



Ethnomedicinal Survey of Medicinal Plants Traditionally Used in Ogurugu Community Southeast Nigeria for the Treatment of Malaria

Cletus .A. Ukwubile*, Otal Otal, Umar Abdulrahim, Alexander .E. Angyu, Y.K. Aliyu⁵, Salihu Njidda, Mathias. S. Bingari

ABSTRACT

Malaria is described as a disease that is caused by a protozoan parasite of the genus Plasmodium. The parasites are transmitted to humans through the bites of an infected vector the female Anopheles mosquitoes. There are about 100 million estimated cases of malaria resulting in more than 300,000 deaths annually in Nigeria. This figure is high when compared to deaths from infectious diseases like HIV/AIDS. Maternal mortality from malaria fever alone is estimated at 11%. Despite preventive measures to avoid mosquito bites by use of insecticide-treated nets (ITN), and chemotherapy such as the use of artemisinin combination therapy (ACT), very little results were achieved, as the parasite seems to have developed resistance to these measures. This study was aimed at surveying medicinal plants used in folk medicine by the Ogurugu community Southeast Nigeria for the treatment of malaria. Traditional medicine practitioners, native herbalists, traditional healers, and product marketers were interviewed orally and the use of 200 structured questionnaires on the plants used to treat malaria as well as medicinal plants used for the treatment. Morphological parts of fifty-four (54) plant species from thirty-two (33) families were collected in the survey. Only 30 % of the plants surveyed were reported to have antimalarial activities against Plasmodium berghei. Family Asteraceae have the highest number of species diversity with 11.54 % (6), followed by Family Annonaceae with 9.62% (5) and Family Euphorbiaceae with 5.77% (3), whereas Amaranthaceae, Anacardiaceae, Humiriaceae and Sterculiaceae Families have each 3.85 % (2) species diversity. Other Families have 1.92 % (1) species distribution. A decoction of the leaves was the popular way of using plant parts in malaria treatment. The study revealed that people in this community believe strongly on the efficacies of these medicinal plants than orthodox drugs in treating malaria, with no serious side effects. Despite these successes recorded in the use of these plants as antimalarial, there are challenges in terms of conservation of species due to urbanization encroachment. These plants, therefore, represent another source for antimalarial drug discovery.

Keywords: Ethnomedicinal; malaria; medicinal plants; Ogurugu; Southeast Nigeria.

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Introduction

Malaria is the main cause of deaths in Nigeria and West Africans. It is reported to be endemic in about 100 countries in the world [1]. The Federal Ministry of Health (FMOH) Nigeria, reported in 2018 that Nigeria is has world's greatest malaria burden, with estimated population of about 51 million cases and approximately 207,000 deaths reported yearly [2]. This figure represent an approximate value of 30 % of Africa's total malaria burdens whereas about 97 % of the total population corresponding to approximate value of 173million people is at risk of the infection [2,3]. This infection is considered a main public health epidemic in Nigeria because, it is responsible for more deaths in the country (Nigeria) than in any other country of the world. Pregnant women, children below the age of five years, HIV/AIDS patients, and immigrants have the highest risks of contracting malaria. Malaria has been reported to kill children under the age of years every two minutes, and it accounts for about 11 % maternal mortality in Nigeria [4].

Malaria infection is usually caused by a protozoan parasites *Plasmodium* that are transmitted to humans through the saliva from the bites of an infected female mosquito of the genus *Anopheles*. This parasite has the following species: *Plasmodium falciparum*, *P. ovale*, *P. vivax*, and *P. malariae*, each of which can cause on form of malaria or the other. The bites by this species of mosquito often make its host very uncomfortable to sleep due their noises especially at night times. The injection of the gametocytes of the *Plasmodium* parasites into the body results in the migration of malaria parasite into the liver for continuation of its life cycle that lasts for up to 78 hours. Various preventive measures have been put in place to eradicate this incidence in Nigeria through various government's initiative programme such as Malaria Eradication Programme (MEP) and Roll Back Malaria Programme (RBMP) by the FMOH, Nigeria. Some of these measures include awareness campaign such as

maintaining clean environment to deny mosquitoes access to breeding site, sleeping under insecticide-treated bednets, avoid places with dense population of mosquitoes especially in the tropics, use of insect-sprays to kill or repel mosquitoes before sleeping, and chemotherapeutic measures such as the use of artemisinin combination therapy (ACT), and antimalarial drugs [5].

Nevertheless, despite the above preventive and treatment measures, malaria still persist in Nigeria with over 80 % of deaths (more than that of HIV/AIDS combined). The species of the parasite called *Plasmodium falciparum* seem to have developed resistance to the present antimalarial drugs in pharmaceutical outlets in Nigeria and other African countries where malaria is prevalence [6]. Because of this resistances to conventional antimalarial drug by the parasites, many Nigerians especially those in the rural areas with estimated population of 120 million, result to the use of herbal plants to treat malaria. Their trust in the efficacies of these medicinal plants were quite high. It is believed that no any form of resistance will emerge in the use of herbal plants to treat malaria infection by the villagers. Among the rural communities in Nigeria is Ogurugu. It is a community located in Enugu State Southeast Nigeria with a population of about 1 million people. The major occupations of Ogurugu people are farming of cash crops such as rice, maize, guinea corn, groundnut, cassava, cocoa, banana, plantain as well as fishing. Ogurugu is bordered in the east by Odolu (in Kogi State), and West by River Anambra. About 40 % of the land area is occupied by waters (streams, lakes, ponds and rivers). The presence of these waters and high vegetation in the community favour mosquito the vector of malaria parasite in their breeding sites. In Ogurugu community, the use conventional antimalarial drugs to treat malaria infection is seen as time-wasting; since the villagers believed in the superiority of herbal and medicinal plants preparations over the former.

