Ethno Botanical Survey of Medicinal Flora Used For the Treatment of Malaria in Madobi Town, Kano State-Nigeria

MUKHTAR Y.[1], ADAM A.I.[2], ABDULKADIR A. I.[3], YAKUDIMA I.I.[4], GALALAIN A.M.[5]
[1, 3, 5] *Department of Plant Biology, Faculty of Life Sciences, Bayero University, Kano PMB 3011, Kano, Nigeria*
[2, 4] *Department of Geography, Kano University of Science and Technology, Wudil, PMB 3244, Kano, Nigeria*

Abstract- ***More than half of the world populations are at the risk of malaria disease and it has become endemic in almost 102 countries globally thereby accounting for 1.1 million deaths per year. Therefore, the present study for the first time provides an inventory for the herbal species used traditionally in the treatment and management of malaria fever in Madobi Town, Kano State, Nigeria. Thirty six (36) semi-structured questionnaires were employed principally on herbalists, traditional healers, hunters and farmers for the purpose of this study. The findings of the survey revealed that 44 different plant species belonging to 40 genera, cutting across 30 families were cited by the respondents as traditionally employed antimalarial agents by the inhabitants in the study area. Senna occidentalis, Eucalyptus camaldulensis and Mangiferaindica of the families Fabaceae, Myrtaceae and Anacardiaceae respectively, were repeatedly mentioned as the three most widely used plants for the treatment of malaria in the study area through oral administration of concoction made from their leaves with other plants. Interestingly, Swartziamadagascariensis and Olaxsubscopioidea are reported for the first time to be used in the treatment of malaria in this study. In general, the most commonly used families were Fabaceae (11.36%), Anacardiaceae and Combretaceae (9.09%), Rutaceae, Lamiaceae, Myrtaceae and Moraceae (4.55%) respectively. The study recommends further laboratory and clinical research on these plants so as to identify and isolate the lead compounds responsible for this pharmacological activity with a view to develop promising antimalarial drugs.***

Indexed Terms- ***Malaria, herbal therapy, phytochemicals, preparation, administration***

I. INTRODUCTION

Traditional medicine is the sum total of all knowledge and practical application used in diagnosis, prevention, treatment and elimination or cure of physiological, physical, or mental diseases which is passed down through generation from one healer to another. Nevertheless, the use of traditional medicine (TM) and complemen¬tary and alternative medicine (CAM), particularly herbal medicinal practice is increasing nowadays throughout the world and it has already accounts for a major part of the health care provided worldwide. In low- and mid¬dle-income countries, up to 80% of the population may rely on traditional therapy for their primary health care needs (WHO, 2002). In many high-income countries, herbal therapy utilization is becoming increasingly popular, with up to 65% of the population reporting that they have used this form of medicine (Ernst, 2000 and WHO, 2002) . This is mostly connected to the high cost, adverse side effect, ineffectiveness and development of resistance by microorganisms and parasites to these modern synthetic drugs.

One of the major deadly or fatal diseases in the world is malaria (Salisu, 2018). More than half of the world populations are at the risk of this disease and it has become endemic in almost 102 countries globally. Malaria accounts for 1.1 million deaths yearly and it affects about 350-500 million people per year worldwide (World Health Organization, 2013). A

protozoan called Plasmodium is the causal agent of the diseases and it is transmitted to humans through the female anopheles mosquito. Because of having various types of parasites by the disease, its treatment is very complicated and this has poses a lot of challenges to people and medical experts generally (WHO, 2003). Sur¬veys conducted by the World Health Organization Roll Back Malaria Program in 1998 showed that in Ghana, Mali, Nigeria and Zambia, more than 60% of children with high fever are treated at home with herbal medicines (Brieger, 1998; Diarriar et al., 1999; Gyapong et al., 1999 and Roll Back Malaria, 1998). Recently, WHO has advocated for the integration of traditional therapy with orthodox medicine for effective delivery of adequate health care system. Notable traditional antimalarial herbal species in Nigeria includes Azadirachta indicia (Neem tree), Senna occidentalis (Coffee Senna), Carica papaya (Pawpaw), Psidiumguajava (Guava), Eucalyptus camaldulensis (Red gum tree), Vernoniaamygdalina (Bitter leaf), Mangiferaindica (Mango) (Abubakar et al., 2016) etc.

