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Local Importance of Wild Woody Plants for Medicinal Use in the Tchambi Region; Maniema (DR Congo)

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ABSTRACT

The contribution of trees to food security and primary healthcare in African societies is well established. The objective of the study was to investigate the diversity and local importance of woody plants used in traditional medicine in Tchambi. Data collection was based on ethnobotanical surveys of 80 traditional practitioners living in ten villages in the peripheral areas of Lomami National Park. Data analysis consisted of calculating medicinal use values and Sorensen's similarity index, the Kh2 test of independence and correlation between the number of organs used and the number of diseases treated for a plant. A total of 42 species belonging to 21 families were identified. *Millettia versicolor* (Med. Uvs = 0.46), *Autranella congolensis* (Med. Uvs = 0.42), *Alstonia bonnei* (Med. Uvs = 0.39), *Bridelia micrantha* (Med. Uvs = 0.37), *Pentaclethra macrophylla* (Med. Uvs = 0.36) and *Piptadeniastrum africanum* (Med. Uvs = 0.23) are the most useful species in the area following their Med. UVS. The Chi-square test showed that the population's perception of the availability of medicinal species was influenced by age; while the correlation test showed that there is a moderate positive correlation between the number of organs used for a plant and the number of diseases it can treat (T = 0.558, p-value = 0.000). The more a plant is used for several organs at the same time, the more it can treat multiple diseases.

Keywords: Med Use value, woody, wild, medicinal use, Tchambi region

INTRODUCTION

Phytotherapy has been used by humans for a long time (Moyabi *et al*., 2021). Trees occupy a significant place in human society given the multiple functions they play, whether in the food, medicinal, cultural, agro-forestry, or technological fields (Goussanou *et al*., 2011). Their contribution to food security and primary health care is no longer in doubt given that more than 80% of the population of developing countries use them for both health reasons and for food (Dossou *et al*., 2012). The dependence of local populations in developing countries on wood resources in the natural environment could therefore be a threat to the survival of these plant species subject to human pressures (Adjahossou *et al*., 2018).

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But, for a long time, in national strategies for the conservation of biological resources, the emphasis has been placed on the 'wood' component (especially timber) of forests, while they are full of many other products exploited by local populations (Allabi *et al*., 2011). The galloping population growth has implied an increase in human dependence on biodiversity (Amoussou *et al*., 2012). This strong pressure dangerously leads to the reduction of forest cover (Djègo and Oumorou, 2009) and very often, their existence is called into question (Yessoufou, 2005). For the Tchambi region, this situation is currently reflected, as already pointed out by Onyumbe, (2022), in a scarcity of certain plant species. These include, for example, *Autranella congolensis* and *Pentaclethra macrophylla*, which traditional practitioners in the area use to treat sexual weaknesses.

The objective of this study is to investigate the diversity and local importance of woody species used in traditional medicine in Tchambi.

MATERIALS AND METHODS

Study Area

The study was carried out in the Bangengele chiefdom, located in the Maniema province of the Democratic Republic of Congo (Figure 1). This territory covers approximately 7,136 km², with an average density of 16 inhabitants/km² (N'Sanda *et al*., 2011). The climate is humid tropical (subequatorial), characterized by two main seasons: a rainy season (September to May) and a dry season (mid-May to mid-August). The vegetation is dominated by dense primary humid forests, including *Gilbertiodendron dewevrei*, *Milicia excelsa* and *Entandrophragma angolense*, as well as fallow areas and shrub savannahs (PDL, 2021).

