Diversity of Healing Plants Used in the Traditional Treatment of Malaria in four Municipalities of Niger

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ABSTRACT— The study was conducted in four municipalities in Niger. The objective is an ethno-medical survey of medicinal plants that local people are used against malaria. Open semi-structured interviews technique was used to collect information. The study has identified twenty-six species traditionally used in the treatment of malaria. These species are divided into sixteen families and twelve genera. Besides of malaria, these plants can cure others pathologies like. Species morphological type analysis show that trees and shrubs are most represented. For different organs used, the leaves are the most used while decoction is the most common drug preparation method. These results show the medicinal plants diversity in malaria treatment in Niger. This study can be a base for new molecular research in the treatment of malaria

Keywords— Malaria, species, medicinal, plants, Niger.

1. INTRODUCTION

Malaria remains one of the diseases of strong prevalence in the tropical zone, with 200 to 450 million cases of infection per year in the world, she talks up to 2.7 million deaths. This disease remains endemic in more than 100 tropical development countries [24]. In spite of the performances of the modern medicine, African pharmacopoeia occupies, today an important place in health care in Africa [31]. According to world health organization [27], 80 % of the undeveloped countries population use traditional medicine with healing plants for primary health care. Healing plants constitute a precious Inheritance for the humanity and more particularly for the majority of deprived communities of the developing countries which depend on it to assure their primary health care and their subsistence [34]. The knowledge on healing plants are hold by people who today have transmission difficulty because their offspring doesn’t want any more to fall into step with them. And according to [2], in rural area, every inhabitant knows and uses the virtues of one or several plants. It is very important to translate this traditional knowledge into a scientific knowledge to revalue, preserve it and use it in a rational way [7].

In Niger malaria is the first cause of morbidity and mortality with a rate 68.51 % and 33.45 % respectively, and it is the main cause of death at the children from 1 to 4 years old with 59.97 % [11]. Malaria is responsible for substantial economic losses particularly in the rural area and constitutes an important brake for the economic and human development. He constitutes a real problem of public health which affects generally all the population and particularly the children of less than five years old and the pregnant women.

The malaria is a worrisome affection, an affection which arouses a lot of concern among the populations today [24]. Niger is classified among the poorest countries of the world, what makes difficult the access to healthcare of the populations which make appeal to the pharmacopoeia [23]. Thus it is necessary to look for less expensive and easily accessible, new therapeutics.
It is necessary to add that in Niger, the antimalarial medicinal plants haven’t be the object of specific works of inventories. But it is necessary to note that certain authors made case partially of antimalarial plants during their ethnobotanic inquiries which concerned the traditional medicine of Niger ([1], [32]). Face to this, it is important to lead an ethnobotanic study, to sit a database of antimalarial medicinal plants in Niger. The main objective of this work consists to inventory plants used by the population in malaria treatment. The specific objectives are: to identify organs and method of preparation; and finally to collect the maximum of information concerning all the therapeutic uses of these plants.

2. MATERIALS AND METHODS

➢ Study Sites

This study was conducted in the municipalities of Gaya, Tanda, Tamou and urban community of Niamey (Figure 1).

Niamey is located between 13°31 N latitude and 2° 26 E longitude. The town is built on the terraces of Niger River, at 218 m of height. The climate of the area is sahelian (Semi-arid) type characterized by a rainy season (4 to 5 months) with total precipitation varies from 500 to 750 mm a year and a drying season (8 to 7), longer than the previous one [23]. The vegetation is characterized by undergrowth consisted mainly species from Combretum kind, on lateritious trays and steppes on the sandy terraces in dry valleys and on dunes [37].

The municipalities of Gaya and Tanda are located in the department of Gaya (Region of Dosso). Gaya is centered on 3°10’35” - 3°37’48” E longitude and 11°48’ - 12°11’32” N latitude. Tanda is situated between 3° 17’ - 3° 16’ E longitude and 12° 6’ - 12°6’ N latitude. The climate of the zone is the Sudanese north with two seasons: a dry season (6 to 7 months) and a rainy season (6 to 5 months). The rainy season extends from May till October, with more than 750 mm precipitation [33]. The vegetation is established by varied formations going from forest to savanna [5].

