Ethnobotanical Characterization of Medicinal Plants Used in Kisantu and Mbanza-Ngungu Terroirs, Kongo-Central Province in DR Congo

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Ethnobotanical characterization of medicinal plants used in Kisantu and Mbanza-Ngungu terroirs, Kongo-Central Province in DR Congo

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Abstract

Background: The phytotherapeutic knowledge of the Kongo people in the terroirs of Kisantu and Mbanza-Ngungu in Kongo-Central Province (DR Congo) is rapidly eroding. To document the remaining knowledge, we conducted an ethnobotanical survey on the most important medicinal plant species and diseases treated with them, as well as plants with therapeutic potential. We also verified how medicinal knowledge differs between different social groups.

Method: From June 2017 until February 2018 and from February until April 2019, we conducted a survey with 188 phytotherapists, selected using the snowball method and surveyed using semi-structured interviews. Voucher specimens were taken for identification. Ethnobotanical database was analyzed using medicinal Use Value (UVs), Informant Agreement Ratio (IARs), Informant Consensus Factor (ICF) and Species Therapeutic Potential (STP). Medicinal knowledge between different social groups was analyze using non parametric tests and the Poisson regression.

Results: A total of 231 plants (i.e. 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 (11.9 %) and genus *Solanum* (1.8%). Most harvested species (45,0%) were from anthropized areas. Most frequent plant part, botanical form, preparation and administration method were leaves (39.4%), herbs (37.1%), decoction (41.7%) and oral ingestion (72%) respectively. Four of all inventoried species showed high UV_S (> 0.05), whereas 8 had an IAR of 1. According to respondent consensus on plant use, 31 diseases were mentioned. Highest ICF (≥ 0,4) were observed for hemorrhoids (0.44), amoebiasis (0.43) and itchy rash (0.42). Fifty-four plant species were identified likely to have interesting therapeutic potential. Analysis of medicinal knowledge showed that the mean number of reported species and diseases vary considerably depending on gender, type and location of therapists ($P < 0.05$).

Conclusion: Results prove that the Kongo phytopharmacopoeia makes use of interesting medicinal plant species that could be further studied for conservation and pharmacological applications.

Keywords: *phytopharmacopoeia, important species, respondent consensus, Informant Knowledge, Kisantu and Mbanza-Ngungu terroirs.*

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Introduction

Since time immemorial, so-called medicinal plants have been used by all civilizations around the globe to treat various types of diseases [1, 2]. Today, medicinal plants still have the interest of modern medicine, the pharmaceutical sector in particular, in search of new drugs [3, 4]. It is estimated that about 80% of the world's population still practices phytotherapy [5]. In Africa, as in most underdeveloped countries, extreme and widespread poverty limits people's access to quality health care or modern medicine [6], forcing them to rely on herbal medicine [7].

Several studies have raised the issue of loss or risk of extinction of traditional knowledge of, and skills in, medicinal plant use. They have identified as the main cause the disappearance of species due to the degradation, deterioration of the natural habitat and the disinterest of young people in traditional culture due to westernization (and acculturation), education, etc. [8, 9]. This problem also prevails in Kongo-Central Province (DR Congo) [10]. In 1983, Daeleman and Pauwels [11] reported the disappearance of *Erythrophleum suaveolens*, a species formerly used in the practice of trial by poison by the Kongo people. It allowed to identify the culprit behind a disease of supposedly mystical origin. In herbal medicine, it was and is used against rheumatism and gynaecological problems.

According to Makumbelo *et al*. [12] and Kibungu [13], some native, wild medicinal plant species in Kongo-Central Province have increasingly become rare. This is e.g. the case for *Mondia whitei*, *Garcinia kola* and *Dorstenia laurentii*, which are used against sexual impotence, abdominal pain and intestinal amoebiasis, respectively. Recently, a medicinal plant vulnerability study in Mbanza-Ngungu conducted by Nzuki *et al*. [14] showed that *Lannea antiscorbutica*, *Mondia whitei*, *Monodora myristica, Pseudospondias microcarpa* and *Annona senegalensis subsp. oulotricha* are - according to their vulnerability index (Iv) - the most vulnerable species in Kongo herbal medicine.

Medicinal plant use and the accumulated knowledge of traditional phytotherapeutic practices are a rich cultural heritage and form integral part of local culture and tradition, and should be safeguarded to ensure their continued use [15].

In Kisantu and Mbanza-Ngungu regions, ancestral knowledge and skills regarding medicinal plants are orally transmitted. They are therefore vulnerable to extinction. Extending medicinal plant studies and documentation can help to save and conserve knowledge on their use [13].

Our ethnobotanical research is based on the assumption that the Kongo phytomedicinal knowledge is full of interesting information about important local species and medicinal plants with effective therapeutic potential. According to Nzuki [10], the most important medicinal plants are those distinguished by their medicinal use value (UVs) or informant agreement ratio (IAR). They are to be prioritized for both cultivation and conservation to prevent their disappearance. Heinrich *et al.* [16] and Lautenschläger *et al*.[17] suggested that informant consensus factor (ICF) is a good indicator for selecting plant species best adapted to pharmacological needs and to be subjected to phytochemical analysis.

The objectives of our study are to: (1) identify the most important medicinal plants and their uses in Kongo phytotherapy, (2) compare herbal medicinal plant use knowledge (number of species cited and number of diseases treated) between different social groups distinguished according to gender, age, marital status, education level, experience, type and location of respondents.

Study area

Our study was carried out in Kisantu and Mbanza-Ngungu towns as well as in the villages surrounding Mbanza-Ngungu, in Kongo-Central Province, Democratic Republic of Congo. Kisantu (also called Inkisi) is located at latitude 5° 08' S and at longitude 15° 03' E. Its altitude is estimated at 530 m [18]. Mbanza-Ngungu is located at latitude 5° 16' S and at longitude 14° 5' E. Its altitude range from 500 m to 750 m [19]. The areas are characterized by a tropical Köppen AW_4 climate with an average annual rainfall of 900 mm to 1500 mm and an annual average temperature of 25°C [20].

They are predominantly inhabited by the Ntându and Ndibu ethnic groups respectively. They're neighbours and are both part of the Kongo people who stretch from Congo-Brazzaville to Angola. They share the same culture inherited from the ancient Kongo kingdom and the use of herbal medicine is well rooted in their customs and habits. Farming and trading are they main economic activities [21].

Kisantu and Mbanza-Ngungu are interconnected, influence each other mutually and share almost the same socio-economic and cultural realities. They are both located in a Province where poverty is general and widespread. The health indicators for this Province show a very worrying situation. These include the low coverage and precariousness of the health system (1 General Reference Hospital for 126,700 inhabitants, 1 Doctor for 17,356 inhabitants, 1Pharmacist for 131,069 inhabitants, 1 bed for 514 inhabitants, 1 reference health centre for 50,013 inhabitants) and low utilization of services of health, as low as 49% for curative care [20].

Fig.1. Study area location (DR Congo map from Lesniewski [22])

Method

Data collection

During field surveys, we distinguished 3 types of herbal therapists according to their attitude: (1) traditional health practitioners (who heal using plant, animal or mineral products); (2) herbalists (who know plants and use them for medicinal purposes) and (3) curing healers (who mainly use religious or other rites to heal).We defined them according to the Congolese [23] and Central African [24] law on herbal medicine. These traditional 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 and do not necessarily use the same plants to treat diseases. They are also distinguished in the art of curing diseases [25].

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 [10, 26, 27] and surveyed using semi-structured interviews. Following to Thomas et al. [28], plant photos were used to complete interviews and check the respondents' ability to recognize plants they use. We used photos depicted in Pauwels *et al*. [29] as well as own photos taken during a preparatory field visits in the study area.

Information on age, gender, marital status, education level, experience, socio-professional category, diseases treated, plants used, their used organs and their growth location, preparation and administration methods were also collected during interviews. Following Sylva *et al.* [30], 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 healers and by consulting studies from Gillet *et al*.[31], Nsimundele [32], Daeleman *et al*.[11], Budiongo [33], Mukoko [34], Pauwels [35], Malaisse [36], Kibungu [13], Nzuki [10], Latham *et al*.[37], Nzenza *et al*.[38]. Voucher specimens of each species were collected 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 IV system were verified using websites such as Tela-Botanica (www.tela-botanica.org) or IPNI (International plant names index: www.ipni.org).

