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Ethnobotanic survey of plants used in the treatment of diarrhea in the MIFI division, West region of Cameroon

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Abstract
Introduction: Plants are a major source of active ingredients that can be used to treat many diseases, including diarrhea. The objective of our study was to identify the plants used in traditional medicine to treat diarrhoea in the Mifi Division (West Cameroon region).
Methods: From January 2013 to June 2014, an ethnobotanical survey was conducted among 66 traditional healers through direct interviews using a semi-structured questionnaire.
Results: The average age of the interviewed traditional practitioners surveyed was 53 ± 13.4 years and the majority were male. This survey enabled us to identify 93 plant species belonging to 51 families. The most represented families were Asteraceae (16.67%), Euphorbiacea (10.60%). These taxa are mainly herbs (86.36%). The most frequently used plant is Psidium guajava (28.78%) followed by Euphorbia hirta (22.72%) and Musa sapientum (22.72%). The most commonly used plant part is the leaves (25%). The main method of preparing recipes remains maceration (40.9%) and raw recipes (40.9%). The most commonly used mea of administration is the oral route (92%).
Conclusion: This study confirms the richness of Cameroonian flora in the treatment of diarrhoea in the Mifi Division.

Keywords: Diarrhea, ethnobotany, medicinal plants, traditional healers

Introduction
Health problems have always been a major challenge for human beings. Faced with this challenge, the international community and the government authorities have been strongly mobilised. Despite this strong mobilisation, some diseases including diarrhea still remain a real public health concern due to their frequency and severity [1]. The probability of an inhabitant of the sub-Saharan Africa to contract diarrhea is 39.1% against 6.9% for a resident of developed countries [2]. The causes of diarrhoea are diverse and varied ranging from non-infectious (side effects of certain medicines, food intolerances, hereditary, emotional) to infectious (bacterial, viral, parasitic or fungal) origin [3]. Several control and management strategies involving prophylaxis and curative treatment are adopted [3]. Chemotherapy not only can cause more or less serious side effects, but it is expensive, restrictive and is associated with the risk of promoting resistant microbial strains. In fact, many cases of multi-resistant bacteria and fungi have been reported in sub-Saharan Africa. Population growth and poverty in developing countries limit access to a good health care system, which justifies increased demand for traditional medicines [4]. In addition to these constraints, financial resources cause the populations of developing countries to turn definitively to traditional medicine for the management of diseases [5]. Improved herbal drugs deriving from plant extracts could then be an alternative. Of the hundreds of thousands of plant species in the world's flora, only about 250,000 have been described and listed; barely 2,000 to 3,000 of them have been the subject of scientific, chemical or pharmacological studies. Many species, especially those growing in the forests of Equatorial Africa, South-East Asia, South America or the Pacific Islands, are still unknown [6]. Though several ethnobotanical studies have been conducted, much research is still needed to explore cameroonian medicinal plants for their biological properties including pharmaco-toxicological, anti-diarrheal activities in order to scientifically validate their therapeutic virtues [7]. Thus, research should be oriented towards the development of effective, antidiarrheal, less toxic and less expensive improved traditional medicines (MTAs). The present work was aimed at identifying the plants used in the Mifi Division, West region of Cameroon for treating diarrhea.

Method

Study site

The ethno botanical survey was conducted in the Mifi Division, West Region of Cameroon. It has a population of 301456 and an area of 402 km^2 with a total density of 749.9 inhabitants per km^2 [15].

Fig 1: Map of the MiFi Division [16].

Plant and technical material

For this study, conventional equipment was used to collect the various information and plant samples. These include survey sheets, pruning shears, newspaper and cardboard folders, digital cameras.

Sites visited

The Mifi Division is composed of 39 villages. We conducted a nonprobability sampling called oriented selection as a sampling method. Most villages were selected on the basis of their different health areas (yagou, badienbou, Famla, king place, djeleng, batoukop, bapi, bayé, tchanda, famtchouet, djiétcha, tyo, lafé, kongso, djunang, wouong, toket, keuleu, kouogouo, kamkop) to obtain information that is fairly representative of the Division. The following choices emerge:

- The sub division of Bafoussam 1st: batoukop, famtchouet, fou'sap, mbow, tyo
- The sub division of Bafoussam 2er: baleng, bandeng, néfoloum, tchanda
- The sub division of Bafoussam 3er: bamoungoum, bapi, kamkop, la'tsit, djunang, Wong, nkabang

Data collection

To carry out this study, the research protocol was submitted to the Institutional Ethical Committee of the Université des Montagnes to obtain ethical clearance. In addition, an administrative authorisation from the senior divisional officer of the Mifi Division to carry out research work within his territorial jurisdiction was also granted. Then we met with the chief of the district health Centre to get the list of traditional health practitioners registered in that health district. Depending on the health areas (20 in total), we solicited the assistance of the traditional healers for information and their presence during the fieldwork. Once in the field, volunteers were interviewed and data were stored onto a survey card. During the fieldwork, each plant was observed in its natural environment before snapping and sample collection. The plant material was then inserted between two woods perforated with holes, and strongly tied with a rubber after spraying with 95% alcohol and then dried.

