# ETHNOBOTANICAL SURVEY AND PHYTOCHEMICAL STUDIES ON SOME PLANTS USED IN TRADITIONAL TREATMENT OF MALARIA AMONG THE BAJJU SPEAKING COMMUNITY OF KADUNA STATE, NIGERIA.

**BY**

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**P13PHPD8012**

**A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES**

**AHMADU BELLO UNIVERSITY, ZARIA**

**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD**

**OF A**

**MASTER OF SCIENCE DEGREE IN PHARMACOGNOSY**

**DEPARTMENT OF PHARMACOGNOSY AND DRUG DEVELOPMENT**

**FACULTY OF PHARMACEUTICAL SCIENCES**

**AHMADU BELLO UNIVERSITY, ZARIA**

**NIGERIA**

**SEPTEMBER, 2016**

## DECLARATION

I declare that the work in this dissertation titled Ethnobotanical Survey and Phytochemical Studies on some Plants used in Traditional Treatment of Malaria among the Bajju Speaking Community of Kaduna State, was carried out by me in the Department of Pharmacognosy and Drug Development, under the supervision of Prof K.Y. Musa and Dr. U.H. Danmalam.

The information derived from the literature was duly acknowledged in the text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma at this or any other Institution.

| _____ | _____ | _____ |
|---|---|---|
| Name of Student | Signature | Date |

## CERTIFICATION

This dissertation entitled ETHNOBOTANICAL SURVEY AND PHYTOCHEMICAL STUDIES ON SOME PLANTS USED IN TRADITIONAL TREATMENT OF MALARIA AMONG THE BAJJU SPEAKING COMMUNITY OF KADUNA STATE by Troy Salvia MALGWI meets the regulation governing the award of the degree of Master of Science (Pharmacognosy) of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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## DEDICATION

I dedicate this write-up to the Almighty God; The King of Kings, the Supreme provider.

(For the Strength and Guidance throughout the course of this work)

## AKNOWLEDGEMENTS

It definitely gives me great joy to express my sincere appreciation to the numerous individuals who stood by me, and supported me throughout the course of this dissertation. Names worthy of mentioning include;

Prof K.Y. Musa, my major supervisor for his intellectual insight and guidance and believing in my ability all through to the completion of the research.

Dr. U. H. Danmalam, my co-supervisor and mentor, for superb advice, guidance and inputs, always accommodating and encouraging.

The staff of Pharmacognosy and Drug Development Department, in persons of Dr I. Garba (HOD), Prof H. Ibrahim, Prof M.S. Abubakar, Prof A. Agunu, Dr A. Ahmed, and staff of the laboratory for their advice and guidance

Mal Namadi Sunusi, staff of the Herbarium unit, Biological Sciences Department, Ahmadu Bello University, for the vital role the played in helping with plant identification.

The Bajju Research assistants and my colleagues in the field, for their steadfastness and dedication, through countless hours of daily consultations and translations.

Mrs. Comfort Malgwi my beloved wife and soulmate, you were the brains behind this whole research, you gave me inputs that cleared barriers and uplifted me in depressing moments, you were my mummy, my supervisor, and research assistant all in one. Thank you for always being there for me.

## ABSTRACT

An Ethnobotanical survey was carried-out among the Bajju speaking community of Kaduna state Nigeria from May 2015 to January 2016, to discover and identify plants used in the treatment of Malaria. Respondents in the survey included; Traditional medical practitioners, herbal sellers and farmers. In all 352 respondents were interviewed out of a slated 500, of which 60% of the respondents were male while 40% were female. It was also recorded that 26% of respondents were between ages 18 and 30, 36% between 31 and 45, 26% between 46 and 59, while 12% were 60 years and above. The research also revealed that only 6% of the surveyed population were traditional medical practitioners, 20% were herbal sellers, with the bulk of respondents being farmers with 34%, other occupations made up the remaining percentage.

Fourteen (14) different species representing twelve (12) families of plants used in the treatment of malaria were obtained. These plants include; *Citrus limon* (L.) Burm.f. (Rutaceae), *Azadirachta indica* A. Juss (Meliaceae), *Vitellaria paradoxa* Gaertn. F (Sapotaceae), *Psidium guajava* L. (Myrtaceae), *Detarium microcarpum* Guill &Perr (Caesalpinaceae) *Sterculia setigera* . Delile (Sterculiaceae) *Senna occidentalis* L (Fabaceae), among others. The most common plant part used for preparation of herbal malaria remedies are the leaves, where they are mostly taken orally as a water decoction or concoction. Plants obtained from the survey also have other medicinal uses ranging from Stomach ache, Acne, Typhoid, Diarrhea, Rheumatism, and Hypertension. Phytochemical studies of selected plants reveal the presence of Saponins, Flavonoids, Anthraquinones and Alkaloids all of which have been linked to be effective against the malaria parasite. In conclusion the survey revealed that medicinal plants are used extensively in the treatment of malaria among the Bajju people, and most of these plants have been domesticated for easy access.

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# CHAPTER ONE

## 1.0 INTRODUCTION

### 1.1 Background of the Study

Ethnobotany encompasses the entirety of the relationship developed by man with plants; this relationship has existed for thousands of years. The term ethnobotany was not coined until 1895, but its history began long before that period (Lans, 2006). Theophrastus the father of botany wrote about plants and their medicinal uses, also the Greek surgeon Pedanius Dioscorides published De materia medica which was a catalog of about 600 plants used medicinally for various infections in the Mediterranean (Betti, 2004).

It was Richard Evans (1989) that defined ethnobotany as the study of the human relationship with plant materials and the evaluation and manipulation of these plant materials, substances and phenomenon (Manzoor *et al.*, 2006).

Ethnobotany is an integrative, multi-disciplinary field of learning. So the tools of ethnobotanical investigations are many: botany, mycology (the study of fungi), taxonomy (ways of categorizing), anthropology, ethnography, archaeology, comparative folklore, religious studies, medicine, chemistry, pharmacology (uses and effects of chemicals in plants), and more. Some of the psychoactive species and their lore carry us deep into realms of ritual, mythology and cosmology. Sometimes, in ethnobotanical inquiry, we call upon ancient history, or colonial socio-economic histories, or even examine the roots of our modern social movements (Soejarto, 2005).

But it is also worthy of note that of the hundreds of thousands of species of living plant, only a fraction has been investigated in the laboratory (Hussaine and Khaliq,1996).

The importance of an ethnobotanical inquiry as a cost-effective means of locating new and useful plant compounds cannot be over emphasized. Most of the so-called secondary plant metabolites employed in modern medicines were first discovered through ethnobotanical investigations (Olubre *et al.*, 1997).

It was reported that out of a total number of 119 pure chemical compounds in use, extracted from higher plants used in medicine throughout the world, 74% have the same or related use as the plants from which they were developed (Farnsworth *et al.*, 1985). The periwinkle plant *Catharanthus roseus* (Apocynaceae) represents a clinical example of the importance of plants used by local people, for the cure of various diseases. This herbaceous plant, native to southern Madagascar, is the source of over 75 alkaloids, two (Vincristine and Vinblastine) of which are clinical used to treat childhood leukaemia and hodgkin's disease. Like Catharanthus, many drugs that are commonly used today e.g. aspirin, ephedrine, erogmetrine, tubocurarine, digoxin, reserpine, atropine etc. came through the indigenous use of medicine (Farnsworth, *et al.*, 1985).

Therefore it can be seen that the investigation of plants use for medicinal purposes by indigenous people can conveniently provide new biodynamic compounds that may have important applications in our society. In many cases, developing countries like Nigeria cannot continue to spend millions of dollars on imported medicine. Several African and Asian nations are encouraging traditional medicines as an integral component of their public health care program (WHO, 2002).

This research work has comprise of among others, an ethnobotanical survey of plants used in the treatment of malaria among the Bajju people of Kaduna State.

## 1.2 The Bajju Community of Kaduna State.

### 1.2.1 Location.

The Bajju people commonly called Kaje or Kache are located approximately 9.6-10.1$^0$ North, 7.8-8.2$^0$ East, north central savannah region of Nigeria, with an estimated population of 300, 000 to 480,000 (Nordhoff *et al.*, 2013).

The Bajju community spans the length of 5 local governments of Kaduna state, they are; Zango Kataf, Kachia, Jaba, Jema'a and Chukun (Kazah, 2012).

The headquarters of the chiefdom is in Zonkwa, Zangon Kataf Local government area of Kaduna State (McKinney, 1992).

### 1.2.2 Origin

The Bajju people are believed to have migrated from a place within the present day Zamfara State Nigeria. They successfully settled in Bauchi and Plateau States of Nigeria, before finally settling in Dibiyi Kurmin-bi in present day Kaduna state.

The father of the Bajju kingdom; Baranzan is believed to have his genealogy in Niger and Cameroon (Asake, 1991).

### 1.2.3 Language, economy and occupation

The Bajju people are known to be great farmers and hunters. The language of the Bajju people is called Jju and this language is spoken in all the districts that comprise the Bajju kingdom (McKinney, 1992).

The economy and occupation of the people showed that the Bajju people are mainly small scale, subsistence farmers, 80-90% of the population rely on agriculture for their daily up-keep (Lewis, 2003)

### 1.2.4 Study site

The study site (Bajju community) as started above lies between latitude 9.6-10.1$^0$ North and longitude 7.8-8.2$^0$ East. North central savannah region of Nigeria. (McKinney, 1992) This site covers five (5) local government areas of Kaduna state. Which are; Zongon kataf, Kachia, Jaba, Jema'a and Chikun as shown in Fig 1.1 below.




Figure 1.1: Map of Kaduna State showing the Study Area

Source: Modified from the Administrative Map of Kaduna State, Kaduna state National library, Document 237-1.

## 1.3 Statement of research problem

Malaria is a serious infectious disease that is causing about 2.7million deaths each year worldwide; with 75% of this deaths occurring in sub-Saharan Africa and mostly young children and pregnant women (WHO, 2012)

Malaria has exerted a significant economic toll in affected areas, reducing economic growth in Africa by up to 1.3% each year. In Nigeria about 50% of the adult population experience at least one episode of malaria attack each year, while children who are under 5 years of age have 2 to 4 attacks annually (FMOH, 2005a). It is responsible for 30% of childhood mortality and 11% maternal mortality each year. More than 60% of out-patient visit in Nigeria is due to malaria (FMOH, 2005a).

The disease has affected the country's economy also, with about 134 billion naira lost to the disease, as cost of treatment and loss in man-hours from 2003 to 2005 (FMOH, 2005b).

Antimalarial drug resistance has emerged as one of the greatest challenges facing malaria control today, the resistance has been implicated in the spread of malaria to new areas and re-emergence of malaria in areas where the disease had been eradicated (WHO, 2001).

## 1.4 Justification

There have been strong claims by traditional medicinal practitioners of Bajju community of their ability to effectively treat malaria fever with the use of various plant species found in their locality. These claims stimulated the interest to gather and document information on these medicinal plants.

It has become necessary to share some of the traditional medicinal knowledge of the Bajju people with other communities in the region.

The findings of this research will provide a platform for further research on any lead medicinal plant obtained.

An extensive literature review, using available resources reveals that there has been no ethno-botanical survey carried out for the Bajju community, even though the people rely heavily on plant resources for their healthcare needs, especially for the treatment of malaria, it is believed that traditional medicinal practitioners of Bajju are well vast in the knowledge of traditional cures of various diseases. However today, like most rural communities, modernity and the infiltration of other cultural values is fast affecting the transfer of some to these traditional medicinal knowledge. Therefore to avoid the extinction of the knowledge and the people practicing them it has become important to document such information

## 1.5 General Aim

The objective of this research work is to carry-out an ethnobotanical survey of plants used in the treatment of malaria among the Bajju people of Kaduna state; as well as carry-out phytochemical analysis on some selected plants obtained from the research.

### 1.5.1 Specific objectives

1. To conduct an ethnobotanical survey of plant used in the treatment of malaria among the Bajju speaking community of Kaduna state.
2. To identify, collect, authenticate and document plants used in the treatment of malaria used by the Bajju community, in other to establish a plant data base.

3. To produce standard herbarium specimen for some selected plants collected.

4. To conduct phytochemical analysis on three (3) most reoccurring plants from the survey

## 1.6 Research Questions

Will an ethnobotanical survey identify and document plants claimed by traditional medicinal practitioners and community individuals of Bajju community in treatment of malaria.

Will the ethnobotanical survey of medicinal plants among the Bajju community produce plants other than those already identified and documented?

# CHAPTER TWO

# 2.0 LITERATURE REVIEW

## 2.1 Malaria

### 2.1.1 Definition and History of Malaria

The word "Malaria" is derived from the Italian Medieval word "*Mala" "aria"* which means bad-air. Malaria was formerly called Marsh-fever by the British, is an infectious disease caused by a parasite of the genus *Plasmodium* affecting mostly women and children in many parts of the world, especially sub-saharan Africa. This disease is characterized by recurrent symptoms of chills, fever, headache and pains in the joint, nausea, vomiting anemia, diarrhea, muscle pain, convulsion, coma, bloody stool, causing about 350-500 million infections worldwide leading to 1.3-3.0 million deaths annually.

These deaths are mainly in the tropics, and Africa accounts for 85 – 90 percent of these fatalities. The death rate is expected to double in the next 20 years. However, exact statistics of morbidities and mortalities are unknown because many cases occur in rural areas, where people do not have access to hospitals and/or the means to afford the health care system. Consequently, many cases are undocumented (Robert *et al*, 2005). Symptoms of malaria and typhoid are usually similar, but typhoid usually have symptoms change in stages and has a characteristic abdominal ache. The disease remains an important public health concern in countries where transmission occurs regularly. It is a complex disease that varies widely in epidemiology and clinical manifestation in different parts of the world. This variability is the result of factors such as the parasites species that occur in a given area, their susceptibility to commonly used or available antimalarial drugs, the

distribution and efficiency of mosquito vectors, other environmental conditions and the behavior and level of acquired immunity of the exposed human population (WHO, 2001).

### 2.1.2 Brief history of Malaria

The earliest recorded description of what might have been malaria as a human disease is found in a document prepared by the Emperor Huang Ti around 2700BC.

In the fifth century BC, Empedocles, a philosopher, physician, poet and student of Pythagoras, was reputed to have delivered the Sicilians City of Selinus from a febrile plague by cleansing the adjacent marshes. Hippocrates, 'the first malariologist, classified the fevers now known to be malaria, though his teachings were neglected and ignored for 2000 years. He was the first to describe the manifestations of malarial disease, and relate them to the time of year and to where the patients lived. Before this, the supernatural was blamed. The association with stagnant waters (breeding grounds for *Anopheles*) led the Romans to begin drainage programs, the first documented intervention against malaria. Early in the 1600s, Jusuit missionaries in Peru became aware of the antimalarial properties of the bark of the Cinchona tree, which was the first recorded treatment of malaria. Thomas Sydenham refocused attention on Hippocrates's methods. He again classified the fevers of malaria, and demonstrated that the Peruvian bark afforded the surest hope of treating intermittent fever effectively when given repeatedly in four-hourly doses. Quinine was later isolated from the Cinchona tree bark by two young French chemists, Pierre Joseph Pelletier and Joseph Bienaime Caventou in 1820, which led to a rapid increase in demand for quinine, and increase in cost of demand outstripped South American bark supplies (Welcome Trust, 2002). Not until 1889 was the protozoal cause of malaria elicited by Laveran working in Algeria, and only in 1897 was the *Anopheles* mosquito demonstrated to be the vector for the disease. At this point, the major features of the epidemiology of malaria seemed to be clear, and control measures started to

be implemented. The discovery of the insecticide, dichlorodiphenyltrichloroethane (DDT) in 1942 and its first use in Italy in 1944 made the idea of global eradication of malaria possible. Subsequently, widespread systematic control measures such as spraying with DDT, spraying marshes with paraffin (to block *Anopheles* mosquito larvae spiracles), draining stagnant water, and the widespread use of nets and cheap, effective drugs such as chloroquine were implemented with impressive results (WHO, 1987, WHO, 1998).

'Despite initial success, there was complete failure to eradicate malaria in many countries due to a number of factors'. Although, technical difficulties such as vector and parasite was a factor, drug resistance have played a major part, in the failure to reduce the occurrence of the disease. The malaria control operation was criticized for being too much like a military operation, and the lack of explanations offered to the local populations meant that the control measures received little support or even outright opposition. Thoughtless man-made irrigation schemes and dams provided new habitats for *Anopheles*, and resulted in 'man-made' malaria. The extension of urban areas lead to more epidemic areas. Political reasons further complicate matters; Africa, where the majority of malarial disease is manifest was not even included in the global control mechanism at the beginning as it had insufficient infrastructure to support the policy. Despite the setbacks, up until 1969, when the global eradication policy was finally abandoned, countries like Hungary, Bulgaria, Romania, Yugoslavia, Spain, Poland, Italy and Portugal had managed to completely eradicate their epidemic malaria by interrupting transmission (WHO, 1987).

From the early 1870's the malaria situation has slowly and progressively deteriorated, and reduced control measures between 1972 and 1976 due to financial constraints led to a massive 2-3 fold increases in cases globally. Spraying never truly eradicated the mosquitoes anywhere and the reduction in the more persistent *P. vivax* infections were much less than for *P. falciparum*,

though, the latter returned in much greater strength as control measures waned. The growing interchange of populations between malarious countries and malaria-free countries is responsible for the continuous increase in the number of imported malaria cases in many countries, and causes serious concern because of possible epidemic focal resurgence in receptive areas such as the Mediterranean. Since 1976, several new pockets of malaria transmission have evolved, and World Health Organisation 1980 report recommended that countries, which had become non-malarious, should maintain at least one malaria vigilance unit (Woodruff *et al.*, 1987).