Ethnobotanical parameters measured

Relative importance attached to a given medicinal species in Kongo herbal medicine was calculated using **UVs** (medicinal use value) parameter by the formula of Phillips et al. [39] modified and used by Thomas *et al*. [40] below.

$$\mathrm{UVs} = \frac{\sum_{i=1}^{n} \mathrm{Uis}}{\mathrm{ns}}$$

With UVS = use value of a given species mentioned by informant i; ΣU is the number of uses of species S mentioned by informant I ; ns is the total number of informants.

As this parameter does not reflect the consensus of informants on medicinal plant use, we have also calculated for each species, the parameter **IAR** (Informant Agreement Ratio) following Trotter and Logan [41], Thomas *et al*.[40] and Nzuki *et al*.[14] according to the formula below:

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

Nr=total number of citations of the species and Na=number of diseases treated by the species.

For each plant use, we calculated the **ICF** (Informant Consensus Factor) parameter. This parameter allows to verify informant agreement for a plant species in the treatment of a particular disease and select species with an interesting therapeutic potential for phytochemical and pharmacological studies according to Trotter and Logan [41]. ICF was computed following Trotter and Logan [41] :

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

Nuc=number of citations for a particular condition; Nt=number of species used for the treatment of that condition.

After documenting local uses, we selected species which seemed to be potentially effective for phytochemical studies. For this purpose, we considered according to Heinrich [42] species cited more than once for the treatment of a mentioned disease as potentially effective. To select easily those species, we defined and used the parameter Species Therapeutic Potential (STP) according to the formula bellow:

$$STP\ (\%) = \frac{Ni-1}{Nti}$$

This parameter takes into account the number of informants who mentioned the use of a species for the treatment of a given disease (Ni) minus 1 and the total number of all informants who mentioned any species for the treatment of that disease (Nti). The advantage of this defined parameter (STP) is that it allows only the most frequently cited plants to be selected for the treatment of a given disease and the plants cited only once to be discarded. In other words, the STP allows only the species with the highest level of consensus for each disease mentioned according to ICF to be selected.

Data analysis

MS Excel 2013 was used to process the data. Differences of traditional medicinal knowledge between social groups were analysed using SPSS 25. Mann-Whitnay and Kruskal-Wallis non-parametric tests and the Poisson regression were employed to analyze differences in disease and medicinal plant knowledge between different social groups (gender, age, experience, education, marital status, categories and informants location). As for Poisson regression or for Mann-Whitney and Kruskal-Wallis tests, the p-value (<0.05) was considered as statistically significant.

Results

Informant profiles

Table 1. Description of informant sociological profiles.

The majority of informants was male (57.4%). Most of them were traditional health practitioners (81.9%). The sector is dominated by adults (72.3%) followed by the elderly (23.4%). Lowest number of respondents were situated in Mbanza-Ngungu urban area (20.7%) compared to Kisantu (43.1%) and Mbanza-Ngungu rural area (36.2%). Majority of respondents had at least received primary (33%) and secondary (45.5%) school education. Most respondents were married (70.2%) and had more than 10 years of experience (78.7%) with phytomedicine. The highest average number of cited species and diseases, were recorded among elderly (4.8±4.2 species and 2.1±1.9 diseases mentioned on average), users with 5-10 years of experience (4.6±4.4 species and 1.9±1.9 diseases mentioned on average), male respondents (4.8±3.9 species and 1.9±1.9 diseases mentioned on

average), curing healers (6.7±5.6 species and 3.1±2.6 diseases mentioned on average), married therapists (4.6±3.9 species and 1.8±1.9 diseases mentioned on average), respondents with at least secondary school education (4.7±4.1 species and 2.1±2.2 diseases mentioned on average) and therapists living in the Mbanza-Ngungu urban area (5.21±4.4 and 2.5±2.6) (Table 1).

Taxonomic diversity noted

From a total of 231 plants inventoried, 227 species could be identified and classified in 192 genera and 79 families. Families representing most species were *Fabaceae* (27 species, i.e. 11.9%), *Euphorbiaceae* (13 species, i.e. 5.7%), *Rubiaceae* (12 species, i.e. 5.3%), *Asteraceae* and *Lamiaceae* (each with 11 species, i.e. 4.8%) and *Solanaceae* (10 species, i.e. 4.4%). The other families contained less than 10 species (Figure 2). Best represented genera are *Solanum* (4 species, 1.8%) and *Allium, Dioscorea, Milletia, Ocimum* and *Vitex* (each with 3 species, 1.3%) (Table2).

Fig. 2. Share (%) of families according to the number of species

Table 2. Rank and proportion of genera by number of species

Medicinal plant use

A total of 337 drug recipes were identified, of which 203 are composed of at least 2 species for the treatment of 103 diseases. The leaf (39.4%) is the most commonly used organ (Figure 3), whereas decoction (41.7%) and oral ingestion (71.7%) are the most common preparation (Figure 4) and administration methods (Figure 5). Herbs (36.4%) are the most widespread biological form (Figure 6). Anthropized areas such as fields, roadsides or around houses (45.0%) are the growth location of most of inventoried medicinal plants (Figure 7).

Hemorrhoids (9.7%), hernias (6.2%) and sexual weakness or impotence (3.9%) are the top three diseases for which there is a high consensus of use of plant species among informants for their treatment (Figure 8).

Fig. 3: Share (%) of harvested organs used according the number of responses.

Fig.4 : Share (%) of drug preparation method according to the number of responses.

Fig. 5. Share (%) of traditional drug administration routes according to the number of responses

Fig. 6: Share (%) of biological forms according to the number of species and the number of responses.

Fig. 7. Share (%) of plant growth locations according to species and number of responses.

Fig.8: Share (%) of diseases treated with phytomedicine in Kongo-Central Province.

Ethnobotanical data analysis

Relative importance of a given plant (UVs, IAR)

Medicinal plant use value ranged from 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) are the most important species in the traditional Kongo pharmacopoeia, with UVs >0.05 (Figure 9).

Fig. 9. The most important species according to their UV_S.

The informant agreement on plant use ranged from 0.1 to 1. Dioscorea smilacifolia De Wild, Abelmoschus esculentus (L.).Moench, Eucalyptus citriodora Hook, Garcinia kola Heckel, Musanga cecropioides R. Br, Steganotaenia araliacea Hochst, Strychnos pungens Soler and Datura stramonium L had the maximum IAR-value of 1 (Fig. 10). They represent the species with the highest level of consensus for their use as a remedy for diabetes, cough, epilepsy, laryngitis, hernia, elephantiasis and hair yellowing and tooth decay, respectively.

Fig.10. Ranking of most important species according to their IAR.

Informant Consensus Factor (ICF) and Therapeutic potential species (STP).

ICF ranged from 0.05 to 0.44. A total of 31 diseases (about 30% of the total inventoried) was mentioned according to informant' plant use knowledge homogeneity. Among them, 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 cough (0.2) have shown an ICF value great or equal to 0.20 (Table 3, written in bold). For each disease mentioned, species used by a large number of healers were selected using STP. A total of 54 plant species have been identified and considered as having effective therapeutic potential (Table 3). Hernia is the pathology with the highest number of reported medicinal plant remedies. *Elaeis guineensis* Jacq reportedly could be used to treat the highest number of diseases (6) including amoebiasis, dental caries, migraine, sciatic neuralgia, splenomegaly and rheumatism (Table 3).

Table 3. Plant use consensus as well as effective potentially species for their treatment.

