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Ethnobotanical Survey of Antimalarial Plants in Areas of: Abukamola, Angeta, Oculokori and Omarari of Alebtong District in Northern Uganda

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Authors' contributions

This work was carried out in collaboration between all authors. Author DRO designed the study, collected and analyzed data and also prepared the first draft manuscript. Author EA refined the questionnaire and reviewed the first draft manuscript. Author GTK also reviewed the first draft manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Rural populations depend heavily on traditional medicine to manage diseases, yet knowledge on traditional medicine is continually being lost. This study was undertaken to document antimalarial plants in a rural community with the view of contributing to conservation of traditional knowledge on antimalarial medicinal plants.
The study was carried out in areas of; Abukamola, Angeta, Oculokori, and Omarari of Alebtong

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district in Northern Uganda in September and October 2015. A semi structured interview questionnaire was administered randomly to households and to selected key informants. This questionnaire was tailored to providing socio-economic and information on antimalarial plants used in this area to treat malaria.
The majority (67.5%) of the respondents were subsistence farmers. Fourty three plants belonging to 26 families were identified. Papilionaceae followed by Asteraceae were the most represented families. *Securidaca longipenduculata Fresen* was the most known plant species for use in treatment of malaria PRK (23.5%). Most antimalarial medicine was derived from plant roots. The medicine was commonly prepared by macerating fresh pounded plant material in water. The extract in water was mostly administered orally. The use of antimalarial herbal medicines in the treatment of malaria was mainly attributed to the cheap price (32.2%) followed by easy access (27.2%) of the medicines and their perceived effectiveness (23.5%) among other reasons. Most (98.8%) of the plants were obtained from the wild and according to 98.8% of the respondents, the plants were still abundant in the wild. However, despite the plant abundance, conservation techniques were still suggested to protect the plants, top amongst these techniques were creating herbal gardens, suggestion by 25.9% of respondents; tree planting suggested by 24.7%.
Several antimalarial plants belonging to different families were document by this study. The adequate knowledge on Securidaca longipenduculata Fresen in treating malaria warrants further investigations of its bioactive properties.

Keywords: Antimalarial; plants; survey; Alebtong.

1. INTRODUCTION

Traditional medicine is still relevant in healthcare; so far a large section of the rural poor are increasingly depending on medicinal plants from traditional medicine to treat malaria and other ailments [1,2,3]. This is important especially considering the debilitating effects of malaria mainly among the world's poorest populations, of which most of them are in Africa. Malaria still continues to claim the lives of many Africans; 90% of those who die globally due to malaria are from Africa [4]. In Uganda 27% of her people still continue to die from this disease [5]. Also because modern antimalarials may not be afforded by the rural poor, due to their high cost in relation to the poverty levels [4,2] and the limited access to health care facilities in these areas [6], many rural communities rely heavily on traditional medicine to manage malaria and other diseases [1].

Traditional medicine has also provided mankind with modern drugs [3]. Quinine for example was discovered and isolated from the use of *Chinchona ledgeriana* back by South American indigenous people to treat malaria; also artemisinin currently the mainstay used in combination therapy, was derived from the use of *Artemisia annua* to treat fevers in Chinese traditional medicine [6]. Therefore medicinal plants used in ethnomedical practices provide a useful resource base from where novel chemotherapeutic compounds can be unearthed. However, despite the significance of traditional medicine to healthcare and drug discovery, its knowledge is being lost [3,7]. Because this knowledge is passed on from elders to young people through oral folklore, it is lost when elders die before passing it on; also interference by western culture, with young people ignoring traditional way of life in favor for a new culture [8]; lack of confidence among users and practitioners has also been attributed to their loss [3]. This loss therefore undermines efforts to manage malaria and other diseases. Drug resistance is a major challenge in the management of malaria; so far, resistance to artemisinins has been reported in Southeast Asia [9]; discovery of novel antimalarial compounds is therefore crucial. Loss of traditional knowledge on antimalarial plants would therefore hamper efforts of discovering novel potent antimalarial compounds.

Alebtong is a newly created rural district with limited health infrastructure and access to health services; also most of the inhabitants of this district are poor and therefore may not afford modern antimalarials. It has been reported that inhabitants of such communities rely heavy on traditional medicine to manage their illness [1]. With the current threat of lose of traditional knowledge on medicinal plants such communities would be gravely affected by malaria and other diseases. It is therefore in this regard that we undertook this study to document antimalarial plants used in the management of

malaria in this area in order to; preserve their traditional knowledge and uses in management of malaria and other diseases.

