



Contribution to the ethnobotanical inventory of medicinal plants used for the treatment of typhoid fever in Adamaoua region, Cameroon

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Received: 03-10-2020

Accepted: 27-12-2020

Published: 31-12-2020

ABSTRACT

Since ancient Greek-Roman times, the use of plants to cure many human diseases is still common. The present ethnobotanical survey was conducted to contribute to the knowledge of medicinal plants used for the treatment of typhoid fever in three sub divisions of Vina division, Adamawa Cameroon. After having explained the importance of this study to interviewees, 41 traditional healers have agreed and delivered information regarding the medicinal plants they use as well as the different preparation and administration through a well-structured questionnaire that was given to them on this matter. Among 41 traditional healers whose attended this study, 32 were men and 09 were women. The ethnobotanical survey allowed the identification of 70 plants belonging to 38 families. With a frequency of 11/70, the Fabaceae family was the most represented followed by that of Rubiaceae and Asteraceae (04/70 each). The leaves are the most used parts (34.28%) followed by leaves + roots (14.28%) and the whole plant (12.86%). The majority of the recipes consisted of four to six plants (34.66), and were prepared by decoction (50%), with water as the main solvent (87.80%). 41.56% of typhoid preparations are administered twice daily for a duration of 14 days (46.77%). This is the first report on antityphoid herbal remedies in Vina division-Adamawa Cameroon. It would therefore be judicious for our government and research institution to investigate on their therapeutic properties in order to develop ameliorated and efficient phytomedicines.

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Keywords: Ethnopharmacology, phytomedicine, salmonellosis, Vina division.

INTRODUCTION

Salmonellosis are one of the most important food borne diseases which affect human and animal. In human beings, three serotypes including *Salmonella typhi* (*S. typhi*), *Salmonella paratyphi A* (*S. paratyphi A*) and *Salmonella paratyphi B* (*S. paratyphi B*) are more pathogenic. These serotypes cause typhoid and paratyphoid fevers (Gatsing et al., 2010). Typhoid fever is a widespread

disease in many tropical countries. An estimated 212 million cases and 129,000 deaths occur worldwide each year (Steele et al., 2016). The global estimate of invasive non-typhoidal salmonella is about 3.4 million cases and the most vulnerable groups (1.9 million cases and 380 000 deaths) are children and young adults in sub-Saharan Africa (Njole et al., 2020).

This food and water borne disease is contacted after consumption of infected raw or semi cooked meat. The clinical manifestations of typhoid fever are usually nonspecific, such as sustained fever with fatigue, headache, abdominal pain, vomiting, or anorexia. Various organs, including the liver, have been involved in the course of typhoid fever, resulting in a wide spectrum of presentations (Habte et al., 2018).

Despite the permanent progress in pharmaceutical companies, resistance to different drug classes (Mfopa et al., 2017; Etou et al., 2019) has become an increasingly important problem (Madhulika et al., 2004, Lakshmi et al., 2006) especially in Subsahelian Africa where the income of $\frac{3}{4}$ of the total population do not allow them to afford and/or achieve antibiotherapy. In addition, although three vaccines are currently recommended by the WHO to prevent typhoid: an injectable vaccine on the purified Vi antigen (aka ViPS vaccine), the live attenuated oral Ty21a vaccine in the first instance and the latest generation typhoid conjugate vaccine (TCV), there is to date no vaccine against paratyphoid fever (Agwu et al., 2009). Natural products and mostly medicinal plants are thus the corner stone of health care delivery for these populations.

In Cameroon, several studies have revealed the effectiveness of the use of medicinal plants in the treatment of typhoid fever (Gatsing et al., 2005; Fodouop et al., 2015; Kengni et al., 2016; Lunga et al., 2014a; Tala et al., 2018; Sokoudjou et al., 2018; Sokoudjou et al., 2019). Therefore, there is no longer any doubt about indigenous knowledge and the use of medicinal plants to treat typhoid fever in Cameroon. Since this knowledge is held by adults and fewer young people are interested in ethnomedicine, it is important that this knowledge is documented and preserved for future research on efficacy and safety as well as the identification of chemical compounds that could serve as a marker for the development of standardized bioantibiotics.

Thus the present work aimed at carrying out an inventory of medicinal plants used for the treatment of typhoid fever in three localities of the Adamaoua region (Mbe, Martap and Ngaoundere 3) in order to know

whether there is a consensus on the indigenous use of medicinal plants from different localities.

MATERIALS AND METHODS

Study area

The Vina division was created from the breakup, in 1983, of the old Adamaoua division into five new divisions: Djerem, Faro et Deo, Mayo-Banyo, Mberé and Vina. The Vina Division has eight subdivisions: Belel, Mbe, Nganha, Ngaoundéré I^{er}, Ngaoundéré II^e, Ngaoundere III^e, Nyambaka, Martap. It covers an area of 17196 km². In 2005, its total population was estimated at 156050 (9.1 inhab/km²) (ASC, 2013).

The Adamaoua region is located between the 6th and 8th degrees of north latitude and between the 11th and 15th degrees of east longitude (Lamy et al., 2018). It is made up of all the high plateaus which cross it from West to East (Figure. 1). Its median position between the southern and northern parts of Cameroon makes this region a crossing point between the forest and the savannah, at the same time as it is a watershed. She was rightly baptized "Cameroon water tower".

As for the climate, it is of Sudano-Guinean type with 02 seasons: a rainy season going from April to October and a dry season from November to March. The annual rainfall from 1600 to 1800 (mm) is spread over 7 to 8 months (Lamy et al., 2018). The soil, mainly consists of red ferralitic structures developed on old basalts. Various types of vegetation are also observed there. They range from meadows to shrub savannas to tree savannas dominated by *Daniellia oliveri* and *Lophira lanceolata*. The density of these characteristic species is clearly decreasing due to anthropogenic action (Mapongmetsem et al., 2012). Concerning the populations, they are composed of several ethnolinguistic groups of unequal distribution, the most representative of which are: Dii or Dourou, Gbaya, Haoussa, Mbororo, Mboum and Peulh (Mapongmetsem et al., 2009; Tchobsala and Mbolé, 2013). The study area includes three subdivisions of the Vina division namely: Mbe, Martap and Ngaoundéré III^e.