Medicinal knowledge

Traditional Kongo medicinal knowledge (number of medicinal species reported and number of diseases reported) was found to be independent of age, education, experience and marital status ($p>0.05$), but was significantly ($p<0.05$) influenced by informant gender, quality and location. The mean number of species cited (cf. Table 4) was found to be significantly ($p<0.05$) different between (1) curing healers, herbalists and traditional health practitioners; curing healers cited 1.457 times more species (b=0.383; S.E=0.1056, p=0.00 than traditional health practitioners; whereas the traditional practitioner cited 0.44 times more species than a herbalist (b=-0.812; S.E=0.216; p=0.00); (2) informants from cities (Kisantu and Mbanza-Ngungu) and those from villages; with no significant differences (p>0,05) between Kisantu and Mbanza-Ngungu cities; informants from Kisantu and Mbanza-Ngungu significantly cited 53 times (b=0.426; S.E=0.977; p=0.00) and 1.76 times (b=0.565; S.E=0.999; p=0.00) more species respectively, than informants from villages near Mbanza-Ngungu; (3) men and women; with men citing 0.75 times more species than women (b= 0.290; S.E= 0.764; p=0.00).

Table 4. Comparison of the average number of species cited within the different social groups

The mean number of cited diseases (cf. Table 5) was (1) not significantly different between curing herbalists and traditional health practitioners, whereas the number of diseases recorded by curing healers was significantly ($p<0.05$) different from those cited by herbalists and traditional health practitioners); the number of diseases cited by traditional health practitioners was 0.63 times higher than that of herbalists; whereas curing healers significantly cited 1.774 times more diseases than traditional health practitioners; (2) significantly different between informant locations($p<0.05$). Informants from Kisantu (b=0.520; S.E=0.1616; p=0.01) and Mbanza-Ngungu (b=0.874; S.E=0.1576; p=0.00) significantly cited 1.682 and 2.40 times, respectively, more diseases than informants from villages near Mbanza-Ngungu; (3) significantly different between men and women ($p<0.05$). Men cited 0.76 times more illnesses than women.

Table 5. Comparison of the average number of diseases cited within the different social groups

Discussion

Medicinal plant use

The Kongo people possess a rich and diversified ancestral medicinal knowledge. Irrespective of their level of education, gender or marital status. Whether they live in cities or on the countryside. Our ethnobotanical medicinal plant study in the region revealed 231 medicinal plants, including 227 identified botanical species, belonging to 192 genera, representing 79 families. Among these species, 135, 170 and 70 species were also identified in ethnomedicinal studies from Nzuki *et al*.[14], Kibungu [13] and Nsimundele [32] in the same Kongo-Central Province.

The predominance of taxa in the Fabaceae family corroborates observations of Ngene *et al*.[43] (Cameroon), Amujoyegbe *et al*.[44] (Nigeria) and Ong *et al*.[45] (India and Bangladesh). The medicinal use of taxa of this family can probably be explained by the bioactive elements they contain, including tannins, alkaloids, coumarins, steroids, saponosides, flavonoids and isoflavonoids [46].

The predominant medicinal plant part (leaves), botanical form (herbs), preparation (decoction) and administration method (ingestion) used were also observed in medicinal plant studies performed by Manzo *et al*.[47], Lee *et al*.[48] and Goërhe *et al*.[49], respectively.

The widespread medicinal use of leaves is probably due to the fact that they are easy and conveniently harvested [50] but also because they are the site par excellence of biosynthesis and storage of secondary metabolites, responsible for biological plant properties [51], [52].

The fact that vegetation has become highly disturbed by human activities in the region, can explain why most cited medicinal plants were herbaceous species. Thus, abandoned fields, rudimentary environments and trampled areas are quickly colonized by herbs to the detriment of forests and savannahs, which require a long transition period to regenerate [53].

The common practice of decoction as a medicinal plant preparation method can be explained by the fact that it easily allows to collect the medicinally active principle compounds and to mitigate or eliminate toxic substances in certain medicinal plants [54]. The frequent use of oral absorption as medicinal plant administration route could be linked with the fact that it is fast and provides a large effective surface area for absorption of the drug's active components [55]. Once absorbed, the drug passes through the intestinal wall and the liver before being transported to the target site by the bloodstream [56], [57].

Local importance of plants and their consensus of use in disease treatment

The findings indicated that twelve (5.2 %) out of all medicinal plants inventoried, are distinguished by a UV_S greater than or equal to 0.05. Whereas 20 species (8.7%) have IAR_S ranged from 0.05 to 1.

According to consensus on plant use, 31 diseases (i.e 30 % of all cited diseases) were mentioned. Among them, hemorrhoids (ICF: 0.44), amoebiasis (ICF:0.43), itchy skin rash (ICF: 0.42), poliomyelitis (ICF: 0.36), intestinal parasitosis (ICF: 0.33), sexual weakness or impotence (ICF: 0,32), splenomegaly (ICF: 0.29), laryngitis (ICF: 0.27), rheumatism (ICF: 0.25), otitis (ICF: 0.25),

hernia (ICF: 0.2) and cough (ICF: 0.2) are distinguished by ICF values between 0.2 and0.44.

These values are low when compared to e.g. the ICF-value (0.71) reported by Ngbolua *et al.*[58] to treat sexual weakness in Kinshasa or by Lautenschläger *et al.* [17] for treatment of intestinal parasitosis (ICF: 0.48), rheumatism (ICF: 0.47) and otitis (ICF: 0.4) in northern Angola in Uíge Province. Low ICF-values could be probably due to the tendency of phytotherapists to keep their knowledge secret from others [59, 60].

It should be noted, however, that the common use of *Elaeis guineensis* as a remedy would be, according to Sillans [61], in most cases attributable to its oil, wine and inflorescence reduced in salt in the form of ashes. These extracts are used respectively as: (1) an excipient for the preparation of vegetable ointments; (2) a maceration liquid to enhance the action of certain drugs with aphrodisiac and galactogenic properties; (3) an addition in many preparations to facilitate the absorption of the drug, the reduction and preservation of certain preparations in powder form. According to Raymond-Hamet [62], the ash salts of *Elaeis guineensis* would release alkaloids from the plants used in the various preparations, which would explain why they are so frequently used by natives in multiple medications.

Traditional medicinal knowledge among social groups

Social factors indicated that male, married, adult, literate, experimented and urban respondents are the most represented among phytotherapists. These findings agree with Nzuki [10] (Mbanza-Ngungu) for gender, age literacy and respondent location and with Ladoh-yemeda *et al.* [63] (Cameroun) for experience.

Descriptive statistics 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. Similar findings were obtained by Dapar *et al.*[64] for men, adults and elderly, married and secondary school therapists as well as by Sanga [65] for therapists living in urban areas, but are contrary to findings of Nzuki [10] who estimated that in Mbanza-Ngungu, rural therapists may have more knowledge than urban's. This difference may be due to the fact that Nzuki's observation is based on the comparison (%) between urban and rural healers who use "more than 10 medicinal plants" but not on the average number of plants used by each.

Analytical test indicated that medicinal knowledge (average number of medicinal species and diseases reported) among respondents was significantly different between male and female and between the different healer and location categories, but not between the different healers' marital status, or age or education categories.

Similar results were found by Dapar *et al.* [64] for gender and categories of healers. In contrast, he found opposite results where the age, education and marital status of respondents influenced their medicinal knowledge whereas there was no influence of their geographical location.

Male are most knowledgeable about medicinal plants than female, probably because in traditional society, knowledge is generally passed on to men, more specifically to the family elder brother, providing them with a certain power in the family and notoriety in the society [66].

The high medicinal knowledge of urban phytotherapists can probably be linked to urban phytotherapists who make false claims about their competence, thereby taking advantage of naive patients who are often destitute but in desperate search of medicinal treatment. These phytotherapists, who only aim at generating profit, might then prescribe medicinal plant treatments, that does not always correspond to accurate ancestral knowledge. The high medicinal knowledge of curing healers can also be associated with the combination of both medicine and mental. Some species are may be prescribed for physical treatments, whereas others for mental health.

