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Full Length Research Paper

Contribution to the knowledge of medicinal plants around Lake Iro (Chad)

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Farmers and rural communities living around Lake Iro in Chad make frequently use of Non-Timber Forest Products (NTFP) for food and other important matters such as health. The region of Lake Iro is renowned for being the fief of the traditional doctors in Chad and could contribute greatly to the knowledge of medicinal plants in the country. The objective of this study carried out is to assess and evaluate the importance of the region in the understanding of medicinal plants' role. Surveys carried out in three sites surrounding Lake Iro (Tiodi, Kilip and Badi) based on a structured questionnaire showed the followings: A total of 57 persons including seven renowned local traditional doctors have been interviewed in households and the market. The results of the survey led to the identification of 39 plant species, 30 genus and 23 families. The dominant family was Caesalpiniaceae with 12%. The plants' parts used by traditional doctors are leaves, fruits, seeds, bark and roots among others. From all these, the roots constitute the important part with 39%. The majority of the preparations were prepared as maceration powder (45%) and the aqueous solutions obtained are taken orally (63%). A total of 24 diseases treated by medicinal plants have been identified during this survey. These plants are mainly used to treat diarrhea, stomach aches and malaria. The information on these species could act as basis in the development of appropriated strategies for domestication in order to introduce them in the existing peasant fields.

Keywords: Non-Timber Forest Products (NTFP), medicinal plants, overexploitation, Lake Iro, Chad.

INTRODUCTION

In Africa, forests play an important role in the preservation of the biodiversity and in the ecological services such as fight against the global warming, the preservation and the improvement of the quality of water (Schneeberger, 2006).

In developing countries, the farmers of the rural area depend for the most part of the Non-Timber Forest Products (NTFP), in particular in term of food, medicine and income (Leakey, 1996; Langlais, 2004). These products allow them to diversify their supplies of food, to

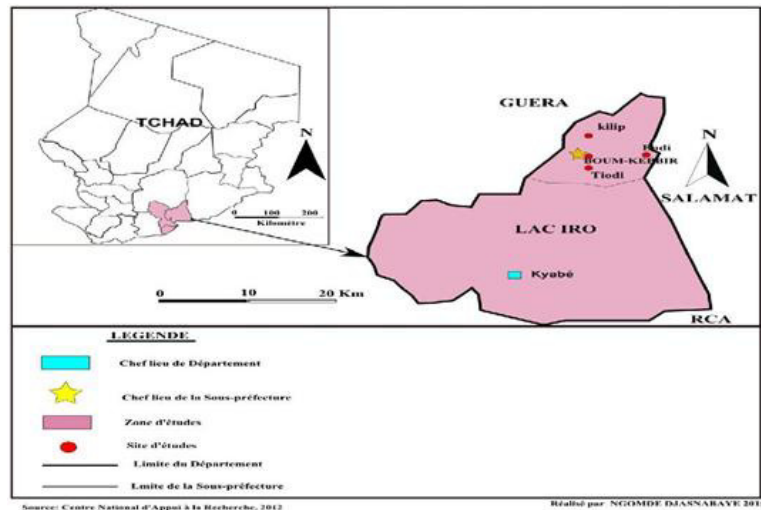


Figure 1 Map of Lac Iro department (Chad)

take care of themselves and to improve their standard of living (Sene, 1994).

Generally in Chad and particularly in the Lake Iro region, the economic non-accessibility to the modern health care, the insufficiency and the bad distribution of the health workers as well as the sociocultural behavior are the main factors which make that more than 80 % of the population resort to traditional medicine (Sangare, 2004; Jiofact et al., 2010; Mpoudo et al., 2012).

Furthermore, substances developed in the laboratory show themselves more expensive than products with medicinal plants (Pamplona, 1999).