Data collection

An ethnobotanical survey took place from June to November 2017 as previously described by Yemele et al. (2014), and it included forty one traditional healers aged between 15 and above 75 years. They were interviewed according to a questionnaire which was previously drawn up and comprised: the types of medication (medicinal plants or pharmaceutical products) used whenever sick; and for each medicinal plant used its medical use, part used during the preparation, mode of preparation, route of administration, the solvent used, the dosage, the duration of treatment and consumer's degree of satisfaction relatively to each treatment were noted. Interviews were conducted on the field during collection trips and after examination and seeking oral consent from informants, fresh plant

specimens were collected, dried and stored in the laboratory. They were later identified at the Cameroon National Herbarium Yaoundé where their full scientific names and voucher number were obtained.

Data analysis

Descriptive statistic was used in this study. First of all, the information about the popular uses of the species collected, along with botanical information, was compiled into a database. The species were listed in alphabetical order by family, scientific name and frequency of use. The frequency of citation (FC) of the used plant species was evaluated using the following formula: FC (number of times a particular species was mentioned/total number of times that all species were mentioned).

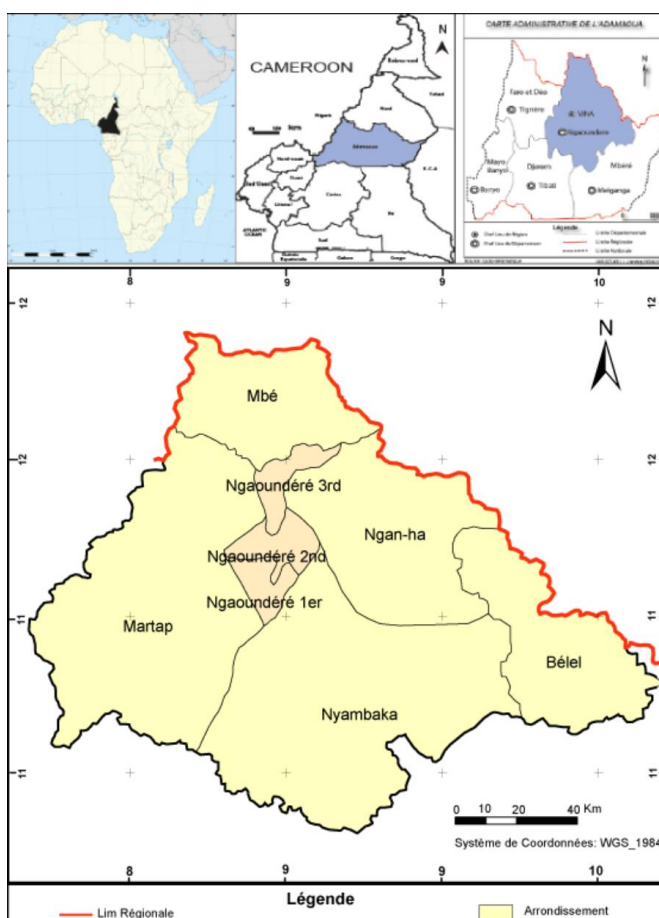


Figure 1: Study area (from the PSFE, 2010 database).

RESULTS

Demographic characteristics of informants

Among the 41 traditional healers interviewed during this study, 32 were men and 9 women (Table 1). This table also shows a fair distribution of age-related surveys. With a frequency of 16/41, Mbe town had the highest numbers of traditional healers who participated in the inquiry (Table 1).

Different plant species recorded and origin of the knowledge

70 plants belonging to 38 families were identified (Table 2). With a frequency of 11/70, Fabaceae was the most represented family followed by that of Rubiaceae and Asteraceae (04/70 each). *Persea americana* (20/308) *Annona senegalensis* 17/308; *Carica papaya* 17/308 ; *Psidium guayava* (17/308) *Citrus limon* (11/308); *Mangifera indica* (14/308); *Piliostigma thonningii* (11/308) and *Harungana madagascariensis* (11/308) were the most cited plant (Table 2).

Regardless of the study district, the practice of traditional medicine is mostly inherited by offspring from their ancestors. However, many people practise it following a

long period of learning from traditional healers (Table 3).

Parts of plant used, mode of preparation of different recipes and mode of administration

The most plant parts used were leaves (34.28%), followed by leaves+stem bark (14.28%) and whole plant (12.86%) (Figure . 3; Table 2).

Among these, decoction is the most used (56%) followed by maceration (32.93%). With a percentage of 87.5, water was the main solvent of extraction (Figure 5; Table 3). Other solvents were oil (4.88%), honey (3.66%), cow milk, (3.66%). All these preparations were administered orally, and the duration of treatment range from four to fourteen days (Table 3). As far as doses in concerned, one glass of the preparation was taken two (41.56%) and tree (38.96%) time per day (Figure 6; Table 3).

Among the 41 recipes obtained, 15.58% were made by using one plant, 33.76% with a mixture of two to three plants, 37.66% with four to six plants and 13% with seven to eleven plants (Figure 2). Apart from typhoid fever, these plant are used to cure several other complaints (Table 2).

Table 1: Distribution of informants according to their age, sex and subdivision.

