

*Full Length Research Paper*

# Non-Wood Forest Products in the Far North Region of Cameroon: A Survey of Medicinal Plants in Kousséri Market

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An ethnobotanical survey was conducted in June 2005 among sellers of non wood forest products settled at the Kousséri market, Kousséri sub-division, Logone et Chari division, far north region of Cameroon. A total of 29 medicinal plants were recorded comprising 26 genera and 21 families. Malaria, diarrhoea, jaundice, fever, and hernia were the major ailments in terms of the number of references made by these sellers. There are considerable differences among different sellers in the prices per gram of the same plant species used for the same ailment. Hence, it is not meaningful to link the relative importance of plants to their selling price. An index of performance (*Ip*) is proposed for each plant species, based on its number of references and according to an arbitrary scale which ranges from 0 to 3. Some plants significantly used (*Ip* > 0) for treating certain ailments are widely used in other African countries in a similar way. There are also plants of which their effectiveness is confirmed in the literature to possess biological activity related to the ailments indicated. Data recorded at the Kousséri market were compared to those gathered on medicinal plants used by people living around the Kalamaloué national park, located in the same sub-division, 10 km from Kousséri.

**Key words:** Non wood forest products, medicinal plants, performance index (*Ip*), sellers, Kousséri market.

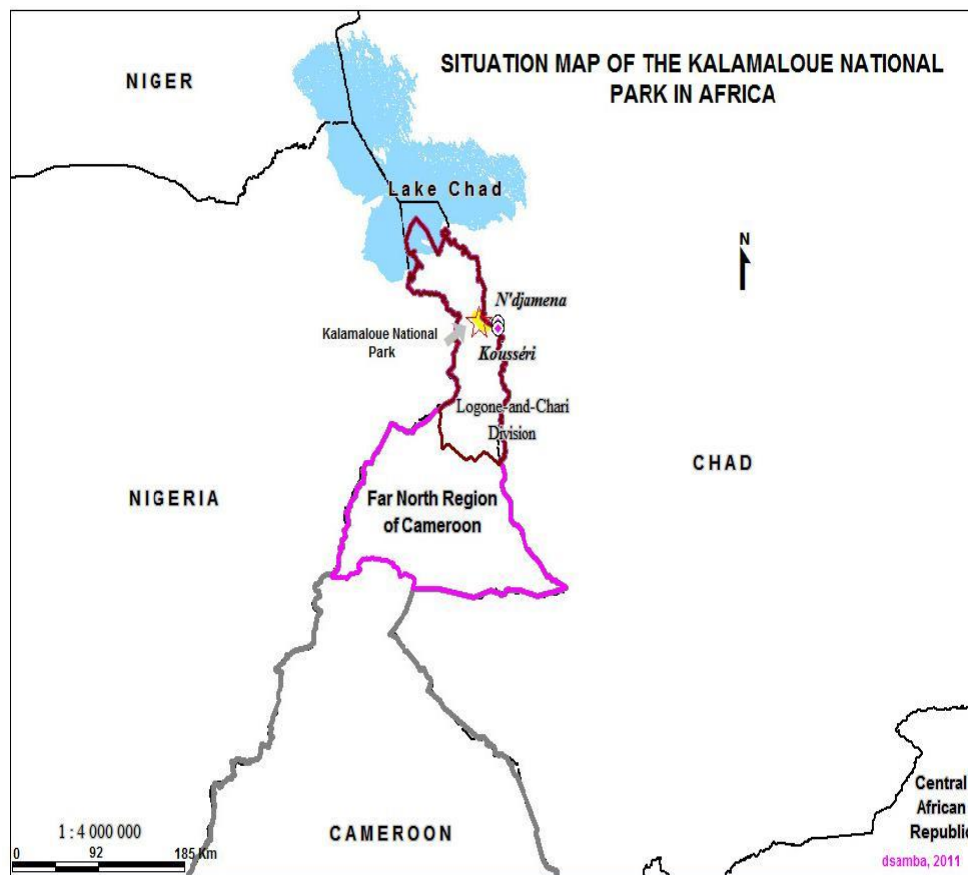
## INTRODUCTION

A product is anything obtained as a result of some operation work, as by generation, growth, labour, study, or skill (Lund, 1998). According to the Food and Agriculture Organisation of United Nations (FAO, 1995), Non wood forest products (NWFPs) include goods of biological origin other than wood, derived from forests, other wooded lands and trees outside forests. The products include the use of plants for food, beverages, forage, fuel and medicine, animals, birds, reptiles and fishes for food, fur and feathers, and their products such as honey, lac, silk, and services of forests for conservation and recreation. Excluded are industrial round wood, timber and all other potential wood products, wood used for energy,

horticultural and livestock products. However, there are emerging areas such as energy sources, including biofuels, which fall in the category of NWFPs and should be considered. NWFPs may be extracted from natural ecosystems, managed plantations, etc., and be utilised within the household (subsistence use), be marketed (commercial and or industrial use), or have social, cultural or religious significance'. From the marketing point of view, NWFPs represent one of the most challenging product groups because of their number, versatility, end-use variation, dissimilarities of the producer base and resource richness.

Some 80% of the population of the developing world depend on NWFPs for their primary health and nutritional needs. Several millions of tribal people all over the world depend on these products for meeting their subsistence consumption and income needs (WHO, 1983; Sofowora,

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**Figure 1.** Kalamaloué national park in Africa.

1996; FAO, 1995). In many countries NWFPs form an important component of forest products exports. It is paradoxical that, in spite of their real and potential value, most NWFPs remain grouped as minor products of forests. These products rarely feature in statistics and are hardly studied or researched. Most NWFPs are often associated with traditional uses that are not widely known and/or they are linked to the problem of poverty and subsistence.

Deforestation in the tropics accelerated in the early 1980s and timber exploitation practices began to be perceived as overly destructive. Gradually, more emphasis was given to the interests of forest-dependent people in developing countries and to the importance of forest products other than timber. The sustainable use of a broader range of forest plant and animal species was receiving more attention, particularly from nature conservation agencies as a way of mitigating deforestation, while at the same time increasing people's income.

