

Ethnobotanical Survey Of Medicinal Plants Used For Treatment Of Malaria By Kipsigis People In Kericho County, Kenya.

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Abstract: Background: Ethnobotanical pharmacopoeia is importantly used in intervention of disease and need arises for documentation and preservation of tradition medicinal knowledge to boost the discovery of new drugs. Due to the emergence of drug resistance to malaria, there is a high possibility of development of resistance to ACT (that is the first line of treatment), thus a need for identification and development of new and novel therapeutic approaches. Herbs offer an opportunity for discovery and development of new chemically diverse antimalarial agents, however little documentation has been done. The first objective of the present study was to identify and document preferred medicinal plants used for treatment of malaria in Kericho East Sub-County.

Methods: Field research was conducted in six Sub- Counties of Kericho County in Kenya namely Kipkelion East, Kipkelion West, Kericho West, Kericho East, Sigowet/Soin and Bureti. We randomly sampled 120 interviewees according to age, gender, occupation and level of education. Plant use data was collected through semi-structured questionnaires; transect walks, oral interviews and focus groups discussions. Voucher specimens of all cited botanic species were collected and deposited at National museum herbarium, Nairobi Botany department.

Results

Twenty medicinal plant species were yielded from the informants which are used to treat different symptoms and signs of malaria including: headache, fever, diarrhea, stomach-ache.

Conclusions

The ethnomedicinal use of plant species was documented in the study area for treatment of human malaria. The major threatening factors reported were factitious and natural. Ethnomedicinal documentation and sustainable plant utilization can support drug discovery efforts in developing countries.

Keywords: Medicinal plants, Traditional medicine, Kericho, Ethnobotanical surveys, Conservation.

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I. Background

Sources of medicine to treat different ailments in East Africa and particularly in Kenya have been plants [1]. Natural products, especially those of plant origin, continue to provide a diverse and unique source for drug discovery [2]. Kericho County have retained indigenous knowledge on use of plants with medicinal value in their environment. This information is however declining rapidly due to changes towards a more western lifestyle, overgrazing and overexploitation of plant resources leading to a decline of the plant material available [3]. There are over four hundred plant species which are used for management of diseases in East Africa [1, 4]. Several ethno-botany studies have shown that up to seventy percent of the rural communities still depends on the traditional medicine as a primary healthcare source while only thirty percent rely on the conventional healthcare systems [5]. Ethnopharmacology and natural product drug discovery remains a significant hope in the improving the poor livelihoods of rural communities. Most modern pharmaceuticals have their origin in ethnomedicine and they rely upon a local pharmacopoeia [6]. The ethnopharmacology knowledge is a holistic system approach that can serve as an innovative and powerful discovery engines for newer, safer and affordable medicines [7]. Medicinal chemists have isolated significant number of compounds from hundreds of plants and have proven to be of poor cost-effectiveness due to lack of comprehensive biological and clinical evaluation [8]. Natural products from botanical sources used in traditional medicine may combat multidrug-resistant (MDR) infectious diseases through the elucidation and validation of biological compounds with novel mechanisms of action [9]. Ethnobotanical studies normally involve field explorations of indigenous medical knowledge and biodiversity [10]. The cultural importance of traditional medicine and physical isolation of communities both in general and from primary health cares (PHCs), are the factors that influence the dramatic use of use herbal medicines in developing countries [11]. Cultural acceptability of traditional practices, along with perceptions of affordability, safety and efficacy play a role in stimulating scientific research and validation of traditional

medicines [12]. The people residing in 18 estates found in Kericho County (Kericho East, South and South East still relies on non-convectinal, traditional agricultural production systems as a primary livelihood source [13]. Herbal medicines are cheap and readily available in the Kericho County areas but lack of sufficient scientific data on efficacy, therapeutic index, toxic effects and other pharmacological and toxicological properties to support their use [14]. There are several ethnomedicinal studies which are being carried out realizing the benefit of traditional medication to promote the cheap and safe disease management. The outcomes of these researches have immense contribution to attitude change and adaptation, though there are very few in light of Kenya's biodiversity. The overdependence on natural vegetation as food, fuel, building and medicine in Kericho County might be the cause for the environmental. Therefore, there is a need to carry out more research pertaining to documentation of useful medicinal plants in this area before they disappear, especially those which are already endangered by natural and anthropogenic activities [15].

