

Phytochemical Analyses of Selected Forest Genetic Resources for Ethno-Medicinal Treatment of Malaria/Fever in Iseyin Local Government Area of Oyo State Nigeria

O.O. OKE, A.S. ADEOYE, A.F. ADEROUNMU
Federal College of Forestry, Jericho Hills, Ibadan, Nigeria.

Abstract. The phytochemical contents and medicinal values of the stem-barks and leaves of selected plant species in Iseyin Local Government Area of Oyo State were investigated. Data were collected from the crude component analyses of the selected plant species through qualitative and quantitative phytochemical approaches. The results showed that the plant parts (barks and leaves) composed of bioactive compounds such as Saponins (39.9, 22.5 and 16.4 mg/100g) in *Morinda lucida*, *Azadirachta indica* and *Carica papaya* respectively; Alkaloids (44.4, 39.6 and 37.8 mg/100g) in *Azadirachta indica*, *Morinda lucida* and *Phyllanthus amarus* respectively; Tannins (40.3, 13.0 and 11.9 mg/100g) in *Azadirachta indica*, *Morinda lucida* and *Carica papaya* respectively; Phenolics (30.2, 27.2, 25.4 GAE/g) in *Morinda lucida*, *Azadirachta indica* and *Phyllanthus amarus* respectively; Steroids (8.3, 7.7 and 7.2 mg/100g) in *Morinda lucida*, *Newbouldia laevis* and *Phyllanthus amarus* respectively. These results showed that extract from the selected stem barks and leaves of plant species were very active for ethno-medicinal treatment of fever in Iseyin Local Government Area of Oyo State.

Keywords: Plant species, Crude components analyses, Bioactive compounds, Ethno-medicinal treatment, Fever

1. Introduction

Malaria is a vector borne disease, caused by protozoan parasites of the genus *Plasmodium* transmitted from the blood of an infected person and passed to a healthy human by a female *Anopheles* mosquito bites (Andrew et al., 2016). The *Plasmodium* cannot survive outside of its host but spread by mosquito bite and eventually resulted into fever (Snow et al., 2005, WHO, 2017). In Africa,

however, fever is a common ailment among the households. According to Okiro and Snow (2010), fever has traditionally served as the entry point for presumptive treatment of malaria in children and recent epidemiological changes of malaria in many African countries have shown accuracy in fever as marked sign of malaria treatment. However, there is still high burden of malaria with 51 million cases and 207,000 deaths annually (approximately 30% of the total malaria burden in Africa) despite high budget allocation on primary health care in Nigeria (FMOH, Nigeria, 2009; WHO, 2014; Dawaki et al., 2016). Therefore, unaffordable drugs/healthcare treatment and resistance to antimalarial treatment have caused a shift to herbal treatment especially by the people in the rural areas. The limitation to effective malaria fever treatment in Nigeria was due to unavailability and unaccessibility to healthcare facilities most especially among the rural people which has brought about preference for available and accessible lower-cost herbal treatment (Okeke et al., 2010 ; Okonkwo et al., 2010). The herbal treatment is the use of various parts (leaves, barks, roots) of forests trees, shrubs and herbs some of which this study delves into. Hence, the following selected forest genetic resources such as *Morinda lucida*, *Carica papaya*, *Magnifera indica*, *Azadirachta indica*, *Phyllanthus amarus*, and *Newbouldia laevis* were selected for the phytochemical analyses.

Brimstone tree (*Morinda lucida*) is a medium size tree with short crooked branches. Although it is very bitter, yet the whole plants, leaves, stem bark and roots are known to have medicinal properties. The many benefits derived from *Morinda lucida* is owed to the high contents of phytochemicals which are powerful antioxidant bioactive components like flavonoids which are effective as free radical scavengers, have anti-allergic, anti-inflammatory,

anti-viral, anti-proliferative and anti-carcinogenic properties. Phenolic which are anti- apoptosis, anti-aging, anti-inflammation, anti-atherosclerosis, anti-carcinogen cardiovascular protection and improvement in endothelial function as well as inhibition of angiogenesis and cell proliferation activities, steroids used as anti-bacterial and anti-plasmodium, alkaloids, the most essential of the phytochemical are used as anti-parasitic agent.(Adeleye et al., 2018). Decoction and infusions of plasters of root bark and leaves are recognized remedies against different types of fever, including yellow fever, malaria, trypanosomiasis, and feverish condition during childbirth. The plants in some cases, is employed in treating diabetes, hypertension, cerebral congestion, dysentery, stomach ache, ulcers, leprosy and gonorrhoea. *Morinda lucida* is reported to contain steroid which makes them useful against cerebral malaria and also confirming its effectiveness as anti-plasmodia agents. The qualitative analysis showed strongly present, present and trace amount of the different phytochemical in *Morinda lucida* plant.

