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Ethnobotanic survey of medicinal plants used for malaria therapy in western Cameroon

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Abstract
Malaria is one of the most prevalent infections worldwide. In Cameroon it is one of the diseases which cause serious concerns to the support health authorities. The increase level of malaria parasite drug resistance, the high cost of those drugs and their several side effects, have led to a gradual loss of faith in the modern drugs and confidence in the use of herbs in the treatment of malaria. Hence the use of plants, herbs and other natural substances to cure malaria and many other ailments has been on increase in Cameroon, and mostly in the rural areas. For many centuries, locally prepared decoctions have been in use for the treatment of malaria. This ethnobotanical study has revealed that 46 plants belonging to 32 families are currently used in the Menoua division, Western Cameroon, to treat malaria. The Asteraceae, Liliaceae and Malvaceae families (3 plants each) were dominant. The top 17 of the plants usually used is constituted of: *Carica papaya, Bidens pilosa, Cymbopogon citratus, Citrus limonum, Cassia alata, Enantia chlorantha, Eucalyptus globulus, Mangifera indica, Allium sativum, Vernonia amygdalina, Psidium guava, Panax ginseng, Eremomastax speciosa, Combretum micranthum, Dacryodes edulis, Aloe vera and Annona muricata.* However, 8 plants including : *Allium sativum, Bidens pilosa, Carica papaya, Combretum micranthum, Dacryodes edulis, Enantia chlorantha, Panax ginseng and Vernonia amygdalina* have been mentioned to been used as single recipe, while 12 plants including *Aloe vera, Annona muricata, Cassia alata, Citrus limonum, Cymbopogon citratus, Eremomastax speciosa, Eucalyptus globulus, Mangifera indica, Moringa oleifera, Musa sapientum, Psidium guava* and *Zinziber officinales* are used as adjuncts in the preparation to cure malaria. Leaves 65%, constituted the main part used. Most of these plants can be a potential source for the development of novel and more potent antimalarial drugs. However, further studies should be undertaken to validate their efficacy and safety, and to standardize practice.

Keywords: Ethnobotany, Malaria therapy, Medicinal plants, Plasmodium, Western Cameroon

1. Introduction
Malaria is the world's most devastating disease [1], especially in the tropical Africa, Asia and Latin America. The World Health Organization reported that there was estimated 246 cases malaria distributed among 3.3 billions people at risk in 2006, causing at least a million deaths. This disease is caused by parasites of the genus plasmodium, which are transmitted to human through the bites of females mosquitoes belonging to the genus anopheles [2].There are four species of plasmodia which infect humans : *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae* and *Plasmodium ovale*. Out of these, only *Plasmodium falciparum* causes severe and potentially fatal malaria. *Plasmodium vivax* and *Plasmodium ovale* cause self-limiting febrile illnesses, but both can become dormant in the liver and re-activate after a few months or even years. The most important species globally are *Plasmodium falciparum* and *Plasmodium vivax* [3]. The symptoms of malaria are : fever, headache chills, shivering, lost of appetite, vomiting, general body weakness, joins paints [4], anemia, lethargy and high body temperature(hot skin) [5]. Confirmation is by laboratory examination of blood for the presence of the parasite. However all these symptoms are not present at the same time on the sick persons.

Globally, deaths associated to malaria are the highest in Africa. Approximately 80% of malaria cases in the world is in Africa, where the disease is endemic [6]. The disease is the major cause of the continent high infant mortality, killing 1 in every 20 children below 5 years of age [7]. The alarming rate at which *Plasmodium falciparum* has developed resistance to Chloroquine and other synthetic antimalarial drugs make it necessary to search for more effective antimalarial compounds [8]. There are records of age-long folkloric uses of plants as

sources of therapeutic agents [9]. It is estimated that over 80% of the world population depend on this form of health care [10]. Scientists and traditional healers now agree that plants are sources of new drugs, and various concoction of plants and crude extracts are effectively used for the prevention and the treatment of malaria and other ailment in several parts of the world [11]. It is therefore important that scientist should investigate the antimalarial activity of plants used worldwide by traditional healers in order to determine their chemical compounds which are responsible of such properties. This may serve as a stating point for the formulation and synthesis of new more potent drugs. In Cameroon, like in most tropical countries, malaria is endemic and still remains a major health problem. Cameroon figures among the 18 countries bearing 90% of malaria deaths in Africa, with 71% of its population living in high-transmission areas [12]. In the West region of Cameroon, this disease causes many health troubles. In this region, malaria was shown to be the most important cause of infant mortality, causing about 45% deaths and 54% hospitalization for children under five [13]. Due to the fact that Plasmodium is more and more resistant to synthetic drugs and the great poverty of the populations living in this part of the country, many of them are obliged to turn towards folk medicine healers in order to get their recovery. The role of traditional healers in the management of severe malaria among children below five years of age has been positively discussed [4]. The administration of traditional drugs has been in the hands of native herbalists who quite often, are old persons in the rural settings.

1.1 This work had the following as specific objectives

1. Make an ethnobotanical survey of plants traditionally used in the West region of Cameroon in the treatment of malaria;
2. Make a botanical description of the most used plants and find out weather there is a scientific confirmation of their uses for this purpose;
3. Describe how they are used in the folkloric medicine to cure malaria.