Age	subdivision	sex		Total
		Male	Female	
15-30	Martap	02	01	09
	Mbe	01	//	
	Ngaoundere 3	05	//	
30-45	Martap	01	01	08
	Mbe	02	01	
	Ngaoundere 3	//	03	
45-60	Martap	02	//	10
	Mbe	07	01	
	Ngaoundere 3	//	//	
65-75	Martap	06	//	09
	Mbe	01	01	
	Ngaoundere 3	01	//	
75-above	Martap	01	//	05
	Mbe	02	//	
	Ngaoundere 3	01	01	
Total		32	09	41

Table 2: Classification of plants counted according to their family, frequency of citation and other uses.

Family	Scientific name	Part used	Mode of preparation (solvent)	FC	Other uses
Aloeaceae	<i>Aloe vera</i>	L	M(W)	03/308	skin infections, gastritis, laxative, abdominal pain
Anacardiaceae	<i>Lannea acida</i>	L,SB	D(W)	07/308	Yellow fever
	<i>Mangifera indica</i> L	L, SB	D(W)	14/308	Jaundice, Stomach ache, Itching, Gastric reflux, Malaria, Yellow fever, Hepatitis, diarrhea, Respiratory pain,
Annonaceae	<i>Annonas senegalensis</i>	L, SB	B(W)	17/308	diarrhea, vermifuge, diabetes, osteoarthritis, anemia, epilepsy, dysentery, malaria, pneumonia
	<i>Annona muricata</i>	L	M,I,D(W)	02/308	Stomach ache
Apiaceae	<i>Apium graveolens</i>	WP	D(W)	02/308	dysentery
Apocynaceae	<i>Voacanga africana</i>	L, SB	D(W)	02/308	anti helmetic, epilepsis, wound, tooth decay
Asteraceae	<i>Bidens pilosalinn</i>	WP	M,D(W)	05/308	Jaundice, dysentery
	<i>Crhysanthellum africanium</i>	WP	M,D (W)	04/308	Jaundice
	<i>Thitonia diversifolia</i>	L	M,i,D(W)		Wired, Scabies, antifilaria, Anti-leukemic
	<i>Vernonia amygdalina</i>	L	M,D(W)	08/308	Gastric disorders, asthma, stomach ache, wounds, anthelmintic, malaria, wound healing, headache
Bromeliaceae	<i>Ananas comosus</i>	F	M,D(W)	07/308	malaria
Burseraceae	<i>Canarium schweinfurthii</i>	SB	D(W)	03/308	//
	<i>Commiphora kerstingii</i>	L, F	D(W)	02/308	Anti-helmentic and hypertension
	<i>Withania somnifera</i>	L	I,D(W)	01/308	aphrodisiac
Caesalpiniaceae	<i>Delonix regia</i>	Fl	M,I(W)	01/308	/
	<i>Senna alata</i>	L	I,D,M(W)	06/308	fever, stomach ache
	<i>Tamarindus indica</i>	L, F	D(W)	05/308	Digestive disorders
Caricaceae	<i>Carica papaya</i> Linn	L, R, sead	M,D(W)	17/308	Jaundice, Dengue, Belly ache, Hemorrhoid, Gastritis, Malaria, Anti-helmentic, blood purification
Combretaceae	<i>Combretum micranthus</i>	L,F,SB	D(W)	04/308	/
	<i>Terminalia macroptera</i>	SB	D(W)	03/308	/
Convolvulaceae	<i>Ipomoea batatas</i> L.	L	I,D(W)	06/308	Against colon cancer

Euphorbiaceae	<i>Euphorbia prostrata</i>	WP	M(W)	03/308	dysentery
	<i>Euphorbia hirta</i> Linn	WP	M(W)	07/308	Dysentery, Stomach ache, Diarrhea, hemostatic, jaundice, asthma
	<i>Manihotes culenta</i>	L	M, I(W)	02/308	/
Fabaceae	<i>Acacia polyakanta</i>	FI	D(W)	01/308	/
	<i>Erythrina sp</i>	SB	D(W)	02/308	/
	<i>Daniella oliveri</i>	SB	D(W)	01/308	Malaria, rheumatism
	<i>Pakia biglobosa</i>	L,F	D,I(W)	01/308	/
	<i>Piliostigma thonningii</i>	L, SB	B,M(W)	11/308	Rheumatism, Fever, gastritis
	<i>Phaseolusvulgaris</i>	L	D,M(W)	01/308	kidney infections
	<i>Senna occidentalis</i>	L	D,M(W)	02/308	Malaria, pregnancy
	<i>Senegalia polyacantha</i>	SB	D,I(W)	01/308	
	<i>Desmodium intortum</i>	L,SB	D(W)	04/308	/ insectifuge
	<i>Senna spactabilis</i>	L	D(W)	01/308	Sore throat
	<i>Senna tora</i>	L, SB	D(W)	01/308	Jaundice
Hypericaceae	<i>Harungana madagascariensis</i>	L, SB	D(W)	11/308	Liver dysfunction, stomach ache, itching
Lamiaceae	<i>Thymus vulgarus/1</i>	WP	I(W)	01/308	/
	<i>Basilicum ocimum</i>	WP	I(W)	01/308	/
	<i>Persea americana</i>	L, SB	D(W)	20/308	Amenorrhea, abortive, anemia, bloating, weight lost, good pregnancy, dysentery, diarrhea, cough, fatigue, pain killer, hemorrhoid, diarrhea, aphrodisiac, wormer, hypertension, malaria, abdominal pain
Lauraceae	<i>Laurusroblis</i>	L	D(W)	01/308	
Liliaceae	<i>Allium cepa L.</i>	L,B	M,D,I(W)	03/308	/
	<i>Aloe buttneri L.</i>				
	<i>Allium sativum</i>	L,B	D,I(W,MI)	05/308	Anticancer, antiviral, hypertension, rheumatism
Loganiaceae	<i>Strychnos spirosa</i>	L,SB,R		02/308	Digestive disorders
Moringaceae	<i>Moringaoleifera</i>	L,F	M, D(W)	04/308	Blood purification, hypertension, diabetes, malaria
Moraceae	<i>Ficus thonningii</i>	SB	D(W)		Cough, itchy skin
Meliaceae	<i>Azadirachta indica</i>	L,SB,F	I, D (W H)	02/308	malaria, diarrhea
Musaceae	<i>Musa sinensis</i>	L	D(W)	03/308	Wound
	<i>Musa paradisiaca</i>	L	D (W)	04/308	malaria
Mimosoideae	<i>Pakia biglobossa</i>	L,F	I,D (W)	01/308	Digestive disorders
Myrtaceae	<i>Eucalyptus globulus</i>	L	D (W)		Asthma, oral hygiene, bronchitis, cold, flu, malaria
	<i>Psidium guayava</i>	L	M, D (W)	17/308	Cold, flu, angina, headache, digestive disorders, stomach ache, dermatitis, leucorrhea, diarrhea,

