AFRICA ENVIRONMENTAL REVIEW Journal
ISSN: 1727-8341

AER Journal Volume 5, Issue 2, pp. 271-286, Nov, 2022

RESEARCH ARTICLE
Available Online at *http://ojs.uoeld.ac.ke/index.php/aerj*

Ethnobotanical Study of Medicinal Plants Used to Treat Malarial Infections by the Marakwet Community in Kenya

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Abstract

Malaria continues to have a devastating impact on public health in Kenya. Resistance to conventional antimalarial drugs is a threat to the treatment of malaria. Globally, medicinal plants have been used to treat malaria for a long time. The objective of this study was to carry out an ethno- botanical survey to identify medicinal plants used to treat malaria in Marakwet East Sub County. The ethno botanical survey was conducted in Marakwet East Sub County from October, 2020 to August, 2021 through oral interviews using structured questionnaires. The plant materials reported by the traditional practitioners were collected, and further authenticated in the laboratory at the department of Biological Sciences University of Eldoret, where voucher specimens were deposited at the departmental herbarium. The results showed that thirty one medicinal plants belonging to twenty four botanical families are used to treat malaria in Marakwet East Sub County. Capparaceae and Rutaceae were the most preferred families while Ximenia americana, Boscia coriacea, were the most frequently used plant species to treat malaria in Marakwet East Sub County. The results of the current study showed that traditional knowledge still plays an important role in the management of malaria in Marakwet East Sub County. The most frequently used plants should be further investigated for efficacy and safety.

Keywords: Medicinal Plants, Malaria, Ethnobotany, Traditional Health Practitioners, Antimalarial Activity

INTRODUCTION

Malaria is a potentially fatal disease caused by Protozoan parasites of the genus *Plasmodium* and is spread by the female *anopheles* mosquitoes (Kwenyamba et al., 2019). There are four species of *Plasmodium* that affect humans. These are *Plasmodium falciparum Plasmodium vivax Plasmodium ovale and Plasmodium malariae*. Of these parasites *P. falciparum* and *P. vivax* are the deadliest malarial parasites in sub-Saharan Africa (Omara, 2020). While *Anopheles gambiae* and *A. funestus* are the main vectors of malaria in East Africa (Murphy et al., 2020). Malaria continues to have a devastating impact on public health worldwide. The WHO estimates that globally 229 million clinical cases of malaria were registered in 2019, leading to 409,000 deaths (WHO, 2020). World Health Organization reported that over 2 billion people are exposed to malaria, with the situation is worsening in African due to poor health services and poverty (WHO, 2017). Estimates indicate that malaria causes up to 2 million deaths annually in Africa (WHO, 2000). In 2016, 41.5 million malaria cases were reported in the East African region (WHO, 2017).

Kenyan population at risk of malaria as at 2016 was estimated at 100% (WHO, 2017).

About 34,000 Kenyan children die every year from malaria in Kenya (DMS, Kenya 2006). Manifestations of Malaria include headaches, weakness, fever, aches and pains, high body temperature, loss of appetite, nausea and vomiting (Nguta et al., 2011). Additionally, Malaria can result in serious complications such as kidney failure, pulmonary oedema, brain tissue injury and severe anemia (Pan et al., 2018).

The fight against malaria is facing enormous setbacks due emergence of *P. falciparum* strains that are resistant to all anti-malarial drugs. Under those circumstances Chloroquine, for instance which was the main stay of malaria Chemotherapy for a long time has been discontinued as the first line treatment for malaria in Kenya and other countries due to the reports of resistant *P. falciparum* strains (Dianne et al., 2003; Kuria et al., 2001).

In that case also the quinolines which include quinine and mefloquine are no longer in the first line of treatment since they have been have reported to cause cardiotoxicity (White, 2007) and also due to the fact that *Plasmodium* parasites have developed resistance to them (Price et al., 2004). Additionally, sulfadoxine-pyrimethamine (SP) has also been discontinued due to increasing resistance of *Plasmodium* parasites to this drug (Deresa & Ali, 2009; Abdissa et al., 2017).