### 2.1.3 Transmission of Malaria

A person gets malaria when bitten by a female mosquito that is looking for a blood meal and is infected with the malaria parasites, *Plasmodium; Plasmodium* is a lower Eukaryote with a genetic complexity five times greater than that of a bacterium. This genetic complexity, combined with the considerable polymorphism of the organism and its ability to adapt to changing situations probably explains why the parasite is so successful. At molecular level, the parasite damages red blood cells using plasmepsin enzymes. Plasmepsins are aspartic acid proteases which degrade hemoglobin (Egan, 2001). The parasites enter the blood stream and travel to the liver, where they multiply. When they re-emerge into the blood, symptoms appear. By the time a patient shows symptoms, the parasites have reproduced very rapidly, clogging blood vessels and rupturing blood cells. Although more than 160 different species of *Plasmodium* parasites have been found, only four species infect humans and are responsible for causing the disease in its various forms. These four species include the following: *P. falciparum* (this is worldwide in occurrence, it causes rapid death and it is resistant to common drugs), *P. vivax* (this also occur worldwide, it causes prolonged relapse) *P. malariae* (This is also worldwide in appearance, it is the least common specie) *P. ovale* (this is found in West African region only; it also causes prolonged relapses), *P. falciparum* is the

most widespread and dangerous of the four species and if not treated in good time it can lead to fatal cerebral malaria, more especially in children.

The four species, beside the differences in geographical distribution they also differ in microscopic appearance, clinical features (periodicity of infection, potential for severe disease, and ability to cause relapses), and potential for development of resistance to antimalarial drugs. So far, drug resistance has only been documented in two of the four species, *P. falciparum* and *P. vivax*. Many animals can get malaria, but human malaria does not spread to animals. In turn, animal malaria does not spread to humans (WHO, 2001).

### 2.1.4 Classification of *Plasmodium*

Kingdom: Protista

Phylum: Apicomplexa

Class: Aconoidasida

Order: Haemosporida

Family: Plasmodiidae

Genus: *Plasmodium*

Species: *P .bergei, P. brassilliaum, P. chabaudi, P. cynomolgi, P. falciparum, P. malariae, P. ovale P. vivax, P. yeoli* etc.

### 2.1.5 Life cycle of *Plasmodium*

Briefly, the life cycle of *Plasmodium* is as shown in (Figure 2.1) Sporozoites, thought to be about at least 100 on each occasion, are released from the female mosquito's salivary glands, into the circulating blood of the victim and within 30 to 45 minutes enter hepatocytes. Growth and division in the liver for the human malaria parasites take from approximately 6 to 15 days depending on the species: approximately 6 days for *P. falciparum*, 10 days for *P. vivax*, and 15 days for *P. ovale* and *P. malariae*. At the end of the pre-erythorcytic cycle, thousands of merozoites are released into the blood flowing through the sinusoids and within 15 to 20 seconds, attach to and invade erythrocytes. In *P. vivax* and *P. ovale*, some of the sporozoites appear to develop for about 24 hours before becoming dormant as a hypnozoite stage. This form can remain as such for months and even years until reactivated to complete the life cycle, releasing merozoites into the blood to precipitate a relapse infection.

The asexual erythrocytic cycle produces more merozoites that are released with the destruction of the red blood cell after 48 or 72 hrs for the human malaria parasites depending on the species, and which then immediately invade additional erythrocytes. The asexual cycle usually continues until controlled by the immune response or chemotherapy or until the patient dies (in the case of *P. falciparum*). Most malaria parasites developing in the victim's red blood cells grow in synchrony with one another, for at least some animal species apparently tuning into the host's circadian rhythms. There is no compelling evidence as yet that this is the case for human malaria parasites. Consequently, they complete schizogony together at the end of the asexual cycle, release pyrogenic materials, which induce the characteristic fever spike and chemical symptoms. The morbidity and mortality associated with malaria are derived solely from the erythrocytic stages.

After invading red blood cells, eventually some merozoites differentiate into sexual forms (gametocytes) and, following ingestion by another female mosquito, they mature to male and female gametes in the blood meal. After fertilization, the resulting zygote matures within 24 hours to the motile ookinete which burrows through the midgut wall to encyst on the basal lamina (the extracellular matrix layer separating the hemocoel from the midgut of the mosquito.) Within the developing oocysts, there are many mitotic divisions resulting in oocysts full of sporozoites. Rupture of the oocysts releases the sporozoites, which migrate through the hemocoel to the salivary glands to complete the cycle approximately 7 to 18 days after gametocyte ingestion, depending on host-parasite combination and external environmental conditions. All stages in the life cycle are thought to be haploid, apart from the diploid zygote, which immediately after fertilization undergoes a two-step meiotic division, the resulting cell containing a nucleus with four haploid genomes. The sexual process and meiotic division following fertilization allow genetic combination to occur, which is reflected in the genetic makeup of the sporozoites and together with mutations provides the raw materials upon which selective pressures such as antimalarial drugs can work (Philips, 2001).

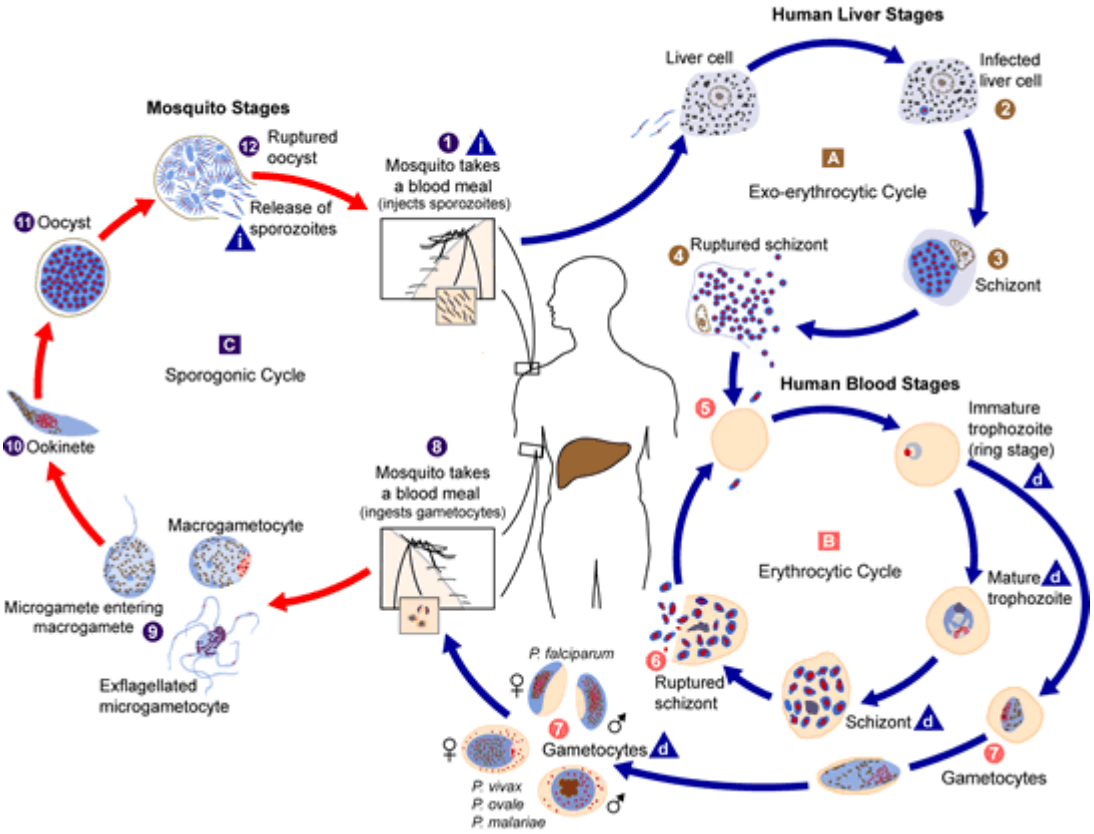



**Figure 2.1: Life cycle of the malaria parasite in Man and Mosquito.**

Adapted from Center for disease control and prevention USA (CDC). Global health- Division of Parasitic Diseases and malaria document March 2016. Outline of the life cycle of the Malaria parasite.

## 2.2 Prevalence of Malaria

### 2.2.1 Prevalence of Malaria in Africa

Most clinical events attributable to *P. falcipurum* were concentrated in the African region (70%). The World Health Organisation suggested that there were 273 million clinical attacks of

malaria worldwide in 1998 and that 90% of the global disease incidence is born in Africa. It is estimated that an individual receives 40-120 infective mosquito bites per year, compared to only 2 per year in other regions. Bearing the figures for Africa in mind, it seems ridiculous that 100% global eradication was envisaged from a policy, which effectively ignored Africa other than for a couple of pilot schemes (Woodruff *et al.*, 1987). Because the African region has a notoriously weak system of reporting infectious diseases, epidemiological evidence from carefully conducted prospective active case-detection studies of malaria morbidity, disability and mortality in populations leaving under different transmission intensity risks have been compiled to estimate the disease burden (Hay *et al*, 2004, Robert, et al., 2005). Mapping malaria risk in Africa (MARA) database findings on climate suitability for stable malaria transmission estimated that 200 million people (24.6% of the total African population) currently live in urban settings where they are at risk of contracting the disease. This is cause for great concern in that the surface area covered by these urban settings is approximately 1.1 - 1.6% of the total African surface. It was also estimated that an annual incidence of 24.8 – 103.2 million cases of clinical malaria attacks are among urban dwellers in Africa. These figures translate to 6-28% of the estimated global annual incidence of the disease (Snow *et al.*, 2003). It appears that urban malaria control will be more cost-effective than in rural areas, but research is needed to confirm that this malaria epidemics have been on the increase during the last 10 years, which results from special interactions between vectors, parasites, humans, and various environmental and anthropogenic determinants (Figure:2.1). The explosiveness of malaria epidemics always strains the capacity of health facilities, causing case fatality rates to increase five-fold or more during outbreaks. People of all ages remain susceptible to the full range of clinical effects (Joel *et al.*, 2014).

### 2.2.2 Prevalence of Malaria in Nigeria

Malaria is the commonest cause of hospital attendance in all age groups in all parts of Nigeria. It is also one of the four commonest causes of childhood mortality in the country, the other three being acute respiratory infection (pneumonia), diarrhea and measles. It is estimated that 50 percent of the population has at least one episode of malaria each year while children under five years of age have an average of 3 to 4 attacks in a year. The disease is characterized by a stable perpetual transmission in all parts of the country. The transmission is however higher in the wet season than in the dry season, though, this seasonal difference is more striking in the northern part of the country (FMOH, 2005a).

## 2.3 Malaria Treatment and Control

### 2.3.1 Economic burden and treatment of Malaria

Malaria costs Africa more than $12 billion in loss of gross domestic product (GDP) every year and it is responsible for a 1.3 % growth penalty per year in some African countries, due to loss in productivity. It accounts for up to a third of all hospital admissions, and up to a quarter of all deaths of children under the age of 5 years. There are up to 800,000 infantile mortalities and a substantial number of miscarriages and very low birth weight (VLBW) babies a year due to the disease. ()The cost of malaria in economic terms is also high, treatment ranges in cost between $ 0.80 and $ 6.30 depending on local drug resistance, and the total cost in Africa is $ 1.8 billion per year. A bout of malaria typically costs 10 working days, adding to the economic burden. The disease profile always has major economic consequences, although the full economic impact of epidemic malaria remains undefined. Specialized intervention approaches are needed for epidemic-prone areas, including enhanced surveillance activities and intensified anti-vector

interventions. Such considerations are particularly critical at a time when malaria epidemics are occurring more frequently in Africa and throughout the World (Joel *et al.*, 2014).

### 2.3.2 Current treatment of Malaria

Current drugs for the treatment of uncomplicated malaria are artemisinin based combination therapies (ACTs). This combination takes advantage of the rapid blood schizontocidal action of the artemisinin and the long duration action of the partner compound to affect rapid cure with low level of recrudescence. Severe malaria is a medical emergency and requires in-patient care. Deaths from severe malaria can result either from direct effect of the disease or the complications. It has been argued that with the limited number of antimalarial drugs available and the growing resistance of the parasites to these drugs, better responses to drug treatment and a significant slowing down of the rate of development of resistance can be achieved by combining antimalarial drugs (Frontline, 2005).

In January 2006, on the occasion of the release of the World Health Organization (WHO) guidelines for the treatment of malaria, WHO issued a press release urging 17 known companies to stop marketing attempting monotherapies, and fore-direct their production efforts towards artemisinin-based combination therapy. The press release received major attention in the international media (newspapers, radio and television) and in the national press in endemic countries. At present, about 100 countries have adopted ACTs as recommended by WHO in the general health services. With increased mobilization of international funds, mainly from the Global Fund to fight AIDS, Tuberculosis and Malaria (GFATM), the procurement of ACTs for the public health sector has increased exponentially during the past few years (WHO, 2006).

### 2.3.3 Limitation of current treatment of Malaria

The drug treatment of malaria depends on the type and severity of the attack typically, guanine sulphate tablets are used and the normal adult dosage is 600mg every twelve hours, which can also be given by intravenous infusion if the illness is severe. *Falciparum* malaria is a medical emergency that should be treated in the hospital. The type of drugs, the method of administering the drugs, and the length of the treatment depend on where the malaria was contracted and how sick the patient is. For all strains except *Falciparum*, the treatment for malaria is usually chloroquine and it's usually treated with a combination of quinine and tetracycline. Nowadays the ACTs are mostly in use. In countries where quinine resistance is developing, other treatments may include clindamycin (Cleocin) mefloquin (Lariam), sulfadoxine/pyrimethamine (Fansidar) or artesunate combination. Most patients receive an antibiotic for seven days. Those who are very ill may need intensive care and intravenous (IV) malaria treatment for the first three days. A patient with *Falciparum* malaria needs to be hospitalized and be given antimalarial drugs in different combinations and doses depending on the resistance of the strain. The patient may need intravenous fluids, red blood cell transfusions, kidney dialysis, and assisted breathing. Drugs like primaquine or halofantrine may prevent relapses after recovery from *P. vivax* or *P. ovale*. These relapses are caused by a form of the parasites that remains in the liver and can reactivate months or years later. However, all these drugs maybe either toxic, ineffective or are not affordable to the common man, who is most affected by the disease (Philips, 2001).

### 2.3.4 Prophylaxis of Malaria

As there is no marketable vaccine available for protection against malaria despite decades of research, there is a need for an alternative method that offers a fairly reliable protection against malaria; since malaria can be severe in the non-immune, all visitors from a non-malarious area to

a malarious area should be protected. Antimalarial drugs offer protection against clinical attacks of malaria. The risk of contracting malaria depends on the region visited, the length of stay, time of visit, type of activity, protection against mosquito bites, compliance with chemoprophylaxis etc. pregnant women, infants and young children and people who have undergone splenectomy should avoid travel to a malarious area as these people are at higher risk of severe malaria. If travel is unavoidable, these people should take strict precautions to avoid mosquito bites and also take adequate chemoprophylaxis without failure (Kakkilaya, 2006).

Several drugs, most of which are also used for treatment of malaria, can be taken prophylactically. Generally, these drugs are taken daily or weekly, at a lower dose than would be used for treatment of a person who had actually contracted the disease. Use of prophylactic drugs is seldom practical for full-time residents of malaria-endemic areas, and their use is usually restricted to short-term visitors and travelers to malaria-endemic areas. Chloroquine and proguanil have an excellent safety record in the recommended dosages. Mefloquine 250 mg once per week is not recommended for patients taken beta blocker or guanidine for pilots and others who need fine motor skills, known neurologic or psychiatric disorders, pregnant women in their first trimester or children less than 15 kg. Fansidar (S/P) has been associated with a relatively high incidence of potentially total reactions and is no longer recommended for prophylaxis but may be used for standby treatment. It should not be taken by pregnant women or by those who are sensitive to sulphonamides. Serious adverse reactions includes toxic epidermal necrosis, agranulocytosis, hypersensitivity, pneumonitis and hepatitis. It has to be stressed here that no prophylaxis is full proof and failure arise most commonly from not taking the drugs as prescribed. In particular they must be started one week before departure and continued for 4-6 weeks after leaving malaria endemic areas. Any fever up to 12-18 months after leaving a malaria endemic should arouse suspicion of malaria and

be investigated accordingly, appropriate advice must be sought prior to departure from a reputable travel advice center (Wyler, 1993).

### 2.3.5 Antimalarial drug resistance

Antimalarial drug resistance is the ability of a parasite strain to survive and/or multiply despite the administration and absorption of a drug given in doses equal to or higher than those usually recommended but within tolerance of the subject. The drug in question must gain access to the parasite or the infected red blood cell for the duration of the time necessary for its normal action (Bruce-Chwatt, 1986). This definition of resistance requires demonstration of malaria parasitaemia in a patient who has received an observed treatment dose of an antimalarial and simultaneous demonstration of adequate blood drug and metabolite concentrations using established laboratory methods (Plowe, 1995; Reichmann, 1978; Su, 1997; White, 1997) a distinction must be made between a failure to clear malarial parasitaemia or resolve clinical disease following a treatment with an antimalarial drug and true antimalarial drug resistance, while drug resistance can cause treatment failure, not all treatment failure is due to drug resistance. Many factors can contribute to treatment failure including incorrect dosing, non-compliance with duration of dosing regimen, poor drug quality, drug interactions, poor or erratic absorption, and misdiagnosis. Probably all of these factors, while causing treatment failure or (apparent treatment failure) in the individual, may also contribute to the development and intensification of true drug resistance through increasing the likelihood of exposure of parasites to a suboptimal drug levels.