					yellow fever, deworming, rheumatism
Onagraceae	<i>Ludwigia abyssinica</i>	WP	D(W)	01/308	Prostatitis
Phyllanthaceae	<i>Hymenocardia acida</i>	L	D(W)	01/308	Gastritis
Poaceae	<i>Bambuseae vulgaris</i>	L	D(W)	02/308	
	<i>Zea mays</i>	Fl	D(W)	02/308	Rheumatoid arthritis
Rosaceae	<i>Prunus domestica</i>	L	D(W)	01/308	
Rhamnaceae	<i>Zizyphus mauritiana</i>	L	D	01/308	Antidiarrheal
rubiaceae	<i>Sarcocéphalus latifolius</i>	L, SB,R	D	01/308	
Rutaceae	<i>Citrus arantium</i>	L,F	D,M(W)	01/308	Rhume grippe
	<i>Citrus limon</i>	L,F	D, M(W)	11/308	Cough, Flu, Cold, Headache, Toning, Stomach Pain, Rheumatism
	<i>Citrus reticulata</i>	L	D,M (W)	01/308	Overweight
	<i>Citrus maxima</i>	L	D,M(W)	01/308	Heart problem, Facilitates the expulsion of gases, colds
Rhamnaceae	<i>Ziziphys mauritana</i>	L,SB	D(W)	01/308	Gonorhea, dysentery
Solanaceae	<i>Withania somnifera</i>	L	D (W)	01/308	
Sapotaceae	<i>Vitellaria paradoxa</i>	L,SB	D(W)	06/308	Rheumatism
Solanaceae	<i>Solanum torvum</i>	L, F	D(W)	05/308	/
	<i>Solanum lycopersicum</i>	L, F	M(W)	01/308	Heart disease
Tropaeolaceae	<i>Tropaelum majus</i>	WP	D(W)	01/308	Headache
Zingiberaceae	<i>Zingiber officinale</i>	R	I,M(W)	01/308	Good digestion

B: bark; **D:** decoction; **F:** fruit; **FC:** Frequency of citation, **Fl:** flower, infusion; **L:** leaves; **M:** maceration; **R:** roots; **SB:** stem Bark; **W:** Water; **WP:** whole plant.

Table 3: Origin of the knowledge, different types of antityphoid preparations according to study area, way of administration, dose and duration of treatment.

Sub-division	Origine of knowledge (number of preparation)	Scientific name	Solvent used, mode of preparation and route of administration	Dose; duration of the treatment
Ngaoundere III ^e	Ancestors (10)	<i>Crysanthélium Africanium</i>	Water, Decoction, oral	3G/D ; 14D
		<i>Vernonia amygdalina</i>		
		<i>Persea americana</i>		
		<i>Sarcocéphalus latifolius</i>	Water, Maceration, oral	3G/D ; 14D
		<i>Euphorbia prostrata</i>		
		<i>Bidenspilosa</i>		
		<i>Persea americana</i>	Water, Decoction, oral	4G/D ; 10D
		<i>Spidium goyajava</i>		
		<i>Mangifora indica</i>		
		<i>Carica papaya</i>		
<i>Annona senegalensis</i>				

	<i>Apiumgraveolens</i>		
	<i>Tithonia diversifolia</i>		
	<i>Canariumschweinfurthii</i>		
	<i>Mangiforaindica</i>		
	<i>Annona senegalensis</i>	Water, Decoction, oral	4G/D ; 14D
	<i>Withania somnifera</i>		
	<i>Persea americana</i>		
	<i>Bambuseae vulgarus</i>		
	<i>Harungana</i>		
	<i>madagascariensis</i>		
	<i>Terminalia macroptera</i>		
	<i>Piliostigma thonningii</i>		
	<i>Thymus vulgarus</i>		
	<i>Eucalyptus globulus</i>		
	<i>Allium sativum</i>	Water, Maceration, oral	3G/D ; 21D
	<i>Citrus limon</i>	/	
	<i>Ananas comosus</i>	Water, Decoction, oral	2G/D ; 14D
	<i>Citrus limon</i>		
	<i>Eucalyptus globulus</i>		
	<i>Psidium guajava</i>		
	<i>Harungana</i>		
	<i>madagascariensis</i>		
	<i>Euphorbia hirta</i>	Water, Decoction, oral	3G/D ; 10D
	<i>Mandiferaindica</i>		
	<i>Annona senegalensis</i>		
	<i>Bidens pilosa</i>		
	<i>Strychnos spirosa</i>		
	<i>Senna siamea</i>		
	<i>Psidium guajava</i>		
	<i>Sarcocéphalus latifolius</i>		
	<i>Harungana</i>		
	<i>madagascariensis</i>		
	<i>Persea americana</i>	Water, Decoction, oral	3G/D ; 14D
	<i>Carica papaya</i>		
	<i>Thitonia diversifolia</i>		
	<i>Commiphora kerstingii</i>		
	<i>Citrus limon</i>		
	<i>Allium sativum</i>		
	<i>Moringa oleifera</i>		
	<i>Combretum micranthus/04</i>	Water, Decoction, oral	4G/D, 21D
	<i>Annona senegalensis</i>		
	<i>Combretum micranthus</i>		
	<i>Sarcocéphalus latifolius</i>	Water, Maceration, oral	3G/D, 14D
	<i>Euphorbia prostrata</i>		
Initiation (10)	<i>Aloe vera</i>	Water, Maceration, oral	1G/D ; 14D
	<i>Carica papaya</i>	/	
	<i>Allium sativum</i>		
	<i>Sarcocephalus latifolius</i>	Water, Decoction, oral	3G/D ; 14D
	<i>Harungana</i>		
	<i>madagascariensis</i>		

