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

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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 anti-typhoid 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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INTRODUCTION

Salmonelloses 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 ¾ 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, Mbere and Vina. The Vina Division has eight subdivisions: Belel, Mbe, Nganha, Ngaoundéré I°, Ngaoundéré II°, Ngaoundere IIIF, 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 ferrallitic 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 Mbolo, 2013). The study area includes three subdivisions of the Vina division namely: Mbe, Martap and Ngaoundéré IIIF.
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:

\[
FC = \frac{\text{number of times a particular species was mentioned}}{\text{total number of times that all species were mentioned}}.
\]

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   |

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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          | Aloe vera           | L         | M(W)                          | 03/308 | skin infections, gastritis, laxative, abdominal pain                     |
| Anacardiaceae      | Lannea acida        | L,SB      | D(W)                          | 07/308 | Yellow fever, Jaundice, Stomach ache, Itching, Gastric reflux, Malaria     |
|                    | Mangifera indica    | L,SB      | D(W)                          | 14/308 | Yellow fever, Hepatitis, diarrhea, Respiratory pain,                       |
| Annonaceae         | Annonas senegalensis| L, SB     | B(W)                          | 17/308 | diarrhea, vermifuge, diabetes, osteoarthritis, anemia, epilepsy, dysentery, |
|                    | Annona muricata     | L         | M, I, D(W)                    | 02/308 | malaria                                                                   |
| Apiaceae           | Apium graveolens    | WP        | D(W)                          | 02/308 | dysentery                                                                  |
| Apocynaceae        | Voacanga africana   | L, SB     | D(W)                          | 02/308 | anti helmetic, epilepsy, wound, tooth decay                              |
| Asteraceae         | Bidens pilosalinm   | WP        | M, D(W)                       | 05/308 | Jaundice, dysentery                                                      |
|                    | Chrysanthemum       | WP        | M, D(W)                       | 04/308 | Jaundice                                                                  |
|                    | africanum           |           |                               |        |                                                                           |
|                    | Thitonia diversifolia | L    | M, I, D(W)                    | 02/308 | Anti-helmentic and hypertension                                           |
|                    | Vernonia amygdalina | L         | M, D(W)                       | 08/308 | Wired, Scabies, antifilaria, Anti-leukemic                                |
| Bromeliaceae       | Ananas comosus      | F         | M, D(W)                       | 07/308 | malaria                                                                   |
| Burseraceae        | Canarium            | SB        | D(W)                          | 03/308 | //                                                                        |
|                    | schweinfurthii      |           |                               |        |                                                                           |
|                    | Commiphora kerstingii | L, F  | D(W)                          | 02/308 | Anti-helmentic and hypertension                                           |
|                    | Withania somnifera  | L         | I, D(W)                       | 01/308 | aphrodisiac                                                              |
| Caesalpinacea      | Delonix regia       | Fl        | M, I(W)                       | 01/308 | /                                                                        |
|                    | Senna alata         | L         | M, I, D(M)                    | 06/308 | fever, stomach ache                                                      |
|                    | Tamarindus indica   | L, F      | D(W)                          | 05/308 | Digestive disorders                                                      |
| Caricaceae         | Carica papaya       | L, R,     | M, D(W)                       | 17/308 | Jaundice, Dengue, Belly ache, Hemorrhoid, Gastritis, Malaria,             |
|                    | Linn                | seed      |                               |        | Anti-helmentic, blood purification                                       |
| Combretaceae       | Combretum           | L, F, SB  | D(W)                          | 04/308 | /                                                                        |
|                    | micranthus          |           |                               |        |                                                                           |
|                    | Terminalia macrrotera | SB      | D(W)                          | 03/308 | /                                                                        |
| Convolvulaceae     | Ipomoea batatas     | L         | I, D(W)                       | 06/308 | Against colon cancer                                                     |
| Family                  | Species                     | Genus        | Code | Year | Disease/Condition                  |
|------------------------|-----------------------------|--------------|------|------|------------------------------------|
| Euphorbiaceae          | *Euphorbia prostrata*       | WP M(W)      | 03/308 | dysentry                     |
|                        | *Euphorbia hirta*           | WP M(W)      | 07/308 | Dysentry, Stomach ache, Diarrhea, hemostatic, jaundice, asthma |
|                        | *Manihot esculenta*         | L M, I(W)    | 02/308 | /                              |
| Fabaceae               | *Acacia polyacantha*        | FI D(W)      | 01/308 | /                              |
|                        | *Erithrina sp*              | SB D(W)      | 02/308 | Malaria, rheumatism             |
|                        | *Daniella oliveri*          | SB D(W)      | 01/308 | /                              |
|                        | *Pakia biglobosa*           | L F D,I(W)   | 01/308 | /                              |
|                        | *Piliostigma thonningii*    | L, SB B,M(W) | 11/308 | Rheumatism, Fever, gastritis    |
|                        | *Phaseolus vulgaris*        | L D,M(W)     | 01/308 | kidney infections              |
|                        | *Senna occidentalis*        | L D,M(W)     | 02/308 | Malaria, pregnancy             |
|                        | *Senegalia polyacantha*     | SB D,I(W)    | 01/308 | /                              |
|                        | *Desmodium intortum*        | L,SB D(W)    | 04/308 | / insectifuge                   |
|                        | *Senna spectabilis*         | L D(W)       | 01/308 | Sore throat                     |
|                        | *Senna tora*                | L, SB D(W)   | 01/308 | Jaundice                        |
| Hypericaceae           | *Harungana madagascariensis*| L, SB D(W)   | 11/308 | Liver dysfunction, stomach ache, itching |
| Lamiaceae              | *Thymus vulgarus*           | WP I(W)      | 01/308 | /                              |
|                        | *Basilicum ocimum*          | WP I(W)      | 01/308 | /                              |
|                        | *Persea americana*          | 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              | *Laurus nobilis*            | L D(W)       | 01/308 | /                              |
| Liliaceae              | *Allium cepa*               | L,B M,D,I(W) | 03/308 | /                              |
|                        | *Aloe buttneri*             | L,B D,I(W,Ml) | 05/308 | Anticancer, antiviral, hypertension, rheumatism |
| Loganiaceae            | *Strychnos panacea*         | L,SB,R       | 02/308 | Digestive disorders            |
| Moringaceae            | *Moringa oleifera*          | L,F M, D(W)  | 04/308 | Blood purification, hypertension, diabetes, malaria |
| Moraceae               | *Ficus thonningii*          | SB D(W)      | 04/308 | Cough, itchy skin              |
| Melliaceae             | *Azadirachta indica*        | L,SB,F I, D (W H) | 02/308 | Malaria, diarrhea              |
| Musaceae               | *Musa sinensis*             | L D(W)       | 03/308 | Wound                          |
|                        | *Musar paradisiaca*         | L D (W)      | 04/308 | malaria                        |
| Mimosoideae            | *Pakia biglobosa*           | L,F I,D (W)  | 01/308 | Digestive disorders            |
| Myrtaceae              | *Eucalyptus globulus*       | L D (W)      | 17/308 | Asthma, oral hygiene, bronchitis, cold, flu, malaria |
|                        | *Psidium guayava*           | L M, D (W)   | 17/308 | Cold, flu, angina, headache, digestive disorders, stomach ache, dermatitis, leucorrhea, diarrhea, |
yellow fever, deworming, rheumatism

