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Original Research Article

Ethno Pharmacological Survey of the Medicinal Flora Used by Some Traditional Healers of Mbam and Inoubou Division (Cameroon)

Bayaga Hervé Narcisse[1*], Guedje Nicole Marie[1], Ondoua Nguele Marc Olivier[2], Njinkio Nono Borgia Legrand[3], Ngameni Bathélemy[1], Fokunang Charles[3], Ngadjui Tchaleu Bonaventure[2]

[1]Department of Pharmacognosy and Pharmaceutical Chemistry, Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, P.O. Box 1364 Yaoundé - Cameroun
[2]Department of Pharmacology and Traditional Medicine, Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, P.O. Box 1364 Yaoundé - Cameroun
[3]Department of Pharmacotoxicology and Pharmacokinetic, Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, P.O. Box 1364 Yaoundé - Cameroun

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***Corresponding author:** Bayaga Hervé Narcisse

Abstract

Introduction: In Cameroon, as in other developing countries, rural populations use medicinal plants based on knowledge and ancestral practices. To promote this type of medicine, the aim of the present study was to characterize medicinal plants and recipes used by traditional healers of Mbam and Inoubou Division in Cameroon. ***Material and methods***: A total of 17 volunteer traditional healers were interviewed. Plants were photographed and the samples collected in the presence of the traditional healers. The identification of these plant samples was carried out by the experts of the National Herbarium of Cameroon. ***Results***: Eighty-two (82) species with 77 genera and 44 botanical families were counted. Herbaceous plants (46%) followed by trees (36%) constituting the morphological types mostly represented. The main families were Fabaceae (9 species), Euphorbiaceae (7 species), Asteraceae (6 species), Poaceae (4 species) and Apocynaceae (3 species). 126 herbal recipes were identified. Decoction was the most widely used method of preparation and the oral route was the main route of administration. *Ageratum conyzoides* L (5.24%), *Citrus medica* L (4.71%), *Carica papaya* L (4.19%), *Elaeis guineensis*. Jacq. (3.67%), *Senna alata* (L.) Roxb (3.67%), *Cymbopogon citratus (*DC.) Stap (3.14%), *Euphorbia hirta* L (3.14%), *Musa paradisiaca* L. (3.14%), *Psidium guajava* L (3.14%) and *Annona muricata* L (2.62%) represented the ten species of medicinal plants most used. ***Conclusion:*** Plants and recipes identified constitute a basis for studies on phytochemical and pharmaco-toxicological analyzes, which are essential for the development of improved traditional medicines.

Key words: Ethno pharmacology, Medicinal plants, Traditional healers, Mbam and Inoubou.

INTRODUCTION

Despite the scientific advances of modern medicine, many populations resort to medicinal plants to alleviate symptoms or overcome a disease. Thus, traditional medicine (TM) appears as a significant alternative to solve some health problems of the populations [1]. This is justified by the poor geographical accessibility to modern health care and the precarious state in which the populations of developing countries such as those in Africa reside. Cameroon in general and the Department of Mbam and Inoubou in particular is not left out; most of the population does not have access to modern health care and medicines and the use of medicinal plants for the treatment of diseases remains a widespread practice [2]. Numerous research studies have been carried out both worldwide and especially in Cameroon in particular on numerous medicinal plant species to identify and evaluate their ethnobotanical, ethnopharmacological, chemical, and biological properties in the laboratory [3-9]. However, to the best of our knowledge, few works have focused on ethnopharmacological studies in the department of Mbam and Inoubou. Thus, in order to contribute to the knowledge of the local therapeutic flora, the present study proposed to identify the plants and recipes used by the traditional therapists living in the different villages of Mbam and Inoubou Division.

MATERIALS AND METHODS

Framework of the study

This was a descriptive cross-sectional study, which took place in different villages of the Mbam and Inoubou Division located in the Central region of Cameroon (Figure 1).