Carica papaya fruits are covered with a smooth thin skin that turns to yellow or red when ripe, the flesh is succulent, varying in texture and colour ranging from yellow to orange to red (Huet, 2006). *Carica papaya* contains many bioactive compounds, two important compounds chymopapain and papain which are widely useful for digestive disorder and disturbance of the gastrointestinal tract, papaya derived papain, caricain, chymopapain and glycine endopeptidase can survive acidic pH conditions and pepsin degradation (Flath and Furrey, 1977). Phytochemical screening indicated the presence of saponins, alkaloids, cardiacglycoside, tannins and anthraquinone in the extracts. The analysis shows that the unripe fruit of *Carica papaya* can be ranked as carbohydrate rich fruit due to its high carbohydrate and starch contents. The fruit and seed of *Carica papaya* of the same plant contained the same constituent and could be used for the same purpose. The result confirmed the presence of antibacterial and antifungal activity of *Carica papaya* extract against various human pathogenic bacteria. (Eke et al., 2014).

The mango tree (*Mangifera indica* Linn Anacardiaceae) is naturalized in West Africa. The tree originated from India to West Africa (Gledhill, 1972; Oliver-Baver, 1986). The bark and leaves have astringent properties and are used in Nigeria as lotion to relieve toothache, sore gums, sore throat or as an infusion in malaria, diarrhea and dysentery treatment (Adesegun and Coker, 2001). All the organs of the plants are rich in tannins and flavonoids (Nunez-Selles, 2005). The extract from mango

(*Mangifera indica*) stem barks and leaves may have antioxidant, anti-inflammatory and immunomodulatory functions (Okwu and Ezenagu, 2008).

Neem (*Azadirachta indica*) is a tree within the Meliaceae family. Neem is also known as 'arista' in Sanskrit-A word that suggests 'ultimate, entire and imperishable'. Fruit, seeds, oil, leaves, roots, bark and just about each part of the tree is bitter and contain compounds with verified antiviral, anti-inflammatory, anti-ulcer and antifungal, antiplasmodial, antiseptic, antipyretic and anti-diabetic houses (Pandey, 2012). The Chemical components incorporate many biologically energetic compounds that can be extracted from neem like alkaloids, flavonoids, triterpenoids, phenolic compounds, carotenoids, steroids and ketones. Azadirachtin is authentically an amalgamation of seven isomeric compounds labeled as azadirachtin A-G and azadirachtin E is more efficacious (Verkerk and Wright, 1993). Phytochemical analysis of methanolic leaf extracts of *Azadirachta indica* has shown the presence of biological compounds like, Alkaloids, Flavonoids, Saponins, etc which are then compared to aqueous leaf extracts of the plant. The result suggests that the *Azadirachta indica* extracts contain plenty of phytochemicals with antimicrobial, anti-inflammatory and antioxidant properties (Dash et al., 2017).

The plant *Phyllanthus amarus* belongs to the family Euphobiaceae and of the genus *phyllanthus* and the species is *amarus* (Trease and Evans, 2001). *P. amarus* is one of the most important herbs discovered recently in Nigeria. It is known among Ibibios and Efik's as "oyomokiso aman ke edem", Yoruba as "eyin olobe", Hausa as "geeron tsutsaayee" and Igbo as "Ite knwonwa nazu" and in English as "leaf flower" or "chamber bitter" (Etukudo, 2003; Okujagu et al., 2005). *P. amarus* is usually used as infusion and drunk by Nigerian for health maintenance and it is considered as a wonder-working herb. The phytochemical analysis of the plant extracts revealed the presence of alkaloids, saponins, glycosides, tannins, steroids, terpenes, and flavonoids (Ekaete et al., 2013).

Newbouldia laevis is a fast growing evergreen shrub or small tree. It is a genus of plants in the family Bignoniaceae native to Africa. The tree, especially the bark is widely used in traditional medicine in Africa. It is an ethno-medicinal plant widely used in treatment of malaria fever and other ailments. The leaves are useful source of phytochemicals and a potential source of potent antiplasmodial compounds

that could be developed into drugs useful in treatment of malaria fever (Igboasoiki et al., 2017). The bioactive component such as alkaloids, saponins, tannins, flavonoids, steroids detected in the extracts of the plant were found to be active against Plasmodium falciparum with percentage elimination range of 43.18 to 79.54% (Andrew et al., 2016).

