JOURNAL OF MODERN DRUG DISCOVERY
AND DRUG DELIVERY RESEARCH
Journal homepage: http://scienceq.org/Journals/JMDDR.php

Research Article Open Access

# Ethno-botanical survey and floristic study of medicinal plant taxa used by Traditional Healers in Gbadolite city (Province of Nord-Ubangi, Congo-Kinshasa)

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Received: September 24, 2017, Accepted: October 29, 2017, Published: October 29, 2017.

## ABSTRACT

In Africa, more than 80% of the population resort to folk medicine to solve the primary health problem. In the present study, an ethno-botanical survey was carried out in Gbadolite city according to the principles laid out in the declaration of Helsinki. The results revealed that informants used 20 different plant species belonging to 14 families and 18 genera as medicines. Among 18 treated diseases, headaches and hemorrhoids have the maximum of consensus among informants. *Cleome viscosa* and *Trema orientalis* are the most used plants for this purpose. Although Gastritis and Anemia have a high consensus value (gastritis: 50%, anemia: 71%), these two diseases are much more well relieved for by the following plants: *Alchornea cordifolia*, *Trema orientalis*, *Brillantaisia cicatricosa*, *Hibiscus sabdariffa*, *Portulaca oleracea*. The value of use (VUs) index ranks first with six taxa out of the 20 listed species of which their value is greater than or equal to 1.5 namely: *Alchornea cordifolia*, *Cola nitida*, *Brillantaisia lancifolia*, *Euphorbia hirta*, *Piper guineensis*, *Manihot glaziovii*. For the confirmation index (CIs), only two taxa out of the 20 inventoried are classified in first position: *Alchornea cordifolia* and *Hibiscus sabdariffa*. At last, by combining the VUs and CIs indices, only *Alchornea cordifolia* has the highest value of agreement use amongst the 20 listed species. As a scientifically validated anti-sickling plant, there is therefore necessity to characterize chemical structure of derived organic acids extracts as epigenetic modulators drugs candidates for the management of Sickle Cell Disease in the future.

According to the life form (morphological types), the inventoried medicinal plant flora is dominated by tree; Cespicious therophytes are the predominant biological types and the most listed medicinal plants are found in ruderal biotope; Pantropical plant species are the most represented. This is the first report involving ethno-botanical survey and floristic study on medicinal plants traditionally used in Gbadolite city (Province of Nord-Ubangi, Democratic Republic of the Congo).

**Keywords:** *Primary health care, Traditional Medicine, medicinal plants.*

## INTRODUCTION

Recent findings reported that more than 80% of the population in Africa uses traditional medicine to solve the primary health problem. According to the World Health Organization, the use of medicinal plants to solve various health problems is not only a choice but also linked to the poverty and high costs of modern medicines [1-3]. The Democratic Republic of the Congo (DRC), with its cultural diversity, the richness and diversity of its flora and fauna, constitutes a real reservoir of biodiversity, as shown in the latest publications [4-11].

However, bibliographic research revealed that data on medicinal plant species in DRC are very fragmentary and scattered [12]. Moreover, the accelerated destruction of tropical forest ecosystems makes it increasingly difficult to conserve these bio-resources [13].

The aim of the present study is to contribute to the knowledge of medicinal plants, their therapeutic uses and their floristic characteristics (morphological types, biological types and phytogeographical distributions) with the purpose of converting traditional knowledge into scientific evidence based medicine in order to upgrade, preserve and sustainably use it in accordance with the Convention on Biological Diversity [14, 15].

## MATERIALS AND METHODS

### Study area

The city of Gbadolite is limited in the North by the Ubangi River, since the confluence of the Bimbi River to the confluence of the Boyi River. It is limited in the West by the mouth of the Bimbi River; in the south by the source of the Loba River, until the intersection with the Wakamba River and in the East by the road of Mobayi Mbongo to the Sokoro River. Its area/surface is

approximately 278 km$^2$ with a density of population of approximately 464 inhabitants per km$^2$ with 128.969 listed inhabitants [16].

