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Ethnopharmacological study of medicinal plants sold in some markets in Haut-Sassandra (Central-West, Côte d'Ivoire)

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Abstract

The Haut-Sassandra region in west-central Côte d'Ivoire provides a significant share of domestic production of food and export products. The local population responsible for this production is generally treated with medicinal plants for various reasons. It became important to know the pathologies affecting this population and the plants used to treat them. Thus, an ethnopharmacological survey was conducted among 100 people in four localities (Daloa, Gonaté, Guessabo and Zoukougbeu). The procedure adopted in this study was a semi-directive interview based on a pre-elaborated questionnaire. The ethnopharmacological fact sheet consists of two main parts. The first relates to socio-demographic information about the respondent. The second part concerns the botanical and pharmacological characteristics of the plants surveyed. The majority of women herbalists (97%) are between 41 and 50 years old. The vast majority of herbalists have no grade level (97%) and 78% are married. The medicinal plants used in Haut-Sassandra, the trees are mostly (76%) and the leaves are the most used organs (51%). The decoction is the most used method (71%) and the drink (45%) dominates the other routes of administration. In addition, malaria treated conditions are the most cited (24.54%). Fifty-three (53) medicinal species were identified belonging to 35 families and that of Rubiaceae is more represented (7.40%). 30% of medicinal plants have various pharmacological properties in the literature. Finally, this study shows that traditional medicine really contributes to the health care of the population and deserves to be accompanied. The identified medicinal plants will guide future research into natural substances for the development of improved traditional medicines.

Keywords: Medicinal plants, Ethnopharmacology, Haut-Sassandra, Côte d'Ivoire

1. Introduction

For centuries and even millennia, man has used plants to relieve pain, heal ailments and heal wounds. From generation to generation, he transmitted simple knowledge and experiences, striving when he could to record them in writing. Thus, even now, despite the progress of modern medicine, the therapeutic use of medicinal plants is very present in some countries of the world and especially in developing countries, in the absence of a modern medical system^[1]. Indeed, there are about 500,000 plant species on earth, of which 80,000 have medicinal properties^[2]. According to the World Health Organization (WHO) in^[3], more than 80 % of the world's population relies on traditional medicine for their primary health care needs^[4]. Several plants can be used in the treatment of many pathologies that range from simple digestive disorders to treatments for chronic diseases such as cancer, ulcer, diabetes, kidney stones^[5-7]. Medicinal plants are a valuable resource for the vast majority of rural populations in Africa, where more than 80 % of this population uses them for health care^[8, 9].

In Côte d'Ivoire, the work carried out on medicinal plants is numerous and varied. This work focused on the pharmacological properties as well as the phytochemical study of plants from the Ivorian pharmacopoeia^[10-12]. These data on medicinal plants have, on the one hand, made it possible to explain their therapeutic action and, on the other hand, to confirm the usefulness of their uses in traditional medicine. However, the region of Daloa, in the Central-West of Côte d'Ivoire, remains poorly studied in terms of the place of traditional medicine in the life of the population. This population faces many recurring diseases and the high cost of health care offered by modern health centers, leads the population to resort to traditional medicine^[13, 14]. These diseases, which can be fatal, are poorly documented and the medicinal plants involved in their treatment are not well known, as the work of Koulibaly *et al.*^[7]. These facts are at the

origin of this investigation which is part of the general objective of the valorisation of medicinal plants from the Ivorian pharmacopoeia. Thus, an ethnopharmacological study of medicinal plants sold in some markets in Haut-Sassandra was carried out with this in mind.

2. Materials and methods

2.1. Type of study

It was an ethnopharmacological survey. It was done through a two-part fact sheet. The first part related to socio-demographic information (age, sex, family status, level of education). The second part related to botanical characteristics (vernacular name, morphological type, preparation of drug recipes).

2.2. Presentation of the study area

Located in central-western Côte d'Ivoire, the Haut-Sassandra region covers an area of 15,205 km². It is limited as follows: to the north, the Worodougou region; to the east, the Marahoué region; to the south, the Fromager and Bas-Sassandra regions; to the west, the Montagnes and Moyen-Cavally regions. The average annual temperature is 26 °C, with average rainfall around 1 276 mm per year ^[15]. This region has many advantages not only for food production, but also for marketing. The Haut-Sassandra region is the country's second-largest cocoa production area and first-largest coffee producer ^[16]. The region presents itself as the second pioneering front in the production of these crops ^[17]. The region is home to the town of Daloa, the capital of the region and the third largest city in the country, which has a large urban population. It contains several ethnic groups representative of the West African sub-region dominated by the Bété indigenous ethnic group. Survey sites included Daloa, Gonaté, Guessabo and Zoukougbeu (Figure 1).

2.3. Fact sheet

The material used in this ethnopharmacological study is a fact sheet with questions that allowed us to collect information about people (tradipraticians, herbalists) and medicinal plants. These plants have been identified at the Laboratory of Agricultural Production Improvement of UFR Agroforestry at the Jean Lorougnon Guédé University of Daloa (Côte d'Ivoire).

