Review Article

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Potential antimalarials from African natural products: A reviw

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ABSTRACT

Malaria remains an overwhelming infectious disease with significant health challenges in African and other endemic countries globally. Resistance to antimalarial drugs has become one of the most momentous challenges to human health, and thus has necessitated the hunt for new and effective drugs. Consequently, few decades have witnessed a surfeit of research geared to validate the effectiveness of commonly used traditionally medicines against malaria fever. The present review work focuses on documenting natural products from African whose activity has been reported *in vivo* or *in vitro* against malaria parasite. Literature was collected using electronic search of published articles (Google Scholar, PubMed, Medline, Sciencedirect, and Science domain) that report on antiplasmodial activity of natural products from differernts Africa region. A total of 652 plant taxa from 146 families, 134 isolated antimalarial compounds from 39 plants species, 2 herbal formulations and 4 insect/products were found to be reported in literature from 1996 to 2015. Plants species from family Asteraceae (11.04%), Fababceae (8.128%), Euphorbiaceae (5.52%), Rubiaceas (5.52%), and Apocyanaceae (5.214%), have received more scientific validation than others. African natural products possess remarkable healing properties as revealed in the various citations as promising antimalarial agents. Some of these natural products from Africa demonstrate high, promising or low activities against *Plasmodium* parasite. This study also shows that natural products from Africa have a huge amount of novel antimalarial compounds that could serve as a leads for the development of new and effective antiplasmodial drugs. However, in a view of bridging the gap in knowledge, clinical validation of these natural products are of paramount importance.

KEY WORDS: Africa, insect, malarial, plants, plasmodial

INTRODUCTION

Malaria remains an overwhelming infectious disease with significant health challenges in African and other endemic countries globally. Over the last decade, prevalence of malaria has been increasing at an alarming rate, especially in third world countries. According to the rescent reports 3.3 billion peoples are at risk of contacting the infection of which 1.2 billion are at high risk. In 2013, an estimated 198 million cases of malaria with 755,000 deaths, 90% of which occur in Africa were documented [1]. According to Joy *et al*. [2], in Africa 3000 children die of malaria daily. Nigeria, the giant of Africa has been reported with the highest prevalence of malaria cases in African region, with all-year round transmission in the South, and more seasonal in the North [3]. About 60 million Nigerians, have malaria more than once in a year, with pregnant women and children (under 5 years) being more susceptible to the attack due to their low resistance and therefore constitute 92% of the prevalence [4].

The species of *Plasmodium vivax*, *Plasmodium ovale*, *Plasmodium Malariae*, and *Plasmodium falciparum* have been implicated in the etiology of the infection [5]. However, the control of these parasites using synthectic antimalarial drugs such as primaquine and chloroquine have been hindered by rapid parasite resistance to these drugs over the few decades [3]. The drug resistance developed by these parasites has therefore necessitated the hunt for more effectual antimalarial agents from natural products. In malaria endemic countries of the world, natural and traditional products (plants and insects/products) are commonly used arsenal to to combat malaria [6]. Therefore, there exists a brawny thought that if these natural products used by the traditional herbalists were not helpful, malaria would have shattered Africa long time ago [7]. Following an extensive survey of the literature, Willcox and Bodeker [8], documented over 160 families of plants with over 1200 species traditionally used for malaria treatment, some of which have been scientifically validated *in vitro* and/or *in vivo* for their claimed activity against the infection. Furthermore, conventional antimalarial drugs such as: Quinine and artemisinin were originated from plant extracts: *Cinchona calisaya* [9] and *Artemisia annua* [10], respectively. This has enthused many researchers especially in Africa to further intensify the search for antimalarial agents

from plant/insect compendium. Currently, the available review on anti-malarial agents focus only on Nigerian plants [11,12], alkaloids, and terpenoids only [5]. This paper has been presented to detail the efforts of African scientists toward finding more effective and cost efficient antimalarial agents from plants and insect (natural products). This will serve as an updated source for recent progress in the recognition of promising antimalaria agents. This paper will also motivate and served as point of reference for scientists, who are willing to work on the subject matter.

MATERIALS AND METHODS

Information for this study was obtained as described previously [11,13], using electronic search of published articles on Google Scholar, PubMed, Medline, Sciencedirect, Science domain. The search keywords include malaria, antimalarial, ethnobotany, African medicinal plants, natural product, antimalaria compounds, suppressive, curative, *in vitro*, *in vivo*, *P. falciparum*, and *P. berghei*. Informations documented on the natural products reviewed in here include the plant species, family, part of the plant used, extraction solvent, methods of antimalarial study (*in vivo/in vitro* or suppressive/curative), strain of the parasite tested, degree of activities and isolated compounds of African grown natural product from 1996 to 2015. Natural products whose level of antimalarial activities was not indicated by author, as well as that were reported outside African countries were completely excluded from this study.

RESULTS AND DISCUSSION

Figure 1 presented the regional distribution of African plants with antimalaria activities. A total of 652 plant species from 146 families and 4 insects/products were found. The activities of 558 plants were found to be reported *in vivo*, while 94 were reported *in vivo*. Plants species from family Asteraceae (11.04%), Fababceae (8.128%), Euphorbiaceae (5.52%), Rubiaceas (5.52%), Apocyanaceae (5.214%), Rutaceae (4.90%), Anonaceae (3.844%), Meliaceae (3.844%), Lamiaceae (3.52%), Combrataceae (2.76%), and Poaceae (2.60%) have received more scientific validation than others. About 36.80% of plants reviewed were grown in West Africa especially Nigeria, Bennin, 31.90% from South Africa, 13.03% from North Africa, 10.88% from Central Africa while 7.36% of the plants were grown from East Africa. The species, family, part use, extraction solvent, as well as inhibitory concentration 50% (IC_{50}) or minimal inhibitory concentration of *in vitro* assayed plant were presented in Tables 1-5. Datas on *in vivo* assayed plants were shown in Table 6. Phyto-chemistry studies of the anti-malarial plants led to the isolation of 134 specific antimalarial compounds from 39 plants species (Table 7).

For the purpose of this work and in accordance with WHO guidelines [14], antimalarial activity of plant extract reviewed in here was classified as highly active (IC_{50} < 5 μg/ml), promising activity (IC_{50} = 5-15 μg/ml), moderate activity (IC_{50} = 15-50 μg/ml), while extract with IC_{50} > 50 μg/ml were considered to be inactive. Furthermore, some authors presented their results

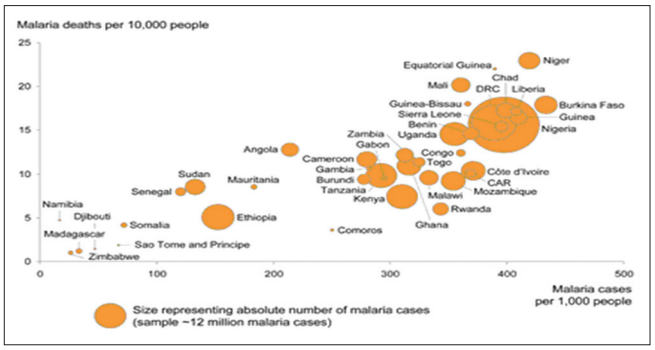

Figure 1: Malaria cases and death in Africa: Countries with negligible burden, such as Algeria, Botswana, Cape Verde, Egypt, Eritrea, Mayotte, Morroco, Swaziland, and South Africa, are not shown

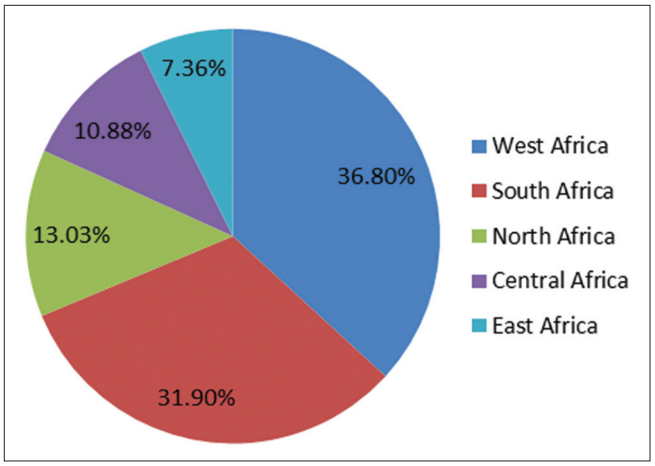

Figure 2: Regional distribution of African plant with potential antimalarial activities

in form of parasite inhibition at particular dose; however, degree of activities reported for such plants could not be classified.

Anti-malarial Activity of Plants from West Africa

Out of the total 170 plants species (53 family) found in West Africa, only 23 were highly active (IC_{50} < 5 μg/ml). The most outstanding activity were demonstrated by methanol stem barks extract of *Parkia biglobosa* (IC_{50} = 0.51 μg/ml) [15]. Ether leaf extract of the *Tithonia diversifola* (IC_{50} = 075 μg/ml) [16], aqueous (AQS) leaf extract of the *Nauclea latifolia* (IC_{50} = 0.60 μg/ml) [17], and *Guiera senegalensis* (IC_{50} = 0.79 μg/ml) [18]. The high antiplasmodial activities demonstrated by these plants render them a good candidate for the identification and isolation of anti-malarial compounds that could serve as a backbone for drug development [13]. A total of 27 plants species demonstrate promising activity (IC_{50} = 5-15 μg/ml), 55 plants species demonstrate moderate activity (IC_{50} = 15-50 μg/ml), while extract from remaining plant species were inactive (IC_{50} > 50 μg/ml).