	<i>Vernonia conferata</i>	Water, Maceration, oral	2G/D, 21D
	<i>Persia americana</i>		
	<i>Psidium guayava</i>	Water, Decoction, oral	1G/D ;14D
	<i>Musa sinensis</i>		
	<i>Persia americana</i>		
	<i>Carica papaya</i>		
	<i>Ananas comosus</i>		
	<i>Harungana</i>	Water, Decoction, oral	2G/D ;7D
	<i>madagascariensis</i>		
	<i>Basilicum ocimum</i>	Water, Decoction, oral	3G/D ; 10D
	<i>Annona senegalensis</i>		
	<i>Senegalia polyacantha</i>		
	<i>Voacanga africana</i>		
	<i>Combretum micranthum</i>		
	<i>Sarcocéphalus latifolius</i>		
	<i>Citrus limon</i>	Water, Infusion, oral	3G/D ; 7D
	<i>Psidium guayava</i>		
	<i>Laurus robilis</i>		
	<i>Moringa oleifera</i>		
	<i>Carica papaya</i>	Water, Maceration, oral	2G/D ; 7D
	<i>Bidens pilosa</i>		
	<i>Mandifera indica</i>		
	<i>Senna siamea</i>	Water, Maceration, oral	2G/D ; 7D
	<i>Persia americana</i>		
	<i>Vernonia amygdalina</i>		
	<i>Annona muricata</i>		
	<i>Prunus domestica</i>	Water, Decoction, oral	2G/D ; 14D
	<i>Tamaridus indica</i>	/Honey, Maceration, oral	
	<i>Musa in</i>		
	<i>Tithoniadiversifolia/02</i>		
	<i>Strychnasspinosa</i>		
	<i>Senna alata</i>		
	<i>Lannea acida/7</i>		
	<i>Carica papaya</i>	Water, Decoction, oral	3G/D ; 10D
	<i>Ananas comosus</i>		
	<i>Annonas senegalensis</i>		
	<i>Ipomea batatas</i>	Water, Maceration, oral	2TS/D ; 10D
	<i>Vitellaria paradoxa</i>	honey/kernel/milk	
	<i>Musa spp</i>	Water, Decoction, oral /	2G/D ; 10D
	Rock salt	Honey or kernel oil	4TS/D ;10D
	<i>Psidium guayava</i>	Maceration, oral	
	<i>Persea americana</i>		
	<i>Ipomoeabatatas</i>		
	<i>Sarcocéphalus latifolius</i>		
	<i>Citrus limon</i>	Water, Decoction, oral	6G/D ; 14D
	<i>Musa paradisiaca</i>		
	<i>Persea americana</i>		
	<i>Spidiumgoyajava</i>		
	<i>Mandiferaindica</i>		
	<i>Caricapapaya</i>		
Martap	Ancestors (08)		

	<i>Annonassenegalensis</i>		
	<i>Voacangaaficana</i>		
	<i>Citrus reticulata/01</i>		
	<i>Acacia polyakanta</i>		
	<i>ananas</i>		
	<i>Bidens pilosa</i>	Water, Decoction, oral	3G/D ; 14D
	<i>Eucalyptus globulus</i>		
	<i>Annonamuricata 02</i>		
	<i>Senna occidentalis</i>		
	<i>Persea americana</i>		
	<i>Sarcocéphalus latifolius</i>		
	<i>Annona senegalensis</i>	Water, Decoction, oral	3G/D ; 21D
	<i>Pakia biglobosa</i>		
	<i>Euphorbia hirta</i>		
	<i>Senna siamea</i>		
	<i>Tamarindusindica</i>		
	<i>Harungana</i>		
	<i>madagascariensis</i>		
	<i>Mandifera indica</i>	Water, Decoction, oral	4G/D ; 14D
	<i>Thitonia diversifolia</i>		
	<i>Apium graveolens</i>		
	<i>Euphorbia prostrata</i>		
	<i>Senna alata</i>		
	<i>Tamarindus indica</i>	Water, Decoction, oral	3G/D ; 21D
	<i>Caricapapaya</i>		
	<i>Ananas comosus</i>		
	<i>Annona senegalensis</i>		
	<i>Solanum torvum</i>		
	<i>Mangiforaindica</i>		
	<i>Allium sativum</i>	Cow milk,	3G/D ; 10D
	<i>Carica papaya</i>	Maceration, oral	
	<i>Persea americana</i>		
	<i>Citrus llmon</i>		
	<i>Psidium guajava</i>		
	<i>Harungana</i>		
	<i>madagascariensis</i>		
	<i>Carica papaya</i>	Water, Maceration, oral	3G/D ; 7D
	<i>Anona comosus</i>		
	<i>Annona senegalensis</i>		
Initiation (10)	<i>Lannea acida</i>	Water, Decoction, oral	3G/D ; 14D
	<i>Solanum torvum</i>		
	<i>Caricapapaya</i>	Water, Decoction, oral	6G/D ; 4D
	<i>Zea mays</i>		
	<i>Citrus limon</i>		
	<i>Mandifora indica</i>		
	<i>Delonix regia</i>		
	<i>Sarcocéphalus latifolius</i>		
	<i>Allium sepa</i>	Water, Maceration, oral	2G/D ; 7D
	<i>Pilostigma thoningii</i>	Water, Decoction, oral	2G/D ; 14D
	<i>Mandifera indica</i>	Water, Infusion, oral	2G/D ; 14D