2.4. Study population

The people interviewed during our study were herbalists and tradipraticians who were 100. These people gave us socio-demographic and botanical information.

2.5. Methods

The Daloa region contains forests in the mesophilic sector of the Guinean domain, in central-western Côte d'Ivoire. Given that the resultant burden of certain conditions is not only considerable in rural areas, but also in the city ^[18] and that tradipraticians can be found in rural areas as well, as urban or peri-urban ^[19]. Our study method is an ethnopharmacological survey. Reconnaissance and courtesy visits were carried out with respondents in the markets of Daloa, Gonaté, Guessabo and Zoukougbeu with the aim of creating a certain familiarity useful for such a study. The second step was to conduct an ethnopharmacological survey using a questionnaire sheet. The procedure adopted in this study was a semi-directive interview based on a pre-elaborated questionnaire. The ethnopharmacological fact sheet consists of two main parts ^[19]. The first relates to socio-demographic information about

the respondent. The second part concerns the botanical and pharmacological characteristics of the plants surveyed. The survey began on October 27, 2018 and ended on January 28, 2019. It involved 100 people (herbalists, tradipraticians).

2.6. Data processing and analysis

On the basis of the survey sheets, the variables were drawn up, in particular the profile of each respondent (sex, age, level of study, etc.). So, we were able to characterize the traders in our study area. For each plant, the data collected included the vernacular name, scientific name, morphological type, organ used, method of preparation, mode of administration and disease treated. For this study, the Microsoft office 2016 (Word, Excel), basic software for calculations and data entry was used.

3. Results

3.1. Socio-demographic characteristics

3.1.1. Marketing of medicinal plants by sex

The marketing of medicinal plants (Figure 2) in the Haut-Sassandra region is carried out by both sexes with a large female dominance (97 %) compared to (3 %) in the male sex.

3.1.2. Marketing of medicinal plants by age

The marketing of medicinal plants in the Haut-Sassandra region is spread over all age groups, with a predominance among people aged 41 to 50 years with (51 %). However, for the age group 31-40, the rate is (39 %) and for the age group 51-60 (6 %), and (4 %) for the age group 20-30 (Figure 3).

3.1.3. Marketing of medicinal plants by level of study

The vast majority of herbalists have no formal education (97 %) followed by primary (2 %) and secondary (1 %) as shown in figure 4.

3.1.4. Marketing of plants according to marital status

These results show that the majority of medicinal plants are marketed by married people (78 %) versus single people (22 %) as shown in figure 5.

3.2. Botanical characteristics of medicinal plants

3.2.1. Morphological types

Among the medicinal plants used in the Haut-Sassandra region, the vast majority of trees are 76 % compared to other species, 11 % of shrubs, 7 % of vines and 6 % of herbs, respectively (Figure 6).

3.2.2. Organs of plants used

The active ingredients can be found in different parts of medicinal plants (leaves, flowers, roots, bark, fruits, stems, rhizomes, etc.). In the area of our study the leaves are the most used parts of medicinal plants with a percentage of 51 %, followed by roots 38 %, then bark (8 %). The other parts (stem, fruit, rhizome) are used to a lesser degree, respectively with a percentage of 1 % (Figure 7).

3.2.3. Methods of preparing drug recipes

Of all the methods of preparation of the drug receipts, the decoction with a percentage of 71 %, occupies the first place. It is followed by infusion with a percentage of 16 %. Maceration with a percentage of 10 % comes in third position and pillage with a percentage of 3 % occupies the last place as shown in figure 8.

3.2.4. Routes of administration of drug receipts

The oral route remains the main route of administration with 45 % versus 43 % bath, followed by purging with 10 % and then local application and eye instillation which are quite negligible (1 %) relative to other jurisdictions (Figure 9).

3.3. Diseases treated by medicinal plants

Several conditions were identified in this study as shown in

figure 10. Malaria is the most cited disease with (24.54 %). It is followed by stomach ulcer (19.47 %), followed by anemia (9.31 %), ill health (6.21 %) and typhoid fever (5.4 %). Other diseases such as marasmus (3.92 %), hemorrhoids (3.6 %), respiratory diseases (3.27 %), general fatigue (3.1%), tooth decay and white loss (1.96 %) are less cited among the conditions affecting the population of the Haut-Sassandra region.