All the plant materials were identified at the Cameroon National Herbarium (families, genera, and species) under specific reference number.

Data processing

The data stored on the survey sheets were entered in the Microsoft Excel software for analysis. The frequency of citations of the plants was determined by the following formula:

Frequency of quotation = (number of times the species is quoted in the recipes) / (number of people surveyed).

Results

Sociodemographic profile of traditional healers

Results in Table 1indicate that out of 66 traditional healers (TPs), 47 (71.2%) were males while 19 (28.8%) were females. Their average age was 53.85 ± 13.4 years ranging from 26 to 90 years. The TPs in the Mifi Division were distributed into six age groups ([25 - 35 years [, [35- 45 years [, [45 - 55 years [, [55 - 65 years [, [65 - 75 years [, [75 - 90 years]). Majority of the TPs (28.8%) fell in the age range [45 - 55 years, while the minority (3%) was in the interval [25 - 35 years]. In addition, this Table shows that 72.7% of these TPs went to school, of whom 34.8% reached a secondary level, 19.7% reached a primary level and 18.2% had a university level. Based on religion, 31.8% were pagans, 28.8% were Catholics, 22.7% were Protestants and 16.7% were Muslims. The knowledge of traditional medicine of most of the tradipratitians was acquired within family secrecy (37), while 26 were initiated into traditional medicine outside the family.

Table 1: Sociodemographic profile of traditional healers in the Mifi Division

Variables	number of citations by traditional practitioners
Sex	
Male	47
Female	19
Age group	
[25 – 35]	2
[35 – 45]	16
[45 – 55]	19
[55 – 65]	15
[65 – 75]	9
[75 – 90 ans]	5
Education profile	
Illiterate	18
Primary school	13
Secondary school	23
University	12
Religion	
Pagans	21
Catholic	19
Protestants	15
Muslims	11
Origin of knowledge on traditional medicine	
exclusive familial inheritage	37
divine revealation	17
traditional initiation	26
Others	7

The occupation of traditional healers is shown in Figure 1 below. Results reveal that only 19% of the participants were full-time traditional healers while the majority (45%) worked in agriculture and livestock. The remaining 21% were either doing business or other activities.

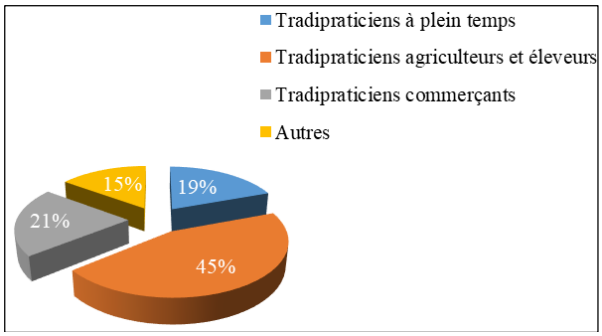

Fig 1: Occupation of traditional healers

Causes of diarrhea according to traditional healers

The traditional medicine-based causes of diarrhea are described in Table 2 below. Based on the survey carried out in the Mifi Division, the causes of diarrhea are of several categories. Food poisoning, poor hygiene and microbial infections were the main causes.

Table 2: Causes of diarrhea according to traditional medicine

Variables	number of citations by traditional practitioners
Causes of diarrhea	
Microbial infections	37
Chemicals	12
Malnutrition	31
Food poisoning	54
Bad hygiene	52
Allergies	19
Tradional practices	27
Others	14

Manifestations of diarrhea according to traditional healers

Results in Table 3 describe signs of diarrhea as perceived by the traditional practitioners in the Mifi Division. These manifestations include loose stool (more than 3 times/day), abdominal pain and cramps, signs of dehydration and asthenia which are the most representative and cited respectively by 60, 37, 33 and 29 of respondents.

Management of diarrhea by the traditional healers

The non-pharmacological management of diarrhea in traditional medicine is illustrated in Table 4. Results indicate that its non-pharmacological management by the traditional healers was based on dietary and hygiene measures such as washing hands with clean water and soap (51), hydration of patients with drinking water (48).