Tamou is located in the department of Say (Region of Tillabery). The area is situated between 11°54’ - 12°35’ N latitude and 02°4’ - 02°50’ E longitude [12]. The annual precipitation average calculated over 28 years of observation (1981-2008) is 632±25mm. The precipitation varies from 600 to 800 mm of rain a year. The climate is sahelo-Sudanese with two seasons: a dry season of more long-lasting (7 in 8 months) and a season of short-term rains (4 in 5 months). Generally the vegetation of the zone is characterized by raised and shrubby savannas, with forest galleries along streams [6].

Figure 1: Location of study sites
Ethnobotanic methods of data collection

Data were collected through a survey employing an random open semi-structured interviews technique with a questionnaire. The questionnaire concern precise information on the informant, the identity of the plant as well as the used part, the method of preparation and the method of administration. The approach is based on a local language dialogue, accompanied with the collection of the samples of the quoted plants.

Data analysis

Fidelity Level (FL) which is the percentage of informants having quoted the use of a species given in the treatment of the malaria was calculated according to the technique of Trotter and Logan [36] used by several authors ([10], [14]): \[ FL(\%) = \frac{Ip}{Iu} \times 100 \] with Ip number of informants having asserted the employment (use) of a species given to handle the malaria and Iu total number of questioned people (informants).

3. RESULTS

Anti-malarial plants diversities

During this investigation, 27 healing plants used against the malaria in the traditional pharmacopoeia of Niger have been count. These plants are distributed in 17 families and 22 kinds. For family diversities, Fabaceae and Combretaceae are the most represented with 5 and 3 respectively. Then come Rutaceae, Myrtaceae and Chlospermaceae with 2 species each. Other families are represented by one spicy (Table 1). Most of these plants were shrubs and trees.

On top of malaria, these plants can care other diseases (Table 1).

Anti-malarial plants origin

Among anti-malaria plants used by the population, 19 plants (68 %) are spontaneous, while 14 plants (32%) are introduced (Figure 2). Among these last, five plants are cultivated in garden or houses.

Figure 2: Species origin proportion.
 ➢ **Morphological types**

For morphological types censuses, Trees and shrubs with 10 species (40%) each come before grasses with 5 species (20 %), (Figure 3).

![Morphological type’s proportion.](image)

Figure 3: Morphological type’s proportion.

 ➢ **Fidelity index**

Fidelity index analysis show that the higher number has been registered with Cassia occidentalis (66, 67) ; Azadiratcha indica (58,33) ; Combretum micranthum (56,67) Khaya senegalensis (51,67) ; Citrus limon (48,33) ; Eucalyptus camalulensis (46,67) ; Combretum nigricans (44, 67) et Citrus auraentifolia (40). Meanwhile the smallest number are registered for Limeum pterocarpum (5) ; Moringa oleifera (8,33) ; Vitex doniana (11,67) ; Psidium guajava (15), Cochlospermum tinctorium et Cochlospermum planchonii (18,33) (Table 1).