2. Methodology

2.1 Study Area

The study was carried out in Iseyin Local Government Area of Oyo State, Nigeria. It is centrally located within the state and accessible through road networks from Ibadan, Oyo, Abeokuta, and Ogbomoso. It is located on latitude 7°58' 0" North and longitude 3°36' 0" East. The population figure of Iseyin Local Government was 286,700 (NPC, 2006), with a land mass of 548 km². The area is peculiar for natural forest trees and horticultural plants with a large percentage of inhabitants predominantly farmers. The vegetation type is guinea

2.3 Selected Plant Species Collected from the Study Area

Table 1 shows the selected forest genetic resources in the study area. These selected forest genetic resources were *Azadirachta indica*, *Mangifera indica*, *Carica papaya*, *Newbouldia laevis*, *Morinda lucida*, and *Phyllanthus amarus*.

Table 1: Collected plant species used for treating malaria fever in the study area

Botanical Name	Common Name	Local Name
<i>Azadirachta indica</i>	Neem	Dongoyaro
<i>Mangifera indica</i>	Mango	Mangoro (Yoruba)
<i>Carica papaya</i>	Pawpaw	Ibepe (Yoruba)
<i>Newbouldia laevis</i>	Boundary tree	Ewe Akoko (Yoruba)
<i>Morinda lucida</i>	Brimstone Tree	Oruwo (Yoruba)
<i>Phyllanthus amarus</i>	Phyllanthus amarus	Eyin Olobe (Yoruba)

Quantitative phytochemical analyses

Preparation of plant extracts

Hot water extraction

Five (5) gm of dried finely powdered sample from each of the plant materials was separately taken into a beaker and 200ml of distilled water was added. The mixture was heated on a hot plate with continuous stirring at 30°-40°C for 20 minutes. The aqueous extract was filtered through filter paper, the filtrate used for the phytochemical analysis while the remaining extract kept in refrigerator for future use.

Solvent extraction

Crude plant extract was prepared by Solvent extraction method. For each of the plant species, 20gm of powdered sample was packed into a thimble and extracted with 250ml of different solvents separately. The solvents used were methanol, ethanol, and acetone. The process of extraction continues for

savannah which is characterized by tall and luxuriant shrubs, grasses with trees such as acacia, locust beans, shea butter, mango, neem, pawpaw etc. (Adeyemo, 2016).

2.2 Materials and Methods

Fresh parts of six (6) identified medicinal plants *Azadirachta indica* (leaves and bark), *Newbouldia laevis* (leaves), *Mangifera indica* (leaves and bark), *Carica papaya* (leaves), *Morinda lucida* (leaves), *Phyllanthus amarus* (leaves) were collected from the three agro-ecological rural zones in Oyo state. The plant materials were taxonomically identified and authenticated by the Department of Forest Product and Utilization of Forestry Research Institute of Nigeria. The plant materials were air-dried under shed until all the water molecules evaporated and plants became well dried for grinding. The dried plant materials were grounded using mechanical blender into fine powder and filled into airtight containers with proper labeling for quantitative and qualitative phytochemical analyses.

24 hours or till the solvent in siphon tube of an extractor become colourless, after which that the extract was taken in a beaker and kept on hot plate and heated at 30-40°C till all the solvent got evaporated. Dried extracts from the various plant species were kept in refrigerator at 4°C for future phytochemical analyses.

2.4 Qualitative Phytochemical Analysis

The extracts were tested for the presence of bioactive compounds using the following standard methods:

Test for phenolics

The amount of phenol in the aqueous extract was determined by Folin-Ciocalteu reagent method with some modifications. 2.5ml of 10% Folin-Ciocalteu reagent and 2ml of 2% solution of Na₂CO₃ were

added to 1ml of plant extract and the resulting mixture incubated for 15 minutes at room temperature. The absorbance of the sample was measured at 765nm. Gallic acid was used as standard (1mg/ml). All the tests were performed in triplicates having a score at each trial in mg/100g. The results were determined from the standard curve and were expressed as gallic acid equivalent (mg/g of extracted compound) (Aiyegoro and Okon, 2010).

Test for tannins

One (1) g of the sample from each of the plant species was weighed and extracted with 25ml of the solvent mixture of 80:20 (Acetone : 10% Glacial Acetic Acid) for 5hours. The absorbance was thereafter filtered and measured at 500nm. Tannins bind to proline rich protein and interfere with protein synthesis.

Test for flavonoids

Aluminium chloride colorimetric method was used with some modifications to determine flavonoid content. 1ml of sample plant extract was mixed with 3ml of methanol, 0.2ml of 10% aluminium chloride, 0.2ml of 1M potassium acetate and 5.6ml of distilled water and stored at room temperature for 30 minutes. The absorbance was measured at 420nm. Quercetin was used as standard (1mg/ml). All the tests were performed in triplicates.