Artemisinin-based combination therapy (ACT) is currently the first line of treatment for malaria in Kenya (Omara, 2020) Incidentally, there are reports of resistance of *P. falciparum* to artemisinin (Rahmatullah et al., 2012). This trend is a worrying. Consequently, there is an urgent need for new antimalarial compounds. One of the possible sources of new antimalarial drugs is traditional medicinal plants (Bagavan et al., 2011). Traditional medicines have been used to treat malaria for thousands of years and are the source of the two main groups (artemisinin and quinine derivatives) of modern anti-malarial drugs (Wilcox & Bodeker, 2004).

Kenya being an agricultural country is endowed with a lot of medicinal plants (Okumu et al., 2017; Kigen et al., 2013). It is usual for local populations to use available medicinal plants in a particular region to treat diseases which are common in that community (Malik et al., 2020). This practice has been there for centuries (Debella, 2014).

Although modern medicine exists, medicinal plants are still widely used in Kenya, especially by the rural communities, just like in other parts of sub-Saharan-Africa (Zirihi et al., 2005). Despite the wide use of medicinal plants in the traditional health care, the information has not been documented in a scientific way and there is an increased risk of losing this traditional knowledge (Rukangira, 2001)

As a consequence of this, this study was conducted to gather and document information on medicinal plants that are used in the traditional treatment of malaria and related symptoms in Marakwet East Sub County, which is useful in rational prioritization of the plant species for further investigations, and integration into modern medicine.

MATERIALS AND METHODS

Study Area

The ethno botanical survey was conducted in Sambirir and Endo wards of Marakwet East Sub County, Elgeyo-Marakwet County. Elgeyo-Marakwet County is one of the 47 counties in Kenya. It consists of four sub counties namely Marakwet East, Marakwet West, Keiyo North, and Keiyo South sub counties. It extends from longitude 35° 0′ to 35° 45′ E and latitude 0° 20′ to 1° 30′ N. It borders West Pokot County to the North, Baringo County to the East, Trans Nzoia County to the Northwest and Uasin Gishu County to the West. The County covers an area of 3029.9 km^2 with a population of 369,998. (http://www.ncapdke.org).

Marakwet East Sub-County consists of four wards, these include Sambirir, Endo, Embobut and Kapyego wards. It covers a total area 784.3 km^2 with a population of

78,749 people (http://en.wikipedia.org).The Sub County has two topographical regions, the highland region which also referred to by the residents as "Mosop" and has an altitude of 2700 m above sea level. Then there is the lowland region located on the floor of kerio valley which is also known as "kew" or "Endo". This region has an altitude of 900 m to 1000 m above sea level. In between the two regions is the conspicuous escarpment, a continuous line of steep slopes composed of cliffs separating the lowland and highland regions with distinct vegetation type (Kipkore et al., 2014).

The difference in altitude from the lowland region to the highland region leads to significant differences in climatic conditions. For instance, temperatures in the Highland region have a minimum of 15°C during rainy season and a maximum of 23°C during the dry season whereas on the Escarpment and the lowland region, temperatures can be as high as 30°C and as low as 17°C (http://en.wikipedia.org)

Furthermore, there is considerable variation in the amount of rainfall across the three topographical zones. The Highland region receives between 1200 mm and 1500 mm per annum while the Escarpment gets rainfall ranging between 1000 mm to 1400 mm per annum. The Lowland region, on the other hand, receives between 850 mm and 1000 mm of rainfall per annum. Long rains usually fall between the months of March and July every year while the short rains fall between August and November every year (Kigen et al., 2014).

Just like many other parts of rural Kenya, herbal medicines are still widely used, in marakwet east sub-county (Kipkore et al., 2014). This is attributed to the fact that health services are not quite accessible in some parts especially the lower region and escarpment due to the difficult terrain. The residents in these areas do still therefore to a large extent rely on herbal medicine (http://www.ncapdke.org). The most prevalent diseases in the district are malaria, upper respiratory tract infections, diarrhea, diseases of the skin including ulcers, and urinary tract infections (Kigen et al., 2014). Disease prevalence also differs according to the topographical regions. Malaria tends to be more prevalent on the lowland region and escarpment, whereas upper respiratory tract infections, including pneumonia tend to be more prevalent on the highland region (http://www.ncapdke.org; Kigen et al., 2014)

Data Collection

The ethno botanical survey was conducted from October, 2020 to August, 2021. In total, 28 traditional health practitioners consisting of 18 men and 10 women were interviewed during this period. All interviews were conducted in the local language. Research assistants acted as the translators during the conversations between the herbalist and the research team, except for a few cases where the respondents could understand Kiswahili. After explaining the objectives of the research and seeking their consent, the herbalists were engaged. The purpose and the benefits of the study were also briefly explained to them. Structured interviews and discussions were held with the herbalist on medicinal plants by use of interview schedules for each respondent. Using semi-structured questionnaire, the ethno botanical data were collected on knowledge of malaria and medicinal plants used for the treatment of malaria and related symptoms, parts used, mode of administration, growth habit, dosing methods, and season of collection.