The use medicinal plants to treat malaria in Africa and in areas where the epidemic is well pronounced had gained global recognition. For instance, in 2006 artemisinin was derived from a medicinal plant called *Artemisia annua* (Asteraceae) a Chinese plant [7-10]. Since then, there are over 1000 compounds with antimalarial activities isolated from various

morphological parts of medicinal plants. There are many medicinal plants use to treat malaria infection for decades before the advent of orthodox medicines, and these plants are still being used with 100 % parasites eradication [11,12,13]. This present study was therefore carried to survey the plants use in traditional medicine to treat malaria in Ogurugu community.

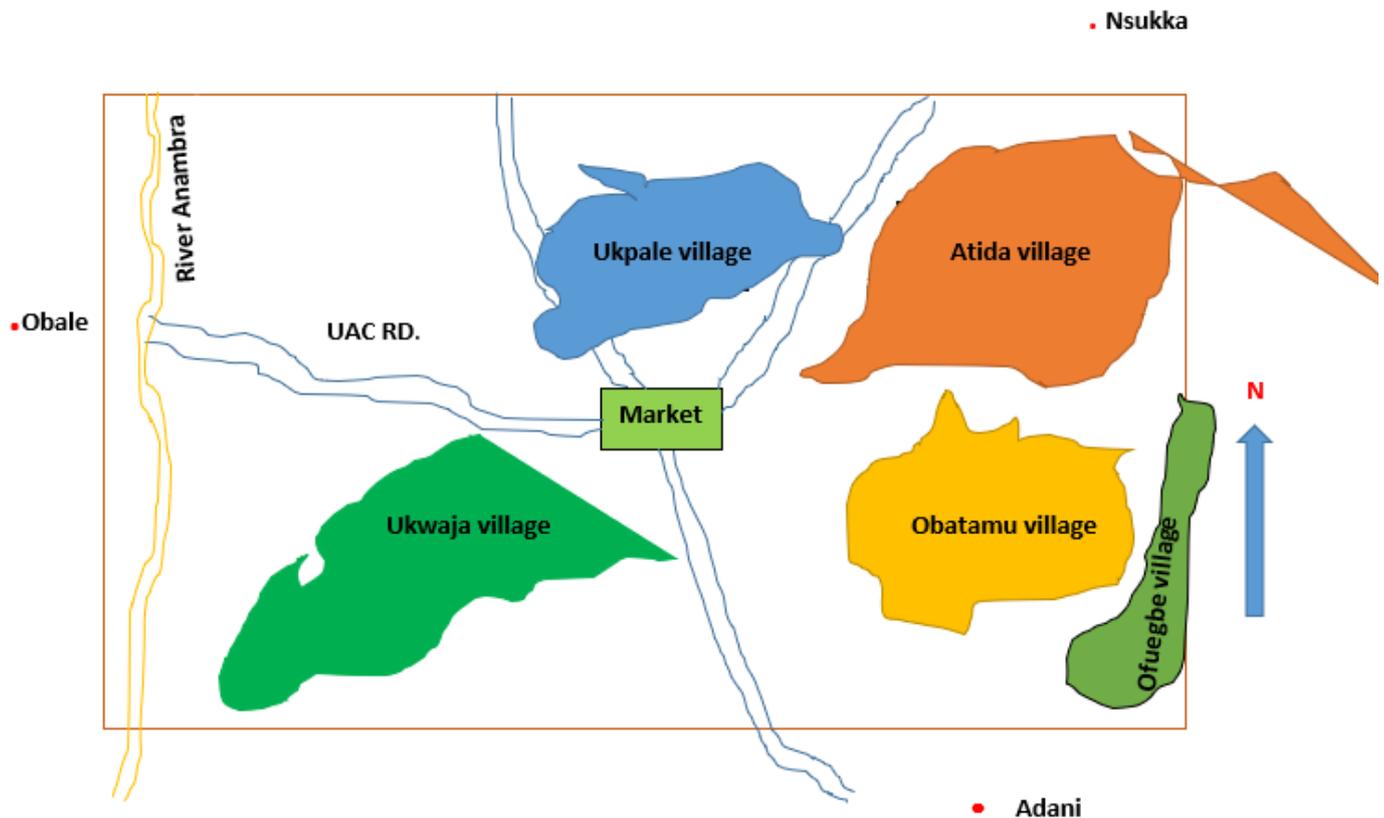


Plate 1. Map of Ogurugu showing major villages. (Source: The researchers).

Materials and methods

The study area

Ethnomedicinal surveys of medicinal plants use for the treatment of malaria were carried out in December, 2018 in Ogurugu community in Uzo-Uwani Local Government Areas Enugu State, Nigeria. The community comprises nine villages with many clans, and it is being ruled by community Chief. The villages are: Achanya, Atida, Edeejor, Obatamu, Ofuegbe, Ofuloko, Okpotopu, Ukpale and Ukwaja. The total land area is about 1000 km². Annual rainfall is 500 mm³ per year with heavy thunder cloud. Official languages in the community are Igala and Igbo as well as Pidgin English.

Plant collection and identification

Various parts of the plants were collected by the help of traditional medicine practitioners in different villages in the community. Each plants were collected at different time of the day according to the herbal use of the plants. Plants were collected, pressed and identified in the Department of Biological

Sciences, Taraba State University Jalingo, Taraba State. On spot identification of some of the plants were made using PlantSnap software in conjunction with field guide textbooks [9].

Oral interviews and questionnaires

Fifty herbal/traditional medicine practitioners in the community ages 30-85 years were interviewed on the plants use for malaria treatment, parts of plants used, methods of preparation, efficacy of herbal preparation over orthodox antimalarial drugs, and conservation status of the plants used. Also, 200 structured questionnaires were designed and issued to semi-literate and well educated one members of the community on use of herbal medicine for the treatment of malaria.