**Methods**

The survey was conducted with vendors of medicinal plants and traditional healers in Gbadolite city using a questionnaire and on the basis of the free consent of the respondents. The survey was carried out according to Helsinki's declaration [12, 13, 17-21]. After perusal of the questionnaire forms, following parameters namely Usage Value (UV), Confirmation Index (CI), Usage Agreement Value (UAV), and Informant Consensus Factor (ICF) were calculated as previously reported [12, 13]. Data were analyzed using Origin 6.1 package software.

The ethno-botanical data collected were then supplemented with information on ecological types as follows:

**Morphological type**: Tree (T), Shrub (Shr), Under-shrub (UShr), Annual herb (Anh), Perennial herb (Peh), Liana (Lia) and Succulent herb (Suh); **Biological type**: Rhizomatous geophytes (RhGe), Megaphanerophytes (MgPh), Mesophanerophytes (MsPh), Nanophanerophytes (NaPh), Dressed chamephytes (DrCh) or Crawling therophytes (CrTh), Cespicious therophytes (CsTh). The **phytogeographic distribution** was: Tropical America (TAm), Guinean (Guin), Central Guinean (Cguin), Pantropical (Pan), Guineo-Congolese (GC), cosmopolitan (Cosm) and Soudano-zambezean (S-Z) plant species.

The identification of the inventoried plant species was carried out by comparison with the herbarium vouchers at the Herbarium of the Laboratory of Systematic Botany and Plant Ecology of the Department of Biology, University of Kinshasa in DRC.

## RESULTS AND DISCUSSION

**Ethno-botanical survey**

The 35 informants interviewed in the ethno-botanical survey used 20 plant species belonging to 14 families and 18 genera in traditional medicine in Gbadolite city, Province of Nord Ubangi, DRC. The list of inventoried plant species is given in Table 1 with their scientific and vernacular names, treated diseases, used plant parts and the dosage.

Table 1. Ethno-botanical data of listed plants

| Scientific names | Local name (Ngbandi) | Treated diseases | Used parts and dosage |
|---|---|---|---|
| *Alchornea cordifolia* (Schumach. & Thonn.) Mull. Arg. (Euphorbiaceae) | Mbonzi-mbonzi | Anti-gastritis | Leaves, roots; 2 glasses/day |
| *Brillantaisia lancifolia* Lindau (Acanthaceae) | Kuma | Anti-otitis | Leaves; ½ glass morning-evening |
| *Brillantaisia cicatricosa* Lindau (Acanthaceae) | Trasongo | Blood stimulant | Leaves; 2 pumps/day |
| *Ceiba pentandra* (L.) Gaertner (Bombacaceae) | Nduru | Anti-spleen | Stem bark; ½ glass morning-evening |
| *Cleome viscosa* L. (Cleomaceae) | Va | Anti-headache | Leaves; ½ glass morning-evening |
| *Cola nitida* (Vent.) Schott & Endl (Malvaceae) | Lengenzo | Strengthen kidneys | Pinched fruit |
| *Corchorus olitorius* L. (Tiliaceae) | Vene | High blood pressure | Leaves; ½ glass morning-evening |
| *Euphorbia candelabrum* Trem. ex Kotschy (Euphorbiaceae) | Ngbokpo | Chase out the thorn of the flesh | Leaves; 2 spoons 3/day |
| *Euphorbia hirta* L. (Euphorbiaceae) | Nsâ ndika | Anti-amoebiasis | Pinched stems |
| *Gilbertiodendron dewevrei* (De Wild) J. Leonard (Fabaceae) | Godo | Boost the appetite | Leaves; No dose |
| *Hibiscus saddariffa* L. (Fabaceae) | Ngaingai | Anemia | Leaves, fruit; 1 fruit/day, 2 pumps/day |
| *Manihot glaziovii* Mull. Arg. (Euphorbiaceae) | Ngunza ndembo | Anti-flu | Leaves; No dose |
| *Megaphrynium macrostachyum* (K. Schum.) Milne-Redh. (Marantaceae) | Ngongo | Anti-gastritis | Leaves; 2 spoons 3 times/day |
| *Mezoneuron angolense* Welw. Ex Oliv. (Fabaceae) | Yorongbo | Anti-venom | Roots, leaves; 1 pump/day |
| *Myrianthus holstii* Engl. (Moraceae) | Ngbolo | Anti-uterine dilatation | Bark, leaves; No dose |
| *Piper guineensis* K. Schum. & Thonn. (Piperaceae) | Ngbongboli | Lumbar stimulant | Roots, leaves, seeds; Crunch 3-5 seeds/day |
| *Portulaca oleracea* L. (Portulacaceae) | Nsa ti mene | Anemia | Leaves: 1 pump twice/day |
| *Sida acuta* Burm. f. (Malvaceae) | Gbaporo | Pain killer, Scald | Pinched Leaves |
| *Trema orientalis* (L.) Blume (Ulmaceae) | Pesu | Anti-hemorrhoid | Leaves; 2 bowls/day |
| *Vernonia lasiopus* O. Hoffm (Asteraceae) | Ngbengbele | Anti-boil | Leaves; ½ glass morning-evening |

