P., Marien, J.-N., Peltier, R., Vermeulen, C., 2010. Conserver ou manger la forêt? Le paradoxe des paysans en périphérie de Kinshasa, RDC. Aires protégées traditionnelles au Bas-Congo. Le flamboyant 66/67, 33-37. http://orbi.ulg.ac.be/handle/2268/71830

Nyunaï, N., Yaya, A.J., Tabi, T.G., Tchamgoue, A., Ngondé, M., Minka, C., 2016. Anti-hyperglycemic and Antioxidant Potential of Water-Ethanol Extract of Musanga cecropioides Stem Bark. IJPSDR 8. https://doi.org/10.25004/IJPSDR.2016.080107

Nzembele, J., 2015. Histoire- Culture- Savoir - Les Bantandu - Kongo Central (BAS-CONGO) [WWW Document]. URL https://www.facebook.com/notes/j%C3%A9r%C3%B4me-nzembele/histoire-culture-savoir-les-bantandu-kongo-central-bas-congo-/1143218185688678/ (accessed 09.09.2020).

Nzenze, F.H., Disengomoka, M.I., 2018. Guide Thérapeutique De La République Démocratique du Congo: Traitement des maladies par les plantes (Phytothérapie) Dans les Régions de l'Ouest de la République Démocratique du Congo Kinshasa, pp. 175, ISBN 978-1-973493-41-9

Nzuki, B.F., 2016. Recherches ethnobotaniques sur les plantes médicinales dans la Région de Mbanza-Ngungu, RDC. Thèse de Doctorat (PhD), Faculté des Sciences en Bio-Ingénierie, University de Gand. pp. 349. ISBN 978-90-5989-950-6

Nzuki, B.F., Vanhove, W., Termote, C., Van Damme, P., 2016. Importance of traditional protected areas for the collection of medicinal plants, Kongo-Central (DRC). Afr. J. Ecol. 54, 479–487. https://doi.org/10.1111/aje.12307

Nzuki, B.F., Termote, C., Kibungu, K., Van Damme, P., 2013. Identification et importance locale des plantes médicinales utilisées dans la région de Mbanza-Ngungu, République Démocratique du Congo. Bois For. Trop. 316(2), 63–77.

Oboh, G., Nwanna, E.E., Oyeleye, S.I., Olasehinde, T.A., Ogunsuyi, O.B., Boligon, A.A., 2016. In vitro neuroprotective potentials of aqueous and methanol extracts from *Heinsia crinita* leaves. Food Science and Human Wellness 5, 95–102. https://doi.org/10.1016/j.fshw.2016.03.001

Obonga, W.O., Omeje, E.O., Nnadi, C.O., Ocheme, W.G., 2019. Phytochemical Evaluation of Extracts and GC-MS analysis of oil from *Monodora myristica* Seed. Dhaka Univ. J. Pharm. Sci 18, 69–73. https://doi.org/10.3329/dujps.v18i1.41893

Ochieng, C.O., Ogweno Mid, J., Okinda Owu, P., 2010. Anti-Plasmodial and Larvicidal Effects of Surface Exudates of *Gardenia ternifolia* Aerial Parts. Research Journal of Pharmacology 4(2), 45–50. https://doi.org/10.3923/rjpharm.2010.45.50

Ogbuagu, E.O., Ogbuagu, U., Unekwe, P.C., Nweke, I.N., Airaodion, A.I., 2020. Qualitative Determination of the Phytochemical Composition of Ethanolic Extract of *Xylopia aethiopica* Fruit. Asian Journal of Medical Principles and Clinical Practice 3(4), 45-52.

Ogukwe, C.E., Okhale, S.E., Ezugwu, B.O., 2012. Phytochemical and GC MS analyses of the bioactive components of *Securidaca longepedunculata* (fresen) roots for anti-breast cancer activity. World Journal of Pharmaceutical Research 4, 1503–1518.

Ojerinde, S., Adepoju, B., Edache, J., Okundaye, E., Alemika, T., 2013. Antioxidant and antibacterial constituents of *Steganotaenia araliacea* stem bark. J. Pharm. Bio. 10, 25–32. https://doi.org/10.4314/jpb.v10i1.4

Okond'ahoka, J., 2013. Politique nationale de la medecine traditionnelle. Séminaire de formation des techniciens biologistes, Brazzavile, pp. 5

Okpako, D.T., 2006. African medicine : tradition and beliefs. The Pharmaceutical Journal 276 (7389), 239-240. https://api.semanticscholar.org/CorpusID:78678502

Okungbowa, A., Okugbo, O., Ezekiel-Hart, O., 2017. Comparative Phytochemical And In Vitro Antioxidant Analysis Of Some Indigenous Plants. Journal of Basic and Applied Sciences 3, 41–51.

Okwu, D., Omodamiro, O., 2006. Effects of hexane extract and phytochemical content of *Xylopia aethiopica* and *Ocimum gratissimum* on the uterus of guinea pig. Bio-Research 3, 40–44. https://doi.org/10.4314/br.v3i2.28589

Olatunji, T.L., Afolayan, A.J., 2019. Comparative Quantitative Study on Phytochemical Contents and Antioxidant Activities of *Capsicum annuum* L. and *Capsicum frutescens* L. The Scientific World Journal 2019, 1–13. https://doi.org/10.1155/2019/4705140

Olawore, N.O., Usman, L.A., Ogunwande, I.A., Adeleke, K.A., 2006. Constituents of Rhizome Essential Oils of Two Types of *Cyperus articulatus* L. Grown in Nigeria. Journal of Essential Oil Research 18, 604–606. https://doi.org/10.1080/10412905.2006.9699179

Olennikov, D.N., Chirikova, N.K., Kashchenko, N.I., Nikolaev, V.M., Kim, S.-W., Vennos, C., 2018. Bioactive Phenolics of the Genus *Artemisia* (Asteraceae): HPLC-DAD-ESI-TQ-MS/MS Profile of the Siberian Species and Their Inhibitory Potential Against α-Amylase and α-Glucosidase. Front. Pharmacol. 9, 756. https://doi.org/10.3389/fphar.2018.00756

Olounlade, P., Moulis, E., Fabre, N., Hoste, H., Valentin, A., Nationale, B., Bénin, D., Azando, E., Akouedegni, G., Hounzangbé-Adoté, T., Tam, H., Fourasté, C., Moulis, N., Fabre, H., Hoste, A., Valentin, Hounzangbé-Adoté, Ha, T., Fourasté, I., Moulis, C., 2020. *Newbouldia laevis* folk medicine: anatomical features, preliminary phytochemical analysis and anthelmintic activity *Newbouldia laevis* (Bignoniaceae) and *Zanthoxylum zanthoxyloides* folk medicine: anatomical features, preliminary phytochemical analysis and anthelmintic activity. Bulletin de la Recherche Agronomique du Bénin (BRAB). Numéro spécial Agronomie, Société, Environnement & Sécurité Alimentaire, pp. 59-69. http://www.slire.net/download/2345/7_me_article_brab_brab_n_sp_cial_projet_niche-ben-174_-_ao_t_2016.pdf (accessed 12.04.2020).

Omoba, O.S., Olagunju, A.I., Salawu, S.O., Boligon, A.A., 2019. HPLC-DAD Phenolic Profiling and In Vitro Antioxidant Activities of Three Prominent Nigerian Spices. pnf 24, 179–186. https://doi.org/10.3746/pnf.2019.24.2.179

Omonzejele, P.F., 2008. African Concepts of Health, Disease, and Treatment: An Ethical Inquiry. Explore 4, 120–126. https://doi.org/10.1016/j.explore.2007.12.001

Omoregie, E.H., Hubert, S., Ehiabhi, O.S., 2015. HPLC Profiling and Phytochemical Analysis of Fruit Extracts of Guinea pepper - Xylopia aethiopica, (Dunal) A. Richard. International Journal of Life Sciences 4, 277–282.

Ong, H.G., Kim, Y.-D., 2020. Medicinal plants for gastrointestinal diseases among the Kuki-Chin ethnolinguistic groups across Bangladesh, India, and Myanmar: A comparative and network analysis study. Journal of Ethnopharmacology 251, 112415. https://doi.org/10.1016/j.jep.2019.112415

Ong, H.G., Kim, Y.-D., 2014. Quantitative ethnobotanical study of the medicinal plants used by the Ati Negrito indigenous group in Guimaras island, Philippines. Journal of Ethnopharmacology 157, 228–242. https://doi.org/10.1016/j.jep.2014.09.015

Onoja, S., Ezeja, M., Omeh, Y., Emeh, E., 2015. Phytochemical and Hypolipidemic Effects of Methanolic Extract of *Aframomum melegueta* Seed. European Journal of Medicinal Plants 5(4), 377–383. https://doi.org/10.9734/EJMP/2015/15101

Onyenekwe, P.C., Okereke, O.E., Owolewa, S.O., 2013. Phytochemical Screening and Effect of *Musa paradisiacal* Stem Extrude on Rat Haematological Parameters. Current Research Journal of Biological Sciences 5(1), 26–29. https://doi.org/10.19026/crjbs.5.5468

Orni, P.R., Shetu, H.J., Khan, T., Sadman Sakib Bin Rashed, S., Dash, P.R., 2018. A comprehensive review on *Commelina benghalensis* L. (Commelinaceae). International Journal of Pharmacognosy 5(10), 637-645. https://ijpjournal.com/wp-content/uploads/2019/05/1-Vol.-5-Issue-10-Oct-2018-IJP-RE-232.pdf

Osigwe, C., Akah, P., Nworu, C., Okoye, F., 2017. Apigenin: A methanol fraction component of *Newbouldia laevis* leaf, as a potential antidiabetic agent. The Journal of Phytopharmacology 6, 38–44.

Oso, B.J., Oyeleke, O., Soetan, O., 2018. Influence of different solvent polarities on the phenolics, flavonoids and antioxidant properties of the fruit of *Xylopia aethiopica* (Dunal) A. Rich. Trends in Phytochemical Research 2, 97–102.

Osuntokun, O.T., 2020. Synergistic efficacy of *Aframomum melegueta* [Roscoe] K. Schum and *Spondias mombin* (Linn), A predictive treatment of SARS-CoV-2 (COVID-19).

Journal of Bioscience & Biomedical Engineering 1, 1–8. https://doi.org/10.13140/RG.2.2.31444.63362
Otłowska, O., Ślebioda, M., Kot-Wasik, A., Karczewski, J., Śliwka-Kaszyńska, M., 2018. Chromatographic and Spectroscopic Identification and Recognition of Natural Dyes, Uncommon Dyestuff Components, and Mordants: Case Study of a 16th Century Carpet with Chintamani Motifs. Molecules 23, 339. https://doi.org/10.3390/molecules23020339
Otunola, G.A., 2011. Comparative analysis of the chemical composition of three spices – *Allium sativum* L. *Zingiber officinale* Rosc. and *Capsicum frutescens* L. commonly consumed in Nigeria. African Journal of Biotechnology 9(41), 6927-6931. https://doi.org/10.5897/AJB10.183
Ousmane, N., Aly, D., Bassimbé, S.M., Aliou, G., 2013. Diversité floristique des peuplements ligneux du Ferlo, Sénégal. Vertigo-la revue électronique en sciences de l'environnement 13(3), 1-13. https://doi.org/10.4000/vertigo.14352
Owokotomo, I., 2014. Chemical Constituents of the Leaf, Stem, Root and Seed Essential Oils of *Aframomum melegueta* (K. Schum) from South West Nigeria. International Research Journal of Pure and Applied Chemistry 4(4), 395–401. https://doi.org/10.9734/IRJPAC/2014/7397
Owoyele, B.V., Owolabi, G.O., 2014. Traditional oil palm (*Elaeis guineensis* jacq.) and its medicinal uses: A review. Journal of Ethnopharmacology 4 (3): 16.1-16.8. https://doi.org/10.5667/TANG.2014.0004
Oyewale, A.O., Mika, A., Peters, F.A., 2002. Phytochemical, Cytotoxicity and microbial screening of *Euphorbia hirta* linn. Global Journal of Pure and Applied Sciences 8, 49–56. https://doi.org/10.4314/gjpas.v8i1.16332
Ozioma, E.-O.J., Nwamaka, C.O.A., 2019. Herbal Medicines in African Traditional Medicine, in: F. Builders, P. (Ed.), Herbal Medicine. IntechOpen. pp. 191-214 https://doi.org/10.5772/intechopen.80348
Ozturk, R.B., Zengin, G., Sinan, K.I., Montesano, D., Zheleva-Dimitrova, D., Gevrenova, R., Uba, A.I., Çakılcıoğlu, U., Kaplan, A., Jugreet, S., Dall'Acqua, S., Mahomoodally, M.F., 2022. Which Extraction Solvents and Methods Are More Effective in Terms of Chemical Composition and Biological Activity of *Alcea fasciculiflora* from Turkey? Molecules 27, 5011. https://doi.org/10.3390/molecules27155011
Padhan, B., Panda, D., 2020. Potential of Neglected and Underutilized Yams (*Dioscorea* spp.) for Improving Nutritional Security and Health Benefits. Front. Pharmacol. 11, 496. https://doi.org/10.3389/fphar.2020.00496
Pandel, R., Poljšak, B., Godic, A., Dahmane, R., 2013. Skin Photoaging and the Role of Antioxidants in Its Prevention. ISRN Dermatology 2013, 1–11. https://doi.org/10.1155/2013/930164
Pandey, S., 2017. Phytochemical Constituents, Pharmacological and Traditional Uses of *Ocimum gratissimum* L. in Tropics. Indo American Journal of Pharmaceutical Sciences 4(11), 4234-4242. https://doi.org/10.5281/ZENODO.1056925
Parasher, A., 2021. COVID-19: Current understanding of its Pathophysiology, Clinical presentation and Treatment. Postgraduate Medical Journal 97(1147), 312–320. https://doi.org/10.1136/postgradmedj-2020-138577
Park, C., Allaby, M., 2017. A Dictionary of Environment and Conservation, 3. ed; ed. Oxford University Press. ISBN 978-0-19-964166-6. https://doi.org/10.1093/acref/9780198609957.001.0001
Park, C.-H., Min, S.-Y., Yu, H.-W., Kim, K., Kim, S., Lee, H.-J., Kim, J.-H., Park, Y.-J., 2020. Effects of Apigenin on RBL-2H3, RAW264.7, and HaCaT Cells: Anti-Allergic, Anti-

Inflammatory, and Skin-Protective Activities. International Journal of Molecular Sciences 21(13), 4620. https://doi.org/10.3390/ijms21134620

Parmentier, I., Stévart, T., Hardy, O.J., 2005. The inselberg flora of Atlantic Central Africa. I. Determinants of species assemblages. Journal of Biogeography 32, 685–696. https://doi.org/10.1111/j.1365-2699.2004.01243.x

Pasa, M.C., Hanazaki, N., Silva, O.M.D., Agostinho, A.B., Zank, S., Esteves, M.I.P.N., 2019. Medicinal plants in cultures of Afro-descendant communities in Brazil, Europe and Africa. Acta Bot. Bras. 33, 340–349. https://doi.org/10.1590/0102-33062019abb0163

Pasa, M.C., Zurra, R.M.O., David, M.D., 2017. Caminhando com os ribeirinhos pela Amazônia Brasileira. In: Pasa MC & David MD (orgs.). Múltiplos Olhares sobre a Biodiversidade. Cuiabá-MT: EdUFMT; Carlini & Caniato Editorial 5, pp. 537-548. ISBN: 978-85-327-0617-1 (EdUFMT).

Patay, É.B., Bencsik, T., Papp, N., 2016. Phytochemical overview and medicinal importance of Coffea species from the past until now. Asian Pacific Journal of Tropical Medicine 9, 1127–1135. https://doi.org/10.1016/j.apjtm.2016.11.008

Patel, N., Sharath Kumar, L., Gajera, J., Jadhav, A., Muguli, G., Babu, U., 2018. Isolation and characterization of flavonoid C-glycosides from *Prosopis glandulosa* Torr. leaves. Pharmacognosy Magazine 14 (56),451-454. https://doi.org/10.4103/pm.pm_505_17

Pauwels, L., 1993. Nzayilu N'ti: guide des arbres et arbustes de la région de Kinshasa - Brazzaville, Scripta botanica Belgica. Ministère de l'Agriculture, Administration de la Recherche Agronomique, Meise, pp. 495, ISBN 90-72619-10-2

Pauwels, L., 1972. Catalogue Des Plantes Cultivées Au Jardin Botanique de Kisantu. Kisantu (Rép. Du Zaïre). pp. 72. [WWW Document]. URL: http://www.nzenzeflowerspauwels.be/Kisantu72.pdf (accessed 06.05.2020)

Pauwels, L., Latham, P., Billiet, F., Bamps, P., n.d. Photos of flowers and plants from Bas-Congo (D.R. congo - africa). [WWW Document]. URL http://nzenzeflowerspauwels.be/Latham2.htm (accessed 22.05.2020).

Peeters, L., Van der Auwera, A., Beirnaert, C., Bijttebier, S., Laukens, K., Pieters, L., Hermans, N., Foubert, K., 2020. Compound Characterization and Metabolic Profile Elucidation after In Vitro Gastrointestinal and Hepatic Biotransformation of an Herniaria hirsuta Extract Using Unbiased Dynamic Metabolomic Data Analysis. Metabolites 10, 111. https://doi.org/10.3390/metabo10030111

Peng, S., Li, F., Yu, K., Zhou, F., Yu, H., Liu, H., Guo, J., Li, G., Wang, C., Yan, X., Li, Z., 2022. Integrating transcriptome and chemical analyses to reveal the anti-Alzheimer's disease components in Verbena officinalis Linn. Front. Plant Sci. 13, 955075. https://doi.org/10.3389/fpls.2022.955075

Péroches, A., Dubiez, E., Peltier, R., Procès, P., Diowo, S., Yamba-Yamba, T., Vermeulen, C., 2019. Les Plans Simples de Gestion destinés à la production de bois-énergie en périphérie de Kinshasa : la participation et la restauration à l'épreuve du foncier. Bois for. trop. 340, 71-90. https://doi.org/10.19182/bft2019.340.a31698

Pfeiffer, J., 2005. Assessing Cultural and Ecological Variation in Ethnobiological Research: The Importance of Gender. Journal of Ethnobiology 25(2): 240–278 240–278. https://scholarworks.sjsu.edu/cgi/viewcontent.cgi?article=1002&context=envs_pub

Phan, A.D.T., Netzel, G., Chhim, P., Netzel, M.E., Sultanbawa, Y., 2019. Phytochemical Characteristics and Antimicrobial Activity of Australian Grown Garlic (*Allium Sativum* L.) Cultivars. Foods 8, 358. https://doi.org/10.3390/foods8090358

Philander, L.E.A., Makunga, N.P., Platten, S.J., 2011. Local Medicinal Plant Knowledge in South Africa Preserved by Apartheid. Human Ecology 39, 203–216.

Phillips, O., Gentry, A.H., 1993. The useful plants of Tambopata, Peru: II. Additional hypothesis testing in quantitative ethnobotany. Econ. Bot. 47, 33–43. https://doi.org/10.1007/BF02862204

Phumthum, M., Srithi, K., Inta, A., Junsongduang, A., Tangjitman, K., Pongamornkul, W., Trisonthi, C., Balslev, H., 2018. Ethnomedicinal plant diversity in Thailand. Journal of Ethnopharmacology 214, 90–98. https://doi.org/10.1016/j.jep.2017.12.003

Pieroni, A., Vandebroek, I., 2009. Traveling Cultures and Plants: The Ethnobiology and Ethnopharmacy of Human Migrations. Berghahn Books. pp. 296 https://doi.org/10.1515/9780857455789. ISBN 978-0-85745-578-9

Pierson, J.T., Monteith, G.R., Roberts-Thomson, S.J., Dietzgen, R.G., Gidley, M.J., Shaw, P.N., 2014. Phytochemical extraction, characterisation and comparative distribution across four mango (*Mangifera indica* L.) fruit varieties. Food Chemistry 149, 253–263. https://doi.org/10.1016/j.foodchem.2013.10.108

Plaskova, A., Mlcek, J., 2023. New insights of the application of water or ethanol-water plant extract rich in active compounds in food. Front. Nutr. 10, 1118761. https://doi.org/10.3389/fnut.2023.1118761

Plassart, L., 2015. *Sarcocephalus latifolius* (Sm.) Bruce : études botanique, chimique et pharmacologique. pp. 15. (accessed 04.12.2023). https://dumas.ccsd.cnrs.fr/dumas-01158031

Poffenberger, M., McGean, B., Khare, A., Campbell, J., 1992. Field Method Manual, Volume II. Community Forest Economy and Use Patterns: Participatory Rural Appraisal (PRA) Methods in South Gujarat, India. New Delhi: Society for Promotion of Wasteland Development, pp. 90. [WWW Document]. URL: https://liberiafti.files.wordpress.com/2013/08/poffenberger_community-forestry-economy-use-patterns-pra-methods-in-south-gujarat-india.pdf (accessed 30.05.2020).

Polat, R., 2019. Ethnobotanical study on medicinal plants in Bingöl (City center) (Turkey). Journal of Herbal Medicine 16, 100211. https://doi.org/10.1016/j.hermed.2018.01.007

Pourchez, L., 2011. Savoirs des femmes. Médecine traditionnelle et nature (Maurice, Rodrigues, La Réunion). Les Tribunes de la santé, 44, 51-71. https://doi.org/10.3917/seve.044.0051

Pousset, J.L., 2006. Place des médicaments traditionnels en Afrique. Méd. Trop. 66, 606–609. [WWW Document]. URL https://www.jle.com/en/MedSanteTrop/2006/66.6/606-609%20%20Place%20des%20m%C3%A9dicaments%20traditionnels%20en%20Afrique%20(Pousset)%20.pdf (accessed 02.05.2020).

Pretorius, E., 1999. Traditional Healers', in: Crisp, N., Ntuli, A. (Eds.), South African Health Review, Health Systems Trust. Durban, South Africa, pp. 249–257. ISBN 978-1-919743-53-0

Price, E.J., Bhattacharjee, R., Lopez-Montes, A., Fraser, P.D., 2018. Carotenoid profiling of yams: Clarity, comparisons and diversity. Food Chemistry 259, 130–138. https://doi.org/10.1016/j.foodchem.2018.03.066

Procès, P., 2009. Recherche bibliographique sur la population Kongo. CIRAD & Projet Makala. pp. 15.

Qian, H., Li, W., Li, J., 2022. The Influence of Seed Characteristics on Seed Dispersal Early Stages by Tibetan Macaques. Animals 12, 1416. https://doi.org/10.3390/ani12111416

Qian, H., Yu, F.-J., Lu, D.-Y., Wu, B.-J., Zhang, X.-W., Wang, H., Ma, Z.-G., 2018. Identification of poliumoside metabolites in rat plasma, urine, bile, and intestinal bacteria with UPLC/Q-TOF-MS. Chin. J. Nat. Med. 16, 871–880. https://doi.org/10.1016/S1875-5364(18)30129-8

Quittel, J., 1983. Féticheurs, sorciers et compagnie. La Pensée universelle. Paris. pp. 26. ISBN 978-2-214-05014-9. [WWW Document]. URL https://excerpts.numilog.com/books/9782402230612.pdf (accessed 02.05.2020).

Qureshi, R., Ghazanfar, S.A., Obied, H., Vasileva, V., Tariq, M.A., 2016. Ethnobotany: A Living Science for Alleviating Human Suffering. Evidence-Based Complementary and Alternative Medicine 2016, 1–3. https://doi.org/10.1155/2016/9641692

Rahayu, S.E., Oktapianti, R., Matondang, I., 2020. Ethnobotany survey of medicinal plants used for traditional maternal healthcare by Serawai tribe, Seluma district, Bengkulu - Indonesia. Journal of Current Medical Research and Opinion 3(4), 441–448. https://doi.org/10.15520/jcmro.v3i04.275

Rahim, R.B.A., 2015. Analysis of phytochemical compounds, antioxidant and antiproliferative activity of aqueous extracts of *Capsicum* fruits. Universiti Sains Malaysia, pp. 42. [WWW Document]. URL https://excerpts.numilog.com/books/9782402230612.pdf (accessed 21.02.2021).

Rahman, I.U., Hart, R., Afzal, A., Iqbal, Z., Ijaz, F., Abd_Allah, E.F., Ali, N., Khan, S.M., Alqarawi, A.A., Alsubeie, M.S., Bussmann, R.W., 2019. A new ethnobiological similarity index for the evaluation of novel use reports. Appl. Ecol. Env. Res. 17, 2765–2777. https://doi.org/10.15666/aeer/1702_27652777

Raimundo e Silva, J.P., Policarpo, I. da S., Chaves, T.P., Coutinho, H.D.M., Alves, H. da S., 2020. A glycosylated β-Sitosterol, isolated from *Tacinga inamoena* (Cactaceae), enhances the antibacterial activity of conventional antibiotics. South African Journal of Botany 133, 193–200. https://doi.org/10.1016/j.sajb.2020.07.017

Rainer Lesniewski, n.d. Carte de la République Democratique du Congo. Illustration Stock - Illustration du national, navigation: 69235895 [WWW Document]. URL https://fr.dreamstime.com/illustration-stock-carte-du-congo-r%C3%A9publique-democratic-image69235895 (accessed 25.06.20).

Rajalakshmi, S., Vijayakumar, S., Arulmozhi, P., 2019. Ethnobotanical survey of medicinal plants in Thanjavur and its surrounding (Tamil Nadu - India). Acta Ecologica Sinica 39, 380–397. https://doi.org/10.1016/j.chnaes.2018.09.010

Ramade, F., 2009. Eléments d'écologie: écologie fondamentale. Dunod, Paris. 4E ed. pp. 712. ISBN 978-2-10-081572-2

Randles, W.G.L., 2002. L'ancien royaume du Congo des origines à la fin du XIXe siècle. Paris: Éditions de l'École des hautes études en sciences sociales, pp. 276 https://doi.org/10.4000/books.editionsehess.314

Ratiba, M., 2017. Recherche et détermination structurale des métabolites secondaires d'espèces du genre *Genista* (Fabaceae). Thèse de doctorat, Université Mentouri - Constantine, Algérie, pp. 215 [WWW Document]. URL http://archives.umc.edu.dz/handle/123456789/10228 (accessed 30.05.2020).

Ravisankar, S., Abegaz, K., Awika, J.M., 2018. Structural profile of soluble and bound phenolic compounds in teff (*Eragrostis* tef) reveals abundance of distinctly different flavones in white and brown varieties. Food Chem. 263, 265–274. https://doi.org/10.1016/j.foodchem.2018.05.002

Rasul M.G., 2018. Conventional extraction methods use in medicinal plants, their advantages and disadvantages. International Journal of Basic Sciences and Applied Computing 2(6), 10–14. https://ijbsac.org/wp-content/uploads/papers/v2i6/F0082122618.pdf

Raymond-Hamet, 1933. Les *Mitragyna* et leurs alcaloïdes. Bull. Se. Pharma., t. XL, n° 11, pp. 593-600, Paris.

Razafindraibe, M., Kuhlman, A.R., Rabarison, H., Rakotoarimanana, V., Rajeriarison, C., Rakotoarivelo, N., Randrianarivony, T., Rakotoarivony, F., Ludovic, R.,

Randrianasolo, A., Bussmann, R.W., 2013. Medicinal plants used by women from Agnalazaha littoral forest (Southeastern Madagascar). Journal of Ethnobiology and Ethnomedicine 9, 73. https://doi.org/10.1186/1746-4269-9-73

Rehman, M.N., Ahmad, M., Sultana, S., Zafar, M., Edwards, S., 2017. Relative popularity level of medicinal plants in Talagang, Punjab Province, Pakistan. Revista Brasileira de Farmacognosia 27, 751–775. https://doi.org/10.1016/j.bjp.2017.09.004

Reimers, Fernández, Reimers, Chaloupkova, del Valle, Milella, Russo, 2019. An Ethnobotanical Survey of Medicinal Plants Used in Papantla, Veracruz, Mexico. Plants 8, 246. https://doi.org/10.3390/plants8080246

Reyes-Garcia, V., 2003. Ethnobotanical Knowledge Shared Widely Among Tsimane' Amerindians, Bolivia. Science 299, 1707–1707. https://doi.org/10.1126/science.1080274

Ribeiro, R.V., Bieski, I.G.C., Balogun, S.O., Martins, D.T. de O., 2017. Ethnobotanical study of medicinal plants used by Ribeirinhos in the North Araguaia microregion, Mato Grosso, Brazil. Journal of Ethnopharmacology 205, 69–102. https://doi.org/10.1016/j.jep.2017.04.023

Rigouzzo-Weiller, A.L., 2002. De l'observation des plantes médicinales aux savoirs traditionnels. In: Fleurentin, J., Pelt, J., & Mazars, G. (Eds.), *Des sources du savoir aux médicaments du futur*. IRD Éditions, pp. 285-288. https://doi.org/10.4000/books.irdeditions.7242.

Rini Vijayan, K.P., Raghu, A.V., 2019. Tentative characterization of phenolic compounds in three species of the genus *Embelia* by liquid chromatography coupled with mass spectrometry analysis. Spectroscopy Letters 52(10), 653–670. https://doi.org/10.1080/00387010.2019.1682013

Rinnerthaler, M., Bischof, J., Streubel, M., Trost, A., Richter, K., 2015. Oxidative Stress in Aging Human Skin. Biomolecules 5, 545–589. https://doi.org/10.3390/biom5020545

Rittà, M., Marengo, A., Civra, A., Lembo, D., Cagliero, C., Kant, K., Lal, U.R., Rubiolo, P., Ghosh, M., Donalisio, M., 2020. Antiviral Activity of a Arisaema Tortuosum Leaf Extract and Some of its Constituents against Herpes Simplex Virus Type 2. Planta Med. 86, 267–275. https://doi.org/10.1055/a-1087-8303

Rivera Cambero, L., González Sánchez, H., González-Palomares, S., Del Val Diaz, R., 2017. Identificación de Compuestos Volátiles en Mango (Mangifera indica L. Var. Tommy Atkins) de Tomatlán, Jalisco. Proyecta-Tec 7, 11–14.

Rivera, D., C, O., C, I., M, H., A, V., J, F., R, L., 2005. The ethnobotanical study of local Mediterranean food plants as medicinal resources in Southern Spain. J. Physiol. Pharmacol. 56 (Suppl 1), 97–114.

Rivera-Yañez, C.R., Ruiz-Hurtado, P.A., Mendoza-Ramos, M.I., Reyes-Reali, J., García-Romo, G.S., Pozo-Molina, G., Reséndiz-Albor, A.A., Nieto-Yañez, O., Méndez-Cruz, A.R., Méndez-Catalá, C.F., Rivera-Yañez, N., 2021. Flavonoids Present in Propolis in the Battle against Photoaging and Psoriasis. Antioxidants 10, 2014. https://doi.org/10.3390/antiox10122014

Rocha da Silva, C., Lgdav, S., Ev, D.S., Tl, F., Tdnp, C., Lea, M., R, de S.C., Cr, de A., Wm, B. da S., I, de S.C., J, S., Hs, D.S., Es, M., Bc, C., Mo, de M., Hvn, J., Jb, A.N., 2022. Evaluation of the antifungal effect of chlorogenic acid against strains of *Candida* spp. resistant to fluconazole: apoptosis induction and in silico analysis of the possible mechanisms of action. Journal of medical microbiology 71(5). https://doi.org/10.1099/jmm.0.001526. PMID: 35575783

Rogers, D.S., Ehrlich, P.R., 2008. Natural selection and cultural rates of change. Proceedings of the National Academy of Sciences 105, 3416–3420. https://doi.org/10.1073/pnas.0711802105

Rui, W., Xia, W., Zhao, W., Li, B., Li, J., Feng, Y., Chen, H., Zhao, S., 2020. Differential Constituents in Roots, Stems and Leaves of *Polygonum multiflorum* Thunb. Screened by UPLC/ESI-Q-TOF-MS and Multivariate Statistical Analysis. Journal of Chromatographic Science 58, 136–143. https://doi.org/10.1093/chromsci/bmz086

Rukangira, E., 2001. Medicinal Plants and Traditional Medicine in Africa : Constraints and Challenges. In: Proceeding of The natural Products and Cosmeceuticals conference. Erboristeria Domani. Sustainable Development International. pp.179-184. Nairobi, Kenya: Conserve Africa International. [WWW Document]. URL https://www.semanticscholar.org/paper/Medicinal-Plants-and-Traditional-Medicine-in-Africa/7b6f7ffe3a8fb509450ab0c52500f6dc36f72667 (accessed 05.03.20).

Salhi, S., Fadli, M., Zidane, L., Douira, A., 2010. Etudes floristique et ethnobotanique des plantes medicinales de la ville de Kenitra (Maroc). Lazaroa 31, 133–147.

Salim, M.A., Ranjitkar, S., Hart, R., Khan, T., Ali, S., Kiran, C., Parveen, A., Batool, Z., Bano, S., Xu, J., 2019. Regional trade of medicinal plants has facilitated the retention of traditional knowledge: case study in Gilgit-Baltistan Pakistan. Jornal of Ethnobiology and Ethnomedicine 15, 6. https://doi.org/10.1186/s13002-018-0281-0

Salvaing, B., 1994. Les missionnaires à la rencontre de l'Afrique au XIXe siècle (Côte des Esclaves et pays yoruba, 1840-1891). In: Revue française d'histoire d'outre-mer, tome 83, n°311, 2e trimestre 1996. pp. 131-132. ISBN 978-2-7384-2289-7

Sánchez, I., Gómez-Garibay, F., Taboada, J., Ruiz, B.H., 2000. Antiviral effect of flavonoids on the Dengue virus. Phytother. Res. 14, 89–92. https://doi.org/10.1002/(SICI)1099-1573(200003)14:2<89::AID-PTR569>3.0.CO;2-C

Sangare, A.D., 2011. Comportements en santé orale et déterminants du recours aux soins dans le département de Dabou - Côte d'Ivoire (phdthesis). Université Claude Bernard - Lyon I. pp. 144. [WWW Document] URLhttps://tel.archives-ouvertes.fr/tel-00845002 (accessed 09.07.20).

Sanogo, Y., 2014. Le tradipraticien face à certains principes du Code de déontologie médicale en Côte d'Ivoire. [WWW Document]. Village de la Justice. URL https://www.village-justice.com/articles/tradipraticien-face-certains,16902.html (accessed 30.05.20).

Santos, M., 1961. Quelques problèmes des grandes villes dans les Pays sous-développés. geoca 36, 197–218. https://doi.org/10.3406/geoca.1961.1721

Sara, K., Balagizi, I., Bahizi, C., Bahaya, A., Museme, 2017. Etude des facteurs favorisant le recours des patients à la Médecine traditionnelle dans la ville de Bukavu. Cahiers du CERUKI 53, 78–90.

Saranraj, P., Ganesh, P., Suresh Kumar, G., 2014. Phytochemical analysis and antibacterial activity of Pepper (*Piper nigrum* L.) against some human pathogens. Central European Journal of Biology 3 (2):36-4.

Sasidharan, S., Nilawatyi, R., Xavier, R., Latha, L.Y., Amala, R., 2010. Wound Healing Potential of Jacq Leaves in an Infected Albino Rat Model. Molecules 15, 3186–3199. https://doi.org/10.3390/molecules15053186

Saslis-Lagoudakis, C.H., Hawkins, J.A., Greenhill, S.J., Pendry, C.A., Watson, M.F., Tuladhar-Douglas, W., Baral, S.R., Savolainen, V., 2014. The evolution of traditional knowledge: environment shapes medicinal plant use in Nepal. Proceedings of the Royal Society B: Biological Sciences 281, 20132768. https://doi.org/10.1098/rspb.2013.2768

Scherrer, A.M., Motti, R., Weckerle, C.S., 2005. Traditional plant use in the areas of Monte Vesole and Ascea, Cilento National Park (Campania, Southern Italy). Journal of Ethnopharmacology 97, 129–143. https://doi.org/10.1016/j.jep.2004.11.002

Schippmann, U., Leaman, D., Cunningham, A.B., 2006. A comparison of cultivation and wild collection of medicinal and aromatic plants under sustainability aspects, in: Bogers,

R.J., Craker, L.E., Dagmar, L. (Eds.), Medicinal and Aromatic Plants: Agricultural, Commercial, Ecological, Legal, Pharmacological and Social Aspects, Wageningen UR Frontis Series. Dordrecht, pp. 75-95. ISBN: 978-1-4020-5448–8.

Schunko, C., Grasser, S., Vogl, C.R., 2012. Intracultural variation of knowledge about wild plant uses in the Biosphere Reserve Grosses Walsertal (Austria). Journal of Ethnobiology and Ethnomedicine 8, 23. https://doi.org/10.1186/1746-4269-8-23

Schymanski, E.L., Jeon, J., Gulde, R., Fenner, K., Ruff, M., Singer, H.P., Hollender, J., 2014. Identifying Small Molecules via High Resolution Mass Spectrometry: Communicating Confidence. Environ. Sci. Technol. 48, 2097–2098. https://doi.org/10.1021/es5002105

Segal, M.H., Ulin, P.R., 1980. Traditional health care delivery in contemporary Africa, Foreign and comparative studies : African series ; 35. Syracuse, N.Y.: Maxwell School of Citizenship and Public Affairs, Syracuse University. pp. 98, ISBN 978-0-915984-57-2

Shaik, Y., Caraffa, A., Ronconi, G., Lessiani, G., Conti, P., 2018. Impact of polyphenols on mast cells with special emphasis on the effect of quercetin and luteolin. Central European Journal of Immunology 43(4), 476–481. https://doi.org/10.5114/ceji.2018.81347

Shalukoma, C., Duez, P., Bigirimana, J., Bogaert, J., Stévigny, C., Pongombo, C., Visser, M., 2016. Characterization of traditional healers in the mountain forest region of Kahuzi-Biega, South-Kivu, DR Congo. Biotechnol. Agron. Soc. Environ. 20(1), 25-41. https://doi.org/10.25518/1780-4507.12616

Shanmugam, A., S, S., S, L., St. Michael College of Enggand Tech,Kalayarkoil, Tamilnadu, 2017. Antibacterial Activity and Phytochemical Analysis of Euphorbia hirta Against Clinical Pathogens. International Journal of Trend in Scientific Research and Development 2(1), 287–293. https://doi.org/10.31142/ijtsrd5939

Sharma, A., Thakur, D., Uniyal, S.Kr., 2019. Plant-derived utility products: knowledge comparison across gender, age and education from a tribal landscape of western Himalaya. Journal of Ethnobiology and Ethnomedicine 15, 67. https://doi.org/10.1186/s13002-019-0346-8

Shavanov, M.V., 2021. The role of food crops within the Poaceae and Fabaceae families as nutritional plants. IOP Conf. Ser.: Earth Environ. Sci. 624, 012111. https://doi.org/10.1088/1755-1315/624/1/012111

Sheuyange, A., Oba, G., Weladji, R.B., 2005. Effects of anthropogenic fire history on savanna vegetation in northeastern Namibia. Journal of Environmental Management 75, 189–198. https://doi.org/10.1016/j.jenvman.2004.11.004

Shi, B., Osunkoya, O.O., Chadha, A., Florentine, S.K., Dhileepan, K., 2021. Biology, Ecology and Management of the Invasive Navua Sedge (*Cyperus aromaticus*)—A Global Review. Plants 10, 1851. https://doi.org/10.3390/plants10091851

Shodehinde, S.A., Oboh, G., 2013. Antioxidant properties of aqueous extracts of unripe Musa paradisiaca on sodium nitroprusside induced lipid peroxidation in rat pancreas in vitro. Asian Pacific Journal of Tropical Biomedicine 3, 449–457. https://doi.org/10.1016/S2221-1691(13)60095-7

Shrivastava, N., Mahajan, S., Varma, A. (Eds.), 2021. Symbiotic soil microorganisms: biology and applications, Soil biology. Springer, Cham, Switzerland, pp. 489. ISBN 978-3-030-51915-5

Shutsha, R., Asimonyio, J., Omatoko, J., Kambale, J.-L., Angoyo, R., Lomba, C., Ndjele, M., Ngbolua, K.-T.-N., 2017. Etudes floristique, phytosociologique et phytogéographique de la végétation herbacée et du sous-bois de la réserve forestière de la Yoko (Province de la Tshopo, RD Congo) [Floristic, phytosociological and phytogeographical studies

of the herbaceous vegetation and the underwood of the Yoko reserve forest (Tshopo Province, DR Congo)]. International Journal of Innovation and Scientific Research 29, 119–136.

Siddig, A.A.H., Ellison, A.M., Ochs, A., Villar-Leeman, C., Lau, M.K., 2016. How do ecologists select and use indicator species to monitor ecological change? Insights from 14 years of publication in Ecological Indicators. Ecological Indicators 60, 223–230. https://doi.org/10.1016/j.ecolind.2015.06.036

Sik, B., Hanczné, E.L., Kapcsándi, V., Ajtony, Z., 2020. Conventional and nonconventional extraction techniques for optimal extraction processes of rosmarinic acid from six Lamiaceae plants as determined by HPLC-DAD measurement. J. Pharm. Biomed. Anal. 184, 113173. https://doi.org/10.1016/j.jpba.2020.113173

Sillans, R., 1951. Sur quelques plantes médicinales de l'Afrique centrale. Revue Internationale de Botanique Appliquée et d'Agriculture Tropicale 31(345), 407–427. https://doi.org/10.3406/jatba.1951.6761

Silva, N.C. da, Gonçalves, S.F., Araújo, L.S. de, Kasper, A.A.M., Fonseca, A.L. da, Sartoratto, A., Castro, K.C.F., Moraes, T.M.P., Baratto, L.C., Varotti, F. de P., Barata, L.E.S., Moraes, W.P., 2019. In vitro and in vivo antimalarial activity of the volatile oil of *Cyperus articulatus* (Cyperaceae). Acta Amaz. 49, 334–342. https://doi.org/10.1590/1809-4392201804331

Silva, F. dos S., Ramos, M.A., Hanazaki, N., Albuquerque, U.P. de, 2011. Dynamics of traditional knowledge of medicinal plants in a rural community in the Brazilian semi-arid region. Rev. bras. farmacogn. 21, 382–391. https://doi.org/10.1590/S0102-695X2011005000054

Silva, H.C., Caraciolo, R.L., Marangon, L., Ramos, M., Santos, L., Albuquerque, U., 2014. Evaluating different methods used in ethnobotanical and ecological studies to record plant biodiversity. Journal of Ethnobiology and Ethnomedicine 10, 48. https://doi.org/10.1186/1746-4269-10-48

Sinisgalli, C., Faraone, I., Vassallo, A., Caddeo, C., Bisaccia, F., Armentano, M.F., Milella, L., Ostuni, A., 2020. Phytochemical Profile of *Capsicum annuum* L. cv Senise, Incorporation into Liposomes, and Evaluation of Cellular Antioxidant Activity. Antioxidants 9, 428. https://doi.org/10.3390/antiox9050428

Siproudhi, L., Vilotte, J., 1996. Conception globale de la maladie hémorroïdaire. In: Vilotte J., Sobhani I, Benhamou G., Couturier D. et Mignon M. (sous la dir de), Proctologie. ESTEM, AUPELF, Paris, Partie Iv, chap 1, pp. 219-224. Editions ESTEM, Paris. ISBN 978-2-909455-54-9

Siyum, Z.G., 2020. Tropical dry forest dynamics in the context of climate change: syntheses of drivers, gaps, and management perspectives. Ecol. Process 9, 25. https://doi.org/10.1186/s13717-020-00229-6

Sliwka-Kaszyńska, M., Anusiewicz, I., Skurski, P., 2022. The Mechanism of a Retro-Diels–Alder Fragmentation of Luteolin: Theoretical Studies Supported by Electrospray Ionization Tandem Mass Spectrometry Results. Molecules 27, 1032. https://doi.org/10.3390/molecules27031032

Sobiecki, J.-F., 2014. The Intersection of Culture and Science in South African Traditional Medicine. Indo-Pacific Journal of Phenomenology 14, 1–10. https://doi.org/10.2989/IPJP.2014.14.1.6.1238

Sofowora, A., 2010. Plantes médicinales et médecine traditionnelle d'Afrique, Economie et développement. Karthala ; Académie suisse des sciences naturelles, Paris : Berne. pp. 378. ISBN 978-2-8111-0330-9

Soha, S.A.S., Dougnon, T.J., Ohouko, F.H.O., Kpodekon, M.T.T., Youssao, A.K.I., 2019. Activités biologiques et utilisations de *Elaeis guineensis* (Jacq) et de *Khaya*

senegalensis (Desr) en médecine traditionnelle humaine et vétérinaire. Int. J. Bio. Chem. Sci. 13, 525. https://doi.org/10.4314/ijbcs.v13i1.41

Somé, M., 2001. Les cultures africaines à l'épreuve de la colonisation. Afrika Zamani. Revue annuelle d'histoire africaine (Annual Journal of African History) (9-10), 41–59. https://www.africabib.org/rec.php?RID=270341722

Somerville, V.S., Braakhuis, A.J., Hopkins, W.G., 2016. Effect of Flavonoids on Upper Respiratory Tract Infections and Immune Function: A Systematic Review and Meta-Analysis. Adv. Nutr. 7, 488–497. https://doi.org/10.3945/an.115.010538

Song, W.-X., Ji, T.-F., Si, Y.-K., Su, Y.-L., 2006. Studies on chemical constituents in herb from Artemisia rupestris. Zhongguo Zhong Yao Za Zhi 31, 1790–1792.

Song, X., He, J., Xu, H., Hu, X.-P., Wu, X.-L., Wu, H.-Q., Liu, L.-Z., Liao, C.-H., Zeng, Y., Li, Y., Hao, Y., Xu, C.-S., Fan, L., Zhang, J., Zhang, H.-J., He, Z.-D., 2016. The antiviral effects of acteoside and the underlying IFN-γ-inducing action. Food Funct. 7, 3017–3030. https://doi.org/10.1039/C6FO00335D

Sorensen, T., 1948. A Method of Establishing Groups of Equal Amplitude in Plant Sociology Based on Similarity of Species Content and Its Application to Analyses of the Vegetation on Danish Commons." Biol. Skar. 5: 1–34.

Souley Kallo, M., Adamou, R., Sawadogo, J., Ayouba Mahamane, A., Maman Maarouhi, I., Ikhiri, K., 2018. Enquête ethnobotanique et criblage phytochimique de quelques plantes tinctoriales du Niger en vue d'une valorisation en énergie solaire. Int. J. Bio. Chem. Sci. 12, 867-883. https://doi.org/10.4314/ijbcs.v12i2.20

Sow, F., 1995. Femmes rurales chefs de famille en Afrique Subsaharienne. [WWW Document]. URL: https://www.fao.org/3/x0237f/x0237f06.htm#P1618_156192 (accessed 28.05.2020).

Srithi, K., Balslev, H., Wangpakapattanawong, P., Srisanga, P., Trisonthi, C., 2009. Medicinal plant knowledge and its erosion among the Mien (Yao) in northern Thailand. Journal of Ethnopharmacology 123, 335–342. https://doi.org/10.1016/j.jep.2009.02.035

Srivastava, A.K., Singh, V.K., 2017. Biological Action of *Piper Nigrum* - The King of spices. European Journal of Biological Research 2017; 7 (3), 223-233 https://doi.org/10.5281/ZENODO.839039

Stachowiak-wencek, A., Prądzyński W., 2013. The effect of temperature on the emission of volatile organic compounds from furniture coatings. Annals of Warsaw University of Life Sciences - SGGW, Forestry and Wood Technology (84), 310-314

Staner, P., Boutique, R., 1937. Matériaux pour l'étude des plantes médicinales indigènes du Congo Belge. Mém. Institut royal colonial belge, Section des Sc. naturelles et médicales, Collection in-8°, fasc. 6 et dernier, pp. 228. [WWW Document]. URL http://www.kaowarsom.be/documents/MEMOIRES_VERHANDELINGEN/Sciences_naturelles_medicales/Nat.Sc.(IRCB)_T.V,6_STANER,%20P.%20et%20BOUTIQUE,%20R._Mat%C3%A9riaux%20pour%20les%20plantes%20m%C3%A9dicinales%20indig%C3%A8nes%20du%20Congo%20belge_1937.PDF (accessed 05.02.2020).

Stevenson, P.C., Dayarathna, T.K., Belmain, S.R., Veitch, N.C., 2009. Bisdesmosidic Saponins from *Securidaca longepedunculata* Roots: Evaluation of Deterrency and Toxicity to Coleopteran Storage Pests. J. Agric. Food Chem. 57, 8860–8867. https://doi.org/10.1021/jf901599j

Su, N., Jarvie, S., Yan, Y., Gong, X., Li, F., Han, P., Zhang, Q., 2022. Landscape context determines soil fungal diversity in a fragmented habitat. CATENA 213, 106163. https://doi.org/10.1016/j.catena.2022.106163

Sun, Y., Zhang, X., Xue, X., Zhang, Y., Xiao, H., Liang, X., 2009. Rapid Identification of Polyphenol C-Glycosides from Swertia franchetiana by HPLC--ESI-MS--MS. Journal of Chromatographic Science 47, 190–196. https://doi.org/10.1093/chromsci/47.3.190

Sun, Z., Migaly, J., 2016. Review of Hemorrhoid Disease: Presentation and Management. Clinics in Colon and Rectal Surgery 29, 022–029. https://doi.org/10.1055/s-0035-1568144

Suzuki, S., Ishimaru, N., Akashi, Y., Takeuchi, Y., Ueda, A., Ushiki, A., Kinami, S., Suzuki, H., Tokuda, Y., Maeno, T., 2020. Physicians' prediction for the assessment of atypical pathogens in respiratory tract infections. J. Gen. Fam. Med. 21, 226–234. https://doi.org/10.1002/jgf2.350

Szymkiewicz, D., 1936. Seconde contribution statistique à la géographie floristique. Acta Societatis Botanicorum Poloniae 13, 271–292. https://doi.org/10.5586/asbp.1936.015

Taborda, C.P., Muñoz, J.E., Gonzalez, A., 2022. Editorial: Tropical fungal diseases. Frontiers in Cellular and Infection Microbiology 12, 1104519 https://doi.org/10.3389/fcimb.2022.1104519

Tahri, N., Basti, A.E., Zidane, L., Rochdi, A., Douira, A., 2012. Etude Ethnobotanique Des Plantes Medicinales Dans La Province De Settat (Maroc). Kastamonu University Journal of Forestry Faculty, 12(2), 192-208.

Tamfu, A.N., Ceylan, O., Kucukaydin, S., Ozturk, M., Duru, M.E., Dinica, R.M., 2020. Antibiofilm and Enzyme Inhibitory Potentials of Two Annonaceous Food Spices, African Pepper (*Xylopia aethiopica*) and African Nutmeg (*Monodora myristica*). Foods 9, 1768. https://doi.org/10.3390/foods9121768

Tane, P., Tatsimo, S., Ayimele, G., Connolly, J., 2005. Bioactive metabolites from Aframomum species. 11th NAPRECA Symposium Book of Proceedings, Antananarivo, Madagascar. pp. 214-223. [WWW Document]. URL https://www.researchgate.net/profile/Pierre-Tane/publication/268424491_Bioactive_metabolites_from_Aframomum_species/links/54f5d6a90cf2ca5efefd36a8/Bioactive-metabolites-from-Aframomum-species.pdf (accessed 20.02.2021).

Tantengco, O.A.G., C. Condes, M.L., T. Estadilla, H.H., M. Ragragio, E., 2018. Ethnobotanical Survey of Medicinal Plants used by Ayta Communities in Dinalupihan, Bataan, Philippines. Pharmacognosy Journal 10(5), 859–870. https://doi.org/10.5530/pj.2018.5.145

Tariq, A., 2015. Antimicrobial property and phytochemical study of ginger found in local area of Punjab, Pakistan. International Journal of Current Pharmaceutical Review and Research 4, 405–409.

Tata Paul. n.d. Makaya ma nsi. Ed. Pères Rédemptoristes, 1966. Mbanza - Ngungu, quatorzième tirage. pp. 30. [WWW Document]. URL: http://nzenzeflowerspauwels.be/Tata_Paul.pdf (accessed 12.05.2020).

Tauseef, S., Shaiq, M., Ahmad, A., Imran, M., Ahmed, Z., Sikander, K., Sherwani, Ghafoor, A., Onocha, P., Joseph, N., Francois, A., Waffo, K., Tauseef, F., Sherwani, G., Ahmed, P., Onocha, N., Joseph, A., Francois, K., Waffo, F., Tauseef, 2014. In vitro Antioxidant activity analysis of five medicinally important plants. Journal of Pharmacognosy and Phytochemistry 2(4), 183-188

Tchatchou, B., Sonwa, D.J., Ifo, S., Tiani, A.M., 2015. Deforestation and forest degradation in the Congo Basin: State of knowledge, current causes and perspectives. CIFOR. pp. 59. ISBN 978-602-387-021-9

Tchouya, G.R., Nantia, E.A., 2015. Phytochemical analysis, antioxidant evaluation and total phenolic content of the leaves and stem bark of *Musanga cecropioides* R.Br. ex Tedlie (Cecropiaceae), growing in Gabon. Journal of Pharmacognosy and Phytochemistry

3(5), 192-195. https://www.phytojournal.com/archives/2015/vol3issue5/PartD/38.1-638.pdf (accessed 2.26.21).

Teme, R., Nwidu, L., 2018. Sub-Chronic Toxicity of Hydromethanolic Stem Bark Extract of *Musanga cecropioides* (Urticaceae) in Rat. EC Pharmacology and Toxicology 6.3, 76–95.

ter Steege, H., Pitman, N.C.A., Sabatier, D., Baraloto, C., Salomão, R.P., Guevara, J.E., Phillips, O.L., Castilho, C.V., Magnusson, W.E., Molino, J.-F., Monteagudo, A., Núñez Vargas, P., Montero, J.C., Feldpausch, T.R., Coronado, E.N.H., Killeen, T.J., Mostacedo, B., Vasquez, R., Assis, R.L., Terborgh, J., Wittmann, F., Andrade, A., Laurance, W.F., Laurance, S.G.W., Marimon, B.S., Marimon, B.-H., Guimarães Vieira, I.C., Amaral, I.L., Brienen, R., Castellanos, H., Cárdenas López, D., Duivenvoorden, J.F., Mogollón, H.F., Matos, F.D. de A., Dávila, N., García-Villacorta, R., Stevenson Diaz, P.R., Costa, F., Emilio, T., Levis, C., Schietti, J., Souza, P., Alonso, A., Dallmeier, F., Montoya, A.J.D., Fernandez Piedade, M.T., Araujo-Murakami, A., Arroyo, L., Gribel, R., Fine, P.V.A., Peres, C.A., Toledo, M., Aymard C., G.A., Baker, T.R., Cerón, C., Engel, J., Henkel, T.W., Maas, P., Petronelli, P., Stropp, J., Zartman, C.E., Daly, D., Neill, D., Silveira, M., Paredes, M.R., Chave, J., Lima Filho, D. de A., Jørgensen, P.M., Fuentes, A., Schöngart, J., Cornejo Valverde, F., Di Fiore, A., Jimenez, E.M., Peñuela Mora, M.C., Phillips, J.F., Rivas, G., van Andel, T.R., von Hildebrand, P., Hoffman, B., Zent, E.L., Malhi, Y., Prieto, A., Rudas, A., Ruschell, A.R., Silva, N., Vos, V., Zent, S., Oliveira, A.A., Schutz, A.C., Gonzales, T., Trindade Nascimento, M., Ramirez-Angulo, H., Sierra, R., Tirado, M., Umaña Medina, M.N., van der Heijden, G., Vela, C.I.A., Vilanova Torre, E., Vriesendorp, C., Wang, O., Young, K.R., Baider, C., Balslev, H., Ferreira, C., Mesones, I., Torres-Lezama, A., Urrego Giraldo, L.E., Zagt, R., Alexiades, M.N., Hernandez, L., Huamantupa-Chuquimaco, I., Milliken, W., Palacios Cuenca, W., Pauletto, D., Valderrama Sandoval, E., Valenzuela Gamarra, L., Dexter, K.G., Feeley, K., Lopez-Gonzalez, G., Silman, M.R., 2013. Hyperdominance in the Amazonian Tree Flora. Science 342, 1243092. https://doi.org/10.1126/science.1243092

Thomas, E., Vandebroek, I., Van Damme, P., 2007. What works in the field? A comparison of different interviewing methods in ethnobotany with special reference to the use of photographs. Economic Botany 61, 376. https://doi.org/10.1663/0013-0001(2007)61[376:WWITFA]2.0.CO;2

Thomas, M., Bomar, P.A., 2022. Upper Respiratory Tract Infection, in: StatPearls. StatPearls Publishing, Treasure Island (FL). PMID: 30422556 https://www.ncbi.nlm.nih.gov/books/NBK532961/

Thouri, A., Chahdoura, H., El Arem, A., Omri Hichri, A., Ben Hassin, R., Achour, L., 2017. Effect of solvents extraction on phytochemical components and biological activities of Tunisian date seeds (var. Korkobbi and Arechti). BMC Complement. Altern. Med. 17, 248. https://doi.org/10.1186/s12906-017-1751-y

Toklo, M., Yayi, E., Sakirigui, A., M.F., A., Géorcelin, A., Ahomadegbe, M., Hounzangbé-Adoté, S., Joachim Djimon, G., 2020. Phytochemistry and pharmacological review of *Mitragyna inermis* (Willd.) Kuntze (Rubiaceae). Journal of Pharmacognosy and Phytochemistry 9, 22–30.