Data collection

Data of plants used to treat malaria in Ogurugu community were obtained through oral interviews from the herbalists, traditional medicine practitioners, traditional healers, community leaders and herb sellers with an average age of 30 years as well as by using phone record, and semi-structured questionnaires.

Statistical analysis

Raw data collected obtained from the study were expressed as mean±SE of original data using SPSS statistical software version 23. Statistical significance differences were determined using analysis of variance (one-way ANOVA) at $p \leq 0.05$.

Results

Distribution of antimalarial plants in Ogurugu community: The results in table 1 and Fig.1 showed that of the 54 plants species and 33 families surveyed, members of the Family Asteraceae has the highest percentage of usage (11.54 %), followed by Family Annonaceae (9.62 %) and Euphorbiaceae (5.77 %) while the Family Anacardiaceae has 3.85 % usage rate in malaria treatment. All other Families have 1 -2 % rate of use.

Table 1.

Medicinal plants used to treat malaria in Ogurugu community

Family	Species	Local name	Parts used
Amaranthaceae	<i>Cyathula prostrata</i>	Ajuto (I)	Whole plant
	<i>Aerva javanica</i>	Alhaji (H)	Whole plant
Anacardiaceae	<i>Mangifera indica</i>	Mangoro (I, Y), Mangworo (H),	Leaves
	<i>Spondias mombin</i>	Echikara (I), Tsadar masar (H), Akika (Y)	Leaves
Annonaceae	<i>Annona senegalensis</i>	Uburu ocha (I), Gwanda daji (H), Abo (Y)	Leaves
	<i>Cleistopholis patens</i>	Ojo(I), Apako(Y)	Stembarks
	<i>Uvaria chamae</i>	Mmimi(I), Ejuru(Y)	Roots, Leaves
	<i>Dennettia tripetala</i>	Ose ufu (I)	Leaves
	<i>Enantia chloranta</i>	Uto-erumeru (I)	Stembarks

Apocynaceae	<i>Alstonia boonei</i>	Akpu (I), Ejuru (Y)	Bark, Leaves
	<i>Adenium obesum</i>	Kariya (H)	Stembarks
	<i>Holarrhena floribunda</i>	Inoli (I), Bakin mutum (H), Irena (Y)	Leaves
	<i>Picralima nitida</i>	Osu-igwe (I)	Seeds, Barks
Asteraceae	<i>Saba florida</i>	Kwarangaa (H)	Stembarks
	<i>Emilia sonchifolia</i>	Nti-ele (I)	Leaves
	<i>Vernonia migeodi</i>	Onugbo-ohia (I), Orungo (Y)	Leaves
	<i>Vernonia amygdalina</i>	Onugbo (I), Shiwaaka (H), Ewuro (Y)	Leaves
	<i>Chromolaena odorata</i>	Obiara-ohuru (I),	Leaves
	<i>Vernonia cinerea</i>	Ahikia-okpo (I), Orungo (Y)	Whole plant
	<i>Ageratum conyzoides</i>	Agadi-isi awo (I), Ako-yunyun (Y)	Leaves
Bignoniaceae	<i>Newbouldia laevis</i>	Ogilishi (I), Aadurukuu (H), Akoko (Y)	Leaves, Roots
	<i>Spathodea campanulata</i>	Imi-ewu (I), Oruru (Y)	Stembarks
Bombaceae	<i>Adansonia digitata</i>	Ubobo (I), Kuuka (H), Ose (Y)	Stembarks
Burseraceae	<i>Boswellia odorata</i>	Ararabii (H)	Leaves
Caesalpinaceae	<i>Dialium guineense</i>	Icheku (I), Tsamiya kurmi Awin (Y)	Leaves, Fruits
Capparidaceae	<i>Gynandropsis gynandra</i>	Oyiliakpu (I), Ekuye (Y)	Roots
Capparaceae	<i>Capparis tomentosa</i>	Kabdarai (H)	Leaves, Flowers
Conneraceae	<i>Byrsocarpus coccineus</i>	Kasa	Leaves, Stembarks
Cucurbitaceae	<i>Lagenaria siceraria</i>	Karuguna (H)	Stembarks
Euphorbiaceae	<i>Bridelia micrantha</i>	Ogaofia (I), Araasa (Y)	Leaves
	<i>Euphorbia hirta</i>	Ogbu-ani (I), Nonan kurchiya (H), Egele (Y)	Whole plant
	<i>Scurinega virosa</i>	Njisi-nta (I), Gussu (H), Ranje (Y)	Leaves
Fabaceae	<i>Acacia polyacantha</i>	Karki (H)	Stembarks, Roots
Humiriaceae	<i>Sacoglottis gabonensis</i>	Ncha-ntala (I)	Barks
	<i>Vigna oleifera</i>	Karatsiki (H)	Leaves
Labiatae	<i>Hyptis suaveolens</i>	Nchanwu-ohia (I), Jogbo (Y)	Leaves
Lecythidaceae	<i>Pterianthus macrocarpus</i>	Anwushi (I), Osun-pupa (Y)	Stembarks, Leaves