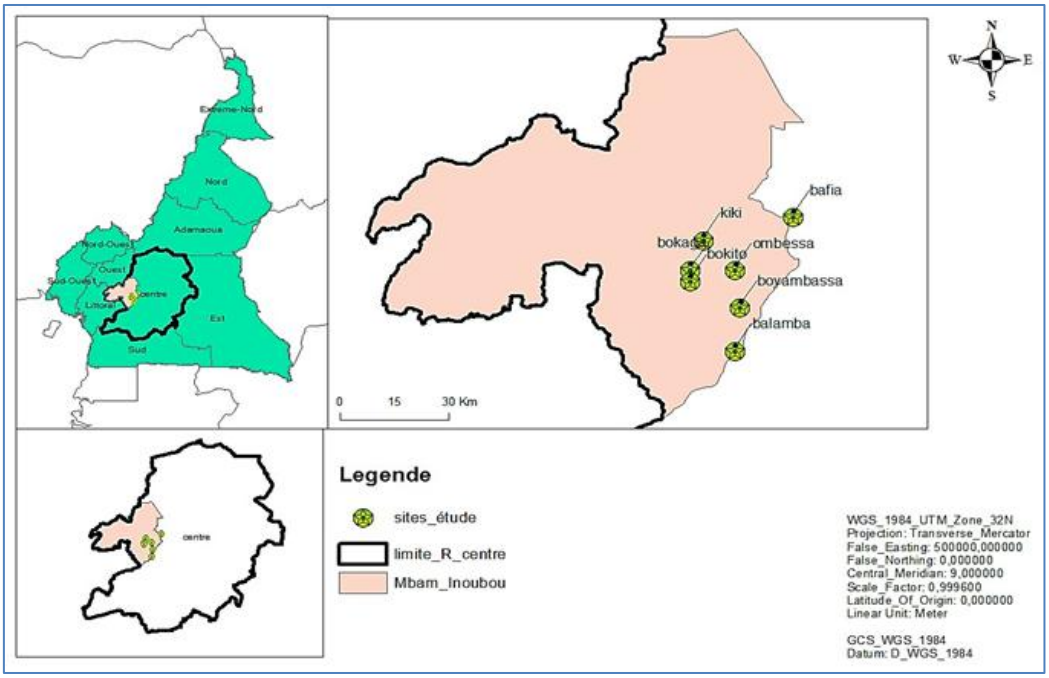

Fig-1: Location of the different study sites in the Mbam and Inoubou subdivision

DATA COLLECTION

The survey form, developed according to the framework proposed by Adjanohoun *et al.* [10], was given to the traditional healers who agreed to participate in this study by sharing their knowledge and therapeutic knowledge. Information on the plants, the part of the plant species collected, and the method of preparation and administration of the remedies was recorded each time [11].

Collection and identification of herbarium specimens

The indicated plants were photographed and botanical samples were collected. Subsequently, these samples were identified at the National Herbarium of Cameroon in Yaoundé with the help of Prof. Jean Michel Onana and Mr. Ngantsop Eric, Botanists and experts of the National Herbarium of Cameroon.

Statistical analysis and graphical representation of data

The frequency of citation (Fc) was calculated to evaluate the importance or frequency of a plant used, a plant drug, a method of preparation or administration of a recipe. The obtained data were recorded in the Microsoft 2016 Excel spreadsheet. The graphs were generated from the pivot tables.

RESULTS

Socio-demographic profile of the traditional healer's interview

A total of forty-three (43) tradithérapeutes were interviewed. Seventeen (17) of these, including six (06) located in Bokito, five (05) in Balamba, three (03) in Bafia, two (02) in Ombessa and one (01) in Kiki, were favorable to the idea of sharing their knowledge on medicinal plants. The other 26 traditional healers, in spite of the assurances and all the explanations given, did not wish to participate in the study. 53% of the traditional therapists interviewed were women, with a female/male (F/M) sex ratio of 1.13 in favor of women. The minimum age was 33 years and the maximum age was 78 years, with an average age of 52.11 years. The minimum year of experience as a traditional healer's was 8 years and the maximum was 42 years. Concerning the origin of the knowledge on medicinal plants, 76.47% of the traditional healer's inherited from their ancestors, 11.76% by self-learning and 11.76% spontaneously following revelations.

Characterization of medicinal plants used by traditional healers

The results of the survey identified a total of eighty-two (82) botanical species included in the recipes indicated by the traditional therapists. These

identified plants were divided into 77 genders and 44 botanical families, of which the most represented were Fabaceae (8 species), Asteraceae (6 species), Euphorbiaceae (6 species), Poaceae (4 species), Apocynaceae (3 species) and Sterculiaceae (3 species). Taking into consideration the number of citation or frequency of citation (Fc), it appears that: *Ageratum conyzoides L* (5.26%), *Citrus medica L* (4.73%), *Carica papaya L* (4.21%), *Elaeis guineensis. Jacq.* (3.68%), *Senna alata (L.) Roxb* (3.68%), *Cymbopogon citratus (DC.) Stap* (3.16%), *Euphorbia hirta L* (3.16%), *Musa paradisiaca L.* (3.16%), *Psidium guajava L* (3.16%) and *Annona muricata L* (2.63%) represented the ten most used medicinal plant species (Table I).

