# Ethnomedicinal study of plants used for treatment of diabetes, hypertension and cardiovascular ailments in Fokoue and Santchou subdivisions, Menoua Division of West Cameroon


## ABSTRACT

**Background:** In Cameroon, numerous people rely on medicinal plants and possess knowledge on the use of these plants. Plant knowledge from indigenous people is rapidly disappearing due to environmental, social and economic pressure, processes and changes. In view of this, ethnobotanical studies have been carried out in the area where medicinal plants are the main source of health care in order to preserve traditional knowledge of plant use. This study aims to document and quantify medicinal plant knowledge on the treatment of diabetes, hypertension and cardiovascular ailments in Fokoue and Santchou subdivisions of Menoua Division, West Cameroon.

**Methods:** Information related to medicinal plant species and plant remedies was collected through semi-structured interviews with 34 informants accompanied by homegarden sampling, walk-in-the-woods and snowball sampling. Quantitative methods were used to determine cultural importance index, relative frequency of citation and fidelity level which represent informants' consensus.

**Results:** A total of 49 medicinal plant species representing 26 different botanical families were recorded in Fokoue and Santchou subdivisions of Menoua Division, West Cameroon. Most-cited plant families were Acanthaceae, Amaryllidaceae, Apocynaceae, Asteraceae, Lamiaceae, Poaceae and Rhamnaceae. Plant species *Allium sativum, Aloe vera, Asystasia* spp., *Cymbopogon citratus, Gouania* spp., *Persea americana, Sonchus oleraceus* and *Vernonia amygdalina* were considered as relatively important plants for treating diabetes, hypertension and cardiovascular ailments.

**Conclusions:** The study indicated the unique knowledge of medicinal plants used for treating diabetes, hypertension and cardiovascular ailments in Fokoue and Santchou subdivisions. Our findings not only confirm uses of medicinal plants documented elsewhere, but also add interesting new information that should be confirmed through formal biochemical analysis and clinical trials.



*Keywords: Africa traditional medicine, Quantitative ethnobotany*, *Medicinal plants*


## 1. INTRODUCTION

Non-communicable diseases (NCDs) are the leading mortality cause in the world, accounting for 67.8% of all deaths globally in 2012 [1]. This figure is especially high in low-

and middle-income countries in which nearly 80% of all NCD deaths occur [2]. In many African countries, the cost of modern medical treatments for chronic diseases is unaffordable for most patients [3, 4]. Medicinal plants are quite popular due to their lower cost of preparation as compared to that of artificial drugs [5]. Herbal medicines are thus considerably cheaper than allopathic ones, whereas traditional healers also sometimes calculate the cost of a treatment on the basis of the income of a patient [6]. Traditional healers and patients often believe healers play an important role in health care. In this line of thinking, certain treatments can only be performed by them, so that this is something that western medicine cannot replace [7]. Medicinal plants are used for treatment of diabetes, hypertension and cardiovascular ailments in many indigenous medicinal systems [5, 8], diabetes mellitus has gained more attentions among them [9-15].

Cameroon is experiencing an increase in the burden of NCDs, which accounted for 31% of all deaths in the counting in 2012 [1]. Mortality by cardiovascular diseases (CVDs) and diabetes stood at 881.9 per 100,000 people in 2008. Prevalence of hypertension was 36.9% in 2008, whereas prevalence of raised blood glucose was 8.8% which amounts to a doubling over the past two decades [16]. In Cameroon, health care and allopathic medicine are no longer provided for free, whereas chronic short supply and high costs of drugs for treatment of NCDs are recent problems in the country's health care system [17]. As a consequence, both rural people and the urban poor in Cameroon are highly relying on the use of traditional medicine (TM) for NCD and general disease treatment [7].

A number of studies in Cameroon have tried to research the pharmacology of medicinal plants which are commonly used among traditional people. However, the use of medicinal plants against NCDs is not well-studied in Cameroon, whereas bioactive compounds of many plants have not been identified yet, although some plant extracts were studied via animal models [for review, see18]. To date, traditional medicinal plant knowledge in Menoua Division, West Cameroon has hardly been documented. This study aims to establish an inventory of medicinal plants used for treating diabetes, hypertension and cardiovascular ailments in this region, and evaluate the uses of these plants by comparing reported uses with those in literature.

It is hypothesised that:

- people in Menoua Division possess unique knowledge of medicinal plants that are used to treat diabetes, hypertension and cardiovascular ailments;
- some medicinal plants that are used in Menoua Division are also used in other regions of Cameroon; and
- the uses of some medicinal plants in this community are not found in other cultures or have not been studied yet.

## 2. MATERIAL AND METHODS

# Methods

### Research area

Menoua division covers an area of 1,380 $km^2$ and is located in the Western Highlands of Cameroon [19]. Fokoue and Santchou are two subdivisions which share a common border (**Error! Reference source not found.**). Four villages (Bamendou, Fokoue and Fotomena and Santchou) were visited for the research as they were easy to reach and had higher household density than other villages in this area, allowing to interview more people in a shorter time.

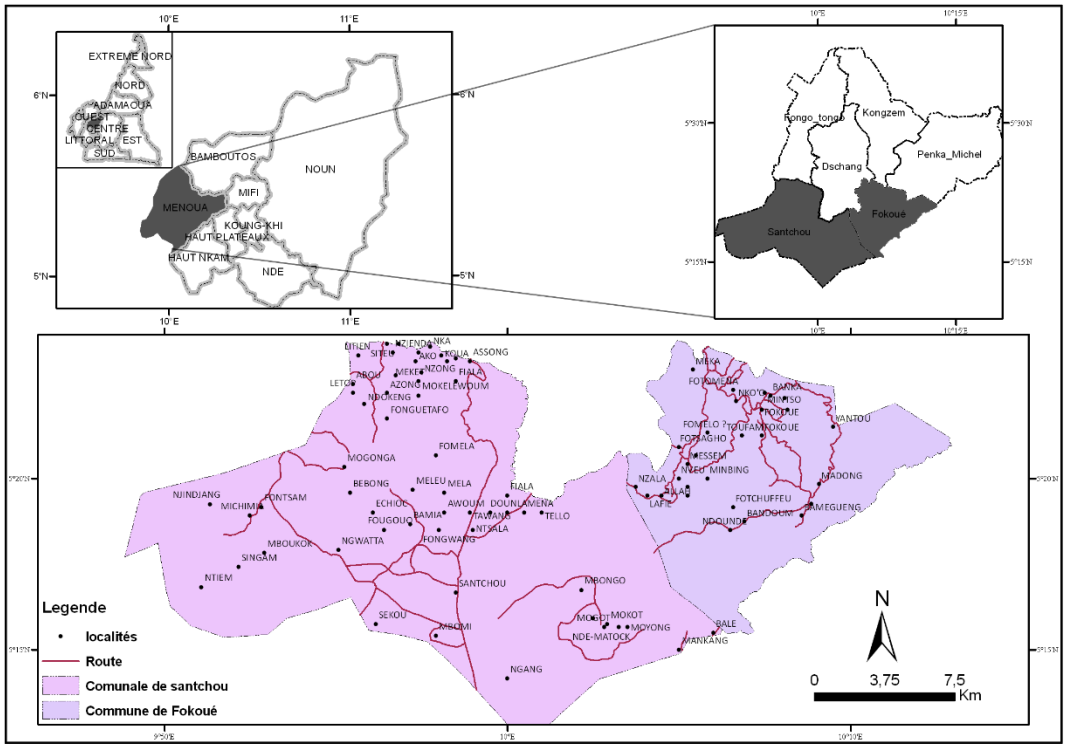


Figure 1: Map of study area in Fokoue and Santchou subdivisions, Menoua division, West Cameroon