It is generally known that the bioactive constituents of plant extracts varies with the solvent used in the extraction process [19,20]. These variations were observed in antimalarial activity of West Africa plant. For example dichloromethane

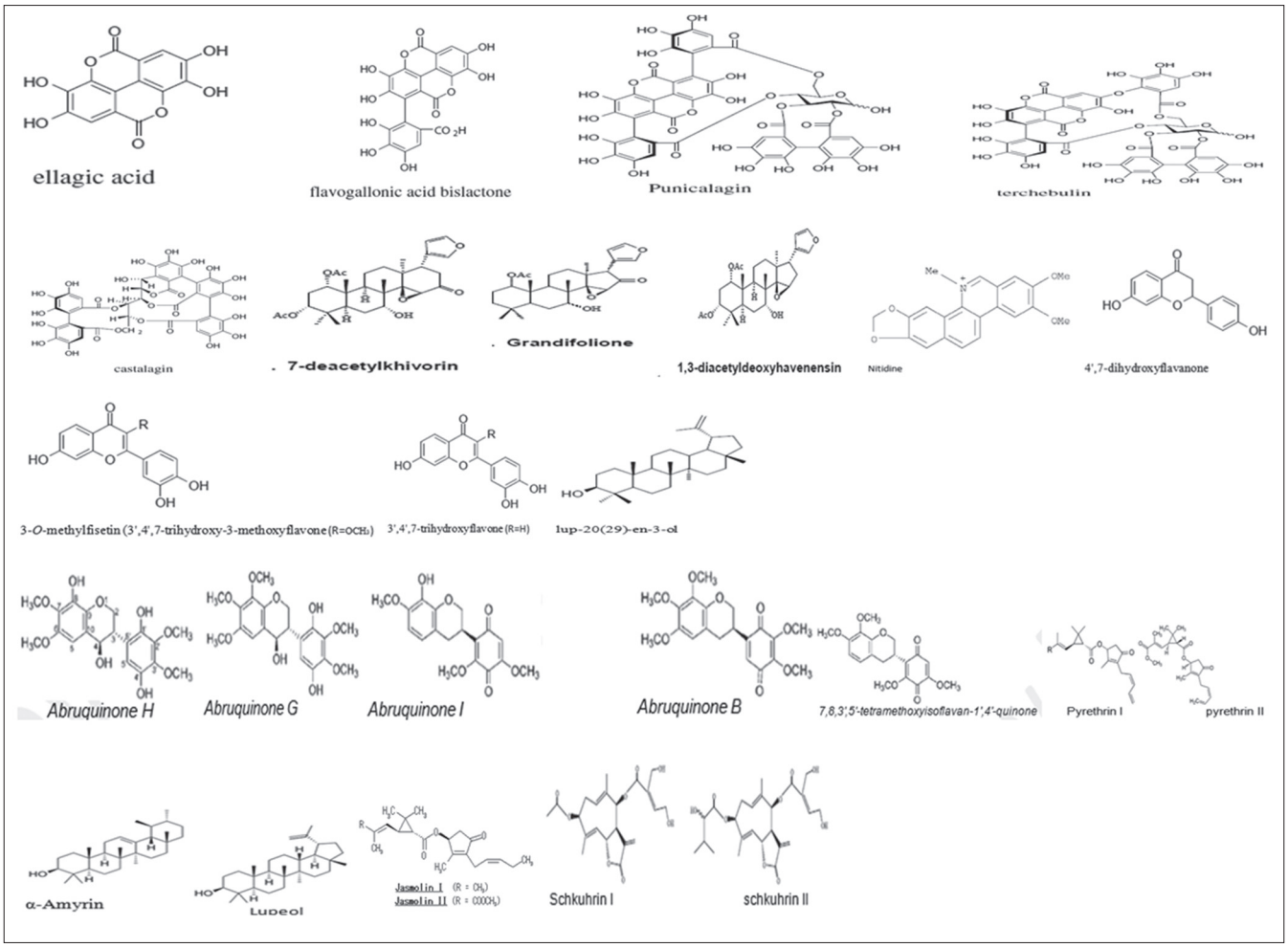

Figure 3: Structure of some antimalarial chemical compounds isolated from African plants

(DCM) extracts from leaf of *Celtis integrifolia* show promising activity (IC_{50} = 10.0) while the methanol and AQS extract were moderately active (IC_{50} = 30.2 and 38.4) against *Pfk1* [21]. DCM extract from aerial part of *Acanthospermum hispidum* show promising activity (IC_{50} = 7.5) while the methanol extract were completely inactive (IC_{50} = 55.6) against *P. f3D7* [22]. DCM extract from leaf of *Carica papaya* was highly active (IC_{50} = 2.6) while the aqueous extract was inactive [23]. The differences reported in antiplasmodial activities with variations in extraction solvent reflect the differences in the availability and concentration of bioactive agents in the extracts [13]. Although traditional healers commonly use water in preparing plants extract for medicinal application, it is surprising that most of the AQS plants extracts reported were either inactive poorly active. These poor activities could be explained by the fact that the AQS extracts were not prepared according to the traditional methods, which often involves boiling for several hours [24].

A total of 64 compounds from extracts of West African plants were reported for antiplasmodial activities. Alkaloids, flavonoids, quinines, terpenes, triterpenoids, polyphenols, and to a lesser extend sterols are the most common implicated phytochemicals in the extracts. Out of the 64 compounds isolated from West African plant 28 were highly active (IC_{50} < 5 μg/ml), 11 demonstrate promising activity (IC_{50} = 5-15 μg/ml), 4 shows moderate activity (IC_{50} = 15-50 μg/ml) while others were completely inactive *in vitro* against malaria parasites. The most interesting results were those of Simalikalactone D from leaf of *Quassia amara* [25], Samaderines B, X and Z from stem of *Quassia indica* [26], Picratidine and Picranitidine from seed of *Picralima nitida* [27], gedunin from leaf of *Azadiracta indica* [28], Fagaronine from roots of *Fagara zanthoxyloides* [29] and Ellagic acid from leaf of *Alchornea cordifolia* [30]. All these compounds excerpt high antiplasomodial activity with IC_{50} < 0.1 μg/ml.

Anti-malarial Activity of Plants from South Africa

Although literature survey revealed a very few researcher (working on antimalaria potency of indigenous plants) from South Africa, Quantitatively South African plants were the most *in vitro* investigated (198 plants from 59 families) plants from Africa. However, only 16 of the plant extracts from this region were highly active (IC_{50} < 5 μg/ml), 54 demonstrated promising activity (IC_{50} = 5-15 μg/ml), 39 demonstrate moderate activity (IC_{50} = 15-50 μg/ml), while others were inactive (IC_{50} > 50 μg/ml) *in vitro* against plasmodial parasite. Although AQS leave extract of *Vahlia capensis*, *Nicolasia*