Plant Collection and Taxonomy

At the end of the interview, the reported medicinal plants were collected from natural vegetation in the study area with the help of the traditional healers. The collected plant specimens were dried, identified and deposited department of Biological Sciences herbarium, University of Eldoret.

Data Analysis

The collected data were entered into SPSS version 16, analyzed and summarized using descriptive statistics. Different indices were also used to summarize the results of the questionnaire. The frequency index (FI) corresponds to the percentage of informants

that mentions the use of the plant species for the treatment/management of malaria (Mahwasane *et al*., 2013) and is given by

$$FI = \frac{FC \times 100}{N}$$

Where FC is the number of informants who mentioned the use of thespecies for the treatment of malaria, and N the total number of informants.

Ethical Considerations

A preliminary pilot survey was taken with Traditional health practitioners to notify them of our study and the date of our visit. The purpose of the study was explained in detail to the participants and all associated questions were answered before starting the interview.

RESULTS

Socio-Demographic Characteristics of the Respondents

A total of 28 traditional health practitioners (18 male and 10 female) from Sambirir and Endo Wards of Marakwet East Sub County participated in the ethno botanical survey. The study revealed that men are more involved in traditional medical practice than women (Table 1). The study also showed that most of the traditional medical practitioners (83%) were over 45 years old (Table 1).

Table 1: General information on the surveyed traditional therapists in Marakwet East Sub County

		Gender		Age range (Year)
Wards	**N**	**Male**	**Female**	
Sambirir	16	10	6	38-72
Endo	12	8	4	52-68
Total	28	18	10	38-72

Key: N- Sample size

Medicinal Plants, Parts Used and Growth Habit

A total of 31 medicinal plant species belonging to 24 families were reported by the traditional healers as being used for the treatment of malaria and related symptoms in Sambirir and Endo wards of Marakwet East Sub-county (Table 3). Most of the medicinal plants used were shrubs (41.9%), followed by trees (35.5%) and climbers (22.6%) (Table 2). Similar trend has been reported in other studies (Omara, 2020). The frequency index result showed that *Ximenia americana* and *Boscia coriacea,* showed the highest incidence of use (Table 3), claimed by 11 (39.3%) and 9 (32.14%) traditional healers respectively. *Maerua crassifolia* and *Tinospora cordifolia* followed with a high incidence of use as each was reported by 7 (25%) of respondents. *Tetradenia riparia* and *Uvaria scheffleri* also showed a high incidence of use as each was reported by 6 (21.4%) of the respondents. *Adenia gumnifera* and *Terminalia browni* andwere also each mentioned by 5 (17.9%) of the respondens while *Capparis cartilaginea, Maerua decumbens, Zanthoxylum chalybeum, Gardenia ternifolia* and were mentioned by 4 (14.3%) of the respondents. Others mentioned by the respondents include *Salvadora persica, Harrisonia abyssinica,* and *Acacia Senegal* which were each mentioned by 3(10.7%) respondents.

The plant parts most frequently used were Leaves (58.1%), followed by stem bark (38.7%), roots (32.3%), and whole plant (12.9%) Fruits (9.7%) and seeds (3.2%), (Table 4). The frequent use of the leaves is justified by the abundance of antimalarial chemical groups they contain (Mangambu *et al*., 2014). The prevalence of leaves in treatment of malaria has also been reported elsewhere (Omara, 2020; Diarra et al., 2015). Plant parts such as fruits, seeds, and flowers though known to contain phytochemicals are rarely used, similar to reports from other countries have been obtained from literature Okello **&** Kang, 2014; Ngarivhume et al., 2015). Herbal preparations used for the treatment of malaria and related symptoms in

this study area were mostly administered by oral route. This is consistent with studies in other countries (Alebie et al., 2017).