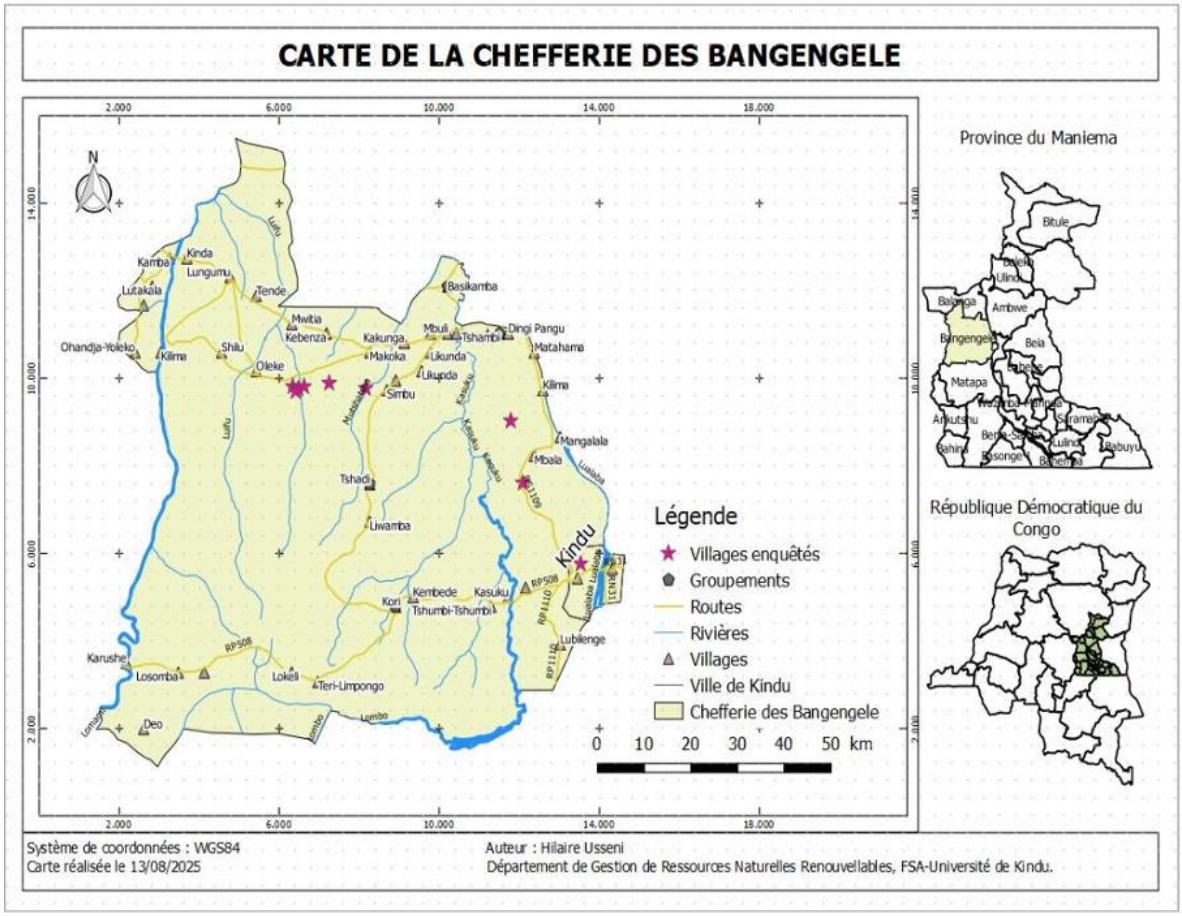

Figure 1: Location map of the Study Area

Methods

Sampling and data collection

Ethnobotanical surveys were conducted in ten villages of the Tchambi group (Kalemba I, Kalemba II, Myango, Dingi, Lomango, Kakungu, Makoka, Oleke, Tchombekilima and Oluwo). Participants were selected using the "snowball" method (Nzuki *et al*., 2013), which consisted of identifying traditional practitioners by successive recommendations.

A total of 80 people (32 women and 48 men), aged at least 20 years, were interviewed. The minimum age was set to provide reliable evidence on the evolution of flora and traditional practices (Brossard, 2019). The semi-structured interviews focused on:

- the identification of wild trees used in traditional medicine;
- the plant organs used (roots, bark, leaves, etc.);
- the methods of preparation (decoction, maceration, powder, etc.);
- routes of administration; etc.

