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Ethnopharmacological survey of plants used against malaria in Lubumbashi city (D.R. Congo)

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ABSTRACT

Ethnopharmacological survey was conducted in Lubumbashi city located in south eastern part of The Democratic Republic of the Congo in order to identify the plant species used in traditional medicine for the treatment of malaria. Thirty one healers belonging to five “communes” of Lubumbashi city namely: Kamalondo, Katuba, Kampemba, Kenya and Rwashi were interviewed about the plant species used in traditional medicine for the management of malaria in this city. The name of the plants, the plant parts, the modes of preparation and the modes of administration of recipes were recorded. Cited plants were collected and identified at herbarium of the Laboratory of Ecology and Plants Resource Management, Faculty of Sciences University of Lubumbashi. The plants ecological status was also determined. Nineteen species of plants belonging to sixteen botanical families were identified. The main habitat preference of species is cultivated (21%), trees constituted 42% of morphological type while 58% of biological type are Microphanerophytes. The decoction was the main mode of preparation (74%). Leaves constituted 57 % of plant organs used for drug preparation. Some plant species cited are known in the literature to possess antimalarial activity. Further studies should be undertaken to investigate effectiveness of other plants that have not yet been studied and to determine their chemical composition.

Keywords: Medicinal plants, malaria, Ethnopharmacological survey, Lubumbashi, D.R.Congo.

INTRODUCTION

Malaria is one of the major tropical parasitic diseases responsible for significant morbidity and mortality especially among children and pregnant women. According to the World Health Organization, half the world’s population is at risk of malaria and one to two million annual deaths can be attributed to this disease [1- 3].

A variety of anti-malaria medications are available. Some antimalarial drugs such as chloroquine, amodiaquine, mefloquine had been used to treat malaria. But most of the drugs used today are becoming less effective because of the problem of drug resistance[1,4]. Plasmodium falciparum, the most severe form of malaria parasite species, is responsible for the vast majority of deaths associated with the disease. Key interventions to control malaria include: prompt and effective treatment with artemisininbased combination therapies; use of insecticidal nets by people at risk; and indoor residual spraying with insecticide to control the vector mosquitoes [1,5].

There is now broad consensus on the urgent need for new, affordable and efficient compounds that could serve as primary molecules for antimalarial treatment. New high¬ly-effective antimalarial drug candidates, based on new mechanisms of action or with new structures, are urgent¬ly needed to overcome the problem of rapid emergence of drug resistance and achieve long-term clinical efficacy [1,3,5].

Due to the crucial role that plant-derived compounds have played in drug discovery and development for the treatment of several diseases, the isolation of new bioac¬tive compounds from medicinal plants based on traditional use or ethnomedical data appears to be a very promising approach [6].

Ethnobotanical survey is an important step in the identification, selection and development of the therapeutic agents from medicinal plants[6,7].

The Democratic Republic of the Congo (DRC), one of the endemic areas strongly affected by malaria, contains a large area of Congo basin forest reputed for the extraordinary richness of its flora and boasts a wide variety of medicinal plants species [8]. It is therefore imperative that Congolese biodiversity should be screened in order to find compounds from plants used in traditional medicine that can give new

antimalarial drugs. This is the reason why some ethnopharcological surveys are undertaken in some parts of the DRC in order to collect data on plants used in traditional medicine to treat some diseases [9-15].

The present work, aims to analyze the traditional use of medicinal plants in the treatment of malaria in Lubumbashi, a city located in the south eastern of the DRC.

EXPERIMENTALS

Study area

The ethnopharmacological investigations were conducted in Lubumbashi, the capital of the Katanga province, located in the south eastern part of DRC (Fig. 1).

Figure 1: Lubumbashi in the Democratic Republic of the Congo, the area of study.

Lubumbashi is the second largest city of DRC, second only to the nation's capital Kinshasa. Lubumbashi lies at around 1,208 meters above sea level. The high altitude serves to cool somewhat the Climate year round which would be very hot otherwise. This city is located in a humid subtropical climate (Cwa, according to the Köppen climate classification). Annual average rainfall is 1,238 mm. Lubumbashi is the mining capital of the Democratic Republic of the Congo, acting as a hub for many of the country's biggest mining companies. Population estimates vary widely but average around 1.5 million and Swahili is the spoken language [16].

