Chapter-2

Review of Literature

The national and international issues related to control and eradicate has been reported in many publications (Down, 1981; Choudhury, 1985a; Sharma and Malhotra, 1986; Reuben, 1989). Down, 1981 considered persistence is the main problem. All other authors blamed administrative, operational and logistics problems as bottlenecks to eradicate malaria. Rather than resurgence, in India, malaria persistence is due to failure of indoor residual spray to control, even after 12-15 years of continuous spray, the areas were never brought under maintenance phase of the NEMP (Sharma and Malhotra, 1986).

The relationship between poverty and malaria incidence, and the causal pathways between the two is scant. An estimated 58% of malaria population (Gwatkin *et al.*,2000). Endemic malaria results in tremendous economic losses and poverty annually in many developing countries (Dhiman, 2009; Gallup *et al*., 2001). People live under low socioeconomic conditions and have high levels of immunity enabling them to serve as reservoirs for malaria transmission (Dev *et al.,* 2003). Poor socioeconomic conditions, knowledge, and perception about malaria and antimalarial policies have contributed to widespread malaria throughout the region (Rabha *et al.,* 2011; Yadav *et al*., 2012; Dev *et al.,* 2004; Dev *et al*., 2006; Das *et al.*, 2007). Kreuels *et al.,* 2008, reported on the role of socio-economic factors and Yadav *et al.*,2012, reported the rich factors which influence malaria occurrence among the community. Gender role also plays an important impact on malaria occurrence. Most of the research conducted that can be classified as female-centred consists of observation of "parasite localization in placental malaria (Beeson *et al.*, 1999). There is little literature that takes into account the possible influence of gender factors and gender relations (Tanner and Vlassoff, 1998).

Agueldo, 1983 reported that a community as a group of people living in a particular area and therefore having shared values, cultural patterns, and social problems.

Chand, 1989 reported that even within a defined geographical area, a community is made up of different groups.

Reiter, 2001 reported the transmission patterns of these diseases and may be affected by ambient temperature. IOM, 1992 reported that the disease incidence has increased greatly over the past two decades because of a variety of demographic, political, societal, and public health changes. Achard *et al.,* 2002; Mayaux *et al.,* 2005; Guerra *et al.,* 2006 and Erhart *et al.*, 2005 reported on the role of forest, the important ecosystem of malaria. Trung *et al.,* 2005; Walker *et al.,* 2013 and Alias *et al*., 2014 established the relation of mosquito vectors vary according to forest locality and their behavior changes.

2.1 Epidemiology of Vector-borne Diseases

Vector-borne diseases result from infections. It is transmitted to humans and other animals by blood-feeding arthropods, such as mosquitoes, fleas, and ticks. The vector-borne pathogens, such as viruses, rickettsia, bacteria, protozoa, and worm parasites, spend part of their life cycle in a cold-blooded arthropod vector. Thus, they are influenced by environmental change. The transmission patterns of these diseases may be affected by ambient temperature (Reiter, 2001). These pathogens are now abundant in India. Although malaria was once controlled effectively in many parts of the world, disease incidence has increased greatly over the past two decades because of a variety of demographic, political, societal, and public health changes (IOM, 1992).

2.2 Epidemiology of Malaria

Malaria as a communicable disease caused by sporozoan parasites of the genus *Plasmodium* sp. and is transmitted to man by certain species of infected female Anopheline mosquitoes as Park, 1972 defines. Periodic chills and fever, enlargement of spleen and secondary anaemia with a tendency to relapse characterize the disease clinically. Malaria still remains as one of the major public health problems in India. Despite anti-malarial measures, the transmission of malaria continues to be uninterrupted

and the disease is endemic in ninety-one countries. The greatest load of morbidity and mortality due to malaria is reported in our country. In 1953, the fight against malaria was started with the National Malaria Control Programme and before the vectors could develop resistance, the shift to the National Malaria Eradication was undertaken in 1958. The total of 390 units, out of which 250 units were declared free from this disease by 1966. Due to this phenomenal success, it was thought that the country has nearly eradicated the disease but the efforts in this field slackened down the whole fortification turned turtle, of course, due to various diseases (Agarwal, 1973).