Conclusion

Kongo herbal medicine is rich in medicinal plant species. Some have high medicinal value while others seem to have interesting therapeutic potential for certain diseases. It is essential to produce and conserve the most important species. They can, for example be cultivated ex situ in fields, homegardens or plantations. In situ conservation by maintaining and protecting their natural ecosystems can also be promoted. Effective therapeutic potential herbal medicines should be subjected to phytochemical analysis in order to demonstrate their value, approve and improve their use. Thus, the Kongo people will be able to take full social and economic advantage of their knowledge

Additional file

Synoptic table of medicinal plants and their use in Kisantu and Mbanza-Ngungu terroirs. Available on https://data.mendeley.com/datasets/4cf2p3mgpc/1; DOI: 10.17632/4cf2p3mgpc.1

Abbreviations

UV_S: Use medicinal value; IAR: Informant Agreement Ratio; FIC : Informant Consensus Factor; STP : Species Therapeutic Potential; DRC: Democratic Republic of Congo; Iv: Vulnerability index; INERA: National Institute for Agronomic Studies and Research; UNIKIN: Kinshasa University; APG: Angiosperm Phylogeny Group; IPNI: International Plant Names Index.

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Availability of data and material

All data are available from the corresponding author. All voucher specimens are deposited at the Herbarium of the National Institute for Agronomic Studies and Research of Kinshasa University and will be deposited at the Botanical Garden of Meise in Belgium as soon as suitable conditions are established.

Authors' contributions

KKP carried out fieldwork, analysed the data collected and wrote the manuscript. NBF and BKH participated in the fieldwork and established contact with the respondents. They also participated with BKH and VDP in the design of the study and the writing of the manuscript. All authors have read and approved the final version of the manuscript.

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Ethics approval and consent to participate

Not applicable.

Consent for publication

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Competing interests

The authors declare that they have no competing interests.

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Figures

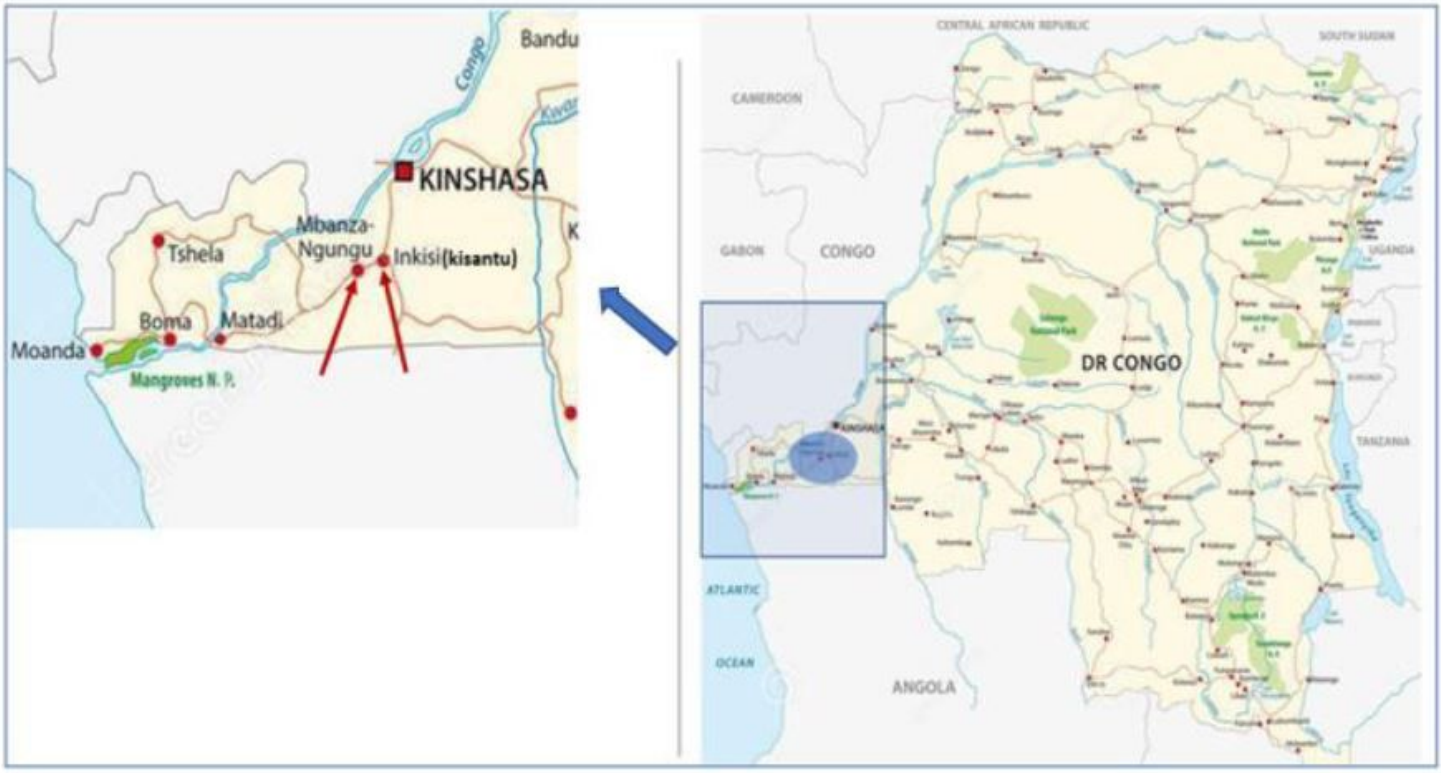

Figure 1

Study area location (DR Congo map from Lesniewski [22])