| Onagraceae                  | Ludwigia abyssinica       | WP | D(W) | 01/308 | Prostatitis |
|----------------------------|---------------------------|----|------|--------|-------------|
| Phyllanthaceae             | Hymenocardia acida        | L  | D(W) | 01/308 | Gastritis   |
| Poaceae                   | Bambuseae vulgaris        | L  | D(W) | 02/308 | Rheumatoid arthritis |
| Zea mays                  |                           | Fl | D(W) | 02/308 | Rheumatoid arthritis |
| Rosaceae                  | Prunus domestica          | L  | D(W) | 01/308 |             |
| Rhamnaceae                | Zizyphus mauritana        | L  | D    | 01/308 | Antidiarrheal |
| rubiaceae                 | Sarcocéphalus latifolius  | L,  | D    | 01/308 |             |
| Rutaceae                  | Citrus arantium           | L,F| D(M) | 01/308 | Rhume grippe |
|                          | Citrus limon              | L,F| D(M) | 11/308 | Cough, Flu, Cold, Headache, Toning, Stomach Pain, Rheumatism |
|                          | Citrus reticulata         | L  | D(M) | 01/308 | Overweight  |
|                          | Citrus maxima             | L  | D(M) | 01/308 | Heart problem, Facilitates the expulsion of gases, colds |
| Rhamnaceae                | Zizyphus mauritana        | L,SB| D(W)| 01/308 | Gonorhea, dysentery |
| Solanaceae                | Withania somnifera        | L  | D    | 01/308 |             |
| Sapotaceae                | Vitellaria paradoxa       | L,SB| D(W)| 06/308 | Rheumatism  |
| Solanaceae                | Solanum torvum           | L, F| D(W) | 05/308 | /           |
|                          | Solanum lycopersicum      | L, F| M(W) | 01/308 | Heart disease |
| Tropaeolaceae             | Tropaelummajus            | WP | D(W) | 01/308 | Headache    |
| Zingiberaceae             | Zingiber officinale       | 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 Back; 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.
| Plant Species                        | Preparation Method       | Duration (G/D) |
|-------------------------------------|--------------------------|----------------|
| *Apium graveolens*                  | Water, Decoction, oral   | 4G/D; 14D      |
| *Tithonia diversifolia*             | Water, Decoction, oral   | 4G/D; 14D      |
| *Canarium schweinfurthii*           | Water, Decoction, oral   | 4G/D; 14D      |
| *Mangifera indica*                  | Water, Decoction, oral   | 4G/D; 14D      |
| *Annona senegalensis*               | Water, Decoction, oral   | 4G/D; 14D      |
| *Withania somnifera*                | Water, Decoction, oral   | 4G/D; 14D      |
| *Persea americana*                  | Water, Decoction, oral   | 4G/D; 14D      |
| *Bambusae vulgaris*                 | Water, Decoction, oral   | 4G/D; 14D      |
| *Harungana madagascariensis*        | Water, Decoction, oral   | 4G/D; 14D      |
| *Terminalia macroptera*             | Water, Decoction, oral   | 4G/D; 14D      |
| *Piliostigma thomningii*            | Water, Decoction, oral   | 4G/D; 14D      |
| *Thymus vulgarus*                   | Water, Decoction, oral   | 4G/D; 14D      |
| *Eucaluptus globulus*               | Water, Decoction, oral   | 4G/D; 14D      |
| *Allium sativum*                    | Water, Maceration, oral  | 3G/D; 21D      |
| *Citrus limon*                      | Water, Decoction, oral   | 3G/D; 21D      |
| *Ananas comosus*                    | Water, Decoction, oral   | 3G/D; 21D      |
| *Citrus limon*                      | Water, Decoction, oral   | 3G/D; 21D      |
| *Eucaluptus globulus*               | Water, Decoction, oral   | 3G/D; 21D      |
| *Psidium guayava*                   | Water, Decoction, oral   | 3G/D; 21D      |
| *Harungana madagascariensis*        | Water, Decoction, oral   | 3G/D; 21D      |
| *Euphorbia hirta*                   | Water, Decoction, oral   | 3G/D; 10D      |
| *Mandieraindica*                    | Water, Decoction, oral   | 3G/D; 10D      |
| *Annona senegalensis*               | Water, Decoction, oral   | 3G/D; 10D      |
| *Bidens pilosa*                     | Water, Decoction, oral   | 3G/D; 10D      |
| *Strychnos spirosa*                 | Water, Decoction, oral   | 3G/D; 10D      |
| *Senna siamea*                      | Water, Decoction, oral   | 3G/D; 10D      |
| *Psidium guajava*                   | Water, Decoction, oral   | 3G/D; 10D      |
| *Sarcocéphalus latifolius*          | Water, Decoction, oral   | 3G/D; 10D      |
| *Harungana madagascariensis*        | Water, Decoction, oral   | 3G/D; 10D      |
| *Persea americana*                  | Water, Decoction, oral   | 3G/D; 14D      |
| *Carica papaya*                     | Water, Decoction, oral   | 3G/D; 14D      |
| *Tithonia diversifolia*             | Water, Decoction, oral   | 3G/D; 14D      |
| *Commiphora kerstingii*             | Water, Decoction, oral   | 3G/D; 14D      |
| *Citrus limon*                      | Water, Decoction, oral   | 3G/D; 14D      |
| *Allium sativum*                    | Water, Decoction, oral   | 3G/D; 14D      |
| *Moringa oleifera*                  | Water, Decoction, oral   | 3G/D; 14D      |
| *Combretum micranthus/04*           | Water, Decoction, oral   | 4G/D, 21D      |
| *Annona senegalensis*               | Water, Decoction, oral   | 4G/D, 21D      |
| *Combretum micranthus*              | Water, Decoction, oral   | 4G/D, 21D      |
| *Sarcocéphalus latifolius*          | Water, Maceration, oral  | 3G/D, 14D      |
| *Euphorbia prostrata*               | Water, Maceration, oral  | 3G/D, 14D      |
| *Sarcocephalus latifolius*          | Water, Maceration, oral  | 3G/D, 14D      |
| *Harungana madagascariensis*        | Water, Maceration, oral  | 3G/D, 14D      |
| *Aloe vera*                         | Water, Maceration, oral  | 1G/D; 14D      |
| *Carica papaya*                     | Water, Maceration, oral  | 1G/D; 14D      |
| *Allium sativum*                    | Water, Maceration, oral  | 1G/D; 14D      |
| *Sarcocephalus latifolius*          | Water, Maceration, oral  | 1G/D; 14D      |
| *Harungana madagascariensis*        | Water, Maceration, oral  | 1G/D; 14D      |