Table-I: List and characteristics of medicinal plants used by traditional therapists in the Mbam and Inoubou subdivision

Family	Specie	Local name	Type	Organ used	Diseases and symptoms treated	Number of citation	Number of recipe
Acanthaceae	*Eremomastax speciosa* (Hochst.) Cufod.	Two sides	Grass	Sheets	Chlamydia, Dysmenorrhea, Red buttocks	2	2
Alliaceae	*Allium sativum* L.	Garlic	Grass	Pods	Typhoid, Cough	2	2
Aloeceae	*Aloe vera* (L.) Burm. F.	Aloe vera	Grass	Sheets	Malaria, Gastric illness, Immunodepression	3	3
Anacardiaceae	*Manguifera indica* L.	Bundoua	Tree	Trunk bark	Urinary incontinence	1	1
Anonaceae	*Annona muricata* L	Guibil guisama	Tree	Sheets	Malaria, Typhoid, Nerve ache	5	5
Apiaceae	*Daucus carota* L.	Carrot	Grass	Tubers	Diarrhea, Anemia	1	1
Apocynaceae	*Alstonia bonei* De Wild	Ikouk	Tree	Barks	Diabetes, Yellow fever, Hepatitis, Typhoid, Malaria,	2	1
	Voacanga africana Stapf	Voacanga	Tree	Roots	Prostate	2	1
	Rauvolfia africana Stapf	Ibiliton	Tree	Roots	Painful rule	1	2
Araceae	*Xanthosoma sagitifolium* (L) Schott	Bucab	Grass	Tubers	Fibroma, Jaundice, Female Sterility	2	2
Araliaceae	*Panax ginsen* C.A. Mey	Ginseng	Grass	Root	Malaria, Sexual asthenia	4	4
Arecaceae	*Elaeis guineensis.* Jacq.	Itand	Tree	Trunk	Jaundice, Cold, Varicella, Edema, Amebic dysentery	7	2
	Cocos nucifera L.	Mfondey	Tree	Fruits	Azoospermia, Infertility mas	1	2
Asteraceae	*Ageratum conyzoides* L.	Buguity	Grass	whole plant	Malaria, Typhoid, , Gastric ulcers,worms	10	9
	Bidens pilosa L.	*Fouguité*	Grass	Sheets	Malaria, Hypertension, Amebic dysentery, Varicella	4	4
	Chromolaena odorata (L.)	Ndogmo	Grass	Sheets	Wound, Abdominal pain	4	9
	Galensoga parviflora Cav.	Kibiendine	Grass	Sheets	Burns, Panaris	3	2
	Emilia coccinea G. Don.	*Otut wa mbua*	Grass	Sheets	Yellow fever, Malaria, Otitis	2	1
	Tithonia diversifolia (Hemsl) A. Gray	Marguerite	Grass	Sheets	Scabies/Varicella	1	1
Bignoniaceae	*Spathodea campanulata* P.Beauv	Ivuvone	Tree	Barks	Wound, Chlamydia, Gonorrhoea, Infertility, Malaria	2	2
Bombacaceae	*Adansonia digitata* L.	Kigoum	Tree	Barks	Hemorrhoids, Epilepsy, Blocked penis, Nausea	4	3
Bromeliaceae	*Pineapple comosus* (L.) Merr	Guibil guisama	Grass	Fruits	Seminal hypersecretion,	1	1
Burseraceae	*Canarium schweinfurthii* Engl	Bouhéte	Tree	Barks	Tuberculosis, Genital infection, Heavy menstruation	2	2
	Dacryodes edulis H.J. Lam	Guiboa	Tree	Sheets	Burns	1	1
Caesalpinaceae	*Guibourtia tesmanii* (Harms)	*Essingan*	Tree	Barks	Fibroma, Cyst and Myoma	2	2
Caricaceae	*Carica papaya* L.	Bounkon-haa	Tree	Sheets	Malaria, Typhoid, Intestinal worms	8	4
Caryophyllaceae	*Drymaria cordata* Willd. ex Schult.		Grass	whole plant	Convulsion , Malaria	1	1
Cecropiaceae	*Musanga cecropioides* R.Br Tedlie	Parasolier	Tree	Roots	Malaria, Wound, Poisoning	1	1
Combretaceae	*Combretum micranthum* G. Don	Kingueliba	Grass	Fruit	Wound	2	1
	Terminalia glaucescens Planch.	Bouloa	Tree	Barks	Chlamydia	1	1