Tableau 1: Plants used in the treatment of malaria

<table>
<thead>
<tr>
<th>Family Names</th>
<th>Scientific Name</th>
<th>Parts uses</th>
<th>Therapeutic indication</th>
<th>Preparation</th>
<th>IFL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aizoaceae</td>
<td>Limeum pterocarpum</td>
<td>Whole plants</td>
<td>Malaria</td>
<td>Decoction</td>
<td>5</td>
</tr>
<tr>
<td>Anarcadiaceae</td>
<td>Mangifera indica</td>
<td>Leaves</td>
<td>Malaria</td>
<td>Decoction</td>
<td>21,67</td>
</tr>
<tr>
<td>Capparaceae</td>
<td>Cleome gynandra</td>
<td>Whole plants</td>
<td>Malaria</td>
<td>Decoction</td>
<td>15</td>
</tr>
<tr>
<td>Caricaceae</td>
<td>Carica papaya</td>
<td>Feuilles</td>
<td>Malaria</td>
<td>Decoction</td>
<td>25</td>
</tr>
<tr>
<td>Chlospermaceae</td>
<td>Cochlospermum planchonii</td>
<td>Leaves</td>
<td>Malaria</td>
<td>Decoction, powder</td>
<td>18,33</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Malaria, hemorrhoid, jaundice</td>
<td>Decoction, powder</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Roots</td>
<td>Malaria, hemorrhoid, jaundice</td>
<td>Decoction, powder</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>fruit</td>
<td>Malaria, Gonorrhea</td>
<td>Decoction</td>
<td>13,33</td>
</tr>
<tr>
<td>Combretaceae</td>
<td>Combretum micranthum</td>
<td>leaves</td>
<td>Malaria, give birth</td>
<td>Decoction, Maceration</td>
<td>56,67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Roots</td>
<td>Malaria, hemorrhoid, against snake bite</td>
<td>Decoction, Powder</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Combretum nigricans</td>
<td>Leaves</td>
<td>Malaria, diarrhea</td>
<td>Decoction, maceration</td>
<td>44,67</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Part Used</th>
<th>Uses</th>
<th>Preparation</th>
<th>Extracts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cucurbitaceae</strong></td>
<td><em>Momordica balsamina</em></td>
<td>Whole plants</td>
<td>Malaria, jaundice, hemorrhoid; itch; evil spirit</td>
<td>Decoction</td>
<td>33,33</td>
</tr>
<tr>
<td><strong>Myrtaceae</strong></td>
<td><em>Eucalyptus camaldulensis</em></td>
<td>Leaves</td>
<td>Malaria hemorrhoid, women wash</td>
<td>Decoction</td>
<td>46,67</td>
</tr>
<tr>
<td><strong>Fabaceae</strong></td>
<td><em>Guiera senegalensis</em></td>
<td>Leaves</td>
<td>Malaria, stomach ache, vomiting; itch; evil spirit</td>
<td>Maceration, decoction, powder</td>
<td>26,67</td>
</tr>
<tr>
<td><strong>Cassia occidentalis</strong></td>
<td><em>Cassia occidentalis</em></td>
<td>Whole plants</td>
<td>Malaria, hemorrhoid</td>
<td>Decoction</td>
<td>66,67</td>
</tr>
<tr>
<td><strong>Tamarindus indica</strong></td>
<td><em>Tamarindus indica</em></td>
<td>Leaves</td>
<td>Malaria</td>
<td>Decoction</td>
<td>30</td>
</tr>
<tr>
<td><strong>Cassia siamea</strong></td>
<td><em>Cassia siamea</em></td>
<td>Leaves</td>
<td>Malaria, hemorrhoid, women wash</td>
<td>Decoction</td>
<td>25</td>
</tr>
<tr>
<td><strong>Pterocarpus erinaceus</strong></td>
<td><em>Pterocarpus erinaceus</em></td>
<td>Barks,</td>
<td>Malaria, hemorrhoid, dysentery, skin diseases</td>
<td>Decoction, powder</td>
<td>30</td>
</tr>
<tr>
<td><strong>Alysicarpus ovalifolius</strong></td>
<td><em>Alysicarpus ovalifolius</em></td>
<td>Whole plants</td>
<td>Malaria</td>
<td>Decoction</td>
<td>36,67</td>
</tr>
<tr>
<td><strong>Myrtaceae</strong></td>
<td><em>Khaya senegalensis</em></td>
<td>Barks,</td>
<td>Malaria, hemorrhoid; stomach ache; evil spirit</td>
<td>Decoction</td>
<td>51,67</td>
</tr>
<tr>
<td><strong>Meliaceae</strong></td>
<td><em>Pseudocedrela Kotschyi</em></td>
<td>Barks,</td>
<td>Malaria</td>
<td>Decoction</td>
<td>35</td>
</tr>
<tr>
<td><strong>Azadiratcha indica</strong></td>
<td><em>Azadiratcha indica</em></td>
<td>Leaves</td>
<td>Malaria</td>
<td>Maceration, decoction</td>
<td>58,33</td>
</tr>
<tr>
<td><strong>Moringaceae</strong></td>
<td><em>Moringa oleifera</em></td>
<td>Leaves</td>
<td>Malaria</td>
<td>Decoction</td>
<td>8,33</td>
</tr>
<tr>
<td><strong>Myrtaceae</strong></td>
<td><em>Psidium guajava</em></td>
<td>Leaves</td>
<td>Malaria; tonic</td>
<td>Decoction</td>
<td>15</td>
</tr>
<tr>
<td><strong>Polygalaceae</strong></td>
<td><em>Eucalyptus camaldulensis</em></td>
<td>Leaves</td>
<td>Malaria, tonic</td>
<td>Decoction</td>
<td>46,67</td>
</tr>
<tr>
<td><strong>Rubiaceae</strong></td>
<td><em>Securidaca longipedunculata</em></td>
<td>Barks</td>
<td>Rheumatism, hemorrhoid</td>
<td>Decoction</td>
<td>22,16</td>
</tr>
<tr>
<td><strong>Rutaceae</strong></td>
<td><em>Crossopteryx febrifuga</em></td>
<td>Roots</td>
<td>Malaria, anguish, stress, hemorrhoid</td>
<td>Decoction</td>
<td>23,33</td>
</tr>
<tr>
<td><strong>Citrus aurentifolia</strong></td>
<td><em>Citrus aurentifolia</em></td>
<td>Leaves</td>
<td>Malaria, women wash</td>
<td>Decoction</td>
<td>40</td>
</tr>
<tr>
<td><strong>Verbenaceae</strong></td>
<td><em>Citrus limon</em></td>
<td>Leaves</td>
<td>Malaria, women wash</td>
<td>Decoction</td>
<td>48,33</td>
</tr>
<tr>
<td><strong>Vitex doniana</strong></td>
<td><em>Vitex doniana</em></td>
<td>Leaves</td>
<td>Malaria</td>
<td>Decoction</td>
<td>11,67</td>
</tr>
</tbody>
</table>
Plants parts use

