Diversity and utilization of antimalarial ethnophytotherapeutic remedies among the Kikuyus (Central Kenya)
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Abstract
Plants in Kenya are becoming increasingly important as sources of traditional medicines. The World Health Organization (WHO) has estimated that malaria kills about 2.7 million people every year, 90% of who are from Africa. Malaria continues to be a national concern in Kenya as it plays a major role in the high mortality rates being experienced currently. The use and miss-use of chloroquine to prevent and treat falciparium malaria has led to widespread appearance of chloroquine resistant parasites in Kenya and other tropical countries. These factors and the rising costs of non-chloroquine drugs have made the local people to turn to traditional remedies for management of this menace.

This paper examines the current utilization of traditional plant medicines in managing malaria menace in Central Kenya. The results show both indigenous and introduced species are in use indicating traditional medicinal practices in this region are dynamic. In total 58 species in 54 genera and 33 families were identified. The family Rubiaceae was found to have the highest number of reported species. Use of the various taxa is compared between five districts within Central Province of Kenya. The commonest species in this pharmacopoeia are: Caesalpinia volkensii Harms, Strychnos henningsii Gilg, Ajuga remota Benth., Warbugia ugandensis Sprague and Olea europaea L. The first three species are used in all the five districts while the others are restricted in some of the districts. In 74% of the anti-malarial plant species reported in this study, the remedies are obtained in destructive manner and may need conservation measures to ensure sustainable utilization. The results of this study become a basis for selecting plants for further pharmacological and phytochemical studies in developing new and locally relevant anti-malarial agents.

Background
Malaria has continued to be a major global public health problem and a health concern in most African countries. It is thought that malaria is by far the most serious tropical disease causing one to two million deaths per year in Africa [1,2]. The World Health Organization (WHO) has estimated that about 2 billion people in over 100 countries are exposed to malaria [2]. The worsening economic situation of the Sub-Sahara African countries makes it difficult to expand modern health services hence effective low-cost delivery medical system is urgently needed [3].

In Kenya, malaria continues to be a national concern as it plays a major role in the high mortality seen in infants and
children. It is also responsible for abortion, premature
deliveries, growth retardation, low birth weight and ane-
mia [4-7]. In Kenya malaria is responsible for 30–50% out
patient treatments, 19% admissions and accounts for 8–
10 million treatments per year [8]. *Anopheles gambiae*
*and Anopheles funestus* are the primary vectors of malaria
in East Africa [9].

The use and miss-use of chloroquine to prevent and treat
*falciparum* malaria has led to widespread appearance of
chloroquine resistant parasites in Kenya and other tropi-
cal countries [2]. Kenya has a diverse climate and ecology,
which leads to a wide variation in malaria and subsequent
disease epidemiology [8]. This is complicated by the fact
that global warming may lead to expansion of areas in
which the ambient temperature and climatic conditions
are suitable for *Plasmodium transmission* [10]. Since
1988, malaria epidemics have occurred in multiple sites
in Kenya highlands. Climatic variability has been associ-
ated with some of the recent epidemics [6].

Kenya, through the division of malaria control (DOMC),
ministry of health has developed several strategies for
dealing with malaria. In regard to highland malaria for
example, management strategies have been proposed
which include, improved planning for the annual resur-
gent outbreak, augmented by simple central nationwide
early warning which is likely to lead to increased epidemic
preparedness [7]. Other key strategic approaches to
malaria control in Kenya include, case management, pro-
viding malaria prevention and control to pregnant
women, ensuring use of insecticide treated nets (ITNs) as
well as improving malaria preparedness and response
[11].

Despite these efforts the disease is still rampant, with over
170 million working days lost annually and treatment
unaffordable to many Kenyans [8]. Factors that make
malaria treatment unaffordable include, rising costs of
non-chloroquine drugs, high poverty levels as well high
prices of insecticide treated nets [12].

Some of the plants used in malaria control in Kenya are
used as repellants for the mosquitoes [13] while others are
taken, as medicines [14]. The drug resistant phenomenon
has created urgent need to search for new drugs and alter-
native medicines for malaria and other diseases in Kenya
[15]. Some of the plants used traditionally for malaria
treatment have been investigated for their efficacy with
positive results. The extracts tested in vitro have been
shown to be active against chloroquine (CQ)- sensitive
and resistant strains of *Plasmodium falciparum*. Such plant
extracts have been recommended for use as sources for
novel anti-malarial compounds to be used alone or in
combination with chloroquin [14]. The plants tested are
far too few. An often-limiting factor to these investigations
is lack of comprehensive ethnobotanical data to help
choose plant candidates for potency/efficacy tests.