	Commelina benghalensis L.		Grass	Whole plant	Amebic dysentery	1	1
Convolvulaceae	*Ipomoea batatas* (L.) Lam.	Potato	Liane	Sheets	Fibroma, abdominal pain, Fontanelle	3	3
	Ipomea alba L.	Wild potato	Liane	Tubers	Fibroids, Female infertility	1	2
Costaceae	*Costus-afer* Kerl-Gawl	*Myane*	Grass	Stem	Measles, Varicella	1	1
Cucurbitaceae	*Zehneria scabra* (L.f.) Sond		Grass	whole plant	Amebic dysentery, infertility	2	1
	Cogniauxia podolaena Baill		Liane	Sheets	Wound,	1	2
	Momordica cabraei (Cogn) Jeffrey	Ekok	Liane	Sheets	Wound	1	2
Cyperaceae	*Croton kongensis* Gagnep	Wild Croton	Shrub	Sheets	Wound	1	6
	Killenga erecta Schumach		Grass	Roots	Erectile dysfunction	1	1
Dioscoreaceae	*Dioscorea rotunda* Poir.	Mbaya (Yam)	Grass	Sheets	Difficult delivery	1	1
Euphorbiaceae	*Euphorbia hirta* L.		Grass	whole plant	Amebic dysentery, intestinal worms, Spleen	6	1
	Alchornea cordifolia (Schumach. □ Thonn.) Müll.Arg	Ilanha	Shrub	Sheets	Anemia, Toothache	2	1
	Codiaeuum variegatum (L) A.Juss	Kroton	Shrub	Sheets	Amebic dysentery, Abdominal pain	2	1
	Bridelia ferruginea Benth.	Mbaa	Shrub	Barks	Wound	1	1
	Jatropha curcas L.	Lambiaga	Shrub	Fruits	Food poisoning	1	1
	Ricinodendron heudolotii (Baill.)Pierre	Sasan haa	Tree	Seeds	Sterility, Sexual Weakness, Ovulation	1	1
Fabaceae	*Senna alata* (L.) Roxb	Elunkan	Shrub	Sheets	Fungus, Hemorrhoids, Typhoid, Hepatitis, Jaundice, Difficulty walking	7	2
	Acacia arabica, Willd	Acacia	Tree	Fruit	Hemorrhoids, Wound	2	1
	Desmodium triflorum (L) DC.	Bossop bwa nyol	Grass	Sheets	Difficult delivery, Toothache	2	1
	Arachis hypogaea L.	Bussop	Grass	Seeds	Typhoid	1	1
	Crotalaria pumila Ortega	Kioyo guia figna	Shrub	Sheets	Conjunctivitis	1	2
	Delonix regia (Boj.ex Hook) Raf.		Tree	Barks	Wound, Malaria	1	1
	Desmodium Adscendens (Swartz) D.C.	Busup wa batata	Grass	Stem	Toothache, Diarrhea	1	7
	Tetrapleura tetraptera (Schumach □ Thonn)	four sides	Tree	Fruits	Wound	1	1
Irvingiaceae	*Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill	Ndanghagnia	Tree	Barks	Typhoid, Obesity	2	1
Lamniacea	*Ocimum gratisimum* L.	Bissia(massep)	Grass	Sheets	Dysmenorrhea	3	3
	Ocimum basilicum L.	Basil	Grass	Sheets	Abdominal pain, restlessness	1	4
Lauraceae	*Persea americana* Mil.	Fia	Tree	Core	Gastric ulcers, Asthenia	4	1
Loranthaceae	*Loranthus sp*	Mbatsia	Liane	Sheets	Sexual asthenia, Dysmenorrhea	1	1
Malvaceae	*Hibiscus rosasinensis* L.		Grass	leaves and flowers	Empoissonnement, Erectile dysfunction	2	1
Mimosaceae	*Albizia gummifera* (J.F. Gmel.) C.A. Sm.	Isack	Tree	Barks	Wound	2	1
	Mimosa invisa Martius ex Cola		Grass	Sheets	Nervousness	1	1
Moraceae	*Ficus exasperata* Vahl		Tree	Sheets	Asthma, Bronchitis	1	1
	Ficus on Forssk.	Silindanya	Shrub	Barks	Women's glass	1	3
Moringaceae	*Moringa oleifer* Lam.	Moringa	Tree	Sheets	Immunodepression	2	6
Musaceae	*Musa paradisiaca* L.	Niconda	Tree	Stem	Wound, Sprain, Fracture	6	1
Myrtaceae	*Psidium guajava* L.	Guayave	Tree	Sheets	Malaria, Typhoid, Nervousness, Flu-like condition	6	6
	Eucalyptus globulus Labill.		Tree	Sheets	Cough, Bronchitis, Malaria, Sinusitis	2	6
Piperaceae	*Piper nigrum* L.	*pepper*	Liane	Seeds	Difficult walk	1	2
Poaceae	*Cymbopogon citratus* (DC.) Stap	Fugue	Grass	Sheets	Malaria, Fever,Hyperlipidemia, Immunodeppression	6	1