Consequently, there is a danger to see disappear the knowledge about the medicinal plants, even if the young generations begin to be interested in it. This type of knowledge possesses a real cultural value and can eventually allow the development of new pharmaceutical medicine. Therefore, they contribute to the preservation of plants and endogenous knowledge (Albuquerque et al., 2007). The sustainable exploitation of the marketed medicinal plants could contribute not only to preserve the biological diversity of rain forests but also to the improvement of the living conditions of the local communities by creation of income.

In the face of this problem, it is made increasingly difficult to protect and to safeguard these ecosystems. Also, the popular knowledge is at present held by few people among whom we find a rate of high illiteracy (Hseini and Kahouadji, 2007). So, it became necessary to protect and to translate this popular knowhow into scientific knowledge to use it in a rational way.

The main objective of the present study is to contribute to the knowledge of medicinal plants to reduce the problem of the sanitary insecurity.

The specific objectives assigned to this study consist in doing of inventory of medicinal plants around Lake Iro area, identifying the used parts of plants, the mode of

area, identifying the used parts of plants, the mode of preparation, administration and the main treated diseases by these plants.

MATERIAL AND METHODS

Description of the site of study

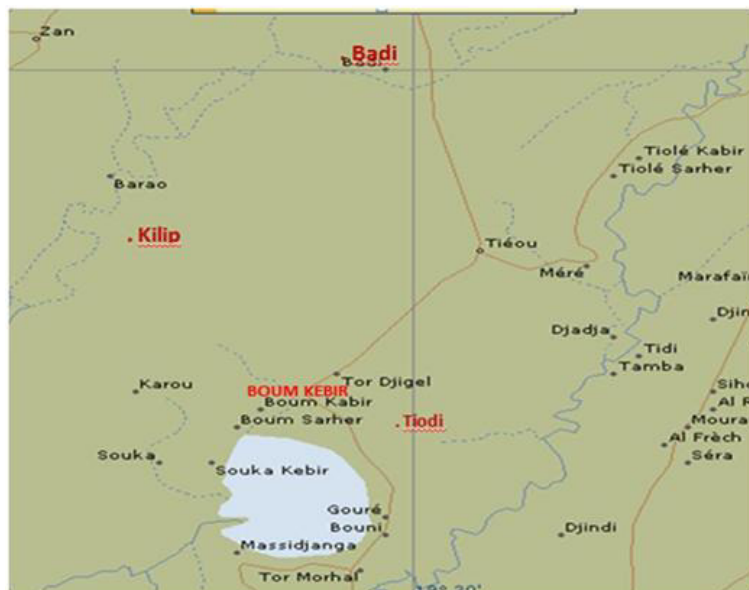
The study was realized in the region of Moyen-Chari (Chad) in the Department of Lake Iro (figure 1).

The climate of this region is Sahelo-Sudanese with two seasons: the dry season which begins from November to April and the rainy season which goes from May till October. The average rainfall is between 500 to 900 mm whereas the monthly temperature oscillates between 24°C and 28°C. The vegetation is essentially a shrubby savanna (Pias and Barbery, 1965). The dominant ethnic groups are Goula, Sara Goula and Arabs.

The choice of these sites of Lake Iro was guided at first by GELT project (Les Grands Ecosystèmes Lacutres Tchadiens) which focused on three lakes among which Lac-Iro is also selected. Then it was guided by the local authority (District officer) who directed us to the villages (Tiodi, Kilip and Badi) in which live the most considered and renowned traditional doctors of health in this region. According to the local authority, they received this traditional medicine an inheritance from their ancestors.

METHODOLOGY

The work took place at the same time in the households and in the market including field visits accompanied with the traditional doctors (figure 5a). It consisted to lead an ethnobotanic investigations based on the structured questionnaire.