Table 1: *In vitro* antimalarial activities of West African plants

Plant species	Family	Part use	Solvents	Parasite strain	IC_{50} (mg/ml)	Parasite inhibition	Country	References
Celtis integrifolia	Ulmaceae	Leaves	DCM/MeOH/ MeOH/AQS/AQS	*Pfk1*	10.0/30.2/ 20.7/38.4		B.Faso	Sanon *et al.* [21]
Opilia eltidifolia	Opiliaceae	Aerial part	AQS	*Pfk1*	83.176		Togo	Koffi *et al.* [31]
Abrus precatorius	Papillionaceae	Leaf	MeOH	*Pfk1*	53		Nigeria	Saganuwan *et al.* [32]
Acanthospermum hispidum	Asteraceae	Arial part and stem	DCM/MeOH/ AQS and eth	*P. f3D7 and Pf FcB1*	7.5/47.1/ 55.6 and 13.7		Benin/ I.Coast	Bero *et al.* [22]/ Zirihi *et al.* [33]
Adenia cissampeloides	Passifloraceae	Whole plant	EtOH	*pf3D7*	8.52		Ghana	Annan *et al.* [34]
Adenia rumicifolia	Passifloraceae	Leaf	MeOH	*pf K1*	>100		Ghana	Jonathan *et al.* [35]
Afzelia africana	Fabaceae	Leaf	MeOH	*3D7/K1*	31.55/39.72		Nigeria	Shuaibu *et al.* [36]
Albizia ferruginea	Fabaceae	Leaf	EtOH	*Pf FcB1*	>50		I.Coast	Zirihi *et al.* [33]
Alchornea cordifolia	Euphorbiaceae	Leaf	EtOH	*Pf FcB1*	>50		I.Coast	Zirihi *et al.* [33]
Alstonia boonei	Apocynaceae	Stem bark	EtOH	*Pf FcB1*	>50 ug/ 0.2 mg		I.Coast/ Nigeria	Zirihi *et al.* [33]/Bello *et al.* [37]
Alternanthera pungens	Amaranthaceae	Whole	EtOH	*Pf FcB1*	>50		I.Coast	Zirihi *et al.* [33]
Anacardium occidentale	Anacardiaceae	Back	AQS/Ethano	*Pf*		73% at 100/ 76 at 100	Nigeria	Sha'a *et al.* [38]
Anchomanes difformis	Araceae	Root	DCM/MeOH/ AQS	*P. f3D7*	>100/>100/ >100		Benin	Bero *et al.* [22]
Anogeissus leiocarpus	Combrataceae	Leaf	MeOH	*FcB1*	2.6		Nigeria	Okpako and Ajaiyeoba [39]
Anogeissus leiocarpus	Combretaceae	Stem bark	MeOH	*3D7/K1*	10.94/13.77		Nigeria	Shuaibu *et al.* [36]
Anthocleista djalonensis	Loganiaceae	Stem bark	EtOH	*FcB1*	>50		I.Coast	Zirihi *et al.* [33]
Anthocleista nobilis	Loganiaceae	Leaves	DCM/MeOH/ MeOH/AQS/AQS	*Pfk1*	1.8/2.5/ 12.5/13.1		Burkina Faso	Sanon *et al.* [21]
Anthonotha macrophylla	Caesalpiniaceae	Stem	EtOH	*Pf FcB1*	>50		I.Coast	Zirihi *et al.* [33]
Aspilia africana	Asteracae	Leaves	EtaC/AQS/ MeOH	*D10*	9.3/22.7/ 23.1		Nigeria	Waako *et al.* [40]
Azadirachta indica	Meliaceae	Leaves	Eth	*W2*	2.40		Nigeria	Benoit *et al.* [41]
Baillonella toxisperma	Sapotaceae	Barks	EtOH	*Pfk1*		99% at 9.6	Benin	Lagnika *et al.* [42]
Baillonella toxisperma	Sapotaceae	Barks	EtOH	*Pfk1*		99.2 at 9.6	Benin	Lagnika *et al.* [42]
Balanites aegyptiaca	Balanticeae	Leaves	MeOH	*pf*	24.56		Togo	Simplice *et al.* [43]
Bersama abyssinica	Melianthaceae	Leaf	EtOH	*Pf FcB1*	23.9		I.Coast	Zirihi *et al.* [33]
Bidens engleri	Asteraceae	Leaves	EtOH	*pf 3D7*	101		B.Faso	Traoré-Coulibaly *et al.* [44]
Boswellia dalzielii	Burceraceae	Leaves	EtOH/MeOH	*Pfk1/3D7*	14.59	62.2 at 9.6	Benin/ Nigeria	Lagnika *et al.* [42]/ Shuaibu *et al.* [36]
Byrsocarpus coccineus	Connaraceae	Arial part	DCM/MeOH/ AQS	*P. f3D7*	41.6/54.7/ >100		Benin	Bero *et al.* [22]
Caesalpinia bonduc	Caesalpiniaceae	Root	MeOH	>100	pf K1		Ghana	Jonathan *et al.* [35]
Carica papaya	Caricaceae	Leaves	Pet/DCM/ MeOH/AQS	*P. f*	16.4/2.6/ 10.8/>50		Nigeria	Melariri *et al.* [23]
Carpolobia lutea	Polygalaceae	Arial part	DCM/MeOH/ AQS	*P. f3D7*	19.4/85.4/ >100		Benin	Bero *et al.* [22]
Cassia alata	Caesalpiniaceae	Leaf	EtOH	*Pf FcB1*	>50		I.Coast	Zirihi *et al.* [33]
Cassia arereh Del	Fabaceae	Leaves	Chloroform	*K562S*	12.5		Sudan	Hager *et al.* [45]
Cassia occidentalis	Caesalpiniaceae	Leaf	EtOH	*Pf FcB1*	36.9		I.Coast	Zirihi *et al.* [33]
Cassia occidentalis	Fabaceae	Root	MeOH	*pf K1*	>100		Ghana	Jonathan *et al.* [35]
Cassia podocarpa	Ceasalpiniaceae	Leaves	EtOH	*pf 3D7*	22		B. Faso	Traoré-Coulibaly *et al.* [44]
Cassia sieberiana	Fabaceae	Leaf	MeOH	*3D7/K1*	>200		Nigeria	Shuaibu *et al.* [36]
Cassia singueana	Fabaceae	Leaf	Eth/chl/ethyl	*Pfk1*		82.1/96.4/ 85.7 at 500	Nigeria	Saidu *et al.* [47]
Cissus populnea	Amplidaceae	Leaf	MeOH	*Pfk1*	19.91		Nigeria	Shuaibu *et al.* [36]
Cissus quadrangulari	Vitaceae	Whole plant	DCM/MeOH	*Pfk1*	23.9/52.8		Mali	Bah *et al.* [48]
Citrus aurantifolia	Rutaceae	Leaf	MeOH	>100	pf K1		Ghana	Jonathan *et al.* [35]
Citrus limon	Rutaceae	Leaves	Pet/DCM/MeOH/ AQS	*P.fk1*	37.2/5.0/ >50/12.0>50		Nigeria	Melariri *et al.* [23]
Cleistopholis patens	Annonaceae	Leaf	MeOH	*pf K1*	8.7		Ghana	Jonathan *et al.* [35]
Cnestis ferruginia	Connaraceae	Root	MeOH	*pf K1*	>100		Ghana	Jonathan *et al.* [35]
Cocoa	-	Powder	MeOH	*Pfk1*	1.6103		Ghana	Amponsah *et al.* [49]
Cocos nucifera	Arecaceae	Seed	Hex	*W2*	10.6		Nigeria	Adebayo *et al.* [50]
Combretum collinum	Combretaceae	Bark	DCM/MeOH/ MeOH/AQS/AQS	*Pfk1*	3.6/4.5/ 7.4/6.8		B. Faso	Sanon *et al.* [21]
Combretum glutinosum	Combretaceae	Leaves	MeOH/hydroMeOH	*W2*	53/43.6		B. Faso	Ouattara *et al.* [51]

(Cond..)

Table 1: *(Continued...)*

Plant species	Family	Part use	Solvents	Parasite strain	IC_{50} (mg/ml)	Parasite inhibition	Country	References
Combretum molle Hyptis spicigera	Combretaceae	Leaves	Eth	*pf 3D7*	25		B. Faso	Traoré-Coulibaly *et al.* [44]
Combretum sericeum	Combretaceae	Leaves	AQS/eth/DCM	*pf 3D7*	68/>100/9		B. Faso	Traoré-Coulibaly *et al.* [44]
Commiphora kerstingii	Burseraceae	Leaf	Eth/chl/ethyl	*Pfk1*	64.3/75/82.1		Nigeria	Saidu *et al.* [47]
Crataeva religiosa	Capparidaceae	Leaf	MeOHhylene chloride/ Cyclohexane	*Pfk1*		88% at 9.6/ 87.7 at 9.6	Benin	Lagnika *et al.* [42]
Cucumis MeOHuliferus	Curcurbitaceae	Leaves	EtOH	*pf 3D7*	>100		B. Faso	Traoré-Coulibaly *et al.* [44]
Cymbopogon citratus	Poaceae	Leaves	Pet/DCM/MeOH/ AQS	*pf*	9.1/7.6/12.1/ 15.9/>50		Nigeria	Melariri *et al.* [23]
Cymbopogon citratus	Poaceae	Leaves	Essential oil	*P. f3D7*	47.92		Benin	Kpoviessi *et al.* [52]
Cymbopogon giganteus	Poaceae	Leaves	Essential oil	*P. f3D7*	11.22		Benin	Kpoviessi *et al.* [52]
Cymbopogon nardus	Poaceae	Leaves	Essential oil	*P. f3D7*	52.61		Benin	Kpoviessi *et al.* [52]
Cymbopogon schoenantus	Poaceae	Leaves	Essential oil	*P. f3D7*	43.15		Benin	Kpoviessi *et al.* [52]
Daniellia oliveri	Fabaceae	Leaves	MeOH	*3D7/K1*	23.14/32.97		Nigeria	Shuaibu *et al.* [36]
Desmodium velutinum	Fabaceae	Leaves	AQS/eth/DCM	*pf 3D7*	>100/35/9		B.Faso	Traoré-Coulibaly *et al.* [44]
Dialium guineense	Leguminosae	Arial part	DCM/MeOH/ AQS	*P. f3D7*	42.1/>100/ 65.5		Benin	Bero *et al.* [22]
Elaeis guineensis	Palmaceae	leaf	EtOH	*pf3D7*	1.195		Ghana	Annan *et al.* [34]
Entada africana	Fabaceae	Leaves	MeOH	*pf*	>100		Togo	Simplice *et al.* [43]
Erigeron floribundus	Asteracea	Stem and leaf	EtOH	*Pf FcB1*	36.9		I.Coast	Zirihi *et al.* [33]
Erythrina senegalensis	Fabaceae	-	MeOH	*3D7/K1*	199.0/153		Nigeria	Shuaibu *et al.* [36]
Erythrina senegalensis	Fabaceae	Leaf	Eth	*K1*	1.82		I.Coast	Kamanzi *et al.* [53]
Euphorbia hirta	Euphorbiaceae	Whole plant	Ethyl/MeOH	*Pfk1*	25.04/2.45		Nigeria	Oyindamola *et al.* [54]
Euphorbia hirta	Euphorbiaceae	Whole plant	EtOH	*Pf FcB1*	44.7		I.Coast	Zirihi *et al.* [33]
Fagara macrophylla	Rutaceae	Stem bark	EtOH	*Pf FcB1*	2.3		I.Coast	Zirihi *et al.* [33]
Fagara zanthoxyloides	Rutaceae	Leaf	AQS	*3D7*	4.90		Nigeria	Kassim *et al.* [29]
Ficus capensis	Moraceae	Leaf	EtOH	*Pf FcB1*	4.53		I.Coast	Zirihi *et al.* [33]
Ficus capraefolia	Moraceae	Leaves	DCM/MeOH/ MeOH/AQS/AQS	*Pfk1*	0.2/11.2/ 2.1/38.4		B.Faso	Sanon *et al.*
Ficus platyhylla	Moraceae	Leaf	MeOH	*3D7/K1*	15.28/13.77		Nigeria	Shuaibu *et al.* [36]
Ficus thonningii	Moraceae	Leaf	MeOH	*3D7/K1*	14.09/25.06		Nigeria	Shuaibu *et al.* [36]
Ficus thonningii	Moraceae	Leaf	MeOH/hex/eth	*Pf*	21.1/10.4/15.3		Nigeri	Falade *et al.*, 2014
Funtumia elastica	Apocynaceae	Stem bark	EtOH	*Pf FcB1*	3.3		I.Coast	Zirihi *et al.* [33]
Guiera senegalensis	Combrataceae	Leaf	AQS	*FcB1*	0.79		Nigeria	Ancolio *et al.* [18]
Harungana madagascariensis	Hypericaceae	Stem bark	MeOH/eth	*K1/P. y*	3.6/0.052		Nigeria	Ndjakou Lenta *et al.* [82]/ Iwalewa *et al.*, 2008
Heliotropium indicum	Boraginaceae	Arial part	DCM/MeOH/ AQS	*P. f3D7*	>100/>100/ >100		Benin	Bero *et al.* [22]
Hyptis spicigera	Lamiaceae	Leaves	OH	*pf 3D7*	Imactive		B.Faso	Traoré-Coulibaly *et al.* [44]
Irvingia gabonensis	Simaroubaceae	Stem bark	EtOH	*Pf FcB1*	2.16		I.Coast	Zirihi *et al.* [33]
Jatropha curcas	Euphorbiaceae	Leaf	Ethyl/MeOH	*Pfk1*	2.39/11.53		Nigeria	Oyindamola *et al.* [54]
Jatropha tanjorensis	Euphorbiaceae	Leaf	EtOH/AQS/ hydro etha	*Pfk1*	10.86/4.4/48.0		Nigeria	Omoregie and Sisodia (2012)
Keetia leucantha	Rubiaceae	Leaf/twig	DCM/MeOH/ AQS	*P. f3D7*	13.8/>100/ >100		Benin	Bero *et al.* [22]
Keetialeucantha	Rubiaceae	Twigs	DCM/AQS	*P. f3D7*	11.3/>100		Benin	Bero *et al.* [103]
Khaya grandifoliola	Maliaceae	Stem	MeOH–MeOHhylene chloride	*W2*	13.23		Nigeria	Bickii *et al.* (2000)
Khaya senegalensis	Maliaceae	Stem	MeOH	*3D7/K1*	28.12/15.46		Nigeria	Shuaibu *et al.* [36]
Khaya senegalensis	Meliaceae	Entire plant	Diethyl ether	*Pfk1*	-	98% at 9.6	Benin	Lagnika *et al.* [42]
Khaya senegalensis	Meliacea	Leaf	Eth/chl/ethyl	*Pfk1*	-	75/82/82 at 500	Nigeria	Saidu *et al.* [47]
Khaya senegalensis	Meliacea	Leaf	MeOH	*3D7*	>50		Nigeria	El Tahir *et al.* (1999)
Khaya senegalensis	Meliaceae	Entire plant	Cyclohexane	*Pfk1*	-	86.3 at 9.6	Benin	Lagnika *et al.* [42]
Lonchocarpus cyanescens	Fabaceae	Leaf	MeOH	*3D7/K1*	52.56/75.46		Nigeria	Shuaibu *et al.* [36]
Lophira alata	Ochnaceae	Leaf	MeOH/hex/eth	*Pfk1*	5.3/2.5/59.4		Nigeri	Falade *et al.*, 2014