Table 2. Treated diseases and their informant consensus factors

| N° | Treated diseases | NtV | NC | ICF |
|---|---|---|---|---|
| 1 | Gastritis | 2 | 3 | 0.5 |
| 2 | Otitis | 1 | 1 | 0 |
| 3 | Anemia | 3 | 8 | 0.714 |
| 4 | Spleen | 1 | 1 | 0 |
| 5 | Headaches | 1 | 2 | 1 |

| | | | | |
|---|---|---|---|---|
| 6 | Kidneys | 1 | 1 | 0 |
| 7 | High blood pressure | 1 | 1 | 0 |
| 8 | Fever | 1 | 1 | 0 |
| 9 | Amoebiasis | 2 | 2 | 0 |
| 10 | Appetite | 1 | 1 | 0 |
| 11 | Flu | 1 | 1 | 0 |
| 12 | Venom | 1 | 1 | 0 |
| 13 | Uterine dilatation | 1 | 1 | 0 |
| 14 | Backache | 1 | 1 | 0 |
| 15 | Pains | 1 | 1 | 0 |
| 16 | Hemorrhoid | 1 | 2 | 1 |
| 17 | Anti-boil | 1 | 1 | 0 |
| 18 | Burn | 1 | 1 | 0 |

*Legend: NtV: Number of plant taxa; NC: Number of citations; ICF: informant consensus factor (1: 100% consensus; 0.5-0.9: High consensus; 0.1-0.4: Low consensus; 0: Lack of consensus or disagreement)* [12, 13].

Table 3. List of used plants for the treatment of different diseases and their use agreement value