Ethnopharmacological survey

This survey was conducted for 10 months, from March 2011 to December 2012. Thirty one healers belonging to four "communes" of Lubumbashi city namely: Kamalondo, Katuba, Kenya, Kampemba and Rwashi were interviewed about the plant species used in traditional medicine for the management of malaria in the city of Lubumbashi. The name of the plants, the plant parts, the modes of preparation and the modes of administration of recipes were recorded. Nineteen plants were collected and identified at herbarium of the Laboratory of Ecology and Plants Resource Management, Faculty of Sciences, University of Lubumbashi in D.R Congo. The plants ecological status was also determined. Vouchers specimens are on deposit at the same laboratory

Floristic Characterizations of Plants Collected

In this work, medicinal plants used in traditional medicine against malaria in Lubumbashi city are characterized by their morphological types, biological types, habitat types and phytogeographical distribution.

1°. Morphological types

The morphological types were inventoried as following: lianas (L), trees (T), shrubs (Sh), sub-shrubs (Ssh), annual herb(Ah), vicace herb (Vh), climbing shrubs (Sh cl).and perennial herb (Ph).

2° Phytogeographical distribution

The phytogeographical types of distribution presented in this work are defined in accordance with the chorological subdivisions agreed for the Central African region. These are: Cosmopolitan (Cosm.), Pantropical (Pan), Paleotropical (Pal), Afro-tropical (Af tr), Guinean (Guin), Centroguinean (C-Guin), Afro-american (Af am), American tropical (Am tr), tropical Asia (Asia tr) and Afro- madagascar (Af ma) [8,11-16].

3° Biological types

Biological types below have been selected: Mesophanerophytes (MsPh), Microphanerophytes (McPh), Nanophanerophytes (NPh), Chamaephytes (Ch), Therophytes (Th) and Geophytes (G), Therophytes scapeux (Th sc), climbing Therophytes (T cl), erected Chamephytes (Ch er) and climbing Chamaephytes (Ch cl).

4° Habitat preferences

Only the most characteristic habitat of each plant species is indicated. The types of habitats retained in this work are therefore: farms or crops which are cultivated species (cult), Forests (For), Fallow (Fal), Ruderal or plants found in the village (Rud) and Subspontaneous
Cultured (Cult Ssp) and Secondary Forest (Fos).

RESULTS AND DISCUSSION

Nineteen species of plants used in Lubumbashi city (DRC) for the management of malaria were identified. These plants are arranged in alphabetical order of family's and species and listed in Tables 1 and 2.

Morphological types

Figure 2 shows morphological types of plants used in management of malaria in Lubumbashi city.

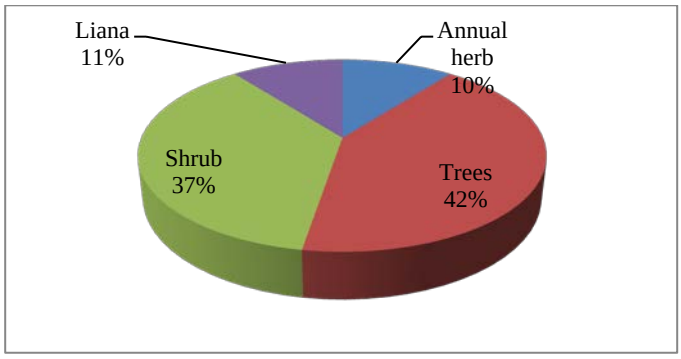

Fig. 2: Weighted morphological types identified.

It can be noted from this figure that ligneous plants represent about 79% of species (Trees=42% and Shrubs=37%) while liana and Annual herb represent 21% .

Table 1. Ecological characteristics of plants used against malaria in Lubumbashi city (DRC)