(Cond..)

Table 1: *(Continued...)*

Plant species	Family	Part use	Solvents	Parasite strain	IC_{50} (mg/ml)	Parasite inhibition	Country	References
Lophira lanceolata	Ochnaceae	Bark	DCM/MeOH/ MeOH/AQS/AQS	*Pfk1*	5.5/9.8/ 14.7/4.7		B.Faso	Sanon *et al.* [21]
Mangifera indica	Anacardiaceae	Stem bark	EtOH	*Pf FcB1*	>50		I.Coast	Zirihi *et al.* [33]
Mareya micrantha	Euphorbiaceae	Stem	EtOH	*Pf FcB1*	27.6		I.Coast	Zirihi *et al.* [33]
Melanthera scandens	Asteracea	Whole	EtOH	*Pf FcB1*	>50		I.Coast	Zirihi *et al.* [33]
Microdesmis keayana	Pandaceae	Leaf	EtOH	*Pf FcB1*	>50		I.Coast	Zirihi *et al.* [33]
Microglossa pyrifolia	Asteracea	Stem and leaf	EtOH	*Pf FcB1*	33.1		Ivory Coast	Zirihi *et al.* [33]
Millettia zechiana	Fabaceae	Stem	EtOH	*Pf FcB1*	16.1		I.Coast	Zirihi *et al.* [33]
Mitragyana stipolosa	Rubiaceae	Leaf	MeOH	*3D7/K1*	>200		Nigeria	Shuaibu *et al.* [36]
Momordica balsamina	Cucurbitaceae	Leaf	MeOH	*3D7/K1*	199.0/250.55		Nigeria	Shuaibu *et al.* [36]
Momordica cissoides	Cucurbitaceae	Whole	MeOH	*pf K1*	>100		Ghana	Jonathan *et al.* [35]
Morinda lucida	Rubiaceae	Leaf	MeOH/MeOHcl/ pet ether	-	5.70/5.2/3.9		Nigeria	Cimanga *et al.* [55]
Morinda morindoides	Rubiaceae	Leaf	EtOH	11.6	Pf FcB1		I.Coast	Zirihi *et al.* [33]
Morinda morindoides	Cucurbitaceae	Root	MeOH	>100	pf K1		Ghana	Jonathan *et al.* [35]
Moringa oleifera	Moringaceae	Leaf	MeOH	*3D7/K1*	>200		Nigeria	Shuaibu *et al.* [36]
Nauclea latifolia	Rubiaceae		AQS	*(FcB1)*	0.60		Nigeria	Benoit-Vical *et al.* [17],
Nauclea latifolia	Rubiaceae	Bark	EtOH	*Pf FcB1*	8.9		I.Coast	Zirihi *et al.* [33]
Ocimum gratissimum	Labiatae	Leaf	Ethyl/MeOH	*Pfk1*	1.84/22.52		Nigeria	Oyindamola *et al.* [54]
Ocimum gratissimum	Lamiilaceae	Ariael/Leaf/ stem	Oil/eth	*Pfk1*	55/41/45		Benin	Kpoviessi *et al.* [52]
Oncoba spinosa	Flacourtiaceae	Seed	MeOH	*Pfk1*	>100		Ghana	Jonathan *et al.* [35]
Opilia celtidifolia	Opiliaceae	Leaves	DCM/MeOH/ MeOH/AQS/AQS	*Pfk1*	2.8/16.2/ 61.2/15.1		B.Faso	Sanon *et al.* [21]
Opilia celtidifolia	Opiliaceae	Aerial part	AQS	*Pfk1*	83.176		Togo	Koudouvo *et al.* [31]
Opilia celtidifolia	Opiliaceae	Roots	AQS/DCM	>100/<11	pf 3D7		Burkina Faso	Traoré-Coulibaly *et al.* [44]
Parinari curatellifolia	Chrysobalanceae	Leaves	MeOH	*pf*	>100		Togo	Simplice *et al.* [43]
Parkia biglobosa	Leguminosae	Stem barks	MeOH	*pf*	0.51		Nigeria	Modupe *et al.* [15]
Parquetina nigrescens	Asclepiadaceae	Leaf	EtOH	*Pf FcB1*	21.2		I.Coast	Zirihi *et al.* [33]
Pavetta corymbosa	Rubiaceae	Aerial part	MeOH/AQS	*Pf*	2.041/6.025		Togo	Koudouvo *et al.* [31]
Phyllanthus amarus	Euphorbiaceae	Leaf	Ethyl/MeOH	*Pfk1*	5.62/22.32		Nigeria	Oyindamola *et al.* [54]
Phyllanthus muellerianus	Euphorbiaceae	Leaf	EtOH	*Pf FcB1*	9.4		I.Coast	Zirihi *et al.* [33]
Physalis angulata	Olanaceae	Whole	EtOH	*Pf FcB1*	7.9		I.Coast	Zirihi *et al.* [33]
Picralima nitida	Apocynaceae	Roots, stem bark/fruit	MeOH	0.188/0.545/ 1.581	Pfk1		I.Coast	Francois *et al.* [56]
Piliostigma thonningii	Leguminosae	Leaf	Ethyl/MeOH	*Pfk1*	3.56/38.86		Nigeria	Oyindamola *et al.* [54]
Pleiocarpa mutica	Apocynaceae	Root	MeOH	*Pfk1*	16.7		Ghana	Jonathan *et al.* [35]
Prosopis africana	Leguminaceae	Leaf	MeOH	*3D7/K1*	14.97/15.2		Nigeria	Shuaibu *et al.* [36]
Psidium guajava	Myrtaceae	Leaves	Pet/DCM/MeOH/ AQS	*Pfk1*	15.5/6.0/21.6/ >50/>50		Nigeria	Melariri *et al.* [23]
Pupalia lappacea	Amaranthaceae	Arial part	DCM/MeOH/ AQS	*P. f3D7*	50.29/>100/ >100		Benin	Bero *et al.* [22]
Pycnanthus angolensis	Myristicaceae	Stem bark	EtOH	*Pf FcB1*	18.2		I.Coast	Zirihi *et al.* [33]
Quassia amara	Simaroubaceae	Leaf	AQS	*FcB1*	8.90		Nigeria	Bertani *et al.* [57]
Rauvolfia vomitoria	Apocynaceae	Root bark	EtOH	*Pf FcB1*	2.5		I.Coast	Zirihi *et al.* [33]
Rhigiocarya racemifera	Menispermaceae	Leaf	EtOH	*Pf FcB1*	>50		I.Coast	Zirihi *et al.* [33]
Rothmania longiflora	Rubiaceae	Stem	MeOH	*pf K1*	>100		Ghana	Jonathan *et al.* [35]
Rourea coccinea	Connaraceae	Arial part	DCM/MeOH	*Pf3D7*	41.6/54.7		Benin	Bero *et al.* [22]
Sansevieria liberica	Dracaenaceae	Arial part	DCM/MeOH/ AQS	*P. f3D7*	44.5/>100/ >100		Benin	Bero *et al.* [22]
Schrankia leptocarpa	Mimosaceae	Leaf/twig	DCM/MeOH/ AQS	*P. f3D7*	34.3/>100/ >100		Benin	Bero *et al.* [22]
Securidaca longipedunculata	Polygalaceae	Leaf	DCM	*P. f3D7*	6.9		Mali	Bah *et al.* [48]
Securinega virosa	Euphorbiaceae	Leaves	DCM/MeOH/ MeOH/AQS/AQS	*Pfk1*	P. f3D7		B.Faso	Sanon *et al.* [21]
Sida acuta	Malvaceae	Leaves	EtOH/H20	*FcM29*	3.90/0.92		Nigeria	Banzouzi *et al.* [58]
Solanum indicum	Olanaceae	Fruit	EtOH	*Pf FcB1*	41.3		I.Coast	Zirihi *et al.* [33]
Solanum nigrum	Olanaceae	Fruit	EtOH	*Pf FcB1*	>50		I.Coast	Zirihi *et al.* [33]
Striga hermonthica	Orobanchaceae	Whole pla	MeOH	*Pfk1*	274.8		Nigeria	Okpako and Ajaiyeoba, [39]
Strychnos spinosa	Loganiaceae	Leaf	DCM/MeOH/ AQS	*P. f3D7*	15.6/>100/ >100		Benin	Bero *et al.* [22]