Source: Encyclopedia Encarta 2008

Figure 2 The different sites investigated in Lake Iro area

Table 1 Geographic coordinates of different sites investigated

Sites	Latitude	Longitude	Distance from BOUM KEBIR (Km)
TIODI	10 ⁰ 09'20.3"	19 ⁰ 28'01.9"	10.01
KILIP	10 ⁰ 19'45.2"	19 ⁰ 16'38.2"	21.3
BADI	10 ⁰ 29'58.7"	19 ⁰ 28'53.6"	36.1

Ethnobotanic Investigations

They are realized in the households and on the market. In all, 57 people were interviewed at the rate of 27 in the households and 30 on the market.

Household-based Surveys

The interview (figure 3) was semi-structured. The questionnaire beforehand elaborated contains open questions, closed questions and others directed.

For the open questions, the farmers expressed freely their point of view while for the closed questions, the informants answered by yes or no. Concerning the directed questions, answers were proposed and the investigated people will chose one or two among them.

After every interview, a field visit was organized together with the traditional Doctor accompanied by his close collaborators to identify the specimen of plants. The samples of plants were collected and identified in the National herbarium of IRED of Farcha (formerly Laboratory of Farcha LRVZ) then in the laboratory of Biodiversity and Sustainable development of the University of Ngaoundéré (Cameroon).

The ethnic groups were Goula, Sara-goula and Arabs

and the choice of the farmers was randomly made. During our walk in the savanna area of Lake Iro, the traditional doctor showed us every time he perceives a plant which treats a disease and he describes the procedure of using (figure 5a). After exhausting of our questions on a plant, the sample of plant was collected for the preparation of a reference herbarium (Figure 5b). This field work with each of the traditional doctors lasted three days.

Besides the households and field surveys, the investigations continued on the only weekly market of this area located in Boum-Kebir (figure 2) and opened every Tuesday. All the sellers of Non-Timber Forest Products (NTFP) are systematically questioned every market day. The information collected with them concerned the ethnic group of the seller, the vernacular name, the mode of preparation and administration.

Collection and data analysis

The collected data concerned the used parts of plants, the mode of preparation and administration and the various diseases treated by the medicinal plants. The results were expressed in percentage. So the quantitative data allowed carrying out graphs by using the spreadsheet Excel Microsoft 2013.



Figure 3: Interview in the household



Figure 4a: interview on the field with traditional Doctor



Figure 4b: Preparation of a herbarium

RESULTS AND DISCUSSION

Medicinal Plants Collected

In total, 39 species of medicinal plants were listed around the Lake Iro area with 21 species in Tiodi, 13 in Kilip and 12 in Badi (Table 2). It can be seen from this table that the processing capacity of these diseases varies from a village to the other one.

This processing capacity is higher in Tiodi than the two other sites. This gives evidence that the traditional doctors of Tiodi are very much on top of the use of medicinal plants in the area of Lake Iro.

According to the results presented below in Table 3, six medicinal plants are relatively more used in traditional herbal medicine (phytotherapy) by the local population. The species *Phyllanthus reticulatus* (100 %), followed by *Ziziphus abyssinica*, *Z. mucronata*, *Cassia javanica*, *Nauclea latifolia* and *Lannea* sp. (71.42 %) for each.

Nevertheless, the excessive harvest of these species could lead to their disappearance. So, it is necessary to exploit these species by taking into account the renewal of the resource to assure their durability.

The figure 6 shows that medicinal plants shall be distributed as follows: 23 families and 30 genera. Families having the highest specific wealth are *Caesalpiniaceae* (12 %), *Rhamnaceae* (10 %) and *Euphorbiaceae* (10 %).