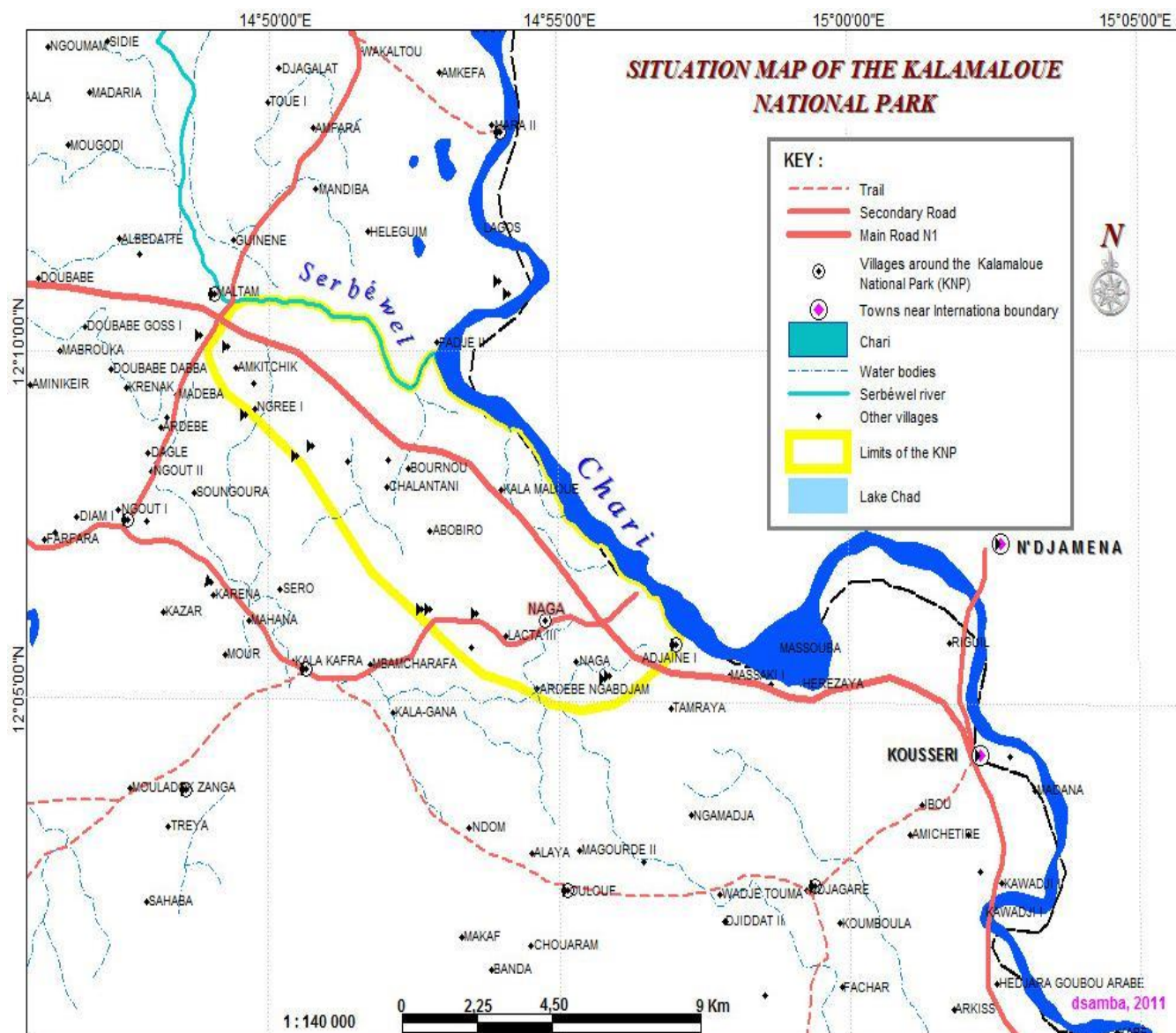
One of the ways of measuring the impact of people pressure on forest resources is to evaluate products that arrive in the local or regional markets. This paper lists medicinal plants sold at the Kousséri market in the far

north region of Cameroon, analyses their relative importance, and examines their link with the Kalamaloué National Park located at 10 km from the Kousséri City based on previous studies.

## **MATERIALS AND METHODS**

### **The study site**

The Kousséri City is located in the far north region of Cameroon, in the Logon and Chari division, and in the Kousséri subdivision to be précised (Figure 1). The Kousséri City is situated at 12°07' latitude north and 15°03' longitude East, at an average altitude of 276 m. The Kousséri City is situated in the limit between Cameroon and the Republic of Chad, at about 7 km from N'djamena, the political capital of Chad. Kousséri is also the city which is more closed to the Kalamaloué National Park (4 500 ha), at 10 km to be précised (Figure 2). The climate is the soudano sahelian type and is characterized by a long dry season (October to May) and a short rainy season (June to September). Annual rainfall are weak and irregular; varying from 230 to 700 mm, with an average of 529 mm. The temperature varies from 21.7 to 35.7°C with an average of 28.4°C. Both Kousséri and Kalamaloué belong to the domain of the lac Chad floor. The surrounding vegetation corresponds to a typical Sudano-sahelian type constituted with shrubby and arbustive steppes. The major ethnic groups include: Arab-choa, Bornoa,



**Figure 2.** Situation of the Kalamaloué national park in the Logone and Chari division, far north region of Cameroon.

Kotoko, Mandara from Cameroon and Kaninsou people who come from Chad. They practise agriculture, livestock farming, and fishing (Letouzey, 1968).

### Ethnobotanical survey

An ethnobotanical survey was conducted in June 2005 in the Kousséri market. As a subdivision, there is only one market in the Kousséri City and all sellers found in that market accepted to collaborate. The survey aimed at identifying plant parts which were sold at the market for their medicinal purpose. For this study, Kousséri, the sub-divisional capital, is suitable than Maroua, the regional capital of the far north region, because of its location close to the Kalamaloué National Park and because a previous ethnobotanical study of medicinal plants were conducted among villages based in the periphery of that park (Betti and Mebere, in

press). Kousséri, situated at 10 km from Kalamaloué is considered as the principal centre of trade for NWFPs harvested in the Kalamaloué National Park. The data collected among sellers can easily be compared with those recorded among people living around the park.