Liliaceae	<i>Aloe barteri</i>	Alovera	Leaves
Loranthaceae	<i>Englerina gabonensis</i>	<i>Kauci</i> (H)	Leaves
Menispermaceae	<i>Cocculus pendulus</i>	<i>Opa-yegeyege</i> (I)	Roots
Meliaceae	<i>Azardirachta indica</i>	<i>Dogoyaru</i> (I)	Whole parts
Mimosoideae	<i>Pentaclethra macrophylla</i>	<i>Ukpaka</i> (I), <i>Apara</i> (Y)	Barks
Moraceae	<i>Artocarpus heterophyllus</i>	<i>Ukwa-oyibo</i> (I)	Roots
Musaceae	<i>Ensete gillettii</i>	<i>Ayabar daajii</i> (H)	Roots
Myrtaceae	<i>Eucalypus globulus</i>	NK	Leaves
Papilionaceae	<i>Crotolaria retusa</i>	<i>Akidi-umuaka</i> (I), <i>Alatun-unse</i> (Y)	Leaves,Roots
Poaceae	<i>Aristida sieberiana</i>	<i>Katsaura</i> (H)	Whole plant
	<i>Cymbopogon citratus</i>	<i>Ahiha-oyibo</i> (I)	Leaves
Rubiaceae	<i>Morinda lucida</i>	<i>Ogere</i> (I)	Leaves
Rutaceae	<i>Citrus sinensis</i>	<i>Oloma</i> (I), <i>Lemu</i> (H)	Leaves
Sapotaceae	<i>Chrysophyllum abbidum</i>	<i>Udara</i> (I)	Stembarks
Sterculiaceae	<i>Cola hispida</i>	<i>Ohala-mmuo</i> (I), <i>Atewo-edun</i> (Y)	Young leaves
	<i>Sterculia setigera</i>	<i>Kukuri</i> (H)	Barks
Verbenaceae	<i>Stachytarpheta jamaicensis</i>	<i>Ogwo-iba</i> (I), <i>Orupupa</i> (Y)	Aerial parts

Note: I (Igbo), H (Hausa), Y (Yoruba), NK (not known).

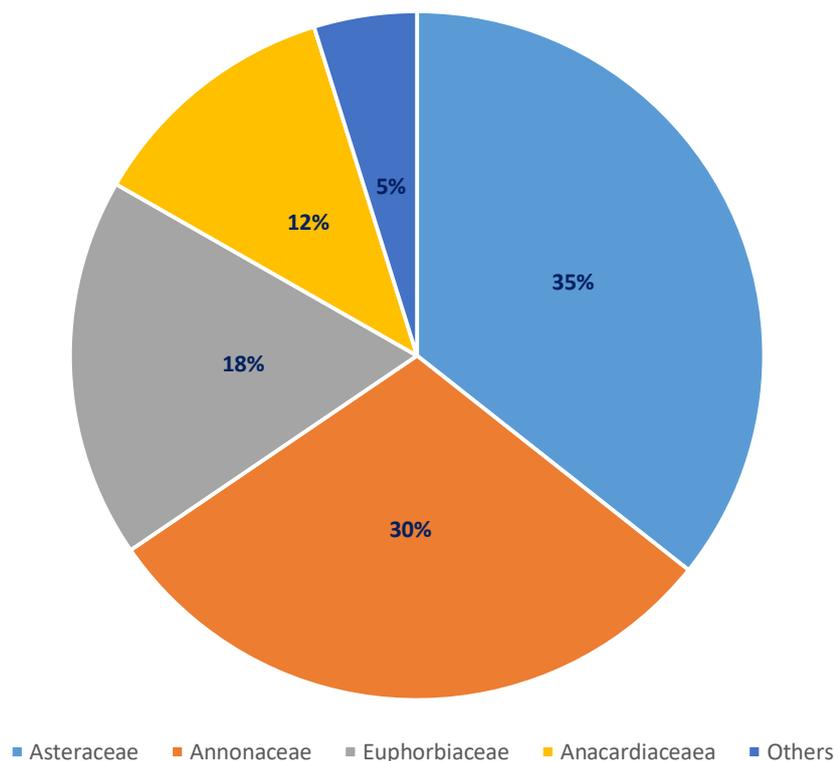


Fig.1. Distribution of antimalarial plants according to their families.

Parts of plant often used for antimalarial drug preparation in Ogurugu community: From the results of the present study, treatment of malaria in the community is mostly done using the leaves (48%) followed by preparation from the

stembarks (19%). The use of the barks, aerial part and seeds of plants are the least methods adopted for the treatment of malaria in Ogurugu community (See fig. 2).

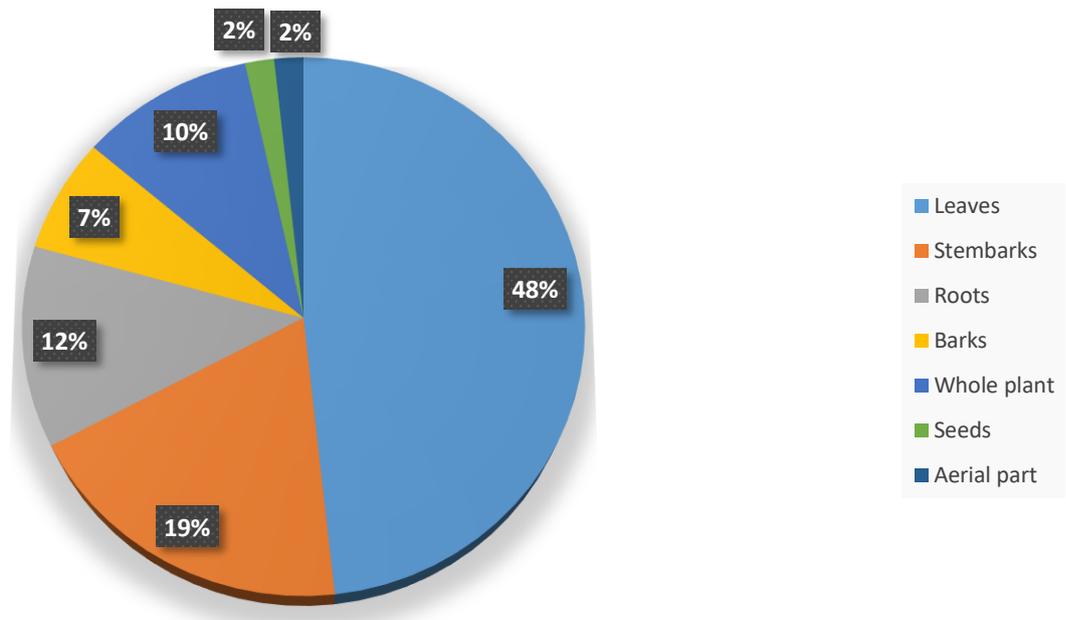


Fig. 2. Distribution of antimalarial plants according to the parts used.