Analysis of Local Importance

As also recognized by Kvist *et al*. (1995) and Thomas *et al*. (2009), it is a question of calculating medicinal use value (Medicinal Use Value). This index makes it possible to better highlight the most useful species based on the knowledge of the respondents, their common use and the diversity of use of the latter in a given environment.

This is done through the following formula:

$$\textbf{Med. UVs} = \frac{\sum Ui}{ns} \quad (1)$$

Or:

Uis = total number of citations of medicinal uses of the species(s), mentioned by the informant (i) (traditional practitioner); and ns = Total number of informants having mentioned the species(s).

Knowledge similarity analysis

To compare the distribution of knowledge between villages, sexes and age groups, Sorensen's similarity index (SI) was calculated (Atakpama *et al*., 2021). This index varies between 0 (no similarity) and 1 (identical knowledge).

This, referring to the following formula:

$$\textbf{SI} = \frac{2C}{(S1+S2)} \quad (2)$$

Where: C = Number of common species; S1= Number of species for village 1 and S2= Number of species for village 2.

Chi-square of independence

To compare proportions, the chi-square test of independence was used between the respondents' perception of some sociodemographic parameters and the availability of medicinal species. This was to determine that belonging to a modality of the first variable has no influence on the modality of belonging to the second variable (Barnier, 2013). This was done according to the following formula:

$$x^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(Oij-Eij)2}{Eij} \quad (3)$$

Kendall's Tau Correlation

The correlation between the number of organs used for a plant and the number of diseases it can treat, was analyzed by Kendall's Tau correlation coefficient, which more specifically measures the rank correlation between two variables (tied).

$$T = \frac{C-D}{\frac{1}{2}n\,(n-1)} \quad (4)$$

Where: T= Kendall's correlation coefficient; C= number of concordant pairs; D= number of discordant pairs and n= total number of observations.

RESULTS

Inventory and Local Importance of Species

Discussions with 80 traditional practitioners, including 32 women and 48 men, across the ten villages, made it possible to identify 42 plant species used in traditional medicine by the Ngengele communities of Tchambi. These 42 species are divided into 40 genera and 21 families. The order of importance of the families is as follows: Fabaceae occupy the 1st position (19%); followed by Euphorbiaceae (14.2%); Rubiaceae (10%); Apocynanaceae and Moraceae 7% each). In total, 438 citations of medicinal use of plants were recorded. The number of citations per species varies from 1 to 37. On the other hand, the number of pathologies per species varies from 1 to 8. The medicinal use value index (Med. UVS) varies from 0.01 to 0.46. In this regard, the species with a high value of importance in the area is *Millettia versicolor* (Med. Uvs = 0.46), followed by *Autranella congolensis* (Med. Uvs = 0.42), *Alstonia boonei* (Med. Uvs = 0.39), *Bridelia micrantha* (Med. Uvs =0.37), *Pentaclethra macrophylla* (Med. Uvs = 0.36), *Piptadeniastrum africanum* (Med. Uvs = 0.23). The pathologies treated with these plants by traditional practitioners are diverse. The main categories are: sexual weakness, hemorrhoids, tension, fractures, lower back pain, malaria, diabetes, etc. Thus, the top 10 most useful species in Tchambi according to the number of pathologies to be treated are as follows:

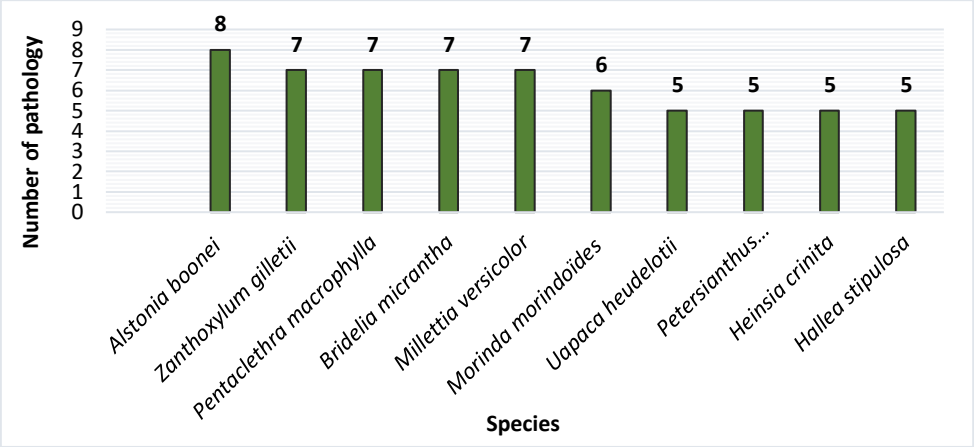

Figure 2: Top ten most reported species

Plant organs used

The most used parts are: Bark: 39% of uses, Roots: 23.4%, Leaves: 19%, Stems: 8%, latex, Seeds and flowers have respectively 6%, 3% and 1.6%. The predominance of bark and roots illustrates a strong pressure on the vital organs of plants, compromising their regeneration.

Methods of preparing recipes and routes of administration

Preparation: predominance of decoction (39%), followed by maceration (22%), pastes and raw (9.3% each).

Administration: The predominant routes are oral (42%), anal (29%) and local application (14.5%).

Biological types

Mesophanerophytes are the most represented (47.6%), followed by Megaphanerophytes (28.6%) and Microphanerophytes (19%). The least represented are Nanophanerophytes (4.8%).

Similarity of Knowledge by Villages

Data related to knowledge similarities are shown in the figure below.