2.3 Effect of Climate change on Malaria and other Vector-Borne Diseases

The role of climatic changes on malaria was established by many researchers (Lamb, 1995 and Chorley and Barry *et al*., 1998). The human activities like burning of fossil fuels attributes global warming (Tett *et al.,* 1999; Houghton *et al.,* 1996 and Wigley and Schimel, 2000). The impact of global warming on human health is a major subject of debate (Taubes, 1997; Kerr, 1997; Gubler, 1998 and Longstreth, 1999).

2.4 Impact of Forest Areas in Malaria Transmission

Forest plays an important ecosystem in the transmission of malaria and it contributes to the global disease burden. People living in forested areas are more at risk (1.4 billion) accounting for 11.7, 18.7, 35.1 and 70.1 million population respectively from 1.5 million in the Amazon region, 1.4 million in Central Africa, 1.2 million in the Western Pacific, and 0.7 million in South East Asia (Achard *et al*., 2002 and Mayaux *et al.,* 2005). The forest areas which contains malaria zones are 11.16 million to 15.71 million km^2, 6.53 million, 7.80 million, 1.93 million, 5.19 million, 2.70 million 2.72 million (Guerra *et al.,* 2006; Achard *et al*., 2002 and Mayaux *et al.,* 2005). Controlling malaria in these forested regions of the world has been a major challenge (Erhart *et al.,* 2005). Reports on forest malaria are focused on local factors associated with malaria transmission. The distance from forest, the impact of deforestation and reforestation, the effect of forest on microclimate, vector bionomics, *Plasmodium* species survival, and

human activities in forests are important factors. Mosquito vectors vary according to forest locality and their behavior changes with the forest micro-climate (Trung *et al.*, 2005), human 7 populations, and their social behaviors (Walker *et al.,* 2013 and Alias *et al.*, 2014). Forest communities are generally tribal and they are coping with poor infrastructure facilities.

2.5 Relationship between Socio-economic Status and Malaria

Malaria is frequently referred to as a disease of poverty or disease of the poor. However, the relationship, and the causal pathways between the two is scant. An estimated 58% of population (Gwatkin *et al.,* 2000) are affected by malaria, causes economic losses and poverty (Dhiman, 2009 and Gallup *et al*., 2001). People live under low socioeconomic conditions and have high levels of immunity enabling them to serve as reservoirs for malaria transmission (Dev *et al.*, 2003). Poor socioeconomic conditions, knowledge, and perception about malaria and antimalarial policies play an important role in widespread malaria throughout the region (Rabha *et al.*, 2011; Yadav *et al.*, 2012; Dev *et al*., 2004; Dev *et al.,* 2006 and Das *et al.,* 2007). The main strategies against malaria in India are personal protection using ITNs and malaria treatment protocol. The socio-demographic factors like ethnic groups, family living standards are important risk factors for malaria transmission and epidemics (Kreuels *et al.*, 2008). For adopting appropriate intervention strategies, knowledge of malaria and socio-economic upliftment are key factors. The proper knowledge about malaria transmission and prevention, demography and socioeconomic status are the risk factors which influence vulnerability (Yadav *et al.,* 2012).

2.6 Gender Role in Malaria Control

In all the societies, men and women play different roles. They have different needs, and face different constraints. Gender roles differ from the biological roles of men and women in that they are socially and culturally constructed, although they may overlap. The biological role of Women's in childbearing may extend their gender

responsibilities that segregate responsibilities between men and women in social and economic activities. But these roles can and do shift with social, economic, and technological change. In the specific case of malaria, for example, most of the research conducted that can be classified as female-cantered consists of observation of "parasite localization in placental malaria and the resulting clinical consequences of pre-term delivery and low birth weight of the fetus" (Beeson *et al.*, 1990). Other concerns for women, such as unsafe working conditions, long hours at difficult tasks that occupational hazards, and the impact of inadequate sanitation and deteriorating environmental conditions – all of which are related to health – receive little time or study. Despite the importance of malaria as a public health problem, there is relatively little literature on malaria that takes into account the possible influence of gender factors and gender relations (Tanner and Vlassoff, 1998).