Ecological features of surveyed antimalarial plants in Ogurugu: The results showed that of the 54 antimalarial plants surveyed in Ogurugu

community, 18% are shrubs, 15% are trees, 14% are herbs and 5% are lianas (See fig. 3).

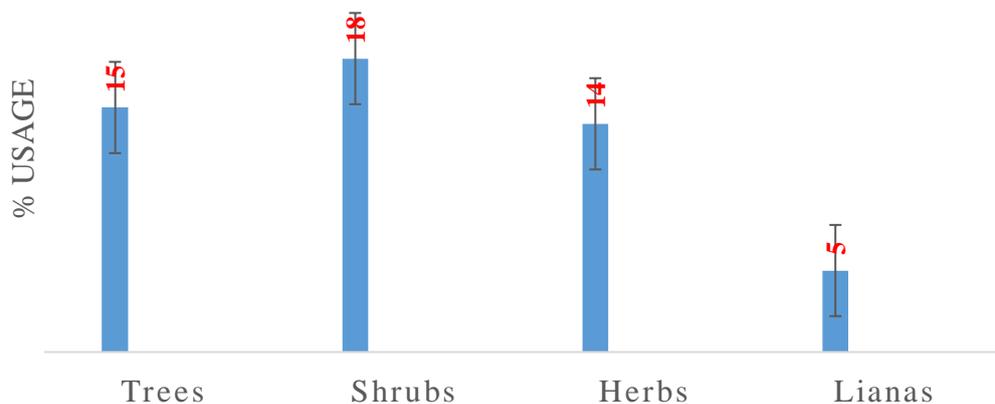


Fig. 3. Distribution of surveyed antimalarial plants according to ecological characteristics.

Mode of preparation of antimalarial medicinal plants: Figure 4 below showed that 38% of the preparation was decoction of leaves, stembarks, roots or barks while 28% is by powder. 22% of the preparation is by infusion

while only 12% is by bathing. The use of any method of preparation largely depends on the plant and the burden of malaria infection in the sick person.

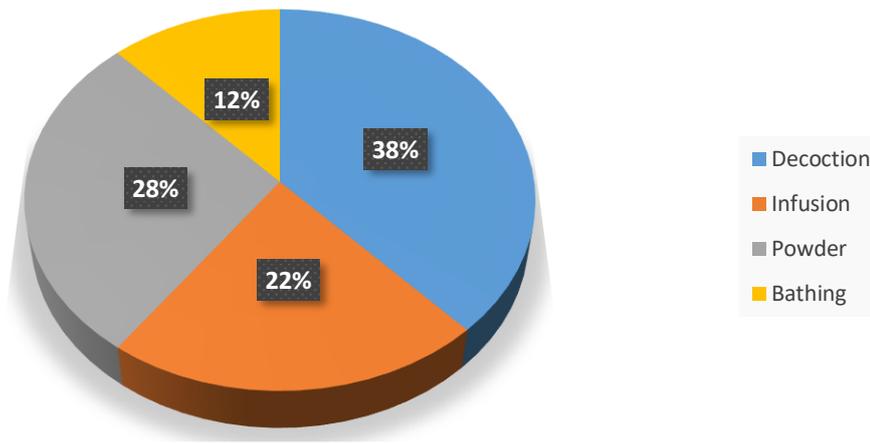


Fig.4. Mode of administering surveyed antimalarial medicinal plants.

Habitudinal description of surveyed antimalarial herbal plants in Ogurugu: The results in figure 5 below showed that 48.2% of the antimalarial plants in Ogurugu community are collected from the wild, 23.21% are

cultivated in various gardens at home while 18.76% are both wild and cultivated. Also, 4.5% of these plants are neither wild nor cultivated but are emergence in wild, home or water.

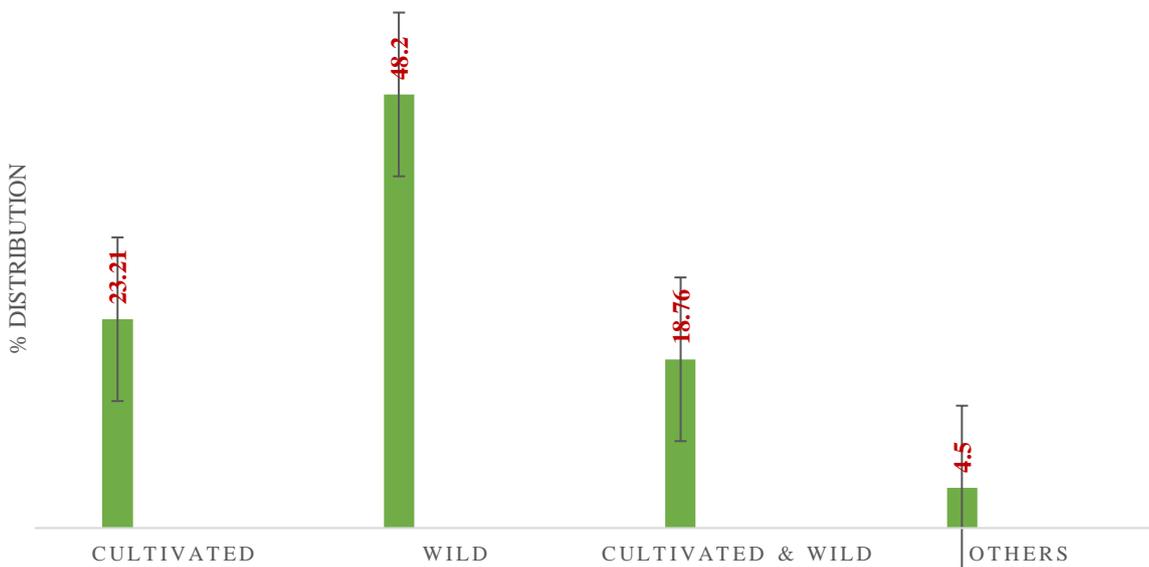


Fig.5. Habitat distribution of surveyed antimalarial plants in Ogurugu community.