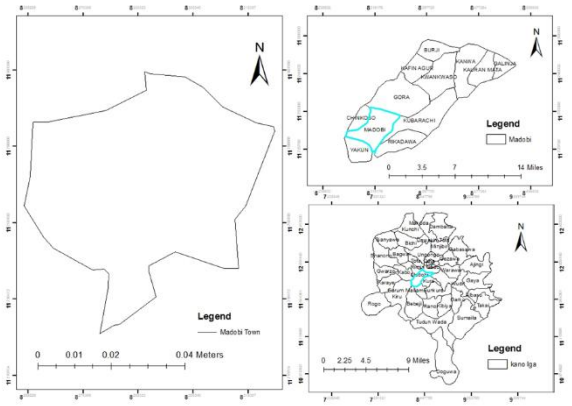
The present study was aimed at providing inventory for the ethnobotanical potentials of common antimalarial herbs in Madobi town, Kano State. This will help in documenting and rescuing this indigenous knowledge for effective transfer to subsequent generations before being lost.

II. MATERIALS AND METHODS

- Study Area

Madobi is found in Kano State, Northwestern Nigeria. It is located between Latitudes 110 42` N to 110 54` N and Longitudes 8015` E to 80 33` E. It is bounded to the North by Tofa LGA, to the North-west by RiminGado and Kabo LGA, to the West by Kiru LGA, to the South-west by Bebeji LGA, to the South by Garun Malam LGA, to the East by Kura and Dawakin Kudu LGAs, and finally to the North-east by Kumbotso LGA (see fig 1). The estimated population of Madobi as at 2006 population census stood at 136,623 inhabitants with an estimated land mass of 273km2. The area is majorly populated by Hausa and Fulani ethnic groups. Madobi has mean annual temperature of about 26oC, but mean monthly values range between 21oC in the coolest months of December/January and 31oC in the hottest months of April/May. (Olofin, 2008). The climate of the area is tropical wet and dry type coded as Aw in Koppen's climatic classification. The annual mean rainfall in the area is between 800 mm and 900 mm, which concentrate between 4-5 months (May to September). The area experience four distinct seasons: the dry and cool, dry and hot, wet and warm and dry and warm seasons (Olofin, 2008).

The natural vegetation of the area is characterized by moderately tall grasses and shrubs and scattered trees. Indigenous trees found include Anacardiumoccidentale, Eucalyptus camaldulensis, Mangiferaindica, Terminalia catappa, Psidiumguajava, Parkiabiglobosa, Phoenix dactylifera, Adansoniadigitata, Faidherbiaalbida, Tamarindusindica, and Ficusthonningii while Azadirachtaindica is an exotic species that grow spontaneously and serve many traditional purposes in the area.



Source: GIS Lab, Kano University of Science and Technology, Wudil, Kano

Figure 1: Map of the Study Area

- Data Collection

The data from the study area were obtained from oral interviews and administration of semi-structured questionnaires principally to the traditional medicine practitioners, herbalists, farmers, and hunters respectively. A total of thirty six participants were sampled using snowball technique. In each case, the objective of the study was explained to them in Hausa, the local language. Questionnaires were designed to obtain data on the plant species used to

treat malaria, part(s) of the plants used, methods of preparation, and mode of administration of the herbal materials as well.

III. RESULTS

- Demographic Characteristics of the Respondents

The demographic characteristics of the inhabitants in the study area revealed that out of 36 respondents that were interviewed, 25 were male (69.44%) while 11 were female (30.56%) (Table 1). The respondents were of different ages, where by 30.56 % ages between 20-30 years, 25.00 % were between 31-40 years, 22.22% were between 41-50 years, while 13.89 % were between 51-60 years. Ages 61 and above had the least percentage of 8.33%. Majority of the respondents were herbalists (30.56%), farmers (27.78%), hunters (19.44%), healers (13.89%), while respondents belonging to other categories of occupation have the least percentage of 8.33%.