2. MATERIALS AND METHODS

2.1 Study Area

Field survey was carried out in September and October 2015, in areas of: Abukamola, Angeta, Oculokori, and Omarari of Alebtong district (Fig. 1). Alebtong district is located in the mid Northern part of Uganda and its geographical coordinates are 02°18′N 33°18′E. It is a newly created and is among the rural districts in Uganda which are marginalized in terms of access to health services and most of its inhabitants are relatively poor.

2.2 Data Collection and Plant Identification

A semi-structured interview questionnaire modified from that of Almeida et al. (2006) was used to collect ethnobotanical information from informants. The questionnaire was tailored to provide information on key areas such as; socio-economic information, antimalarial plants used in the community, why they are used, method of preparation- administration and- the availability status of the antimalarial plants within the community. The interviews were conducted in

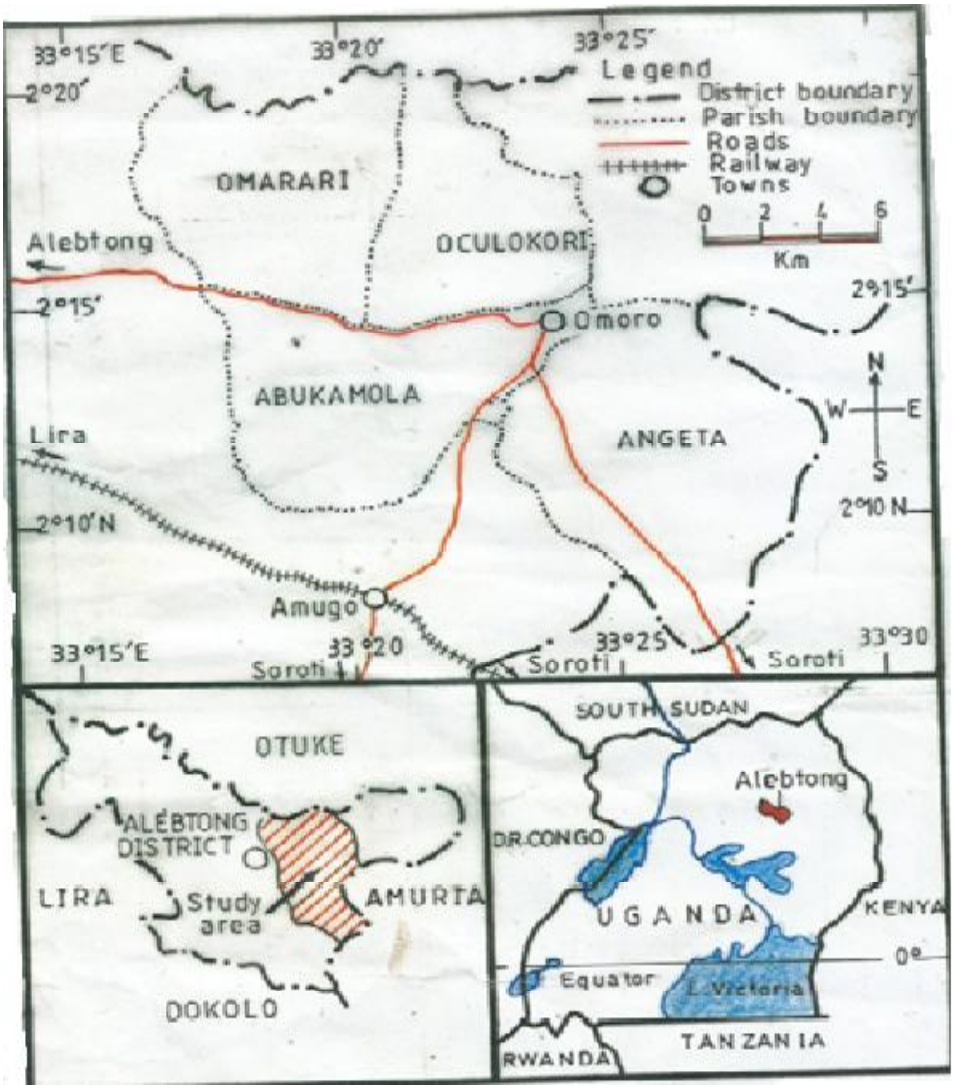

Fig. 1. Study areas in Alebtong district Uganda

two ways: House to house interviews were conducted to households chosen at random and interview with herbalist was administered to selected herbalists identified by local leaders and still conducted by a trained assistant. The interviews were translated to their local language by research assistants for the respondents who did not understand English.

