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An ethnomedicinal survey of plants used to treat malaria in the Central Region of Ghana

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ABSTRACT

Herbal medicines form a major component of traditional medicine in Africa because they are perceived to be efficacious and safe. The study aimed at investigating anti-malarial plants used by the indigenous people in the Central Region of Ghana. The study was conducted in three districts: Cape Coast (CC), Assin and Asikuma-Odoben-Brakwa (AOB). Ethnomedicinal data on antimalarial plants was collected using a convenient sampling technique consisting of field observation, collection of vouchers and semi-structured interviews of herbalists/herbal practitioners and general public. Respondents interviewed constituted Herbal practitioners/Vendors (8%), Traditional birth attendants (TBAs, 6%), Chiefs/Opinion leaders (2%), and general public (84%). The female respondents formed 54% and 46% were males. Eighty-nine plant species belonging to 41 families were recorded as useful in treating malaria. Leaves were the commonest plant part used for herbal preparation (49.5%), followed by Stem bark (21.2%), roots (14.1%), fruits (7.2%), seeds and whole (3.0% each) and flowers (2.0%). Thirty two plant species belonging to 23 families were found to be common in all study areas. Herbal medicine patronage for malaria treatment in Central Region of Ghana is high with common species occurring in all study areas.

Keywords: Malaria, Medicinal plants, Survey, Assin, Central Region.

INTRODUCTION

Herbal medicines have formed a major component of traditional medicine in African nationals long before the introduction of scientific medical care by the Europeans^[1]. Herbs are effective in disease prevention as well as cleansing the body of harmful substances^[2] and are also known to upregulate the endocannabinoid system to protect against migraine, fibromyalgia, irritable bowel syndrome, psychological disorders,^[3,4] and other conditions^[5], hence the use of traditional or herbal medicine has been a practice of various ethnic groups for centuries^[6]. Globally, over 1000 plants have been used as potential antimalarials in resource-poor settings^[7]. Malaria kills a child every 30 seconds globally and the lives of three people on daily basis in Ghana. Due to fragile health-care systems, lack of accessibility and affordability of artemisinin-based combination therapies (ACTs) and other orthodox medicines, people often turn to traditional herbal remedies. It is estimated that in Ghana, about 70% of the population mostly in the rural settings depend on herbal medicine for the cure and treatment of tropical diseases including malaria^[8,9]. With a modern twist of research into the efficacies in herbal preparations, traditional medical care has been incorporated into mainstream medical training in Ghana whereas some certified health facilities already provide homeopathic care to the people. Formal documentation of Ghana's herbal heritage has been lacking, this is because Ghanaian medicinal plants have been passed on over the years through oral traditions from one herbalist to another^[10]. In the midst of the rapid destruction and degradation of the environment, the loss of useful medicinal plant species is obvious. The passing away of the custodians' knowledge and the poor documentation^[11] pose a great threat to Ghana's traditional medicine heritage. This study therefore investigated and documented anti-malarial plants and parts used by the indigenous people, their distribution, status and conservation in the Central Region of Ghana.

MATERIALS AND METHODS

The study was conducted in three districts: Cape Coast, Assin and Asikuma-Odoben-Brakwa (AOB) all in the Central Region of Ghana. These districts were zoned into two: coastal (Cape Coast) and rain forest, (Assin and AOB) depending on the type of vegetation and climate. The Assin and AOB districts are located in the thick rainforest zone and farming is the main occupation for the people. Some of the people live within the forests and have home gardens of ornamental medicinal plants. Ethnomedicinal data on antimalarial plants was collected in 2008 using a convenient sampling technique consisting of field observation, semi-structured interviews and collection of vouchers. One hundred and fifty respondents participated. The respondents were made up of herbalists/herbal practitioners, medicinal plant vendors, pastors, traditional birth attendants, chiefs, opinion leaders and individuals who were

using or had used herbs to treat diseases and as anti-malarial drugs

Data analysis

Frequencies, percentages, and means were computed using the software GraphPad Prism for Windows Version 5.

RESULTS

Representation of Respondents to questionnaires

Of 150 respondents, 8% were Herbal practitioners/Vendors, 6% Traditional birth attendants (TBAs), 2% Chiefs/Opinion leaders, and 84% general public. The female respondents formed 54% and 46% were males. Respondents who have had at least some level of basic education were considered literate and constituted 56% whereas 44% were considered illiterate with no formal education. On the average, respondents had known the plants and used them for not less than 2 years. All participants indicated that knowledge of these species was passed on orally from relatives (parents/grandparents) who practiced traditional medicine.