Directed interviews were used with each seller. For any plant species sold at the market, the vernacular names of the plant and the name and ethnic group of the seller were recorded. Then we asked the seller questions concerning plant parts used and their therapeutic indication. These indications (therapeutic statements or ailments or judgements) were made on a specific disease, a symptom or a physiological effect. The plant parts were then weighed and the prices were recorded. We bought one sample of the plant parts for information set and from each seller. The plants were identified at the herbarium of the Wildlife School of Garoua, Cameroon. To classify the data according to the world system, the ailments were grouped according to the classification proposed by

the World Health Organisation and adapted by the African Unity Organisation (AUO) for the Cameroonian pharmacopoeia (Adjahoun et al., 1996).

### Performance index of medicinal plants

In ethnobotanical surveys, informants (traditional healers or sellers) use to cite many plant species in the treatment of many ailments. Some of those citations may be false. The problem therefore is to find among many plants and ailments cited, which are really used by the healer/seller. In this paper, the performance index ( $lp$ ) designates for each ailment cited, the plant species that is "significantly used" among author plant species cited for the same ailment. "Significantly used" means that the traditional usage of the plant species indicated is valid, nothing with the efficiency in terms of active compounds. This index has been used with success for medicinal plants sold in Yaoundé markets (Betti, 2002).

For analysing the data, "specific flora" is defined as the list of plants used for treating a specific ailment, symptom or physiological effect. The "global flora" is defined as the total list of plants recorded in the Kousséri market for all diseases.

For the relationship between the "specific flora" and the "global flora", a null hypothesis is tested, that the "specific flora" for a given disease is randomly selected from the "global flora". The proportion of citations (records) for a specific disease to the total number of citation is considered as a theoretical proportion (P2). This proportion is compared to the proportion of observed number of citations of a plant for a specific disease to the total number of citations for the same plants for all diseases (P1). The difference (D) between the two proportions is then used to define a performance index ( $lp$ ), which ranges from 0 to 3 according to the following scales:

- (1) if  $P1-P2 < 0$ ,  $lp = 0$ : the plants concerned are rejected, not significant;
- (2) if  $0 < P1-P2 \leq 1/3$ ,  $lp = 1$ : average performance;
- (3) if  $1/3 < P1-P2 \leq 2/3$ ,  $lp = 2$ : high performance;
- (4) if  $P1-P2 > 2/3$ ,  $lp = 3$ : very high performance.

The proportions used here are calculated from the ratios of number of citation for diseases. A citation for each record is shown in Table 1. To illustrate this, an example is given for the performance index of a plant, *Tamarindus indica* used in the treatment of fever.

C1 = number of citations of *T. indica* for treating fever = 3;  
C2 = number of citations of *T. indica* in the global list (all ailments) = 13;  
C3 = total number of citations of the fever = 9;  
C4 = total number of citations for all ailments = 124.  
P1 (observed) and P2 (theoretical) are calculated as follows:

$$P1 = C1/C2 = 3/13 = 0.23$$

$$P2 = C3/C4 = 9/124 = 0.07$$

$$D = P1-P2 = 0.23-0.07 = 0.16$$

$P1-P2 = 0.16 < 1/3$ , therefore  $lp = 1$ , which denotes an average performance

## RESULTS

### Sample

A total of 124 citations were prescribed by 25 sellers of medicinal plants at the Kousséri market (Table 1).

The sellers have an average of 46 years old (Table 2)

and belong to five ethnic groups including: Arab-choa (7 sellers), Bornoa (4), Kaninsou (3), Kotoko (6), Mandara (5).

### Relative importance of ailments

From this survey, a total of 29 medicinal plants were prescribed in the treatment of 34 ailments. The importance of each ailment is evaluated based on the number of citations made by the sellers. The 34 ailments recorded are classified into 13 broad categories as shown in Table

3. Digestive system (27.4% of citations), specific symptoms (23.4%), parasitic diseases (10.5%), cardio vascular system (8.8%), and specific diseases and conditions (8%) are in this order, the most cited ailment groups by sellers settled at the Kousséri market. Intestinal helminthiasis (9.7% of the citations), malaria (8%), diarrhoea (8%), jaundice (7.2%), fever (7.2%), and hernia (6.4%) were frequently mentioned by the sellers.

### Plant parts cited

A total of 7 plant parts were recorded including fruits, leaves, latex/sap, roots, seeds, stem barks, and woods. Stem barks (42.7%), fruits (26.6%), and roots (20.9%) are the most cited plant parts (Figure 3).

### Relative importance of plant species

#### Prices per gram

Table 1 shows the 124 citations of medicinal plants collected at Kousséri market with their respective unit prices. There are considerable differences among different sellers in the prices per gram of the same plant species used for the same ailment. Table 4 shows the quantity of plant parts in gram, the total price and the price for a gram for each plant species (NB 1 USD = 485.33 FCFA). In all, 6.926 kg of plant medicine was bought for the price of 15 475 FCFA. This gives an average price of 2.23 FCFA per gram. The fruit of *Hyphaene thebaica* was the most sold (1.073 kg) in quantitative terms, followed by stem bark of *Ochna rhizomatosa* (0.62 kg) and fruits, leaves and roots of *T. indica* (0.61 kg). The fruits of *Swartzia madagascariensis* was the most expensive (27.78 FCFA per gram), followed by the stem barks of *Sterculia setigera* (20 FCFA per gram) and *Daniella oliveri* (14.29 FCFA per gram).

