



# An ethnobotanical survey of Malaria-treating plants in Ado-Ekiti Local Government Area, Ekiti State, Nigeria

Chukwuma Deborah Moradeke, Chukwuma Emmanuel Chukwudi, Adekola Oluwapelumi Oluwadamilola

## Research

### Abstract

**Background:** The present study reports the indigenous knowledge of plants used for the treatment of Malaria in Ado-Ekiti Local Government Area, South-Western Nigeria. Findings include quantitative and qualitative data on the important species.

**Methods:** Information was collected using semi-structured questionnaires which were administered to a total of 150 respondents, including herbalists, herb sellers, aged people and traditional medicine practitioners resident in the study area. Recipes, mode of preparation and methods of administration were noted and adequately reported in this work. All plants mentioned by the respondents were collected and carefully identified at the Forest Herbarium Ibadan (FHI).

**Results:** A total of 36 plant species belonging to 17 families were reported to be useful. The most represented family was Fabaceae with 5 different species, closely followed by Anacardiaceae with 4 species. Sixteen (16) recipes were reported, and prominent in these recipes include *Alstonia boonei*, *Enantia chlorantha* and *Zingiber officinale*.

**Conclusions:** Respondents reiterated that plant materials used were collected from the wild and traditional medicine is preferable in the treatment of malaria compared to Artemisinin-based combination therapies (ACT). We suggest further pharmacological studies to ascertain the potencies of the reported plant species.

**Keywords:** Ado-Ekiti, malaria, ethnobotany, medicinal plants, conservation

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**Ethnobotany Research & Applications  
18:37 (2019)**

## Background

Ethnobotany shows how communities of a particular region make use of the indigenous plants for their everyday activities which include food, clothing, shelter and medicine (Aiyeloja & Bello 2006). The documentation of this relationship between plants and humans, which cuts across different cultures, is very important for the conservation and utilization of biological resources (Muthu *et al.* 2006). Georgescu *et al.* (2016) emphasized the importance of plants for medicine noting that these plants contain chemical substances that produce a physiological action on the human body. According to Nitta *et al.* (2002), natural products of plant source are the main source of new, safer and more effective bioactive compounds with medicinal properties.

Malaria is caused by species of the genus *Plasmodium* Marchiafava & Celli, 1885; and these parasites are transmitted to humans through the bites of female *Anopheles* Meigen, 1818 mosquito (Rawlins *et al.* 2008). In a survey conducted in

Nigeria (Nigeria Malaria Indicator Survey, 2016), some of the symptoms include fever, headache, chills, shivering and loss of appetite, vomiting, general body weakness and joint pains. The constant evolution of malaria parasite has rendered the most widely available anti-malarial treatments ineffective and recent reports show the increasing resistance of *Plasmodium falciparum* Welch, 1897 to artemisinin-based compounds (Htut 2009, Cui *et al.* 2012). Ukaga *et al.* (2006) earlier noted that the persistence of malaria symptoms after treatment with modern antimalarial drugs has resulted in loss of reliance on such drugs and has led to increased tendency towards the use of herbs in the treatment of malaria in Nigeria.

As put by Pan *et al.*, (2013), about 25% of the synthesized drugs are manufactured from medicinal plants. In addition, Food and Agriculture Organization's (FAO) report shows that about 70–80 % of the world's population, especially in developing countries, rely on herbal medicine to prevent and cure diseases (Ekor 2014). Consequently, the continued dependence on plants for survival has resulted in the renewed interest in drugs which originate from these plants, as earlier noted by Obisesan & Adeyemo (1998). Interestingly, more than 50,000 species are utilized medicinally out of about 422,000 species of flowering plants (Giday *et al.* 2016). Over the years, ethnobotanical studies have provided us with indigenous knowledge of plants for the management of ailments in southern Nigeria (Gills 1992; Okoli *et al.* 2007; Ariwaodo *et al.* 2012; Olanipekun *et al.* 2016; Soladoye *et al.* 2018; Ugbogu & Chukwuma, 2019), but little is known about this aspect of local medicine in Ado-Ekiti metropolis. With the re-occurrence of malaria even after treatment with orthodox drugs as mentioned above, this study aimed at providing information of medicinally useful plant species for the treatment of malaria in Ado-Ekiti Local Government Area of Ekiti State, Nigeria. It is the first report of malaria treating plants in the study area.