	Zea corn L.	Mbassia	Grass	Beard	High blood pressure	2	7
	Echinochloa crus-galli L.		Grass	whole plant	Sprain/fracture/dislocation	1	1
	Sorghum arundinaceum (Desv.) Stapf	Ndassia	Grass	Seeds	Sexual weakness	1	2
Portulacaceae	*Portulaca oleracea* L.		Grass	Sheets	Stocking	1	1
Rubiaceae	*Mitracarpus villosus* (SW) DC.S		Grass	Sheets	Wound	1	1
Rutaceaea	*Citrus medica* L.	Ofuum	Shrub	Sheets	Malaria, Thyphoid, Bronchitis, Influenza, Dysmenorhea, Prostate, Amebic dysentery	9	1
Solanaceae	*Capsicum frutescens* L.	Ndiglaha wanyol	Grass	Sheets	Cryptorchidism, difficulty of walking	2	8
Sterculiaceae	*Theobroma cacao* L.	Cocoa	Tree	Fruit	Panaris	2	2
	Cola nitida (Vent.) Schott & Endl.	Nihéne	Tree	Fruits	Sexual asthenia	1	2
	Garcinia kola. Heckel	Mbitacola	Tree	Fruits	Chronic wound	1	2
Zingiberaceae	*Zingiber officinale*. Roscoe	Djindja	Grass	Rhizome	Cough	3	2
	Aframomum megueleta K.Schum	Kibasse	Grass	Seeds	Amebic dysentery	2	3

Herbs (46%) followed by trees (36%) were the morphological types represented in majority, while shrubs (12%) and lianas were the least represented (Figure 2). Leaves (49.49%), fruits (13.26%) and barks (11.22%) represented the plant drugs most used by the traditional healers in the preparation of recipes (Figure 3).

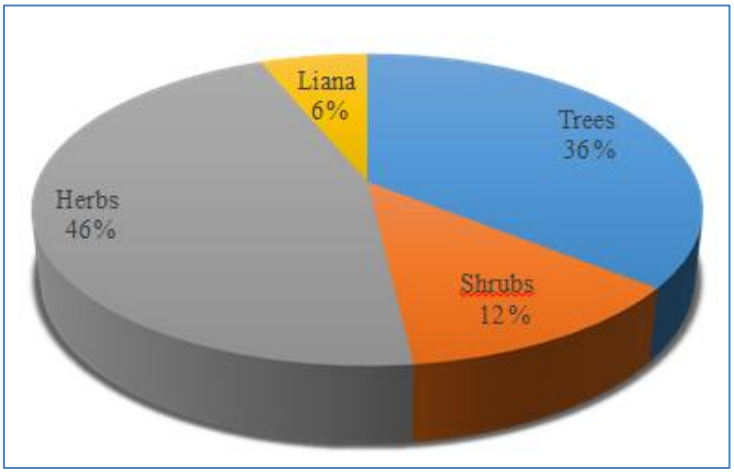

Fig-2: Morphological types of medicinal plants identified.

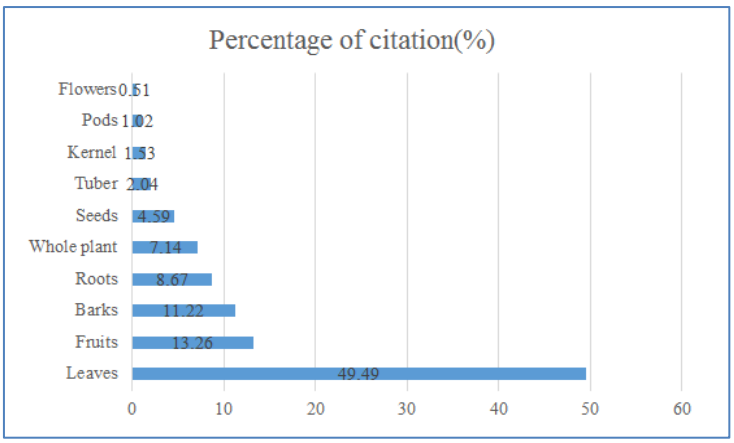

Fig-3: Proportion of plant organs used in recipe preparation

Therapeutic indications and characteristics of the recipes proposed by the traditional therapists

One hundred and twenty-six (126) recipes were described by the different resource persons for a total of fifty-five (57) therapeutic indications. Infectious and parasitic diseases (51 recipes), followed by diseases of the genito-urinary organs (28 recipes) and traumatic lesions (16 recipes) were the most prevalent. Malaria (12 recipes), wounds (09 recipes), infertility (08 recipes), amoebic dysentery (07 recipes), typhoid fever (06 recipes) were the five (05) most frequent indications considering the number of recipes listed and the plants involved in the preparation of these recipes. Table II presents the complete list of therapeutic indications, the number of recipes for each indication as well as the number of plants per recipe (Table II).