### Index of performance

The 29 medicinal plant species cited comprise 26 genera and 21 botanical families. The Caesalpiniaceae family is

**Table 1.** Citations of medicinal plants in the Kousséri market.

Scientific name	Code of the seller	Plant part	Ailment	Quantity (gram)	Price of buying (FCFA)	Price of the gram (FCFA)
<i>Acacia nilotica</i>	Bo2	Fruit	Fever	63	25	0.40
<i>Acacia nilotica</i>	Bo2	Fruit	HAIDS	63	25	0.40
<i>Acacia nilotica</i>	Bo2	Fruit	Toothache	63	25	0.40
<i>Acacia nilotica</i>	Bo2	Fruit	Wound	63	25	0.40
<i>Acacia nilotica</i>	Bo3	Fruit	Diarrhoea	63	25	0.40
<i>Acacia nilotica</i>	Ka1	Fruit	Diarrhoea	70	25	0.36
<i>Acacia nilotica</i>	Ka1	Fruit	Ear pain	70	25	0.36
<i>Allium cepa</i>	Ko3	Fruit	Vomiting			#DIV/0!
<i>Balanites aegyptiaca</i>	Ko2	Seed	Diarrhoea	49	50	1.02
<i>Balanites aegyptiaca</i>	Ko3	Seed	Gastritis	97	25	0.26
<i>Balanites aegyptiaca</i>	Cha1	Seed	Intestinal helminthiasis	49	50	1.02
<i>Boswellia dalzielii</i>	Ma4	Stem bark	Hernia	75	150	2.00
<i>Boswellia dalzielii</i>	Ma4	Stem bark	Intestinal helminthiasis	75	150	2.00
<i>Boswellia papyrifera</i>	Bo1	Latex/sap	Diarrhoea	20	50	2.50
<i>Boswellia papyrifera</i>	Bo1	Latex/sap	Lumbago	20	50	2.50
<i>Boswellia papyrifera</i>	Ma1	Stem bark	Fœtal malposition	25	50	2.00
<i>Boswellia papyrifera</i>	Ma1	Stem bark	Hernia	25	50	2.00
<i>Boswellia papyrifera</i>	Ma1	Stem bark	Intestinal helminthiasis	25	50	2.00
<i>Boswellia papyrifera</i>	Ma1	Stem bark	Malaria	25	50	2.00
<i>Boswellia papyrifera</i>	Ma3	Root	Diarrhoea			#DIV/0!
<i>Boswellia papyrifera</i>	Ma3	Root	Jaundice			#DIV/0!
<i>Boswellia papyrifera</i>	Ma3	Root	Asthenia			#DIV/0!
<i>Boswellia papyrifera</i>	Ma4	Stem bark	Fever	75	150	2.00
<i>Boswellia papyrifera</i>	Ma5	Stem bark	Fever	21	250	11.90
<i>Capsicum frutescens</i>	Ko6	Fruit	Fever			#DIV/0!
<i>Capsicum frutescens</i>	Bo1	Fruit	Diarrhoea			#DIV/0!
<i>Capsicum frutescens</i>	Bo1	Fruit	Intestinal helminthiasis			#DIV/0!
<i>Capsicum frutescens</i>	Ko3	Fruit	Fever			#DIV/0!
<i>Capsicum frutescens</i>	Ko3	Fruit	Vomiting			#DIV/0!
<i>Cassia sieberiana</i>	Ma1	Stem bark	Hernia	52	200	3.85
<i>Cassia sieberiana</i>	Ma1	Stem bark	Intestinal helminthiasis	52	200	3.85
<i>Cassia sieberiana</i>	Ma1	Stem bark	Malaria	52	200	3.85
<i>Cassia sieberiana</i>	Ma2	Stem bark	Jaundice	38		0.00
<i>Cassia sieberiana</i>	Ma3	Root	Diarrhoea			#DIV/0!
<i>Cassia sieberiana</i>	Ma3	Root	Jaundice			#DIV/0!
<i>Cassia sieberiana</i>	Ma3	Root	Asthenia			#DIV/0!
<i>Cassia sieberiana</i>	Ma5	Stem bark	Anorexia	34	300	8.82
<i>Cassia sieberiana</i>	Ma5	Stem bark	Intestinal helminthiasis	34	300	8.82
<i>Cassia sieberiana</i>	Ma5	Stem bark	Lumbago	34	300	8.82
<i>Cassia sieberiana</i>	Ma5	Stem bark	Malaria	34	300	8.82
<i>Cassia sieberiana</i>	Ma5	Stem bark	Asthenia	34	300	8.82
<i>Celtis toka</i>	Ma1	Stem bark	Hernia	96	300	3.13
<i>Celtis toka</i>	Ma1	Stem bark	Intestinal helminthiasis	96	300	3.13
<i>Celtis toka</i>	Ma1	Stem bark	Malaria	96	300	3.13
<i>Daniellia oliveri</i>	Ma4	Stem bark	Sorcery	70	1000	14.29
<i>Detarium microcarpum</i>	Bo1	Fruit	Intestinal helminthiasis	95	25	0.26
<i>Ficus sur</i>	Ma2	Stem bark	Good luck charm	110		0.00
<i>Ficus sur</i>	Ma4	Stem bark	Good luck charm	28	200	7.14
<i>Ficus sur</i>	Ma4	Stem bark	Scabies	2	200	100.00
<i>Hyphaene thebaica</i>	Ar2	Fruit	Blood pressure	130	25	0.19



Table 1. Contd.