**Ethnobotanical data collection**

An ethnobotanical study was conducted in the rainy season between 1 and 28 of July 2013, the permission of conducting the study was issued by the local administrative office, respectively for each subdivision. Face-to-face, semi-structured interviews described by Cotton [20] were used to gather information on demographic characteristics and plant remedies. Interviews were conducted individually either in French or in local dialects. Individual, semi-structured interviews included respondents' age, gender, occupation, source of knowledge, method of diagnosis, local names of medicinal plants, ailments treated, other plant uses, plant growth forms (herbs/shrubs/trees, etc.), habitat (wild/cultivated), plant parts used, condition of plant used (fresh/dried), method and route of remedy administration, other ingredients or additives (if any), approximate dosage of the remedy and adverse effects of remedies (if any) following the questionnaires used by previous studies [21, 22]. Ethnobotanical information about sampled plant species was collected according to the techniques described in the study of Thomas *et al.* [23]. These included *in situ* interviewing, walk-in-the-woods, homegarden sampling, and *ex situ* interviewing using fresh plant specimens and photographs as prompts. Most plant species were identified in the field by botanist when it was recognizable. Voucher specimens of unknown medicinal plants were collected with the assistance of the interviewees using the standard herbarium specimen collection method described by Martin [24]. Voucher specimens were identified and confirmed at the National Herbarium in Yaoundé, Cameroon. The botanical names of plants were confirmed via IPNI (International Plant Names Index) [25]. Plant species were classified into families using the Missouri Botanical Garden database [26].

Most traditional healers from Fokoue who participated in the study were contacted with the help of local government officials. Other participants, including farmers and traditional healers, were selected through snowball sampling [27, 28], i.e. each interviewee (from a household that was randomly chosen when the researchers walked around the village) was first asked whether he/she had plant knowledge; if not, then the respondent was asked whether he/she knew someone who is a traditional healer or possesses plant knowledge. Following their willingness to participate and individual knowledge, eventually 34 people participated in and completed the full questionnaire.

**Data analysis**

Descriptive statistics were used to summarise the info on demographic characteristics and plant remedies. Pearson's chi-square test (α = 0.05) was employed to determine whether there is an association between age of correspondents and medicinal plant knowledge, and years of practice and medicinal plant knowledge [$p<0.05$ was considered statistically significant]. Use report (UR) is defined as "informant *i* mentions the use of species *s* in use category *u*" [20]. The derived UR was then used for further calculation.

The cultural importance index (CI) developed by Tardio, Pardo-De-Santayana [29] was calculated by the following formula:

$$\mathrm{CI}_s = \sum_{u=u_1}^{u_{\mathrm{NC}}} \sum_{i=i_1}^{i_{\mathrm{N}}} \mathrm{UR}_{ui}/\mathrm{N} \quad (1),$$

where $UR_{ui}$ is the use report from informant *i* for species *s*, N is number of informants, and NC is total number of use categories reported for species *s*. A higher value of CI evidences that more informants mention the use of the species in more use categories considered in the survey. Theoretically, the maximum value of $CI_s$ is the NC for species *s* [29], i.e. three (diabetes, hypertension and cardiovascular ailments) in the current study.

Relative frequency of citation (RFC) for a species, described by Tardio, Pardo-De-Santayana [29], was calculated by dividing frequency of citation (FC) by total number of informants (N) who participated in this survey:

$$\mathrm{RFC}_s = \mathrm{FC}_s/\mathrm{N} \ (2).$$

This index summarises the use report of the species from all informants without considering the use category. It is the sum of all URs of all informants for a given species, i.e., informant *i* mentioning species *s* to be useful for two different diseases is considered as one citation. A small value (close to 0) indicates a lower number of informants report the use of this plant species, whereas a high value (close to 1) indicates more informants mentioning this plant to be useful. In other words, plants most-often cited are considered to be the most relevant ones [29].

The fidelity level (FL) was calculated using the formula:

$$\mathrm{FL} = (\mathrm{I}_p/\mathrm{I}_u) \times 100 \ (3),$$

where $I_p$ is number of informants who independently cited a plant species for the particular use against the same major ailment, and $I_u$ is total number of informants who mentioned the plant for use against other ailments. A bigger number means the species is considered more important for this specific illness category [30].

The relatively most important plant species that had been identified by the indices mentioned above were further assessed through existing literature, i.e. we compared the use of these plants to those in other regions within and outside Cameroon, and evaluated the validity of uses by their pharmaceutical or chemical activities.

## 3. RESULTS AND DISCUSSION

## Demographic characteristics

In total, 14 women and 20 men participated in the interviews. Twenty-four were from Fokoue subdivision and ten were from Santchou subdivision. Participants' ages ranged from 23 to 95 years old (mean age 54.5 years). Twenty-three (67.6%) participants were farmers (13 in Fokoue, 10 in Santchou), whereas eight (23.5%) practiced as traditional healers (all from

Fokoue); the other three informants are, respectively, plumber, teacher and retired. Participants had practiced TM for an average of 23 years (median 16.5); the shortest practicing time was one month while the longest was 70 years. Two participants could not recall how long they had been practicing TM. There was no significant association ($p>0.05$) between either age or years of practice and number of plant species reported by each informant.

Most participants had had primary school education. Among participants, 29 (85.3%) could read and write. None of them had had higher education. Twenty-eight participants (82.4%) claimed that they had acquired the plant knowledge from someone who possessed medicinal plant knowledge, e.g. parents, relatives or traditional healers (**Error! Reference source not found.**). A number of them had had multiple information sources, such as from different family members, traditional healers and herb sellers, etc. However, six participants claimed that their knowledge source had been dreams. African traditional healers often believe in the power of spirits that communicate information on plants via dreams, as suggested by Makhubu [31]. Additionally, some traditional healers believed that they had been born with the healing talent as "a gift from God", therefore the knowledge of medicine and treatment had come via their dreams naturally [7]. Knowledge sources are comparable to results found in Uganda [32] where the main sources were close family members, whereas dreams were also mentioned as one of the sources.