## Materials and Methods

### Study area

The survey was carried out in Ado-Ekiti (Lat. 7°36'44"N; Long. 5°14'14"E, Alt. 455m), Ekiti State, South West Nigeria (Figure 1). The State has 16 Local Governments Areas and Ado-Ekiti is the state capital with one local government, Ado Local Government covering the entire town. The town is a center of business activities of the State. The residents are mainly of the Yoruba ethnic group and

the areas include Oke-ila, Odo-ado, Ugbeyinadun, Ereguru, Ogbon Ado, Oja Oba, Ile-ileri, Ajilosun, amongst others.

### Ethical approval

The purpose of this study was explained to the 150 respondents comprising herb sellers, aged people, traditional medicine practitioners and herbalists in Ado-Ekiti Local Government Area and each respondent gave his/her consent.

### Data collection

Respondents were interviewed using semi-structured questionnaire to obtain information about their knowledge of various species of plants used in the treatment of malaria (Soladoye *et al.* 2014; Polat and Cakırcıoğlu, 2018). The information was obtained through verbal conversations with them (Ariwaodo *et al.* 2012; Soladoye *et al.* 2012; Soladoye *et al.* 2018). The respondents cut across age groups except individuals below the age of 18 years. Some of the information contained in the questionnaire include: respondents' identity (i.e., sex, age, religion, and educational level), origin of their knowledge about medicinal plants, how they diagnosis patients with malaria, local names of plant, part(s) used, time of harvesting part used, method(s) of preparation, mode of administration, dosage, duration of treatment and side-effects, if any.

The data collected were analyzed using descriptive statistics such as percentage, frequencies and mean to describe the socio-demographic characteristics and the types of plant species used as traditional medicine for malaria treatment.

### Plant collection and identification

For proper identification of the plants and future studies, plants were collected and carefully identified at the Forest Herbarium Ibadan (FHI) (Holmgren *et al.* 1990) using taxonomic keys provided in Flora of West Tropical Africa (Hutchinson *et al.* 1954-1972) and Trees of Nigeria (Keay 1989). All plant names follow International Plant Name Index (IPNI) (<http://www.ipni.org>), while families follow Angiosperm Phylogeny Group (APG) IV (2016). Voucher specimens were also prepared and deposited at Federal University Oye-Ekiti Herbarium (FUOH), Ekiti State, Nigeria, constituting the pioneer records for the herbarium. Nevertheless, some specimens were not prepared because the collections were sterile as at the time of this study.

