Use of Putative Antimalarial Herbal Medicines among Communities in Trans-Mara, Kuria and Suba Districts of Kenya

Grace K Nyambati1, Rosebella O Maranga2, Hastings Ozwara3 and Paul K Mbugua4*

1Department of Biomedical Sciences and Technology, Technical University of Kenya, Kenya
2Department of Zoology, Jomo Kenyatta University of Agriculture and Technology, Kenya
3Department of Tropical Diseases, Institute of Primate Research, Kenya
4Department of Plant Sciences, Kenyatta University, Kenya

*Corresponding author: Paul Kamau Mbugua, Professor of Plant Taxonomy and Biosystematics, Kenyatta University, School of Pure and Applied Sciences, Department of Plant Sciences, P.O. Box 43844 00100 GPO Nairobi, Kenya, Tel: 254722924002; Email: paulkmbugua@gmail.com

Submitted: 23 March 2018
Accepted: 18 April 2018
Published: 21 April 2018

Keywords: Ethnobotanical; Herbs; Antimalarial; Communities; Herbalists

Abstract
Malaria is a major health problem in the tropics and subtropics with profound medical, social and economic consequences. Herbal medicines are traditionally used for the management and treatment of the disease by various communities in Kenya. Sources and community knowledge of the herbs are not adequately documented. The aim of the study was to collect and document ethnobotanical information regarding anti-malarial herbs among local communities in Trans-Mara, Kuria and Suba districts of Kenya. Cluster sampling technique was used to sample putative anti-malarial herbal plants in the districts, and their taxonomy identified using taxonomic keys. Plant parts subsequently and separately harvested from fields and scientifically identified in the herbarium. Semi-structured questionnaires and interviews were then administered to selected herbalists and local communities (n = 150/district) regarding preparation and potential application of the herbs in the treatment of malaria in respective study regions. And data on gender, age and marital status of the respondents were obtained. Eighteen (18) anti-malarial herbal plant species were collected and identified. More females (74%) than males (65%) potentially use the herbs for antimalarial applications. Marital status significantly influenced the potential anti-malarial use of the herbs, with more married than unmarried respondents using the herbs. Similarly, age significantly influenced the potential anti-malarial herbal plants mostly applied with mature and experienced members of the community, which might be related to their societal responsibilities and/or previous experiences. Use of herbs to treat/manage malaria in the three districts were correlating. In vivo and in vitro validation of the anti-malarial potential in the herbs will shed light on the medical implications of the herbs on the community which in turn will inform alternative local interventions against malaria.

Introduction
Malaria is the most important parasitic infection in humans. Globally, 3.2 billion people in 97 countries and territories are at risk of being infected with malaria and developing disease. In 2014, 198 million cases of malaria occurred, causing 584,000 deaths, especially in sub-Saharan African countries, where children under 5 years were the most affected population group [1]. In Sub-Saharan Africa (SSA) over 50% of all outpatient visits and 30% - 50% of all hospital admissions are attributed to malaria [2,3]. In Kenya, 22 million people are at risk of malaria, 70% of them are in rural areas and about 34,000 Kenyan children die every year from malaria compared to a total estimate of 42,000 people died [4-6]. Due to either limited availability or affordability of pharmaceutical medicines in many tropical countries, about 80% of the rural population in Africa still depends on traditional herbal remedies [6]. Although there is widespread use of traditional herbal remedies in the treatment of malaria scientific understanding of the plants is largely unexplored [6]. As so, there is a need to evaluate traditionally used plants in order to validate their antimalarial properties. Furthermore, although chemotherapy of malaria is one of the key pillars in the control of the disease, both Plasmodium falciparum and Plasmodium vivax, which are the most widespread etiological agents for human
malaria have become increasingly resistant to standard antimalarial drugs and the resistance is spreading fast [7]. This has made many of the first line drugs such as chloroquine (CQ) ineffective. Additionally, the disease has developed resistance to most conventional drugs. Chloroquine was an inexpensive, safe and once effective anti-malarial was a pillar of the 20th century, malaria eradication and control efforts [8]. But the parasite developed resistance to the drug by 1990’s and was replaced by antifolate combination sulphadoxine/pyrimethamine (SP) in 1999 in Kenya. The parasite subsequently developed resistance to the SP by 2004 and was replaced by artemisinin based artemether-lumefantrine (AL) These developments have forced the communities to seek for alternative traditional herbal medications as the first line of treatment for malaria, in Kenya. The herbs are readily available in the wild, easy to cultivate [9]. Herbal plants used for the management of malaria vary among communities and regions in Kenya, and clear documentation and understanding of preferential used of the herbs in specific regions will inform conservation of the plant biodiversity that form the raw materials for herbal medicines for the community. This study was, therefore, conducted to identify and documented malarial use of herbal medicines by communities in Trans-Mara, Kuria and Suba districts of Kenya.