<i>Hyphaene thebaica</i>	Ar2	Fruit	Palpitation	130	25	0.19
<i>Hyphaene thebaica</i>	Ar3	Fruit	Dizziness	79	25	0.32
<i>Hyphaene thebaica</i>	Ar6	Fruit	Blood pressure	150	25	0.17
<i>Hyphaene thebaica</i>	Ar6	Fruit	Palpitation	150	25	0.17
<i>Hyphaene thebaica</i>	Ko1	Fruit	Blood pressure	120	25	0.21
<i>Hyphaene thebaica</i>	Ko1	Fruit	Dizziness	120	25	0.21
<i>Hyphaene thebaica</i>	Ko4	Fruit	Blood pressure	97	25	0.26
<i>Hyphaene thebaica</i>	Ko4	Fruit	Dizziness	97	25	0.26
<i>Khaya senegalensis</i>	Ma5	Stem bark	Haemorrhoid	37	150	4.05
<i>Leptadenia hastata</i>	Ma2	Root	Scabies	15		0.00
<i>Lonchocarpus laxiflorus</i>	Ma1	Stem bark	Hernia	67	150	2.24
<i>Lonchocarpus laxiflorus</i>	Ma1	Stem bark	Intestinal helminthiasis	67	150	2.24
<i>Lonchocarpus laxiflorus</i>	Ma1	Stem bark	Malaria	67	150	2.24
<i>Lonchocarpus laxiflorus</i>	Ma1	Stem bark	Rheumatism	67	150	2.24
<i>Mitragyna inermis</i>	Ko5	Leaf	Fever	200	100	0.50
<i>Ochna rhizomatosa</i>	Ma1	Stem bark	Hernia	97	200	2.06
<i>Ochna rhizomatosa</i>	Ma1	Stem bark	Intestinal helminthiasis	97	200	2.06
<i>Ochna rhizomatosa</i>	Ma1	Stem bark	Jaundice	97	200	2.06
<i>Ochna rhizomatosa</i>	Ma1	Stem bark	Malaria	97	200	2.06
<i>Ochna rhizomatosa</i>	Ma2	Stem bark	Jaundice	65		0.00
<i>Ochna rhizomatosa</i>	Ma4	Stem bark	Jaundice	37	500	13.51
<i>Ochna rhizomatosa</i>	Ma4	Stem bark	Malaria	37	500	13.51
<i>Ochna rhizomatosa</i>	Ma4	Stem bark	Wound	37	500	13.51
<i>Ochna rhizomatosa</i>	Ma5	Stem bark	Jaundice	90	200	2.22
<i>Piliostigma reticulatum</i>	Ma1	Root	Headache	54	100	1.85
<i>Piliostigma reticulatum</i>	Ma1	Root	Hernia	54	100	1.85
<i>Piliostigma reticulatum</i>	Ma1	Root	Intestinal helminthiasis	54	100	1.85
<i>Piliostigma reticulatum</i>	Ma1	Root	Malaria	54	100	1.85
<i>Piliostigma reticulatum</i>	Ma1	Root	Palpitation	54	100	1.85
<i>Piliostigma reticulatum</i>	Ma2	Root	Diarrhoea	92		0.00
<i>Piliostigma reticulatum</i>	Ma5	Stem bark	Jaundice	65	250	3.85
<i>Salvadora persica</i>	Ka1	Root	Tooth stick	12	25	2.08
<i>Salvadora persica</i>	Ka2	Root	Tooth stick	15	25	1.67
<i>Sclerocarya birrea</i>	Ma1	Stem bark	Hernia	6	50	8.33
<i>Sclerocarya birrea</i>	Ma1	Stem bark	Intestinal helminthiasis	6	50	8.33
<i>Sclerocarya birrea</i>	Ma1	Stem bark	Lumbago	6	50	8.33
<i>Sclerocarya birrea</i>	Ma1	Stem bark	Malaria	6	50	8.33
<i>Sclerocarya birrea</i>	Ma2	Stem bark	Good luck charm	53		0.00
<i>Sclerocarya birrea</i>	Ma4	Stem bark	Long period	25	100	4.00
<i>Sclerocarya birrea</i>	Ma4	Stem bark	Scabies	25	100	4.00
<i>Sclerocarya birrea</i>	Ma5	Stem bark	Anaemia	79	200	2.53
<i>Securidaca longipedunculata</i>	Bo1	Stem bark	Diabetes	10	50	5.00
<i>Securidaca longipedunculata</i>	Bo1	Stem bark	Dizziness	10	50	5.00
<i>Securidaca longipedunculata</i>	Bo4	Stem bark	Diabetes	7	50	7.14
<i>Securidaca longipedunculata</i>	Bo4	Stem bark	Dizziness	7	50	7.14
<i>Securidaca longipedunculata</i>	Ma1	Root	Headache	96	300	3.13
<i>Securidaca longipedunculata</i>	Ma2	Root	Headache	120	1000	8.33
<i>Securidaca longipedunculata</i>	Ma2	Root	Sorcery	120	1000	8.33
<i>Securidaca longipedunculata</i>	Ma4	Root	Headache	23	200	8.70
<i>Securidaca longipedunculata</i>	Ma4	Root	Sorcery	23	200	8.70
<i>Sterculia setigera</i>	Ma5	Stem bark	Diarrhoea	30	600	20.00
<i>stereospermum kunthianum</i>	Ma4	Stem bark	Knee pain	27	150	5.56

Table 1. Contd.

<i>Swartzia madagascariensis</i>	Ma4	Fruit	Lumbago	9	250	27.78
<i>Swartzia madagascariensis</i>	Ma4	Fruit	Thyphoenteritis	9	250	27.78
<i>Tamarindus indica</i>	Ar1	Fruit	Gastritis	60	25	0.42
<i>Tamarindus indica</i>	Ar4	Fruit	Gastritis	70	25	0.36
<i>Tamarindus indica</i>	Ar4	Leaf	Fever	70	25	0.36
<i>Tamarindus indica</i>	Ar5	Root	Gonorrhoea	70	50	0.71
<i>Tamarindus indica</i>	Ar5	Root	Haemorrhoid	70	50	0.71
<i>Tamarindus indica</i>	Ko3	Leaf	Anorexia			#DIV/0!
<i>Tamarindus indica</i>	Ko3	Fruit	Fever	98	25	0.26
<i>Tamarindus indica</i>	Ko3	Leaf	Malaria			#DIV/0!
<i>Tamarindus indica</i>	Ko3	Fruit	Vomiting	98	25	0.26
<i>Tamarindus indica</i>	Ko6	Fruit	Fever	82	25	0.30
<i>Tamarindus indica</i>	Ma3	Fruit	Diarrhoea			#DIV/0!
<i>Tamarindus indica</i>	Ma3	Fruit	Jaundice			#DIV/0!
<i>Tamarindus indica</i>	Ma3	Fruit	Asthenia			#DIV/0!
<i>Terminalia avicennioides</i>	Ar7	Wood	Bad spirits	350	100	0.29
<i>Terminalia macroptera</i>	Ar7	Wood	Bad spirits	350	100	0.29
<i>Ziziphus mucronata</i>	Ar5	Root	Gonorrhoea	70	50	0.71
<i>Ziziphus mucronata</i>	Ar5	Root	Haemorrhoid	70	50	0.71
<i>Ziziphus spina-christi</i>	Ar5	Root	Gonorrhoea	70	50	0.71
<i>Ziziphus spina-christi</i>	Ar5	Root	Haemorrhoid	70	50	0.71
<i>Ziziphus spina-christi</i>	Bo1	Wood	Flu			#DIV/0!
Total				6926	15475	#DIV/0!