II. Materials and Methods

Study Site

This study involved population residing within Kericho County, Kenya. Kericho County is located on the western side of the Great Rift Valley in a highland area near Lake Victoria (elevation 1,600–3,000 m above sea level) [16]. It has a population of 758,339 (2009 census) and the soils are deep and well drained [16]. Its capital and largest town is Kericho. The 2,479 km County is located in south western Kenya and borders Nakuru to the east and south east, Kisumu to the west and north-west, Bomet to the south, Nandi to the north, Baringo and UasinGishu to the north-east, and Homa Bay and Nyamira to the south-east [17]. This town hosted the county's first medical facility that was built by colonial settlers in the early 20th century. The county is composed of six sub-counties, namely, Kipkelion East, Kipkelion West, Kericho West/Belgut, Kericho East, Sigowet/Soin and Bureti. The sub-counties are further sub-divided into 15 administrative divisions, namely, Ainamoi in Ainamoi Constituency, Belgut and Kabianga in Belgut constituency, Bureti, Roret and Cheborge in Bureti Constituency, Sigowet and Soin in Sigowet/Soin Constituency and seven more divisions located in Kipkelion East and West Constituencies. These are Kunyak, Chilchila, Kamasian and Kipkelion in Kipkelion West and Londiani, Sorget and Chepseon in Kipkelion East. The county also has 85 locations and 209 sub locations [17]. Climate Kericho East Sub-County experiences a warm and temperate climate. The Sub County records significant rainfall throughout the year, with average annual rainfall standing at 1735mm. Much of the rainfall is recorded in April (average of 256mm) and January receives the least amount of rainfall at 71mm. February is the warmest month in Kericho East Sub County with the average temperature being 19.1 °C, while July records the lowest annual average temperature at 17 °C [17]. These climatic conditions are suitable for agriculture being the people's main economic activity. Availability of rainfall, warm temperature and the presence of vegetation due to agriculture provide a good breeding and hiding place for mosquitoes, the main vectors for transmitting malarial parasites in the region, thus malaria becomes one of the common disease.

Data collection

Information on the use of medicinal plants was collected between January 2015 and December 2015. 120 traditional healers were identified through community and healers association leaders. Six Sub-Counties of Kericho County, Kenya were identified. With acquiescence of a taxonomist samples of antimalarial herbs were obtained for this research study. To evaluate consistency, semi-structured interviews were conducted with herbalists of Kericho County government. The ethnographic interview included age, sex, and occupation of informants as well human health indications treated, vernacular plant names, category of plants, plant part used, methods of preparation, dosages, route of administration and possible contraindications, pharmacological effects of medicinal plants to humans were also documented. We relied on the knowledge of healers and the taxonomist to select the products of greatest importance. This enabled us target products that have a high likelihood of possessing significant pharmacological activity.

The methods used for ethnobotanical data collection were semi structured interviews, field observation and preference ranking according to [18]. These interviews were conducted in vernacular (Kipsigis), six different field trips were conducted. The morphological characteristics and habits of medicinal plants were observed, photographed and recorded during and after the interviews. The key informants for purposes of ranking these species were selected randomly from among all informants [19]. At the end of the interview, the plant specimens were collected dried using specified herbarium procedures before they were identified and preserved. Voucher specimens for all the medicinal plants were deposited at the National Herbarium Museum Nairobi for future reference.

Geographical Positioning Systems readings were also taken at the sites where each medicinal plant was collected. Some of the plants were identified in the field by herbalists while most were identified at the National Museum herbarium, Nairobi Botany department.