Table-II: Number of recipes and medicinal plants according to therapeutic indications

Pathology / Indications	**Receipt (R)**		**Plant (P)**		**E/R**
	Number	**Percentage (%)**	**Number**	**Percentage (%)**	
Infectious and parasitic disease	**51**	**40,48**	**82**	**100**	**1,61**
Malaria	12	9,52	16	19,51	1,33
Amoebic dysentery	7	5,56	11	13,41	1,57
Typhoid	6	4,76	14	17,07	2,33
Yellow fever	6	4,76	8	9,76	1,33
Scabies	3	2,38	3	3,66	1
Varicella	3	2,38	4	4,88	1,33
Chlamydia	2	1,59	9	10,98	4,5
Helminthiasis	2	1,59	3	3,66	1,5
Scab	2	1,59	1	1,22	0,5
Whitlow	2	1,59	2	2,44	1
Hepatitis	1	0,79	6	7,32	6
Measles	1	0,79	1	1,22	1
Ringworm	1	0,79	1	1,22	1
Tuberculosis and Bronchitis	1	0,79	1	1,22	1
Disease of the genito-urinary organs	**28**	**22,22**	**38**	46,34	**1,36**
Female infertility	8	6,35	8	9,76	1
Sexual weakness	6	4,76	7	8,54	1,17
Dysmenorhea	3	2,38	4	4,88	1,33
Azoospermia	3	2,38	5	6,1	1,67
Erectile dysfunction	2	1,59	4	4,88	2
Ovulation stimulation	1	0,79	3	3,66	3
Seminal hypersecretion	1	0,79	2	2,44	2
Prostatitis	1	0,79	2	2,44	2
Cryptorchidism	1	0,79	1	1,22	1
Heavy and black periods	1	0,79	1	1,22	1
Uterotonic	1	0,79	1	1,22	1
Traumatic injuries and poisoning	**16**	**12,7**	**19**	**23,17**	**1,31**
Wound	9	7,14	9	10,98	1
Sprain/fracture/dislocation	1	0,79	3	3,66	3
Poisoning	2	1,59	2	2,44	1
Burn	1	0,79	2	2,44	2
Conjunctivitis	1	0,79	1	1,22	1
Food poisoning	2	1,59	2	2,44	1
Defined symptoms, signs and disease states	**12**	**9,52**	**16**	**19,51**	**1,33**
Abdominal pain	3	2,38	5	6,1	1,67
General Asthenia	2	1,59	2	2,44	1
Difficulty walking	2	1,59	2	2,44	1
Towards women	1	0,79	1	1,22	1
Urinary incontinence	1	0,79	2	2,44	2
Nausea and vomiting	1	0,79	2	2,44	2
Oedema	1	0,79	1	1,22	1
Convulsion	1	0,79	1	1,22	1

Disease of the digestive system	**8**	**6,35**	**7**	**8,54**	**0,88**
Diarrhea	2	1,59	2	2,44	1
Gastric illness	2	1,59	4	4,88	2
Dental pain	2	1,59	1	1,22	0,5
Tumor	**6**	**4,76**	**6**	**7,32**	**1**
Fibroma	3	2,38	3	3,66	1
Clogged trumpet	2	1,59	2	2,44	1
Cysts and Myomas	1	0,79	1	1,22	1
Disease of the respiratory system	**5**	**3,97**	**7**	**8,54**	**1,4**
Bronchitis and cough	4	3,17	6	7,32	1,5
Asthma	1	0,79	1	1,22	1
Diseases of the circulatory system	**4**	**3,17**	**5**	**6,1**	**1,25**
Hemorrhoids	3	2,38	4	4,88	1,33
High blood pressure	1	0,79	1	1,22	1
Endocrine, nutritional and metabolic diseases and immune disorders	**4**	**3,17**	**10**	**12,2**	**2,5**
Obesity	2	1,59	2	2,44	1
Diabetes	1	0,79	5	6,1	5
Immunodepression	1	0,79	3	3,66	3
Disease of the blood and hematopoietic organs	**4**	**3,17**	**4**	**4,88**	**1**
Anemia	2	1,59	3	3,66	1,5
Spleen	2	1,59	1	1,22	0,5
Disease of the nervous system	**3**	**2,38**	**5**	**6,1**	**1,67**
Epilepsy	1	0,79	2	2,44	2
Depression	2	1,59	3	3,66	1,5
Diseases of the osteo-articular system, muscles	**1**	**0,79**	**1**	**1,22**	**1**
Rheumatism	1	0,79	1	1,22	1

The traditional healers of the Mbam and Inoubou subdivision who participated in this study use several techniques to prepare the different recipes. Decoction (60%), followed by maceration (18.97%), pulverization (10.68) and infusion (7.69%) were the most prevalent methods of preparation (Figure 4). Enema, steam bath, poultice, instillation, external bath, intimate bath, friction, and powder application constituted the means of administration. As the most used modes of administration included: oral (68.98%), enema (12.04%) and steam bath (6.94%) (figure 5).