Table 3: Signs of diarrhea according to the traditional healers

Variables	number of citations by traditional practitioners
Signs of dirrhea	
Fever	15
Loose stool and frequency (> 3 times/day)	60
Abdominal pain and cramps	37
Asthenia	30
Dehydration	33
Nausea & vomiting	29
Anorexia	14
Others	7

Table 4: Management of diarrhea by traditional healers

Variables	number of citations by traditional practitioners
Hygiene and dietary measures	
Handwashing with water and soap	51
Hydration	48
Others	7

The parts of plants used for the preparation of drugs

The parts of plants used for the preparation of anti-diarrheal medications and routes of administration are described in Figure 2 (Data not shown). The ethnopharmacology survey revealed that the composition of anti-diarrheal recipes was mostly made up of plant leaves (25%) (Figure 2). The primary route of administration was oral (92%), whereas the anal, scarification and dermal routes were represented at 2%, 3% and 3%, respectively (Figure 2).

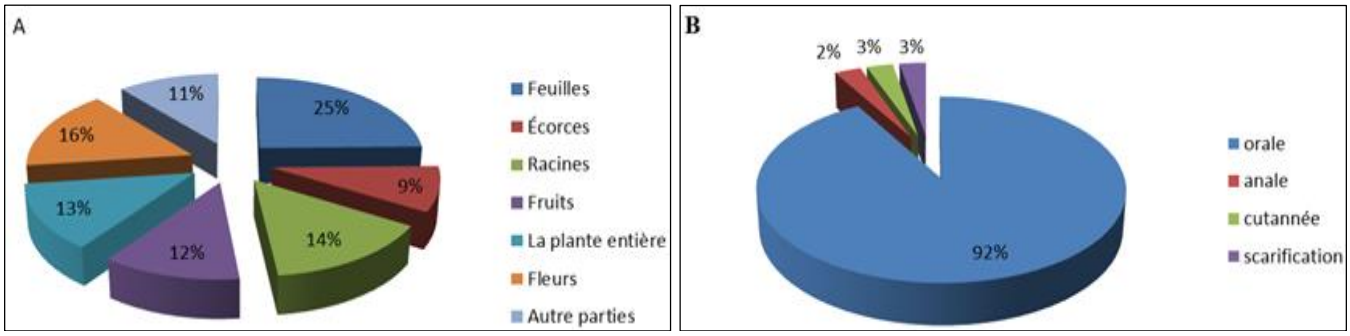

Fig 2(a, b): les parties de plantes utilisées pour la préparation des médicaments anti-diarrhéiques et voies d'administration respectivement

Mode of preparation of traditional medicines

Table 5 summarises the different ways of preparing traditional herbal medicines. Results show that the raw recipes or maceration recipes were the most cited (27) followed respectively by decoction (23) and calcination (18).

Table 5: Mode of preparation of traditional medicines

Variables	number of citations by traditional practitioners
Mode of preparation	
Maceration	27
Decoction	23
Infusion	4
Raw	27
Calcination	18
Others	16

Plant Condition and Location of harvesting

The descriptions of the harvest conditions and plant locations by traditional healers are shown in Table 6. Results indicate that only 16.7 % of samples had unknown harvest conditions whereas most of the traditional healers preferred to harvest mature plants (63.6%). In terms of location, savannah (75.2%) was the most represented plant locations.

Table 6: Plant harvesting conditions and locations by TPs

Variables	number of citations by traditional practitioners
Harvesting conditions	
At maturity	42
Unknown haevesting conditions	19
Any plant developmental stage	21
Other haeveting conditions	11
Biotope	
Forest	44
Savanah	50
Garden	49
Other places	31

Harvest time, harvesters, origin and conservation of plants

The results of the survey on the harvest period, harvesters, origin and conservation of medicinal plants used as anti-diarrheal drugs are listed in Table 7 below. It is indicated that majority of the respondents (49) collected the plant materials at all seasons, 52 of them did the harvest themselves, 59 use plants of natural origin and 16 opted to keep the plant material cool.