(Cond..)

Table 1: *(Continued...)*

Plant species	Family	Part use	Solvents	Parasite strain	IC_{50} (mg/ml)	Parasite inhibition	Country	References
Strychnos spinosa	Loganiaceae	Stem bark	EtOH	21.8	Pf FcB1		I.Coast	Guede *et al.* [33]
Stylosanthes erecta	Fabaceae	Aerial parts	DCM/MeOH	*Pfk1*	21.9/23.3		Mali	Bah *et al.* [48]
Swartzia madagascariensis	Leguminosae	Roots bark	AQS, MeOH, hydroMeOH	*W2*	50.6/60.5/ 15.5		B.Faso	Ouattara *et al.* [51]
Tamarindus indica	Caesalpiniaceae	Fruit	AQS/MeOH	*Pfk1*	4.786/55.544		Togo	Koudouvo *et al.* [31]
Tapinanthus dodoneifolius	Euphorbiaceae	Leaves	DCM/MeOH/ MeOH/AQS/AQS	*Pfk1*	6.5/5.2/ 20.6/43.7		Burkina Faso	Sanon *et al.* [21]
Tapinanthus sessilifolius	Lorantheciae	Leaves	MeOH	*Pfk1*	200.5		Nigeria	Okpako and Ajaiyeoba [39]
Terminalia avicennioides	Combretaceae	Leaves	DCM/MeOH/ MeOH/AQS/AQS	*Pfk1*	1.6/1.9/ 5.4/2.6		B.Faso	Sanon *et al.* [21]
Terminalia avicennoides	Combretaceae	Stem bark	MeOH	*3D7/K1*	12.28/14.09		Nigeria	Shuaibu *et al.* [36]
Terminalia catappa	Combretaceae	Leaf	Ethyl/MeOH	*Pfk1*	3.05/7.42		Nigeria	Oyindamola *et al.* [54]
Terminalia ivorensis	Combretaceae	Stem bark	EtOH	*pf3D7*	6.949		Ghana	Annan *et al.* [34]
Tinospora bakis	Menispermaceae	Roots	AQS	*W2*	59.8		B.Faso	Ouattara *et al.* [51]
Tithonia diversifola	Asteraceae	Leaves	Ether	*FCA*	0.75		Nigeria	Goffin *et al.* [16]
Trema orientalis	Ulmaceae	Leaf	Ethyl/MeOH	*Pfk1*	1.99/6.79		Nigeria	Oyindamola *et al.* [54]
Trichilia emethanolica	Meliaceae	Leaf	DCM/MeOH/ AQS	*P. f3D7*	59.2>100 >100		Benin	Bero *et al.* [22]
Trichilia emthenolica	Meliaceae	Leaves	DCM/MeOH	*Pfk1*	11.9/47.6		Mali	Bah *et al.* [48]
Turreae heterophylla	Meliaceae	Root	MeOH	*pf K1*	>100		Ghana	Jonathan *et al.* [35]
Uvaria chamae	Annonaceae	Twig	MeOH	*Pfk1*	21.6		Ghana	Jonathan *et al.* [35]
Vernonia amygdalina	Asteraceae	Leaves	Pet/DCM/MeOH/ AQS	*Pfk1*	14.2/4.1/10.7/ >50/>50		Nigeria	Melariri *et al.* [23]
Vernonia colorata	Compositae	Stem	MeOH	*Pfk1*	>100		Ghana	Jonathan *et al.* [35]
Vitex doniana	Verbenaceae	Stem bark	Ethyl/MeOH	*Pfk1*	3.87/34.17		Nigeria	Oyindamola *et al.* [54]

DCM: Dichloromethane, MeOH: Methanol, EtOH: Ethanol, HO: Hydroxide, AQS: Aqueous, pf: *Plasmodium falciparum*, IC_{50}: Inhibitory concentration 50%

Table 2: *In vitro* antimalarial activities of South African plants

Plant species	Family	Part use	Solvents	Parasite	IC_{50} (μg/ml) P. inhibition	Country	References
Abrus precatorius	Fabaceae	Whole	DCM/MeOH (1:1)	*Pf NF*	3.99	S. Africa	Makoka *et al.* [62]
Acacia erioloba	Fabaceae	Root	DCM/MeOH (1:1)	*Pf NF*	10.7	S. Africa	Makoka *et al.* [62]
Acacia nilotica	Fabaceae	Twig	DCM/MeOH (1:1)	*P. f D10*	13	S. Africa	Clakson *et al.* [24]
Acacia tortilis	Fabaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	4.8	S. Africa	Clakson *et al.* [24]
Achyranthes aspera	Amaranthaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	9.9	S. Africa	Clakson *et al.* [24]
Agathosma apiculata	Rutaceae	Whole plant	DCM/MeOH (1:1)	*Pfk1*	0.209	S. Africa	Makoka *et al.* [63]
Agathosma puberula	Rutaceae	Root	DCM	*P. f D10*	33	S. Africa	Clakson *et al.* [24]
Agathosma puberula	Rutaceae	Roots	DCM	*Pfk1*	8.35	S. Africa	Makoka *et al.* [63]
Ageratum conyzoides	Asphodelaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	27	S. Africa	Clakson *et al.* [24]
Albizia versicolor	Fabaceae	Root	DCM	*2 Pf-NF54*	2.12	S. Africa	Bapela *et al.* [64]
Alepidea amatymbica	Apiaceae	Whole	DCM/MeOH (1:1)	*P. f D10*	12.5	S. Africa	Clakson *et al.* [24]
Alepidea amatymbica	Apiaceae	whole plant	DCM/MeOH (1:1)	*Pfk1*	3.7	S. Africa	Makoka *et al.* [63]
Aloe ferox	Asphodelaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	8	S. Africa	Clakson *et al.* [24]
Aloe maculata	Asphodelaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	12.4	S. Africa	Clakson *et al.* [24]
Aloe marlothii	Asphodelaceae	Leaf	DCM	*P. f D10*	74	S. Africa	Clakson *et al.* [24]
Annona senegalensis	Annonaceae	leaf	DCM/MeOH (1:1)	*P. f D10*	35	S. Africa	Clakson *et al.* [24]
Anthocleista grandiflora	Gentianaceae	Leaves	DCM	*P. f D10*	>100	S. Africa	Clakson *et al.* [24]
Anthocleista grandiflora	Loganiaceae	Stem bark	DCM	*Pf-NF54*	8.69	S. Africa	Bapela *et al.* [64]
Artabotrys brachypetalus	Annonaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	>100	S. Africa	Clakson *et al.* [24]
Artabotrys monteiroae	Annonaceae	Twigs	DCM/MeOH (1:1)	*P. f D10*	8.7	S. Africa	Clakson *et al.* [24]
Artabotrys monteiroae	Annonaceae	leaves	DCM/MeOH (1:1)	*Pfk1*	8.79	S. Africa	Makoka *et al.* [63]
Artemisia afra	Asteraceae	Leaf	DCM	*P. f D10*	5	S. Africa	Clakson *et al.* [24]
Artemisia afra	Asteraceae	leaves	DCM/MeOH	*Pfk1*	6.22/13.3	S. Africa	Makoka *et al.* [63]
Asparagus virgatus	Asparagaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	8	S. Africa	Clakson *et al.* [24]
Asystasia gangetica	Acanthaceae	Twigs	DCM/MeOH (1:1)	*P. f D10*	16	S. Africa	Clakson *et al.* [24]
Asystasia gangetica	acanthaceae	leaves	DCM/MeOH (1:1)	*4 Pfk1*	4.2	S. Africa	Makoka *et al.* [63]
Barringtonia racemosa	Lecythidaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	18	S. Africa	Clakson *et al.* [24]
Berula erecta	Apiaceae	Whole	DCM/MeOH (1:1)	*P. f D10*	6.6	S. Africa	Clakson *et al.* [24]
Bidens pilosa	Asteraceae	Leaf	DCM	*P. f D10*	8.5	S. Africa	Clakson *et al.* [24]
Bridelia micrantha	Euphorbiaceae	Twig	DCM/MeOH (1:1)	*P. f D10*	59.3	S. Africa	Clakson *et al.* [24]
Bridelia mollis	Phyllanthaceae	Roots	DCM	*Pf-NF54*	3.06	S. Africa	Bapela *et al.* [64]
Bruguiera gymnorhiza	Rhizophoraceae	Twigs	DCM/MeOH (1:1)/AQS	*P. f D10*	11.7/>100	S. Africa	Clakson *et al.* [24]
Burchellia bubaline	Rubiaceae	Twigs	DCM/MeOH (1:1)	*P. f D10*	18	S. Africa	Clakson *et al.* [24]

(Cond..)