Initiation (10)
| Plant Name | Preparation/Method | Duration(s) |
|------------|--------------------|-------------|
| *Vernonia conferata* | Water, Maceration, oral | 2G/D, 21D |
| *Persia americana* | | |
| *Psidium guayava* | Water, Decoction, oral | 1G/D ; 14D |
| *Musa sinensis* | | |
| *Persia americana* | | |
| *Carica papaya* | | |
| *Ananas comosus* | | |
| *Harungana madagascariensis* | Water, Decoction, oral | 2G/D ; 7D |
| *Basilicium ocimum* | Water, Decoction, oral | 3G/D ; 10D |
| *Annona senegalensis* | | |
| *Senegalia polyacantha* | | |
| *Voacanga africana* | | |
| *Combretum micranthum* | | |
| *Sarcocéphalus latifolius* | | |
| *Citrus limon* | Water, Infusion, oral | 3G/D ; 7D |
| *Psidium guayava* | | |
| *Laurus robilis* | | |
| *Moringa oleifera* | | |
| *Carica papaya* | Water, Maceration, oral | 2G/D ; 7D |
| *Bidens pilosa* | | |
| *Mandifera indica* | | |
| *Senna siamea* | Water, Maceration, oral | 2G/D ; 7D |
| *Persia americana* | | |
| *Vernonia amygdalina* | | |
| *Annona muricata* | | |
| *Prunus domestica* | Water, Decoction, oral /Honey, Maceration, oral | 2G/D ; 14D |
| *Tamarindus indica* | | |
| *Musa in* | | |
| *Tithoniadiversifolia/02* | | |
| *Strychnasspinosa* | | |
| *Senna alata* | | |
| *Lannea acida/7* | | |
| *Martap Ancestors (08)* | | |
| *Carica papaya* | Water, Decoction, oral | 3G/D ; 10D |
| *Ananas comosus* | | |
| *Annonas senegalensis* | | |
| *Ipomea batatas* | Water, Maceration, oral honey/kernel/milk | 2TS/D ; 10D |
| *Vitellaria paradoxa* | | |
| *Musa spp* | Water, Decoction, oral /Honey or kernel oil Maceration, oral | 2G/D ; 10D |
| *Rock salt* | | |
| *Psidium guayava* | | |
| *Persea americana* | | |
| *Ipomoeabatatas* | | |
| *Strychnasspinosa* | | |
| *Senna alata* | | |
| *Lannea acida* | | |
| *Martap Ancestors (08)* | | |
| *Carica papaya* | Water, Decoction, oral | 6G/D ; 14D |
| *Ananas comosus* | | |
| *Annonas senegalensis* | | |
| Plant Name                        | Preparation Method                      | Duration |
|----------------------------------|----------------------------------------|----------|
| Annonassa senegalensis           | Water, Decoction, oral                 | 3G/D ; 14D |
| Voacanga africana                |                                        |          |
| Citrus reticulata/01             |                                        |          |
| Acacia polyakanta ananas         |                                        |          |
| Bidens pilosa                    | Water, Decoction, oral                 | 3G/D ; 21D |
| Eucalyptus globulus              |                                        |          |
| Annonamuricata 02                |                                        |          |
| Senna occidentalis               |                                        |          |
| Persea americana                 |                                        |          |
| Sarcocephalus latifolius         |                                        |          |
| Annona senegalensis              | Water, Decoction, oral                 | 3G/D ; 14D |
| Pakia biglobosa                  |                                        |          |
| Euphorbia hirta                  |                                        |          |
| Senna siamea                     |                                        |          |
| Tamarindus indica                | Water, Decoction, oral                 | 4G/D ; 14D |
| Harungana madaigascariensis      |                                        |          |
| Mandifera indica                 | Water, Decoction, oral                 | 3G/D ; 21D |
| Thitonia diversifolia            |                                        |          |
| Apium gravedens                  |                                        |          |
| Euphorbia prostrata              |                                        |          |
| Senna alata                      |                                        |          |
| Tamarindus indica                | Water, Decoction, oral                 | 3G/D ; 21D |
| Caricapapaya                     |                                        |          |
| Ananas comosus                   |                                        |          |
| Annona senegalensis              | Water, Maceration, oral                | 3G/D ; 7D |
| Carica papaya                    |                                        |          |
| Persea americana                 |                                        |          |
| Citrus llimon                    |                                        |          |
| Psidium guajava                  |                                        |          |
| Harungana madaigascariensis      |                                        |          |
| Carica papaya                    | Water, Maceration, oral                | 3G/D ; 7D |
| Anona comosus                    |                                        |          |
| Annona senegalensis              |                                        |          |
| Lannea acida                     | Water, Decoction, oral                 | 3G/D ; 14D |
| Solanum torvum                   |                                        |          |
| Caricapapaya                     | Water, Decoction, oral                 | 6G/D ; 4D |