2.7 Relationship between Socio-economic and Nutritional Status with Malaria

Social scientist including anthropologists has long defined different societies as being organized in diverse ways, with varying social structures and often conflicting social groups, differentiated by class, religion, ethnicity, and lineage. Identifying and understanding the community and its dynamics is not simple. Agueldo, 1983 has defined a community as a group of people living in a particular area and therefore having shared values, cultural patterns, and social problems. Chand, 1989 however, observes that even within a defined geographical area, a community is made up of different groups. Understanding this is crucial in developing health programmes since not all members will be motivated to participate in these efforts in the same way. Another concept valuable to our understanding of a community is the feeling that members have of belonging to a particular group, which gives a special motivation and willingness to work for the good of that group. This explanation (a sense of belonging, a joint problem, and a shared approach) can play a crucial role in the success or failure of programmes aimed at disease prevention or control.

Socio-economic status (SES) itself defines the measure of societal, and economic conditions of an individual in society. The measurement is calculated in terms of income, education and occupation of an individual or a family's difference in society (NCEC, 2008). Other variables associated with SES are the health, wealth, political participation, language development, literacy development, influence on non-verbal behavior. Socio-economic status defines the privileged and opportunity, one can afford for the quality of life in a society. SES affects our society in human functioning, especially physical and mental health (Evans *et al.*, 1997). It is reported that lower category of SES deprives children's academic skills (Morgan *et al.*, 2009). Many studies reveal that interventions of influences of SES in an individual's early life to reduce disease burden.

Malaria is frequently referred to as a disease of poverty or disease of the poor. An estimated 58% death occurs due to malaria among poorest of world population (Gwatkin *et al.*, 2000). People live under low socioeconomic conditions and have high levels of immunity enabling them to serve as reservoirs for malaria transmission (Dev *et al*., 2003). Poor socioeconomic conditions, knowledge, and perception about malaria and antimalarial policies play an important role in widespread malaria throughout the region (Rabha *et al*., 2011; Yadav *et al*., 2012; Dev *et al*., 2004; Dev *et al.*, 2006 and Das *et al.*, 2007). Malaria transmission and epidemics are depending upon socio-demographic factors, such as ethnic groups (Kreuels *et al.*, 2008). For adopting appropriate intervention strategies, knowledge of malaria and socio-economic upliftment are key factors.

A major health determinant of host resistance to infection is nutritional status (Keusch, 1979 and Gershwin *et al*., 1985). In children, less <5 years of age, morbidity of infectious disease, mortality have been estimated about a half of 12 million world's populations (Pinstrup-Andersen *et al*., 1993 and Rice *et al*., 2000). The relation between nutritional status and mortality is well documented (Broek *et al.*, 1993; Garenne *et al*., 2000 and Rice *et al.*, 2000). The increasing risk of mortality increases with the decrease in nutritional status (Broek *et al*., 1993; Garenne *et al*., 2000 and Rice *et al*., 2000).

Diarrhea, acute respiratory illness (ARI), malaria and measles cause more than half of the global burden of childhood mortality. This can be easily be prevented if treatment is given timely (Tulloch, 1999 and Snow *et al.,* 1999). Displacement and food storage are one of the major causes for children inappropriate suffering which results from malnutrition and increases the risk of mortality from infectious diseases including malaria. The risk mortality is highest in the group of the children with severe malnutrition (<70% normal height/weight). They may have high parasitemia with or without fever or sign of malaria, are more infectious and vulnerable to severe malaria and fatal (WHO, 2005).