Tolba, H., Moghrani, H., Benelmouffok, A., Kellou, D., Maachi, R., 2015. Essential oil of Algerian Eucalyptus citriodora : Chemical composition, antifungal activity. Journal de Mycologie Médicale 25, e128–e133. https://doi.org/10.1016/j.mycmed.2015.10.009

Tosta, E., 2021. The seven constitutive respiratory defense barriers against SARS-CoV-2 infection. Rev. Soc. Bras. Med. Trop. 54, e0461-2021. https://doi.org/10.1590/0037-8682-0461-2021

Tourabi, M., Metouekel, A., Ghouizi, A.E.L., Jeddi, M., Nouioura, G., Laaroussi, H., Hosen, Md.E., Benbrahim, K.F., Bourhia, M., Salamatullah, A.M., Nafidi, H.-A., Wondmie, G.F., Lyoussi, B., Derwich, E., 2023. Efficacy of various extracting solvents on phytochemical composition, and biological properties of Mentha longifolia L. leaf extracts. Sci. Rep. 13, 18028. https://doi.org/10.1038/s41598-023-45030-5

Treasure, I.O., Obaghwarhievwo, A.J., Odigie, O., 2020. Ethnobotanical Survey of Medicinal Plants in Ughelli North Local Government Area of Delta State. J. Med. Stud. Res. 3: 014. https://doi.org/10.24966/MSR-5657/100014

Trotter, R.T.I., Logan, M.H., 1986. Informant consensus: a new approach for identifying potentially effective medicinal plants, in: Etkin, N.L. (Ed.), Plants in Indigenous Medicine & Diet: Biobehavioral Approaches. Redgrave Publishing Company, Bedford Hills, N.Y, pp. 91-112. ISBN: 978-0-913178-02–07.

Troy, N.M., Bosco, A., 2016. Respiratory viral infections and host responses; insights from genomics. Respir. Res. 17, 156. https://doi.org/10.1186/s12931-016-0474-9

Tshibinda, W.B., 2010. Mécanismes de garantie des « droits - créances » reconnu par la constitution droit à la santé : obligation de l'Etat (président, gouvernement, assemblée nationale, pouvoir judiciaire). The rule of law in Africa, Lubumbashi, pp. 25. [WWW Document]. URL https://www.hamann-legal.de/upload/4Baudouin_Franz.pdf (accessed 09.05.2020).

Tshimpi, A., Phaka, P., Loleke, E., Ndarabu, T., Tambwe, F., Mbendi, C., Mbendi, N., 2016. Prise en charge de la maladie hémorroïdaire à Kinshasa (RDC) Management of hemorrhoid disease in Kinshasa (DRC). Spécialités médicales 9 (3): 2328. https://anafrimed.net/prise-charge-de-maladie-hemorroidaire-a-kinshasa-rdc-management-of-hemorrhoid-disease-in-kinshasa-drc/

Tshitenge, D.T., Feineis, D., Awale, S., Bringmann, G., 2017. Gardenifolins A–H, Scalemic Neolignans from *Gardenia ternifolia*: Chiral Resolution, Configurational Assignment, and Cytotoxic Activities against the HeLa Cancer Cell Line. J. Nat. Prod. 80, 1604–1614. https://doi.org/10.1021/acs.jnatprod.7b00180

Tugume, P., Kakudidi, E.K., Buyinza, M., Namaalwa, J., Kamatenesi, M., Mucunguzi, P., Kalema, J., 2016. Ethnobotanical survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda. Journal of Ethnobiology and Ethnomedicine 12, 5. https://doi.org/10.1186/s13002-015-0077-4

Tumoro, G., Melesse, M., 2016. Determination of informant consensus factor and fidelity level of ethnomedicinal plants used in Misha Woreda, Hadiya Zone, Southern Ethiopia. Int. J. Biodivers. Conserv. 8, 351–364. https://doi.org/10.5897/IJBC2016.1020

Ulanowska, K., Tkaczyk, A., Konopa, G., Węgrzyn, G., 2006. Differential antibacterial activity of genistein arising from global inhibition of DNA, RNA and protein synthesis in some bacterial strains. Arch. Microbiol. 184, 271–278. https://doi.org/10.1007/s00203-005-0063-7

Ullah, R., Hussain, Z., Iqbal, Z., Hussain, J., Khan, F.U., Khan, N., Muhammad, Z., Ayaz, S., Ahmad, S., Najeeb-ur-Rehman, Hussain, I., 2010. Traditional uses of medicinal plants in Darra Adam Khel NWFP Pakistan. Journal of Medicinal Plants Research 4, 1815–1821.

UN-REDD, 2012. Etude qualitative sur les causes de la déforestation et de la dégradation des forêts en République démocratique du Congo - ONU-REDD/Version finale 2012. pp. 165. http://www.forestpeoples.org/sites/fpp/files/publication/2013/05/etude-qualitative-causes-dd-menee-par-le-gtcr-faofinalaout2012.pdf (Accessed 06.05.20)

Unuigbe, C., Enahoro, J., Erharuyi, O., Okeri, H.A., 2019. Phytochemical analysis and antioxidant evaluation of lemon grass (*Cymbopogon citratus* DC.) Stapf leaves.

Journal of Applied Sciences and Environmental Management 23, 223. https://doi.org/10.4314/jasem.v23i2.4

Valko, M., Leibfritz, D., Moncol, J., Cronin, M.T.D., Mazur, M., Telser, J., 2007. Free radicals and antioxidants in normal physiological functions and human disease. The International Journal of Biochemistry & Cell Biology 39, 44–84. https://doi.org/10.1016/j.biocel.2006.07.001

Van Andel, T., Van't Klooster, C., 2007. Medicinal Plant Use by Surinamese Immigrants in Amsterdam, the Netherlands: Results of a Pilot Market Survey, in: Pieroni, A., Vandebroek, I. (Eds.), Traveling Cultures and Plants. Berghahn Books, pp. 122–144. https://doi.org/10.1515/9780857455789-008

Van Asseldonk, T., Laskey, C., 2020. Gender aspects and multiple contexts in ethnoveterinary practice and science, in: McGaw, L.. J., Muna, A.A. (Eds.), Ethnoveterinary Medicine, Present and Future Concepts. Springer, Gewerbestrasse 11, 6330 Cham, pp. 125-149. ISBN: 978-3-030-32270-0. https://doi.org/10.1007/978-3-030-32270–0.

Van der Veen, L.J., 1994. Maladies, remèdes et langues en Afrique Centrale. Ouvrage collectif en préparation. pp 453. [WWW Document]. URL http://193.48.145.249/fulltext/Van%20Der%20Veen/Van%20der%20Veen_m.s_Collectif.pdf (accessed 02.05.20).

Van Rensburg, H.C.J., Fourie, A., Pretorius, E., 1992. Health care in South Africa: structure and dynamics. Academica, Pretoria. pp. 438. ISBN 978-0-86874-471-1

Vandebroek, I., 2010. The Dual Intracultural and Intercultural Relationship between Medicinal Plant Knowledge and Consensus1. Economic Botany 64, 303–317. https://doi.org/10.1007/s12231-010-9135-y

Vaou, N., Stavropoulou, E., Voidarou, C. (Chrysa), Tsakris, Z., Rozos, G., Tsigalou, C., Bezirtzoglou, E., 2022. Interactions between Medical Plant-Derived Bioactive Compounds: Focus on Antimicrobial Combination Effects. Antibiotics 11, 1014. https://doi.org/10.3390/antibiotics11081014

Vermeulen, M., Tamburini, D., Müller, E.M.K., Centeno, S.A., Basso, E., Leona, M., 2020. Integrating liquid chromatography mass spectrometry into an analytical protocol for the identification of organic colorants in Japanese woodblock prints. Sci. Rep. 10, 20921. https://doi.org/10.1038/s41598-020-77959-2

Vijayarathna, S., Zakaria, Z., Chen, Y., Latha, L.Y., Kanwar, J.R., Sasidharan, S., 2012. The Antimicrobial Efficacy of *Elaeis guineensis*: Characterization, in Vitro and in Vivo Studies. Molecules 17, 4860–4877. https://doi.org/10.3390/molecules17054860

Voeks, R.A., 2004. Disturbance Pharmacopoeias: Medicine and Myth from the Humid Tropics. Annals of the Association of American Geographers 94, 868–888. https://doi.org/10.1111/j.1467-8306.2004.00439.x

Voeks, R.A., 1996. Tropical Forest Healers and Habitat Preference. Econ. Bot. 50, 381–400. https://doi.org/10.1007/BF02866520

Voeks, R.A., Leony, A., 2004. Forgetting the forest: Assessing medicinal plant erosion in Eastern Brazil. Econ. Bot. 58, S294–S306. https://doi.org/10.1663/0013-0001(2004)58[S294:FTFAMP]2.0.CO;2

Vu, D.L., Nguyen, T.V.A., Nguyen, T.D., Dang, V.H., Le, H.D., Nguyen, X.T., 2023. Anti-diabetic Effect of Major Compounds from *Commelina diffusa*. Rev. Bras. Farmacogn. 33, 657–661. https://doi.org/10.1007/s43450-023-00394-7

Wakchaure, R., Ganguly, S., 2018. Phytochemistry and Pharmacological Properties of Ginger (*Zingiber officinale*), in: Mahdi, A.A., Murtaza, A., Khan, A.A., Ansair, M.I., Maheshwari, R.K. (Eds.), Molecular Biology and Pharmacognosy and Beneficial Plants. Lenin Media Private Limited, Delhi, India, pp. 97-103. ISBN: 978-93-85995-56–9.

Wamuini L.S., Vreven, E., Vandewalle, P., Mutambue, S., & Snoeks, J., 2010. Contribution à la connaissance de l'ichtyofaune de l'Inkisi au Bas-Congo (RD du Congo). Cybium. 34(1), 83-91.

Wang, D., Qi, M., Yang, Q., Tong, R., Wang, R., Bligh, S.W.A., Yang, L., Wang, Z., 2016. Comprehensive metabolite profiling of Plantaginis Semen using ultra high performance liquid chromatography with electrospray ionization quadrupole time-of-flight tandem mass spectrometry coupled with elevated energy technique: Liquid Chromatography. Journal of Separation Science 39(10), 1842–1852. https://doi.org/10.1002/jssc.201501149

Wang, L., Zhang, C., Layba, M., Zhang, M., 2011. Triterpenes and sterols from Nauclea latifolia. Zhongguo Zhong Yao Za Zhi 36, 2511–2514.

Wang, X., Chang, X., Luo, X., Su, M., Xu, R., Chen, J., Ding, Y., Shi, Y., 2019. An Integrated Approach to Characterize Intestinal Metabolites of Four Phenylethanoid Glycosides and Intestinal Microbe-Mediated Antioxidant Activity Evaluation In Vitro Using UHPLC-Q-Exactive High-Resolution Mass Spectrometry and a 1,1-Diphenyl-2-picrylhydrazyl-Based Assay. Front. Pharmacol. 10, 826. https://doi.org/10.3389/fphar.2019.00826

Wangchuk, P., 2018. Therapeutic Applications of Natural Products in Herbal Medicines, Biodiscovery Programs, and Biomedicine. Journal of Biologically Active Products from Nature 8, 1–20. https://doi.org/10.1080/22311866.2018.1426495

Wani, Z.A., Samant, S.S., Pant, S., 2022. Diversity, utilization pattern and representativeness of dye yielding plants in North Western and Western Himalaya, India: an untapped source for Bioprospection. Environ. Dev. Sustain. 24, 4493–4510. https://doi.org/10.1007/s10668-021-01664-x

Wanjohi, B.K., Sudoi, V., Njenga, E.W., Kipkore, W.K., 2020. An Ethnobotanical Study of Traditional Knowledge and Uses of Medicinal Wild Plants among the Marakwet Community in Kenya. Evidence-Based Complementary and Alternative Medicine 2020, 1-8. Article ID 3208634. https://doi.org/10.1155/2020/3208634

Waridel, P., Wolfender, J.-L., Ndjoko, K., Hobby, K.R., Major, H.J., Hostettmann, K., 2001. Evaluation of quadrupole time-of-flight tandem mass spectrometry and ion-trap multiple-stage mass spectrometry for the differentiation of C-glycosidic flavonoid isomers. Journal of Chromatography A 926, 29–41. https://doi.org/10.1016/S0021-9673(01)00806-8

Wassie, S.M., Aragie, L.L., Taye, B.W., Mekonnen, L.B., 2015. Knowledge, Attitude, and Utilization of Traditional Medicine among the Communities of Merawi Town, Northwest Ethiopia: A Cross-Sectional Study. Evid Based Complement Alternat Med 2015. https://doi.org/10.1155/2015/138073

Watcho, P., Defo, P.B.D., Wankeu-Nya, M., Carro-Juarez, M., Nguelefack, T.B., Kamanyi, A., 2013. *Mondia whitei* (Periplocaceae) prevents and *Guibourtia tessmannii* (Caesalpiniaceae) facilitates fictive ejaculation in spinal male rats. BMC Complement Altern. Med. 13, 4. https://doi.org/10.1186/1472-6882-13-4

Watt, J.M. and Breyer-Brandwijk, M.G., 1962. The Medicinal and Poisonous Plants of Southern and Eastern Africa. 2nd Edition, E. and S. Livingstone Ltd., Edinburgh and London. pp. 1457.

Watts, M., Hutton, C., Mata Guel, E.O., Suckall, N., Peh, K.S.-H., 2022. Impacts of climate change on tropical agroforestry systems: A systematic review for identifying future research priorities. Front. For. Glob. Change 5, 880621. https://doi.org/10.3389/ffgc.2022.880621

Weckmüller, H., Barriocanal, C., Maneja, R., Boada, M., 2019. Factors Affecting Traditional Medicinal Plant Knowledge of the Waorani, Ecuador. Sustainability 11, 4460. https://doi.org/10.3390/su11164460

Weinhold, A., Döll, S., Liu, M., Schedl, A., Pöschl, Y., Xu, X., Neumann, S., Van Dam, N.M., 2022. Tree species richness differentially affects the chemical composition of leaves, roots and root exudates in four subtropical tree species. Journal of Ecology 110, 97–116. https://doi.org/10.1111/1365-2745.13777

Westerlund, D., 2006. African Indigenous Religions and Disease Causation: From Spiritual Beings to Living Humans, African Indigenous Religions and Disease Causation. Brill. pp. 237. ISBN 978-90-04-14433-0

White, P., 2015. The concept of diseases and health care in African traditional religion in Ghana. HTS Teologiese Studies / Theological Studies 71, 7 pages. https://doi.org/10.4102/hts.v71i3.2762

Whittaker, R.H., 1972. Evolution and measurement of species diversity. Taxon 21, 213–251. https://doi.org/10.2307/1218190

Wilbur, J.J., 2007. Final Report on the Safety Assessment of *Capsicum annuum* Extract, *Capsicum Annuum* Fruit Extract, *Capsicum Annuum* Resin, *Capsicum annuum* Fruit Powder, *Capsicum Frutescens* Fruit, *Capsicum Frutescens* Fruit Extract, *Capsicum Frutescens* Resin, and Capsaicin1. Int. J. Toxicol. 26, 3–106. https://doi.org/10.1080/10915810601163939

Wu, L., Zhang, M., Xie, X., Lv, J., Zhou, X., Shen, N., 2023. Effect of wetland hydrological connectivity on runoff based on a basin comparison. Journal of Hydrology 619, 129348. https://doi.org/10.1016/j.jhydrol.2023.129348

Xiang, Z., Lin, C., Zhu, Y., Deng, J., Xia, C., Chen, J., 2021. Phytochemical profiling of antioxidative polyphenols and anthocyanins in the wild plant *Campanumoea lancifolia* (Roxb.) Merr. Int. J. Food Prop. 24, 105–114. https://doi.org/10.1080/10942912.2020.1867570

Xiao, Z., 2022. Dual ecological functions of scatter-hoarding rodents: pollinators and seed dispersers of Mucuna sempervirens (Fabaceae). Integrative Zoology 17, 918–929. https://doi.org/10.1111/1749-4877.12603

Xu, Y.-J., Foubert, K., Dhooghe, L., Lemière, F., Cimanga, K., Mesia, K., Apers, S., Pieters, L., 2012. Chromatographic profiling and identification of two new iridoid-indole alkaloids by UPLC–MS and HPLC-SPE-NMR analysis of an antimalarial extract from *Nauclea pobeguinii*. Phytochemistry Letters 5, 316–319. https://doi.org/10.1016/j.phytol.2012.02.010

Yangakola, J.-M., de Foucault, B., Yongo, O., Lejoly, J., 2004. Analyse phytogéographique comparative des savanes et des forêts de Ngotto (République Centrafricaine). Acta Botanica Gallica 151, 221–229. https://doi.org/10.1080/12538078.2004.10516036

Yao, J., Zhang, Y., Wang, X.-Z., Zhao, J., Yang, Z.-J., Lin, Y.-P., Sun, L., Lu, Q.-Y., Fan, G.-J., 2022. Flavonoids for Treating Viral Acute Respiratory Tract Infections: A Systematic Review and Meta-Analysis of 30 Randomized Controlled Trials. Front. Public Health 10, 814669. https://doi.org/10.3389/fpubh.2022.814669

Yapi, B.A., Gnahoue, G., Camara, D., Zirihi, G. N., 2015. Etude botanique, évaluation de l'activité antifongique des feuilles de *Acanthospermum hispidum* DC., (Asteraceae) sur la croissance in vitro de *Candida albicans* et étude de la toxicité sur les cellules humaines hff. European Scientific Journal 11, 225-237 https://eujournal.org/index.php/esj/article/view/6364

Ye, J., Su, J., Chen, K., Liu, H., Yang, X., He, Y., Zhang, W., 2014. Comparative investigation on chemical constituents of flower bud, stem and leaf of *Lonicera japonica* Thunb. by

HPLC-DAD-ESI-MS/MS n and GC-MS. J. Anal. Chem. 69, 777–784. https://doi.org/10.1134/S1061934814080036

Yeboah, T., 2008. Improving the provision of traditional health knowledge for rural communities in Ghana*: Traditional health knowledge in Ghana. Health Libraries Review 17, 203–208. https://doi.org/10.1111/j.1471-1842.2000.00297.x

Yeligar, V. C., Desai, A. V., Patil, V. M., Patil, S. S., Patil S. V.,2017. Phytochemical investigation of *Eleusine indica* for *in-vivo* diuretic and in-vitro anti-urolithiatic activity. World Journal of Pharmaceutical Research 6(8): 1292-1304 https://doi.org/10.20959/wjpr20178-8978

Yineger, H., Yewhalaw, D., Teketay, D., 2008. Ethnomedicinal plant knowledge and practice of the Oromo ethnic group in southwestern Ethiopia. Journal of Ethnobiology and Ethnomedicine 4, 11. https://doi.org/10.1186/1746-4269-4-11

Yoccoz, N.G., 2022. From design to analysis: A roadmap for predicting distributions of rare species. Global Change Biology 28, 3745–3747. https://doi.org/10.1111/gcb.16162

Yüce, I., Agnaniet, H., Morlock, G.E., 2019. New Antidiabetic and Free-Radical Scavenging Potential of Strictosamide in *Sarcocephalus pobeguinii* Ground Bark Extract via Effect-Directed Analysis. ACS Omega 4, 5038–5043. https://doi.org/10.1021/acsomega.8b02462

Yurnaliza, Y., Nurwahyuni, I., Lenny, S., Rizal, E., Wirandi, D., Harahap, N.F., Lutfia, A., Hartanto, A., 2019. Total Phenolic Content of Oil Palm Roots *(Elaeis Guineensis* Jacq.) As Preliminary Health Indicators in Oil Palm Plantation. J. Phys.: Conf. Ser. 1351, 012026. https://doi.org/10.1088/1742-6596/1351/1/012026

Zabo, A.I., Ndombe, T., National Pedagogical University (Université Pédagogique Nationale), Lusala, D., Kasangulu High School (Lycée Kasangulu), 2019. Phytochemical study of medicinal plants used against buruli ulcer by Ntandu people in Kongo Central, DRC. Trop. Plant. Res. 6, 49–53. https://doi.org/10.22271/tpr.2019.v6.i1.009

Zakaryan, H., Arabyan, E., Oo, A., Zandi, K., 2017. Flavonoids: promising natural compounds against viral infections. Arch. Virol. 162, 2539–2551. https://doi.org/10.1007/s00705-017-3417-y

Zengin, G., Mahomoodally, M.F., Sinan, K.I., Ak, G., Etienne, O.K., Sharmeen, J.B., Brunetti, L., Leone, S., Di Simone, S.C., Recinella, L., Chiavaroli, A., Menghini, L., Orlando, G., Jekő, J., Cziáky, Z., Ferrante, C., 2021. Chemical Composition and Biological Properties of Two Jatropha Species: Different Parts and Different Extraction Methods. Antioxidants 10, 792. https://doi.org/10.3390/antiox10050792

Zhang, J., Guan, S., Sun, J., Liu, T., Chen, P., Feng, R., Chen, X., Wu, W., Yang, M., Guo, D., 2015. Characterization and profiling of phenolic amides from Cortex Lycii by ultra-high performance liquid chromatography coupled with LTQ-Orbitrap mass spectrometry. Anal Bioanal Chem 407, 581–595. https://doi.org/10.1007/s00216-014-8296-4

Zhang, M., Zhao, G., Zhang, G., Wei, X., Shen, M., Liu, L., Ding, X., Liu, Y., 2020. A targeted analysis of flavonoids in asparagus using the UPLC-MS technique. Czech J. Food Sci. 38, 77–83. https://doi.org/10.17221/168/2019-CJFS

Zhang, X., Liang, C., Li, C., Bu, M., Bu, L., Xiao, Y., Sun, H., Zhang, L., 2018. Simultaneous Qualitative and Quantitative Study of Main Compounds in *Commelina communis* Linn. by UHPLC–Q-TOF-MS-MS and HPLC–ESI-MS-MS. J. Chromatogr. Sci. 56, 582–594. https://doi.org/10.1093/chromsci/bmy030

Zhang, Y., Yao, J., Qi, X., Liu, X., Lu, X., Feng, G., 2017. Geniposide demonstrates anti-inflammatory and antiviral activity against pandemic A/Jiangsu/1/2009 (H1N1)

influenza virus infection in vitro and in vivo. Antivir. Ther. 22, 599–611. https://doi.org/10.3851/IMP3152

Zhao, Y., Wang, M., Sun, L., Jiang, X., Zhao, M., Zhao, C., 2020. Rapid characterization of the chemical constituents of Sanhua decoction by UHPLC coupled with Fourier transform ion cyclotron resonance mass spectrometry. RSC Adv. 10, 26109–26119. https://doi.org/10.1039/D0RA02264K

Zhou, F., Peng, J., Zhao, Y., Huang, W., Jiang, Y., Li, M., Wu, X., Lu, B., 2017. Varietal classification and antioxidant activity prediction of *Osmanthus fragrans* Lour. flowers using UPLC-PDA/QTOF-MS and multivariable analysis. Food. Chem. 217, 490–497. https://doi.org/10.1016/j.foodchem.2016.08.125

Zhou, Q., Mrowietz, U., Rostami-Yazdi, M., 2009. Oxidative stress in the pathogenesis of psoriasis. Free Radical Biology and Medicine 47, 891–905. https://doi.org/10.1016/j.freeradbiomed.2009.06.033

Zhou, T., Liu, H., Wen, J., Fan, G., Chai, Y., Wu, Y., 2010. Fragmentation study of iridoid glycosides including epimers by liquid chromatography-diode array detection/electrospray ionization mass spectrometry and its application in metabolic fingerprint analysis of *Gardenia jasminoides* Ellis: Fragmentation study of iridoid glycosides. Rapid Commun. Mass Spectrom. 24, 2520–2528. https://doi.org/10.1002/rcm.4643

Zhou, X., Zeng, M., Huang, F., Qin, G., Song, Z., Liu, F., 2023. The potential role of plant secondary metabolites on antifungal and immunomodulatory effect. Applied Microbiology and Biotechnology 1. https://doi.org/10.1007/s00253-023-12601-5

Zhuang, X.-C., Zhang, Y.-L., Chen, G.-L., Liu, Y., Hu, X.-L., Li, N., Wu, J.-L., Guo, M.-Q., 2021. Identification of Anti-Inflammatory and Anti-Proliferative Neolignanamides from *Warburgia ugandensis* Employing Multi-Target Affinity Ultrafiltration and LC-MS. Pharmaceuticals 14, 313. https://doi.org/10.3390/ph14040313

Zillich, O.V., Schweiggert-Weisz, U., Eisner, P., Kerscher, M., 2015. Polyphenols as active ingredients for cosmetic products. Int. J. Cosmet. Sci. 37, 455–464. https://doi.org/10.1111/ics.12218

Zoghbi, M. das G.B., Andrade, E.H.A., Oliveira, J., Carreira, L.M.M., Guilhon, G.M.S.P., 2006. Yield and Chemical Composition of the Essential Oil of the Stems and Rhizomes of *Cyperus articulatus* L. Cultivated in the State of Pará, Brazil. Journal of Essential Oil Research 18, 10–12. https://doi.org/10.1080/10412905.2006.9699371

Zou, D., Wang, J., Zhang, B., Xie, S., Wang, Q., Xu, K., Lin, R., 2015. Analysis of Chemical Constituents in Wuzi-Yanzong-Wan by UPLC-ESI-LTQ-Orbitrap-MS. Molecules 20, 21373–21404. https://doi.org/10.3390/molecules201219765

Żukowski, W., Bogdanowicz, A., Lembicz, M., 2010. Seed germination in sedges: a short review. Biodiversity: Research and Conservation 19, 15–22. https://doi.org/10.2478/v10119-010-0015-1

APPENDICES

Informant survey questionnaire

Date: ...../...../.....

Respondent information

1. Name: .....
2. Age: 18-25 ☐ 26-50 ☐ > 50 ☐
3. Gender: Male ☐ Female ☐
4. Marital status: Married ☐ Single ☐ Widowed ☐
5. Professional status: Healer ☐ Herbalist ☐ Traditional Practitioner ☐
6. Residence/location Kisantu ☐ Mbanza-town ☐ Mbanza-village ☐
7. Education level: Iliterate ☐ Primary ☐ Secondary ☐ High school ☐
8. Experience (year): < 5 ☐ 5-10 ☐ >10 ☐

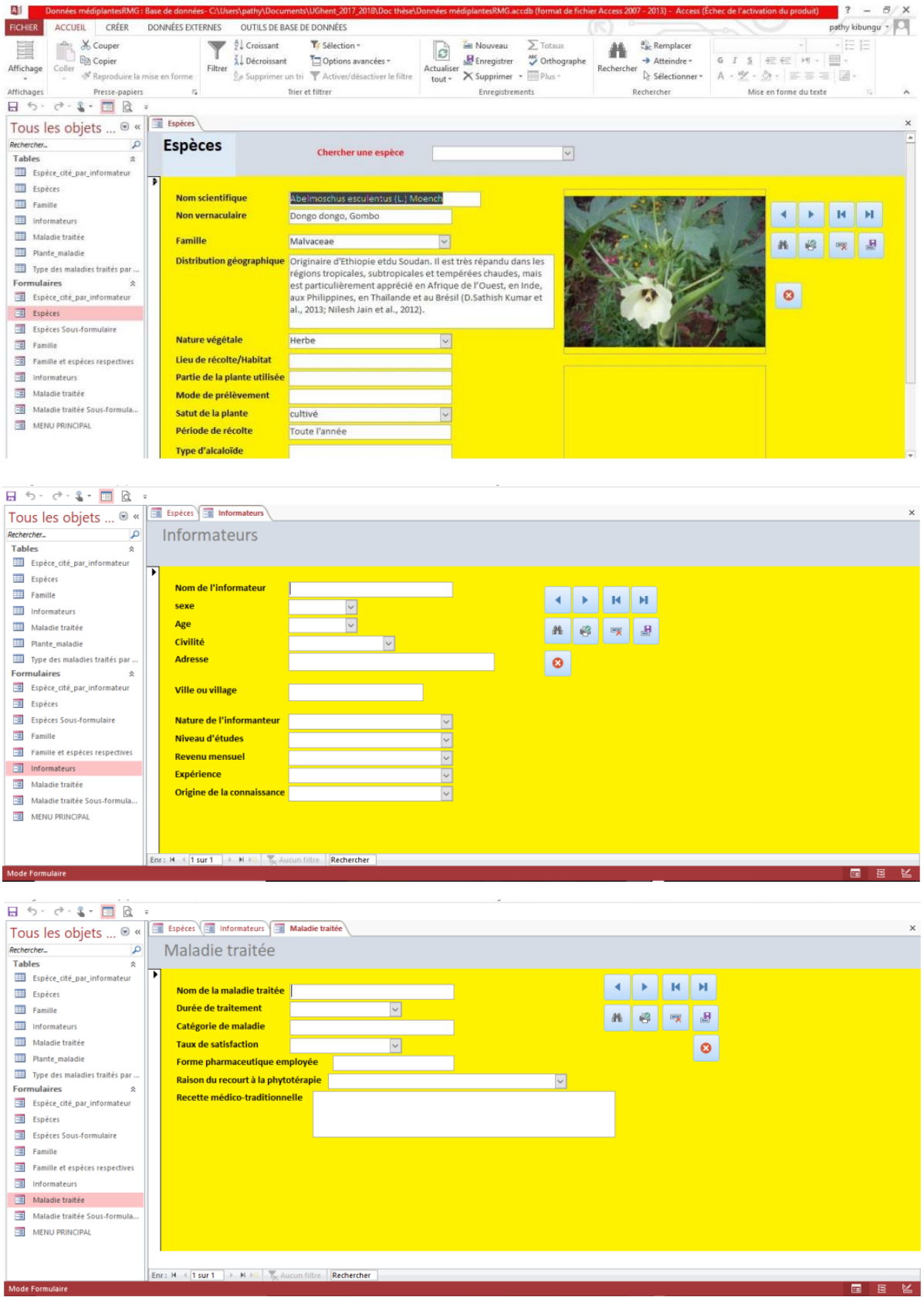
Plant use knowledge

Medicinal purpose (disease/ ailment)	Plant used	Harvesting area	Growth stage		Part collected	Plant material form		Mode of prepation	Mode of administration	Treatment	
			Young shoots	Adult plant		Fresh	Dried			Dosage	Time

Other information

1. Origin of knowledge: Transmission ☐ By vision ☐ Other (precise) ☐
2. Patients motivation to TM: Dissatisfaction to CM | Low Cost/accessible | Cultural/personal belief | Other (precise)
3. Patients level of satisfaction: Disapointed | Slightly satisfied | satisfied | Very satisfied
4. Mensual income: < $ 50 US ☐ $50-100 US ☐ > $100 US ☐
5. Patients sex: Most of women ☐ Most of men ☐
6. Patients age: Children (<18) ☐ Young (18-25) ☐ Old (26-50) ☐ Elder (>50) ☐

Appendix 1. Ethnobotanical survey questionnaire



Appendix 2. Worksheet for ethnobotanical data management using MS Access 2013

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Abelmoschus esculentus (L.) Moench	Dongodongo	*Malvaceae*	a, b	0.01	1.00	Diabetes	Fruit/semence	Powder, maceration	Oral administration	Herb	Field, home garden
Abrus precatorius subsp. *africanus* Verdc.	Ngenguba	*Fabaceae*	a, c	0.01	0.00	Cough	Whole plant	Decoction	Oral administration	Liana	Savanna
						Madness	Root	Pounded			
Acanthospermum hispidum DC.	Madiata nzau	*Asteraceae*	a, b, c	0.02	0.00	Pallor or dry skin, intermittent sever fevers, continuous diarrhea and loss of weigth of the baby due to infidelity by one of the parents (Sanga)	Leaf	Powder	Scarification	Herb	Ruderal
						Tooth decay		Pounded	Application on the organ		
						Appendicitis		Decoction	Oral administration		
						Zoster		Powder	External application		
Adenia cissampeloides (Planch. Ex Benth.) Harms	Mupembe	*Passifloraceae*	b	0.01	0.00	Gastritis	Root	Decoction	Oral administration	Liana	Forest recruit
Aframomum alboviolaceum K.Schum.	Kitundubila, Ntundulu	*Zingiberaceae*	a, b, c	0.04	0.00	Microfilariate	Root	Pounded	External application	Herb	Savanna
						Hernia	Stem	Decoction	Oral administration		
						Paralysis	Root, Stem	Pounded	Scarification		
						Bronchitis	Leaf	Pounded	Oral administration		
						Rheumatism	Root	Decoction	Friction		
						Interruption of the menstruation without being pregnant	Root	Pounded	Oral administration		
						Back pain	Fruit/semence	Pounded	Anal route		
Aframomum melegueta (Roscoe) K. Schum.	Mondongo, Ndungu zi nzô	*Zingiberaceae*	a, b, c	0.04	0.57	Rheumatism	Fruit/semence, leaf	Powder	Scarification	Herb	Field, home garden
						Hemorrhoids	Fruit/semence	Pounded, maceration	Oral administration, anal route		
						Polio	Fruit/semence, leaf	Decoction	Oral administration		
						Hookworm	Fruit/semence	Powder	Oral administration		
						Epilepsy	Fruit/semence	Powder	Oral administration		
						Chest or intercostal pain	Fruit/semence	Pounded	Oral administration		
						Female infertility	Whole plant	Maceration	Oral administration		
Ageratum conyzoides L.	Mpata kasakula	*Asteraceae*	b	0.02	0.00	Tooth decay	Leaf	Pounded	Instillation	Herb	Ruderal
						Female infertility		Maceration	Seat bath		
						Back pain		Pounded	Friction		
						Bronchitis		Trituration	Oral administration		

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Albizia adianthifolia var. *intermedia* (De Wild. & T. Durand) Villiers	Mululu	*Fabaceae*	a	0.01	0.00	Hookworm	Leaf	Decoction	Oral administration	Tree	Forest recruit
Alchornea cordifolia (Schumach.) Müll.Arg.	Kibunsi	*Euphorbiaceae*	a, b	0.03	0.20	Tooth decay	Leaf	Decoction	Gargle	Shrub	Humid forest
						Back pain		Pounded	Anal route		
						Hemorrhoids		Decoction, maceration	Igestion, anal route		
						Repeated abortion or frequent delivery of stillbirths		Decoction	Seat bath		
						Epilepsy		Raw state	Oral administration		
Allium cepa L.	Bola	*Amaryllidaceae*	a, b, c	0.03	0.43	Chest or intercostal pain	Bulb	Pounded	Friction	Herb	Field, home garden
						Hookworm		Infusion	Oral administration		
						Gastritis		Maceration	Oral administration		
						Madness		Decoction	Oral administration		
						Gastritis		Decoction	Oral administration		
						Hookworm		Infusion	Oral administration		
						Epilepsy	Leaf, Fruit/semence	Powder	Oral administration		
Allium fistulosum L.	Ndembi	*Amaryllidaceae*	a, c	0.01	0.00	Mastitis	Root	Pounded	Friction	Herb	Field, home garden
						Prostate	Whole plant	Maceration	Oral administration		
Allium sativum L.	Ayi	*Amaryllidaceae*	a, b, c	0.03	0.50	Amoebiasis	Bulb, Whole plant, Fruit/semence	Raw state, pounded, decoction	Oral administration, anal route	Herb	Field, home garden
						Premature ejaculation	Bulb	Pounded	Oral administration		
						Hookworm	Bulb	Decoction	Oral administration		
						Gastritis	Bulb	Decoction, maceration	Oral administration		
						Hemorrhoids	Bulb	Maceration	Oral administration		
						Hookworm	Bulb	Powder	Oral administration		
						Chickenpox	Bulb	Pounded	Oral administration		
						Hookworm	Bulb	Infusion	Oral administration		
Aloe congolensis De Wild. & T. Durand	Bà di nseki	*Aloaceae*	a, b, c	0.03	0.00	Hernia	Leaf	Decoction	Oral administration	Herb	Savanna
						Diabetes					
						Joint pain					
						Splenomegaly					
						Mastitis					
Alstonia congensis Engl.	Nsanga	*Apocynaceae*	b	0.01	0.00	Zoster	Stem	Decoction	Oral administration	Tree	Swamp forest
Amaranthus blitum L.	Nkuka bangulu	*Amaranthaceae*	b	0.01	0.00	Alcoholism and smoking	Leaf	Powder	Oral administration	Herb	Ruderal
Amphiblemma ciliatum Cogn.	Nsa masa	*Melastomata-ceae*	a, b	0.01	0.00	Rheumatism	Leaf	Decoction	Oral administration	Shrub	Ruderal
						Epilepsy		Maceration	Instillation		

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Ananas comosus (L.) Merr.	Nanasi	*Bromeliaceae*	a, b, c	0.03	0.00	Sexual weakness or impotence	Fruit/semence	Pounded	Oral administration	Herb	Field, home garden
						Hernia	Fruit/semence	Decoction	Oral administration		
						Sciatic neuralgia	Fruit/semence	Infusion	Oral administration		
						Gastritis	Fruit/semence	Decoction, maceration	Oral administration		
						Yellow fever	Leaf	Pounded	Anal route		
Anchomanes difformis Engl.	Kikwa ki ba nkita	*Araceae*	b	0.01	0.00	Hepatic sirosis	Tuber	Decoction	Oral administration	Herb	Humid forest
						Hernia					
Anisophyllea quangensis Engl. ex Henriq.	Mfungu-Mfungu, Mbila esobe	*Anisophilla-ceae*	a	0.01	0.00	Asthma	Leaf	Powder	Oral administration	Shrub	Savanna
Annona muricata L.	Mbundu ngombi	*Annonaceae*	a, b	0.02	0.00	Pertussis	Leaf	Decoction	Oral administration	Shrub	Field, home garden
						Itchy skin rash		Pounded	External application		
						Cough		Decoction	Oral administration		
Annona senegalensis Pers. Subsp. Oulotricha Le Thomas	Lomboloka	*Annonaceae*	a, b	0.04	0.00	Tripanosomiasis	Root	Decoction	Oral administration	Shrub	Savanna
						Hemorrhoids	Root		Oral administration		
						Splenomegaly	Root		Anal route		
						Testicular disappearance	Root		Oral administration		
						Hernia	Root		Oral administration		
						Diabetes	Root		Oral administration		
						Anemia	Leaf		Oral administration		
Anthocleista schweinfurthii Gilg	Mpuku mpuku	*Gentianaceae*	b	0.01	0.00	Diarrhea	Root	Decoction	Anal route	Tree	Forest fallow
						Female infertility		Maceration			
Undefined	Anti-poison	*Undefined*	b	0.01	0.00	Poisoning	Bark	Raw state	Oral administration	Liana	Forest recruit
Antidesma rufescens Tul.	Fuitidi	*Euphorbiaceae*	b	0.01	0.00	Infections due to STI (sexually transmitted infections)	Bark	Decoction	Oral administration	Shrub	Savanna
Arachis hypogaea L.	Nguba	*Fabaceae*	a, c	0.01	0.00	Madness	Fruit/semence	Decoction	Oral administration	Herb	Field, home garden
						Diarrhea		Raw state			
Artemisia annua L.	Artemisia	*Asteraceae*	a	0.01	0.00	Malaria	Leaf	Decoction	Oral administration	Herb	Field, home garden
								Powder			
Bambusa vulgaris Schrad. ex J.C. Wendl.	Tùutu	*Poaceae*	b	0.01	0.00	Tension	Young shoot	Decoction	Oral administration	Shrub	Forest recruit
Bidens pilosa L.	Nsolokoto	*Asteraceae*	a, c	0.02	0.00	Ache	Leaf	Trituration	Friction	Herb	Ruderal
						Sciatic neuralgia	Leaf	Decoction	Oral administration		
						Hemorrhoids	Fruit/semence	Crushed	Oral administration		
Boerhavia diffusa L.	Dibatabata, linioko ya tembe	*Nyctaginaceae*	a, b	0.02	0.00	Splenomegaly	Whole plant	Pounded	Anal route	Herb	Ruderal
						Furuncle	Leaf	Buckling	External application		

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
						Bronchitis	Leaf	Pounded	Oral administration		
Brassica oleracea L.	Nkoofi	*Brassicaceae*	a	0.01	0.00	Splenomegaly	Leaf	Pounded	Oral administration	Herb	Field, home garden
						Prostate		Decoction			
Bridelia ferruginea Benth.	Kimwindu	*Phyllanthaceae*	a, b, c	0.04	0.14	Gastritis	Root	Decoction	Oral administration	Shrub	Savanna
						Tuberculosis	Root	Decoction			
						Diabetes	Root	Decoction			
						Laryngitis	Root	Decoction			
						Rheumatism	Root	Decoction			
						Laryngitis	Root	Decoction			
						Interruption of the menstruation without being pregnant	Root	Pounded			
						Hemorrhoids	Bark	Decoction			
Brillantaisia patula T. Anderson	Lemba-lemba	*Acanthaceae*	a, b, c	0.05	0.31	Buruli ulcer	Leaf	Pounded	External application	Shrub	Field, home garden
						Heaviness in the head, seems to split in the baby	Leaf	Maceration	Oral administration		
						Headache	Leaf	Decoction	Oral administration		
						Madness	Root	Pounded	Oral administration		
						Joint pain	Leaf	Decoction	Oral administration		
						Chronic scabies with itching and stink	Leaf	Powder	External application		
						Acute nervousness	Whole plant	Pounded	Oral administration		
						Itchy skin rash	Leaf	Maceration	Oral administration		
						Headache	Leaf	Powder	Friction		
						Itchy skin rash	Leaf	Pounded	Oral administration		
						Gastritis	Leaf	Decoction, maceration	Oral administration		
						Alcoholism and smoking	Leaf	Powder	Oral administration		
						Gastritis	Leaf	Decoction	Oral administration		
						Madness	Leaf	Pounded	Oral administration		
Bryophyllum pinnatum Kurz.	Liyuki-yuki	*Crassulaceae*	a, c	0.01	0.00	Cough	Leaf	Pounded	Oral administration	Shrub	Ruderal
						Otitis		Trituration	Instillation		
Cajanus cajan (L.) Millsp.	Wàandu	*Fabaceae*	a, b	0.03	0.00	Migraine	Leaf	Pounded	Instillation	Shrub	Field, home garden
						Chronic scabies with itching and stink	Fruit/semence	Powder	Friction		
						Gonorrhea	Fruit/semence	Decoction	Oral administration		
						Skin rash	Fruit/semence	Maceration	Oral administration		
						Polio	Leaf	Decoction	Oral administration		
Caloncoba welwitschii Gilg	Kisani	*Salicaceae*	a	0.01	0.00	Chest or intercostal pain	Leaf	Pounded	Friction	Shrub	Forest recruit

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories
(in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Canarium schweinfurthii Engl.	Kibidi	*Burseraceae*	b	0.01	0.00	Migraine	Bark	Maceration	Enema	Tree	Forest gallery
Canna indica L.	Makombu kombu	*Cannaceae*	a	0.01	0.00	Lack of uvula causing the baby to cry continuously	Leaf	Maceration	Oral administration	Herb	Ruderal
Capsicum frutescens L.	Ndungu zi ntendi	*Solananceae*	a, b, c	0.05	0.27	Rheumatism	Leaf	Powder, ointment	Massage, scarification	Herb	Field, home garden
						Sexual weakness or impotence	Fruit/semence	Powder	Oral administration	Herb	Field, home garden
						Hemorrhoids	Fruit/semence, leaf	Pounded	Oral administration, anal route		
						Hernia	Root	Decoction	Oral administration		
						Chronic scabies with itching and stink	Leaf	Powder	Friction		
						Migraine	Leaf	Trituration	External application		
						Whitlow	Fruit/semence	Pounded	External application		
						Mastitis	Leaf	Pounded	Friction		
						Female infertility	Fruit/semence	Maceration	Oral administration		
Carica papaya L.	Dipapayi	*Caricaceae*	a, b, c	0.03	0.00	Amoebiasis	Fruit/semence	Pounded	Anal route	Tree	Field, home garden
						Tooth decay	Fruit/semence	Raw state	Fumigation		
						Sciatic neuralgia	Root	Decoction	Friction		
						Epilepsy	Leaf	Powder	Oral administration		
						Mastitis	Root	Pounded	Friction		
						Malaria	Leaf	Infusion	Oral administration		
Catharanthus roseus (L.) G.Don	vinca	*Apocynaceae*	a	0.01	0.00	Amoebiasis	Leaf, root	Decoction	Oral administration	Herb	Ruderal
Ceiba pentandra (L.) Gaertn.	Mfuma	*Malvaceae*	b	0.01	0.00	Pneumonia	Bark	Pounded	Friction	Tree	Forest gallery
						Epilepsy		Maceration	Oral administration		
Cenchrus purpureus (Schumach.) Morrone	Madiadia	*Poaceae*	b	0.01	0.00	Madness	Leaf	Pounded	Oral administration	Herb	Swamp
Chamaesyce hirta (L.) Millsp.	Kimvumina nkombo, Kula ntesi	*Euphorbiaceae*	a, c	0.02	0.63	Amoebiasis	Leaf, whole plant	Decoction, raw state, pounded	Oral administration	Herb	Ruderal
						Breastfeeding	Whole plant	Decoction	Oral administration		
						Hemorrhoids	Whole plant	Maceration	Oral administration, anal route		
						Hookworm	Whole plant	Infusion	Oral administration		
Chenopodium ambrosioides L.	Nkasa kindongo	*Chenoponideae*	a, c	0.02	0.00	Tooth decay	Whole plant	Decoction	Oral administration	Herb	Ruderal
						Cough	Whole plant	Pounded	Oral administration		
						Amoebiasis	Leaf, stem	Decoction	Oral administration		
						Rheumatism	Whole plant	Decoction	Friction		
Chromolaena odorata (L.) R.M. King & H. Rob.	Kolera	*Asteraceae*	a	0.01	0.00	Cough	Leaf	Decoction	Oral administration	Herb	Savanna

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Cinnamomum verum J.Presl	Arbre du bonheur	*Lauraceae*	a	0.01	0.00	Premature ejaculation	Bark	Decoction	Oral administration	Tree	Humid forest
Cissus aralioides (Welw. ex Baker) Planch.	Mbua mpimbidi, kindamina	*Vitaceae*	b, c	0.01	0.00	Elephantiasis and yellowing of the hair	Leaf	Decoction	Oral administration	Liana	Humid forest
						Malnutrition and kwashiorkor					
Cissus rubiginosa (Welw. Ex Baker) Planch.	Mumpongo mpongo	*Vitaceae*	a	0.01	0.00	Back pain	Leaf	Decoction	Oral administration	Liana	Forest fallow
						Amoebiasis		Infusion			
Citrullus lanatus (Thunb.) Matsum. Et Nakai	Mbika ntetu	*Cucurbitaceae*	b	0.01	0.00	Epilepsy	Leaf	Raw state	Oral administration	Liana	Field, home garden
Citrus limon (L.) Osbeck	Lala di ngani	*Rutaceae*	a, b, c	0.03	0.17	Pertussis	Leaf	Decoction	Oral administration	Shrub	Field, home garden
						Buruli ulcer	Fruit/semence	Raw state	Enema		
						Sciatic neuralgia	Fruit/semence	Decoction	Friction		
						Anemia	Fruit/semence	Decoction	Oral administration		
						Gastritis	Fruit/semence	Decoction, infusion	Oral administration		
						Mastitis	Fruit/semence	Pounded	Friction		
Citrus reticulata Blanco	Mandeleni	*Rutaceae*	b	0.01	0.00	Female infertility	Root	Maceration	Seat bath	Shrub	Field, home garden
Clematis hirsuta Guill. & Perr.	Nkonka-ntu	*Ranunculaceae*	a	0.02	0.00	Headache	Leaf	Decoction	Oral administration	Liana	Forest recruit
						Migraine	Leaf	Pounded	Friction		
						Splenomegaly	Root	Maceration	Oral administration		
						Prostate	Leaf	Decoction	Oral administration		
Clerodendrum formicarum Gürke	Makuku ma tatu	*Lamiaceae*	a, b, c	0.03	0.20	Asthma	Leaf	Powder	Oral administration	Herb	Ruderal
						Pallor or dry skin, intermittent sever fevers, continuous diarrhea and loss of weigth of the baby due to infidelity by one of the parents (Sanga)	Leaf	Powder	Scarification		
						Headache	Leaf	Crushed	Friction		
						Itchy skin rash	Leaf	Maceration, pounded	Oral administration		
						Epilepsy	Leaf	Raw state	Oral administration		
Clerodendrum splendens G.Don	Kindangolo	*Lamiaceae*	a	0.01	0.00	Polio	Leaf	Powder	Scarification	Liana	Forest recruit
Cocos nucifera L.	Nkandi mputu, Kokoti	*Arecaceae*	a	0.01	0.00	Sexual weakness or impotence	Fruit/semence	Pounded	Oral administration	Tree	Field, home garden
Coffea sp.	Kafi	*Rubiaceae*	a, b	0.01	0.50	Sexual weakness or impotence	Fruit/semence	Powder	Oral administration	Shrub	

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
						Hernia					Field, home garden
Cogniauxia podolaena Baill.	Kisakamba	*Cucurbitaceae*	a	0.01	0.00	Frigidity and narrowing of the vagina	Root	Decoction	Oral administration	Liana	Ruderal
Cola acuminata (P.Beauv.) Schott & Endl.	Kasu	*Malvaceae*	a, b, c	0.04	0.14	Heaviness in the head, seems to split in the baby	Fruit/semence	Maceration	Oral administration	Shrub	Field, home garden
						Hemorrhoids		Maceration			
						Premature ejaculation		Infusion			
						Epilepsy		Powder			
						Skin rash		Maceration			
						Sexual weakness or impotence		Infusion			
						Chest or intercostal pain		Pounded			
Combretum racemosum P. Beauv.	Nsumbila	*Combretaceae*	b	0.01	0.00	Healing	Leaf	Trituration	External application	Liana	Forest gallery
						Pneumonia		Pounded	Friction		
Commelina africana L.	Nlakisi	*Commelinaceae*	a, b, c	0.01	0.50	Itchy skin rash	Leaf	Maceration, pounded	Enema	Herb	Ruderal
						Migraine		Maceration			
Corymbia citriodora (Hook.) K. D. Hill & L. A. S. Johnson	Bikalipitusu	*Myrtaceae*	b	0.01	1.00	Cough	Leaf	Decoction	Oral administration	Tree	Forest gallery
Costus lucanusianus J. Braun et K. Schum.	Maboso boso	*Costaceae*	a, b, c	0.02	0.00	Asthma	Whole plant	Pounded	Oral administration	Herb	Humid forest
						Hiccup	Leaf	Pounded			
						Chickenpox	Whole plant	Pounded			
						Madness	Root	Decoction			
Costus phyllocephalus K. Schum.	Minkeni	*Costaceae*	a, b, c	0.04	0.00	Asthma	Whole plant	Pounded	Oral administration	Herb	Humid forest
						Enuresis	Root	Decoction	Oral administration		
						Tension	Whole plant	Pounded	Oral administration		
						Female infertility	Stem	Decoction	Oral administration		
						Breastfeeding	Stem	Decoction	Oral administration		
						Acute nervousness	Whole plant	Pounded	Oral administration		
						Itchy skin rash	Leaf	Pounded	External application		
						Mastitis	Whole plant	Pounded	Oral administration		
Craterispermum schweinfurthii Hiern	Muntoma-ntoma	*Rubiaceae*	a	0.01	0.00	Mastitis	Root	Decoction	Oral administration	Shrub	Forest recruit
Crossopteryx febrifuga (Afzel. ex G. Don) Benth.	Mvala, Kigala	*Rubiaceae*	a, b, c	0.04	0.00	Elephantiasis and yellowing of the hair	Leaf et Root	Decoction	Oral administration	Shrub	Savanna
						Ovarian or tubal inflammation	Root	Decoction	Oral administration		
						Hernia	Bark	Infusion	Anal route		
						Laryngitis	Bark	Decoction	Oral administration		

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
						Rheumatism	Bark	Decoction	Oral administration		
						Interruption of the menstruation without being pregnant	Bark	Pounded	Oral administration		
						Female infertility	Bark	Maceration	Oral administration		
						Splenomegaly	Leaf	Raw state	Oral administration		
Croton mubango Müll.Arg.	Mbangu mbangu	*Euphorbiaceae*	b, c	0.02	0.00	Testicular disappearance	Bark	Pounded	Oral administration	Tree	Field, home garden
						Gastritis		Decoction			
						Dermatosis		Powder			
Cucurbita maxima Duchesne	Mbika malenge	*Cucurbitaceae*	c	0.01	0.00	Tuberculosis	Leaf	Maceration	Oral administration	Liana	Field, home garden
						Microfilariate		Decoction			
Culcasia scandens P. Beauv.	Lulama lama	*Araceae*	b	0.01	0.00	Alcoholism and smoking	Leaf	Powder	Oral administration	Herb	Humid forest
Curcuma longa L.	Kingoni	*Zingiberaceae*	b	0.01	0.00	Madness	Rhizome	Decoction	Oral administration	Herb	Field, home garden
						Hernia					
Cymbopogon citratus (DC.) Stapf	Sinda di mputu	*Poaceae*	a, b, c	0.02	0.50	Cough	Leaf	Pounded, decoction	Oral administration	Herb	Field, home garden
						Polio		Decoction			
						Hookworm		Powder			
Cyperus articulatus L.	Lusaku saku	*Cyperaceae*	a, b, c	0.03	0.33	Hemorrhoids	Root	Infusion, macération	Oral administration	Herb	Swamp
						Enuresis	Root	Decoction			
						Polio	Root	Decoction			
						Skin rash	Root	Maceration			
						Hookworm	Root	Powder			
Cyperus papyrus L.	Bù, Nkuala	*Cyperaceae*	a	0.01	0.00	Migraine	Stem	Powder	Friction	Herb	Swamp
Dacryodes edulis (G. Don) H.J. Lam	Nsafu	*Burseraceae*	a, b, c	0.05	0.00	Rheumatism	Leaf	Powder	Scarification	Tree	Field, home garden
						Repeated abortion or frequent delivery of stillbirths	Leaf	Maceration	Enema		
						Tooth decay	Leaf	Decoction	Fumigation		
						Chronic scabies with itching and stink	Leaf	Powder	External application		
						Headache	Leaf	Powder	Friction		
						Nephritis	Leaf	Pounded	Oral administration		
						Testicular disappearance	Leaf	Decoction	Oral administration		
						Zoster	Leaf	Powder	External application		
						Hernia	Root	Decoction	Oral administration		