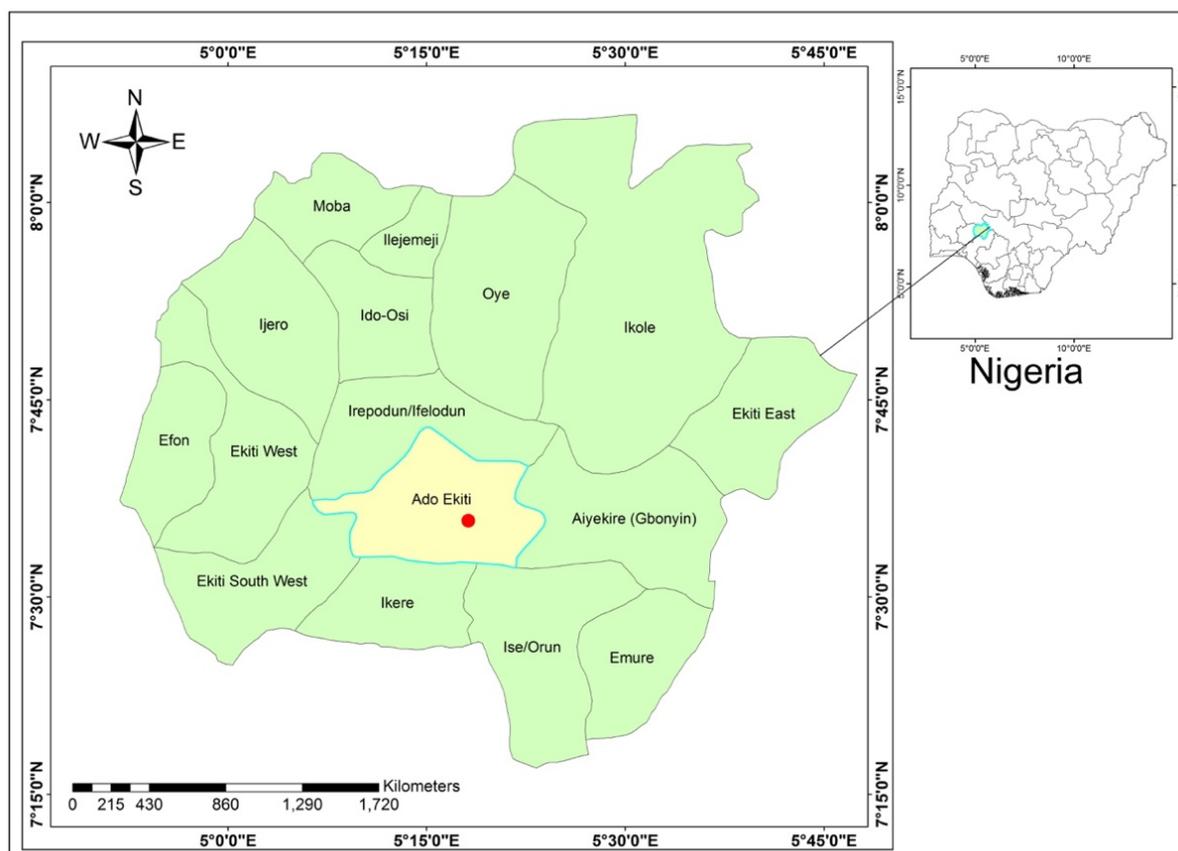


Figure 1. Map of Ekiti State, Nigeria showing location of the study area. (Map generated using ArcGis10.3)

## Results and Discussion

The survey was carried out with 150 respondents who had knowledge of medicinal plants used in the treatment of malaria. These respondents included 74 men and 76 women. The gender and age distribution of the respondents is represented in Table 1. The results revealed that slightly more than half (50.67%) of the respondents were female while the remaining (49.33%) were male. This depicts that more female participants were involved in herbal treatment than male and this could be as a result of their roles in the family and society. This trend was also reported in the work of Karakaya *et al.* (2019). The mean age of the respondents was 60.39 years and the modal class for the distribution was above 51 years. About 23.33% of the respondents were above 70 years, more than half (57.34%) were between the age range of 51 and 70 years, while 16.00% of them were between the age range of 31 and 50 years and the remaining 3.33% were below 31 years. Thus, the mean age of the respondents was 60.39 years. This implies that most of the respondents in the study area who use herbal medicine for the treatment of malaria were aged people.

Further report in Table 1 also showed that 36.67% of the population practice Christianity while Islam is practiced by 27.33% and 36.00% African traditional religion. Larger percentage (96.00%) of the respondents is of the Yoruba ethnic group while the remaining 4.00% are from Ebira ethnic group, probably owing to the location of the study, which is a Yoruba speaking community. About two-fifth (38.00%) of the respondents had tertiary education, 32.67% had secondary education, 7.33% had primary education, 0.67% had Arabic education while 21.33% had no formal education. This implies that majority of the respondents in the study area had one or more form (s) of formal education.

A total of 36 angiosperm species belonging to 17 families in 34 genera were reported to be useful in the treatment of malaria among the people of Ado-Ekiti Local Government area of Ekiti State, Nigeria. Fabaceae and Anacardiaceae were the most abundant of all the families, with 5 and 4 species represented (Tables 2 & 3). This was followed by Annonaceae, Asteraceae, Meliaceae and Rutaceae, with 3 species each. Malvaceae, Poaceae, Rubiaceae and Zingiberaceae all had 2 species each

represented while the remaining seven (7) families were each represented with only 1 species. The dominance of Fabaceae is substantiated by Ayodele

and Yang (2012), who reported that this family Fabaceae has the highest number of occurrence in Nigeria and the most utilized.