The leaves with 55% are the main plant parts that are used to care malaria, and then come in second position roots, whole plants, barks and fruits with 17%, 14%, 10% and 4% respectively (Figure 4).

Drug preparation

For drug administration, three methods of preparation (Figure 5) are used to care malaria: decoction (76%), powder (8%) and maceration (16%).

Figure 4: Plants different parts used proportions

Figure 5: Drug preparation proportion
Others therapeutic indications

The antimalarial plants of this study can care other diseases, like hemorrhoid, jaundice, snake bite, Women wash after given birth, stomach ache (Fig 6).

Figure 6: Others diseases proportion

4. DISCUSSION

This study indicates that traditional medicine has wide acceptability among people with 95% of questioned people who used plants parts for medicine. This is in agreement with [27] which notify that 80% of the undeveloped countries populations are using plants for primary health.

For plants origin, spontaneous (native) species are the most used than the introduce ones. This can be justifying by ancestor’s knowledge on these plants. The population has more information on local plants than introduce ones; the evidence is the uses of plants to care many diseases. On top of these plants, introduce ones are used against the same disease (Malaria) in many countries. It is the case of: Azadirachta indica, Cassia siamea, Eucalyptus camaldulensis, Mangifera indica and Psidium guajava which are used against malaria in Niger, these plants are mentioned by [16] to cure the same disease in Burkina Fasso. According to [19], the population of Bangui use Mangifera indica, Carica papaya, Citrus aurantiifolia, Azadirachta indica against malaria and these plants appear on the list of this study. In Nigeria, [28] indicate Carica papaya; Azadirachta indica, Mangifera indica, Citrus aurantiifolia and Psidium guajava as antimalarial healing plants; these plants appear on the list of this present study. In Cameroon [13] mentioned the use of Carica papaya and Psidium guajava against malaria by Bassa people of Douala. The use of introduce species for the same disease in many countries show that these species can really treat the disease and also the knowledge on these plants is known. The common knowledge on herbal medicines used in the traditional treatment of malaria with introduce species are common in Niger as well in other countries. So the knowledge, attitudes and practices related to malaria treatment are the same in these countries.