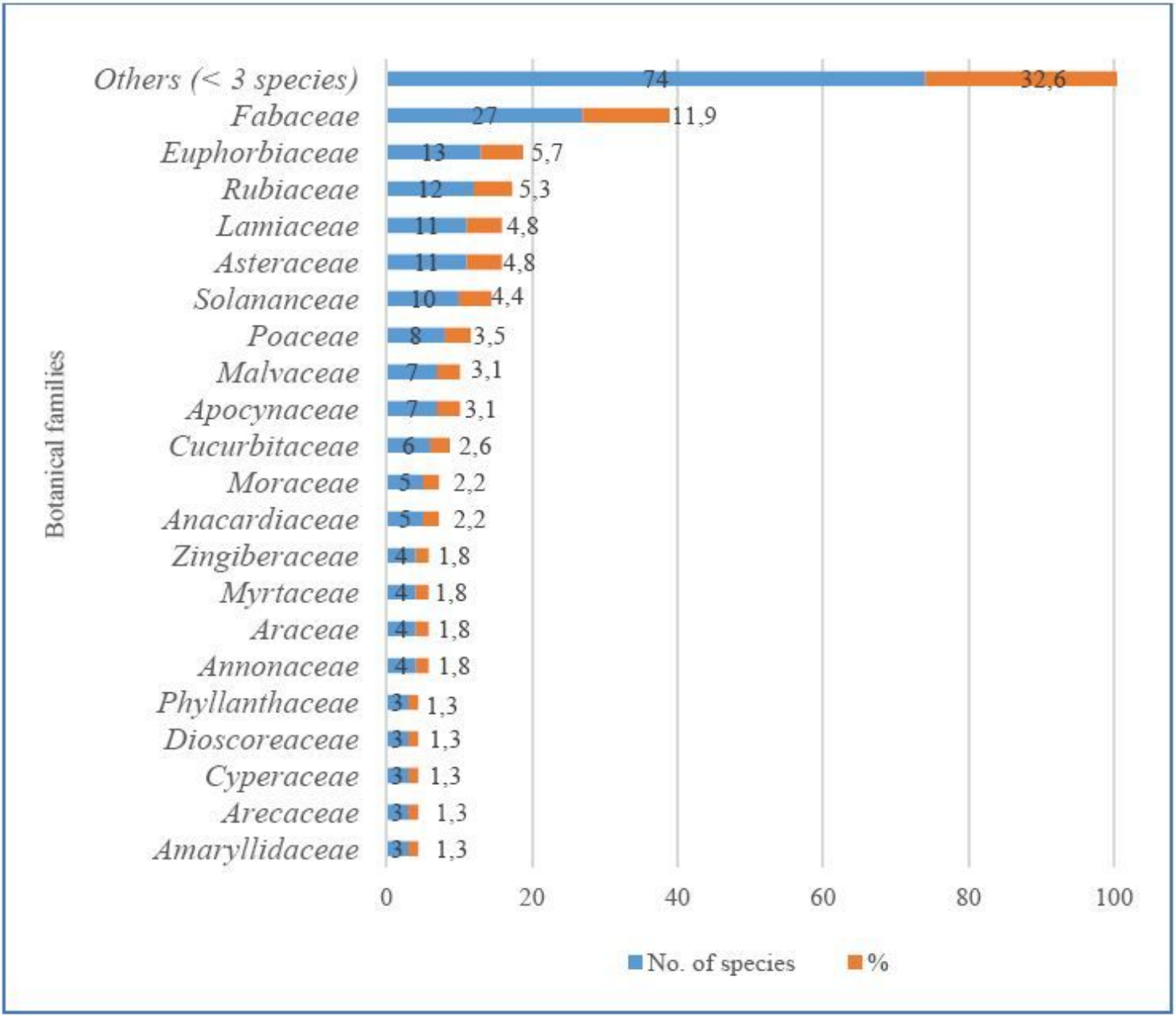

Figure 2

Share (%) of families according to the number of species

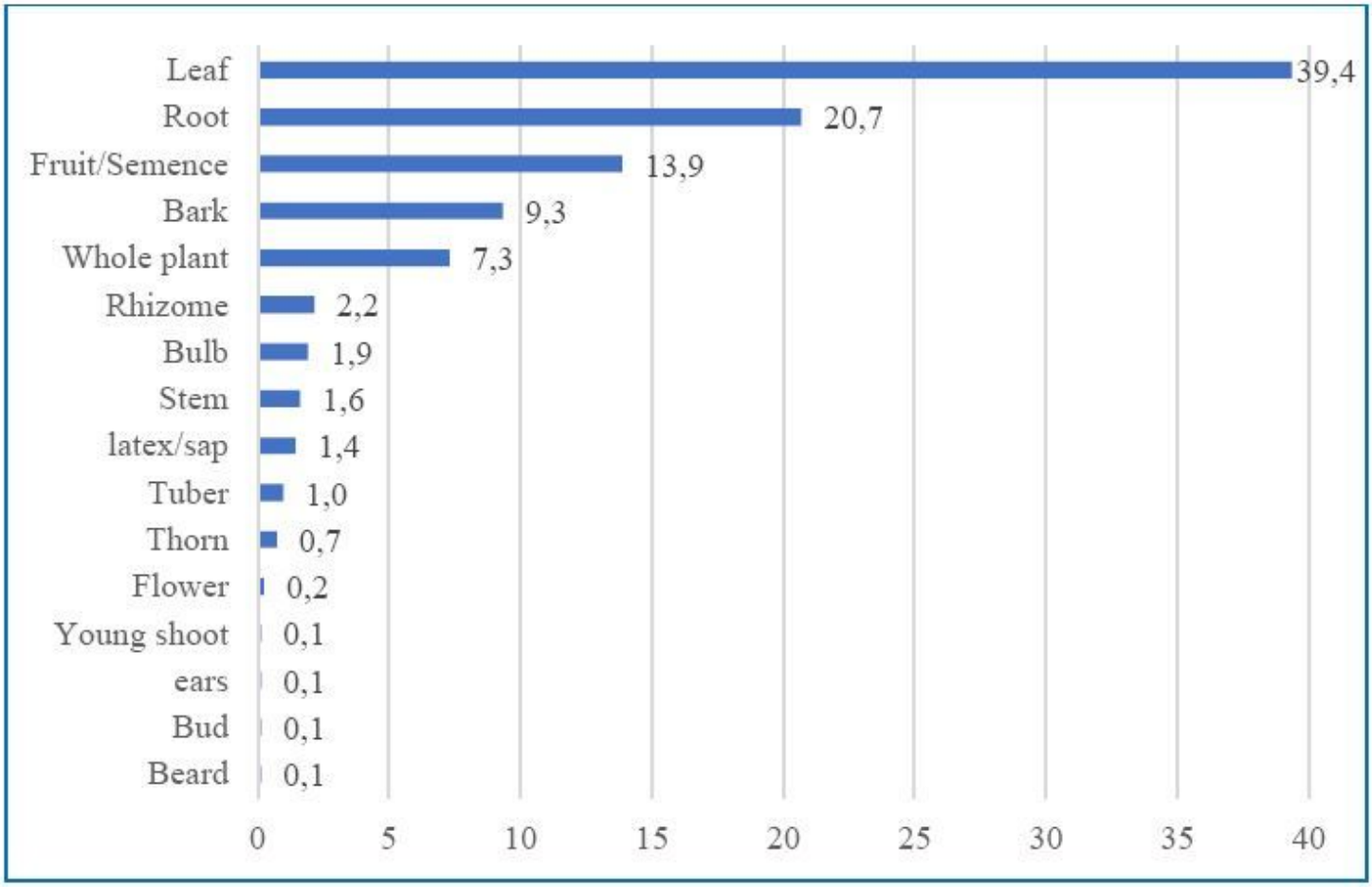

Figure 3

Share (%) of harvested organs used according the number of responses.