| Zea mays                         |                                        |          |
| Citrus limon                     |                                        |          |
| Mandifora indica                 |                                        |          |
| Delonix regia                    |                                        |          |
| Sarcocephalus latifolius         |                                        |          |
| Allium sativum                   | Cow milk, Maceration, oral             | 3G/D ; 10D |
| Carica papaya                    |                                        |          |
| Persea americana                 |                                        |          |
| Citrus limon                     |                                        |          |
| Psidium guajava                  |                                        |          |
| Harungana madaigascariensis      |                                        |          |
| Caricapapaya                     | Water, Maceration, oral                | 3G/D ; 7D |
| Annona comosus                   |                                        |          |
| Annona senegalensis              |                                        |          |
| Lannea acida                     | Water, Decoction, oral                 | 3G/D ; 14D |
| Solanum torvum                   |                                        |          |
| Caricapapaya                     | Water, Decoction, oral                 | 6G/D ; 4D |
| Zea mays                         |                                        |          |
| Citrus limon                     |                                        |          |
| Mandifora indica                 |                                        |          |
| Delonix regia                    |                                        |          |
| Sarcocephalus latifolius         |                                        |          |
| Allium sepa                      | Water, Maceration, oral                | 2G/D ; 7D |
| Pilostigma thongii               | Water, Decoction, oral                 | 2G/D ; 14D |
| Mandifera indica                 | Water, Infusion, oral                  | 2G/D ; 14D |
| Plant Names                  | Preparation        | Duration  |
|-----------------------------|--------------------|-----------|
| Caccia occidentalis         | Water, Decoction, oral | 3G/D; 14D |
| Ludwigia abyssinica         |                    |           |
| Canarium schweinfurthii     |                    |           |
| Persea americana            | Water, Decoction, oral | 3G/D; 14D |
| Allium cepa                 |                    |           |
| Carica papaya               | Water, Infusion, oral | 3G/D; 7D  |
| Vitellaria paradoxa         | Water, Decoction, oral | 3G/D; 14D |
| Mandiféra indica            |                    |           |
| Solanum torvum             |                    |           |
| Allium cepa                 | Water, Decoction, oral | 3G/D; 10D |
| Carica papaya               |                    |           |
| Psidium guajava             | Water, Decoction, oral | 2G/D; 14D |
| Musa paradisiaca natron     |                    |           |
| Ipomoea batatas             | Kernel oil, Maceration, oral | 4TS/D 10D |
| Vitellaria paradoxa         | Cow Milk, Infusion, oral milk | 4G/D; 14D |
| Persea americana            | Water, Decoction, oral | 2G/D; 14D |
| Musa paradisiaca            |                    |           |
| Psidium guajava             |                    |           |
| Ipomoea batatas             | Azadirachta india oil, Maceration, oral | 4TS/D; 7D |
| Vitellaria paradoxa         | Water, decoction, oral | 3G/D; 14D |
| Zizyphus mauritiana         | Water, Decoction, oral | 2G/D; 14D |
| Harungana madagascariensis  |                    |           |
| Citrus limen                | Water, Decoction, oral | 3G/D; 14D |
| Senna spectabilis           |                    |           |
| Allium cepa                 |                    |           |
| Crhysanthellum africanaum   |                    |           |
| Sena tora                   |                    |           |
| Senna alata                 |                    |           |
| Annona senegalensis         | Water, Decoction, oral | 3G/D; 14D |
| Pakia biglobossa            |                    |           |
| Eucalyptus globulus         |                    |           |
| Harungana madagascariensis  |                    |           |
| Manihotes culenta           |                    |           |
| Ipomoea batatas             |                    |           |
| Zea mais                    | Cowmilk, Maceration, oral | 2G/D; 14D |
| Citrus avrantium            |                    |           |
| Solanum lycopersicum        | Water, Decoction, oral | 2-4G/D; 10D |
| Zingiber officinale         | Water, Decoction, oral | 1G/D; 14D |
| Phasealus vulgaris          |                    |           |
| Lannea acida                |                    |           |
| Erythrina senegalensis      |                    |           |
| Annona senegalensis         | Water, Decoction, oral | 2G/D; 14D |
| Withania somnifera          |                    |           |