This result confirms that of Adomou et al. (2012) in Benin who reported that on 75 listed families, *Leguminosae* is the most represented (with 31 species corresponding to the percentage of 15 %) followed by *Rubiaceae* (15 species corresponding to 7 %) and *Euphorbiaceae* families (9 species equivalent to 4 %). However, this result is different to that obtained by Benlamdini et al. (2014) in Moulouya (Morocco) who mention that on 45 families, *Lamiaceae* is the most represented (20 species) followed by *Asteraceae*

Table 2 Medicinal plants listed in three sites of Lake Iro area (Tiodi, Kilip and Badi)

Local Name (Goula. Sara goula et Arabe)	Scientific Name	Diseases treated	Tiodi	Kilip	Badi
Falaa. Garate	<i>Acacia nilotica</i> var. <i>nilotica</i>	Cough	x		
Toli	<i>Albizia lebbek</i>	Malaria, Diarrhea, Constipation		x	
Toum	<i>Allium sativum</i>	Guinea worm	x		
Porio	<i>Annona senegalensis</i>	Sexual weakness			x
Kabo	<i>Balanites aegyptiaca</i>	Guinea worm	x		
Naba. Kulkul	<i>Bauhinia rufescens</i>	Typhoid, Malaria			x
Ara. Millesse	<i>Bridelia ferruginea</i>	Sexual weakness			x
Mordon. Kiringne	<i>Capparis tomentosa</i>	Tooth decay			x
Thiome. Kidjékété.					
Aboumkachoye	<i>Cassia javanica</i>	Bellyache, Diarrhea, Malaria	x	x	
Kakamaza	<i>Cassia nigricans</i>	Measles	x		
Fourou	<i>Combretum collinum</i>	Wound	x		
Koubéou	<i>Combretum glutinosum</i>	Wound		x	
Moyon	<i>Crossopteryx febrifuga</i>	Malaria, Diarrhea, Constipation		x	
Poutora	<i>Cucumis metuliferus</i>	Hemorrhoid	x		
Foum	<i>Ficus platyphylla</i>	Abscess	x		
Tayam	<i>Hymenocardia acida</i>	Sexual weakness			x
Fidjo	<i>Khaya senegalensis</i>	Measles	x		
Atoulum. Ougou	<i>Kigelia africana</i>	Icterus		x	
Hil ou Hel	<i>Lannea</i> sp.	Wound	x		x
Aloum	<i>Moringa oleifera</i>	Bellyache, Hernia	x		
Feletaon. Ngoudja					
	<i>Nauclea latifolia</i>	Arterial high blood pressure (Hupertension) Hernia and Bellyache	x	x	
Doukoun	<i>Penisetum thyphoides</i>	Sexual weakness			x
Kamor. Nari. Kardja- Kardja	<i>Phyllanthus reticulatus</i>	Bellyache, Diarrhea, Typhoid	x	x	x
Kayame. Robé	<i>Sclerocarya birrea</i>	Gonorrhea		x	
Fala. Klamar	<i>Securidaca longepedunculata</i>	Tooth decay	x		
Faam	<i>Sterculia setigera</i>	Wound	x		
Paindoc. Koutourou	<i>Stereospermum kunthianum</i>	Diarrhea		x	
Himboyle	<i>Strychnos spinosa</i>	Gonorrhea			x
Mal	<i>Tamarindus indica</i>	Measles, Conjunctivitis	x		
Tem de Toma	<i>Tapinanthus dodoneifolius</i>	Measles	x		
Tem de Koubéou	<i>Tapinanthus globiferus</i>	Measles	x		
Tem de Tanyon	<i>Tapinanthus voltensis</i>	Measles	x		
Tibirkiti. Poonle	<i>Ximenia americana</i>	Anemia, Wound		x	
Ongakago	<i>Ziziphus abyssinica</i>	Diarrhea, Bellyache, Typhoid	x		x
Palaconam. Ngorendibo	<i>Ziziphus mucronata</i>	Wound, Bellyache	x	x	
Chiokhadji	Unspecified	Malaria, Diarrhea, Constipation		x	
Gang	Unspecified	Sexual weakness		x	
Kirimfiyal	Unspecified	Typhoid, Malaria			x
Ouwao	Unspecified	Hemorrhoid			x

(11 species) and Apiaceae (8 species).