Types of plant species used as antimalarials in the study areas

Eighty-nine plant species belonging to 41 families were recorded as useful in treating malaria during the study (Table 1). The Family *Euphorbiaceae* recorded the highest number of species (8) while families *Apocynaceae*, *Asteraceae* and *Meliaceae* had 5 each, *Caesalpiniaceae*, *Fabaceae* and *Poaceae* 4 each,

Combretaceae, *Rubiaceae*, *Rutaceae*, and *Solanaceae* recorded 3 each. The following families recorded 2 species each - *Anacardaceae*, *Bignoniaceae*, *Compositae*, *Labiatae*, *Mimosaceae*, *Myrtaceae*, *Palmaceae*, *Sapotaceae*, *Ulmaceae* and *Verbanaceae* while 19 others, *Agavaceae*, *Amaranthaceae*, *Annonaceae*, *Bromeliaceae*, *Caricaceae*, *Connaraceae*, *Convolvulaceae*, *Cucurbitaceae*, *Lauraceae*, *Lecythidaceae*, *Lauranthaceae*, *Malvaceae*, *Maranthaceae*, *Musaceae*, *Nymphaeaceae*, *Passifloraceae*, *Periplocaceae*, *Sapindaceae* and *Sterculiaceae* recorded 1 species each.

Parts of plant species used, mode of preparation and administration of drug

As indicated in figure 1, leaves were the most common part of the plant used for herbal preparation to cure malaria recording 49.5%, Stem bark constituted 21.2%, and roots 14.1%. Fruits followed with 7.2%, seeds and whole plant constituted 3.0% each whereas flowers had 2.0%. Eighty five percent (85%) of respondents prepared their drugs by boiling while, 7% used the drugs after freshly collecting them, 3% prepare a paste of the herbal product by grinding the plant and 5% powdered the plant material (figure 2). Most of the respondents 68.2% administered their preparation orally (table 1). Steam bathing was employed by 21.2%, whereas 9.4% used enema as mode of administration. Other approaches used were smearing and cold bath each of which recorded 1.2%. The documented antimalarial plants and their distribution are presented in Table 1.

Distribution and Status of Antimalarial Plants

Most of the plants were common in all the districts whereas others were peculiar to only one area (Table 1). In summary, 32 plant species

belonging to 23 families were found to be common in all the three study areas, 28 species in 18 families, 16 species in 11 families and 4 species in 4 families were peculiar to Assin, AOB and CC respectively whereas 7 species in 7 families were common to Assin and AOB alone.

Information gathered on the status of the species indicated that the plants have always been readily available on farmlands, river banks, waste places, around play grounds and in herbal gardens around homes of most respondents and could be picked at any time of the day. Only *Spiropetalum heterophyllum* (Connaraceae) occurred at long distance into the forest and required special rituals before harvesting strictly at night.

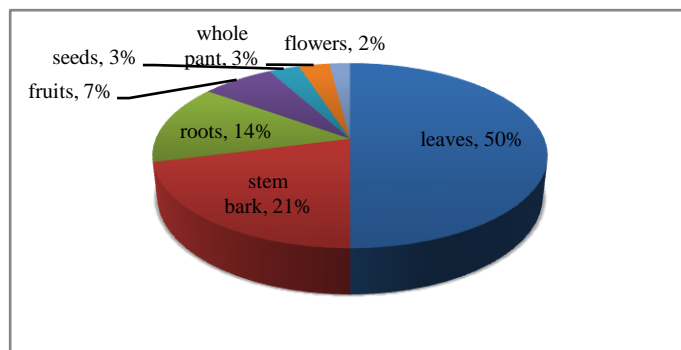


Figure 1: Parts of plants used in treating malaria

Majority of the respondents (50%) used leaves of the locally used plants to treat malaria.

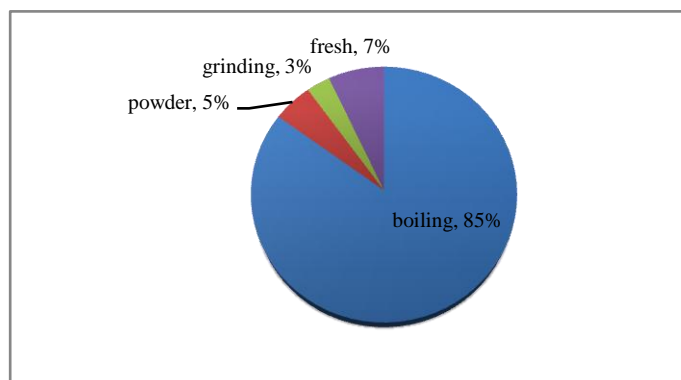


Figure 2: Mode of preparation of the herbal product

Boiling was the most reported mode of preparing the antimalarial herbal preparation representing 85% of the reported mode of herbal product preparation.