Table 2: Plant Habit

Plant Habit	Plant species	%
Shrubs	13	41.9
Trees	11	35.5
Climbers	7	22.6

Table 3: Medicinal Plants Used to Treat Malaria in Marakwet East Sub County

NO	Family	Scientific name/ Local name/ Voucher No.	Habit	Part used	Method of preparation	No. of informants	Frequency index (FI) %
1	*Annonaceae*	*Uvaria scheffleri Diels* (Murkuiywo) muh/UVS/03/86	Shrub	Leaves	Decoction	6	21.4
2	*Balanitaceae*	*Balanites pedicellaris Mildbr. & Schltr.* (Lomion) muh/Balo/23/85	Shrub	Leaves / Stem bark Roots	Decoction	2	7.1
3	*Caesalpiniaceae*	*Tamarindus indica L.* (Tamarind) muh/tami/038/87	Tree	Leaves Fruit	Decoction Chewing	1	3.6
4	*Canellaceae*	*Warbugia ugandensis* (Sokwon) muh/Waru/37/85	Shrub	Leaves / Stem Bark	Maceratiom Chewed	1	3.6
5	*Capparaceae*	*Maerua crassifolia Forssk* (Mesken) muh/macr/085/89	Tree	Leaves / Roots Stem bark	Decoction	7	25.0
6	*Capparaceae*	*Capparis cartilaginea* Decne (Chemakinget) muh/Cap/04/92	Shrub	Whole plant	Decoction Leaves chewed	4	14.3
7	*Capparaceae*	*Maerua decumbens (Brongn.) DeWolf* (Chepiliswo) uoeh/Meb/33/03	Shrub	Roots	Decoction Chewed	4	14.3
8	*Capparidaceae*	*Boscia coriacea Pax* (Sorukwo) muh/boco/011/85	Shrub	Roots	Decoction	9	32.1
9	*Combretaceae*	*Terminalia browni Fresen* (Koloswo) muh/Terb/035/83	Tree	Leaves Stem Bark	Decoction Maceration	5	17.9
10	*Cucurbitaceae*	*Momerdica foetida Schumach* (Cheserya) muh/Mof/11/85	Climber	Leaves Roots	Decoction chewed	1	3.6

11	*Cucurbitaceae*	*Cucumis prophetanum Linn.* (Kishangwa) muh/Cupr/039/94/21	Climber	Leaves	Decoction	1	3.6
12	*Ebenaceae*	*Euclea divinorum Hiern* (Uswo) muh/Eud/13/88	Shrub	Leaves	Maceration	1	3.6
13	*Euphorbiaceae*	*Croton dichogamus Pax. Croton* (Kerelwo) muh/crodi/3/98	Shrub	Leaves / Roots	Maceration	2	7.1
14	*Lamiaceae*	*Tetradenia riparia (Hochst) Codd* (Lonwo) muh/Ttr/37/86	Shrub	Stem bark/ leaves	Decoction chewed	6	21.4
15.	*Leguminosae*	*Acacia senegal (L.) Willd.* (Bililwo) muh/acs/36/99	Tree	Stem Bark	Chewed	3	10.7
16.	*Meliaceae*	*Azadirachta indica A. Juss* (Muarubaini) Muh/Azin/027/85	Tree	Leaves	Decoction	2	7.1
17	*Menispermaceae*	*Tinospora cordifolia (Willd.) Miers* (Sandaryaa chepo kakimugon) uoeh/Ticor/11/04	Climber	Whole plant	Decoction	7	25.0
18.	*Menispermaceae*	*Chasmanthera dependens* (Chepnyalilbei) muh/chad/98	Climber	Leaves	Maceration	2	7.1
19	*Myrtaceae*	*Szigium cordatum* Hochst. ex sond (Lamaiywet) muh/szco/028/86	Tree	Stem bark	Decoction	1	3.6
20	*Olacaceae*	*Ximenia americana L* (Kinyotwo) muh/Xia/09/89	Shrub	Stem bark	Decoction	11	39.3
21	*Passifloraceae*	*Adenia gumnifera Harv* (Chepnyali ldet) muh/Adgumm/35/85	Climber	Whole plant	Decoction Chewed	5	17.9
22.	*Phytolaccaceae*	*Phytolacca dodecandra L' Hér.* (Petkawa) muh/phtdo/031/88	Climber	Leaves	Decoction	1	3.6
23.	*Rubiaceae*	*Gardenia ternifolia Schumach. & Thonn.* (Mokilion) muh/Gart/28/02	Tree	Fruit/ Stem bark	Decoction	3	10.7
24.	*Rutacea*	*Zanthoxylum chalybeum* (Songororwo) muh/Zach/27/86	Tree	Fruits Roots Stem bark Seeds	Chewed Decoction	4	14.3
25.	*Rutaceae*	*Harrisonia abyssinica Oliv.* (Chepkara) muh/Hara/86	Tree	Root Leaves	Decoction	3	10.7
26.	*Rutaceae*	*Zanthoxylum gillettii* (De. wild)	Tree	Stem bark	Decoction	1	3.6