Materials and methods
Study Sites
The study sites were Kilgoris (GIS), Gwassi (GIS) and Kehancha (GIS) locations of Trans-Mara, in Suba and in Kuria districts respectively in South Western Kenya, where malaria is endemic and inhabited by communities employing herbal medicines for primary health care.

Trans-Mara
The District is situated in the South Western part of the Rift Valley Province in Kenya, 300 Km South West of Nairobi city. The district lies between latitude 0°50’ and 1°50’ South and longitude 34°35’ and 35°15’ East and borders the Republic of Tanzania to the Kuria and Migori Districts to the west, Gucha and Bomet Districts to the north and the Narok District to the east. It covers an area of about 2,932km² of which the famous Masai Game Reserve occupies 31km². It is about with a population of over 274,532 (Census, 2009). The District is divided into 5 divisions, namely: Kilgoris, Lolgorian, Pirrar, Keiyan and Kirindoni. The topography comprises the highlands which lie between 2,200m and 2,500m and the plateau, which rises from 900m to 2,200m above sea level. The plateau covers the eastern part of Kirindoni Division and southern part of Lolgorian Division, parts of Masai Mara, Murgan and Soit in Kirindoni Division, Masurura in Keiyan Division, Kerinkan, Olopopikidoge and Angata Barikoi in Lolgorian Division. The highlands consist of the Osupuko, Kapune, Meguara and Shankoe hills in Keiyan Division and are the main sources of permanent and seasonal rivers in the district. Major rivers, which originate from these areas, are the Mara River and its tributaries Mogor, Enkare, Entituak, Shartuka, Orerai and Siteti. The district records a mean annual rainfall of 1600mm.

Figure 1: Map showing Transmara Administrative boundary
The area inhabited by Maasai, Kipsigis and Bantu communities who practice cattle rearing and subsistence farming. The terrain found in the highlands and plateau permits agricultural and livestock activities. The area has poor infrastructure, high illiteracy as most young men drop out of school.
to either graze cattle or be morons, while the girls are married at tender ages. Migration is a form of life and survival is seen as a strategy to overcome drought and diseases.

The study was conducted in Oltangi and Poroko locations which enjoys favorable temperatures of 14.8°C to 20.3°C and humidity of 60-68% allows vector breeding and malaria transmission which makes the region malaria endemic. The long rains are between February and June reaching its peak in April, while the short rains are experienced between August and November. The rainfall amount and regime are influenced by the passage of the Inter-Tropical Convergence Zone giving rise to a bi-modal rainfall pattern. The pastoralists have identified many cultural and economic uses of trees and shrubs one of which is for the treatment of malaria epidemics and other ailments.

**Suba**

The District is located in the southwestern part of Kenya along Lake Victoria about 380 Km South East of Nairobi cities and covers an area of 1,055Km² with a population of over 214,463 people (Census, 2009). It borders Bondo District to the north across the lake, Homa Bay District to the east, Migori District to the south and Lake Victoria to the west. It is located between longitude 34°E and 34.20°E and latitudes 0.20°S and 0.52°S. The district covers an area of 1,063km² exclusive of water surface. The district comprises sixteen islands, the biggest in size being Mfangano and Rusinga; the water mass covers an area of 1,190km².

The altitude varies from 1,125m to 2,275m. The main relief feature in the district is the upland plateau, which is composed of undulating surfaces characterized by residual highlands like Gwassi hills to the south and Gembe hills to the north of the district. To the east of the district lies the Lambwe Valley at 1,219 meters and forms the border between Suba and Homa Bay Districts. The Lakeshore is a narrow stretch of land with an average height of between 1,163m and 1,219m high. Lake Victoria lowlands offer rich fishing grounds and sandy beaches with potential for the development of tourist sites. The district has an inland equatorial type of climate that is modified by the effect of altitude and its closeness to Lake. The area along the Lakeshore is dry with only one cropping season while that around Gwassi Hills is wet with the possibility of two cropping seasons.

The annual rainfall ranges from 700mm to 1,200mm with 60% reliability. The long rains occur in March/May, while the short rains occur in August/December. Temperatures increase towards the lowland regions of Mbita division, which range from 17.1°C to 34.8°C all year round. The natural vegetation is mainly deciduous seasonal forest around Gwassi and Gembe hills, while the rest of the area is covered by Savanna grassland. The region has not Permanent River, mainly due to environmental degeneration of the catchment areas that has taken place over several years. The once permanent rivers such as river Sulu and Gera are now seasonal streams.