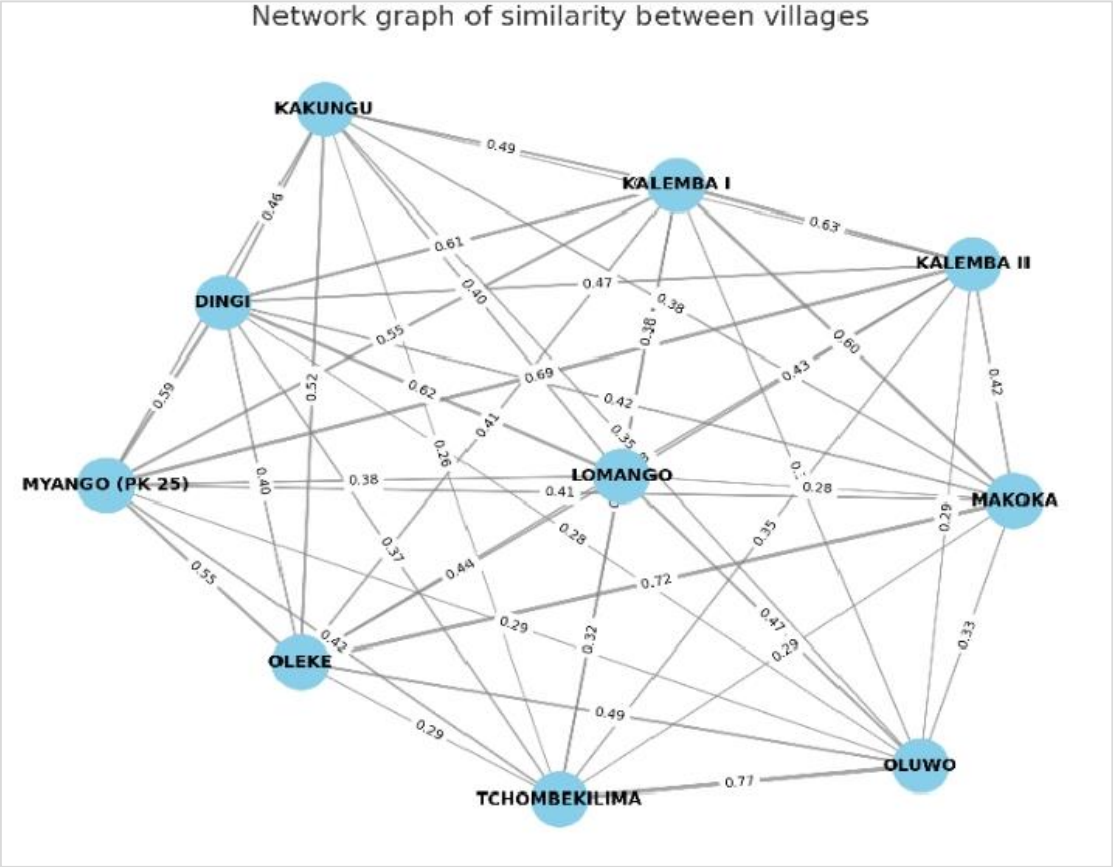

Figure 3: Similarity of knowledge across villages

The Sorensen index (SI) varies between 0.28 and 0.77 depending on the village. The strongest similarities are observed between Tchombekilima and Oluwo (SI = 0.77) and between Oleke and Makoka (SI = 0.72). Geographically close villages generally have more homogeneous knowledge.

Chi-square of Independence and Kendall's Correlation

The Chi-square test of independence between the sexes and the population's observation on the availability of medicinal species in the forest shows that the difference is not statistically significant (p-value=0.157), which means that these two variables are independent of each other. On the other hand, respondents belonging to the age group of 61 years and above, have further noted that there is indeed a certain decrease in medicinal plant species in the area, the difference between the age groups is statistically significant (p value = 0.001), therefore the perception on the availability of medicinal plants is influenced by age.

As for the correlation test between the number of organs and the number of diseases treated for a plant, the results show that there is a moderate positive correlation between the number of organs used for a plant and the number of diseases it can treat (T = 0.558, p-value = 0.000). The more a plant is used for several organs at the same time, the more it can treat multiple diseases.

DISCUSSIONS

This study, with the main objective of studying the diversity and local importance of woody species used in traditional medicine in Tchambi, revealed 42 species of wild trees of medicinal interest frequently used by traditional practitioners surveyed in Tchambi. These species are divided into 40 genera and 21 families. Nzuki *et al*., (2013) identified 165 botanical species, divided into 138 genera and 56 families in Mbanza-Ngungu. On the other hand, Ouattara *et al*., (2023) also identified 25 medicinal species in the Sahelian zone of Burkina. These twenty-five species were divided into 25 genera and 18 families. The main families encountered are Fabaceae-Mimosoideae (4 species), Fabaceae-Caesalpinioideae (2 species), Annonaceae (2 species), Anacardiaceae (2 species), Meliaceae (2 species). The other families are each represented by one species. The families of woody plants frequently used in Tchambi are Fabaceae; Euphorbiaceae; Rubiaceae; Apocynanaceae and Moraceae. Zerbo *et al*. (2005) and Asse *et al*., (2011) respectively in Ghana and Burkina Faso, attest to the importance of the Fabaceae family. The popularity of this family can be attributed to the wide collection of bioactive compounds it contains (Kyaw TUN *et al*., 2006). Indeed, according to them, Fabaceae have significant levels of tannins and alkaloids and are characterized by isoflavonoids, known for their estrogenic effects.