2. Methodology

The study area, Menoua division, Dschang sub-division, Western Cameroon, is a city located about 350 Km from the capital territory Yaoundé. The dominant ethnic group is Bamileke and the local mother tongue is "Yemba". As in other part of the country, communicable diseases including malaria are the main public health problems of the area. one hundred persons including 25 traditional practitioners, aged between 35 and 75 years old, and 75 ordinary persons were interviewed to ascertain the plants used traditionally in that locality to treat malaria. The distribution of the respondents and their sex is shown in table 1. Plants specimens were shaped and collected with the help of a botanist to ensure that correct specimens were obtained for taxonomic identification and future scientific investigation. The survey questionnaire was constituted of space on paper where the plants names, the parts used to cure malaria and method of preparation were to be filled. The interview with traditional healers consisted for them to show among their plants, those they usually used to treat malaria, and the role of botanist was to identify them and give their scientific names. The study was conducted between June and September 2015. Informations about medicinal plants were compiled according to their botanic families, their scientific names, their French names, their local names**,** their frequency and the parts used.

3. Results

46 plants were said to been effective against malaria. Their botanic families, their scientific names, their French names, their local names, their frequency of use and the parts used are depicted in Table 2. The plants are distributed among 32 families, with a dominance of Asteraceae, Liliaceae and Malvaceae families (3 plants each). However, only 8 of those plants are used as a single recipe against malaria (Table3), while the others, 12 of them are currently used as adjuncts in combination with the principal antimalarial plants (Table4). The top 17 of plants used by people of the locality to manage problems related to malaria and their frequency are shown in table 5, while their pictures are on figure 1. The recipes used contained plants leaves, barks, flowers, fruits, seeds, roots, stem, bulb, rhizomes or the whole plant, but main part used were leaves (65%), followed by bark (13%). This is in accord with the work of Caraballo *et al* [14] conducted in the South-Eastern Venezuelan Amazon, where they proved that the leaves constituted 70% of the parts used. The choice of this plant part is to be promoted, because it is renewable and permits a sustainable use of medicinal plants to preserve our health. The reason which pushes people to prefer leaves instate of others parts could be due to the fact that they are the sit of synthesis of organic substances and, therefore, antimalarial substances [15, 16].

4. Local population knowledge on the disease

The study revealed that the respondents were well aware of the signs and symptoms of malaria since each of them was capable to give at least 3 symptoms of malaria and could readily distinguish the disease from other feverish conditions. 89% of the interviewed persons knew at least 3 of these plants. Consequently, the ability of these people to treat and their knowledge of herbal prescription for malaria are impressive. This also showed the prevalence of the disease and how it has been tackled with plants and other natural substances over the time.

Table 1: distribution of respondents showing categories and their sex.

Categories	Number of respondents	% male	% Female
Traditional healers	25	80	20
Ordinary people	75	60	40

Table 2: List of medicinal plants and parts used in the treatment of malaria in the Menoua division**.**

Nº	Family names	Nº	Scientific names	French names	Local names	Freq (%)	Parts used
1	Acanthaceae	1	Brillantaisia patula	?	?	14	Leaves, flowers
		2	Eremomastax specisa	?	panzemzoh	53	
2	Anarcadiceae	3	Mangifera indica	Manguier	Mangroh	60	Leaves, bark
3	Annonaceae	4	Annona muricata	Corossol	?	31	Leaves
		5	Enantia chloranta	Enantia	?	34	Bark
4	Apiaceae	6	Centella asiatica	Centella asiatique	?	21	Whole plant
5	Apocyanaceae	7	Catharanthus roseus	Pervenche de Madagascar	?	4	Leaves and Flowers