The study was conducted in Gwassi division, which is mountainous with scattered woodland, grassland and shrubs. The Luo community dominant, Kisii and Maragolis have settled in the area and the main occupational activity is fishing and subsistence farming and dairy. The hottest months are between December and March. The long rains are more reliable in the Gwassi hills than along the Lakeshore because the lowlands adjacent to the lake form a rain convective shadow zone. The area is a holo-endemic malaria zone with transmission all year round. Favorable temperatures all year round; high humidity of 70 to 75% and large water mass of Lake Victoria with the hyacinth swamps offers breeding grounds for the vectors throughout the year and hence, disease transmission takes place.

**Kuria**

The District borders Migori District to the north, TransMara District to the east and the Republic of Tanzania to the southeast (Figure 3). The district is located between latitudes 0.015° and 0.030° south and longitudes 34.15° and 34.30° east. About 350Km South East of Nairobi city and covers a total area of 581Km² with a population of over 256,086 (Census, 2009). It is divided into five administrative divisions, namely Kehancha, Masaba, Kedging, Madera and Tamara. It has twenty-three locations and forty-seven sub-locations. The largest division in the district is Kehancha with an area of 193.3km². The district altitude varies between 1,400m and 1,887m above sea level in Madera Division and Tamara Division respectively in rich volcanic soils with scattered woodland and shrubs of *Lantana camara* L.

Undulating hills interspaced with a few stretches of flat land most of the district’s surface area. Some of the hills found in the district include Gwitembe in Ntimaru Division, Ngonchi (1,442m) and Ranchoka (1,590m) in Mabera division, Taragwiti (1,625m) in Kehancha Division and Maeta forest. Although the climate of the district favors the growth of natural forest, to a large extent such forests have virtually been depleted for fuel, timber and for construction purposes. Gold found in parts of Kehancha Division,
ballast in Masaba and Mabera Divisions. The region is known for its rich and unexploited biodiversity.

Studies were conducted in Kehancha and Nyamtiro divisions which have high illiteracy and poor development and lack infrastructure. The area is occupied by both Bantu and Nilotic communities.
who practice intensive subsistence farming and some cattle rearing. The area is a malaria endemic zone, especially after the long rains between May and July. Favorable temperatures of 28°C to 37°C and humidity of 68 to 72% favors vector breeding and malaria transmission. A large community population indulges in the use of herbs more than conventional treatment of most ailments including malaria due to the limited health facilities.

**Methods of data collection**

**Interviews**

Interviews allowed respondents to freely participate and identify the commonly used local herbs for treatment of malaria as outlined by Mugenda [10].

**Questionnaires**

Two sets of Questionnaires were used in the study; the first was used to interview the Herbalists from the locations of Kilgoris in TransMara, Kihancha in Kuria and Gwassi in Suba in their homes or the work stations.. The second questionnaire was used to interview respondents from households that were randomly identified and sampled. The semi-structured open ended Questionnaire gathered information on social, cultural, economic and demographic aspects of the herbal medicines and on herbal usage in relation to age, gender, marital status.

**Plant collection and herbalists’ interviews**

An ethnobotanical survey was conducted in Trans Mara, Kuria and Suba regions establish and document herbal plants used for the treatment of malaria by the communities. Herbalists were identified by the Herbalist Society of Kenya for authenticity. The selection was purposeful and the criterion was that they were registered members of the Herbalist society of Kenya. Informant interviews were conducted to document the traditional management of malaria by the herbalists in TransMara (Kilgoris), Kuria (Kehancha) and Suba (Gwassi). The perceptions of the cause and symptoms of malaria, the herbs used, harvesting techniques of herbal medicines, their preparation, administration and preservation methods and techniques were also recorded. Herbalists were interviewed using semi-structured questionnaire on the herbal medicines they used for treatment of malaria. Same questionnaires were used for interview community respondents. Local Interpreters assisted in cases of illiteracy. The interviews allowed respondents to give their bio-data and respond on usage of herbs for treatment of malaria. Other information collected includes the social, cultural, economic and demographic aspects of the herbal medicines and the herbal usage in relation to age, gender, marital status.

The plant parts like leaves, barks and roots were harvested and prepared using herbarium technique, air drying at room temperature under shade for 2-4 weeks and preserved. The parts were preserved in polythene papers without folding and carefully transported to the East Africa Herbarium at the National Museums of Kenya for plant taxonomists. Data on parts of the plant used and age of the herbs were made as considered. The time of harvesting was equally considered since the active ingredients of a plant can vary in quantity and quality from time to time and can be significant [9,11].