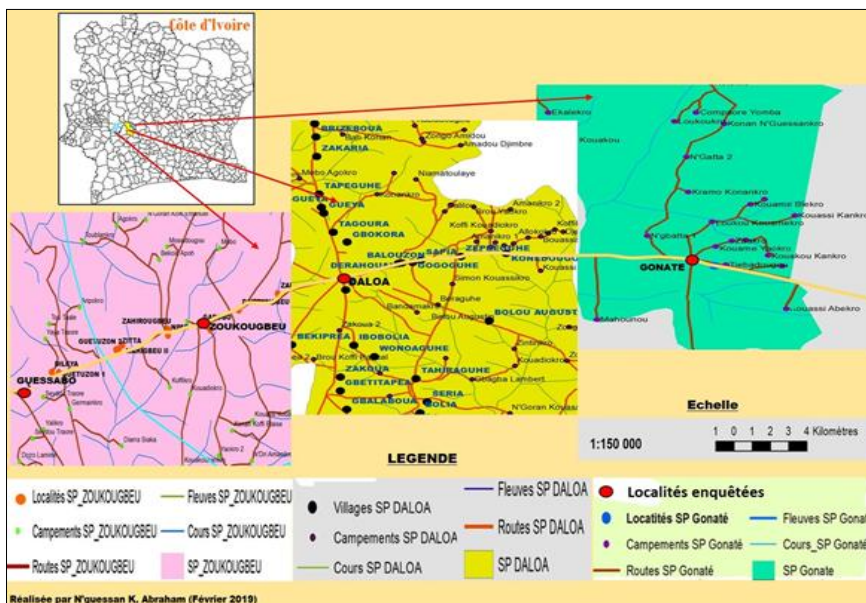


Fig 1: Study area location map

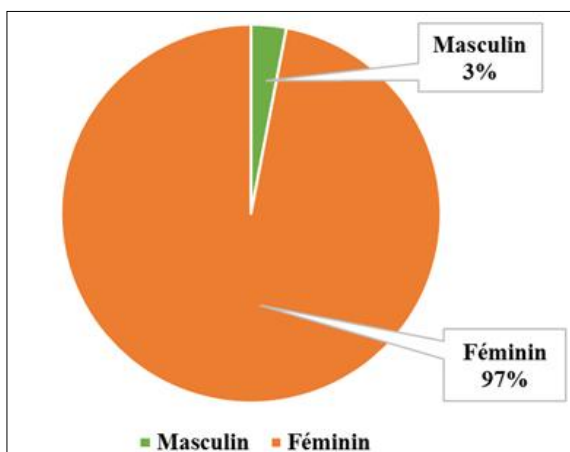


Fig 2: Spectrum of distribution of the herbalists by sex

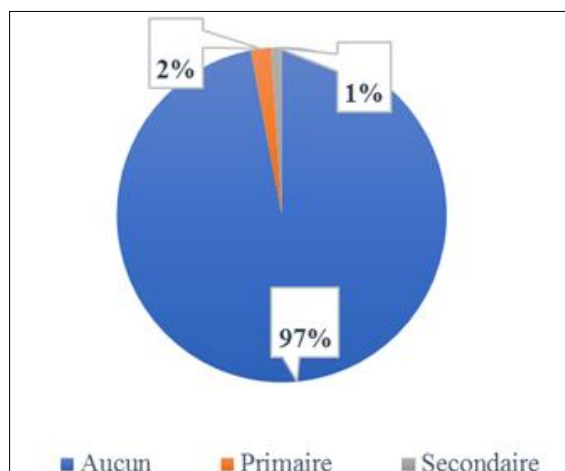


Fig 4: Spectrum of different levels of education of the medicinal plant sellers

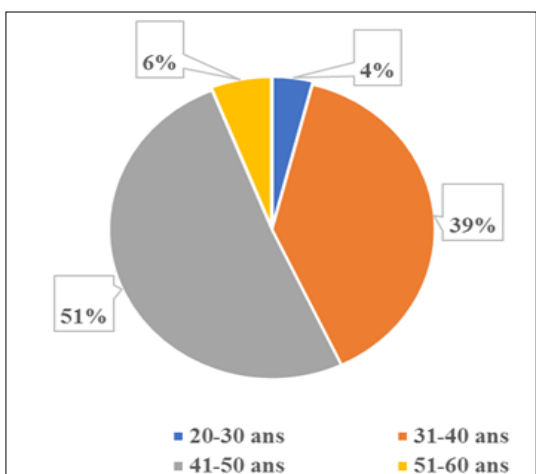


Fig 3: Spectrum of the different age classes of medicinal plant sellers

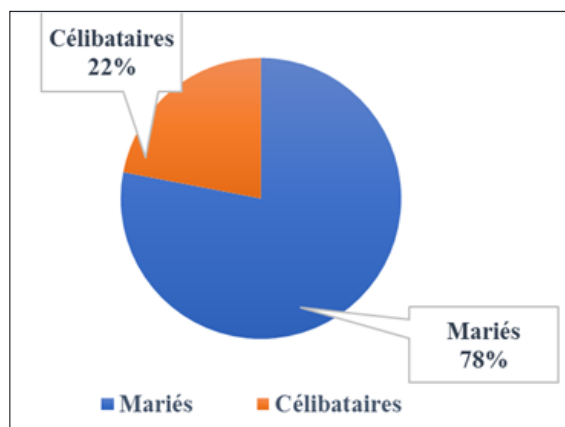


Fig 5: Spectrum of distribution of the herbalists by marital status

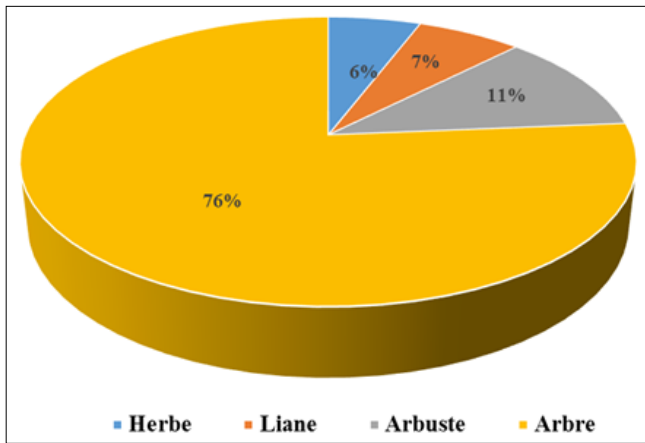


Fig 6: Spectrum of different morphological types

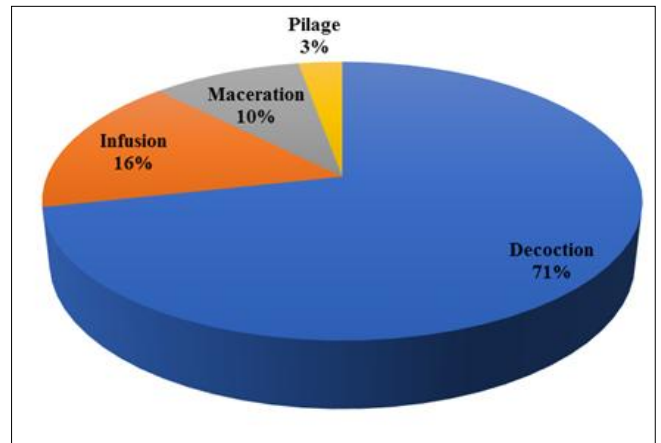


Fig 8: Spectrum of different recipe preparation techniques