Table 7: Harvest period, harvesters, origins and conservation of plants

Variables	number of citations by traditional practitioners
Period of harvest	
All season	49
At the sunrise	47
At sunset	37
At any time of the day	39
Other	14

The harvester	
The healer	52
The patient	22
The one who knows	18
Other	11
Plant origin	
The artificial plant	26
The natural plant	59
Other	11
Conservation of plant material	
Fresh	14
Kept cool	16
Other	10

Botanical characteristics and diversity of plant with antidiarrheal properties

Results reported in Figure 2 reveal 93 plant species belonging to 51 families. The most represented families were Asteraceae with 11 species namely *Dichrocephala integrifolia*, Bidens pilosa, *Erigeron floribundus*, *Taraxacum officinale*, *Lactuca* sp, *Spilanthes filcaules*, *Emilia* sp, *Ageratum conyzoides*, *Dichrocephala integrifalia*, *Coco nucifera*, *Vernonia* sp. Euphorbiaceae and Malvaceae were represented by seven species each followed by Fabaceae, Rutaceae, Annonaceae, Apiaceae with 4 species, Cucurbitaceae, Acanthaceae with three species each. Six families were represented by two species each and 35 represented by one species each (Figure 2 below).

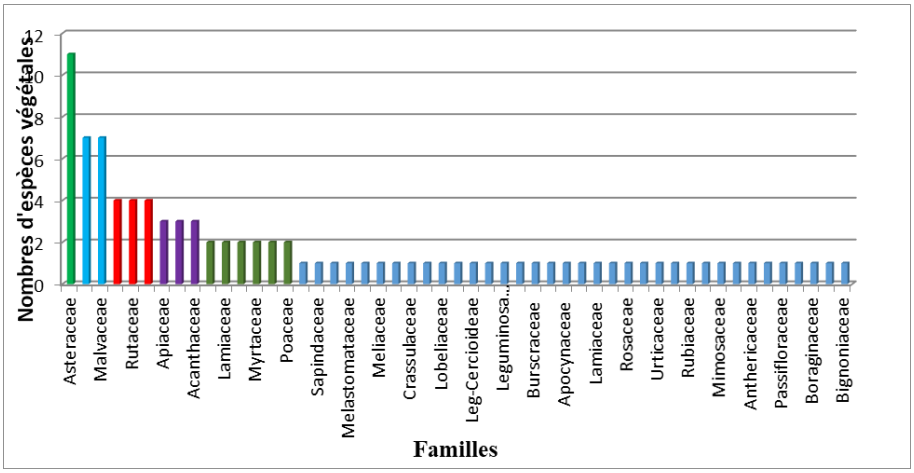

Fig 3: Distribution of identified plant families according to the number of plant species cited.

The plants listed have been grouped by family in Table 8. Each plant is followed by its botanical description, the number of citations by respondents, the name of the collector, its harvest number, its reference to the National Herbarium of Cameroon and its other therapeutic properties as cited by tradipractitioners (TPs). It appears from this table that 9 plant species were mentioned at least 5 times. These include Psidium guajava, which has been mentioned 19 times, Euphorbia hirta and Musa sapientum, each mentioned 15 times, Cola anomala, Vernonia sp, Euphorbia hymifolia, Mangifera indica, Zea mays, Dichrocphala integrifolia, each mentioned 5 times.

Table 8: Different plants listed and grouped by family

3	N°	Scientific name	Common names	Number of citations by TPs	Botanical description /Nature	Harvesting location	Collector. & Number	Ref HNC	Other traditional uses
	1	*Ageratum conyzoides*	Roi des Grasss	3	Grass	Bamougoum	C.N.A.D. 1762	23645	Antidiabetic, mystical diseases
Asteraceae	2	*Bidens pilosa*	Lielianiock	3	Grass	Baleng	R.letouzey 3417	48711SRFR	Antibacterial, anti-malarial
	3	*Coco nucifera*	Noix de coco	2	Shaft	Dschang	----------	----------	Anti-tumor, anti-fungal
	4	*Conyza aegyptiara*	mévévétcheu	1	Grass	Bandenkop	Letouzey R. 4670	5604	Colic, antimalarial
	5	*Dichrocephala integrifolia*	Bacfack	5	Grass	Bafoussam	R.Letouzéy 4657	5603/SRECM	Anti-malarial, antiemetic
	6	*Emilia sp*	Grass au lapin	1	Grass	Bafoussam	----------	----------	Antimicrobial
	7	*Erigeron floribundus*	Queue de cheval	1	Grass	Bafoussam	SCA	36014/HNC	Antimicrobial
	8	*Lactuca sp*	Tse-tsé	1		Bamoungom			Antipyretic
	9	*Spilanthes*	Œil de poule	4	Grass	Bafoussam	Letouzey R.	6584	Anti inflammatory