The association of malaria and malnutrition is always controversial and many studies shows proactive wasting effect against malaria, Fillol *et al.*, 2009; Snow *et al.*, 1991 and Deribew *et al.*, 2010 reported no association (Carswell *et al.,* 1981) or an increased risk of malaria among stunted (Deen *et al*., 2002) and underweight children (Ehrhardt *et al.,* 2006). Muller *et al.*, 2003 reported on malaria and protein-energy malnutrition (PEM) and found there was no association, but malnourished children had a higher mortality rate than non-malnourished children. Micronutrients deficiency co-existence with malnutrition is a complex cycle and plays an important role in infections in vulnerable populations (Niehaus *et al*., 2002; Schorling *et al.,* 1990 and Howie *et al*., 1990). Breastfeeding is the most protective methods for children for diarrhoea and many respiratory diseases and provides better nutritional status than the others who don't, (Ellestad-Sayed *et al*., 1979). Despite socio-economic conditions, educational status and number of family members, breastfeeding has the independent role (Niehaus *et al*. 2002). Birth weight is a growth indicator indices and many studies reported the association of growth, development, morbidity, and mortality, (Ho, 2001, Lima *et al.* 2004 and Victora *et al.,* 1988). Arinaitwe *et al*., 2012 reported the association of increased incidence of malaria with stunting, which indicative of chronic malnutrition.

With the exponential human population growth to meet the food demands have been accelerated with cultivable and wild vegetables, which are regarded as a cheap

source of food for the marginal communities (Hussain *et al*., 2009a). About 840 million undernourished people in 1998–2000 are reported by Food and Agricultural Organization (FAO). Out of whom, 799 million are in developing countries and 30 million in the countries in transition. Others 11 million are in the industrialized countries (Sartaj, 2001; Diouf, 2002; Gilani *et al*., 2010 and Dini *et al*., 2005). The interests have been centralized on the exploitation, quantification, and utilization of food plants, especially the vegetables to apprehend the situation (Dini *et al*., 2005). Vegetable is the rich source of carbohydrates, fats and proteins, which form the major portion of the human diet. Sreedevi and Chaturvedi, 1993; Mathews *et al*. 1999; Kalita *et al*., 2007 and Hussain *et al*., 2009a, have reported the importance of these biochemicals. Besides these, the moisture, fiber, and ash contents and the energy values which are derived from vegetables and plants are important to the human health (Wahrmund-Wyle *et al*., 2000; Chevaux *et al*., 2001; Cummings *et al*., 2004; Mcsweeney *et al*., 2005 and Hussain *et al*., 2010a, 2010b).

The relationship between malaria and under-nutrition is controversial. Although a number of observations have indicated a deleterious effect of malaria on nutritional status (Ehrhardt *et al*., 2006 and Snow *et al*., 1999), it is still unclear whether and how nutritional status influences malaria-related morbidity. Earlier observational studies provide some evidence of the protective effect of under-nutrition against malaria (Murray *et al*., 1975 and Hendrickse *et al*., 1971). However, more recent studies have presented inconsistent findings. Deen *et al.*,2002 in Gambia and Friedman *et al*., 2005 in Kenya reported that under-weight was not associated with infection with malaria Deen *et al*., 2002 and Friedman *et al.*, 2005. Another study in the Gambia showed that nutritional status was not associated with the occurrence of malaria (Snow *et al*., 1991).

Decades back many scientists have reported on diet of Amerindian groups of Amazonians (Ribeiro, 1967, Denevan, 1976; Herrera *et al*., 1978, Dufour, 1983 and Holmes, 1981). On the lower slopes of the Andes of the western peripheral of Amazonia

live a number of groups ((Berlin and Markell, 1977; Vickers, 1989; Behrens, 1984; Hodges and Dufour, 1991). These groups similar diets like study village, mainly on cassava, banana/plantain, fish and game (Behrens, 1984; Berlin and Markell, 1977; Dricot-D'Ans and Dricot, 1978; Ross, 1976 and Vickers, 1989). Dufour, 1988, reported that cassava is the largest source of energy in many Amazonian groups.