Table 1: Demographic Data of the Respondents

Variables	Frequency	%Frequency
Sex		
Male	25	69.44
Female	11	30.56
Age		
20-30	11	30.56
31-40	09	25.00
41-50	08	22.22
51-60	05	13.89
>61	03	08.33
Occupation		
Farmers	10	27.78
Hunters	07	19.44
Herbalist	11	30.56
Healers	05	13.89
Others	03	08.33

Source: Field survey, 2019

- Antimalarial Plant Species

A total number of 44 botanicals belonging to 30 families cutting across 40 genera were cited by the traditional medical practitioners, herb sellers, hunters and farmers as being used in the town for the treatment of malaria fever as highlighted in Table 2. Members of the family Fabaceae had the highest number of occurrence with 5 plant species, followed by Anacadiaceae and Combretaceae with 4 species each. Meanwhile Rutaceae, Lamiaceae, Myrtaceae and Moraceae have 2 species each, while other families had 1 species each. Senna occidentalis (11.61%), Eucalyptus camaldulensis (9.82%), Mangiferaindica (7.14%), Psidiumguajava and Ficusthonningii (5.36%), and Carica papaya (4.46%) were frequently mentioned as the mostly used plants for the treatment of malaria by the respondents in the study area. The majority of the plant species were trees, followed by shrubs and herbs with the least frequency.

Table 2: Antimalarial Herbal Species Used in the Study Area

S/N	Species Name	Family	Habit	Frequency	%Frequency
1	Acacia ataxacantha	Fabaceae	Shrub	01	0.89
2	Adansoniadigitata	Bombaceae	Tree	01	0.89
3	Anacardiumoccidentale	Anacardiaceae	Tree	01	0.89
4	Ananascomosus	Bromaliaceae	Shrub	02	1.79
5	Annogeissusleiocarpus	Combretaceae	Tree	02	1.79
6	Antidesmavenosum	Euphorbiaceae	Tree	01	0.89
7	Azadirachtaindica	Meliaceae	Tree	02	1.79
8	Bougainvillea glabra	Rubiaceae	Shrub	01	0.89
9	Carica papaya	Caricaceae	Tree	05	4.46
10	Citrus aurantifolia	Rutaceae	Tree	03	2.68
11	Citrus sinensis	Rutaceae	Tree	01	0.89
12	Clerodendrumcapitatum	Lamiaceae	Herb	03	2.68

13	Cochlospermumplanchorii	Cochlospermaceae	Tree	02	1.79
14	Combretummicranthum	Combretaceae	Shrub	01	0.89
15	Commiphorakerstingii	Burseraceae	Tree	01	0.89
16	Diospyrosmespiliformis	Ebenaceae	Tree	03	2.68
17	Dodoneaviscosa	Sapindaceae	Shrub	04	3.57
18	Erythrinasenegalensis	Fabaceae	Tree	02	1.79
19	Eucalyptus camaldulensis	Myrtaceae	Tree	11	9.82
20	Ficussycomorus	Moraceae	Tree	01	0.89
21	Ficusthonningii	Moraceae	Tree	06	5.36
22	Guerasenegalensis	Combretaceae	Shrub	01	0.89
23	Ipomoea asarifolia	Convulvulaceae	Herb	01	0.89
24	Lanneamicrocarpa	Anacardiaceae	Tree	01	0.89
25	Mangiferaindica	Anacardiaceae	Tree	08	7.14
26	Moringaoleifera	Moringaceae	Shrub	03	2.68
27	Mormodicacharantia	Cucurbitaceae	Herb	01	0.89
28	Musa sapientum	Musaceae	Shrub	04	3.57
29	Myristicafragrans	Myristicaceae	Tree	01	0.89
30	Newbouldialaevis	Bignoniaceae	Tree	04	3.57
31	Ocimum sanctum	Lamiaceae	Herb	01	0.89
32	Olaxsubscopioidea	Olaceae	Tree	01	0.89
33	Olea europea	Oleaceae	Shrub	01	0.89
34	Parkiabiglobbosa	Fabaceae	Tree	02	1.79
35	Piliostigmareticulatum	Fabaceae	Tree/Shrub	02	1.79
36	Psidiumguajava	Myrtaceae	Tree	06	5.36
37	Saccharumofficianarum	Poaceae	Herb	01	0.89
38	Scleracariabirrea	Anacardiaceae	Tree	02	1.79
39	Securidacalongepedunculata	Polygalaceae	Tree	01	0.89
40	Senna occidentalis	Fabaceae	Shrub	13	11.61
41	Sida ovate	Malvaceae	Shrub	01	0.89
42	Swartziamadagascariensis	Papilionoideaceae	Tree	01	0.89
43	Terminalia catappa	Combretaceae	Tree	02	1.79
44	Vernoniaamygdalina	Asteraceae	Shrub	01	0.89

