Moroccan Journal of Agricultural Sciences
Vol 4 No 2 (2023): (June 2023), 76-85
Natural Resources and Forestry

Ethno-botanical survey of medicinal plants species traditionally used for the treatment of diseases in Kasangulu Territory (Democratic Republic of Congo)

Colette Ashande MASENGO	Faculty of Science, University of Gbado-Lite, Gbado-Lite, Democratic Republic of the Congo
Jean-Paul Koto-Te-Nyiwa NGBOLUA	Faculty of Science, University of Gbado-Lite, Gbado-Lite, Democratic Republic of the Congo
Sam Imani wa Rusaati BUTOTO	School of Forest Sciences and Land Architecture College of Agriculture and Life Sciences, Kyungpook National University, Daegu 41566, Republic of Korea
Benjamin Zoawe GBOLO	University of Gbado-Lite, Gbado-Lite, Democratic Republic of the Congo
Clément Liyongo INKOTO	University of Gbado-Lite, Gbado-Lite, Democratic Republic of the Congo
Pius Tshimankinda MPIANA	Faculty of Science, University of Kinshasa, Kinshasa, Democratic Republic of the Congo

In Africa, much knowledge is lost due to lack of transmission, which does not promote resource conservation by local populations. It is therefore obvious to assess people's knowledge on the importance of resources to develop conservation and sustainable management strategies. This study was conducted to identify medicinal plants used in traditional medicine to treat common diseases in the Kasangulu Territory of the Democratic Republic of the Congo. To achieve this objective, an ethnobotanical survey was carried out through an open-ended questionnaire that was administered to herbal therapists in the local language to obtain more reliable informations. Some ethnobotanical parameters have been compiled for the identified medicinal plants. A total of 66 species belonging to 33 families and 59 genera have been recorded. The results showed that married and unmarried people have a shared medicinal knowledge, with a slight priority for the married. Sterility is the predominant disease with a rate of 15%. The leaf is the most commonly used organ and the infusion is the most common method of preparation in traditional medicine. There is a predominance of mesophanerophytes and pantropical. Bushfires and agricultural practices are increasing the pressure on medicinal resources, which is believed to be at the root of the loss of some more vulnerable species. There is an urgent need for a sustainable management approach to safeguard and preserve these plant species. This study of the medicinal plants used in Kasangulu constitutes a reservoir of information that contributes to build knowledge to protect the medicinal flora and safeguard local popular know-how.

Keywords: Traditional healers, medicinal plants, folk medicine, biodiversity, sustainable management

INTRODUCTION

In African countries, much endogenous knowledge is lost due to the lack of transmission, which does not allow local populations to promote resource conservation. Therefore, there is an urgent need to assess the population’s knowledge on the resource importance in order to develop conservation and sustainable management strategies (Ghislain et al., 2007). Furthermore, the

World Health Organization (WHO) reported a high rate of dependence of Africans on traditional medicine for primary health care. The socio-economic benefits of the use of this medicine are that they allow the treatment of various diseases at once, thus the need of developing this medicine (Nbgolua et al., 2019; Inkoto et al., 2018; Muthu et al., 2006). The Democratic Republic of Congo (DRC) constitutes a real rich and highly diverse reservoirs of biodiversity allowing it to be a privileged place amongst the countries of the Congo Basin, in which the traditional know-how is based on the use of medicinal plants (Inkoto et al., 2018; Asimonyio et al., 2015; Ngbolua et al., 2016). Yet, a literature research in phytotherapy indicated that data on medicinal plants in the DRC is very fragmented and dispersed (Katemo et al., 2012). Moreover, the accelerated human destruction of natural areas is making it increasingly difficult to conserve these plant genetic resources. Several studies have been carried out on the inventory of medicinal plants used in the treatment of several ailments in traditional medicine throughout the DRC, precisely in Kinshasa, Bikoro (Equateur amongst Pygmies), South Kivu and Gbado-Lite (Ngbolua et al., 2016; Ilumbe et al., 2014). The general objective of this study is to valorize medicinal plants used in traditional Congolese medicine in Kongo Centrak province, precisely in Kasangulu city. The specific objectives are to conduct an ethnobotanical survey of the population to inventory the plants used in the treatment of different diseases in this region, identify the ecological characteristics of each listed species, identify the medicinal plant use agreement factor and identify the informant consensus factor in the use of these medicinal plants.