		filcaules					5916		
	10	*Taraxacum officinale*	Pissenli	1	Grass	Bafoussam	Dang D. 315	25627	Hypolipemic
	11	*Vernonia sp*	Ndolé	6	Bush	Bafoussam	----------	----------	Antimicrobial
Family	N°	Scientific name	Common names	Number of citations by TPs	Botanical description /Nature	Harvesting location	Collector. & Number	Ref HNC	Other traditional uses
	12	*Euphorbia hirba*	Euphorbe	15	Grass	Bafoussam	Letouzey 4659	5691	Vermifuge
	13	*Euphorbia hymifolia*	Plante lait de bébé	5	Grass	Bamoungoum	J.A raynal 9792	11327 SRF Cam	Antibacterial
Euphorbiaceae	14	*Hemenocardia acida*	----------	1	Shaft	Foumban	R.Letouzey 2589	3257/SRFK	Anti fertility
	15	*Jatropha curcas*	Jatropha	1	Bush	Bafoussam	Damg Daniel 549	25713/SRF/Cam	Sexually Transmitted Diseases
	16	*Lobelia columnaris*	Voacanya	1	Shaft	Bamoungoum	SCA 909	32976HNC	Anti oxidant, anti inflammatory
	17	*Phyllanthus anaris*	----------	1	Grass	Bamoungoum	JαA.Raynal 10652	11293SRF/Cam	Anti inflammatory
	18	*Phyllantus sp*	Chanca piedra	1	Grass	Bafoussam	----------	----------	Anti hepatitis B
Malvaceae	19	*Cola anomala*	Kolatier	14	Shaft	Bamoungoum	Cheek M. 9069	61266	Anti microbial
	20	*Hibiscus lobatus*	ombrelle blanche	1	Grass	Bafoussam	R.Letouzey 7122	8521	Hepatoprotective
	24	*Sida rhombifolia*	Sessam	1	Grass	Baleng	R.letouzey	3390SRFK	Antipyretic
	21	*Hibiscus Rosasinensis*	Hibiscus	1	Bush	Bamoungoum	----------	----------	Fertility, antidiabetic
	22	*Hibiscus sp*	Fleur de biscuit	1	Bush	Bafoussam	----------	----------	Anti hypertensive
	25	*Hibiscus Surattensis*	Kikicrock	1	Grass	Baleng	R.Letouzéy 2500	3389/SRFK	Anti inflammatory
	23	*Sida sp.*	Rocher	2	Grass	Baleng	----------	----------	Anti typhoid
Family	N°	Scientific name	Common names	Number of citations by TPs	Botanical description /Nature	Harvesting location	Collector. & Number	Ref HNC	Other traditional uses
Fabaceae	26	*Arachis hypogaea*	Béang	1	Grass	bamoungoum	Dang D. 82	18614	coughing
	27	*Desmodium sp*	lelempieuh	1	Grass	Baleng	----------	----------	Anti-spasmodic
	28	*Guibourtia tesmannii*	Esynga	1	Shaft	Foumbot	----------	----------	Sexual weakness
	29	*Tamarindus indica*	Tamarin dus	1	Shaft	Bafoussam	----------	----------	Anti-malarial, anti-inflammatory
Rutaceae	30	*Citrus maxima*	pamplemousse	1		bamoungoum	Gayum H. 1	65106	Hepatoprotective
	31	*Citrus reticulata*	Mandarine	1	Bush	Baleng	Dang D. 554	25858	Anti fungal
	31	*Citrus sirensis*	Orange	1	Bush	bamoungoum	Dang D. 551	25859	spasmolytic, antibacterial
	32	*Zanthoxylum tessmannii*	Fagara	1	Shaft	Bandenkop	Nana P. 229	19146	
Annonaceae	33	*Annona muricata*	Corosole	2	Shaft	Bafoussam	Ogu 146	32879	Anti cancer, anti inflammatory
	34	*Annona senegalensis*	Goyave sauvaye	1	Bush	Foumbot	Ralzy P.70	14813SRF/Cam	Anti microbial
	35	*Xylopia aethiopica*	Poivre de guinée	1	Shaft	bamoungoum	Letouzey R. 546	1914	Anti infertility
Family	N°	Scientific name	Common names	Number of citations by TPs	Botanical description /Nature	Harvesting location	Collector. & Number	Ref HNC	Other traditional uses
	36	*Xylopia africana*	Poivre africain	1	Shaft	bamoungoum	Gosline 75	61048	Condiment
Apiaceae	37	*centella asiatica*	Centella	1	Grass	Bamoungoum	R. Letouzey 3946	5430/SRFK	Antiutussive, antiepileptic
	38	*Daucus carota*	Carotte	2	Grass	Bamoungoum	Dang D. 514	25579	Anti inflammatory
	39	*Sanicula elata*	quinte feuilles	1	Grass	Bafoussam	SCA 671	32913HNC	Anti ulcers
Curcubitaceae	42	*Coccinia sp*	Cinq doigts	1	Grass	Bandenkop	----------	----------	Sexual weakness
	41	*Momordica Cissoides*		1	Grass	Bandjoun	Letouzey R. 4607	5639	Anti-malarial
	40	*Zehnaria scabra*	Leulap	1	Grass	Baleng	OSTE 1127	22152SRFm	Antibacterial
Acanthaceae	43	*Asystasia gangetica*	Vègne	1	Grass		R.letouzey 2725	29031SRFR	Anti-asthmatic, analgesic, anti inflammatory
	44	*Eremomastax*	rouge d'un	1	Grass	Bafoussam	R.Letouzéy	16371/SRF Cam	Anti-secretory, anti