Test for saponins

One (1) g of the sample from each of the plant species was weighed and 5ml of 20% Ethanol added. The mixture was placed in a water bath at 55° for 4hours then filtered, and the residue washed twice with 20% ethanol. The extract was reduced to about 5ml in the oven and 5ml of Petroleum Ether added to the concentrated extract inside a separating funnel. The pet Ether layer was discarded, 3ml of butanol added to it and washed with 5ml of 5% Sodium Chloride. Butanol was poured into a weighed petri dish and put in the oven to evaporate to dryness and the residue reweighed. Saponins have the property of precipitating and coagulating red blood cells.

Test for steroid

Crude extracts from each of the plant species was mixed with 2ml of chloroform and concentrated H₂SO₄ was added sidewise. A red colour produced in the lower chloroform layer indicated the presence of steroids. Steroids have been reported to have antibacterial properties (Raquel, 2007).

Test for alkaloids

Mixture of crude extract with 2ml of chloroform, then 2ml of each of concentrated H₂SO₄ and acetic acid were poured into the mixture. The development of a greenish coloration indicated the presence of steroids.

3. Results and Discussion

Qualitative phytochemical analyses of the selected plant species

Table 2 shows the result of the qualitative phytochemical analyses for the crude components of plant species used for treating malaria in the study area

Table 2: Qualitative phytochemical analyses of the selected plant species used for ethno-medicinal purposes in the study area

Parameters	Leaves						Barks	
	<i>Phyllanthus amarus</i>	<i>Newbouldia laevis</i>	<i>Azadirachta indica</i>	<i>Mangifera indica</i>	<i>Morinda lucida</i>	<i>Carica papaya</i>	<i>Mangifera indica</i>	<i>Azadirachta indica</i>
Saponins	+++	++	++	++	+++	++	+	+++
Alkaloids	+++	++	+++	++	+++	++	+++	+++
Tannins	+	++	+++	++	++	++	++	+++
Flavonoids	++	++	+	++	++	+	-	-
Phenolics	++	+	++	+	++	+	++	+
Terpenoids	+	++	++	+++	++	+	++	+
Steroids	++	++	++	+	++	+	+	+

+++ = high presence of the phytochemicals
 ++ = moderate presence of the phytochemicals
 + = low presence of the phytochemicals
 - = none presence of the phytochemicals

The concentrations of the various bioactive components varied for the various plant species. The implication of the signs is showing the various concentration levels of the bioactive ingredients present through phytochemical analyses of the plants for treating malaria. The sign (+++) shows high concentration; (++) moderate and (+) low concentration of bioactive ingredients of the phytochemicals while (-) shows absence of active ingredients of the phytochemicals on the medicinal plants analysed.

Saponin: The leaves of *Phyllanthus amarus*, *Morinda lucida* and the bark of *Azadirachta indica* had high concentration (+++) of saponins. The leaves of *Newbouldia laevis*, *Azadirachta indica*, *Mangifera indica* and *Carica papaya* had moderate (++) concentration of saponin (++) while the bark of *Mangifera indica* had it in low (+) concentration.

Alkaloids: Alkaloids were present in high concentration (+++) in the leaves of *Phyllanthus amarus*, *Azadirachta indica*, *Morinda lucida*; and the bark of *Mangifera indica* and *Azadirachta indica*. However, their concentrations were moderate in the leaves of *Newbouldia laevis*, *Mangifera indica* and *Carica papaya*.

Tannins: High (+++) concentrations of Tannins were only present in *Azadirachta indica*, both in its leaves and bark. Concentrations of tannins were moderate for all other plant species analysed except for *Phyllanthus amarus* which had low (+) content in its leaves.

Flavonoids: Flavonoids were present in moderate (++) concentrations in the leaves of *Phyllanthus amarus*, *Newbouldia laevis*, *Mangifera indica* and *Morinda lucida*, while *Carica papaya* and *Azadirachta indica* had low (+) concentrations and none present in the bark of the plants.

Phenolics: *Phyllanthus amarus*, *Azadirachta indica*, *Morinda lucida* bark had moderate (++) concentrations of phenols while *Newbouldia laevis*, *Mangifera indica*, *Carica papaya* leaves and *Azadirachta indica* bark had low (+) contents of phenols.

Terpenoids: High (+++) concentration of terpenoids was only recorded in *Mangifera indica* leaves. Leaves of *Newbouldia laevis*, *Azadirachta indica*, *Morinda lucida* and bark of *Mangifera indica* had moderate quantities while *Carica papaya* leaves and *Azadirachta indica* bark had low (+) content of terpenoid.