METHODS

Study area

The Territory of Kasangulu is located in Kongo Central Province, between 4 and 6 degrees south latitude and 12 and 16 degrees east longitude over a 53,920 km2 area. Kongo Central has a tropical Sudanese type climate, which is sud-divided into two types: the first that extends along the coast, is a steppe type climate having a high variability which lasts four months (from May 15 to September 15), while the other type of climate lasts eight months. The Lower River is an area where the risk of drought is very high and we can observe off the coast an ecological niche of Mangrove. In the coastal zone, the minimum temperature can be between 15 and 17°C while the maximum is 27°C (Kalombo et al., 2016).

Field studies

Ethno-botanical information on the different species inventoried in this study was obtained by interviewing traditional practitioners and medicinal plant suppliers in Kongo Central Province, specifically in the city of Kasangulu (Figure 1).

The fieldwork was conducted between December 2016 and May 2017. It consisted in surveying people with proven knowledge of traditional Congolese pharmacopeia. This survey made it possible to inventory and identify people using medicinal plants in the treatment of common diseases in Kasangulu. This study was carried out using an open-ended questionnaire that was interviewed by herbal therapists in the local language (Lingala) to obtain information that was too reliable. This questionnaire was divided into three sections: (i) personal information (name, age, sex, marital status, level of study) and reason for the use of traditional medicine; (ii) plant material (vernacular and scientific name of the plant); (iii) practice of traditional medicine (diseases treated, diagnosis of diseases, parts used in the plant, condition of the plant, methods of preparation and conservation of recipes, method of administration and dose of recipes, results of post-treatment care, knowledge of toxic plants in the study area).

The study followed the guidelines of the Declaration of Helsinki and was approved by the Ethics Committee of the Biology Department of the University of Kinshasa in accordance with the laws governing access to genetic resources, their derivatives, associated traditional knowledge and the

fair and equitable sharing of benefits arising from their use in Democratic Republic of the Congo. Thus, all participants voluntarily agreed to be included in the study (free and informed consent).

Data processing and Data analysis

Microsoft Excel version 2010, SPSS version 20, and Origin version 8.5 Pro were used for data processing and analysis.

The voucher of collected plants was conserved and identified by comparing the samples with specimen conserved at Kinshasa University Herbarium. Scientific names were updated to currently accepted names according to the plant list (www.theplantlist.org), and the Angiosperm Phylogeny Group (APG IV) was consulted in order to update the family names (APG IV, 2016). In addition, the ecological spectra were determined using the classification of Raunkiaier (Raunkiaer, 1934) adapted for tropical Africa by Schmitz (Schmitz, 1988). The phytogeographical distribution types defined in this study were established using the work of Lebrun (Lebrun, 1947). The conservation status all recorded plant species was checked online using the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN, 2019).

Voucher specimens were prepared and deposited in the herbarium of the Department of Biology (Faculty of Science, University of Kinshasa) under Prof Ngbolua collection name.

Quantitative data analysis

After the survey sheets were reviewed, several parameters were calculated such as the number of plant taxa, the number of citations, Informant Consensus Factor, Confirmation Index, Use Agreement Value (Ngbolua et al., 2016; Ilumbe et al., 2014). The Value of Agreement to Use (VAUs), an index for assessing the medicinal and cultural value of plants, has been calculated as previously reported.

Where UVs: use-value, ICs: confirmation index, Uis: the number of uses of the species cited by the informant, Ns: number of species, Ni: number of informants who cited this species, Nt: total number of informants. Value of use agreement is useful while identifying plants most commonly used (most frequently mentioned) in the treatment of a disease with a given informant (Ilumbe et al., 2014).

Informant consensus factor (ICF) was obtained by using the formula:

Where nur is the number of citations and nt is the number of plant species used for disease.