Table 2: *(Continued...)*

Plant species	Family	Part use	Solvents	Parasite	IC_{50} (μg/ml)	P. inhibition	Country	References
Capparis tomentosa	Capparaceae	leaf	DCM	*P. f D10*	65		S. Africa	Clakson *et al.* [24]
Capparis tomentosa	Capparidaceae	Root	DCM	*Pf-NF54*	2.19		S. Africa	Bapela *et al.* [64]
Cardiospermum halicacabum	Sapindaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	20		S. Africa	Clakson *et al.* [24]
Carissa edulis	Apocynaceae	Stem	DCM	*P. f D10*	33		S. Africa	Clakson *et al.* [24]
Catha eduli	Celastraceae	Seed	DCM/DCM/MeOH (1:1)	*P. f D10*	10/46		S. Africa	Clakson *et al.* [24]
Catha edulis	Celastraceae	Root	DCM	*Pfk1*	4.91		S. Africa	Makoka *et al.* [63]
Centella asiatica	Apiaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	8.3		S. Africa	Clakson *et al.* [24]
Cephalanthus natalensis	Rubiaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	24.3		S. Africa	Clakson *et al.* [24]
Clausena anisata	Rutaceae	Twig	DCM/MeOH (1:1)	*P. f D10*	88		S. Africa	Clakson *et al.* [24]
Clausena anisata	Rutaceae	Roots	DCM/MeOH (1:1)	*Pf NF*	3.61		S. Africa	Makoka *et al.* [62]
Clematis brachiata	Ranunculaceae	Leaves/stems/ flowers	DCM/MeOH (1:1)	*P. f D10*	20		S. Africa	Clakson *et al.* [24]
Clematis brachiata	Ranunculaceae	Roots	DCM	*Pf-NF54*	5.36		S. Africa	Bapela *et al.* [64]
Clerodendrum glabrum	Verbenaceae	twigs	DCM/MeOH (1:1)	*P. f D10*	19		S. Africa	Clakson *et al.* [24]
Clerodendrum glabrum	Verbenaceae	leaves	DCM	*Pf-NF54*	8.89		S. Africa	Bapela *et al.* [64]
Clutia hirsuta	Euphorbiaceae	Whole plant	DCM	*P. f D10*	15		S. Africa	Clakson *et al.* [24]
Clutia pulchella	Euphorbiaceae	Root	DCM/MeOH (1:1)	*Pf NF*	3.19		S. Africa	Makoka *et al.* [62]
Combretum zeyheri	Combretaceae	Twigs	DCM/MeOH (1:1)	*P. f D10*	15		S. Africa	Clakson *et al.* [24]
Conyza albida	Asteraceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	2		S. Africa	Clakson *et al.* [24]
Conyza albida	Asteraceae	whole plant	DCM/MeOH (1:1)	*Pfk1*	5.79		S. Africa	Makoka *et al.* [63]
Conyza podocephala	Asteraceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	6.8		S. Africa	Clakson *et al.* [24]
Conyza podocephala	Asteraceae	whole plant	DCM/MeOH (1:1)	*Pfk1*	5.45		S. Africa	Makoka *et al.* [63]
Conyza scabrida	Asteraceae	Flower	DCM/MeOH (1:1)	*P. f D10*	7.8		S. Africa	Clakson *et al.* [24]
Conyza scabrida	Asteraceae	Leaves	DCM/MeOH (1:1)	*Pfk1*	6.66		S. Africa	Makoka *et al.*[63]
Crinum macowanii	Amaryllidaceae	Bulbs	DCM/MeOH (1:1)	*P. f D10*	26		S. Africa	Clakson *et al.* [24]
Crotalaria burkeana	Fabaceae	Leafs	DCM	*P. f D10*	30		S. Africa	Clakson *et al.* [24]
Croton gratissimus	Euphorbiaceae	Leaf	DCM	*P. f D10*	3.5		S. Africa	Clakson *et al.* [24]
Croton menyhartii	Euphorbiaceae	Leaves	DCM/MeOH (1:1)	*Pfk1*	2.63		S. Africa	Makoka *et al.* [63]
Croton menyhartii Pax	Euphorbiaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	1.7		S. Africa	Clakson *et al.* [24]
Momordica balsamina	Cucurbitaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	18		S. Africa	Clakson *et al.* [24]
Cussonia spicata	Araliaceae	Leaf	DCM	*P. f D10*	45		S. Africa	Clakson *et al.* [24]
Cussonia spicata	Araliaceae	Root	DCM	*Pf-NF54*	3.25		S. Africa	Bapela *et al.* [64]
Cymbopogon validu	Poaceae	Whole plant	MeOH/DCM (1:1)	*P. f D10*	5.8		S. Africa	Clakson *et al.* [24]
Cymbopogon validus	Poaceae	Leave	DCM/MeOH (1:1)	*Pfk1*	6.67		S. Africa	Makoka *et al.* [63]
Dicerocaryum eriocarpum	Pedaliaceae	Leaf	AQS	*Pfk1*		48% at 50	Namibia	Iwanette *et al.* [59]
Dichrostachys cinerea	Fabaceae	Roots	DCM	*Pf-NF54*	2.10		S. Africa	Bapela *et al.* [64].
Diosma sp.	Rutaceae	Root	DCM/MeOH (1:1)	*P. f D10*	55		S. Africa	Clakson *et al.* [24]
Diospyros mespiliformis	Ebenaceae	Roots	DCM	*Pf-NF54*	4.40		S. Africa	Bapela *et al.*
Diplorhynchus condylocarpon	Apocynaceae	Root	DCM	*P. f D10*	26.5		S. Africa	Clakson *et al.* [24]
Dodonaea viscose	Sapindaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	15.5		S. Africa	Clakson *et al.* [24]
Drypetes gerrardii	Meliaceae	Stem/leaves	DCM/MeOH (1:1)	*Pf NF*	0.50/21.60		S. Africa	Makoka *et al.* [62]
Ekebergia capensis	Maesaceae	Fruit	DCM/MeOH (1:1)	*P. f D10*	10		S. Africa	Clakson *et al.* [24]
Ekebergia capensis	Meliaceae	Fruit/twig	DCM/MeOH (1:1)	*Pfk1*	3.5/13.3		S. Africa	Makoka *et al.* [63]
Ekebergia capensis	Meliaceae	Roots	DCM/MeOH (1:1)	*Pf NF*	6.81		S. Africa	Makoka *et al.* [62]
Elephantorrhiza elephantina	Fabaceae	Root	DCM/MeOH (1:1)	*P. f D10*	28		S. Africa	Clakson *et al.* [24]
Euclea natalensis	Ebenaceae	Stem	DCM/MeOH (1:1)	*P. f D10*	5.3		S. Africa	Clakson *et al.* [24]
Euclea natalensis	Ebenaceae	roots	DCM/MeOH (1:1)	*7.59*	Pfk1		S. Africa	Makoka *et al.* [63]
Eucomis autumnalis	Hyacinthaceae	Bulbs	DCM	*P. f D10*	70		S. Africa	Clakson *et al.* [24]
Eucomis autumnalis	Asparagaceae	flowers/buds	DCM	*22.1*	Pfk1		S. Africa	Makoka *et al.* [63]
Euphorbia heterophylla	Euphorbiaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	40		S. Africa	Clakson *et al.* [24]
Euphorbia tirucalli	Euphorbiaceae	Leaf	DCM	*P. f D10*	12		S. Africa	Clakson *et al.* [24]
Flacourtia indica	Flacourtiaceae	Root	DCM	*P. f D10*	86.5		S. Africa	Clakson *et al.* [24]
Flueggea virosa	Euphorbiaceae	Leaves/twigs	DCM/MeOH (1:1)	*P. f D10*	19		S. Africa	Clakson *et al.* [24]
Gloriosa superba	Colchicaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	17		S. Africa	Clakson *et al.* [24]
Gnidia cuneata	Thymelaeaceae	Leaf	DCM/DCM/MeOH (1:1)	*P. f D10*	31.1/51		S. Africa	Clakson *et al.* [24]
Gnidia kraussiana	Thymelaeaceae	Tuber	DCM/MeOH (1:1)	*P. f D10*	16		S. Africa	Clakson *et al.* [24]
Gomphocarpus fruticosus	Apocynaceae	Fruit	DCM/MeOH (1:1)	*P. f D10*	26		S. Africa	Clakson *et al.* [24]
Helichrysum nudifolium	Asteraceae	Whole	DCM/MeOH (1:1)	*P. f D10*	6.8		S. Africa	Clakson *et al.* [24]
Helichrysum nudifolium	Asteraceae	whole plant	DCM/MeOH (1:1)	*9.36*	Pfk1		S. Africa	Makoka *et al.* [63]
Helichrysum pedunculatum	Asteraceae	Whole	DCM/MeOH (1:1)	*6.46*	Pf NF		S. Africa	Makoka *et al.* [62]

(Cond..)