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Datura stramonium L	36 oiseaux	*Solananceae*	a	0.01	1.00	Tooth decay	Fruit/semence	Burnt	Fumigation	Shrub	Field, home garden
Daucus carota L.	Kaloti	*Apiaceae*	a	0.01	0.00	Sexual weakness or impotence	Tuber	Pounded	Application on the organ	Herb	Field, home garden
Desmodium mauritianum (Willd.) DC.	Lunzila nzila	*Fabaceae*	a	0.02	0.25	Splenomegaly	Whole plant	Decoction	Anal route	Herb	Ruderal
						Hernia	Leaf, root		Oral administration		
						Pallor or dry skin, intermittent sever fevers, continuous diarrhea and loss of weigth of the baby due to infidelity by one of the parents (Sanga)	Leaf		Scarification		
						Hookworm	Leaf		Oral administration		
Desmodium velutinum subsp. *Velutinum* (Willd.) DC.	Lundondu	*Fabaceae*	a	0.01	0.00	Hernia	Root	Decoction	Oral administration	Herb	Ruderal
						Headache	Leaf	Crushed	Friction		
Dichrostachys cinerea (L.) Wight & Arn.	Nsendi vanga	*Fabaceae*	b	0.02	0.00	Poisoning	Leaf	Decoction	Oral administration	Shrub	Savanna
						Hookworm	Leaf	Powder			
						Gastritis	Root	Decoction			
Dioscorea cayenensis Lam.	Kisadi	*Dioscoreaceae*	a, b	0.02	0.00	Hernia	Thorn	Decoction	Oral administration	Liana	Field, home garden
						Sciatic neuralgia		Infusion			
						Hookworm		Powder			
Dioscorea smilacifolia De Wild. &T. Durand	Ngolo	*Dioscoreaceae*	a	0.01	1.00	Sexual weakness or impotence	Thorn	Powder	Oral administration	Liana	Humid forest
							Fruit/semence				
Dioscorea bulbifera L.	Nsoko ngamba, kimasoko	*Dioscoreaceae*	b	0.01	0.00	Diabetes	Tuber	Decoction	Oral administration	Liana	Field, home garden
Dissotis brazzae Cogn.	Ntongu ntongu	*Melastomataceae*	a	0.01	0.00	Rheumatism	Leaf	Decoction	Oral administration	Herb	Savanna
Dorstenia laurentii De Wild.	Kintamba	*Moraceae*	b, c	0.02	0.00	Hookworm	Root	Decoction	Oral administration	Herb	Forest gallery
						Erectil malfunction		Decoction	Oral administration		
						Mastitis		Pounded	Friction		
Dracaena mannii Baker	Boma libala	*Asparagaceae*	b	0.01	0.00	Smallpox	Bark	Decoction	Anal route	Shrub	Forest gallery
Elaeis guineensis Jacq.	Bà di ngasi	*Arecaceae*	a, b	0.14	0.28	Pneumonia	Fruit/semence	Pounded	Friction	Tree	Field, home garden
						Splenomegaly	Fruit/semence	Oil, raw state, paste	Oral administration, scarification, anal route		
						Buruli ulcer	Fruit/semence	Pounded	External application		
						Amoebiasis	Fruit/semence	Raw state	Oral administration		
						Vitiligo	Fruit/semence	Oil	Oral administration, External application		

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a “Kisantu”, b “Mbanza-Ngungu urban area and, c “Mbanza-Ngungu rural area”)

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
						Breast care to keep it upright	Fruit/semence	Powder	Scarification		
						Sexual weakness or impotence	Root	Pounded	Oral administration		
						Migraine	Fruit/semence	Pounded	Friction		
						Sciatic neuralgia	Fruit/semence	Pounded	Friction		
						Tooth decay	Fruit/semence	Burnt	Fumigation		
						Headache	Fruit/semence	Pounded	Friction		
						Ache	Fruit/semence	Pounded	Friction		
						Chest or intercostal pain	Fruit/semence	Pounded	Friction		
						Amoebiasis	Fruit/semence, sève/latex	Decoction, pounded	Oral administration		
						Sciatic neuralgia	Fruit/semence	Oil	Oral administration		
						Hemorrhoids	Fruit/semence	Ointment	Anal route		
						Premature ejaculation	Fruit/semence	Raw state	Oral administration		
						Testicular disappearance	Latex/sap	Decoction	Oral administration		
						Hernia	Latex/sap	Decoction	Oral administration		
						Madness	Latex/sap	Decoction	Oral administration		
						Chronic scabies with itching and stink	Latex/sap	Raw state	Friction		
						Diabetes	Latex/sap	Decoction	Oral administration		
						Frigidity and narrowing of the vagina	Latex/sap	Decoction	Oral administration		
						Whitlow	Fruit/semence	Pounded	External application		
						Rheumatism	Fruit/semence	Powder	Massage		
						Asthma	Leaf	Decoction	Oral administration		
						Epilepsy	Latex/sap	Maceration	Oral administration		
						Yellow fever	Latex/sap	Pounded	Anal route		
						Gastritis	Leaf	Decoction	Oral administration		
Eleusine indica (L.) Gaertn.	Kimbansi, Lumvumvu	*Poaceae*	a, b	0.03	0.38	Migraine	Whole plant	Maceration, pounded	Friction	Herb	Ruderal
						Chest or intercostal pain	Leaf, whole plant	Pounded	Friction		
						Splenomegaly	Root, whole plant	Pounded	Scarification		
						Prostate	Whole plant	Decoction	Oral administration		
						Asthma	Leaf	Decoction	Oral administration		
						Gastritis	Whole plant	Decoction	Oral administration		
Emilia coccinea (Sims) G. Don	Nkofi masa	*Asteraceae*	b	0.01	0.00	Repeated abortion or frequent delivery of stillbirths	Root	Decoction	Oral administration	Herb	Ruderal
Erigeron floribundus (Kunth) Sch. Bip.	Fumu di Kyula	*Asteraceae*	a, b	0.02	0.00	Hemorrhoids	Whole plant	Pounded	Anal route	Herb	Ruderal
						Mastitis		Decoction	Oral administration		
						Microfilariate		Decoction	Oral administration		
						Migraine		Maceration	Enema		

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a “Kisantu”, b “Mbanza-Ngungu urban area and, c “Mbanza-Ngungu rural area”)

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Eriosema glomeratum (Guill. et Perr.) Hook.f.	*Wandu nseke*	*Fabaceae*	b	0.01	0.00	Hernia	Root	Powder	Oral administration	Herb	Savanna
Erythrina abyssinica Lam.	Kikumbu ki Nzambi	*Fabaceae*	a, c	0.02	0.00	Anemia	Leaf	Decoction	Oral administration	Tree	Savanna
						Madness	Bark	Pounded			
						Edema and yellowing of the hair	Leaf	Decoction			
Erythrococca atrovirens (Pax) Prain	Nzeke nzeke	*Euphorbiaceae*	a	0.01	0.00	Chest or intercostal pain	Leaf	Pounded	Friction	Shrub	Forest recruit
						Asthma		Powder	Oral administration		
Erythrophleum suaveolens (Guill. & Perr.) Brenan	Nkasa, epomi	*Fabaceae*	a	0.01	0.00	Matrix cancer	Root	Decoction	Fumigation	Tree	Forest gallery
						Rheumatism	Leaf	Powder	Scarification		
Euphorbia candelabrum Trémaux ex Kotschy	Songe	*Euphorbiaceae*	b	0.01	0.00	Epilepsy	Leaf	Trituration	Massage	Shrub	Ruderal
Ficus lutea Vahl	Bubu	*Moraceae*	a	0.01	0.00	Chronic scabies with itching and stink	Bark	Powder	External application	Tree	Forest gallery
Ficus thonningii Blume	Nsanda	*Moraceae*	a, c	0.01	0.00	Pertussis	Leaf	Decoction	Oral administration	Tree	Humid forest
						Headache	Root	Ointment	Friction		
Gaertnera paniculata Benth.	Kimbodia	*Rubiaceae*	b	0.01	0.00	Cough	Bark	Decoction	Oral administration	Shrub	Forest recruit
Garcinia huillensis Welw. ex Oliv.	Kisima	*Clusiaceae*	a, c	0.01	0.00	Diabetes	Leaf	Pounded	Oral administration	Shrub	Savanna
						Erectil malfunction	Fruit/semence	Decoction			
Garcinia kola Heckel	Ngadiadia	*Clusiaceae*	c	0.01	1.00	Epilepsy	Fruit/semence	Powder	Oral administration	Shrub	Field, home garden
Gardenia ternifolia Schumach. & Thonn. Subsp.	Kilemba nzau	*Rubiaceae*	a, b, c	0.02	0.40	Sexual weakness or impotence	Root	Pounded, decoction	Oral administration	Shrub	Savanna
						Hernia	Root	Decoction	Oral administration		
						Tooth decay	Fruit/semence	Infusion	Gargle		
						Chest or intercostal pain	Bark	Pounded	Oral administration		
Gnetum africanum Welw.	Mfumbu	*Gnetaceae*	a	0.01	0.00	Diabetes	Leaf	Powder	Oral administration	Liana	Forest gallery
Gossypium barbadense L.	Gusu	*Malvaceae*	a, b, c	0.05	0.10	Tooth decay	Leaf	Decoction	Oral administration	Shrub	Field, home garden
						Heaviness in the head, seems to split in the baby		Maceration	Oral administration		
						Breast care to keep it upright		Powder	Scarification		
						Lack of uvula causing the baby to cry continuously		Maceration	Oral administration		
						Chest or intercostal pain		Pounded	Friction		
						Laryngitis		Maceration	Oral administration		
						Chronic scabies with itching and stink		Powder	Friction, external application		
						Enuresis		Decoction	Oral administration		

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
						Skin rash		Maceration	Oral administration		
						Tuberculosis		Maceration	Oral administration		
Habenaria laurentii De Wild.	Mumpemba	*Orchidaceae*	c	0.01	0.00	Erectil malfunction	Leaf	Powder	Scarification	Herb	Forest gallery
Hallea stipulosa (DC.) J.-F. Leroy	Nlongo	*Rubiaceae*	a, b	0.03	0.20	Sexual weakness or impotence	Bark	Pounded	Oral administration	Tree	Swamp forest
						Hernia		Decoction, macération			
						Hemorrhoids		Pounded			
						Female infertility		Decoction			
						Mastitis		Decoction			
Harungana madagascariensis Lam. ex Poir.	Ntunu	*Hypericaceae*	a	0.02	0.00	Diarrhea	Bud	Raw state	Oral administration	Shrub	Forest fallow
						Jaundice	Bark	Decoction			
						Gonorrhea	Bark	Decoction			
						Hemorrhoids	Root	Maceration			
Heinsia crinita (Wennberg) G.Taylor	Nsiamuna, Kita-mata	*Rubiaceae*	a, b, c	0.05	0.11	Hemorrhoids	Root	Decoction	Oral administration	Shrub	Forest recruit
						Sexual weakness or impotence		Decoction			
						Premature ejaculation		Decoction			
						Madness		Pounded			
						Rheumatism		Decoction			
						Erectil malfunction		Decoction			
						Mastitis		Decoction			
						Hernia		Decoction			
						Gastritis		Decoction			
Helichrysum mechowianum Klatt	Ludimi lua mbua	*Asteraceae*	a	0.01	0.00	Circumcision	Leaf	Buckling	External application	Herb	Savanna
Hibiscus acetosella Welw. ex Hiern	Nsa, Ngayi-ngayi	*Malvaceae*	a, c	0.02	0.00	Female infertility	Root	Decoction	Oral administration	Herb	Field, home garden
						Epistaxis with sometimes sudden death	Leaf	Decoction			
						Mastitis	Leaf	Pounded			
Hymenocardia acida Tul.	Mpete, Kigéete	*Phyllanthaceae*	a, b	0.04	0.13	Sexual weakness or impotence	Bark, root	Pounded	Application on the organ, oral administration	Shrub	Savanna
						Tooth decay	Bark	Decoction	Gargle		
						Breastfeeding	Leaf	Decoction	Oral administration		
						Wound	Bark	Powder	Enema		
						Otitis	Fruit/semence	Trituration	Instillation		
						Diarrhea	Root	Decoction	Oral administration		
						Anemia	Bark	Decoction	Oral administration		
						Hernia	Root	Decoction	Oral administration		

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a “Kisantu”, b “Mbanza-Ngungu urban area and, c “Mbanza-Ngungu rural area”)

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Hyptis suaveolens (L.) Poit.	Nkama n'songo	*Lamiaceae*	b	0.01	0.00	Rheumatism	Leaf	Ointment	Massage	Herb	Ruderal
						Epilepsy		Raw state	Oral administration		
Impatiens irvingii Hook. f.	Nsa lua nsa	*Balsaminaceae*	b	0.01	0.00	Headache	Bark	Trituration	Instillation	Herb	Ruderal
Imperata cylindrica (L.) P.Beauv.	N'sonia	*Poaceae*	a, c	0.02	0.33	Asthma	Root	Powder	Oral administration	Herb	Savanna
						Sciatic neuralgia		Decoction			
						Sexual weakness or impotence		Infusion			
Indigofera capitata Kotschy	Nkeka za ngo	*Fabaceae*	a	0.01	0.00	Diabetes	Whole plant	Powder	Oral administration	Herb	Savanna
Jatropha curcas L.	Mpuluka *kongo*	*Euphorbiaceae*	a, b, c	0.03	0.20	Gastritis	Latex/sap, leaf	Maceration, decoction	Oral administration	Tree	Field, home garden
						Hemorrhoids	Leaf	Decoction	Oral administration		
						Diarrhea	Fruit/semence	Raw state	Oral administration		
						Madness	Leaf	Pounded	Oral administration		
						Prostate	Leaf	Maceration	Oral administration		
Kalaharia uncinata (Schinz) Moldenke	Nkongi Nkongi	*Lamiaceae*	a, b, c	0.02	0.25	Laryngitis	Root	Decoction	Oral administration	Tree	Savanna
						Nephritis		Pounded			
						Testicular disappearance		Decoction			
						Hernia		Decoction			
Landolphia camptoloba (K.Schum.) Pichon	Mbungu mbungu	*Apocynaceae*	a	0.01	0.00	Asthma	Leaf	Powder	Oral administration	Liana	Savanna
Landolphia owariensis P.Beauv.	Goki di kuku	*Apocynaceae*	c	0.01	0.00	Hemorrhoids	Fruit/semence	Infusion	Oral administration	Liana	Savanna
Lannea antiscorbutica (Hiern) Engl.	Nkumbi	*Anacardiaceae*	a, b	0.01	0.00	Chronic scabies with itching and stink	Leaf	Powder	Friction	Tree	Savanna
						Tooth decay	Bark	Decoction	Fumigation		
Lantana camara L.	Nsudi nsudi	*Verbenaceae*	a, c	0.01	0.50	Cough	Leaf	Pounded, decoction	Oral administration	Shrub	Ruderal
						Hemorrhoids	Leaf, fruit	Pounded	Anal route		
Lasimorpha senegalensis Schott	Kilodia	*Araceae*	b	0.01	0.00	Malnutrition and kwashiorkor	Leaf	Decoction	Oral administration	Herb	Swamp forest
Lippia multiflora Moldenke	Bulukutu	*Verbenaceae*	a, c	0.01	0.50	Epilepsy	Leaf	Powder	Oral administration	Shrub	Field, home garden
						Diabetes		Decoction			
Luffa cylindrica (L.) M.Roem.	Tsanu	*Cucurbitaceae*	b	0.01	0.00	Gonorrhea	Leaf	Maceration	Oral administration	Liana	Ruderal
Lygodium microphyllum (Cav.) R.Br.	Kizola nkata	*Lygodiaceae*	b	0.01	0.00	Amoebiasis	Leaf	Decoction	Oral administration	Liana	Humid forest
Macaranga schweinfurthii Pax	Mfumfu	*Euphorbiaceae*	b	0.01	0.00	Healing	Latex/sap	Raw state	External application	Tree	Humid forest
Macaranga spinosa Müll.Arg.	Sasa	*Euphorbiaceae*	b	0.01	0.00	Hemorrhoids	Root	Powder	Anal route	Tree	Humid forest
Undetermined	Malungula	-	b	0.01	0.00	Anemia	Leaf	Decoction	Oral administration	Herb	Savanna

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Mangifera indica L.	Manga	*Anacardiaceae*	a, b, c	0.02	0.75	Hemorrhoids	Bark, Root	Infusion, decoction, pounded, ointment, maceration	Oral administration	Tree	Field, home garden
						Gonorrhea	Bark	Decoction	Oral administration		
						Hernia	Bark	Maceration	Oral administration		
Manihot esculenta Crantz	Dioko	*Euphorbiaceae*	a, c	0.05	0.00	Laryngitis	Leaf	Decoction	Oral administration	Shrub	Field, home garden
						Migraine	Stem	Powder	Friction		
						Sexual weakness or impotence	Tuber	Pounded	Oral administration		
						Headache	Stem	Powder	Friction		
						Heaviness in the head, seems to split in the baby	Leaf	Maceration	Oral administration		
						Vitiligo	Stem	Powder	Oral administration, external application		
						Repeated abortion or frequent delivery of stillbirths	Leaf	Maceration	Enema		
						Amoebiasis	Tuber	Pounded	Oral administration		
						Hernia	Tuber	Raw state	Oral administration		
						Conjunctivitis and cataract	Tuber	Pounded	Instillation		
Manotes expansa Sol. ex Planch.	Dila dila	*Connaraceae*	b	0.01	0.00	Anemia	Leaf	Decoction	Oral administration	Liana	Forest recruit
Maprounea africana Müll.Arg.	Kisiedi-siedi	*Euphorbiaceae*	a, b	0.02	0.00	Female infertility	Bark	Decoction	Oral administration	Shrub	Savanna
						Tooth decay	Bark	Decoction	Gargle		
						Splenomegaly	Root	Raw state	Oral administration		
Melinis minutiflora P. Beauv.	Maleka mbua	*Poaceae*	a	0.01	0.00	Hernia	Leaf	Decoction	Oral administration	Herb	Savanna
						Sciatic neuralgia		Pounded	Friction		
Milicia excelsa (Welw.) C.C. Berg	Nkamba, Kambala	*Moraceae*	a, b, c	0.02	0.00	Female infertility	Bark	Decoction	Oral administration	Tree	Forest gallery
						Rheumatism	Bark	Decoction	Friction		
						Hernia	Bark	Maceration	Oral administration		
						Mastitis	Leaf	Decoction	Oral administration		
Millettia laurentii De Wild.	Kiboto	*Fabaceae*	a	0.01	0.00	Diabetes	Bark	Decoction	Oral administration	Tree	Forest recruit
Millettia eetveldeana (Micheli) Hauman	Mbuenge	*Fabaceae*	a, b, c	0.02	0.00	Tooth decay	Root	Pounded	Application on the organ	Tree	Forest recruit
						Laryngitis		Decoction	Oral administration		
						Hemorrhoids		Maceration	Oral administration		
						Otitis		Pounded	Instillation		
Millettia versicolor Welw. ex Baker	Mbota	*Fabaceae*	a, b	0.02	0.00	Repeated abortion or frequent delivery of stillbirths	Leaf	Maceration	Enema	Tree	Forest recruit

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a “Kisantu”, b “Mbanza-Ngungu urban area and, c “Mbanza-Ngungu rural area”)

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
						Hemorrhoids		Decoction	Oral administration		
						Mycosis		Maceration	External application		
						Epilepsy		Raw state	Oral administration		
Mimosa pudica L.	Kifua ngambu, Kanga nzô	*Fabaceae*	a, c	0.01	0.00	Hemorrhoids	Whole plant	Powder	Oral administration	Herb	Ruderal
						Lack of voice in children	Leaf	Infusion			
Mitracarpus hirtus (L.) DC.	Banda nzazi	*Rubiaceae*	b, c	0.02	0.00	Mycosis	Leaf	Maceration	External application	Herb	Ruderal
						Head lice		Decoction	External application		
						Zoster		Powder	External application		
						Epilepsy		Trituration	Instillation		
Momordica charantia L.	Lumbusu	*Cucurbitaceae*	a, b, c	0.05	0.18	Mastitis	Leaf, whole plant	Decoction, pounded	Oral administration	Liana	Ruderal
						Microfilariate	Leaf, whole plant	Decoction, maceration	Oral administration		
						Sciatic neuralgia	Leaf	Decoction	Oral administration		
						Chronic scabies with itching and stink	Leaf	Powder	External application		
						Headache	Leaf	Powder	Friction		
						Measles	Whole plant	Maceration	Enema		
						Hemorrhoids	Whole plant	Maceration	Anal route		
						Skin rash	Whole plant	Maceration	Oral administration		
						Tuberculosis	Whole plant	Maceration	Oral administration		
						Prolonged crying of the baby due to intestinal parasitosis	Leaf	Maceration	Enema		
Mondia whitei (Hook.f.) Skeels	Kimbiolongo	*Apocynaceae*	a, b, c	0.10	0.25	Ascites	Root	Decoction	Oral administration	Liana	Forest gallery
						Cough	Whole plant	Decoction			
						Elephantiasis and yellowing of the hair	Root	Decoction			
						Hemorrhoids	Root	Decoction			
						Microfilariate	Root	Decoction			
						Itchy skin rash	Root, whole plant	Maceration, pounded			
						Enuresis	Root	Decoction			
						Epistaxis with sometimes sudden death	Root	Decoction			
						Hookworm	Whole plant	Decoction			
						Erectil malfunction	Root	Decoction			
						Gastritis	Root	Decoction, maceration			
						Rheumatism	Root	Decoction			
						Nephritis	Root	Pounded			
						Anemia	Whole plant	Decoction			
						Gonorrhea	Whole plant	Decoction			
						Testicular disappearance	Whole plant	Decoction			

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
						Interruption of the menstruation without being pregnant	Whole plant	Pounded			
						Sexual weakness or impotence	Root	Infusion, decoction, pounded			
						Hernia	Root	Decoction			
Monodora angolensis Welw.	Mpeya, mpeve	*Annonaceae*	a, c	0.03	0.44	Hernia	Fruit/semence	Powder	Oral administration	Tree	Humid forest
						Abdominal colic	Fruit/semence	Pounded	Friction		
						Whitlow	Fruit/semence	Pounded	External application		
						Hemorrhoids	Fruit/semence	Decoction, maceration, pounded	Oral administration, anal route		
						Erectil malfunction	Fruit/semence	Decoction	Oral administration		
						Dermatosis	Fruit/semence	Powder	Oral administration		
Morinda lucida Benth.	N'siki	*Rubiaceae*	a, b, c	0.05	0.00	Intestinal parasitosis	Leaf	Decoction	Oral administration	Tree	Forest recruit
						Tooth decay	Leaf, Root		Fumigation		
						Hookworm	Leaf		Oral administration		
						Microfilariate	Leaf		Oral administration		
						Epilepsy	Leaf		Oral administration		
						Hernia	Root		Oral administration		
						Mastitis	Leaf		Oral administration		
						Measles	Leaf		Oral administration		
						Hemorrhoids	Root		Oral administration		
Morinda morindoides (Baker) Milne-Redh.	*Kongo* bololo	*Rubiaceae*	a, b, c	0.04	0.00	Intestinal parasitosis	Leaf	Decoction	Oral administration	Liana	Forest gallery
						Abdominal colic	Fruit/semence	Decoction	Oral administration		
						Smallpox	Leaf	Decoction	Enema		
						Gonorrhea	Leaf	Pounded	Oral administration		
						Diabetes	Leaf	Decoction	Oral administration		
						Joint pain	Leaf	Decoction	Oral administration		
						Hemorrhoids	Leaf	Decoction	Anal route		
						Malaria	Leaf	Decoction	Oral administration		
Moringa oleifera Lam.	Muringa	*Moringaceae*	a	0.01	0.00	Conjunctivitis and cataract	Flower	Trituration	Instillation	Tree	Field, home garden
						Diabetes	Leaf	Powder	Oral administration		
(Undetermined)	Mpeya mpeya		a	0.01	0.00	Sexual weakness or impotence	Root	Pounded	Application on the organ	Shrub	Savanna
Mucuna pruriens (L.) DC.	Mankundia	*Fabaceae*	a, c	0.02	0.33	Epilepsy	Leaf	Powder	Oral administration	Liana	Forest fallow
						Asthma	Leaf	Powder	Oral administration		
						Tuberculosis	Leaf	Maceration	Oral administration		
Musa × *paradisiaca* L.	Dinkondo di matiba	*Musaceae*	a, c	0.02	0.33	Rheumatism	Bark, Fruit/semence	Powder	Scarification	Shrub	Field, home garden
						Female infertility	Root	Decoction	Oral administration		
						Hemorrhoids	Fruit/semence	Pounded	Oral administration		

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Musanga cecropioides R.Br. ex Tedlie	N'senga	*Urticaceae*	a, c	0.01	1.00	Laryngitis	Bark	Decoction	Oral administration	Tree	Forest recruit
Myrianthus arboreus P. Beauv.	Mantusu, Mbuba	*Urticaceae*	c	0.01	0.00	Tuberculosis	Leaf	Maceration	Oral administration	Tree	Forest recruit
Nauclea latifolia Sm.	Kilolo (Kienga) ki nseke	*Rubiaceae*	a, b	0.03	0.17	Hernia	Root	Decoction	Oral administration	Shrub	Savanna
						Prostate					
						Back pain					
						Female infertility					
						Mastitis					
						Sexual weakness or impotence					
Nauclea pobeguinii (Pobég.) Merr.	Kilolo (Kienga) ki masa	*Rubiaceae*	a, b, c	0.03	0.29	Elephantiasis and yellowing of the hair	Root	Decoction	Oral administration	Tree	Swamp forest
						Microfilariate		Decoction			
						Laryngitis		Decoction			
						Nephritis		Pounded			
						Testicular disappearance		Decoction			
						Hernia		Decoction			
Newbouldia laevis (P.Beauv.) Seem. ex Bureau	Mumpesi mpesi (di gâta)	*Bignoniaceae*	a, c	0.03	0.33	Elephantiasis and yellowing of the hair	Root	Decoction	Oral administration	Shrub	Ruderal
						Hemorrhoids	Bark, root	Decoction, pounded	Oral administration		
						Sexual weakness or impotence	Bark, root	Decoction, pounded	Oral administration		
						Tuberculosis	Bark	Decoction	Oral administration		
						Whitlow	Leaf	Pounded	External application		
Nicotiana tabacum L.	Fumu	*Solananceae*	a, c	0.01	0.50	Hemorrhoids	Leaf	Infusion, maceration	Oral administration	Shrub	Field, home garden
						Tooth decay		Paste	Application on the organ		
Undetermined	Nkelo		a	0.01	0.00	Prostate	Leaf	Maceration	Oral administration	Herb	Savanna
Nymphaea lotus L.	Longa longa	*Nymphaeaceae*	a, b, c	0.04	0.13	Chronic scabies with itching and stink	Whole plant	Powder	External application	Herb	Swamp
						Acute nervousness	Whole plant	Pounded	Oral administration		
						Itchy skin rash	Whole plant	Maceration, pounded	Oral administration		
						Epilepsy	Whole plant	Maceration	Instillation		
						Alcoholism and smoking	Whole plant	Powder	Oral administration		
						Migraine	Leaf	Maceration	Enema		
						Edema	Leaf	Maceration	Oral administration		
						Edema and yellowing of the hair	Leaf	Decoction	Oral administration		
Ochna afzelii R. Br. ex Oliv.	Kidiimbi, Ngonti	*Ochnaceae*	a	0.01	0.00	Anemia	Bark	Decoction	Oral administration	Shrub	Savanna

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a “Kisantu”, b “Mbanza-Ngungu urban area and, c “Mbanza-Ngungu rural area”)

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Ocimum basilicum L.	Mazulu	*Lamiaceae*	a, b, c	0.04	0.00	Sudden dizziness with headache and blurred vision (Zieta)	Leaf	Pounded	Oral administration	Herb	Field, home garden
						Amoebiasis		Pounded	Anal route		
						Migraine		Trituration	Friction		
						Hemorrhoids		Decoction	Anal route		
						Hookworm		Decoction	Oral administration		
						Gastritis		Decoction, maceration	Oral administration		
						Malnutrition and kwashiorkor		Decoction	Oral administration		
Ocimum gratissimum L.	Dinsusu-nsusu di neni	*Lamiaceae*	a, b, c	0.08	0.26	Headache	Leaf	Crushed, trituration, pounded	Friction, instillation	Herb	Field, home garden
						Cold	Leaf	Maceration	Oral administration		
						Tooth decay	Leaf	Decoction	Oral administration		
						Asthma	Leaf	Pounded	Oral administration		
						Cough	Whole plant	Pounded	Oral administration		
						Pneumonia	Leaf	Pounded	Friction		
						Sciatic neuralgia	Leaf	Pounded	Friction		
						Slight fracture	Leaf	Trituration	External application		
						Sciatic neuralgia	Leaf	Decoction	Oral administration		
						Hemorrhoids	Leaf	Decoction	Anal route		
						Migraine	Leaf	Trituration	Instillation		
						Mastitis	Leaf	Crushed	Friction		
						Diabetes	Leaf	Decoction	Oral administration		
						Back pain	Leaf	Pounded	Anal route		
						Rheumatism	Leaf	Décoction, ointment	Friction, massage		
						Otitis	Leaf	Trituration	Instillation		
Ocimum minimum L.	Dinsusu di fioti	*Lamiaceae*	a	0.01	0.50	Migraine	Leaf	Pounded	Friction	Herb	Field, home garden
						Cough		Crushed			
Oncoba spinosa Forssk.	Nsansi	*Flacourtiaceae*	a	0.01	0.00	Syphilis	Leaf	Maceration	Oral administration	Shrub	Forest galerie
Ottelia ulvifolia (Planch.) Walp.	Làadi	*Hydrocharita-ceae*	a, b, c	0.02	0.00	Rheumatism	Leaf	Decoction	Oral administration	Herb	Swamp
						Acute nervousness	Leaf, root	Pounded	Oral administration		
						Headache	Leaf	Powder	Friction		
						Epilepsy	Leaf	Maceration	Instillation		
Parinari capensis Harv.	Nsudi funi	*Chrysobalana-ceae*	b	0.01	0.00	Diabetes	Leaf	Decoction	Oral administration	Herb	Savanna
						Malaria					
Paullinia pinnata L.	Ngudi nkayi	*Sapindaceae*	b	0.01	0.00	Pneumonia	Leaf	Trituration	Friction	Liana	Forest recruit
Pentaclethra eetveldeana De Wild. & T. Durand	Kiseka	*Fabaceae*	a	0.01	0.00	Microfilariate	Leaf	Pounded	External application	Tree	Forest recruit

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Pentaclethra macrophylla Benth.	N'gansi	*Fabaceae*	a	0.01	0.00	Hernia	Bark	Decoction	Oral administration	Tree	Forest recruit
Pentadiplandra brazzeana Baill.	Nkengi kiasa	*Pentadiplandraceae*	a, b, c	0.06	0.23	Hernia	Whole plant, Root	Decoction, maceration, powder	Oral administration	Shrub	Forest gallery
						Sexual weakness or impotence	Root	Pounded	Oral administration		
						Hemorrhoids	Root	Maceration	Oral administration		
						Laryngitis	Root	Decoction	Oral administration		
						Rheumatism	Leaf	Decoction	Friction		
						Parkinson	Leaf	Decoction	Oral administration		
						Sciatic neuralgia	Root	Decoction	Friction		
						Gonorrhea	Root	Decoction	Oral administration		
						Gastritis	Leaf	Decoction	Oral administration		
						Dermatosis	Root	Powder	Oral administration		
						Mastitis	Root	Pounded	Friction		
Persea americana Mill..	Divoka	*Lauraceae*	a, b	0.01	0.00	Tooth decay	Leaf	Decoction	Fumigation	Tree	Field, home garden
						Tension	Fruit/semence		Oral administration		
Phaseolus vulgaris L.	Madesu	*Fabaceae*	c	0.01	0.00	Diabetes	Fruit/semence	Infusion	Oral administration	Liana	Field, home garden
Phyllanthus niruri L.	Ntéeta nteta	*Phyllanthaceae*	a, b	0.01	0.00	Migraine	Leaf	Pounded	Friction	Shrub	Ruderal
						Amoebiasis		Decoction	Oral administration		
Physalis angulata L.	Bobo	*Solananceae*	b	0.01	0.00	Gastritis	Leaf	Pounded	External application	Herb	Ruderal
Piper nigrum L.	Kupidi	*Piperaceae*	a, b, c	0.03	0.43	Hernia	Fruit/semence	Powder	Oral administration	Liana	Humid forest
						Hemorrhoids	Fruit/semence	Decoction, maceration, pounded	Oral administration		
						Hookworm	Fruit/semence	Powder	Oral administration		
						Back pain	Leaf	Pounded	Friction		
						Dermatosis	Fruit/semence	Powder	Oral administration		
Piper umbellatum L.	Lumba-lumba	*Piperaceae*	a, b	0.02	0.00	Lack of uvula causing the baby to cry continuously	Leaf	Maceration	Oral administration	Herb	Forest gallery
						Laryngitis	Leaf	Maceration			
						Alcoholism and smoking	Leaf	Powder			
Plumeria alba L.	Frangipanier	*Apocynaceae*	a	0.01	0.00	Hiccup	Latex/sap	Raw state	Instillation	Shrub	Field, home garden
Polygala acicularis Oliv.	Lusambi sambi	*Polygalaceae*	a, b, c	0.02	0.00	Diabetes	Bark	Decoction	Oral administration	Herb	Savanna
						Hemorrhoids	Leaf	Decoction	Anal route		
						Madness	Whole plant	Pounded	Oral administration		
Portulaca oleracea L.	Madia ngulu	*Portulaceae*	b	0.01	0.00	Nephritis	Whole plant	Decoction	Oral administration	Herb	Ruderal
	N'yibu	*Anacardiaceae*	a, c	0.02	0.00	Enuresis	Bark	Decoction	Oral administration	Tree	

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Pseudospondias microcarpa (A.Rich.) Engl.						Sexual weakness or impotence Female infertility Hookworm		Pounded Decoction Powder			Forest gallery
Psidium guineense Sw.	Mfulunta	*Myrtaceae*	a	0.01	0.00	Abdominal colic Amoebiasis	Leaf	Pounded	Friction Oral administration	Shrub	Savanna
Psidium guajava L.	Dipela	*Myrtaceae*	a	0.01	0.00	Hemorrhoids	Leaf	Maceration	Oral administration	Shrub	Field, home garden
Psophocarpus scandens (Endl.) Verdc.	Kikalakasa	*Fabaceae*	b	0.01	0.00	Malnutrition and kwashiorkor	Leaf	Decoction	Oral administration	Liana	Forest fallow
Psorospermum febrifugum Spach		*Plantaginaceae*	b	0.01	0.00	Yellow fever	Bark	Decoction	Oral administration	Shrub	Savanna
Pteridium aquilinum (L.) Kuhn	Misili	*Pteridaceae*	b	0.01	0.00	Gastritis	Root	Maceration	Oral administration	Herb	Savanna
Pterocarpus angolensis DC.	Sokosoko	*Fabaceae*	a, c	0.01	0.00	Diabetes Mastitis	Bark	Decoction Pounded	Oral administration	Shrub	Savanna
Quassia africana (Baill.) Baill.	Munkadi nkadi	*Simarubaceae*	b	0.01	0.00	Diabetes Malaria	Root Leaf	Maceration Decoction	Oral administration	Shrub	Forest gallery
Raphia textilis Welw.	Mawusu	*Arecaceae*	c	0.01	0.00	Zoster	Flower	Powder	External application	Tree	Humid forest
Rauvolfia vomitoria Wennberg	Kilungu	*Apocynaceae*	a, c	0.02	0.00	Hernia Mastitis Microfilariate	Root	Decoction	Oral administration	Shrub	Forest fallow
Renealmia africana Benth.	Susa	*Zingiberaceae*	c	0.01	0.00	Epistaxis with sometimes sudden death	Leaf	Decoction	Oral administration	Herb	Humid forest
Rhipsalis baccifera (J.S. Muell.) Stearn	Kisadi	*Cactaceae*	b	0.01	0.00	Nephritis Gastritis	Thorn	Pounded Decoction	Oral administration	Shrub	Ruderal
Saccharum officinarum L.	Mukuku	*Poaceae*	a, b	0.02	0.00	Hemorrhoids Female infertility Tension Gastritis	Stem Stem Leaf Stem	Decoction Wine Decoction Wine	Oral administration	Herb	Field, home garden
Salacia pynaertii De Wild.	Mbondi	*Celastraceae*	b	0.01	0.00	Diabetes	Leaf	Raw state	Oral administration	Liana	Forest recruit
Sansevieria bracteata Baker	Kula nioka	*Asparagaceae*	a, c	0.01	0.00	Migraine Stomach aches	Leaf Root	Pounded Infusion	Friction Oral administration	Herb	Savanna
Schwenckia americana L.	Tumpu di nkombo	*Solananceae*	a, b, c	0.04	0.00	Rheumatism Sciatic neuralgia Headache Testicular disappearance Gastritis Epilepsy Hernia	Leaf Leaf Leaf Root Leaf Leaf Root	Decoction Decoction Crushed Decoction Decoction Raw state Decoction	Oral administration	Herb	Ruderal

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a “Kisantu”, b “Mbanza-Ngungu urban area and, c “Mbanza-Ngungu rural area”)

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Scleria achtenii De Wild.	Wedi wedi, welekese	*Cyperaceae*	a	0.01	0.00	Hernia	Root	Decoction	Oral administration	Herb	Swamp
Sclerocroton cornutus (Pax) Kruijt & Roebers	Kititi	*Euphorbiaceae*	a, b	0.02	0.00	Bronchitis	Leaf	Pounded	Oral administration	Shrub	Savanna
						Female infertility	Bark	Decoction			
						Madness	Leaf	Decoction			
Sclerosperma mannii H. Wendl.	Mabondo	*Araceae*	b	0.01	0.00	Migraine	Fruit/semence	Pounded	Enema	Tree	Humid forest
Scoparia dulcis L.	Kiese kiese	*Plantaginaceae*	a	0.01	0.00	Premature ejaculation	Root	Raw state	Oral administration	Herb	Ruderal
						Polio	Leaf	Powder	Scarification		
Scorodophloeus zenkeri Harms	Kiwaya	*Fabaceae*	b, c	0.01	0.00	Hemorrhoids	Bark	Maceration	Anal route	Tree	Forest gallery
						Hookworm	Root	Powder	Oral administration		
Securidaca longepedunculata Fresen	Nkama n'sunda	*Polygalaceae*	a, b, c	0.04	0.30	Hernia	Root	Powder	Oral administration	Shrub	Savanna
						Hemorrhoids	Root	Decoction	Oral administration		
						Ovarian or tubal inflammation	Leaf	Decoction	Oral administration		
						Rheumatism	Leaf, root	Decoction, ointment	Friction, massage		
						Parkinson	Root	Decoction	Oral administration		
						Polio	Leaf, root	Decoction	Oral administration		
						Dermatosis	Root	Powder	Oral administration		
						Testicular disappearance	Root	Pounded	Oral administration		
Senna alata (L.) Roxb.	Bwalu,	*Fabaceae*	a	0.01	0.00	Mycosis	Leaf	Trituration	External application	Shrub	Ruderal
Senna occidentalis L	Kanga nsundi	*Fabaceae*	b	0.01	0.00	Dysmenorrhea	Root	Maceration	Oral administration	Shrub	Ruderal
Sesamum indicum L.	Wangila	*Pedaliaceae*	a, b	0.01	0.00	Paralysis	Fruit/semence	Oil	Scarification	Herb	Field, home garden
						Madness	Leaf	Decoction	Oral administration		
Sesamum radiatum Schumach. & Thonn.	Wangila matebo	*Pedaliaceae*	a	0.01	0.00	Gastritis	Leaf	Maceration	Oral administration	Herb	Ruderal
Sida rhombifolia L.	Lumbumvu	*Malvaceae*	a, c	0.02	0.00	Enuresis	Root	Decoction	Oral administration	Herb	Ruderal
						Childbirth pain	Leaf	Maceration			
						Amoebiasis	Leaf	Raw state			
Smilax anceps Willd.	Kikalala	*Smilacaceae*	a, c	0.01	0.00	Bronchitis	Leaf	Pounded	Oral administration	Liana	Ruderal
						Microfilariate		Decoction			
Solanum aethiopicum L.	Kinsumba	*Solananceae*	a, b	0.01	0.00	Belly bloating ventral	Leaf	Pounded	Friction, oral administration	Herb	Field, home garden
						Gastritis		Maceration	Oral administration		
Solanum lycopersicum L.	Lumantu	*Solananceae*	a, c	0.02	0.33	Migraine	Leaf	Pounded	Friction	Herb	Field, home garden
						Hemorrhoids	Leaf	Pounded, decoction	Oral administration, anal route		
						Headache	Leaf	Decoction	Inhalation		
Solanum melongena L.	Mbolongo	*Solananceae*	b	0.01	0.00	Bronchitis	Leaf	Trituration	Oral administration	Herb	Field, home garden

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a “Kisantu”, b “Mbanza-Ngungu urban area and, c “Mbanza-Ngungu rural area”)

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Solanum macrocarpon L.	Nkeka	*Solananceae*	a	0.01	0.00	Belly bloating ventral	Leaf	Pounded	Friction, oral administration	Shrub	Field, home garden
Solanum sp	Binsukula	*Solananceae*	a	0.01	0.00	Bronchitis	Leaf	Pounded	Oral administration	Shrub	Field, home garden
Spondias cytherea Sonn.	Manga nsendi	*Anacardiaceae*	a	0.01	0.00	Tooth decay	Bark	Decoction	Gargle	Tree	Field, home garden
Spondias mombin L.	Mungyengi	*Anacardiaceae*	b	0.01	0.00	Mastitis	Leaf	Raw state	Oral administration	Tree	Field, home garden
Steganotaenia araliacea Hochst.	Kula mvumbi, mvumbi mvumbi	*Apiaceae*	a, b	0.01	1.00	Hernia	Root	Decoction	Oral administration	Shrub	Savanna
Strychnos cocculoides Baker	Kalakonki	*Loganiaceae*	a, c	0.01	0.00	Epilepsy Hernia	Leaf, root Root	Powder Decoction	Oral administration	Shrub	Savanna
Strychnos pungens Soler.	Mabumi	*Loganiaceae*	b	0.01	1.00	Elephantiasis and yellowing of the hair	Fruit/semence, leaf	Décoction, pounded	Oral administration, Scarification	Shrub	Savanna
Synedrella nodiflora Gaertn.	Madia ma nlumba	*Asteraceae*	b	0.01	0.00	Gastritis	Leaf	Decoction	Oral administration	Herb	Ruderal
Syzygium guineense (Willd.) DC . Subsp . *Macrocarpum* (Engl .) F.White	Nkizu	*Myrtaceae*	b	0.01	0.00	Urinary and vaginal infection Anemia	Bark	Decoction	Oral administration	Shrub	Savanna
Tapinanthus poggei (Engl.) Danser	Kinkunda nkunda	*Loranthaceae*	a, b	0.01	0.00	Joint pain Alcoholism and smoking	Leaf	Decoction Powder	Oral administration	Shrub	Forest recruit
Tephrosia vogelii Hook. F.	Bwalu mbaka	*Fabaceae*	b	0.01	0.00	Mycosis Itchy skin rash	Leaf	Maceration Pounded	External application	Shrub	Ruderal
Tetracera alnifolia Willd.	Nzyanzi	*Dileniaceae*	a	0.01	0.00	Hernia	Leaf	Decoction	Oral administration	Liana	Swamp forest
Tetradenia riparia (Hochst.) Codd	Mutuzo	*Lamiaceae*	a	0.01	0.00	Influenza	Leaf	Trituration	Instillation	Shrub	Ruderal
Tetrorchidium didymostemon (Baill.) Pax & K. Hoffm.	Nsusa	*Euphorbiaceae*	a, c	0.02	0.00	Back pain Hookworm Edema and yellowing of the hair	Root Leaf Leaf	Decoction Powder Decoction	Oral administration	Tree	Forest gallery
Tithonia diversifolia (Hemsl.) A. Gray	Nkadi nkadi	*Asteraceae*	a	0.01	0.00	Malaria	Leaf	Decoction	Oral administration	Shrub	Ruderal
Trema orientalis (L.) Blume	Mundia nuni	*Cannabaeae*	b	0.01	0.00	Gastritis	Leaf	Decoction	Oral administration	Shrub	Forest recruit
Trilepisium madagscariense DC.	Nsekenia	*Moraceae*	b	0.01	0.00	Anemia	Bark	Decoction	Oral administration	Tree	Forest gallery
Urena lobata L.	Mpungala	*Malvaceae*	a	0.01	0.00	Diabetes	Bark	Decoction	Oral administration	Herb	Ruderal

Appendix 3. Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu territories (in which a "Kisantu", b "Mbanza-Ngungu urban area and, c "Mbanza-Ngungu rural area")

Species	Local name	Botanic family	Recording area	UV	IAR	Diseases	Organ	Method of preparation	Method of administration	Morpho-logy	Harvested area
Vernonia amygdalina Delile	Mundudi-ndudi	*Asteraceae*	a, b	0.01	0.00	Hookworm	Leaf	Decoction	Oral administration	Shrub	Savanna
						Poisoning		Pounded			
Vigna subterranea (L.) Verdc.	Nguba zi nsamba	*Fabaceae*	b	0.01	0.00	Gastritis	Fruit/semence	Maceration	Oral administration	Herb	Field, home garden
Vigna unguiculata (L.) Walp.	Madesu ma Mbuengi	*Fabaceae*	a	0.02	0.00	Chest or intercostal pain	Fruit/semence	Pounded	Scarification	Herb	Field, home garden
						Splenomegaly	Fruit/semence	Pounded	Scarification		
						Laryngitis	Fruit/semence	Decoction	Oral administration		
						Vitiligo	Leaf	Powder	Oral administration, external application		
Vitex doniana Sweet	Fiolongo	*Lamiaceae*	a	0.01	0.00	Tension	Bark	Pounded	Oral administration	Tree	Swamp forest
Vitex ferruginea Schumach. & Thonn.	Ozu	*Lamiaceae*	a	0.01	0.00	Wound	Bark	Powder	Enema	Shrub	Savanna
						Hernia		Infusion	Anal route		
Vitex madiensis Oliv.	Kifilu	*Lamiaceae*	a, b, c	0.02	0.25	Hemorrhoids	Leaf, root	Maceration, decoction	Oral administration, anal route	Shrub	Savanna
						Hookworm	Leaf	Decoction	Oral administration		
						Tension	Leaf	Decoction	Oral administration		
						Cervical lymphadenopathy	Root	Infusion	Oral administration		
Xylopia aethiopica (Dunal) A. Rich.	Nkuya nkuya	*Annonaceae*	a, b, c	0.03	0.17	Hernia	Bark, leaf	Maceration, powder	Oral administration	Tree	Swamp forest
						Ascites	Bark	Decoction			
						Hemorrhoids	Bark	Decoction			
						Sexual weakness or impotence	Fruit/semence	Decoction			
						Diabetes	Bark	Decoction			
						Polio	Bark	Decoction			
Zea mays L.	Masangu	*Poaceae*	a	0.03	0.00	Headache	Ears	Powder	Friction	Herb	Field, home garden
						Prostate	Beard, leaf	Decoction, maceration	Oral administration		
						Hemorrhoids	Leaf	Decoction	Oral administration		
						Laryngitis	Fruit/semence	Decoction	Oral administration		
Zingiber officinale Roscoe.	Tangawisi	*Zingiberaceae*	a, b, c	0.04	0.53	Hemorrhoids	Rhizome	Decoction, infusion, maceration, pounded	Oral administration, anal route	Herb	Field, home garden
						Cough	Rhizome	Decoction	Oral administration		
						Sexual weakness or impotence	Rhizome	Decoction	Oral administration		
						Premature ejaculation	Rhizome	Infusion, pounded	Oral administration		
						Gonorrhea	Rhizome	Decoction, maceration	Oral administration		
						Intestinal parasitosis	Rhizome	Decoction	Oral administration		
						Hookworm	Rhizome	Decoction	Oral administration		
						Rheumatism	Rhizome	Ointment	Massage		

Appendix 4. Distribution level, presence, frequency and autoecological characterization of inventoried species
(species that are classified as medicinal are written in bold)

Species	Local name	Family	Genus	Specimen number and collection site	Presence of species by plant formation				Sp-Dist. level	Frequency (%) of species by plant formation				Autoecological characteristics of identified plant species					
					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
***Abelmoschus esculentus* (L.) Moench**	Dongo dongo	Fabaceae	*Abelmoschus*	MB01/AT1		1			1		4.2			Pan	H	Thd	Bal	Macro	Cu
Abrus canescens Welw.	Nzala kuenda)	Fabaceae	*Abrus*	MB02/JA15			1	1	2			10.2	3.3	GC	L	Phgr	Bal	Nano	MT
***Abrus precatorius* L.**	Ngenguba	Fabaceae	*Abrus*	MB03/JA18	1	1	1	1	4	7.1	8.3	28.6	3.3	Pan	L	Phgr	Bal	Nano	MT
Abutilon mauritianum (Jacq.) Medik.	Kimvumvu	Malvaceae	*Abutilon*	MB04/AT18		1			1		4.2			AT	H	Ch	Bal	Méso	RM
Acacia auriculiformis A.Cunn. ex Benth.	Akasia	Fabaceae	*Acacia*	MB05/AT9		1	1	1	3		12.5	4.1	6.7	Pal	A	MsPh	Bal	Méso	Cu
Acalypha indica L.	Nkila mfuenge	Euphorbiaceae	*Acalypha*	MB06/AT15		1			1		12.5			Pal	H	Chd	Sar	Méso	RM
Acanthospermum australe (Loefl.) Kuntze	Diata ngombe	Asteraceae	*Acanthospermum*	MB07/AT20		1			1		20.8			Cosm	H	Thd	Desm	Micro	RM
***Acanthospermum hispidum* DC.**	Madiata nzau	Asteraceae	*Acanthospermum*	MB08/AT4		1			1		41.7			Cosm	H	Thd	Desm	Micro	RM
Acanthus montanus T.Anderson	Manzala ma ngo	Acanthaceae	*Acanthus*	MB09/AT9		1			1		4.2			GC	B	NPh	Bal	Macro	MT
Acmella oleracea (L.) RKJansen		Asteraceae	*Acmella*	MB10/AT9		1			1		4.2			Pan	H	Chp	Pog	Micro	RM
***Adansonia digitata* L.**	Baobab	Malvaceae	*Adansonia*	MB11/JA6		1	1		2		4.2	2.0		Pal	A	MgPh	Bal	Méso	MT
***Adenia cissampeloides* (Planch. ex Benth.) Harms**	Tambi kia lunguenia	Passifloraceae	*Adenia*	MB12/MA5	1		1		2	28.6		24.5		GC	L	Phgr	Sar	Méso	MT
Adenia lobata Engl.	Nkenkete	Passifloraceae	*Adenia*	MB13/JA37	1		1		2	14.3		8.2		BGC	L	Phgr	Sar	Méso	MT
Adenia poggei Engl.	Mupemba	Passifloraceae	*Adenia*	MB14/JA3	1		1		2	7.1		10.2		GC	L	Phgr	Sar	Méso	MT
Adenostemma viscosum J.R. Forst. et G.Forst.		Asteraceae	*Adenostemma*	MB15/MA7	1				1	14.3				AT	H	Thd	Pog	Micro	RM
Aeschynomene indica Burm.f.		Fabaceae	*Aeschynomene*	MB16/AT11		1			1		16.7			Pan	H	Nph	Desm	Lepto	RM
Aeschynomene lateritia Harms		Fabaceae	*Aeschynomene*	MB17/AT11		1			1		12.5			GC	H	Nph	Desm	Lepto	RM
***Aframomum alboviolaceum* K. Schum.**	Kitundu bila	Zingiberaceae	*Aframomum*	MB18/S21		1	1	1	3		20.8	30.6	30.0	BGC	H	mGrh	Sar	Méso	Hy
Aframomum angustifolium K. Schum.	Nsansi fioti	Zingiberaceae	*Aframomum*	MB19/MA6	1		1		2	14.3		2.0		BGC	H	mGrh	Sar	Méso	Ha
***Aframomum melegueta* (Roscoe) K. Schum.**	Mondongo	Zingiberaceae	*Aframomum*	MB20/AT8		1			1		4.2			GC	H	mGrh	Sar	Méso	Ha
Aframomum sanguineum K. Schum.	Nsansi neni. Mambombo	Zingiberaceae	*Aframomum*	MB21/MA11	1				1	42.9				BGC	H	mGrh	Sar	Méso	Ha
***Ageratum conyzoides* L.**	Mpata kasakula	Asteraceae	*Ageratum*	MB22/AT2		1			1		62.5			Pan	H	Thd	Pog	Micro	RM
***Albizia adianthifolia* W. Wight**		Fabaceae	*Albizia*	MB23/JA21			1		1			2		AT	A	MsPh	Bal	Lepto	MT
Albizia altissima Hook. f.	N'samua nzadi	Fabaceae	*Albizia*	MB24/JA7	1		1		2	21.4		6.1		CGC	A	MsPh	Bal	Lepto	Ha
Albizia chinensis (Osbeck.) Merr.	Nkasa fioti	Fabaceae	*Albizia*	MB25/S26		1	1	1	3		4.2	14.3	3.3	Pal	A	MsPh	Bal	Lepto	MT
Albizia ferruginea Benth.	Sela. Nkasa-nkasa	Fabaceae	*Albizia*	MB26/S23			1	1	2			57.1	10.0	BGC	A	MsPh	Bal	Nano	MT

Appendix 4. Distribution level, presence, frequency and autoecological characterization of inventoried species
(species that are classified as medicinal are written in bold)