Steroids: Moderate (++) concentration of steroids were present in the leaves of *Phyllanthus amarus*, *Newbouldia laevis*, *Azadirachta indica* and *Morinda lucida*, while *Mangifera indica* and *Carica papaya* leaves and *Azadirachta indica* bark had low concentrations of steroids.

Quantitative phytochemical analyses of the Selected Plant Species used for Ethno-Medicinal Purposes in the Study Area after Three Trials

The result from Table 3 shows the quantitative phytochemical analyses for the crude components of the selected plant species.

Table 3: Average Quantitative Analyses of the Selected Plant Species used for Ethno-Medicinal Purposes in the Study Area after Three Trials

Parameters	LEAVES						BARK	
	<i>Phyllanthus amarus</i>	<i>Newbouldia laevis</i>	<i>Azadirachta indica</i>	<i>Mangifera indica</i>	<i>Morinda lucida</i>	<i>Carica papaya</i>	<i>Mangifera indica</i>	<i>Azadirachta indica</i>
Saponins (mg/100g)	14.35	6.25	22.45	17.1	39.85	16.4	6.65	40.65
Alkaloids (mg/100g)	37.8	17.05	44.35	19.3	39.6	15.95	36.9	40.45
Tannins (mg/100g)	2.9	10.45	40.25	8.65	12.95	11.9	9.65	38.75
Flavonoids (mg/100g)	9.95	10.9	4.55	8.5	10.25	2.6	0.75	0.4
Phenolics (GAE/g)	25.4	15.4	27.2	12.5	30.2	17.2	32.3	16.0
Terpenoids (mg/100g)	5.35	10.9	11.55	23.25	9.65	2.75	8.3	4.25
Steroids (mg/100g)	7.2	7.65	6.65	3.95	8.25	3.7	4.1	2.85

Note: Each value is the crude component present in mg/100g of each parameter.

The average quantities of bio-actives present in the analyzed plant samples are presented in Table 3.

Saponin: The bark of *Azadirachta indica* had the highest quantity of saponin with 40.65mg/100g. This was followed by *Morinda lucida* with 39.85mg/100g; *Azadirachta indica* leaves (22.45mg/100g), *Carica papaya* (16.40mg/100g), *Mangifera indica* (17.1mg/100g), *Phyllanthus amarus* (14.35mg/100g),

Mangifera indica bark (6.65mg/100g) and *Newbouldia laevis* (6.25mg/100g).

Alkaloids: Alkaloids quantities varied with the various plant species. *Azadirachta indica* leaves and bark had 44.35 mg/100g and 40.45 mg/100g respectively. These were followed by *Morinda lucida* leaves (39.6mg/100g), *Phyllanthus amarus* leaves (37.8mg/100g), bark and leaves of *Mangifera indica*

had 36.9mg/100g) and 19.3mg/100g respectively while leaves of *Newbouldia laevis* (17.05mg/100g) and *Carica papaya* (15.95mg/100g).

Tannins: *Azadirachta indica* had the highest quantities of tannins from leaves and bark with 40.25 mg/100g and 38.75 mg/100g respectively. Other plant samples had much lower quantities: *Morinda lucida* (12.95 mg/100g), *Carica papaya* (11.9 mg/100g), *Newbouldia laevis* (0.45 mg/100g), bark and leaves of *Mangifera indica* had 9.65 mg/100g and 8.65 mg/100g respectively while *Phyllanthus amarus* had the least of 2.9mg/100g.

Flavonoids: High quantities of flavonoids were recorded only in the leaves of the selected plants. *Newbouldia laevis*, *Morinda lucida*, *Phyllanthus amarus*, *Mangifera indica*, *Azadirachta indica* and *Carica papaya* had 10.9 mg/100g, 10.25 mg/100g, 9.95 mg/100g, 8.5 mg/100g, 4.55 mg/100g and 2.6 mg/100g respectively, while the bark of *Mangifera indica* and *Azadirachta indica* also had 0.75 mg/100g and 0.4mg/100mg respectively.

Phenolics: Bark of *Mangifera indica* had the highest quantity on phenol (32.3 GAE/g) among the selected plant species. This was followed by the leaves of *Morinda lucida* (30.2 GAE/g). Other quantities were *Azadirachta indica* (27.2 GAE/g), *Phyllanthus amarus* (25.4 GAE/g), *Carica papaya* (17.2 GAE/g); *Azadirachta indica* bark (16.0 GAE/g), *Newbouldia laevis* (15.4 GAE/g) and leaves of *Mangifera indica* with 12.5 GAE/g.