Table 1: Demographic information of respondents

Gender	Frequency	Percentage (%)
Male	74	49.33
Female	76	50.67
<b>Total</b>	<b>150</b>	<b>100.00</b>
Age (Years)	Frequency	Percentage (%)
< 31	5	3.33
31 – 50	24	16.00
51 – 70	86	57.34
Above 70	35	23.33
<b>Total</b>	<b>150</b>	<b>100.00</b>
<b>Mean</b>		<b>60.39</b>
Religion	Frequency	Percentage (%)
Christianity	55	36.67
Islam	41	27.33
African Traditional Religion	54	36.00
<b>Total</b>	<b>150</b>	<b>100.00</b>
Tribe	Frequency	Percentage (%)
Ebira	6	4.00
Yoruba	144	96.00
<b>Total</b>	<b>150</b>	<b>100.00</b>
Educational Background	Frequency	Percentage (%)
No Formal Education	32	21.33
Primary Education	11	7.33
Secondary Education	49	32.67
Arabic Education	1	0.67
Tertiary Education	57	38.00
<b>Total</b>	<b>150</b>	<b>100.00</b>

The species were distributed in only 3 habits viz: herbs, shrubs and trees (Figure 2). The trees were dominant, contributing 58% of the total enumeration, while the shrubs and herbs made up the remaining 42%. Only four (4) families were represented by two habits while the remaining thirteen (13) families were all represented by only one habit, mostly trees (Table 3). All the species identified in this study had also been reported by previous authors to be useful in the treatment one ailment or the other especially in south-western Nigeria (Odugbemi, 2008, Ariwaodo *et al.* 2012, Soladoye *et al.* 2012, Soladoye *et al.* 2013, Soladoye *et al.* 2014, Soladoye *et al.* 2018).

In furtherance, the respondents affirmed that traditional treatment is cheaper and more accessible than synthetic drugs. Therefore, resort to the use of herbal plants in the treatment of malaria. Healers reported that patients can develop shortage of blood in severe cases of malaria and hence noted that it is safer to treat malaria as soon as symptoms are noticed in patients. This corroborates the works of

Weatherall *et al.* (2002) and Lamikanra *et al.* (2007) who both reported that malaria leads to anemia.

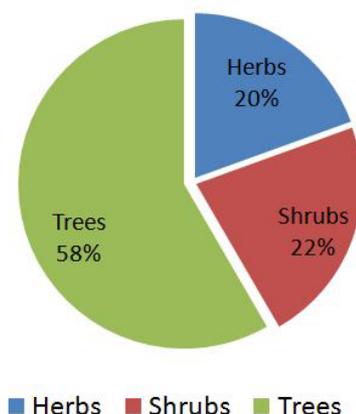


Figure 2. Medicinal plants across their habits.

In recent times, herb sellers are faced with difficulty in getting the useful plant species, as a result of continuous deforestation within the study area and no appropriate measures for plant regeneration. Herbs are mainly obtained from the wild and as such, fresh plants cannot be easily accessed by the healers. In the course of this study, it was revealed

that knowledge and information about the use of ethnobotanicals are being hoarded within the lineage as there is the belief that the information is to be kept as a secret for the lineage and serve as power to be handed over to generations