Some ethnobotanical studies have been accomplished in
Kenya targeting the different people groups/tribes and
localities [16-26] among others. These studies cover vari-
ous aspects of plant utilisation by local communities in
Kenya. Studies however, on anti-malarial plants targeting
the Kikuyus have not been done.

Effort was made in this study to indicate the frequency of
mention of each anti-malarial plant species in the entire
survey as an estimation of agreement on use in this region.
The results provide data for further pharmacological and
phytochemical studies. Since the plant parts utilized in
preparation of anti-malarial remedies are reported in this
survey, it serves as an indication of species that may need further ecological assessment on their regeneration status.

**Methodology**

**Subjects and study area**

The Kikuyu people mostly occupy the Central Province of Kenya (Fig. 1), which is often referred to as the Kikuyu escarpment. Half of the 2.9 million Kenyans living within 5 km of the forest are in Central Kenya [27]. From the latest census (1998) the province has a population of about 3724159 people, of which, 1828616 are males and 1895543 are female. Farming is the main economic activity in the area with coffee and tea as the main cash crops.

This region has high population density and large concentration of forests, which are facing intense pressure due to over-utilization and hence medicinal plants may be disappearing before their uses are documented. Care was taken in this study however, to collect plants mentioned as useful anti-malarial remedies outside the forests. This is especially because non-forest species such as weeds are now known to be important sources of pharmaceuticals [28].

**Data collection and analysis**

Fieldwork was carried out between January, 2001-October, 2004 as part of a larger ethnobotanical work covering this region. To obtain the plants used traditionally for management of malaria, interviews were conducted using semi-structured questionnaires. Random sampling technique was applied in distributing the questionnaires. Before carrying out the interviews however, an oral consent was sought from every respondent.

A total of 59 respondents were interviewed, these included males and females that depended on wild plants as sources of anti-malarial medicines either for self-medication or for treating others among the Kikuyus. Prior to surveys in each area, a research assistant was identified who had grown up in the area and knew the people and the language well. The assistant accompanied the researcher during the interviews and was helpful in winning trust of the respondents as well as in explaining any hidden meanings. The Kikuyu word for malaria is almost the same as the English word and therefore it was easy to communicate to the local people the nature of the disease remedy under investigation. In some cases malaria was equated to fever and joint pains, plant records for such are not included in this study as they may not necessarily be anti-malaria remedies.

In the cases where the local people recommended specific persons as excellent in knowledge of traditional herbal medicines, such respondents accompanied the researcher to collect ethnobotanical specimens [29]. During such missions personal discussions on management of malaria through herbal preparations as well as local means of identifying anti-malarial plants were encouraged.

Various ethnographic skills were applied in the fieldwork such as direct observations of what the local people were using or selling in the markets, taking part in the local peoples activities such as weeding, medicinal plants harvests and gathering of wild fodder. Group interviews were sometimes carried out especially where there was need to

| Plant families with two or more species used in malaria treatment in Central Kenya. |
|---|---|---|---|---|---|---|---|
| Kambu District | Frequency | Maragwa District | Frequency | Murang’a District | Frequency | Nyeri District | Frequency |
| Caesalpinia volkensii | 7 | Caesalpinia volkensii | 12 | Caesalpinia volkensii | 4 | Olea europea | 6 |
| Rhoicissus tridentata | 5 | Fageropsis angolensis | 7 | Strychnos henningsii | 4 | Ajuga remota | 5 |
| Aloe kedongensis | 4 | Strychnos henningsii | 6 | Aloe lateritia | 4 | Strychnos henningsii | 5 |
| Ajuga remota | 3 | Penas longiflora | 5 | Ajuga remota | 4 | Rhannus prinoides | 3 |
| Senna didymobrya | 3 | Warburgia ugandensis | 5 | Zanthoxylum chalybeum | 2 | Azardrachta indica | 3 |