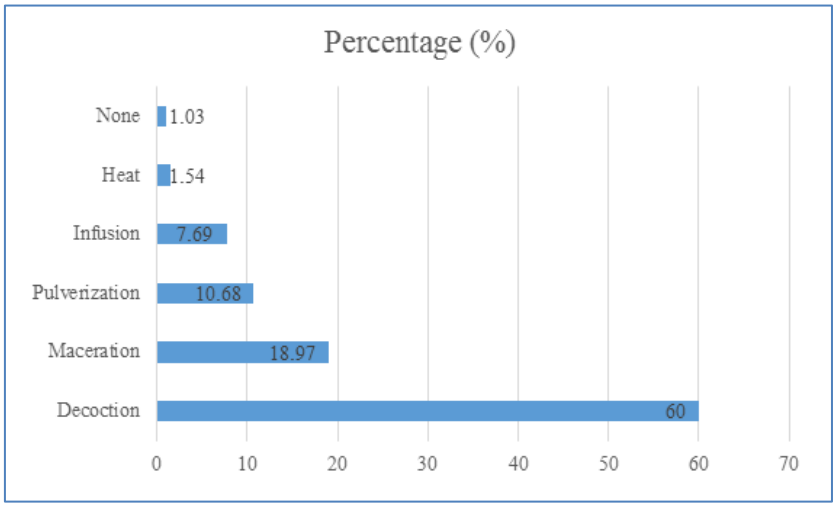

Fig-4: Methods of preparation of medicinal plant recipes

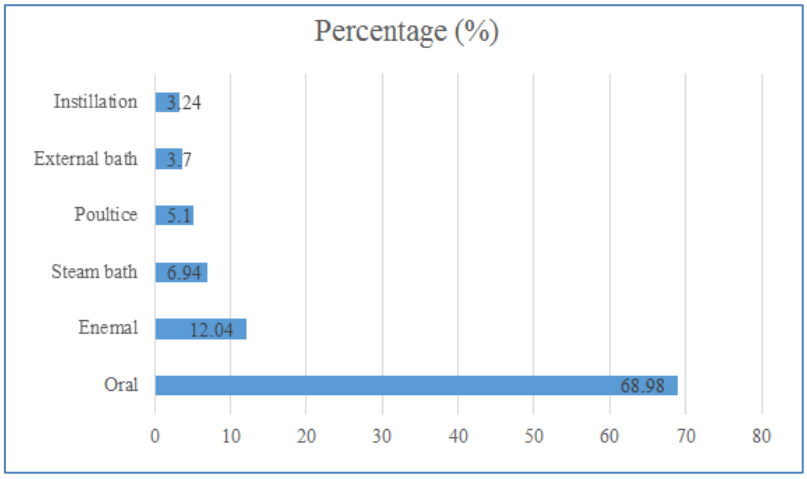

Fig-5: Method of administration of herbal treatments

DISCUSSION

The purpose of this study was to contribute to the knowledge of medicinal plants in Cameroon in general and in the Mbam and Inoubou subdivision, through the identification and characterization of recipes used by their traditional practitioners.

Characterization of medicinal plants

Eighty-two (82) botanical species were identified as having medicinal potential. This result showed the rich and diversity of the pharmacopoeia found in the Mbam and Inoubou subdivision. Fabaceae, Euphorbiaceae, Asteraceae, Poaceae, Apocynaceae and Sterculiaceae were the most represented botanical families. These families are among those with a strong representation in medicinal plants. Indeed, numerous phytochemical and ethnopharmacological studies of species that belong to these botanical families have revealed their potential in secondary metabolites such as polyphenols, alkaloids, flavonoids, coumarins, saponosides, responsible for many pharmacological properties [12-14].