Families	Plants and species	Morphological types	Biologial types	Habitat type	Phytogeographical distribution
Anisophylleaceae	*Anisophyllea pomifera* Engl. & Brehmer	T	McPh	Fal	Af tr
Annonaceae	*Hexalobus monotalus* (A. Rich) Engl.&Diels	Sh	MsPh	Rud.	Af ma
Apiaceae	*Centella asciatica* (L.) Urb.	Ah	Ch cl	Rud.	Pan
Apocynaceae	*Landolphia congolensis* (Stapf) Pichon	L	Ph cl	For	C-Guin
Asteraceae	*Bidens pilosa* L. *Vernonia amygdalina* Del.	Ah T	Th McPh	Rud. Fal	Pan Af tr
Caricaceae	*Carica papaya* L.	T	McPh	Cult.ssp	Pan (Am tr)
Fabaceae	*Dalbergia boenhmii* Taub. *Dalbergia nitidula* Welw.ex Baker	T Sh	McPh McPh	For For	C-Guin Af tr
Loganiaceae	*Strychnos cocculoides* Baker	Sh	McPh	Fal	Pan (Af tr)
Melliaceae	*Ekebergia bangwelensis* Welw. ex C. DC	T	McPh	Fal	Af tr
Menispermaceae	*Cissampelos owariensis* P. Beauv ex DC	L	Ph cl	For	Guin
Oleaceae	*Schrebera trichoclada* Welw.	Sh	McPh	For	Af tr
Phyllanthaceae	*Antidesma venosum* E. Mey. ex Tal	Sh	McPh	For	C-Guin
Rubiaceae	*Crossopteryx febrifuga* (C.Don) Benth *Hymenodictyon floribundum* (Hoscht & Steud) BL Rob	T Sh	MsPh McPh	For Fal	Af tr Af tr
Solanaceae	*Capsicum frutenscens* L.	T	Ch er	Cult. ssp	Pan (Am tr)
Verbenaceae	*Vitex madiensis* Oliv.	Sh	MaPh	Cult.	C-Guin

Legend:

Trees (T), Shrubs (Sh), Liana (L) and annual herb (Ah).

Macrophanerophytes (MaPh), Mesophanerophytes (MsPh), Microphanérophytes (McPh), Therophytes (Th), climbing Chamephytes (Ch cl), erected Chamephytes (Ch er) and climbing Phanerophytes (Ph cl).

Cultured (Cult), subspontaneous Cultured (Cult ssp), Ruderals (Rud), Fallow (Fal), and Forest (For).

Pantropical (Pan), Afro-tropical (Af tr), Guinean (Guin), Centro-guinean (C-Guin), tropical America (Am tr) and Afro-madagascar (Af ma).

Table 2. Ethnobotanical data on plants used against malaria in Lubumbashi city (DRC)

Families	**Plants Species**	**Used Parts**	**Treated Diseases**	**Preparation Mode (Solvent)**	**Frequency**
Anisophylleaceae	*Anisophyllea pomifera* Engl. & Brehmer	Leaves Stem	Hypertension , cough, Malaria,Cough, malaria	Decoction (Water) Decoction (Water)	34 57
Annonaceae	*Hexalobus monopetalatus*	Leaves Stem	Malaria , fever, cough Malaria, cough,	Decoction (Water) Decoction	

			sore tooth.	(Water)	
Apiaceae **Apocynaceae**	*Centella asiatique* (L.) Urb. *Landolphia congolensis* (Stapf) Pichon	Leaves Roots Leaves Stem	Malaria Against eczema, skin ulcers malaria, dysentery	Maceration Powder to apply Decoction (Water) Decoction (Water	65 45
Asteraceae **Caricaceae**	*Bidens pilosa* L. *Vernonia amygdalina* Del *Carica papaya.L*	Leaves Leaves Leaves	Malaria, pneumonia , urinary infection. Malaria Malaria, Against amoebae and jaundice	Decoction (Water) Decoction (Water) Decoction (Water)	76 32 17
Phyllanthaceae	*Antidesma venosum*	Leaves	Snake bite Diarrhea, malaria	Suppository powder Decoction (Water)	49
Euphorbiaceae	*Jatropha curcas. L.*	Leaves Stem	Malaria jaundice, vomiting, rheumatism	Decoction (Water) Decoction (Water) *Maceration* *Powder to apply*	55
Fabaceae	*Dalbergia boehmii*	Leaves Stem	Cancer, malaria Stomach aches, cancer	Decoction (Water) Decoction (Water	25
	Dalbergia Nitidula	Leaves Roots	Sore teeth, malaria, gonorrhea Toothache, malaria , dysentery	Decoction (Water) Decoction (Water)	38 67
Loganiaceae	*Strychnos cocculoides*	Leaves Roots	Swelling of the testicles , malaria, menstrual pain umbilical hernia	Decoction (Water) Decoction (Water)	62
Manispermaceae	*Cissampelos owariensis* P. Beauv ex DC	External Parts	Malaria , diuresis, stomach aches	Decoction	27
Méliaceae	*Ekebergia bangwelensis* Welw.	*Leaves*	Malaria , Female Infertility	Decoction (Water)	59