**Table 1: Most frequently mentioned plant species in management of malaria by district in Central Kenya.**

![Graph showing number of species per plant family](image-url)
Table 2: List Of Species Mentioned In This Study As Used For Malaria Management By Frequency Of Mention In Central Kenya

| Local name (Kikuyu) | Latin Name | Family Name | Number of times mentioned | Place cited |
|---------------------|------------|-------------|---------------------------|-------------|
| mubuthi/mucuthi     | Caesalpinia volkensii Harms | Caesalpinaceae | 37 | Kiambu, Maraga, Muranga, Nyeri & Thika |
| muteta              | Stychnos henningsii Gilg | Loganiaceae | 26 | Thika, Nyeri, Murang’a, Maraga, Kiambu |
| wanjiru             | Ajuga remota Benth | Lamiaceae | 18 | Kiambu, Muranga, Nyeri, Thika |
| Muthiga             | Warburgia ugandensis Sprague | Canellaceae | 11 | Kiambu, Maraga, Nyeri & Thika |
| Mutamayu            | Olea europaea L. | Oleaceae | 10 | Kiambu, Maraga & Nyeri |
| mukarakinga         | Rhamnus prinoides L. He’rit | Rhamnaceae | 8 | Nyeri, Maraga & Kiambu |
| mugware             | Fagopropis angolensis (Engl.) Dale | Rutaceae | 7 | Maraga |
| mugkenera           | Zanthoxylum chalybeum Engl. | Rutaceae | 7 | Maraga, Murang’a & Thika |
| mwinu               | Senna didymobotrya(Fresen.) Irwin & Barneby | Caesalpinaceae | 6 | Kiambu, Maraga & Nyeri |
| mugwanugu           | Aloe kedongensis Reynolds | Liliaceae | 6 | Kiambu & Thika |
| mwarubaine          | Azadirachta indica A.Juss. | Meliaceae | 6 | Kiambu, Murang’a & Nyeri |
| Muthura             | Rhus vulgaris Melkde | Anacardiaceae | 5 | Maraga |
| Muhindahindi        | Trimeria grandifolia (Hochst.) Warb. | Flacourtiaceae | 5 | Thika, Nyer & maraga |
| kiiruma             | Aloe lateriting Engl. | Liliaceae | 5 | Maraga & Murang’a |
| Muhuti              | Erythrine abyssinica DC | Papilionaceae | 5 | Maraga |
| Muhuha              | Pentas longiflora Oliv. | Rubiaceae | 5 | Maraga |
| Mutimutu            | Citrus aurantiifolia (Christm.) Swingle | Rutaceae | 5 | Maraga |
| Munderendu          | Teclea simplicifolia (Engl.) Verdoorn | Rutaceae | 5 | Maraga |
| Munjuga Iria        | Clerodendrum myricoides (Hochst.) Vatke | Verbenaceae | 5 | Maraga & Nyeri |
| ndurutta             | Rhoicissus tridentata (L.f.) Wild & Drummond | Vitaceae | 5 | Maraga |
| Ruithiki/Ruithiki   | Lantana camara L. | Verbenaceae | 4 | Murang’a & maraga |
| Mukawa              | Canssa edulis (Forsk.)Vahl | Apocynaceae | 3 | Maraga & Murang’a |
| Gakuminini          | Schkuhria pinnata (Lam.) Thell. | Asteraceae | 3 | Thika & maraga |
| muthuthi            | Myrtens senegalensis (Lam.) Exell. | Celastraceae | 3 | Maraga |
| muthima mburi       | Clita abyssinica Jaub. & Spach | Euphorbiaceae | 3 | Maraga |
| Maruru              | Talhonia diversifolia (Hems.) Gray | Asteraceae | 2 | Thika & Maraga |
| gakungui            | Guccis aculeatus Cogn. | Cucurbitaceae | 2 | Kiambu |
| gacuki              | Oaumun kilimanjaricax Guaerke | Lamiaceae | 2 | Murang’a |
| muthaieti           | Ooetia usumbarense Engl. | Lamiaceae | 2 | Maraga & Nyeri |
| mubau               | Eucalyptus globulus Labil. | Myrtaceae | 2 | Maraga & Nyeri |
| Mwikunya            | Scutia myrtina (Burm.f.) Harms | Rhamnaceae | 2 | Maraga |
| muthathi            | Cassipourea malosana (Bak.) Atlon | Rhizophoraceae | 2 | Thika |
| Muiri               | Prunus africana (Hook. f.) Kalkm. | Rosaceae | 2 | & Thika |
| mururue             | Toddalia asiatica (L.) Lam. | Rutaceae | 2 | Nyeri & maraga |
| muthithi            | Osyris lanceolata Hochst. & Steudel | Santalaceae | 2 | Kiambu |
| thabai              | Urtica massaica Milbr. | Urticaceae | 2 | Kiambu |
| muthigiu            | Rhus natalensis Krauss | Anacardiaceae | 1 | Murang’a |
| Muimbathunu         | Periploca lineanfollia Dill. & A. Rich. | Asclepiadaceae | 1 | Thika |
| mukungugu           | Commiphora emini Engl. | Burseraceae | 1 | Murang’a |
| Mahuthia            | Kalanche laceolata (Forsk.) Pers. | Crassulaceae | 1 | Thika |
| mukinduri           | Croton megacarpus Del. | Euphorbiaceae | 1 | Maraga |
| kariria             | Euphorbi tricall L. | Euphorbiaceae | 1 | Maraga |
| kayiba              | Doywall coffra (Hook. F. & Herv.) Warb | Flacourtiaceae | 1 | Kiambu |
| mukambura           | Doywall abyssinica A. Rich | Flacourtiaceae | 1 | Maraga |
| muthigiria          | Hydnora abyssinica Schweinf. | Hydnoraceae | 1 | Murang’a |
| mutoo               | Azanza gaskellana (F. Hoffm.) Excell & Hillcoat | Malvaceae | 1 | Maraga |
| mukuriahungu        | Ekebergia capensis Sparrm. | Malvaceae | 1 | Maraga |
| Mucugu              | Cajanus cajan Milsp. | Papilionaceae | 1 | Maraga |
| Mwaritha            | Dalbergia lactea Vatke | Papilionaceae | 1 | Thika |
| hondo               | Passiflora ligularis A.Juss. | Passifloraceae | 1 | Kiambu |
| munyamati           | Pittosporum lanatum Hutch. & Bruce | Pittosporaceae | 1 | Nyeri |
| ngukura             | Rhamnus staddo A. Rich | Rhamnaceae | 1 | Nyeri |
| Mugukuma            | Keesta gueinzl (Son) Bridson | Rubiaceae | 1 | Maraga |
| mugwaua             | Zanthoxylum usambarense (Engl.) Kokwaro | Rutaceae | 1 | Maraga |
| Muba                | Poppea capensis (Spreng) Eckl. & Zeyh. | Sapidaceae | 1 | Maraga |
| murumbae            | Withania somnifera (L.) Dunal | Solanaceae | 1 | Maraga |
| mutura              | Solanum acaulastrum Dunal | Solanaceae | 1 | Maraga |
| mutambi             | Cyphostemma maranguense (Gilg) Desc. | Vitaceae | 1 | Maraga |
identify most preferred anti-malarial herbal remedies in the study area [30].