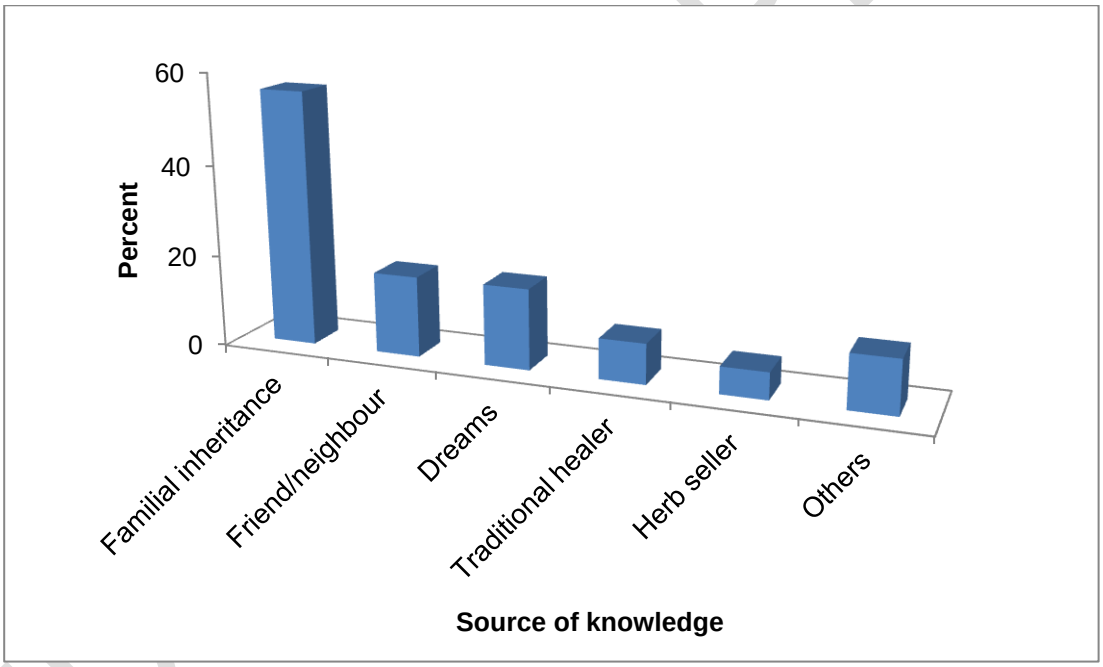


Figure 2: Plant knowledge sources on medicinal uses (multiple answers possible)

Each informant was asked whether she/he knew about the symptoms of the disease when they had reported the uses of the plants for treating diabetes, hypertension and cardiovascular ailments (**Error! Reference source not found.**). However, the majority of respondents (24 informants; 70%) did not know about the exact symptoms and stated that they had proposed plant remedies for patients who had been diagnosed by physicians before coming to them. As suggested by Heinrich *et al.* [33], the treatments could have been developed locally or adopted from neighbouring cultures. Heinrich *et al.* [33] also pointed out that the diseases investigated in ethnomedical studies, in a strict sense, could have no treatment in traditional medicine because they were traditionally unknown. For instance, some symptoms of diabetes might have been recognized in the survey, but the disease

could be not the one described in modern medicine, i.e. not diabetes. As a consequence, an ethnobotanical survey should include the local name of a disease and how it is normally diagnosed even though sometimes it is extremely difficult to translate symptoms from one disease to another across cultural lines [33].

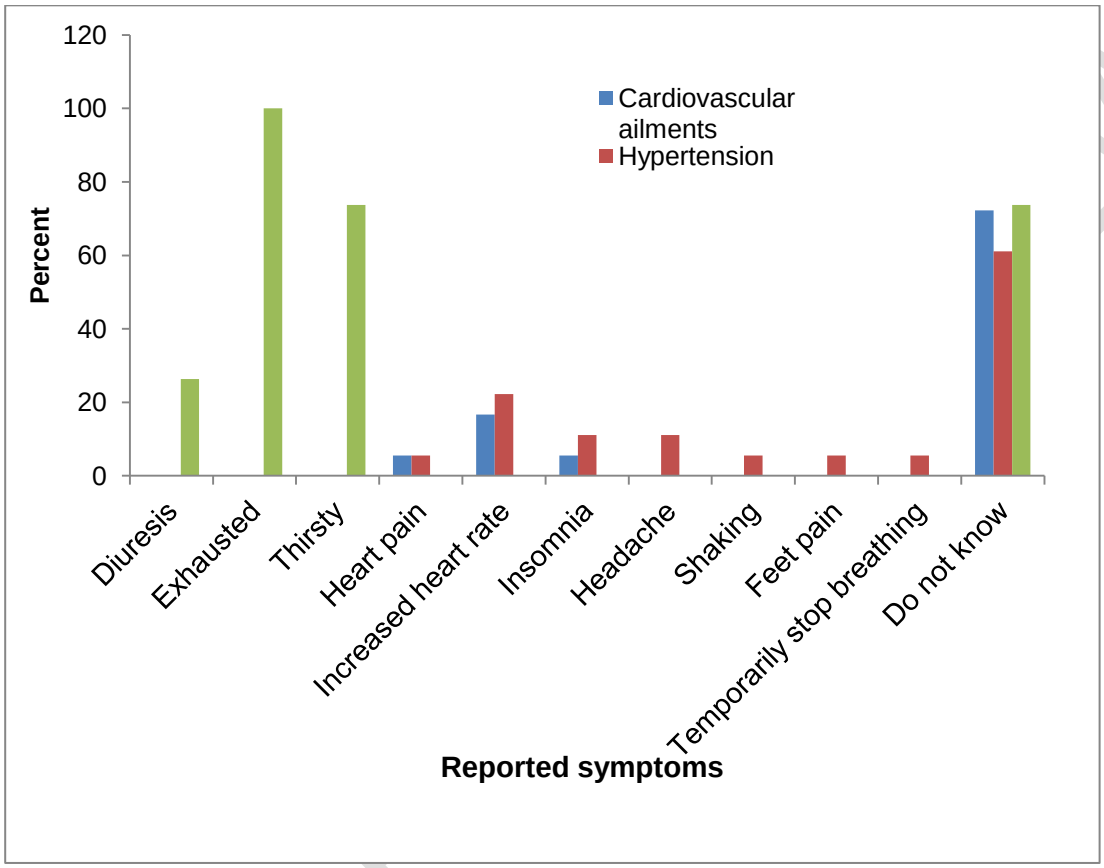


Figure 3: Percentage of reported symptoms by informants according to disease category

## Medicinal plant reports

A large number of medicinal plants are traditionally used for the treatment of diabetes, hypertension and cardiovascular ailments by the people in the study area (**Error! Reference source not found.**). A total of 49 medicinal plant species belonging to 26 different botanical families were reported.