		speciosa	coté				8274		anaemic, anti-microbial
	45	*Graptophyllum pictum*	Vine rouge	1	Bush	Bafoussam	----------	----------	Anti inflammatory
Musaceae	46	*Musa parasidiaca*	Plantain	3	Grass	bamoungoum	----------	----------	Antispasmodic
	47	*Musa sapientum*	Banane cochon	15	Grass	Bafoussam	----------	----------	Antibacterial, antidepressant
Family	N°	Scientific name	Common names	Number of citations by TPs	Botanical description /Nature	Harvesting location	Collector. & Number	Ref HNC	Other traditional uses
Lamiaceae	48	*Mentha sp*	La melisse	1	Grass	Bafoussam	----------	----------	Anti-stress
	49	*Ocimum gratissimum*	Massep	1	Grass	Baleng	Leeuwenberg A.J.M 10685	49083	Anti inflammatory
Commelinaceae	50	*Commelina sp*	Wouewoue	1	Grass	Bafoussam	----------	----------	Antibacterial, antipyretic
	51	*Commelina benghalensis*	wouewoue	1	Grass	Baleng	Letouzey R. 14242 37189	37189	Hypolipemic
Myrtaceae	52	*Psidium guajava*	Goyave	19	Shaft	Bafoussam	Mpom.B.312	2884/SRFK	Antibacterial, antifungal antidiabetic, antimalarial
	53	*Ecalyptus sp*	Eucalyptus	4	Shaft	Bafoussam	----------	----------	Anti inflammatory
Solanaceae	54	*Solanum aculeastrum*	Aubergine sauvage	1	Bush	Bafoussam	Swarbrick 2395	SCA 12871	Anti microbial
	55	*Solanum indicum*	Guedjeu	1	Grass	Baleng	----------	----------	Anti helminthic
Poaceae	56	*Saccharum officinarum*	Canne à sucre	1	Grass	Bafoussam	Dang D. 227	25820	Anti hemorrhagic
	57	*Zea mays*	Mais	5	Grass	Bafoussam	----------	----------	Anti-hypertensive
Portulacaceae	58	*Portulaca oleracea*	leulobooh	1	Grass	Bamoungoum	Surville N 615	14491 SFR.Cam	Antidiabetic, anticancer, antimicrobial
Family	N°	Scientific name	Common names	Number of citations by TPs	Botanical description /Nature	Harvesting location	Collector. & Number	Ref HNC	Other traditional uses
Sapindaceae	59	*paullinia pinata*	Nduhh	2	Grass	Bafoussam	Mpom benoit 313	2734 SRF	Antithypoid, antidiabetic, antifungal
Piperaceae	60	*Piper capense*	Ombrelle noir	1	Grass	Bafoussam	8836	17432/SRF/Cam	Anticancerous
Melastomataceae	61	*Dissotis sp*		1	Grass	Foumban	----------	----------	Antimycobacterial
Crassulaceae	62	*Bryophyllum pinnatum*	tankeyou	1	Grass	Bafoussam	JαA.Raynal 10878	11098SRF/Cam	Antihypertensive
Meliaceae	63	*Azadirachta indica*	Neem	2	Grass	Bafoussam	Sans collecteur	4447SRFK	Anti hemmoragic, anti bacterial
Oxalidaceae	64	*Oxalis corniculata*		1	Grass	Bafoussam	Letouzey 6889	8680/SRF/Cam	Anti-diabetic
Crassulaceae	65	*Kalanchoe crenata*	tankeyou	3	Grass	Bafoussam	JαA raymal 9453	11097/SRF Cam	Analgesic, anti-convulsive
Amaranthaceae	66	*Achyranthes asper*	Courage	1	Grass	Bamoungoum	2949	2919/SRFK	Anti inflammatory, anti diabetic
Lobeliaceae	67	*Lobelia columnaris*	Voacanga	1	Shaft	Bafoussam	SCA909	33976HNC	Contraction inducer
Scrophilariaceae	68	*Scopania dulcis*	Jujube en Grass	1	Grass	Baleng	Ed.boounougow 66	8943/SRF/Cam	Antimicrobial, anti-fungal
Leg-Cercioideae	69	*Ptiostigma thonningie*	Pien	1	Shaft	Foumbot	SCA369	33238HNC	Anti-diabetic
Family	N°	Scientific name	Common names	Number of citations by TPs	Botanical description /Nature	Harvesting location	Collector. & Number	Ref HNC	Other traditional uses
Polygonaceae	70	*Polygonum salicifolium*	polygonacea	1	Grass	Bafoussam	Check 9011	61231HNC	Anti diabetic, anti cancer, anti inflammatory
Leguminosa Papihonordeae	71	*Abrus canescens*	Pince gold	1	Grass	Baleng	Letouzey R. 6310	8245	
Caryophyllaceae	72	*Drymania cordata ou stellaria*	Toung toug ou oreille souris	1	Grass	Bafoussam	H.jacque felix 18995	24337/SRF/Cam	Analgesic, antipyretic, antifungal
Burscraceae	73	*Dacryodes edulis*	prunier	1	Shaft	Baleng	Mpombenoit50	1874/SRFK	Anti-diabetic, lipid-lowering