	ex C. DC	Roots	Malaria , Female Infertility	Decoction (Water)	
Oleaceae	*Schrebera trichoclada* Welw.	Leaves Stem	Stomach Pain , Malaria, Gonorrhea Gonorrhea , Malaria	Decoction ,Maceration Decoction (Water)	38
Rubiaceae	*Crossopterix febrifuga* *Hymenodictyon floribundum* (Hoscht & Steud) BL Rob	*Leaves* *Roots*	hernia,gonorrhea, rheumatism, Constipation,fever , poisoning, malaria	Decoction (Water) Decoction (Water)	74 43
Solanaceae	*Capsicum frutescens.L*	Roots leaves	Hemorrhoid,tooth decay bile disorders , Malaria abscess	Maceration Infusion Powder to apply	65
Verbenaceae	*Vitex madiensis* Oliv.	leaves	Lung disease , malaria	Decoction (Water)	48

Biological types

It can be deduced from the analysis of the biological types of the inventoried flora used in folk medicine against malaria in Lubumbashi city that the Microphanerophytes constituted itself more than half (58%) of plants species used for malaria management in this city, followed by climbing Phanerophytes and Mesophanerophytes (11%) each, followed respectively by Macrophanerophytes, erected Chemophytes, climbing Chamephytes and Theophytes that are the less represented biological type (5%) (Fig. 3).

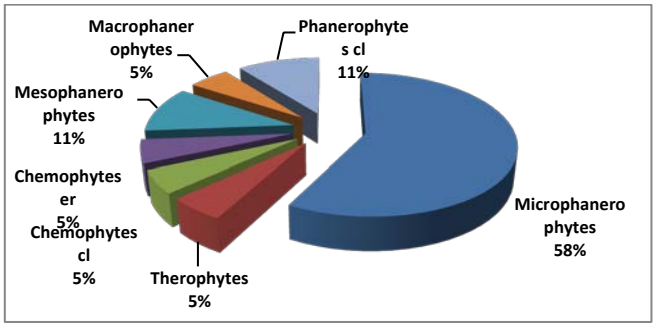

Fig.3. Weighted biological types

Habitat preferences

As it can be seen in figure 4, the analysis of habitat preference of plant species from the survey indicates that about one plant on five (21%) are cultivated species, Fallow represent 15%; Ruderal represent 16% and Forest, 37%.

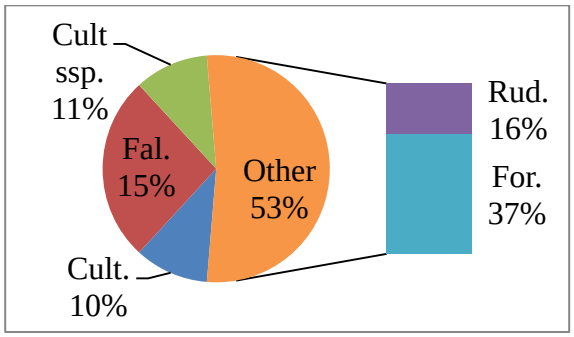

Fig.4. Weighted of biotopes

Phytogeographic Distribution

The Phytogeographic distribution of the inventoried flora against malaria in Lubumbashi city (Fig. 5) can be resumed as follow : Afro- tropical represent 37% of all species, followed respectively by C-Guin (21%),Pan (Am tr) (16%),Pan (11%), Pan (Af tr), Af ma and Guin represent only 5% each.

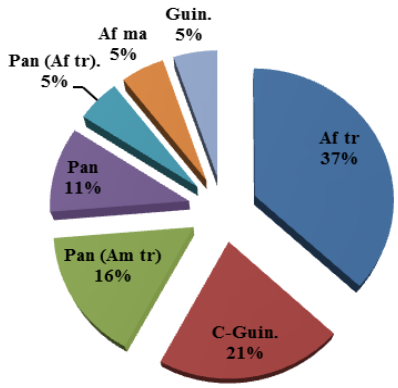

Fig. 5: Weighted distribution phytogeographic

Botanical Families Involved in the Study

Nineteen species of plants belonging to 16 different families were collected. Asteraceae and Fabaceae families are the most represented with two plants species each (11%) followed by Melliaceae, Loganiaceae, Caricaceae, Apocynaceae, Apiacea, with one specie each (5%) and the others families are represented as shown in Figure 6.