		Westerman (Sakawatiet) muh/zag/01/85					
27.	*Salvadoracea*	*Salvadora persica L* (Chechan) muh/salp/19/95	Tree	Roots, Stem bark	Decoction	3	10.7
28.	*Sapindaceae*	*Doonea angustifolia* (Tebelekwo) uoeh/Doan/021/07/21	Shrub	Leaves	Decoction	2	7.1
29.	*Verbenaceae*	*Lantana camara* (Lantana) muh/lanca/007/85	Shrub	Leaves	Maceration	1	3.6
30.	*Verbenaceae*	*Lippia javanica (Burm. f.) Spreng* (Chebobet) muh/lija/02/05	Shrub	Leaves	Decoction	1	3.6
31.	*Vitaceae*	*Cissus quadrangularis L.* (Kirorot) muh/Ciq/04/90	Climber	Whole plant	Decoction	1	3.6

Table 4: Plant Parts Used

Plant parts	No. of plants	%
Leaves	18	58.1%
Stem bark	12	38.7%
Roots	10	32.3%
Whole Plant	4	12.9%
Fruits	3	9.7%
Seeds	1	3.2%

Methods of Preparation and Routes of Administration of Recipes

The main method of preparation used by traditional therapists are mainly decoction (Table 3). This is due to the fact that a decoction collects the most active ingredients and attenuates or cancels the toxic effect of certain recipes (Keita et al., 2020). Most of the preparations are administered orally as a drink. Our results correlate to those of other studies elsewhere (Diarra et al., 2015; Diallo et al., 2007) which found that antimalarial plants are mainly prepared by decoction and administered orally.

Diversity of Medicinal Plant Taxa

From the data collected, 31 species of plants belonging to 24 botanical families were identified (Table 5). Most of them are the *Capparaceae* and *Rutaceae* (3 species each or 9.7%). Others are the *Menispermaceae*, *Cucurbitaceae and Verbenaceae* (2 species each or 6.5%). The other seventeen families were represented by one species each (3.2%). These results show some similarities with other studies (Keita et al., 2020; Diarra et al., 2015).

Table 5: Diversity of medicinal plant use

No.	Family	plant species	%
1.	*Capparaceae*	3	9.7
2.	*Rutaceae*	3	9.7
3.	*Menispermaceae*	2	6.5
5.	*Cucurbitaceae*	2	6.5
6	*Verbenaceae*	2	6.5
7.	*Euphorbiaceae*	1	3.2
7.	*Combretaceae*	1	3.2
8.	*Annonaceae*	1	3.2
9.	*Lamiaceae*	1	3.2
10.	*Capparidaceae*	1	3.2
11.	*Passifloraceae*	1	3.2
12.	*Olacaceae*	1	3.2
13.	*Salvadoracea*	1	3.2
14.	*Leguminosae*	1	3.2
15.	*Balanitaceae*	1	3.2
16.	*Vitaceae*	1	3.2
17.	*Canellaceae*	1	3.2
18.	*Ebenaceae*	1	3.2
19.	*Rubiaceae*	1	3.2
20.	*Myrtaceae*	1	3.2
21.	*Sapindaceae*	1	3.2
22	*Phytolaccaceae*	1	3.2
23.	*Caesalpiniaceae*	1	3.2
24.	*Meliaceae*	1	3.2

DISCUSSION

Malaria is a devastating disease in Sub-Saharan Africa (Murray et al., 2012). The current malaria control measures targeting the mosquito vector with insecticides have helped to alleviate the malaria burden in many endemic areas (Greenwood et al., 2008). However, due to the overwhelming nature of the disease, wide ranges of differences in the coverage of health services and distribution of health facilities that persists among regions as well as between urban and rural areas (Njoroge & Bussman, 2006).