Akpi *et al*., (2019) identified 68 woody species belonging to 57 genera and 26 families in the Guinean-Congolese zone of Benin, still with a predominance of Fabaceae over other families. 438 citations of medicinal use of plants have been recorded in Tchambi. The number of citations per species varies from 1 to 37. The medicinal use value index (Med. Uvs) varies from 0.01 to 0.46. The species with high importance value in the area is *Millettia versicolor* (Med. Uvs = 0.46), followed by *Autranella congolensis* (Med. Uvs = 0.42), Alstonia boonei (Med Uvs = 0.39), *Bridelia micrantha* (Med. Uvs =0.37), *Pentaclethra macrophylla* (Med. Uvs = 0.36), *Piptadeniastrum africanum* (Med. Uvs = 0.23). For Nzuki *et al*., (2013), the Med.UVs of the plants surveyed among traditional practitioners in the Mbanza-Ngungu region vary from 0.02 to 0.71. The plant species with the highest Med.UVs is Elaeis guineensis (0.71). It is followed by *Brillantaisia patula* (0.39), *Mondia whitei* (0.35), *Zingiber officinale* (0.35), Allium sativum (0.33), *Manihot esculenta* (0.31), *Aframomum melegueta* (0.30), *Monodora myristica* (0.27), *Dorstenia laurentii* (0.25), *Senna occidentalis* (0.25) and *Annona senegalensis* (0.24).

The pathologies treated with these plants by traditional practitioners are diverse. The main categories are: sexual weakness, hemorrhoids, tension, fractures,lower back pain, malaria, diabetes, etc. In Kongo-Central, Nzuki *et al*., (op cit) also record several pathologies treated by traditional practitioners in Mbanza-Ngungu, the main categories of which are: poison/inflammation, diseases due to parasitic worms (mvp), diseases of the circulatory system (msc), culture-related syndromes (slc), diseases of the respiratory system (msr), microbial diseases (mm), skeletal diseases and pain (msq/d), diseases of the digestive system (msd), diseases of the genital system (msg) and miscellaneous (div).

Intensive exploitation of roots and bark (62.4% of uses) is the main factor of vulnerability of woody plants. Unlike leaves or fruits, the removal of these organs often leads to the death of the plant. This leads to a progressive decrease in the regeneration capacity of plant populations and, ultimately, to a degradation of forest ecosystems. This has already been reported by Nga *et al*., (2016) and Ngbolua *et al*. (2022) for other areas of Central Africa. Ouattara *et al*., (2023) attests to the predominance of roots, stems and bark over woody plants for medicinal purposes in the Sahel region. These organs would be the storage site of several secondary metabolites with diverse therapeutic properties due to their underground position which would favor the conservation of active substances from other organs, the active ingredients being chemical substances that can alleviate health problems (Houmenou *et al*., 2017; Dongock *et al*., 2018 and Bashige *et al*., 2020). These results contradict those of

Youssouf *et al*., (2018): (68.89%) and attested by Zirihi (2006), Bla *et al*., (2015) and Kipré *et al*., (2017) for whom the leaves are the most used organs. This difference could be justified by the morphological type of the plant as well as the disease to be treated.

Decoction (39%) is the most cited method of preparation. Indeed, water is the best and most widespread solvent for collecting the most active ingredients (Koman *et al*., 2019). In addition, this method is said to attenuate or inhibit the toxic effect of certain recipes.

The predominant routes of administration are oral (42%) and anal (29%). Moyabi *et al*. (2021) believe that this practice could be explained by the simplicity of this method. (Salhi *et al*., 2010) also agree that the preparations are almost all administered as a drink (oral route) and sometimes as a purge (rectal route). This can be explained by the simplicity of this method of administration, but also by the fact that since the drugs are in raw form, the oral route is the least dangerous, with the absorption of the active ingredients occurring in the small intestine.

All species listed were phanerophytes. These results are similar to those of Ouattara *et al*. (2023) for whom Phanerophytes represented (80%), including 76% for simple phanerophytes and 4% for climbing phanerophytes. This reflects the state of vegetation in equatorial and tropical forests, whose proportion of phanerophytes is estimated between 80 and 90% (Ambé, 2006) and (Ngbolua, *et al*., 2022).