A study on food variety and dietary diversity were adopted for the research area. Based on this a set household questionnaire was asked to both to the head of the household and to the woman who prepares food. The questionnaire was included demographic information and food items have been used in the meal preparation or eaten by any of the household members. The list of food items was elaborated based on in-depth interviews and local knowledge of the area (Haitely *et al.*,1999 and Ponka *et al*., 2005). They revealed the quantifications of macronutrients as well as phytochemicals.

Malnutrition is the result of dietary inadequacy and unhealthy lifestyles and the factors like poor purchasing power, faulty feeding habits, large family size, frequent infections, poor health care, poor sanitation, and inadequate food production are associated with it. Population living in the backward and drought-prone rural areas and urban slums, and those belonging to the socially backward groups are highly susceptible to the ideal ranges of weights for a given height are provided by WHO.

Body mass index (BMI) is a measure for indicating the nutritional status of an individual. The weight and height of an individual comprised of BMI and universally expressed in units of kg/m^2 . It is defined as body mass divided by the square of the body height BMI quantifies the amount of muscle, bone, and fat. On the basis of that a person is categorized as underweight, normal weight, overweight, or obese. The normal BMI ranges are : underweight: under 18.5 kg/m^2, normal weight : 18.5 to 25, overweight: 25 to 30; obese: over 30 (Kendrick, 2015*).*According to WHO, the cut-off point for overweight is 25 kg/m^2. Among different Asian populations, cut-off for observed risk varies.

According to the National Institutes of Health (NIH, 1985) consensus conference recommended that overweight BMI is set at a BMI of 27.8 for men and 27.3 for women. In the 1990s, the World Health Organization (WHO) concluded the BMI of 25 to 30 as overweight and over 30 is obese. BMI of less than 18.5 as underweight is considered due to malnutrition, equal to or greater than 25 is overweight and above 30 is obese.

In India, Das *et al*., 1988 carried out a hospital-based study of children suffering from falciparum malaria. Raman *et al.,* 2011, reported on school children which showed iron deficiency among them. Ghosh *et al.*, 2007, reported on the community with asymptomatic malaria which showed moderate to severe anemia was recorded in 48.8% in children.

2.8 Food Varieties and Phytochemicals in Malaria Control

Haitely *et al.*, 1999 and Ponka *et al*., 2005 reported on the methods of preparation and determination of the nutritional potential of dishes consumed in the rural areas, which is a malaria endemic zone, revealed the quantifications of macronutrients as well as phytochemicals.

The exponential human population growth demands an accelerated availability for growing food crops and vegetables (Hussain, *et al.,* 2009a). To meet the food demands, cultivable and wild vegetables are regarded as a cheap source of food for the marginal communities as an alternative (Hussain, *et al.,* 2009a). There are about 840 million undernourished people in 1998–2000, out of whom 799 million are in the developing countries, 11 million in the industrialized countries and 30 million in the countries in transition (Diouf *et al*., 2002; Dini *et al.,* 2005; Gilani *et al*., 2010 and Sartaj *et al*., 2001). The interest in exploitation, quantification, and utilization of food plants, especially the vegetables has been centralized to apprehend the situation (Dini *et al.,* 2005). The major portion of the human diet is vegetables, which are a rich source of carbohydrates, fats, and proteins, and are the cheaper source of energy (Sreedevi *et al.,* 1993; Mathews *et al.,* 1999 and Kalita, *et al.,* 2007). Earlier reports on the importance of biochemical's and the

moisture, fiber, ash content and the energy values of individual vegetable and plant species was carried out by various scientists (Chevaux *et al.*, 2001; Cummings *et al*., 2004; Hussain *et. al*. 2009b; Mcsweeney *et al.*, 2005 and Wahrmund-Wyle *et al.*, 2000).