6	Araliaceae	8	Panax ginseng	Ginseng	Ginseng	37	Rhizomes
7	Asteraceae	9	Ageratum conyzoides	Roi des herbes	Tchouomo	7	Whole plant
		10	Bidens pilosa	Sornet	Leliet	72	Whole plant
		11	Vernonia amygdalina	Ndolé	Mekang	45	Leaves
8	Bromeliaceae	12	Ananas comosus	Ananas	Lelan	21	Leaves, fruits
9	Burseraceae	13	Dacryodes edulis	Safourtier?	Kiop	47	Leaves, Bark
10	Caesalpinaceae	14	Cassia alata	Dartrier	Koyo	62	Leaves
11	Caricaceae	15	Carica papaya	Papayer	Popo	80	Whole plant
12	Combretaceae	16	Combretum micranthum	Kinkeliba	Afonet	39	Leaves, fruit
13	Crassulaceae	17	Kalanchoe pinnata	Kalanchoé	Joujou	12	Leaves
14	Euphorbiaceae	18	Euphorbia hirta	Malnommée	?	9	Whole plant
		19	Manihot esculenta	Manioc	Kassa	19	Leaves
15	Costaceae	20	Costus afer	Gingembre Spirale	Koukou mefak	17	Leaves, stem
16	Fabaceae	21	Arachis hypogea	Arachide	Biang	7	Leaves
17	Lamiaceae	22	Ocimun gratissimum	Basilic Africain	?	24	Leaves, stem
18	Lauraceae	23	Persea americana	Avocatier	Pieh	16	Leaves
19	Liliaceae	24	Allium cepa	Oignon	Gnossi	13	Bulb
		25	Allium sativum	Ail	Ail	44	Bulb
		26	Aloe vera	Aloès véra	Alo vera	30	Leaves
20	Malvaceae	27	Gossypium arboreum	Cotonnier	?	7	Leaves
		28	Hibiscusrosa-sinensis	Hibiscuit	?	10	Leaves, flowers
		29	Sida acuta	?	?	9	Leaves, flowers
21	Moringaceae	30	Moringa oleifera	Moringa	Moringa	11	Leaves, seeds
22	Musaceae	31	Musa sapientum	Banane douce	Kedienghe	15	Leaves, roots
		32	Musa sinensis	Banane plantain	Kedon	23	Leaves, roots
23	Myrtaceae	33	Eucalyptus glogulus	Eucalyptus	Kartussi	60	Leaves, Bark
		34	Psidium guajava	Goyavier	Goya	42	Leaves, Bark
24	Passifloraceae	35	Passiflora edulis	Fruit de la passion	?	11	Leaves
25	Poaceae	36	Cymbopogon citratus	Citronnelle	Fipagrassi	67	Leaves
		37	Zea mays	Maïs	Nguessang	12	Leaves, flowers
26	Rhamnaceae	38	ZiZiphus jujuba	Jujubier	Dideuh	8	Fruits
27	Rubiaceae	38	Coffea arabica	Café	Café	5	Leaves
28	Rutaceae	40	Citrus limonum	Citronnier	Citron	50	Leaves, fruits
		41	Citrus sinensis	Oranger	Pouma	18	Leaves
29	Solanaceae	42	Capsicum frutescens	Petit piment	zizisissoc	13	Leaves, fruits
30	Sterculiaceae	43	Cola acuminata	kola	Lepieh	17	Leaves, Bark
31	Zingiberaceae	44	Curcuma longa	Curcuma	?	14	Rhizomes
		45	Zingiber officinales	Gingembre	Didja	20	Rhizomes
32	Verbenaceae	46	Lantana camara	Lantanier	?	25	Leaves, fruits

Table 3: Medicinal plants used as single recipe in malaria treatment.

Nº	Plants	Parts used	Method of extraction
1	Allium sativum	Bulb	Concoction, tincture
2	Bidens pilosa	Whole plant	Decoction
3	Carica papaya	Fruits, leaves and roots	Decoction
4	Combretum micranthum	Fruits and leaves	Decoction
5	Dacryodes edulis	Leaves and Bark	Decoction
6	Enantia chlorantha	Bark	Decoction
7	Panax ginseng	Rhizomes	Infusion, decoction
8	Vernonia amygdalina	Leaves and roots	Concoction, decoction

Table 4: Main Medicinal plants used as adjuncts in recipes to cure malaria.

Nº	Plants	Parts used	Uses
1	Aloe vera	Leaves	Blood supplement
2	Annona muricata	Leaves	Relief fever
3	Cassia alata	Leaves	Relief fever
4	Citrus limonum	Leaves and fruits	Coated tongue
5	Cymbopogon citratus	Leaves	Relief fever
5	Eremomastax specisa	Leaves and flowers	Blood supplement
7	Eucalyptus globulus	Leaves and bark	Relief fever
8	Mangifera indica	Leaves and bark	Coated tongue
9	Moringa oleifine	Leaves	Blood supplement
10	Musa sapientum	Leaves	?
11	Psidium guava	Leaves	?
12	Zingiber officinales	Rhizomes	Relief fever

Table 5: The top 17 of plants used by people of the locality to manage problems related to malaria and their frequency.

Plants	Frequency (%)	Plants	Frequency (%)
Carica papaya	80	Vernonia amygdalina	45
Bidens pilosa	72	Allium sativum	44
Cymbopogon citratus	67	Psidium guava	42
Cassia alata	62	Combretum micranthum	39
Eucalyptus globulus	60	Panax ginseng	37
Mangifera indica	59	Enantia chlorantha	34
Eremomastax speciosa	53	Annona muricata	31
Citrus lemonum	50	Aloe vera	30
Dacryodes edulis	47		

