

Full Length Research Paper

Specialization in ethnomedicinal plant knowledge among herbalists in the forest region of Rivercess County, Liberia

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The ethnomedicinal uses of plants reported by 22 herbalists in the Rivercess County of Liberia show a rich knowledge of medicinal plant usage for both common and less common health problems. We set out with the objectives of documenting the ethnomedicinal plant knowledge and assessing gender differences in the use of the plants by male and female herbalists. Through semi-structured interviews conducted with herbalists, a total of 112 species belonging to 52 families in 93 genera were recorded to be in use. Seven plant families were known to account for 43.9% of the total number of species utilized including *Annonaceae*, *Apocynaceae*, *Costaceae*, *Rubiaceae*, *Euphorbiaceae*, *Fabaceae* and *Verbenaceae*. Traditional herbalists comprising male (64%) and female (36%) possessed extensive knowledge of the use of these plants, with male and female herbalists showing specializations in several categories of health problems based on their knowledge of medicinal plants. Female herbalists possessed a slightly higher knowledge of ethnomedicinal plants than male herbalists. Many ailments were reported with a large number of the plants utilized for malaria, snakebites, ulcer, spiritual/witchcraft, infection and diarrhoea. New and unrecorded ethnomedicinal uses for several plants were documented, including *Tetraberlinia tubmaniana* J. Léonard, *Delpyodora gracilis* A.Chev., *Campylospermum subcordatum* (Stapf) Farron, *Cyathula prostrata* Blume, *Heisteria parvifolia* Sm., *Keetia rufivillosa* (Robyns ex Hutch. & Dalz.) Bridson, *Pavetta sonjae* W.D.Hawth., *Chrysophyllum pentagonocarpum* Engl. & K.Krause, *Placodiscus pseudostipularis* Radlk, and the naturalized plant, *Caladium bicolor* (Aiton) Vent. Further documentation of this knowledge is recommended, with the goal of assessing gender differences in the use of medicinal plants in Liberia.

Key words: Ethnomedicine, medicinal plants, herbalists, remedies, Liberia.

INTRODUCTION

Liberia is home to one of the richest flora in the Upper Guinean region of West Africa, with initial exploration

dating back to the 1800s, beginning with collections made by European and American botanists like Bunting,

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Dinklage, Harley, Johnston, Leeuwenberg, Voorhoeve, etc. In recent times, additional documentations of the flora were carried out in three National Forest Reserves, with some 548 species recorded, including records of three new species to science (Jongkind, 2007). It has been estimated that some 2,300 species of vascular plants occur in Liberia, although given the apparent location of two centers of endemism in the country, the actual number of plant species occurring in the country might be higher (Poorter et al., 2004).

This rich diversity of plants also features extensively in the cultural heritage of the local inhabitants, and has been a source of herbal remedies for several health problems faced by the population. However, scientific documentations of the ethnomedicinal uses of the plants have been sporadic, and very little exist on the local uses to which these plants are put. Early documentations of this knowledge date back to the early 19th Century when a medical doctor stationed in the interior of the country documented the ethnomedicinal uses of over 200 medicinal plants among the Mano of Nimba County (Harley, 1941). Similar documentations of plant use among the Mano tribe were conducted by Adam and Adam (1970), and some four decades later, the local names and uses of over 250 important plant species in 7 communities was carried out by Marshall and Hawthorne (2013). In the Salala District of central Liberia, Orr (1968) conducted an anthropological examination of medical practices and belief systems of the Kpelle tribe, sometimes indicating the local names of plants and their ethnomedicinal uses. The actual scientific names of these plants were not reported.

Following this long hiatus, recent documentations of ethnobotanical knowledge have resumed, with assessments of Non-timber forest products (NTFP) in communities around the Sapo National Park in Liberia (Manvell, 2011). In the rainforest around the Putu Range in Grand Gedeh County, of 624 species of plants inventoried in five different habitats, 69% were of medicinal significance, with 55 species reported to include shade-bearing guild (Marshall and Hawthorne, 2012). In the Wonegizi region of Lofa County, the knowledge of local traditional medicinal practitioners was documented, producing a list of 101 species of plants in 48 families commonly used in treating 11 categories of ailments (Kpadehyea et al., 2015).

Liberia is currently going through a major transformation following the last civil war, and the need for rapid development is leading to increased exploitation of its natural resources, especially its vast resources of tropical rainforest (Blackett et al., 2009). Timber features highly in this drive, but the needs of local people are also centred on the use of important forest products such as poles, fruits, fibre and medicinal plants, among others. Like other developing countries around the world, poorly developed health care delivery systems have led to more reliance on the use of medicinal plants in most rural

areas (Farnsworth and Soejarto, 1991). As local communities become speedily absorbed into the global economy, ethnomedicinal plant knowledge can quickly disappear and fears have been expressed in this regard (Lambert et al., 1997). Documenting the medicinal plant knowledge of forest dwelling communities is crucial before much of the forest disappears, and with it the extensive knowledge of traditional herbalists that interact with this rich plant biodiversity. In this regard, the main objectives of this study were to document the ethnomedicinal plant knowledge of herbalists in a forest region of Liberia, and to assess gender differences in the use of plants by male and female herbalists.

MATERIALS AND METHODS

Study area

Fieldwork for documenting the medicinal plant knowledge took place in central Rivercess County of Liberia, located some 320 km from the capital city of Monrovia. Garpue Town was the main study site (Figure 1), and its population like the rest of the county is dominated by the Bassa speaking tribe of Liberia, and comprised stakeholders drawn from 7 communities located within walking distances of each other. The 7 communities included Garpue Town, Beh Town, Gbetar, Saykpayah, Poewoh Town, Bodaza and Vondeh Town, all located in the central Morweh District. Rivercess County has an area of 5,263.4 km² and its geographic coordinates are N 5° 36' 23" and W 9° 39' 31" at an altitude of 84 m. The total population of the County is less than 120,000 people and 93% of them speak Bassa. It is largely a forest-dominated County and was home to three major logging activities during the past civil conflict (Blackett et al., 2009).