DISCUSSION

A medicinal plant is any plant or its parts that contain useful substances for therapeutic purposes or which are used for the synthesis of useful drugs^[12]. The total reliance of herbal preparations for curing malaria in the communities of the study areas was attributed to the non-availability of health facilities, bad roads and poverty. Others consider medicinal plants as health foods which should always be taken to enhance their wellbeing. More so knowledge of the use of traditional medicine had been with them for ages and this is in agreement with reports elsewhere^[8,13]. There is easy accessibility to various plant species for use as medicines due to

Table 1: Plants used as remedies for malaria in three districts of Central Region, Ghana

Family	Scientific name	Local Name	Plant form	Parts used	Districts of plant usage		
					CC	ASN	AOB
1. Agavaceae	<i>Sansevieralongiflora</i> Thunb	Twiton (Twi)	-	-		✓	
2. Amaranthaceae	<i>Pupalialappacea</i> (Adans) Mut. Juss.	Mpupua (Twi)	Herb	Leaf		✓	
3. Anacardaceae	<i>Mangifera</i> indica Linn.	Mango (English)	Tree	Leaf stem bark	✓	✓	✓
	<i>Spondiasmombin</i> Linn.	Atoa (Twi)	Tree	Leaf			✓
	<i>Annonamuricata</i> Linn.	Apple (English)	Tree	Leaf stem bark		✓	
5. Apocynaceae	<i>Alstoniaboonei</i> Linn.	Nyamedua (Twi)	Tree	Leaf stem bark.	✓	✓	✓
	<i>Picralimanitida</i> Pierre.	Akuama (twi)	Tree	Leaf fruit		✓	
	<i>Pleiocarpamutica</i> Benth.	Onwenma (Twi)	Shrub	Stem bark fruit		✓✓	
	<i>Rauvolfiavomitorea</i> Linn.	Kakapenpen (Twi)	Tree	Flowers stem bark Root bark root		✓✓	
	<i>Thevetiaperuviana</i> (Linn.) Juss Ex Endl.	Milkbush (english) (Twi) nye me nkyereme	Shrub	Leaf			✓
	<i>Voacanga</i> africana Thou.	Amanafoa/Mpentem/Obede (Twi)	Shrub	Root bark			✓
6. Asteraceae	<i>Acanthospermum</i> hispidum Schrank	Patakunsakum/ patakunsoe (Fante)	Herb	Aerial part	✓	✓	✓
	<i>Ageratum conyzoides</i> Linn.	Ntumunum (Fante)	Herb	Aerial part	✓		
	<i>Aspilia</i> africana Thou.	Mfofobedee (Twi)	Herb	All parts		✓✓	
	<i>Lactucataraxasifolia</i> Thunb	Dandelion (English)	Herb	Leaf			✓
	<i>Tridaxprocumbens</i> Linn.	Fomizegbe (Ewe)	Herb	Leaf		✓	
7. Bignoniaceae	<i>Kigelia</i> africana Engl.	Nufuten/Nufusuo (Twi)	Tree	Leaf		✓	
	<i>Newbouldiala</i> aevis SeeM Ex Burr	Sasanemasa (Twi)	Shrub	Root bark Stem bark		✓	
8. Bombacaceae	<i>Bombax</i> buonopozense P.B eauv.	Akata (Twi)	Tree	Leaf		✓	
	<i>Bombax</i> brevicuspe Sprague	Kuntunkuri (Twi)	Tree	Stem bark Leaf		✓	
9. Bromeliaceae	<i>Ananas</i> sativa (Linn.)Merrill.	Pineapple	herb	Fruit	✓	✓	✓
10. Caesalpinaceae	<i>Cassia</i> alata Linn.	Nsempii (Twi)	Shrub	Leaf	✓	✓	✓
	<i>Cassia</i> occidentalis Linn.	Mofrabrode (Fante)	Herb	Leaf Flowers seeds	✓	✓	✓