A shoot with leaves, flowers and in some cases fruit was cut from the antimalarial plants identified by respondents and placed in a plant press for drying. After drying they were taken to Makerere University botany herbarium where plant identification and classification was done by a trained taxonomist. Voucher specimens were preserved at the Makerere University botany herbarium.

2.3 Data Analysis

Data from the questionnaire was coded and entered into SPSS software 16.0.1. for analysis. From the data, frequencies were summarized, percentages calculated and tables and graphs derived.

The percentage of respondents having knowledge (PRK) regarding the use of a species in the treatment of malaria was estimated using the formula adopted from Wangpan et al. 2016:

$$PRK\ (\%) = Np/Nt \times 100$$

Np is the total number of informants that are claiming to use a plant species to treat malaria and Nt is the total number of individuals interviewed [10].

3. RESULTS

3.1 Demographic Characteristics

This study interviewed 81 respondents; 43(53.1%) were male and 38(46.9%) female distributed as below in the study areas: Abukamola(36%), Angeta(26%), Oculoko(18%) and Omarari(1%). Most of the respondents were aged above 47 years old and married (Table 1).

Very few of the respondents had attained higher levels of education: (2.5%) had university education and (1.2%) attended tertiary institutions like technical colleges and polytechnics. Majority had only attained primary school education (46.9%); also 23.5% of them had attained secondary school education and (25.9%) had no formal education.

Table 1. Demographic characteristics

Characteristics		Percentages
Location	Abukamola	36(44.4)
	Angeta	26(32.2)
	Oculokori	18(22.2
	Omarari	1(1.2)
Sex	Male	38(46.9)
	Female	43(53.1)
Age(Years)	18-27	6(7.4)
	28-37	23(28.4)
	38-47	11(13.6)
	Above 47	41(50.6)
Marriage	Single	2(2.5)
	Married	79(97.5)
Education Level	Primary	38(46.9)
	Secondary	19(23.5)
	University	2(2.5)
	Tertiary Institution	1(1.2)
	No formal Education	21(25.9)
Occupation	Subsistence farmer	55(67.9)
	Herbalist	8(9.9)
	Health Worker	6(7.4)
	Teacher	2(2.5)
	Business	1(1.2)
	Builder	3(3.7)
	Musician	1(1.2)
	Tailor	1(1.2)
	Statistician	1(1.2)
	Miller	1(1.2)

Most of the respondents (67.9%) relied on subsistence farming for a living (Table 1). Very few: (9.9%) were professional herbalist and (7.4%) health workers who were either medical officers/medical assistants or belonged to village health teams (VHT).

3.2 Ethno Medicinal Plants Identified, Plant forms and Plant Parts

We were able to document 43 plants used in malarial treatment -some of the documented plants were also used to treat other diseases in addition to malaria (Table 2). The plants belonged to 26 families; the predominant families were Papilionaceae with 6 plants, Asteraceae with 4 plants, Maliaceae and Rubiaceae with 3

plants each (Fig. 2). The most known antimalarial plant species were: *Securidaca longipenduculata Fresen* followed by *Chamaecrista hildbrandtii (Vatke) Lock*, *Chasmanthera dependens Hochst* and *Crotolaria laburnifolia* with PRK values of 23.5%, 17.2%, 14.8% and 12.3% respectively (Table 2).

Most antimalarial remedies were derived from trees (34.9%), herbs (30.2%) and climbers (25.6%); other plants forms were also used, these included; grasses, stragglers and scramblers (Fig. 3).

Plant parts utilized in herbal therapy were primarily roots (61.5%) and leaves (23.1%); other plant parts utilized were: bark of trees (5.8%), stems (3.8), fruits (1.9%) flowers (1.9%) and whole plant (1.9%) (Fig. 4).