Data collection and analyses

We worked with traditional herbalists, identified through consultative meetings held in the chieftom headquarter (Garpue Town), where the paramount resides. During a natural resource mapping exercise with community stakeholders, information was proffered on the heavy reliance on traditional herbalists given the lack of health facilities (Lebbie et al., 2009). These herbalists were reported to be members of the male and female secret societies, and are generally reputed for their knowledge in the use of plant remedies (Lebbie and Guries, 1995).

The number of herbalists in each community was not assessed and therefore unknown, but it was revealed through the consultative meetings that nearly every adult person possesses knowledge of the use of some plants in traditional medicine. Through further consultations with key stakeholders present at the resource mapping exercises conducted in Garpue Town, 22 practicing herbalists voluntarily consented to participate in the documentation of their ethnomedicinal plant knowledge. Using semi-structured questionnaires, we collected information on age, number of plants known and utilized, and ailments the herbalists specialized in treating. Following a brief practical guidance on how to collect specimens for taxonomic identification and herbarium vouchers, we asked herbalists to collect plant specimens known to each of them for proper scientific identification. For each plant collected and presented by herbalists, information on the ethnomedicinal uses and the parts utilized were obtained from the herbalists. No questions were asked about mode of preparation, manner of administration and local names, as herbalists had expressed

concern that such information were proprietary, and we agreed not to extract such information from them.

Scientific identification and naming of medicinal plants were done on the spot, and confirmed with the aid of a field guide for woody plants known for this part of West Africa (Hawthorne and Jongkind, 2006), as well as the several volumes of the "Flora of West Tropical Africa" (Keay et al., 1954, 1958, 1963, 1968, 1972). While every effort was made to encourage herbalists to bring plant materials with complete of morphological features (leaves, fruits/seeds and flowers) to aid in identification, on a few occasion, some herbalists brought bark specimens without leaves, flowers and fruits, and the difficulties in identification of such specimens necessitated us to discard them. Some sterile materials were insufficient to identify beyond the genus level. All specimens were tagged and with voucher numbers, are housed in the National Herbarium of Sierra Leone (SL), given the lack of a formal herbarium in Liberia. Data obtained were compiled into tables, percentages and portrayed graphically.

RESULTS AND DISCUSSION

Gender differences and specialization in ethnomedicinal knowledge

Twenty-two (22) herbalists aged 27-77 years consented to participate in the documentation of their knowledge associated with ethnomedicine and the use of plants in treating various ailments. More of the herbalists were male (64%) than female (36%), with the majority of the herbalists over the age of 40 years (Table 1). The number of plants known and reportedly used by herbalists ranged between 2-40, with female herbalists knowing on average 18.1 plants more, while male herbalists knew 16.3 plants. Herbalists between the ages of 41-50 years reported knowing on average 19.1 medicinal plants, which was higher than other age categories.

Gender and age relationships have been observed in various studies involving medicinal plant knowledge. In Brazil, generally older people are reported knowing more medicinal plants than the younger people (Silva et al., 2011; Voeks and Leony 2004). For male herbalists in Nasarawa State of Nigeria, it was reported that they held more knowledge of medicinal plants than female herbalists (Ibrahim et al., 2016), although another study from Nigeria found men and women holding similar knowledge (Ayantunde et al., 2008). In three rural communities in Niger, Guimbo et al. (2011) utilizing participant observation and key-informant interviews found ethnobotanical knowledge to increase with age, but noted differences in ethnobotanical knowledge for both men and women as it related to medicinal plants. However, our study found female herbalists to know more medicinal plants than their counterpart male herbalists. Such differences can arise as a result of "limited experience", little interaction with other members of the community or due to problems with memory and forgetfulness on the part of the elderly as age sets in. The increased role often played by older women in child

rearing is known to play a role in the acquisition of medicinal plant knowledge (especially over younger women).

In a study done around the Sapo National Park to document the use of non-timber forest products in adjacent communities, Manvell (2011) found women to be able to name more plants than men for the most common categories of illnesses. He attributed this to the unwillingness of the participants to share their knowledge. This is not uncommon among herbalists, and the differences in the number of medicinal plants reportedly known by each herbalist could also reflect under-reporting for fear of sharing their knowledge. We found a few of the men unwilling to share their knowledge in comparison to the women. A similar situation was observed in Sierra Leone, although in the same country, women of the sande/bondo secret societies willingly shared their knowledge of medicinal plants (Lebbie and Guries, 1995). In a review and meta-analysis of the effect of gender on medicinal plant knowledge conducted at various scales comprising national, regional and global (Torres-Avilez et al., 2016), no significant differences were apparent in the medicinal plant knowledge of men and women. Significant differences in medicinal plant knowledge were however observed at the national and continental level for both men and women. In Niger, Müller et al. (2015) found older people to be more knowledgeable about medicinal plants, with women knowing more about food plants. Given the small number of herbalists in the various age and gender categories we sampled, observed differences in reported knowledge of medicinal plants might be due purely to sample size, and possibly the unwillingness of herbalists to sometimes share their proprietary knowledge. In the Himalayas, Gupta et al. (2014) noted that herbalists (*Amchis*) are reluctant to disclose knowledge of medicinal plants given that this might reduce the effectiveness of the remedy. But more importantly, the knowledge of the remedies to the herbalists is what brings them "recognition", and sharing this knowledge might be seen as reducing their control over such proprietary knowledge.