Table 2: *(Continued...)*

Plant species	Family	Part use	Solvents	Parasite	IC_{50} (μg/ml) P. inhibition	Country	References
Hermannia depressa	Sterculiaceae	Whole plant	DCM/MeOH (1:1)	*P.fD10*	6.9	S. Africa	Clakson *et al.* [24]
Hippobromus pauciflorus	Sapindaceae	Leaf	DCM/MeOH (1:1)	*P.fD10*	34	S. Africa	Clakson *et al.* [24]
Hypericum aethiopicum	Hypericaceae	Leaves/flowers	DCM/MeOH (1:1)	*P.fD10*	14	S. Africa	Clakson *et al.* [24]
Hypericum aethiopicum	Hypericaceae	Leaves	DCM/MeOH (1:1)	*2.35*	Pfk1	S. Africa	Makoka *et al.* [63]
Hypoxis colchicifolia	Hypoxidaceae	Bulb	DCM: Ethyl acetat	*>100*	pf D10	S. Africa	Mthokozisi *et al.*, 2013
Hyptis pectinata	Lamiaceae	Leaves/stems/ fruit	DCM/MeOH (1:1)	*P.fD10*	17.5	S. Africa	Clakson *et al.* [24]
Justicia flava	Acanthaceae	Whole plant	DCM/MeOH (1:1)	*P.fD10*	31	S. Africa	Clakson *et al.* [24]
Kigelia africana	Bignoniaceae	Leaf	DCM	*P.fD10*	51	S. Africa	Clakson *et al.* [24]
Kirkia wilmsii	Kirkiaceae	Leaf	DCM/MeOH (1:1)	*P.fD10*	3.7	S. Africa	Clakson *et al.* [24]
Lannea discolor	Anacardiaceae	Fruit	DCM	*P.fD10*	25	S. Africa	Clakson *et al.* [24]
Leonotis leonurus	Lamiaceae	roots	DCM/MeOH (1:1)	*P.fD10*	15	S. Africa	Clakson *et al.* [24]
Leonotis leonurus	Lamiaceae	leaves	DCM/MeOH (1:1)	*2.9*	Pfk1	S. Africa	Makoka *et al.* [63]
Leonotis nepetifolia	Lamiaceae	Whole plant	DCM/MeOH (1:1)	*P.fD10*	15	S. Africa	Clakson *et al.* [24]
Leonotis ocymifolia	Lamiaceae	Leaf	DCM	*P.fD10*	17	S. Africa	Clakson *et al.* [24]
Leonotis ocymifolia	Lamiaceae	Leaves	DCM/DCM/MeOH (1:1)	*2.7/4.5*	Pfk1	S. Africa	Makoka *et al.* [63]
Leucas martinicensis	Lamiaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	13.3	S. Africa	Clakson *et al.* [24]
Lippia javanica	Verbenaceae	Roots	DCM/DCM/MeOH (1:1)/ AQS	*P. f D10*	3.8/27/27	S. Africa	Clakson *et al.* [24]
Macrostylis squarrosa	Rutaceae	stem	DCM/MeOH (1:1)	*P.fD10*	10	S. Africa	Clakson *et al.* [24]
Maesa lanceolata	Maesaceae	Twigs	DCM/MeOH (1:1)	*P.fD10*	5.9	S. Africa	Clakson *et al.* [24]
Maytenus senegalensis	Celastraceae	Root	DCM	*P.fD10*	15.5	S. Africa	Clakson *et al.* [24]
Maytenus undata	Celastraceae	Leaf	DCM	*P.fD10*	>100	S. Africa	Clakson *et al.* [24]
Maytenus undata	Celastraceae	Roots	DCM	*Pfk1*	8.53	S. Africa	Makoka *et al.* [63]
Mimusops caffra	Sapotaceae	Leaf	DCM: Ethyl acetat	*pf D10*	2.14	S. Africa	Mthokozisi *et al.*, 2013
Mimusops obtusifolia	Sapotaceae	Bark	DCM: Ethyl acetat	*32.5*	pf D10	S. Africa	Mthokozisi *et al.*, 2013
Nicolasia costata	Asteraceae	Leaf	AQS	*Pfk1*	21.5% at 50	Namibia	Iwanette *et al.* [59]
Ocimum americanum	Lamiaceae	Whole plant	DCM/MeOH (1:1)	*P.fD10*	4.2	S. Africa	Clakson *et al.* [24]
Oedera genistifolia	Asteraceae	Whole	DCM/MeOH (1:1)	*Pf NF*	2.88	S. Africa	Makoka *et al.* [62]
Olea europaea	Olacaceae	Leaf	DCM/MeOH (1:1)	*P.fD10*	12	S. Africa	Clakson *et al.* [24]
Osteospermum imbricatum	Asteraceae	Stem	DCM/MeOH (1:1)	*P.fD10*	7.3	S. Africa	Clakson *et al.* [24]
Ozoroa sphaerocarpa	Anacardiaceae	Whole	DCM	*Pf NF*	12.9	S. Africa	Makoka *et al.* [62]
Pappea capensis	Sapindaceae	Root	DCM	*Pf NF*	10.10	S. Africa	Makoka *et al.* [62]
Pappea capensis	Sapindaceae	Root/leaves	DCM/MeOH (1:1)	*Pf NF*	5.33/9.67	S. Africa	Makoka *et al.* [62]
Pappea capensis	Sapindaceae	Twigs	DCM	*Pf-NF54*	5.47	S. Africa	Bapela *et al.* [64]
Parinari curatellifolia	Chrysobalanaceae	Leaves/flowers	DCM	*P.fD10*	17	S. Africa	Clakson *et al.* [24]
Parinari curatellifolia	Rosaceae	Stem bark	DCM	*Pf-NF54*	6.99	S. Africa	Bapela *et al.* [64]
Parkinsonia aculeata	Fabaceae	Twigs	DCM/MeOH (1:1)	*P.fD10*	9	S. Africa	Clakson *et al.* [24]
Pelargonium alchemilloides	Gentianaceae	Whole plant	DCM/MeOH (1:1)	*P.fD10*	15	S. Africa	Clakson *et al.* [24]
Pentzia globosa	Asteraceae	Leaf	DCM	*P.fD10*	12.5	S. Africa	Clakson *et al.* [24]
Pentzia globosa	Asteraceae	Roots/stem bark	DCM	*Pfk1*	4.27/6.04	S. Africa	Makoka *et al.* [63]
Piliostigma thonningii	Fabaceae	Leaf	DCM/MeOH (1:1)	*P.fD10*	32	S. Africa	Clakson *et al.* [24]
Pittosporum viridiflorum	Pittosporaceae	Whole plant	DCM/AQS	*P.fD10*	3/>100	S. Africa	Clakson *et al.* [24]
Plantaginaceae Plantago majo	Plantaginaceae	Whole plant	DCM/AQS	*P.fD10*	21.5/>100	S. Africa	Clakson *et al.* [24]
Plumbago zeylanica	Plumbaginaceae	Roots	DCM	*P.fD10*	43	S. Africa	Clakson *et al.* [24]
Plumbago zeylanica	Plumbaginaceae	Leaves	DCM/MeOH (1:1)	*12.4*	Pfk1	S. Africa	Makoka *et al.* [63]
Pollichia campestris	Illecebraceae	Twigs	DCM/MeOH (1:1)	*P. f D10*	6.8	S. Africa	Clakson *et al.* [24]
Pseudarthria hookeri	Fabaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	100	S. Africa	Clakson *et al.* [24]
Psiadia punctulata	Asteraceae	Twig	DCM	*P. f D10*	9	S. Africa	Clakson *et al.* [24]
Psoralea pinnata	Fabaceae	Leaves	DCM	*Pf NF*	8.46	S. Africa	Makoka *et al.* [62]
Ptaeroxylon obliquum	Ptaeroxylaceae	Root	DCM	*P. f D10*	19	S. Africa	Clakson *et al.* [24]
Ptaeroxylon obliquum	Rutaceae	Leaves	DCM	*Pfk1*	10.9	S. Africa	Makoka *et al.* [63]
Pterocarpus angolensis	Fabaceae	Stem	DCM	*P. f D10*	15	S. Africa	Clakson *et al.* [24]
Pyrenacantha grandiflora	Icacinaceae	Roots	DCM	*Pf-NF54*	5.82	S. Africa	Bapela *et al.* [64]
Ranunculus multifidus	Ranunculaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	2.3	S. Africa	Clakson *et al.* [24]
Rapanea melanophloeos	Myrtaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	44	S. Africa	Clakson *et al.* [24]
Rauvolfia caffra	Apocynaceae	Fruit	DCM	*P. f D10*	88	S. Africa	Clakson *et al.* [24]
Rauvolfia caffra	Apocynaceae	Roots	DCM	*Pfk1*	8.44	S. Africa	Makoka *et al.* [63]
Rauvolfia caffra	Apocynaceae	Stem	DCM	*Pf-NF54*	2.13	S. Africa	Bapela *et al.* [64]

(Cond..)