## Plant species, growth forms and habitat

Asteraceae was the most-represented family with the highest number of plant species (thirteen species), followed by Lamiaceae and Poaceae (four species each), Amaryllidaceae (three species), Acanthaceae, Apocynaceae, and Rhamnaceae (two species each). The remaining 19 families were represented by only one species per family. The reason that some plant families are being used more extensively than others could be explained by the fact that some families tend to dominate the pharmacopoeia in specific regions and traditional healers are compelled to use those plants with higher availability [34]. Interestingly, Thomas *et al.* [35] stated that the most diverse plant families in the entire local flora would provide the highest number of medicinal plant species. Asteraceae was also the most-reported medicinal plant family in other studies [22, 36], whereas the popularity of

Asteraceae is due to its wide array of bioactive components and the typical bitter phytochemicals derived from them [36].
Most of the reported medicinal plants were herbs (55.10%), followed by shrubs (20.41%) and trees (18.37%). Similar results have been reported by Lulekal *et al.* [22] and Thomas *et al.* [36]. However, other studies found that the most important growth forms were trees and shrubs [35, 37, 38]. This difference in results can be explained by the fact that different surveys focused on different uses of plants whereas only the plants used for treatment of diabetes, hypertension and cardiovascular ailments were investigated in the present study. Habitat also influences the frequencies of different plant species appearing in a study. The study area belongs to the Western Highlands of Cameroon, therefore it has both montane forest and alpine savannah [39].
A number of plants were initially collected from the wild but were also cultivated in homegardens by some informants. Twenty species (40.82%) were only gathered from the wild. This is comparable to the findings of other studies [12, 40] in which reported plants were mainly obtained from family gardens.

## Plant parts used in the remedies

**Error! Reference source not found.** summarises the plant parts used in the preparation of remedies. The most commonly used parts were leaves (71.43%), followed by entire plants (16.33%) and roots (10.20%). Succulent plants were not distinguished from leaf plants. For example, the use of succulent stems of *Cissus quadrangularis* was classified as use of leaves because the informants said that they used “leaves” of this plant for treatment. The leaf is mostly used because of its supposed higher concentration of active compounds, as Chintamunnee, Mahomoodally [12] suggested. Gazzaneo *et al.* [41] also demonstrated that people tend to use leaves for plant remedies in an area where vegetation is always green and leaves are abundant. Furthermore, Heinrich *et al.* [33] pointed out that leaves will be the most frequently used plant part if herbs and little shrubs are the most frequently used plants, as is the case in the current study (75% of plants are herbs or shrubs).
Aerial plant parts (leaves, stem, fruit) were used most frequently (87.8%); whole plant and underground parts were used least (12.2%). Sharma *et al.* [34] asserted that it is good for the local flora when aerial parts are the predominantly used parts, because the survival of these valuable plants will thus not be threatened.
It is important to select the proper plant part that contains adequate amounts of active substances in order to achieve a positive response of medicinal plant treatments. This is because in many plants, different plant parts either contain different concentrations of the active substances or even completely different chemical compounds [42]. For example, in the case of *Picralima nitida* (treatment of CVDs), some informants used leaves whereas others used fruits. Interestingly, Erharuyi *et al.* [43] reviewed the uses of *P. nitida* and concluded that both leaf and fruit have significant hypoglycaemic and hypotensive effects in animal models and suggested further investigation of this plant. Many plants were mentioned to be used for treatment of two or three diseases because of the chemical complexity of plant parts [e.g. 44, 45]. For example, *Ageratum conyzoides* was reported to be used for the treatment of cardiovascular ailments and diabetes in the current survey. Studies have shown that *A. conyzoides* possesses hypoglycaemic, antioxidant and antibacterial property [46-48], whereas its other uses against cough, fever and skin disease were also recorded from other ethnobotanical studies [18].

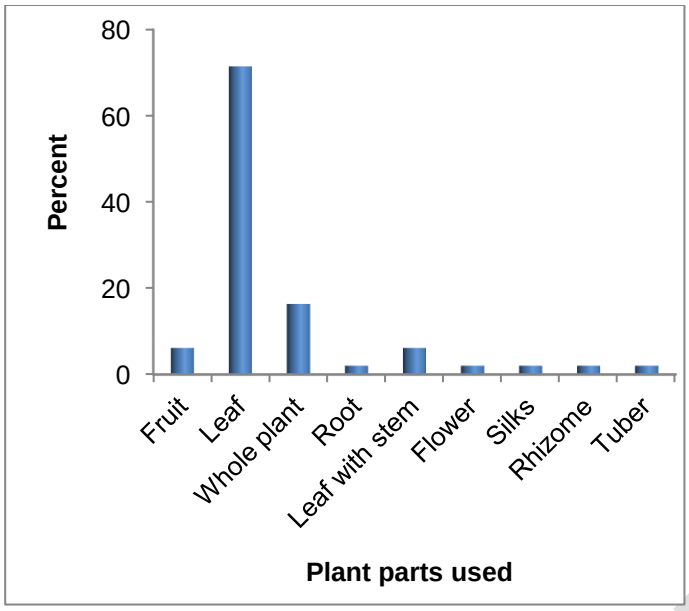

Figure 4: Medicinal plants parts used in the preparation of remedies (multiple answers possible)

## Preparation of plant remedies

In the current survey, a majority of informants used fresh plants to treat diseases (85.4%), whereas 12.5% plants were used in both fresh and dry forms; one species was reported to be used only in its dry form (i.e. *Zea mays*). People prefer to use fresh plants because they are afraid of losing the medical properties of the plant with drying, as suggested by Upadhyay *et al.* [49]. Chintamunnee, Mahomoodally [12] also suggested that local people would use fresh plant if they could easily obtain them in all seasons.

Decoction (boiling in water) was found to be the predominant method of remedy preparation, followed by crushing, maceration (soaking in cold water) and infusion (pouring boiled water over dry/fresh plant materials and steeping, similar to tea making) (**Error! Reference source not found.**). Decoction was reported to be the most frequent way of preparation in other studies as well [12, 50]. Teklehaymanot, Giday [37], however, reported crushing as the main method of preparation for plant remedies that are used to treat different ailments in some southern nations of Ethiopia. Other methods of extraction were used by only a small proportion of informants. One plant species, *Cucurbita pepo*, was cooked and taken as food. More than half of the plant species (28 species) were prepared in mixtures for the treatment of single or multiple ailments; others were used singly. Gurib-Fakim [5], Nanyingi *et al.* [51] and Tabuti *et al.* [52] state that mixtures of medicinal plants are commonly used in Chinese, Indian and African traditional medicines. Other studies reported that plants were used singly to treat most of the diseases [12].