The results of Kendall's correlation test between the number of organs and the number of diseases to be treated for a plant showed that there is a moderate positive correlation between the number of organs used for a plant and the number of diseases it can treat ($r = 0.558$, p-value = 0.000). For Nzuki *et al*., (2013), the Spearman correlation test carried out on the use values and the importance value indices of the species in each phytodistrict, shows a positive and significant correlation in the Lama phytodistrict.

CONCLUSION

By interviewing 80 traditional practitioners about wild woody species used for medicinal purposes in the Tchambi region of the Democratic Republic of Congo, 42 species of medicinal plants were identified, divided into 40 genera and 21 families. Fabaceae dominate the local pharmacopoeia. Among the species with high medicinal value in the area, we find at the top *Millettia versicolor* (Med. Uvs = 0.46). It was noticed apreferential exploitation of roots and bark; which increases the risk of vulnerability of trees.

The diversity of recipes as well as that of the organs used, the different methods of preparation and administration, show that traditional practitioners in these regions have a good knowledge of the woody plants which are involved in the treatment of different pathologies.

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Appendix 1: Scientific/vernacular names of species and diseases to be treated

No.	SPECIES		Families	Diseases treated
	Scientific names	***Vernacular names***		
1	*Aidia micrantha* (K. Schum.) Bullock	Inkendu (Kaboa)	Rubiaceae	Sexual weakness, hemorrhoids, breakages
2	*Alchornea cordifolia* (Schumach.&Thonn	Mabundjibundji	Euphorbiaceae	Diarrhea, dysentery, anemia, tooth decay
3	*Alchornea yambuyaensis* From Will.	Ihoma mboloko	Euphorbiaceae	Bronchitis, Cough
4	*Alstonia boonei* From Willd.	Motodo	Apocynaceae	Fracture, Back pain, Stomach ache, Bad spirit, Milk production in women, Convulsion, Tension, Hernia
5	*Annonidium mannii* (Oliv.) Engl.&Diels	Ohombi	Annonaceae	Tooth decay, Migraine
6	*Anthocleista schweinfurtii*Gilg.	Dihongo	Gentianaceae	Epilepsy, Blood Pressure, Fever
7	*Antidesma velosum* Tul.,	Jaatala	Euphorbiaceae	Acute gastritis
8	*Autranella congolensis* (From Wild.)	Kabolongo	Sapotaceae	Sexual weakness, children's relaxation, Low back pain
9	*Bridella micrantha* (Hochst.) Baill.	Osaku	Euphorbiaceae	Cough, Anemia, Back Pain, Paronychia, Abscess, Hemorrhoidal Fracture
10	*Carpolobia alba* G. Don	Bonsoke	Polygalaceae	Sexual weakness, Malaria, Hemorrhoid, Fever
11	*Chrysophyllum lacourtianum* Aubrev. & Pellegr.	Okomu duma	Sapotaceae	Sexual weakness (associated with alcohol), Low back pain
12	*Cola acuiunata* (P. Beauv.) Schott & Endl.	Makasu	Sterculiaceae	Sexual weakness, Lower back pain, Intestinal worms, Diabetes
13	*Dacryotes edulis* (G.Don) HJLam	Lutimu (Safou)	Burseraceae	Lower back pain, tension
14	*Desmodium velutinum* (Willd.) DC.	Olongole	Fabaceae (Faboideae)	Wound, Snake bite
15	*Diospyros heterotricha* (Welw. Ex Hiern) F. White	Ilala isile	Ebenaceae	Anemia, Hemorrhoid
16	*Ficus exasperate* Vahl.	Lwela	Moraceae	Breast milk production, softening the effects.
17	*Funtumia Africana* (Benth.) Stapf	Osomba	Apocynaceae	Wound, Scar
18	*Gilbertiodendron dewevrei* (From Wild.) J.Leonard	Lwete (Limbalu)	Fabaceae	Dysentery, Anemia, Sexual weakness, Back pain, Diarrhea, Wound, Cough
19	*Hallea stipulosa* (DC.) Léroy	Osakate	Rubiaceae	Fracture, Hernia, Lower Back Pain, Hemorrhoids, Tension
20	*Heinsia crinite* (Afzel.) G. Taylor	Ipando	Rubiaceae	Bulletproof, Hasme, Cough, Wound and Break
21	*Milicia excelsa* (Welw.) CCBerg	Olondo (Mufula)	Moraceae	Production and purification of breast milk, black powder, rheumatism
22	*Milletia versicolor* Welw ex Baker	Mukulukulu	Fabaceae (Faboideae)	Asthenia, softening the effects, lower back pain, sexual