### 2.3.6 Mechanisms of antimalarial resistance

In general, resistance appears to occur through spontaneous mutations that confer reduced sensitivity to a given drug or class of drugs. For some drugs, only a single point mutation is

required to confer resistance while for others, multiple mutations appear to be required provided the mutations are not deleterious to the survival or reproduction of the parasite, drug pressure will remove susceptible parasites while resistant parasites survive. In the case of malaria, a single malaria isolates have been found to be made up of heterogeneous populations of parasites that can have widely varying drug response characteristics, from highly resistant to completely sensitive. Similarly, within a geographical area, malaria infections demonstrate a range of drug susceptibility. Over time, resistance becomes established in the population and can be very stable; persisting long after specific drug pressure is removed (Thaithong, 1983). For example, the biochemical mechanism of resistance of chloroquine is that, when the malaria parasite digests hemoglobin, large amounts of a toxic by-products are formed. The parasite polymerizes this by-product in its food vacuole, producing, non-toxic haemozoin (malaria pigment). It is believed that resistance of *P. falciparum* to chloroquine is related to an increased capacity for the parasite to expel chloroquine at a rate that does not allow chloroquine to reach levels required for inhibition of haem polymerization. This chloroquine efflux occurs at a rate of 40 to 50 times faster among resistant parasites than sensitive ones. Further evidence supporting this mechanism is provided by the fact that chloroquine resistance can be reversed by drugs which interfere with the efflux system. It is unclear whether parasite resistance to other quinolone antimalarials (amodiaquine, mefloquine, halofantrine and quinine) occurs via similar mechanisms (Krogstad, 1987; Martin *et al*, 1987; Foley and Tilley, 1997).

## 2.4 Traditional medicine

Traditional medicine is the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the

maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness, while a medicinal plant is a plant that has similar properties as conventional pharmaceutical drugs. Humans have used them throughout history to either cure or lessen symptoms from an illness. A pharmaceutical drug is a drug that is produced in a laboratory to cure or help an illness. (WHO, 2002).

### 2.5 Traditional Knowledge of Malaria and Its Treatment

Medicinal plants remain a major source of drugs in the treatment of various categories of human ailments especially in the developing countries. They have formed the basis for traditional medicine systems, which have been used for thousands of years in African countries. The World Health Organization estimates that 80% of the world's inhabitants continue to rely mainly on traditional medicine systems for their health care. Herbal traditional medicine has the potential to improve the health of developing countries and contributes immensely to strategic reduction of excess mortality, disability and other risk factors to human health (WHO, 2002). In the modern world, interest in the therapeutic value of medicinal plants are getting revived and attention is being directed to explore and evaluate the efficacy of herbal drugs for the treatment of various diseases, including malaria, as also for those which do not respond adequately to synthesized drugs. The new interest in the strategies on malaria treatment and control is to investigate the folkloric medicine in the search for potent antimalarials, since approximately 80 percent of the affected populations still depend on traditional medicine as its primary source of treatment of the diseases (WHO, 2002). For example artemisinin isolated from the herb *Artemisia annua*, which has been in use in traditional Chinese medicine as a remedy for chills and fever for more than 2000 years. Clinical studies have shown the drug to be a safe and effective antimalarial agent even

in the case of chloroquine-resistant *Plasmodium falciparum* malaria including those of cerebral malaria (Klayman 1985).

Researchers are now studying traditional African herbal remedy against malaria. Extracts from *Azadirachta indica* (Meliaceae), *Microglossa pyrifolia* (Asteraceae), *Cassia singueana* (Fabaceae) and *Mammea africana* (Guttiferae), are showing promising results in the treatment of malaria (Coluzzi and costantini, 2002; Kohter *et al*, 2002; Isah *et al*, 2003; Bulus *et al*, 2003; Herbal gram, 2003, Wright, 2004, Jude *et al*, 2006; Katsayal and Obamiro, 2007; Bulus *et al*, 2008).

### 2.5.1 Traditional knowledge of Malaria and its treatment in Nigeria

It is a known fact that the oldest component of the Nigeria health sector consists of traditional healers and birth attendants. They are the providers of primary healthcare. These healers provide a client -centered and personalized health care that is culturally appropriate, holistic and tailored to meet the needs and expectations of the patients (Iwu, 1994). In Northern Nigeria where malaria is endemic, there has been a traditional use of plants as antimalarials, although without proven scientific justification. The relevant ethno-botanical, pharmacological and toxicological studies may not be available (Omulokoli, *et al*, 1997).

Traditional healers across the northern region of Nigeria claim that traditional knowledge of malaria and their remedies offer a huge potential to fight the disease. Even though there is no sufficient scientific evidence, and there is also lack of evidence of quality control measures, safety, dosing and toxicity of the remedies, the healers continue to enjoy the confidence of the local people who continue to patronize them. The herbal remedies used by the healers for the treatment of

malaria are also mostly in the form of decoctions or infusions of leaves, stem-barks, roots and other parts of the plants (Weenen *et al*, 1990)

The traditional healers claim that they find many plant species to be effective against malaria in their daily practices, and investigations have revealed that many of such plants are being selected and screened for their antimalarial properties in-vivo and /or in -vitro (Weenen *et al*, 1990; Jurg *et al*; 1991; Gessler *et al*, 1994, 1995; Benot *et al*, 1996; Omulokoli *et al*, 1997; El-tahir *et al*, 1999a, b; Tona *et al*, 1999; Munoz *et al*; 2000).

Literature search revealed that Nigeria has remarkable diversity of flora, and quite a number of them are used medicinally for the treatment of malaria. Some of the researches have been highlighted below.

Omosun *et al.,* (2013), carried out an Ethnobotanical study of medicinal plants useful for malaria therapy in eight local government areas of Abia State, Southeast Nigeria, using questionnaires obtained from oral interviews for practicing herbalists and other individuals involved in the use of medicinal plants. Results of this survey indicated that twenty-one plant species belonging to eighteen families of plants featured as recipes in the preparation and treating of infectious diseases including malaria. Some of the families obtained included; the Meliaceae, Anonaceae, Asteraceae, Solanaceae, with the following medicinal plants; *Azadirachta indica, Manihot esculentum, Anacadum occidentalis, Pterocarpus santalinoides, Mangifera indica, Carica papaya, Vernonia amygdalina, Aspillia latifolium*. Investigation on plant parts used, mode of preparations and administration, indicated that irrespective of plant and plant parts or their combination used, water was the main medium for all medicinal preparations. Treatment regime included drinking the aqueous preparations for five to ten days or until malaria fever symptom disappeared. Although the efficacy of the recipes described by the respondents is not known with

certainty, the people are certain that it works for them and they still rely heavy on herbal medicines than orthodox malaria drugs. This survey provides a basis for further screening and research on these plants used for malaria in the eight local government of Abia State, Nigeria.

Also Ampitan A., (2013) conducted an Ethnobotanical survey of medicinal plants in Biu local government area of Borno state, Nigeria, using a semi-structured questionnaire. Respondents included traditional medicine practitioners (TMP) and herbal medicine sellers. The survey was to identify the medicinal plants in this area, how these medicinal plants are sourced, used, preserved and the problems confronting the traditional medicine practitioners and hawkers in the area. Results obtained show that 27 plant species from 24 families were identified as medicinal plants, some of these medicinal plants are; *Adansonia digitata, Acacia nilotica, Allium sativum, Azadirachta indica, Balanites aegyptiaca, Citrus sinensis, Eucalptus camaldulensis, Faidherbia albida, Ficus sycomorus, Khaya senegalensis*. While the people sourced their medicinal plants from uncultivated land, protected forests and farms. The survey discovered some of the local uses of these plants and the different ailments they cured which include fever, diarrhea, anemia, snake bite and others. The majority of the traditional medicine practitioners and hawkers of medicinal plants had no formal education, mostly males with 5-8 years of practicing. The major problems confronting the practitioners and hawkers were transportation and police harassment.

Olorunnisola *et al.*, (2013) carried out an Ethnobotanical survey of medicinal plants used in the treatment of malaria in Ogbomoso, Southwest Nigeria. The results of the survey revealed that 40 plant species from 32 plant families were mostly used for treating malaria infection in Ogbomoso. Twenty-three different antimalarial recipes were mentioned in the survey. The Asteraceae and Anacardinceae were the most represented plant families followed by Malvaceae, Solanaceae, Annonaceae, Poaceae, Rutaceae and Meliaceae. The leaf and the stem bark have been

the most frequently used plant parts while concoction and decoction were the most common method of preparation. Treatment regimens of malaria generally included drinking, bathing and steam inhalation of the aqueous herbal preparations for 5-7 days or until symptoms of malaria disappear. About 53% of the plants mentioned in the survey had side effects.

Another Ethnobotanical survey of antimalarial plants used in Ogun State, Southwest Nigeria, was carried out by Idowu *et al.,* (2010) in 17 communities of Ogun State, Southwest Nigeria. According to the results, 38 plant species belonging to 24 families were used in herbal antimalarial recipes. Among the plants mentioned, the most frequently used were *Morinda lucida (7.87%), Lawsonia inermis (7.41%), Citrus medica (6.94%), Sarcocephalus latifolius (6.48%) and Morinda morindiodes (6.48%).* Investigations were carried out on the plant part used, method of preparing herbal antimalarial remedies and how it is administered. Result showed that irrespective of plant and part or combinations of the plant parts, water and aqueous extract from fermented maize were the main medium of herbal antimalarial preparations. Treatment regimens of malaria generally included drinking, bathing and steam inhalation of the aqueous herbal preparations for 4 - 10 days or until symptoms of malaria disappear. About 65% of all the plants mentioned in the survey have been documented to have toxic effect on the liver and kidney of experimental mice. Continuous consumption of these plants could therefore have pathological effects on the consumers. Hence, this show the need for more research in order to identify lead compounds in indigenous antimalarial plants with less or no toxicity.

Traore *et al.,* (2013) conducted an Ethnobotanical survey on medicinal plants used by Guinean traditional healers in the treatment of malaria. In the survey, a total of 258 people (141 males and 117 females) from which 150 traditional healers and 108 herbalists were interviewed. The age of informants ranged from 28 to 82 years old. 57% (149/258) of the interviewees were

more than 50 years old. The respondents had good knowledge of the symptoms of malaria, and a fairly good understanding of the causes. One hundred and thirteen plant species were recorded, out of which 109 were identified. They belonged to 84 genera and 46 families. The most frequently cited plants were *Vismia guineensis, Parkia biglobosa, Nauclea latifolia, Harungana madagascariensis, Terminalia macroptera, Crossopteryx febrifuga, Terminalia albida, Annona senegalensis, and Nauclea pobeguinii*. The leaves were most frequently used, followed by stem bark and roots. The remedies were mostly prepared by decoction, followed by maceration. Only one species was prepared by infusion.

Kadiri, *et al.,* (2013) published their findings after conducting a survey about the folk use of herbal plants used in the treatment of malaria fever in Abeokuta North Local Government, Ogun, State. Nigeria. Results of this study showed that a total of 71 plants belonging to 45 families were collated Rubiaceae, Compositae, Anacardiaceae, and Caesalpiniaceae were the most frequent. The most frequently mentioned plants were *Morinda lucida (60.56%), Azadirachta indica (56.33%), Cymbopogon citrates (56.33%), Sarcocephalus latifolia (56.33%), Alstonia boonei (54.93%), Carica papaya (53.52%), Khaya grandifolia (52.11%), Petivera alliaceae (50.70%) Tithonia diversifolia (49.29%), Mangifera indica (46.48%).* The most frequently used parts were leaves (22.53%) followed by combination of leaves and barks (23.94%). Various solvents for herbal preparation were mentioned out of which aqueous extract from fermented maize the most was frequently used. The herbal preparations (250-300ml) were normally taken by oral application, 2-3times daily for at least 7 days.

Tolu *et al.,* (2007) also conducted a survey "Medicinal plants useful for malaria therapy in Okeigbo, Ondo state, Southwest Nigeria". This study thus, has the main objective of presenting medicinal plants used for malaria therapy in Okeigbo, Ondo State, South west Nigeria. Focus

group discussions and interview were held about plants often found useful for malaria therapy in the community. Fifty species including: *Morinda lucida, Enantia chlorantha, Alstonia boonei, Azadirachta indica and Khaya grandifoliola* plants were found to be in use for malaria therapy at Okeigbo, Southwest Nigeria . The parts of plants used could either be the barks, roots, leaves or whole plants. The recipes also, could be a combination of various species of plants or plant parts. This study highlights potential sources for the development of new antimalarial drugs from indigenous medicinal plants found in Okeigbo, Nigeria.

Ogbuehi *et al.,* (2015) conducted a survey on Traditional Medicine Treatment of Malaria in Onitsha, South East Nigeria. The survey was conducted in the commercial city of Onitsha, South-east Nigeria to ascertain the plants used in the treatment of malaria and the treatment practice in the herbal markets studied. Information was collected from herb sellers using semi-structured questionnaires, in-depth interviews and direct observation. Samples of all plants claimed to have antimalarial property were collected, identified and authenticated. A total of 481 respondents were interviewed. Of these, of which 49.7% were males and 50.3% females. Majority (79.4%) of the respondents were herb-sellers while 20.6% were trainees. Eleven plant species used in the treatment of malaria were identified and information regarding the plants collected. The information collected includes their common names, parts used, methods of preparation, duration of treatment and other medicinal values, compiled. The frequency of encounter of the plants identified during the survey were as follows: *Nauclea latifolia (22.6%); Azadirachta indica (17.0%); Sida acuta (11.8%); Cymbopogon citratus (9.5%); Alstonia boonei (7.6%); Carica papaya (7.3%); Morinda lucida (6.7%); Ocimum gratissimum (6.4%); Mangifera indica (4.2%); Vernonia amygdalina (3.8%); and Psidium guajava (3.1%).* Sixty percent of the concoction studied contained plant combination than single plants for the treatment of malaria. However,

scientific validation of the traditional claims of antimalarial properties is imperative. This will contribute positively to the search for newer and more effective antimalarial drugs.

Ene *et al.,* (2010) conducted a survey titled "Locally used plants for malaria therapy amongs the hausa, Yoruba and Ibo communities in Maiduguri, Northeastern Nigeria", to ascertain the plants locally used in northeastern Nigeria to treat malaria amongst some of the major ethnic groups in Maiduguri. Traditional healers from these ethnic groups were interviewed to ascertain the plants used traditionally to treat malaria. The study discovered that the plant commonly used included; *Azadirachta indica, Magnifera indica, Psidum guajava, Musa sapietum* among others. Their selected parts were prepared in various liquid mixtures and administered orally. Most of the herbalists claim that their traditional plant remedies are effective and elicit little or no side effect.

Sanjay Singh and Rupashree Singh, (2014) conducted a survey called Herbal Medicinal Treatment of Malaria in Aliero Local Government Area of Kebbi, Nigeria. A total of 119 respondents were interviewed, comprising of homemade herbal medicine user 105 (88.2%) and traditional healers 14 (11.8%). Nineteen plants species belonging to15 families were identified. The most frequently mentioned species were *Azadirachta indica (72.2%), Magifera indica (63.0%), Citrus aurantifolia (48.7%), Carica papaya (31.9%), and Psidium gujava (22.7%).* These plants can be a potential source for the development of new antimalarial drug. Therefore, the most frequently mentioned species should be considered for further research to standardize and validate their safety and efficacy.

# CHAPTER THREE

## 3.0 MATERIALS AND METHOD

### 3.1 Material

Digital camera

An Audio recorder

Stationaries.

Note-Book

Survey questionnaire.

Plant press

Digital camera

Absorbent paper

Masking tapes

Shears

Secateurs

Hoe

Card-board paper

Adhesive glue

File jacket.

Cutlasses.

## 3.2 Method

This research work was divided into four (4) parts.

PART 1: Ethnobotanical survey.

PART 2: Collection of plants

PART 3: Preparation of herbarium Specimen, Identification and Authentication

PART 4: Phytochemical studies.

### 3.2.1. Ethnobotanical survey

#### 3.2.1.1 Study area

The studied population for the ethnobotanical research work include five (5) Local Governments in Kaduna State, where the Bajju people reside, these Local Governments have been identified as; Zangon Kataf, Kachia, Jema'a, Jaba and Chikun.

#### 3.2.1.2 Study population

Five (5) villages/towns in each of the Local Governments was surveyed. These towns/villages include the following:

A. Zangon kataf Local Government Area

1) Tudun wada

2) Kofam

3) Fadia Mugu gida

4) Fandan Kaje

5) Zuturung Karyi

B. Kachia Local Government Area

1) Mafo fadia

2) Gumel

3) Gidan Tagwai

4) Ankwa

5) Badoko.

C. Jaba Local Government area

1) Bitaro

2) Kwoi

3) Angwan Galadima

4) Nok

5) Daddu.

D. Jema'a local government area

1) Fadan Kagoma

2) Afana Kagoma

3) Afana Daji

4) Afana Kaje

5) Bayan Loko.

E. Chikun local government area

1) Narayi

2) Sabon yelwa

3) Sabon tasha

4) Ugwan sunday

5) Kakau.

For each village/town a target of 20 (Twenty) respondents were to be interviewed to obtain information about plants used in the treatment of malaria.

The respondents cut across all works of life including: Traditional medicinal practitioners, herb sellers, traders, and the elderly with claims of traditional medicinal knowledge, housewives, hunters and so forth.

**3.2.1.3 Sampling technique**

Due to the nature and type of survey to be conducted, it has been found that the snow-ball sampling technique is the most appropriate to use.