Species	Local name	Family	Genus	Specimen number and collection site	Presence of species by plant formation				Sp-Dist. level	Frequency (%) of species by plant formation				Autoecological characteristics of identified plant species					
					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
Albizia gummifera (J.F. Gmel.) C. A. Sm.	Nkasa nkasa ya nzanza	Fabaceae	*Albizia*	MB27/JA3			1		1			12.2		GC	A	MsPh	Bal	Nano	MT
***Alchornea cordifolia* (Schumach.) Müll.Arg.**	Kibunsi	Euphorbiaceae	*Alchornea*	MB28/S19	1	1	1	1	4	100.0	16.7	67.3	20.0	AT	B	MsPh	Sar	Méso	Ha
Alchornea floribunda Müll.Arg.		Euphorbiaceae	*Alchornea*	MB29/JA48			1		1			8.2		GC	B	MsPh	Bal	Méso	SP
Alectra sessiliflora (Vahl) Kuntze		Orobanchaceae	*Alectra*	MB30/AT9		1			1		4.2			Pal	H	Ch	Bal	Nano	RM
Allamanda cathartica L.		Apocynaceae	*Allamanda*	MB31/AT5		1			1		8.3			Pan	L	Phgr	Sar	Méso	Cu
Allanblackia floribunda Oliv.	Nsongia	Clusiaceae	*Allanblackia*	MB32/JA49			1		1			4.1		GC	A	MsPh	Sar	Méso	Sp
***Allium cepa* L.**	Bola	Amaryllidaceae	*Allium*	MB33/AT23		1			1		4.2			Cosm	H	Gb	Bar	Micro	Cu
***Allium fistulosum* L.**	Ndembi	Amaryllidaceae	*Allium*	MB34/AT23		1			1		4.2			Cosm	H	Gb	Bar	Micro	Cu
***Aloe buettneri* A. Berger**	Bâ di nseke	Asphodelaceae	*Aloe*	MB35/S21		1		1	2		4.2		10.0	AT	H	Gb	Sar	Micro	Hy
Alpinia purpurata (Vieill.) K. Schum.		Zingiberaceae	*Alpinia*	MB36/AT14		1			1		4.2			Pan	H	mGrh	Sar	Méga	Cu
Alstonia boonei De Wild.	Lungunzila	Apocynaceae	*Alstonia*	MB37/MA4	1		1		2	28.6		4.1		GC	A	MgPh	Pog	Méso	MT
***Alstonia congensis* Engl.**	Nzanga	Apocynaceae	*Alstonia*	MB38/MA2	1				1	14.3				GC	A	MgPh	Pog	Méso	Ha
***Alternanthera sessilis* (L.) R. Br. ex DC.**		Amaranthaceae	*Alternanthera*	MB39/AT8		1			1		16.7			Pan	H	Chp	Sar	Lepto	RMP
Alvesia rosmarinifolia Welw.	Lufua lu ndombe lu nseki	Lamiaceae	*Alvesia*	MB40/S23			1	1	2			4.1	3.3	BGC	B	Nph	Bal	Nano	RMP
Alysicarpus vaginalis (L.) DC.	Lunguba nguba	Fabaceae	*Alysicarpus*	MB41/AT3		1	1		2		12.5	2.0		Pal	H	Ch	Bal	Nano	Hy
Amaranthus blitum L.	Nkuka bangulu	Amaranthaceae	*Amaranthus*	MB42/AT9		1			1		12.5			AT	H	Th	Scl	Méso	Cu
Amaranthus cruentus L.	Bowa. biteku teku	Amaranthaceae	*Amaranthus*	MB43/AT9		1			1		8.3			AT	H	Thd	Scl	Méso	Cu
***Amaranthus spinosus* L.**	Bowa di nsendi	Amaranthaceae	*Amaranthus*	MB44/AT9		1			1		4.2			Cosm	H	Thd	Scl	Méso	sp
Amaranthus viridis	Nkuka bangulu	Amaranthaceae	*Amaranthus*	MB45/AT2		1			1		12.5			Pan	H	Thd	Scl	Méso	RMP
Amaryllis belladonna L.	Bola di bankita	Amaryllidaceae	*Amaryllis*	MB46/AT13		1			1		8.3			GC	H	Gb	Sar	Micro	Ha
***Ampelocissus bombycina* Planch.**		Vitaceae	*Ampelocissus*	MB47/MA1	1		1		2	7.1		4.1		GC	L	Phgr	Sar	Méso	MT
***Amphiblemma ciliatum* Cogn.**	Nsa masa	Melastomataceae	*Amphiblemma*	MB48/MA8	1				1	14.3				BGC	H	Ch	Ptér	Méso	Ha
***Ananas comosus* (L.) Merr.**	Nanasi	Bromeliaceae	*Ananas*	MB49/JA11		1	1		2		4.2	30.6		Pan	H	Grh	Sar	Méso	Cu
***Anchomanes difformis* Engl.**	Kikua ki ba nkita	Araceae	*Anchomanes*	MB50/JA39	1		1		2	14.3		6.1		GC	H	mG	Sar	Méga	Ha
***Anchomanes giganteus* Engl.**	Dioko di kisimbi	Araceae	*Anchomanes*	MB51/MA3	1				1	21.4				GC	H	mG	Sar	Méga	MT
Andropogon africanus Franch.		Poaceae	*Andropogon*	MB52/S5		1		1	2		4.2		83.3	BGC	H	Hc	Scl	Micro	Hy
Andropogon chinensis (Nees) Merr.		Poaceae	*Andropogon*	MB53/S1		1	1	1	3		20.8	20.4	100	Pal	H	Hc	Scl	Micro	Hy
Andropogon gayanus Kunth.	Soola	Poaceae	*Andropogon*	MB54/S1			1	1	2			2.0	16.7	Pan	H	Hc	Scl	Micro	Hy
Aneilema aequinoctiale (P. Beauv.) G.Don		Commelinaceae	*Aneilema*	MB55/MA3	1				1	7.1				AT	H	Thd	Scl	Méso	MT

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
***Anisophyllea quangensis* Engl. ex Henriq.**	Mbila esobe	Anisophylleaceae	*Anisophyllea*	MB56/S26		1		1	2		12.5		3.3	GC	B	NPh	Sar	Micro	Ea
***Annona muricata* L.**	Mululu	Annonaceae	*Annona*	MB57/AT17		1			1		4.2			Pan	A	McPh	Sar	Méso	Cu
***Annona senegalensis* Pers.**	Lomboloka	Annonaceae	*Annona*	MB58/S1		1	1	1	3		4.2	6.1	93.3	BGC	B	McPh	Sar	Méso	Ea
Anthocleista liebrechtsiana De Wild. et T. Durand	Mpuku mpuku	Gentianaceae	*Anthocleista*	MB59/JA22	1		1		2	14.3		4.1		GC	A	MsPh	Scl	Macro	Ha
***Anthocleista schweinfurthii* Gilg**	Mpuku-mpuku	Gentianaceae	*Anthocleista*	MB60/JA6	1		1		2	21.4		51.0		GC	A	MsPh	Scl	Macro	MT
Anthocleista vogelii Planch.	Tompa	Gentianaceae	*Anthocleista*	MB61/JA2			1		1			18.4		AT	A	MsPh	Scl	Macro	Ha
Anthonotha gilletii (De Wild.) J. Léonard	Koya mu situ	Fabaceae	*Anthonotha*	MB62/JA33			1		1			6.1		GC	A	MsPh	Bal	Macro	MT
Antidesma membranaceum Müll. Arg.	Fuitidi	Phyllanthaceae	*Antidesma*	MB63/AT12	1	1	1		3	28.6	4.2	40.8		AT	A	MsPh	Sar	Méso	Hy
***Antidesma venosum* E.Mey. ex Tul.**	Fuitidi koko	Phyllanthaceae	*Antidesma*	MB64/S9			1	1	2			6.1	10.0	GC-Z	A	MsPh	Sar	Méso	Sp
***Antigonon leptopus* Hook. & Arn.**	Liane corail	Polygonaceae	*Antigonon*	MB65/AT21		1			1		8.3			Pan	L	Phgr	Sar	Méso	Cu
Anti-poison	Anti-poison	ND	*ND*	MB66/JA32			1		1			12.2			L	Phgr	Sar	Méso	MT
Aphelandra sinclairiana Nees		Acanthaceae	*Aphelandra*	MB67/AT9		1			1		4.2			AnT	B	Nph	Bal	Méso	Cu
***Arachis hypogaea* L.**		Fabaceae	*Arachis*	MB68/AT10		1			1		4.2			Pan	H	Thd	Sar	Nano	Cu
Aristida adscensionis L.	Nsyeense	Poaceae	*Aristida*	MB69/S4		1		1	2		8.3		23.3	Pan	H	Hc	Scl	Micro	RM
Aristolochia ringens Vahl		Aristolochiaceae	*Aristolochia*	MB70/AT3	1	1	1		3	14.3	33.3	42.9		Pan	L	Phgr	Bal	Méso	MT
***Artemisia annua* L.**		Asteraceae	*Artemisia*	MB71/AT10		1			1		4.2			Pan	H	Chd	Pog	Méso	Cu
Artocarpus altilis (Parkinson) Fosberg	Santu petelo. Momboya	Moraceae	*Artocarpus*	MB72/AT14		1			1		4.2			Pan	A	MsPh	Sar	Méga	Cu
Artocarpus heterophyllus Lam.	Jaki	Moraceae	*Artocarpus*	MB73/AT15		1			1		4.2			Pan	A	MsPh	Sar	Méga	Cu
*Asparagus flagellaris (*Kunth) Baker	Nkila mfuenge	Asparagaceae	*Asparagus*	MB74/S26		1	1	1	3		4.2	2.0	3.3	BGC	A	Ch	Sar	Lepto	MT
Aspilia africana (Pers.) C. D. Adams		Asteraceae	*Aspilia*	MB75/AT8		1			1		8.3			AT	H	Thd	Pog	Méso	SB
Aspilia kotschyi (Sch. Bip. ex Hochst.) Oliv.	Mika mi mbua	Asteraceae	*Aspilia*	MB76/AT4		1	1	1	3		33.3	2.0	3.3	AT	H	Thd	Pog	Micro	SB
Asplenium africanum Desv.		Aspleniaceae	*Asplenium*	MB77/JA6	1		1		2	21.4		10.2		GC	H	Grh	Scl	Méso	Ha
*Asystasia gangetica (*L.) T.Anderson		Acanthaceae	*Asystasia*	MB78/AT8		1		1	2		12.5		3.3	Pan	H	Ch	Bal	Méso	SB
***Averrhoa carambola* L.**	Paka paka	Oxalidaceae	*Averrhoa*	MB79/AT2		1			1		4.2			Pan	A	McPh	Sar	Micro	Cu
***Bambusa vulgaris* Schrad. ex J.C.Wendl.**	Ntutu	Poaceae	*Bambusa*	MB80/AT14	1	1	1		3	7.1	4.2	12.2		Pan	A	MsPh	Scl	Micro	MT
Barteria fistulosa Mast.	Munsumi-nsumi	Passifloraceae	*Barteria*	MB81/AT7	1	1	1		3	7.1	8.3	57.1		BGC	A	MsPh	Sar	Méso	MT
***Basella alba* L.**	Épinard	Basellaceae	*Basella*	MB82/AT7		1			1		4.2			Pan	H	Thd	Sar	Micro	Cu
Bauhinia petersiana Bolle		Fabaceae	*Bauhinia*	MB83/JA4		1	1		2		4.2	2.0		GC-Z	A	MsPh	Bal	Méso	Cu
Bauhinia tomentosa L.		Fabaceae	*Bauhinia*	MB84/JA5			1		1			2.0		Pal	A	MsPh	Bal	Méso	Cu

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
Bellucia pentamera Naudin	Ekoti ya monseigneur	Melastomataceae	*Bellucia*	MB85/JA37			1		1			2.0		AnT	A	MsPh	Sar	Macro	MT
Berlinia grandiflora (Vahl) Hutch. & Dalziel		Fabaceae	*Berlinia*	MB86/JA19			1		1			10.2		GC	A	MsPh	Bal	Méso	MT
***Bertiera congolana* De Wild. et T. Durand**	Gunsi	Rubiaceae	*Bertiera*	MB87/JA43	1		1		2	50.0		2.0		CGC	A	MsPh	Sar	Micro	MT
*Bidens oligoflora (*Klatt) Wild		Asteraceae	*Bidens*	MB88/AT9		1			1		4.2			Pan	H	Thd	Desm	Micro	SB
***Bidens pilosa* L.**	Nsolokoto	Asteraceae	*Bidens*	MB89/AT14		1			1		33.3			Pan	H	Thd	Desm	Micro	SB
Bixa orellana L.		Bixaceae	*Bixa*	MB90/AT9		1	1		2		4.2	4.1		Pan	B	McPh	Bal	Méso	Cu
Blighia unijugata Baker		Sapindaceae	*Blighia*	MB91/JA15			1		1			2.0		BGC	A	MsPh	Bal	Méso	SP
Boehmeria nivea (L.) Gaudich		Urticaceae	*Boehmeria*	MB92/AT10		1			1		4.2			Pan	A	McPh	Bal	Méso	RM
Boehmeria platyphylla D.Don	Mungulungulu	Urticaceae	*Boehmeria*	MB93/JA39			1		1			2.0		GC	A	McPh	Bal	Méso	RM
***Boerhavia diffusa* L.**	Dibata bata	Nyctaginaceae	*Boerhavia*	MB94/AT2		1			1		33.3			Pan	H	Chp	Desm	Micro	RMP
Bokila (non determinated)	Bokila	ND	ND	MB95/S24				1	1				3.3		A				
Bombax buonopozense P. Beauv.		Malvaceae	*Bombax*	MB96/JA48			1		1			4.1		GC	A	MsPh	Sar	Méso	Cu
Borassus aethiopum Mart.	Bâ di diingi	Arecaceae	*Borassus*	MB97/AT9		1			1		4.2			AT	A	MsPh	Sar	Méga	Hy
Bougainvillea glabra Choisy		Nyctaginaceae	*Bougainvillea*	MB98/AT9		1			1		4.2			Cosm	L	Phgr	Desm	Micro	Cu
Brachiaria brizantha (A.Rich.) Stapf	Nzumbu	Poaceae	*Brachiaria*	MB99/S4				1	1				26.7	Pan	H	Grh	Scl	Micro	Hy
Brachiaria eruciformis (Sm.) Griseb.		Poaceae	*Brachiaria*	MB100/AT1		1			1		8.3			Pan	H	Grh	Scl	Micro	RM
Brachiaria leersioides (Hochst.) Stapf		Poaceae	*Brachiaria*	MB101/JA12		1			1		8.3			Pal	H	Grh	Scl	Micro	RM
Brachiaria ramosa (L.) Stapf		Poaceae	*Brachiaria*	MB102/AT19		1			1		8.3			Pan	H	Grh	Scl	Micro	RM
Brassica juncea (L.) Czern		Brassicaceae	*Brassica*	MB103/AT9		1			1		4.2			Pan	H	Ch	Bal	Micro	Cu
***Brassica oleracea* var. capitata L.**	Choux	Brassicaceae	*Brassica*	MB104/AT23		1			1		4.2			Pan	H	Th	Bal	Macro	Cu
Brassica rapa subsp. *chinensis* (L.) Hanelt	Blettes. ponti-noire	Brassicaceae	*Brassica*	MB105/AT23		1			1		4.2			Pan	H	Th	Bal	Macro	Cu
***Bridelia ferruginea* Benth.**	Kimwindu nseke	Phyllanthaceae	*Bridelia*	MB106/S1		1	1	1	3		4.2	12.2	53.3	BGC	A	MsPh	Sar	Méso	Ea
Bridelia micrantha (Hochst.) Baill.	Kimwindu mfinda	Phyllanthaceae	*Bridelia*	MB107/S18	1		1	1	3	14.3		22.4	6.7	BGC	A	MsPh	Sar	Méso	MT
***Brillantaisia patula* T. Anderson**	Lemba lemba	Acanthaceae	*Brillantaisia*	MB108/AT2		1			1		25.0			GC	B	Nph	Bal	Méso	Cu
Brugmansia versicolor Lagerh.		Solanaceae	*Brugmansia*	MB109/AT9		1			1		4.2			Pan	B	Nph	Scl	Méso	Cu
***Bryophyllum pinnatum* Kurz**	Liyuki yuki	Crassulaceae	*Bryophyllum*	MB110/AT4		1	1		2		8.3	6.1		Pan	H	Chsuc	Bal	Méso	Cu
Caesalpinia pulcherrima (L.) Sw.		Fabaceae	*Caesalpinia*	MB111/AT9		1			1		4.2			BGC	B	Mcph	Bal	Lepto	Cu
***Cajanus cajan* (L.) Huth**	Wandu	Fabaceae	*Cajan*	MB112/AT11		1			1		8.3			Pal	B	McPh	Bal	Micro	Cu
Caladium bicolore (Aiton) Vent.		Araceae	*Caladium*	MB113/AT4		1	1		2		4.2	18.4		Pan	H	Gb	Sar	Méso	MT
Calea urticifolia (Mill.) DC.		Asteraceae	*Calea*	MB114/AT8		1			1		8.3			AnT	B	Ch	Pog	Micro	RM

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
Calliandra calothyrsus Meisn.		Fabaceae	*Calliandra*	MB115/AT9		1			1		4.2			ND	B	McPh	Bal	Lepto	Cu
***Caloncoba welwitschii* (Oliv.) Gilg**	Kisani	Achariaceae	*Caloncoba*	MB116/JA2	1		1		2	14.3		73.5		GC	A	MsPh	Sar	Méso	MT
Calopogonium mucunoides Desv.		Fabaceae	*Calopogonium*	MB117/AT7		1	1		2		12.5	2.0		Pal	H	Chp	Bal	Méso	SB
***Canarium schweinfurthii* Engl.**	Kibidi	Burseraceae	*Canarium*	MB118/JA6	1		1		2	14.3		12.2		GC	A	MgPh	Sar	Méga	Sp
***Canna indica* L.**	Makombu kombu	Cannaceae	*Canna*	MB119/AT4		1	1		2		33.3	2.0		Pan	H	Grh	Bal	Méga	Cu
***Cannabis sativa* L.**	Diamba	Cannabaceae	*Cannabis*	MB120/AT1		1			1		8.3			AT	H	Thd	Bal	Micro	Cu
***Capsicum baccatum* L.**	Matubulu	Solanaceae	*Capsicum*	MB121/AT10		1			1		4.2			Pan	H	Thd	Sar	Méso	Cu
***Capsicum frutescens* L.**	Ndungu zi ntzndi	Solanaceae	*Capsicum*	MB122/AT21		1			1		4.2			Pan	H	Nph	Sar	Méso	Cu
Cardiospermum grandiflorum Sw.		Sapindaceae	*Cardiospermum*	MB123/AT9		1	1		2		4.2	6.1		Pan	H	Chg	Sar	Méso	MT
Carex spp.		Cyperaceae	*Carex*	MB124/AT17		1			1		8.3			Pal	H	Grh	Scl	Micro	RM
***Carica papaya* L.**	Dipapayi	Caricaceae	*Carica*	MB125/AT17		1			1		8.3			Pan	A	MsPh	Sar	Macro	Cu
Cascabela thevetia (L.) Lippold	Chapeau de napoleon	Apocynaceae	*Cascabela*	MB126/AT2		1			1		12.5			Pan	B	Mcph	Sar	Micro	Cu
Castanola paradoxa (Gilg) G. Schellenb		Connaracea	*Castanola*	MB127/JA32			1		1			4.1		GC	L	Phgr	Sar	Méso	MT
***Catharanthus roseus* (L.) G. Don**	Vinca	Apocynaceae	*Catharanthus*	MB128/AT2		1			1		12.5			Pan	H	Chd	Sar	Micro	Cu
***Ceiba pentandra* (L.) Gaertn.**	Mfuma	Malvaceae	*Ceiba*	MB129/JA4	1		1		2	7.1		8.2		Pan	A	MsPh	Pog	Méso	MT
Celosia argentea L.		Amaranthaceae	*Celosia*	MB130/AT9		1			1		4.2			Cosm	H	Thd	Scl	Méso	RM
Celosia trigyna L.	Teta bowa	Amaranthaceae	*Celosia*	MB131AT8		1			1		16.7			Pal	H	Thd	Scl	Micro	RM
Cenchrus purpureus (Schumach.) Morrone	Madiadia	Poaceae	*Cenchrus*	MB132/MA2	1		1		2	21.4		2.0		AT	H	Ch	Scl	Micro	P
Centella asiatica (L.) Urb.	Kidoka doka	Apiaceae	*Centella*	MB133/JA39	1		1		2	7.1		2.0		Pal	H	Chp	Scl	Micro	RM
Centrosema pubescens Benth.		Fabaceae	*Centrosema*	MB134/AT6		1	1		2		8.3	6.1		Pal	H	Chp	Bar	Micro	SB
Cereus repandus (L.) Mill.		Cactaceae	*Cereus*	MB135/AT9		1			1		4.2			Pan	B	McPh	Sar	aph	Cu
Chaetocarpus africanus Pax	Sesa. kungu nteke	Peraceae	*Chaetocarpus*	MB136/S25			1	1	2			69.4	3.3	BGC	A	MsPh	Bal	Méso	MT
Chamaecrista diphylla (L.) Greene		Fabaceae	*Chamaecrista*	MB137/AT4		1			1		4.2			AnT	H	Chp	Bal	Micro	RM
Chamaecrista fasciculata (Michx.) Greene		Fabaceae	*Chamaecrista*	MB138/AT4		1			1		4.2			AnT	H	Chd	Bal	Lepto	RM
Chamaecrista kirkii (Oliv.) Standl.		Fabaceae	*Chamaecrista*	MB139/AT13		1			1		20.8			BGC	H	Chd	Bal	Lepto	RM
Chamaecrista mimosoides (L.) Greene		Fabaceae	*Chamaecrista*	MB140/AT5		1			1		4.2			Pal	H	Chd	Bal	Lepto	RM
Chamaecrista nictitans (L.) Moench		Fabaceae	*Chamaecrista*	MB141/JA8		1			1		4.2			Pan	H	Chd	Bal	Lepto	RM

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
***Chamaesyce hirta* (L.) Millsp.**	Mvumina nkombo	Euphorbiaceae	*Chamaesyce*	MB142/AT3		1			1		25.0			Pan	H	Thd	Bal	Nano	RMP
Chassalia cristata (Hiern) Bremek.	Bofola	Rubiaceae	*Chassalia*	MB143/S19	1		1		2	7.1		32.7		Pan	B	McPh	Sar	Méso	Sp
***Chenopodium ambrosioides* L.**	Nkasa kindongo	Amaranthaceae	*Chenopodium*	MB144/AT1		1			1		12.5			Cosm	H	Thd	Scl	Nano	Cu
***Chromolaena odorata* (L.) R. M. King et H. Rob.**	Colera	Asteraceae	*Chromolaena*	MB145/S15	1	1	1	1	4	21.4	58.3	61.2	26.7	Pan	B	Ch	Pog	Micro	SB
Chytranthus stenophyllus Gilg		Sapindaceae	*Chytranthus*	MB146/JA4			1		1			2		GC	A	MsPh	Sar	Méso	Sp
***Cinnamomum verum* J.Presl**	Bonheur	Lauraceae	*Cinnamomum*	MB147/JA6			1		1			4.1		Pan	A	MsPh	Sar	Méso	Cu
***Cissus aralioides* (Welw. ex Baker) Planch.**	Mbua mbimpidi	Vitaceae	*Cissus*	MB148/JA3	1		1		2	50.0		28.6		GC	L	Phgr	Sar	Méso	MT
Cissus petiolata Hook.f.	Mbandi-mbadi ya mbuaki	Vitaceae	*Cissus*	MB149/JA3	1		1		2	14.3		8.2		GC-Z	L	Phgr	Sar	Méso	MT
***Cissus rubiginosa* (Welw. ex Baker) Planch.**	Mbadi-mbadi	Vitaceae	*Cissus*	MB150/S10	1	1	1	1	4	7.1	12.5	16.3	16.7	AT	L	Phgr	Sar	Méso	Sp
***Citrullus lanatus* (Thunb.) Matsum. & Nakai**	Mbika ntetu	Cucurbitaceae	*Citrullus*	MB151/AT7		1			1		4.2			Pan	H	Chp	Sar	Macro	Cu
***Citrus limon* (L.) Osbeck**	Lala di ngani	Rutaceae	*Citrus*	MB152/JA37			1		1			2.0		Pan	A	MsPh	Sar	Méso	Cu
***Citrus maxima* (Burm.) Merr.**	Pamplemousse rouge	Rutaceae	*Citrus*	MB153/JA37			1		1			2.0		Pan	A	MsPh	Sar	Méso	Cu
***Citrus sinensis* Pers.**	Malala	Rutaceae	*Citrus*	MB154/JA37			1		1			2.0		Pan	A	MsPh	Sar	Méso	Cu
Clappertonia ficifolia (Willd.) Decne.	Mpungala ki masa	Malvaceae	*Clappertonia*	MB155/JA8	1		1		2	14.3		2.0		GC	B	NPh	Bal	Méso	Ha
***Clematis hirsuta* Guill. & Perr.**	Nkonka ntu	Ranunculaceae	*Clematis*	MB156/JA32			1		1			2.0		AT	B	Chp	Pog	Méso	Sp
Cleome gynandra L.		Cleomaceae	*Cleome*	MB157/AT16		1			1		16.7			Pal	H	Thd	Bal	Méso	RM
Cleome rutidosperma DC.	Kuluatenda	Cleomaceae	*Cleome*	MB158/AT13		1			1		62.5			Pal	H	Thd	Scl	Micro	RM
***Clerodendrum formicarum* Gürke**	Makuku matatu	Lamiaceae	*Clerodendrum*	MB159/S24		1	1	1	3		25.0	14.3	20.0	AT	H	Chd	Sar	Méso	MT
***Clerodendrum splendens* G. Don**	Kindangolo	Lamiaceae	*Clerodendrum*	MB160/S19		1	1	1	3		20.8	36.7	13.3	AT	L	Phgr	Sar	Méso	Sp
Clerodendrum welwitschii Gürke.		Lamiaceae	*Clerodendrum*	MB161/JA25			1		1			6.1		BGC	H	Chgr	Sar	Méso	MT
Cnestis ferruginea Vahl ex DC.	Mfumba	Connaracea	*Cnestis*	MB162/JA1	1		1		2	21.4		61.2		GC	L	Phgr	Sar	Micro	MT
Cnestis glabra Lam.	Singa funde	Connaracea	*Cnestis*	MB163/JA11			1		1			4.1		AOA	L	Phgr	Sar	Méso	MT
Cnestis iomalla Gilg	Dinkundia	Connaracea	*Cnestis*	MB164/S24	1		1	1	3	7.1		55.1	3.3	AT	B	Phgr	Sar	Micro	MT
Cnestis palala (Lour.) Merr.		Connaracea	*Cnestis*	MB165/JA8			1		1			22.4		Pan	B	Phgr	Sar	Micro	MT
Cnidoscolus aconitifolius (Mill.) I. M. Johnst.	Manioc batard	Euphorbiaceae	*Cnidoscolus*	MB166/AT9		1			1		8.3			AnT	B	McPh	Bal	Méso	Cu
Coccinia grandis (L.) Voigt	Faux éponge (Nkanda bala)	Cucurbitaceae	*Coccinia*	MB167/JA43	1	1	1		3	7.1	4.2	4.1		Pan	L	Phgr	Sar	Méso	MT
***Cocos nucifera* L.**	Bâ di nkandi. Nkandi mputu	Arecaceae	*Cocos*	MB168/AT6		1			1		4.2			Pan	A	MsPh	Sar	Méso	Cu

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
***Coffea canephora* Pierre et A. Froehner**	Kafi	Rubiaceae	*Coffea*	MB169/AT9		1			1		4.2			Pan	B	Mcph	Sar	Méso	Cu
***Cogniauxia podolaena* Baill.**	Kisakamba	Cucurbitaceae	*Cogniauxia*	MB170/JA1			1		1			18.4		GC	L	Phgr	Sar	Méso	MT
Cogniauxia trilobata Cogn.	Faux kisakamba	Cucurbitaceae	*Cogniauxia*	MB171/AT6		1	1		2		4.2	4.1		GC	L	Phgr	Sar	Méso	MT
Coix lacryma-jobi L.	Mansanga	Poaceae	*Coix*	MB172/AT10		1	1		2		4.2	2.0		Pan	H	Ch	Scl	Micro	RM
***Cola acuminata* (P. Beauv.) Schott & Endl**	Makasu	Malvaceae	*Cola*	MB173/JA6			1		1			10.2		GC	A	MsPh	Sar	Méso	Sp
Cola bruneelii De Wild.		Malvaceae	*Cola*	MB174/JA18			1		1			6.1		CGC	A	MsPh	Sar	Méso	Sp
Colocasia esculenta (L.) Schott		Araceae	*Colocasia*	MB175/AT2		1			1		4.2			Pan	H	Gt	Sar	Macro	Cu
Combretum celastroides Welw. ex M. A. Lawson	Muzimba	Combretaceae	*Combretum*	MB176/S24				1	1				3.3	AT	L	Phgr	Ptér	Méso	Sp
Combretum confertum (Benth.) M. A. Lawson	Nsumbila	Combretaceae	*Combretum*	MB177/JA31			1	1	2			10.2	3.3	GC	L	Phgr	Ptér	Méso	MT
Combretum hispidum M. A. Lawson	Sumbala	Combretaceae	*Combretum*	MB178/JA26			1	1	2			2.0	6.7	BGC	L	Phgr	Ptér	Méso	MT
Combretum platypetalum Welw. ex M. A. Lawson		Combretaceae	*Combretum*	MB179/S24				1	1				3.3	GC	L	Phgr	Ptér	Méso	MT
Combretum psidioides Welw.	Nkwinkiti	Combretaceae	*Combretum*	MB180/S26			1	1	2			14.3	3.3	GC-Z	B	McPh	Ptér	Méso	Ea
Combretum racemosum* P.*Beauv.	Nsumbala	Combretaceae	*Combretum*	MB181/JA7		1	1		2		4.2	16.3		GC	L	Phgr	Ptér	Méso	Ha
***Commelina africana* L.**	Nlakisi mfinda	Commelinaceae	*Commelina*	MB182/AT15 JKIS 18B	1	1	1		3	7.1	4.2	4.1		Pal	H	Chr	Scl	Micro	MT
Commelina benghalensis L.	Nlakisi (velu)	Commelinaceae	*Commelina*	MB183/AT1		1	1		2		16.7	2.0		Pal	H	Chr	Scl	Micro	MT
***Commelina diffusa* Burm. f.**	Nlakisi	Commelinaceae	*Commelina*	MB184/S15		1	1	1	3		62.5	2.0	6.7	Pan	H	Chr	Scl	Micro	P
Cordyline rubra Otto et A.Dietr.		Asparagaceae	*Cordyline*	MB185/AT15		1			1		4.2			Pal	B	Mcph	Sar	Méso	Cu
***Corymbia citriodora* (Hook.) K.D.Hill & L.A.S.Johnson**		Myrtaceae	*Corymbia*	MB186/AT2		1			1		4.2			AOA	A	MsPh	Sar	Méso	Cu
Cosmos sulphureus Cav.		Asteraceae	*Cosmos*	MB187/AT9		1			1		4.2			Pan	B	NPh	Desm	Micro	Cu
***Costus afer* Ker Gawl.**	Minkeni	Costaceae	*Costus*	MB188/JA10			1		1			24.5		BGC	H	Grh	Sar	Macro	MT
***Costus lucanusianus* J.Braun & K. Schum.**	Boso boso	Costaceae	*Costus*	MB189/JA32	1		1		2	92.9		10.2		GC	H	Grh	Sar	Méso	MT
Costus phyllocephalus K.Schum.	Munkuiza	Costaceae	*Costus*	MB190/MA1	1				1	28.6				GC	H	Grh	Sar	Méso	MT
***Costus spectabilis* (Fenzl) K.Schum.**	Lubatabata	Costaceae	*Costus*	MB191/S3				1	1				83.3	AT	H	Grh	Sar	Méso	Hy
Crassocephalum crepidioides (Benth.) S. Moore		Asteraceae	*Crassocephalum*	MB192/AT11		1			1		8.3			AT	H	Thd	Pog	Nano	RM
Crassocephalum montuosum (S. Moore) Milne-Redh.		Asteraceae	*Crassocephalum*	MB193/AT11		1			1		4.2			AT	H	Thd	Pog	Nano	RM
***Craterispermum schweinfurthii* Hiern**	Muntoma-ntoma	Rubiaceae	*Craterispermum*	MB194/JA35	1		1		2	7.1		8.2		AT	A	MsPh	Sar	Méso	MT

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Crinum ornatum (Aiton) Herb.		Amaryllidaceae	*Crinum*	MB195/JA4			1		1			6.1		GC	H	Gb	Sar	Micro	Ha
***Crossopteryx febrifuga* (Afzel. ex G. Don) Benth.**	Mvala	Rubiaceae	*Crossopteryx*	MB196/S1			1	1	2			6.1	60	BGC	A	MsPh	Sar	Micro	Ea
Crotalaria glauca Willd.	Nsaambi	Fabaceae	*Crotalaria*	MB197/JA13			1		1			4.1		AT	H	Thd	Bal	Micro	RMP
Crotalaria retusa L.		Fabaceae	*Crotalaria*	MB198/S19		1		1	2		4.2		3.3	Pan	H	Chd	Bal	Micro	RMP
Croton hirtus L'Hér.		Euphorbiaceae	*Croton*	MB199/AT2		1		1	2		58.3		3.3	BGC	H	Thd	Bal	Micro	SB
***Croton mubango* Müll.Arg.**	Mbangu mbangu	Euphorbiaceae	*Croton*	MB200/JA13			1		1			4.1		BGC	A	MsPh	Bal	Méso	MT
Cucumeropsis mannii Naudin	Mbika nsudi	Cucurbitaceae	*Cucumeropsis*	MB201/AT22		1			1		4.2			GC	H	Chp	Sar	Méso	Cu
***Cucurbita maxima* Duchesne**	Mbika malenge. courge	Cucurbitaceae	*Cucurbita*	MB202/AT7		1			1		8.3			Pan	H	Thgr	Sar	Méso	Cu
Cucurbita moschata Duchesne	Concombre	Cucurbitaceae	*Cucurbita*	MB203/AT22		1			1		4.2			Pan	H	Thgr	Sar	Macro	Cu
Culcasia angolensis Welw. ex Schott		Araceae	*Culcasia*	MB204/MA6	1				1	7.1				GC	H	Phgr	Sar	Macro	SP
Culcasia falcifolia Engl.		Araceae	*Culcasia*	MB205/MA5	1				1	14.3				BGC	H	Phgr	Sar	Méso	SP
Culcasia scandens P. Beauv.	Lulama	Araceae	*Culcasia*	MB206/JA41	1		1		2	42.9		2.0		AT	H	Phgr	Sar	Méso	MS
***Curcuma longa* L.**	Kingoni	Zingiberaceae	*Curcuma*	MB207/AT6		1			1		4.2			Pal	H	Grh	Sar	Méga	Cu
Cussonia angolensis (Semble.) Hiern	Mungoma ngoma	Araliaceae	*Cussonia*	MB208/S22	1		1	1	3	7.1		2.0	10.0	GC	A	MsPh	Sar	Micro	Hy
Cyathula prostrata (L.) Blume		Amaranthaceae	*Cyathula*	MB209/AT1		1	1		2		20.8	6.1		Pan	H	Thd	Desm	Micro	RM
***Cymbopogon citratus* (DC.) Stapf**	Sinda	Poaceae	*Cymbopogon*	MB210/AT14		1			1		20.8			AT	H	Hc	Scl	Micro	Cu
***Cymbopogon densiflorus* (Steud.) Stapf**		Poaceae	*Cymbopogon*	MB211/AT9		1			1		4.2			AT	H	Hc	Scl	Micro	Cu
Cynodon dactylon (L.) Pers.	Kinkala	Poaceae	*Cynodon*	MB212/AT1		1		1	2		8.3		53.3	Cosm	H	Chr	Scl	Lepto	RM
Cyperus alternifolius L.		Cyperaceae	*Cyperus*	MB213/AT11		1			1		12.5			Pan	H	Grh	Scl	Micro	RM
***Cyperus articulatus* L.**	Saku saku	Cyperaceae	*Cyperus*	MB214/AT8		1			1		4.2			Pan	H	Hc	Scl	Nano	Cu
Cyperus cyperoides (L.) Kuntze		Cyperaceae	*Cyperus*	MB215/AT2		1			1		25			Pan	H	Geh	Scl	Micro	RM
Cyperus difformis L.		Cyperaceae	*Cyperus*	MB216/AT13		1			1		16.7			AT	H	Hc	Scl	Nano	RM
Cyperus esculentus L.		Cyperaceae	*Cyperus*	MB217/AT2		1	1		2		37.5	2.0		Pan	H	Hc	Scl	Nano	RM
Cyperus haspan L.		Cyperaceae	*Cyperus*	MB218/AT10		1			1		20.8			AT	H	Ge	Scl	Micro	RM
Cyperus hortensis (Salzm. ex Steud.) Dorr		Cyperaceae	*Cyperus*	MB219/AT12		1			1		25.0			AnT	H	Grh	Scl	Micro	RM
Cyperus longus L.		Cyperaceae	*Cyperus*	MB220/AT13	1	1			2	21.4	4.2			Cosm	H	Hc	Scl	Nano	RM
Cyperus mapanioides C.B.Clarke		Cyperaceae	*Cyperus*	MB221/JA17			1		1			2.0		AOA	H	Hc	Scl	Nano	MT
Cyperus odoratus L.		Cyperaceae	*Cyperus*	MB222/MA12	1				1	14.3				Pan	H	Grh	Scl	Micro	Ha
***Cyperus papyrus* L.**	Nkuala	Cyperaceae	*Cyperus*	MB223/MA6	1				1	7.1				Pan	H	Grh	Scl	Micro	Ha
Cyperus rotundus L.		Cyperaceae	*Cyperus*	MB224/AT6		1	1		2		33.3	2.0		Pan	H	Grh	Scl	Micro	RM
***Dacryodes edulis* (G. Don) H. J. Lam**	Nsafu	Burseraceae	*Dacryodes*	MB225/AT16		1	1		2		8.3	12.2		BGC	A	MsPh	Sar	Méso	Cu
Dalbergia armata E.Mey.		Fabaceae	*Dalbergia*	MB226/JA17			1		1			4.1		AOA	L	Phgr	Ptér	Lepto	MT
Dalbergia hostilis Benth.		Fabaceae	*Dalbergia*	MB227/JA8			1		1			8.2		BGC	L	Phgr	Ptér	Lepto	MT
Dalbergia kisantuensis De Wild. et T.Durand		Fabaceae	*Dalbergia*	MB228/JA11	1		1		2	14.3		10.2		BGC	L	phgr	Ptér	Lepto	MT

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Dalbergia lactea Vatke		Fabaceae	*Dalbergia*	MB229/S26	1	1	1	1	4	14.3	4.2	40.8	3.3	AT	B	McPh	Ptér	Micro	MT
Dalbergia melanoxylon Guill. & Perr.		Fabaceae	*Dalbergia*	MB230/JA9			1		1			4.1		AT	B	McPh	Ptér	Lepto	MT
Dalbergia pachycarpa (De Wild. & T. Durand) Ulbr. ex De Wild.	Kifundi	Fabaceae	*Dalbergia*	MB231/S23			1	1	2			2.0	3.3	GC	L	Phgr	Ptér	Micro	MT
Dalbergia saxatilis Hook.f.	Kifundi nseke	Fabaceae	*Dalbergia*	MB232/S22			1	1	2			6.1	6.7	CGC	L	Phgr	Ptér	Micro	MT
Dalbergia sp2		Fabaceae	*Dalbergia*	MB233/JA9			1		1			6.1		GC	B	McPh	Ptér	Lepto	MT
***Datura stramonium* L.**	36 oiseaux	Solanaceae	*Datura*	MB234/AT9		1			1		4.2			GC	H	Thd	Scl	Méso	Cu
***Daucus carota* L.**	Kaloti	Apiaceae	*Daucus*	MB235/AT23		1			1		4.2			Pan	H	Gt	Desm	Micro	Cu
Delonix regia (Bojer et Hook.) Raf.	Nsiese mputu	Fabaceae	*Delonix*	MB236/JA41		1	1		2		4.2	2.0		Pan	A	MsPh	Bal	Lepto	Cu
Desmodium adscendens (Sw.) DC.		Fabaceae	*Desmodium*	MB237/AT10		1			1		12.5			Pan	H	Grh	Desm	Nano	RMP
***Desmodium mauritianum* (Willd.) DC.**	Lunzila nzila	Fabaceae	*Desmodium*	MB238/S5		1	1	1	3		33.3	14.3	13.3	Pan	H	Chd	Desm	Micro	RMP
Desmodium triflorum (L.) DC.	3 amis	Fabaceae	*Desmodium*	MB239/AT20		1	1		2		4.2	2.0		Pan	H	Chp	Desm	Nano	RMP
***Desmodium velutinum* (Willd.) DC.**	Lundondu	Fabaceae	*Desmodium*	MB240/S23		1		1	2		4.2		3.3	Pal	H	Chd	Desm	Micro	MT
Dialium englerianum Henriq.	Mboti nseke	Fabaceae	*Dialium*	MB241/JA3			1		1			14.3		BGC	A	MsPh	Ptér	Méso	Ea
Dialium polyanthum Harms	Nti-ntadi	Fabaceae	*Dialium*	MB242/JA43			1		1			16.3		GC	A	MsPh	Sar	Méso	Sp
Dichapetalum lujae De Wild. et T. Durand	Dila	Dichapetalaceae	*Dichapetalum*	MB243/JA5	1		1		2	7.1		20.4		AT	L	Phgr	Sar	Micro	Sp
Dichrocephala integrifolia (Lf.) Kuntze		Asteraceae	*Dichrocephala*	MB244/AT1		1			1		12.5			Pan	H	Thd	Pog	Micro	RMP
Dichrostachys cinerea* (L.) *Wight et Arn.	Nsendi vanga	Fabaceae	*Dichrostachys*	MB245/S13		1		1	2		29.2		20.0	AT	B	MsPh	Bal	Lepto	MT
Dieffenbachia seguine (Jacq.) Schott		Araceae	*Dieffenbachia*	MB246/JA37			1		1			2.0		Pan	H	Grh	Sar	Macro	Cu
Digitaria horizontalis Willd.		Poaceae	*Digitaria*	MB247/S19		1		1	2		29.2		20.0	Pan	H	Th	Scl	Micro	RM
Digitaria sanguinalis (L.) Scop.		Poaceae	*Digitaria*	MB248/S21				1	1				6.7	Pan	H	Hc	Scl	Micro	RM
Dinginda	Dinginda	ND	*ND*	MB249/JA3			1		1			8.2			A	MsPh		Méso	MT
Dioclea reflexa Hook. f.		Fabaceae	*Dioclea*	MB250/MA2	1				1	7.1				AnT	L	Phgr	Bal	Méso	MT
Diodia sarmentosa Sw.		Rubiaceae	*Diodia*	MB251/AT8		1			1		4.2			GC	H	Thd	Sar	Nano	Sp
Dioscorea alata L.	Wukula	Dioscoreaceae	*Dioscorea*	MB252/AT9		1			1		4.2			AT	L	Ge	Pléo	Méso	Cu
***Dioscorea bulbifera* L.**	Soko ngamba	Dioscoreaceae	*Dioscorea*	MB253/AT2	1	1	1		3	42.9	4.2	18.4		Pan	L	Gt	Ptér	Macro	MT
***Dioscorea cayenensis* Lam.**	Kisadi	Dioscoreaceae	*Dioscorea*	MB254/S25	1	1	1	1	4	35.7	8.3	55.1	3.3	AT	L	Gt	Ptér	Méso	MT
Dioscorea dumetorum (Kunth) Pax.		Dioscoreaceae	*Dioscorea*	MB255/JA28			1		1			10.2		GC	L	Ggr	Ptér	Méso	MT
Dioscorea Plum. ex L.		Dioscoreaceae	*Dioscorea*	MB256/JA11			1		1			2.0		Cosm	L	Ggr	Ptér	Méso	MT
Dioscorea quartiniana A.Rich.		Dioscoreaceae	*Dioscorea*	MB257/JA38			1		1			6.1		AT	L	Ge	Ptér	Méso	MT
***Dioscorea sansibarensis* Pax**	Sansala	Dioscoreaceae	*Dioscorea*	MB258/JA1	1		1		2	35.7		49		AFM	L	Gt	Ptér	Méso	Cu
***Diospyros heterotricha* (Welw. ex Hiern) F.Blanc**	Lufua lu ndomba (nzete ya minu)	Ebenaceae	*diospyros*	MB259/JA36			1		1			2.0		GC	B	MsPh	Sar	Méso	Sp

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Diplorhynchus condylocarpon (Müll.Arg.) Pichon	Mvondongolo	Apocynaceae	*Diplorhynchus*	MB260/JA12			1		1			4.1		GC	A	McPh	Sar	Méso	MT
***Dissotis brazzae* Cogn.**	Ntongu ntongu	Melastomataceae	*Dissotis*	MB261/S15	1	1	1	1	4	7.1	8.3	20.4	26.7	BGC	H	Chp	Ptér	Micro	SG
Dissotis procumbens A.Fern. & R.Fern.		Melastomataceae	*Dissotis*	MB262/MA10	1				1	7.1				BGC	H	Chp	Scl	Micro	Ha
Dorstenia laurentii De Wild.	Kintamba	Moraceae	*Dorstenia*	MB263/JA35			1		1			2.0		AT	H	Grh	Bal	Méso	SP
***Dracaena mannii* Boulanger**		Asparagaceae	*Dracaena*	MB264/AT2		1	1		2		4.2	2.0		BGC	A	NPh	Scl	Micro	MT
Drymaria cordata (L.) Willd. ex Schult.	Lunguba lu fioti	Caryophyllaceae	*Drymaria*	MB265/AT8		1			1		20.8			Pan	H	Chd	Bal	Lepto	RM
Drypetes capillipes (Pax) Pax & K. Hoffm.		Putranjivaceae	*Drypetes*	MB266/JA41			1		1			4.1		GC	A	MsPh	Sar	Méso	Sp
Echinochloa colonum (L.) Link		Poaceae	*Echinochloa*	MB267/AT14		1			1		8.3			Pan	H	Hc	Scl	Micro	Ha
Eclipta prostrata (L.) L.		Asteraceae	*Eclipta*	MB268/AT2		1			1		8.3			Pan	H	Thd	Desm	Micro	RM
Ectadiopsis oblongifolia (Meisn.) Benth. ex B.D.Jacks.	Mvulumukina	Apocynaceae	*Ectadiopsis*	MB269/JA11			1		1			14.3		AT	H	Phgr	Pog	Méso	SB
***Elaeis guineensis* Jacq.**	Bâ di ngasi	Arecaceae	*Elaeis*	MB270/S24	1	1	1	1	4	92.9	4.2	57.1	6.7	Pan	A	MsPh	Sar	Méso	MT
***Eleusine indica* (L.) Gaertn.**	Kimbansi	Poaceae	*Eleusine*	MB271/AT2		1			1		41.7			Pan	H	Th	Scl	Micro	RMP
Eleutherine bulbosa (Mill.) Urb.	Tomboka	Iridaceae	*Eleutherine*	MB272/T8		1			1		8.3			Pan	H	Gb	Scl	Méso	RM
***Emilia coccinea* (Sims) G.Don**		Asteraceae	*Emilia*	MB273/AT9	1	1	1		3	7.1	20.8	2.0		Pan	H	Chd	Pog	Micro	RM
Emilia fosbergii Nicolson		Asteraceae	*Emilia*	MB274/AT9		1			1		8.3			Pan	H	Thd	Pog	Micro	MT
Entada abyssinica Steud. ex A. Rich.	Nsiensie	Fabaceae	*Entada*	MB275/JA27			1		1			12.2		AFM	A	MsPh	Bar	Lepto	MT
Entada gigas (L.) Fawc. & Rendle	Fute	Fabaceae	*Entada*	MB276/MA3	1				1	21.4				GC	L	Phgr	Bar	Micro	MT
Entolasia olivacea Stapf		Poaceae	*Entolasia*	MB277/JA18	1		1		2	7.1		6.1		GC	H	Hc	Scl	Micro	MT
Eragrostis tenella (L.) P.Beauv. ex Roem. et Schult.		Poaceae	*Eragrostis*	MB278/AT16		1	1		2		8.3	2.0		Pan	H	Hc	Scl	Micro	RM
Eragrostis tremula Hochst. ex Steud.		Poaceae	*Eragrostis*	MB279/AT12		1			1		33.3			Pal	H	Th	Scl	Micro	RM
Eremospatha haullevilleana De Wild.	Lubamba	Arecaceae	*Eremospatha*	MB280/JA41			1		1			2.0		BGC	L	Lph	Sar	Méso	Ha
***Erigeron floribundus* (Kunth) Sch.Bip.**	Fumu di kiula	Asteraceae	*Erigeron*	MB281/AT6		1		1	2		33.3		3.3	Pan	H	Thd	Pog	Micro	MT
***Eriosema glomeratum* (Guill. et Perr.) Hook. f.**	Wandu nseke	Fabaceae	*Eriosema*	MB282/S7		1	1	1	3		4.2	4.1	36.7	AT	B	NPh	Scl	Micro	SB
Eriosema laurentii De Wild.		Fabaceae	*Eriosema*	MB283/S9		1		1	2		8.3		6.7	CGC	B	NPh	Scl	Micro	Hy
Eriosema psoraleoides (Lam.) G.Don		Fabaceae	*Eriosema*	MB284/S9		1		1	2		8.3		10	AFM	B	Nph	Desm	Micro	Hy
***Erythrina abyssinica* Lam.**	Kikumbu	Fabaceae	*Erythrina*	MB285/JA27			1		1			2.0		AOA	A	MsPh	Bal	Méso	MT
***Erythrococca atrovirens* (Pax) Prain**	Nzekenzeke	Euphorbiaceae	*Erythrococca*	MB286/JA35			1		1			2.0		CGC	B	Nph	Bal	Méso	MT
***Erythrophleum suaveolens* (Guill. & Perr.) Brenan**	Nkasa. nti ba ndoki	Fabaceae	*Erythrophleum*	MB287/JA36			1		1			2.0		AT	A	Mgph	Bar	Micro	sp
***Ethulia conyzoides* L.**	Dinsusu nsusu di nsimba	Asteraceae	*Ethulia*	MB288/AT9		1			1		8.3			Pan	H	Thd	Pog	Micro	RM

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
Eucalyptus racemosa Cav.		Myrtaceae	*Eucalyptus*	MB289/AT6		1			1		4.2			ND	A	MsPh	Sar	Méso	Cu
Eucalyptus robusta Sm.		Myrtaceae	*Eucalyptus*	MB290/JA13		1	1		2		4.2	4.1		Pan	A	MsPh	Sar	Méso	Cu
Euclinia longiflora Salisb.		Rubiaceae	*Euclinia*	MB291/JA20			1		1			2		BGC	B	Nph	Sar	Méso	MT
Eulophia bouliawongo (Rchb. f.) J.Raynal	Palm de marais	Orchidaceae	*Eulophia*	MB292/JA39	1		1		2	42.9		4.1		GC	H	Grh	Scl	Micro	Ha
Euphorbia heterophylla L.	Milk cochon	Euphorbiaceae	*Euphorbia*	MB293/AT3		1			1		16.7			Pan	H	Chd	Scl	Nano	RM
Fargesia robusta T. P. Yi		Poaceae	*Fargesia*	MB294/JA5	1		1		2	7.1		4.1		GC	H	Grh	Scl	Micro	MT
Ficus asperifolia Miq.		Moraceae	*Ficus*	MB295/AT20	1	1			2	21.4	4.2			AT	B	Phgr	Sar	Méso	Ha
Ficus elastica Roxb. ex Hornem.	Nzete ya kake	Moraceae	*Ficus*	MB296/JA9			1		1			2.0		GC	A	MsPh	Sar	Méso	MT
Ficus exasperata Vahl	Lengo lengo (Kikuya)	Moraceae	*Ficus*	MB297/S20	1	1	1	1	4	21.4	4.2	8.2	3.3	Pal	A	MsPh	Sar	Méso	MT
***Ficus lutea* Vahl**	Bubu	Moraceae	*Ficus*	MB298/JA6			1		1			8.2		GC	A	MsPh	Sar	Méso	Sp
Ficus mallotocarpa Warb.		Moraceae	*Ficus*	MB299/MA2	1				1	7.1				AT	A	MsPh	Sar	Méso	Sp
Ficus mucuso Welw. ex Ficalho		Moraceae	*Ficus*	MB300/AT9		1			1		4.2			AT	A	MsPh	Sar	Méso	MT
Ficus recurvata De Wild.		Moraceae	*Ficus*	MB301/MA2	1				1	21.4				BGC	A	MsPh	Sar	Méso	Ha
Ficus saussureana DC.		Moraceae	*Ficus*	MB302/MA4	1				1	7.1				AT	A	MsPh	Sar	Méso	Ha
Ficus sur Forssk.	Etrangleur	Moraceae	*Ficus*	MB303/MA3	1		1		2	7.1		4.1		AT	A	MsPh	Sar	Méso	MT
***Ficus thonningii* Blume**	Nsanda	Moraceae	*Ficus*	MB304/S24			1	1	2			12.2	3.3	GC-Z	A	MsPh	Sar	Méso	MT
Fimbristylis dichotoma (L.) Vahl		Cyperaceae	*Fimbristylis*	MB305/AT8		1			1		4.2			Pan	H	Hc	Scl	Micro	RM
Funtumia africana (Benth.) Stapf	Kimbaki *kongo*	Apocynaceae	*Funtumia*	MB306/JA4	1		1		2	7.1		16.3		GC	A	MsPh	Sar	Méso	MT
Funtumia elastica (Preuss) Stapf	Kimbaki	Apocynaceae	*Funtumia*	MB307/JA4			1		1			28.6		GC	A	MsPh	Pog	Méso	MT
Gaertnera leucothyrsa (K.Krause) E.M.A.Petit	Kimbodia	Rubiaceae	*Gaertnera*	MB308/JA5			1		1			20.4		GC	A	MsPh	Sar	Méso	Ha
***Gaertnera paniculata* Benth.**	Kimbodia	Rubiaceae	*Gaertnera*	MB309/JA6	1		1		2	7.1		61.2		GC	A	MsPh	Sar	Méso	MT
Galinsoga parviflora Cav.		Asteraceae	*Galinsoga*	MB310/JA4		1			1		45.8			Pan	H	Thd	Pog	Micro	RMP
***Garcinia huillensis* Welw. ex Oliv.**	Kisima	Clusiaceae	*Garcinia*	MB311/JA35			1	1	2			2.0	3.3	AT	B	NPh	Bar	Micro	Ea
***Garcinia kola* Heckel**	Ngadiadia	Clusiaceae	*Garcinia*	MB312/JA36			1		1			2.0		GC	A	MsPh	Sar	Méso	Sp
Garcinia mangostana L.	Mangoustan	Clusiaceae	*Garcinia*	MB313/JA37			1		1			2.0		Pal	A	MsPh	Sar	Méso	Cu
Gardenia ternifolia* subsp. *jovis-tonantis (Welw.) Verdc	Kilemba nzau	Rubiaceae	*Gardenia*	MB314/S16				1	1				20.0	AT	A	MsPh	Sar	Méso	Hy
Gilbertiodendron dewevrei (De Wild.) J.Léonard	Mbotia	Fabaceae	*Gilbertiodendron*	MB315/AT11		1	1		2		4.2	2.0		BGC	A	Mgph	Bar	Méso	Sp
Gladiolus abbreviatus Andrews		Iridaceae	*Gladiolus*	MB316/MA10	1				1	7.1				ND	H	Gb	Scl	Méso	Ha
Glyphaea brevis (Spreng.) Monach.		Malvaceae	*Glyphaea*	M317/JA41	1		1		2	7.1		4.1		AT	A	MsPh	Scl	Méso	MT
***Gnetum africanum* Welw.**	Mfumbua	Gnetaceae	*Gnetum*	MB318/JA19			1		1			2.0		BGC	L	Phgr	Sar	Micro	Sp
Gongronema latifolium Benth.		Apocynaceae	*Gongronema*	MB319/JA47	1		1		2	7.1		2.0		AT	H	Chgr	Pog	Méso	CT
***Gossypium barbadense* L.**	Wusu	Malvaceae	*Gossypium*	MB320/AT2		1			1		20.8			Pan	B	NPh	Pog	Méso	Cu
Gouania longispicata Engl.		Rhamnaceae	*Guania*	MB321/JA7			1		1			4.1		GC	L	Phgr	Ptér	Micro	MT