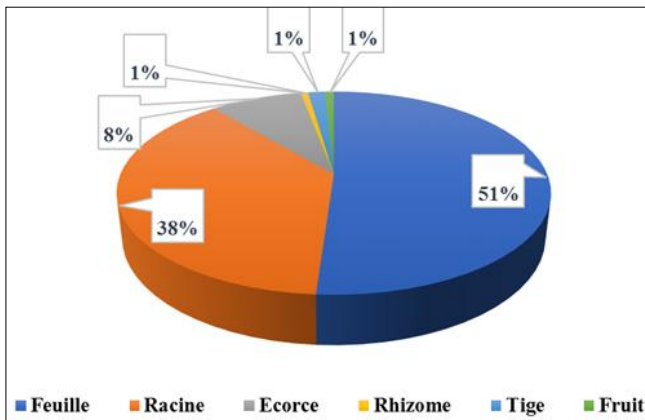


Fig 7: Spectrum of different parts of plants used

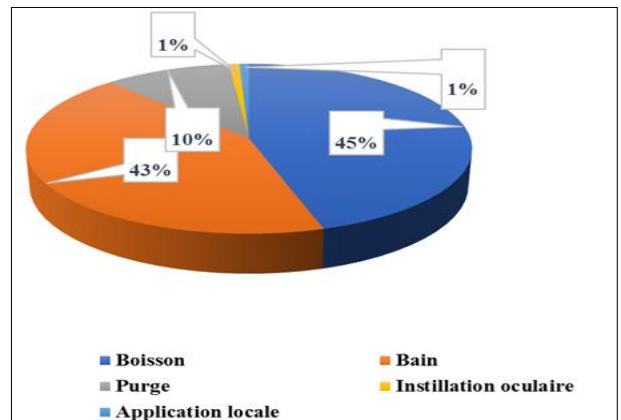


Fig 9: Spectrum of different routes of administration

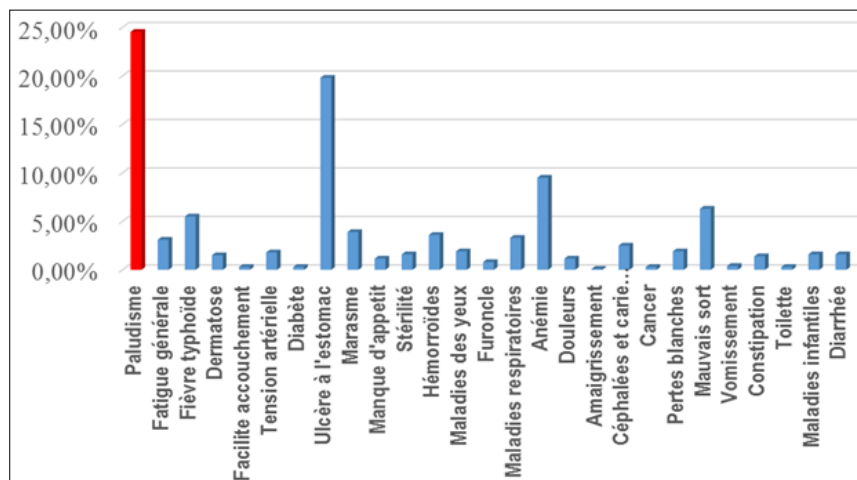


Fig 10: Distribution of diseases treated with medicinal plants

3.4. Floristic analysis

Surveys in the Haut-Sassandra region have enabled us to identify different species of medicinal plants. We selected 53 species from thirty-five (35) families (Table 1). The number of species in the families of the different medicinal plant species selected is shown in table 2. Rubiaceae predominate with a percentage of 7.40 %; Annonaceae follow-up, Caesalpiniaceae, Moraceae and Mimosaceae with a

percentage of 5.55 %.