**Sampling of respondents**

Members of households were sampled based on selection of clusters human habitation which was randomly selected, numbered and sampling mode. Heads of households were interviewed using a semi-structured designed questionnaire and in the absence of head of household their spouses or eldest sons or other guardians were interviewed.

**Sample size determination**

The formula of [10] was used to determine the sample size, based on the national demographic parameters. The formula is as follows:

\[
\text{Sample size } N = \frac{Z^2 \cdot P \cdot (1-P)}{d^2}
\]

Where: 
- \( n \) = the desired sample size (when the target population is greater than 10,000)
- \( Z \) = Standard normal deviate at the required confidence level. (CI = 0.95)
- \( P \) = Proportion of the target population estimated to have characteristics being measured = 0.118
- \( Q = 1- p = 0.882 \)
- \( d \) = Level of statistical significant set. (Absolute precision) = 0.025

\[
\text{Sample size } N = \frac{(0.95)^2 \cdot 0.118 \cdot 0.882}{(0.025)^2}
\]

\[
N = 150
\]

A total of the hundred and fifty (150) respondents from the local community were interviewed from each study region, Kilgoris in TransMara, Kehancha in Kuria and Gwassi in Suba. Participation was voluntary and participant voluntarily answered any question posed for them. They were allowed to decline to respond to any question deemed difficult. Each division has an average population of 30,000 using the Census 2009 statistics. A Similar sample size had been used by Fisher, 1977 in French Guiana where he collected data from one hundred and seventy people from five different groups with a population of 50,000.
Ethnobotanical information

**Leucas calostachys Olive**

*Leucas calostachys* oliv belong to the family Lamiaceae, and order Lamiaceae. Plants of genus *Leucas* are widely used in traditional medicine to cure many diseases such as cough, cold, diarrhoea and inflammatory skin disorder. Anti-inflammatory, analgesic, anti-diarrhoeal, antimicrobial, antioxidant and insecticidal activities have been reported in the extracts of these plants and their phytoconstituents. *L. calostachys* is an erect herb with densely pubescent stems and leaves. Leaves are usually opposite, shortly stalked, up to 4 cm long. Flowers are white with corolla being longer than the calyx [12]. Its crushed leaves and roots in water are drunk to treat serious stomachache among the Luo community in western Kenya. The herb has also been indicated as a treatment for fevers and sexually transmitted infections among the Luhyia people of the Vihiga country in western Kenya where a decoction prepared from the leaves is drunk as a treatment for STIs [13-15], reported its use among the Keiyo community for the treatment of heartburn and peptic ulcers. Its leaves are pressed and used to treat abdominal distension and heart problems while its leaves and root decoction is used to treat malaria. Among the Sabaot community in Mt. Elgon area in Kenya pounded leaves of *L. calostachys* is used to treat headache and colds [12], which are among the symptoms of malaria. In Transmara, largely occupied by the Maasai community, *L. calostachys* is used to treat malaria and a large proportion of members of this community (72%) use herbal medicine for disease management. [2,3]. As such, there is a need to evaluate these medicinal plants for anti-plasmodial activity against *P. falciparum* in order to validate the herbalists’ claim that it cures malaria.

**Rubia cordifolia Linn.**

*Rubia cordifolia* is a perennial, prickly or scabrous, climbing herb that belongs to the family Rubiaceae. Leaves are variable, arranged four in a whorl, cordate-ovate to ovate-lanceolate with base slightly cordate. Its petioles are quadrangular, sometimes prickly on the angles, glabrous and shining. Stipules are absent. The stem is slender, rough, four angled with sharp curved prickles on the ridges. Flowers are in cymes, greenish white. Fruits are didymous or globose, smooth, shining and purplish black when ripe [16]. *R. cordifolia* is reputed as an efficient blood purifier and is extensively used against blood, skin and urinary tract diseases. The root is sweet, bitter, acrid, astringent, thermogenic, anti-dysenteric, anti-inflammatory, antipyretic, analgesic, anodyne, anthelmintic, antiseptic, constipating, diuretic, galactopurifier, febrifuge, rejuvenating and tonic [16]. The root extract has a wide range of pharmacological properties, thus used against ailments such as, Arthritis, Cephalalgia, Cough, Diabetes, Dysmenorrhoea, general debility, Hepatopathy, intermittent fevers, Jaundice, Leucorrhoea, Neuralgia, Pharyngitis, Splenopathy, slow healing of broken bones, and Urethrorrhoea. However, the use of roots is not sustainable. In Ethiopia, the leaves are used to treat malaria, itches and to stop bleeding, the roots to treat amoebic dysentery, cancer and cough [17,18]. In Kenya, [2,3], reported its use in the management of malaria in among the Maasai people with high antiplasmodial activity against *Plasmodium knowlesi*. Hence there is a need to investigate its efficacy against *P. falciparum* to justify their claim.