		<i>Caccia occidentalis</i>		
		<i>Ludwigia abyssinica</i>		
		<i>Canarium schweinfurthii</i>		
		<i>Persea americana</i>	Water, Decoction, oral	3G/D ; 14D
		<i>Allium cepa</i>		
		<i>Carica papaya</i>	Water, Infusion, oral	3G/D ; 7D
		<i>Vitellaria paradoxa</i>	Water, Decoction, oral	3G/D ; 14D
		<i>Mandifera indica</i>		
		<i>Solanum torvum</i>		
		<i>Persea americana</i>	Water, Decoction, oral	3G/D ; 10D
		<i>Psidium guajava</i>		
		<i>Musa paradisiaca</i>		
		<i>natron</i>		
		<i>Ipomoea battatos</i>	Kernel oil, Maceration, oral	4TS/D 10D
		<i>Vitellaria paradoxa</i>	Cow Milk, Infusion, oral milk	4G/D ; 14D
		<i>Persea americana</i>	Water, Decoction, oral	2G/D ; 14D
		<i>Musa paradisiaca</i>		
		<i>Psidium guajava</i>		
		<i>Ipomoea batatas</i>	Azadirachta india oil, Maceration, oral	4TS/D ; 7D
		<i>Vitellaria paradoxa</i>	Water, decoction, oral	3G/D ; 14D
		<i>Zizyphus mauritiana</i>	Water, Decoction, oral	2G/D ; 14D
		<i>Hurungana</i>		
		<i>madagascariensis</i>		
		<i>Citrus limen</i>	Water, Decoction, oral	3G/D ; 14D
		<i>Senna spactabilis</i>		
		<i>Allium cepa</i>		
		<i>Crhysanthellum africanium</i>		
		<i>Sena tora</i>		
		<i>Senna alata</i>		
		<i>Annona senegalensis</i>	Water, Decoction, oral	3G/D ; 14D
		<i>Pakia biglobossa</i>		
		<i>Eucalyptus globulus</i>		
		<i>Harungana</i>		
		<i>madagascariensis</i>		
		<i>Manihotes culenta</i>		
		<i>Ipomoea batatas</i>		
		<i>Senna alata</i>		
		<i>Zea mais</i>	Cowmilk, Maceration, oral	2G/D ; 14D
		<i>Citrus avrantium</i>		
		<i>Solanum lycopersicum</i>	Water, Decoction, oral	2-4G/D ; 10D
		<i>Zingiber offocinale</i>	Water, Decoction, oral	1G/D ; 14D
		<i>Phasealus vulgaris</i>		
		<i>Lannea acida</i>		
		<i>Erythrina senegalensis</i>		
		<i>Annona senegalensis</i>	Water, Decoction, oral	2G/D ; 14D
		<i>Withania somnifera</i>		
		<i>Persea americana</i>		
		<i>Bambuseae vulgarus</i>		

	<i>Harungana madagascariensis</i>		
	<i>Terminalia macroptera</i>		
	<i>Piliostigma thonningii</i>		
	<i>Citrus limon</i>		
	<i>eucaluptusglobulus</i>		
	<i>Psidium guajava</i>		
	<i>Psidium guajava</i>	Water, Maceration, oral	2G/D ; 14D
	<i>Vernonia amygdalina</i>		
	<i>Annona senegalensis</i>		
	<i>Pilostigma tanningii</i>		
	<i>Ehphorbia hirta</i>	Water, Maceration, oral	2G/D ;10D
	<i>Persea améridana</i>		
	<i>Carica papaya</i>		
	<i>Gympobogannadus</i>		
	<i>Pilostigma tanningii</i>	Water, Maceration, oral	2G/D ; 14D
	<i>Annona senegalensis</i>		
	<i>Psidium guayava</i>		
	<i>Persea americana</i>		
	<i>Mandiféra indica</i>		
	<i>Mangifera indica</i>	Water, Decoction, oral	2G/D ; 10D
	<i>Thitonia diversifolia</i>		
	<i>Persea americana</i>		
	<i>Carica papaya</i>		
	<i>Piliostigma thonningii</i>	Water, Decoction, oral	3G/D ; 7D
	<i>Psidium guayava</i>		
	<i>Moringa oleifera</i>		
	<i>Vernonia amygdalina</i>	Water, Decoction, oral	2G/D ; 7D
	<i>Piliostigma thonningii</i>		
	<i>Eucalyptus camaldulensis</i>		
	<i>Psidium guayava</i>		
	<i>Annona senegalensis</i>		
	<i>Citrus sinensis</i>	Azaderachta indica oil,	2G/D ; 7D
	<i>Azadiracta indica</i>	Maceration, oral	
	<i>Citrus maxima</i>		
	<i>Sarcocéphalus latifolius</i>		
	<i>Carica papaya</i>	Water, Infusion, oral	2G/D ; 14D
	<i>Psidium guayava</i>		
	<i>Musa spp</i>		
	<i>eucalyptus globulus</i>		
	<i>Combretum micranthum</i>		
	<i>Lannea acida</i>		
Initiation (06)	<i>Euphorbia hirta</i>	Water, Maceration, oral / Water, Infusion, oral	2G/D ; 10D
	<i>Citrus sinensis</i>	Water, Decoction, oral	2G/D ; 10D
	<i>Psidium guayava</i>		
	<i>Zizyphys mauritana</i>		
	<i>Vernonia amygdalina</i>	Water, Decoction, oral	1G/D ; 21D
	<i>Eucalyptus globulus</i>		
	<i>Annonasenegalensis</i>		