3.5. Phytochemical and pharmacological characteristics of some plants

This literature review shows that 14 of the identified medicinal plants have various pharmacological properties in relation to the presence of phytochemical constituents as shown in table 3.

Table 1: Ethnobotanical data on all plants surveyed

	Scientific name	Family	Local name	Morpho-logical type	Organ used	Method of preparation	Method of administration	Pathology
1	<i>Acacia nilotica</i>	Mimosaceae	Acacia	Tree	Leaf, Root	Decoction	Drink, Bath	Malaria
2	<i>Adansonia digitata</i>	Bombacaceae	Baobab ou Sira	Tree	Leaf	Decoction	Drink Bath	Childhood diseases Ulcer
3	<i>Azelia africana</i>	Caesalpiniaceae	Dangha ou Lingué	Tree	Leaf Stem bark Root	Decoction	Drink Bath Purge	Envoutement, Malaria, Clogged trompe, Hemorrhoid
4	<i>Afrormosia laxiflora</i>	Papilionaceae	Kolokolo	Tree	Leaf Stem bark Root	Decoction Maceration Infusion	Drink Bath Purge	Slump, Headaches, Malaria, General fatigue
5	<i>Alchornea cordifolia</i>	Euphorbiaceae	Diéca ou Koyira	Shrub	Leaf Stem bark Root	Decoction	Drink Bath	White loss, Malaria, Ulcer, Cough, Typhoid fever
6	<i>Anogeissus schimperi</i>	Annonaceae	Krékété	Tree	Leaf Stem bark	Decoction	Drink Bath	Malaria, Typhoid fever
7	<i>Anthocleista nobilis</i>	Annonaceae	Farata-débè ou Woô Wowounio	Tree	Leaf Stem bark Root	Decoction Pilage Maceration	Drink Bath Purge	Malaria, White loss, Ulcer, Constipation, Toilet, Tooth decay
8	<i>Annona muricata</i>	Annonaceae	Corossolier	Tree	Leaf, Root	Decoction	Drink	Cancer
9	<i>Bidens pilosa</i>	Asteraceae	Tagiaani	Tree	Leaf Stem bark Root	Decoction Maceration Infusion	Drink Bath	Ulcer Vomiting
10	<i>Blighia sapida</i>	Bignoniaceae	Kaa	Tree	Leaf Root	Decoction Pilage	Drink Bain/Purge	Malaria
11	<i>Bridelia ferruginea</i>	Euphorbiaceae	Sagba	Tree	Leaf Stem bark Root	Decoction Maceration Infusion	Drink Bath Purge	Ulcer Anemia
12	<i>Carica papaya</i>	Caricaceae	Oflè	Shrub	Leaf Root	Decoction Maceration Infusion	Drink Bath	Malaria, Cancer, Typhoid fever, Tooth decay
13	<i>Ceiba pentandra</i>	Bombacaceae	Bana	Tree	Stem bark	Decoction	Drink, Bath	Cough
14	<i>Celtis integrifolia</i>	Ulmaceae	Kouka	Tree	Leaf, Root	Decoction	Drink, Bath	Ulcer
15	<i>Chlorophora excelsa</i>	Moraceae	Bakana	Tree	Leaf, Root Stem bark	Decoction Maceration	Drink Bain, Purge	Ulcer, Typhoid fever
16	<i>Citrus limon</i>	Rutaceae	Citronnier	Shrub	Leaf Stem bark Fruit	Decoction Pilage	Drink Bath Purge	Typhoid fever Cleans the blood
17	<i>Cola cordifolia</i>	Sterculiaceae	Tawa	Tree	Leaf	Decoction	Drink Bath	Slump
18	<i>Daniellia oliveri</i>	Caesalpiniaceae	Sanan	Tree	Leaf Stem bark Root	Decoction	Drink Bath	Envoutement Headaches
19	<i>Erythrina senegalensis</i>	Ebenaceae	Kiangui	Tree	Leaf	Decoction	Drink Bath	Malaria
20	<i>Ficus capensis</i>	Moraceae	Toro	Tree	Leaf, Root Stem bark	Decoction Infusion	Drink Bath	Anaemia Lack of appetite
21	<i>Ficus mucoso</i>	Moraceae	Gonan	Tree	Leaf Stem bark	Decoction	Drink Bain	Malaria Ulcer
22	<i>Gardenia divers</i>	Rubiaceae	Tienné	Liana	Stem bark	Decoction	Drink Bain	Stomach and mouth wound
23	<i>Glyphaea brevis</i>	Malvaceae	Golglo-iri	Liana	Leaf	Decoction	Drink Bath	Malaria
24	<i>Gossypium hirsutum</i>	Malvaceae	Cotonnier	Shrub	Leaf	Decoction	Drink Bath	Envoutement
25	<i>Khaya senegalensis</i>	Meliaceae	Diala	Tree	Stem bark Root	Decoction	Drink	Malaria Typhoid fever
26	<i>Leea guineensis</i>	Lecythidaceae	Adiapokou	Shrub	Leaf, Root	Pilage	Drink, Bath	Clogged horn
27	<i>Loesnera kalantha</i>	Caesalpiniaceae	Souosébé	Tree	Leaf Root	Decoction	Drink Bath	Malaria Typhoid fever
28	<i>Lophira alata</i>	Ochnaceae	Mana	Tree	Leaf	Decoction	Drink Bath	Marasme
29	<i>Mangifera indica</i>	Anacardiaceae	Manguier	Tree	Leaf Stem bark	Decoction	Drink Bath	Malaria
30	<i>Microglossa afzelii</i>	Asteraceae	Assuebo	Herb	Rhizome	Pilage	Drink	Angina, Cough, Cold
31	<i>Moringa lucida</i>	Rubiaceae	Mangana	Tree	Leaf Root Stem bark	Decoction Infusion	Drink Bath	Envoutement
32	<i>Moringa oleifera</i>	Moringaceae	Moringa	Tree	Leaf Fruit	Decoction Maceration	Drink	Anemia, Tooth decay, Constipation
33	<i>Musa Sapientum</i>	Musaceae	Bananier	Shrub	Leaf	Decoction	Drink Bath	Malaria Typhoid fever
34	<i>Nauclea latifolia</i>	Rubiaceae	Gouinga	Tree	Leaf Root Stem bark	Decoction Maceration	Drink Bath Purge	Malaria Typhoid fever Cough
35	<i>Ochna schweinfurthiana</i>	Ochnaceae	Kongomaniami	Herb	Whole plant	Decoction	Drink Bath	Dermatosis
36	<i>Ocimum gratissimum</i>	Lamiaceae	Alomagnirin	Herb	Leaf	Decoction Pilage	Drink Nasal instillation	Cough, Dermatosis, Typhoid fever, Headaches
37	<i>Omphalogonus</i>	Apocynaceae	Ababa	Liana	Leaf	Decoction	Drink	Malaria