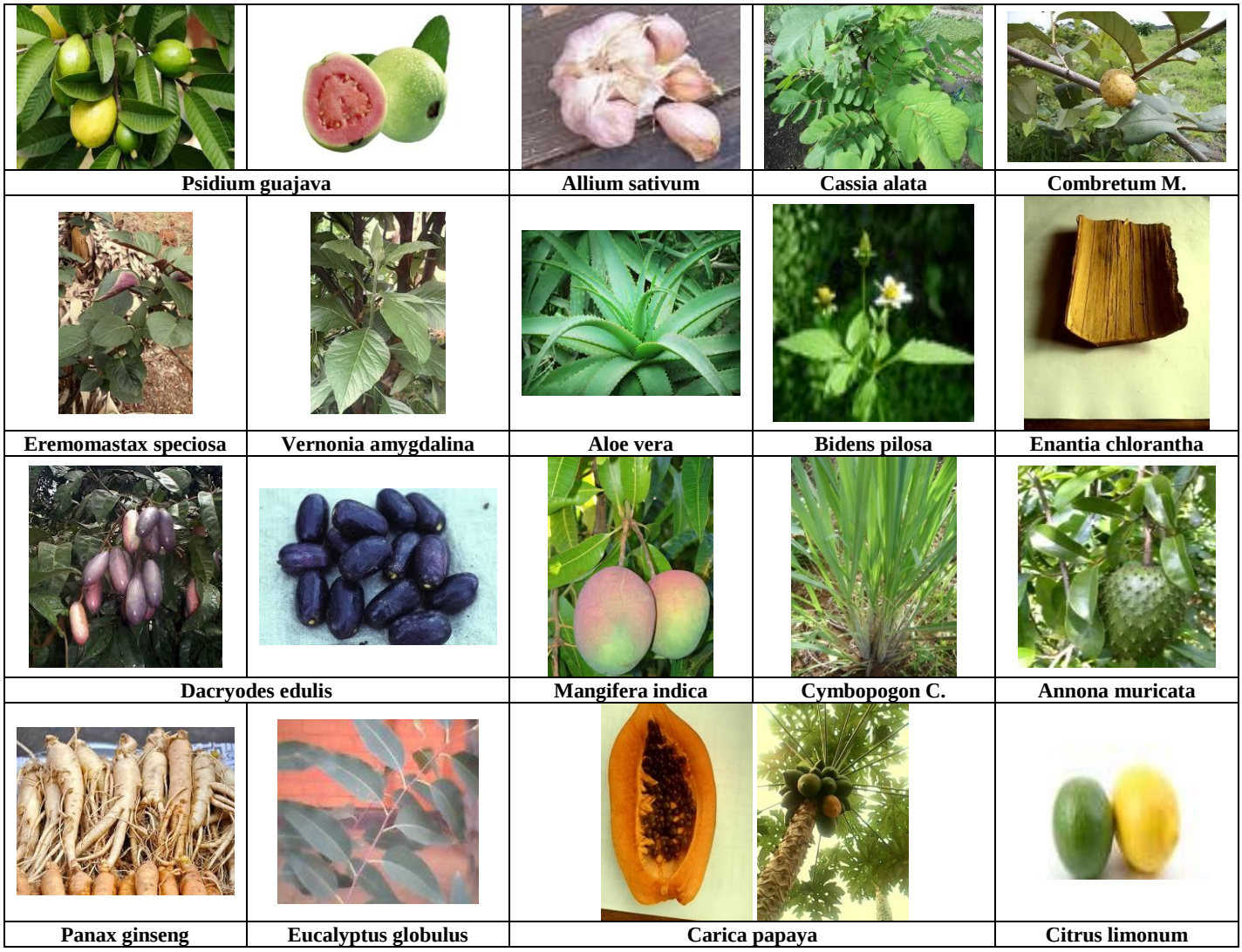

Fig 1: Top 17 of plants used by people of the Menoua Division to manage problems related to malaria.

5. Taxonomy, scientific evidence and other virtues of the 17 main plants used in the treatment of malaria in the Menoua Division.

5.1 Carica papaya

Carica Papaya Linn, belonging to the family Caricaceae, is commonly known as papaja in English. Originally derived from the southern part of Mexico, *Carica Papaya* is a perennial plant, and it is presently distributed over the whole tropical area [17]. The plant, recognized by its weak and usually unbranched soft stem yielding copious white latex and crowded by a terminal cluster of large and long stalked leaves, is rapidly growing and can grow up to 20m tall [18]. The ripe fruit is the most appreciated part, and it is known as food or as quasi-drug. Many scientific investigations have been conducted to estimate the effectiveness of various parts of *Carica Papaya*, in term of it chemical composition. All parts of the plant, including leaves, fruits, roots, seeds, peel, trunk and latex are used in traditional medicine to cure different ailments. Among these diseases, malaria occupies a prevalent place. Many scientists agree the fact that *Carica Papaya* is effective in the treatment of malaria [14, 17, 19, 20]. In the Western Cameroon, people usually boil a mixture of mature yellow leaves, green leaves, unripe fruit and lemon grass during 30min.They then drink a tea cup thrice during 5 days, and use another part of the hot juice for bathing for 3 consecutive days, to cure malaria.

Other uses of this plant in Cameroon are against fever, headache, tooth pains, corns and eczema, sinuses, constipation, amenorrhea, sexually transmitted diseases, to expel worms, to lower blood sugar level, to stimulate reproductive organs, just to name the few.

5.2 Bidens pilosa

This herbaceous plant belongs to the Asteraceae family. It is widely distributed in Africa, America, China and Japan. The herb is originally native to South America which today is spreading all over the world, especially in tropical and subtropical regions [21]. It is an annual herb, 60-90cm high. Stem quadrangular, grooved, branches opposite. Leaves pinnately compound, usually 2.5-13.5 cm long including petiole, leaflets 3-5. Heads 21-42 in compounds cymes terminating main stem and lateral branches, and 0.7-1cm in diameter including rays florets, peduncles 1-9cm long; outer involucres bracts spatulate-tipped, 2.5- 5mm long; rays florets absent or 4-7 per head, rays white or yellowish, 2-8 mm long; disk florets 35-75 per head, corollas yellow, pappus of 2-3 barbed awns 1-2 mm long. A chenes dark brown or black, straight, wingless, 8-16 mm long. The antimalarial activity of this plant has been scientifically proved [22, 23]. In Dschang, populations usually boil the whole plant in water, and drink a tea cup twice for 1 week to cure malaria.