Terpenoids: *Mangifera indica* leaves had the highest quantity of terpenoid with 23.25mg/100g. Other quantities in other plant samples were much lower in the leaves of *Azadirachta indica* (11.55 mg/100g), *Newbouldia laevis* (10.9 mg/100g), *Morinda lucida* (9.65 mg/100g); and the bark of *Mangifera indica* (8.3 mg/100g), leaves of *Phyllanthus amarus* (5.35 mg/100g), bark of *Azadirachta indica* (4.2 mg/100g) and leaves of *Carica papaya* (2.75 mg/100g).

Steroids: Steroid quantities varied in all the plant samples analyzed. The highest quantity was obtained in *Morinda lucida* (9.65 mg/100g) and followed by *Newbouldia laevis* (7.65 mg/100g), *Phyllanthus amarus* (7.2 mg/100g), *Azadirachta indica* (6.65 mg/100g), *Mangifera indica* bark and leaves (4.1 mg/100g and 3.95 mg/100g), *Carica papaya* (3.7 mg/100g) and *Azadirachta indica* bark (2.85 mg/100g).

4. Discussion

Natural antioxidants mainly come from plants in the form of phenolic compounds such as flavonoid, phenolic acids, tocopherols etc. (Ali, 2008). Flavonoids are hydroxylated phenolic substances known to be synthesized by plants in response to

microbial infection and they have been found to be antimicrobial substances against wide array of microorganisms in vitro. They also are effective antioxidant and show strong anticancer activities (Salah, *et al.*, 2007 and Okwu, 2004). The phenolic compounds are one of the largest and most ubiquitous groups of plant metabolites (Singh, 2014). Several studies have described the antioxidant properties of medicinal plants which are rich in phenolic compounds (Krings and Berger, 2001). The content of tannin recorded is in accordance with Reddy *et al.*, (2007) whose finding confirmed that tannin-rich fractions containing ellagic acid and punicalins exhibited antiparasmodial activity against *Plasmodium falciparum* which is the malaria causing micro-organism. Some of the characteristics of saponins include formation of foams in aqueous solutions, hemolytic activity, cholesterol binding properties and bitterness (Okwu, 2001). Though, saponins are not characteristics of being anti-malaria compounds but their contribution as hemolytic agent has led to investigating their anti-plasmodial properties. The antimalaria activity of steroid as investigated by Newman and Cragg (2016) revealed that steroids with certain structures showed 100% suppression of parasitemia such as *Plasmodium falciparum*.

Several workers have reported the analgesic, antispasmodic and antibacterial properties of alkaloids (Okwu, 2001). The results obtained in this study thus suggest that the identified phytochemical compounds may be the bioactive constituents and these plants are proving to be an increasingly valuable reservoir of bioactive compounds of substantial medicinal merit.

Oseni and Ayinla (2013) measured the anti-plasmodial efficacy of the root and leaf extract of the alkaloid rich plant "*Morinda lucida*". The result of their finding shows the presence of actively alkaloid by name "*tetranortriterpenoid gedunin*" in the plant which was reported as a high *anti-plasmodial* agent comparatively higher in activity than chloroquine.

This implies from the result of the analyses of the plants that *Morinda lucida* leaves and other plants identified in the study area have the high quantities and concentrations of such active metabolite for use in malaria treatment while the bark of Mango also has similar concentration and quantity for malaria treatment. The implication of this is that *Morinda lucida* leaves and mango stem bark still rated as the most preferred plant for treating malaria because of the presence of active ingredients that are capable of curing malaria. The result of his experiment showed that a flavonoid (quercetin analogue rutin) is the most

active substance in field isolates as well as laboratory-adapted cultures providing the first evidence of its activity against *Plasmodium falciparum* parasites.

High saponin content of *Morinda lucida*, followed by Neem and thereafter pawpaw is also an indication of the acceptability of these plants as used in the treatment of malaria.

5. Conclusion

Alternative medicine is widely embraced for treating various ailments especially malaria which is common in Africa. The results from the phytochemical analyses of the plant species showed the presence of crude contents from high ++++, to moderate ++, and low + phytochemicals such as phenols, tannis, flavonoids, saponins, steroids, terpenoids and alkaloids on the leaves and barks of the plants based on qualitative and quantitative screening. The analyses established the presence of reasonable quantities and qualities of basic active chemical components that qualify the plant materials for treating malaria in the study area.

6. Recommendations

- Conservation efforts should be geared towards plants of medicinal values.
- Plantation establishment of *Morinda lucida* should be encouraged.
- Steps should be taken towards standardization of use of herbal medicine.