**3.2.1.4 Method of data collection**

A combined open and close ended structured questionnaire was used as a means of data collection for this research work. Therefore a researcher-interviewer approach was adopted and the services of an interpreter was required during the administration the questionnaire.

This questionnaire was administered after the proper content validation by Professor K.Y. Musa and Dr. A. Ahmed both of the Department of Pharmacognosy and Drug Development, Faculty of pharmaceutical sciences, Amadu Bello University Zaria, and Professor I. M. Hussain Department of Pharmacology, Faculty of Pharmacy; University of Maiduguri.

#### 3.2.1.5 Pilot study

After the necessary validation of the instrument of Data collection, a pilot survey was conducted in the Sabo main market, Chikun Local Government area of Kaduna State to pre-test the questionnaire, this helped in identifying questions that needs reframing and ensure that questions have been placed in the right order and well understood by all classes of respondents.

#### 3.2.1.6 Face validity for Pilot study (bilingual method)

For the purpose of face validation of the pilot study, the questionnaire was translated into Hausa by a resource person from the Department of Linguistic, University of Maiduguri and then back translated to English language at the Department of Linguistics, University of Maiduguri.

#### 3.2.1.7 Face validation for main survey

The combined open and close ended structured questionnaire was translated to Jju (The language of the Bajju people) by a Bajju community elder and then translated back to English by a resource person of the English Department LEGA comprehensive grammar secondary school Mahuta, Kaduna south Local Government area of Kaduna State, Nigeria.

#### 3.2.1.8 Method of Data Presentation

For the purpose of this research work, a descriptive statistical tool was used. Information obtained in this research is presented as frequency distribution tables for grouped and ungrouped data and bar charts.

### 3.2.2 Collection of plants

All plants documented during the questionnaire data collection aspect of this research were collected, identified and documented.

#### 3.2.2.1 Procedure for collection

The plants were collected as directed by each informant with the help of a Traditional medical practitioner who has practice the act of traditional healing for more than 20 years and has claimed mastery over the act of medicinal plant collection.

During the process of collection, the plants was first photographed in their natural habitat, data on the location such as longitude and latitude, topography of the area; proximity to landmark and other information that will aid in determining location were recorded.

For every plant collected, the leaves, flowers, fruits, bark and roots were collected and appropriately pressed. Parts that cannot be pressed were appropriately labeled and placed in suitable transparent containers. The medicinal part and method of administration was clearly stated.

### 3.2.3 Preparation of herbarium specimen, identification and authentication.

A standard herbarium specimen sheet (11 x 16 inches) was used (Holmgren, 1990) Pressed plants was also accommodated to suite this dimensions.

The appropriately pressed plant was then carefully mounted on the sheet and fastened permanently with adhesive material; adequate space was left on the bottom right-hand corner to affix the label.

### 3.2.3.1 Herbarium specimen label:

The label was assigned a voucher number, based on the cataloging method of the herbarium of the department of Biological sciences, Ahmadu Bello University, Zaria, where the specimens was deposited. The label has the name of the herbarium, date at which the plants were collected, a description of location of collection, plant description details, Botanical name, family name, the name and designation of the collector and the name and designation of the Authenticator (Sawhney, 1978).

### 3.2.3.2 Procedure for identification and authentication

The plant species obtained from the survey was identified using keys and description given in the flora of west tropical Africa (Hutchison and Dalziel, 1963) and also the useful plants of west tropical Africa (Burkill 1985). This procedure was done with the help of Professor M.A Sanusi a taxonomist with the Department of Botany Faculty of Sciences, University of Maiduguri, and Mallam Namadi Sunusi, herbarium unit Department of Biology, Faculty of Sciences Ahmadu, Bello University Zaria.

### 3.2.4 Phytochemical Studies

The various plant parts prescribed as medicinal by all respondents (used either single or in combination) as recipe to cure the ailment in question were screened based on the phytochemical markers of particular families. Such tests included tests for alkaloids, tannins, anthraquinones, flavanoids, steroids, terpenes, cardiac glycoside, saponins etc.

### 3.2.4.1 Extraction procedure

The morphological parts of the plants were air dried and then pulverized using pestle and mortar. 300g of the powdered plant material was extracted by maceration for 48 hours using ethanol. This was then filtered and the filtrate concentrated using a rotary evaporator and evaporated to dryness on a water bath.

### 3.2.4.2 Phytochemical screening

The procedure for the detection of the various phytochemicals was investigated as follows: and was based on specific chemical markers.

**A. Test for Anthraquinones and their derivatives:**

i. Borntrager's Test: the extract was shaken with 10ml of benzene, the content was then filtered and 5ml of 10% ammonia solution was added to the filtrate, the mixture was shaken. Formation of a bright red colour in the upper part of the aqueous layer indicates the presence of free anthraquinones (Evans, 2009).

ii. Modified Borntrager's Test: the extract was boiled with 10ml of aqueous sulphuric acid and filtered hot. The filtrate was shaken with 5ml benzene, the benzene layer was separated and half of its volume, 10% ammonium hydroxide was added. A pink, red or violet coloration in the ammonia phase (lower phase) indicates the presence of combined anthraquinone or anthraquinone derivatives (Evans, 2009).

**B. Test for Cardiac glycoside.**

Keller-Killiani Test : About 500 mg of the extract was dissolved in 2ml of glacial acetic acid containing one drop of ferric chloride solution. This was then under layered with 1ml of

concentrated sulphuric acid. A brown ring obtained at the interphase indicates the presence of a deoxy sugar characteristic of cardenolides (Evans, 2009).

**C. Test for Cyanogenic glycosides**

Plant extract (500 mg) was moistened with water in a test tube. Sodium picrate paper (yellow) was suspended with a cork at the neck of the test tube. The test tube was warmed on water bath for 40 minutes. A brick-red coloration on the sodium picrate paper was taken as an indication of the presence of cyanogenic glycosides (Evans, 2009).

**D. Test for Saponin glycosides:**

i. Frothing test: 100mg of the extract in test tube was dissolved in 5ml of water and vigorously shaken for 1 minute. A persistent froth that lasted for 15minutes was taken as indication of the presence of saponins in the extract (Sofowara, 1993).

**E. Test for Flavonoids**

i. Shinoda Test: 500mg of the extract was dissolved in 5ml 95% ethanol, warmed and filtered. Three (3) pieces of magnesium chips were added followed by five drops of concentrated hydrochloric acid. The appearance of a pink, orange or red to purple color indicates the presence of flavonoids (Evans, 2009).

ii. Sodium hydroxide Test: 500 mg of the extract was dissolved in water and filtered; 2ml of 10% aqueous sodium hydroxide solution was then added. The solution was observed for the presence of yellow color, and a change in color from yellow to colorless on addition of dilute hydrochloric acid indicates the presence of flavonoids (Evans, 2009).

iii. Ferric Chloride test: 1ml of detanned extract was diluted with water in a ratio: 1:4 in test tube. 2 drops of 5% ferric chloride solution was added to give a green or blue colour-that was taken as indication of the presence of phenolic nucleus (Abubakar, 1993).

**F. Test for steroids and terpenoids**

i. Salkowski's test: 500mg of extract was extracted with 2.5ml of chloroform. The extract was filtered into a clean dried test tube and to it was added 1ml of concentrated sulphuric acid carefully down the side of the test tube to from a lower layer. A reddish brown colour at the interface indicates the presence of steroidal ring (Sofowora, 1993).

ii. Liebermann-Burchard test:

Plant extract (100mg) was dissolved in 2.5ml chloroform. Equal volume of acetic anhydride was added, followed by concentrated sulphuric acid down the side of the test tube. The solution was observed for the presence of a brown ring at interphase which indicates the presence of steroids/triterpenes (Evans, 2009).

**G. Test for tannins**

i. Ferric Chloride Test;

Plant extract (0.5g) was stirred with 10ml distilled water and filtered. Two drops of 1% ferric chloride solution was added to 2ml of the filtrate. Formation of a blue-black (hydrolysable/gallitannins) or green or blue-green (condensed/cathehic tannins) precipitate indicates the presence of tannins (Evans, 2009).

ii. Lead sub-acetate test: 2ml of aqueous extract in test tube was added 3 drops of lead sub acetate solution. A colored precipitate indicated the presence of tannins (Abubakar, 1993).

**H. Test for alkaloids**

Three portion of the plant extract (0.5g each) was separately placed in a test tube. 5ml of hydrochloric acid was added to each test tube and boiled on a water bath; it was cooled and filtered. To 1ml of the first filtrate, 0.5ml of Mayers reagent was added dropwise, formation of a cream coloured precipitate was considered positive for Mayer's test. To the second 1ml of filtrate, 0.5ml of Dragendorff's reagent was added dropwise, formation of orange-red precipitate was considered positive for Dragendorff's test. While to a third 1ml of each filtrate, 0.5ml of Wagner's reagent was also added dropwise, formation of brownish-red precipitate was considered positive for Wagner's test (Evans, 2008).

When no precipitate is observed, then to a small amount of fresh filtrate, ammonia solution was added to make it alkaline by testing with litmus paper. 1ml chloroform was added and shaken gently, layers was allowed to separate and chloroform layer pipetted into another test-tube. To the chloroform layer 5ml of dilute HCl was added and allowed to form separate layers, the chloroform layer was discarded while the aqueous layer used to test the presence of alkaloids with Mayer, Dragendorff and Wagner reagents (Mohammed, 2002).

**3.2.4.3 Procedure for thin layer chromatographic analysis**

Pre-coated silica gel plates were used, plates were individually spotted with ethanol leaf extract of the three plants selected from the survey. Spots were allowed to dry and chromatogram developed with suitable solvent system of ethyl acetate and methanol in the ratio 4:1 (El-Mahmood *et al.*, 2008). The plates were visualized in day light, UV light and later sprayed with general detecting reagents; p-anisaldehyde solution, and 10% sulphuric acid. After development, the

various $R_F$ (retention factor) of the different chromatograms were determined (Gibbons and Gray, 1998). Specific detecting reagents

(Borntrager's reagent and Liebermann Burchard reagent) were also used and the plates slightly heated in an oven to enhance the spots. Aluminum Chloride  was also sprayed on the plates and viewed under UV light 365nm and 254nm

# CHAPTER FOUR

# 4.0 RESULTS

## 4.1 Ethnobotanical survey of plants used in the treatment of Malaria

A total of 352 interactive interview sessions were successfully conducted, to obtain information about plants used for the treatment of malaria among the Bajju Speaking community of Kaduna state. 500 interview sessions were slated in the study design in twenty five (25) villages/town cutting across Five (5) local government areas of Kaduna state, but only 352 sessions representing 70.4 % were successfully carried out.

Twenty five (25) of these sessions were repeated at random for selected respondents to represent all the local governments under study. These was done to randomly authenticate data received from those session. Results of the repeat session were compared to those carried out initially on the same respondent.

Table 4.1 below gives the responses for the five Local Government Areas surveyed. A total of 352 respondents have been highlighted representing 70.4% of the initial number planned. Chikun Local Government Area, and Jema'a Local Government Areas had the highest response rate of 72% each.

**Table 4.1 Ethnobotanical survey of Bajju Community with their Responses**

| S/NO. | LOCAL GOVERNMENT | TOWNS/VILLAGES | *NO. OF RESPONDENT | % RESPONSE |
|---|---|---|---|---|
| **1.** | Zangon kataf | Tudun wada<br>Kofam<br>Fadia mugu gida<br>Fadan kaje<br>Zunturung karyi | 10<br>13<br>15<br>15<br>15 | 50<br>65<br>75<br>75<br>75 |
| **2.** | Kachia | Mafo fadia<br>Gummel<br>Gidan tagwai<br>Ankwa<br>Badoko | 15<br>12<br>13<br>15<br>15 | 75<br>60<br>65<br>75<br>75 |
| **3.** | Jaba | Bitaro<br>Kwoi<br>Anguwam galadima<br>Nok<br>Daddu | 12<br>15<br>13<br>15<br>15 | 60<br>75<br>65<br>75<br>75 |
| **4.** | Jema'a | Fadan kagoma<br>Afana kagoma<br>Afana daji<br>Afana kaje<br>Bayan loko | 14<br>15<br>14<br>15<br>14 | 70<br>75<br>70<br>75<br>70 |
| **5.** | Chikun | Narayi<br>Sabon yelwa<br>Sabon tasha<br>Ungwan Sunday<br>Kakau | 15<br>15<br>13<br>15<br>14 | 75<br>75<br>65<br>75<br>70 |
| | | ***TOTAL** | **352** | **70.4** |

*A Total of 20 respondents were targeted for each Town/Village

100 respondents from each Local Government Area.

Figure: 4.1 gives the percentage responses for each of the selected Local Government Areas. Zangon kataf Local Government Area had the lowest responses.

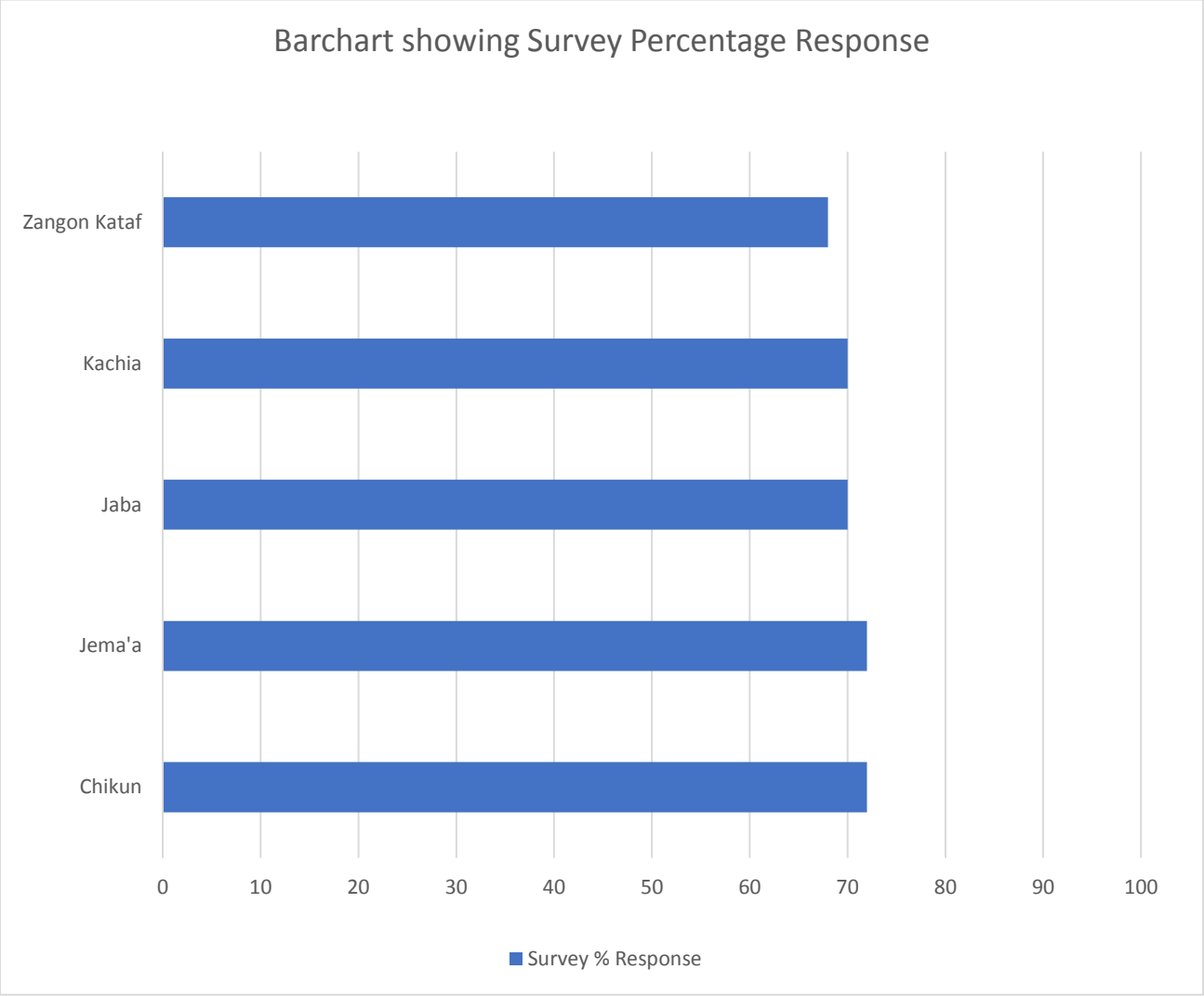



Figure 4.1: Percentage response of the five (5) Local Governments surveyed

Table 4.2 gives the distribution of respondents based on gender, and this shows that 210 Male and 142 female representing 60% and 40% respectively, took part in the survey. Zunturung karyi in Zangon kataf Local Government Area and Fadan kagoma in Jema'a Local Government Area had the lowest number of female respondents with 20% and 21% respectively.