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
Gymnanthemum amygdalinum (Delile) Sch. Bip.	Nlulukulu	Asteraceae	*Gymnanthemum*	MB322/JA3			1		1			6.1		AT	B	MsPh	Pog	Méso	MT
***Hallea stipulosa* (DC.) J.-F. Leroy**	Nlongo	Rubiaceae	*Hallea*	MB323/MA4	1		1		2	85.7		4.1		AT	A	MsPh	Ptér	Macro	Ha
***Harungana madagascariensis* Lam. ex Poir.**	Ntunu	Hypericaceae	*Harungana*	MB324/JA5	1		1		2	28.6		14.3		AnT	A	MsPh	Sar	Méso	MT
Haumania liebrechtsiana (De Wild. & T. Durand) J. Léonard	Kasa kwanga (face rose)	Marantaceae	*Haumania*	MB325/JA8	1		1		2	7.1		2.0		GC-Z	H	Thd	Sar	Macro	Sp
***Heinsia crinita* (Wennberg) G.Taylor**	Nsiamuna. kita mata	Rubiaceae	*Heinsia*	MB326/JA17			1		1			4.1		GC	B	McPh	Sar	Méso	MT
***Helichrysum mechowianum* Klatt**	Ludimi lu mbua	Asteraceae	*Helichrysum*	MB327/S2		1		1	2		4.2		76.7	AT	H	Grh	Scl	Micro	Hy
***Hibiscus acetosella* Welw. ex Hiern**	Ngayi ngayi	Malvaceae	*Hibiscus*	MB328/AT2		1			1		8.3			Pan	H	Thd	Bal	Méso	Cu
Hibiscus rosa-sinensis L.		Malvaceae	*Hibiscus*	MB329/AT12		1			1		4.2			Pan	B	Nph	Bal	Méso	Cu
Hibiscus rostellatus Guill. & Perr.		Malvaceae	*Hibiscus*	MB330/AT8		1	1		2		8.3	4.1		GC	H	Thd	Bal	Méso	MT
***Hibiscus sabdariffa* L.**	Ngayi ngayi rouge	Malvaceae	*Hibiscus*	MB331/AT7		1			1		4.2			Pan	H	Thd	Bal	Méso	Cu
Hibiscus surattensis L.		Malvaceae	*Hibiscus*	MB332/AT16		1			1		4.2			Pal	H	Thd	Bal	Micro	SB
Hippocratea micrantha Cambess.		Celastraceae	*Hippocratea*	MB333/JA26			1		1			2.0		GC	L	Lph	Ptér	Méso	Ha
Holarrhena floribunda (G. Don) T. Durand et Schinz	Kinzenze	Apocynaceae	*Holarrhena*	MB334/JA29			1		1			55.1		GC	A	MsPh	Sar	Méso	MT
Hura crepitans L.		Euphorbiaceae	*Hura*	MB335/AT5		1	1		2		4.2	4.1		Pan	A	MsPh	Bal	Méso	Cu
***Hymenocardia acida* Tul.**	Mpete	Phyllanthaceae	*Hymenocardia*	MB336/S2		1	1	1	3		4.2	24.5	93.3	BGC	B	McPh	Ptér	Nano	Ea
Hymenocardia ulmoides Oliv.	Munsanga	Phyllanthaceae	*Hymenocardia*	MB337/S25			1	1	2			63.3	3.3	AT	A	MsPh	Ptér	Nano	MT
Hyparrhenia diplandra (Hack.) Stapf	Nsoki	Poaceae	*Hyparrhenia*	MB338/S18				1	1				10.0	BGC	H	Hc	Scl	Micro	Hy
Hyparrhenia familiaris (Steud.) Stapf		Poaceae	*Hyparrhenia*	MB339/S2	1	1		1	3	21.4	20.8		90.0	BGC	H	Hc	Scl	Nano	Hy
Hyparrhenia rufa (Nees) Stapf		Poaceae	*Hyparrhenia*	MB340/S27			1	1	2			8.2	13.3	Pan	H	Hc	Scl	Micro	Hy
Hypoestes cancellata Nees		Acanthaceae	*Hypoestes*	MB341/AT8		1			1		4.2			AT	H	Chd	Bal	Micro	SB
Hypoestes forskaolii (Vahl) R.Br.		Acanthaceae	*Hypoestes*	MB342/AT9		1		1	2		4.2		3.3	AT	H	Chd	Bal	Micro	SB
Hypselodelphys scandens Louis & Mullend.	Lutete	Marantaceae	*Hypselodelphys*	MB343/JA4			1		1			8.2		GC	H	mGrh	Sar	Méso	MP
***Hyptis suaveolens* (L.) Poit.**	Nkama nsongo	Lamiaceae	*Hyptis*	MB344/AT10		1			1		20.8			Pal	H	Nph	Desm	Micro	Ha
Icacina mannii Oliv.	Ntadi-ntandi	Icacinaceae	*Icacina*	MB345/JA5	1		1		2	7.1		6.1		GC	L	Phgr	Sar	Méso	MT
***Impatiens irvingii* Hook. f.**		Balsaminaceae	*Impatiens*	MB346/AT15		1			1		4.2			BGC	H	Chd	Scl	Micro	Cu
***Imperata cylindrica* (L.) P. Beauv**.	Nsonia	Poaceae	*Imperata*	MB347/AT23		1	1	1	3		29.2	8.2	40	Pan	H	Grh	Pog	Micro	SB
Indigofera congesta Welw. ex Baker		Fabaceae	*Indigofera*	MB348MA1	1				1	7.1				AT	H	Chd	Bal	Lepto	Hy
Indigofera hendecaphylla Jacq.		Fabaceae	*Indigofera*	MB349/S23				1	1				3.3	Pan	H	Chd	Bal	Lepto	RM

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
Indigofera hirsuta L.		Fabaceae	*Indigofera*	MB350/AT8		1			1		4.2			Pan	H	Chp	Bal	Lepto	RM
***Indigofera paracapitata* J. B.Gillett**		Fabaceae	*Indigofera*	MB351/S19			1	1	2			2.0	3.3	AT	H	Thd	Bal	Lepto	Hy
Indigofera pulchra Willd.		Fabaceae	*Indigofera*	MB352/AT22		1			1		4.2			AT	H	Thd	Bal	Lepto	Hy
Indigofera spicata Forssk.		Fabaceae	*Indigofera*	MB353/AT24		1	1		2		4.2	2.0		Pal	H	Chd	Bal	Lepto	RM
Indigofera suffruticosa Mill.	Lunguba	Fabaceae	*Indigofera*	MB354/S20			1	1	2			4.1	10	Pan	H	Chd	Bal	Lepto	RM
Inga edulis Mart.	Bisicre	Fabaceae	*Inga*	MB355/JA6			1		1			2.0		Pan	A	MsPh	Sar	Méso	Cu
Ipomoea aquatica Forssk.		Convolvulaceae	*Ipomoea*	MB356/MA5	1				1	7.1				Pan	L	Phgr	Pléo	Méso	P
***Ipomoea batatas* (L.) Lam.**	Kikua ki sukadi	Convolvulaceae	*Ipomoea*	MB357/AT2		1			1		8.3			Pan	L	Gt	Pléo	Méso	Cu
Ipomoea fistulosa Mart. ex Choisy		Convolvulaceae	*Ipomoea*	MB358/MA7	1		1	1	3	7.1		2.0	3.3	Pan	L	Gt	Pléo	Méso	Ha
Ipomoea involucrata P. Beauv.		Convolvulaceae	*Ipomoea*	MB359/JA19			1		1			6.1		GC	L	Chgr	Bal	Micro	RM
Ipomoea mauritiana Jacq.		Convolvulaceae	*Ipomoea*	MB360/S24		1	1	1	3		4.2	10.2	3.3	Pan	L	Chgr	Pléo	Méso	Ha
Ipomoea palmata Forssk.		Convolvulaceae	*Ipomoea*	MB361/MA3	1				1	7.1				Pan	L	Phgr	Pléo	Méso	Ha
Jacaranda mimosifolia D. Don		Bignoniaceae	*Jacaranda*	MB362/JA41		1	1		2		4.2	2.0		Pan	A	MsPh	Ptér	Lepto	Cu
***Jatropha curcas* L.**	Mpuluka	Euphorbiaceae	*Jatropha*	MB363/AT2		1			1		8.3			Pan	A	MsPh	Bal	Méso	Cu
Justicia insularis T.Anderson	Teka ngola	Acanthaceae	*Justicia*	MB364/AT4		1			1		8.3			AT	H	Ch	Scl	Micro	MT
Justicia striata (Klotzsch) Bullock		Acanthaceae	*Justicia*	MB365/MA9	1				1	7.1				AT	H	Th	Bal	Micro	MT
Justicia tenella (Nees) T.Anderson		Acanthaceae	*Justicia*	MB366/AT12		1			1		4.2			AT	H	Thd	Bal	Nano	MT
***Kalaharia uncinata* (Schinz) Moldenke**	Nkongi nkongi	Lamiaceae	*Kalaharia*	MB367/AT9		1			1		4.2			AT	L	Phgr	Sar	Micro	RM
Kyllinga erecta Schumach.		Cyperaceae	*Kyllinga*	MB368/AT7		1	1		2		20.8	2.0		GC	H	Grh	Scl	Nano	RM
Lactuca inermis Forssk.		Asteraceae	*Lactuca*	MB369/AT17		1	1		2		4.2	4.1		AT	H	Ch	Scl	Micro	RMP
***Lagenaria siceraria* (Molina) Standl.**	Mbika nkalu	Cucurbitaceae	*Lagenaria*	MB370/AT9		1			1		4.2			Pan	H	Thgr	Sar	Méso	Cu
***Landolphia camptoloba* (K. Schum.) Pichon**	Mbungu mbungu	Apocynaceae	*Landolphia*	MB371/JA36			1		1			2.0		GC	L	Phgr	Sar	Méso	SP
Landolphia congolensis (Stapf) Pichon	Litonge (blanc)	Apocynaceae	*Landolphia*	MB372/JA37			1		1			2.0		GC	L	Phgr	Sar	Méso	SP
Landolphia lanceolata (K.Schum.) Pichon	Mambulu	Apocynaceae	*Landolphia*	MB373/S24				1	1				3.3	GC	L	Grh	Sar	Micro	Hy
***Landolphia owariensis* P. Beauv.**	Goki di kuku	Apocynaceae	*Landolphia*	MB374/JA35	1		1		2	7.1		4.1		GC	L	Phgr	Sar	Méso	MT
Landolphia parvifolia K. Schum	Singa nkuezo	Apocynaceae	*Landolphia*	MB375/MA4	1		1		2	7.1		12.2		GC	L	Phgr	Sar	Méso	MT
***Lannea antiscorbutica* (Hiern) Engl.**	Nkumbi	Anacardiaceae	*Lannea*	MB376/JA16	1	1	1	1	4	7.1	4.2	28.6	3.3	AT	A	MsPh	Sar	Méso	Sp
Lannea welwitschii (Hiern) Engl.	Munkombo	Anacardiaceae	*Lannea*	MB377/JA5	1		1		2	14.3		14.3		GC	A	MsPh	Sar	Méso	Ha
***Lantana camara* L.**		Verbenaceae	*Lantana*	MB378/AT18		1			1		12.5			Pan	B	Nph	Sar	Méso	Cu
Laportea aestuans (L.) Chew		Urticaceae	*Laportea*	MB379/AT13	1	1	1		3	7.1	16.7	2.0		Pal	H	Thd	Desm	Méso	RMP
Laportea alatipes Hook. f.		Urticaceae	*Laportea*	MB380/MA6	1				1	14.3				AOA	H	Thd	Desm	Méso	Ha

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
Laportea ovalifolia (Schumach. & Thonn.) Chew		Urticaceae	*Laportea*	MB381/AT3		1	1		2		4.2	2.0		GC	H	Thd	Desm	Méso	RM
Laportea peduncularis (Wedd.) Chew		Urticaceae	*Laportea*	MB382/AT3		1	1		2		4.2	2.0		BGC	H	Thd	Desm	Méso	RM
***Lasimorpha senegalensis* Schott**	Malodia	Araceae	*Lasimorpha*	MB383/MA7	1				1	85.7				AT	H	Gt	Sar	Macro	Ha
Leea guineensis G.Don		Vitaceae	*Leea*	MB384/JA6	1		1		2	21.4		6.1		BGC	B	Nph	Sar	Méso	MT
Leersia hexandra Sw.		Poaceae	*Leersia*	MB385/AT11	1	1			2	64.3	8.3			Pan	H	Grh	Scl	Micro	P
Leonotis nepetifolia (L.) R.Br.		Lamiaceae	*Leonotis*	MB386/AT14		1			1		8.3			AT	H	Thd	Scl	Méso	RMP
Leptactina leopoldi-secundi Büttner		Rubiaceae	*Leptactine*	MB387/JA9			1		1			65.3		BGC	B	Mcph	Sar	Méso	Sp
Leptactina mannii subsp. *arnoldiana* (De Wild.) Neuba ex Figueiredo		Rubiaceae		MB388/JA4			1		1			2.0		CGC	B	Thd	Sar	Méso	Sp
Leptactina platyphylla (Hiern) Wernham		Rubiaceae	*Leptactina*	MB389/JA40			1		1			2.0		GC-Z	B	McPh	Sar	Méso	Sp
Leptactina pynaertii De Wild.		Rubiaceae	*Leptactina*	MB390/JA40			1		1			2.0		BGC	B	McPh	Sar	Méso	Sp
Leptaspis zeylanica Nees ex Steud.	Nzuuundu	Poaceae	*Scrotochloa*	MB391/JA39			1		1			2.0		Pal	H	Grh	Scl	Micro	SP
Leptochloa chinensis (L.) Nees		Poaceae	*Leptochloa*	MB392/AT7		1	1		2		8.3	2.0		BGC	H	Hc	Scl	Micro	RM
Leptochloa coerulescens Steud.		Poaceae	*Leptochloa*	MB393/AT2		1		1	2		16.7		3.3	AFM	H	Hc	Scl	Micro	RM
Leptoderris congolensis (De Wild.) Dunn	Funde	Fabaceae	*Leptoderris*	MB394/JA5	1		1	1	3	14.3		34.7	3.3	BGC	L	Phgr	Ptér	Micro	Sp
Leptoderris fasciculata (Benth.) Dunn		Fabaceae	*Leptoderris*	MB395/S28			1	1	2			6.1	3.3	GC	L	Phgr	Ptér	Micro	Sp
Leptoderris nobilis (Welw. Ex Baker) Dunn	Funde (poilu)	Fabaceae	*Leptoderris*	MB396/JA32			1		1			8.2		BGC	L	Phgr	Bal	Méso	Sp
Leptonychia multiflora K.Schum.		Malvaceae	*Leptonychia*	MB397/JA43			1		1			2.0		BGC	A	MsPh	Sar	Méso	Ha
Leucaena leucocephala (Lam.) De Wit		Fabaceae	*Leucaena*	MB398/AT17		1			1		4.2			Pan	A	MsPh	Bal	Lepto	Cu
Limaciopsis loangensis Engl.		Menispermaceae	*Limaciopsis*	MB399/JA41			1		1			2.0		GC	L	Phgr	Sar	Méso	MT
Lindackeria dentata (Oliv.) Gilg	Kinsiedi-fioti	Achariaceae	*Lindackeria*	MB400/JA4			1		1			4.1		AT	B	McPh	Sar	Méso	MT
***Lippia alba* (Mill.) N.E.Br. ex Britton et P.Wilson**		Verbenaceae	*Lippia*	MB401/AT2		1			1		4.2			ND	H	Chd	Scl	Méso	Cu
***Lippia multiflora* Moldenke**	Bulukutu	Verbenaceae	*Lippia*	MB402/AT23		1			1		4.2			AT	H	Chd	Scl	Méso	Hy
Loranthus djamuensis K. Krause		Loranthaceae	*Loranthus*	MB403/JA2	1	1	1		3	7.1	4.2	8.2		ND	L	Phgr	Sar	Méso	MT
Loudetia simplex (Nees) C.E. Hubb.		Poaceae	*Loudetia*	MB404/S11		1		1	2		8.3		10	AT	H	Hc	Scl	Micro	Hy
Ludwigia abyssinica A.Rich.	Ndunda ya mayi	Onagraceae	*Ludwigia*	MB405/AT5	1	1	1		3	42.9	4.2	10.2		AnT	H	Chd	Pléo	Lepto	Ha
Ludwigia leptocarpa (Nutt.) H. Hara		Onagraceae	*Ludwigia*	MB406/MA1	1				1	14.3				AnT	H	Chd	Pléo	Lepto	Ha

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
***Luffa cylindrica* (L.) M. Roem.**	Tsanu	Cucurbitaceae	*Luffa*	MB407/AT17		1			1		16.7			Pan	H	Thgr	Sar	Méso	SB
Lycopodium cernuum L.		Lycopodiaceae	*Lycopodium*	MB408/JA38			1		1			2.0		Pan	H	Phgr	Scl	Méso	Ha
***Lygodium microphyllum* (Cav.) R. Br.**		Schizaeaceae	*Lygodium*	MB409/JA37	1		1		2	21.4		4.1		Pal	H	Thd	Scl	Micro	Ha
Lygodium smithianum C.Presl		Schizaeaceae	*Lygodium*	MB410/JA39	1		1		2	21.4		8.2		GC	H	Thd	Scl	Micro	Ha
Macaranga monandra Müll. Arg.	Yenze	Euphorbiaceae	*Macaranga*	MB411/JA3	1		1		2	21.4		51.0		BGC	A	MsPh	Sar	Méso	MT
***Macaranga schweinfurthii* Pax**	Mfumfu	Euphorbiaceae	*Macaranga*	MB412/JA39	1		1		2	85.7		6.1		GC	A	MsPh	Sar	Méso	MT
***Macaranga spinosa* Müll. Arg**.	Sasa	Euphorbiaceae	*Macaranga*	MB413/JA5			1		1			10.2		GC	A	MsPh	Sar	Méso	MT
Macroptilium lathyroides (L.) Urb		Fabaceae	*Macroptilium*	MB414/AT10		1			1		8.3			Pan	H	Ch	Bal	Micro	RM
Maesobotrya sp.		Phyllanthaceae	*Maesobotrya*	MB415/JA18			1		1			2.0		GC	A	MsPh	Sar	Méso	Sp
Maesobotrya staudtii (Pax) Clapier.	Mansiesi	Phyllanthaceae	*Maesobotrya*	MB416/JA19			1		1			2.0		GC	A	MsPh	Sar	Méso	Sp
Maesopsis eminii Engl.	Kingembu. ndunga	Rhamnaceae	*Maesopsis*	MB417/JA6			1		1			30.6		BGC	A	MsPh	Sar	Méso	MT
***Mangifera indica* L.**	Manga	Anacardiaceae	*Mangifera*	MB418/JA4	1	1	1		3	7.1	4.2	26.5		Pan	A	MsPh	Sar	Méso	Cu
***Manihot esculenta* Crantz**	Dioko	Euphorbiaceae	*Manihot*	MB419/JAT21		1			1		16.7			Pan	B	Gt	Bal	Méso	Cu
***Manihot glaziovii* Müll. Arg.**	Kawusu. dioko di nkueso	Euphorbiaceae	*Manihot*	MB420/AT18		1			1		8.3			Pan	B	McPh	Bal	Méso	Cu
Manniophyton fulvum Müll. Arg.	Kilendila	Euphorbiaceae	*Manniophyton*	MB421/JA32			1		1			8.2		GC	L	Phgr	Bal	Macro	Sp
***Manotes expansa* Sol. ex Planch.**	Dila-dila	Connaracea	*Manotes*	MB422/JA8			1		1			55.1		GC	B	Phgr	Sar	Micro	MT
***Maprounea africana* Müll. Arg.**	Siele-siele	Euphorbiaceae	*Maprounea*	MB423/S1			1	1	2			8.2	86.7	AT	B	MsPh	Bal	Micro	Ea
Maranta arundinacea L.		Marantaceae	*Maranta*	MB424/JA35		1	1		2		4.2	2		GC	H	mGrh	Sar	Méso	Sp
Marantochloa congensis (K. Schum.) J.Léonard & Mullend.		Marantaceae	*Marantochloa*	MB425/MA9	1				1	7.1				BGC	H	mGrh	Sar	Méso	Sp
Margaritaria discoidea (Baill.) G. L. Webster		Phyllanthaceae	*Margaritiara*	MB426/JA26			1		1			4.1		BGC	A	MsPh	Bal	Micro	MT
Markhamia tomentosa (Benth.) K.Schum. ex Engl.	Nsasa	Bignoniaceae	*Markhamia*	MB427/JA1	1		1		2	7.1		61.2		GC	A	MsPh	Ptér	Méso	MT
Megaphrynium macrostachyum (K.Schum.) Milne-Redh.	Kasa kwanga ya munene	Marantaceae	*Megaphrinium*	MB428/JA12	1		1		2	7.1		6.1		GC	H	mGrh	Sar	Méga	MT
***Melinis minutiflora* P.Beauv.**	Maleka mbua	Poaceae	*Melinis*	MB429/JA25			1		1			6.1		AT	H	Hc	Scl	Micro	Hy
Memecylon gilletii De Wild.	Ntadi	Melastomataceae	*Memecylon*	MB430/JA5	1		1		2	7.1		4.1		C	A	McPh	Sar	Méso	MT
Mentha piperata Stokes	Bulukutu chinois	Lamiaceae	*Mentha*	MB431/AT8		1		1	2		4.2		3.3	ND	H	Chd	Bal	Micro	Cu
***Mentha x piperita* L.**	Ndamba	Lamiaceae	*Mentha*	MB432/AT12		1			1		12.5			ND	H	Chd	Bal	Micro	Cu
Merremia angustifolia (Jacq.) Hallier f.		Convolvulaceae	*Merremia*	MB433/S28		1	1	1	3		8.3	4.1	3.3	Pal	L	Thp	Pléo	Micro	MT
Merremia tuberosa (L.) Rendle	Matembele mayi	Convolvulaceae	*Merremia*	MB434/MA2	1		1		2	57.1		4.1		Pan	L	Phgr	Pléo	Méso	MT

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
Merremia umbellata (L.) Hallier f.		Convolvulaceae	*Merremia*	MB435/JA37			1		1			2		Pan	L	Phgr	Pléo	Méso	MT
Miconia calvescens DC.		Melastomataceae	*Miconia*	MB436/JA39	1		1		2	14.3		2		ND	B	NPh	Sar	Micro	MT
Microglossa angolensis Oliv. & Hiern	Nlula-nlula	Asteraceae	*Microglossa*	MB437/S5			1	1	2			2.0	3.3	GC	B	Ch	Pog	Méso	MT
Microsorum punctatum Copel.	Makinda -ngolo	Polypodiaceae	*Microsum*	MB438/JA4	1		1		2	14.3		4.1		Pal	H	Grh	Scl	Méso	MT
Mikania chenopodiifolia Willd.	Bodisa	Asteraceae	*Mikania*	MB439/AT10		1			1		4.2			AT	H	Chd	Pog	Micro	RMP
***Milicia excelsa* (Welw.) C.C. Berg**	Nkamba	Moraceae	*Milicia*	MB440/JA3	1		1	1	3	35.7		34.7	3.3	GC	A	MsPh	Sar	Méso	MT
Millettia barteri (Benth.) Dunn	Kifundi	Fabaceae	*Millettia*	MB441/MA10	1				1	28.6				GC	L	Phgr	Bal	Méso	Ha
***Millettia drastica* Welw. ex Baker**	Mbuenge	Fabaceae	*Millettia*	MB442/S20		1	1	1	3		12.5	77.6	10.0	BGC	A	MsPh	Bal	Micro	MT
***Millettia laurentii* De Wild.**	Kiboto	Fabaceae	*Millettia*	MB443/AT7		1	1		2		8.3	61.2		BGC	A	MsPh	Bal	Méso	SP
Millettia macroura Harms	Kifundi	Fabaceae	*Millettia*	MB444/JA38			1		1			4.1		GC	L	Phgr	Bal	Méso	SP
Millettia theuszii (Büttner) De Wild.	Kifundi	Fabaceae	*Millettia*	MB445/S24			1	1	2			10.2	6.7	CGC	L	Phgr	Bal	Méso	Ha
***Millettia versicolor* Welw. ex Baker**	Mbota	Fabaceae	*Millettia*	MB446/S20	1	1	1	1	4	21.4	37.5	53.1	6.7	AT	A	MsPh	Bal	Méso	MT
Mimosa invisa Mart.	Kikoki	Fabaceae	*Mimosa*	MB447/AT12	1	1			2	7.1	8.3			Pan	H	Nph	Desm	Lepto	SB
Mimosa pigra L.	Koke ki nseke	Fabaceae	*Mimosa*	MB448/S15	1	1	1	1	4	14.3	8.3	2.0	3.3	Pan	H	Nph	Desm	Lepto	Ha
***Mimosa pudica* L.**	Kanga nzo	Fabaceae	*Mimosa*	MB449/AT4		1			1		20.8			AnT	H	Ch	Desm	Lepto	SB
Mirabilis jalapa L.		Nyctaginaceae	*Mirabilis*	MB450/AT15		1			1		4.2			Pan	H	NPh	Bal	Micro	Cu
***Mitracarpus hirtus* (L.) DC.**	Banda-nzazi	Rubiaceae	*Mitracarpus*	MB451/AT22		1			1		16.7			AT	H	Thd	Pog	Micro	RMP
***Momordica charantia* L.**	Lumbusu	Cucurbitaceae	*Momordica*	MB452/AT6	1	1	1		3	21.4	8.3	2.0		GC	H	Thgr	Sar	Micro	MT
***Mondia whitei* (Hook. f.) Skeels**	Kimbiolongo	Apocynaceae	*Mondia*	MB453/JA26		1	1		2		4.2	2.0		AT	L	Phgr	Sar	Méso	MT
***Morinda lucida* Benth.**	Nsiki	Rubiaceae	*Morinda*	MB454/JA1		1	1	1	3		4.2	20.4	6.7	GC	A	MsPh	Sar	Macro	MT
***Morinda morindoides* (Baker) Milne-Redh.**	*Kongo* bololo	Rubiaceae	*Morinda*	MB455/JA36			1		1			4.1		GC	L	Lph	Sar	Méso	MT
***Moringa oleifera* Lam.**		Moringaceae	*Moringa*	MB456/AT6		1			1		4.2			Pan	A	MsPh	Sar	Lepto	Cu
Mpoki (Non determinated)	Mpoki	Dioscoreaceae	*ND*	MB457/JA6	1		1		2	14.3		4.1		ND	H				
***Mucuna flagellipes* Vogel ex Hook. f.**	Singa kumbu	Fabaceae	*Mucuna*	MB458/MA5	1		1		2	35.7		4.1		GC	L	Phgr	Bal	Micro	Ha
***Mucuna pruriens* (L.) DC.**	Mankundi	Fabaceae	*Mucuna*	MB459/S25	1	1	1	1	4	42.9	16.7	20.4	3.3	Pan	H	Chgr	Bal	Méso	SB
Murdannia allardii (De Wild.) Brenan	Nlakisi mazanga	Commelinaceae	*Commelina*	MB460/MA4	1				1	42.9				C	H	Grh	Scl	Micro	Hy
Murdannia simplex (Vahl) Brenan	Flamand	Commelinaceae	*Murdannia*	MB461/S1				1	1				63.3	Pal	H	Hc	Scl	Micro	RMP
***Musa acuminata* Colla**	Mankondo ma sukadi	Musaceae	*Musa*	MB462/AT15		1			1		12.5			Pan	B	mG	Sar	Macro	Cu
***Musa* × *paradisiaca* L.**		Musaceae	*Musa*	MB463/AT24		1			1		4.2			Pan	B	mG	Sar	Macro	Cu
***Musanga cecropioides* R.Br. ex Tedlie**	Nsenga	Urticaceae	*Musanga*	MB464/JA1	1		1	1	3	92.9		38.8	3.3	GC	A	MsPh	Sar	Macro	MT
***Myrianthus arboreus* P.Beauv.**	Mantusu. mbuba	Urticaceae	*Myrianthus*	MB465/JA18	1		1	1	3	28.6		18.4	3.3	GC	A	MsPh	Sar	Macro	MT

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
***Nauclea latifolia* Sm.**	Kilolo, nlolo	Rubiaceae	*Nauclea*	MB576/S1		1	1	1	3		12.5	4.1	66.7	AT	A	MsPh	Sar	Méso	Ea
***Nauclea pobeguinii* (Pobég.) Merr.**		Rubiaceae	*Nauclea*	MB577/MA14	1				1	7.1				GC	B	MsPh	Sar	Méso	Ha
Neostenanthera gabonensis (Engl. & Diels) Exell		Annonaceae	*Neostenanthera*	MB466/JA38			1		1			2.0		CGC	B	MsPh	Sar	Méso	Sp
Nephelium lappaceum L.	Mapoilu	Sapindaceae	*Nephelium*	MB467/JA37			1		1			2.0		Pan	A	MsPh	Bar	Méso	Cu
Nephrolepis biserrata (Sw.) Schott		Polypodiaceae	*Nephrolepis*	MB468/JA3			1		1			4.1		Pan	H	Grh	Scl	Méso	MT
***Newbouldia laevis* (P.Beauv.) Semble. ex Bureau**	Mumpesi-mpesi	Bignoniaceae	*Newbouldia*	MB469/AT2		1			1		8.3			GC	A	MsPh	Bal	Méso	Cu
***Nicotiana tabacum* L.**	Fumu	Solanaceae	*Nicotiana*	MB470/AT18		1			1		8.3			Pan	H	Thd	Scl	Méga	Cu
N'saki	N'saki	ND	*ND*	MB471/JA6			1		1			4.1			L				
***Nymphaea lotus* L.**	Kilonga-longa	Nymphaeaceae	*Nymphaea*	MB472/MA7	1				1	14.3				Pal	H	Hydr	Pléo	Macro	Po
***Ochna afzelii* R. Br. ex Oliv.**	Kuluba	Ochnaceae	*Ochna*	MB473/S9		1	1	1	3		4.2	16.3	23.3	BGC	A	Msph	Bal	Micro	MT
***Ocimum basilicum* L.**	Mazudi	Lamiaceae	*Ocimum*	MB474/AT2		1			1		8.3			Pan	H	Chd	Scl	Nano	Cu
***Ocimum gratissimum* L.**	Dinsusu nsusu di neni	Lamiaceae	*Ocimum*	MB475/AT13		1			1		12.5			Pan	H	Chd	Scl	Méso	Cu
***Ocimum minimum* L.**	Dinsusu nsusu di fioti	Lamiaceae	*Ocimum*	MB476/AT2		1			1		8.3			Pan	H	Chd	Scl	Méso	Cu
Oldenlandia affinis (Roem. & Schult.) DC.	Kimbeni	Rubiaceae	*Oldenlandia*	MB477/AT16		1			1		25.0			Pal	H	Th	Pog	Nano	RMP
Oldenlandia corymbosa L.		Rubiaceae	*Oldenlandia*	MB478/AT11		1			1		8.3			Pan	H	Thpr	Scl	Nano	SB
Oldenlandia herbacea (L.) DC.	Kimbeni	Rubiaceae	*Oldenlandia*	MB479/AT11		1			1		8.3			Pan	H	Thpr	Scl	Nano	SB
Olyra latifolia L.	Tutu di Ngo	Poaceae	*Olyra*	MB480/JA10			1		1			6.1		Pan	H	Chp	Scl	Méso	Sp
Oncoba spinosa Forssk.	Nsansi	Salicaceae	*Oncoba*	MB481/S25				1	1				3.3	AT	A	MsPh	Sar	Méso	MT
Oplismenus hirtellus (L.) P. Beauv.	Tudama dama	Poaceae	*Oplismenus*	MB482/AT1		1	1		2		41.7	4.1		Pan	H	Hc	Scl	Micro	MT
Otomeria guineensis Benth.		Rubiaceae	*Otomeria*	MB483/JA35			1		1			2.0		BGC	H	Thd	Scl	Nano	MT
***Ottelia ulvifolia* (Planch.) Walp.**	Laadi	Hydrocharitaceae	*Ottelia*	MB484/MA10	1				1	7.1				AFM	H	Hydr	Pléo	Méso	Po
Oxalis corniculata L.		Oxalidaceae	*Oxalis*	MB485/AT12		1			1		16.7			Pan	H	Chp	Sar	Micro	RM
Oxyanthus speciosus DC.	Mbanzi	Rubiaceae	*oxyanthus*	MB486/JA4			1		1			22.4		AT	A	MsPh	Sar	Macro	SP
Pachira glabra Pasq.	Nguba-nguele	Malvaceae	*Pachira*	MB487/JA13		1	1		2		4.2	18.4		GC	A	McPh	Bal	Méso	Cu
Palisota ambigua (P. Beauv.) C. B. Clarke	Bunda bunda grand	Commelinaceae	*Palisota*	MB488/JA7	1		1		2	21.4		14.3		BGC	H	Chd	Sar	Macro	MT
Palisota barteri Hook. f.	Bunda-bunda	Commelinaceae	*Palisota*	MB489/JA42			1		1			10.2		GC	H	Chd	Sar	Micro	MT
Palisota hirsuta (Thunb.) K. Schum.	Bunda-bunda	Commelinaceae	*Palisota*	MB490/JA27			1		1			10.2		GC	H	Chd	Sar	Micro	MT
Pancovia laurentii (De Wild.) Gilg et De Wild.		Sapindaceae	*Pancovia*	MB491/JA4			1		1			4.1		GC	A	MsPh	Sar	Micro	Sp
Pandanus candelabrum P.Beauv.	Kenge	Pandanaceae	*Pandanus*	MB492/AT2		1			1		4.2			GC	B	Grh	Sar	Méga	Cu
Panicum maximum Jacq.	Panicum max	Poaceae	*Panicum*	MB493/S19		1	1	1	3		45.8	18.4	10.0	AnT	H	Hc	Scl	Micro	SB
Paropsia growioides Welw. ex Mast.	Nkaka-kiinsa	Passifloraceae	*Paropsia*	MB494/JA8			1		1			8.2		BGC	B	McPh	Bal	Méso	MT

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Paspalum conjugatum P. J. Bergius		Poaceae	*Paspalum*	MB495/S19		1		1	2		37.5		3.3	Pan	H	Chr	Scl	Micro	RMP
Paspalum notatum Flüggé		Poaceae	*Paspalum*	MB496/AT19		1			1		8.3			Pan	H	Chd	Scl	Micro	RMP
Paspalum orbiculare G.Forst.		Poaceae	*Paspalum*	MB497/AT6		1			1		8.3			Pal	H	Ch	Scl	Micro	RMP
Passiflora edulis Sims	Maracuja	Passifloraceae	*Passiflora*	MB498/AT13		1	1		2		8.3	2.0		Pan	H	Thg	Bal	Micro	MT
Passiflora foetida L.	Mbuma muselekete	Passifloraceae	*Passiflora*	MB499/AT12		1			1		8.3			Pan	L	Phgr	Sar	Micro	SB
***Paullinia pinnata* L.**	Ngudi nkayi	Sapindaceae	*Paullinia*	MB500/JA7			1		1			6.1		AnT	L	Phgr	Sar	Micro	MT
Pauridiantha callicarpoides (Hiern) Bremek.	Nkaka	Rubiaceae	*Pauridiantha*	MB501/JA3	1		1		2	21.4		10.2		BGC	A	MsPh	Sar	Méso	MT
Pedilanthus tithymaloides (L.) Poit.		Euphorbiaceae	*Pedilanthus*	MB502/AT9		1			1		4.2			Pan	H	Chsuc	Bal	Micro	Cu
***Pentaclethra eetveldeana* De Wild. et T.Durand**	Kiseka	Fabaceae	*Pentaclethra*	MB503/JA9		1	1	1	3		4.2	55.1	3.3	BGC	A	MsPh	Bal	Lepto	MT
***Pentaclethra macrophylla* Benth.**	Mvansi	Fabaceae	*Pentaclethra*	MB504/JA6		1	1		2		4.2	40.8		GC	A	MsPh	Bal	Micro	MT
***Pentadiplandra brazzeana* Baill.**	Nkengi kiasa	Pentadiplandraceae	*Pentadiplandra*	MB505/JA28			1		1			4.1		GC	L	Phgr	Sar	Méso	MT
Periploca nigrescens Wennberg		Apocynaceae	*Periploca*	MB506/S25			1	1	2			2.0	3.3	AT	L	Phgr	Pog	Méso	SB
***Persea americana* Mill.**	Divoka	Lauraceae	*Persea*	MB507/AT14		1	1		2		4.2	12.2		Pan	A	MsPh	Bar	Méso	Cu
Phaseolus lunatus L.	Pampidika. Mambambi	Fabaceae	*Phaseolus*	MB508/AT9		1			1		4.2			Cosm	H	Chgr	Bal	Méso	Cu
Phaseolus vulgaris L.	Madesu	Fabaceae	*Phaseolus*	MB509/AT4		1			1		8.3			Cosm	H	Chgr	Bal	Méso	Cu
Phaulopsis imbricata (Forssk.) Sweet	Dinguansi	Acanthaceae	*Phaulopsis*	MB510/AT9		1			1		4.2			AFM	H	Th	Bal	Micro	MT
Philodendron ernestii Engl.		Araceae	*Philodendron*	MB511/MA12	1				1	21.4				GC	L	Phgr	Sar	Macro	Ha
Philodendron giganteum Schott		Araceae	*Philodendron*	MB512/MA6	1				1	7.1				GC	L	Phgr	Sar	Macro	Cu
Philodendron scandens K.Koch & Sello		Araceae	*Philodendron*	MB513/JA40			1		1			2.0		GC	L	Phgr	Sar	Macro	Cu
Phoenix reclinata Jacq.	Dinsongo	Arecaceae	*Phoenix*	MB514/MA6	1				1	7.1				Pal	A	McPh	Sar	Méso	Cu
***Phyllanthus amarus* Schumach. & Thonn.**	Ntetanteta	Phyllanthaceae	*Phyllanthus*	MB515/AT1	1	1	1		3	7.1	62.5	6.1		Pal	H	NPh	Bal	Lepto	RM
Phyllanthus muellerianus (Kuntze) Exell.		Phyllanthaceae	*Phyllanthus*	MB516/JA35			1		1			4.1		GC	H	NPh	Sar	Nano	MT
Phyllanthus nivosus W.Bull	Phyllantus	Phyllanthaceae	*Phyllanthus*	MB517/AT6		1			1		4.2			Pal	H	Thd	Sar	Lepto	Cu
Phyllanthus sp.	Kimiaka miaka	Phyllanthaceae	*Phyllanthus*	MB518/JA36			1		1			2.0		GC	H	Nph	Sar	Nano	RM
Phymatosorus scolopendria (Burm. f.) Pic.Serm.		Polypodiaceae	*Phymatosorus*	MB519/JA33	1		1		2	7.1		6.1		Pal	H	Thd	Scl	Méso	RM
***Physalis angulata* L.**	Bobo	Solanaceae	*Physalis*	MB520/AT5		1			1		41.7			Pan	H	Thd	Sar	Méso	RMP
Phytolacca dodecandra L'Hér.	Tiidi	Phyllanthaceae	*Phytolacca*	MB521/AT4		1			1		4.2			AFM	L	Phgr	Sar	Méso	Cu
Piliostigma reticulatum (DC.) Hochst.	Pilio Grand	Fabaceae	*Piliostigma*	MB522/JA39			1		1			4.1		AFM	A	MsPh	Bal	Méso	MT
Piliostigma thonningii (Schumach.) Milne-Redh.	Pilio petit	Fabaceae	*Piliostigma*	MB523/JA39			1		1			2.0		AT	A	McPh	Bal	Méso	MT
Piper capense L.f.		Piperaceae	*Piper*	MB524/MA10	1				1	7.1				AFM	B	Nph	Sar	Méso	Ha

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
***Piper guineense* Schumach. & Thonn.**	Kupidi	Piperaceae	*Piper*	MB525/JA35			1		1			2.0		AFM	L	Phgr	Sar	Méso	Sp
***Piper umbellatum* L.**	Kilembe ki mfinda	Piperaceae	*Piper*	MB526/JA35			1		1			2.0		Pan	B	NPh	Sar	Méso	MT
Piptadeniastrum africanum (Hook. f.) Brenan	Nsinga-nsinga	Fabaceae	*Piptadeniastrum*	MB527/JA27			1		1			2.0		GC	A	MgPh	Bal	Lepto	SP
Plagiostyles africana (Müll. Arg.) Prain	Ngolo muntanga	Euphorbiaceae	*Plagiostyles*	MB528/JA6			1		1			2.0		BGC	A	MsPh	Sar	Méso	Sp
Plantago palmata Hook. f.		Plantaginaceae	*Plantago*	MB529/AT1		1			1		8.3			GC-Z	H	Grh	Sar	Méso	RM
Platycerium angolense Welw.		Polypodiaceae	*Platycerium*	MB530/JA6			1		1			8.2		AT	H	Grh	Scl	Méso	RM
Pleiotaxis eximia O.Hoffm.		Asteraceae	*Pleiotaxis*	MB531/S18				1	1				13.3	Pan	H	Th	Scl	Micro	Hy
Plumbago zeylanica L.		Plumbaginaceae	*Plumbago*	MB532/AT9		1			1		4.2			Pan	H	Chg	Desm	Micro	RM
***Polygala acicularis* Oliv.**	Lunsambi-nsambi	Polygalaceae	*Polygala*	MB533/S23				1	1				10.0	AT	H	Thd	Bal	Micro	SG
Polygonum senegalense Meisn.		Polygonaceae	*Polygonum*	MB534/MA10	1				1	14.3				Pal	H	Chr	Scl	Méso	Ha
Pontederia brevipetiolata (Verdc.) M. Pell. & C. N. Horn		Pontederiaceae	*Pontederia*	MB535/MA10	1				1	7.1				AT	H	Hydr	Scl	Méga	Po
***Portulaca oleracea* L.**	Ndia ngulu	Portulacaceae	*Portulaca*	MB536/AT16		1			1		4.2			Pal	H	Thpr	Scl	Méso	RMP
Protea angolensis Welw.		Proteaceae	*Protea*	MB537/S22				1	1				3.3	GC-Z	B	McPh	Sar	Méso	Hy
Pseudarthria hookeri Wight & Arn.	Dintata	Fabaceae	*Pseudarthria*	MB538/S26		1	1	1	3		16.7	6.1	13.3	GC	A	MsPh	Bal	Lepto	Sp
Pseuderanthemum ludovicianum (Büttner) Lindau		Acanthaceae	*Pseuderanthe-mum*	MB539/JA12			1		1			4.1		GC	H	Chd	Bal	Méso	SP
***Pseudospondias microcarpa* (A.Rich.) Engl.**	Mviwa	Anacardiaceae	*Pseudospondias*	MB540/JA4	1		1		2	64.3		16.3		BGC	A	MsPh	Sar	Méso	Ha
***Psidium guajava* L.**	Lipela	Myrtaceae	*Psidium*	MB541/AT15		1	1		2		16.7	18.4		Pan	A	McPh	Sar	Méso	MT
Psidium guineense Sw.	Mfulunta	Myrtaceae	*Psidium*	MB542/S2	1	1	1	1	4	7.1	8.3	12.2	26.7	Pan	B	McPh	Sar	Méso	MT
***Psophocarpus scandens* (Endl.) Verdc.**	Kikalakasa	Fabaceae	*Psophocarpus*	MB543/AT3		1	1		2		8.3	4.1		AT	H	Chgr	Bal	Méso	RM
***Psorospermum febrifugum* Spach**	Soko soko	Hypericaceae	*Psorospermum*	MB544/S1			1	1	2			10.2	73.3	AT	B	McPh	Sar	Méso	Hy
Psychotria dermatophylla (K.Schum.) E.M.A.Petit	Kimbodia kia koko	Rubiaceae	*Psychotria*	MB545/JA7			1		1			10.2		BGC	B	NPh	Sar	Méso	SG
Psychotria vogeliana Benth.		Rubiaceae	*Psychotria*	MB546/JA2			1	1	2			18.4	3.3	GC	B	Nph	Sar	Méso	SP
***Pteridium aquilinum* (L.) Kuhn**	Misili. matekua tekua	Dennstaedtiaceae	*Pteridium*	MB547/S14		1	1	1	3		25.0	8.2	6.7	Cosm	H	Grh	Scl	Micro	MT
Pteris atrovirens Willd.		Pteridaceae	*Pteris*	MB548/JA11	1		1		2	57.1		16.3		BGC	H	Grh	Scl	Micro	Sp
Pteris ensiformis Burm.	Pteris sous-bois-panaché	Pteridaceae	*Pteris*	MB549/JA48			1		1			2.0		Pal	H	Grh	Scl	Méso	MT
Pteris similis Kuhn et Decken	Sielele	Pteridaceae	*Pteris*	MB550/MA3	1		1		2	14.3		2.0		BGC	H	Grh	Scl	Méso	SP
Pterygota bequaertii De Wild.		Malvaceae	*Pterigota*	MB551/JA49			1		1			4.1		GC	A	MsPh	Sar	Méso	Ha
Pueraria phaseoloides (Roxb.) Benth.		Fabaceae	*Pueraria*	MB552/JA41		1	1		2		29.2	4.1		Pal	H	Phgr	Bal	Méso	SB
Pycnanthus angolensis (Welw.) Warb.	Lombela	Myristicaceae	*Pycnanthus*	MB553/MA1	1		1		2	21.4		12.2		GC	A	MgPh	Bal	Méso	MT

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
***Raphia* sp1 (textilis ?)**	Bâ di magusu	Arecaceae	*Raphia*	MB554/MA11	1				1	7.1				BGC	A	MsPh	Sar	Méso	Ha
Raphia sp2	Bâ di makoko	Arecaceae	*Raphia*	MB555/MA7	1				1	7.1				BGC	A	MsPh	Sar	Méso	Ha
Rauvolfia mannii Stapf	Matubulu matebo	Apocynaceae	*Rauvolfia*	MB556/JA9			1		1			46.9		GC	B	NPh	Sar	Méso	SP
***Rauvolfia vomitoria* Wennberg**	Kilungu	Apocynaceae	*Rauvolfia*	MB557/S25	1	1	1	1	4	42.9	20.8	75.5	10.0	GC	B	McPh	Sar	Méso	MT
Ravenala madagascariensis Sonn.	Arbre du voyageur	Strelitziaceae	*Ravenala*	MB558/AT2		1			1		4.2			Pan	A	MsPh	Sar	Macro	Cu
***Renealmia africana* Benth.**	Susa	Zingiberaceae	*Renealmia*	MB559/MA14	1				1	7.1				BGC	H	Grh	Sar	Macro	Ha
Ricinodendron heudelotii (Baill.) Heckel	Kingela	Euphorbiaceae	*Ricinodendron*	MB560/JA5			1		1			14.3		GC	A	MgPh	Sar	Méso	MT
***Ricinus sanguineus* Groenland**		Euphorbiaceae	*Ricinus*	MB561/AT2		1			1		12.5			Pan	A	MsPh	Bal	Macro	Cu
Rothmannia longiflora Salisb.		Rubiaceae	*Rothmannia*	MB562/JA19			1		1			6.1		GC	B	MsPh	Sar	Méso	MT
Rothmannia octomera (crochet.) Fagerl.		Rubiaceae	*Rothmannia*	MB563/JA18			1		1			4.1		BGC	B	MsPh	Sar	Méso	MT
Rottboellia cochinchinensis (Lour.) Clayton		Poaceae	*Rottboellia*	MB564/AT1		1			1		8.3			Pan	H	Hc	Scl	Micro	MT
Rourea coccinea (Schumach. & Thonn.) Benth.		Connaracea	*Rourea*	MB565/JA31			1		1			2.0		BGC	B	Phgr	Sar	Micro	MT
Rumex usambarensis (Engl.) Dammer	Ngayi ngayi chinois	Polygonaceae	*Rumex*	MB566/AT18		1			1		12.5			GC	B	Gt	Scl	Méso	Cu
***Rungia congoensis* C. B. Clarke**	Kinzonzi	Acanthaceae	*Rungia*	MB567/JA41		1	1		2		4.2	4.1		G	H	Ch	Bal	Micro	RM
Rutidea smithii Hiern		Rubiaceae	*Rutidea*	MB568/JA7			1		1			2		AT	B	McPh	Sar	Méso	Sp
Rytigynia dewevrei (De Wild. et T. Durand) Robyns		Rubiaceae	*Rytigynia*	MB569/JA19			1		1			6.1		CGC	B	McPh	Sar	Méso	Sp
Sabicea africana (P.Beauv.) Hepper		Rubiaceae	*Sabicea*	MB570/JA39			1		1			2.0		BGC	B	Ch	Sar	Méso	MT
***Saccharum officinale* Salisb.**		Poaceae	*Saccharum*	MB571/AT8		1			1		4.2			Pan	H	Hc	Scl	Méso	Cu
Sacosperma paniculatum (Benth.) G.Taylor		Rubiaceae	*Sacosperma*	MB572/MA1	1				1	14.3				BGC	B	Chgr	Sar	Méso	Ha
Samanea leptophylla (Harms) Brenan & Brummitt	Nsiesi	Fabaceae	*Samanea*	MB573/JA5			1		1			6.1		GC-Z	A	MsPh	Sar	Lepto	Ha
***Sansevieria trifasciata* Prain**	Kula nioka	Asparagaceae	*sansevieria*	MB574/JA13			1		1			8.2		Pan	H	Grh	Scl	Méso	Cu
***Sapium cornutum* Pax**	Ntiti	Euphorbiaceae	*Sapium*	MB575/JA1			1		1			77.6		BGC	A	MsPh	Bal	Micro	MT
Schizachyrium brevifolium (Sw.) Nees ex Buse		Poaceae	*Schizachyrium*	MB578/S3				1	1				23.3	Pan	H	Th	Scl	Micro	Hy
***Schwenckia americana* L.**	Tumpu di nkombo	Solanaceae	*Schwenkia*	MB579/S23		1	1	1	3		33.3	6.1	10.0	AnT	H	Chd	Scl	Nano	RM
***Scleria achtenii* De Wild.**	Welekese	Cyperaceae	*Scleria*	MB580/JA32			1		1			4.1		GC	H	Grh	Scl	Micro	MT
Scleria racemosa Bojer	Mbele tata	Cyperaceae	*Scleria*	MB581/MA3	1				1	14.3				GC	H	Grh	Scl	Micro	P
Scleria secans (L.) Urb.	Wedi-wedi	Cyperaceae	*Scleria*	MB582/JA2			1		1			8.2		GC	H	Grh	Scl	Micro	MT
Scleria verrucosa Willd.	Welekese masa	Cyperaceae	*Scleria*	MB583/MA2	1				1	64.3				GC	H	Grh	Scl	Micro	Ha
***Scoparia dulcis* L.**	Kiese kiese	Plantaginaceae	*Scoparia*	MB584/AT9		1			1		4.2			Pan	H	Chd	Scl	Nano	RM
***Scorodophloeus zenkeri* Harms**	Kiwaya	Fabaceae	*Scorodophloeus*	MB585/JA35			1		1			2.0		BGC	A	Mgph	Bar	Lepto	Sp

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
***Securidaca longepedunculata* Fresen**	Nkama nsunda	Polygalaceae	*Securidaca*	MB586/S24/			1	1	2			2.0	3.3	BGC	B	McPh	Ptér	Lepto	MT
Selaginella cathedrifolia Spring		Selaginellaceae	*selaginella*	MB587/MA6	1				1	14.3				GC	H	Thpr	Scl	Nano	Ha
Selaginella myosurus (Sw.) Alston		Selaginellaceae	*Selaginella*	MB588/JA35			1		1			2.0		GC	H	Thpr	Scl	Nano	MT
Senegalia pentagona (Schumach.) Kyal. & Boatwr.		Fabaceae	*Senegalia*	MB589/JA3			1		1			2.0		AT	L	Phgr	Bal	Lepto	Sp
***Senna alata* (L.) Roxb.**	Nti wa loti	Fabaceae	*Senna*	MB590/AT9		1			1		4.2			Pan	B	NPh	Bal	Méso	RM
***Senna hirsuta* (L.) H.S.Irwin et Barneby**	Faux kinkeliba	Fabaceae	*Senna*	MB591/AT2		1	1		2		37.5	4.1		AnT	B	NPh	Bal	Micro	CT
Senna obtusifolia (L.) H.S. Irwin et Barneby		Fabaceae	*Senna*	MB592/S23		1	1	1	3		8.3	2	3.3	Pan	B	NPh	Bal	Méso	RM
***Senna occidentalis* (L.) Link**	Nzunza ntu	Fabaceae	*Senna*	MB593/AT17		1			1		45.8			Pan	B	NPh	Bar	Micro	RM
Senna siamea (Lam.) H. S. Irwin & Barneby	Mbuenge mputu	Fabaceae	*Senna*	MB594/JA14			1	1	2			18.4	6.7	Pan	A	MsPh	Bar	Micro	RM
Senna spectabilis (DC.) H.S. Irwin et Barneby		Fabaceae	*Senna*	MB595/JA7			1	1	2			28.6	3.3	Pan	A	MsPh	Bar	Micro	RM
***Sesamum indicum* L.**	Wangila	Pedaliaceae	*Sesamum*	MB596/AT11		1			1		4.2			GC	H	Thd	Bal	Micro	Cu
***Sesamum radiatum* Thonn. ex Hornem.**	Wangila matebo	Pedaliaceae	*Sesamum*	MB597/S3		1		1	2		20.8		10.0	Pan	H	Thd	Scl	Micro	SB
Sesbania sesban (L.) Merr.	Nongu nongu	Fabaceae	*Sesbania*	MB598/AT5		1			1		25.0			Pal	B	McPh	Bal	Lepto	Ha
Setaria barbata (Lam.) Kunth	Kangaya fioti	Poaceae	*Setaria*	MB599/AT7		1	1		2		4.2	2.0		AT	H	Thc	Scl	Micro	SB
Setaria megaphylla (Steud.) T. Durand et Schinz	Kangaya	Poaceae	*Setaria*	MB600/JA3	1		1		2	50.0		10.2		Pan	H	Chp	Scl	Macro	SB
Setaria verticillata (L.) P. Beauv.		Poaceae	*Setaria*	MB601/AT10		1			1		4.2			Pan	H	Hc	Scl	Micro	RM
Setaria viridis (L.) P.Beauv.		Poaceae	*Setaria*	MB602/AT10		1			1		4.2			Pan	H	Hc	Scl	Micro	RM
Sherbournia batesii (Wernham) Hepper		Rubiaceae	*Sherbournia*	MB603/JA12			1		1			6.1		GC	L	Phgr	Sar	Méso	SP
Sherbournia bignoniiflora (Welw.) Hua		Rubiaceae	*Sherbournia*	MB604/JA48			1		1			6.1		AT	L	Phgr	Sar	Méso	MT
Sherbournia curvipes (Wernham) N. Hallé		Rubiaceae	*Sherbournia*	MB605/JA41			1		1			2		GC	L	Phgr	Sar	Méso	MT
***Sida acuta* Burm. f.**	Lumvumvu	Malvaceae	*Sida*	MB606/S24		1	1	1	3		62.5	6.1	3.3	Pan	H	Thd	Bal	Micro	SB
Sida linifolia Juss. ex Cav.		Malvaceae	*Sida*	MB607/S18		1		1	2		8.3		6.7	Pan	H	Thd	Bal	Micro	Hy
***Sida rhombifolia* L.**		Malvaceae	*Sida*	MB608/AT5		1			1		54.2			GC	H	Thd	Bal	Méso	SB
***Smilax anceps* Willd.**	Kikalala	Smilacaceae	*Smilax*	MB609/S7	1	1	1	1	4	7.1	37.5	34.7	33.3	AT	L	Phgr	Sar	Méso	MT
Solanecio angulatus (Vahl) C. Jeffrey.	Lulaka lu ngombe	Asteraceae	*Solanecio*	MB610/AT9		1			1		4.2			CGC	H	Ch	Scl	Micro	RM
Solanum aculeastrum Dunal	Ngindu-ngindu	Solanaceae	*Solanum*	MB611/AT14		1			1		4.2			GC	H	Nph	Sar	Micro	RM
***Solanum aethiopicum* L.**	Kinsumba	Solanaceae	*Solanum*	MB612/AT3		1			1		8.3			AT	H	Th	Sar	Méso	RM
Solanum incanum L.	Ndindu-ngindu ya neni	Solanaceae	*Solanum*	MB613/AT13		1			1		25.0			Pal	H	NPh	Sar	Méso	RM