Gender differentiation in ethnomedicinal knowledge and use of plants to treat certain categories of diseases was apparent, with female herbalists possessing specialized knowledge in treating children's health problems, snakebite, cholera and other medical problems related to women (Table 2). Male herbalists possessed diverse knowledge on various health problems, including broken bones, epilepsy, evil spirit, heart disease, high blood pressure, erectile dysfunction and infection of the testes, among others. Kpadehyea et al. (2015) noted also that female herbalists in the Lofa County of Liberia reported more traditional medicines that focused on children's health issues and menstrual problems than their male counterparts. Given the limited access to health facilities and drugs by these communities (Lebbie et al., 2009), women's traditional role of taking care of

Table 1. Gender and age distribution of herbalists and knowledge of medicinal plants.

Categories	Frequency	Percent	Mean number of plants known by herbalist
Gender			
Male	14	64.0	16.3
Female	8	36.0	18.1
Age (years)			
≤40	1	4.5	3.0
41 – 50	7	31.8	19.1
51 - 60	8	36.4	15.5
≥60	6	27.3	18.8

Table 2. Gender differentiation in ethnomedicinal knowledge in treating diseases.

Gender	Specialized strength of herbalists
Male	Broken bones, epilepsy, diarrhoea, evil spirit, heart disease, high blood pressure, erectile dysfunction, infection of the testes, back pain, bodily pain, asthma, insanity, worms, rheumatism, “African sign”, infection
Female	Children’s medical problems, treating pain associated with teenage rape, snakebites, stomach complaints, abortion, hookworms, infections, cholera, headache, “African sign”

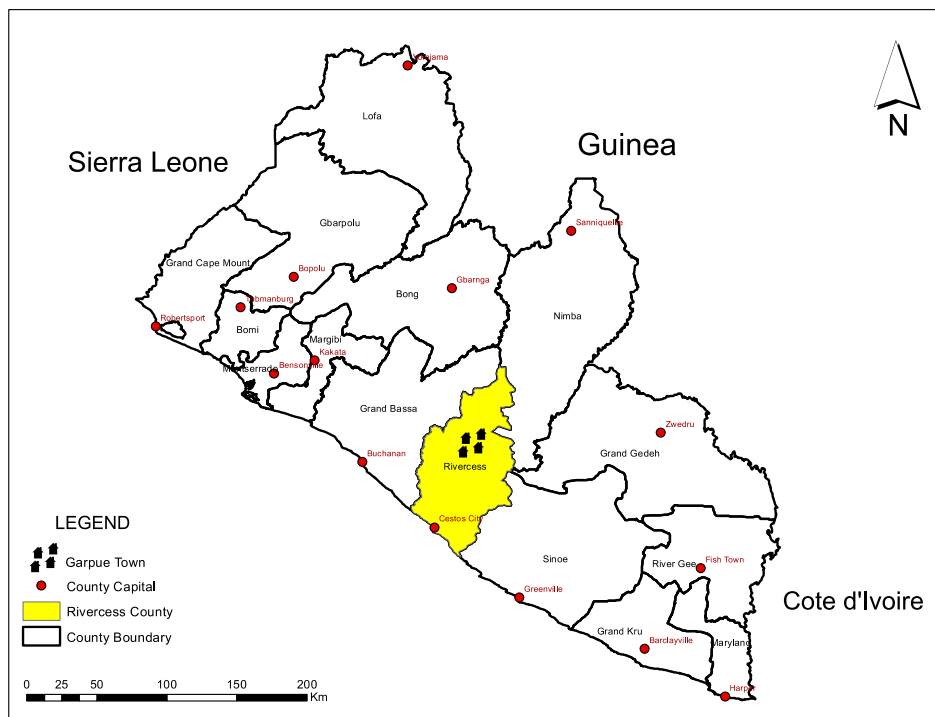


Figure 1. Map of Liberia showing the study area, Garpue Town, in Rivercess County. Source: <http://d-maps.com/m/africa/liberia/liberia51.pdf> Downloaded 2017

children could potentially help to explain their knowledge of medicinal plants associated with children’s health.

One common area of specialization among some male and female herbalists is an ethnomedical problem