**Table: 4.2 Distribution of Respondents Based on Gender**

| S/NO. | LOCAL GOVERNMENT | TOWN/VILLAGE | MALE | *% MALE | FEMALE | *% FEMALE |
|---|---|---|---|---|---|---|
| **1.** | Zangon kataf | Tudun wada | 07 | 70 | 03 | 30 |
| | | Kofam | 09 | 69 | 04 | 31 |
| | | Fadia mugu gida | 11 | 75 | 04 | 25 |
| | | Fadan kaje | 06 | 40 | 09 | 60 |
| | | Zunturung karyi | 12 | 80 | 03 | 20 |
| **2.** | Kachia | Mafo fadia | 10 | 67 | 05 | 33 |
| | | Gummel | 08 | 67 | 04 | 33 |
| | | Gidan tagwai | 07 | 54 | 06 | 46 |
| | | Ankwa | 09 | 60 | 06 | 40 |
| | | Badoko | 08 | 53 | 07 | 47 |
| **3.** | Jaba | Bitaro | 06 | 50 | 06 | 50 |
| | | Kwoi | 09 | 60 | 06 | 40 |
| | | Anguwam galadima | 09 | 69 | 04 | 31 |
| | | Nok | 11 | 73 | 04 | 27 |
| | | Daddu | 09 | 60 | 06 | 40 |
| **4.** | Jema'a | Fadan kagoma | 11 | 79 | 03 | 21 |
| | | Afana kagoma | 09 | 60 | 06 | 40 |
| | | Afana daji | 07 | 50 | 07 | 50 |
| | | Afana kaje | 05 | 33 | 10 | 67 |
| | | Bayan loko | 10 | 71 | 04 | 29 |
| **5.** | Chikun | Narayi | 09 | 60 | 06 | 40 |
| | | Sabon yelwa | 06 | 40 | 09 | 60 |
| | | Sabon tasha | 07 | 54 | 06 | 46 |
| | | Ungwan Sunday | 08 | 53 | 07 | 47 |
| | | Kakau | 07 | 50 | 07 | 50 |
| | | ***TOTAL** | **210** | **60** | **142** | **40** |

*Percentages approximated to the nearest Whole number.

Figure: 4.2 gives the percentage responses based on gender, where 60% of respondents were Male and 40% were female.

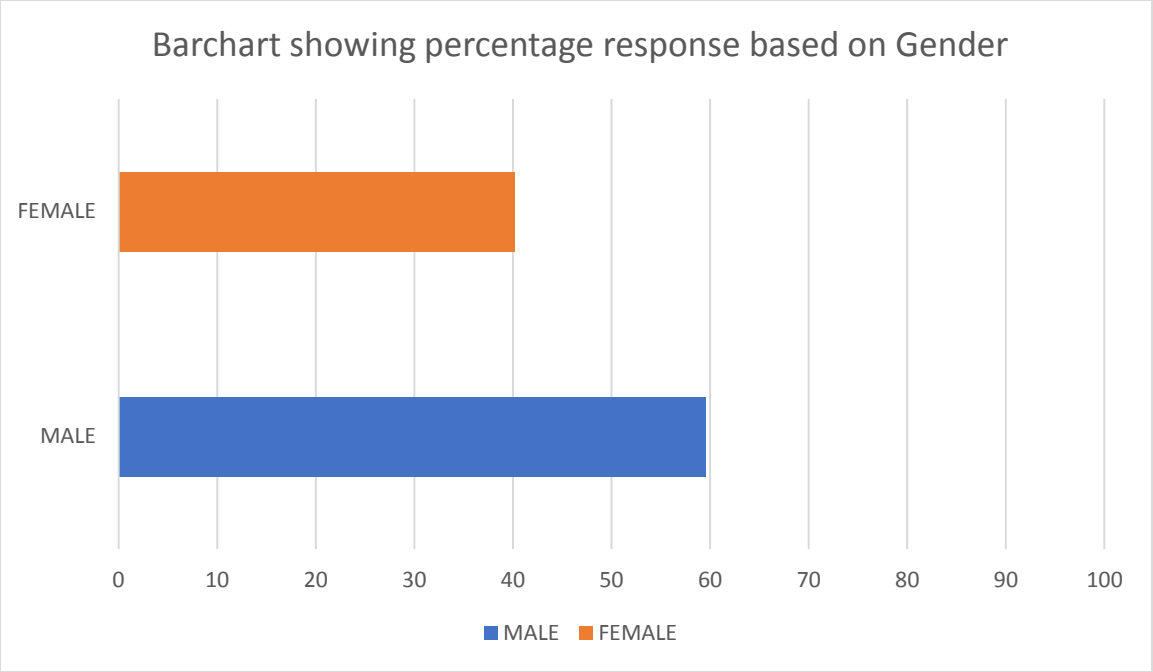



Figure 4.2: Percentage Response based on Gender for the Entire Study area.

Figure: 4.3 and 4.4 gives the distribution of respondents based on age. Respondents were grouped into four categories; 18-30 years, 31-45, 46-59 and then 60 years and above. 31-45 had the highest response rate, with 36 % while 60 years and above had the lowest response rate of 12%.

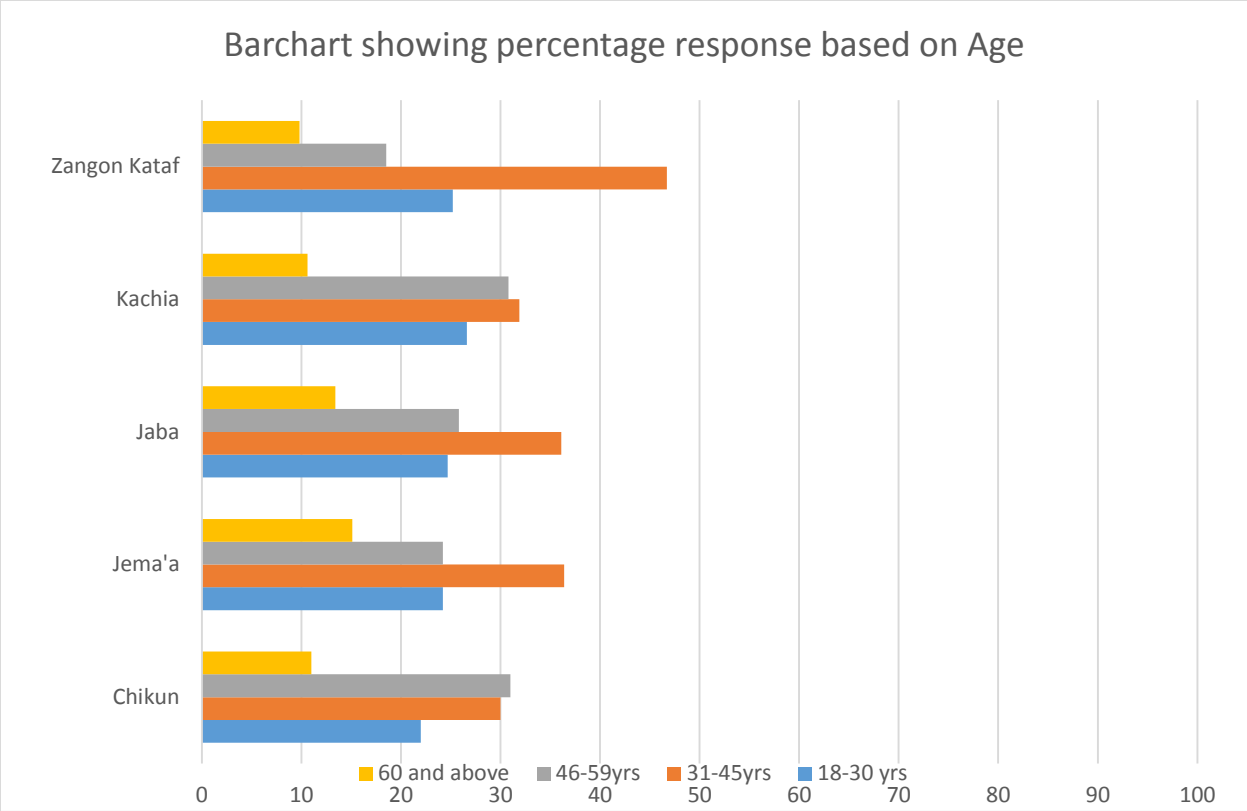



Figure 4.3: Percentage Response based on Age of the Five (5) Local Governments surveyed

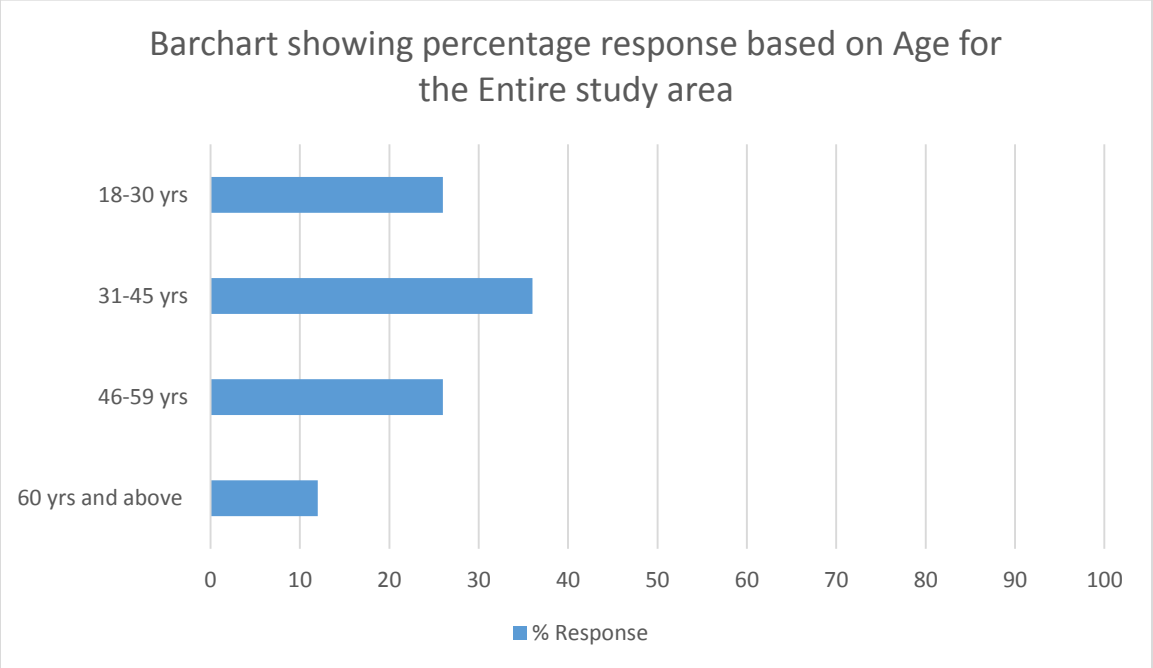
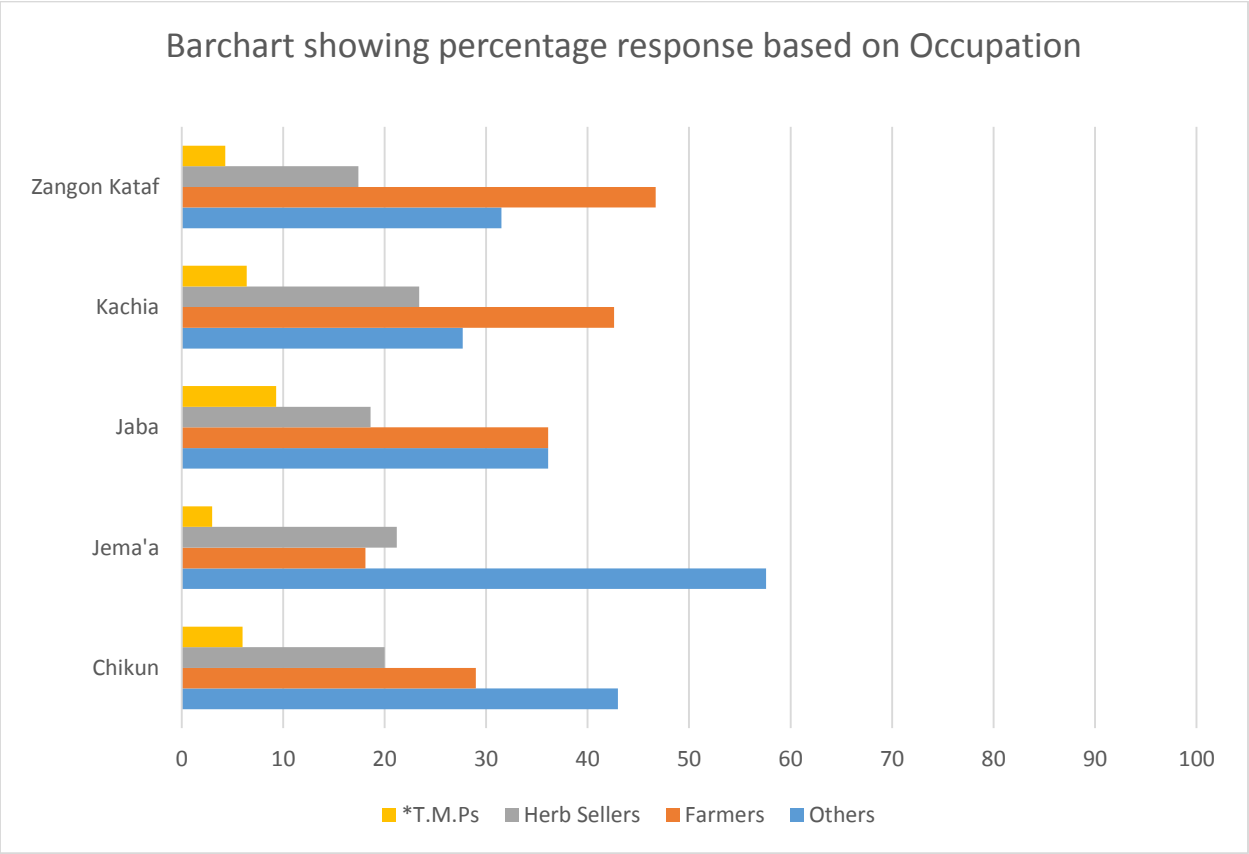



Figure 4.4: Percentage Response based on Age for the Entire study area.

Figure: 4.5 and 4.6 below gives the percentage responses based on Occupation. Traditional medicinal practitioners had the lowest response rate with only 6% of the total responses, while farmers had a high response rate with 34%




*T.M.Ps- Traditional medicinal practitioners

Figure 4.5: Percentage response based on occupation for the five (5) local government areas surveyed.

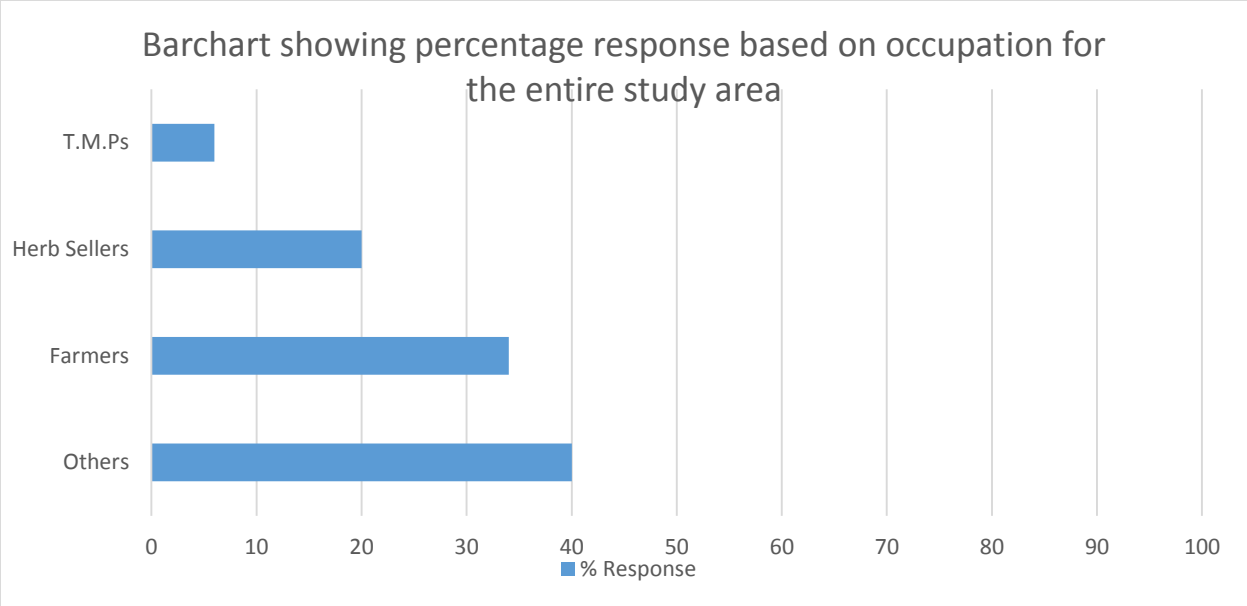



Figure 4.6: Percentage response based on occupation for the Entire study area.

**4.2 Traditional Medicinal plants used in the treatment of Malaria, among the Bajju Speaking community of Kaduna State.**

A total of 14 Medicinal Plant species representing 14 genera have been collected from the ethnobotanical survey of the Bajju community. All medicinal plants collected are used either as mono or multi therapy for the treatment of Malaria. Table 4.5 below gives a concise analysis on medicinal plant species, Families and corresponding vernacular names in Jju, (The language of the Bajju people) and Hausa.