				weakness, abdominal disorders, intestinal worms, snake bite
23	*Morinda morindoides* (Baker) Milne-Redh	Kongo bololo	Rubiaceae	Malaria, Flu, Back pain, Hernia, Sexual weakness, Fever
24	*Musanga cecropioides* R Br.	Kombo kombo (Caterpillars)	Urticaceae	Palpitation (Kambelembele)
25	*Myrianthus arboreus* P. Beauv.	Ogomu	Cecropiaceae	Anemia
26	*Ochna afzelii* F. Hoffm.	Sakumato	Ochnaceae	Anemia
27	*Onchoba welwitschia* D. Oliver.	Osakesake (Caterpillars)	Flacourtiaceae	Sinusitis, Hasme, Cough, Abscess
28	*Pentaclethra macrophylla* Benth.,	Owala	Fabaceae (mimosoideae)	Sexual weakness, Diabetes, Hemorrhoid, Fever, Low back pain, Fracture, Diarrhea, Tension, Low back pain
29	*Petersianthus macrocarpus* (P. Beauv.) Liben	Mobale (Caterpillars)	Lecythidaceae	Malaria, breast milk production, fever, asthenia and anorexia
30	*Piliostigma thonongii* Hochst.,	Inkina	Fabaceae (Caesalpinioideae)	Wound, Whitlow
31	*Piptadeniastrum africanum* (Hook. f.) Brenan.	Okungu	Fabaceae (mimosoideae)	Hernia, Sexual weakness, Hemorrhoid, Tooth decay, Lower back pain
32	*Rauvolfia vomitoria* Afzel.,	Kilulukundju dume	Apocynaceae	Hemorrhoids, Abdominal Disorders, Sexual Weakness, Lower Back Pain and Diabetes
33	*Ricinodendron heudelotii* (Baill.) Pierre ex Heckel.	Mulelalela	Euphorbiaceae (caterpillars)	Weakness in children
34	*Sapium cornutum* (Pax)	Oselekete	Euphorbiaceae	Stomach, Poison
35	*Scorodophloeus zenkeri* Harms.	Bopidi	Fabaceae	Sinusitis, Hemorrhoid, Diabetes
36	*Senna spectabilis* (DC.) Irwin & Barneby	Longolongo ya asili	Fabaceae (Caesalpinioideae)	Sexual weakness, Hemorrhoid
37	*Trema orientalis* (L.) Blume	Weesesu	Ulmaceae	Diabetes, Blood Pressure, Stomach, Tooth Decay, Fracture, Fungal Infections
38	*Trichilia rubescens* Oliv.,	Muti mukavu	Meliaceae	Malaria, Back Pain, Abscess, Fracture, Tension
39	*Tristemma mauritianum* JF Gmel.	Kihondohondo	Melastomaceae	Ratte, Soften the effects.
40	*Uapaca guinnensis* Müll.Arg.	Sengeelo	Phyllanthaceae	Sexual weakness, lower back pain
41	*Uapaca heudelotii* Bail.	Lisenge	phyllantaceae	Lower back pain, asthenia, toning, sexual weakness, tension
42	*Zanthoxyylum gilletii* EA De Wildeman) PG Waterman.	Kempangapanga	Rutaceae	Sexual weakness, Malaria, Back pain, Tooth decay, Nausea, Paronychia