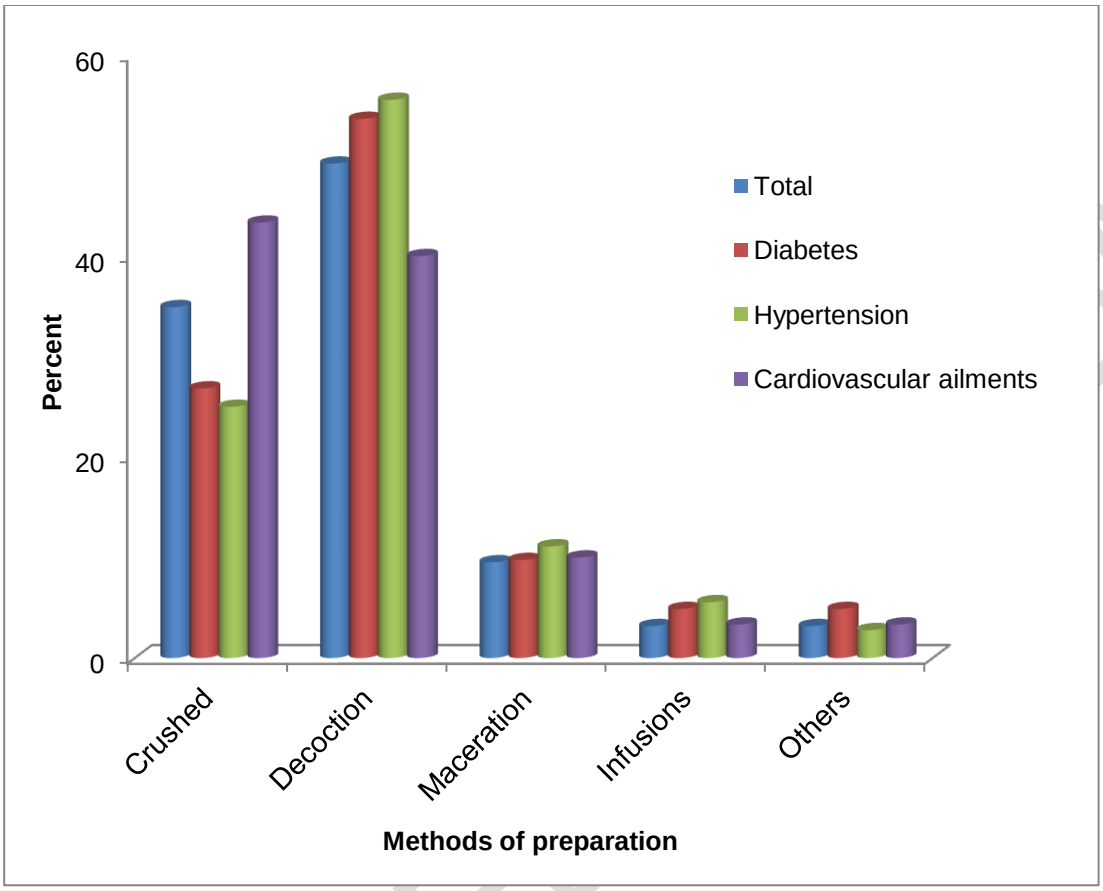

Figure 5: Preparation methods of plant remedies against diabetes, hypertension and cardiovascular ailments (multiple answers possible)

Water was the only solvent used in our study. Some plants were mixed with other ingredients such as eggs, honey and palm oil; e.g. *Sonchus oleraceus* was reported to be taken along with honey. This can be explained by the fact that additives are often used to reduce unpleasant tastes (e.g. bitterness) [12].

## Administration of plant remedies

All reported plant remedies were taken orally. In most cases, the treatment dosage was one glass (approximately 200 mL), to be taken two or three times per day until disease symptoms disappeared. A number of informants claimed that they did not know the exact dosage; for example, *S. oleraceus* can be taken as tea so patients could drink it several times per day. Similar results were also reported in other studies in which dosages were not specific and plants were taken as vegetables or tea [12, 37].

The dosage of almost all remedies was the same for different ages in both gender groups in the current survey. The only exception is for *Crassocephalum biafrae* (Asteraceae): a handful of the whole plant is crushed and macerated in 1.5 litres water and should be drunk once a day in the evening for men and twice a day for women during one month. In other studies, the dosage of most herbal remedies depends on sex, age, pregnancy status and severity of disease [12, 50].

Informants in the current study believed plant remedies are safe because they rarely reported adverse effects of plant remedies. Only two plants were mentioned to have some adverse effects: (1) excessive use of *Solanum nigrum* influences amount of urine; (2) and leaves of *Guizotia scabra* are crushed and eaten, but were reported to allegedly cause soft-

tissue injury in the mouth. It would seem that in many cases long-term use of medicinal plants does not cause any problem; however, some undiscovered activities may nevertheless appear. Therefore, it is of critical importance to continuously evaluate the safety of plant remedies [53].

# Quantitative analysis

## Cultural importance index

We calculated the CI to identify culturally important plant species. The CI index not only reflects how widely spread each species is being used, but also in what different ways it is used. Plants that are used by a large number of people for several uses obtain higher CI values. A high-agreement for its cultural use was considered in the survey area if a plant obtained a high value of CI [29]. Table 2 shows the contribution of each use category in total CI of the ten most-relevant and useful plant species in the study area.

*Gouania* ("*botetee*" in local dialect) which could not be determined to a specific botanical species level, had most citations (FC=7). It is culturally the most significant medicinal plant species according to the CI index in our survey. Furthermore, it is considered to be more important for treating CVDs ($CI_C$=0.21) than for treating hypertension ($CI_H$=0.09). To date, genus *Gouania* has hardly been studied. *G. leptostachya* and *G. lupuloides* were reported to be used in Thailand and Ecuador, respectively [54, 55]. Plant extract of *G. longipetala* was tested for its toxicity [56], and two new triterpenoids of *G. ulmifolia*. have been identified [57], whereas a taxonomic revision of genus *Gouania* has been conducted in Madagascar and other west Indian Ocean islands [58].

*Persea americana* (Lauraceae) was reported to be useful in the three disease categories studied, with a predominance in the treatment of diabetes and hypertension. Leaves of *P. americana* were reported to be commonly used to treat diabetes in Douala [38], and the Littoral, Southwest and Sudano-Sahelian regions of Cameroon [44]. Lima *et al.* [59] demonstrated that leaf extracts of *P. americana* can reduce blood sugar levels in diabetic rats. Ojewole *et al.* [60] found that leaves of *P. americana* can reduce blood pressure and heart rate, and suggested it could be used in cases of hypertension and some cardiac dysfunctions.

*Allium sativum* (Amaryllidaceae) is used globally for the treatment of diabetes and hypertension, and its medicinal activity has been confirmed by clinical trials [5, 61]. In Cameroon, it was also cited as a treatment for diabetes in Douala [38], and for hypertension in Bafia [62], Littoral, Southwest and Sudano-Sahelian regions of Cameroon [44].

Teugwa *et al.* [63] pointed out that *S. oleraceus* (Asteraceae) is commonly used by traditional healers to treat diabetes in Cameroon. Their study in animal models suggests that leaves of *S. oleraceus* indeed possess anti-diabetic properties. The hypoglycaemic effect of *S. oleraceus* extracts was found by AbouZid *et al.* [64] in animal models as well. However, further clinical trials are required to quantify the safety and effectiveness of this medicinal plant species [65]. Publications confirming the pharmacological effect of *S. oleraceus* on blood pressure were not found.