Fieldwork for this study concentrated on five main districts in Central Kenya: Kiambu, Maragwa, Murang’a, Nyeri and Thika. This was a purposeful sampling of the districts as the other two districts not sampled (Nyandarua and Kirinyaga) were found to be uniquely different from these five. Nyandarua district, for example was formally an area occupied by white settlers and has only recently been occupied by local communities when the land was sub-divided. Kirinyaga district comprises of a group of Kikuyu people with a different dialect and are likely to have different indigenous knowledge form the other districts.

Data on plant species and families, parts used, plant habit, the vernacular name and district were entered in excel worksheets and frequency of each species worked out (Table 2). Voucher specimens were collected and are preserved at the Jomo Kenyatta University herbarium, Botany department while duplicates will be sent to the East African Herbarium (EA). Plant identifications were done partly by the first author and partly by Mr. Simeon Mathenge, a botanist at the university of Nairobi Herbarium.

Results

In total 58 species in 54 genera and 33 families were identified as anti-malarial herbal remedies in this region (Table 2). The commonest species in this pharmacopoeia are: Caesalpinia volkensii, Strychnos henningsii, Ajuga remota, Warbugia ugandensis and Olea europaea. The first three species are used in all the five districts while the others are restricted in some of the districts.

Based on frequency with which the respondents mentioned the anti-malarial species, it was possible to establish the five most important species for each district (Table 1).