Perception of people in the community about various antimalarial drugs: Results in figure 6 below showed a strong trust in the efficacy herbal medicinal plants with 28% agreeing that herbal medicinal plant preparations are more potent in eradicating malarial protozoan parasite

from the blood, 25% believed that herbal medicinal products are very good while 23% believe in the efficacy of conventional antimalarial drugs in eradicating malarial parasites.

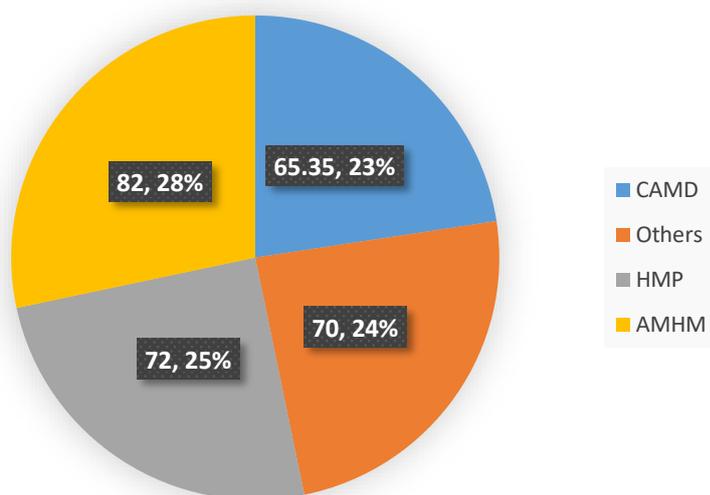


Fig. 6. Perceptions of people about use of conventional medicines for malaria treatment. CAMD (conventional antimalarial drugs), HMP (herbal medicine products), AMHM (antimalarial herbal medicines).

Spatial distribution of respondents in surveyed area: The results table 2 showed that out of 200 questionnaires distributed, herbal medicine practitioners (HMP) has the highest number of 15 % response to the questions on use of herbal medicinal plants for malarial treatment followed by herbal sellers with 12.5 % respondents while malaria patients have 11 % respondents. Number of female respondents were 120 (60%) while males were 80 (40%). The average age of herbal medicine practitioners

was 30 years with maximum age 92 years. In terms of years of experience of practice of herbal medicine people with years of experiences 31-60 and 61-90 were 10 each. Herbal medicine practitioners with over 91 years' experience were 7 in number. Only 3 people had 10-30 years of experience in herbal medicine. Out of 200 sampled population in Ogurugu community, 60% were Christians, 37.5% were Idol worshippers while 2.5% were Islam believers.

Table 2.

Spatial distribution of respondents on knowledge of plants used for malaria treatment

<u>Index</u>	<u>Category</u>	<u>Number of respondents</u>
Interviewed	HMP	30 (15%)
	Herb sellers	25 (12.5%)
	Patients	22 (11%)
		N= 200
YEHMP	10-30	3 (3%)
	31-60	10 (33.33%)
	61-90	10 (33.33%)
	>91	7 (26.33%)
		n=30

AOHMP	<30	2 (6.33%)
	30-50	8 (26.33%)
	51-70	10 (33.33%)
	>71	10 (33.33%)
		n= 30
Sex	Males	80 (40%)
	Females	120 (60%)
		N=200
Beliefs	Christianity	120 (60%)
	Islam	5 (2.5%)
	Idol worshippers	75 (37.5%)
		N=200

HMP (Herbal medicine practitioners), YEMP (Years of experience of herbal medicine practitioners), HMS (Herbal medicine sellers), AOHMP (Ages of herbal medicine practitioners).

Distribution of antimalarial plants according to land areas in Villages of Ogurugu community: Results in figure 7 showed that most of the plants surveyed antimalarial medicinal plants used in Ogurugu community were not evenly distributed according to land areas of the nine Villages of the community.

From the results, there were more antimalarial plants in Atida Village with 25.1% distribution, followed by Ofuegbe Village with 24.34%, while Ukwaja Village had 22.5% distribution of antimalarial plants. The least distributions were surveyed in land areas of Achanya and Obatamu Villages with 6.7% and 8.2% respectively.