	<i>Cassia (Senna) siamea</i> Lam.	Senna	Tree	Lvs., Sb., Rt.	✓	✓	✓
	<i>Daliumguineense</i> Willd.	Akyitoekyi (Ewe)	Tree	Fruit.	✕		
11. Caricaceae	<i>Carica papaya</i> Linn.	Pawpaw (English)	Tree	Seeds Leaf	✓	✓	✓
12. Combretaceae	<i>Combretumgrandiflorum</i> G. Don.	Whiremnini (Twi)	Shrub	Leaf		✓	
	<i>Terminaliaivorensis</i> Linn.	Emire (Twi)	Tree	Stem bark Root		✓	
	<i>Terminaliacatapa</i>	aborofonkatee (Twi)	Tree				✓
13. Compositae	<i>Vernoniaamygdalina</i> Del.	Awonwene (Twi)	Shrub	Leaf	✓	✓	✓
	<i>Vernoniaconferta</i> Schreb.	Wudifookete (Twi)	Shrub	Leaf Stem bark		✓✓	
14. Connaraceae	<i>Spiropetalumheterophyllum</i> (Bak)Gilg	Ahomakyem/Ahoma-bosom (Twi)	Tree	Leaf Stem bark	✓	✓	✓
15. Convolvulaceae	<i>Ipomoea batata</i>	Santom (Fante)	Herb	Leaf		✓✓	
16. Cucurbitaceae	<i>Mormordicacharantia</i> Linn.	Nyanya (Twi)	Herb	Leaf	✓	✓	✓
17. Euphorbiaceae	<i>Alchoniacordifolia</i> (Shun Ex Thonn) Murr. Arg.	Ogyama (Twi)	Tree	Leaf Root bark	✓	✓	✓
	<i>Brideliaatroviridis</i> Willd. Cor. Spreng	Opamkotokurodu (Twi)	Tree	Leaf Stem bark		✓	
	<i>Jatrophaacurcas</i> Linn.	Akaneadua (Twi)	Tree	Leaf	✓	✓	✓
	<i>Jatrophagossypifolia</i> Linn.	Yesumogya (Twi)	Shrub	Leaf.			✓
	<i>Mallotusoppositifolius</i> Lour	Satadua (Twi)	Shrub	Leaf.			✓
	<i>Manihotesculenta</i> , Crantz.	Cassava	Shrub	Leaf	✓	✓	✓
	<i>Phyllantusamarus</i> Murr.	Abomaguekyir (Fante)	Herb	Whole plant	✓	✓✓	
	<i>Securinegavirosa</i> Comm. Ex Juss.	Akansa (Twi)	Shrub	Root		✓	
18. Fabaceae	<i>Cassia nigrican</i> Linn.	Osempe (Twi)	Tree	Stem bark Root		✓	
	<i>Erythrophleumivorense</i> DC.	Potrodom (Twi)	Tree	Stem bark		✓	
	<i>Parkiabiglobosa</i> Benth.	Osokronsroma (Twi)	Tree	Stem bark		✓	
	<i>Tamarindusindica</i> Linn.	Borofo (Twi)	Tree	Fruit Stem bark Leaf		✓	
19. Labiatae	<i>Hoslundiaopposita</i> Vahl.	Abrewaninkwan/nunumerewa (Twi)	Shrub	Leaf Root		✓✓	
	<i>Ocimumviride</i>	Nunum (Twi)	Shrub	Leaf.	✓	✓	✓
20. Lauraceae	<i>Persia Americana</i> Mill.	Pear (English)	Tree	Leaf Stem bark	✓	✓	✓
21. Lecythidaceae	<i>Petersianthus</i> Merr.	Esiaa (Twi)	Tree	Leaf			✓
22. Loranthaceae	<i>Tapinanthusbangwensis</i> Engler & K Krause	Akrampan/Gyankurudu/Okurodu (Twi)	Shrub	Leaf.		✓	✓