ICF is used to infer homogeneity in information on the use of a given plant to treat several diseases, and it ranges from 0 to 1. A high ICF value (nearly 1) means that a small number of plant species is cited by a large number of informants for a specific type of treatment (Lawal et al., 2022).

Jaccard index (JI): studies conducted in other Territories of DRC and others from neighboring countries were compared with this study. It is calculated according to the presence or absence of the species (Faruque et al., 2019).

Where A is the recorded number of species of the present study, B is the number of species of another study, and C is the common number of species in A and B.

RESULTS AND DISCUSSION

Socio-demographic profile

Socio-demographics by age, gender, profession, education, marital status is summarized in Table 1.

Medicinal diversity of the listed plants and their ecological characteristics are shown in Figure 2, 3 and table 1.

Parts of the medicinal plants used, preparation method, and administration mode

Data on the use of the listed plants are shown in Figure 4.

Quantitative analysis

Data from the quantitative analyses including the UV, ICs, VAUs, ICF, JI are shown in Tables 3 and 4.

A total of 50 informants including traditional healers, housewives, state employees, lectures, and students were interviewed comprised 58 % of males and 42% of females in the age range from 18-73 years old, with 82% under 50 years old. From the total respondents, more than half (66 %) had been to secondary school while 14% and 8% respectively finished primary level and superior level.

A total of 66 plants species was inventoried and belonged to 35 families and 59 genera. Of these, one species (Hibuscus sp) was identified only to the genus level and 65 were identified to species level.

Fourteen families (out of 35) provided 71.2 % of all inventoried plants. The dominant families were Rubiaceae (12.1 %), followed by Fabaceae (9.0 %), Malvaceae (7.6 %), and Lamiaceae (6.0 %), Euphorbiaceae, and Anacardiaceae (4.5 % each), Acanthaceae, Asteraceae, Clusiaceae, Lauraceae, Poaceae, Rutaceae, Solanaceae, and Zingiberaceae (3 % each) (Figure 2). The remaining families were represented only one species (1.5 %). Fifty-two genera were represented by only one species, while the remaining seven genera were represented by 2 species each (Aframomum, Citrus, Gardenia, Hibiscus, Milletia, Morinda, Ocimum) (Table 2).

Regarding the morphology type, our study area has shown a predominance of shrubs with 30.3%, followed by trees (27.3%) and Herbs (25.8%) (Figure 3A).

The prevalence of woody species is explained by the fact that most of the medicinal plants used in the Kasangulu pharmacopeia come from forest areas.

The inventoried medicinal flora consists of several biological types such as phanerophytes (Ph: 43 species) followed by therophytes (Th: 9 species), geophytes (Ge: 8 species), and chameophytes (Ch: 6 species) (Figure 3B).

The phytogeographic distribution was dominated by pantropical species (Pan: 40.9%) followed by Afro-tropical species (At: 22.7%), Guinea-Congolese (GC: 13.6%), Central Guinea (Cguin), and Guinea (Guin): 6.1% each (Figure 3A).

Leaves were the commonly used part accounting for 67.6 %, followed by bark and roots with 11.8 % each (Figure 4B). Numerous studies conducted in various countries pointed out the common use of leaves (Amjad et al., 2015; Azam et al., 2014; Bano et al., 2014), as they are less destructive to the plant (Asiimwe et al., 2013), and they store various active compounds with medicinal properties (Lara et al., 2018). Several methods of recipe preparation are used for medicinal plants. However, the most frequent mode is an infusion (54%), followed by maceration (9%), and decoction (8%). Massage is the least common practice (5%) (Figure 4A). This result is in line with Oliveira et al. (Oliveira et al., 2011) and Angulo et al., (Kasika et al., 2015), who mentioned the infusion as principal recipes preparation in their study area. However, on comparing with a few other studies

conducted in DRC (Katemo et al., 2012; Kasika et al., 2015; Manya et al., 2018; Okombe et al., 2014) and with ethnomedicinal works published in other countries (Axiotis et al., 2018; Leso et al., 2017; Ngezahayo et al., 2015), we noted decoction was the most used as recipes preparation. The majority of plant parts were used fresh (80%), while 20% were dried. As far as the drying method, the plants were exposed either to the sun, the open, or in the shade. These results are similar to those of Ngbolua et al. (2019; 2016) who report that the population in different markets in Kinshasa prepares their recipes from fresh plants.