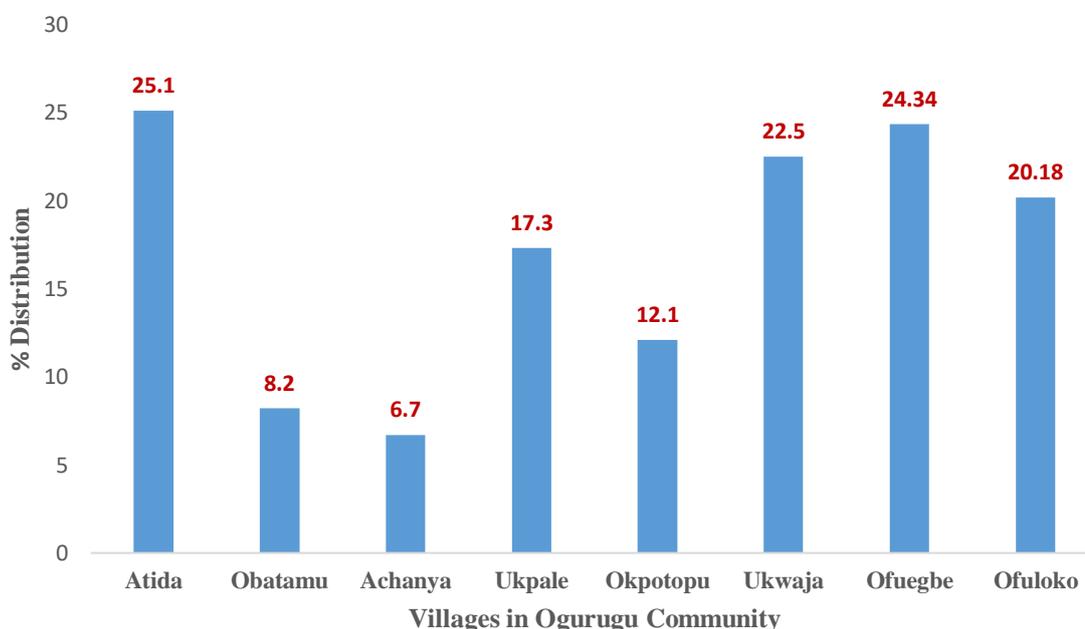


Fig. 7. Land areas distribution of surveyed antimalarial medicinal plants in Ogurugu

Reported surveyed antimalarial medicinal plants in Ogurugu community: Table 3 below showed that of the 54 plants surveyed, only 15 species from 9 families were extensively

reported to have antimalarial activities against various strains of plasmodium especially Plasmodium berghei both *in vitro* and *in vivo* studies. The rest of the plants were not fully or

never reported at all. Although, some were reported to have antiplasmodial activities in mixture of other plants. This survey does not consider such report as valid because, the main plant with such activity was not defined or singled out.

Table 3.**Surveyed antimalarial plants in Ogurugu community already reported**

Family	Plant	References
<i>Anacardiaceae</i>	<i>Mangifera indica</i>	10
<i>Annonaceae</i>	<i>Enatia chloranta</i>	11, 12
	<i>Uvaria chamae</i>	13
	<i>Annona senegalensis</i>	14
<i>Apocynaceae</i>	<i>Alstonia boonei</i>	11
		15
	<i>Picralima nitida</i>	11, 16, 17, 18
<i>Asteraceae</i>	<i>Vernonia amygdalina</i>	11
	<i>Chromolaena odorata</i>	18
	<i>Ageratum conyzoides</i>	18
<i>Bignoniaceae</i>	<i>Spathodea campanulata</i>	19, 20
	<i>Newbouldia laevis</i>	18
<i>Euphorbiaceae</i>	<i>Euphorbia hirta</i>	21
<i>Rubiaceae</i>	<i>Morinda lucida</i>	18, 22
<i>Rutaceae</i>	<i>Citrus sinensis</i>	11
<i>Poaceae</i>	<i>Cymbopogon citratus</i>	10, 18, 23

Discussion

It has been reported that malaria affects 3.3 billion people, or half of the world's population, in up to 106 countries territories. The world health organization (WHO) had estimated 216 million cases of malaria prevalence in 2010. Out of this, 81% were in the African region. It further estimated that, there were about 655,000 deaths due to malaria in 2010 [17-24]. Again, about 91% of these deaths occurred in African; 86% which were children under the age of 5 years. Malaria

has been described as the third leading cause of deaths for children under the age of 5 years globally, ranking after pneumonia and diarrheal disease [24].

Malaria is one of the major public health problems in Nigeria, where it accounts for more cases of deaths than any other disease in some countries in the world. In Nigeria, about 97% of the country's population is at risk of malaria due to environmental factors such as presence of collecting-waters in the gutters, bushes, lack of

proper drainages, nearness to waters like streams, rivers, ponds, and lakes, lack of insecticide-treated bednets, and heavy rainfalls in the tropical parts of the country. The remaining 3% of the population live in the malaria free highlands. The death cases resulting from malaria annually worldwide was put at 100 million with over 300,000 deaths annually in Nigeria. This figure when compared with 215,000 deaths resulting from HIV/AIDS annually is still on the high side. The highest prevalence of malaria with an estimated figure close to 50% in children ages 6 months and 3 years is in the South-west, North-central, and North-west regions of Nigeria. The prevalence rate of malaria in children within the ages of 6 months to 3 years was least with estimated figure of 27.6 % in the South-east region of Nigeria, and it contributed to an estimated 11% of maternal mortality in the region. The variation in prevalence in these regions was due to preventive and treatment measures adopted by the people of the regions especially, the use of herbal medicinal plants. Herbal medicines in had been included in pharmacovigilance systems due to the increase demand in the use of herbal medicines and herbal products for the treatment of diseases globally [25].

Ogurugu is a community in the South-east region of Nigeria whose populace believed so much in the efficacy of herbal medicines for the treatment of malaria. This type of trust in the use of herbal plants to manage and treat malaria is possibly prevalence in the region. Recently, it was reported that malaria parasite plasmodium showed some form of resistances to antimalarial conventional drugs especially the chloroquine-resistant species. Resistant to the use of herbal plants to treat malaria has not been reported, and these herbal plants are safe when taken as ethnomedicinal prescription for malaria [26].