*Cymbopogon citratus* (Poaceae) was reported to be used against hypertension in Bafia region of Cameroon [62]. Based on an *in vivo* study, Campos *et al.* [66] suggest that it improves vessel relaxation and consequently might lead to blood pressure reduction. The cardio-protective effects of *C. citratus* have been demonstrated by means of animal models in a study conducted by Gayathri *et al.* [67].

## Comparison of different indices

The RFC was applied for determining the relative importance of each plant species cited in the study. The RFC index does not consider the use category whereas the CI index does take it into account. The importance of a plant species tends to be under-rated (ranked lower) when using RFC index, which only considers number of citations [29]. According to

the latter authors, the importance of a plant is better represented when the diversity of uses is taken into account via the CI index. However, in our study no difference in ranking was found between the two indices (

Table 3); which might be due to the fact that only 34 informants participated in our survey. The RFC index depends on the sample size: it increases when the number of citation increases [68].

The CI value allows to discover patterns of agreement and disagreement in plant knowledge in a given area. The global value of the CI index in a specific community does not tell us whether it is a species with a well-defined, specific use or rather a species with a diversified number of uses [29]. In our study, *C. citratus* and *A. vera* yielded the same total CI index value (0.15), even though the number of informants mentioning them (5 versus 4), and the number of use categories (3 versus 2) were different. This is because CI is related to UR not FC; that is, an informant could mention one species for more than one use (increase UR) but this would still count as one citation while using FC. Moreover, it is possible to use the CI index value within each use category for the analysis (Table 2). In this example, one could say that *A. vera* is more important for treating diabetes, while its use in treating hypertension is considered less important than that of *C. citratus*.

A lower value (both CI and RFC) does not necessarily mean the plant species is less important. Tardio, Pardo-De-Santayana [29] pointed out that plants with low index values are not always less interesting. Lower values might be due to the inhomogeneous distribution of the knowledge on their uses. For instance, *Allium cepa* was cited once in the present survey for the treatment of diabetes although its hypoglycaemic effects have already been demonstrated in previous studies [69, 70]. It was also reported to be used to treat diabetes in Douala, Cameroon [38].

Additionally, a low value may indicate the species is scarce or inaccessible [71]. Camou-Guerrero *et al.* [71] stated that the use frequency of a plant is dynamic through time within a community. Heinrich *et al.* [33] also suggested that a plant species with few citations may have fallen into disuse because of cultural changes or because it may belong to the cultural knowledge fringe. Plant species with low RFC/CI values in our study are actually important elsewhere. For example, *Annona muricata* was reported for the treatment of hypertension in the Central region of Cameroon [62], whereas *Ageratum conyzoides* was reported to be an important plant for treating diabetes in Cameroon [18].

## The fidelity level

Table 4 summarises the FL value of those plant species that were cited by three or more informants for use against a given disease. For example, *A. vera* was reported as useful by four informants. All four cited it to be used in the treatment of diabetes, whereas one cited it for treating hypertension. Hence, $I_u$=4 in the case of *A. vera*, $I_p$=4 in the category of diabetes and $I_p$=1 in the category of hypertension.

*Gouania* (Botetee) (against cardiovascular ailment), *A. vera* and *V. amygdalina* (against diabetes) got a high FL value (100), whereas *P. americana* and *S. oleraceus* (for diabetes), *Asystasia* (against hypertension) scored 83, 80 and 75, respectively.

*A. vera* is cultivated in many countries and its gel and extracts are commercially used [5]. Its uses for treating diabetes or other diseases such as malaria and wounds etc., were reported in Douala [38], and Littoral and Southwest region of Cameroon [44]. *A. vera* has been studied for many years for its effectiveness and safety and has shown promising results on patients with diabetes [72-74].

*V. amygdalina* was reported to be used for treatment of diabetes in the Littoral and Southwest regions of Cameroon [44]. The leaves of *V. amygdalina* can improve glucose intolerance and lowers blood glucose in rats. However, the mechanism and chemical compounds responsible for these effects still need to be confirmed [75, 76].

To date, genus *Asystasia* has not received much attention. *A. gangetica* has been studied for its activities against high blood pressure and diabetes [77, 78]. This could imply the species of *Asystasia* reported in the present survey may contain similar compounds.