| Persea americana            |                    |           |
| Bambuseae vulgarus          |                    |           |
| Initiation (06) | Plant Species | Preparation Method/Extraction | Duration |
|----------------|---------------|------------------------------|----------|
|                | Harungana madagascariensis | Water, Maceration, oral | 2G/D : 14D |
|                | Terminalia macroptera | Water, Maceration, oral | 2G/D : 10D |
|                | Piliostigma thonningii | Water, Maceration, oral | 2G/D : 14D |
|                | Psidium guayava | Water, Maceration, oral | 2G/D : 14D |
|                | V. amygdalina | Water, Maceration, oral | 2G/D : 10D |
|                | A. senegalensis | Water, Maceration, oral | 2G/D : 7D |
|                | P. thonningii | Water, Decoction, oral | 2G/D : 7D |
|                | E. hirta | Water, Decoction, oral | 2G/D : 7D |
|                | P. guayava | Azadirachta indica oil, Maceration, oral | 2G/D : 7D |
|                | A. senegalensis | Water, Infusion, oral | 2G/D : 14D |
|                | Euphorbia hirta | Water, Maceration, oral / Water, Infusion, oral | 2G/D : 10D |
|                | C. sinensis | Water, Decoction, oral | 2G/D : 10D |
|                | P. guayava | Water, Decoction, oral | 2G/D : 10D |
|                | Zizyphus mauritana | Water, Decoction, oral | 1G/D : 21D |
|                | V. amygdalina | Water, Decoction, oral | 2G/D : 10D |
|                | E. globulus | Water, Decoction, oral | 2G/D : 10D |
|                | A. senegalensis | Water, Decoction, oral | 2G/D : 10D |
| Herb                         | Preparation                  | Duration |
|-----------------------------|------------------------------|----------|
| **Crhysanthellum africanium** | Water, Decoction, oral       | 2G/D : 7D |
| **Solanum torvum**          |                              |          |
| **Harungana madagascariensis** |                              |          |
| **Terminalia macroptera**   |                              |          |
| **Piliostigma thonningii**  |                              |          |
| **Caricapapaya**            |                              |          |
| **Sarcocéphalus latifolius**|                              |          |
| **Vitellaria paradoxa**     |                              |          |
| **Solanum torvum**          |                              |          |
| **Tropoelummajus**          |                              |          |
| **Moringa oleifera**        |                              |          |
| **Psidium guajava**         |                              |          |
| **Carica papaya**           |                              |          |
| **Citrus lemon**            |                              |          |
| **Lannea acida**            |                              |          |
| **Erythrina**               |                              |          |
| **Vernonia amygdalina**     | Water, Maceration, oral      | 2G/D : 14D |
| **Aloes vera**              | /Water, Decoction, oral      |          |
| **Persea americana**        |                              |          |
| **Citrus limon**            |                              |          |
| **Euphorbia hirta**         |                              |          |
| **Lannea acida**            |                              |          |
| **Crhysanthellum africanium**| /Water Decoction, oral       | 3G/D : 10D |
| **Persea americana**        |                              |          |
| **Komniphora kersthengii**  |                              |          |
| **Vernonia amygdalina**     |                              |          |
| **Piliastigma thonningii**  |                              |          |
| **Citrus limon**            |                              |          |
| **Hymennocardia acida**     | Water, Maceration, oral      | 2G/D : 10D |
| **Psidium guajava**         |                              |          |
| **Daniella oliveri**        |                              |          |
| **Piliastigma thonningii**  |                              |          |
| **Ficus thonningii**        |                              |          |
| **Euphorbia hirta**         |                              |          |
| **Annona senegalensis**     | Water, Decoction, oral       | 3G/D : 14D |
| **Vitellaria paradoxa**     |                              |          |
| **Eucalyptus globulus**     |                              |          |
| **Aloe vera**               |                              |          |
| **Azadirachta indica**      |                              |          |
| **Tamarindus indica**       |                              |          |
| **Lannea acida**            |                              |          |
| **Sarcocéphalus latifolius**| Water, Decoction, oral       | 2G/D : 14D |
| **Canarium schweinfurthii** |                              |          |
| **Erythrina senegalensis**  |                              |          |
| **Senna alata**             |                              |          |
| **Allium sativum**          | Milk, Infusion, oral         | 2G/D : 10D |
| **Citrus limon**            | Water, Decoction, oral /     | 2G/D : 14D |
|                             | Water, Infusion, oral        |          |
### Table