Bidens pilosa has been reported to possess effective pharmacological properties like antibacterial activity, anti-inflammatory and anti-allergic activity, T helper cell modulator, immunosuppressive anti-hyperglycemic, anti-hypertensive, anti-ulcerogenic, hepatoprotective, antileukemic, anticancer, antipyretic, antivirus, anti-angiogenic, antirheumatic and antibiotic activity [22].

5.3 Vernonia amygdalina

From the Asteraceae family, and also known as bitter leaf, this plant is a popular African vegetable that grows as a shrub which can reach 5 m high. It is well known in Cameroon, mostly in Douala community where they use its leaves to cook a soup called “Ndolè”. They then use this soup to eat fried or boiled unripe plantain or a prepared cassava pate called “Miodo”. The leaves are bitter and said to have medicinal uses, among which the treatment of malaria. Many scientific researchers have proved the antimalarial activity of its leaves [24-28]. The acute toxicity test showed that aqueous extract of *vernonia amygdalina* is nontoxic [24]. In our study area, to treat malaria, populations usually boil the leaves 30min in water and drink a one quarter liter 3 times per day for 1 week. They sometime add honey in the preparation in order to reduce it bitter flavor.

Other uses of the plant include promotion of dieresis, cure of tonsillitis, fever, diabetis, pneumonia, jaundice, anemia, stomach problems, and ascaris [29, 30]. Aqueous solution is also successfully used as a purgative and in treatment of eczema [28]. In Cameroon, the aqueous solution of its leaves is drunk to stimulate appetite.

5.4 Psidium guajava

Known as guava, this medicinal plant belongs to the Myrtaceae family. It is native to Central America, but is now widely cultivated and distributed, and the fruits enrich the diets of million of people in the tropics of the world [31, 32]. In Cameroon, guava is widely distributed and grows in every part of the country. It is found mostly along the roadside and can grow up to 10m. Its fruits are much appreciated, and are sometime used to prepare juices by crushing them and then, adding water and sugar. The mixture is allowed to boil for 15min.After this, the preparation is filtered and the pure juice is collected. The juice can be drunk as such or iced. *Psidium guajava* is a well know traditional medicinal plant used in various indigenous systems of medicine [33]. The leaves and bark of *Psidium guajava* tree have a long history of medicinal uses, that is still employed today. Among the ailment treated by this plant, malaria occupies a relevant place. Many authors have studied the antimalarial activity of the plant and their findings were very encouraging [34-36].

A part from malaria, guava leaves have been successfully used for the treatment of gastrointestinal disturbances such as vomiting, diarrhea, inhibition of peristaltic reflex, gastroenteric, spasms, dysentery, abdominal distention, flatulence, and gastric pains [37-39]. The leaves also have antidiabetic properties [40]. In Cameroon the young leaves are chewed to treat toothache.

5.5 Mangifera indica

It belongs to Anacardiaceae family and is well known as mango. The tree grows 35-40m tall; with a crow radius of about 10 m. The leaves are alternate, simple, 15-35 cm long and 6-16 broad. They are dark green when they are mature. The flowers are produced in terminal panicles 10-13cm long; each flower is small and white with 5 petals 5-10mm long. The fruit is variable in size and color [36]. *Mangifera indica* has been involved in the cure of many diseases including malaria [35-41]. In Cameroon, it is associated with other herbs and plants such as *Cassia alata*, *Cymbopogon citratus*, *Vernonia amygdalina*, *Bidens pilosa* and *Carica papaya* for the treatment of malaria. The leaves and bark are the main parts commonly used.

Other uses of this plant are against headache and diarrhea [42]. The leaves and bark are anti-inflammatory drugs [43]. The tender leaves are used as diuretic [44], for the hypertension and infertility treatment [45]. In Cameroon, leaves and bark are boiled in the water and the juice is drunk against rheumatism and dental problems.

5.6 Cirus limonum

The plant belongs to the Rutaceae family and is commonly called lemon. It is a small evergreen tree, with oval leaves, flagrant flowers and green fruits turning to yellow. Its fruits have been used over the years as food, as well as to treat many diseases. The fruits are also used to detoxifying human body, as antiseptic, antifungal, antioxidant, insects repelling, to soothing a sore throat; for hair, skin and nail care, for invigorating and refreshing. In western Cameroon, its fruits and leaves are popularly used in the preparation used to cure malaria. It antimalarial activity is well documented [41].

5.7 Cymbopogon citratus

This herb usually called lemon grass is a plant of the Poaceae family that looks like perennial herb with aromatic leaves banked forming clumps up to 1 m in height. It repents a citrus smell. The plant is rarely fades and it requires regular irrigation [44]. The leaves swells slightly at the base to form a fleshy stolon or underground stem. The edges of mature leaves are rough and sharp. The plant is involved in the treatment of many ailments where it is mixed with other leaves and barks, but the main use is against malaria [5, 35, 36, 41]. In Cameroon, *Cymbopogon citratus* is called fever grass, since it helps in the treatment of malaria by reducing fever induced by this disease. The leaves are then boiled with *Citrus limonum* in water, and the resulting solution is drunk each time where the sick person is thirsty. The essential oil from this herb is appreciated worldwide for its antibacterial, anti-inflammatory and analgesic properties [46]. It is also used for food preservation [47].