Data analysis

Both descriptive statistics by using general linear model was employed to determine the most commonly used herb/plant by the Kericho people. Informant data and factors of informants consensus (Fic) values obtained from the questionnaires were employed [20].

III. Results**The plants and their medical application**

The survey gathered information on 20 plant species reported by the informants for their medicinal use (Table 1). The reported species were distributed among 18 botanical families. Euphorbiaceae, Curcubitaceae and Asteraceae were best represented in terms of the number of species. All the medicinal plants were reported in their local names since the local communities know them only by their local names. All species were used as remedies against malaria.

Table 1: Plants of Antiplasmodial activity used in Kericho County

Family	Species	Local name	Voucher No	Parts used	Preparations	Side effects
1.Papilionaceae	<i>Pittosporumviridiflorum</i> Sims. Var.viridiflorum(S.L)	Chepngororiot	01/15	Bark	Hot decoction, cooling and infusion	Nausea and intestinal pain
2.Simaroubaceae	<i>Harrisoniaabyssinica</i> Oliv.	Kulelwet	02/15	Roots	Hot decoction	Headache
3.Rubiaceae	<i>Gardenia ternifolia</i> Schum.&Thonn.	Kipulwet	03/15	Roots bark	Hot decoction	Headache and nausea
4.Caesalpiniaceae	<i>Senna didymobotrya</i> (Fresen.) Irwin &Barneby	Senetwet	04/15	Leaves	Powder, mix with sour milk	Intestinal pain
5.Rutaceae	<i>Teclatrachocarpa</i> (Engl.) Engel.	Kurusiot	05/15	Leaves	Cold decoction	No side effect
6.Euphorbiaceae	<i>Clusiaabyssinica</i> Jaub. &Spach	Kurbanyat	06/15	Roots	Hot decoction	Vomiting
7.Asteraceae	<i>Vernoniaamagydalina</i> Del.	Ngwandepengwo	07/15	Roots	Hot decoction, cooling	No side effect
8.Rubiaceae	<i>Leucascalostachys</i> Oliv. Var. calostachys	Ngechepchot	08/15	Leaves	Crushing, cold decoction	Vomiting and headache
9.Phytolaceae	<i>Phytolacadodecandra</i> L Herit	Patkawet	09/15	Leaves	Powder, Hot decoction	Vomiting and intestinal pain
10.Curcubitaceae	<i>Zehneriascabra</i> (L.F.) Sond.	Manereriat	10/15	Roots	Hot decoction, cooling while removing foam	Vomiting
11.Curcubitaceae	<i>Mormodicafoetida</i> Schumach	Cheptenderet	11/15	Seeds	Powder, burn to ash	Intestinal pain
12.Amaranthaceae	<i>Cyathula cylindrical</i> Moq	Ngatumyat	12/15	Roots	Hot decoction, cooling	Vomiting
13.Canellaceae	<i>Warburgiaugandensis</i>	Soget	13/15	Leaves	Hot decoction, cooling	Headache
14.Asteraceae	<i>Tithonia</i> diversifolia	Mauwat	14/15	Leaves	Hot decoction, cooling	Vomiting
15.Acanthaceae	<i>Justiciabetonica</i> L	Turukwot	15/15	Leaves	Hot decoction, cooling	Vomiting and headache
16.Aloeaceae	<i>Aloe kedongensis</i> Reynolds	Tangaratwet	16/15	Leaves	Crushing, Cold decoction	Intestinal pains
17.Apocynaceae	<i>Carissa edulis</i> (Forsk.) Vahl.	Legetetiot	17/15	Roots	Hot decoction, cooling	Headache
18.Euphoraceae	<i>Ricinuscommunis</i> L.	Imaniat	18/15	Leaves	Hot decoction	Vomiting and joint pains
19.Asclepiadaceae	<i>Curroriavolubilis</i> (Schltr.)	Simotwet	19/15	Bark	Cold decoction	Headache
20.Vitaceae	<i>Rhoicissus tridentate</i> (L.F.)	Paiwataptarit	20/15	Leaves	Crushing, cold decoction	Vomiting