Hypericaceae	74	*Harungana madagascariensis*	Kéto	1	Bush	Bandjoun	Letouzey R. 2590	3338	Antispasmic
Apocynaceae	75	*Voacanga Africana*	voaganga	1	Shaft	Baleng	de Wilde W.J.J.O 1125	26114	anti-malarial, antifungal
Anacardiaceae	76	*Mangifenia Indica*	mango	5	Shaft	Bafoussam	Dang D. 104	18646	Anti malaria
Lamiaceae	77	Persea *americana*	avocatier	2	Shaft	Bafoussam	Guarisma 2	31940	Anti malaria
Caricaceae	78	*Carica Papaye*	papayer	3	Shaft	Bafoussam	Betti J.L 243	66220	Antidiabetic
Rosaceae	79	*Rubus fellata*	ronce	1	Grass	Bafoussam	Jacques-Félix H. 9061	25065	Anti hypertensive
Convolvulaceae	80	*Ipomoea batatas*	Patate	3	Grass	Bafoussam	Westphal 8983	42441	Anti cancer, anti-inflammatory
Urticaceae	81	*Laportea aestuans*	Orti	1	Grass	Bafoussam	Letouzey R. 5505	7460	Anti microbian
Family	N°	Scientific name	Common names	Number of citations by TPs	Botanical description /Nature	Harvesting location	Collector. & Number	Ref HNC	Other traditional uses
Caesalpiniaceae	82	*Senna occidentalis*	caspuante	1	Grass	Bafoussam	----------	----------	Anti poison
Rubiaceae	83	*Coffea sp*	café	1	Bush	bamoungoun	----------	----------	Anti malaric
Plantaginaceae	84	*Plantago sp*	plantain	1	Grass	Baleng	----------	----------	Hepatoprotective
Mimosaceae	85	*Albizia sp*		1	Shaft	Bafoussam	----------	----------	antibacterial
Moraceae	86	*Ficus sp*	Ntoch	1	Shaft	Baleng	----------	----------	antibacterial
Anthericaceae	87	*Aloe sp*	Aloe vera	3	Grass	Bafoussam	----------	----------	antibacterial
Burseraceae	88	*Canaruim schweinfurthii*	Fruit noir	3	Shaft	Bafoussam	Bos 6756	30666	Analgesic, anti-inflammatory
Passifloraceae	89	*Passiflora edulis*	Fruit de la passion	1	Grass	Baleng	Letouzey R 11143	30115	Analgesic
Salicaceae	90	*Populus sp*	Peupliers	1	Shaft	Bafoussam	----------	----------	antibacterial
Boraginaceae	91	*Symphytum sp*	Consoude	1	Grass	Bafoussam	----------	----------	antibacterial
Dennstaedtiaceae	92	*Pteridium aquilinum*	Fougère	1	Grass	Baleng	----------	----------	Anti poison
Bignoniaceae	93	*Martkhamia lutea*	Wane	2	Shaft	Bafoussam	----------	----------	Antifungal, anti-inflammatory