5.8 Eucalyptus globulus

The tree is from Myrtaceae family. It was discovered on the island of Tasmania in 1792 by French explorers and was one of the first eucalyptus species to be formally described. The primeval eucalyptus forest of Tasmania was among the tallest in the world and the Eucalyptus globules trees up to 101 min height were recorded [48]. Like other several species of the genus Eucalyptus, *Eucalyptus globulus* is used in many parts of the world for the cure of various diseases, including malaria. Some research papers have yet evocated the involvement of the leaves and barks of this plant in the management of malaria cases [16]. In Dschang, rural populations usually boil a combination of *Eucalyptus globulus* leaves and bark with other plants such as *Bidens pilosa*, *Vernonia amygdalina*, *Cassia alata*, *Carica papaya* and *Cymbopogon citratus* in the preparation to heal malaria, and they are very satisfy with the results obtained.

Other uses of this tree include: anthelmintic, wound healing, antibacterial, antifungal, antidiabetic and antiplaque activities [49], antitumor, antiviral, antihistaminic, anti-inflammatory, anti-oxidant, larvicidal, Nerves blocker, miscellaneous activities and to treat respiratory diseases [48]. In Cameroon, this tree is also used to fight against the swamps, since it roots sink very deeply in the soil and then absorb lots of water. As a result, the place becomes dry.

5.9 Annona muricata

Commonly known as graviola, it is an Annonaceae family small upright evergreen tree, 5-10m high, with large, glossy dark green leaves that produce a large, heart shape, edible fruit of 15-23cm diameter. The fruit is yellow green in color and has white fleshy endocarp [50]. According to current consensus, *Annona muricata* is probably originated from the West Indies and Northern South America [50]. Today, this plant is found in almost all tropical countries, including Cameroon. All the parts of the graviola plant are used in natural medicine in Cameroon, including leaves, fruits, bark, seeds and roots. Graviola has been earlier reported to cure many ailments, and particularly malaria [51, 52]. In western Cameroon, leaves infusion is taken in the evening as sedative before going to bed. It is also taken against nerves problems, malaria and to prevent cancers. In South-East Nigeria, the fruit juice is taken for the treatment of worm infections, head lice, fever, diarrhea, dysentery and as a lactogogue, while the bark, seed and roots are used as sedatives, antispasmodics and as antihypertensive [53]. Additional local usage in traditional medicine in other parts of the world include usage as antifungal, antibacterial, heart tonic, rheumatism, arthritis, coughs, difficult childbirth, asthma, convulsion and as muscle relaxant [50]. In Menuoa Division, graviola leaves are one of the most used adjuncts in the preparation for cure malaria, while its fruits are largely appreciate by the populations of that locality, and they often use them to prepare juices.

No much has been reported about the adverse effects of this plant. However, it is contraindicated during pregnancy because of it uterine stimulant effect as well as in hypotension patients because of it blood pressure lowering effect [50].

5.10 Cassia alata

Cassia alata, a shrub belonging to Caesalpiniaceae family, in popularly known as an ornamental plant, but it also possesses medicinal virtues which need to be discovered and exploited. This large handsome shrub with thick downy branches is widely distributed in Cameroon, where it is one of the plants most used to prepare natural remedies. For instance, it leaves are used as purgative, antihypertensive, against coughs, skin problems and fever, as well as an adjunct in the preparation of traditional decoction intended to treat malaria. Many authors have previously demonstrated the antimalarial properties of *Cassia alata* [34, 54-56].

This plant possesses many other uses. Extract from lives have been reported to have analgesic, antibacterial, anti-inflammatory, antifungal, hypoglycemic, oxytoxic and wounds healing activities [57].

5.11 Enantia chlorantha

The plant belongs to Annonaceae family. This dense forest tree is particularly known as African Yellow wood and is widely distributed along coast of West and Central Africa. *Enantia chlorantha* grows up to 30m high with dense foliage and spreading crown. The stem is fluted, the bark is fissured geometrically and the outer bark is thin and dark brown [58]. The stem bark figures among the medicinal plants sold in the local markets in Cameroon. In the Southern forest zone of Cameroon, barks are used for the traditional treatment of stomach problems, jaundice, urinary tract infections, tuberculosis, hepatitis, forms of ulcer and malaria [59]. Its stem bark antimalarial activity have also been proved by other authors [60]. In Nigeria, the stem bark of the plant is commonly used for the treatment of malaria and other ailments for the human body such as coughs and wounds [61].

Phytochemical studies of the stem bark of *Enantia chlorantha* have revealed the presence of berberine and protoberberine alkaloids possessing antimalarial, anti H.I.V and antihepatotoxic [62-65]. Properties. The protoberberine alkaloids (7.8-dihydro-8-hydroxypalmatine) obtained from the bark of this plant have also demonstrated the cytoprotective and ulcers healing actions, as well as it *in vitro* and *in vivo* anti helicobacter actions [66, 67].

It has been shown scientifically that the bark aqueous extract is nontoxic after sub-acute in take up to 500mg/Kg.