Considering the administration method of plants mentioned by the inhabitants, report consist of oral, anal, massage, cutaneous application, and eyes drop. Among the oral route (75.4 %) was the predominant mode of administration of the recipes, followed respectively by the anal route (16.4%), local application (4.9 %) (Figure 4C). On comparing our data with a few studies so far published, we noted that oral route was the most used to administrate the recipes (Alqahtani et al., 2021).

The plants were used to treat 30 illnesses. The UV ranged between 6 and 0.04. Based on this result, 24 plant species predominate with values greater than or equal to 1.5. The four high UV recorded were Mangifera indica (6), Aframomum melegueta (5.5), Carica papaya (4), Sarcocephalus latifolius (4). The lowest UV was obtained for Abrus precatorius, Citrus aurantium, Citus maxima, and Hibiscus acetosella (0.25 each), Moringa oleifera (0.04) (Table 2). These species were used to treat different illnesses including Hemorrhoids, flu, Amoeba Hernia, and infertility, while the lowest UV (M. oleifera) was used for glue vision.

In the present study, ICs values ranged from 0.3 to 0.001. The highest ICs was Dacryodes edulis (0.3), followed by Chenopodim ambrosioides (0.2). The highest VAUs values Dacryodes edulis (0.15), followed by Persea americana (0.08), while the lowest was Tephrosia vogelii (0.001).

The table shows that the 66 medicinal plants listed in this study treat 30 diseases grouped into 13 categories. The four most-cited ailment categories are “Infectious and parasitic diseases” (17 uses report), “Diseases of the circulatory system” (16 uses report), “Diseases of the digestive system” (11 uses report), and “Symptoms, signs, and ill-defined disease states” (10 uses report). However, the “Diseases of the genitourinary organs” was the one with a high ICF value (ICF 0.50) followed by “Circulatory system diseases” (ICF 0.27), and “Symptoms, signs, and ill-defined disease states” (ICF 0.22).

21.2% of inventoried plant species were used to treat infectious and parasitic diseases followed respectively by circulatory system diseases (18.2%); Symptoms, signs, and ill-defined disease states (12.1%); Diseases of the blood and blood-forming organs (10.6%); Respiratory system diseases (6.1%) (Table 3).

Jaccard index was compared between this study and either other studies done in other parts of the Democratic Republic of the Congo or neighboring countries. In total 15 papers were analyzed. The highest degree of similarity in the neighboring countries was with studies conducted in Kayes and Madingou in the Republic of Congo (Kimpouni et al., 2019). The lowest similarity was with Novotna et al. (Novotna et al., 2020) (Table 4).

Comparing the present study with other studies done in DRC, the JI between Ngbolua et al. (Ngbolua et al., 2016), and our area were 19.15 and 18.88. The low similarity was with Mongeke et al. (2018); a study conducted in Nord-Ubangi Province.

According to Raven et al. (2009), about 13 million hectares of forest are lost annually on Earth and this deforestation results in a net annual loss of about 12 million hectares of forest area, of which about 8 million hectares are tropical forests. Thus, about 1% of tropical forests are cleared or severely degraded each year. Among the causes of this deforestation is slash-and-burn agriculture (Kpula et al., 2021), a practice that can lead to the reduction of the population or stand of plant taxa. It should also be noted that the vulnerability of a plant also depends on its frequency of use in

traditional medicine, its morphological type, its abundance in the environment, the uses made of it, the organs used, the biotope, the mode of dissemination of diaspores, the stage of development of the plant and the mode of collection (Ngbolua, 2020; Masengo et al., 2021a, b). Hence the need to know the conservation status of the listed plant species to propose strategies for their sustainable use. The Red List of Threatened Species revealed that 46 of our studied plants are not listed, while 17 namely Aframomum alboviolaceum, Alchornea cordifolia, Annona muricata, Crossopteryx febrifuga, Eleusine indica, Euphorbia tirucalli, Gossypium barbadens, Hymenocardia acida, Millettia drastica, Millettia macroura, Morinda lucida, Moringa oleifera, Persea americana, Psidium guajava, Securidaca longepedunculata, Tephrosia vogelii and Tetradenia riparia are “least concern” (LC), two species (Carica papaya an Mangifera indica) are “data deficient”(DD) and one (Garcinia kola) is “vulnerable”(VU).