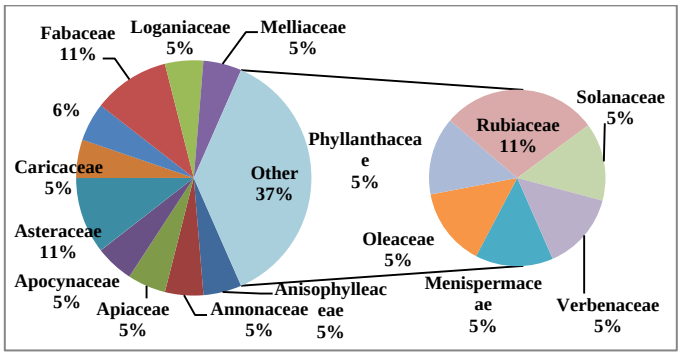

Fig.6. Distribution of species according to botanical families

Characteristic of Recipes of Medicinal Plants

Recipes used are characterized by the relative importance of plant parts, mode of preparation and administration used.

1. Plant parts used

The leaves are the most used parts in the treatment of malaria with medicinal plants in Lubumbashi city (Fig. 7). It represents 57% of used plant parts cited by traditional healers in this survey. The use of leaves could be justified by the abundance of chemical groups they contain. In fact, leaves are known as main synthesis site of secondary metabolites in plants and are the most commonly used plant parts by traditional medicine practitioners [9-15, 17].

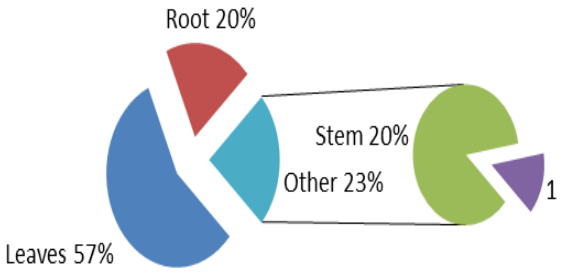

Fig. 7. Weighted used parts

2. Mode of preparation of recipes

Water is the most used solvent for the preparation of the recipes (92%) and decoction is the main mode of preparation of remedies, it represents 74% of preparation modes (Fig.8).This confirms the results already reported by several other authors [9-15,17-19].In fact, water is the cheapest and the most available solvent that can dissolve a high number of metabolites and high temperature permits a rapid extraction of active ingredients. However, some of these metabolites can be degraded by heat.

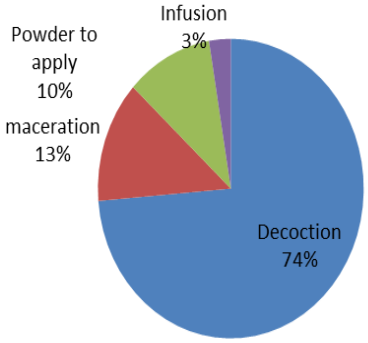

Fig. 8. Mode of preparation of recipes

3. Administration route and dose

Careful observation and discussions with traditional healers during surveys revealed that traditional healers had knowledge of dosage and frequency of phytomedicines to be administered. Dosage is often determined after observing physical condition of the patient (i.e. patient height, weight or age and history of ailments).

In general, the concentration or the amount of the organ, the dose, the frequency or the period of taking the product depends to the prescriber. In most cases, the drug is prescribed in two or three doses. Usually a beer glass is taken as the first step of the assay and all preparations were administered orally (100% of cases).

7. Similarities of Use

Some species found in Tables 1 and 2, used in Lubumbashi against malaria are also commonly used as phytomedicines against this disease in Bukavu and Butembo cities in DRC [15,20]. This is the case of Bidens pilosa L ,carica papaya L., Vernoniaamygdalin and Crossopterix febrifuga wihich are also used in the treatment of malaria in the eastern part of Africa [21]. Some of these plant species in tables 1 and 2 are also reported by some authors as antimalarial recipes in African traditional medicine [15,20-35].

CONCLUSION

This study, done in Lumbashi city (DRC), lists some plants used in malaria management in Congolese traditional medicine. Several of these plants are also used against this parasitic disease in other Congolese and African parts. Thus, some plant species used as antimalarial by the traditional medicine practitioners in the study area need to be screened in order to identify the species having antiplasmodial activity, isolate bioactive compound(s) and determine their structure(s) and their toxicity. Such results could help in the development of new drugs for the management of malaria.

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