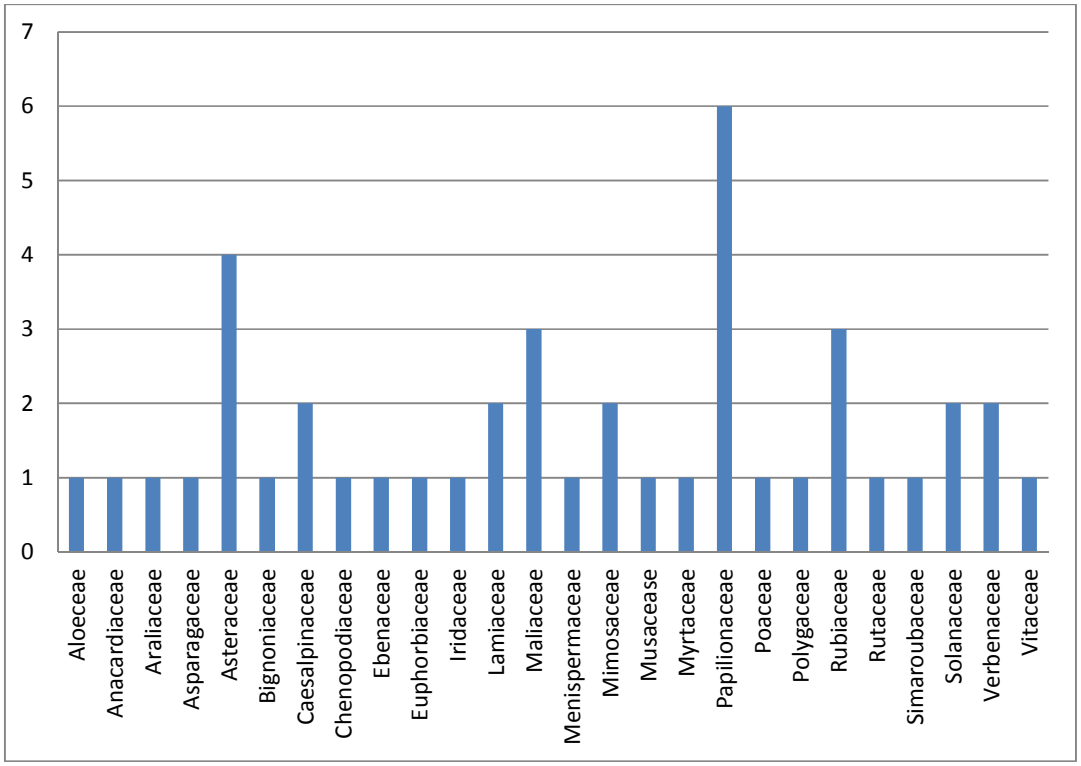

Fig. 2. Plant families utilized locally to treat malaria

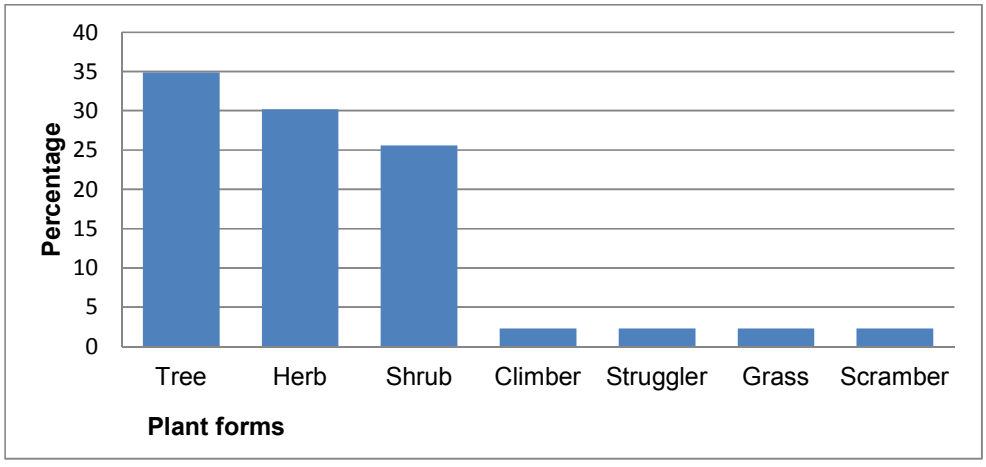

Fig. 3. Plant forms utilized locally to treat malaria

Table 2. Plant species commonly used in the treatment of malaria and other diseases

Family	Plant species	Local name (Lango name)	Life form	Plant part	Disease	Number of diseases treated	FC	PRK(%)	Method preparation	Administration
Polygalaceae	*Securidaca longipenduculata Fresen.*	Ilila	Tree	Root	Malaria Diarrhoea Cough Headache	5	19	23.5	Maceration of pounded fresh roots in water	Administered orally by drinking the extract
					Body pain				Pound roots	Apply on incisions made on the skin
Caesalpinaceae	*Chamaecristahildbrandtii (Vatke) Lock*	Ayebi	Herb	Leaves and Roots	Malaria Cough Stomachache Diarrhoea Intestinal worms Toothache	6	14	17.2	Maceration or decoction of pounded fresh leaves and roots in water	Administered orally by drinking the extract
Menispermaceae	*Chasmanthera dependens Hochst*	Akeng	Climber	Leaves and Roots	Malaria Stomachache Nausea	3	12	14.8	Maceration or decoction of pounded fresh leaves and roots in water	Administered orally by drinking the extract
Papilionaceae	*Crotolaria laburnifolia*	Alaju	Herb	Leaves	Malaria UTI	2	10	12.3	Maceration or decoction of pounded fresh leaves in water	Administered orally by drinking the extract or by chewing fresh leaves
Rubiaceae	*Canthium lactescens Hiern*	Ibele	Tree	Roots	Malaria Intestinal worms	3	9	11.1	Maceration or decoction of pounded fresh roots in water	Administered orally by drinking the extract
					Stomachache				Pound roots	Apply on incision made on the skin
Verbenaceae	*Clerodendrumumbellatm Poir*	Acer	Straggler	Leaves and roots	Malaria Intestinal worms Stomachache	3	8	9.9	Maceration of pounded fresh leaves and roots in	Administered orally by drinking the extract