| Scientific names | Nr | NI | NC | VUs | CIs | VAUs |
|---|---|---|---|---|---|---|
| *Alchornea cordifolia* (Schumach. & Thonn.) Mull. Arg. | 10 | 4 | 6 | 1.5 | 0.08 | 0.12 |
| *Brillantaisia lancifolia* Lindau | 3 | 2 | 3 | 1.5 | 0.02 | 0.03 |
| *Brillantaisia cicatricosa* Lindau | 1 | 1 | 1 | 1 | 0.02 | 0.02 |
| *Ceiba pentandra* (L.) Gaertner | 1 | 1 | 1 | 1 | 0.02 | 0.02 |
| *Cleome viscosa* L. | 1 | 1 | 1 | 1 | 0.02 | 0.02 |
| *Cola nitida* (Vent.) Schott & Endl | 2 | 2 | 4 | 2 | 0.02 | 0.04 |
| *Corchorus olitorius* L. | 1 | 2 | 2 | 1 | 0.02 | 0.02 |
| *Euphorbia candelabrum* Trem. ex Kotschy | 1 | 1 | 1 | 1 | 0.02 | 0.02 |
| *Euphorbia hirta* L. | 3 | 2 | 3 | 1.5 | 0.02 | 0.03 |
| *Gilbertiodendron dewevrei* (De Wild) J. Leonard | 1 | 1 | 1 | 1 | 0.02 | 0.02 |
| *Hibiscus saddariffa* L. | 6 | 4 | 3 | 0.75 | 0.08 | 0.06 |
| *Manihot glaziovii* Mull. Arg. | 2 | 1 | 2 | 2 | 0.02 | 0.04 |
| *Megaphrynium macrostachyum* (K. Schum.) Milne-Redh. | 1 | 2 | 2 | 1 | 0.02 | 0.02 |
| *Mezoneuron angolense* Welw. Ex Oliv. | 1 | 1 | 1 | 1 | 0.02 | 0.02 |
| *Myrianthus holstii* Engl. | 1 | 1 | 1 | 1 | 0.02 | 0.02 |
| *Piper guineensis* K. Schum. & Thonn. | 2 | 2 | 4 | 2 | 0.02 | 0.04 |
| *Portulaca oleracea* L. | 1 | 1 | 1 | 1 | 0.02 | 0.02 |
| *Sida acuta* Burm. F. | 5 | 4 | 5 | 1.25 | 0.04 | 0.05 |
| *Trema orientalis* (L.) Blume | 1 | 1 | 1 | 1 | 0.02 | 0.02 |
| *Vernonia lasiopus* O. Hoffm | 1 | 1 | 1 | 1 | 0.02 | 0.02 |

*Legend: Nr: Number of recipes, NI: Number of informants, NC: Number of citations, VU: Value of use, CI: Confirmation index, VAUs: Value of agreement use.*

As noted in this table 2, among 18 treated diseases, headaches and hemorrhoids have the maximum (100%) of consensus among informants for the use of medicinal plants for their healing. Two taxa are responsible for the cure of these two diseases, namely: *Cleome viscosa* and *Trema orientalis.*

Although Gastritis and Anemia have a high consensus value (gastritis: 50%, anemia: 71%), these two diseases are much more well relieved for by the following plants: *Alchornea cordifolia*, *Trema orientalis*, *Brillantaisia cicatricosa*, *Hibiscus sabdariffa*, *Portulaca oleracea*.

From the above table, it is shown that the VU index ranks first with six taxa out of the 20 listed species of which their value is greater than or equal to 1.5 namely: *Alchornea cordifolia*, *Cola nitida*, *Brillantaisia lancifolia*, *Euphorbia hirta*, *Piper guineensis*, *Manihot glaziovii*. For the CIs index, only two taxa out of the 20 inventoried are classified in first position because they have values greater than or equal to 0.5, in particular, *Alchornea cordifolia* and *Hibiscus sabdariffa*.

At last, by combining the VUs and CIs indices, only *Alchornea cordifolia* has the highest (i.e. greater than 0.10) VAUs amongst the 20 listed species. These results can be explained by the disagreement between the users of medicinal plants in this area.

The use of medicinal plants according to gender is given in figure 1.

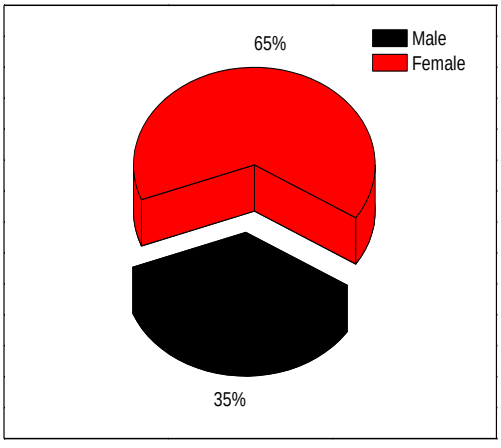


**Figure 1: Use of medicinal plants according to gender**

This figure shows that 65% of female respondents use medicinal plants against 35% of male respondents.