Source: Field Survey, 2019

- Method of Preparation and Administration

Based on the information gathered from this study, various parts of these plants were reported to be used in the preparation of herbal medicine for the treatment of malaria (Table 3), but leaves were reported as the most widely used portion over all other parts. In some cases, the whole plant (e.g. Mormodicacharantia) is utilized for the preparation of the herbal remedy. The different methods of preparation and administration of the plants used to treat malaria indicated that most of the plant species were prepared by decoction, meaning boiling of the plants in water to extract the active component for drinking. Another common preparation method is concoction, i.e. mixing and boiling of different plant species in order to extract its medicinal portion for administration. Infusion, which involves the soaking of plant material in boiled water for extraction purpose is also used to prepare herbal remedies. In some situations, some plant species were air dried, pulverized and then macerated in water, milk, pap or tea. Drinking is the most frequently method of administration as reported by the respondents.

Table 3: Inventory of Antimalarial Plant Species, Parts Used, Method of Preparation and Administration in the Study Area

S/N	Species Name	Common Name	Local Name	Parts Used	Method of Preparation	Mode of Administration
1	Acacia ataxacantha	Fodder tree	Sarkakiya	Root	Tincture	Drinking
2	Adansoniadigitata	Baobab	Kuka	Stem bark	Concoction	Drinking
3	Anacardiumoccidentale	Cashew	Kanju, Kashu	Leaves	Concoction	Drinking, bathing
4	Ananascomosus	Pineapple	Abarba	Peel	Decoction	Drinking, vapour bath, bathing
5	Annogeissusleiocarpus	African birch	Marke	Leaves	Concoction	Drinking, bathing
6	Antidesmavenosum	Tassel berry	Kirni	Leave, root, stem bark	Grinded and maceration	Drinking
7	Azadirachtaindica	Neem tree	Darbejiya	Leaves	Decoction	Drinking, vapour bath, bathing
8	Bougainvillea glabra	Paper flower		Leaves, flower	Decoction	Drinking, bathing
9	Carica papaya	Pawpaw	Gwanda	Leaves	Concoction	Drinking, vapour bath, bathing
10	Citrus aurantifolia	Lime	Lemon tsami	Leaves	Concoction	Drinking, vapour bath
11	Citrus sinensis	Orange	Lemon zaki	Leaves	Concoction	Drinking, vapour bath
12	Clerodendrumcapitatum	Bag flower	Taba-taba	Whole plant	Decoction, compress	Drinking, rubbing
13	Cochlospermumplanchorii	False cotton	Rawaya	Stem bark, root	Decoction	Drinking
14	Combretummicranthum	Bush tea	Geza	Leaves	Powdered, infusion	Drinking
15	Commiphorakerstingii	African myrrh	Ararrabi	Leaves	Infusion/boiling	Drinking
16	Diospyrosmespiliformis	African ebony	Kanya	Stem bark	Concoction	Drinking
17	Dodoneaviscosa	Privit		Leaves, stem	Concoction	Drinking, vapour bath, bathing
18	Erythrinasenegalensis	Coral tree	Minjirya	Stem bark	Grinded, mixed with pap or	Drinking