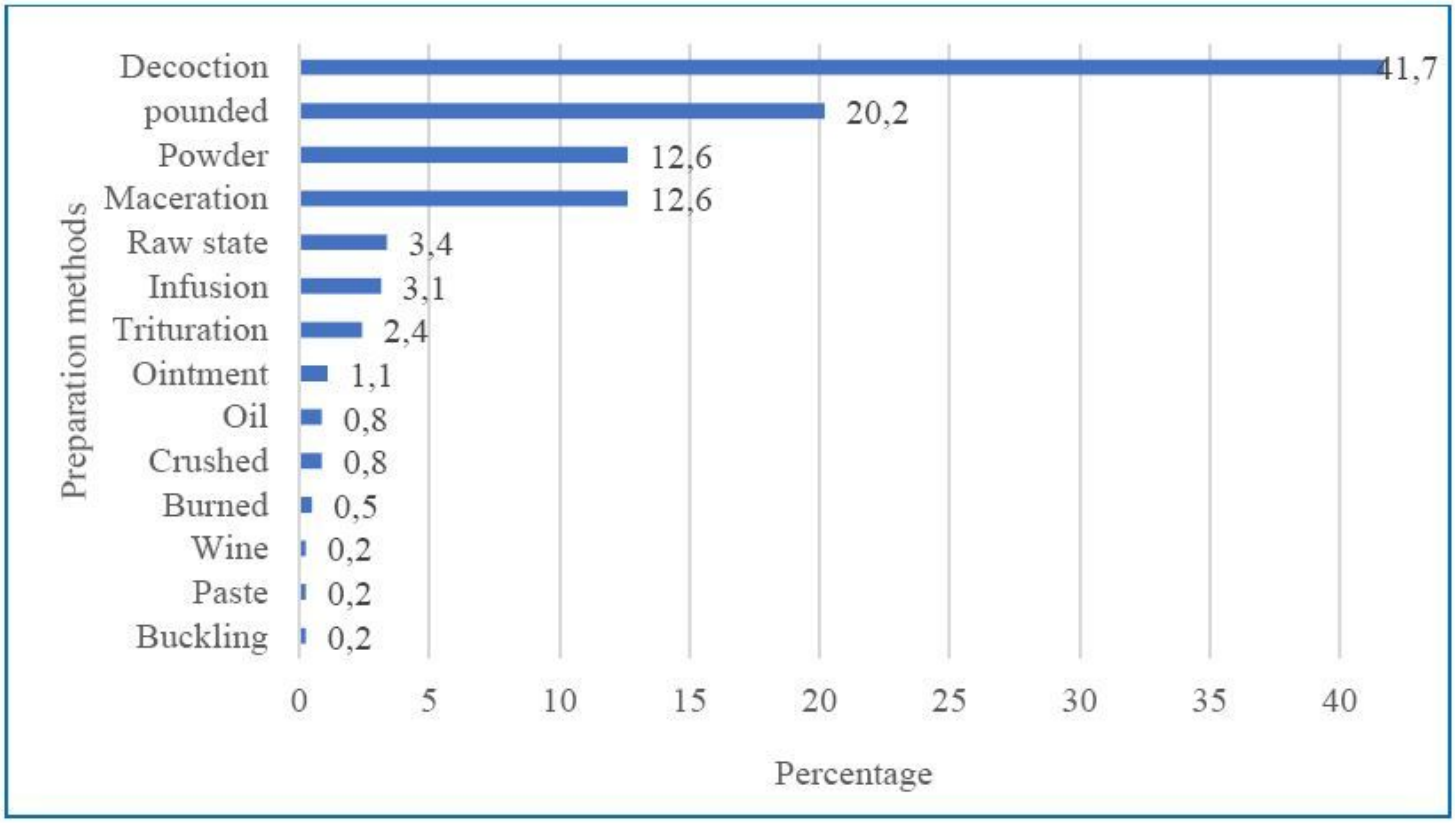

Figure 4

Share (%) of drug preparation method according to the number of responses

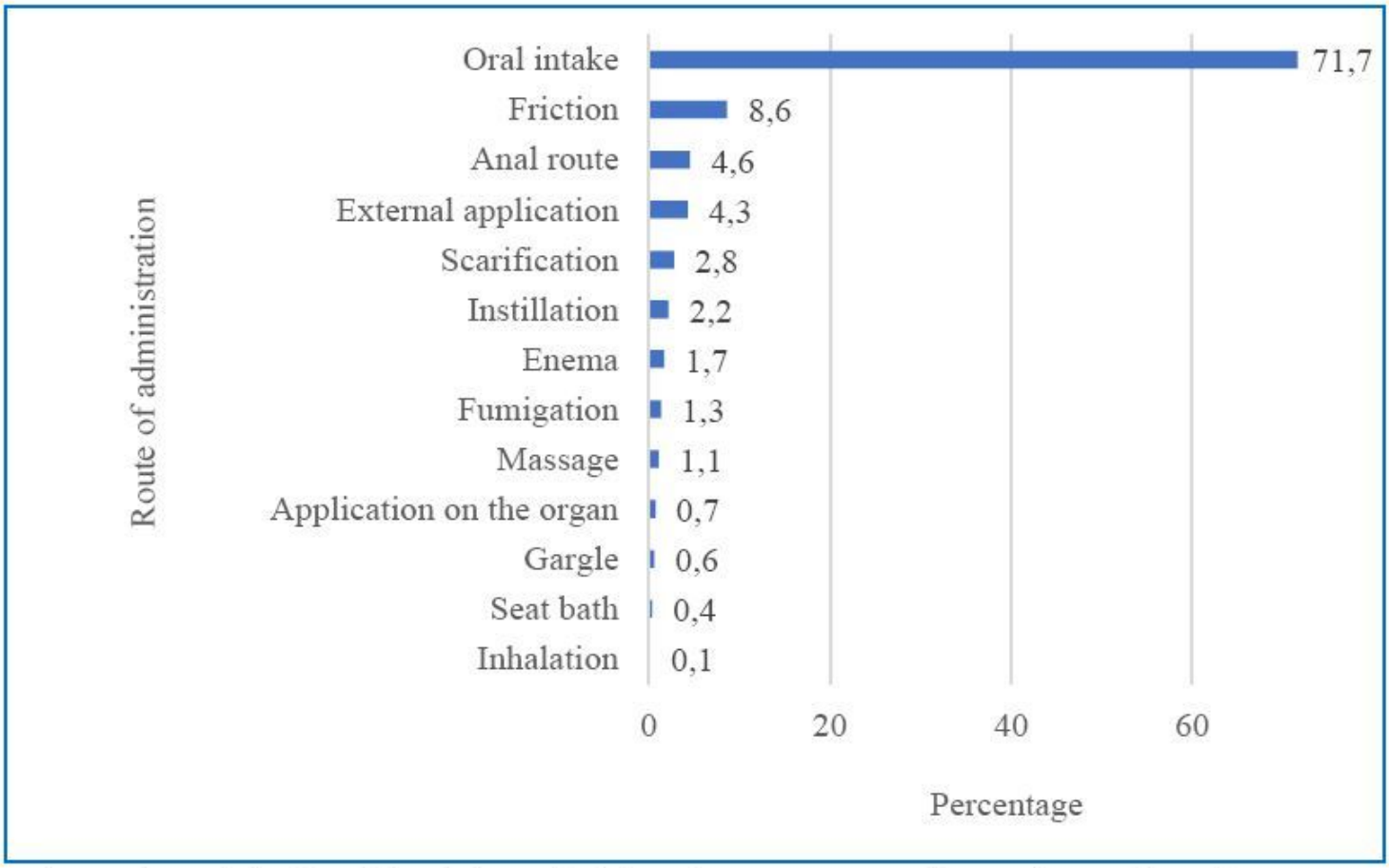

Figure 5

Share (%) of traditional drug administration routes according to the number of responses

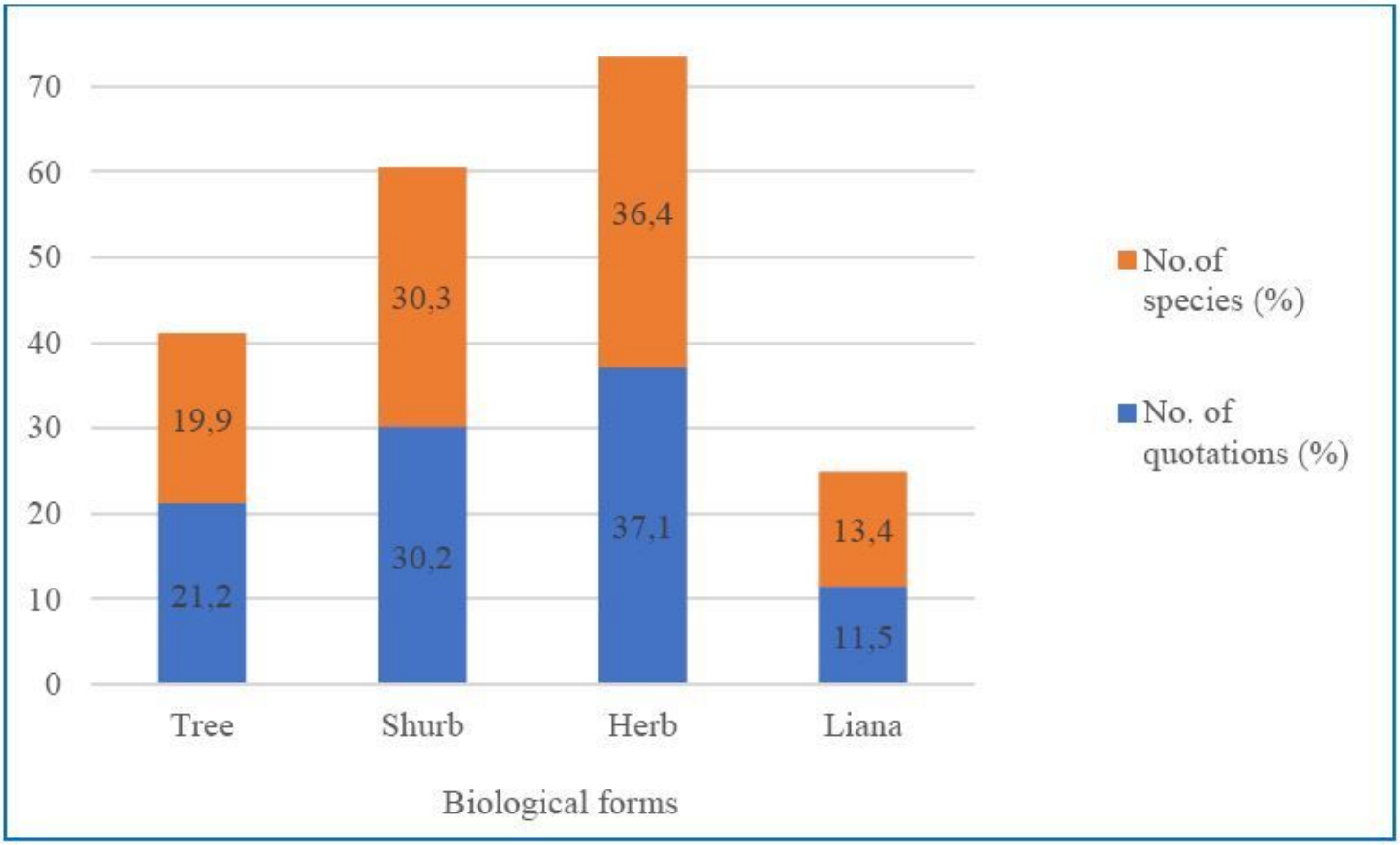

Figure 6

Share (%) of biological forms according to the number of species and the number of responses.