The used parts of plants

Among the used organs of plants, roots (39 %) constitute the most used parts followed by barks of plants (37 %) (Figure 7).

This result confirms that of Adomou et al. (2012) in Benin who reported that the most used parts of plants are leafed stalks (67 %), roots (15 %) and barks (7 %). However, it is different from that obtained by Benlamdini et al. (2014) who mention that the most used parts of plant are the leaves (44.28 %), the whole plant (16.12 %) and seeds (13.19 %).

The frequency of high use of roots and/or barks can be explained by the fact that they are available at any time. Yet, certain parts of plants as leafed stalks, seeds, fruits, leaves and bulbs are present only in a certain period of the year.

Nevertheless, the picking of these organs is disorderly made by the local users who tend to extract the whole plant instead of being only interested in the desired part. Consequently, this practice can contribute to the

deforestation and to the degradation of the ecosystem and the natural resources.

Various methods of preparing of medicinal plants

Various therapeutic practices are used by the local population as decoction, maceration and infusion. The technic of maceration is the most frequent mode of preparation (45 %) used by the population around Lake Iro (Figure 8). It is followed by the decoction and by the infusion of powder (22 % and 20 % respectively). These results are different from those obtained by Dibong et al. (2011) who report that in three markets of Douala in Cameroon, the decoction, the infusion and the maceration are respectively the most used methods of preparation of medicinal plants.

According to Dexteint (1984), the best use of a plant would be the one which would protect all the properties of this plant and it will allow in the same time, the extraction and the assimilation of active ingredients.

The maceration of powder consists to soak this powder in a liquid at the room temperature (especially water) for a period of time. This method of extraction does not allow

Table 3 Frequency of use of medicinal plants in the sites investigated (Lake Iro area)

Local Name (Goula.Sara goula et Arabe)	Scientific Name	Family	Frequency (%)
Falaa. Garate	<i>Acacia nilotica</i> var. <i>nilotica</i>	Mimosaceae	42.85
Toli	<i>Albizia lebbek</i>	Mimosaceae	28.57
Toum	<i>Allium sativum</i>	Liliaceae	42.85
Porio	<i>Annona senegalensis</i>	Annonaceae	28.57
Kabo	<i>Balanites aegyptiaca</i>	Balanitaceae	42.85
Naba. Kulkul	<i>Bauhinia rufescens</i>	Caesalpiniaceae	28.57
Ara. Millesse	<i>Bridelia ferruginea</i>	Euphorbiaceae	28.57
Mordon. Kiringne	<i>Capparis tomentosa</i>	Capparidaceae	28.57
Thiome. Kidjékété. Aboumkachoye	<i>Cassia javanica</i>	Caesalpiniaceae	71.42
Kakamaza	<i>Cassia nigricans</i>	Caesalpiniaceae	42.85
Fourou	<i>Combretum collinum</i>	Combretaceae	42.85
Koubéou	<i>Combretum glutinosum</i>	Combretaceae	28.57
Moyon	<i>Crossopteryx febrifuga</i>	Rubiaceae	28.57
Poutora	<i>Cucumis metuliferus</i>	Cucurbitaceae	42.85
Foum	<i>Ficus platyphylla</i>	Moraceae	42.85
Tayam	<i>Hymenocardia acida</i>	Hymenocardiaceae	28.57
Fidjo	<i>Khaya senegalensis</i>	Meliaceae	42.85
Atoulum. Ougou	<i>Kigelia Africana</i>	Bignoniaceae	28.57
Hil ou Hel	<i>Lannea</i> sp.	Anacardiaceae	71.42
Aloum	<i>Moringa oleifera</i>	Moringaceae	42.85
Feletaon. Ngoudja	<i>Nauclea latifolia</i>	Rubiaceae	71.42
Doukoun	<i>Penisetum thyphoides</i>	Poaceae	28.57
Kamor. Nari. Kardja-kardja	<i>Phyllanthus reticulatus</i>	Euphorbiaceae	100
Kayame. Robé	<i>Sclerocarya birrea</i>	Anacardiaceae	28.57
Fala. Klamar	<i>Securidaca longepedunculata</i>	Polygalaceae	42.85
Faam	<i>Sterculia setigera</i>	Sterculiaceae	42.85
Paindoc. Koutourou	<i>Stereospermum kunthianum</i>	Bignoniaceae	28.57
Himboyle	<i>Strychnos spinosa</i>	Loganiaceae	28.57
Mal	<i>Tamarindus indica</i>	Caesalpiniaceae	42.85
Tem de Toma	<i>Tapinanthus dodoneifolius</i>	Loranthaceae	42.85
Tem de Koubéou	<i>Tapinanthus globiferus</i>	Loranthaceae	42.85
Tem de Tanyon	<i>Tapinanthus voltensis</i>	Loranthaceae	42.85
Tibirkiti. Poonle	<i>Ximenia Americana</i>	Olcaceae	28.57
Ongakago	<i>Ziziphus abyssinica</i>	Rhamnaceae	71.42
Palaconam. Ngorendibo	<i>Ziziphus mucronata</i>	Rhamnaceae	71.42
Chiokhadji	Unspecified		28.57
Gang	Unspecified		28.57
Kirimfiyal	Unspecified		28.57
Ouwao	Unspecified		28.57