23. Malvaceae	<i>Gossypium arboreum</i> Linn.	Asaawa (Twi)	Shrub	Leaf	✓	✓	✓
24. Marantaceae	<i>Ataenidiaconferta</i> Benth.	Abuabua (Twi)	herb	Fruit		✓	
25. Meliaceae	<i>Azadirachtaindica</i> Juss.	Neem (English)	Tree	Leaf Stem bark Root	✓	✓	✓
	<i>Carapaprocera</i> Aubl.	Kwakuobese (Twi)	Tree	Seed		✓	
	<i>Gueracedrata</i> Adans Ex Juss.	Kwabohoro (Twi)	Tree	Stem bark		✓	
	<i>Khayasenegalensis</i> A.Chev.	Mahogany (English)	Tree	Leaf Stem bark	✓	✓	✓
	<i>Trichiliamonadelpha</i> R. Br.	Tanuro (Twi)	Tree	Leaf Stem bark		✓	
	<i>Tetrapleuratetraptera</i> Bent h.	Prekese (Twi)	Tree	Stem bark Fruitt	✓	✓	✓
27. Musaceae	<i>Musa paradisiaca</i> Linn.	Plantain sucker (English)	Herb	Leaf	✓	✓	✓
28. Myrtaceae	<i>Psidiumgujava</i> Linn	Guava (English)	Tree	Leaf Stem bark	✓	✓	✓
	<i>Syzygiumguineense</i> Willd.	Atena (Twi)	Tree	Stem bark		✓	
29. Nymphaeaceae	<i>Nymphaealotus</i> Linn.	Asukooko (Twi)	Herb	Leaf			✓
30. Palmaceae	<i>Cocosnucifera</i> Linn.	Kube (Twi)	Tree	Stem bark Root Fruitt	✓	✓	✓
	<i>Elaiesguineensis</i> Linn.	Abe (Twi)	Tree	Lvs.			✓
31. Passifloraceae	<i>Adenialobata</i> Jacq.	Nsurogya (Twi)	Tree	Stem leaf		✓	
32. Periplocaceae	<i>Cryptolepissanguinolenta</i> (Wall) R. Br.	Nibima (Twi)	Shrub	Root		✓	
33. Poaceae	<i>Cymbopogoncitrates</i> Spreng.	Lemon grass (English)	Grass	Leaf	✓	✓	✓
	<i>Cynodondactylon</i> (Linn.) Pers.	Aponkyeabodwese (Twi)	Grass	Stem bark			✓
	<i>Sorghum vulgare</i> Moench.	Millet (English)	Grass	Leaf			✓
	<i>Zeamays</i> Linn.	Aburoo (Twi)	Grass	hull			✓
34. Rubiaceae	<i>Canthiumglabriflorum</i> Hier n.	Teteadupon (Twi)	Tree	Leaf	✓	✓	✓
	<i>Morindalucida</i> (Benth)	Okonkroma (Twi)	Tree	Leaf Stem bark Root	✓	✓	✓
	<i>Nauclealatifolia</i> Korth.	Adesekankye (Fante)	Shrub	Leaf Stem bark Root	✓		
35. Rutaceae	<i>Citrus aurantiifolia</i> (Christm)Swin gle	Lime (English)	Tree	Leaf Fruit	✓	✓	✓
	<i>Citrus medica</i> Linn.	Ankaatwaree (Twi)	Tree	Leaf	✓	✓	✓

	<i>Clausenaanisata</i> Burm.	Samanobiri (Twi)	Shrub	Leaf Stem bark Root				✓
36. Sapindaceae	<i>Paullinia piñata</i> Linn.	Toantini (Twi)	Tree	Leaf Root				✓
37. Sapotaceae	<i>Synsepalumdulcificum</i> P.&K	Asaa (Twi)	Tree	Leaf Root				✓✓
	<i>Tieghemellaheckelii</i> , Piere Ex A. Chev.	Beko (Twi)	Tree	Stem bark				✓
38. Solanaceae	<i>Lycopersicumesculentum</i> Hill.	Tomato (English)	Herb	Leaf				✓
	<i>Solanummellogena</i> Linn.	Nsusua (Twi)	Herb	Fruit.				✓
	<i>Solanumtorvum</i> Linn.	Bedrui (Twi)	Shrub	Leaf Fruit	✓	✓		✓
39. Sterculiaceae	<i>Theobroma cacao</i> (Linn)	Cocoa (English)	Tree	Leaf Stem bark	✓	✓		✓
40. Ulmaceae	<i>Celtisadolphi-fidrichi</i> Linn.	YisoNkesua (Twi)	Tree	Stem bark Leaf	✓			
	<i>Celtis Africana</i> Linn.	Esakosua (Twi)	Tree	Stem bark				✓
41. Verbanaceae	<i>Lantana camara</i> Linn.	Anansedokono (Twi)	Herb	Aerial part.	✓	✓		✓
	<i>Lippiamultiflora</i> Moldenke	Saanunum (Twi)	Shrub	Leaf.				✓

the maintenance of home gardens with desired plants that could contribute to the extraction and development of several drugs and chemotherapeutics [1] as well as traditionally used rural herbal remedies. Most of these plant species are used as ornamentals and hedge plants [14] to beautify homes and the environment hence accounting for their common use as in the case of Euphorbiaceae, Apocynaceae, Asteraceae and Meliaceae being the highest recorded antimalarial plants in this study. Moreover, in these societies, herbal remedies have become more popular in the treatment of minor ailments, and also on account of the increasing costs of personal health maintenance [11]. The abundance of most plants closer to the human habitats attested to the fact that these people relied on herbal plants for their wellbeing.