**Table 1 List of medicinal plant species reported by people in Fokoue and Santchou, Menoua Division, West Cameroon**

| Family | Scientific name of plant | Vernacular name of plant [a] | Growth form | Habitat status [b] | Part used [c] | Method of preparation | Fresh/dry | Use [d] | Voucher numbers | FC [e] |
|---|---|---|---|---|---|---|---|---|---|---|
| Acanthaceae | *Asystasia* spp. | Lezoute (F) | Herb | C/W | L | Crushed /decoction | Fresh | C, H | N/A | 4 |
| | *Eremomastax speciosa* (Hochst.) Cufod. | Heguembopoc (S) | Shrub | C | L | Decoction | Fresh | D | 16371/SRF/Cam | 1 |
| Amaranthaceae | *Cyathula prostrate* (L.) Blume | Zutgoute (F) | Herb | C/W | L | Decoction | Fresh | H | 6377/SRF/Cam | 1 |
| Amaryllidaceae | *Allium sativum* L. | Ail/lelan (F, S) | Herb | C | B | Decoction | Fresh | D, H | 44810/HNC | 6 |
| | *Allium cepa* L. | Onion/ lelan (F) | Herb | C | B | Decoction | Fresh | D | 034/UDS | 1 |
| | *Crinum natans* Baker | Lelanzo/ vengtsetse (F) | Herb | C/W | L | Maceration | Fresh | D, H | 18263/SRF-Cam | 2 |
| Anacardiaceae | *Mangifera indica* L. | Mango (S) | Tree | C | L | Decoction | Fresh | C | 5734/HNC | 1 |
| Annonaceae | *Annona muricata* L. | Corosole (F) | Tree | C/W | L | Decoction | Fresh | H | 3289/HNC | 2 |
| Apocynaceae | *Catharanthus roseus* (L.) G.Don | Pervenche de Madagascar (F) | Shrub | C | L, R | Decoction | Fresh | D | N/A | 1 |
| | *Picralima nitida* Th. & H.Dur. | Djickkack (F) | Tree | C/W | LS, Fr | Decoction/ maceration | Fresh | C | 1942/SRFK | 1 |
| Asteraceae | *Ageratum conyzoides* L. | Tchouamou/ vengensia (F) | Herb | W | L | Crushed/ maceration | Fresh | C, D | 6575/SRFK | 2 |
| | *Aspilia africana* (Pers.) C.D.Adams | Menounouletse/ guekackne (F) | Herb | W | L | Crushed | Fresh | C | 6555/SRF/Cam | 1 |
| | *Chromolaena odorata* (L.) R.M.King & H.Rob. | Vengfemla (S) | Herb | W | L | Crushed | Fresh | D | | 1 |
| | *Crassocephalum biafrae* S.Moore | Zuckack (F) | Herb | C/W | Wh | Crushed | Fresh | C, H | 5619/SRF/Cam | 1 |
| | *Crassocephalum crepidioides* S.Moore | N/A(F) | Herb | W | L | Crushed | Fresh | C | N/A | 1 |
| | *Crassocephalum mannii* (Hook.f.) Milne-Redh. | Kepang (F) | Tree | W | L | Crushed | Fresh | D | 7623/SRF-Cam | 1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Emilia coccinea* G.Don | Herbe du lapin (F) | Herb | W | Wh | Crushed | Fresh | C | 20079/HNC | 1 |
| | *Erigeron floribundus* Sch.Bip. | Veng guymme (F) | Herb | W | L, Wh | Crushed | Fresh | C | 5619 SRF/Cam | 1 |
| | *Guizotia scabra* Chiov. | N/A(F) | Herb | W | LS | Decoction | Fresh | C | 13013/SFR/Cam | 1 |
| | *Sonchus oleraceus* L. | Tietie (F) | Herb | C/W | L, Wh | Crushed/ maceration / decoction/ infusion | Fresh | D, H | 53051/HNC | 5 |
| | *Vernonia amygdalina* Delile | Mekang/ biter leaf (F, S) | Shrub | C/W | L | Crushed | Fresh | D | 31149/SRFK/Cam | 3 |
| | *Vernonia calvoana* Engl. | Mekang woua (S) | Shrub | C | L | Crushed | Fresh | D | 42401/HNC | 1 |
| | *Vernonia guineensis* Benth. | Ginseng (F) | Shrub | W | T | Decoction | Fresh | D, H | N/A | 2 |
| Burseraceae | *Dacryodes edulis* (G.Don) H.J.Lam | Tchep (F) | Tree | C | L | Decoction | Fresh | D, H | N/A | 1 |
| Caricaceae | *Carica papaya* L. | Papaya (F, S) | Tree | C | L | Decoction | Fresh | C, D | 18647/SRF-Cam | 2 |
| Cucurbitaceae | *Cucurbita pepo* L. | Melon/l epoc (F) | Herb | C | Fr | Cooked | Fresh | D | 15630/HNC | 1 |
| Dioscoreaceae | *Dioscorea hirtiflora* Benth. | Lougnenong (F) | Climber | W | L | Decoction | Fresh | D, H | 46844/HNC | 1 |
| Fabaceae | *Mimosa pudica* L. | Kiotepoo (F) | Herb | W | L | Crushed/ powdered | Fresh | C, D | 54102/HNC | 2 |
| Lamiaceae | *Clerodendrum* spp. | Kacke (F) | Shrub | C/W | L | Decoction | Fresh | H | N/A | 1 |
| | *Leucas deflexa* Hook.f. | Guemetouck/ tuetong (F) | Herb | W | L, Wh | Crushed | Fresh/dry | C | 22294/SRF/Cam | 2 |
| | *Ocimum gratissimum* L. | Masepe/ kotimadjo (F) | Shrub | C/W | LS | Crushed /decoction /powdered & decoction | Fresh | D, H | 29880/HNC | 3 |
| | *Thymus vulgaris* L. | N/A (F) | Shrub | W | L | Decoction | Fresh | D, H | 42851/HNC | 1 |
| Lauraceae | *Persea americana* Mill. | Pear (F) | Tree | C | L | Crushed /decoction | Fresh/dry | C, D, H | 57756 NHC | 6 |
| Loranthaceae | *Loranthus* spp. | Tsapla (F) | Shrub | C/W | L | Decoction | Fresh/dry | C, D, H | N/A | 2 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Lycopodiaceae | *Lycopodium cernuum* L. | Venginete (F) | Herb | W | Wh | Crushed /decoction | Fresh | C | 44388/HNC | 1 |
| Melastomataceae | *Dissotis perkinsiae* Gilg | N/A(F) | Herb | W | L | Decoction | Fresh | C | 24719/SRF/Cam | 1 |
| Musaceae | *Musa* × *sapientum* L. | Melouck pengue (F)/ kadie (S) | Herb | C | L, Fl | Decoction | Fresh/dry | C, D, H | N/A | 2 |
| Myrtaceae | *Eucalyptus globulus* Labill. | Calitousse (F) | Tree | W | L | Decoction | Fresh | D, H | N/A | 1 |
| Poaceae | *Cymbopogon citratus* Stapf | Fever grass (F) | Herb | C | L, Wh | Decoction /infusion | Fresh/dry | C, D, H | 18628/SRF/Cam | 5 |
| | *Melinis minutiflora* P.Beauv. | Djockke foue (F) | Herb | W | Wh | Maceration | Fresh | C | 35516/HNC | 1 |
| | *Pennisetum purpureum* Schumach. | Sussongo (F) | Herb | W | L | Decoction | Fresh/dry | C, D, H | N/A | 1 |
| | *Zea mays* L. | Maize(F) | Herb | C | Si | Decoction | Dry | D | N/A | 1 |
| Rhamnaceae | *Gouania* spp. [f] | Botetee (F)/ duotetee (S) | Climber | W | L | Crushed | Fresh | C, H | N/A | 7 |
| | *Gouania* spp. | Lepifoue (F) | Shrub | W | L | Crushed | Fresh | C, H | N/A | 1 |
| Rutaceae | *Citrus limon* (L.) Burm.f. | Lemon (F, S) | Tree | C | Fr | Decoction | Fresh | C, D, H | 65106/HNC | 4 |
| Solanaceae | *Solanum nigrum* L. | Zaplack (S) | Herb | C | L | Crushed | Fresh | D | N/A | 1 |
| Vitaceae | *Cissus quadrangularis* L. | N/A (F) | Climber | C/W | L | Decoction | Fresh | D | 7739/SRF-Cam | 1 |
| Xanthorrhoeaceae | *Aloe vera* (L.) Burm.f. | Aloe/ lelan/ melan guepe (F) | Herb | C | L | Crushed/ maceration /decoction | Fresh | D, H | N/A | 4 |
| Zingiberaceae | *Zingiber officinale* Roscoe | Ginger (F) | Herb | C | Rh | Crushed | Fresh | H | N/A | 1 |

[a] Medicinal plant species labelled with F were only reported in Fokoue and S in Santchou. Those labelled with F and S were reported in both areas. Those were reported have no vernacular names labelled with N/A.

[b] C= cultivated; W= wild.

[c] B= bulb; Fl= flower; Fr= fruit; L= leaf; LS= leaf with stem; R= root; Rh= rhizome; Si= silks; T= tuber; Wh= whole plant.

[d] D= diabetes; H= hypertension; C= cardiovascular diseases.

[e] FC=frequency of citation

[f] Two different plant species but could only be identified on genus level.