The therapeutic uses of some plants recorded during this study are recognized in other countries: Tamarindus indica, Khaya senegalensis, Mangifera indica, Carica papaya, Citrus aurantiifolia and Azadirachta indica find themselves on the list of the antimalarial healing plants of [19] during their studies in Bangui city (Centrafrique). So during their investigations, [16] listed in Burkina Fasso 72 species for their use (alone or in association) in the traditional treatment of the malaria. Of this list 13 species: Azadirachta indica, Cassia occidentalis, Cassia siamea, Cochlosperrum planchonii, Combretum micranthum, Crossopteryx febrifuga, Eucalyptus camaldulensis, Guiera senegalensis, Khaya senegalensis, Mangifera indica, Psidium guajava, Pterocarpus erinaceus and Securidaca longepedunculata were mentioned as antimalarial during the present study. Studies led by [4] in SouthWest of Niger confirm the use of Alysicarpus ovalifolius and Azadirachta indica against malaria. Cochlosperrum planchonii is used in ivory coast [17] and in Burkina Fasso [29] against malaria. In Democratic Republic of the Congo, [35] listed nine antimalarial plants, among them only Cassia occidentalis is present for this study. In Kenya [26] listed Cassia occidentalis, Azadirachta indica and Securidaca longepedunculata as healing plants to care malaria and all of them have been recorded during this study.

It is also necessary to note that in Nigeria, [28] indicate that *Hyptis suaveolens* is use as an antimalarial healing plant, while during this study; people listed the plant as an anti-mosquito. People are collecting the stems with leaves, which are pull down in houses and the odor will drive away mosquitoes.

Among the medicinal species used by the population, the spontaneous plants are the most used. This confirms the results of [22] who counted 34 spontaneous plants against 8 exotic plants during their investigation in Morocco. This strong use of the local species can give some explanation by the availability of the resource. It is necessary to note a low difference between the local species and those introduced during this present study. Thus the use of the introduced species is growing, because they are accessible to all during all the season.

Medicinal plant mixture preparation varies according to the relative importance of plants parts, some preparation methods and administration [3]. According to plants parts use, leaves are the most used. For [9], this frequency of higher use of leaves is due to the easy and to the speed of the harvest. According to [8], leaves are the photosynthesis site and sometimes the storage of the secondary metabolites responsible for biological properties of the plant.

Decoction is the most used preparation method and according to [34], it allows collecting chemical compound group and also limits or cancels the toxic effect of some plants mixture. Thus this is why most of the traditional drugs are prepared by decoction.

This work, allowed listing a number of diseases handled by healing plants besides of malaria. The results show that hemorrhoids (29, 41 %), wash of the women (11, 76 %), stomach ache (8, 82 %), jaundice, dysentery and tonic (5, 88 % respectively) (Figure 5), are the diseases after which these antimalarial plants look most. The number of species listed for hemorrhoid treatment is the most important, because this disease is frequent in Niger republic.

5. CONCLUSION

The results obtained during this study, allowed collecting several information on the medicinal plants species used by the population in the treatment of malaria which is the first cause of morbidity and mortality in Niger. Diverse plants parts (Leaves, fruits, roots and whole plants) coming from 27 botanical species are used by the populations against malaria. To note that three drugs preparation method (decoction, maceration, and powder) were registered.

This work represents an information source which is going to contribute to the knowing of antimalarial healing plants and to safeguard the local knowledge. So he can be a database for the valuation of these antimalarial medicinal floras to discover new chemical compounds.

It would be interesting to spread this kind of work to all country municipalities for recording the maximum of information about the antimalarial medicinal flora which will be of use to the science, by establishing a catalog of these plants.

6. REFERENCES