Moreover, owing to the failure of most affordable drugs to treat malaria because of resistance by the parasite (Omara, 2020), means that there is still an urgent need to search for new and more effective antimalarial drugs. The fact that traditional medicines are the main source of the two main groups (artemisinin and quinine) derivatives of modern anti-malarial drugs (Willcox & Bodeker, 2004), indicates potential in traditional medicinal plants.

In Kenya, different communities possess adequate knowledge on the use of antimalarial plants that has been transferred from one generation to another. This is mainly done through word of mouth with no proper documentation (Asnake, 2016). The knowledge possessed by traditional healers is also becoming less transmitted and may disappear (Desissa & Binggeli, 2000). Furthermore, there is a danger of losing the knowledge due to the rapid degradation of natural habitats and ecosystems and thus there is a need for its documentation (Asnake, 2016).

In this study, the traditional healers reported that they conventionally define malaria and related illnesses in terms of fever, chills, and/or headache. The socio-demographic characteristics of the respondents revealed men are more involved in traditional medical practice than women, which could be due to

the fact that parents usually prefer boys in the transfer of the indigenous knowledge. Additionally since indigenous medicinal knowledge is retained within families/clans, the boys are preferred because the girls would normally be married off to other families/clans. Similar results were observed from other studies in Ethiopia Giday et al., 2009; Suleiman & Alemu, 2012).

Most of the traditional medical practitioners were ≥ 45 years old. This indicates that most young people are not willing or unable to take up the role of traditional medicine or are not trusted by the elders to take the role as traditional healers. Most young people also are engaged in school and colleges. Furthermore, the ever-increasing influence of modernization might have led to loss of interest among the younger generation to learn and practice traditional medicine (Giday et al., 2009). Indigenous knowledge is not included in formal school curriculum. Therefore there is risk of losing information on medicinal plants. Consequently, there is an urgent need for the documentation of this knowledge and inclusion in school curriculum.

In this study a wide variety of medicinal plant species (n = 31) belonging to 24 families were reported by the traditional healers as being used for the treatment of malaria and related symptoms in Sambirir and Endo wards of Marakwet East Sub County. The majority of the medicinal plants used were shrubs and trees, which is in fact in agreement with previous studies conducted in Kenya (Omara, 2020; Muthaura et al., 2007), Ethiopia (Sulema et al., 2009), and Namibia (Cheikhyoussef et al., 2011). Where most of the anti-malarial herbal remedies were obtained from shrubs and trees. The current study has also revealed that leaves were mostly used for the treatment of malaria and related symptoms. This encourages safe utilization of the medicinal plants to avoid extinction of the plants species. Roots part of medicinal plants are also rich in bioactive compounds (Alebie et al., 2017), nonetheless their use in antimalarial therapy is a threat to the survival of these plant species. For example, *Zanthoxylumchalybeum* has been reported to face a threat due to improper harvesting methods (Burness Communications, 2011).

Oral based herbal medicines were commonly prepared using water as excipients. This is in line with studies conducted elsewhere where water, honey and milk were the predominant vehicle in the preparation of traditional herbal remedies (Seifu et al., 2006; Guji et al., 2011).

The study results revealed that *Ximenia americana* and *Boscia coriacea* showed the highest incidence of use, claimed by traditional healers. A number of studies have revealed that these species are commonly used by traditional healers and communities in the treatment of malaria and related symptoms in Kenya (Gathirwa et al., 2007; Teklehaymanot & Giday, 2010). Furthermore, *Ximenia americana* and *Boscia coriacea* were used to manage malaria and related symptoms in different parts of African countries (Diallo et al., 2002; Gronhaug et al., 2008; Orwa et al., 2008). The fact that the same plants are used by different communities for a similar indication could possibly show their effectiveness and need to be subjected to further scientific investigations. The aforementioned species have a great role in the traditional treatment of different illnesses in addition to malaria and related symptoms in some parts of Africa for instance, *Ximenia americana* is used to treat schistosomiasis, diarrhea and venereal diseases (Kokwaro, 2009), while *Boscia coriacea* is used to manage diarrhoea, and stomachache (Kaigongi & Musila, 2015).