**Table 4.3: Medicinal plants recorded among the Bajju community and their corresponding vernacular names.**

| S/No. | Family | Botanical Name | Jju name | Hausa Name |
|---|---|---|---|---|
| 1 | Anarcardiaceae | *Magnifera indica* .L | *A'mangrang* | *Mangoro* |
| 2 | Bignoniaceae | *Newbouldia leavis* (P.Beauv) | *A'duruku* | *Aduruku* |
| 3 | Caesalpinaceae | *Detarium microcarpum* Guill &Perr | *Ka'bovu* | *Taura* |
| 4 | Caricaceae | *Carica papaya* L. | *A' Kanbivut* | *Gwanda* |
| 5 | Cochlospermaceae | *Chochlospermum tinctorum* (A. Rich) | *Ka' Kon* | *Balge/ Balagande* |
| 6 | Fabaceae | *Parkia biglobosa*. (Jacq.) R. Br. ex G.Don | *Ka'ron* | *Dorawa* |
| 7 | Fabaceae | *Senna occidentalis* L. | *A'maaniyo* | *Farar albasa* |
| 8 | Meliaceae | *Azadirachta indica* A. Juss | *A'douaro* | *Dogon yaro* |
| 9 | Meliaceae | *Khaya senegalensis* (Desr.) | *Ka' Kwo* | *Madachi* |
| 10 | Myrtaceae | *Psidium guajava* L. | *A' gwaiba* | *Gwaiba* |
| 11 | Poaceae | *Cymbopogon citratus* L | *A' luwai* | *Isauri* |
| 12 | Rutaceae | *Citrus limon* (L.) Burm.f. | *A' udyi* | *Lemun tsami* |
| 13 | Sapotaceae | *Vitellaria paradoxa* Gaertn. F | *Ka'dait* | *Kadanya* |
| 14 | Sterculiaceae | *Sterculia setigera* . Delile | *Niboi /A'rufu* | *Kukuki* |

Plate I-XIV – The pictures of the Plants as taken during the survey as given in:



**Plate I:** ***Detarium microcarpum*** **Guill &Perr [Caesalpinaceae] (***Ka'bovu*)



**Plate II:** ***Citrus limon*** **(L.) Burm.f. [Rutaceae] (***A' udyi*)



**Plate III:** ***Azadirachta indica*** **A. Juss [Meliaceae]** (*A'douaro*)

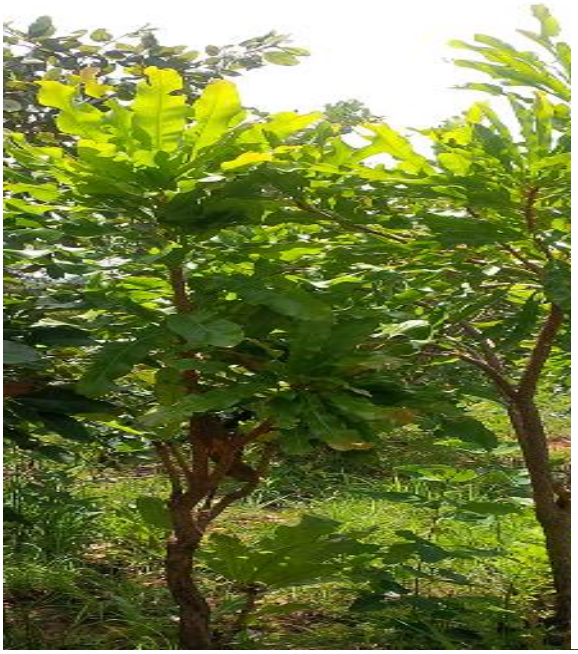


**Plate IV:** ***Vitellaria paradoxa*** **Gaertn. F [Sapotaceae]** (Ka'dait)



**Plate V: *Psidium guajava* L. [Myrtaceae]** ***(****A' gwaiba)*



**Plate VI: *Sterculia setigera* . Delile [Sterculiaceae]**



**Plate VII: *Senna occidentalis* L [Fabaceae] *(A'maaniyo)***



**Plate VIII: *Chochlospermum tinctorum* A. Rich [Cochlospermaceae] *(Ka' Kon)***



**Plate IX: *Khaya senegalensis* Desr. [Meliaceae] *(Ka' Kwo)***



**Plate X: *Newbouldia leavis* P.Beauv [Bignoniaceae] *(A'duruku)***



**Plate XI: *Cymbopogon citratus* L. [Poaceae] *(A' luwai)***



**Plate XII: *Carica papaya* L. [Caricaceae*] (A' Kanbivut)***



**Plate XIII: *Parkia biglobosa*. (Jacq.) R. Br. ex G.Don [Fabaceae- Mimosoideae]** *(Ka'ron)*



**Plate XIV: *Magnifera indica* .L [Anarcardiaceae]** *(A'mangrang)*

**Table 4.4: Medicinal plant used for the treatment of Malaria among the Bajju community with Parts used, Plant description and Plant habitat**

| | Botanical Name | Plant Part Used | Plant Description | Habitat |
|---|---|---|---|---|
| 1 | *Citrus limon* (L.) Burm.f. | Leaves | Small tree | Tropical/ sub-tropical |
| 2 | *Azadirachta indica* A. Juss | Leaves/Bark | Tree | Dry Savannah |
| 3 | *Vitellaria paradoxa* Gaertn. F. | Leaves | Small tree | Semi-Arid Savannah |
| 4 | *Psidium guajava* L. | Leaves/Root | Small Tree | Sub-tropical |
| 5 | *Detarium microcarpum* Guill &Perr | Leaves | Leguminous Tree | Dry savannah |
| 6 | *Sterculia setigera* . Delile | Bark/Leaves | Tree | Savannah woodland |
| 7 | *Senna occidentalis* L. | Leaves | Shrub | Savannah |
| 8 | *Chochlospermum tinctorum* (A. Rich) | Leaves/Root | Shrub | Savannah scrubland |
| 9 | *Khaya senegalensis* (Desr.) | Leaves/Bark | Tree | Dry savannah |
| 10 | *Newbouldia leavis* (P.Beauv) | Leaves | Small tree | Sub-tropical |
| 11 | *Cymbopogon citratus* L. | Whole plant | Herb | Tropical/ sub-tropical |
| 12 | *Carica papaya* L. | Leaves | Tree | Savannah |
| 13 | *Parkia biglobosa*. (Jacq.) R. Br. ex G.Don | Leaves/Root /Bark | Tree | Sub-tropical |
| 14 | *Magnifera indica* .L | Leaves | Tree | Tropical/sub-tropical |

### 4.3 Selection of Medicinal Plants with potential Antimalarial activity

In Table 4.5 the criteria used for selection of medicinal plant with potential antimalarial activity is clearly highlighted. When a criterion is met, the medicinal plant in question is assigned a value of one, and zero when it fails to meet the stated criterion.

**Table 4.5 gives the criteria for the selection of medicinal plant with potential antimalarial activity**

| 1 | **Botanical Name** | **No. of Citation (20-above)** | **Mono-component recipe** | **Accessibility** | **Little or No scientific Justification** | **Total score** |
|---|---|---|---|---|---|---|
| 2 | *Citrus limon* (L.) Burm.f. | 1 | 0 | 1 | 0 | 2 |
| 3 | *Azadirachta indica* A. Juss | 1 | 0 | 1 | 0 | 2 |
| 4 | *Vitellaria paradoxa* Gaertn. F. | 1 | 1 | 1 | 1 | 4 |
| 5 | *Psidium guajava* L. | 1 | 0 | 1 | 0 | 2 |
| 6 | *Detarium microcarpum* Guill &Perr | 1 | 1 | 1 | 1 | 4 |
| 7 | *Sterculia setigera* . Delile | 0 | 1 | 0 | 1 | 2 |
| 8 | *Senna occidentalis* L. | 0 | 1 | 1 | 0 | 2 |
| 9 | *Chochlospermum tinctorum* (A. Rich) | 0 | 1 | 1 | 1 | 3 |
| 10 | *Khaya senegalensis* (Desr.) | 1 | 1 | 1 | 0 | 3 |
| 11 | *Newbouldia leavis* (P.Beauv) | 1 | 1 | 1 | 1 | 4 |
| 12 | *Cymbopogon citratus* L. | 1 | 0 | 1 | 0 | 2 |
| 13 | *Carica papaya* L. | 1 | 0 | 1 | 0 | 2 |
| 14 | *Parkia biglobosa*. (Jacq.) R. Br. ex G.Don | 0 | 1 | 0 | 1 | 2 |
| | *Magnifera indica* .L | 1 | 0 | 1 | 0 | 2 |

**Table 4.6 Medicinal plant with Mode of Administration and Route of Administration**

| | Botanical Name | Route of Admin. | Mode of Administration |
|---|---|---|---|
| 1 | *Citrus limon* (L.) Burm.f. | Oral | Fresh leave boiled with guava and mango leaves, to be taken orally and for Aromatherapy |
| 2 | *Azadirachta indica* A. Juss | Oral | Fresh leaves and bark soaked in hot water and taken, also rubbed all over the body then |
| 3 | *Vitellaria paradoxa* Gaertn. F. | Oral | Fresh leaves boiled and then taken orally, Morning and Evening |
| 4 | *Psidium guajava* L. | Oral | Fresh leaves and roots boiled with neem leaves, pawpaw leaves and mango leaves, taken orally |
| 5 | *Detarium microcarpum* Guill &Perr | Oral | Fresh leaves boiled with water and a little Palm oil, the decoction is allowed to cool for hours and then taken orally |
| 6 | *Sterculia setigera* . Delile | Oral | Dried leaves and bark grounded to powder and added to food. |
| 7 | *Senna occidentalis* L. | Oral | Fresh leaves placed in hot water and allowed to stay two days before taken orally |
| 8 | *Chochlospermum tinctorum* (A. Rich) | Topical/oral | Dried roots are grounded and mixed with pap and taken orally, The leaves are soaked and squeezed in cold water and rubbed all over the body |
| 9 | *Khaya senegalensis* (Desr.) | Oral | Fresh leaves are pounded washed vigorously and eaten raw<br>Leaves cooked with food and taken or taken raw |
| 10 | *Newbouldia leavis* (P.Beauv) | Oral | Plant placed in hot water and steam inhaled under a blanket. |
| 11 | *Cymbopogon citratus* L. | Aromatherapy | Fresh leaves boiled with Mango, guava, neem leaves and the resulting extract taken orally |
| 12 | *Carica papaya* L. | Oral | Dried leaves and roots powdered and taken with pap |
| 13 | *Parkia biglobosa*. (Jacq.) R. Br. ex G.Don | Oral | Fresh leaves boiled with pawpaw, guava, neem leaves and the resulting extract taken orally cold. |
| 14 | *Magnifera indica* .L | Oral | |

**Table 4.7: Medicinal plant used for the treatment of Malaria among the Bajju community with other medicinal uses**

| | Botanical Name | Other Medicinal uses |
|---|---|---|
| 1 | *Citrus limon* (L.) Burm.f. | Stomach ache, acne, skin rashes, pile, worms, wounds |
| 2 | *Azadirachta indica* A. Juss | Typhoid, skin rash |
| 3 | *Vitellaria paradoxa* Gaertn. F. | Rheumatism, pile, cough |
| 4 | *Psidium guajava* L. | Diarrhea, typhoid, worms diabetes |
| 5 | *Detarium microcarpum* Guill &Perr | Aphrodisiac, tuberculosis, HIV, diarrhea, menstrual pain, stomach pain |
| 6 | *Sterculia setigera* . Delile | Pneumonia, cancer, hypertension |
| 7 | *Senna occidentalis* L. | Convulsion in children, hypertension |
| 8 | *Chochlospermum tinctorum* (A. Rich) | Ulcer, gout, cough |
| 9 | *Khaya senegalensis* (Desr.) | Influenza, skin rash, typhoid, whitlow |
| 10 | *Newbouldia leavis* (P.Beauv) | Pneumonia, infertility, typhoid, asthma |
| 11 | *Cymbopogon citratus* L. | Cough, asthma, toothache, stomach ache, worms |
| 12 | *Carica papaya* L. | Skin rash, worms, diabetes, acne |
| 13 | *Parkia biglobosa*. (Jacq.) R. Br. ex G.Don | Cough, asthma, hypertension, coccidiosis in poultry |
| 14 | *Magnifera indica* .L | Conjunctivitis, typhoid |

## 4.4 Preliminary Phytochemical Screening

The results of a Preliminary Phytochemical analysis for selected medicinal plants based on criteria presented in Table 4.5 above are presented in table 4.8 below. The selected medicinal plants were extracted with ethanol, and then subjected to preliminary phytochemical screening.

**Table 4.8: Preliminary Phytochemical screening of selected plants**

| | **Botanical Name** | **An& Dv** | **Ca** | **Cd Gly** | **Cy gly** | **Fla** | **Str & Tp** | **Sa gly** | **Ta** | **Alkaloids** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | **D** | **M** |
| 1 | *Vitellaria paradoxa* Gaertn. F. | + | + | + | - | + | - | + | + | + | + |
| 2 | *Detarium microcarpum* Guill &Perr | + | + | - | - | + | - | + | + | + | - |
| 3 | *Newbouldia leavis* (P.Beauv) | - | + | + | - | + | + | - | + | + | + |

+ = Present - = Absent

**KEY:** An & Dv =Anthraquinones and Derivatives D= Dragendorff test

Ca= Carbohydrates M= Mayer's test
Cd gly= Cardiac glycoside
Cy gly= Cyanogenic glycoside
Fl= Flavanoids
Str & Tp = Steriods and Terpenoids
Sa gly= Saponin glycoside
Ta= Tannins

### 4.5 Thin Layer Chromatographic Profile of selected plants

Thin layer chromatographic technique to fingerprint the metabolites present in the ethanol extract of the selected medicinal plants using commercially pre-coated silica gel plates are presented in table 4.9 below;

**Table 4.9: Thin Layer Chromatographic Profile of Selected Plant species from the Ethnobotanical survey**

| | **Extracts** | **Solvent system** | **$R_f$ Value** | **Color (P-anisaldehyde Reagent)** |
|---|---|---|---|---|
| A | *Vitellaria paradoxa* Gaertn. F. | Ethyl acetate: Methanol (4:1) | 0.32<br>0.49<br>0.63<br>0.81<br>0.88 | Green<br>Yellow<br>Yellow<br>Purple<br>Brown |
| B | *Detarium microcarpum* Guill &Perr | Ethyl acetate: Methanol (4:1) | 0.46<br>0.63<br>0.77<br>0.81 | Purple<br>Brown<br>Yellow<br>Green |
| C | *Newbouldia leavis* (P.Beauv) | Ethyl acetate: Methanol (4:1) | 0.79<br>0.82<br>0.87<br>0.92 | Purple<br>Green<br>Yellow<br>Brown |

**Figure 4.7: Thin layer chromatographic plates showing separated spots with different detecting reagents.**

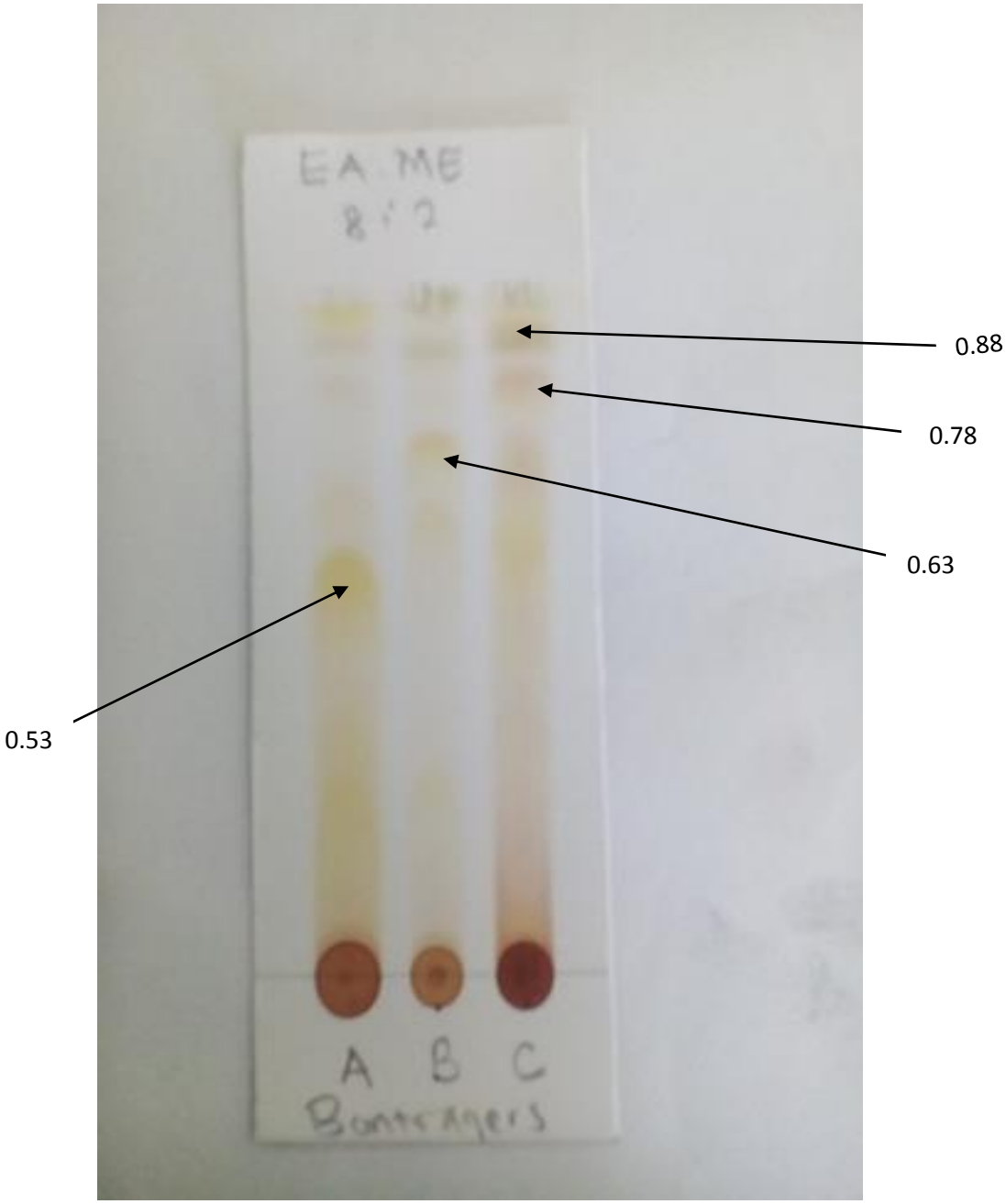



PLATE A: BONTRAGER'S REAGENT

Key:

A= *Vitellaria paradoxa* Gaertn. F.