Code of the seller: the two first letters designate the initial of the ethnic group, Ar = Arab-choa; Bo = Bornoa; Ka = Kaninsou; Ko = Kotoko; Ma = Mandara. The number designates the order number of the seller in a given ethnic group. 1 USD = 485.33 FCFA.

more represented with six species and 29% of citations. Table 5 shows the plant species collected, with their performance index for a specific disease. For example, among the ten plant species cited for treating intestinal helminthiasis at the Kousséri market, *Detarium microcarpum* ( $Ip = 3$ ) and *Boswellia dalzielii* ( $Ip = 2$ ) are considered to be more performant or more significantly used than other plant species.

## DISCUSSION

### Relative importance of ailments

In terms of the number of citations for medicinal uses, the ailments in the digestive system category (Table 3) are most important, followed by the specific symptoms category. In the Cameroonian pharmacopoeia report (Adjanohoun et al., 1996), in the survey conducted at the markets of Yaoundé (Betti, 2002), and in the survey conducted around the National Park of Kalamaloué (Betti and Mebere, in press), the digestive ailments and the specific symptoms appear to be the most important groups of ailments to be treated with medicinal plants. Diarrhoea, malaria, fever, and jaundice were the ailments most frequently cited in the Cameroonian pharmacopoeia

report, at the Yaoundé markets and recently in the Kalamaloué National Park (Adjanohoun et al., 1996; Betti, 2002; Betti and Mebere, in press).

### Relative importance of medicinal plants

The average price per gram of medicinal plants sold at the Kousséri market is 2.23 FCFA. This is lower than the 3.24 FCFA obtained with the same method for medicinal plants sold in Yaoundé markets (Betti, 2002). The difference may be link to the fact that Yaoundé is the political capital and a big city of Cameroon, and medicinal plants are more expensive there than in other cities. Even for the same plant species used for the same ailment, the price per gram varied from one seller to another. For example, the price per gram for the stem barks of *Boswellia papyrifera* to treat fever ranged from 2 FCFA at one Mandara seller to 11.9 FCFA at another seller in the same ethnic group. To treat intestinal helminthiasis, price per gram of stem barks of *Cassia sieberiana* ranged from 3.85 to 8.82 FCFA among two sellers of the Mandara ethnic group. The factors influencing these variations are not clear, but it may be due to the manner in which the plant parts are obtained from the local collectors. We conclude that it is not meaningful to link the importance of a plant to its price

**Table 2.** List of sellers of medicinal plants interviewed at the Kousséri market.

Ethnic group	Code of seller	Age
Arabe choa	Ar1	55
	Ar2	43
	Ar3	30
	Ar4	50
	Ar5	17
	Ar6	40
	Ar7	30
Bornoa	Bo1	36
	Bo2	65
	Bo3	29
	Bo4	29
Kaninsou	Ka1	35
	Ka2	30
	Ka3	45
Kotoko	Ko1	55
	Ko2	45
	Ko3	60
	Ko4	43
	Ko5	17
	Ko6	40
Mandara	Ma1	60
	Ma2	59
	Ma3	35
	Ma4	45
	Ma5	42

Code of informant: the two first letters designate the initial of the ethnic group, ar = arab-choa; bo = bornoa; Ka = Kaninsou; ko = kotoko; ma = mandara. The number designates the order number of the informant in a given ethnic group.

in the market. The importance can only be expressed by the performance index ( $lp$ ).

The plants sold at the Kousséri market were compared with the plants used in other parts of Africa, mostly in the same soudano sahelian areas as shown in Table 6. Some plant species which are significantly more frequently used for a specific ailment (with  $lp > 0$ ) are widely known in the literature for their similar usages: *Acacia nilotica* (diarrhoea, toothache), *Allium cepa* (vomiting), *Balanites aegyptiaca* (diarrhoea, Intestinal helminthiasis) or *Piliostigma reticulatum* (diarrhoea, headache, malaria), *Sterculia setigera* (diarrhoea), are some examples of such plant species. There are also plant species with higher performance index ( $lp \geq 2$ ) for specific ailments, which are not yet mentioned elsewhere in the literature for similar usages. For example, *Hyphaene thebaica* is significantly cited ( $lp = 2$ ) by sellers for treating blood pressure. This usage is not yet mentioned in the literature. Same

observations can be made for *Leptadenia hastata* (against scabies), *Ochna rhizomatosa* (jaundice), *Stereospermum kunthianum* (knee pain), *Terminalia avicennioides* (bad spirits) and *Terminalia Macroptera* (bad spirits). Such usages constitute our contribution in ethnobotanical and drugs development researches. Further activities should be conducted to better investigate the efficiency of those usages.