Family	Plant species	Local name (Lango name)	Life form	Plant part	Disease	Number of diseases treated	FC	PRK(%)	Method preparation	Administration
									water	or by chewing fresh leaves or roots Oral
Poaceae	*Sporobolus pyramidalis Beauv.*	Alioc	Grass	Roots	Malaria Stomachache Diarrhoea	3	7	8.6	Maceration of pounded fresh roots in water	Administered orally by drinking the extract
Ebenaceae	*Euclea racemosa Murray subsp. Schimperi (A.DC.) F. White*	Imuk	Shrub	Roots	Malaria Body pain Joint swelling Diarrhoea	4	7	8.6	Pound fresh roots	Apply on incision made on the skin
Asteraceae	*Vernonia amygdalina*	Okelo kelo	Tree	Leaves	Malaria Diarrhoea Stomachache	3	6	7.4	Maceration of pounded fresh leaves in water	Administered orally by drinking the extract
Maliaceae	*Ekebergia capensis sperrm*	Akwirakwir	Tree	Roots and leaves	Malaria Snake bite Diarrhoea	3	6	7.4	Maceration of pounded fresh roots and leaves in water	Administered orally by drinking the extract
Lamiaceae	*Hoslundia opposita Vahl*	Etutu	Shrub	Root	Malaria Stomach ache	2	5	6.2	Maceration of pounded roots in water	Administered orally by drinking the extract
Mimosaceae	*Carissa edulis (Forssk.) Vahl*	Acuga	Shrub	Roots	Malaria Headache	2	3	3.7	Pound fresh roots Or Maceration of pounded fresh roots in water	Apply on incisions made on the skin Administered orally by drinking the extract
Iridaceae	*Gladiolus dalenii Van Geelsubsp.dalenii*	Obworka	Herb	Roots and leaves	Malaria Fever	2	3	3.7	Maceration of pounded fresh roots and leaves in water	Administered orally by drinking the extract
Caesalpinaceae	*Piliostigma thonnongii(schumach.) Milne-Redh*	Ogali	Tree	Back and roots	Malaria Diarrhoea	2	3	3.7	Maceration of pounded fresh back and roots in water	Administered orally by drinking the extract

Family	Plant species	Local name (Lango name)	Life form	Plant part	Disease	Number of diseases treated	FC	PRK(%)	Method preparation	Administration
Aloeceae	*Aloe sp.*	Otebakori	Herb	Leaves	Malaria Stomach ache Headache	3	2	2.5	Boil fresh plant leaves in water	Administered orally by drinking the extract
Papilionaceae	*Desmodium velutinum DC.*	Bokekware	Shrub	Roots	Malaria	1	2	2.5	Pound fresh roots Maceration of pounded fresh roots in water	Apply on incisions made on the skin Administered orally by drinking the extract
Papilionaceae	*Indigofera garckeana Vatke*	Ocukulac	Herb	Roots	Malaria UTI	2	2	2.5	Maceration of pounded fresh roots in water	Administered orally by drinking the extract
Rutaceae	*Zanthoxylumchalybeum Engl.var.chalybeum*	Agodaman	Tree	Roots	Malaria Diarrhoea	2	2	2.5	Maceration of pounded fresh roots in water	Administered orally by drinking the extract
Papilionaceae	*Rhynchosia resinosa(A.Rich)Bak*	Aremu	Scrambler	Roots	Malaria Diarrhoea	2	2	2.5	Maceration of pounded fresh roots in water	Administered orally by drinking the extract
Vitaceae	*Rhoicissus tridentata(L.f.) Wild.& Drumm*	Amurugweno	shrub	Stem,Roots	Malaria Joint pain	2	2	2.5	Maceration of pounded fresh stem and roots in water	Administered orally by drinking the extract
Myrtaceae	*Syzygium guineense(Willd.)DC.*	Kano	Tree	Roots	Malaria Fever	2	2	2.5	Pound fresh roots soft	Apply on incisions made on the skin
Papilionaceae	*Philenoptera laxiflora(Guill.&Perr.) Roberty*	Olwedo	Tree	Leave, Roots	Malaria	1	2	2.5	Maceration of pounded fresh leaves and roots in water	Administered orally by drinking the extract
Rubiaceae	*Fadogia cienowskii Schweinf*	Alwak	Shrub	Roots	Malaria Diarrhoea	2	2	2.5	Maceration of pounded fresh roots in water	Administered orally by drinking the extract
Bignoniaceae	*Kigalia africana(Lam.) Benth.*	Yago	Tree	Leaves	Malaria Skin diseases	2	1	2.5	Maceration of pounded fresh leaves in water	Administered orally by drinking the extract