Figure 2 gives information on the use of medicinal plants according to the education level.

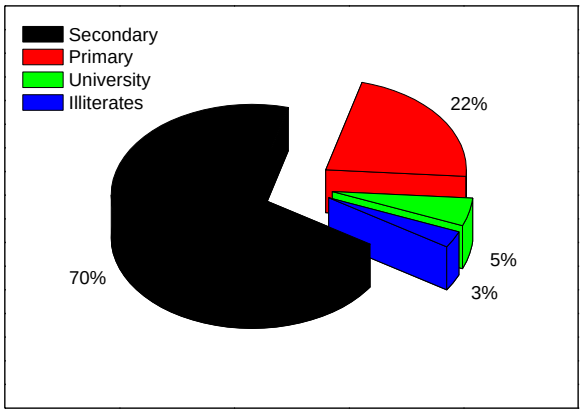


**Figure 2: Use of medicinal plants according to the education level of informants**

As it is shown in the above figure, 3% of respondents are illiterates, 5% have the university level, 70% have a secondary education level and 22% have a primary education level.

The use of medicinal plants according to the marital status of informants is presented in the figure 3.

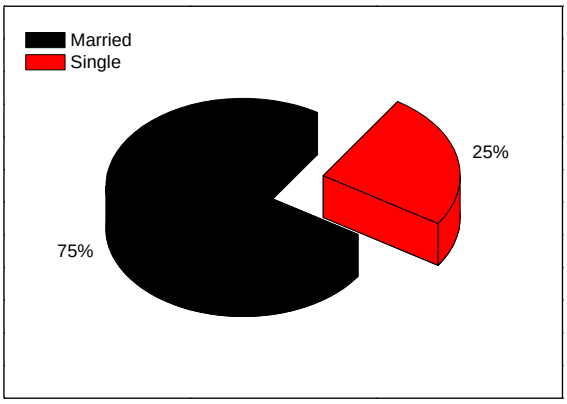


**Figure 3: Use of medicinal plants according to the marital status of informants**

The above figure shows that medicinal plants are much more used by married people (75%) than by single people (25%).

The figure 4 below gives the preference of the informants concerning different types of Medicine.

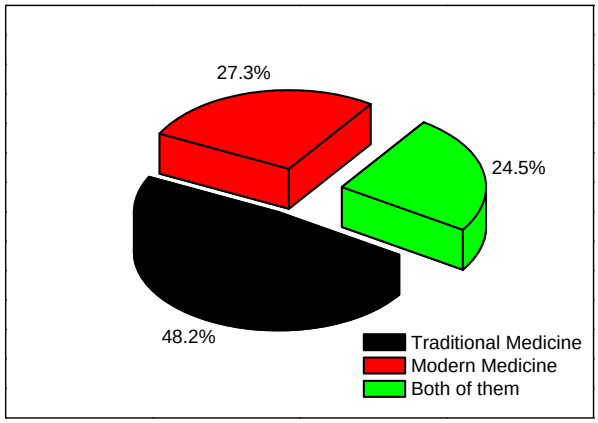


**Figure 4: Preference of medicine by the respondents**

As shown above, 48.2% of the local population uses traditional medicine versus 27.3% of this population who are interested in modern medicine. Nevertheless, the 24.5% of them are interested in both types of medicine when using medicinal plants for their cure.

This strong dominance of traditional medicine can be explained by several reasons. Indeed, traditional medicine is cheaper and access to plants is easier than modern medicine in developing countries like DRC [22, 23].