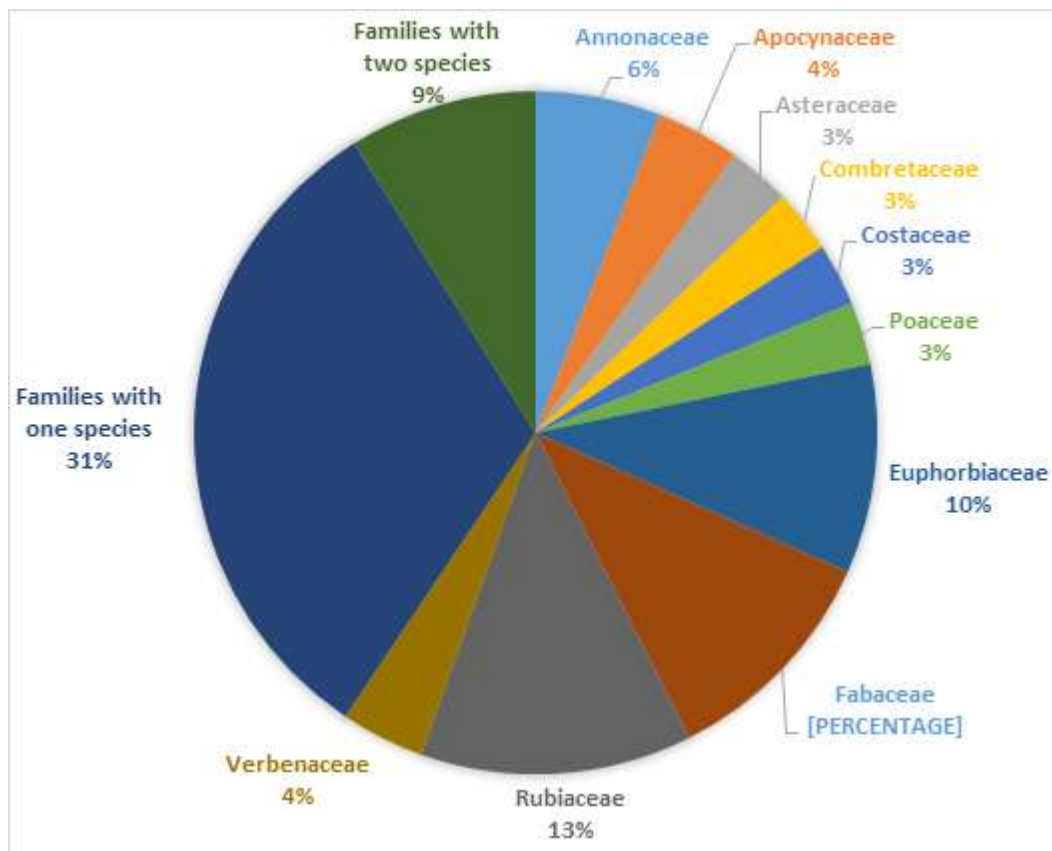


Figure 2. Distribution of medicinal plant families reported by herbalists.

referred to as “African sign”; a condition of ill health reported to be associated with unforeseen forces perpetuated by evil persons, “witchcraft” and or supernatural forces, for which western medicine is believed to be unable to address. It is apt to say that ill health, as perceived by the Bassa herbalists of Rivercess County is not seen entirely in the context of witchcraft or supernatural forces. Most of the ailments/diseases for which the herbalists were specialists in were not pegged on witchcraft or sorcery *per se*, as is often painted by ethnocentric western medical and social anthropologists (Konadu, 2008). Herbalists were quick to affirm their ability to distinguish between disease conditions in which malevolence was involved, either through witchcraft or supernatural forces, or generally as a result of some underlying etiologic or physiological condition. “African sign” and “dragon spirit” or “evil spirit” were not situated in the context of etiologic agents, but rather ailments for which evil persons have caused to happen to an otherwise perfectly healthy person. Such a sickness can be cured only by herbalists skilled in traditional Bassa ethnomedicine, with western medical interventions believed to be powerless in treating it, as has been noted in some parts of Kenya (Good, 1987). In South Africa, Petrus (2011) noted the increasing role of witchcraft in

the lives of the people, and cited instances where allegations of ill health resulted from the interplay of witchcraft.

Medicinal plant species and ethnomedicinal uses

A total of 112 medicinal plants, belonging to 98 plant genera and 52 families, were indicated by the herbalists as forming part of their local ethno-pharmacopoeia (Table 3). The most species rich families with at least 3 species were Rubiaceae (13 species), Euphorbiaceae (10 species), Fabaceae (11 species), Annonaceae (6 species), Apocynaceae (4 species), Asteraceae (3 species), Combretaceae (3 species), Poaceae (3 species), Costaceae (3 species) and Verbenaceae (4 species) (Figure 2). They constitute 53.4% of all medicinal plants, with the remaining 46.6% distributed among 42 families comprising of 1 or 2 species per family. In a study conducted in the Nasarawa State of Nigeria utilizing the knowledge of traditional herbalists, it was found that medicinal plants belonging to the families Euphorbiaceae, Fabaceae and Rubiaceae comprised the most species rich (Ibrahim et al., 2016). While we recorded slightly different species composition and

Table 3. Medicinal plants and ethnomedicinal uses reported by herbalists in the study area.