	<i>nigritanus</i>						Bath	
38	<i>Pantaclethra macrophylla</i>	Pedaliaceae	Dio	Herb	Leaf	Decoction	Drink Bath	Envouement
39	<i>Parkia biglobosa</i>	Mimosaceae	Néré ou Tchigué	Tree	Stem bark Fruit Leaf	Decoction Infusion	Drink Bath	Envouement Hypertension Ulcer
40	<i>Persea americana</i>	Lauraceae	Avocatier	Tree	Core	Pilage	Drink	Hypertension
41	<i>Phoenix dactylifera</i>	Arecaceae	Dattier	Shrub	Leaf	Decoction	Drink	Malaria
42	<i>Phyllanthus discoideus</i>	Periplocaceae	Bakoko	Tree	Leaf Stem bark Root	Decoction Infusion Maceration	Drink Bath Purge	Ulcer Abdominal pain
43	<i>Premna hispida</i>	Verbenaceae	Wagné	Tree	Leaf	Decoction	Drink Bath	Malaria
44	<i>Psidium guajava</i>	Myrtaceae	Goyavier	Tree	Leaf	Decoction	Drink Bath	Diarrhea
45	<i>Sapium ellipticum</i>	Sapindaceae	Tomé	Tree	Leaf Stem bark	Decoction	Drink Bath	Slump Eye diseases
46	<i>Sarcocephalus esculentus</i>	Rubiaceae	Bâti	Tree	Leaf Stem bark Root	Decoction Maceration	Drink Bath	Malaria Hypertension
47	<i>Securidaca longedunculata</i>	Polygalaceae	Dioro	Tree	Leaf Stem bark Root	Decoction Maceration	Drink Bath Purge	Hemorrhoid, Ulcer, Boil, Clogged horn
48	<i>Trichilia heudelotii</i>	Tiliaceae	Trô	Shrub	Leaf	Decoction	Drink Bath/Purge	Hemorrhoid Facilitates delivery
49	<i>Strophanthus hispidus</i>	Sterculiaceae	Tokéré	Tree	Leaf	Decoction	Drink Bath	Ulcer
50	<i>Tectona grandis</i>	Verbenaceae	Teck	Tree	Leaf	Decoction	Drink, Bath	Ulcer, Anaemia
51	<i>Uapaca togoensis</i>	Phyllanthaceae	Somon	Tree	Leaf Root	Decoction Maceration	Drink Bath/Purge	Hypertension
52	<i>Uragoga peduncularis</i>	Ulmaceae	Kiriba	Tree	Leaf	Decoction	Drink Bath	Typhoid fever
53	<i>Xylia evansii</i>	Mimosaceae	Bouho	Tree	Leaf Root	Decoction Maceration	Drink Bath/Purge	Malaria Diarrhea