Some plants were also significantly mentioned by traditional healers as remedies for malaria. They Include *Maerua crassifolia*, *Tinospora cordifolia, Tetradenia riparia, Uvaria scheffleri, Adenia gumnifera, Terminalia browni, Capparis cartilaginea, Maerua decumbens, Zanthoxylum chalybeum, Gardenia ternifolia,* and *Acacia Senegal.*

Maerua crassifolia leaf has long been used for the treatment of gastric ulcer, toothache and intestinal diseases (Rahman et al., 2004). Methanol extract from leaves of *Maerua crassifolia* has been found to possess good *in vivo* antimalarial activity (Akuodor et al., 2004). *Tinospora cordifolia* and *Acacia senegal* have been found to possess good *in vivo* antimalarial activity (Singh & Banyal, 2011; Ballal et al., 2011).

On the other hand leaves of *Tetradenia riparia* has been reported to be used in treatment of malaria, fever and mumps (Kokwaro, 2009). Scientific investigation on *T. riparia* have shown that the leaves contain analgesic and antimicrobial activities (Gazim et al., 2014), antimalarial activity (Campell et al., 1997) and antileishmanial activity (Cardoso *et al*., 2015). *Uvaria scheffleri* is used to treat malaria in some parts of Kenya (Nguta et al., 2011). Investigation on Methanol extracts of leaves of *Uvaria scheffleri* have shown good antimalarial activity with IC_{50} of 6.8 µg/ml (Muthaura et al., 2015), indicating its antimalarial potential as reported by traditional health practitioners. *Adenia gummifera* is popular for treating leprosy and malaria (Watt & Breyer-Brand Wijk, 1981). Although it is toxic (Spencer & Seigler, 1982), it has been reported to have good antiplasmodial activity on *Plasmodium falciparum* (Kraft et al., 2003).

Incidentally, *Terminalia brownii*is used in the Kenyan folklore medicine for the treatment of malaria (Muthaura et al., 2007; Kisangau et al., 2017). While crude extracts of the stem bark of *Terminalia browni* have exhibited good *in vivo* antimalarial activity (Hana et al., 2020).

Equally, *Capparis cartilaginea* has many traditional uses. For example in Arab region, it is use for easing bruises, earache, headache, paralysis, knee problems and snakebites (Hamed et al., 2007). Scientific investigation on *C. cartilaginea* has demonstrated that it has both antioxidant activity and antibacterial activities (Moharan et al., 2018). This demonstrates its potential as antimalarial as claimed by traditional health practitioners.

Literature search revealed that the roots of *Maerua decumbens* have long been used by the Tugen and Pokot communities in Kenya to treat stomachache and venereal diseases while its leaves are used to treat allergy (Quattrocchi, 2016)

Notably, *Zanthoxylum chalybeum* is used to manage malaria in Kenya (kato *et al*., 1996; Kiraithe et al., 2016; Njoroge & Bussman 2006). Apart from malaria *Zanthoxylum chalybeum* is also used to treat sexually transmitted diseases, flu, and throat infections elsewhere (Kokwaro, 1993; Kiringe, 2006). Methanol Extracts from its stem bark have been reported to have good antiplasmodial activity (Ogwang, 2008). Indicative of its potential antimalarial activity as reportedly used in traditional medicine (Kiraithe et al., 2016).

Salvadora persica is used traditionally to treat malaria among the Maasai (Tsigemelak et al., 2016). *Salvadora persica* has been found to possess antimicrobial activity (Khalil et al., 2019). Similarly, *Harrisonia abyssinica Oliv* was also mentioned by the traditional health practitioners. It has been established from literature to exhibit good antimalarial activity (Irungu et al., 2007; Nanyinyi *et al*., 2010).

Gardenia ternifolia is used in Africa to manage respiratory infections, headache, hypertension, diabetes, gastrointestinal disorders, erectile dysfunction, malaria, convulsions, and epilepsy (Maroyi, 2020). Coincidentally stem bark and roots of *G. ternifolia* are reportedly used in Ethiopian folklore medicine to treat malaria. Scientific investigation on stem barks, root barks and leaves of *Gardenia ternifolia* has revealed that it possess good antimalarial activity (Bwogo, 2020; Nureye et al., 2021).