**Table 2 Cultural importance index of the ten most relevant plant species in the three disease categories**

| Scientific name of plant | Cultural importance index (CI) | | | |
|---|---|---|---|---|
| | C | D | H | Total CI |
| *Gouania* spp. | 0.21 | - | 0.09 | 0.30 |
| *Persea americana* | 0.03 | 0.15 | 0.09 | 0.27 |
| *Allium sativum* | - | 0.06 | 0.12 | 0.18 |
| *Sonchus oleraceus* | - | 0.12 | 0.06 | 0.18 |
| *Cymbopogon citratus* | 0.03 | 0.06 | 0.06 | 0.15 |
| *Aloe vera* | - | 0.12 | 0.03 | 0.15 |
| *Asystasia* spp. | 0.03 | - | 0.09 | 0.12 |
| *Citrus limon* | 0.03 | 0.03 | 0.06 | 0.12 |
| *Vernonia amygdalina* | - | 0.09 | - | 0.09 |
| *Ocimum gratissimum* | - | 0.03 | 0.06 | 0.09 |

C=Cardiovascular disease, D=diabetes, H=hypertension.

**Table 3 Results of ranking by different indices on useful plants against diabetes, hypertension and cardiovascular ailments**

| Scientific name of plant | Basic Values | | | Indices | | Ranking | |
|---|---|---|---|---|---|---|---|
| | NU | UR | FC | CI | RFC | CI | RFC |
| *Gouania* spp. | 2 | 10 | 7 | 0.30 | 0.21 | 1 | 1 |
| *Persea americana* | 3 | 9 | 6 | 0.27 | 0.18 | 2 | 2 |
| *Allium sativum* | 2 | 6 | 6 | 0.18 | 0.18 | 3 | 2 |
| *Sonchus oleraceus* | 2 | 6 | 5 | 0.18 | 0.15 | 3 | 4 |
| *Cymbopogon citratus* | 3 | 5 | 5 | 0.15 | 0.15 | 5 | 4 |
| *Aloe vera* | 2 | 5 | 4 | 0.15 | 0.12 | 5 | 6 |
| *Asystasia* spp. | 2 | 4 | 4 | 0.12 | 0.12 | 7 | 6 |
| *Citrus limon* | 3 | 4 | 4 | 0.12 | 0.12 | 7 | 6 |
| *Vernonia amygdalina* | 1 | 3 | 3 | 0.09 | 0.09 | 9 | 9 |
| *Ocimum gratissimum* | 2 | 3 | 3 | 0.09 | 0.09 | 9 | 9 |

Only plant species cited more than three times are listed.
NU=number of uses, UR=use reports, FC=frequency of citation, RFC=relative frequency of citation, CI=cultural importance index.

**Table 4 Fidelity levels of medicinal plants cited by informants in Fokoue and Santchou subdivisions, West Cameroon**

| Category of illness | Medicinal plant | $I_p$ | $I_u$ | FL value |
|---|---|---|---|---|
| Cardiovascular ailment | *Gouania* spp. (botetee) | 7 | 7 | 100 |
| | *Asystasia* spp. | 1 | 4 | 25 |
| | *Citrus limon* | 1 | 4 | 25 |
| | *Cymbopogon citratus* | 1 | 5 | 20 |
| | *Persea americana* | 1 | 6 | 17 |
| Diabetes | *Aloe vera* | 4 | 4 | 100 |
| | *Vernonia amygdalina* | 3 | 3 | 100 |
| | *Persea americana* | 5 | 6 | 83 |
| | *Sonchus oleraceus* | 4 | 5 | 80 |
| | *Cymbopogon citratus* | 2 | 5 | 40 |
| | *Allium sativum* | 2 | 6 | 33 |
| | *Ocimum gratissimum* | 1 | 3 | 33 |
| | *Citrus limon* | 1 | 4 | 25 |
| Hypertension | *Asystasia* sp. | 3 | 4 | 75 |
| | *Allium sativum* | 4 | 6 | 67 |
| | *Ocimum gratissimum* | 2 | 3 | 67 |
| | *Persea americana* | 3 | 6 | 50 |
| | *Citrus limon* | 2 | 4 | 50 |
| | *Gouania sp. (botetee)* | 3 | 7 | 43 |
| | *Cymbopogon citratus* | 2 | 5 | 40 |
| | *Sonchus oleraceus* | 2 | 5 | 40 |
| | *Aloe vera* | 1 | 4 | 25 |

Only plant species reported by more than three informants are listed

## 4. CONCLUSION

Our study confirmed that the indigenous people of Fokoue and Santchou subdivisions of Menoua Division possess knowledge of medicinal plants uses for the treatment of diabetes, hypertension and cardiovascular ailments. To our knowledge, such medicinal plant uses were documented for the first time in the area.

A large number of local plant species, mainly from the Asteraceae family, are used to combat diabetes, hypertension and cardiovascular ailments. The rich knowledge of subdivision people on plants used for treatment of these three diseases was recorded in this specific area for the first time. The current study only considered just three disease categories, therefore future studies could go deeper into different medicinal uses on plants in Menoua Division to discover more indigenous plant knowledge. The inventories of medicinal plants thus can be generated into monographs as a guideline for consultation to ensure the proper use of plant remedies.

Activity against diabetes, hypertension and cardiovascular ailments of a number of plant species documented here has been confirmed by other studies. A number of plant species is considered to be culturally important. Informants highly agreed on the uses of *Allium sativum* and *Asystasia* spp. for treating hypertension, and *Aloe vera*, *Gouania* spp., *Persea americana*, *Sonchus oleraceus* and *Vernonia amygdalina* for the treatment of diabetes. A number of plant species were reported to be useful for the same disease in other regions of Cameroon. Examples include *A. vera*, *P. americana*, *S. oleraceus* and *V. amygdalina* for diabetes treatment; *A. sativum* for treatment of diabetes and hypertension; and *Cymbopogon citratus* for treating hypertension.

Our study is also limited as the current survey was conducted only once with each interviewee in the rainy season, therefore the seasonal variation has not been assessed. Future ethnobotanical fieldwork should cover vegetation cycles and flowering period of all plant species. Furthermore, future ethnomedicinal studies should be conducted on the basis of larger numbers of interviewees in the Menoua Division. However, some of our findings are unique. For example, plant species from genus *Gouania* and *Asystasia* were first reported to be used to treat human diseases in Cameroon, whereas only limited number of studies about their use potentials elsewhere. Based on the latter finding, it would be useful to further explore the potential of both genera. In this regard, a larger number of respondents and more specific ethnomedical surveys can consolidate the present findings and be the basis for bioprospecting and crop development of most promising species.

## CONSENT (WHERE EVER APPLICABLE)

Not applicable

## ETHICAL APPROVAL (WHERE EVER APPLICABLE)

Not applicable

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## DEFINITIONS, ACRONYMS, ABBREVIATIONS

| | |
|---|---|
| CI | cultural importance index |
| CVD | cardiovascular disease |
| FC | frequency of citation |
| FL | fidelity level |
| NCD | non-communicable disease |
| RFC | relative frequency of citation |
| TM | traditional medicine |
| UR | use report |