B= *Detarium microcarpum* Guill &Perr

C= *Newbouldia leavis* (P.Beauv)

Solvent System= Ethyl acetate: Methanol (4:1)

Adsorbent= Precoated Silica gel.

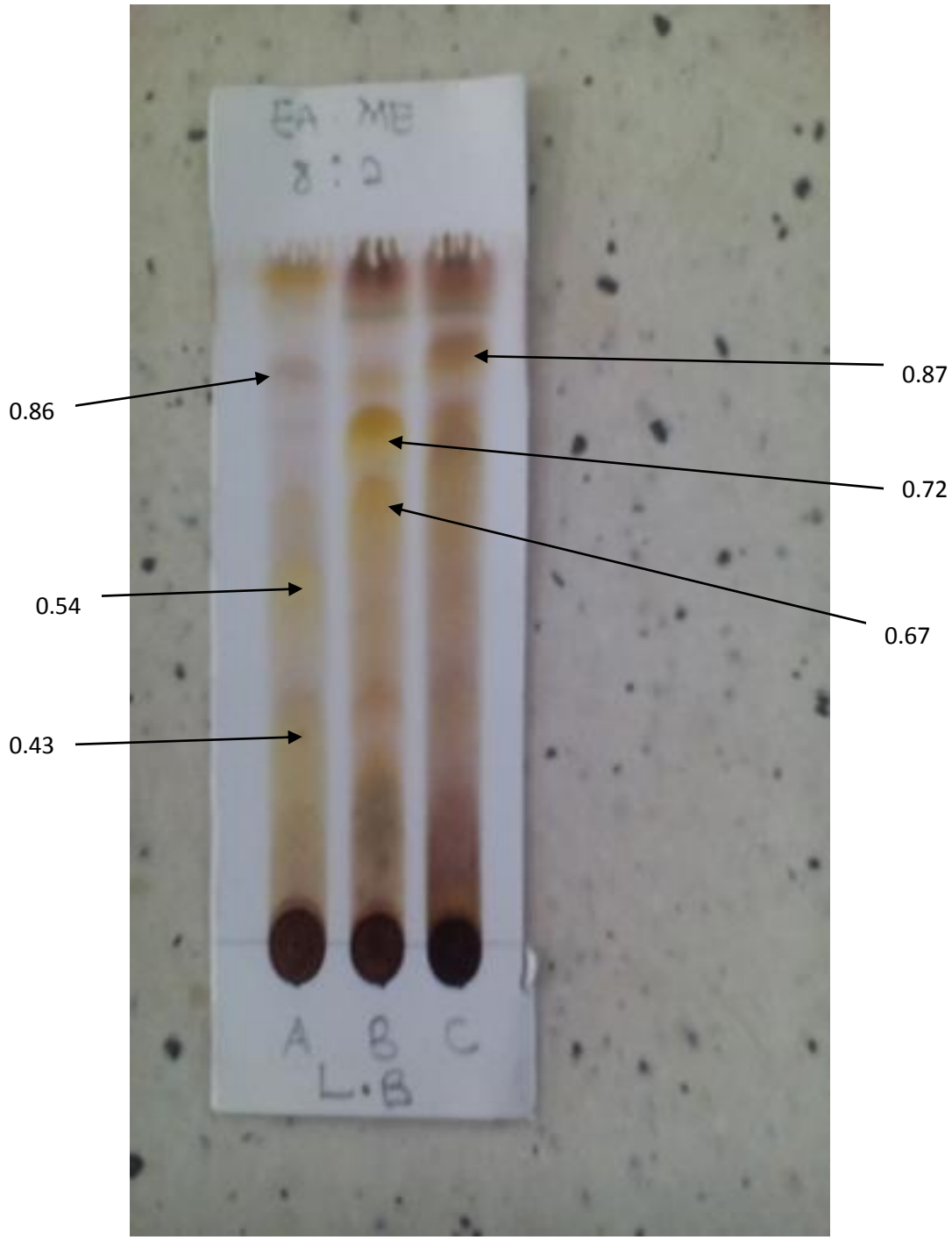



PLATE B: LIEBERMANN-BURCHARD REAGENT

Key:

A= *Vitellaria paradoxa* Gaertn. F.
B= *Detarium microcarpum* Guill &Perr
C= *Newbouldia leavis* (P.Beauv)

Solvent system: Ethylacetate: Methanol (4:1)
Absorbent: Precoated Silica gel

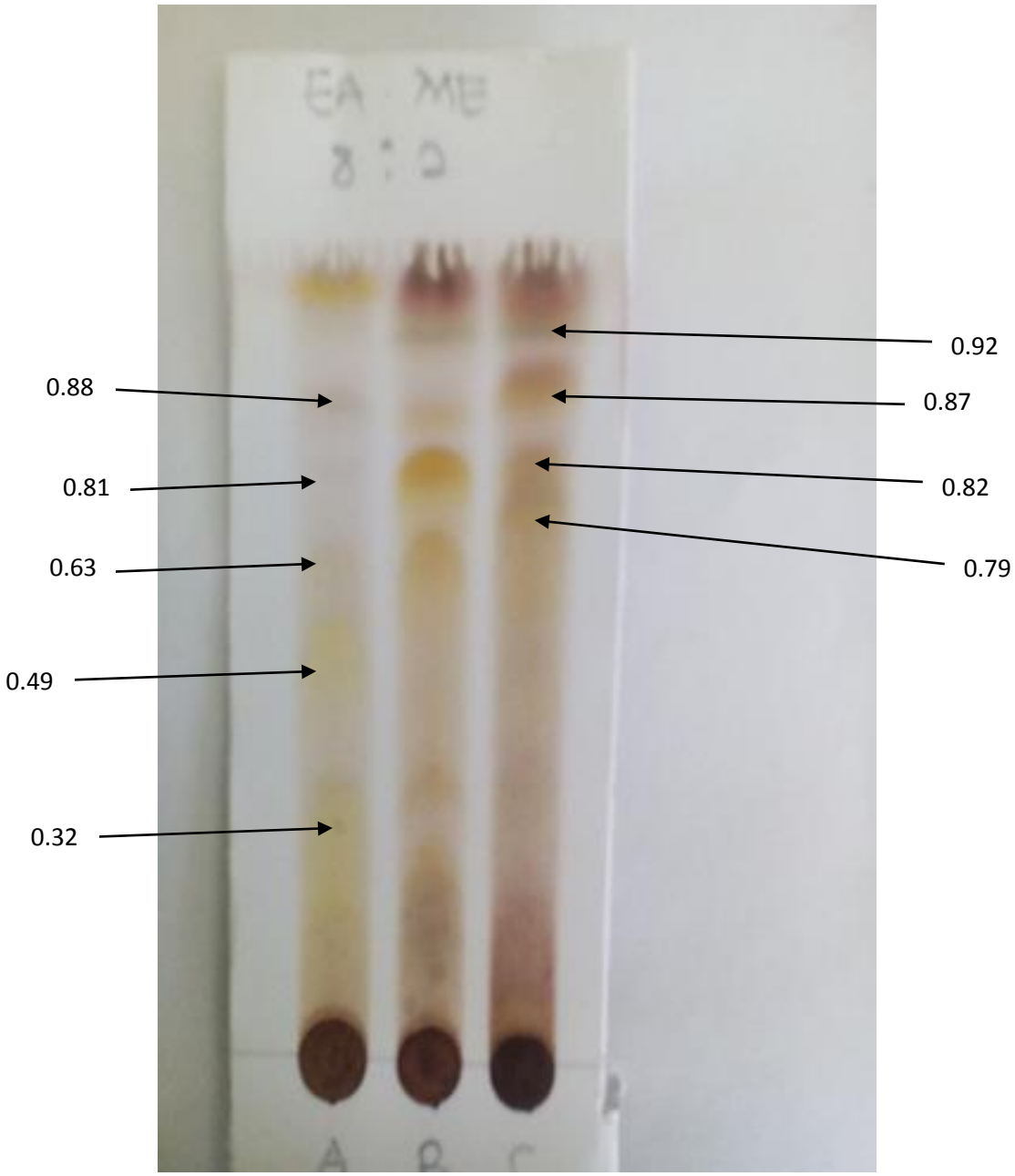



PLATE C: P-ANISALDEHYDE REAGENT

Key:

A= *Vitellaria paradoxa* Gaertn. F.

B= *Detarium microcarpum* Guill &Perr

C= *Newbouldia leavis* (P.Beauv)

Solvent system: Ethylacetate: Methanol (4:1)

Absorbent: Precoated Silica gel.

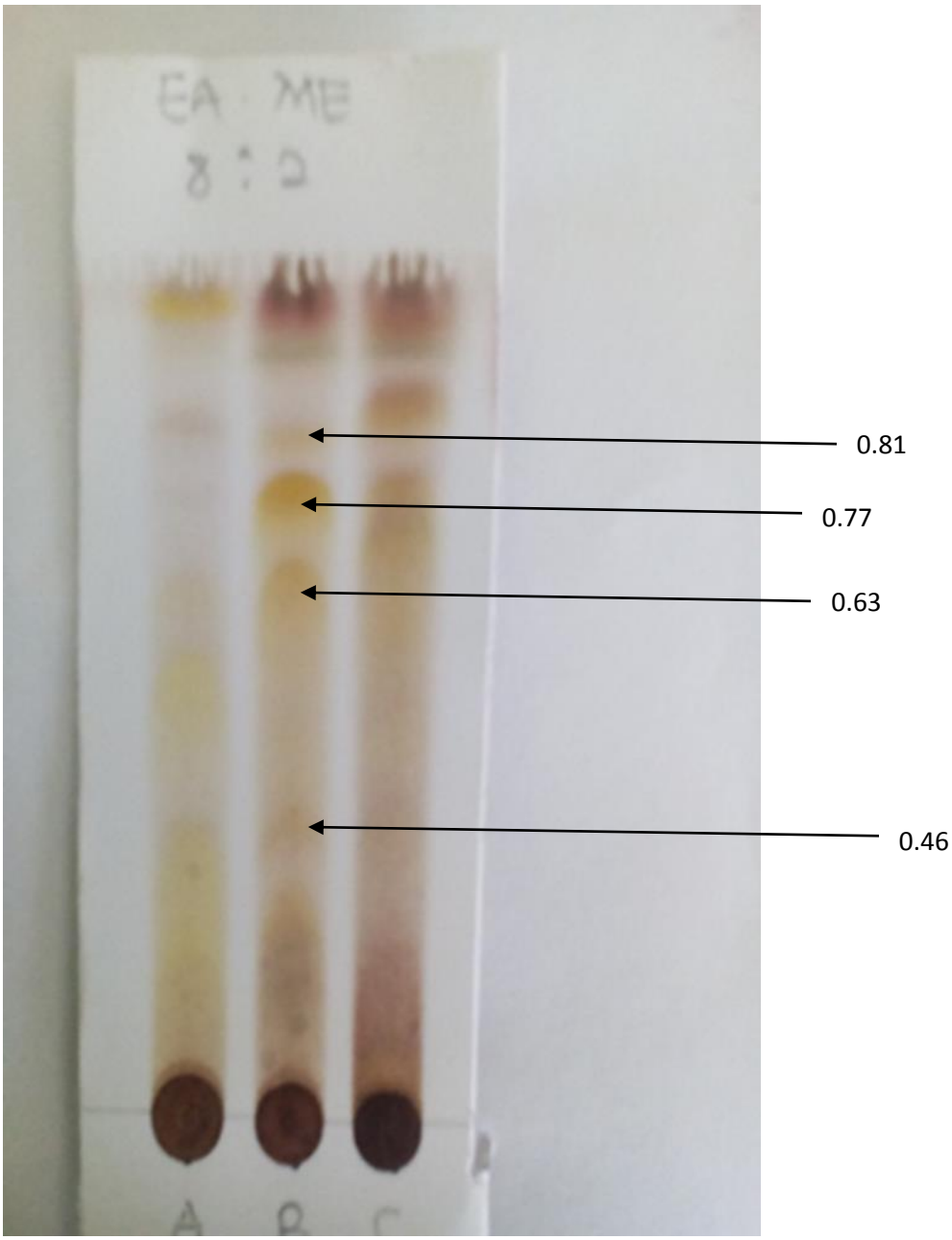



PLATE D: P-ANISALDEHYDE REAGENT

Key:

A= *Vitellaria paradoxa* Gaertn. F.

B= *Detarium microcarpum* Guill &Perr

C= *Newbouldia leavis* (P.Beauv)

Solvent system: Ethylacetate: Methanol (4:1)

Absorbent: Precoated Silica gel.

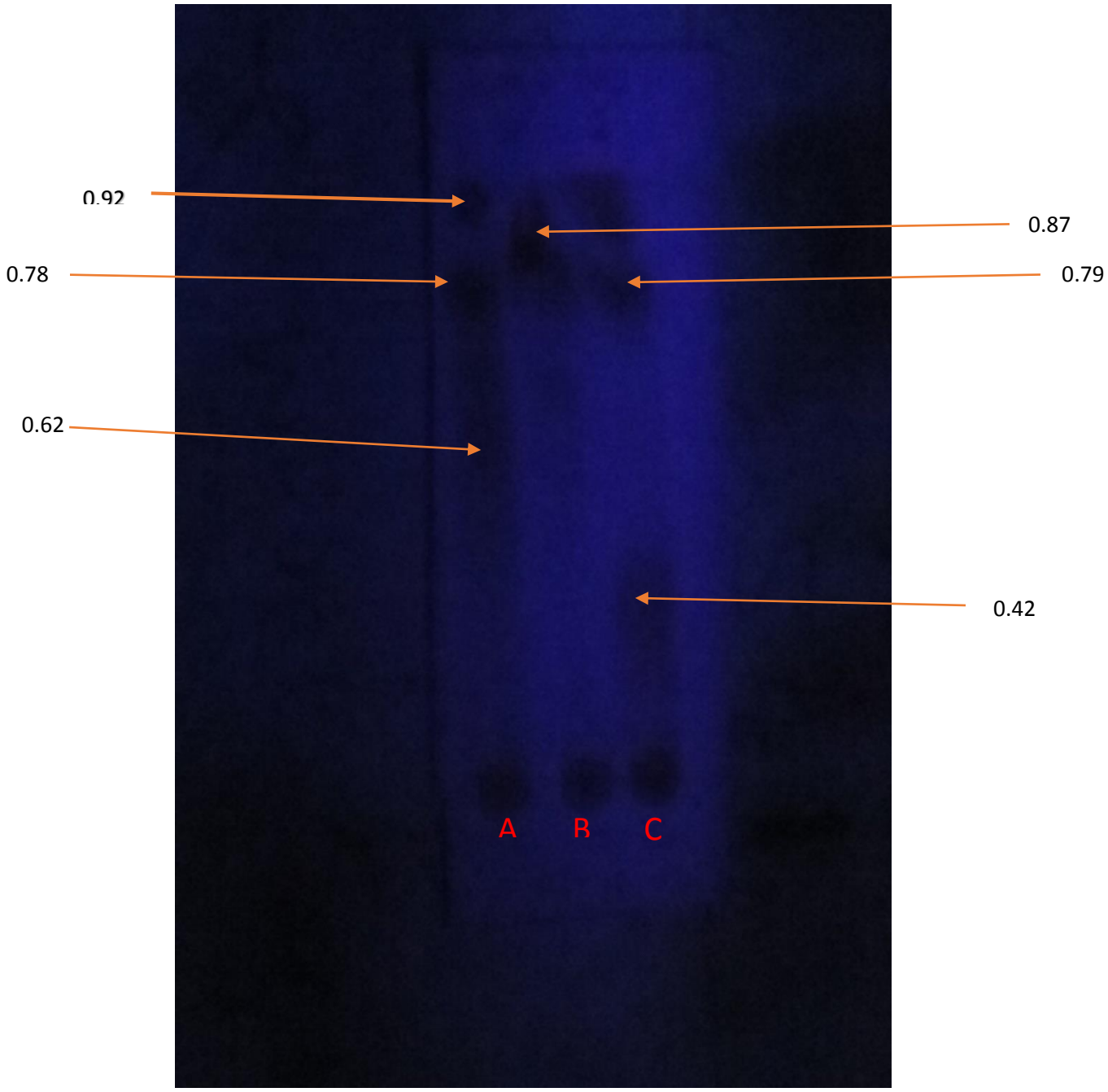



PLATE E: $Al_2cl_3$ Spray then UV 365nm

Key:

A= *Vitellaria paradoxa* Gaertn. F.

B= *Detarium microcarpum* Guill &Perr

C= *Newbouldia leavis* (P.Beauv)

Solvent system: Ethylacetate: Methanol (4:1)

Absorbent: Precoated Silica gel.

# CHAPTER FIVE

## 5.0 DISCUSSION

There is a renewed interest for the choice of traditional medicinal plants as potent remedies for the treatment of malaria, in the past several medicinal plant products have been investigated leading to the isolation of several compounds that have proven to be very effective in the treatment of malaria, some of these plants include; *Azadirachta indica* (Meliaceae), *Microglosia pyrifolia* (Asteraceae), *Cassia singueana* (Fabaceae), *Cryptolepis sanuinolenta* (Periplocaceae), *Mammea africana* (Guttiferae), *Zuziphus spina-cristi* (Rhamnaceae), *Cissampelos mucronata* (Menispermaceae) *Pedilanthus tithymaloides* (Eurphorbiaceae) (Coluzzi and Costantini, 2002; Kohler *et al*., 2002; Isah *et al.*, 2003; Bulus *et al*., 2003; Herbal- gram, 2003; Wright, 2004, Jude *et al*, 2006, Bulus *et al*., 2007; Katsayal and Obamiro, 2007; Bulus *et al*., 2008).