In this current study, medicinal plants used for the treatment of malaria in Ogurugu community in South-east Nigeria were surveyed. The study revealed that out of the 54 plants species and 33 families surveyed, members of the family

Asteraceae were mostly used with 35% usage, followed by the families Annonaceae (30%), Euphorbiaceae (18%), Anacardiaceae (12%) while others have below 10% usage in malaria treatment in the community (Table 1; Fig.1.). Studies by Ukwubile *et al.* [26], on survey of anticancer plants in three local government areas of Taraba State also showed the family Asteraceae was mostly used for the treatment of cancers. It is possible that plants from this family (Asteraceae) are the popular used to treat most tropical diseases. Therefore, a focus into plants species from this family will lead to the discovery of very effective antimalarial drug with less resistance against malarial parasite (*Plasmodium*). The study also revealed three novel plant families Conneraceae (with a species *Byrsocarpus coccineus*), Humiriaceae (with *Sacoglottis gabonensis* and *Vigna oleifera*) and Menispermaceae (with *Cocculus pendulus*). This is the first time any members of these families will be reported to be used as antimalarial medicinal plants. Although, this claim by herbal medicine practitioners in Ogurugu community has not been scientifically verified, yet the use of these plants in the community are overwhelming. Most antimalarial drugs exhibit high pharmacological activities against *Plasmodium berghei*, *P. ovale*, *P. malariae*, *P. vivax* and *P. falciparum* according to their composition, doses, and route of administration. The leaves were the mostly used part with 48% usage, followed by the stembarks 19% and roots 12%. There are an overwhelming use of leaves of herbal plants for ethnomedicinal treatment of diseases such as malaria, cancers, typhoid, and diabetes as well as other common illnesses in South-east Nigeria and other regions of Nigeria. The predominant use of leaves as ethnomedicinal preparation for ailments (Fig.2) is due to the fact that most plants bioactive compounds are domicile in leaves than in other morphological parts of the plants [18, 28]. This report confirmed the use of leaves than any other parts of plant for the treatment of malaria in Ogurugu community. Similarly, most of the surveyed antimalarial medicinal plants were

shrubs (18%), followed by trees (15%), herbs (14%) while lianas had only 5% usage from the survey (Fig.3).

In this study, decoction of the plants which is boiling of the leaves, stembarks, roots, and whole plants is the major methods of preparation of these plant for administration with 38%. It was followed by use of powdered form with 28%, infusion method with 22% and bathing with herbal medicine preparation in hot water with 12% (Fig.4). The powdered parts of antimalarial plants are usually mixed with palp before taken by patients. In Nigeria, most of the plants used in the management and treatment diseases are collected from the wild. In this present study, 48.2% of plants used for the treatment of malaria in Ogurugu community are collected from the wild, 23.21% are cultivated in gardens at home while 18.76% exist in both wild and cultivated (Fig.5).

The use of medicinal herbs for the treatment of malaria had significant levels of acceptance and perceptions with 28% of the people agreed that antimalarial herbal medicines were more potent in treatment of malaria than conventional antimalarial drugs 23% (Fig.6), in this community cut across every religions and belief (Table 2), but there exist some variations in the distribution of surveyed plants across the nine villages that made up Ogurugu community with more antimalarial plants surveyed in Atida (25.1%), Ofuegbe (24.34%), and Ukwaja (22.5%) villages (Fig.7). This showed that there are no limitations to the use of herbal medicinal plants in the treatment of diseases in the community of which malaria inclusive. It is very interesting to say from this study that of all the fifty-four (54) plants species and thirty-three families surveyed in the community, only fifteen (15) plants from nine families were investigated and documented for their antimalarial and antiplasmodial activities against various strains of plasmodium *in vitro* and *in vivo* (Table 3). Many antimalarial compounds have been isolated from these plant families Asteraceae, Annonaceae, Euphorbiaceae, Apocynaceae, Rubiaceae,

Bignoniaceae, Rutaceae, Anacardiaceae, and Poaceae [18]. These compounds had displayed significant antimalarial activities especially against *Plasmodium berghei*.

This present study acknowledges the overwhelming use of herbal medicinal plants for the treatment of malaria due to their easy accessibility, low cost, easy way of preparations, low toxicity and availability. There is no doubts however, that there exist some limitations to the use of these plants such as doses, hygiene in herbal medicines, toxicity concern and acceptability in Nigerian health care system. Despite some of these limitations raised in this study, antimalarial herbal medicinal plants play crucial roles in reducing total malarial burdens in this community and most parts of Nigeria [14]. This is because of the occurrence of resistance to most conventional antimalarial drugs used in Nigeria. Some of these drugs are either adulterated or of low quality production, hence the result to use of herbal antimalarial drugs ethnomedicinally prescribed in various communities and villages in South-east Nigeria.

Conclusion

The study showed that there are many herbal medicinal plants used as antimalarial remedy in Ogurugu which are mostly shrubs whose leaves have potent bioactive compounds. These plants therefore, represent a source for new antimalarial drugs discovery if investigated further to scientifically ascertain their antimalarial claims. There is therefore, the need for conservation of these plants from urbanization encroachment in Ogurugu community. It is also recommended here that as with conventional medicines, herbal medicines have also its side effects, some of which may be adverse in nature. Some adverse cases reported in association with herbal medicines are linked with problems of quality assurances and hygiene. Major causes of such cases are adulteration of herbal medicines with other herbal products as well as potent pharmaceutical substances, such as corticosteroids and non-steroidal anti-

inflammatory drugs. Adverse cases may also arise from the mistaken use of the wrong species of medicinal plants, incorrect dosing, and errors in the use of herbal medicines both by herbal medicine practitioners and consumers, interactions with other medicines, and use of products contaminated with potentially hazardous substances, such as toxic metals, pathogenic microorganisms and agrochemical residues like fertilizers. Hence, for proper use of these antimalarial medicinal plants in health care systems, the above issue raised must be addressed to bring about sanity and global trust in use of herbal medicines and herbal products.

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