Table 2: Specific nature of medicinal plant families selected by family

Family	Number of species	% specific
Anacardiaceae	1	1.85 %
Annonaceae	3	5.55 %
Apocynaceae	1	1.85 %
Arecaceae	1	1.85 %
Asteraceae	2	3.70 %
Bignoniaceae	1	1.85 %
Bombacaceae	2	3.70 %
Caesalpiniaceae	2	3.70 %
Caricaceae	1	1.85 %
Ebenaceae	1	1.85 %
Euphorbiaceae	2	3.70 %
Lamiaceae	1	1.85 %
Lecythidaceae	1	1.85 %
Liliaceae	1	1.85 %
Loganiaceae	1	1.85 %
Malvaceae	2	3.70 %
Meliaceae	1	1.85 %
Mimosaceae	3	5.55 %
Moraceae	3	5.55 %
Moringaceae	1	1.85 %
Musaceae	1	1.85 %
Myrtaceae	1	1.85 %
Ochnaceae	2	3.70 %
Papilionaceae	1	1.85 %
Pedaliaceae	1	1.85 %
Periplocaceae	1	1.85 %
Poaceae	1	1.85 %
Polygalaceae	1	1.85 %
Rubiaceae	4	7.40 %
Rutaceae	1	1.85 %
Sapindaceae	1	1.85 %
Sterculiaceae	2	3.85 %
Tiliaceae	1	1.85 %
Ulmaceae	2	3.70 %
Verbenaceae	2	3.70 %

Table 3: Phytochemical and pharmacological characteristics of some medicinal plants

Plant	Phytochemical constituent	Reference	Pharmacological property	Reference
<i>Acacia nilotica</i>	Chlorogenic acid Gallic acid Leucoanthocyanidin	[42]	Antidiarrheal	[43]
			Antibacterial	[42]
<i>Adansonia digitata</i>	Vitamins A, B and C Saponins Anthocyanins	[44]	Antidiabetic	[45]
			Antiviral	[46]
<i>Alchornea cordifolia</i>	Alkaloids, Tannins Flavonoids Proanthocyanidins	[47]	Antiplasmodial	[14]
			Antiulcer	[48]
<i>Annona muricata</i>	Phenolic acid Alkaloids, Terpenes Flavonoids	[49]	Antitumoral	[50]
			Antidiabetic	[51]
<i>Bridelia ferruginea</i>	Flavonoids, Phenols, Saponins, Steroids, Tannins, Terpenoids	[52]	Antimicrobial, Anti-VIH	[53]
<i>Carica papaya</i>	Vitamins A, C and E, Fatty acids and organic acids	[54]	Antihypertensive Antidiabetic Antibacterial	[54]
<i>Khaya senegalensis</i>	Quinons Sterols, Saponins	[55]	Antidiabetic	[51]
<i>Mangifera indica</i>	Polyphenols, Reducing sugars, Terpenoids	[56]	Antidiabetic	[57]
			Antipaludique	[58]
<i>Morinda lucida</i>	Anthraquinons Terpenoids	[59]	Antiplasmodial	[59]
<i>Moringa oleifera</i>	Alkaloids, β -carotene Sucres réducteurs, Tannins, Flavonoids	[60]	Antidiabetic	[51]
<i>Ocimum gratissimum</i>	Volatile oils, Terpenes, Reducing sugars	[61]	Anti-VIH-1	[62]
<i>Parkia biglobosa</i>	Flavonoids, Sterols, Saponins, Tannins, Terpenes	[63]	Antihypertensive	[64]
<i>Persea americana</i>	Alkaloids, Quinons, Polyphenols, Terpenes Saponines	[57]	Antidiabetic	[57]
<i>Securidaca longepedunculata</i>	Alkaloids, Terpenes Quinons, Saponins, Sterols,	[65]	Antidiabetic	[65]

4. Discussion

The ethnopharmacological study confirmed that the vast majority of populations, from various social strata, use plants to treat themselves, through the recipes of tradipraticians or herbalists from their own experiences. This traditional use of medicinal plants forms the basis of both preventive and curative medicine for populations in sensitive strata [3]. This knowledge is still well transmitted today in the Haut-Sassandra region despite the fragility of this sector of activity which is invaded by malicious practitioners [20].