Discussion

The present study focused on the ethnobotanical investigation related to the management of diarrhea by traditional healers in the Mifi Division, West Region of Cameroon. Most traditional healers (71.2%) in the Mifi Division were males. In contrast, Holaly *et al*. (2015) reported that 51% of traditional healers were women against 49% males in Togo [8]. It was clearly indicated that the knowledge of a recipe in traditional medicine is a family secret that is transmitted from generation to generation through customs and oral tradition. Accessing the knowledge of traditional medicine necessarily requires a certain degree of maturity and trustworthiness. This may be the main reason why this profession was practiced mostly by older people who were initiated into it within the family circle. These results corroborate those of Holaly and teammates [8] who reported that more than 95% of traditional healers obtained knowledge of traditional medicine via family heritance. Moreover, the traditional healers interviewed in this study were mainly pagans. This could unveil that traditional healers venerate their ancestors as God [9]. Concerning the educational profile, most traditional healers (34.8%) reached the secondary school level. This level of education could explain the precise knowledge of these TPs on the causes of diarrhea (food contamination, poor hygiene etc.), symptoms of diarrhea (loose stools, vomiting, abdominal pain and cramps), hygiene and dietary measures to prevent dirrahoea (hand washing and hydration) and signs of healing from diarrhea (decreased stool frequency, stopping nausea and vomiting, etc). The harvest period, origin and conservation of the plant preparations as described by TPs in the Mifi region would suggest differences in the composition of these medications in bioactive metabolites. For instance, the biotic and abiotic stress to which plants are subjected influence their phytochemical composition and thus their antidiarrheal activities [10]. In this survey, the most represented plant parts were leaves (25%) followed by flowers (16%). The leaves, the flowers as well as stems, which are the most vulnerable parts of plants, were the most frequently used in medicinal preparations [11]. The preference for these particular parts may be attributed to the fact that it is in those parts that more chemical compounds, including biologically active secondary metabolites are synthesised by the plants for their defense [12]. In addition, education on good practices concerning the use of renewable plant parts (leaves) instead of roots and bark will contribute to the preservation of plant biodiversity; the ease and frequency at which leaves were harvested might also be responsible for the high rate of leaf utilisation by the population of Mifi [13]. Our results are similar to those of Nkechi *et al*. en 2011 au Nigeria, who also reported that leaves were the most used parts of the plant [14]. The plant recipes prepared by the traditional practitioners of the Mifi Division were mostly given raw or after maceration. Indeed, Barimah *et al*. (2017) have shown that the use of heat depending on its source would reduce their secondary metabolites content and consequently their activities [15]. This could explain the high use of fresh plants by traditional healers. In addition, the oral route was the preferred method by traditional healers for the administration of their medications. This route of administration has been recorded in many ethnobotanical studies [8, 16]. The ethnobotanical information obtained showed a good biodiversity of plants used in the treatment of diarrhea in the Mifi Division. In fact, 93 plant species belonging to 51 families were identified, with Asteraceae (16.7%) being the most represented family. These

results are consistent with the work of Madikizela *et al*. (2012) who also found Asteraceae as the most cited family during an ethnobotanical survey of antidiarrheal plants in the Pondoland region of South Africa [16]. In addition, other families were identified during our investigation, namely Solanaceae, Mimosaceae and Myrtaceae, which were also found in the works of Madikizela *et al*. (2012) [16]. It has also been observed that anti-diarrheal recipes could be obtained from a mixture of different plants or parts of the same plant. The majority of the recipes consisted of a single plant or in few cases from association of many plant species. The interactions of plant bioactive compounds could reduce the anti-diarrheal activity of such plant recipes [17]. This could explain why traditional healers in Nigeria made their medications from individual plant to treat diarrhea. In the present study, some traditional practitioners were skeptical and hesitant to share their knowledge on traditional medicine. This observation could underline three reasons: researchers would use their knowledge to make modern drugs for the sole purpose of making money excluding their TP partners; researchers would never come back to give the results of their work; researchers could be taken for usurpers seeking secrecy and /or traditional medicines in order to use them for their own ends.

Conclusion

This study shows that the MiFi Division has an interesting floristic biodiversity in terms of plants with anti-diarrheal properties. These results show that plant parts (leaves, flowers, roots, barks, whole plant), which were used by traditional healers to treat diarrhea derived from 93 plant species. There were several methods of preparation mainly, maceration, raw recipe, and decoction. There were three modes of drug administration: oral, scarification/cutaneous and anal. The results of this study will serve as a basis for new natural molecules in the treatment of diarrhea.

Conflict of interest statement

We declare that we have no conflict of interest.

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