5.12 Eremomastax speciosa

From the Acathaceae family, the plant is an erect multi-branched tropical herb that grows in forest as well as around living houses in Africa, due to it traditional uses as medicinal plant. It leaves are green on one side and red on other side. The antimalarial and antimicrobial activities of the leaves extract of this herb have been reported [68]. The effect of its leaves extract on ulcer formation and gastric secretion, as well as the haemato protective properties of *Eremomastax speciosa* ethanol leaves extract on a compensated haemolytic anemia induced by acute treatment with phenyl hydrazine have been proved [69, 70].This result justifies the traditional usage of this plant leaves to treat anemia related to malaria. In Cameroon, the leaves of the plant is used as adjunct in a mixture to prepare decoction against malaria, where it serves as blood supplement.

5.13 Aloe vera

The plant belongs to the genus Aloe, Aloeaceae family. It has been widely used by pharmaceutical and cosmetic industries, as well as traditional medicine by indigenous people to cure various ailments. The plant is native of Southern and eastern Africa, along the upper Nile in the Sudan, and it was subsequently introduced into Northern Africa and naturalized in the Mediterranean region and other countries across the Globe [29]. *Aloe vera* can resist even to extreme temperature, including in hot temperatures of 104°F and with stand in below freezing temperatures until root is not damaged [71]. This succulent perennial herb has triangular sessile stem, shallow root system, fleshy serrated leaves arranged in rosette having

30-50cm length and 10cm breath at the base; color pea-green [72]. This medicinal plant is used worldwide to treat many diseases, including malaria [73]. The antimalarial activity of the dilute latex obtained from *Aloe vera* may be due to the presence of anthroquinones and other quinoïd compounds which exert a good activity against *Plasmodium falciparum* [74]. In the Menoua division, this plant is commonly used to cure stomach pain, skin diseases, in the treatment against malaria, to lower sugar level in the blood, as well as a blood supplement.

Other uses of the plant include wound healing, anti-inflammatory action, antitumor, antidiabetic, antibacterial and antiviral activities [71].

5.14 Panax ginseng

Panax ginseng belongs to the Araliaceae family and is found throughout East Asia and Russia. It is one of the most used plants in the world. It grows natively in remote forest of Manchuria and North Korea, but has been over harvested in the other parts of Asia [75]. It is cultivated in Korea, China and Japan for export, and used as a medicinal herb. *Panax ginseng* is a shade-loving, deciduous perennial with five-fingered leaves, tiny white flowers, red berries, and a yellowish-brown root [75, 76]. The flowers are hermaphrodite (have both male and female organs).The root is used medically, although active compounds are present in all other parts of the plant. The root of *Panax ginseng* is a thick structure that resembles a human-like form, which is responsible for it name in Chinese, Jen Shen, or man root. Ginsenoside is the main component of it root, medically used. Growing time seriously impacts ginsenoside content, with roots from plants older than five years being more potent than those from one to two years old plants [75, 77]. There are many species of *Panax ginseng*, which lead to some confusion in the literature. However, the two species that have been extensively researched and used are *Panax ginseng* (Asian Ginseng) and *Panax quinquifolium* also known as American Ginseng. The Asian ginseng grows to about 0.7-0.8m, while American ginseng is smaller, and grows to about 0.4-0.5m at a low rate. In Cameroon, *Panax ginseng* grows in some mountains of west, North-West and South-West regions, and is well appreciated by the populations of those localities due to its medicinal virtues. Its roots are the main part used for this purpose. Decoction from roots are used against general body weakness, backache, to lower high blood pressure an high blood sugar level, to prevent cancer, to combat sexual weakness, against infertility, erectile dysfunction, menopause problems, anemia as well as in the treatment of malaria. The involvement of this plant in the cure of malaria is well documented. A study published in 2011 by Han *et al* revealed that protopanadiol-type ginsenoside component from *Panax ginseng* root have a remarkable suppressive activity during early infections, while acidic ginseng polysaccharides have significant prophylactic activity against malaria by stimulating immune system [*in vitro* antimalarial]. In Western Cameroon, fresh roots are crushed and boil with lemon, and the resulting filtrate is drunk a tea cup three times per day and during one week, in order to cure malaria.

Despite its multiple virtues caution is advised during pregnancy and lactation, due to the lack of controlled human clinical studies [77, 78].

5.15 Combretum micranthum

The plant, belonging to Combretaceae family is commonly known as kinkeliba. It is native to Western Africa, and is distributed from Senegal and Mauritania to Nigeria and Niger. This plant is also known in other countries of the continent, including Cameroon. It possesses many medicinal properties. Fruits and leaves are the plant parts mostly collected and used to prepare traditional medicines than the stem bark. This is to preserve the sustainable use of the plant. *Combretum micranthum* is used in traditional medicine for the treatment of wounds, and sores [79, 80], and fever (especially malaria fever), cough and bronchitis [81, 82]. Other virtues of this plant include antibacterial activity [83, 84], antifungal activity [85] and antiviral activity [86]. It has been scientifically proved that this plant is effective against malaria [87, 88]. *In vitro* research has proved that aqueous extract of leaves shows high antiplasmodial properties with an IC_{50} inferior to 5g/ml [89, 90] and against strains of *Plasmodium falciparum* resistant to chloroquine, at an IC_{50} lower than that of *Azadirachta indica* [91]. Alcohol extract of the leaf also exhibits a strong antimalarial property against strains of *Plasmodium falciparum* [92]. In Cameroon and in West region in particular, almost all preparation intended to heal malaria comprises *Combretum micranthum*. Some time, only its fruits and leaves are boiled and the filtrate is drunk to cure malaria. The herbal beverage is traditionally used for weight loss, digestion, as a diuretic and mild antibiotic, and to relieve pain.