Spiropetalum heterophyllum (Connaraceae) was considered as a sacred plant that required a special ritual before harvesting. However, further interrogation of the traditionalists revealed the potency and effectiveness of the plant on various ailments and so instituted measures to prevent excessive harvesting that would lead to its extinction.

Fifty four percent of the respondents happened to be women attesting to the fact that women over the centuries have used herbal remedies safely and effectively although there have not been rigorous scientific studies backing their use. Herbs are used in women's health to regulate hormones, reduce water retention and body weight [4,15-17], elevate mood, and reduce pain and cramping and are used to treat menstrual problems, heavy bleeding, skipped periods, excessive bleeding, and menopause. Women also use herbal remedies to support their Pregnancy and natural childbirth.

To overcome the complex manifestations of the malaria disease, some procedures are employed in the preparation of herbal remedies for treatment. Many plant species and parts may be combined in the preparation of decoctions for oral administration [18]. This interesting concept could bring together small quantities of active compounds present in individual herbs to benefit from their therapeutic effect [19], as has been used in the preparation of allopathic drugs as combined therapy. Most of the plants [20] *Artemisia annua* which is also reported to possess a contraceptive agent [21], *Phyllanthus niruri* [22], and *Nigella sativa* [23] could contain important properties like antioxidants, free radical scavenging activities, hypolipidemic potential and protection against apoptosis of erythrocytes, anti-microfilarial, antianaphylactic regulate blood glucose [19, 20, 24-32] to treat multiple symptoms as mentioned earlier. Leaves are easy to process and have always formed the major plant part for use [18] in decoctions for easy extraction of ingredients although stem barks are reported to be preferred by the people of India [33]. The cocktail preparation for oral consumption [20] and regular heating to prevent decay made decoction the preferred choice of many. As gathered, decoctions are taken three times a daily, i.e. morning, afternoon and evening after meals as prophylaxis to prevent disease occurrence [20, 34]. However, investigation should be conducted to ascertain whether prolong use of decoctions would not impair immunity to enhance susceptibility to opportunistic infections. A similar approach should be employed to clarify the practice by pregnant women and children who use extraction from combined plants for enema to ascertain the teratogenic effects on the unborn fetus and also the consequent side effects in these infants. "Vapour bath" and or "extract bath" was another approach of usage. In this process involves the boiling of the plant part for use (mostly leaves) to a very high temperature. The victim is then covered with heavy clothings while sitting by the preparation to prevent the escape of

vapour. The preparation is occasionally stirred for the victim to inhale the vapour which results in profuse sweating. This procedure was explained to just diffuse the extractive through the skin without the accumulation of any toxic substance in the body. Generally, administration of herbal preparations as was gathered, enhanced the mood of users and gave them a sense of well-being [35] to enable them carry out their farming and other daily activities.

The inability of the respondents to attribute any untoward effects to any of the herbs could stem from the lack of knowledge of the possible signs and symptoms of adverse reaction in response to a specific herb. Perhaps no significant side effects are produced because the active ingredients are combined with other compounds in the herb and administered in different dosages. Further, due to combination of the herbs in preparation, the effect of one herb may nullify the side effect of the other [36]. The popularity of ethnoherbal recipes is attributed partly to the inaccessibility to modern healthcare facilities that are expensive for the poor villagers [13]. In contrast, herbal medicines are cheaper, acceptable to local people and readily available [1]. The respondents considered some herbs new because those plants were not previously used to treat malaria; however, anti-malaria herbs of different origin, have been hyped by the media in recent times such that most people could now use them. Plants were perceived to be suitable antimalarial or medicinal when domestic animals have fed on them with no adverse reactions of toxicity.

CONCLUSION

The instances cited above might be true to the discovery of new anti-malarial plant species in the Central Region. In furtherance, most of these plant species were not peculiar to one locality; therefore it is believed that they might be true anti-malarial plants known very well to the people of Central Region, which would require further research and documentation.

Competing of Interests

The authors declare no competing conflict of interests.

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