**Harrissonia Abyssinia Olive**

The genus *Harrissonia* belongs to the family Rutaceae, which has around 30 genera and 150 species of trees and shrubs widely distributed in the tropics [19]. The stem bark and leaves of this family have a characteristic bitter taste. The plants in the family are used in traditional medicine as anti-helminths, anti-viral, anti-leukemia, anti-feedant, anti-tuberculosis, anti-malarial and also for the treatment of cancer [20]. *Harrissonia abyssinica* grows in tropical Africa. It is an evergreen shrub or tree which grows up to 6M high. The branches have curved or straight spines which are usually in pairs. Its flowers are cream or yellow and the fruits are red when ripe. It grows mainly in river-run dry bush land, wooded grassland and coastal forest margins. The species is ever threatened due to overexploitation for medicinal purposes [21]. *H. abyssinica* has been put to various uses in herbal medicine and it is the most used medicinal plant among the herbalist in the Luo community in western Kenya, where its root bark decoction is prescribed for treatment of fevers and venereal diseases. The roots and barks soaked in water is also drunk to strengthen and purify the body, while hot water extract of fresh and dried root bark is used to treat skin diseases. Among the Maasai, Kuria and the Luo communities in Kenya it is commonly used as a treatment for malaria [2,3].

Data analysis

The data collected was presented using descriptive in the form of tables and figures and analyzed using descriptive statistical methods. Analysis was done using Chi - Square ($\chi^2$) and ANOVA to compare the herbal usage among and within groups for age, gender and marital status, using Windows SPSS.
Identification and documentation of commonly used Medicinal Herbs

Eighteen (18) herbal medicines identified as used for malaria treatment in the three study regions were identified and documented (Table 1). Vernonia brachycalyx O Hoffm (Compositae), Vernonia lasiopa Lam (Compositae), Leucas calostachys Oliv (Labiatae), Leonitis mollisima warsson (Labiatae), H abyssinica Oliv (Simaroubaceae), Cassia didymobotrya Fresen (Leguminosae), Rubia cordifolia L (Rubiaceae), Erythrina abyssinica DC(Leguminosae), Bidens pilosa L (Compositae), Sanchus schweinfurthii Oliv & Hiern (Leguminosae), Solanum incaum L (Solanaceae), Aloe barbadensis Mill.(vera) (Liliaceae/aloeaceae), Acacia nilotica (L.) Wild ex Delile (Legimunosae) and Warburgia salutaris (G. Bertol) Chiov (Canellaceae). Four herbal plants commonly used in the districts included L. calostachys Oliv (Plant 1), R. cardifolia L. S. schweinfurthii Oliv & Hiern and H. abyssinica Oliv. These herbs were commonly administered by herbalists in the form of infusions and decoctions of leaves, barks and stems. The results show that the indigenous knowledge of the community on malaria encompasses not only the symptoms of malaria, but also the factors that are responsible for causing malaria, attributes favoring the breeding of mosquitoes and practices employed to guard against mosquito bites or to protect households against malaria. This knowledge is closely in harmony with scientific approaches to the treatment and control of the disease.

Table 1: Medicinal Herbs used for malaria treatment in from Kuria, Suba and Transmara Districts of Kenya.