Family	Plant species	Local name (Lango name)	Life form	Plant part	Disease	Number of diseases treated	FC	PRK(%)	Method preparation	Administration
Asteraceae	*Schkuhria pinnata (Lour.) O.Ktze.*	-	Herb	Whole plant	Malaria	1	1	2.5	Maceration of pounded fresh whole plant in water	Administered orally by drinking the extract
Simaroubaceae	*Harrisonia abyssinica Oliv*	Akere	Shrub	Roots	Malaria Stomachache	2	1	1.2	Maceration of pounded fresh roots in water	Administered orally by drinking the extract
Maliaceae	*Azadirachta indica Linn*	-	Tree	Leaves	Malaria	2	1	1.2	Decoction of fresh leaves in water	Administered orally by drinking the extract
					Toothache					Chewing fresh leaves
Asteraceae	*Targetes minuta L.*	Yat yamo adongo	Herb	Leaves	Malaria Skin diseases	2	1	1.2	Boiling leaves in water	Inhaling moisture from the boiling plant material while covered with a blanket Or Bathing with extract
Lamiaceae	*Hyptis suaveolens Poir*	Yat Jok/aburdi	Herb	Leaves	Malaria	1	1	1.2	Maceration of pounded fresh leaves in water	Administered orally by drinking the extract
chenopodiaceae	*Chenopodium procerum Moq.*	Abong	Herb	Roots	Malaria	1	1	1.2	Maceration of pounded fresh roots in water	Administered orally by drinking the extract
Araliaceae	*Cussonia arborea A. Rick*	Ibucibu	Tree	Roots	Malaria	1	1	1.2	Maceration of pounded fresh roots in water	Administered orally by drinking the extract
Verbenacea	*Vitex madiensis Oliv.subsp.madiensis*	Oweloto	Shrub	Roots	Malaria	1	1	1.2	Maceration of pounded fresh roots in water	Administered orally by drinking the extract

Family	Plant species	Local name (Lango name)	Life form	Plant part	Disease	Number of diseases treated	FC	PRK(%)	Method preparation	Administration
Solanaceae	*Physalis angulata L*	Kongogwalogwal	Herb	Roots	Celebral malaria	1	1	1.2	Pound roots soft Maceration of pounded fresh roots in water	Apply on incisions made on the skin Administered orally by drinking the extract
Musacease	*Ensete ventricosum(Welw.) Cheeseman*	Otodi	Tree	Roots	Malaria	1	1	1.2	Maceration of pounded fresh roots in water	Administered orally by drinking the extract
Asparagaceae	*Asparagus africanus Lam*	Ogudo	Herb	Fruit	Malaria	1	1	1.2		Eating fresh fruit
Anacardiaceae	*Ozoroa insignis Del.*	Eryarya	Tree	Bark	Malaria Cough	2	1	1.2	Maceration of pounded fresh back in water	Administered orally by drinking the extract
Papilionaceae	*Indigofera arrecta A. Rich*	Aweedyang	Herb	Roots	Malaria Severe Headache	2	1	1.2	Maceration of pounded fresh roots in water	Administered orally by drinking the extract
Euphorbiaceae	*Flueggea virosa(Willd.) Voigt*	Elaka	Shrub	Roots	Malaria	1	1	1.2	Pound fresh roots	Apply on incisions made on the skin
Mimosaceae	*Albizia coriaria Oliv*	Etek	Tree	Flowers	Malaria	1	1	1.2	Maceration of pounded fresh flowers in water	Administered orally by drinking the extract
Maliaceae	*Pseudocedrella kotschyii(Schwienf.) Harms*	Iputi	Tree	Roots	Malaria	1	1	1.2	Maceration of pounded fresh roots in water	Administered orally by drinking the extract
Asteraceae	*Chrysanthellum americanum(L.)Vatke*	Atabo	Herb	Leaves	Malaria	1	1	1.2	Pound fresh leaves	Apply on incisions made on the skin
Rubiaceae	*Psorosperm febrifugum Spach var*	Okwero	Shrub	Roots	Malaria	1	1	1.2	Pound fresh roots Maceration of pounded fresh roots	Apply on incisions made on the skin Administered orally by drinking the extract
Solanaceae	*Solanum sp.*	Ocokocok	Shrub	Roots	Malaria Stomachache	2	1	1.2	Maceration of pounded fresh roots in water	Administered orally by drinking the extract