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
Solanum linnaeanum Hepper et P.-M. L. Jaeger	Ngindu-ngindu	Solanaceae	*Solanum*	MB614/AT16		1			1		8.3			Pan	H	Thd	Sar	Méso	RM
***Solanum lycopersicum* L.**	Lumantu	Solanaceae	*solanum*	MB615/AT2		1			1		12.5			AT	H	Ch	Sar	Nano	Cu
***Solanum macrocarpon* L.**	Nkeka	Solanaceae	*Solanum*	MB616/AT24		1			1		4.2			AT	H	Thd	Sar	Méso	Cu
Solanum mammosum L.	Tête de cochon	Solanaceae	*Solanum*	MB617/AT21		1			1		8.3			Pan	H	Thd	Sar	Méso	Cu
Solanum mauritianum Scop.	Ngindu-ngindu	Solanaceae	*Solanum*	MB618/AT6		1			1		8.3			Pal	H	Chd	Sar	Méso	RM
***Solanum melongena* L.**	Mbolongo. aubergine	Solanaceae	*Solanum*	MB619/AT10		1			1		4.2			Pan	H	Thd	Sar	Méso	Cu
***Solanum nigrum* L.**	Ngindu-ngindu	Solanaceae	*Solanum*	MB620/AT5		1			1		12.5			Cosm	H	Thd	Sar	Méso	RM
***Solanum* spp**	Binsukula	Solanaceae	*Solanum*	MB621/AT1		1			1		8.3			AT	H	Th	Sar	Méso	Cu
Solanum terminale Forssk.	Ngindu-ngindu	Solanaceae	*Solanum*	MB622/JA47			1		1			2.0		GC	H	Thgr	Sar	Micro	MT
Solanum torvum Sw.	Ngindu-ngindu	Solanaceae	*Solanum*	MB623/AT13		1			1		33.3			Pan	H	Nph	Sar	Méso	RM
Solenostemon latifolius (Hochst. ex Benth.) J. K. Morton		Lamiaceae	*Solenostemon*	MB624/AT11		1			1		4.2			GC	H	Thd	Scl	Nano	RM
Solenostemon monostachyus (P. Beauv.) Briq.		Lamiaceae	*Solenostemon*	MB625/MA10	1				1	7.1				AT	H	Thd	Scl	Nano	RM
Sonchus arvensis L.		Asteraceae	*Sonchus*	MB626/S19				1	1				3.3	Pan	H	Th	Pog	Micro	SB
***Spathodea campanulata* P. Beauv.**	Masamasa	Bignoniaceae	*Spathodea*	MB627/JA35			1		1			4.1		AT	A	MsPh	Sar	Méso	MT
Spermacoce latifolia Aubl.	Faux banda nzazi	Rubiaceae	*Spermacoce*	MB628/AT3		1			1		29.2			Pan	H	Thpr	Scl	Micro	SB
Spermacoce verticillata L.	Zima tiya. kimbundi	Rubiaceae	*Spermacoce*	MB629/AT20		1			1		29.2			Pan	H	Thpr	Scl	Micro	RM
Sphagneticola trilobata (L.) Pruski		Asteraceae	*Sphagneticola*	MB630/AT8		1			1		12.5			Pan	H	Chp	Scl	Micro	RM
Sphenostylis stenocarpa (Hochst. ex A.Rich.) Harms		Fabaceae	*Sphenostylis*	MB631/S14				1	1				3.3	GC	H	Ch	Bal	Lepto	Sp
***Spondias cytherea* Sonn.**	Manga nsendi	Anacardiaceae	*Spondias*	MB632/AT11		1	1		2		4.2	2.0		BGC	A	MsPh	Sar	Méso	Cu
***Spondias mombin* L.**	Mungiengi	Anacardiaceae	*Spondias*	MB633/AT17	1	1	1		3	7.1	4.2	10.2		BGC	A	MsPh	Sar	Méso	Cu
***Stachytarpheta indica* (L.) Vahl**		Verbenaceae	*Stachytarpheta*	MB634/AT18		1	1		2		29.2	2.0		AnT	H	Thd	Sar	Méso	Hy
Staudtia kamerunensis Warb.	Nsusu menga	Myristicaceae	*Staudtia*	MB635/JA5			1		1			6.1		GC	A	MgPh	Bal	Méso	MT
***Steganotaenia araliacea* Hochst.**	Kula mvumbi	Apiaceae	*Steganotaenia*	MB636/S17		1	1	1	3		4.2	10.2	16.7	AT	A	MsPh	Scl	Micro	Hy
Sterculia bequaertii De Wild.	Kinsiedi	Malvaceae	*Sterculia*	MB637/JA6	1		1		2	42.9		10.2		BGC	A	MsPh	Bal	Méso	MT
Sterculia tragacantha Lindl.		Malvaceae	*Sterculia*	MB638/JA29			1		1			2.0		GC	A	MsPh	Bal	Méso	Ha
Stipularia africana P.Beauv.		Malvaceae	*Stipularia*	MB639/MA3	1				1	35.7				GC	B	McPh	Sar	Méso	Ha
Stomatanthes africanus (Oliv. & Hiern) R. M. King & H. Rob.	Zaire	Asteraceae	*Stomatanthes*	MB640/S1				1	1				13.3	CGC	H	Chd	Pog	Micro	Hy
Strombosia grandifolia Hook. f. ex Benth.	Mbota masa	Olacaceae	*Lavalleopsis*	MB641/MA7	1				1	14.3				BGC	A	Msph	Sar	Méso	SP
***Strychnos cocculoides* Baker**	Kalakonki	Loganiaceae	*Strychnos*	MB642/S10			1	1	2			16.3	40.0	AT	A	MsPh	Sar	Méso	Ea
***Strychnos pungens* Soler.**	Bumi	Loganiaceae	*Strychnos*	MB643/S21		1	1	1	3		8.3	8.2	13.3	AnT	A	MsPh	Sar	Méso	Ea
Stylosanthes guianensis (Aubl.) Sw.		Fabaceae	*Stylosanthes*	MB644/S10		1		1	2		25.0		23.3	Pal	H	Chr	Bal	Lepto	Hy

Appendix 4. Distribution level, presence, frequency and autoecological characterization of inventoried species
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Species	Local name	Family	Genus	Specimen number and collection site	Presence of species by plant formation				Sp-Dist. level	Frequency (%) of species by plant formation				Autoecological characteristics of identified plant species					
					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
***Symphonia globulifera* L.f**	Nsongi	Clusiaceae	*Symphonia*	MB645/JA41	1		1		2	7.1		2.0		GC	A	MsPh	Sar	Méso	Ha
***Synedrella nodiflora* (L.) Gaertn.**	Ndia ma nlumba	Asteraceae	*Synedrella*	MB646/AT4		1			1		45.8			Pan	H	Thd	Pog	Micro	RMP
Syzygium guineense (Willd.) DC. Subsp. *guineense*	Kikulu	Myrtaceae	*Syzygium*	MB647/MA11	1				1	7.1				Pan	B	McPh	Sar	Méso	Ha
***Syzygium guineense* var. *macrocarpum* Engl.**	Nkizu mfinda	Myrtaceae	*Syzygium*	MB648/S1			1	1	2			6.1	73.3	AT	A	MsPh	Sar	Méso	MT
Syzygium jambos (L.) Alston	Jambosier	Myrtaceae	*syzygium*	MB649/JA6			1		1			2		Pan	A	MsPh	Sar	Méso	MT
Syzygium malaccense (L.) Merr. & L. M. Perry	Pomme rouge	Myrtaceae	*Syzygium*	MB650/JA35		1	1		2		4.2	2		Pan	A	MsPh	Sar	Méso	Cu
***Tabernaemontana crassa* Benth.**	Makata ma nkewu	Apocynaceae	*Tabernaemontana*	MB651/MA14	1	1	1		3	21.4	8.3	4.1		GC	A	MsPh	Sar	Macro	MT
Tabernaemontana inconspicua Stapf		Apocynaceae	*Pterotaberna*	MB652/JA31			1		1			6.1		BGC	B	MsPh	Sar	Méso	MT
Tacca leontopetaloides (L.) Kuntze	Nkukua kiula	Dioscoreaceae	*Tacca*	MB653/S1				1	1				40.0	Pal	H	Gt	Sar	Méso	Hy
Talinum triangulare (Jacq.) Willd.	Lipopi	Talinaceae	*Talinum*	MB5654/AT2		1			1		8.3			Pan	H	Th	Scl	Micro	RM
Tanacetum cinerariifolium (Trevis.) Sch.Bip.		Asteraceae	*Tanacetum*	MB655/AT9		1			1		4.2			Pan	H	Th	Pog	Micro	RM
Tapinanthus globifer (A. Rich.) *Tiegh.*	Kinkunda	Loranthaceae	*Tapinanthus*	MB656/JA11	1		1		2	7.1		8.2		AOA	Eph	Chéph	Sar	Micro	Sp
***Tapinanthus poggei* (angl.) Danser**	Kinkunda nkunda	Loranthaceae	*Tapinanthus*	MB657/JA6			1		1			8.2		AOA	Eph	Chéph	Sar	Micro	Sp
Tephrosia nana Kotschy et Schweinf.	Bualu nseke	Fabaceae	*Tephrosia*	MB658/S22		1	1	1	3		8.3	2	10.0	AT	B	Nph	Bal	Lepto	Hy
***Tephrosia vogelii* Hook.f.**	Bualu mbaka	Fabaceae	*Tephrosia*	MB659/AT2		1			1		20.8			AT	B	Nph	Bal	Lepto	Cu
Terminalia catappa L.	Lidame	Combretaceae	*Terminalia*	MB660/AT9		1			1		4.2			Pan	A	MsPh	Ptér	Méso	Cu
Terminalia mantaly H. Perrier		Combretaceae	*Terminalia*	MB661/AT9		1			1		4.2			Pan	A	MsPh	Ptér	Nano	Cu
Terminalia superba Engl. & Diels	Limba	Combretaceae	*Terminalia*	MB662/AT9		1			1		4.2			GC	A	MsPh	Ptér	Méso	MT
***Tetracera alnifolia* Willd.**	Nzionzio fioti	Dilleniaceae	*Tetracera*	MB663/JA3	1		1	1	3	7.1		36.7	3.3	GC	L	Phgr	Sar	Micro	Ha
Tetracera masuiana De Wild. et T.Durand	Kikuya ki nseke	Dilleniaceae	*Tetracera*	MB664/JA11			1	1	2			20.4	3.3	AT	H	Chd	Sar	Méso	SG
Tetracera poggei Gilg	Nzionzio vert	Dilleniaceae	*Tetracera*	MB665/JA9	1		1		2	7.1		24.5		GC	L	Phgr	Bal	Méso	MT
Tetracera potatoria Afzel. ex G.Don	Nzionzio neni	Dilleniaceae	*Tetracera*	MB666/JA4	1		1		2	7.1		14.3		GC	L	Phgr	Bal	Méso	Ha
***Tetradenia riparia* (Hochst.) Codd**	Mutuzo	Lamiaceae	*Tetradenia*	MB667/AT2		1			1		4.2			SZ	B	NPh	Scl	Micro	Cu
***Tetrorchidium didymostemon* (Baill.) Pax & K.Hoffm.**	Nsusa	Euphorbiaceae	*Tetrorchidium*	MB668/JA35			1		1			4.1		GC	A	MsPh	Sar	Méso	MT
Thelypteris gongylodes (Schkuhr) Small	Nzonzanga	Aspleniaceae	*Thelypteris*	MB669/MA2	1		1		2	85.7		6.1		ND	H	Grh	Scl	Micro	MT
Thelypteris palustris Schott		Aspleniaceae	*Thelypteris*	MB670/MA2	1				1	42.9				ND	H	Grh	Scl	Micro	Ha

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
Theobroma cacao L.		Malvaceae	*Theobroma*	MB671/AT8		1			1		4.2			Pan	B	McPh	Bar	Méso	Cu
Thomandersia butayei De Wild.		Thomandersiaceae	*Thomandersia*	MB672/JA12			1		1			8.2		GC	A	Nph	Bal	Méso	CT
Thomandersia congolana De Wild. et T.Durand		Acanthaceae	*Thomandersia*	MB673/JA6/			1		1			4.1		BGC	B	NPh	Bal	Méso	SP
Thomandersia hensii De Wild. et T. Durand		Thomandersiaceae	*Thomandersia*	MB674/JA12			1		1			6.1		BGC	A	Nph	Bal	Méso	MT
Tiliacora funifera Oliv.		Menispermaceae	*Tiliacora*	MB675/JA29			1		1			6.1		BGC	L	Phgr	Sar	Méso	MT
***Tithonia diversifolia* (Hemsl.) A. Gray**	Nkadi nkadi	Asteraceae	*Tithonia*	MB676/AT9		1			1		4.2			Pan	H	Chd	Scl	Méso	Cu
Trachyphrynium braunianum (K. Schum.) Baker	Mviyi	Marantaceae	*Trachyphrynium*	MB677/MA8	1		1		2	28.6		6.1		GC	H	mGrh	Sar	Méso	Sp
Trema orientale (L.) Blume	Mundia nuni	Cannabaceae	*Trema*	MB678/AT21		1	1		2		8.3	28.6		Pal	A	Mcph	Sar	Méso	MT
Tribulus terrestris L.		Zygophyllaceae	*Tribulus*	MB679/S19				1	1				3.3	Pan	H	Chd	Bal	Lepto	Hy
Trichilia gilgiana Harms		Meliaceae	*Trichilia*	MB680/JA29			1		1			6.1		GC	A	MsPh	Bal	Méso	Sp
Trichilia gilletii De Wild.	Nsati	Meliaceae	*Trichilia*	MB681/JA6			1		1			8.2		GC	A	MsPh	Bal	Méso	Sp
Triclisia dictyophylla Diels		Menispermaceae	*Triclisia*	MB682/JA35			1		1			2.0		GC	L	Phgr	Sar	Macro	Ha
Tridax procumbens L.		Asteraceae	*Tridax*	MB683/AT1		1			1		16.7			Pan	H	Thd	Pog	Micro	SB
***Trilepisium madagascariense* DC.**	Nsekenia	Moraceae	*Trilepisium*	MB684/JA33	1		1		2	7.1		2		AT	A	MsPh	Sar	Méso	MT
Tristemma mauritianum J.F. Gmel.		Melastomataceae	*Tristemma*	MB685/JA39	1		1		2	21.4		2		AT	B	Chp	Sar	Micro	SB
Triumfetta cordifolia A.Rich.		Malvaceae	*Triumfetta*	MB686/AT2	1	1	1		3	57.1	25	4.1		AT	H	Ch	Desm	Méso	MT
Triumfetta rhomboidea Jacq.		Malvaceae	*Triumfetta*	MB687/S24		1		1	2		37.5		3.3	Pan	H	Ch	Desm	Micro	MT
Uncaria africana G. Don	Koke	Rubiaceae	*Uncaria*	MB688/MA4	1		1		2	21.4		2.0		AFM	L	Phgr	Sar	Méso	Ha
Uraria picta (Jacq.) Desv. ex DC.	Nsunda	Fabaceae	*Uraria*	MB689/S4			1	1	2			2.0	13.3	Pan	H	Chd	Bal	Méso	Hy
***Urena lobata* L.**	Mpungala	Malvaceae	*Urena*	MB690/S24		1	1	1	3		75	6.1	3.3	Pan	H	NPh	Desm	Micro	MT
Vernonia auriculifera Hiern	Mupembe (kinsuunsa)	Asteraceae	*Vernonia*	MB691/S1			1	1	2			2.0	33.3	Pan	B	Thd	Pog	Micro	SB
Vernonia brazzavillensis Aubrév. ex Compère	Mpuku blanc	Asteraceae	*Vernonia*	MB692/JA9			1		1			34.7		CGC	A	MsPh	Pog	Macro	MT
Vernonia cinerea (L.) Moins.		Asteraceae	*Vernonia*	MB693/T24		1		1	2		8.3		3.3	Pan	H	Thd	Pog	Méso	MT
Vernonia daphnifolia O.Hoffm		Asteraceae	*Vernonia*	MB694/S6				1	1				46.7	GC	H	Chd	Pog	Nano	MT
Vernonia guineensis Benth.		Asteraceae	*Vernonia*	MB695/S5				1	1				6.7	GC	B	Grh	Pog	Méso	SG
Vernonia kirungae R. E. Fr.		Asteraceae	*Vernonia*	MB696/S7			1	1	2			4.1	16.7	BGC	B	Chd	Pog	Méso	MT
Vernonia perrottetii Sch. Bip. ex Walp.		Asteraceae	*Vernonia*	MB697/AT16		1			1		8.3			AT	H	Chd	Pog	Micro	Hy
Vernonia potamophila Baker	Kinsunsa	Asteraceae	*Vernonia*	MB698/S5				1	1				3.3	GC	B	McPh	Pog	Méso	Hy
Vernonia smithiana Less.	Mawema ndundu	Asteraceae	*Vernonia*	MB699/S10				1	1				10.0	AT	H	Chd	Pog	Micro	Hy
***Vigna subterranea* (L.) Verdc.**	Nguba zi nsamba	Fabaceae	*Vigna*	MB700/AT10		1			1		4.2			Pan	H	Thd	Sar	Méso	Cu
***Vigna unguiculata* (L.) Walp.**	Bizangi. mbuengi	Fabaceae	*Vigna*	MB701/AT6		1			1		4.2			AT	H	Thd	Bal	Méso	Cu
***Vitex doniana* Sweet**	Fiolongo	Lamiaceae	*Vitex*	MB702/MA4	1	1	1		3	85.7	4.2	22.4		AT	A	MsPh	Sar	Méso	Ha

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					MA	AT	JA	S		MA	AT	JA	S	DG	FB	TB	TD	TF	SP
***Vitex ferruginea* Schumach. & Thonn.**	Kifilu ki mfinda	Lamiaceae	*Vitex*	MB703/S19			1	1	2			4.1	3.3	GC	A	MsPh	Sar	Méso	MT
***Vitex madiensis* Oliv.**	Kifilu nseke	Lamiaceae	*Vitex*	MB704S2		1	1	1	3		8.3	16.3	83.3	AT	A	MsPh	Sar	Méso	Ea
***Voacanga africana* Stapf**	Munkodi nkodi	Apocynaceae	*Voacanga*	MB705/JA4			1		1			12.2		GC	B	MsPh	Sar	Méso	CT
Voacanga chalotiana Pierre et Stapf	Munkodi nkodi	Apocynaceae	*Voacanga*	MB706/JA32			1		1			2.0		BGC	B	MsPh	Sar	Méso	MT
Waltheria indica L.		Malvaceae	*Waltheria*	MB707/ AT8		1	1		2		12.5	2.0		Pan	A	Thd	Bal	Méso	RMP
Whitfieldia elongata (P.Beauv.) De Wild. et T.Durand		Acanthaceae	*Whitfieldia*	MB708/JA5			1		1			4.1		BGC	H	Chd	Bal	Méso	Sp
Xanthosoma sagittifolium (L.) Schott	Mbala makoko	Araceae	*Xanthosoma*	MB709/AT16		1			1		4.2			Pan	H	Gb	Sar	Méga	Cu
***Xylopia aethiopica* (Dunal) A. Rich**	Nkuya nkuya	Annonaceae	*xylopia*	MB710/MA13	1				1	14.3				AT	A	MsPh	Sar	Micro	MT
Zanthoxylum gilletii (De Wild.) PGWaterman	Nungu nkuma	Rutaceae	*Zanthoxylum*	MB711/JA5	1		1		2	7.1		8.2		GC	A	MsPh	Bal	Macro	MT
***Zea mays* L.**	Masangu	Poaceae	*Zea*	MB712/AT23		1			1		12.5			Cosm	H	Hc	Scl	Micro	Cu
***Zingiber officinale* Roscoe.**	Tangawusu	Zingiberaceae	*Zingiber*	MB713/AT24		1			1		4.2			Pan	H	Grh	Sar	Méga	Cu
Zinnia angustifolia Kunth		Asteraceae	*Zinnia*	MB714/AT9		1			1		4.2			ND	H	Th	Scl	Nano	RM

AT: Anthropized vegetation, MA: swamp forest, JA: dryland forest, S : savannah or herbaceous vegetation, AFM: Afro-Malagasy, AnT: African-American or African-Tropical, AOA: Eastern and Southern Africa, AT: Afrotropical, BGC: Lower Guinean-Congolese, C: Congolese, CGC: Central Guinean-Congolese, Cosm: Cosmopolitan, G: Guinean, GC: Guinean-congo, GC-Z: Guinean-congo-Zambezian, Pal: Paleo-tropical, Pan: Pantropical, SZ: Sudano-Zambesian, A: tree, B: shrub, H: herb, L: liana, Mega: megaphyll, Macro: macrophyll, Meso: mesophyll, Micro: microphyll, Nano: nanophyll, Lepto: leptophyll, Aph : aphylla, Bal: ballochore, Bar: barochore, Desm: desmochore, Pleo: pleochore, Pog: pogonochore, Ptér: pterochore, Sar: sarcochore, Scler: sclerochore, P: Phragmitetea, SB: Soncho-Bidentetea, SG : Soncho-Gloriosea, Ha: Halleetea, Hy: Hyparrhenietea; RM: Ruderali-Manihotetea, Cu: Cultivated; Ea: Erythrophloetea africani, MT: Musango-Terminalietea, Sp: Strombosio-Parinarietea, RMP: Ruderali- Manihotetea and post-cultural, Ch: chamaephytes, Chd: erect chamaephytes, Chgr: climbing chamaephytes, Chp: prostrate chamaephytes, Chr: creeping chamaephytes, Cheph: epiphyte chamaephytes, Chsuc: succulent chamaephytes, Gb: bulbous geophyte, Ge: geophyte, Gt: tuberous geophyte, Grh: rhizornate geophyte, Hc: cespitous hemicryptophyte, Lph: lianeous phanerophyte, mG: megageophyte, MgPh: megaphanerophyte, MsPh: mesophanerophyte: McPh: microphanerophyte, NPh: nanophanerophyte, , Th: therophyte, Thd: erect therophyte, Thgr: climbing therophyte, Thpr: prostrate therophyte, Thc: cespitous therophytes, Hydr: hydrophytes, TB : biological type, SP : phytosociological status, TD : diaspore type, TF : leaf size, FB : Biological form, DG : geographic distribution).

Appendix 5. Descriptions of different types of species according to the (%) frequency of occurrence

Type of species	Descriptions
Characteristic	Species that is closely associated with a particular habitat or ecosystem and is not found elsewhere, except accidentally. It is a species that exhibits a strong preference for specific environmental conditions or possesses specific adaptations that enable it to thrive in that particular habitat.
Constant	Species that is constantly present in the majority, if not all ecofloristic plots of a given plant formation. These species are considered as key species and to be reliable indicators of the habitat or plant formation in question. Their regular presence means that they are strongly associated with the given plant formation and that they play an important role in defining its ecological characteristics. They have a high occurrence can be regarded as the most common and abundant species within that plant formation.
Regular	Species frequently observed within a given plant community, but their presence is less systematic than constant species. They may be more sensitive to certain environmental variations or exhibit more specific distribution patterns. Although they are not as common as constant species, they are nevertheless regularly observed during inventories of that plant formation.
Accidental opportunistic	Species that occurs in a particular plant formation due to chance events or temporary favorable conditions, rather than being a natural or established member of that ecosystem. They are characterized by their temporary presence in an ecosystem. They emerge in response to disturbances such as natural disasters, human activities, or environmental changes. These species have the ability to exploit these disturbances or favorable conditions, allowing them to establish transient populations in areas where they are not typically found. These species often exhibit traits such as rapid growth, high reproductive rates, and efficient dispersal mechanisms, which facilitate their quick colonization and exploitation of new environments. Some may successfully establish and naturalize in the area, eventually becoming regular or even invasive species. Their adaptability and capacity to take advantage of available resources contribute to their success in new habitats.
Ubiquitous	Species widely distributed and present in many habitats or plant formation. They have the ability to colonize and adapt to a wide range of environmental conditions. Ubiquitous species have a wide ecological tolerance and are often considered generalists, able to thrive in a variety of habitats.
Transgressive	species found in unusual habitats or beyond its typical range. These species are considered to be ecological transition species. They have the ability to move outside their normal geographical range and colonize plant formations where they are usually rare or absent, generally those that are closely related in the natural order of vegetation succession. They often appear in response to environmental changes, disturbances or interactions with other species. Their presence in unusual habitats serves as an indicator of ecological changes or modifications to the ecosystem.
Rare very rare	species that is uncommon and occurs in low numbers within its geographic range. These species are characterized by their limited population size, making them vulnerable to various threats and susceptible to decline.

Appendix 6. comparison of dissimilarity coefficients between ecofloristic plots by plant formations

Combined Cluster			
Step	Cluster 1	Cluster 2	Coefficients
1	12	14	6,000
2	12	13	10,000
3	11	12	17,000
4	7	8	28,000
5	4	5	38,000
6	4	11	40,000
7	6	9	42,000
8	2	4	42,167
9	7	10	44,000
10	2	7	44,571
11	2	6	46,100
12	2	3	47,333
13	1	2	71,077

a. Dissimilarity coefficients between ecofloristic plots from swap forest

Combined cluster			
Step	Cluster 1	Cluster 2	Coefficients
1	29	30	5,000
2	8	12	5,000
3	6	8	5,500
4	2	6	6,333
5	27	28	8,000
6	1	2	8,250
7	27	29	9,500
8	1	9	9,600
9	1	16	10,333
10	1	4	10,429
11	1	11	11,625
12	13	17	13,000
13	1	3	13,556
14	1	13	14,400
15	14	15	15,000

Combined cluster			
Step	Cluster 1	Cluster 2	Coefficients
16	1	27	15,083
17	1	18	18,375
18	1	7	18,941
19	1	5	20,222
20	1	10	20,895
21	1	22	22,250
22	14	21	23,500
23	1	14	24,254
24	1	20	28,333
25	1	26	36,880
26	1	23	38,769
27	1	25	39,852
28	1	19	40,714
29	1	24	53,586

b. Dissimilarity coefficients between ecofloristic plots from savannahs

Combined clusters			
Step	Cluster 1	Cluster 2	Coefficients
1	23	24	29,000
2	21	23	32,500
3	21	22	35,333
4	15	18	40,000
5	13	19	43,000
6	3	4	45,000
7	15	16	46,000
8	12	14	50,000
9	3	7	50,500
10	10	12	52,000
11	5	21	52,500
12	3	5	53,733

Combined clusters			
Step	Cluster 1	Cluster 2	Coefficients
13	13	15	54,500
14	10	13	56,067
15	3	10	58,313
16	3	17	62,063
17	3	20	63,588
18	1	3	66,389
19	1	6	68,316
20	1	11	69,100
21	1	8	75,714
22	1	2	79,636
23	1	9	130,043

c. Dissimilarity coefficients between ecofloristic plots from anthropized formations

Combined clusters			
Step	Cluster 1	Cluster 2	Coefficients
1	1	2	18,000
2	44	46	19,000
3	48	49	23,000
4	44	45	23,500
5	24	34	25,000
6	1	44	27,333
7	24	29	29,500
8	25	26	30,000
9	1	47	31,200
10	15	23	33,000
11	24	25	33,667
12	24	28	35,400
13	10	24	36,833
14	14	15	37,500
15	9	10	37,714
16	9	30	38,500

Combined clusters			
Step	Cluster 1	Cluster 2	Coefficients
17	9	20	39,111
18	11	22	40,000
19	9	14	40,333
20	17	18	41,000
21	11	21	42,000
22	1	19	43,000
23	11	12	44,000
24	1	9	45,407
25	1	27	46,200
26	1	33	46,905
27	1	11	48,409
28	1	17	49,731
29	31	32	50,000
30	1	8	50,071
31	1	13	52,103
32	1	16	54,167

Combined clusters			
Step	Cluster 1	Cluster 2	Coefficients
33	1	31	56,355
34	39	43	57,000
35	4	5	57,000
36	1	40	59,939
37	1	48	61,676
38	36	38	63,000
39	1	4	64,528
40	41	42	67,000
41	1	7	67,684
42	1	37	72,487
43	1	39	73,750
44	1	36	75,357
45	1	3	76,477
46	1	41	79,100
47	1	35	83,596
48	1	6	86,854

d. Dissimilarity coefficients between ecofloristic plots from dryland forests

Appendix 7. Main phytochemical components of selected potentially effective species

Potentially effective species	UV (>0.05)	IAR (>0.2)	Ailments (ICF≥0.2)	Chemical groups	Main components	References
Aframomum melegueta (Roscoe) K. Schum.	0.04	0.6	Haemorrhoids, Poliomyelitis, Rheumatism	Essential oils, saponins, tannins, terpenes, alkaloids, flavonoids	Trans-β-ocimene, 6-methoxymelene, 6-hydroxymelene, linalool, capsaicin, 6-gingerol, 8-gingerol, methyl-6-gingerol, 6-shogaol; 6-rac-6-dihydro paradol,6-gingeredione, 2-(5-butylfuran-2-yl) ethyl}-2-methoxyphenol, 6-paradol, (-)-buplerol, (-)-arctigenin, (E)- 14-hydroxy-15-norlabda-8(17), 12-dien-16-al, labda-8(17), 12-dien-15, 16-dial, 16-oxo-8(17), 12(E)-labdadien-15-oic acid, 5-hydroxy-7-methoxy flavone, apigenin. *Essential oils in leaf*: Mryrtenyl acetate, iso-limonene, γ-elemene, germacrene-D, βguainene, elemene, longiborneol. *Essential oil of the stem*: caryophyllene oxide, myrtenyl acetate, βeudesmene, β-caryophyllene, β-chamigrene. *Essential oil of the root*: myrtenyl acetate, pinocarvyl acetate, cyperene, caryophyllene oxide, myrtenol, β-caryophyllene, elixene. *The seed essential oil*: α-caryophyllene, β-caryophyllene, linalool, E-nerolidol. Quercetin, kaempferol, DL-Arabinose, hexadecanoic acid, methyl ester, humulene, cis-vacceni acid, d-manose	Onoja *et al.* (2015); Amadi *et al.* (2016) Adigun *et al.* (2016), Ilic *et al*. (2010) Tane *et al.* (2005) Osuntokun (2020) Owokotomo (2014) Amadi *et al.* (2016) Agim *et al.* (2017).
Allium sativum L.	0.03	0.5	Amoebiasis	Flavonoids, steroids, alkaloids, terpenoids, tannins, reducing sugars, phenols	Alliin, ajoenes (E-ajoene, Z-ajoene), thiosulfinates (allicin), vinyldithiins (2-vinyl-(4H)-1,3-dithiin, 3-vinyl-(4H)-1,2-dithiin), sulfides (diallyl disulfide (DADS) Diallyl trisulfide (DATS), s-propyl-cysteine sulfoxide, s-methyl-cysteine sulfoxide, cyanidin-3-(6'-malonyl)-glucoside, allyl disulfides, allyl sulfides, allyl trisulfides, cycloalliin, cysteine, cysteine sulfoxides, cystine, diallyl sulfides, dimethyl sulfides, disulfides, glutathione, methionine, methyl sulfides, pseudoscordine, scordinine, sulfanes, tetrathiol, thiosulfinates, trisulfides, linalool, citral, á-phellandrene, geraniol, propionic aldehyde and valeraldehyde.	Fadiji (2019), Nazir and Chauhan (2019), Ali and Ibrahim (2019), Batiha *et al.* (2020), Phan *et al*. (2019), Butt *et al.* (2009), Choudhary (2008), Lanzotti (2006), Ahmed and Khalid (2014).
Brillantaisia patula T. Anderson	0.05	0.3	Itchy skin rash	Tannins, alkaloids, anthocyanins, polyphenols, steroids, flavonoids, saponins, coumarins	Sitosterol, savenasterol, stigmasterolcampesterol, luteolin, kaemferol, naringenin, quercetin, myricetin, sapogenin, saponine, neochlorogenin -epi-*a*-bisabolol 6-deoxy-*B*-*D*-gulopyranodide, epi-*a*-bisabolol, 6-deoxy-*D*-gulose.	Zabo *et al.* (2019) Faparusi *et al.* (2012), Kalu *et al.* (2019), Foning Tebou *et al.*, (2018) Kalu *et al.* (2019), Asai *et al.* (2012)
Capsicum frutescens L.	0.05	0.3	Rheumatism, Hemorrhoids	Alkaloids, tannins, saponins, flavonoids,	Capsaicinoids, quercetin, luteolin, capsaicin (Bhat and Rajanna, 2017); phenols (caffeic acid and 2,4-di- tert-butylphenol); capsinoids (capsiate and dihydrocapsiate); carotenoids (*β*-carotene, capsorubin,	Otunola (2011), Koffi-Nevry *et al.*

Appendix 7. Main phytochemical components of selected potentially effective species

Potentially effective species	UV (>0.05)	IAR (>0.2)	Ailments (ICF≥0.2)	Chemical groups	Main components	References
				carotenoids, steroids, phenols, anthocyans	antheraxanthin, and β- cryptoxanthin); sesquiterpenoids (canusesnol F); flavones (luteolin, luteolin-apiosylacetyl-glucoside, apigenin-6,8-di- *C*- glucoside and vitexin); flavonols (isoquercetin, rutin, kaempferol-3- *O*- glucoside, kaempherol and myricetin); flavan-3-ols (catechin); vitamins (ascorbic acid and tocopherol); and capsaicinoids (nordihydrocapsaicin, capsaicin and dihydrocapsaicin), chrysoeriol, capsaicin, dihydrocapsaicin, *phenolic compounds* : myricetin, quercetin, kaempferol, luteolin, apigenin, trans-pferulic acid, trans-p-sinapic acid, trans-pferuoyl-*β-D*-glucopyranoside and trans-psinapoyl-*β-D*-glucopyranosi phenylpropanoid glycosides; *monoterpenes* : δ-3-carene,(E)-βocemene ; *sesquiterpenes :* cadinadiene, βionone.	(2012), Olatunji and Afolayan (2019), Sinisgalli *et al.* (2020), Wilbur (2007), Nascimento *et al*. (2014), Rahim (2015)
Chamaesyce hirta (L.) Millsp.	0.02	0.6	Amoebiasis	Reducing sugars, terpenoids, alkaloids, steroids, tannins, saponins, coumarins, quinones, flavonoids, phenols.	Afzelin, quercitrin, myricitrin, rutin, quercitin, euphorbin-A, euphorbin-B, euphorbin-C, euphorbin-D, 2,4,6-tri-*O*-galloyl-*β-d*-glucose, 1,3,4, 6-tetra-*O*-galloyl-*β-d*-glucose, kaempferol, myricitriu, 3,4-di-*O*-galloylquinic acid, 2,4,6-tri-*O*-galloyl-D-glucose, 1,2,3,4, 6-penta-*O*-galloyl-beta-*D*-glucose, Euphorbins A-E, euphorbianin, leucocyanidol, camphol, luteolin, isoquercitrin, caffeic, chlorogenic acids, β-sitosterol-*D*-glucoside, β-sitosterol, stigmasterol, α-amyrin, β-amyrin, taraxerone, taxerol, β-amyrin acetate, taraxerone, 11α, 12α-oxidotaraxerol, methyl 14-methylpentadecanoate, palmitic acid, 5-methyl-1,3-oxazolidin-2-one; 2-amino-3-sulfanylpropanoic acid, S-methyl-*L*-cysteine, chloromorpholin-4-ium, 2,3,5-trimethyl-1 H-pyrrole; niacin or nicotinic acid, 4-amino-4-oxobut-2-enoic acid, 17-carboxyheptadec-9-en-1- ylium, Caffeic, p-coumaric, ferulic, ellagic and gallic acids, kaempferol, 3-glucuronyl-kaempferol, quercetol, quercitrin, rhamnoglucosyl-3-quercetol, chlorogenyl-3-rhamnoside quercetol, 3-*b-D*-glucuronyl-quercetol; leucocyanidol, cyanidin-3,5-diglucoside and pelargonidol-3,5-diglucoside; phorbol, resiniferol, ingenol, betulin, friedelin, lupeol, taraxerol, taraxerone; rhamnose; cycloartenol, methylene-24-cycloartanol, campesterol, b-sitosterol, stigmasterol, Azulene, 2-propenoic acid,3-phenyl, Phytol, Bis(2-ethylhexyl) , Leucocyanidol, quercitol, camphor, aquercitol, taraxerone, campesterol, stgmasterol, 1-inositol, cycloartenol, jambulol, euphosterol, quercetrin, dimethoxy quercetrin, (hirtacoumaroflavonoside) 7-O-(p-coumaroyl)-5,7,4'-trihydroxy-6-(3,3-dimethyl allyl)-flavonol-3-*O-β-D*-glucopyranosyl-(2″→1‴)-*O-α*-l-rhamnopyranoside and (hirtaflavonoside-B) 5, 7, 3'4'-trihydroxy-6-(3, 3-dimethyl allyl)-8-(iso-butenyl)-flavonol-3-*C-β*-dglucopyranoside.	Al-Snafi (2017), Ghosh *et al.* (2019), Lanhers *et al*. (2005), Shanmugam *et al.* (2017), Oyewale *et al*. (2002), Kausar *et al*. (2016)

Appendix 7. Main phytochemical components of selected potentially effective species

Potentially effective species	UV (>0.05)	IAR (>0.2)	Ailments (ICF≥0.2)	Chemical groups	Main components	References
Clerodendrum formicarum Gürke	0.03	0.2	Itchy skin rash	steroids, terpenoids, flavonoids, alkaloids, saponins, tannins	*Flavonoids* (kaempferol, 3-glucuronyl-kaempferol, quercetol, quercitrin, rhamnoglucosyl-3-quercetol, chlorogenyl-3-rhamnoside quercetol, 3-*B*-*D*-glucuronyl-quercetol), *Leuco-Anthocyanes* (leucocyanidol, cyanidin-3,5-diglucoside and pelargonidol-3,5-diglucoside); *Trepenes* (phorbol, resiniferol, ingenol, betulin, friedelin, lupeol, taraxerol, taraxerone, saponin (rhamonidol, rhamonidin, taraxerone, *saponin* (rhamnose); *sterols* (cycloartenol, methylene-24-cycloartanol, campesterol, b-sitosterol, stigmasterol); *terpenoids* (formidiol; 12,16-epoxy-11,14-dihydroxy-6-methoxy-17(15→16)-abeo-abieta5,8,11,13,15-pentanene-3,7-dione; trans-phytol, friedelin and friedlan-3β-ol).	Ahmed *et al.*, (2017) ; Tauseef *et al.*, (2014) ; Ali *et al.* (2010a, 2010b) ; Mahamat *et al.* (2021)
Coffea canephora Pierre ex A.Froehner	0.01	0.5	Sexual weakness or impotence	Steroids, phenols, flavonoids, alkaloids, saponins, terpenoids, essential oils	Mangiferin, caffeine, theobromine, theophylline, trigonelline, choline, sitos-terol, dihidrositosterin, stigmasterol, coffeasterin, aminophylline, kaempherol, quercetin, rutoside, isoquercitrin, sucrose , caffeoylquinic acids, dicaffeoylquinic acids, feruloylquinic acids, p-coumaroylquinic acids, caffeic, quinic, ferulic acids, naringenin; hesperetin, catechins, gallocatechins, pelargonidin, cyanidi, malvidin, prodelphinidins, daidzein, genistein, glycitein, apigenin, luteolin, kaempferol, quercitin, myricetin, cafestol, kahweol	N'guessan *et al.* (2009), Acidri *et al.* (2020), Patay *et al.* (2016), Affonso *et al.* (2016), European Food Safety Authority (EFSA), (2020), Farah and Donangelo (2006)
Cymbopogon citratus (DC.) Stapf	0.02	0.5	Poliomyelitis, Cough	Alkaloids, terpenes, reducing sugars, saponins, tannins, flavonoids, anthroquinones	Quercetin, rutin, kaempferol, myricetin, myrictrin, isoquercitrin, apigenin-7-O-glucoside, caffeic and quinic acids, linalool, citral, geranol, citronellol, myrcene, citrenellal, luteolin, borneol, cineole, geraniol, methanone, menthol, fenchone, fenchyl alcohol, β-ionone, myrcenol, α-elemol, β-eudesmol, Geraniol, Humulene, Viridiflorol, Neral, luteolin, luteolin 7-*O*-glucoside (cynaroside), isoscoparin, 2"-*O*-rhamnosyl isoorientin, quercetin, kaempferol, apigenin, elimicin, catechol, chlorogenic acid, caffeic acid, hydroquinone, cymbopogone, cymbopogonol, geraniol, citronellol, piperitone, elemin, neral, geranial, citral, myrcene.	Unuigbe *et al.*(2019), Ekpenyong *et al.* (2015), Boukhatem *et al.* (2014), Avoseh *et al.*(2015), da Cruz *et al.* (2020), Gebashe *et al.* (2020).
Cyperus articulatus L.	0.03	0.3	Poliomyelitis	Essential oils (terpenoids), flavonoids, saponins,	cyperene, rotundene, cypera-2,4-diene, patchoulenone, β-citronellal, cyperotundone, α-cyperone, cyperene, articulone, copaene, α-corymbolol, β-corymbolone, mandassidione, mustakone, ledol, caryophyllene oxide, cyclocolorenone, α-pinene; pogostol, α-copaene, Myrtenol, cyperotundone,	Azzaz *et al.* (2014); Silva *et al.* (2019), Zoghbi *et al.* (2006)

Appendix 7. Main phytochemical components of selected potentially effective species

Potentially effective species	UV (>0.05)	IAR (>0.2)	Ailments (ICF≥0.2)	Chemical groups	Main components	References
				polyphenols, tannins, quinones, flavonoids	piperitone, β-maaliene, germacrone, cedrol, guaia5-en-11-ol, cyperotundone, cubenene, corymbolol, corymbolone, mandassidion, patchoul-4(5)-en-3-one, eucalyptol; pentylenetetrazol	Nogueira *et al.* (2020), *Olawore et al.* (2006), Muriithi *et al.* (2017), Herrera-Calderon *et al*. (2018).
Desmodium mauritianum (Willd.) DC. (Also named D. incanum)	0.02	0.3	Hernia	Alkaloids, steroids, flavonoids, terpenoids, tannins, coumarins	6-*C*-galactosyl-8-*C*-glucosylapigenin, 6-*C*-glucosyl-8-*C*-galactosylapigenin, 6-*C*-galactosyl-8-*C*-arabinosylapigenin, 6-C-arabinosyl-8-C-galactosylapigenin, 2"-O-glucosyl-8-C-glucosylapigenin, isoschaftoside, schaftoside, isovitexin, vitexin, vicenin-2	Hao *et al*. (2015) Hooper *et al.* (2015)
Dioscorea cayenensis Lam	0.01	1.0	Sexual weakness or impotence	Flavonoids, phenols, saponins, tannins, alkaloids	Beta-carotene, mutatochrome, lutein neoxanthin, violaxanthin, zeta-carotene, phytoene, antheraxanthin, beta-cryptoxanthin, zeaxanthin, C25-epoxy-apocarotenoid persicaxanthin, allantoin, Asperin, gracillin, protodeltonin, protodioscin, protobioside, deltonin, parrisaponin, dioscin, gracillin, progenin III	Padhan and Panda (2020), Lebot et al. (2019), Price *et al*. (2018), Avula (2012)
Elaeis guineensis Jacq.	0.14	0.3	Amoebiasis, Splenomegaly, Rheumatism	Flavonoids, tannins, coumarins, alkaloids, saponins, terpenoids, steroids, phenolic compounds, Reducing sugars	Tetrahydro-trans-3, 4-Furandiol;1-Amino-2,6-dimethylpiperidine; 2,3-dihydro-3,5-dihydroxy-6-methyl-4H-Pyran-4-one, 4-methyl-1-(1-methylethyl)-3-Cyclohexen-1-ol, 5-(hydroxymethyl)-2-Furancarboxaldehyde, D-mannose, 1,6-anhydro-α-*D*-glucopyranose (levoglucosan), 3-tert-butyl-4-hydroxyanisole; 3,4-dihydro-2(1H)-isoquinolinecarboximidamide, 5-isopropenyl-2-methylcyclopent-1-ene-carboxaldehyde ; phytoanticipin, syringic acid, caffeic acid, 4-hydroxybenzoic acid Alpha-bêta-carotene, tocopherols, tocotrienols; epigallocatechin, catechin, epicatechin, epigallocatechin gallate, epicatechin gallate	Abdullah *et al.* (2013), Sasidharan *et al.* (2010), Vijayarathna *et al*. (2012), *Yurnaliza et al*. (2019), Owoyele and Owolabi (2014), Soha *et al.* (2019).
Eleusine africana Kenn.-O'Byrne	0.03	0.4	Splenomegaly	Alkaloids, saponins, tannins, flavonoids, steroids, reducing sugars	Schaftoside, vitexin, isovitexin, orientin, isoorientin	*Condori Penaloza et al. (2018), Yeligar et al.* (2017), Ettebong and Obot (2020)
Corymbia citriodora (Hook.) K. D. Hill & L. A. S. Johnson	0.01	1.0	Cough	alkaloids, flavonoids, saponins, sterols, tannins, phenols	Eucalyptol, citriodiol, citronellal, citronellol, Isopulegol, 2,6-octadiene 2,6-dimethyl, caryophyllene, gerenial, linalool, isopulegol , citronellyl acetate, β-caryophyllene, borneol, menthol, neral, eugenol, limonene, p-menthane-3,8-diol.	Abdo (2019), Buckle (2015), Insuan and Chahomchuen,

Appendix 7. Main phytochemical components of selected potentially effective species

Potentially effective species	UV (>0.05)	IAR (>0.2)	Ailments (ICF≥0.2)	Chemical groups	Main components	References
						2020; Manika *et al.* (2012), Tolba *et al.* (2015).
Gardenia ternifolia Schumach. & Thonn. Subsp.	0.02	0.4	Sexual weakness or impotence, Hernia	Alkaloids, anthocyanins, coumarins, flavonoids, phenols, quinones, saponins, steroids, tannins, terpenoids	Stigmasterol; *β*-sitosterol; quercetin-4,7-*O*-dimethyl ether; naringenin-4,7-*O*-dimethyl-ether; naringenin-7-*O*-methyl ether; kaempferol-7-*O*-methyl ether; gardenifolins A − H; geniposide; β-amyrin; 3,4′dimethoxy-5,7-diacetylflavone; 3,5,3′-trihydroxy-7,4′-dimethoxyflavone; 4,5-dihydroxy-6,7-dimethoxyflavanone;5,4′-dihydroxy-7-methoxyflavanone; 5,7-dihydroxy-3,4′-dimethoxyflavone;5,7-trihydroxy-4′-methoxy flavone; kaempferol-7-*O*-methyl ether; naringenin-7-*O*-methyl ether; naringenin-4,7-*O*-dimethyl-ether	Ochieng *et al.* (2010), Awas *et al.* (2016), Tshitenge *et al.* (2017), Agbodjento *et al.* (2019), Maroyi (2020).
Hallea stipulosa (DC.) J.-F.Leroy	0.03	0.2	Hernia	Tannins, alkaloids, reducing sugars, flavonoids, triterpenes, steroids, coumarins, anthocyanins, saponosides, quinones	*Alkaloids :* rotundifolatein, isorotundifolatein, rhynchophylline, isorhynchophylline, ciliaphylline, rhynchociline, speciophylline, mitraciliatine, uncarine F, uncarine D, Pteropodine (or uncarine C), isomitraphylline, mitraphylline, 9- methoxy-3-epi-α-yohimbine, nauclectone D, nauclefiline, naucleficine, nauclefidine, angustoline, angustine, pentacyclic indole, tetracyclic indole, pentacyclic oxindole, tetracyclic oxindole, isorhynchophilline, strictosamide. *Terpenoids and saponins*: ursolic acid, oleanolic acid, betulinic acid, barbinervic acid, quinovicic acid 3-*O*-*α*-L-rhamnopyranoside, quinovicic acid 3β-*β*-*D*-glucopyranosyl-(1→4)-*α*-L-rhamnopyranosyl-28-*O*-*β*-glucopyranoside, 3-*O*-[*β*-*D*-glucopyranosyl-(1→4)-*α*-lrhamnopyranosyl]quinovic acid, 3-*O*-[*β*-*D*-glucopyranosyl-(1→4)-*α*-L-rhamnopyranosyl]quinovic acid, quinovic acid 3- *O*-*β*-*D*-quinovopyranoside, quinovic acid 3β-*O*-*β*-*D*-glucopyranoside, quinovic acid 3-*O*-*β*-*D*-glucopyranosyl-28- *O*-*β*-*D*-glucopyranoside, quinovic acid, 3-oxoquinovic acid, inermiside I, inermiside II, *β*-*D*-glucopyranosyl-[3-*O*-(*β*-*D*-glucopyranosyl)]quinoviate, 3-*O*-(b-d-6-deoxyglucopyranosyl)-quinovic acid, 3-*O*-[*β*-*D*-glucopyranosyl-(1- >4)-a-l-rhamnopyranosyl]quinovoic acid. *Phenolics*: quercetin, dihydrodiconiferyl alcohol, isolariciresinol, isolariciresinol-3α-*O*-*β*-*D*-glucopyranoside. *Other compounds*: dihydroepinaucledal, sweroside, 1- (2,3,4 trimethyl phenyl) ethanone, phenol 2,5 -dimethyl acetate, 3- acetate pentane-2,4-dione, 4H-pyran 4-one- 3- acetyl-2,6-dimethyl, 5-cholesten-3-phenyl-22, 24-β-diketone, Quinovic acid - 3-*O*-*β*-*D*-quinovopyranoside-27-*O*-*β*-*D*-glucopyranosyl,	Toklo *et al.* (2020)

Appendix 7. Main phytochemical components of selected potentially effective species

Potentially effective species	UV (>0.05)	IAR (>0.2)	Ailments (ICF≥0.2)	Chemical groups	Main components	References
					quinovic acid, ursolic acid, quinovine-*C*-glycoside, 3-*O*-acetyl-βursolic acid, quinovic acid-3-*O*-*β*-*D*-glucopyranoside, oleanolic acid, zygophyloside B, zygophyloside D, daucosterone	
Heinsia crinita (Afzel.) G.Taylor	0.05	0.1	Sexual weakness or impotence	Tannins, reducing sugar, steroids, flavonoids, saponins, alkaloids, polyphenols, terpenoids	Phytol, *n*-Hexadecanoic acid, oleic acid, nonadecanoic acid, 11-octadecenoic acid, heptacosanoic acid, 11-tetradecen-1-ol-acetate, gallic acid, catechin, chlorogenic acid, caffeic acid, ellagic acid, epicatechin, rutin, quercitrin, quercetin, kaempferol, ethylbenzene, 1,4-dimethylbenzene, dodecane, 1-ethyl-3-methyl-benzene, 1,2,3-trimethyl- benzene; naphthalene, phytol, oleic acid, oleic acid, hexadecanoic acid, ethylbenzene, Nonane, 7-oxalic{4.1.0}heptane, 1,2,3-trimethylbenzene, oxalic acid	Okungbowa *et al.* (2017), Ebong *et al*, (2014), Oboh *et al.* (2016), Mgbeje *et al.* (2019), Morah and Ashipu (2017); Iwara *et al.* (2017).
Lantana camara L.	0.01	0.5	Cough	Terpenoids, saponins, tannins, reducing sugars, anthocyanins, steroids.	Eugenol, phellandrene, dipentene, terpineol, geraniol, linalool, cineole, citral, terpinene, *β*-caryophyllene, sabinene, limonene, spathulenol, spatulenol, *β*-gurjunene, bicyclogermacrene, germacrene-D, *y*-elemene, *β*-caryophyllene, *β*-elemene, *α*-copaene, *α*-cadinenepentadecanoic acid, 14-methyl-,methyl ester, tetradecanoic acid, octadecanoic acid, turmerone 2-Methyl-6-(4-methyl-1,3-cyclohexadien-1-yl)-2-hepten-4-one, benzene, (1,1-dimethylbutyl)-(1,1-dimethylbutyl)benzene,2-Methyl-2-phenylpentane, Glutaraldehyde, 2(4H)-benzofuranone, 5,6,7,7a-tetrahydro-4,4,7atrimethyl.	Gorai (2016), Khan *et al.*(2002), Medeiros *et al.* 2012), Bashir *et al.* (2019).
Mangifera indica L.	0.02	0.8	Hemorrhoids	Flavonoids, saponins, steroids, tannins, terpenoids, alkaloids, phenols	Mangiferin, friedeline, *beta*-sitosterol, linamarin, thujene, ocimene, mangiferolic acid, hydroxymangiferonic acid, catechins, quercetin, kaempferol, rhamnetin, anthocyanins, mangiferin, isorhamnetin, fisetin, myricetin, dimethyl mangiferin, homomangiferin, isomangiferin, *α*-carotene *β*-carotene, γ-carotene, auroxanthin, antheraxanthin, neoxanthin, lutein, violaxanthin, zeaxanthin, pinene, limonene, *α*-terpinolene, *D*-carvone, *β*-elemene, *α*-bourbonene, *β*-cubebene, *α*-cubebene, aromadendrene, *α*-humulene, *D*-germacrene, *cis*-caryophyllene, eucalyptol	Helen *et al.* (2013), Pierson *et al.* (2014) Rivera Cambero *et al.* (2017), Bashir *et al.* (2019).
Mondia whitei (Hook. f.) Skeels	0.10	0.3	Itchy skin rash, Sexual weakness or impotence	Reducing sugars, triterpenes, phenolics, flavonoids, tannins, steroids,	2-hydroxy-4-methoxybenzaldehyde, isovanillin, coumarinoligan, loliolide, dopamine, isovalilin, norepinephrine, coumarinolignan, phytol, safranal, linalool, 1-hexanol, heptacosane, (E)-2-hexen-1-ol, propacin, (E)-2-hexen-1-ol, heptacosane, phytol, 1-hexanol, (E)-2-hexanal; 2-hydroxy-p-anysaldehyde; 2-hydroxy-4-methoxybenzaldehyde	Esievo *et al.* (2018), Watcho *et al.*(2013), Aremu *et al.* (2011), Ekalu *et al.* (2019), Idayat and Sherifat (2016), Ngbolua *et al.* (2018a), Likibi *et al.* (2020).