					maceration	
19	Eucalyptus camaldulensis	Red gum tree	Dogon yaro, Turare	Leaves	Decoction	Drinking, vapour bath, bathing
20	Ficussycomorus	Fig tree	Baure	Stem bark	Decoction or tincture	drinking
21	Ficusthonningii	Strangler	Chediya	Leaves	Concoction	Drinking, bathing
22	Guerasenegalensis	Senegal tree	Sabara	Leaves	Grinded and maceration	Drinking
23	Ipomoea asarifolia	Morning glory	Dumanrafi	Whole plant	Decoction	Bathing
24	Lanneamicrocarpa	African grape	Faru	Stem bark	Powdered and maceration	Drinking
25	Mangiferaindica	Mango	Mangwaro	Leaves, stem bark	Decoction	Drinking, vapour bath, bathing
26	Moringaoleifera	Horse raddish	Zogale	Leaves, flower	Decoction	Drinking, eating
27	Mormodicacharantia	Bitter melon climber	Garafuni	Whole plant	Concoction	Drinking. vapour bath
28	Musa sapientum	Banana	Ayaba	Leaves	Decoction	Drinking, vapour bath, bathing
29	Myristicafragrans	Nutmeg tree	Mace guntuwa	Leaves, flower, fruits	Decoction	Drinking
30	Newbouldialaevis	African tulip tree	Aduruku	Leaves	Concoction	Drinking, bathing
31	Ocimum sanctum	Mint	Daddoya	Leaves	Compress	rubbing
32	Olaxsubscopioidea		Gwano	Root	Grinded and soak in pap	Drinking
33	Olea europea	Olive	Zaitun	Leaves	Maceration or tincture	Drinking
34	Parkiabiglobbosa	Locust bean	Dorawa	Leaves, stem bark	Concoction	Drinking, bathing
35	Piliostigmareticulatum	Camel's foot	Kalgo, Kargo	Immature leaves, stem bark	Decoction, powdered	Drinking
36	Psidiumguajava	Guava	Gwaiba	Leaves	Decoction	Drinking
37	Saccharumofficianarum	Sugarcane	Rake	Peel	Decoction	Drinking, vapour bath, bathing
38	Scleracariabirrea	Cider tree	Danya	Stem bark	Concoction	Drinking
39	Securidacalongepedunculata	Violet tree	Sanya	Root	Decoction	Drinking
40	Senna occidentalis	Coffee	Rai-rai	Whole	Decoction/boiling	Drinking,

		senna		plant		eating
41	Sida ovate		Miyartsanya	Leaves	Decoction	Drinking, bathing
42	Swartziamadagascariensis	Snake bean	Bayama	Root	Maceration	Drinking
43	Terminalia catappa	Tropical almond	Katafa	Leaves	concoction	Drinking, vapour bath
44	Vernoniaamygdalina	Bitter leaf	Shuwaka	Leaves	Concoction	Drinking, bathing

Source: Field Survey, 2019

IV. DISCUSSION

The outcome of the present study has indicated that traditional therapy has a long history and is widely acceptable among the people in the area, as total number of 44 plant species were identified to be useful as medicine in the management and treatment of malaria fever in the town. This supports the claim that an effective health cannot be achieved in Africa by orthodox medicine alone unless complemented with traditional medicines (Elujoba, 2005). This can be attributed to the poor economic situations, expensive and inadequate availability of orthodox medicines (Saeed, 2004). More, so ineffectiveness of the synthetic drugs may also be a contributing factor to the resurgence of traditional therapy nowadays and that is the reason why the World Health Organization has advocated for the search of botanicals with promising potential in treatment of various ailments and their subsequent integration with conventional method of healing for an effective delivery of well health care system.

Plants have been employed as an important form of drug in the traditional medicinal practices in the study area as clearly highlighted from the response of the interviewers. This practice is fast growing among population of the world as these plants are found to be cheap, available, effective and easy to access and prepare. Most of the medicinal plants are administered through maceration or decoction using water or in its powdered form (Belewu et al., 2009).

In this study, majority of the respondents were herbalists and farmers, this has clearly indicates that, they have a prerequisite expertise, information and knowledge on traditional medicine. Different parts of the plant have been identified to be used in herbal preparation for the treatment of malaria, but in some cases, the whole plant is often utilized. However, in this study, leaves were predominantly used above all other parts for preparation. This findings corroborated the work of Caraballo et al. (2004) conducted in Cameroon, where they reported that the leaves were most frequently used plant part by local inhabitants. This could be because leaves contain reasonable amount of secondary metabolites that have the potential of targeting the disease causing organisms or regulating defects in body cells or tissues.