It is well established that in Africa, in addition to the fact that more than 80% of the population uses medicinal plants for health care (WHO, 2002), these biological resources remain a product of gathering and the period of gathering is variable and extends practically throughout the year in their natural habitat, thus demonstrating the pressure exerted by the population on these resources and the need to integrate them into agricultural activity to develop sustainable peasant agriculture, This demonstrates the pressure exerted by the population on these resources and the need to integrate them into agricultural activity to develop a reasoned, multifunctional and sustainable peasant agriculture to ensure the resilience of the population to climate change on the one hand and improving human health on the other (Sustainable Development Goal 3).

Agro-ecology, which can be defined as the science of natural resource management for the benefit of the poorest people facing an unfavorable environment, is a discipline that should be developed and popularized to achieve this objective in the DRC (Altieri, 1996).

Study strengths and weaknesses

The present research has inventoried a good number of value-added medicinal plants and associated traditional knowledge necessary for the effective implementation of the Nagoya Protocol on access and benefit sharing in Democratic Republic of the Congo. It should be noted, however, that the inventory of these plant genetic resources concerns only a tiny part of the national territory.

CONCLUSION

The purpose of this study was to make an ethnobotanical inventory of medicinal plants used in Congolese pharmacopeia. The results obtained in this study showed that herbal remedies are widely used in Kasangulu Territory. We found that married and single people have shared medical knowledge, with a slight predominance of married people; infertility is the most cited disease, dominance among people with high school education. However, the analysis of the recipes has allowed us to show that the leaf is the most commonly used organ and an infusion is the most common method of preparation in traditional medicine. In addition, the analysis of the ecological spectrum showed the predominance of phanerophytes while the chronological spectrum shows the predominance of pantropical species. This study of the medicinal plants used in Kasangulu constitutes a reservoir of information that contributes to knowledge to protect the medicinal flora and safeguard local popular know-how.

REFERENCES

Alqahtani M.M., Kazi M., Alsenaidy M.A., Ahmad M.Z. (2021). Advances in Oral Drug Delivery. Front. Pharmacol., 12:618411.

Altieri M.A. (1996). Agroecology: the science of sustainable agriculture. Second Edition.

Amjad M.S., Arshad M., Qureshi R. (2015). Ethnobotanical inventory and folk uses of indigenous plants from Pir Nasoora National Park, Azad Jammu and Kashmir. Asian Pacific Journal of Tropical Biomedicine; 5: 234-241.

APG (2016). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. Botanical Journal of the Linnean Society; 181: 1-20.

Asiimwe S., Kamatenesi-Mugisha M., Namutebi A., Borg-Karlsson A.K., Musiimenta P. (2013). Ethnobotanical study of nutri-medicinal plants used for the management of HIV/AIDS opportunistic ailments among the local communities of western Uganda. Journal of Ethnopharmacology; 150: 639-648.

Asimonyio J.A., Kambale K., Shutsha E., Bongo G.N., Tshibangu D.S.T., Mpiana P.T. (2015). Phytoecological Study of Uma Forest (Kisangani City, Democratic Republic of The Congo). Journal of Advanced Botany and Zoology, V3I2.

Axiotis E., Halabalaki M., Skaltsounis L.A. (2018). An ethnobotanical study of medicinal plants in the Greek islands of North Aegean Region. Frontiers in Pharmacology; 9: 1-6.

Azam F.M.S., Biswas A., Mannan A., Afsana N.A., Jahan R., Rahmatullah M. (2014). Are famine food plants also ethnomedicinal plants? An ethnomedicinal appraisal of famine food plants of two districts of Bangladesh. Evidence-Based Complementary and Alternative Medicine.