<table>
<thead>
<tr>
<th>Family Name</th>
<th>Botanical Name</th>
<th>Vernacular Name</th>
<th>Voucher Specimen Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPOSITAE</td>
<td>Vernonia brachycalyx O Hoffm.</td>
<td>Olusia (Luo)</td>
<td>P.Kuchi,E.Msafiri, R.Seet</td>
</tr>
<tr>
<td></td>
<td>Lasiopa Lam.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMPOSITAE</td>
<td>Microglossa pyrifolia (Lam.)</td>
<td>Nyabung-Odide (Luo)</td>
<td>Quinid Jahnansen</td>
</tr>
<tr>
<td></td>
<td>Kuntze</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LABIATAE</td>
<td>Leucas calostachys Oliv.</td>
<td>Bware (Luo)</td>
<td>E.Gemdia</td>
</tr>
<tr>
<td>LABIATAE</td>
<td>Leonotis ocymifolia var. raineriana (Vis.)</td>
<td>Nyanondhi(Luo)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Vis.) Iwarsson (Leonitis mollisima)</td>
<td></td>
<td>Cheseng C.M.C</td>
</tr>
<tr>
<td>SIMAROUBACEAE</td>
<td>Harrisonia abyssinica Oliv.</td>
<td>Osiro (Luo)</td>
<td>F.J. Breteler</td>
</tr>
<tr>
<td>VERBENAECIEAE</td>
<td>Lippia javanica (Burm.f.) Spreng</td>
<td>Angware-Rao</td>
<td>J.O. Kokwaro</td>
</tr>
<tr>
<td>COMPOSITAE</td>
<td>Vernonia brachycalyx O Hoffm.</td>
<td>Irisabakw (Kuria)</td>
<td>P.Kirika</td>
</tr>
<tr>
<td>LEGUMINOSAE</td>
<td>Cassia didymobotrya Fresen.</td>
<td>Irebeni (Kuria)</td>
<td>Dr. Sheil, Sminky EA</td>
</tr>
<tr>
<td>RUBIACEAE</td>
<td>Rubia cordifolia L.</td>
<td>Urumurwa (Kuria)</td>
<td>Cosminky EA</td>
</tr>
<tr>
<td>LEGUMINOSAE</td>
<td>Erythrina abyssinica DC.</td>
<td>Omutembe (Kuria)</td>
<td></td>
</tr>
<tr>
<td>SIMAROUBACEAE</td>
<td>Harrisonia abyssinica Oliv.</td>
<td>Orongoriwe (Kuria)</td>
<td>Cosminky EA</td>
</tr>
<tr>
<td>LEGUMINOSAE</td>
<td>Albizia zygia (DC) J.F.Macbr.</td>
<td>Ekegonchori (Kuria)</td>
<td>R.L. Davidson</td>
</tr>
<tr>
<td>COMPOSITAE</td>
<td>Bidens pilosa L</td>
<td>Irinyabake (Kuria)</td>
<td>Quind</td>
</tr>
<tr>
<td>LEGUMINOSAE</td>
<td>Sanchus schweinfurthii Oliv.&amp;Hiern</td>
<td>Egesemi (Kuria)</td>
<td></td>
</tr>
<tr>
<td>COMPOSITAE</td>
<td>Vernonia brachycalyx O Hoffm.</td>
<td>Irisabakw (Kuria)</td>
<td>P.Kuchar, Beentje</td>
</tr>
<tr>
<td></td>
<td>Olsua (Luo)</td>
<td></td>
<td>9210, 2808</td>
</tr>
<tr>
<td>COMPOSITAE</td>
<td>Vernonia auriculifera Hiern</td>
<td>Irisabakw(Kuria) Olsua (Luo)</td>
<td>P.Kuchar</td>
</tr>
<tr>
<td>SOLANACEAE</td>
<td>Solanum incaum L.</td>
<td>Entulelei</td>
<td>J.Kokwarra</td>
</tr>
<tr>
<td>LEGUMINOSAE</td>
<td>Cassia didymobotrya Fresen.</td>
<td>Bsunete</td>
<td>P.Kuchar</td>
</tr>
</tbody>
</table>
### LABIATAE

<table>
<thead>
<tr>
<th>Plant 1: Leaves and fruits of <em>Harrisonia abyssinica</em></th>
</tr>
</thead>
</table>

### LEGUMINOSAE

<table>
<thead>
<tr>
<th>Plant 2: Whole plant of <em>Rubia cordifolia</em> Linn.</th>
</tr>
</thead>
</table>