Some plant species significantly more frequently used for a specific ailment (with  $lp > 0$ ) are known in the literature to possess active compounds. For example, *Acacia nilotica* is significantly cited for its usage against diarrhoea. Activities related to the usages are confirmed in the literature (Arbonnier, 2000; Fortin et al., 1990; Pousset, 1989). *Balanites aegyptiaca* is significantly indicated by sellers in the treatment of intestinal helminthiasis; the activity of that plant species against intestinal helminthiasis is confirmed by Watt and Breyer-



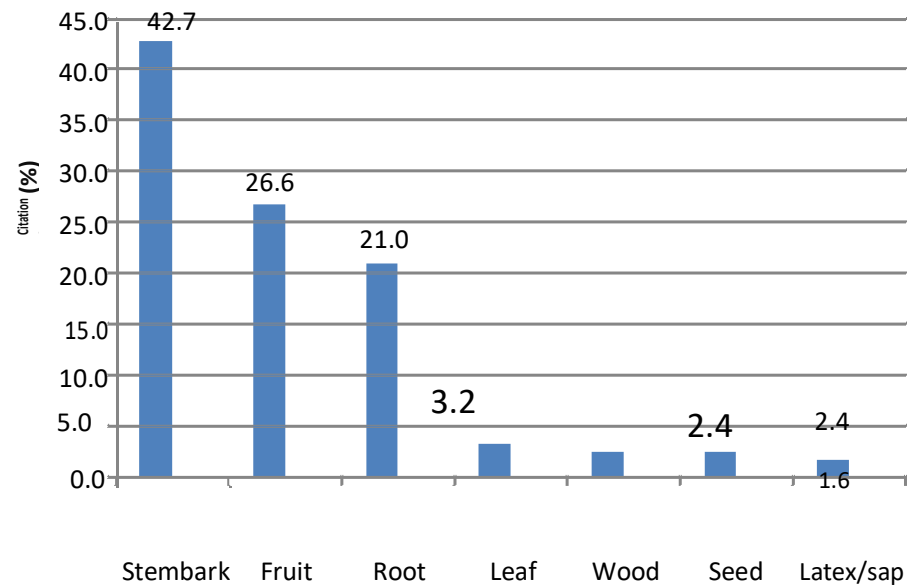
**Table 3.** Citations of ailments and ailment groups by sellers settled at the Kousséri market.

Ailment group	Ailment	Number of citations
Cardiovascular system	Blood pressure	4
	Haemorroid	4
	Palpitation	3
Digestive system	Anorexia (loss of appetite)	2
	Diarrhoea	10
	Gastritis	3
	Intestinal helminthiasis	12
	Thyphoenteritis	1
	Tooth stick	2
	Toothache	1
	Vomiting	3
Directions for medico-magic use	Bad spirits	2
	Good luck charm	3
	Sorcery	3
Ear, nose, and throat	Ear pain	1
Female genital system: obstetrics and gynaecology	Foetal malposition	1
	Long period	1
Infectious diseases	HAIDS	1
Male genito-urinary system	Gonorrhoea	3
Musculo-skeletal system	Knee pain	1
	Lumbago	4
	Rheumatism	1
Nervous system and mental disorders	Dizziness	5
Parasitic diseases (Not digestive system)	Malaria	10
	Scabies	3
Respiratory system	Flu	1
Specific diseases and conditions	Diabetes	2
	Hernia	8
Specific symptoms	Anaemia	1
	Asthenia	4
	Fever	9
	Headache	4
	Jaundice	9
	Wound	2
Total number of citations		124

Brandwijk (1962) and by Kerharo and Adam (1974). Pousset (1989) noted that *B. aegyptiaca* was not active against bacteria. *Securidaca longipedunculata* is significantly used for treating headache. This usage can be link to the anti-inflammatory properties discovered from that plant species. *T. indica* is cited for treating diarrhea and malaria. The usage against diarrhea is confirmed by

Pamplona (1999), whereas Kerharo and Adam (1974) found no anti malarial activity from that plant species.

One of the objectives of this paper was to compare the usage of medicinal plants sold at the Kousséri market with medicinal plants used by people living in the periphery of the Kalamaloué National Park, located at 10 km of the city of Kousséri. Hence, twelve out of the 29 plant species



**Figure 3.** Relative importance of plant parts cited by sellers of medicinal plants in the Kousséri market, far north region of Cameroon.

**Table 4.** List of medicinal plants sold in the Kousséri market with their prices.

Plant species	Family	Arabic name	Quantity (gram)	Price of buying (FCFA)	Price of the gram (FCFA)
<i>Acacia nilotica</i> (L.) Willd. ex Del.	Mimosaceae	Garad	455	175	2.70
<i>Allium cepa</i> L.	Liliaceae	Oignon			
<i>Balanites aegyptiaca</i> (L.) Del.	Balanitaceae	Kernaka	195	125	2.30
<i>Boswellia dalzielii</i> Hutch.	Burseraceae	Ararabi	150	300	4
<i>Boswellia papyrifera</i>	Burseraceae	Gashilla	236	700	2.97
<i>Capsicum frutescens</i> L.	Solanaceae	Piment			
<i>Cassia sieberiana</i> DC.	Caesalpiniaceae	Zaya	364	2100	5.77
<i>Celtis toka</i> (Forssk.) Hepper & wood (Syn: <i>C. integrifolia</i> Lam.)	Ulmaceae	Falmaro	288	900	9.38
<i>Daniellia oliveri</i> (Rolfe) Hutch. & Dalz.	Caesalpiniaceae	Lamda	70	1000	14.29
<i>Detarium microcarpum</i> Guill. & Perr.	Caesalpiniaceae	Abulele	95	25	0.26
<i>Ficus sur</i> Forssk. (Syn: <i>F. capensis</i> Thunb.)	Moraceae	Houdaha	140	400	107.14
<i>Hyphaene thebaica</i> (L.) Mart.	Arecaceae	Dom	1073	225	1.97
<i>Khaya senegalensis</i> (Desv.) A. Juss.	Meliaceae	Kahe	37	150	4.05
<i>Leptadenia hastata</i> (Pers.) Decne	Asclepiadaceae	Hagalhadjar	15	0	0.00
<i>Lonchocarpus laxiflorus</i> Guill. & Perr.	Fabaceae	Jomala	268	600	8.96



Table 5. Contd.