Scientific name of plant	Voucher specimen	Family	Ethnomedicinal uses reported by herbalists	Part used
<i>Cyathula prostrata</i> (L.) Blume	LKK 23	<i>Acanthaceae</i>	Sanitary pad for women	Leaf
<i>Annickia polycarpa</i> (DC.) Setten & Maas	LKK 36	<i>Annonaceae</i>	Malaria	Bark
<i>Cleistopholis patens</i> Engl. & Diels	LKK 5	<i>Annonaceae</i>	Miscarriage caused by worms, bloody diarrhoea, rheumatism, stomach pain	Bark
<i>Greenwayodendron oliveri</i> (Engl.) Verdc.	LKK 45	<i>Annonaceae</i>	Male infertility	Leaf
<i>Isolona campanulata</i> Engl. & Diels	LKK 16	<i>Annonaceae</i>	Thrush (fungal infection in new born)	Leaf
<i>Xylopia aethiopica</i> A.Rich.	LKK 35	<i>Annonaceae</i>	Pneumonia, protrusion of uterus, snake bite, weakness in limbs of children, miscarriage caused by worms, jaundice, typhoid, pain in the ribs	Leaf, bark
<i>Xylopia</i> sp.	LKK 50	<i>Annonaceae</i>	Snake bite	Leaf
<i>Baissea</i> sp.	LKK 58	<i>Apocynaceae</i>	Chicken pox	Leaf
<i>Funtumia elastica</i> (P. Preuss) Stapf	LKK 6	<i>Apocynaceae</i>	Sore, diarrhoea	Leaf
<i>Landolphia dulcis</i> (Sabine) Pichon	LKK 65	<i>Apocynaceae</i>	Side and rib pains, chronic sore, dysentery	Leaf, bark
<i>Rauvolfia vomitoria</i> Wennberg	LKK 24	<i>Apocynaceae</i>	Vomiting, prolonged menstruation, hookworm, malaria, jaundice, snake bite, diarrhoea	Leaf, root
<i>Anchomanes difformis</i> Engl.	LKK 49	<i>Araceae</i>	Broken bone	Leaf
<i>Caladium bicolor</i> (Aiton) Went.	LKK 71	<i>Araceae</i>	To constrict the vagina	Petiole
<i>Elaeis guineensis</i> Jacq.	LKK 4	<i>Arecaceae</i>	Maturity (in children)	Leaf
<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob.	LKK 57	<i>Asteraceae</i>	Malaria	Leaf
<i>Vernonia cinerea</i> (L.) Less.	LKK 88	<i>Asteraceae</i>	Side and rib pains	Leaf
<i>Vernonia conferta</i> Benth.	LKK 46	<i>Asteraceae</i>	Gonorrhea, African sign, food poison, rheumatism, broken bone	Leaf
<i>Newbouldia laevis</i> Seem.	LKK 103	<i>Bignoniaceae</i>	Snake bite	Leaf
<i>Canna indica</i> L.	LKK 15	<i>Cannaceae</i>	Malaria	Leaf
<i>Myrianthus libericus</i> Rendle	LKK 110	<i>Cecropiaceae</i>	Snake bite	Leaf
<i>Salacia camerunensis</i> Loes.	LKK 37	<i>Celastraceae</i>	Malnutrition	Leaf
<i>Combretum comosum</i> G.Don	LKK 111	<i>Combretaceae</i>	Infertility, sore in stomach	Leaf
<i>Combretum racemosum</i> P.Beauv.	LKK 1	<i>Combretaceae</i>	Cataract, African sign	Leaf
<i>Terminalia superba</i> Engl. & Diels	LKK 56	<i>Combretaceae</i>	Ulcer	Bark
<i>Palisota hirsuta</i> Schumann	LKK 70	<i>Commelinaceae</i>	Measles, joint pain, thrush, sore in the stomach of new born baby	Leaf
<i>Manotes expansa</i> Sol. ex Planch.	LKK 87	<i>Connaraceae</i>	Difficulty in a woman becoming pregnant	Leaf
<i>Costus afer</i> Ker Gawl.	LKK 102	<i>Costaceae</i>	Open sore in babies, poison, joint pain	Leaf
<i>Costus dubius</i> (Afzel) Schumann	LKK 2	<i>Costaceae</i>	Pain in the eye	Leaf
<i>Costus</i> sp.	LKK 92	<i>Costaceae</i>	Miscarriage	Fruit
<i>Bryophyllum pinnatum</i> (Lam.) Oken	LKK 66	<i>Crassulaceae</i>	Childhood cough	Leaf
<i>Cyathea</i> sp.	LKK 108	<i>Cyatheaceae</i>	African sign	Leaf
<i>Scleria naumanniana</i> Boeck.	LKK 25	<i>Cyperaceae</i>	Difficulty breathing, pain in the sides, cataract	Leaf
<i>Scleria</i> sp.	LKK 77	<i>Cyperaceae</i>	Bodily pain	Leaf
<i>Nephrolepis biserrata</i> (Sw.) Scott	LKK 47	<i>Davalliaceae</i>	Difficulty in breathing, heartburn, retention of urine, bleeding in pregnant women, epilepsy, sore, rash, joint pain, painful and swollen female breast, gonorrhea	Fronde
<i>Dichapetalum dictyospermum</i> Bret.	LKK 3	<i>Dichapetalaceae</i>	Elephantiasis	Leaf

Table 3. Cont'd.