	<i>Crhysanthellum africanium</i>		
	<i>Solanum torvum</i>		
	<i>Harungana</i>	Water, Decoction, oral	2G/D ; 7D
	<i>madagascariensis</i>		
	<i>Terminalia macroptera</i>		
	<i>Piliostigma thonningii</i>		
	<i>Caricapapaya</i>		
	<i>Sarcocéphalus latifolius</i>		
	<i>Vitellaria paradoxa</i>		
	<i>Solanum torvum</i>		
	<i>Tropoelummajus</i>	Water, Decoction, oral	3G/D ; 7D
	<i>Moringa oleifera</i>		
	<i>Psidium guajava</i>		
	<i>Carica papaya</i>		
	<i>Citrus lemon</i>		
	<i>Lannea acida</i>		
	<i>Erythrina</i>		
	<i>Vernonia amygdalina</i>	Water, Maceration, oral	2G/D ; 14D
	<i>Aloes vera</i>	/Water, Decoction, oral	
	<i>Persea americana</i>		
	<i>Citrus limon</i>		
	<i>Euphorbia hirta</i>		
	<i>Lannea acida</i>	Water, Maceration, oral	3G/D ; 10D
	<i>Crhysanthellum africanium</i>	/ Water Decoction, oral	
	<i>Persea americana</i>	Water, Maceration, oral	3G/D ; 14D
	<i>Kommiphora kersthengii</i>		
	<i>Vernonia amygdalina</i>		
	<i>Piliastigma thonningii</i>		
	<i>Citrus limon</i>		
	<i>Hymenocardia acida</i>	Water, Maceration, oral	2G/D ; 10D
	<i>Psidium guajava</i>		
	<i>Daniella oliveri</i>		
	<i>Piliastigma thonningii</i>		
	<i>Ficus thonningii</i>		
	<i>Euphorbia hirta</i>		
	<i>Annona senegalensis</i>	Water, Decoction, oral	3G/D ; 14D
	<i>Vitellaria paradoxa</i>		
	<i>Eucalyptus globulus</i>		
	<i>Aloe vera</i>	Water, Maceration, oral	3G/D ; 4D
	<i>Azadirachta indica</i>		
	<i>Tamarindus indica</i>		
	<i>Lannea acida</i>	Water, Decoction, oral	2G/D ; 14D
	<i>Sarcocéphalus latifolius</i>		
	<i>Canarium schweinfurthii</i>		
	<i>Erythrina senegalensis</i>		
	<i>Senna alata</i>		
	<i>Allium sativum</i>	Milk, Infusion, oral	2G/D ; 10D
	<i>Citrus limon</i>	Water, Decoction, oral /	2G/D ; 14D
	<i>Eucalyptus globulus</i>	Water, Infusion, oral	
	<i>Ananas comosus</i>		

Initiation and/or
ancestors (12)

<i>Euphorbia hirta</i>		
<i>Mandifera indica</i>	Water, Decoction, oral	2G/D ; 14D
<i>Citrus limon</i>		
<i>Eucalyptus globulus</i>		
<i>Pilostigma thomingii</i>	Water, Maceration, oral	3G/D ; 14D
<i>Tamarindus indica</i>		
<i>Citrus limon</i>		
<i>Senna alata</i>	Water, Maceration, oral	3G/D ; 10D
<i>Manihotes culenta</i>		
<i>Ipomea batatas</i>		
<i>Bidens pilosa</i>		

77

G/D, glass per day.

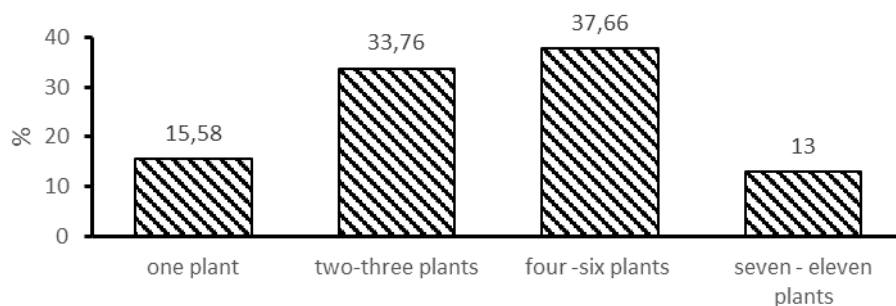


Figure 2: Number of plants per preparation.

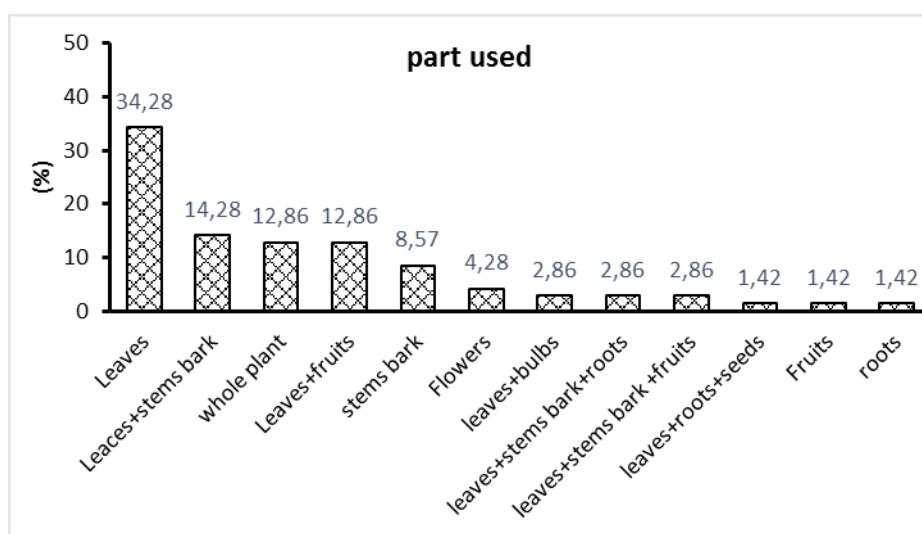


Figure 3: Parts of plant used.