Figure 5 gives the origin of information at the moment of using medicinal plants

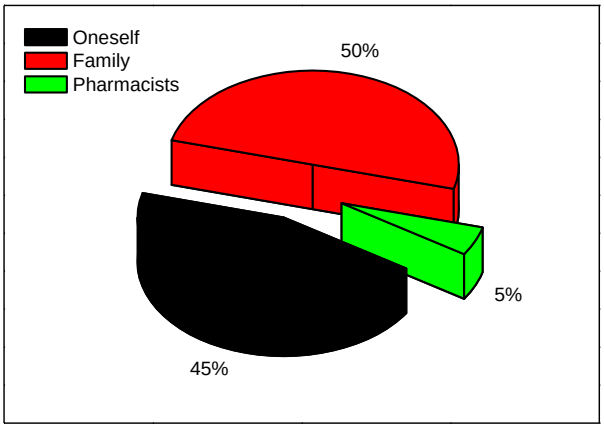


**Figure 5: Source of information when using medicinal plants**

This figure shows that 45% of users of medicinal plants diagnose diseases by themselves, while 50% of the population recourse to their families for diagnosis of the diseases before using medicinal plants. Lastly, medicinal plants users who obtain information from pharmacists represent 5%.

Figure 6 gives different perceptions that the respondents have about medicinal plants .

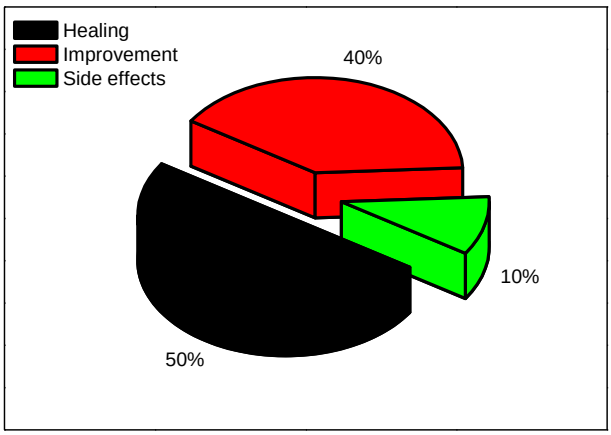


**Figure 6: Perceptions on the effects of medicinal plants**

As shown above, 50% of the respondents believe that medicinal plants can heal different diseases, 40% believe that medicinal plants only improve health, while 10% of the respondents believe that medicinal plants cause side effects. Recent findings revealed that many plants used in traditional medicine are potentially toxic, mutagenic and carcinogenic. Such information would be useful in evaluating the effectiveness of folk medicine and in the comparative pharmacological evaluation of the reported plant

species [22, 23].
The knowledge on the toxic medicinal plants is given in figure 7 below.

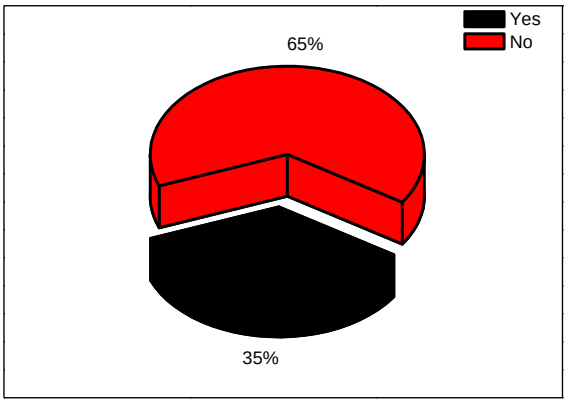


**Figure 7: Knowledge on toxic plants**

From the figure 8 it is shown that only 35% of medicinal plants users have a good knowledge on toxic plants while 65% do not know the toxic plants in their area. It is thus necessary to train traditional healers on plant extracts toxicity and the evaluation of their effects in human**.**

**Similarity of medicinal plants usage**

It was reported that the convergence of the medicinal plant species usage in different countries and the frequency of citations by both traditional healers and literature constitute a consistent proof of the plant virtue. Indeed, if a plant species is employed as remedy by local communities in different countries, this may be considered as strong evidence that the *in vitro* bioactivity could be effective [23].