These listed plant species are typically used by the traditional therapists of Mbam and Inoubou for 55 therapeutic indications. *Ageratum conyzoides* L, *Citrus medica* L, *Carica papaya* L, *Elaeis guineensis.* Jacq. *Senna alata* (L.) Roxb, *Cymbopogon citratus* (DC.) Stap, *Euphorbia hirta* L, *Musa paradisiaca* L. *Psidium guajava* L and *Annona muricata* L represented the ten most important species, based on the number of citation. Indeed, these species were the most cited by different informants and they are well known in Cameroon and even in the African traditional medicine. Numerous ethnopharmacological studies have mentioned the interest of these plants for the same therapeutic indications including malaria, diabetes, jaundice, scabies, headache, fever, dermatosis, ascites, epilepsy, skin rashes, gonorrhoea, intestinal worms, arterial hypertension and salmonellosis [2,15-19]. These results would reinforce the therapeutic interest of the plants elicited in traditional therapeutics and would thus constitute a database for pharmacological and toxicological studies which are essential for the development of new drugs.

Characteristics of herbal recipes

The therapies proposed by the Mbam and Inoubou traditional therapists are diverse. One hundred and twenty-six (126) recipes prepared from one or more plants or parts of plants were described. The interest in leaves can be explained by the fact that herbaceous plants, for which the most used organ is the leaf, represent the most abundant morphological type in the Mbam and Inoubou subdivision, characterized by the presence of vast savannah Moreover, the biosynthesis that usually takes place on the leaves may protect the body and may be responsible for the biological properties of the plant, through the mechanism of photosynthesis [20]. The prevalence of leaves in the recipes proposed by the traditional healers of Mbam and Inoubou is common to the majority of ethnobotanical and ethnopharmacological studies in Cameroon or in Africa [11, 14, 19].

Decoction followed by maceration was the most commonly used preparation methods. In the present study, water, which was the only solvent used for these two processes, was recognized to be among the best extraction solvents. In fact, water is known to be among the solvents allowing the extraction of the majority of the chemical constituents of a plant [21]. According to the traditional therapists interviewed, decoction would extend the shelf life of the preparation as compared to a cold process such as maceration. The work of Kouadio *et al.* [22], Dibong *et al.* [19] and Bayaga *et al.* [11] also emphasize the preference of decoction as a method of preparing recipes.

The preparations were mainly administered orally, and numerous studies, in particular those of

Dibong *et al.* [19] in Cameroon, showed that the oral route was the most frequently used in traditional medicine. Most of the recipes identified in the present study were multi-specific, involving at least two plant species. Several studies on traditional treatments in Africa have highlighted this complexity in the preparation and content of traditional remedies, which rarely included a single plant [11, 23]. This form of association of various medicinal species in treatments may present risks of interactions or toxicity according to Yemoa *et al*. [23]. It would therefore be essential to conduct phytochemical and pharmaco-toxicological studies of the recipes and plants identified here.

The medicinal plants identified were involved in the treatment of fifty-seven (57) diseases, of which malaria (12 recipes and 16 plants) was the most cited. The same observation was made by Dibong *et al*. [19]. This was explained by the fact most symptoms of malaria (headaches, fever, sweating, chills, diarrhea, vomiting, jaundice, etc.) are well known to the population, who, lacking the financial means to confirm the diagnosis, resort to traditional plant-based medicine to regain their health [19]. The lack of respect for environmental hygiene measures coupled with the reduced use of impregnated mosquito nets by the population, despite the efforts of the government, may justify the prevalence of this disease.

Limitations of the study

The main difficulty encountered was the reluctance of the informants, despite the assurances and all the explanations given. Some of the traditional healers were very reluctant to provide information about plants and recipes, putting forward numerous arguments, including the fact that their knowledge was a family secret and even a trade secret. These difficulties may explain the size of our sample and the fact that not all the districts in the subdivision were represented in our study.

CONCLUSION

This ethno pharmacological survey of 17 traditional healers located in six (06) villages that belong to three districts of the Mbam and Inoubou subdivision revealed the rich and diverse use of medicinal plants. These findings attest the level of knowledge of medicinal plants and the dependence of the local population for primary health care. Also, phytochemical and pharmaco-toxicological studies must be carried out to shed light on the scientific and therapeutic evidence of the plant species identified in this study.

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AUTHORS' CONTRIBUTIONS

Hervé Narcisse Bayaga contributed to the design and structuring of the study, the collection of data in the field, the literature search, the analysis and interpretation of the data, and the drafting, discussion and finalization of the article. Nicole Marie Guedje contributed to the design and structuring of the study and the critical revision of the article. Marc Olivier Ondoua Nguelé, Njinkio Nono Borgia Legrand contributed to the literature search and discussion of the results. Ngameni Bathélemy, Fokunang Charles and Bonaventure Ngadjui Tchaleu contributed to the design and structuring of the study.

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