<i>Tetracera potatoria</i> (Afzel.) G.Don	LKK 34	<i>Dilleniaceae</i>	Oedema, retained placenta, impotence, open sore, pile	Leaf, bark
<i>Triphyophyllum peltatum</i> (Hutch. & Dalz.) Airy Shaw	LKK 89	<i>Dioncophyllaceae</i>	Open sore	Bark
<i>Diospyros kamerunensis</i> Gürke	LKK 7	<i>Ebenaceae</i>	Diarrhoea, abnormal heart beats, sore in the stomach of newborn child, dysentery	Leaf, bark
<i>Diospyros mannii</i> Hiem	LKK 40	<i>Ebenaceae</i>	Dysentery	Leaf
<i>Alchornea cordifolia</i> (Schumach.) Müll.Arg.	LKK 27	<i>Euphorbiaceae</i>	Toothache, gonorrhoea, high blood pressure, post-delivery pain, sore in the stomach (ulcer), irregular menstruation pain, heartburn, wound, high fever	Leaf, bark, fruit, root
<i>Croton hirtus</i> L'Hér.	LKK 17	<i>Euphorbiaceae</i>	Jaundice	Leaf
<i>Euphorbia hirta</i> L.	LKK 61	<i>Euphorbiaceae</i>	White growth on the eye (cataract)	Leaf
<i>Macaranga heterophylla</i> Müll.Arg.	LKK 90	<i>Euphorbiaceae</i>	Diarrhoea, sore in stomach, malaria	Leaf
<i>Maesobotrya barberi</i> Hutch.	LKK 79	<i>Euphorbiaceae</i>	Snake bite	Leaf
<i>Manihot esculenta</i> Crantz	LKK 107	<i>Euphorbiaceae</i>	Heartburn	Bark
<i>Manniophyton fulvum</i> Müll.Arg.	LKK 8	<i>Euphorbiaceae</i>	Wound, sore, rheumatism, African sign	Leaf
<i>Mareya micrantha</i> Müll.Arg.	LKK 69	<i>Euphorbiaceae</i>	Food poison, snake bite, infection in pregnant women	Leaf
<i>Phyllanthus muellerianus</i> (Kuntze) Exell	LKK 86	<i>Euphorbiaceae</i>	Rib and chest pains, jaundice	Leaf
<i>Tetrorchidium didymostemon</i> (Baill.) Pax & K.Hoffm.	LKK 101	<i>Euphorbiaceae</i>	"Dragon spirit"	Bark
<i>Albizia adianthifolia</i> W.Wight	LKK 95	<i>Fabaceae</i>	Open sore	Leaf
<i>Amphimas pterocarpoides</i> Harms	LKK 39	<i>Fabaceae</i>	Prolonged labor pains	Leaf
<i>Anthonota macrophylla</i> P.Beauv.	LKK 26	<i>Fabaceae</i>	Headache, African sign, oedema in children, malnutrition	Leaf
<i>Dalbergia saxatilis</i> Hook.f.	LKK 91	<i>Fabaceae</i>	Miscarriage	Leaf
<i>Dalbergiella welwitschii</i> Baker f.	LKK 18	<i>Fabaceae</i>	Stomach pain due to pregnancy, side/rib pains, oedema, toothache	Leaf, stem
<i>Desmodium adscendens</i> (Sw.) DC	LKK 60	<i>Fabaceae</i>	Convulsion	Leaf
<i>Desmodium</i> sp.	LKK 68	<i>Fabaceae</i>	Pile, excessive bleeding during menstruation, African sign, oedema, low blood, hernia	Leaf, Bark
<i>Leptoderris trifoliolata</i> Hepper	LKK 85	<i>Fabaceae</i>	Erectile dysfunction	Bark
<i>Tetraberlinia tubmaniana</i> J.Léonard	LKK 106	<i>Fabaceae</i>	Sore in stomach	Bark
<i>Entada</i> sp.	LKK 9	<i>Fabaceae</i>	Pain in the leg	Leaf
<i>Mimosa pudica</i> L.	LKK 112	<i>Fabaceae</i>	Irregular heartbeats, bloody diarrhoea, thrush	Stem, leaf
<i>Schrankia leptocarpa</i> DC.	LKK 92	<i>Fabaceae</i>	Heartburn	bark
<i>Harungana madagascariensis</i> Poir.	LKK 32	<i>Hypericaceae</i>	Sore in the stomach of newborn child, rheumatism, pain in the ribs, sore, thrush, snake bite	Leaf
<i>Vismia guineensis</i> Druce	LKK 67	<i>Hypericaceae</i>	Oedema (of arms, legs and stomach)	Leaf
<i>Beilschmiedia mannii</i> Benth. & Hook.f.	LKK 78	<i>Lauraceae</i>	African sign	Leaf
<i>Napoleonaea heudelotii</i> A.Juss.	LKK 19	<i>Lecythidaceae</i>	Heart failure, erectile dysfunction, painful redness of the eye, sore in stomach, sore in the stomach of newborn child/baby	Leaf, bark, root
<i>Napoleonaea</i> sp.	LKK 38	<i>Lecythidaceae</i>	Snake bite	Leaf
<i>Anthocleista nobilis</i> G.Don	LKK 48	<i>Loganiaceae</i>	Bodily pain, skin rash, rheumatism, sore, snake bite	Bark, leaf
<i>Lycopodiella cernua</i> (L.) Pic.Serm.	LKK 100	<i>Lycopodiaceae</i>	Rheumatism	Leaf
<i>Tristemma</i> sp	LKK 59	<i>Melastomataceae</i>	Incontinence	Leaf
<i>Carapa procera</i> DC	LKK 84	<i>Meliaceae</i>	Weak penis	Root
<i>Ficus capensis</i> Hort.Berol. ex Kunth & C.D.Bouché	LKK 10	<i>Moraceae</i>	Low blood, snake bite, malaria	Leaf

Table 3. Cont'd.