A total of 352 interactive interview sessions were carried out for this survey in five local government area of Kaduna state, this figure represents 25 towns/villages of selected local government areas, 352 respondent translates to 70.4% of the researcher's intended target (Table 4.1).

Results from table 4.1 shows the distribution of respondents based on local government areas. Zangon kataf, Chikun and Jaba local government areas had very high response rates compared to other local government areas, this can be explained from the fact that these local government areas have the highest concentration of Bajju speaking people. Gummel in Kachia local government had response rate of 60%, because Gummel is a mixed community, with different tribes living among the Bajju people in the area.

The results obtained go in line with a similar survey carried out in the region by (Mathias, 2008) for the Takkad people of Kaduna state. A total of 78 respondents were interviewed during his survey to obtain information about traditional uses of local plants for various ailments.

Figure 4.2 shows a marked difference in responses among gender, where more male took part in the interactive session than women. Results from Tudun wada and Zunturug Karyi in Zango Kataf local government areas, as well as results from Mafo fadia in Kachia local government area showed two times the number of male respondents compared to females. This might be due to more interests in Traditional medicinal practice among men compared to women. Traditional medicinal knowledge is mostly pass down from parents to male off springs, except in situations where the custodian of the traditional medicinal knowledge is female, such information is easily pass down to female offspring. The relatively high percentage of women respondents in some areas might also be associated with the fact that most of the remedies collected are plants that have been domesticated, and are easily accessible to women that are full time house wives. This going in line with results obtained from an ethnobotanical survey of Plants used by Guinean traditional healers in the treatment of malaria conducted by (Traore *et al.*, 2013), where a total of 258 people took part in the survey, and 141 respondent were males while 117 respondents were females. The same was obtained for another Ethnobotanical research conducted for seventeen (17) communities of Ogun State, Southwest Nigeria., to document medicinal plants used for the treatment of malaria carried out by (Idowu,*et al.*, 2010), in which 65% of the respondent population were male. Ogbuehi and co-workers, (2015) conducted a survey on Traditional Medicine Treatment of Malaria in Onitsha, South East Nigeria, obtained a contrary result which shows that 50.3% of all respondents were female.

Tolu and co-workers, (2007) also reported a higher male response rate than female, in a research that was carried out in Okeigbo, Ondo state, Southwest Nigeria to study "Medicinal plants useful for malaria therapy".

The distribution of respondents based on age, which clearly shows that, unlike what was obtainable in the past, where the elderly are believed to be custodian of traditional medicinal knowledge (Sofowora, 1993), a huge percentage of young people are beginning to develop interest in traditional medicine. These figures are similar to those obtained by Tolu *et al.*, (2007), who conducted an ethnobotanical survey of medicinal plants used for Malaria therapy in Okeigbo, Ondo state, Southwest Nigeria, where the highest number respondents were between the ages of 22 and 50.

It is clear from Figure 4.3 and 4.4 that the highest number of respondents fall between the ages of 31-45. It is becoming difficult to get the elderly to talk about medicinal plants, this might be due to the fact that the elderly still believe this knowledge, should be passed down to members of their kin only.

The high number of youths clearly justifies the recent increase in the commercial benefits of trading in medicinal plants, as more and more people are now relying on natural products for drug and cosmetic use (WHO, 2002).

Figure 4.5 highlight the distribution of respondents, based on occupation. This table shows a high percentage of farmers, which pointed out that a huge number of the population of Bajju people are subsistence farmers. Only 6% of respondents are Traditional Medicinal Practitioners, this low figure for traditional medicinal practitioners was obtained due to the need by most traditional medicinal practitioners to guard vital information, regarding traditional medicine and

medical plants. Most of the traditional medicinal practitioners that were approached, refuse to divulge information about traditional medicines for the treatment of malaria, some demanded monetary compensation for their knowledge, results from Zangon Kataf shows that only four traditional medicinal practitioners were interviewed, unlike Jaba local government and Kachia which had nine (9) and six (6) respectively.

A huge percentage of herb sellers, were eager to provide information about plants used in the treatment of malaria for a price, These results go in line with results obtain by Sanjay and Rupashree, (2014), whose findings also showed the highest percentage of respondent were Famers whom are home-made users, with 88.2% of the response, while Traditional healers had only 11.8% of the response.

Ogbuchi *et al.,* (2015) reported an entirely different finding in a survey carried out in Onitsha, Southeast Nigeria, to ascertain the plants used in the treatment of malaria. A high percentage (79.4%) of respondents were herb sellers. This result was obtained because the research concentrated more on responses from herb sellers.

A total of 14 medicinal plant species (Table 4.3) were collected from the ethnobotanical survey of Bajju community. Most of the plants collected are common household plants that have been domesticated and used for a wide variety of functions, including treatment of malaria. This findings goes in line with a research carried out by Omosun *et al.,* (2013) in eight local government areas of Abia state, southeast Nigeria. In this survey twenty one (21) different species of medicinal plants representing eighteen families were collected. These plants include *Azadirachta indica , Manihot esculentus, Anacadium occidentalis, Carica papaya, Magnifera indica, Vernonia amygdalina.* Some of the families include Meliaceae, Solanaceae, Anonaceae, Asteraceae.

Ampitan, (2013) who conducted an ethnobotanical survey in Biu Local Government Area of Borno state, Northeast Nigeria, obtained results of domesticated plants as well that are used in the treatment of malaria. Some of these plants include; *Azadirachta indica, Balanites aegyptiaca, Citrus senensis* and *Khaya senegalensis.*

Kadiri *et al.*, (2013), published similar findings in an ethnobotanical research about the folkloric use of Herbal plants in the treatment of malaria in Abeokuta North Local Government Area of Ogun state Nigeria. Plants frequently mentioned in the survey were *Azadirachta indica, Cymbopogon citrate, Carica papaya, Magnifera indica.*

Table 4.4 highlights the medicinal plant part used for the treatment of malaria, and the plant description with the habitat that best accommodates them.

The table shows that the most frequently used parts are the leaves, followed by the bark. Reasons for this might be due to the ease by which leaves are extracted and used. These findings are in line with what was obtained in a research carried out by Mathias, (2008), where the most used plant part is the leaf. Olorunisola *et al.*, (2013), also reported the leaves as the most frequently used plant part, in an ethnobotanical research of medicinal plants used in the treatment of malaria in Ogbomoso, Southwest Nigeria. Traore *et al.*, (2013), in an ethnobotanical research on medicinal plants used by Guinean traditional healers for the treatment of malaria, showed also that the leaves were the most frequently used plant part. Kadiri *et al.*, (2013), also published their findings after conducting an ethnobotanical survey about folk use of herbal plants for the treatment of malaria in Abeokuta North local government area of Ogun state, Nigeria. Their findings reveal the leaves as the most used plant part.

Plant description from Table 4.4 vary from being trees, to shrubs and herbs growing in a mainly dry savannah regions of Nigeria. These goes in line with results obtained by Mathias, (2008), where the plants he collected thrive better in dry semi-arid to dry savannah grasslands.

Table 4.5 gives the criteria for selection of medicinal plants with potential antimalarial activity. This step was necessary in order to choose medicinal plants that will serve as lead for potential antimalarial activity. From Table 4.5 it is clear that *Vitellaria paradoxa, Detarium microcarpum* and *Newbouldia leavis* have met all the criteria as mentioned in Table 4.6. These results are similar to what was obtained by Katsayal, (2010) in a research on the Antiplasmodial activity of *Plumeria rubra* and *Cissampelos mucronata.* The criteria for selection of plant with potential antimalarial activity were; availability of plant material, recipe being mono-component, frequency of being mentioned and little or no existing scientific justification.

The route of administration as described in Table 4.6 clearly shows that the oral route was the most frequently used route of administration. The reason being the systemic nature of the pathophysiology of the malaria parasite, the malaria parasite thrives in blood, hence the oral route which gives better systemic absorption serves best. These findings goes in line with Ene *et al*, (2010) results when they conducted a survey titled "Locally used plants for malaria therapy among the Hausa, Yoruba and Igbo communities in Maiduguri, Northeastern Nigeria". The most common route obtained from their research was the oral route.

Table 4.6 also gives information about the mode of preparation of these herbal remedies. From the research it was discovered that the most common methods of preparation were the cold and hot macerations. Other methods includes; infusions and aromatherapy. Omosun *et al.,* (2013) and Olorunnisola *et al.,* (2013) in separate researches showed that the common mode of

preparation was the cold and hot macerated decoction or concoction. These findings are similar to what was obtained from table 4.6.

Table 4.7 highlights the other medicinal uses of the plants collected from the survey. These clearly shows that the plants collected are also used for a variety of ailments, some of which include; typhoid fever, rheumatism, pile, diabetes, diarrhea. Therefore these plant are not used for the treatment of malaria only by the Bajju people. The reason for the diversity in action might have something to do with the wide range of active constituents present in these plants, conferring on them many physiological and pharmacological activity.

Mathias, (2008) in his research on traditional medicine used by the Takkad people of Kaduna state, found out that medicinal plants can be used for a wide variety of ailments proving the findings from table 4.7. Some of his findings include; *Asparagus africana* for dysentery, *Cissampelos mucronata* antidote for snake bite and toothache, *Borreria radiate* for stomachache and diarrhea, *Indigofera pulchra* for ringworm.

Ampitan, (2013) also reported that plants used in the treatment of malaria can be used for other ailments. Some of his findings include; *Adansonia digitata* for typhoid fever, *Acacia nolitica* for diarrhea, *Allium sativa* for anaemia.

An extensive literature review, reveals the chemical markers for Bignoniaceae are; Alkaloids, Flavonoids, Tannins, Saponins and sterols, (Aliyu *et al.,* 2009), (Usman *et al.,* 2007), those for Caesalpinaceae are; flavonoids, diterpenes, Anthraquinones and saponins (Baldim *et al*, 2009), (Mohammed *et al.,* 2014) and Sapotaceae has Alkaloids, Flavonoids Anthraquinones and tannins as markers (Abougle *et al.,* 2013), (Bharat *et al.,* 2012).

Research has also revealed that Phytochemicals responsible for Antimalarial activity are mostly, Alkaloids, Flavonoids and Anthraquinones. (Adebayo *et al.*, 2014), (Nwaozuikpe *et al.*,2013), (Mikhail *et al.*, 2013), (Vincent *et al.*, 2008).

Table 4.8 gives the result of a preliminary phytochemical screening for ethanol extracts of the selected plants obtained from the survey, results for *Vitellaria paradoxa* shows the presence of cardiac glycoside, steroids, tannins, saponins and alkaloids. This result agrees with what was obtained by El-Mahmood *et al.,* (2008) where they reported the presence saponins, tannins alkaloids and cardiac glycoside in the plant.

Olaleye *et al.*, (2015) in a research on the phytochemical properties and antimicrobial activity of *Vitellaria paradoxa* obtained results that were consistent with what was obtained in Table 4.10. Kamoldeen *et al.*, (2015) also reported the presence of glycosides, tannins, steroids, alkaloids in a comparative research of the antibacterial efficacy of *Vitellaria paradoxa,*

From Table 4.8, *Detarium microcarpum* contains saponins, flavonoids, tannins and Alkaloids. Anthraquinone derivatives were also present. These agrees with results published by Abubakar, *et al.,* (2014), "A Pharmacognostic study of the stem-bark of *Detarium microcarpum."*

*Newbouldia leavis* extract was shown to contain, cardiac glycosides, flavonoids, steroids, tannins and alkaloids. Saponin, cyanogenic glycoside and anthraquinone derivatives were absent. These results disagrees with the report from Usman and Osuji, (2007), whose findings showed the presence of anthraquinones. Ugbabe *et al.*, (2010) also obtained results that showed the presence of anthraquinones in a research carried out on the stem bark of *Newbouldia leavis.* This also disagrees with results obtained from Table 4.8.

As observed from Table 4.9, the Thin-layer Chromatographic profile of the selected medicinal plants, produced a whole range of compounds with $R_f$ values as presented above. The best solvent system for the three ethanolic extracts was Ethyl acetate: Methanol (4:1), (El-Mahmood *et al.*, 2008). *Vitellaria paradoxa* Gaertn. F. ethanolic extract revealed five distinct spots with $R_f$ value 0.32, 0.49, 0.63, 0.81, 0.88 when the thin-layer chromatography was carried on commercially prepared silica gel pre-coated plates and developed in ethyl acetate: methanol (4:1) for 30 minutes. Some of the spots shown in Figure: 4.7 became visible when sprayed with p-anisaldehyde reagent and heating at $105^{O}C$ for 5 minutes. *Detarium microcarpum* Guill & Perr ethanolic extract revealed four spots with $R_f$ values 0.46, 0.63, 0.77, 0.81 when developed with ethyl acetate: methanol (4:1) for 30 minutes. *Newbouldia leavis* (P.Beauv) extract showed five spots with $R_f$ values 0.79, 0.82, 0.87, 0.92 when the thin-layer chromatography was carried on commercially prepared silica gel pre-coated plates and developed in ethyl acetate: methanol (4:1) for 30 minutes. Various spots were also obtained from specific detecting reagents, which included Liebermann-Burchard, Borntrager's and Aluminium chloride and viewed under UV light at 365nm. These results goes in line with the findings published by (Aliyu *et al.*, 2009), (Usman *et al.*, 2007), (Baldim *et al.*, 2009), (Mohammed *et al.*, 2014) (Abougle *et al.*, 2013), (Bharat *et al.*, 2012), for the presence Alkaloids, Flavonoids, Tannins, Saponins,Sterols, Diterpenes and Anthraquinones in the Bignoniaceae, Caesalpinaceae and Sapotaceae families

The Specific reagents tests on the TLC Plates also confirmed the presence of phytochemicals responsible for antimalarial. Similar to those published by (Adebayo *et al.*, 2014), (Nwaozuikpe *et al.*, 2013), (Mikhail *et al.*, 2013) and (Vincent *et al.*, 2008).

# CHAPTER SIX

## 6.0 SUMMARY, CONCLUSION AND RECOMMENDATION

### 6.1 Summary

A total of 14 medicinal plant species from 12 families representing 14 genera were obtained from the research. This survey, was conducted in five Local Government Areas of Kachia, Jema'a, Zangon Kataf, Chikun and Jaba, for each Local Government, five towns /villages were chosen due to their high concentration of Bajju people. In all 352 respondents were interviewed, out of a proposed 500, representing 70.4%

This study was aimed at documenting novel medicinal plant remedies used by the Bajju speaking people. The research was undertaken because of claims made by the Bajju community to effectively treat malaria despite the nature of the area that allows for easily breeding of mosquitoes.

This study exposed the fact that it is highly unlikely that traditional medicinal knowledge, especially knowledge about herbal medicine resides only with the male gender, and this knowledge is still strong among the youths between the ages of 20-45

This knowledge is not only vested with traditional medicinal practitioners or herbal sellers but also with common individuals of diverse occupation.

Most of the medicinal plants mentioned in the survey were common household plants that have seen extensive use and research.

The study was able to obtain three novel plant that are used for the treatment of malaria.

It became clear from the research that most of the medicinal plants obtained, are plants that have been domesticated and are readily accessible by the people of the community. It should therefore not come as a surprise that many of the youths in these areas have vast knowledge about medicinal plants especially ones used for the treatment of malaria.

Most of the recipes mentioned were decoctions (mono-component) or concoctions comprising of two or more species of plants. The oral route was the most common route of administration with water as the most common medium of extraction.

Phytochemical analysis on three (3) of the most reoccurring novel plants, revealed the presences of saponins, cyanogenic glycosides, alkaloids and tannins.

## 6.2 Conclusion

The ethnobotanical survey of the Bajju speaking community of Kaduna state, has revealed several useful novel plants that will serve as lead for the production of new anti-malarials that will stand the test of time.

This research was the beginning of an extensive anti-malaria research in a bid to produce a compound with anti-malarial activity that will equal or supersede those that are already in the market.

Domestication of most of these medicinal plants by the communities of Bajju have made the work easy as most of them are readily available on demand almost everywhere in the community. The fact that most of these plant have been used as food as part of delicacies, clears the issues surrounding toxicity and misuse of these remedies.

This research discovered that medicinal plants are the first line remedies for the treatment of malaria among the Bajju speaking community of Kaduna State.

Youths of ages 31-45 including women are more involved with herbal remedies for the treatment of malaria in most of the communities surveyed.

This research work is proof that Ethnobotanical and Ethno medical information are very useful tools in the development of new drugs in Nigeria and the continent as a whole.

### 6.3 Recommendation

The burden of malaria is heaviest on Africa where on average 2.7million deaths occur each year worldwide; with 75% of this deaths occurring in Sub-Saharan Africa and mostly young children and pregnant women (WHO, 2012). Despite the enormous wealth of traditional medicinal knowledge and use, very few novel compounds have been produced from this region, therefore it is necessary that the results obtained from this survey, be used effectively in the search of a novel product for the treatment of malaria.

It has also become necessary that an ethnobotanical survey be carried out for every tribal community in Nigeria, this is because the ethnobotanical survey conducted for the Bajju community, has revealed an immense wealth of traditional medicinal knowledge just waiting to be explored, many more can be tapped for other communities in the country, as almost every community in the country is vested with knowledge that holds potentials for a new discovery in the country.

It will also be suggested that more interest be paid by Government in discovering new leads through ethnobotanical surveys as this aspect is often neglected, but still serves as the best approach in discovering novel medicinal remedies.

Stakeholders should also develop a guideline on how to conduct an ethnobotanical survey, so as to maximize the potential benefit of such an exercise.

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