References

Adeleye, O.O., Ayeni, O.J. and Ajamu, M.A. (2018). Traditional and Medicinal Uses of *Morinda lucida*. *Journal of Medicinal Plants Studies*. 6(2):249-254. Available at www.plantjournal.com

Adesegun, S.A. and H. A. B. Coker, H.A.B. (2001). Plants Used in Traditional Medicine Against Malaria. *Nigerian Journal of Pharmacy*. 32:50-62. Available at <https://www.ncbi.nlm.nih.gov/pmc>

Adeyemo, O.O. (2016). Operational Performance of Ikere-Gorge Dam in Iseyin Local Government Area of Oyo State, Southwestern Nigeria. *International Journal of Advanced Academic Research*. 2(8):19-28. Available at www.ijaar.org/articles

Aiyegoro, O.A and Okoh, A. I. 2010. Preliminary Phytochemical screening and in vitro antioxidant activities of the aqueous extract of *Helichrysum longifolium* DC. *Bio Medical Centre Complimentary and*

Alternative Medicine 10:21.doi:10.1186/1472-6882-10-21.

Ali, M. 2008. *Textbook of Medicinal Knowledge*. Indian Book Publishing House, New Delhi, India. pp10-1

Andrew, E.T., Adeyemi, M.M. and Salihu, L. (2016). In vitro Antiplasmodial Activity and Phytochemical Screening of *Newbouldia laevis* Used in Treating Malaria-associated Symptoms. *British Journal of Pharmaceutical Research*. 9 (3):1-8. Available at www.sciencedomain.org/

Brown, K. 1992. Medicinal plants indigenous Medicine and conservative of Biodiversity in Ghana. Centre for Social and Economic Research on the Global Environment. University of East Anglia and University College London. Working paper GEC 92-36.

Dash, S.P., Dixit, S. and Sahoo, S. (2017). Phytochemical and Biochemical Characterizations from Leaf Extracts from *Azadirachta indica*: An Important Medicinal Plants. *Biochem Anal Biochem*. 6(2). Available at <https://www.researchgate.net>>3181

Dawaki, S., Al-Mekhlafi, M., Ithol, I., Ibrahim, J., Atroosh, W.M., Abdulsalam, A.M., Sady, H., Elyana, F.N., Adamu, A.U., Yelwa, S.I., Ahmed, A., Al-Areeqi, M.A., Subramaniam, L.R., Nasr, N.A., and Lau, Y. (2016). Is Nigeria Winning the Battle against Malaria? Prevalence Risk Factors and KAP Assessment among Hausa Community in Kano State. *Malaria Journal*. 15:351. Available at malariajournal.biomedcentral.com

Ekaete, D.U., Ukana, D.A. and Itoro, E.U. (2013). Phytochemical Screening and Nutrients Analysis of *Phyllanthus amarus*. *Asian Journal of Plant Science and Research*. 3(4):116-122. Available at www.pelagiaresearchlibrary.com

Eke, O.N., Augustine, A.U. and Ibrahim, H.F. (2014). Qualitative Analysis of Phytochemical and Antibacterial Screening Extracts of *Carica papaya* Fruits and Seeds. *International Journal of Modern Chemistry*. 6(1):48-56. Available at www.modernscientific.press.com

Etukudo, I. (2003). Ethnobotany conventional and traditional uses of plants. The Verdict Press, Uyo, Akwa Ibom State. 89-90. Available at www.sciepub.com/reference

Flath, A. and Furrey G. (1977). Volatile component of *Carica papaya*, solo variety). *Journal of Agriculture Food Chemistry*. 25:103-109. Available at <https://pubs.acs.org/doi/abs>