Appendix 7. Main phytochemical components of selected potentially effective species

Potentially effective species	UV (>0.05)	IAR (>0.2)	Ailments (ICF≥0.2)	Chemical groups	Main components	References
Monodora angolensis T. Anderson	0.03	0.4	Hemorrhoids	Phenolics, saponin, alkaloids, tannin, flavonoids, terpenoids	1,1-diphenyl-2-picrylhydrazyl; 2,2'-azinobis(3-ethylbenzothiazoline-6-sulfonic acid, 1,3,3-Trimethyl-2-oxabicyclo[2,2,2] octan-6- ol, eucalyptol; 1,3,3- Trimethyl-2-oxabicyclo[2,2,2] oct-6-yl acetate; 4-(2,2-Dimethyl-6-Methylenecyclohexylidene)-3-methyl-2-butanon; palmitic acid; n-pentadecanoic acid; stearic acid; eicosanoic acid; nonadecylic acid; oleic acid; cis-9-Hexadecenal; 6-(3-methylbut-2-enyl)-1,3-dihydroindol-2-one; annonidine F; 1H-indole-5-carbaldehyde; 6-(3-methyl-2-butenyl)-1H-indole; 6-(3-methylbuta-1,3-dienyl)-1H-indole; 6-(4-Oxobut-2-enyl)-1H-indole; 3-geranylindole; 1-monolinoleoylglycerol; 6,9,12-octadecatrienoic acid benzyl ester; 3-hydroxyspirost-8-en-11-one; ethyl-3,4,5-trimethoxybenzoate; palmitic acid (hexadecanoic); ursodeoxycholic acid; glycerol; α-cymene, γ-terpinene; nopinane; limonene; carvotanacetone; β-pinene; aromadendrene; germacrene; *α*-amorphene; copaene; myristicin; caffeic acid; elemicin; eugenol.	Agiriga and Siwela (2018), Adewole *et al.* (2013), Amoa *et al.* (2013), Nkunya *et al*. (2004), Tamfu *et al.* (2020), Obonga *et al.* (2019)
Musa x paradisiaca L.	0.02	0.3	Rheumatism	Tannins, saponins, flavonoids, alkaloids, polyphenols, reducing sugars, steroids, terpenoids.	*β*-carotene, delphinidin, pelargonidin, peonidin, malvidin, ethanol, *α*-tocopherol, flavonones, flavones, dihydroflavonols, flavonols, flavan 3-ols, anthocyanidins, isoflavones, proanthocynidins, β-sitosterol, quercetin, cyanidin-3-rutinoside, delphinidin, pelargonidin, peonidin, malvidin, petunidin, apigenin, capsaicin, isorhaemnetin, caffeic acid, kampferol, quercetin, gingerol, glycitein, *p*-hydroxybenzoic acid, shogaol, ellagic acid, gallic acid, rutin, myricetin, naringenin, phytol, octadecatrienoic acid, hexadecanoic acid, octadecadienoic, beta-tocopherol, estragole, hexadecanoic acid ethyl, epicatechin, gallocat-echin, p-coumaric acid ethyl ester; 1,2 benzenedicarboxylic acid mono (2-ethylhexyl) ester, *trans-beta* carotene, (S)-(+)-6-methoxy-*α*-methyl-2-naphthaleneacetic acid, sesamin, quercetin, lectin, kaempferol, dopamine, caffeoylquinic acid, anigorufone, campesteryl glucoside, cycloartenol, delphinidin-3-rutinoside, episesamin, methoxyanigorufone, naproxen, apigenin, *β*-sitosterol.	Onyenekwe *et al*., (2013), Mahmood *et al.* (2011), Kibria *et al.* (2019), Alexandra Pazmiño-Durán *et al.* (2001), Lavanya *et al*.. (2016), Shodehinde and Oboh (2013), Behiry *et al.* (2019), Ahmed *et al*. (2020), Mathew and Negi (2017)
Musanga cecropioides R. Br.	0.01	1.0	Laryngitis	Phenols, coumarins, tannins, flavonoids, saponins, anthraquinones,	Kalaic, musangic and cecropioic acid; isovitexin, vitexin, chlorogenic acid, catechin, procyanidins, sorientin, isoorientin; protocatechuic acid, protocatechualdehyde, salbutamol, phentolamine, chromone, methyl tormentate, methyl 2-acetyltormentate, methyl 28-glucosyltormentate, methyl pomolate, methyl euscaphate, methyl cecropioate	Ibitoye *et al.* (2020), Tchouya and Nantia (2015), Teme and Nwidu (2018), Nyunaï *et al.* (2016),

Appendix 7. Main phytochemical components of selected potentially effective species

Potentially effective species	UV (>0.05)	IAR (>0.2)	Ailments (ICF≥0.2)	Chemical groups	Main components	References
				alkaloids, terpenoids reducing sugars		Ayinde *et al.* (2007) Dongmo *et al.* (2002), Lontsi *et al.* (1998)
Newbouldia laevis (P.Beauv.) Seem. ex Bureau	0.03	0.3	Sexual weakness or impotence	Flavonoids, terpenoids, tannin, alkaloids, phenols, coumarins, quinone	Apigenin, hyperin, phenyl 2-phenoxy ethyl beta -2-phenoxy ethyl-3-propanoate, benzene-(1-methyl nonadecyl), 6-phenyl undecane, eicosyne, acid methyl hexadecanoester, *n*-hexadecanoic acid, *z*-octadecanoic acid, 9-octadecanoic acid, phytol, oleic acid, octadecanoic acid, squalene.	Olounlade *et al.*, (2020), Osigwe *et al.* (2017), Iwu *et al.* (2018)
Ocimum gratissimum L.	0.08	0.3	Otitis, Rheumatism	Alkaloids, phenols, steroids, tannins, flavonoids, terpenoids, saponins, quinones, coumarins, steroids	Estragol, eugenol, linalool, cineol, pinene, citral, methylcinnamate, methylchavicol, camphor, benzoic acid, ursolic, oleanolic acids, 1,8-cineole, cirsimaritin, isothymusin, xanthomicrol, luteolin, thymol, eugenol, geraniol, cirsiliol, camphene, cymene, terpineol, cineole, terpinene, spathulenol, caryophyllene, Methylchavicol rosmarinic acid, salvigenin, trans-ferulic acid, xanthomicrol, cirsimaritin, rutin, kaempferol, vicenin, luteolin, apigenin, vitexin, isovitexin, quercetin, cirsimaritin, isothymusin, xanthomicrol, hymenoxin, nevadensin, basilimoside, thymol, thymol p-cyme, γ-terpene, t-sabiene hydrate, *β*-phellandrene, limonene, eugenol, eugenol spathulenol, geraniol, eugenol γ-muurolene, 1,8-cineole, gratissimol, germacrene-D, β-caryophyllene, xantomicrol, cirsimaritine, beta-selinene, citral, ethyl cinnamate, linalool, methyl eugenol, pinene, camphor, cis-ocimene, trans-ocimene, trans-carypohyllene, germacrene-D, farnesene, l-bisabolene, bisaboline, oleanolic acid, 1,8-cineole, terpinolene γ-terpinene, p-cymene, thymol, eugenol, methyl chavic, gratissimol, P-cymene, ɣ terpene, trans sabiene hydrate, euginol, 1,8-cineole, linalool, methyl eugenol, *cis*-ocimene, pinene, camphor, germacrene-D, trans-carypophyllene, farnesene, 1-bisabolene, bisabolin, citral, ethyl cinnamate, ɣ terpinene, limonene, terpinolene, oleanolic acid, β-caryophyllene, farenesene, α-terpineol, *β*-salinene, methylisoeugenol, αcopaene, bisabolol, *α*-pinene, fenchone, cubenene, camphene, *T*-cadinol, ɣ-eudesmol, sabinene, myrcene, *β*-bisoboline, *α*-humelene, *β*-elemene.	Nicolas (2012), Galindo *et al.* (2010), Vieira *et al.* (2001), Pandey, (2017), *Bhavani et al.* (2019),
Pentadiplandra brazzeana Baillon	0.06	0.2	Hernia, Laryngitis	Alkaloids, Tannins, Saponins, Essential oils, Terpenes	Benzyl isothiocyanate, benzyl cyanide, benzyl-, 3-methoxybenzyl-, 4-methoxybenzyl-, 3,4-dimethoxybenzyl-, choline, methyl N-benzylthiocarbamate, methyl N-methoxybenzylthiocarbamate, ethyl, benzyl, 4-methoxybenzyl glucosinolates, glucotropaeolin, glucolimnanthin, glucoaubrietin, 3,4-	Ngbolua *et al.* (2018b), Alagbe *et al.* (2020), Kitamura *et al.* (2015), De

Appendix 7. Main phytochemical components of selected potentially effective species

Potentially effective species	UV (>0.05)	IAR (>0.2)	Ailments (ICF≥0.2)	Chemical groups	Main components	References
					dimethoxybenzylGL, glucobrassicin campholenol, benzylcyanide, benzylisothiocyanate, p-methoxybenzylcyanide	Nicola *et al.* (2012), Ndoye Foe *et al.* (2016).
Piper nigrum L.	0.03	0.4	Hemorrhoids	Terpenoids, flavonoids, alkaloids, reducing sugars, steroid, phenol, quinones, saponin, tannin	Piperine, phellandrene, caryophyllene, sabinene, pinene, piperine, piperidine, tuyaurettine, piperanine, chavicine, guineensine, piperamide, piperamine, piperettine, pipericide, piperine, piperolein, trichostachine, sarmentine, sarmentosine, tricholein, retrofractamide, gluulol, *α*-pinene, *β*-caryophyllene and α-terpinene, chavicin, piperidine, piperetine, tricostacin, peepuloidin, piplartin, trichonine	Nicolas (2012), Saranraj *et al*., (2014), Srivastava and Singh (2017).
Sarcocephalus latifolius (Sm.) E. A. Bruce	0.03	0.2	Hernia	Tannins, Flavonoids, alkaloids, Saponins, terpenes, coumarins,	Flavones, flavonols, dihydroflavonols, tangetin, catechin, strictosamide, 19-*O*-ethylangustoline, angustine, angustoline, angustidine, nauclefine, latifoliamide, strictosamide, tramadol, naufoline, naulafine, *β-D*-glucopyranose, α-methylmannopyranoside.	Ikpefan *et al.* (2014), Souley Kallo *et al.* (2018), Bolaji *et al.* (2018), Haudecoeur *et al.* (2018), Mgbeje and Abu (2020), Plassart (2015), Wang *et al*. (2011)
Sarcocephalus pobeguinii Pobeg.	0.03	0.3	Hernia	Alkaloids, coumarins, flavonoids, glycosides, anthocyans, saponosides, steroids, tannins and terpenoids	Strictosamide, ajmalicine, angustine, naufoline, angustoline, nauclefine, *O*-acetyl-angustoline, 3,14-dihydro-angustine, nauclequiniine, (5S)-5-carboxystrictosidine, 19-*O*-methylangustoline, 3-O--fucosylquinovic acid, 3-ketoquinovic acid strictosamide, naucleidinic acid, 19-*O*-methyl-3,14-dihydroangustoline, naucleidinal, magniflorin, naucleofficin D, strictosidine, desoxycordifolin, 3α,5α-tetrahydrodeoxycordifolin lactam, kelampayoside A.	Dhooghe *et al.* (2008), Yüce *et al.* (2019), Mesia *et al.* (2010), Xu *et al.* (2012)
Securidaca longepedunculata Fresen.	0.04	0.3	Poliomyelitis, Rheumatism	Alkaloids, flavonoids, saponins, tannins, quinones, steroids, reducing sugars, terpenes	1-heptadecene; 1-nonadecene; 1,2-benzenedicarboxylic acid; bis (2-methylpropyl) ester; 7,9-Di-tert-butyl-1-oxaspiro (4,5) deca-6,9-diene; 1-decanol, 2,2-dimethyl; 5-octadecenal; *n*-nonadecanol; *n*-tetracosanol; octasiloxane 1,1,3,3,5,5, 7,7,9,9,11,11,13,1315,15-hexadecamethyl; 1-pentadecene; ethylhexyl bis(2-phthalate; presenegenin; Rutin; securinin; *β*-Sitosterol; 1,7-dihydroxy-4-methoxyxanthone; quercetin-3-*O*-*D*-xyloside; stigmasterol-3-*O*-*D*-glucopyranoside; quercetin; *p*-	Ogukwe *et al.* (2012), Mongalo *et al.* (2015), Meyer *et al*. (2008), Stevenson *et al.* (2009),

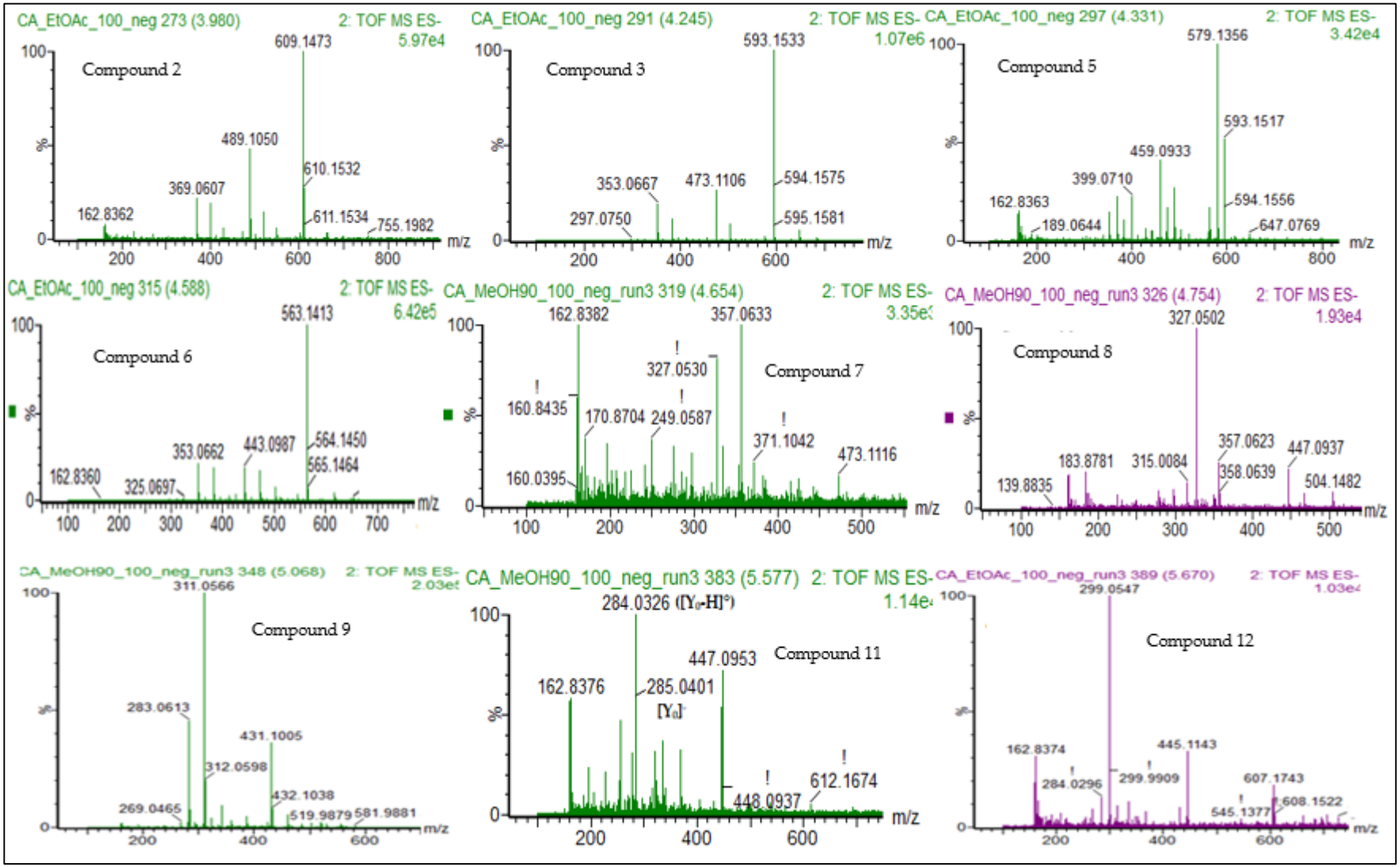
Appendix 7. Main phytochemical components of selected potentially effective species

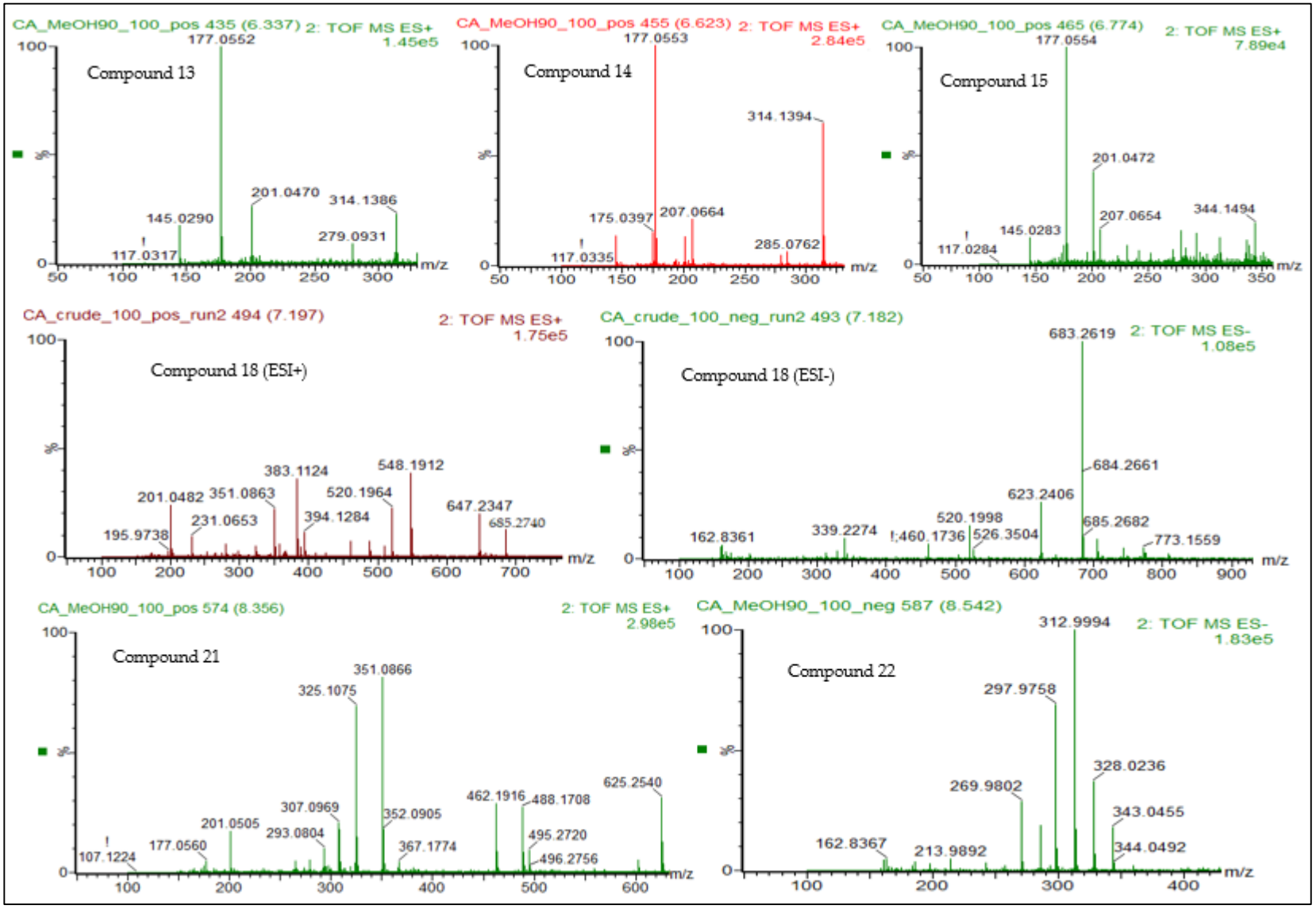
Potentially effective species	UV (>0.05)	IAR (>0.2)	Ailments (ICF≥0.2)	Chemical groups	Main components	References
					coumaric acid; cinnamic acid; caffeic acid; chlorogenic acid; methyl salicylate; methyl 2-hydroxy-6-methoxybenzoate; securidacaside A&B; sapogenin; senegin; elymoclavine; dehydroelymoclavine; 3,4,5-tri-o-caffeoylquinic acid,4,5-di-*O*-caffeic acid; sinapic acid; securidacaxanthone A; securinine, 1,3,6,8-tetrahydroxy-2,5-dimethoxyxanthone; 1,6,8-trihydroxy-2,3,4,7-tetramethoxyxanthone; securidacaside A & B; tenuifoline, prosapogenin.	Mitaine-Offer *et al*. (2010)
Steganotaenia araliacea Hochst.	0.01	1.0	Hernia	Alkaloids, flavonoids, tannins, coumarins, steroids, phenols	*α*-pinene, *β*-caryophyllene, germacrene D, *β*-pinene, limonene, αcubebene, α-copaene, *cis*-muroladien, *trans*-*α*-bergamotene, *α*-guaien, *α*-caryophyllene, δ-cadinene, ar-curcumene, *cis*-calamene, caryophyllene, araliangin, neoisostegan, prestegan A, prestegan B, steganacin, steganolide A-B-C, steganone, barringtogenol C, steganogenin, *O*-Xylene , 2-ethylhexanal, cadinanol, citronellol, cumene, muuroladien, trichocolein, citronellol, methylcitronellate, *β*-citronellene, methylcitronellate, cyclohexanemethanol, muuroladien, , falcarinol, apiol, scoparone, stigmasterol, myristicin, 1-dodecosanol, nonacosanol, hexacosene, myristicin, 4-allyl-1,2-dimethoxy-benzene, p-menth-1-en-8-ol, acetate, p-Menth-1-en-8-ol, p-Menth-1-en-4-ol, α-Linalool, *m*-cresol, *α*-Pinene, spiropreussomerin A, conrauiflavonol/afzelin A, steganoprotoflavanone, steganangin, steganacin, episteganangine, steganoate A&B, steganolide A, protosteganoflavanone	Ojerinde *et al*. (2013), Demoz *et al.* (2014), Capistrano *et al*. (2015), Okwu and Omodamiro (2006).
Xylopia aethiopica (Dunal) A. Rich.	0.03	0.2	Hernia	Saponins, terpenes alkaloids, saponins, tannins, reducing sugar, flavonoids quinones, steroids	α-β-pinene, myrcene, p-cymene, limonene, linalool, guaiol, elemol, 1,8-cineole, linalool, vanillin, thymol, α-thujene, α-pinene, ethyl-2-methylbutanoate, decanal, camphene, sabinene, β-pinene, α-terpinene, αphellandrene, limonene, 1, 8-cineole, trans-β-ocimene, β-phellandrene, p-mentha-3, 8-triene, 3-cerene, myrtenol, αterpinol, terpinen-4-ol, α-fernessene, β-citroneollol, graniol, fenchone; Xylopic acid, kauran, oxophoebin, liriodenine, oxoglaucine, *O*-methylmoschatoline, lysicamine, xylopioxide, 15-oxo-ent-kaur-16-en-19-oic acid, ent-kaur-16-en-19-oic acid, trachyloban-19-oic acid, 7β-hydroxytrachyloban-19-oic acid, lupeol, isotetrandrine, 7α-hydroxytrachyloban-19-oic acid, kolavenic acid, 2-oxo-kolavenic acid, pinene, sabinene, cineole, linalool, β-eudesmol, transpinocarveol, p-cymene, α-cadinol, α-pinene, sabinol, xylopic acid, caffeic acid, chlorogenic acid, ellagic acid, apigenin, rutin, kaempferol, quercetin, kaempferol, quercitrin	Aguoru *et al.* (2016), Ogbuagu *et al.* (2020), Omoregie *et al.* (2015), Fetse *et al*. (2016), Omoba *et al*. (2019), Oso *et al.* (2018).
Zingiber officinale Roscoe	0.04	0.5	Hemorrhoids, Intestinal parasitosis	Alkaloids, tannins, saponins, flavonoids, terpenoids, phenolic compounds, steroids	Zingerone, gingerodiol, zingibrene, gingerols, shogaols, zingiberene, curcumene, farnesene, zingiberol, D-camphor, diarylheptanoids, paradol, zerumbone, 1-dehydro-(10) gingerol, paradol, zerumbone [6]-gingerols, [8]-gingerols, [10]-gingerols, 1,7-bis-(40-Hydroxy-30-methoxyphenyl)-3,5-heptadione, adenine, 1-dehydro-3-dihydro-[10]-gingerdione, acetoxy-6-dihydroparadol, [4]-Isogingerol, 5-	Otunola (2011), Wakchaure and Ganguly (2018), Tariq (2015),

Appendix 7. Main phytochemical components of selected potentially effective species

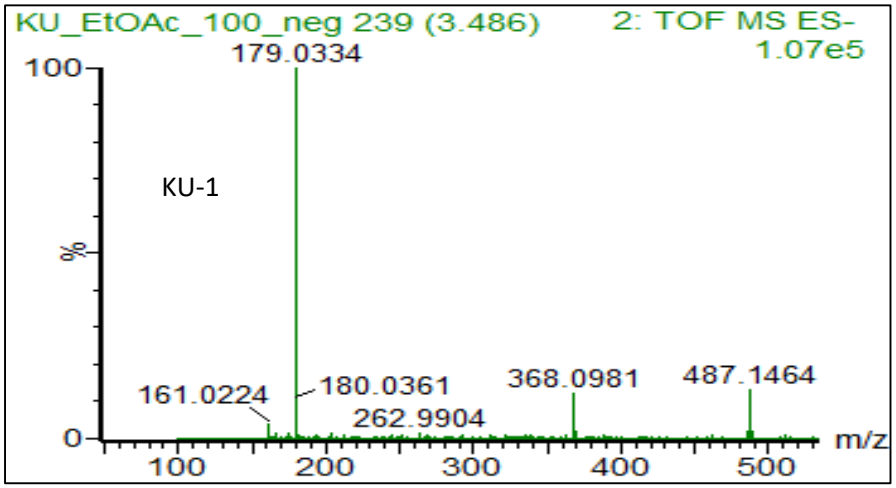
Potentially effective species	UV (>0.05)	IAR (>0.2)	Ailments (ICF≥0.2)	Chemical groups	Main components	References
					methoxy-[6]-gingerol, methyl diacetoxy-[4]-gingerdiol, methyl diacetoxy-[10]-gingerdiol, 1-dehydro-[3]-gingerdione, acetoxy-[4]-gingerol, [4]-shogaol, [6]-shogaol, [8]-shogaol, [10]-shogaol, [12]-shogaol, [6]-paradol, [7]-paradol, [8]-paradol, [9]-paradol, [10]-paradol, [11]-paradol, [13]-paradol, 1-(40-hydroxy-30-methoxyphenyl)-7-octen-3-one, 1-(40-hydroxy-30-methoxyphenyl)-7-decen-3-one, beta-sitosterol palmitate, isovanillin, glycol monopalmitate, hexacosanoic acid 2,3-dihydroxypropyl ester, maleimide-5-oxime, p-hydroxybenzaldehyde, 1-(omega-ferulyloxyceratyl) glycerols	(Kumar and Lalramnghinglova (2011)

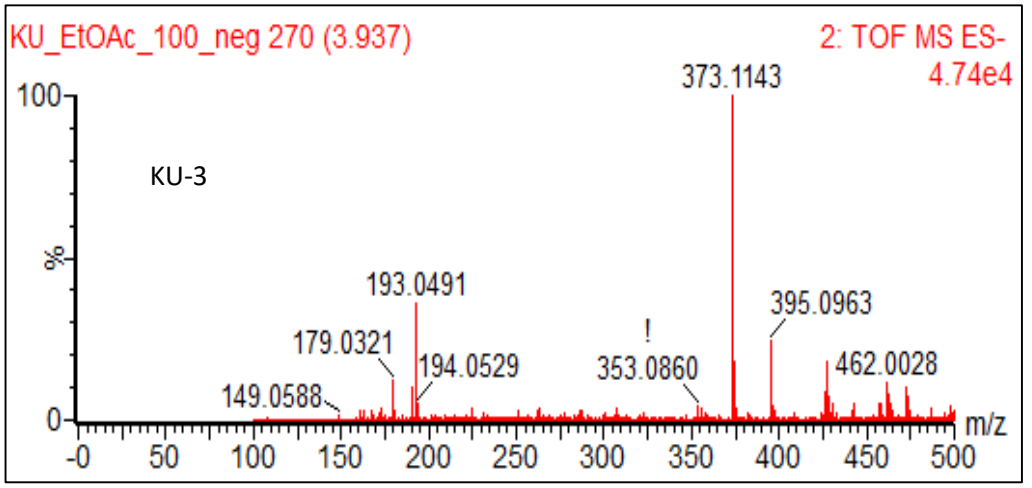
Appendix 8. UPLC-ESI-MS/MS spectra of compounds ***C2-C3***, ***C5-C9***, ***C11-C15***, ***C18*** *and* ***C21-C22***

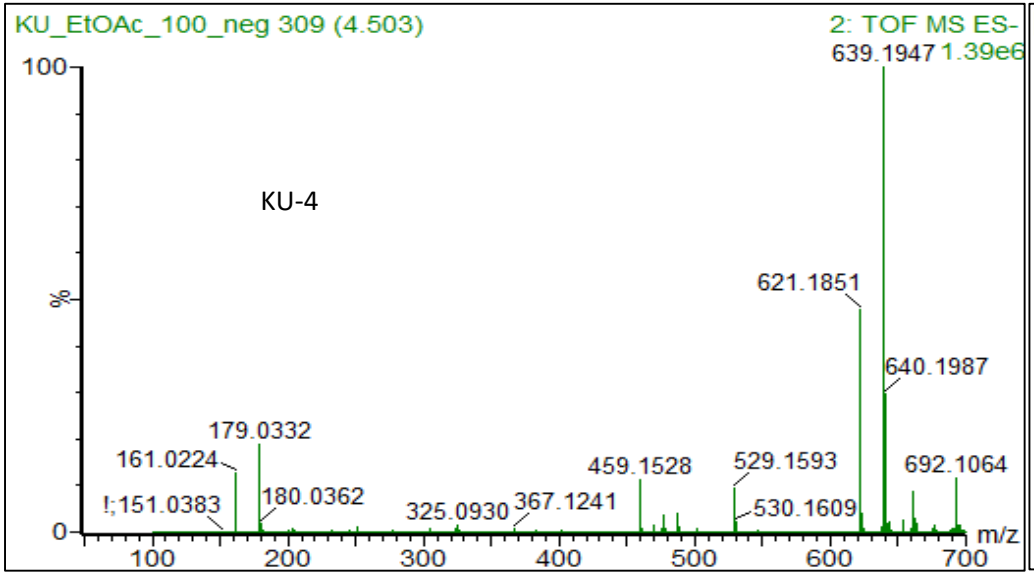


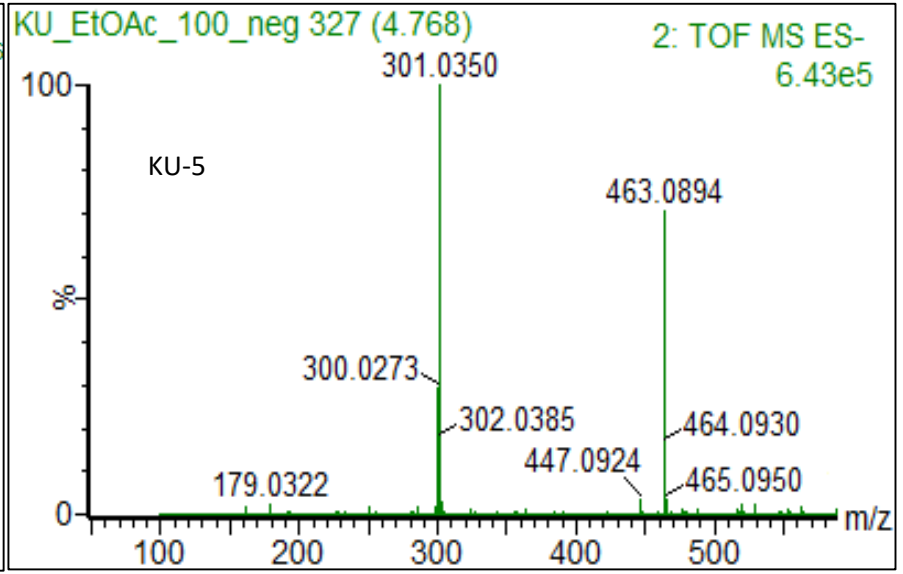

CA_MeOH90_100_pos 435 (6.337) 2: TOF MS ES+ 1.45e5
Compound 13
177.0552
201.0470
314.1386
145.0290
279.0931
117.0317
CA_MeOH90_100_pos 455 (6.623) 2: TOF MS ES+ 2.84e5
Compound 14
177.0553
314.1394
175.0397
207.0664
285.0762
117.0335
CA_MeOH90_100_pos 465 (6.774) 2: TOF MS ES+ 7.89e4
Compound 15
177.0554
201.0472
207.0654
344.1494
145.0283
117.0284
CA_crude_100_pos_run2 494 (7.197) 2: TOF MS ES+ 1.75e5
Compound 18 (ESI+)
383.1124
548.1912
201.0482
351.0863
520.1964
647.2347
231.0653
394.1284
685.2740
195.9738
CA_crude_100_neg_run2 493 (7.182) 2: TOF MS ES- 1.08e5
Compound 18 (ESI-)
683.2619
684.2661
623.2406
520.1998
685.2682
162.8361
339.2274
460.1736
526.3504
773.1559
CA_MeOH90_100_pos 574 (8.356) 2: TOF MS ES+ 2.98e5
Compound 21
351.0866
325.1075
625.2540
462.1916
488.1708
307.0969
352.0905
201.0505
293.0804
495.2720
177.0560
367.1774
496.2756
107.1224
CA_MeOH90_100_neg 587 (8.542) 2: TOF MS ES- 1.83e5
Compound 22
312.9994
297.9758
328.0236
269.9802
343.0455
162.8367
213.9892
344.0492

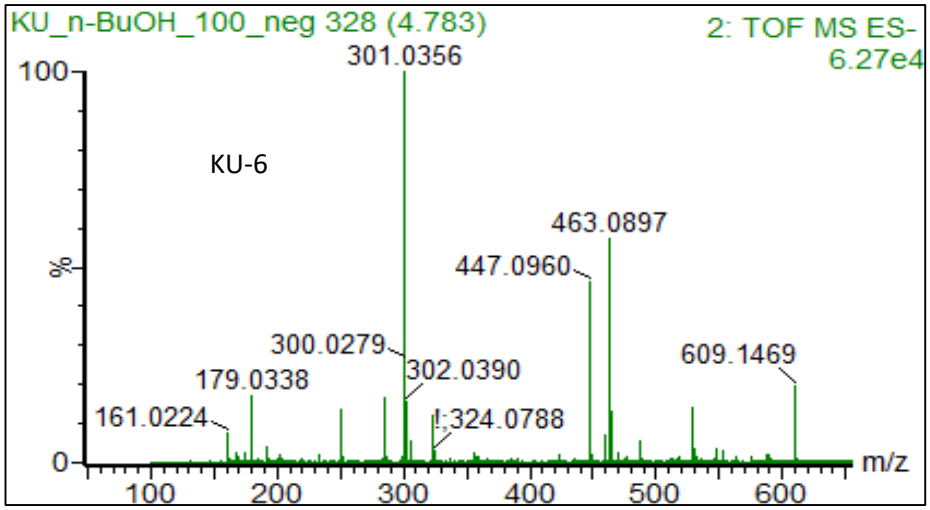
Appendix 9. UPLC-ESI-MS/MS spectra of compounds **K1, K3-K17, K20, K22 and K23**

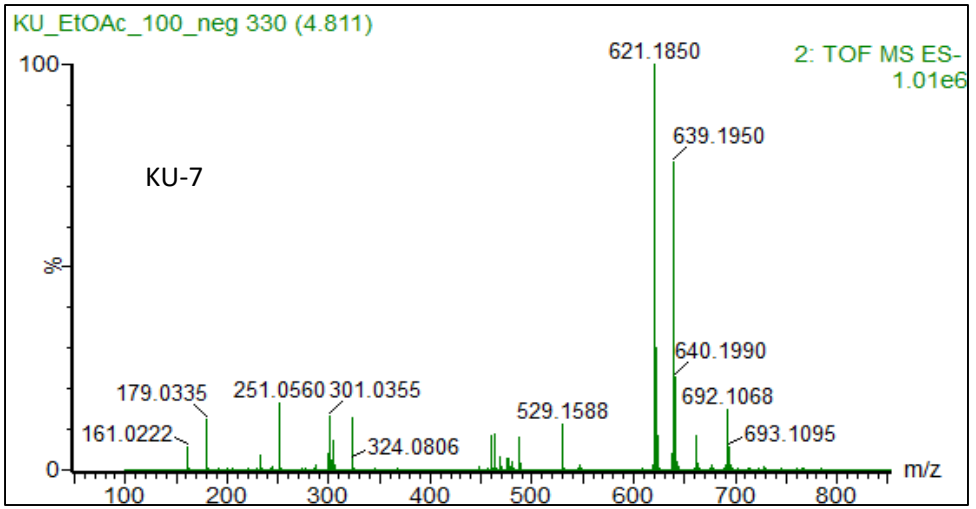


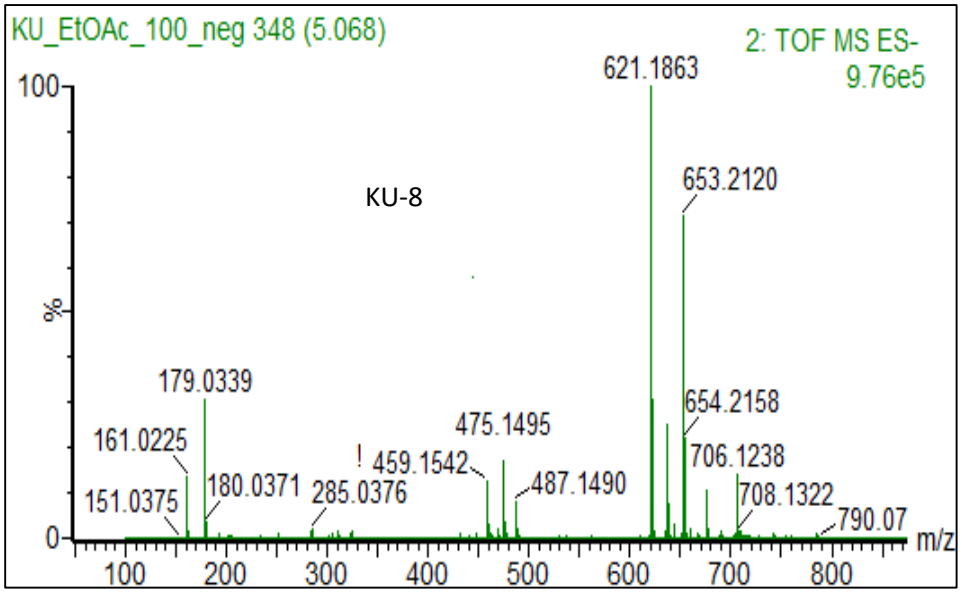


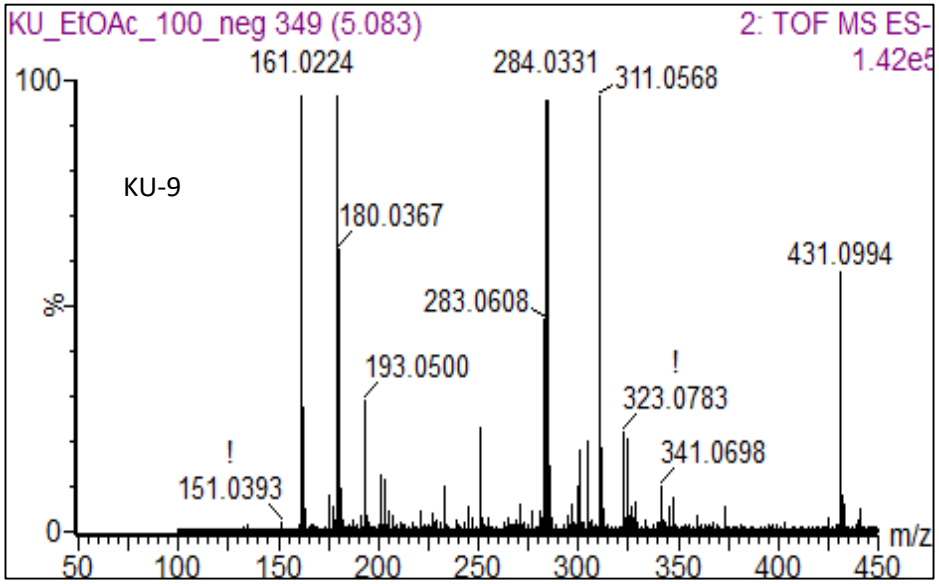


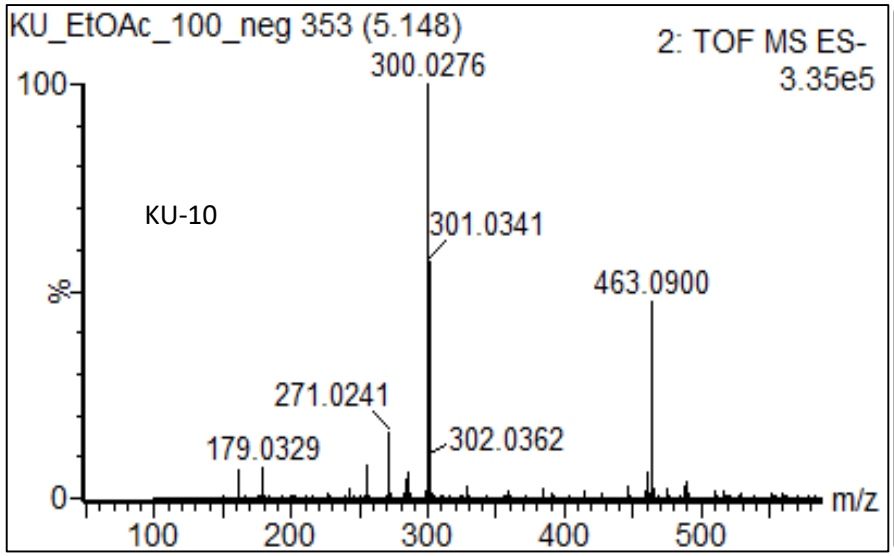


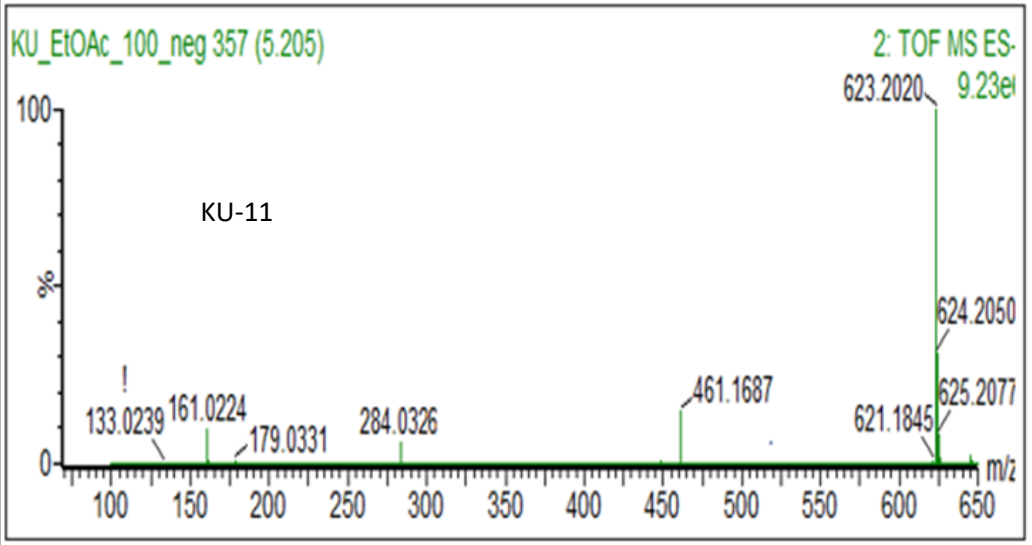

KU_n-BuOH_100_neg 328 (4.783)
2: TOF MS ES-
6.27e4
KU-6
301.0356
463.0897
447.0960
300.0279
302.0390
179.0338
609.1469
161.0224
324.0788
m/z

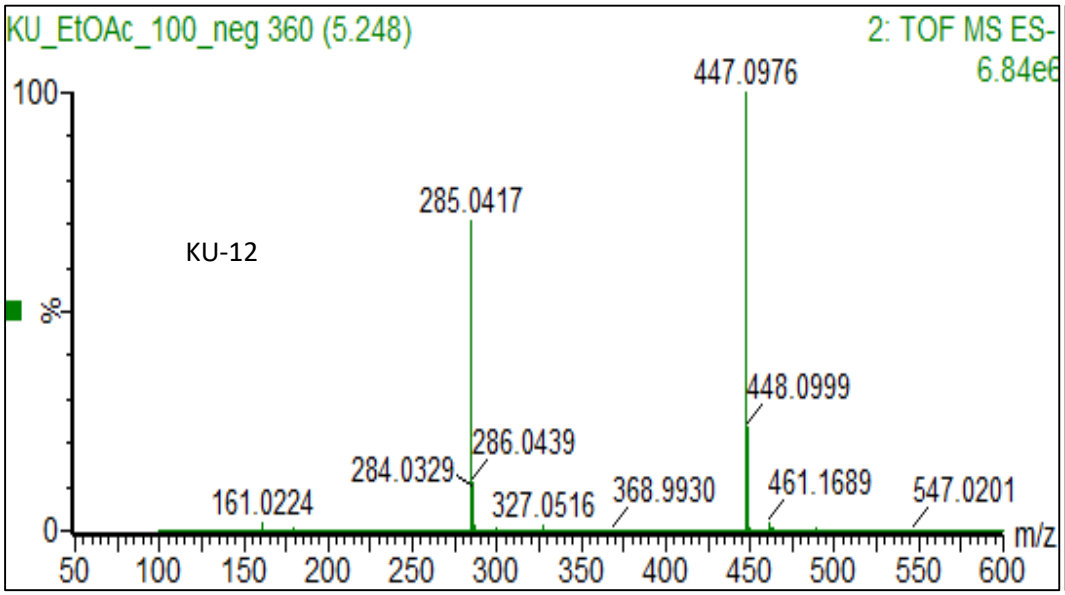

KU_EtOAc_100_neg 330 (4.811)
2: TOF MS ES-
1.01e6
KU-7
621.1850
639.1950
640.1990
692.1068
693.1095
179.0335
251.0560
301.0355
529.1588
161.0222
324.0806
m/z

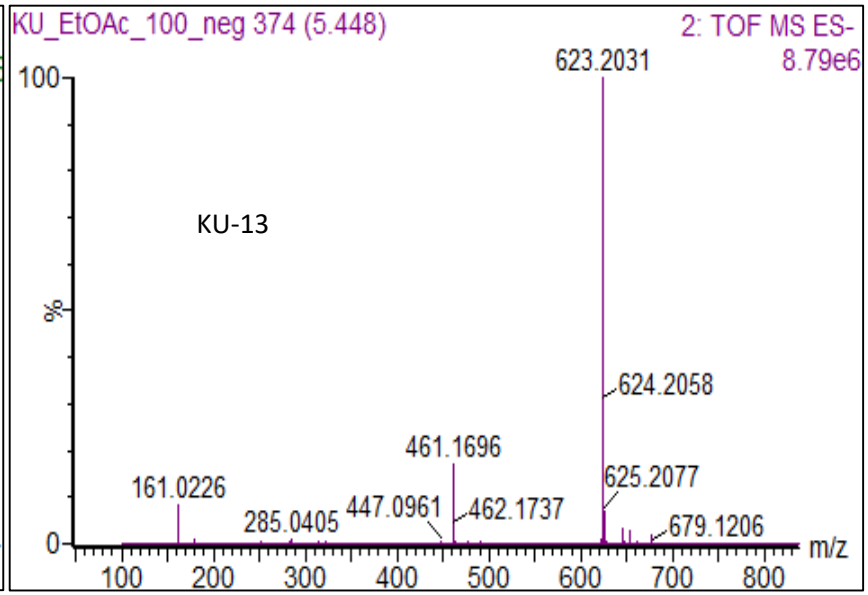

KU_EtOAc_100_neg 348 (5.068)
2: TOF MS ES-
9.76e5
KU-8
621.1863
653.2120
654.2158
706.1238
708.1322
790.07
179.0339
161.0225
180.0371
151.0375
285.0376
459.1542
475.1495
487.1490
m/z

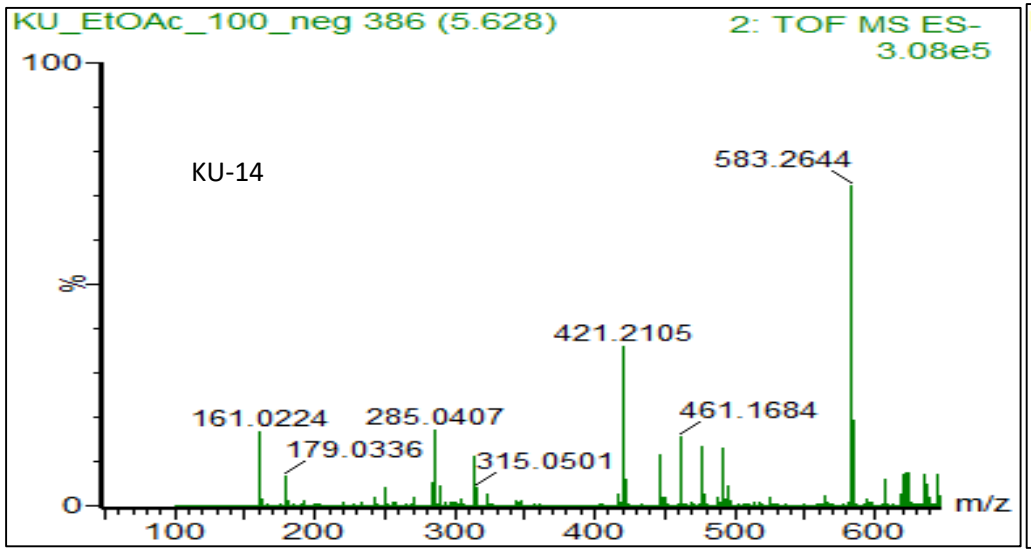

KU_EtOAc_100_neg 349 (5.083)
2: TOF MS ES-
1.42e5
KU-9
161.0224
284.0331
311.0568
180.0367
431.0994
283.0608
193.0500
323.0783
341.0698
151.0393
m/z

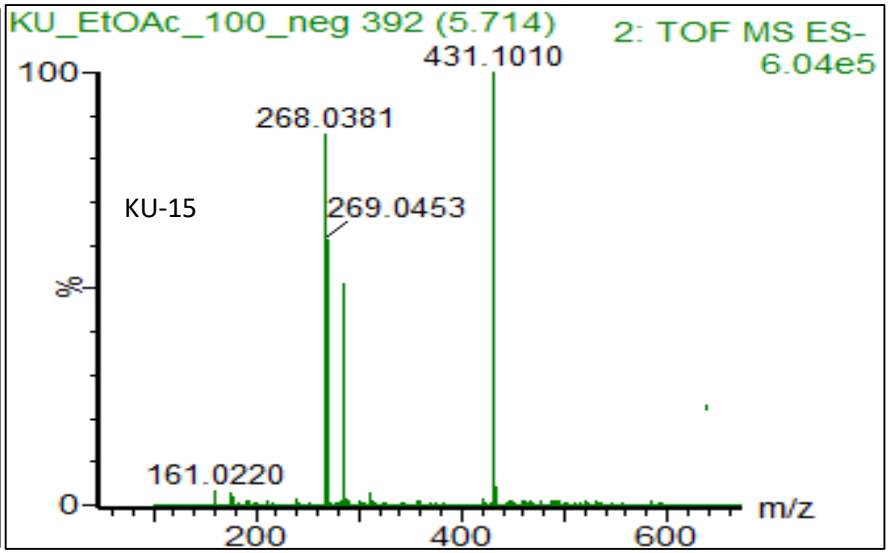

KU_EtOAc_100_neg 353 (5.148)
2: TOF MS ES-
3.35e5
KU-10
300.0276
301.0341
463.0900
271.0241
302.0362
179.0329
m/z

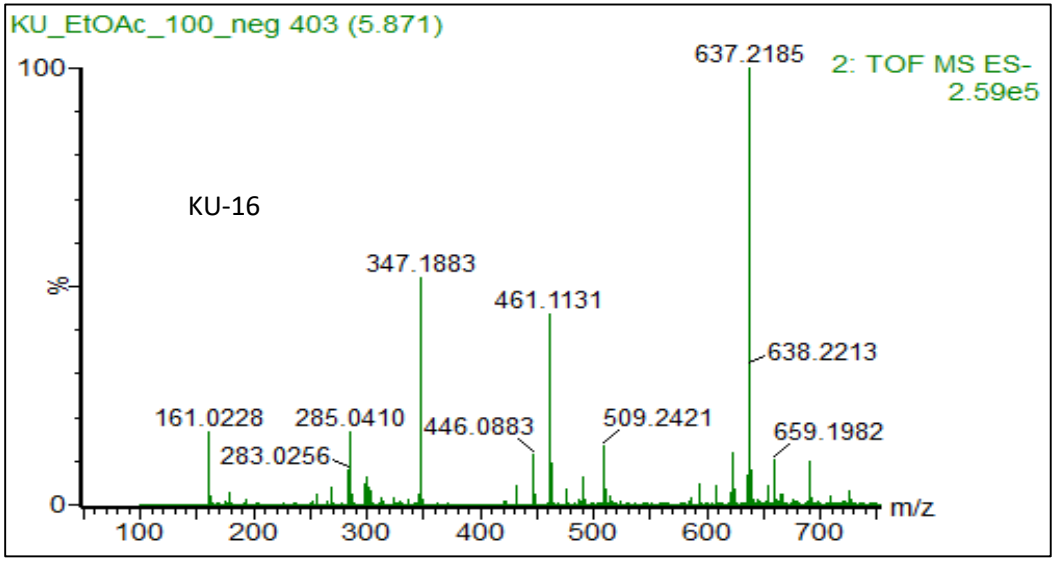

KU_EtOAc_100_neg 357 (5.205)
2: TOF MS ES-
KU-11
623.2020
624.2050
625.2077
461.1687
621.1845
133.0239
161.0224
179.0331
284.0326
m/z

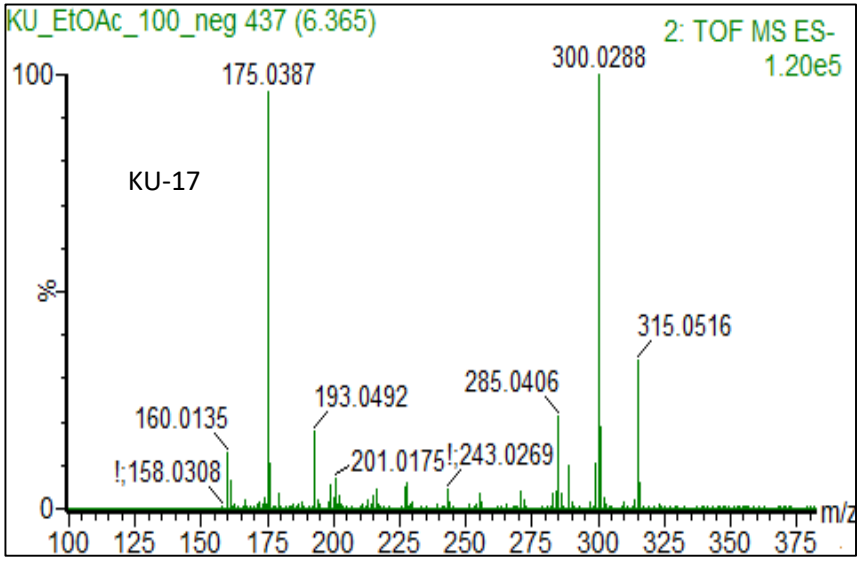

KU_EtOAc_100_neg 360 (5.248)
2: TOF MS ES-
6.84e6
KU-12
447.0976
285.0417
448.0999
286.0439
284.0329
161.0224
327.0516
368.9930
461.1689
547.0201
m/z

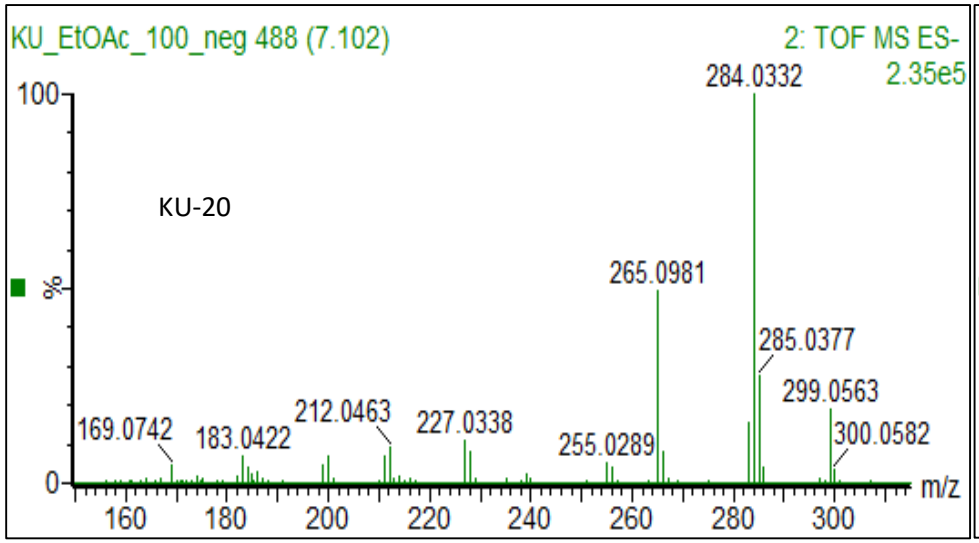

KU_EtOAc_100_neg 374 (5.448)
2: TOF MS ES-
8.79e6
KU-13
623.2031
624.2058
461.1696
625.2077
161.0226
285.0405
447.0961
462.1737
679.1206
m/z