Table 2. List of plants used in the treatment of malaria in the studied area

Family	Scientific name / Voucher #	Habit	Local name	Part(s) used
Amoryllidaceae	<i>Allium sativum</i> L.	Herb	Ayu	Bulb
Anacardiaceae	<i>Anacardium occidentale</i> L. – FUOH002	Tree	Kasu	Leaves, stem bark
Anacardiaceae	<i>Lannea welwitschii</i> (Hiern.) Engl.	Tree	Orira	Stem bark
Anacardiaceae	<i>Mangifera indica</i> L. – FUOH010	Tree	Mongoro	Leaves, stem bark
Anacardiaceae	<i>Spondias mombin</i> L. – FUOH015	Tree	Iyeye	Leaves, stem bark
Annonaceae	<i>Enantia chlorantha</i> Oliv.	Tree	Awopa	Stem bark
Annonaceae	<i>Polyalthia longifolia</i> (Sonn.) Thwaites	Tree	-	Leaves
Annonaceae	<i>Xylopia aethiopica</i> (Dunal) A. Rich.	Tree	Arunje	Fruit, leaves
Apocynaceae	<i>Alstonia boonei</i> De Wild.	Tree	Ahun	Stem bark
Arecaceae	<i>Cocos nucifera</i> L.	Tree	Agbon	Stem bark, fruits
Asteraceae	<i>Ageratum conyzoides</i> L. – FUOH001	Herb	Imiesu	Leaves, roots
Asteraceae	<i>Chromolaena odorata</i> (L.) R.M. King & H.Rob. – FUOH008	Shrub	Akintola	Leaves
Asteraceae	<i>Vernonia amygdalina</i> Del. FUOH016	Shrub	Ewuro	Leaves
Bromeliaceae	<i>Ananas comosus</i> (L.) Merr.	Herb	Ope oyinbo	Fruits
Caricaceae	<i>Carica papaya</i> L.	Shrub	Ibepe	Leaves, fruit
Euphorbiaceae	<i>Bridelia ferruginea</i> Benth. – FUOH004	Tree	Era	Bark
Fabaceae	<i>Caesalpinia bonduc</i> (L.) Roxb. – FUOH006	Shrub	Ayo	Leaves
Fabaceae	<i>Cajanus cajan</i> (L.) Millsp. – FUOH005	Shrub	Feregedede	Leaves
Fabaceae	<i>Cassia fistula</i> L. – FUOH007	Tree	Kaashia	Leaves
Fabaceae	<i>Parkia biglobosa</i> (Jacq.) G. Don – FUYOH013	Tree	Iru, Igba	Seed, bark
Fabaceae	<i>Pterocarpus osun</i> Craib – FUOH014	Tree	Osun	Stem bark, root
Malvaceae	<i>Gossypium barbadense</i> L. FUOH009	Shrub	Owu	Leaves
Malvaceae	<i>Theobroma cacao</i> L.	Tree	Koko	Leaves
Meliaceae	<i>Azadirachta indica</i> A. Juss. – FUOH003	Tree	Dongoyaro	Leaves, stem bark
Meliaceae	<i>Khaya grandifoliola</i> C.DC.	Tree	Oganwo	Stem bark
Meliaceae	<i>Khaya senegalensis</i> (Desv.) A. Juss.	Tree	Aganwo	Stem bark
Poaceae	<i>Cymbopogon citratus</i> (DC.) Stapf	Herb	Ewe tea, kookooba	Leaves
Poaceae	<i>Sorghum bicolor</i> (L.) Moench	Shrub	Okababa	Grain head, leaves
Rubiaceae	<i>Morinda lucida</i> Benth. – FUOH011	Tree	Oruwo	Leaves, stem bark, Root
Rubiaceae	<i>Nauclea latifolia</i> Sm. – FUOH012	Shrub	Egberesi	Roots, leaves
Rutaceae	<i>Citrus aurantiifolia</i> (Christm.) Swingle	Tree	Osanwewe	Fruit, leaves, twigs

Rutaceae	<i>Citrus aurantium</i> L.	Tree	Osan ganginganin	Fruit
Rutaceae	<i>Citrus paradisi</i> Macfad.	Tree	Giirepu	Fruit, stem, twigs
Solanaceae	<i>Capsicum annum</i> L.	Herb	Atawewe	Fruit
Zingiberaceae	<i>Aframomum melegueta</i> K. Schum	Herb	Ataare	Fruit
Zingiberaceae	<i>Zingiber officinale</i> Roscoe	Herb	Ata ile	Rhizome

Table 3. Distribution of medicinal plant species across families, genera and habits

Family	No. of species	No. of genus/genera	Herb	Shrub	Tree
Amaryllidaceae	1	1	1	-	-
Anacardiaceae	4	4	-	-	4
Annonaceae	3	3	-	-	3
Apocynaceae	1	1	-	-	1
Arecaceae	1	1	-	-	1
Asteraceae	3	3	1	2	-
Bromeliaceae	1	1	1	-	-
Caricaceae	1	1	-	1	-
Euphorbiaceae	1	1	-	-	1
Fabaceae	5	5	-	2	3
Malvaceae	2	2	-	1	1
Meliaceae	3	3			3
Poaceae	2	2	1	1	
Rubiaceae	2	2	-	1	1
Rutaceae	3	1	-		3
Solanaceae	1	1	1	-	-
Zingiberaceae	2	2	2	-	-
	<b>36</b>	<b>34</b>	<b>7</b>	<b>8</b>	<b>21</b>