- FMOH, Nigeria (2009). National Malaria Control Programme Strategic Plan 2009-2013. "A Road Map for Malaria Control in Nigeria" Abridge Version, Abuja, Yaliam Press Limited.
- Federal Ministry of Health: 2009. Available at <https://extranet.who.int/files>
- Gledhill, D. (1972). West African Trees, Longman, Hong Kong. 67. Available at <https://www.amazon.com>west.Af...>
- Huet, B. (2006). The natural guide to medicinal herbs and plants. RJPBCS. 2: 15-23. Available at www.amazon.com
- Igboasoiyi, A.C., Attih, E.E., and Egbeolu, A.P. (2017). Antiplasmodial Activity of the Ethanol Leaf Extract of *Newbouldia laevis*. *World Journal of Pharmacy and Pharmaceutical Sciences*. 6 (4):50-56. Available at <https://researchgate.net/>
- Krings, U. and Berger, R.G. (2001). Antioxidant Activity of Some Roasted Foods. *Food Chemistry Journal*. 72:223-22. Available at www.sciencedirect.com
- Newman, D.J. and Cragg, G.M. (2016). Natural Products as Sources of New Drugs from 1981 to 2014. *Journal of Natural Products*. 79(3):629-661. Available at <https://pubs.acs.org>doi>
- Nunez-Selles, A.J. (2005). Antioxidant Therapy; Myth or Reality? *J. Braz. Chem. Soc.* 16 (4): 101-108. Available at <https://www.scielo.br>pid=...>
- Oliver-Baver, B. (1986). Medicinal Plants in Tropical West Africa, Cambridge University Press London. 51. Available at <https://www.cambridge.org>books>
- Okeke, T.A. and Okeibunor, J.C. (2010). Rural-Urban Differences in Health-Seeking for the Treatment of Childhood Malaria in Southeast Nigeria. *Health Policy Journal*. 95(1):62-68. Available at <https://www.researchgate.net>4068...>
- Okiro, E.A. and Snow, R.W. (2010). The Relationship between Reported Fever and *Plasmodium falciparum* Infection in Children. *Malaria Journal*. 9(99) Available at <https://malariajournal.biomedical.com>
- Okonkwo, A.D. and Okonkwo, U.P. (2010). Patient Medicine Vendors Community Pharmacists and STI Management in Abuja, Nigeria. *African Health Science Journal*. 10(3):253-265. Available at <https://www.researchgate.net>>
- Okujagu, T.E., Eze, T., Jimoh, B. and Mohammed, Z. (2005). Medicinal plant of Nigeria, Southwest Nigeria. Sap-Del Print and Co. Ltd Lagos. 1:48
- Okwu, D.E. and Ezenagu, V. (2008). Evaluation of The Phytochemical Composition of Mango; *Manifera indica* Linn. Stem Bark and Leaves. *International Journal of Chem. Sci.* 6(2):705-716. Available at <https://www.tsijournals.com>
- Okwu, D. E. (2001). Evaluation of chemical composition of medicinal plants belonging to Euphorbiaceae, *Pak vet. Journal*, 14: 160-162.
- Oseni, T.O. and Ayinla, K.I. (2013). Antiplasmodia Efficacy of Methanolic Extract of leaf of *Morinda lucida*. *Science Focus Journal*. 18(1):57-62. Available at <https://www.researchgate.net/>
- Pandey, I.P., Ahmed, S.F., Chhimwal, S. and Pandey, S. (2012). Chemical Composition. Wound Healing Activity of Volatile Oil of Leaves of *Azadirachta indica* A. juss. *APAC*. 62:2167-0854. Available at <http://worldsciencepublisher.org/journals/index.php/APAC/article/view/671>
- Raquel, F.E. (2007). Bacterial Lipid composition and antimicrobial efficacy of cationic steroid compounds. *Biochemical of sustainability Agric. Environ.*, 6(1):30-37.
- Reddy, M.K., Kasimsetty, S. and Khan, S. (2007). Antioxidants, Antimalarial and Antimicrobial Activities of Tannin-Rich Fractions, Ellagitannins and Phenolic Acids from *Punica aratum* Linn. *Journal of Planta Medica*. 73 (5):461-467. Available at <https://www.researchgate.net/>
- Sallah, E. (2007). Traditional Medicine in Nigeria Today. *The Herbal Doctor. Journal of African Medicine* 1(2) Pp.32-39
- Singh, R., Musa, J., Singh, S., and Ebere, UV. (2014). Knowledge, Attitude and Practices of Malaria Among the Rural Communities in Aliero, Northern Nigeria. *Journal of Family Medicine Primary Care* 3(1):39-44.
- Snow, R.W., Guerra, C.A., Noor, A.M., Myint, H.Y., Hay, S.I. (2005). The Global Distribution of Clinical Episodes of *Plasmodium falciparum*. *Nature*. 434(7030):214-217. Available at <https://www.scopus.com>
- Trease, G.E. and Evans, W.C. (2001). Text book of Pharmacognosy. 14th ed, WB Saunders Company Limited, U.K. 612p. Available at https://www.amazon.in>Trease_Pha...
- Verkerk, R.H.J. and Wright, D.J. (1993). Biological Activity of Neem Seed Kernel Extracts and Synthetic Azadirachtin against Larvae of *Plutella xylostella* L. Available at <http://dx.doi.org/10.1002/ps.2780370113>
- WHO (2014). World Malaria Report. Geneva, Switzerland: World Health Organization; 2014. Available at <https://www.who.int>publications>
- WHO (2017). World Malaria Report. Geneva, Switzerland: World Health Organization; 2017. Available at <https://www.who.int>publications>