Key: PRK= Percentage of respondents having knowledge regarding the use of a species, FC= Frequency of citation, UTI=Urinary tract infection

3.3 Methods of Preparation and Administration

Many methods were exploited in either preparing the herbal remedies or its administration, in most of the cases, fresh plant material was pounded soft and macerated in water and the extract drank or the pounded soft plant material applied on incision made on the body by a razor blade; decoction of fresh plant material and drinking the extract , hot water bath with plant material boiled in water, inhaling steam from plant material boiled in water, direct chewing of plant material and eating of fresh fruits (Table 2).

3.4 Why Herbal Remedies are Used

The following factors influenced the use of anti malarial herbal remedies in the community. Firstly the price, 32.1% of the respondents alluded to the cheap price of herbal medicines. Secondly 27.2% attributed the use of the herbal medicines to ease of accessing the plants; the plants were easy to find. Further 23.5% responded that the plants were effective, 8.6% that you do not have to pay for the plants and lastly 7.4% that these medicines cure diseases that western medicines does not (Table 3).

Table 3. Reasons for using medicinal plants to treat malaria

Reason for using medicinal plants	Frequency	Percentage
Cheap	26	32.1
Effective	19	23.5
Easy to access	22	27.2
Freely available	8	9.9
Cure diseases western medicine does not	6	7.4

3.5 Source of the Plant, Status in the Wild and Conservation Issues

Almost all the plants (98%) utilized in malarial therapy in this community were obtained from the wild; very few (1.2%) came from herbal gardens (Table 4). The plants were still abundant in the wild and easy to obtain; you do not have to move long distances to find them (Table 4).

Some measures that would help in conserving these antimalarial plants were highlighted. At the forefront were the following measures: Creating herbal gardens, suggestion by 25.9% of respondents; tree planting suggested by 24.7%; avoiding bush burning suggested by 22.2%; avoid cutting of trees 13.6%; promoting awareness of the medicinal value of plants in their community 8.6%. A few of the respondents also believed that enacting and implementing policies to protect these plants and creating seed banks would help conserve the plants (Table 5).

Table 4. Source and status of antimalarial plants in the wild

Source	Frequency	Percentage
Wild	80	98.8
Herbal gardens	1	1.2
Status in the wild		
Abundant: you move short distances to find	80	98.8
Scarce: you move long distances to fine	1	1.2

Table 5. Measures to conserve antimalarial plants

How to conserve antimalarial plants	Frequency	Percentage
Tree planting	20	24.7
Avoid cutting of trees	11	13.6
Promoting awareness of the value of medicinal plants	7	8.6
Planting Herbal gardens	21	25.9
Avoid bush burning	18	22.2
Policy to protect plants	3	3.7
Preserve seeds	1	1.2

4. DISCUSSION

Medicinal plants from family asteraceae are the most commonly used in antimalarial herbal medicine in Uganda [4,1,11,7], they are known to contain a wide range of bioactive compounds notably sesqueterpene lactones important for human health [12,13]. It is therefore not surprising that they were among the most utilized antimalarial plants in the study areas. Plants species from family Papilionaceae have also been cited to be used in medicinal preparations in Uganda [1,7], however not as highly utilized plants. Although in this study plants belonging to family Papilionaceae were the most represented, this may not indicate that they are the most distributed in the study area compared to plants of family Asteraceae because the difference in numbers of plants contributed by the two families