The different methods of preparation and administration of the plants used to treat malaria in this study indicated that most plant species were prepared by decoction method, meaning boiling of the plants in water to extract the active component for drinking, others by concoction, i.e. mixing and boiling of different plants in water for administration e.g. leaves concoction of Eucalyptus camaldulensis, Carica papaya, Citrus aurantifolia and Ficusthonningii is a potent recipe for malaria treatment as reported by some of the respondents. Infusion is another common preparation method, whereby plant material is soaked in boiled water for extraction of the active constituents. In some situations, plants species are air dried, pulverized and remedies are administered orally although products such as honey, garlic and red potash are added in the decoction/concoction depending on the methods used by the herbalist. As stated by one of the respondents, these ingredients are sometimes added to either increase or decrease the efficacy of the preparation depending on the severity of the malaria on the

patient. Bathing and vapour bath were also commonly administration method for the decoction or concoction after drinking, while some plant species such as Ocimum sanctum are compressed and applied topically on the body.

The findings of this study conforms with the work of Salisu (2018) who reported that, Mangiferaindica, Senna occidentalis, Commiphorakerstingii and Azadirachtaindica are used for the treatment of malaria fever in Kiyawa Town of Jigawa State, Nigeria.

The traditional application of Parkiabiglobbosa, Ficusthonningii, Citrus sinensis, Piliostigmareticulatum, and Carica papaya in treatment of malaria reported in this study has also tallied with the findings of Abubakar and colleagues (2017) in which they conducted an ethnopharmacological survey of medicinal plants used for the management of pediatric ailments in Kano State, Nigeria.

Erythrinasenegalensis, Ipomoea asarifolia, Lanneamicrocarpa, Swartziamadagascariensis, Securidacalongepedunculata and Saccharumofficianarum are reported for the first time as antimalarial agents in this study. The present study also discovered the application of Combretummicranthum and Olaxsubscopioidea as antimalarial agents for the first time. More surveys should be conducted in several areas so as to ascertain this claim.

The finding of the study highlighted that Senna occidentalis, Eucalyptus camaldulensis, Mangiferaindica, Ficusthonningii, Psidiumguajava and Carica papaya showed the highest incidence of encounter. Thus, these plant species could be considered as promising candidates for further scientific validation in the search for new, effective and affordable antimalarial drugs. The families, Fabaceae, Anacardiaceae, Combretaceae, Rutaceae, Lamiaceae, Myrtaceae and Moraceae respectively have the highest proportion of antimalarial plants encountered in this study. Previous studies also indicate that the families Anarcadiaceae, Rutacea, Moraceae, Myrtaceae, Poaceae and Fabaceae have many species used in management of malaria (Adelanwa and Tijjani, 2013; Abubakar et al., 2016 and Precious et al., 2012).

The antimalarial and other pharmacological activities of these medicinal plants are due to the presence of bioactive constituents possessed by these botanicals (Mukhtar et al., 2017). These primary and secondary metabolites in plants have numerous functions (Namadina and Sani, 2018). Crude, pure and isolated alkaloids and their synthetic derivatives have been used as analgesic, antispasmodic and bactericidal agents (Stary, 1998; Okwu and Okwu, 2004). Nevertheless, some of the plant species e.g. Commiphorakerstingii reported in this study area are rare and difficult to access in the study area. This may be connected to the fact that their habitats have been disturbed due to human activities and exploitation for various purposes. Therefore, the available ones must be conserved and their knowledge be documented before they finally cease to exist.

V. CONCLUSION AND RECOMMENDATIONS

The present study has been able to document the indigenous knowledge on the use of plants in treating malaria fever in the study area, as 44 different herbal species were identified. The data from the study revealed that the inhabitants of Madobi town in Kano state, Nigeria still relied on the use of plants for primary healthcare. However, the phytochemical characterization and pharmacological validation of these plants should be carried out especially those that receive high frequency of occurrence. This will provide bedrock for further pharmacological researches and clear guide on the isolation of the lead bioactive constituents for synthesis of promising antimalarial drugs. More so, awareness regarding the conservation status of rare medicinal plants, domestication strategies as well as appropriate methods of exploitation is crucial for further studies to ensure a sustainable utilization and availability of these plants in their habitats.

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Competing Interest
The authors declared no conflict of interest.

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