<i>Khaya senegalensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
<i>Leptadenia hastata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	1	
<i>Lonchocarpus laxiflorus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	4	
<i>Mitragyna inermis</i>	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
<i>Ochna rhizomatosa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	1	0	0	0	0	0	9	
<i>Piliostigma reticulatum</i>	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	1	1	0	0	0	0	0	7	
<i>Salvadora persica</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	
<i>Sclerocarya birrea</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	1	1	0	0	1	0	0	8	
<i>Securidaca longipedunculata</i>	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	9	
<i>Sterculia setigera</i>	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
<i>stereospermum kunthianum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	
<i>Swartzia madagascariensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	2	
<i>Tamarindus indica</i>	0	1	1	0	0	0	1	0	0	1	0	0	1	1	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	13
<i>Terminalia avicennioides</i>	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
<i>Terminalia macroptera</i>	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
<i>Ziziphus mucronata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
<i>Ziziphus spina-christi</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	
NUMBER OF CITATIONS (C3)	1	2	4	2	4	2	10	5	1	9	1	1	3	3	3	4	1	4	8	12	9	1	1	4	10	3	1	3	3	1	2	124

(41.3%) sold at the Kousséri market are found in the Kalamaloué National Park (Betti and Mebere, in press). Height of the 12 plant species are cited on similar ailments by people living around the park. Following are those plant species with the ailments indicated in brackets: *Acacia nilotica* (diarrhea, ear pain and toothache), *Balanites aegyptiaca* (diarrhoea), *Capsicum frutescens* (fever), *Khaya senegalensis* (haemorrhoid), *Mitragyna inermis* (fever), *Salvadora persica* (tooth stick), *T. indica* (diarrhea, fever, gonorrhoea,

haemorrhoid, malaria), *Ziziphus mucronata* (gonorrhoea, haemorrhoid). The five other plant species are used in Kalamaloué but in different ways. For example, *Sclerocarya birrea* is only cited for treating haemorrhoid whereas at the Kousséri market that plant species is cited for treating height ailments. *Celtis toka* is cited at Kousséri for treating three ailments; at Kalamaloué, the plant is only known as food (Betti and Mebere, 2011). Moreover, it is paradoxical that

*Hyphaene thebaica* and *Ochna rhizomatosa* which are the most sold species in quantitative terms, are not listed among useful plant species of the Kalamaloué National Park located close to the city of Kousséri, and in the same ecological zone (Soudano-sahelian area). Same observation can be made for *Swartzia madagascariensis*, *Sterculia setigera*, and *Daniella oliveri* identified as the most expensive plant species in terms of price per gram. Further investigations should be conducted to assess the availability/endangerment of such plant species in the Kalamaloué National Park. *T. indica* is the only most sold plant in quantitative term at Kousséri market which is also used by people oh the Kalamaloué National Park.

## Conclusion

Through the ethnobotanical survey of medicinal plants conducted among sellers settled at the

Kousséri market, a total of 29 medicinal plants were recorded from 25 sellers of the Arab Choa, Bornoa, Kaninsou, Kotoko, Massa, and Mandara ethnic groups. Linking the relative importance of medicinal plants to their price in the market is not meaningful due to the large variability of the price per gram among plant species, the importance of plants can only be expressed through the performance index. Some plants significantly used (with  $lp > 0$ ), were found to be widely used in other regions of Africa for the same purposes. There are plants in the literature known for their effective properties against certain ailments, which leads credibility to pharmacopoeia used by the sellers found at the Kousséri market. There are also plant species with higher performance index for specific ailments, which are not yet mentioned elsewhere in the literature for similar usages. Further chemical and pharmacological researches should be conducted on such plant species. Height ailments of the 29 plant species

**Table 6.** Use of medicinal plants of sold in the Kousséri market in other African regions.

Plant species	Ailment	References (country/ area)
<i>Acacia nilotica</i>	Toothache	Ar (Wa), Ri (Nga, Ni, Se)
	Diarrhoea	Ar (Wa), Ke (Se), Po (Se), Ri (Ni, Se)
	Wound	Ri (Be, Ni)
<i>Allium cepa</i>	Vomiting	Ri (Be, Nga, To)
<i>Balanites aegyptiaca</i>	Diarrhoea	Ar (Wa)
	Intestinal helminthiasis	Od (Ni), Ri (Ni, Se)
<i>Capsicum frutescens</i>	Fever	Od (Ni)
<i>Cassia sieberiana</i>	Diarrhoea	Ri (Be, Bu, Ci, Se, To)
	Intestinal helminthiasis	Ri (Bu, Se)
<i>Detarium microcarpum</i>	Intestinal infection	Ri (Se, To)
<i>Mitragyna inermis</i>	Fever	Od (Ni), Ri (Bu, Se)
<i>Piliostigma reticulatum</i>	Malaria	Ri (Bu, Se)
	Diarrhoea	Ar (Wa), Ri (Ni, Se)
	Headache	Ar (Wa)
<i>Securidaca longipedunculata</i>	Headache	Ri (Be, Bu, Ni)
	Diabete	Od (Ni)
<i>Sterculia setigera</i>	Diarrhoea	Od (Ni)
<i>Tamarindus indica</i>	Diarrhoea	Ar (Wa), Od (Ni)
	Fever	Od (Ni)
	Jaundice	Ri (Ni, Se, To)
	Malaria	Ar (Wa), Ri (Be, Bu)
<i>Ziziphus mucronata</i>	Gonorhoea	Ri (Bu, Se)

References: Ar: Arbonnier (2000), Ke: Kerharo and Adam (1974), Pa: Pamplona (1999), Od: Odugbemi and Odunayo (2008), Po: Pousset (1989), Ri: Richel (1995). Country/ area: Wa: West Africa, Be: Benin, Bu: Burkina Faso, Ci: Côte d'Ivoire, Nga: Nigeria, Ni: Niger, Se: Senegal, To: Togo.

sold at the Kousséri market are used with similar ailments by people living around the Kalamloué National Park. With the exception of *T. indica*, the other most sold plant species in both quantitative and price per gram terms, are not known by people living around the Kalamoué national park based in the same sub-division. Ecological researches should be conducted to better investigate the availability/endangerment of those plant species inside the Kalamaloué National Park. Also, simple management plans should be developed and implemented for important medicinal plants such as *T. indica* found in the Kalamaloué National Park, in the agro pastoral area to be précised as to ensure a fair participative management of the park with a total involvement of local people.

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