<i>Psidium guajava</i> L.	LKK 93	Myrtaceae	Dysentery	Leaf
<i>Nymphaea lotus</i> L.	LKK 80	Nymphaeaceae	Typhoid	Leaf
<i>Campylospermum subcordatum</i> (Stapf) Farron	LKK 28	Ochnaceae	Dysentery, chest pain in children caused by worms	Leaf
<i>Heisteria parvifolia</i> Sm.	LKK 33	Oleaceae	Asthma	Leaf
<i>Microdesmis keayana</i> J.Léonard	LKK 97	Pandaceae	Severe stomach pain, gonorrhoea, pneumonia, pain in the heart, abscess, tuberculosis, snake bite, jaundice, whooping cough, convulsion, toothache, painful and swollen testicles, severe side/rib pains	Leaf, bark
<i>Smeathmannia laevigata</i> Sol. ex R.Br.	LKK 11	Passifloraceae	Dysentery, stomach pain in pregnant women, abnormal heart beats	Leaf
<i>Smeathmannia pubescens</i> Sol. ex R.Br.	LKK 31	Passifloraceae	Diarrhoea, thrush	Leaf
<i>Eleusine indica</i> (L.) Gaertn.	LKK 42	Poaceae	Miscarriage caused by worms, joint pain	Leaf
<i>Paspalum scrobiculatum</i> L.	LKK 20	Poaceae	Worms, toothache, severe rib pain	Leaf, stem
<i>Setaria chevalieri</i> Stapf	LKK 54	Poaceae	Sore, diarrhoea	Leaf
<i>Craterispermum laurinum</i> Benth.	LKK 73	Rubiaceae	Malaria, cough	Bark
<i>Geophila obvallata</i> Didr.	LKK 72	Rubiaceae	Neck pain, food poison, severe heart pain	Leaf
<i>Hallea ledermannii</i> (K.Krause) Verdc.	LKK 62	Rubiaceae	Pile, rheumatism, used in divination to tell the fate of a sick person, sore, severe headache	Leaf, bark
<i>Hallea</i> sp.	LKK 98	Rubiaceae	Poison	Leaf
<i>Keetia rufivillosa</i> (Robyns ex Hutch. & Dalz.) Bridson	LKK 12	Rubiaceae	Malaria	Leaf
<i>Massularia acuminata</i> (G.Don) Bullock ex Hoyle	LKK 53	Rubiaceae	Used in divination to tell the fate of a sick person, typhoid, gonorrhoea	
<i>Morinda longiflora</i> G.Don	LKK 83	Rubiaceae	Bodily pain	Leaf
<i>Morinda lucida</i> Benth.	LKK 104	Rubiaceae	Jaundice, malaria, dysentery	Leaf, stem
<i>Morinda morindoides</i> (Baker) Milne-Redh.	LKK 43	Rubiaceae	Malaria, measles, worms	Leaf, stem
<i>Pavetta sonjiae</i> W.D.Hawth.	LKK 99	Rubiaceae	Cataract	Bark
<i>Pavetta</i> sp.	LKK 74	Rubiaceae	Diarrhoea	Bark
<i>Psychotria peduncularis</i> (Salisb.) Steyerm.	LKK21	Rubiaceae	Sore in stomach	Leaf
<i>Psychotria</i> sp.	LKK 105	Rubiaceae	Hernia	Bark
<i>Zanthoxylum gilletii</i> (De Wild.) P.G.Waterman	LKK 82	Rutaceae	Weak babies, rheumatism	Bark, leaf
<i>Placodiscus pseudostipularis</i> Radlk	LKK 13	Sapindaceae	Difficulty breathing	Stem
<i>Placodiscus</i> sp.	LKK 55	Sapindaceae	Ringworm	Leaf
<i>Chrysophyllum pentagonocarpum</i> Engl. & K.Krause	LKK 75	Sapotaceae	Pile	Leaf
<i>Delpydera gracilis</i> A.Chev.	LKK 63	Sapotaceae	Failure of the testes to descend (cryptorchidism)	Leaf
<i>Selaginella myosorus</i> (Sw.) Alston	LKK 29	Selaginellaceae	Rheumatism, bloody diarrhoea	Leaf
<i>Capsicum frutescens</i> L.	LKK 41	Solanaceae	Severe headache (migraine)	Stem
<i>Clappertonia</i> sp.	LKK 109	Tiliaceae	Malaria	Leaf
<i>Triumfetta</i> sp.	LKK 81	Tiliaceae	Inflammation of breast	Leaf
<i>Urera</i> sp.	LKK 96	Urticaceae	Malaria	Leaf
<i>Clerodendrum splendens</i> G.Don	LKK 30	Verbenaceae	Burning sensation in the foot, pain in the leg	Leaf
<i>Premna hispida</i> Benth.	LKK 76	Verbenaceae	Typhoid	Leaf
<i>Vitex micrantha</i> Gürke	LKK 22	Verbenaceae	African sign associated with pain on the sole of one's foot	Leaf
<i>Vitex rivularis</i> Gürke	LKK 51	Verbenaceae	Jaundice, malaria, abnormal bowel movement	Leaf

Table 3. Cont'd.

<i>Rinorea</i> sp.	LKK 64	<i>Violaceae</i>	Bloody diarrhoea, nightmare	Leaf, bark
<i>Cissus aralioides</i> Planch.	LKK 14	<i>Vitaceae</i>	Ulcer	Bark
<i>Aframomum sceptrum</i> Schumann	LKK 52	<i>Zingiberaceae</i>	Rashes on skin	Rhizome
<i>Aframomum</i> sp.	LKK 44	<i>Zingiberaceae</i>	Impotence, rheumatism	Rhizome

numbers for these families in our study area, all three species also comprised the most important families in terms of medicinal plants recorded among the herbalists.

Most medicinal plants had single or double uses, but we recorded twelve plants with at least five uses including *Xylopiya aethiopica* A.Rich., *Rauvolfia vomitoria* Wennberg, *Vernonia conferta* Benth., *Nephrolepis biserrata* (Sw.) Schott, *Tetracera potatoria* Afzel. ex G.Don, *Alchornea cordifolia* (Schumach.) Müll. Arg., *Harungana madagascariensis* Poir., *Napoleonaea heudelotii* A.Juss., *Desmodium adscendens* (Sw.) DC., *Anthocleista nobilis* G. Don, *Microdesmis keayana* J.Léonard and *Hallea ledermannii* (K.Krause) Verdc. (Table 2). Among these, *M. keayana* J. Léonard had over 13 different medicinal uses, while *N. biserrata* (Sw.) Schott was utilized for 11 different medical problems. A large number of the medicinal uses indicated for *M. keayana* J. Léonard by herbalists appear new in the ethno-pharmacopoeia of Liberia, although its utilization in treating gonorrhoea is also corroborated by the folk medicine of the Edo of Nigeria (Burkill, 1998), and none by Kpadehyea et al. (2015) for Lofa County of Liberia. An unspecified species of *Nephrolepis* sp. is reportedly utilized in Cameroon for the management of gonorrhoea (Kuete, 2013). Burkill (1998) noted the use of the plant as a haemostatic, and in the prevention of abortion, uses which mirror utilization by female herbalists in stopping bleeding in pregnant women in the Rivercess County.