5.16 Dacryodes Edulis

Dacryodes edulis belongs to the Burseraceae family. It is an evergreen tree attaining a height of 18-40m in the forest but not exceeding 12m in plantation [93].The plant can be cultivate widely, since it adapts well to differences in the duration of day light, temperature, rainfall, soils and altitudes. The plant is used in traditional medicine as remedy for parasitic skin diseases, jigger, mouth wash, tonsillitis, sickle cell and malaria [94, 95].

Phytochemical analysis of the leaves revealed the presence of phenolic compounds [96], and several compounds from this class have previously been shown as having antiplasmodial activity [97]. Denis Zofou *et al* isolated in 2013, 5 compounds from ethyl acetate and hexane extract of *Dacryodes edulis* stem bark. 2 of them showed high activity against multidrug-resistant Plasmodium with IC50 of 0.37 to 6.07ug/ml and 0.55 to 19.34ug/ml respectively. These findings justify traditional use of this plant to treat malaria.

In western Cameroon, leaves and bark of *Dacryodes edulis* are associated to *Citrus lemonum* and *Cymbopogon citratus*, and then boiled. The resulting liquid is drunk in order to cure malaria. Its leaves are also known in this part of the country to be effective against digestive disorders, toothache and earache. Its barks extract is equally used to cure dysentery and anemia.

5.17 Allium sativum

Allium sativum, commonly known as garlic, belongs to Alliaceae family. It is used as food and as medicine. The part mostly used is bulb. Garlic has been in use since ancient times in India and China for it valuable effect on the heart and circulation, cardiovascular diseases [98-100], and regular use of garlic may help to prevent cancer, to treat malaria and to raise immunity. Garlic has also been proposed to treat asthma, colds, diabetes, and antibacterial effect against food borne pathogen like salmonella, shigella and staphylococcus aureus are known [101]. Two compounds extracted from garlic including Ajoene and allicin were active against *Plasmodium berghei* in mice [102] and against *Plasmodium falciparum* [103] respectively. This validates the ethnobotanical use of these plants in the treatment of malaria. Abigot *et al* showed in 2006 that garlic is very effective against malaria [104].

In the Menoua Division, Garlic is crushed and mixed with

lemon cut into small pieces and allowed to ferment for 24h. The liquid resulting from this fermentation is taken twice per day to treat malaria. The same solution is said to be effective against diabetes, high blood pressure and bad cholesterol as well as to lose weight.

6. Discussion

Malaria remains the most killer disease in the tropic zone of the world, particularly of children and pregnant women. Measures to avoid mosquitoes bites such as the use of insect repellent, wearing long sleeves and long pants, staying indoors and use of flying insect spray or mosquitoes coils to clear rooms of mosquitoes and sleeping under bed-nets have been advised, but it has been very difficult to obtain decisive results with this measures. In the absence of a credible vaccine and with emergence of resistance to almost all antimalarial drugs, the dream of eradication of malaria appears to be a huge challenge [105]. Persistence of malaria symptoms after treatment with modern antimalarial drugs and lack of financial means have led to increase tendency towards the use of medicinal plants in the malaria therapy. Medicinal plants appear then to be a good source of remedies for the populations infected by plasmodium and for the discovery of novel drug. The use of plant as single recipe or a combination of 2, 3, 4, 5 or more of these herbs and plants is claimed to cure several ailments and dysfunctions in the body related to malaria. The use of plants to treat malaria in the western region of Cameroon has been earlier reported [93], and majority of the populations living there are still using them today. Almost all the plants mentioned in this ethnobotanical study have been previously reported by many authors to being involved in the malaria therapy, without any major side effect. More even, there are 8 of these plants which are effectively used as single recipe for the treatment of malaria. This includes *Allium stivum*, *Bidens pilosa*, *Carica papaja*, *Combretum micranthum*, *Dacryodes edulis*, *Enantia chloranta*, *Panax ginseng* And *Vernonia amygdalina*. This study justifies local claims on the efficacy of the plants and provides effective and naturally available remedies to cure malaria.

7. Conclusion

The high antimalarial and negligible adverse effects of the plants listed in this study make them ideal candidate for investigating new and more potent drugs. Therefore, their use for the treatment of malaria should be promoted and encouraged, mostly among the rural populations, but practice should be standardized and their side effects deeply studied.

8. Recommendations

We have done this study without benefit of any financial support or any grant. So, it has been very difficult for us to achieve it by our own resources. We are then seeking for some financial support, some grant or collaboration with other research laboratories dealing with medicinal plants, to study phytochemical components present in the main 8 plants, which are responsible for their antimalarial properties and later formulate a combination of 2 or 3 plants that might be advised to rural populations worldwide for their empowerment in the malaria therapy.

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