Plant parts used and mode of preparation

The plants parts used of these medicinal plants were leaves, roots, bark and fruit/seeds. The preparation of the medicines employed several methods; hot decoction, cold decoction and powdering. Sometimes ash infusion is used. In all these preparations, there is a standardized decoction in water, prepared with a handful of plants. However, there was a lack of precision in the determination of doses to be taken and it was a real drawback in the use of traditional medicine in Kericho County. It was also observed that most of the reported preparations in the area are drawn from a single plant; mixtures are used rarely.

Route of administration and dosage

All of the remedies are taken orally but in different forms majorly in liquid form mix with warm water, cold milk or honey. Also others are taken ash form. The juice prepared from the stems bark, leaves and roots, for instance, is usually taken with honey to reduce its bitterness. Most of the remedies were taken once or twice a day as a full dose. Although variants like age, physical and health conditions of the patient determined the dose given. It was noted that there was still a lot of inconsistency among the informants on doses of certain remedies prescribed

IV. Discussion

The survey provides a documentation of 20 plants used by the people of Kericho County to treat Malaria. The plants are generally used in malaria signs and symptoms including; headache, fever, diarrhea and stomach-ache. Analysis of the plants parts used of these medicinal plants revealed that leaves were the most frequently used constituting (50%), followed by roots (35%), bark (10%), and fruit/seeds (5) (Table 5). The result of this study was in agreement with other studies which reported that leaves [21, 22], were the most used parts. This study showed that shrubs were found to be the most used plants (9 species) followed by plants (7 species), climbers and Herbs (2 species) (Table 4). This result indicated that shrubs were common and easily harvested when compared to others. Furthermore, most of the study areas for this study were open areas suitable for shrub growing.

The preparation of the medicines employed several methods; hot decoction (60%) followed by cold decoction (25%) and powdering (15%) respectively. The majority of these preparations were drawn from mixtures of different plant species for the treatment of a single ailment. Oral administration was the predominant route of administration.

Many medicinal plants in the study area were mainly threatened by anthropogenic and natural factors. The majority of medicinal plants declined due to deforestation for construction tools, firewood, fodder, agricultural expansion and ceremonial purposes. The result was in agreement with the study of Tabuti [23], Wodah and Asase [24] who reported on the decrease of medicinal plants in Northwest Ghana and Uganda. Drought, overgrazing, bush fires had reportedly affected a significant number of Medicinal plant species.

The measurements used to determine the dosages were not standardized and depended on the age and physical appearance of the patient, socio-cultural explanation of the illness, diagnosis and experience of individual herbalist [25].

Table 2: An overview of the traditional healers interviewed

County	Sub-County	No of healers	Sex		Age (yrs)
			Male	Female	
Kericho	Kericho East	1	0	1	35-39
		3	1	2	40-44
		2	2	0	45-49
		5	1	4	50-54
		4	4	0	55-59
		2	1	1	60-64
		3	2	1	65-69
	Kericho West	0	0	0	35-39
		1	0	1	40-44
		3	3	0	45-49
		3	1	2	50-54
		2	1	1	55-59
		6	4	2	60-64
		5	3	2	65-69
Kipkelion East	0	0	0	35-39	
	0	0	0	40-44	
	2	2	0	45-49	
	4	2	2	50-54	
	5	1	4	55-59	
	6	3	3	60-64	
		3	3	0	65-69

	Kipkelion West	0	0	0	35-39
		0	0	0	40-44
		5	3	2	45-49
		6	3	3	50-54
		5	1	4	55-59
		6	2	4	60-64
		0	0	0	65-69
	Sigowet/Soin	2	1	1	35-39
		1	1	0	40-44
		5	3	2	45-49
		2	2	0	50-54
		1	0	1	55-59
		2	0	2	60-64
		8	5	3	65-69
	Bureti	1	0	1	35-39
		1	0	1	40-44
		1	1	0	45-49
		2	1	1	50-54
		5	3	2	55-59
		5	4	1	60-64
		5	3	2	65-69