| Plant Species                  | Preparation Method              | G/D; Day(s) |
|-------------------------------|---------------------------------|-------------|
| *Euphorbia hirta*             |                                  |             |
| *Mandifera indica*            | Water, Decoction, oral          |             |
| *Citrus limon*                |                                 |             |
| *Eucalyptus globulus*         |                                 |             |
| *Pilostigma thomingii*        | Water, Maceration, oral         |             |
| *Tamarindus indica*           |                                 |             |
| *Citrus limon*                |                                 |             |
| *Senna alata*                 | Water, Maceration, oral         |             |
| *Manihot esculenta*           |                                 |             |
| *Ipomea batatas*              |                                 |             |
| *Bidens pilosa*               |                                 |             |
| *Manihotes culenta*           |                                 |             |
| *Ipomea batatas*              |                                 |             |
| *Bidens pilosa*               |                                 |             |

G/D, glass per day.

### Figure 2

**Figure 2**: Number of plants per preparation.

### Figure 3

**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 (Sospe ter 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.

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REFERENCES

Agwu E, Ihongbe JC, Okogun GR, Inyang NJ. 2009. High incidence of co-infection with malaria and typhoid in febrile HIV infected and aids patients in Ekpoma, Edo State, Nigeria. Brazilian Journal of Microbiology, 40: 329-32. DOI: 10.1590/S1517-83822009000200022

Amado DAV, Helmann GAB, Detoni AM, Carvalho SLC, Aguiar CM, Martin CA, Tiuman TS, Cottica SM. 2019. Antioxidant and antibacterial activity and preliminary toxicity analysis of four varieties of avocado (Persea Americana Mill.). Brazilian Journal of Food
Amit G, Samrat SP, Pendharkar N. 2017. Antimicrobial and anti-inflammatory activity of aqueous extract of Carica papaya. Journal of Herbmed Pharmacology, 6(4): 148-152.