There are a number of rural community groups who make a living by horticulture, hunting, fishing and sell their products in the marketplace for fulfilling their other needs. But still, there are a number of groups who are self-sufficient in food production. They have their diets to be traditional. Their diets define in terms of ecological variables, food resources characteristics, and use (Darna, 1991). In a mass survey, it was seen that the prevalence of asymptomatic malaria among the vulnerable groups, was found to be high in the malnourished population. It is seen that well-nourished people have better immunity to fight against malaria and other tropical endemic diseases (Dupin *et al*., 1984). In fact, previous studies like those of in Tanzania, (Tanner *et al.,* 1987), Madagascarin Central Africa (Tonglet *et al*., 1999), showed that protein–calorie malnutrition favors the evolution of malaria (Ponka *et al*., 2005).

International Conference on Nutrition held in Geneva, 1992 reported about 780 million chronically undernourished. More than 2 billion people are affected by micronutrient deficiency and 192 million children below 5 years old are affected by Protein-Calorie insufficiency (FAO, 1992). Studies show that despite food diversity many countries like Cameron faces from nutritional problems (Latham, 1997). According to Lowé *et al.*, 1993 reported that protein-calorie malnutrition and micronutrient deficiencies are high in vulnerable groups in Cameroon. He showed that the prevalence of pathology is high in the juvenile group leads to high juvenile-infant morbidity. Resistance is better in well-nourished populations towards endemic disease like malaria (Dupin, 1984). Similar studies reported by Tanner *et al.,* 1987 in Tanzania; Pereira *et al*., 1995; Razanamparany *et al.* 1995 in Madagascar; Man *et al*.1998 in the Gambia and Tonglet *et al.,* 1999 in Central Africa on protein–calorie malnutrition which supports the evolution of malaria.

Carbohydrates, fats, proteins, vitamins, minerals, and water are important constituents of diet (Indrayan *et al., 2005*). To meet the need for their activities, human beings require a number of complex organic/inorganic compounds in the diet. Every constituent plays an important role and deficiency of any one constituent may lead to abnormal developments in the body. Plants are the rich source of all the elements essential for human beings. Plant elements are essential for growth and there is a relationship with nutritional status. They are used for structure formation, reproduction or as biological active components (Wall *et al*., 1996).

Ponka *et al*., 2005 reported the higher consumption of dishes made from seeds of leguminous, egusi, green leafy vegetables, and low consumption of tubers, unripe bananas and plantains lead to a good nutritional balance. To fight against malaria, the nutritive value of prepared dishes ready for consumption is necessary. ICIDR (malaria project) showed a malaria prevalence of 57.2% and 52% in 1998 and 2002, respectively, in Ngali II. The results showed a new path to study the describing the methods of preparation and determination of the contents in moisture, ash, proteins, lipids, crude fibers and carbohydrates in the Ngali II malaria endemic zone.

Malaria prevalence in the tropics is characterized by their typical symptoms as well as asymptomatic phase. Despite the availability of various therapies, many traditional medicines used whole plant or crude plant extracts which shows greater anti-plasmodial activity. This research was carried out for determining the phytochemicals and physiochemical properties of such different varieties of plant species consumed by the community in malaria endemic and malaria tolerance zone of Kamrup Metro District, Assam. Results reported evidence of several types of plant species, which are reported to be used a different geographical location in the world. Their extracts contain many useful phytochemicals and secondary metabolites which may contain multi-drug inhibitor or may have immunomodulatory effect as well as anti plasmodial activity. The study indicates potential inhibition factors for malaria tolerance in the community of the study area.

Malaria is a fatal infectious disease which affects people of all ages in developing countries with tropical and sub-tropical climates around the world. As per World Health Organization (WHO) record reports approximately 40% of the world population lives in malaria-endemic areas, with around 300-500 million clinical cases and about 1.5-2.7 million deaths per year globally. The five protozoan species *P. falciparum*, *P. vivax, P. ovale, P. malariae, P.Knowlesi* and *P. falciparum*, which causes infections in human has become an increasingly important clinical issue in malaria chemotherapy worldwide (Dinio *et al.*, 2005 and Sashidhara *et al.*, 2012). Traditional medicines have been playing important role in the treatment of diseases including malaria since ancient time (Rudrapal, 2017). A modern chemotherapeutic form of malaria treatment started with the discovery of quinine (QN) from cinchona bark (Rudrapal, 2017). As per earlier studies, plants and/or plant-based traditional medicines are believed as the most reliable and alternative means for the discovery of new antimalarial molecules (Rudrapal, 2017). Polyphenolic flavonoids are abundant in dietary or medicinal plants, which have been identified to possess good *in vitro* and *in vivo* antimalarial activities (Al-Adhroey *et al*., 2011 and Lehane *et al.*, 2008).