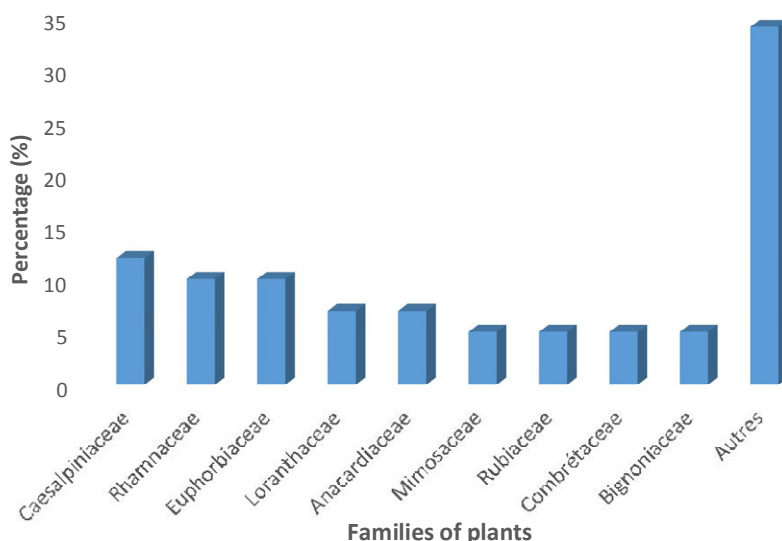


Figure 5 Percentage of the families of medicinal plants

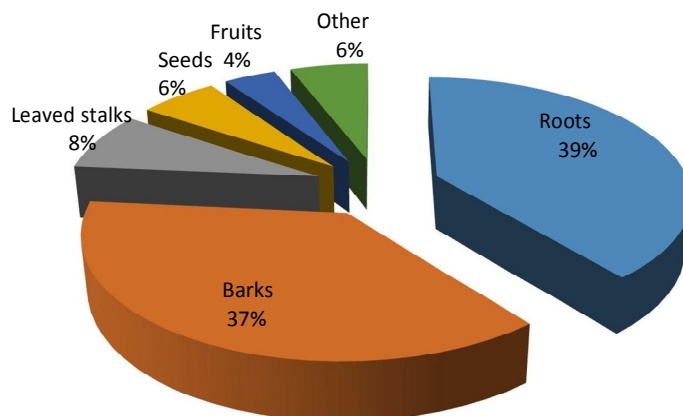


Figure 6 Various used parts of medicinal plants

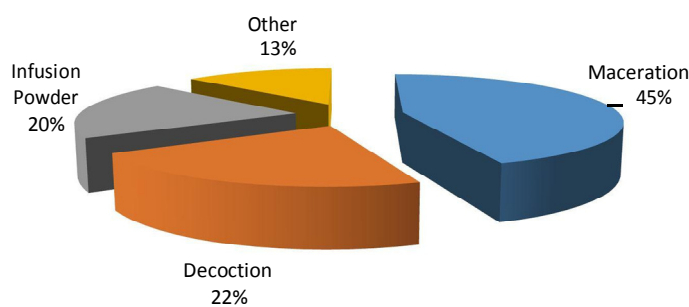


Figure 7 Percentage of various methods of preparing of medicinal plants

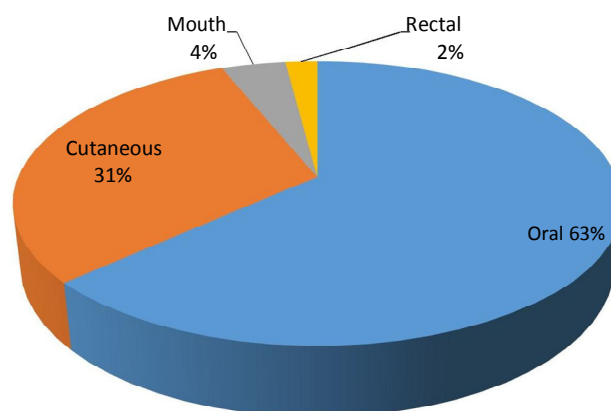


Figure 8 Percentage of various administration ways of medicinal plants

canceling the toxic effect of certain plants. Therefore, the decoction which involves heating of plants will allow to disinfect and destroying the main toxic effect of plants. Furthermore, medicinal plants have undesirable effects when they are practiced in an incorrect way by the patients. For that purpose, the alternative medicine has to practice with caution and very precise measures.

Methods of administration of medicinal plants

Various ways are used by the local population such as cutaneous, oral and rectal route. The oral route is the most frequent mode of administration (63 %) in this area of Lake Iro. It is followed by the cutaneous way (31 %) and the rectal route (2%) is the least used way (Figure 9).

The exploitation of medicinal plants is a regular and permanent activity which requires a good knowledge of the rules of exploitation and sustainable management of

the traditional Doctors and the consumers.

Various diseases treated by medicinal plants in Lake Iro area

The ethnobotanic analysis of the collected information allowed to list 24 diseases treated by medicinal plants. The results show that the majority of medicinal plants used in this region intervene mainly in the treatment of diarrhea with a percentage of 12 % followed by bellyache with 10 %. The malaria which is most frequent in this part of Chad is treated with 7 % of medicinal plants.

The spectrum of the listed diseases in this region reflects the pattern of the current diseases on the national and local level which shows that the diarrhea, the bellyache and the malaria remain the most frequent diseases in the Chad. In Africa in general, the diseases such as the diarrhea, the malaria and the pneumonia constitute the major causes of the infant mortality (Black et al., 2010).

CONCLUSION

The main target of this study was to list the medicinal plants used by the renowned traditional doctors to treat population around the lake Iro region. In the term of our investigations, we noticed that the populations of this area exploit a diversity of medicinal plants for their medical care. The floral analysis of the results obtained by this study allowed to list in total 39 medicinal plants. The most dominant families are Caesalpiniaceae. So, the obtained results showed that roots constitute the parts of plant the most used with a percentage of 39 %. The maceration of powder in the aqueous shape is the most frequent mode of preparation (45 %) and the oral route is the mode of administration the most used (63 %).

The most treated diseases are the diarrhea, the bellyache and the malaria. Therefore, the production and the valuation of medicinal plants as well as the rationalization of the harvest of these plants are imperative now to protect and reduce the pressure on these plants which have a big socioeconomic interest.

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