Table 4. Some recipes used in the treatment of malaria within the study area

Plants	Part(s) used	Mode of preparation	Solvent & administration
<i>Carica papaya</i>	Fruit	<b>Decoction</b>	Pap Water (omidun)
<i>Citrus paradisi</i>	Fruit	Fruits are thoroughly washed,	Orally - Patients drink 1/2
<i>Ananas comosus</i>	Fruit	rinsed and cut into smaller	glass cup of herbal
<i>Citrus aurantium</i>	Fruit	pieces. Leaves are rinsed once	preparation twice daily.
<i>Cymbopogon citratus</i>	Leaves	in clean water and placed in a pot	
<i>Polyalthia longifolia</i>	Leaves	and the fruit placed on top. Pap	
<i>Sorghum bicolor</i>	Head grain	water is added, and pot placed	
		on fire to boil for about 15-20minutes.	
<i>Vernonia amygdalina</i>	Leaves	<b>Concoction</b>	Water
<i>Aframomum melegueta</i>	Fruits	The plant parts are collected,	Orally-patient 3-5 tablespoon
		properly rinsed, and ground	(depending on age) early in
		together to form a smooth paste.	the morning
<i>Morinda lucida</i>	Bark, Leaves	The plant parts are collected,	Water
		properly rinsed, and ground	Orally -- patient drinks 1/2
		together to form a smooth paste.	glass cup twice daily.
		And it is later mixed with a little	
		quantity of water.	
<i>Bridelia feruginea</i>	Stem bark	The plant parts are collected,	Water
<i>Capsicum annum</i>	Fruit	properly rinsed, and ground	Orally- Patient takes once
		together to form a smooth paste.	per day

<i>Bridelia feruginea</i>	Stem bark	<b>Concoction</b>	Water
<i>Capsicum annuum</i>	Fruits	The plant parts rinsed in clean water, ground together and cooked with palm oil and meat for 10-15 minutes to form a concoction.	Orally - Patients drink the soup and can use it to take meals.
<i>Pterocarpus osun</i>	bark, roots		
<i>Parkia biglobosa</i>	Seed		
<i>Zingiber officinale</i>	Rhizome		
<i>Enantia chlorantha</i>	Stem bark	<b>Infusion</b>	Palm wine
<i>Alstonia boonei</i>		The stem bark from the tree is immersed in palm wine for about 24 hours to allow the extraction of the contents of the stem bark sip into the palm wine. Color change signifies that herbal preparation is ready for use.	Orally- Patients drink the mixture twice daily, preferably morning and night-time
<i>Chromolaena odorata</i>	Leaves	The leaves are rinsed in clean water and boiled for about 10-15 minutes and afterwards allowed to cool.	Water Orally- Patient drinks once per day.
<i>Citrus aurantifolia</i>	Fruit	Extract juice from <i>Citrus aurantifolia</i> fruit by squeezing. Already ground <i>Zingiber officinale</i> is added to the juice and thoroughly mixed. The content (Yolk and Albumen) of the local egg is added to the mixture and thoroughly mixed.	Juice from <i>Citrus aurantifolia</i>
<i>Zingiber officinale</i>	Rhizome		Orally- Patient drinks early in the morning
<i>Alstonia boonei</i>	Stem bark	Rhizomes of <i>Zingiber officinale</i> are properly washed and ground. Tap water is then added to stem bark of <i>Alstonia boonei</i> and already ground <i>Zingiber officinale</i> . The mixture is allowed to stand for 3hours.	White pap water
<i>Zingiber officinale</i>	Rhizome		Orally- Patient drinks twice daily
<i>Xylopia aethiopaca</i>	Stem bark,	Ingredients are rinsed and soaked in solvent for 2 hours after which it is ready for use.	Alcohol (Dry Gin)
<i>Mangifera indica</i>	Leaves		Orally- Patient drinks two times daily
<i>Cajanus cajan</i>	Leaves	The plants are placed in a pot preferably earthen pot. Solvent is added and allowed to boil for 20-40mins.	Water/White pap water.
<i>Sorghum bicolor</i>	Grain head		Orally- Patient drinks two times daily.
<i>Cymbopogon citratus</i>	Leaves	The plant parts are washed and placed in earthen pots and boiled for about 20-40 minutes and allowed to cool.	Pap water/Water
<i>Polyalthia longifolia</i>	Fruit		Orally- Patient drinks early in the morning and later in the Evening.
<i>Citrus aurantium</i>	Leaves		Dermally- Patient will bathe with the mixture
<i>Carica papaya</i>	Leave drop	The leaves are placed in an earthen pot, water is added and then boiled and left to cool.	Water
<i>Chromolaena odorata</i>	Leaves		Patients take baths with the solution and Soda Soap
<i>Enantia chlorantha</i>	Bark and Leaves	The plant parts are placed in an earthen pot containing the white pap water. It is boiled for 15-30 minutes.	White Pap Orally- Patient drinks twice daily.
<i>Enantia chlorantha</i>	Bark and Leaves	The ingredients will be well ground together, the ground ingredients and Alabukun	Soda drink Orally-PatientDrinks mixture once daily