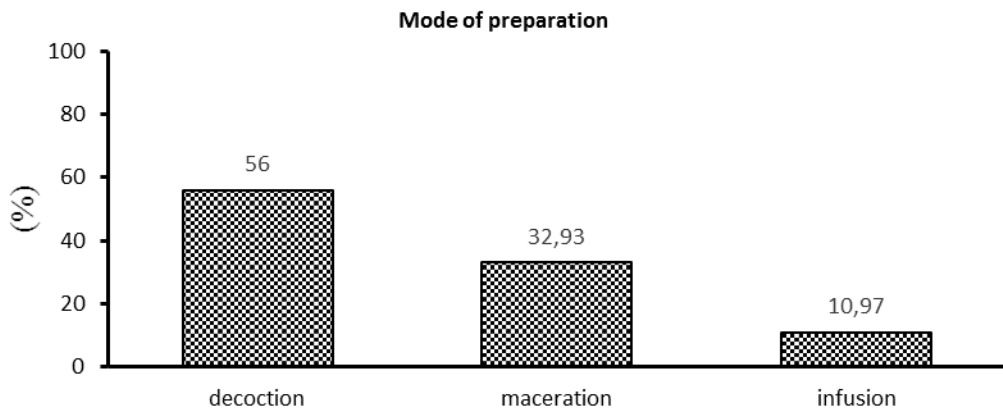


Figure 4: Modes of preparation.

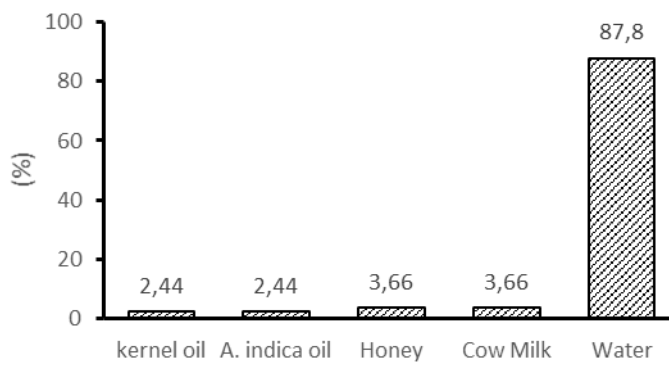
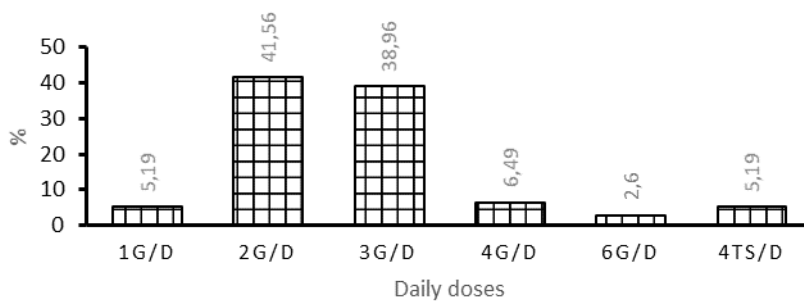


Figure 5: Solvents used for the preparations.



DISCUSSION

The high frequency of man participating in this study may be justified by the fact that the ancestors were initiating mainly their child boy to the practice of the traditional medicine. In addition, socio-cultural habits of peoples in the northern part of Cameroon in general and in the study area in general limits the contacts between man and woman (Mokam, 2012). The precariousness in which the populations of the study area live could be the main reason why young people introduce themselves to the practice of traditional medicine. This is not only in order to provide for their family's needs, but also to improve the health of their population who, for most of them, are not able to get rid of pharmaceutical drugs.

The high frequency of Fabaceae (Table 2) may either be due to the wide range of biologically active compounds present in that family, but also because this family is the most widespread in the plant kingdom (Thomas et al., 2009). The high frequency of citation *Persea americana* (20/308) *Annona senegalensis* 17/308; *Carica papaya* 17/308 ; *Psidium guayava* (17/308) *Citrus limon* (11/308): *Mangifera indica* (14/308); *Piliostigma thonningii* (11/308) and *Harungana madagascariensis* (11/308) may be linked to their efficacy. Indeed, some of these plants have been reported worldwide to be used in the treatment of many diseases (Kengni et al., 2014; Yemele et al., 2015). Relatively to bacterial infection, the antibacterial activity of many of the above mentioned plants has been proved (Sospeter et al., 2015 ; Kengni et al., 2014; Amit, 2017 ; Amado et al., 2019 ; Srividya et Rama, 2019).

With a percentage of 34.28%, leaves were the most plant parts used. In fact, leaves are known to accumulate plants secondary metabolites, which are known to possess many biological properties (OMS 2004; Focho et al., 2009a). Moreover, utilization of leaves and stem bark rather than root is advantageous for the survival of plants since their harvest does not induce the irreversible destruction of plants (Telefo et al., 2012). Besides, leaves are easier to harvest than root.

Recipes prepared with more than one medicinal plant is a common practice in our traditional medicine milieu and could be justified by the fact that, association of many plants and thus many secondary metabolites may improve the synergistic or additive effects of their constituents (Igoli et al., 2005). Apart from typhoid fever, these plants are used to cure several other complaints (Table 2). This could be attributed to large distribution of secondary metabolite with different properties in a single plant extract.

Conclusion

This study has shown that rural populations of the 3 targeted localities possess traditional knowledge on anti-infectious plants that are efficient and cost-effective for the treatment of typhoid fever. Nevertheless, these practices deserve to be validated experimentally in order to be considered as sustainable tools for the management of typhoid and para-typhoid fevers.

COMPETING INTERESTS

The authors declare that they have no competing interests.

ACKNOWLEDGMENTS

The authors are very grateful to the traditional healers for providing information about their practices.

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