Crump JA, Luby SP, Mintz ED. The global burden of typhoid fever. 2004. Bull. World Health, 82: 346-35. DOI: 10.1590/S0042-96862004000500008

David M. 2012. Les chemins d’émancipation de la femme sahélienne camerounaise. Nigerian Journal of the Humanities, 18: 61-81.

https://www.researchgate.net/publication/311545253

Deciga-Campos M, Rivero-Cry I, Arriaga-Alba M, Castaneda-Corral G, Angeles Lopez GE, Navarrete A, Mata R. 2007. Acute toxicity and mutagenic activity of Mexican plants used in traditional medicine. Journal of Ethnopharmacology, 110: 334–337. DOI: 10.1016/j.jep.2006.10.001

Etou AW, Ossibi MA, Elouma N, Epa C, Wossolo LBS, Bonose MN, Okemy AJM, Moutsambote, Abena AA. 2019. Chemical composition and diuretic potential of the essential oil of Cymbopogon densiflorus (Steud.) Stapf. (Poaceae) in the mouse. Int. J. Biol. Chem. Sci., 13(6): 2777-2784. DOI: 10.4314/ijbcs.v13i6.28

Kengni F, Fodouop SPC, Tala DS, Djimeli MN, Fokunang C, Gatsing D. 2016. Antityphoid properties and toxicity evaluation of Harungana madagascariensis Lam (Hypericaceae) aqueous leaf extract. Journal of Ethnopharmacology, 179: 137–145. DOI: 10.1016/j.jep.2015.12.037

Focho DA, Ndam WT, Fonge BA. 2009a. Medicinal plants of Aguambu – Banumbu in the Lebialem highlands, southwest province of Cameroon. African Journal of Pharmacy and Pharmacology, 3(1): 1-13. DOI: https://doi.org/10.5897/AJPP.9000204

Fodouop CSP, Gatsing D, Tagne SR, Tala SD, Tchoumboué J, Kuiate J-R. 2015. Effect of Salmonella Typhimurium infection on rat’s cell oxidation and in vivo antioxidant activity of Vitellaria paradoxa and Ludwigia abyssinica aqueous extract. Asian Pacific Journal of Tropical Disease, 5(1): 38-46. DOI: 10.1016/S2222-1808(14)60624-1

Gatsing D, Nkeugouapi CFN, Nji-Nkah BF, Kuiate JR, Tchouanguep FM. 2010. Antibacterial activity, bioavailability and acute toxicity evaluation the leaf extract of Alchornea cordifolia (Euphorbiaceae). Int. J. Pharmacol., 6:173–82. DOI: 10.3923/ijp.2010.173.182

Lamy LGM, Ibrahima A, Ndjonka D, Mapongmetsem P-M. 2018. Etude ethnobotanique des sous-variétés de Syzygium guineense (Will.) DC. var. macrocarpum (Engl.) F. White dans les Hautes Savanes Guinéennes (Adamaoua, Cameroun). Int. J. Biol. Chem. Sci., 12(4): 1636-1649. DOI: 10.4314/ijbcs.v12i4.11

Habte ET, Getachew F, Anteneh A. 2018. Typhoid fever: clinical presentation and associated factors in febrile patients visiting Shashemene Referral Hospital, southern Ethiopia Limenih. BMC Res. Notes, 11: 605. DOI : 10.1186/s13104-018-3713-y

Igoli JO, Ogali OG, Tor-Anyiin, TA, Igoli NP. 2005. Traditional medicine practice amongst the Igede people of Nigeria. Part II. African Journal Traditional Complementary and Alternative Medicines, 2(2) : 134–152. DOI: 10.4314/ajtcam.v2i2.31112

Lakshmi V, Ashok R, Susmita J, Shailaja VV. 2006. Changing trends in the antibigrams of Salmonella isolates at a tertiary care hospital in Hyderabad. Ind. J. Med. Microbio., 24(1) : 45-48. DOI: 10.4103/0255-0857.19894
Lunga LK, Tamokou JD, Fodouop CSP, Kuiate J-R, Tchoumboue J, Gatsby D. 2014a. Antityphoid and radical scavenging properties of the methanol extracts and compounds from the aerial part of *Paulinia pinnata*. *SpringerPlus*, 3(302): 1-9. DOI: 10.1186/2193-1801-3-302

Madhuilka U, Harish BN, Parija SC. 2004. Current pattern in antimicrobial susceptibility of *Salmonella* Typhi isolates in Pondicherry. *Ind J. Med Res.*, **120**: 111-114. DOI: 10.15413/ajmr.2013.0006

Mapongmetsem PM, Kapchie VN, Tefempa Mapongmetsem PM, Hamawa Y, Baye Madhulika U, Harish BN, Parija SC. 2004. Conservation and valorisation de la biodiversité dans les agrofôrets de case de la zone Soudano-Guinéenne. In *Systematics and conservation of African Plants*, van der Burgt T, van der Maesen BH. 2012. Diversity of local fruit trees and their contribution in sustaining the rural livelihood in the northern Cameroon. *Ethiopian Journal of Environmental Studies and Management*, 5(1): 32-46. DOI: 10.4314/ejesm.v5i1.5

Mfopa AN, Mbouna CDJ, Tchokouaha LRY, Tchuente MAT, Kouipou RMT, Fokou PVT, Kemgne EAM, Kamkumo RG, Boyom FF. 2017. *In vitro* and *in vivo* antiplasmodial activity of extracts from *Polyalthia suaveolens*, *Uvaria angolensis* and *Monodora tenuifolia* (Annonaceae). *Int. J. Biol. Chem. Sci.*, **11**(1): 118-130. DOI: 10.4314/ijbcs.v11i1.10