Plants produce many phytochemicals as secondary metabolites in their various parts. These phytochemicals play a various biochemical and pharmacological role when ingested by animals (Trease, 1989). Flavonoids are the most diversified groups of phenolic compounds found in plants various parts, which impart a variety of colours such as yellow, orange, purple, blue etc. to flower petals, fruit peels, vegetables and certain grains (Rudrapal, 2017). Because of their widespread distribution in dietary plants such as fruits and vegetables, flavonoids form an integral part of the human diet. Flavonoids consumed through diet as raw forms, processed products or cooked preparations contribute beneficial effects to human health (Rudrapal, 2017). Flavonoids from *Artemisia annua* as antioxidants has their potential synergism with Artemisinin against malaria and cancer (Jorge *et al*., 2010).

Many ethnobotanical studies were carried out on plants and their parts for the treatment of malaria around the world like many African countries (Omosun *et al*., 2013 and Betti *et al.*, 2013), Cameroon and Ghana (Saotoing *et al*., 2011). In Ngeria (Idowu *et al.*, 2010), reported on *Carica papaya*, L. on its leaves which was successfully used for treatment of malaria for the presence of alkaloids as quinine is present. Bergonio *et.al*., 2016 reported on male papaya flower. Natural antiprotozoal activities of papaya by Wright 1990, traditional antimalarial activities by Gasquet, 1993 and in India, Kovendan, 2012a reported on larvicidal properties, Ahmad, 2011 and Goel *et al*., 2001, also reported on various parts of *Carica papaya* and its anti-malarial properties for treatment of malaria.

A relevant literature survey showed that the various species of Araceae, *Colocasia esculenta* (L.) Schott used for traditionally used for malaria, headache and fever (Frausin, 2015; Pedralli, 2002; Milliken *et al*. 1997a, 1997b; Kvist *et al*., 2006; López *et al*., 2006; Adepoju *et al*., 2008; Pravakar Padhial, 2011 and Williams *et al*., 1981). Secondary metabolites of plats are useful for the treatment of many protozoan diseases including malaria (Pohlit *et al*., 2011a, 2011b, 2013). Melo *et al*., 2009; Punthanara *et al*., 2009; Velayutham *et al.*, 2016; Betti *et al*., 2013 and Omosun *et al*., 2013 reported on *Manihot esculenta* Crantz. *Capsicum frutescens* L., *Capsicum annum* L., (Betti *et al*., 2013 and Mojab *et al.*, 2003), *Oryza sativa* (Betti *et al*., 2013) are largely cited as associated plant species which are used for treating malaria. Balogun *et al*., 2012, reported that extracts of *Momordica charantia* L. is effective for treatment of malaria and diabetes. In India Reddy *et al*., 1989 and Singh *et al.*, 2006 reported on its enthobotanical efficacy of malaria fever. Prakash and Unnikrishna, 2013 reported entho-medical survey on herbs like *Curcuma longa* L., *Zingiber officinale* Roscoe for the management of malaria in Karnataka, India. Similarly Reddy, 2005 and Rasoanaivo *et al.*, 2011 also reported on *Curcuma longa* L. Coe, 1996; Shankar, 1999; Singh, 1994; Vongo, 1999; Betti *et al*., 2013; Rasoanaivo *et al*., 2011 and Titanji *et al*., 2008, reported on *Zingiber officinale* about its medicinal properties of malaria treatment.