Of the families mentioned in this study the Rubiaceae had the highest number of species used in the treatment of malaria in Central Kenya. Thirteen families had at least two species mentioned as important in malaria treatment (Fig. 2).

Various parts of the plants were utilized in preparation of anti-malarial herbal remedies in this area. In majority of the species (34%) the medicines were obtained from the roots (Fig. 3). Except for plants where the drugs are obtained from leaves the use of fruits, bark or uprooting the whole plant of a given species were found to be destructive means of obtaining the anti-malarial herbal remedies. Results from the habit of anti-malarial species shows that 77% of the anti-malarial herbal remedies are obtained from trees and shrubs (Fig. 4).

The number of cited anti-malarial plant species varied between districts (Fig. 5). The highest number of plant species was cited in Maragwa district while the other districts had almost equal numbers.

Maragwa is classified as one of the districts with endemic malaria whiles the other districts may not have much malaria transmission throughout the year. People in Maragwa unlike the other districts may be more knowledgeable about the anti-malarial plant species. Since this is a major health challenge in the area using local plant resources may be one way this people are dealing with the problem.
Discussion and Conclusion

Malaria continues to be a major health challenge in Kenya especially due to resistance of Plasmodium to the drugs in use currently. The results of this study show both indigenous and introduced species are in use for malaria treatment. This may indicate that traditional medicinal practices in this region are dynamic. The information on frequently utilized anti-malarial plant species (Table 2) is an important lead to the species that can be targeted for further phytochemical analysis. Since there is no safer, effective and cheaper anti-malarial remedies than chloroquine [31] in the treatment of malaria, development of new anti-malarial drugs especially from plant sources may be the way forward in dealing with global drug-resistant problems of malaria.

There are species, which were commonly cited in this study that are also known to be used as sources of anti-malarial remedies in other parts of Africa. These included: Azadirachta indica, Eucalyptus globulus, Ocimum gratissimum, Azanza gackeana and Warburgia ugandensis. [32] Other studies have shown that active substances have been obtained against Plasmodium sp., for example, o-Naphthoquinones have been isolated from Azanza gackeana with demonstratable anti-malarial activity [4]. Consequently, further studies could investigate anti-malarial activity of the active substances likely to be isolated from the plant species identified form the current study.

Some of the species cited in this study are also used for management of Malaria outside the African continent, these include Eucalyptus globulus and Citrus aurantifolia, which are popularly used anti-malarial plants in Brazil [2]. This study revealed however, some very popular anti-malarial plant species in this region that may not be popular in other regions. These include: Strychnos hemmensii, Caesalpinia volkensii, Senna didymobotrya, Fagaropsis angolensis, Zanthoxylum chalybeum, Rahmnus prinoides, Olea europaea, Aloe kedongensis, Trimeria grandifolia, Teclea simplicifolia, Rhus vulgaris, Rhoicissus tridentata, Pentas longiflora and Ajuga remota.

Studies from other regions of Africa indicate the family Rubiaceae to have many species used in malaria management in different countries [33]. The current study however, has revealed other hitherto undocumented anti-malarial species that could be new records for this ailment.

The parts utilized show that most of the anti-malarial drugs (74%) are obtained from fruits, barks, roots and sometimes the whole plant is uprooted and used in the preparation of the drugs. This calls for conservation measures to facilitate sustainable utilization of these plant resources. Some of the anti-malarial tree species for example, Warburgia ugandensis are already known to be over-exploited and in some parts of Kenya rare [34].

Investigations into plants in the region with repellent abilities or fatal effects on mosquitoes need to be investigated for development of drugs that can eradicate or minimize these malaria vectors. Investigation of anti-malarial remedies in the districts of Central province that were not covered in this study is recommended. Ecological studies on regeneration of these plant species may form an interesting study which could provide data on management of these species for sustainable utilization.

The local community of Central Kenya is the owner of the traditional knowledge presented in this paper, consequently any benefits that may accrue from the use this knowledge must be shared with them.

Acknowledgements

The authors acknowledge financial support of BIOTA East Africa during the fieldwork. Technical support in identifying of plant specimens by Mr Simeon Mathenge of Nairobi University Herbarium is here acknowledged. We also thank all those people of Central Kenya who shared their information during the fieldwork surveys.

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