		powder will be mixed with the 7up drink.	
<i>Alstonia boonei</i>	Stem bark,	Ingredients are rinsed and	White pap water
<i>Aframomum melegueta</i>	Leaves	soaked in white pap water for 3	Orally Patient drinks early in
	Fruit	days.	the morning

### Preparation methods

The active ingredients that bring about the medicinal properties of plants include alkaloids, cardiac glycosides, flavonoids, phenols, tannins and vitamins. Azwanida (2015) emphasized the need to extract the active ingredients from plants in order to separate the soluble plant components leaving behind the insoluble residue. In the survey conducted, the following methods were used by traditional healers to prepare herbal medicine.

**Infusion:** extraction of active ingredients from plant materials by steeping the material in water or alcohol for a period of time. Infusion time ranges differently depending on plant materials

**Decoction:** boiling plant materials to extract the active ingredients. Boiling is usually done for a minimum of 15 minutes and increases depending on the quantity of plant materials. The herb sellers prefer this method of preparation and this supports the claims of Gronhaug *et al.* (2008) and Simbo (2010).

**Concoction:** mixing or boiling together of different plant materials and several other ingredients.

Oral administration and dermal application of medicine were the two main administration methods employed by respondents.

Prominent among the recipes for the treatment of malaria in the study area are *Alstonia boonei*, *Enantia chlorantha* and *Zingiber officinale*; all utilized in 3 of the 16 recipes reported (Table 4). Others include *Bridelia feruginea*, *Capsicum annum*, *Chromolaena odorata*, *Cymbopogon citratus*, *Polyalthia longifolia* and *Sorghum bicolor*, all useful in the preparation of 2 of the recipes, thus importance of plants in local medicine cannot be over-emphasised. Further, the most useful plant parts reported were the fruits, leaves and stem bark. The respondents noted that these plant parts especially for the specific species are almost readily available for collection from the wild and hence reason for their frequent use in the treatment of malaria within the study area. Previous studies cited above (Soladoye *et al.* 2010; Soladoye *et al.* 2014) have also reported similar case where this plant parts are mostly used for the management of haemorrhoids and female infertility in South western Nigeria. A research

conducted in West Pupa also noted that the leaves and stem bark are the most widely used plant parts among the local people, in traditional medicine (Lense 2012). While the collection of plants for medicinal uses cannot be discouraged, it is more important to consider urgent conservation measures, which must be taken to avert degradation of the ecosystems where these species thrive

### Conclusions

The present study has reported a total of 36 angiosperm species for the treatment of malaria as used by the Traditional Medical Practitioners in Ado-Ekiti Local Government Area of Ekiti state. While the information provided could be accessed for future research, we recommend further pharmacognostic study on the species listed, to ascertain beyond reasonable doubt the potencies reported by the respondents. Nevertheless, we will in our study attempt to examine the phytochemicals present in some of the prominent species among the recipes which will also give valuable information to draw a specific conclusion on these Anti-Malarial plants. The conservation of our rich but endangered ecosystem is also of utmost importance, if we must continue to rely on plants for survival.

### Declarations

#### List of abbreviations:

FHI –Forest Herbarium Ibadan

FUOH – Federal University Oye-Ekiti Herbarium

**Ethics approval and consent to participate:** The study was carried out following the general ethics of Ekiti state and those of the local people of the study area.

**Consent for publication:** Not applicable.

**Author contributions:** Conceptualization and study design: Chukwuma Deborah Moradeke, Data collection: Adekola Oluwapelumi Oluwadamilola, Data analysis: Chukwuma Emmanuel Chukwudi, Manuscript writing: Chukwuma Deborah Moradeke, Review and editing: Chukwuma Deborah Moradeke & Chukwuma Emmanuel Chukwudi

**Competing interest:** The authors declare no competing interest of any kind.

## Acknowledgments

We are grateful to the respondents, especially the traditional healers for providing us with information regarding the plants reported in this work.

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