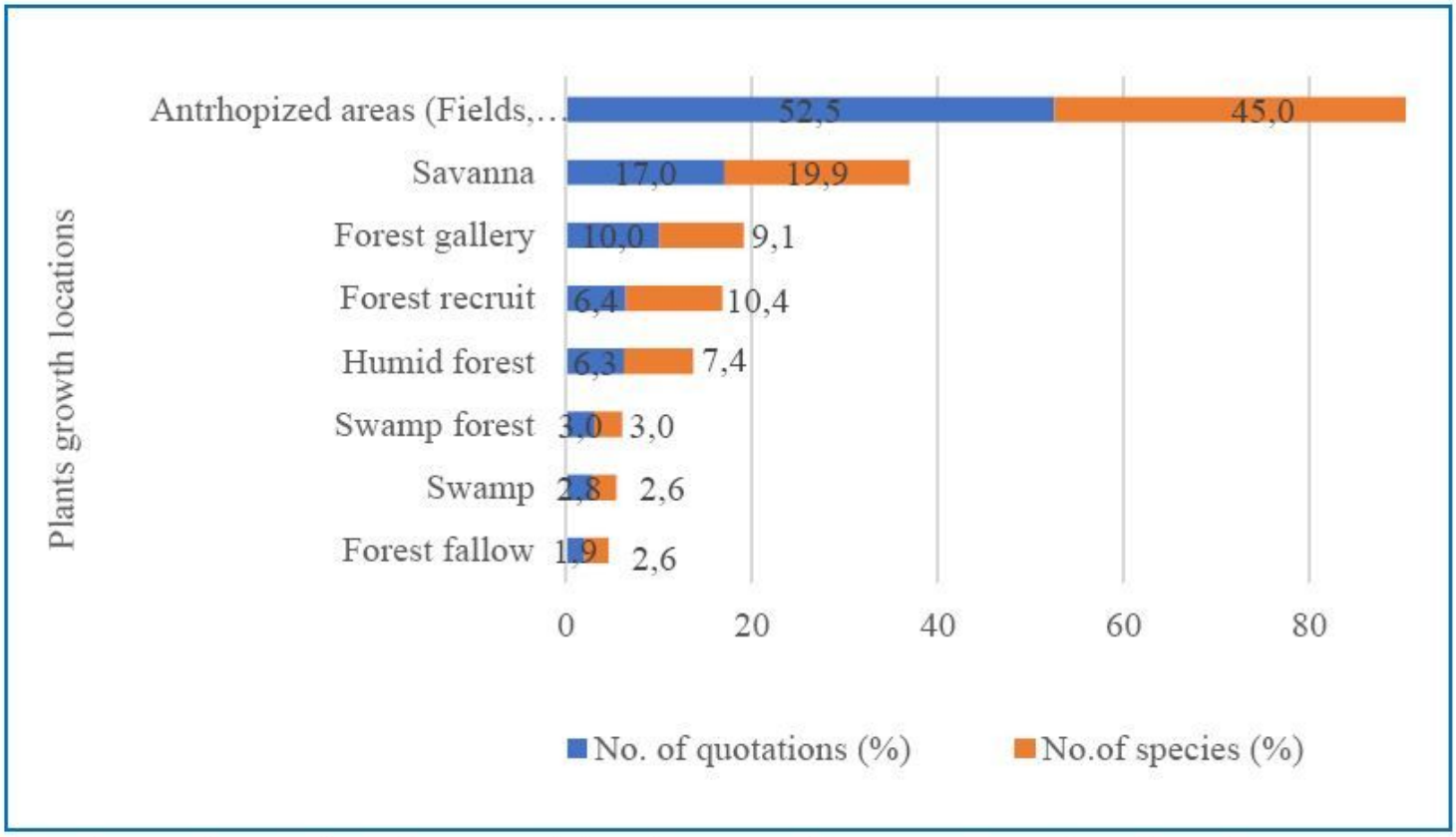

Figure 7

Share (%) of plant growth locations according to species and number of responses

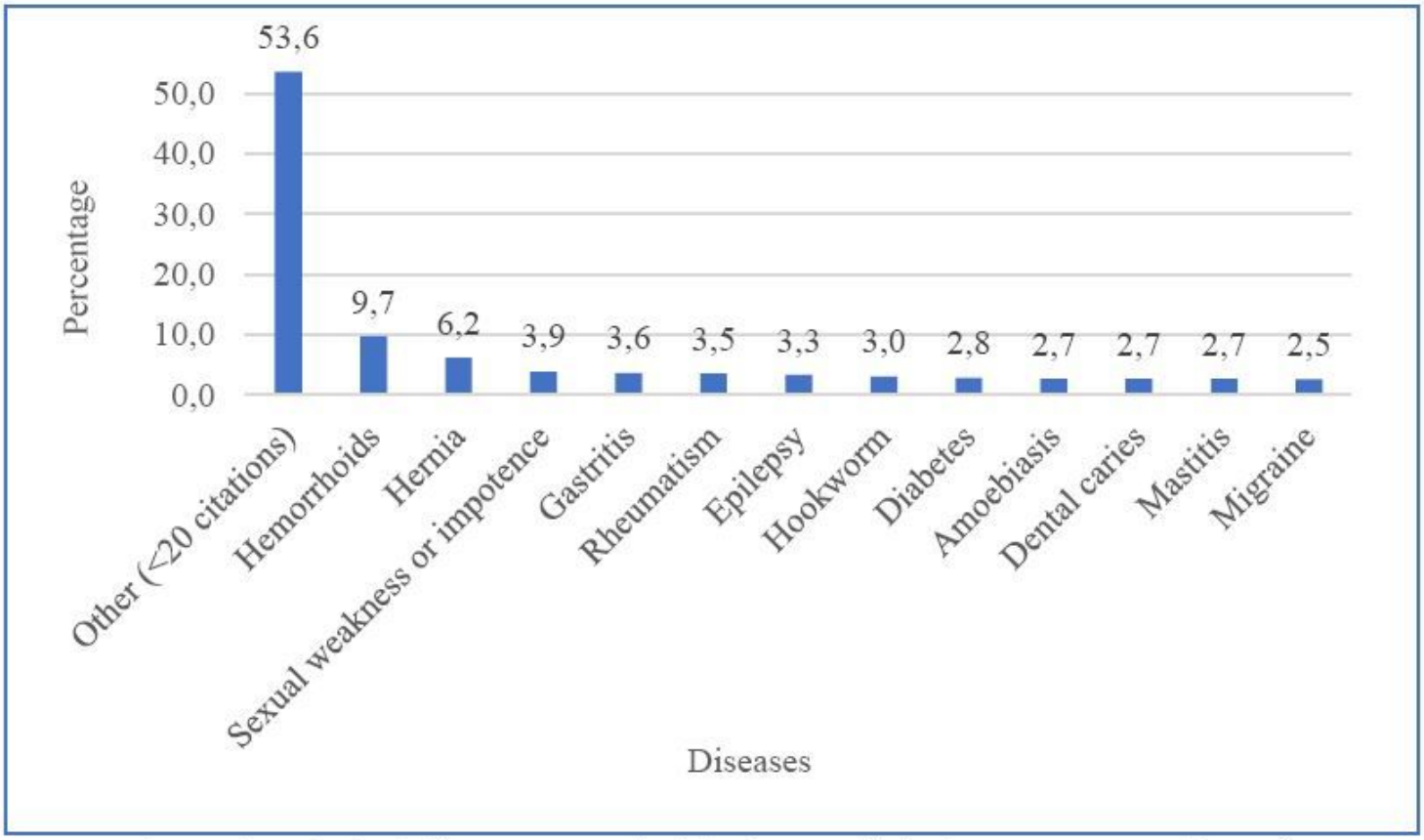

Figure 8

Share (%) of diseases treated with phytomedicine in Kongo-Central Province