### SIMAROUBACEAE

| Plant 1: Leaves and fruits of *Harrisonia abyssinica* |

| Plant 2: Whole plant of *Rubia cordifolia* Linn. |

### LILIACEAE

| Plant 1: Leaves and fruits of *Harrisonia abyssinica* |

| Plant 2: Whole plant of *Rubia cordifolia* Linn. |

### ALOACEAE

| Plant 1: Leaves and fruits of *Harrisonia abyssinica* |

| Plant 2: Whole plant of *Rubia cordifolia* Linn. |

### LEGUMINOSAE

| Plant 1: Leaves and fruits of *Harrisonia abyssinica* |

| Plant 2: Whole plant of *Rubia cordifolia* Linn. |

### CANELLACEAE

| Plant 1: Leaves and fruits of *Harrisonia abyssinica* |

| Plant 2: Whole plant of *Rubia cordifolia* Linn. |

### LABIATAE

| Plant 1: Leaves and fruits of *Harrisonia abyssinica* |

| Plant 2: Whole plant of *Rubia cordifolia* Linn. |

### LEGUMINOSAE

| Plant 1: Leaves and fruits of *Harrisonia abyssinica* |

| Plant 2: Whole plant of *Rubia cordifolia* Linn. |

### LILIACEAE

| Plant 1: Leaves and fruits of *Harrisonia abyssinica* |

| Plant 2: Whole plant of *Rubia cordifolia* Linn. |

### ALOACEAE

| Plant 1: Leaves and fruits of *Harrisonia abyssinica* |

| Plant 2: Whole plant of *Rubia cordifolia* Linn. |

### CANELLACEAE

| Plant 1: Leaves and fruits of *Harrisonia abyssinica* |

| Plant 2: Whole plant of *Rubia cordifolia* Linn. |
Traditional Methods of preparing herbal drugs by herbalists

Herbalists used different methods to prepare herbal drugs, which include:

1. Boiling the whole or the useful part of the plant parts in a covered pot or pan for 1-3 hours: Roots, barks and leaves of herbal medicines were boiled in water or with goat meat and the resulting decoction/soup were used either internally (orally) or externally.

2. Freshly harvested plant parts were dried, then pondered with mortar and pestle into powder or macerated then soaked in cold or warm water for 24hrs or overnight to form infusion which was used internally or externally. The concoctions were also consumed directly in soups.

3. Part or whole of the plant dried indoors or under the shed, then were burned in an open tray or enclosed pot into ashes; then were used either (orally) internally with water or soup.

4. The ashes were also mixed with creams as ghee or directly applied under bandage on wounds, boils, skin infections.

5. Heating and roasting was applied to the succulent parts of plant parts which were freshly harvested roasted then cooled. The juice was then extracted by squeezing the soft succulent parts and used for treatment of stomach and mouth diseases. The juice was also applied on the skin externally for treatment of sprains, aches and joint pains.

Herbal usage in treatment of malaria in Transmara, Suba and Kuria districts

Use of herbs was common among communities of Trans-Mara district followed by Kuria district and then Suba district (Figure 4). The mean proportion of herbal usage in Kuria was 63% users and 37% non users respectively. In Suba district, the mean proportion of herbal use was 58% of users and 42% of non users, while in Trans Mara district, the proportion was 72% of users and 28% of non users respectively. Though TransMara District showed the highest proportion of herbal medicine dependants compared to other districts, data analysis using the Pearson chi square test revealed that there was no significant association between use of herbs and the districts ($\chi^2_{[2]} = 2.257, p=0.324$).

![Figure 4: Percentage usage of herbs in TransMara, Kuria and Suba Districts](image-url)
Herbal use in relation to gender
Use of herbs was higher in females (74%) compared to males (63%) in all the three study regions combined as compared to 37% male non-users and 26% non-user females (Figure 2). However, the Pearson Chi square test revealed that there was no significant association between use of herbs and gender ($\chi^2_{[1]} = 0.608, p=0.435$).

**Figure 5**: Combined Percentage usage of herbs by gender in TransMara, Suba and Kuria

Use of Herbs in relation to marital status
Herbal usage in the communities was higher among the married respondents (74%) as compared to unmarried ones (36%). Non users of herbal medicine were 26% and 64% in married and non-married respectively (Figure 6). The Pearson’s chi square test revealed that there was a significant difference between usage of herbs and marital status ($\chi^2_{[1]} = 21.648, p<0.001$).

**Figure 6**: Percentage combined usage of herbs in relation to marital status in TransMara, Suba and Kuria districts

Herbal use in relation to age
Figure (7) shows the relationship between age and herbal usage of the respondents from TransMara, Suba and Kuria districts. The average age of herbal usage was 43 years while for non herbal users was 24 years. Analysis of variance (ANOVA) showed a significant difference between the age and herbal usage in the three districts ($F_{[1,144]} = 32.002, p<0.001$) indicating that herbal usage was popular among the older age group while non herbal usage was found among the younger age.
Discussion