Some of the 20 inventoried plant species have been reported to treat various diseases elsewhere [24].

Three plant species (*Alchornea cordifolia* Schumach. & Thonn. Mull. Arg., *Ceiba pentandra* (L.) Gaertner and *Trema orientalis* (L.) Blume) were validated scientifically by biological experiments *in vitro* in our laboratory as exciting anti-sickling plants [25].

By comparing the present work to previous studies [12, 13, 17], 13 out of 20 plant species in the present study were not reported in our previously surveys notably *Brillantaisia cicatricosa* Lindau, *Brillantaisia lancifolia* Lindau, *Cleome viscosa* L., *Corchorus olitorius* L., *Euphorbia candelabrum* Trem. ex Kotschy, *Gilbertiodendron dewevrei* (De Wild) J. Leonard, *Hibiscus saddariffa* L., *Manihot glaziovii* Mull. Arg., *Megaphrynium macrostachyum* (K. Schum.) Milne-Redh., *Mezoneuron angolense* Welw. Ex Oliv., *Myrianthus holstii* Engl., *Portulaca oleracea* L., *Vernonia lasiopus* O. Hoffm

A possible reason for this could be that the surveys were not carried out in the same areas. However, the recourse of the population to traditional medicine for their primary health care in both rural (Nord Ubangi) and urban (Kinshasa) areas and the fact that bark, stem and roots are among the used parts as medicine represent an environmental risk for the used bio-resources.

**Floristic study**

Figure 8 gives the morphological characteristic types of the inventoried plants

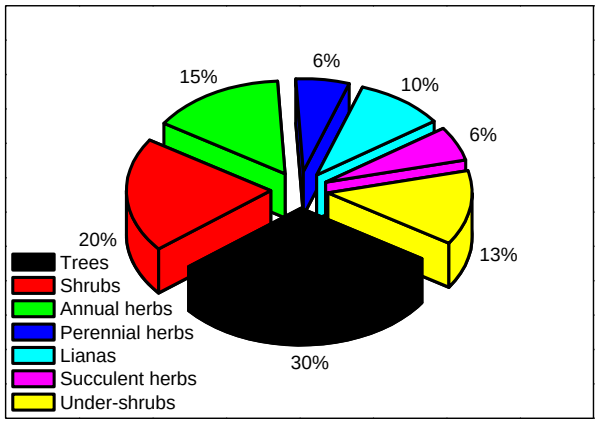


Figure 8: Types morphological characteristics of the inventoried pl ants

The inventoried plant flora is dominated by trees (30%), followed by shrubs (20%), annual herbs each with 15%. Lianas also show a non-negligible rate (10%). Finally, we have succulent herbs which are only represented at 5%.

Figure 9 gives the biological types of the plants

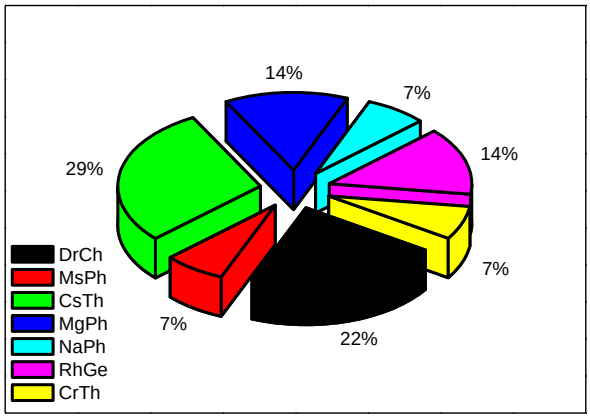


**Figure 9: Different biological types of the plants:** *Rhizomatous geophytes* (RhGe), *Megaphanerophytes (MgPh), Mesophanerophytes (MsPh), Nanophanerophytes (NaPh), Dressed chamephytes (DrCh), Crawling therophytes (CrTh) or Cespicious therophytes (CsTh).*