Herbalists in Central Rivercess District are utilizing medicinal plants to treat an ethnomedical problem referred to as "African Sign". This is a condition of ill health that may result from allegedly the evil workings of bad persons through witchcraft, supernatural forces and "bad medicine" (Good, 1987). Seven (7) medicinal plants are used to treat persons with such afflictions and include *Vitex micrantha* Gürke, *Desmodium* sp., *Anthonota macrophylla* P. Beauv., *Manniophyton fulvum* Müll.Arg., *Cyathia* sp., *Combretum racemosum* P. Beauv. and *Vernonia conferta* Benth. In Sierra Leone, the use of fetish like *hale nyamu* (bad medicine) can result in chronic illness or death (Wallis, 1905), which is similar to the "African sign" reported by herbalists in the study area.

Remedies for snakebite were common knowledge among all the female herbalists, with 11 medicinal plants commonly employed, including *X. aethiopica* A.Rich., *R. vomitoria* Wennberg, *Newbouldia laevis* Seem., *Myrianthus libericus* Rendle, *Maesobotrya barteri* Hutch., *Mareya micrantha* Müll. Arg., *Harungana*

madagascariensis Poir., *Napoleonaea* sp., *Anthocleista nobilis* G.Don, *Ficus capensis* Hort. Berol. ex Kunth & C.D. Bouché and *M. keayana* J.Léonard. In the ethnomedicine of Africa, the anti-venom uses of *R. vomitoria* Wennberg and *M. keayana* J. Léonard have been noted (Burkill, 1985, 1994; Chifundera, 1987; Neuwinger, 1996; Kutalek and Prinz, 2007). Harley (1941), in an elaboration of the ethnomedicine of snakebite among the Mano of Liberia, reports the use of *M. spicata* Baill., which is a synonym of *M. micrantha* Müll. Arg as a snakebite remedy. Traditional herbalists in Lofa County have also confirmed the use of *M. micrantha* Müll. Arg and *R. vomitoria* Wennberg as anti-venom plants (Kpadehyea et al., 2015). It is not yet known to what extent the other plants reported by the herbalists as anti-venom plants are effective, as the current ethno-pharmacopoeia of Liberian plants does not mention their anti-venom uses among other cultures. However, this does not preclude the fact that herbalists could come up with new uses for such plants in their communities, given that we are yet to fully document ethnomedicinal uses of plants across the different cultures in Liberia.

Various health problems were reported by herbalists for which medicinal plants are used including malaria, ulcer and stomach sores, impotence and erectile dysfunction. Ten plants were indicated as remedies for malaria (Table 3), 9 for ulcer (and sore in the stomach of babies/children), and 6 plants for impotence (infertility/erectile dysfunction). Some of these plants are also known in the folk medicine of other countries (Lebbie and Guries, 1995; Neuwinger, 1997) as well as Liberia (Harley, 1941; Kpadehyea et al., 2015). However, some uses reported for certain medicinal plants by the herbalists might represent new and unrecorded uses. *Tetraberlinia tubmaniana* J. Léonard, *Delpyodora gracilis* A. Chev., *Campylospermum subcordatum* (Stapf) Farron, *Cyathula prostrata* (L.) Blume, *Heisteria parvifolia* Sm., *Keetia rufivillosa* (Robyns ex Hutch. & Dalz.) Bridson, *Pavetta sonjae* W.D.Hawth., *Chrysophyllum pentagonocarpum* Engl. & K.Krause, *Placodiscus pseudostipularis* Radlk and *Caladium bicolor* (Aiton) Went., all represent plants which have new uses in the ethno-pharmacopoeia of Liberia. *Tetraberlinia tubmaniana* J. Léonard, a tree endemic to the Upper Guinean forest, is used by herbalists to treat stomach ulcer, while the naturalized plant, *C. bicolor* (Aiton) Went., has found a new use hitherto unreported. Its use to constrict the female vagina is reported by herbalists as a

measure to increase sexual satisfaction in both men and women, as a dilated vagina is reported to reduce sexual satisfaction. In the ethnomedicine of the Lofa County, *C. bicolor* (Aiton) Went., is used in combination with *Musanga cecropioides* R. Br., to treat skin cancer (Kpadehyea et al., 2015).

Conclusion

There is a rich medicinal plant knowledge base among male and female herbalists in the forest region of Liberia, with clear gender differentiation and specialization in the use of medicinal plants for the treatment of illnesses. A total of 112 species of medicinal plants in 52 families were recorded through interviews conducted with traditional herbalists, with the most commonly utilized medicinal plants reported by them belonging to plants in the following families: *Annonaceae*, *Apocynaceae*, *Costaceae*, *Rubiaceae*, *Euphorbiaceae*, *Fabaceae* and *Verbenaceae*. Species in these families were utilized in the treatment of ailments such as malaria, snakebites, ulcer, evil spirit, witchcraft, infection and diarrhoea. New and unrecorded ethnomedicinal uses for several medicinal plants were reported by the traditional herbalists, including *Tetraberlinia tubmaniana* J. Léonard, *Delpyodora gracilis* A.Chev., *C. subcordatum* (Stapf) Farron, *C. prostrata* (L.) Blume, *H. parvifolia* Sm., *K. rufivillosa* (Robyns ex Hutch. & Dalz.), *P. sonjae* W.D.Hawth., *C. pentagonocarpum* Engl. & K.Krause, *P. pseudostipularis* Radlk and *C. bicolor* (Aiton) Went. Further documentations are required to fully comprehend the wealth of knowledge possessed by herbalists, as well as unravel the gender differentiation and specialization in the use of medicinal plants in the ethnomedicine of Liberia.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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