Bano A., Mushtaq A., Taibi B.H., Abdul S., Shazia S., Muhammad Z. (2014). Quantitative ethnomedicinal study of plants used in the skardu valley at high altitude of Karakoram-Himalayan range, Pakistan. Journal of Ethnobiology and Ethnomedicine; 10: 1-17.

Faruque O.M., Feng G., Khan A.N., Barlow W.J., Ankhi R.U., Hu S. (2019). Qualitative and quantitative ethnobotanical study of the Pangkhua community in Bilaichari Upazilla, Rangamati District, Bangladesh. Journal of Ethnobiology and Ethnomedicine; 15: 8.

Ghislain C.A., Elie A.P., Flora J.C., Achille E.A. (2007). Importance ethnobotanique et valeur d'usage de Picralima nitida (stapf) au Sud-Bénin (Afrique de l'Ouest). International Journal of Biological and Chemical Sciences, 11: 1979-1993.

Ilumbe B.G., Van Damme P., Lukoki F.L., Joiris V., Visser M., Lejoly J. (2014). Contribution à l'étude des plantes médicinales dans le traitement des hémorroïdes par les pygmées de Twa et leur voisin Oto de bikoro, RDC. Congo Sciences, 2: 46-54.

Inkoto L.C., Bongo N.G., Kapepula M.P., Masengo A.C., Gbolo Z.B., Tshiama C. (2018). Microscopic features and chromatographic fingerprints of selected Congolese medicinal plants: Aframomum alboviolaceum (Ridley) K. Schum, Annona senegalensis Pers. and Mondia whitei (Hook.f.) Skeels. Emergent Life Sciences Research; 4: 1-10.

IUCN (2019). The IUCN Red List of Threatened Species. http://www.iucnredlist.org.

Kalombo K.D. (2016). Évolution des éléments du climat en RDC, Ed. Universitaires Européennes.

Kasika E.L., Vasombolwa V.K., Lejoly J. (2015). Contribution to the Knowledge of Plants Used by Bantu and Pygmy Healers in Beni and Lubero Territories (Democratic Republic of Congo). Journal of Plant Studies; 4(2).

Katemo M., Mpiana P.T., Mbala B.M., Mihigo S.O., Ngbolua K.N., Tshibangu D.S.T. (2012). Ethnopharmacological survey of plants used against diabetes in Kisangani city (DR Congo). Journal of Ethnopharmacology; 144: 39-43.

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.

Kpula N.M., Ngbolua K.N., Assi R.L., Nzamonga A.G., Andia P.L., Masengo C.A. (2021). Pratique de l'agriculture traditionnelle sur brûlis dans la commune de Molegbe (Gbado-Lite, Nord-Ubangi) en République Démocratique du Congo. Revue Marocaine des Sciences Agronomiques & Vétérinaires, 9: 730-735.

Lara Reimers E.A., Cusimamani E.F., Lara Rodríguez E.A., del Valle J.M.Z., Polesny Z., Pawera L. (2018). An ethnobotanical study of medicinal plants used in Zacatecas state, Mexico. Acta Societatis Botanicorum Poloniae, 87: 0-5.

Lawal I.O., Rafiu B.O., Ale J.E., Majebi O.E., Aremu A.O. (2022). Ethnobotanical Survey of Local Flora Used for Medicinal Purposes among Indigenous People in Five Areas in Lagos State, Nigeria. Plants, 11: 633.

Lebrun J. (1947). La végétation de la plaine alluviale au sud du lac Eduard. Institut des Parcs Nationaux du Congo Belge, Bruxelles. 153p.

Leso L.K., Elansary H.O., Mearns K., Yessoufou K. (2017). Ethnobotany at a local scale: Diversity of knowledge of medicinal plants and assessment of plant cultural importance in the Polokwane local municipality, South Africa. Botany Letters, 164: 93-102.

Manya M.H., Keymeulen F., Ngezahayo J., Bakari A.S., Kalonda M.E., Kahumba J. (2020). Antimalarial herbal remedies of Bukavu and Uvira areas in DR Congo: An ethnobotanical survey. Journal of Ethnopharmacology; 249: 112422.