Study findings indicate that communities of TransMara, Suba and Kuria districts use herbal medicines to treat malaria. Culture, traditions, availability and affordability of herbal medicines are factors that contribute to usage of traditional medicines as opposed to conventional medicines among communities. The research findings confirm the earlier reports [22,23], indicate that leaves of various plant parts have been used as ethnomedicines against malaria in Meru, and Kisii respectively. Many plant preparations are used by the Meru community without any available scientific study on the efficacy and safety [6,24]. Studies for the collection of ethno-botanical information about anti-malarial medicinal plants which are essential for evaluation of the efficacy, including the use, preparation and administration by traditional healers in Kilombero Valley and Dar es Salaam, Tanzania have been documented [25,26]. Findings from studies conducted on herbal usage in relation to age is in agreement with those reported among the Bench ethnic group in Ethiopia, where older generations of ages 45 to 60 uses traditional medicines more as compared to younger generations under 35 years [16]. Similar pharmaceutical studies have been conducted in Granada province (Spain) with an aim of cataloguing, documenting and making known the uses of plants for the folk medicine. Studies on diversity and utilization of anti-malarial ethno-phytotherapeutic remedies among the Kikuyus (Central Province) identified three herbal medicines used for malaria treatment in all the five districts namely, Caesalpinia volkensii Harm, Strychnos hemmingsii Gilg and Ajuga remota Benth [27,28], conducted studies on the documentation of ethno-botanical information on malaria treatment in Kisumu district with the goal of eventually testing the medicinal plant extracts for anti-plasmodial activity. The results obtained are similar to findings made from French Guiana which showed that two third (66%) of the interviewed population confirmed regularly drinking some herbal remedies to prevent febrile illnesses and malaria. The finding of the study is in agreement with those conducted by [27], which states that despite change of lifestyle of Maasai from nomadic to sedentary; the community still maintains traditional plant knowledge in their surrounding for treatment of malaria and other ailments. Similar work on traditional herbs for treatment of malaria has been reported from the Democratic Republic of Congo by [29,30], in which three herbs were reported to treat malaria.

Figure 7: Herbal usage in relation to age in TransMara, Suba and Kuria districts
malaria, namely *Croton mubango*, *Nauclea pobequinnii* and *Pyrenacantha staudii*. Studies conducted in Mali and Sao Tome by [31], reported in the area herbal medicines were used for the management of malaria namely, *Guiera senegalensis*, *Combretum micranthum*, *Morinda citrifolia*, *(Benth.), Securidaca longepedunculata*(Don.) *Feretia apodantha* (Del.). In Burkina Faso [32], and Yemen [37]; Younger leaves and buds were preferred for foliage materials as well as older barks & roots. These findings are in agreement with studies conducted in Kilombero Valley and Dar es Salaam, Tanzania by [25]; and in Meru by [33], an anti-malarial activities suggest that the locality and time the plant is harvested have an impact on the effectiveness and composition of active ingredient [9,34,35].

Conclusions
Herbal medicines face the challenge of access to formal health care system due to inadequate scientific validation to show evidence of anti-malarial activity and safety of herbal medicines. This requires partnering between the herbal medicine practitioners and scientists. Scientific validation has the advantage of confirming that a medicinal plant is a safe anti-malarial. Once herbal medicines are confirmed as efficacious anti-malarial, the medicinal plant becomes a repository for development of pharmaceuticals against malaria. Results from the study could be important for selecting plants that can be used for further phytochemical and pharmacological studies and therefore developing new and relevant anti-malarial agents for malaria treatment and control.

The ethno-botanical data generated in this study will be useful for further evaluations of the traditional claims of anti-malarial herbs in Kenya.

Recommendations
There is a need for national documentation of indigenous herbal-medicines for the elderly who disseminate the knowledge verbally and informally to be conducted in Kenya. This will form part of national wealth and heritage.

1. Ethno-botanical information should be documented as a great deal is derived from the elderly who lack documentation as they die, much of their knowledge of local vegetation dies too without any records.
2. Herbal practitioners should be educated on better preparation and preservation methods of ethno-medicines recommend them for long term management of diseases.
3. Further studies are required to isolate the efficacious anti-plasmodial specific components of the herbs for possibilities of discovering new drugs from ethno-medicines which are still enormous course of the rich biodiversity.
4. There should be sensitize communities, policy makers, development agencies, ethno-botanists and herbalists on effective use of herbal medicines and to in-cooperated in the development of herbal remedy for malaria in line with WHO concern.

Therefore, there is a need for further studies to be made on extraction of active ingredients in the plants that cure malaria.

Acknowledgements
The authors would like to acknowledge the Herbalists Society of Kenya through their assistance in identifying the herbalists. We thank the herbalists, Tinga Tinga, Elijah Odongo, Okibo Nyara and Serah Chemtai Bogita for providing ethno-botanical information harvesting, collecting and preparing herbal medicines. Special thanks to the members of the communities for participating in the interviews. We thank the community in the regions for assisting in the collection and the harvesting of herbal medicine. Special thanks to Mr. G.M. Munene of East Africa Herbarium at National Museums of Kenya for identifications of herbal medicines and Ms. Margaret Kwamboka of Daystar University editing and typesetting the manuscript and for technical assistance in graphics work.

References