Figure 10 shows the habitat types of the inventoried plants

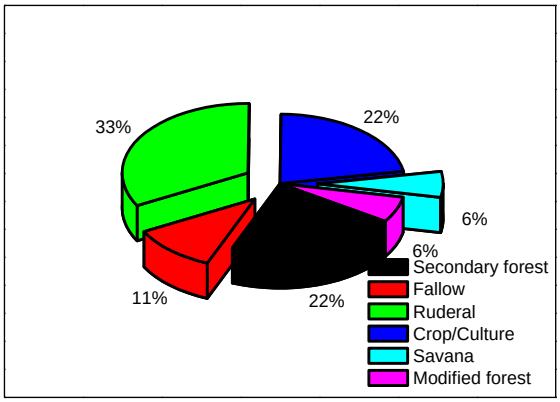


**Figure 10: Habitat of plants inventoried**

This figure shows that 33% of the listed medicinal plants are found in ruderal biotope. However, plants found in a secondary forest and agro-ecosystem account for 22% each. Fallow ecosystem species account for 11%. Other ecosystems represent 12% (6% modified forest and 6% savanna).

Figure gives 11 types the phytogeographic distribution of the inventoried plants

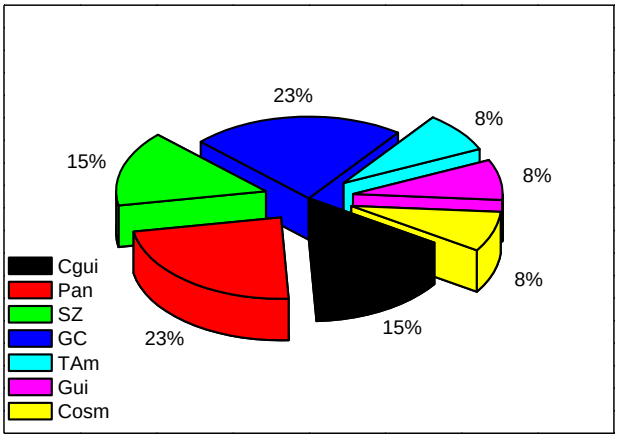


Figure 11: Plant phytogeographic distribution of the inventoried plants

Figure 11 shows that the species listed have wide distribution in the study area. Pantropical species (Pan) and Guineo-Congolese (GC) are the most represented with a rate of 23% each followed by Central Guinean (Cguin) and Soudano-zambezean (S-Z) (15% each). Nevertheless, cosmopolitan (Cosm), Guinean (Gui) and Tropical America (TAm) species have are represented by 8% each.

## CONCLUSION

The diversity of plant species (20 species, 14 families and 18 genera) inventoried in this survey demonstrates that there is much to be discovered in these medicinal plant taxa. Results revealed that leaves are the most used part while headaches and hemorrhoids present the maximum of consensus among informants in the use of medicinal plants for their healing. Although, among the plants listed only *Alchornea cordifolia* received the high agreement use value. As a scientifically validated anti-sickling plant, there is therefore necessity to characterize chemical structure of derived organic acids extracts as epigenetic modulators drugs candidates for the management of Sickle Cell Disease in the future.

This is the first report involving ethno-botanical survey and floristic study on medicinal plants traditionally used in Gbadolite city (Province of Nord-Ubangi, Democratic Republic of the Congo).

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**Citation:** Koto-te-Nyiwa Ngbolua *et al*. (2017). Ethno-botanical survey and floristic study of medicinal plant taxa used by Traditional Healers in Gbadolite city (Province of Nord-Ubangi, Congo-Kinshasa). J. of Modern Drug Discovery and Drug Delivery Research. V5I2. DOI: 10.5281/zenodo.1116857