Table 3: Diversity of medicinal plant species in Kericho County

Family	Number of medicinal plant species	Percentage of total species mentioned as medicine
1.Papilionaceae	1	5
2.Simaroubaceae	1	5
3.Rubiaceae	1	5
4.Caesalpinaceae	1	5
5.Rutaceae	1	5
6.Euphorbiaceae	2	10
7.Asteraceae	2	10
8.Rubiaceae	1	5
9.Phytolaceae	1	5
10.Curcubitaceae	2	10
11.Amaranthaceae	1	5
12.Canellaceae	1	5
13.Acanthaceae	1	5
14.Aloeaceae	1	5
15.Apocynaceae	1	5
16.Asclepiadaceae	1	5
17.Vitaceae	1	5

Table 4: Life forms of medicinal plant species used in management of malarial disease in Kericho County.

Categories of plants	Number of species
Herbs	2
Shrubs	9
Climbing	2
Plants	7

Table 5: Plant parts used and it's percentage

Plant parts used	Number of plant parts Used	Percentage of plant parts used
Leaves	10	50%
Roots	7	35%
Bark	2	10%
Fruits/Seeds	1	5%

V. Conclusion

The naming of diseases by local people when compared to conventional systems, at times did not distinguish between diseases and symptoms of diseases. This is because local disease nomenclature is based on symptoms of diseases and not according to aetiological information [26].

While conducting this study, some informants raised some concern on false promises about getting the feedback. They agreed that scientific methods are better in revealing harmful effects of herbs. In the drug development research and bioprospection, biological activity based on ethnomedical uses seems as a better approach compared to randomly selected plants [27].

Dissemination of knowledge of useful phytomedicinal practices amongst areas that share key flora may aid health practices in those areas. In any case, further studies and phytochemical analyses need to be completed before addition of plants to the pharmacopeia for PNG (a goal of the National Policy for Traditional Medicine in PNG) [28]. To this far the diverse efforts of PNG botany, ethnobotany, ethnopharmacology and plant conservation need to collaborate more rigorously to define useful interfaces for each other's data needs [28]. Currently we are undertaking field trials, *in-vitro* and *in-vivo* tests of some plants most commonly used in Kericho East Sub-County for antiplasmodial activity and their toxicity to confirm the therapeutic properties claimed by informants.

Declarations

Authors' contributions

All authors participated in the Data analysis, PB conceptualized the study and wrote the manuscript, BN supervised this ethnobotanical project and helped in plant identification while RM helped in editing the manuscript and participated in carrying out the field work. All authors read, revised and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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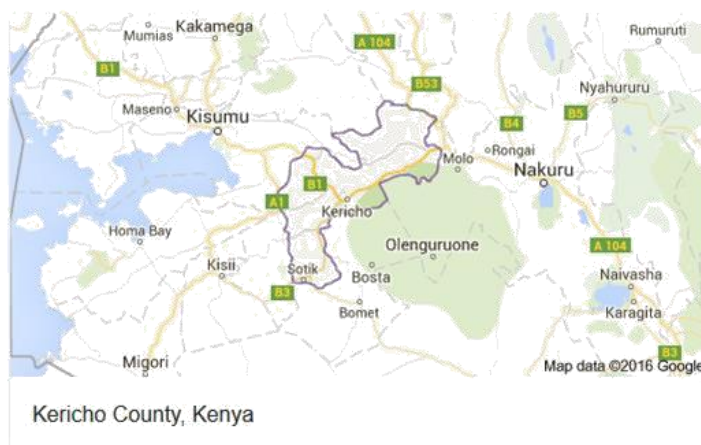


Figure 1: Map of Kericho County

Legend sect