Masengo C.A., Bongo N.G., Robijaona B., Ilumbe G.B., Ngbolua K.N., Mpiana P.T. (2021). Etude ethnobotanique quantitative et valeur socioculturelle de Lippia multiflora Moldenke (Verbenaceae) à Kinshasa, République Démocratique du Congo. Revue Marocaine des Sciences Agronomiques et Vétérinaires, 9: 93-101.

Masengo C.A., Inkoto C.L., Munsebi J.M., Mandjo B.L., Mpiana P.T., Ngbolua K.N. (2021b). Connaissance et usages de Quassia africana (Simaroubaceae) par les peuples Mongo, Yaka et Yombe de Kinshasa en République Démocratique du Congo. Revue Marocaine des Sciences Agronomiques et Vétérinaires; 9: 761-769.

Mongeke M.M., Ngbolua K., Bakola R.D., Inkoto C.L., Elikanpani P.N., Mouli C. (2018). Enquête sur les plantes utilisées en médecine traditionnelle par les Bambenga: pygmées du secteur de Dongo en République Démocratique du Congo. Revue Marocaine Sciences Agronomiques et Vétérinaires; 6: 469–475.

Muthu C.C., Ayyanar M.M., Raja N.N., Ignacimuthu S. (2006). Medicinal plants used by traditional healers in Kancheepuram District of Tamil Nadu, India. Journal of Ethnobiology and Ethnomedicine, 2:43.

Ngbolua K.N., Inkoto C., Mongo N., Ashande M.C., Masens Y., Mpiana P.T. (2019). Étude ethnobotanique et floristique de quelques plantes médicinales commercialisées à Kinshasa, République Démocratique du Congo. Revue Marocaine Des Sciences Agronomiques et Vétérinaires; 7: 118-128.

Ngbolua K.N., Shetonde O.M., Mpiana P.T., Inkoto L.C., Masengo C.A., Tshibangu D.S.T. (2016). Ethno-pharmacological survey and Ecological studies of some plants used in traditional medicine in Kinshasa city (Democratic Republic of the Congo). Tropical Plant Research, 3: 413-427.

Ngbolua K.N. (2020). Ethnobotanique quantitative: Approches méthodologiques pour l'évaluation et la valorisation du savoir endogène en régions tropicales. Editions Universitaires Européennes, Riga: Latvia.

Ngezahayo J., Havyarimana F., Hari L., Stévigny C., Duez P. (2015). Medicinal plants used by Burundian traditional healers for the treatment of microbial diseases. Journal of Ethnopharmacology, 173: 338-351.

Novotna B., Polesny Z., Pinto-Basto M.F., Van Damme P., Pudil P., Mazancova J., Duarte M.C. (2020). Medicinal plants used by 'root doctors', local traditional healers in Bié province, Angola. Journal of Ethnopharmacology; 260: 112662.

Okombe E.V., Lumbu S.J.B., Stévigny C., Vandenput S., Pongombo S.C., Duez P. (2014). Traditional plant-based remedies to control gastrointestinal disorders in livestock in the regions of Kamina and Kaniama (Katanga province, Democratic Republic of Congo). Journal of Ethnopharmacology; 153:686-693.

Oliveira A.K.M., Oliveira N.A., Resende U.M., Martins P.F.R.B. (2011). Ethnobotany and traditional medicine of the inhabitants of the Pantanal Negro sub-region and the raizeiros of Miranda and Aquidauna, Mato Grosso do Sul, Brazil. Brazilian Journal of Biology, 71: 283-289.

Raunkiaer C. (1934). The life forms of plants and statistical plant geography. Oxford Clarendon Press, 632p.

Raven P.H., Hassenzahl M.D., Hager C.M., Gift Y.N., Berg R.L. (2009). Environnement, 6e édition, Nouveaux horisons, De Boeck: Bruxelles, Belgique.

Schmitz A. (1988). Révision des groupements végétaux décrits du Zaïre, du Rwanda et du Burundi. Publ. CIDAI, Mus. Roy. Afr. Centr. Tervuren, 315p.

World Health Organization (2002). Traditional medicine strategy 2002-2005. https://apps.who.int/iris/handle/10665/67163

References