Bamba M, Neut C, Bordage S, Dramane S, Kouadio NJ, Yacoubia S, Samailie J, Zamble A, Tah T, Tra-Bi-Fezan H, Sevser S. 2020. Screening phytochimique des extraits méthaniques des feuilles de *Combretum collinum* et des racines de *Anogeissus leiocarpus* et effet antibactérien *in vitro* sur des souches multirésistantes de *Staphylococcus aureus*. *Int. J. Biol. Chem. Sci.*, **14**(6): 2362-2372. DOI: 10.4314/ijbcs.v14i6.34

Njolle AB, Tientche B, Asaah S, Forfuet DF, Kamga HLF. 2020. The Prevalence of Salmonellosis in Patients with Malaria Attending an Urban Hospital in Douala, Littoral Region, Cameroon. *Journal of Advances in Medicine and Medical Research*, **32**(2): 32-45. DOI: doi.org/10.9734/jammr/2020/v32i23036

Sokoudjou JB, Chegaing Fodouop SP, Djoueudam FG, Kodjio N, Kana JR, Fowa AB, Kamsu TG, Gatsby D. 2019. Antisalmonellal and antioxidant potential of hydroethanolic extract of *Canarium schweinfurthii* Engl. (Burseraceae) in *Salmonella enterica* serovar Typhimurium-infected chicks. *Asian Pac J. Trop. Biomed.*, **9**(11): 474-483. DOI: 10.4103/2221-1691.270980

Sokoudjou JB, Njateng GSS, Fodouop CSP, Kodjio N, Atsafack SS, Fowa AB, Merline Namekong Djimeli NM, Gatsby D. 2018. *In vitro* antisalmonellal and antioxidant activities of *Canarium schweinfurthii* stem bark extracts. *Academia Journal of Medicinal Plants*, **6**(10): 331-341. DOI: 10.15413/ajmp.2018.0166

Sospeter NN, Meshack AO, Silas MN, Samwel NO, John MN, Paul KK. 2015. Antituberculous, antimicrobial, cytotoxicity and phytochemical activity study of *Piliostigma thonningii* extract fractions. *Journal of Medicinal Plants Research*, **9**(22): 655-663. DOI: 10.5897/jmpr2015.5822.

Srividya L, Rama A, Narsimha R. 2019. Antibacterial Activity of *Carica papaya* Leaves and *Allium sativum* Cloves Alone and in Combination against Multiple Strains. *Pharmacogn J.*, **11**(3): 600-602. DOI:10.5530/pj.2019.11.95.

Steele AD, Burgess DCH, Diaz Z, Carey ME, Zaidi AKM. 2016. Challenges and opportunities for typhoid fever control: A call for coordinated action. *Clinical
Infectious Diseases, 62: S4–8. 
DOI: 10.1093/cid/civ976

Stuart D. 2004. Dangerous Garden: The Quest for Plants to Change Our Lives. Havard University Press, Cambridge.

Tala SD, Fodouop CSP, Tsafack ND, Kodjio N, Fokunang C, Gating D. 2018. Toxicological Investigations of Ethanolic Leaves Extract of Dissothis thollonii (Melastomataceae). Journal of Pharmaceutical Research International, 24(4): 1-14.

Tchobsala MM. 2013. Characterization and impact of wood logging on plant formations in Ngaoundéré District, Adamawa Region, Cameroon. Journal of Ecology and the Nature Environment, 5(10): 265-277. DOI: 10.5897/JENE10.102.

Telefo PB, Lemfack MC, Bayala B, Lienou LL, Goka CS, Yemele MD, Mouokeu C, Tagne SR, Moundipa FP. 2012. Enquête ethnopharmacologique des plantes utilisées dans le traitement de l’infertilité féminine dans les localités de Fossong-Wentcheng et Foto, Cameroun. Phytotherapie, 10(1): 25-34. DOI:10.1007/s10298-011-0678-6

Thomas E, Vandebroek I, Sanca S, Van Damme P. 2009. Cultural significance of medicinal plant families and species among the Quechua farmers in Apillapampa, Bolivia. Journal of Ethnopharmacology, 112: 60–67. DOI: 10.1016/j.jep.2008.11.021

WHO Weekly epidemiological record. 2014. Typhoid fever surveillance and vaccine use, South-East Asia and Western Pacific Regions, 2009–2013. WHO, 89: 429-440.

Yemele MD, Telefo PB, Lienou LL, Tagne SR, Fodouop CSP, Goka CS, Lemfack MC, Moundipa FP. 2015. Ethnobotanical survey of medicinal plants used for pregnant women’s health conditions in Menoua division-West Cameroon. Journal of Ethnopharmacology, 160: 14–31. DOI: 10.1016/j.jep.2014.11.017

Zava DT, Dollbaum CM, Blen M. 1998. Estrogen and progestin bioactivity of foods, herbs and spices. Society for Experimental Biology and Medicine, 217: 369–371. DOI: 10.3181/00379727-217-44247.