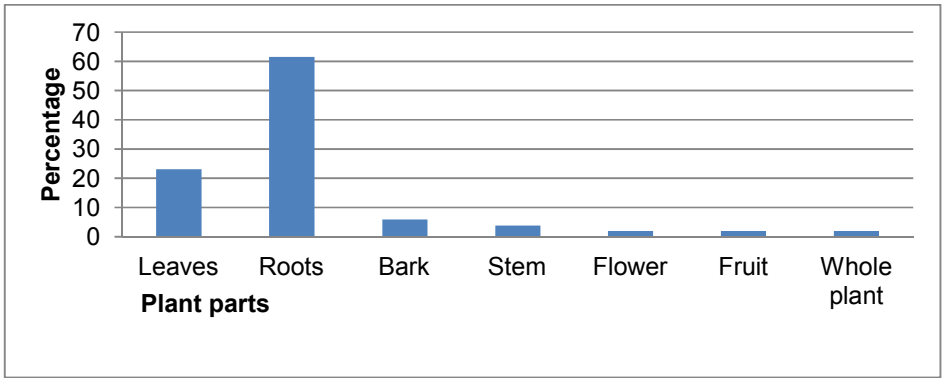

Fig. 4. Plant parts utilized locally to treat malarial

was only slight. However the prevailing geographical and climatic conditions may cause differences in plant distribution, such that some plants may be more or less represented in particular areas and therefore affecting their availability [14]. The observation of *Securidaca longipenduculata Fresen* as a highly known artimalarial plant species is corroborated by a study done in Otwal and Ngai in Oyam district Northern Uganda; the plant was used to treat malaria like symptoms of headache and body pain (Kamatenesi et al. 2011); elsewhere the anti inflammatory and analgesic properties of this plant species has been reported [15]. Also antibacterial, antifungal, antimalarial, insecticidal and pesticidal effect of its root back extract has been reported [16,17]. Some compounds identified from root back extracts from this plant include; xanthones, some benzyl benzoates and triterpene saponins which may be responsible for its bioactivity [16].

Most antimalarial medicines were harvested from trees and herbs; this was also reported elsewhere [4,13]. However for sustainable utilisation of medicinal plants, it is the plant parts harvested which is very crucial, in this present study roots were the most harvested. Harvesting roots primarily has a devastating consequence on the plant and therefore is not a sustainable way of exploiting medicinal plants for medicinal purposes [1,13]; leaves can regenerate and therefore ensure sustainable use of plants [4]. Despite reliance on roots as the major plant part, there was no apparent threat to the plants. The respondents reported them to still be abundant in the wild. This observation could probably be because in traditional medicine, exploitation of medicinal plants is usually on small scale which may not necessarily destroy the plant. It is the over exploitation for commercial benefits, fueled by demand from local and international market which may threaten medicinal plants to extinction [18]. Some of the plants which have been affected in this way in Africa include: Mondia whitei, Prunas african, Warburgia salutaris and W. ugandensis [19]. Over exploitation of Saussuria obvallata, Rauwolfia serpentine and Mecanopsis aculeate for their high export values led to their near extinction in India [18].

Uncontrolled bush burning and tree cutting appears to threaten the survival of antimalarial plants in the study area; they are known contributors to habitat destruction, a leading cause of loss of medicinal plants [20]. It is therefore in light of this that planting of herbal gardens is recommended as the most effective strategy to conserve the plants. Propagating medicinal plants in herbal gardens is an ex-situ conservation strategy which is especially important in conserving overexploited and endangered medicinal plants with slow growth, low abundance, and high susceptibility to replanting diseases [21].

It was not surprising to note that the major reason for using herbal medicines to treat malaria was because they were cheap; considering that the studied community consisted of mainly subsistence farmers who may not be able to afford modern antimalarials, hence resort to herbal medicine. Further also accessibility; according to the respondents was the second most highlighted reason for using antimalarial herbal medicines ; this is particularly important considering that rural communities have been reported to be limited in accessing healthcare services and facilities [1]. Also herbal medicines are generally perceived as effective by rural communities [1]; this same perception is also a major influence to the use of these medicines in

the study area; elsewhere herbal medicine has also been reported as very effective and promising [3].

5. CONCLUSION

The poor social-economic conditions of the studied rural community reinforce medicinal plant use in management of malaria. Antimalarial plants belonging to family Papilionaceace were the most utilized in herbal preparations; the high PRK of Securidaca longipenduculata Fresen highlights it as a potential candidate for drug discovery research. Habitat destruction as a result of uncontrolled bush burning and cutting down of trees may pause a major threat to the survival of antimalarial medicinal plants in the studied community.

CONSENT

As per international standard or university standard, the consent of respondents was collected and preserved by the authors.

ETHICAL APPROVAL

This study received ethical clearance from the Uganda National Council of Science and Technology Ref: N533. Consent of informants where sought for prior to administering the questionnaire to them.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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