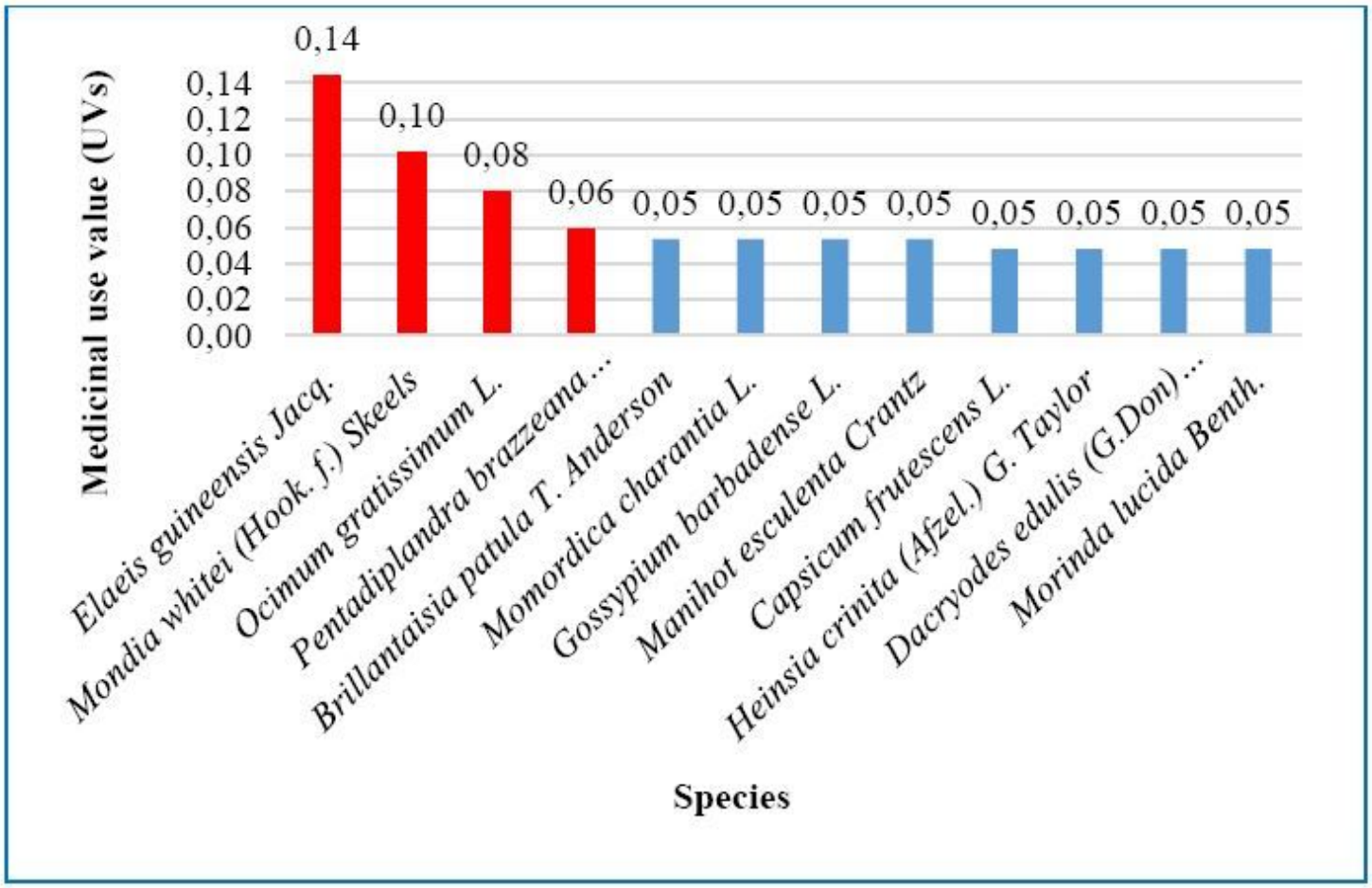

Figure 9

The most important species according to their UVS

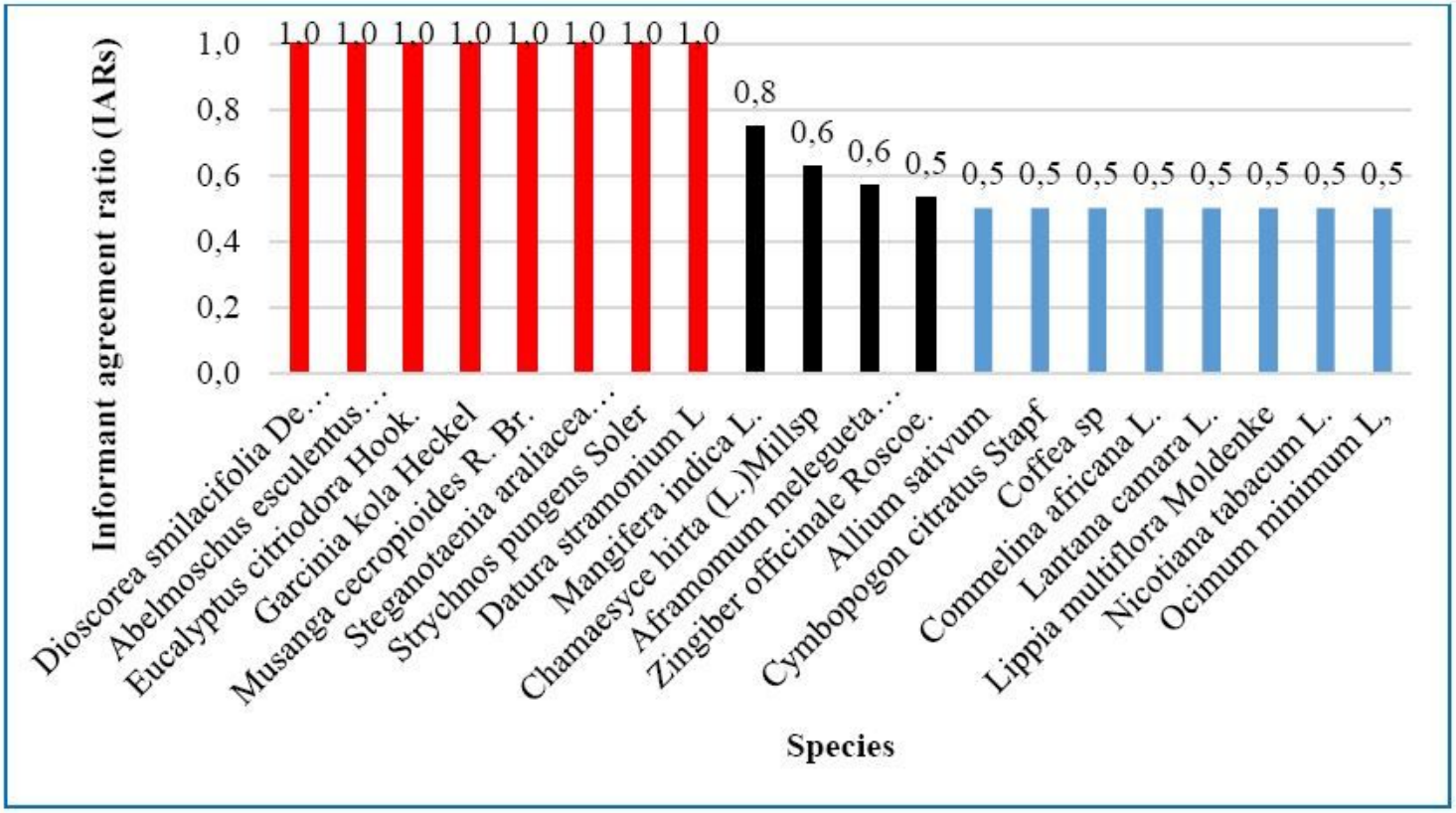

Figure 10

Ranking of most important species according to their IAR.

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