It is encouraging to note that gum Arabic, which is an extract from *Acacia Senegal* has been found to possess *in vivo* antimalarial activity (Ballal, 2011).

The root bark, stem bark and leaf decoction of *Azadirachta indica* is used for malaria in many parts of Africa including Kenya (Nguta et al., 2010). It has been reported to have a good in vitro antiplasmodial (Kirira et al., 2006; Nanyinyi et al., 2010).

Momordica foetida has been reported for treatment of malaria in Kenya (Jeruto et al., 2011) and Uganda (Okello & Kang, 2019). However, *M. foetida* has been reported exhibit cytoxicity (Obbo et al., 2019)

Dodonea angustifolia is traditionally used as a medicine to treat infections, and digestive system disorders (Cook, 1995). This plant has been reported to show good antimalarial activity in mice (Berhan et al., 2012). This portrays that *D. angustifolia* has potential as a future antimalarial and needs further studies.

Euclea divinorum Hiern is used by some Kenyan communities as a cure for malaria (Jeruto et al., 2011; Orwa et al., 2008). It has had been established to have antimicrobial activity (Mbabazi et al., 2020). *Warbugia ugandensis* on the other hand is widely used as an antimalarial by different communities in Kenya (Njoroge & Bussman, 2006)

Indeed, *Warbugia ugandensis* has been found to have good antiplasmodial activity (M uthaura et al., 2007; Irungu et al., 2007). Roots of *Balanites pedicellaris* is used to treat fever and diarrhoea (Quattrocchi, 2016).

The essential oils from aerial parts of *Croton dichogamus* have demonstrated antimalarial activity (Kweyamba et al., 2019). *Cissus quadrangularis* L. is traditionally used to treat Syphilis, dandruff, back pain (Issa et al., 2008). *Cucumis prophetarum* is used to treat malaria like symptoms among the keiyo community (Kigen et al., 2014). *Phytolacca dodecandra* has been established to have good *in vivo* activity (Getinet, 2014)

Chasmanthera dependens is used in the treatment of malaria in Southern Nigeria (Iyamah & Idu, 2015). Methanol extract from roots of *Lippia javanica* have been reported to have good antiplasmodial activity (Oketch-Rabah et al., 1999)

Tamarindus indica is used to treat malaria in Kenya (Orwa et al., 2008). Scientific investigation on water extract of stem bark from *Tamarindus indica* has shown a good antimalarial activity (Nguta & Mbaria, 2013).

Lantana camara has been found to have good antimalarial activity (Ranpariya et al., 2016). *Zanthoxylum gillettii* is used by the Luhya community as antimalarial (Nyunja et al., 2009) and to treat gonorrhea and stomach ache (Gaya et al., 2013). Moreover *Z. gillettii* has been reported to exhibit *in vitro* antiplasmodial activity (Muganga et al., 2014). *Szigium cordatum* has also been found to have good antimalarial activity (Clarkson et al., 2004).

Medicinal plants used by Traditional health practitioners to treat malaria contain potentially active compounds. However their effective use is hindered by little data on their safety and efficacy. There is also lack of consensus, among traditional healers, on which plants, preparations, and dosages are the most effective.

CONCLUSION AND RECOMMENDATION

The study documented the indigenous knowledge of medicinal plants commonly used for treatment of malaria in Sambirir and Endo wards of Marakwet East Sub County, Kenya. In this Study, 31 medicinal plant species are reported to be used in the traditional treatment of Malaria by Kenyan Marakwet people. The data gathered in this survey therefore, may provide leads in the discovery and development of new anti-malarial drugs. Hence, there is need to develop potentially effective drugs while noting dangerous drugs and practices that should be discarded.

FINANCIAL SUPPORT AND SPONSORSHIP

This study did not receive any specific grant from funding agencies in the public, commercial, or not for profit sectors.

ACKNOWLEDGMENTS

The authors are grateful to the Department of Biological Science, University of Eldoret. Sincere gratitude goes to Dr. Wanjohi, Department of Wildlife, University of Eldoret, for botanical Identification and the people of Marakwet East Sub-County for sharing their tremendous ethno botanical knowledge.

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