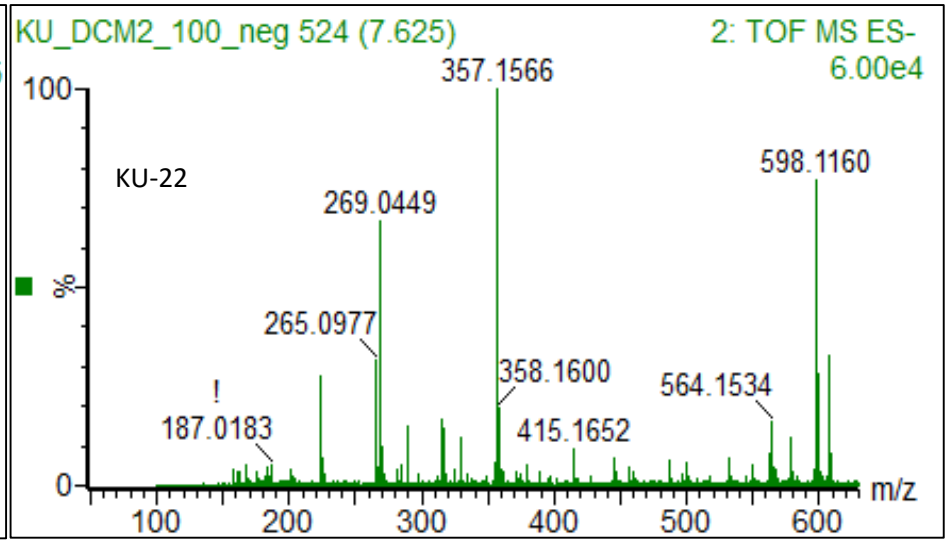

KU_EtOAc_100_neg 386 (5.628)
2: TOF MS ES-
3.08e5
KU-14
583.2644
421.2105
161.0224
285.0407
461.1684
179.0336
315.0501
m/z

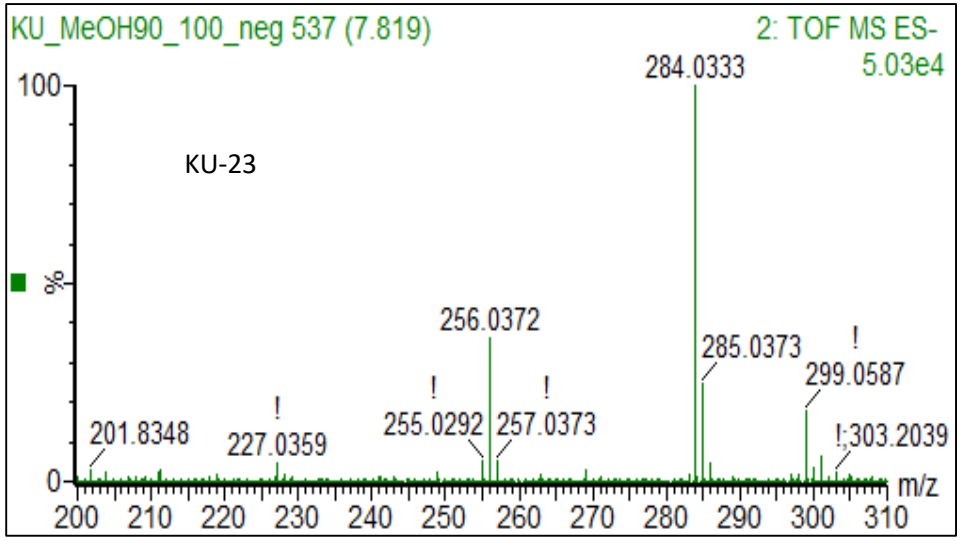

KU_EtOAc_100_neg 392 (5.714)
2: TOF MS ES-
6.04e5
431.1010
268.0381
KU-15
269.0453
161.0220
m/z


KU_EtOAc_100_neg 403 (5.871)
2: TOF MS ES-
2.59e5
637.2185
KU-16
347.1883
461.1131
638.2213
161.0228
285.0410
446.0883
509.2421
659.1982
283.0256
m/z

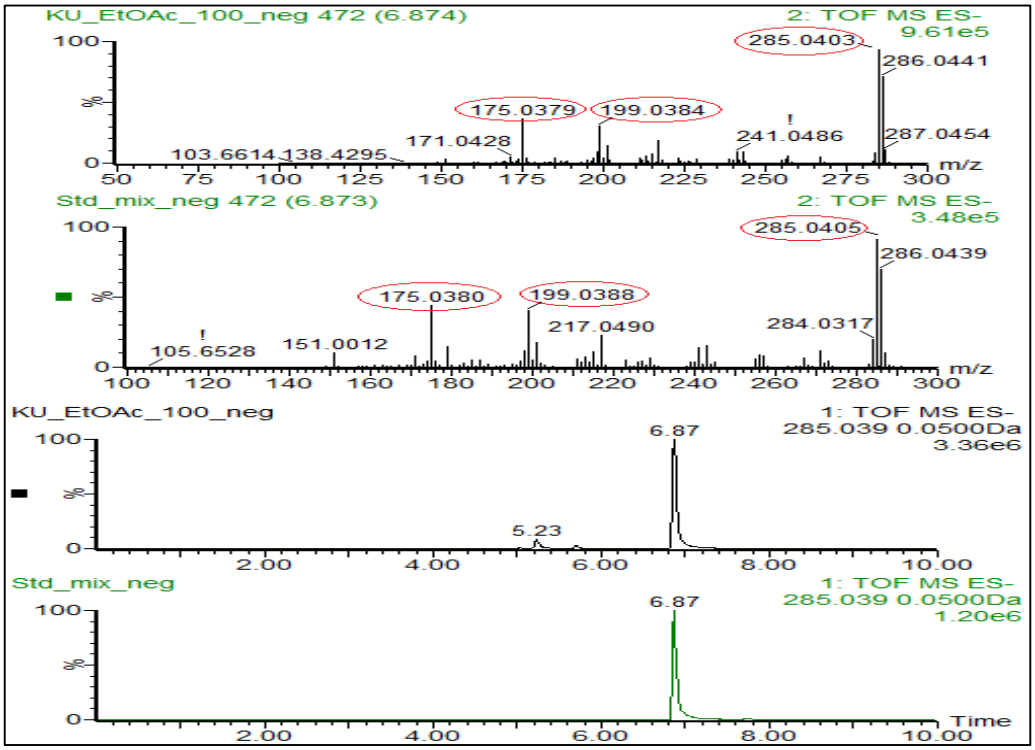

KU_EtOAc_100_neg 437 (6.365)
2: TOF MS ES-
1.20e5
175.0387
300.0288
KU-17
315.0516
285.0406
193.0492
160.0135
201.0175
243.0269
158.0308
m/z


KU_EtOAc_100_neg 488 (7.102)
2: TOF MS ES-
2.35e5
KU-20
284.0332
265.0981
285.0377
299.0563
300.0582
169.0742
183.0422
212.0463
227.0338
255.0289
100
%
0
160
180
200
220
240
260
280
300
m/z

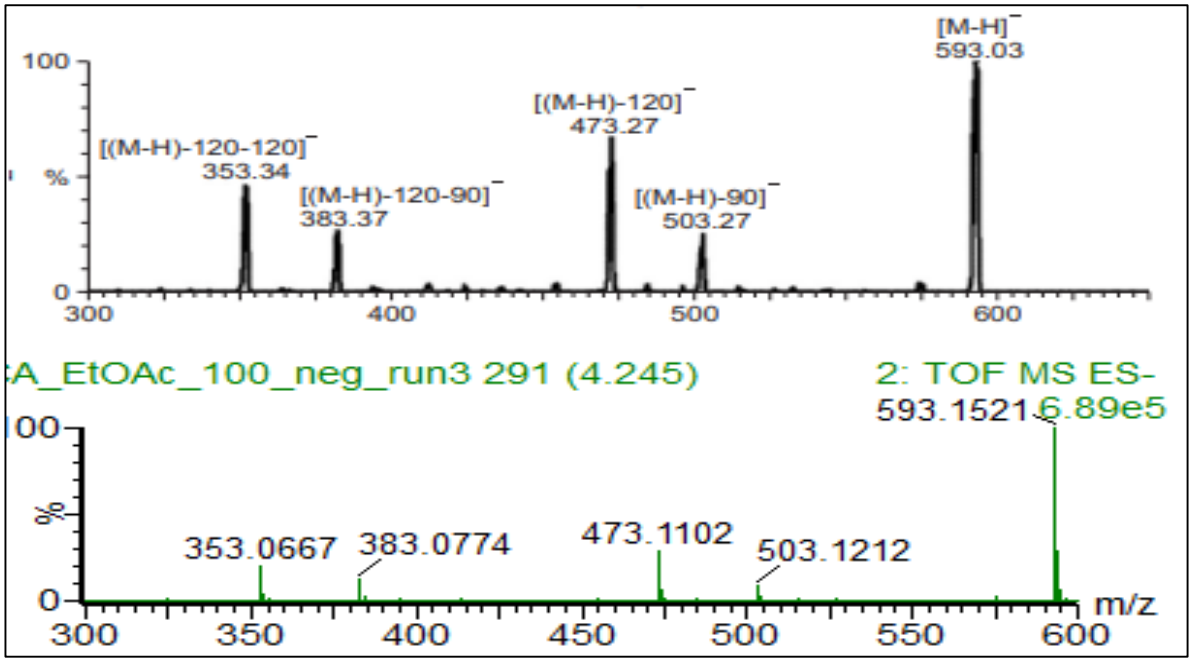

KU_DCM2_100_neg 524 (7.625)
2: TOF MS ES-
6.00e4
KU-22
357.1566
598.1160
269.0449
265.0977
358.1600
564.1534
187.0183
415.1652
100
%
0
100
200
300
400
500
600
m/z


KU_MeOH90_100_neg 537 (7.819)
2: TOF MS ES-
5.03e4
KU-23
284.0333
256.0372
285.0373
299.0587
303.2039
201.8348
227.0359
255.0292
257.0373
100
%
0
200
210
220
230
240
250
260
270
280
290
300
310
m/z

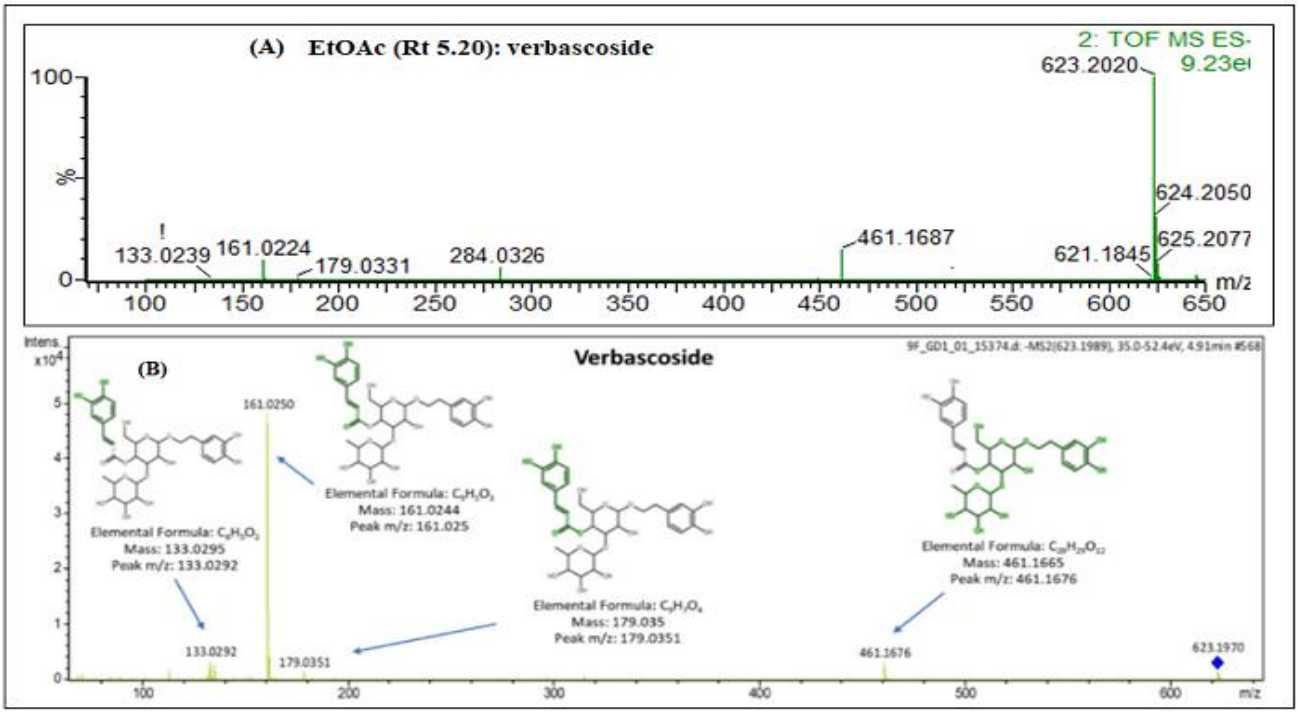
Appendix 10. MS/MS spectrum and selected ion chromatogram of compound **K18** (luteolin) in the AcOEt fraction of K.uncinata (top) compared with reference standard (bottom) in ESI$^-$ mode



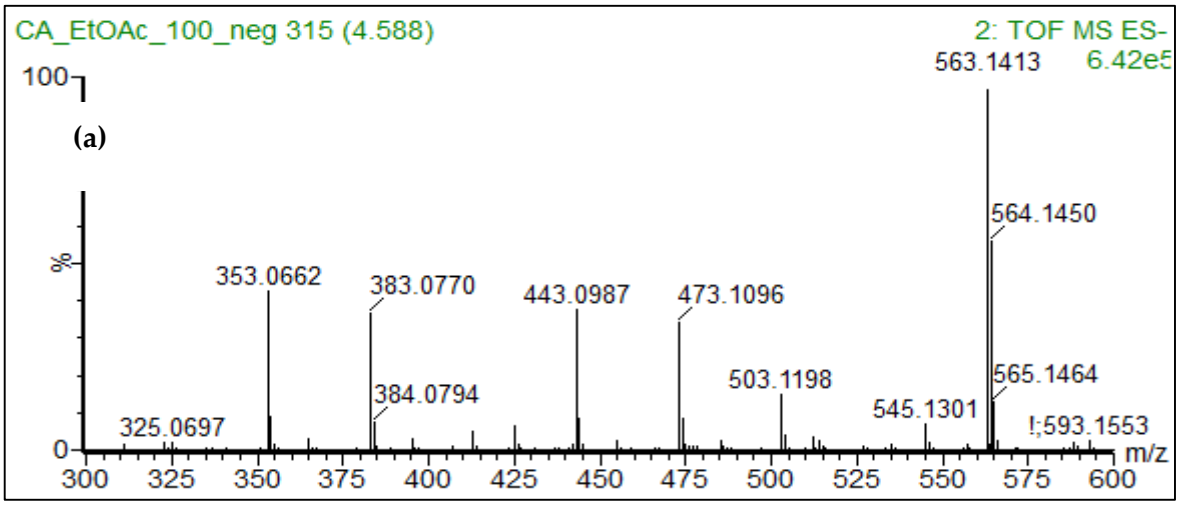
Appendix 11. Mass spectrum comparison between the AcOEt fraction (bottom) and literature data (top) of trihydroxyflavone-6,8-di-*C*-hexoside (vicenin-2) from Kim *et al.*(2016)

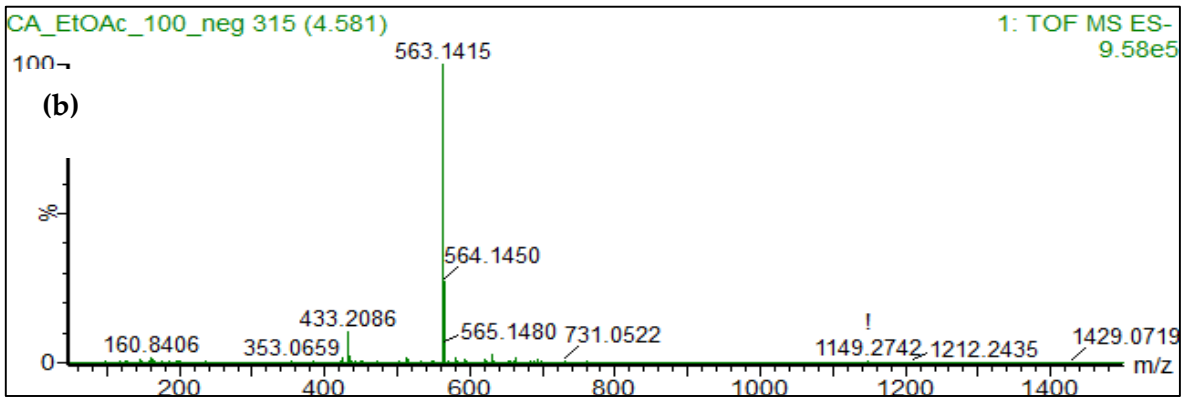


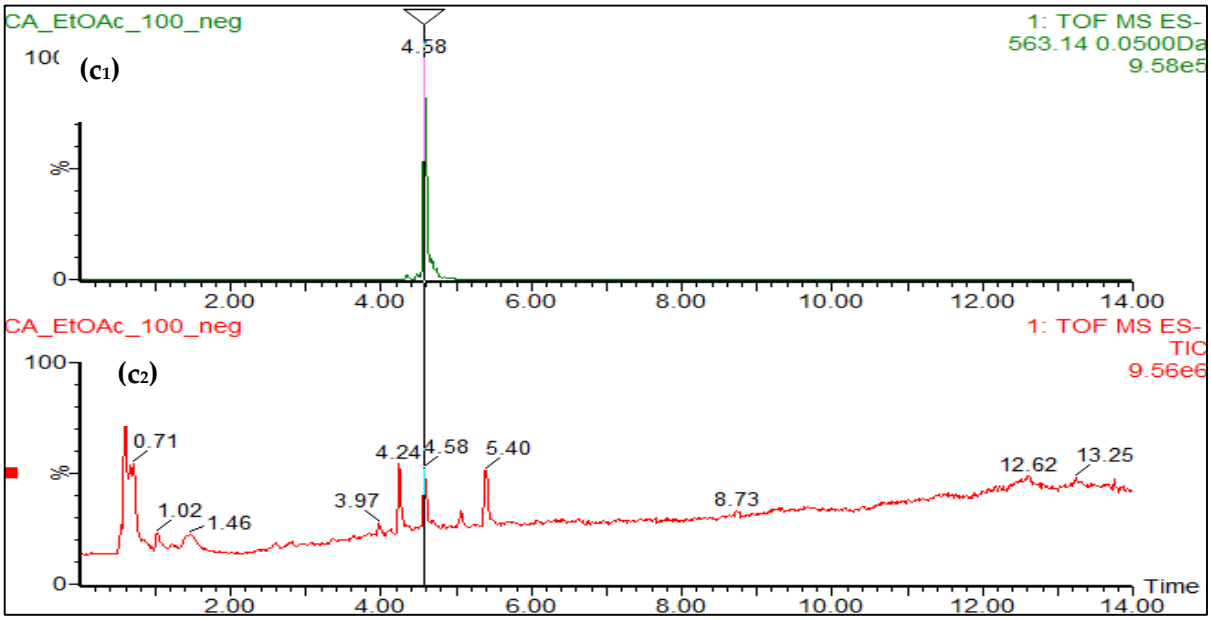
Appendix 12. Comparison between the mass fragmentation spectrum of verbascoside from the AcOEt fraction of *K. uncinata* (top) and that provide by literature (bottom) from Kritikou *et al.*(2020)



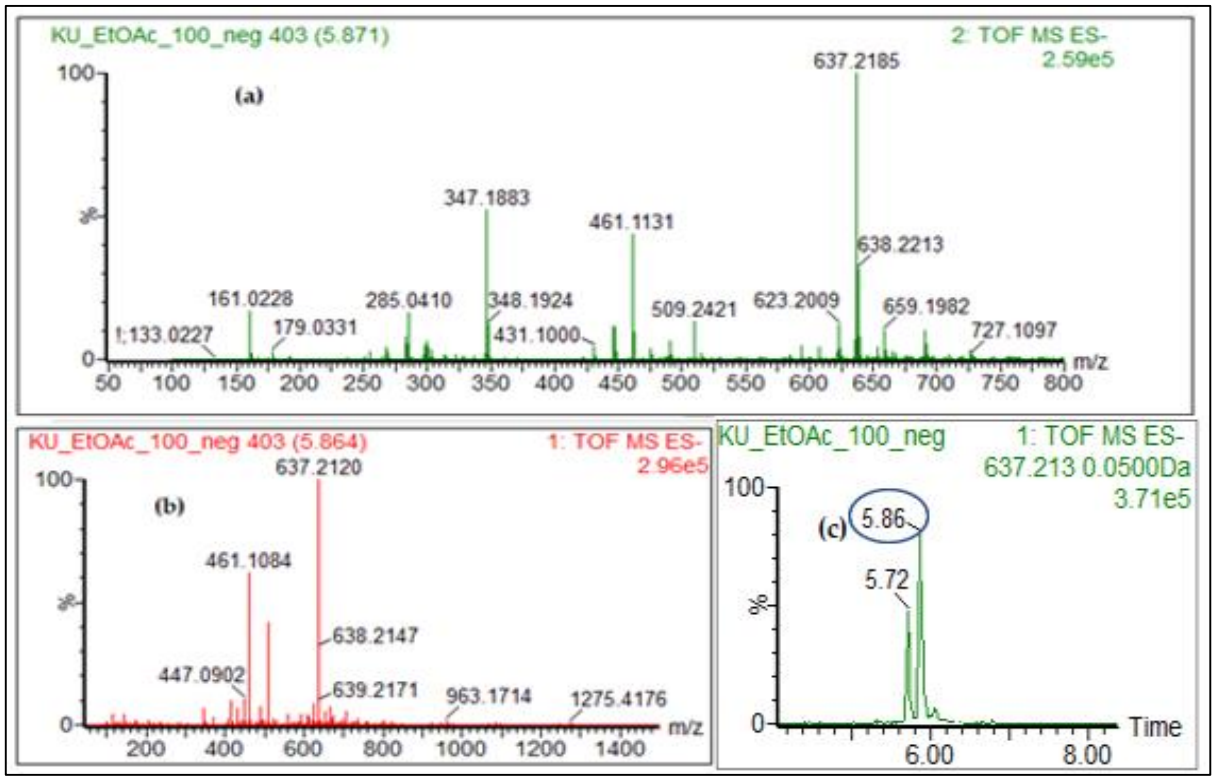
Appendix 13. Mass fragmentation mass spectrum (a), mass spectrum (b), extracted ion chromatogram (c_1) and total ion chromatogram of AcOEt fraction (c_2) of the tentatively identified trihydroxyflavone-6-*C*-hexoside-8-*C*-pentoside in the AcOEt fraction at Rt 4.58 min.



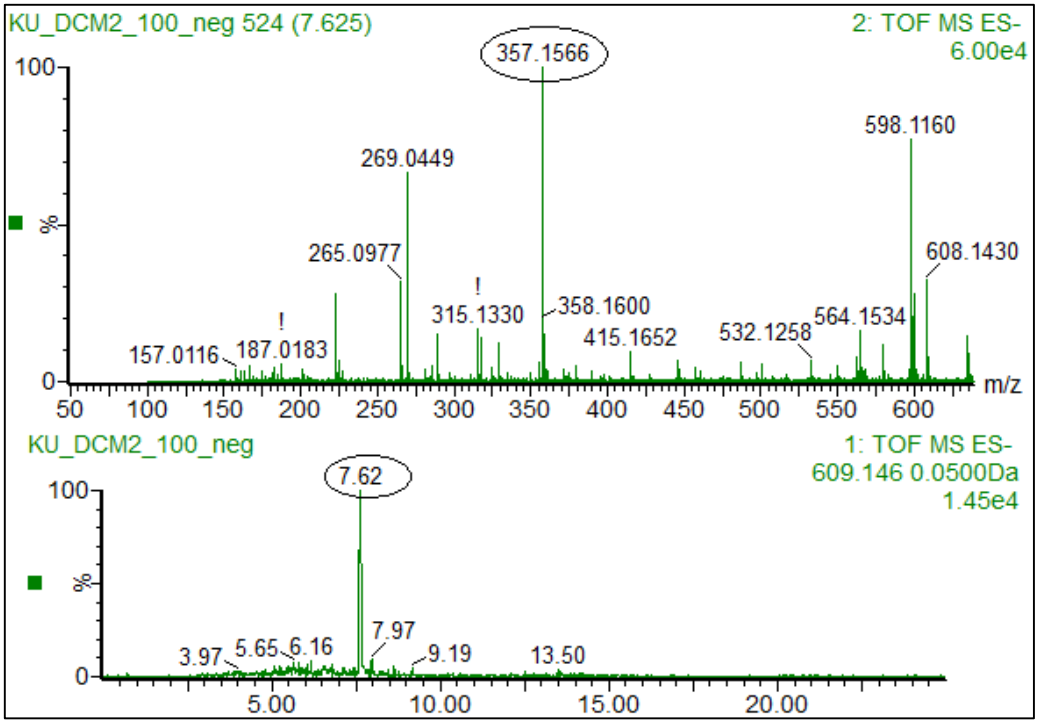




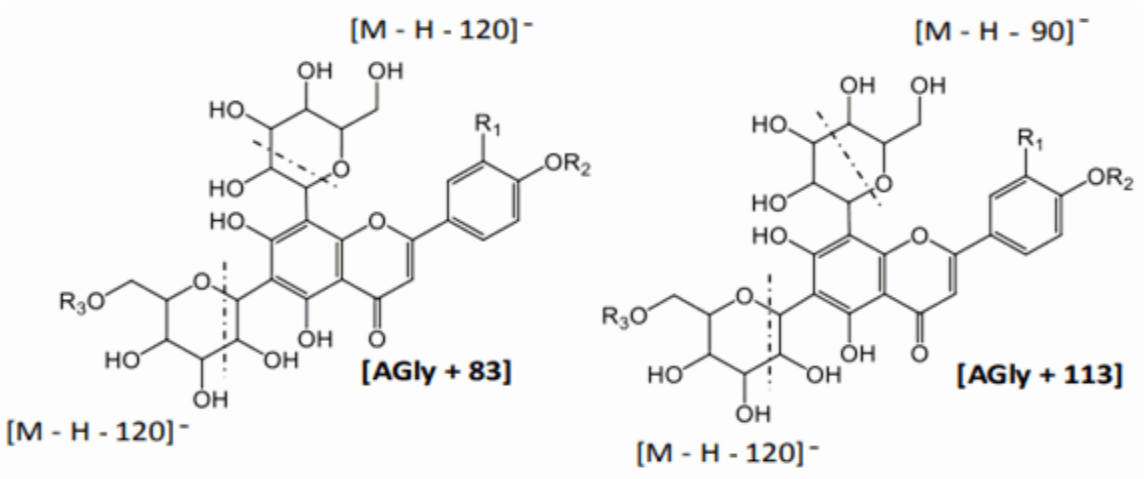
Appendix 14. KU mass fragmentation spectrum (a), mass spectrum (b) and extracted ion chromatogram (c) of the AcOEt fraction of an unknown compound at Rt 5.86 min in ESI$^-$ mode



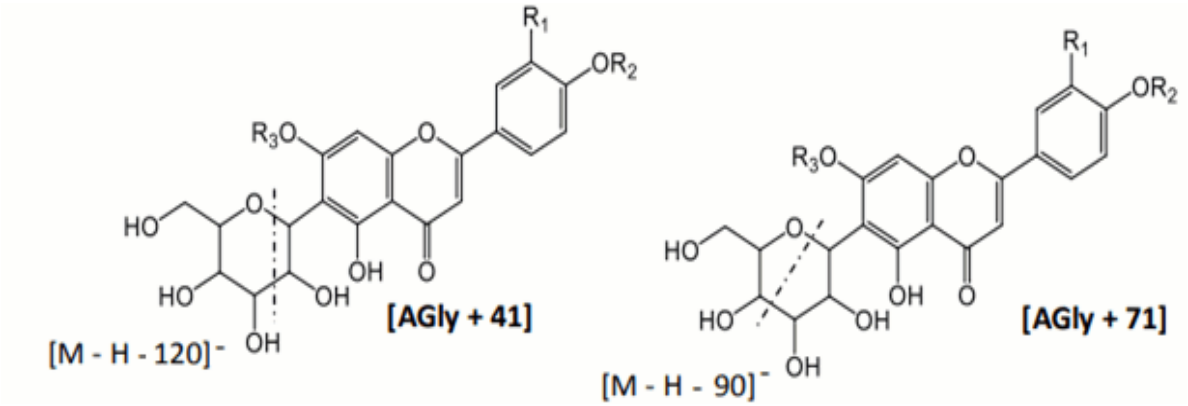
Appendix 15. Mass fragmentation spectrum (a) and extracted ion chromatogram (b) of a tentatively identified tetrahydroxy-flavone-6-*C*-hexosyl-*O*-hexoside in the AcOEt fraction at Rt 7.62 min (*K. uncinata*)



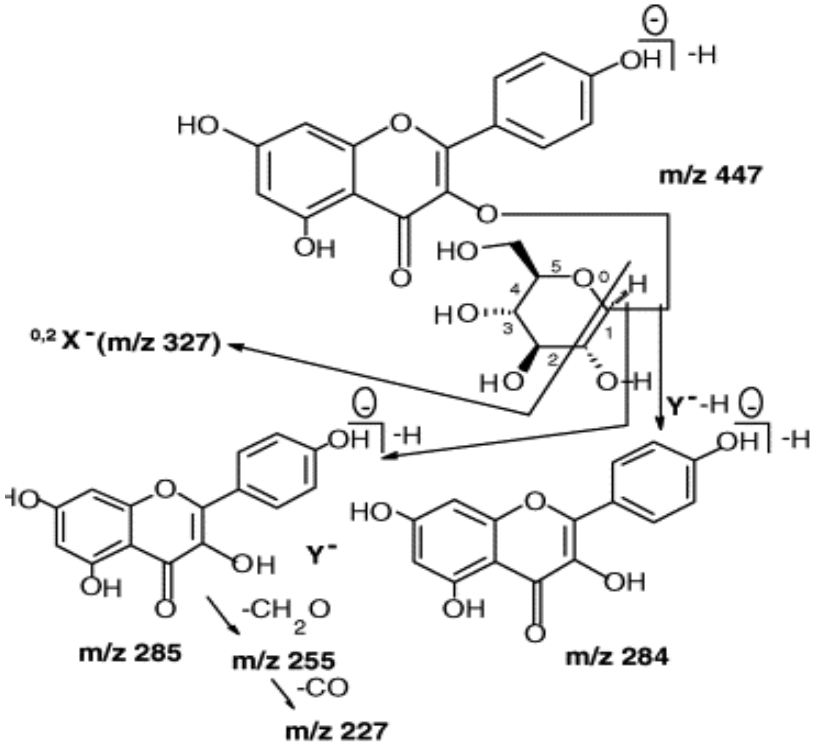
Appendix 16. Characteristic fragmentation patterns of *C*-linked flavone diglycosides



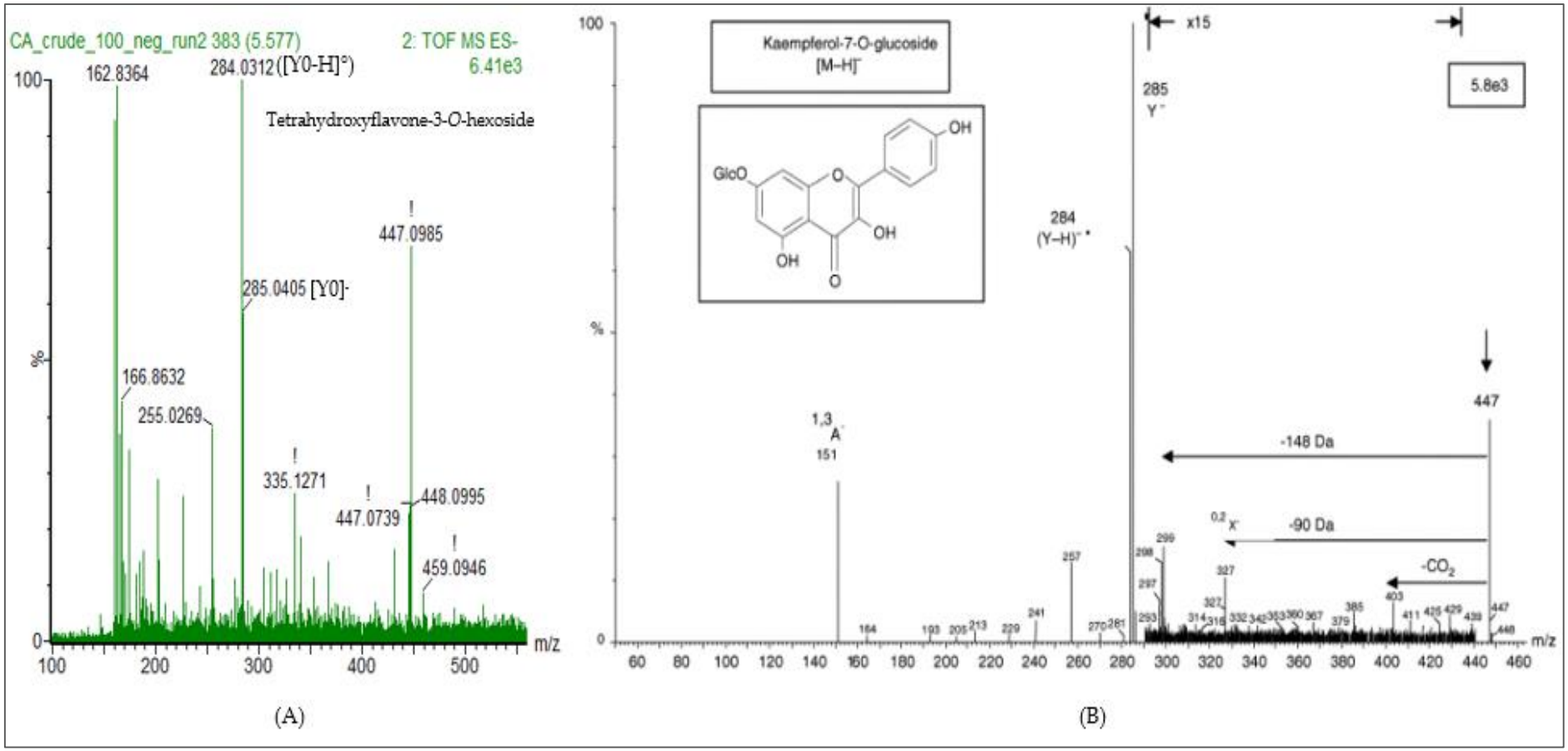
Appendix 17. Characteristic fragmentation patterns of *C*-linked flavone monoglycosides



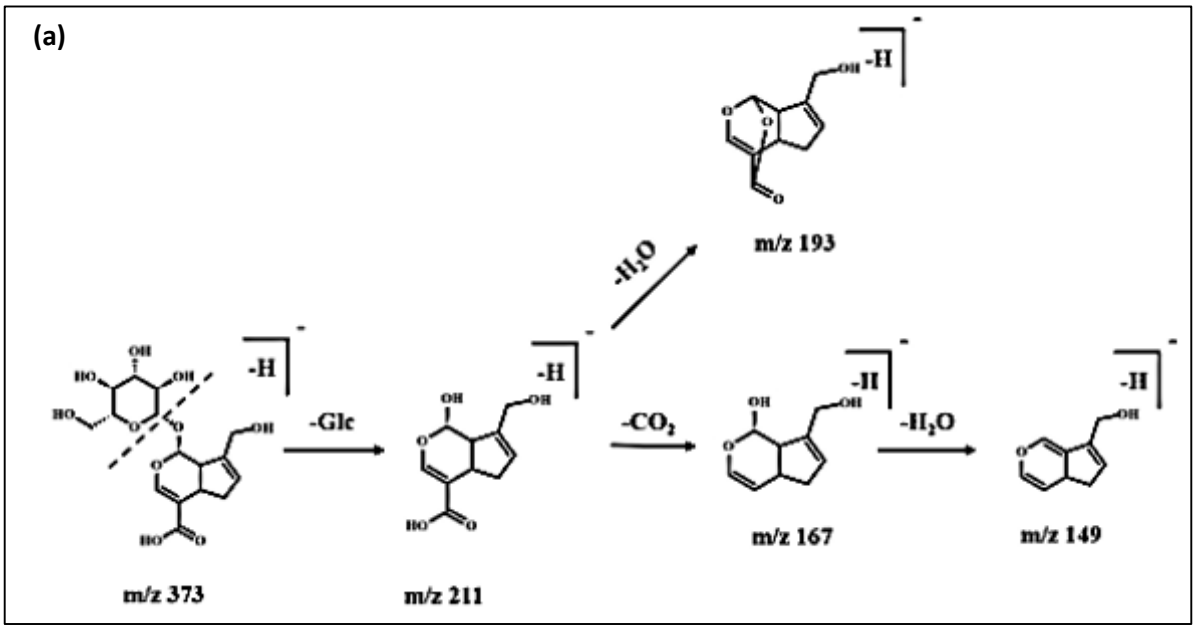
Appendix 18. Fragmentation scheme of $[M-H]^-$ of kaempferol-3-*O*-glucoside

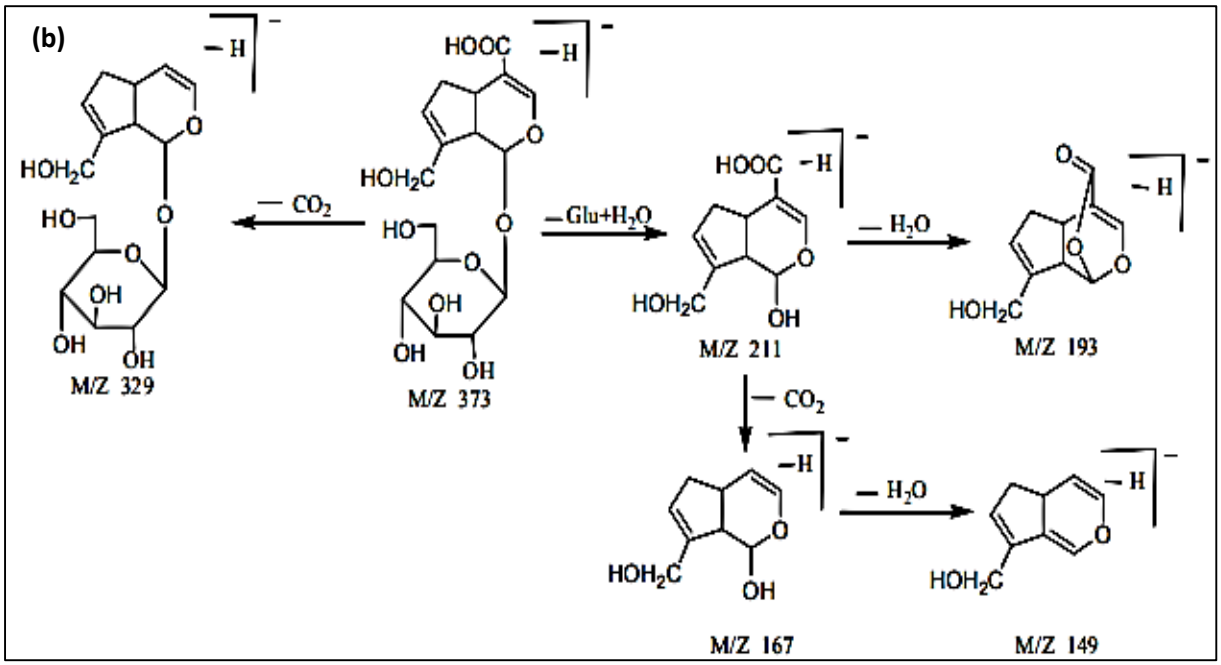


Appendix 19. Mass fragmentation spectra of (A) tetrahydroxyflavone-3-*O*-hexoside and (B) that obtained at a collision energy of 47 eV of kaempferol (tetrahydroxyflavone)-7-*O*-glucoside from March *et al.*(2006)

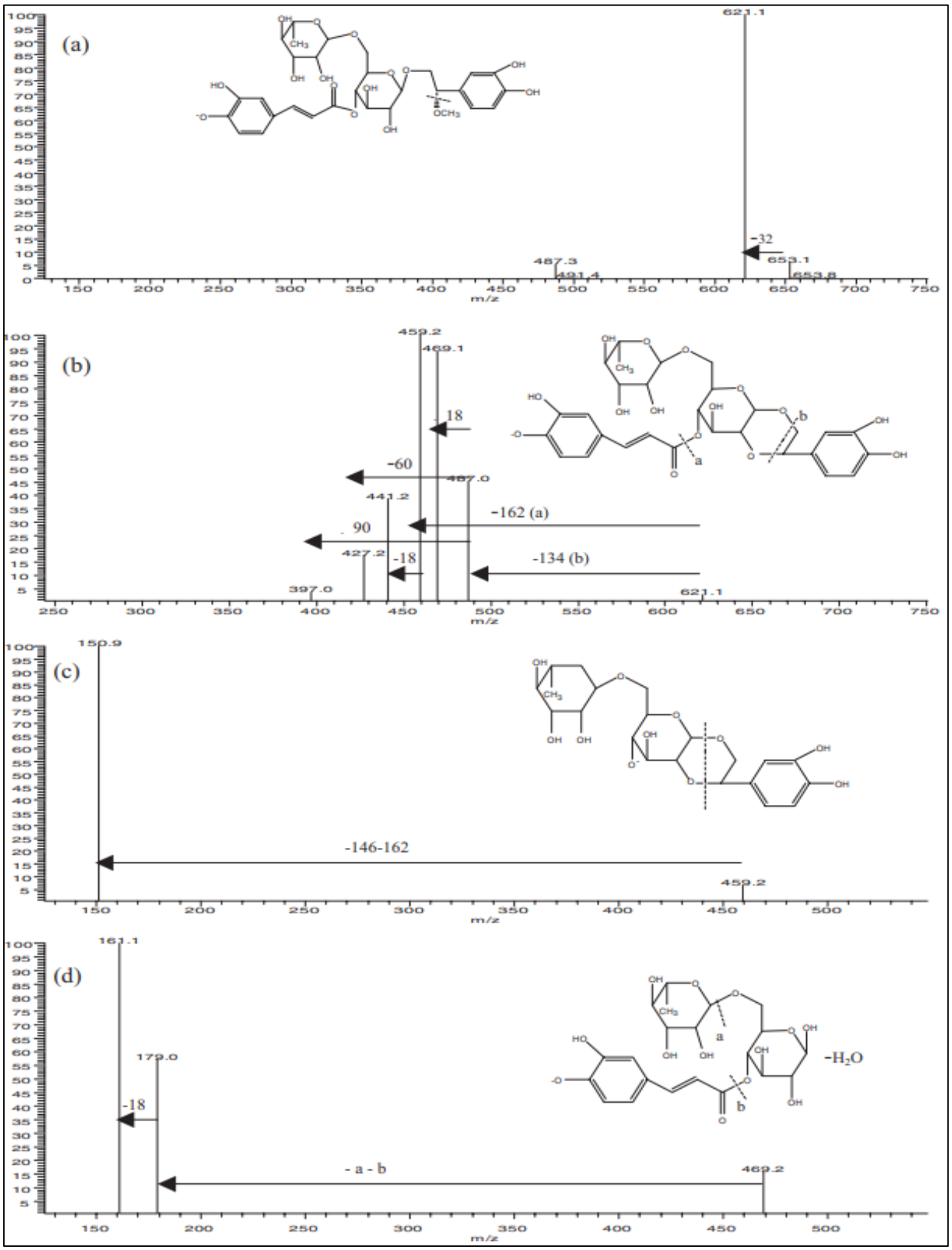


Appendix 20. Fragmentation patterns of geniposidic acid from Gao *et al*. (2022) (a) and Zou *et al*. (2015) (b)

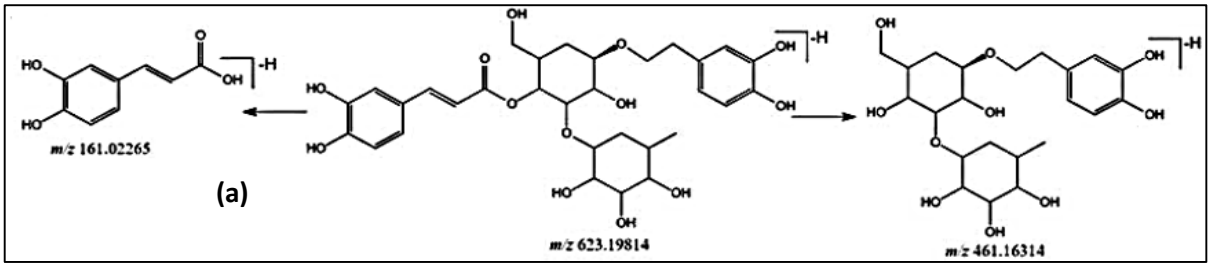


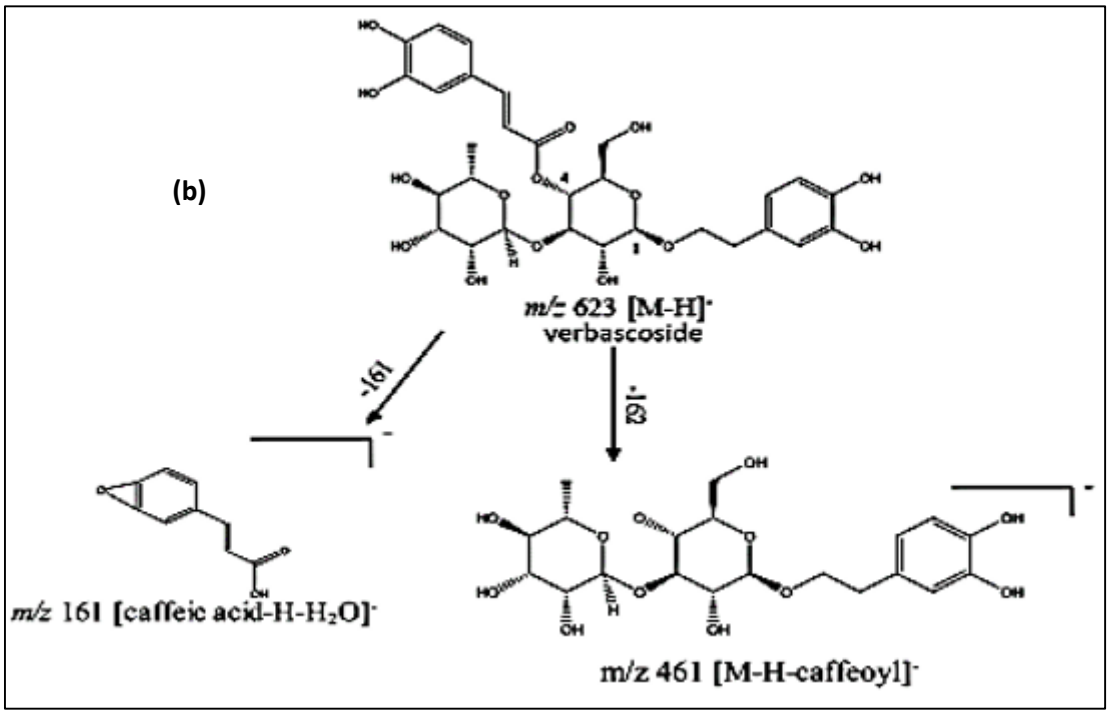


Appendix 21. ESI-MS/MS spectra and characteristic fragmentation patterns for compound **K9** (suspensaside methyl-ether), from Guo *et al.* (2007). (a) at MS^2 spectrum at *m/z* 653; (b) MS^3 spectrum of *m/z* 621 (653-621); (c) MS^4 spectrum of *m/z* 459 (653-621-459); and (d) MS^4 spectrum of *m/z* 469 (653 -621-469).



Appendix 22. Fragmentation patterns of acteoside from Zhao *et al.* (2020) (a) and verbascoside fromAttia *et al.*(2018) (b)





Appendix 23. Ethical approval of the research study

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UNIVERSITE DE KINSHASA
FACULTE DES SCIENCES
B.P. 190
KINSHASA XI
Bureau du Doyen

ATTESTATION D'APPROBATIONETHIQUE DE LA RECHERCHE

Je soussigné Professeur **MUSESA LANDA**, Doyen à la Faculté des Sciences de l'Université de Kinshasa, atteste par la présente que le protocole de recherche de Monsieur **Pathy KIBUNGU KEMBELO**, portant caractérisation ethnobotanique des plantes médicinales utilisées dans les terroirs de Kisantu et Mbanza-Ngungu, Province du Kongo-Central, en République Démocratique du Congo a été reçu et approuvé par la commission de recherche scientifique de la Faculté des Sciences de l'Université de Kinshasa.

L'intéressé a donc été autorisé à réaliser ses recherches doctorales et effectuer ses enquêtes ethnobotaniques, écologiques et phytochimiques ainsi que de publier les résultats desdites recherches en convenance avec son Département d'attache et son Promoteur Local, Professeur **Honoré BELESI KATULA**.

Par ailleurs, le chercheur est dans l'obligation de déposer à l'issue de ses recherches, un exemplaire d'herbiers d'espèces inventoriées, sa base des données et tous les résultats de ses recherches ainsi que son document de thèse rédigé en français et en anglais auprès de son Promoteur Local et à la Bibliothèque facultaire.

En foi de quoi, cette attestation lui est délivrée pour servir et faire valoir ce que de droit.

Fait à Kinshasa, le 21 SEP 2020

UNIVERSITE DE KINSHASA * FACULTE DES SCIENCES * BUREAU DU DOYEN

Le Doyen de la Faculté des Sciences,

MUSESA LANDA

Professeur Ordinaire

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Personalia

Name:	Pathy KIBUNGU KEMBELO,
Date and place of birth	Kinshasa, 15 September 1985
E-mail	pathy_kibungu@yahoo.fr; pathy.kibungukembelo@ugent.be, pathy.kibungukembelo@student.uantwerpen.be

Education

2021-2023 PhD student in Pharmaceutical Sciences
Natural Products & Food Research and Analysis (NatuRA)
University of Antwerp
Universiteitsplein 1, BE-2610 Antwerp, Belgium

2018-2023 PhD student in Bioscience Engineering
Departement of Plant and Crops (BW21)
Laboratory of Tropical and Subtropical Agronomy and Ethnobotany
Ghent University
Coupure Links 653, B-9000 Ghent, Belgium

2014-2018 Master degree in Bio Engineering
Environmental Science and Management
Catholic Univesity of Louvain
Place de l'université 1, 1348 Louvain-La-Neuve

2006-2008 Master in Agronomic Sciences
Management and conservation of wildlife resources: Flora and Fauna
Kinshasa University
Commune de Lemba, Kinshasa XI BP 127, DR Congo

2003-2006 Bachelor degree in Agronomic Sciences
Departement of General Agriculture
Kinshasa University
Commune de Lemba, Kinshasa XI, BP 127, DR Congo

Training, employment and internship

2021-2023 Present PhD thesis
Phytochemical profiling of *C. africana* and *K. Uncinata* using UPLC-ESI-QTOF-MS analysis
Natural Products & Food Research and Analysis (NatuRA)
University of Antwerp
Universiteitsplein 1, BE-2610 Antwerp, Belgium

2018 Project Assistant
Study and characterization of polluted soils
ABESIM sprl
Chau. de Wavre 504, 1390 Grez-Doiceau

2016 Researcher
Institut Scientifique de Service public (ISSeP)
Ammonia survey (NH_3) in ambient air in natural environments and Natura 2000 in Wallonia
Colfontaine/Belgium

2010 to date Teaching and Research Assistant
Faculty of Agronomic Sciences
Kongo University
23- Kolo Street, BP 202, Mbanza-Ngungu, *Kongo* Central Province, DR Congo

2009 to date Agronomist Engineer/Responsible for agronomic and botanical activities
Kisantu Botanical Garden/ Congolese Institute of Nature Conservation

Kisantu, Kongo Central Province, DR Congo

2012-2014 Technical Advisor
Project DRC/SGP/OP5/Y2/CORE/BD/2012/24
CMTA/PNUE/FEM
Kisantu, *Kongo* Central Province, DR Congo

Scientific publications

Papers in peer-reviewed journals

2023 Pathy Kibungu Kembelo, Flavien Nzuki Bakwaye, Honoré Belesi Katula, Jean-Francois Tsimba, Wouter Vanhove, Patrick Van Damme - Ecofloristic characterization of the vegetation of Mbanza-Ngungu territory, in *Kongo* Central Province, DR Congo
Under peer-review in the Scientific Reports journal

2023 De Meyer Emiel; Kibungu Kembelo Pathy; Epila Jackie; Eduardo de la Pena - The urban jungle, an underexplored habitat for neglected and Indigenous plant diversity
Under peer-review in Plants, People, Planet Central Office Journal

Published papers

2021 Kibungu Kembelo Pathy, Nzuki Bakwaye Flavien, Belesi Katula Honoré, Wouter Vanhove, Patrick Van Damme. Ethnobotanical characterization of medicinal plants used in Kisantu and Mbanza-Ngungu territories, *Kongo* Central Province in DR Congo. *Journal of Ethnobiology and Ethnomedicine* 17, 5 (2021), https://doi.org/10.1186/s13002-020-00428-7

2023 Pathy Kibungu Kembelo, Emmy Tuenter, Wouter Vanhove, Honoré Belesi Katula, Patrick Van Damme and Luc Pieters. Phytochemical profiling by UPLC-ESI-QTOF-MS of Commelina africana L. widely used in traditional medicine in DR Congo
South African Journal of Botany 157, 325-334, https://doi.org/10.1016/j.sajb.2023.04.010

2023 Pathy Kibungu Kembelo, Emmy Tuenter, Wouter Vanhove, Honoré Belesi Katula, Patrick Van Damme and Luc Pieters. Phytochemical profiling by UPLC-ESI-QTOF-MS of *Kalaharia uncinata* (Schinz) Moldenke widely used in traditional medicine in DR Congo. *Chemistry & Biodiversity* 20(9), e202300826, https://doi.org/10.1002/cbdv.202300826

2024 Laura Van Damme, Lars Chatrou, Eduardo de la Peña, Pathy Kibungu, Césarine Sinatu Bolya, Patrick Van Damme, Wouter Vanhove, Melissa Ceuterick and Emiel De Meyer. Plant use and perceptions in the context of sexual health among people of Congolese descent in Belgium. . *Journal of Ethnobiology and Ethnomedicine* 20, 20. https://doi.org/10.1186/s13002-024-00662-3

Other Publications

2018 Soil survey of the former railway workshop of Haine Saint-Pierre, located at Boulevard du Roi Baudoin, 7100 La Louvière. End of study dissertation (in French), Catholic University of Louvain, Fac. Bioengineering, Master's Program in Environmental Sciences and Management.

2010 Contribution to the study of indigenous food plants of the population of Madimba territory, Bas-Congo Province, DR Congo (written in French). Botanical Garden of Kisantu, Bas-Congo Province, DRC.

2008 Determination of species in the normal natural succession of *Terminalia superba* and their impact on Banana. End of study dissertation (in French), University of Kinshasa/ Faculty of Agronomic Sciences/RD Congo

2006 Effect of plant extracts (*Allium sativum*, *Zingiber officinale*, *Citrus grandis*) on mycelial growth of *Aspergillus flavus* and aflatoxin production. End of study dissertation (in French), University of Kinshasa/ Faculty of Agricultural Sciences/RD Congo

Scientific activities

2021 Reviewer of the article paper with reference: *Trop. Med. Health* **49**, 52 (2021). https://doi.org/10.1186/s41182-021-00341-z

20/03/2018 Participation to a career day at Janssen Pharmaceutica