In terms of the botanical characteristics of these plants, among the medicinal plants used in the Haut-Sassandra region, the majority of the trees are, with 76 % compared to other morphological types. This could be explained by the fact that this region is a forest area. Thus, according to Monnet [21], trees are frequently found in the immediate environment and access to organs is easy. For other authors [5, 22], it is trees, whereas with N'guessan *et al.* [10], herbs are the majority. Our results are consistent with the authors' work [5, 22]. Our studies also showed that leaves were the most commonly used organ of medicinal plants with a 51 % percentage followed by roots 38 %. Ethnobotanical work by Zerbo *et al.* [23] 41 %, N'guessan *et al.* [10] 51.22 %, and Lakouéténé *et al.* [24] 67 % showed that leaves are the majority organ used in various therapeutic preparations. There may be concerns about the excessive use of leaves in medicinal plants, but studies by Poffenberger *et al.* [25] have shown that 50 % of the leaves taken from a tree do not significantly affect its survival. Therefore, the high frequency of leaf use can be explained by the ease and speed of harvesting [26] but also because they are the site of photosynthesis and storage of secondary metabolites responsible for the biological properties of the plant [27]. According to Yapi *et al.* [28], roots with 10 % use are the second most used organ. But their removal removes the possibility of supplying the plant with nutrients, which affects its vegetative aspect as well as its physiology. Thus, our results are close to those of N'guessan *et al.* [10] which indicate 51.22 % use of leaves in these studies. However, our results are very far from those of Yapi *et al.* [28] in terms of the percentage of this author's roots. This could be explained by the fact that the regions are different. In addition, the majority of the population of Haut-Sassandra uses decoction as a

method of preparing drug recipes with (71 %) for the treatment of conditions. These results are consistent with those obtained by Dongock *et al.* [29] which showed that decoction was the most commonly used method with a rate of 62 %. According to Lahsissène *et al.* [30] public interest in the use of decoction resides in the fact that it increases the temperature in the body. For Salhi *et al.* [31], decoction is the best preparation method to be used to best value the active ingredient of medicinal plants and it also allows to collect the most active ingredients and to mitigate or cancel the toxic effect of some revenues. The best use of a plant would be to preserve all its properties while allowing the extraction and assimilation of the active ingredients [32]. Medicinal plants have undesirable effects when they are practiced without precaution by patients. Therefore, alternative medicine should be practiced with caution and within specific parameters and measurements [9]. The results of our study indicated that the most commonly used route of administration was drink (oral) with 45 %, followed by bath (dermal) with 43 %. These results are similar to those of N'Guessan *et al.* [10] which places the beverage at 46.98 % and Bla *et al.* [11] 57.69 %. They indicate that delicted ingredients containing oral bio-active ingredients require a much faster and more efficient metabolic process than other techniques. The tradipraticians interviewed would explain this by the fact that by drinking the decocted, the probability of neutralizing the parasite would be higher and that it would be eliminated through the urine. These results are consistent with those of some authors [33, 34] who rate the oral route at around 94 %. So that route is the most popular route of administration, even though it was much higher than what we got. However, several works reveal other avenues. Vangah-Manda [20], with 27.83 % for the rectal tract, Diatta *et al.* [22], with 46 % for the dermal tract. During our ethnopharmacological survey we identified 53 species belonging to 35 families with Rubiaceae dominance (7.40 %). These results are different from those obtained by Erasto *et al.* [35] in South Africa and those of Etuk *et al.* [36] in Nigeria. Indeed, for each author, the family most represented was different, from one study to another. This disparity in results is influenced, on the one hand, by the geographical difference in the study areas and, on the other hand, by the difference in the populations and flora studied

themselves, from one country to another, Etuk *et al.* [36].

Several conditions were identified in this study. Malaria is the most treated disease in Haut-Sassandra at 24.54 %. Our results confirm those obtained by Koulibaly *et al.* [7]. These results show that the health profile of Côte d'Ivoire is strongly dominated by infectious and parasitic diseases. In fact, malaria is currently the leading cause of consultation in basic health units and accounts for 57 % of pathologies reported in health centers [37]. It is the leading cause of death in children under 5 years of age in pediatric services [38]. According to Fakhir [39] 50 % of farm income losses are due to malaria. As a result, this disease is now considered a cause of poverty [38]. However, the results of our work are in contrast to those reported by Koné *et al.* [40] in the Ferkessedougou region. These authors note in their work that diarrhea is the cause of death in children. This diversity of results could be explained by the fact that the study areas were different. Finally, a review of the literature has enabled us to understand that the species surveyed are of great therapeutic interest and common use in several regions of Côte d'Ivoire as well as elsewhere in the sub-region West African region in agreement with the work of some authors [5, 11, 29, 41].

5. Conclusion

Traditional medicine is currently being sought by people who have confidence in popular practices and who cannot afford the costs of modern medicine. Thus, this work has been carried out with the aim of compiling an inventory of medicinal plants used in the Haut-Sassandra and gathering information on the therapeutic uses practiced in that region. Our ethnopharmacological investigations have yielded several results. These results showed that women were more interested in selling medicinal plants and the majority of herbalists were between 41 and 50 years of age. Those engaged in this activity have virtually no educational level and are largely married. In this study we identified 53 medicinal species belonging to 35 families of which the Rubiaceae family is the most represented. Leaves are the most commonly used organ and decoction is the most commonly used method. Similarly, of all the diseases treated, malaria was the most cited disease. This study shows that traditional medicine really contributes to the health management of the population in Côte d'Ivoire, particularly in the Haut-Sassandra region, so it deserves to be supervised. It is important to extend this kind of research to other parts of the country. Finally, to validate experimentally the remedies identified by scientific protocols in order to produce later improved traditional medicines.

6. References

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