Table 2: *(Continued...)*

Plant species	Family	Part use	Solvents	Parasite	IC_{50} (μg/ml) P. inhibition	Country	References
Rhizophora mucronata	Rhizophoraceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	24	S. Africa	Clakson *et al.* [24]
Ricinus communis	Euphorbiaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	27.5	S. Africa	Clakson *et al.* [24]
Rumex crispus	Polygonaceae	Leaf	DCM	*P. f D10*	36.8	S. Africa	Clakson *et al.* [24]
Rumex sagittatus	Poaceae	Whole plant	MeOH/DCM (1:1)	*P. f D10*	18	S. Africa	Clakson *et al.* [24]
Rutaceae agathosma apiculata	Rutaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	5.2	S. Africa	Clakson *et al.* [24]
Salvia repens	Lamiaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	10.8	S. Africa	Clakson *et al.* [24]
Salvia repens	Lamiaceae	whole plant	DCM/MeOH (1:1)	*Pfk1*	7.61	S. Africa	Makoka *et al.* [63]
Scaevola plumieri	Goodeniaceae	Twig	DCM	*P. f D10*	11	S. Africa	Clakson *et al.* [24]
Schefflera umbellifera	Araliaceae	Leaf	DCM/DCM/MeOH (1:1)	*P. f D10*	3.7/19.5	S. Africa	Clakson *et al.* [24]
Schefflera umbellifera	Araliaceae	Roots	DCM/MeOH (1:1)	*Pfk1*	2.7	S. Africa	Makoka *et al.* [63]
Schkuhria pinnata	Asteraceae	Whole	DCM/MeOH (1:1)	*Pf NF*	2.19	S. Africa	Makoka *et al.* [62]
Senecio oxyriifolius	Asteraceae	Whole	DCM/MeOH (1:1)	*P. f D10*	13	S. Africa	Clakson *et al.* [24]
Senna didymobotrya	Fabaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	40	S. Africa	Clakson *et al.* [24]
Senna petersiana	Fabaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	>100	S. Africa	Clakson *et al.* [24]
Senna petersiana	Fabacea	Leaves	DCM	*Pf-NF54*	22.5	S. Africa	Bapela *et al.* [64]
Setaria megaphylla	Poaceae	Whole plant	MeOH/DCM (1:1)	*P. f D10*	4.5	S. Africa	Clakson *et al.* [24]
Setaria megaphylla	Poaceae	Whole plant	DCM/MeOH (1:1)	*Pfk1*	4.44	S. Africa	Makoka *et al.* [63]
Spilanthes mauritiana	Asteraceae	Stem	DCM	*P. f D10*	38	S. Africa	Clakson *et al.* [24]
Strychnos madagascariensis	Strychnaceae	Stem	DCM	*P. f D10*	70	S. Africa	Clakson *et al.* [24]
Strychnos potatorum	Strychnaceae	Leaf	DCM/DCM/MeOH (1:1)	*P. f D10*	60/>100	S. Africa	Clakson *et al.* [24]
Strychnos pungens	Strychnaceae	Leaf	DCM/DCM/MeOH (1:1)	*P. f D10*	12.6/80.4	S. Africa	Clakson *et al.* [24]
Syzigium cordatum	Myrtaceae	Twigs	DCM/MeOH (1:1)	*P. f D10*	14.7	S. Africa	Clakson *et al.* [24]
Syzygium cordatum	Myrtaceae	Leaves	DCM	*6.15*	Pf-NF54	S. Africa	Bapela *et al.* [64]
Tabernaemontana elegans	Apocynaceae	Stem bark	DCM/MeOH: AQS	*Pf-NF54*	0.33/0.83	S. Africa	Bapela *et al.* [64]
Tarchonanthus camphorates	Asteraceae	Whole	DCM/MeOH (1:1)	*P. f D10*	6	S. Africa	Clakson *et al.* [24]
Tarchonanthus camphorates	Asteraceae	Whole plant	DCM/MeOH (1:1)	*Pfk1*	6.23	S. Africa	Makoka *et al.* [63]
Tecomaria capensis	Bignoniaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	11.6	S. Africa	Clakson *et al.* [24]
Tetradenia riparia	Lamiaceae	Leaf	DCM	*P. f D10*	>100	S. Africa	Clakson *et al.* [24]
Tridax procumbens	Asteraceae	Whole	DCM/MeOH (1:1)	*P. f D10*	17	S. Africa	Clakson *et al.* [24]
Triumfetta welwitschii	Tiliaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	3.6	S. Africa	Clakson *et al.* [24]
Turraea floribunda	Meliaceae	Bark/Leaf/ Roots	DCM/MeOH (1:1)	*Pf NF*	4.52/12.7/ 5.56	S. Africa	Makoka *et al.* [62]
Vahlia capensis	Vahilaceae	Leaf	AQS	*Pfk1*	26.6% at 50	Namibia	Iwanette *et al.* [59]
Vangueria infausta	Rubiaceae	Fruit	DCM/MeOH (1:1)	*P.f D10*	23	S. Africa	Clakson *et al.* [24]
Vangueria infausta	Rubiaceae	Roots	DCM	*Pf-NF54*	1.84	S. Africa	Bapela *et al.* [64]
Vernonia colorata	Asteraceae	Twig	DCM/MeOH (1:1)	*P.f D10*	14.1	S. Africa	Clakson *et al.* [24]
Vernonia fastigiata	Asteraceae	Leaf	DCM	*P.f D10*	10	S. Africa	Clakson *et al.* [24]
Vernonia hirsuta	Asteraceae	Whole	DCM/MeOH (1:1)	*P. f D10*	14	S. Africa	Clakson *et al.* [24]
Vernonia hirsute	Asteraceae	Whole plant	DCM/MeOH (1:1)	*Pfk1*	10.2	S. Africa	Makoka *et al.* [63]
Vernonia mespilifolia	Asteraceae	Leaves	DCM/MeOH (1:1)	*Pf NF*	5.09	S. Africa	Makoka *et al.* [62]
Vernonia myriantha	Asteraceae	Leaf	AQS	*P. f D10*	>100	S. Africa	Clakson *et al.* [24]
Vernonia natalensis	Asteraceae	Whole plan	DCM	*P. f D10*	19.5	S. Africa	Clakson *et al.* [24]
Vernonia natalensis	Asteraceae	whole plant	DCM/MeOH (1:1)	*Pfk1*	8.53	S. Africa	Makoka *et al.* [63]
Vernonia oligocephala	Asteraceae	Roots	DCM	*P. f D10*	>100	S. Africa	Clakson *et al.* [24]
Vernonia oligocephala	Asteraceae	Leaves	DCM	*7.69*	Pfk1	S. Africa	Makoka *et al.* [63]
Ximenia americana	Olacaceae	Roots	DCM	*Pf-NF54*	28.2	S. Africa	Bapela *et al.* [64]
Ximenia caffra	Olacaceae	Leaf	DCM/MeOH (1:1)	*P. f D10*	55	S. Africa	Clakson *et al.* [24]
Xylopia parviflora	Annonaceae	Leaves	DCM	*Pf-NF54*	2.19	S. Africa	Bapela *et al.* [64]
Xysmalobium undulatum	Araliaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	6	S. Africa	Clakson *et al.* [24]
Zehneria scabra	Cucurbitaceae	Whole plant	DCM/MeOH (1:1)	*P. f D10*	5.5	S. Africa	Clakson *et al.* [24]
Ziziphus mucronata	Rhamnaceae	Leaf	DCM	*P. f D10*	12	S. Africa	Clakson *et al.* [24]

DCM: Dichloromethane, MeOH: Methanol, EtOH: Ethanol, HO: Hydroxide, AQS: Aqueous, pf: *Plasmodium falciparum*, IC_{50}: Inhibitory concentration 50%

costata, and *Dicerocaryum eriocarpum* exhibit 48.0%, 26.6%, and 21.5 48% parasite inhibition at 50 μg/ml [59], their level of activities could not be ascertained. A total of 15 compounds were isolated from South African plant, 7 of which demonstrated high activities (IC_{50} > 5 μg/ml) while others show promising activities (IC_{50} 5-15 μg/ml). The most highly active compound is 13-epi-dioxiabiet-8(14)-en-18-ol isolated from leave extracts of *Hyptis suaveolens* (IC_{50} = 1.0 μg/ml) [60]. Despite the traditional use against malarial fever, most of the plants reviewed show no noticeable antiplasmodial activity, the traditional uses of this plant against malarial infection could only be linked to their antipyretics or immune modulatory effect to alleviate the

Table 3: *In vitro* antimalarial activities of North African plants

Plant	Family/common name	Part use	Solvents	IC_{50} (μg/ml)	P.strain	P.inhibion at conc	Country	References
Sisymbrium irio	Brassicaceae	Leaves	EtOH		*pf D6*	3 at 15.867	Egypt	Shimaa *et al.* [68]
Acacia nilotica	Fabaceae	Seed	MeOH	0.9/4.1	*3D7 and Dd2*		Sudan	El-Tahir *et al.* [68]
Acanthospermum hispidum	Asteraceae	Aerial shoots	MeOH	4.9	*pfDd2*		Sudan	El-Tahir *et al.* [70]
Aerva javanica	Amaranthaceae	Whole	Pet ether/ CLF (1:1)		*pf*	100 at 500	Sudan	Ahmed *et al.* [66]
Alhagi graecorum	Papilionaceae	Leaves	EtOH		*pf D6*	47 at 15.867	Egypt	Shimaa *et al.* [68]
Amaranthus lividus	Amaranthaceae	Leaves	EtOH		*pf D6*	46 at 15.867	Egypt	Shimaa *et al.* [68]
Ambrosia maritime	Asteraceae	Whole	Pet ether/ chlorof (1:1)		*pf*	94.112 at 500	Sudan	Ahmed *et al.* [66]
Anastatica hierochuntica	Cruciferae	Leaves	EtOH		*pf D6*	44 at 15.867	Egypt	Shimaa *et al.* [68]
Aristolochia bracteata	Aristolchiaceae	Stem	Chloroform/ AQS/MeOH	12/210/ 59	*Pf3D7*		Sudan	El-Tahir *et al.* [70]
Aristolochia bracteo-lata	Aristolochiaceae	Whole	Pet ether/ chlorof (1:1)		*pf*	100 at 500	Sudan	Ahmed *et al.* [66]
Artemisia Absinthium	Asteraceae	Leaves	EtOH		*pf D6*	52 at 15.867	Egypt	Shimaa *et al.* [68]
Aster squamatous	Compositae	Leaves	EtOH		*pf D6*	45 at 15.867	Egypt	Shimaa *et al.* [68]
Balanites aegyptiaca	Balantitiaceae	Stem	MeOH	55	*pfDd2*		Sudan	El-Tahir *et al.* [69]
Beta vulgaris	Chenopodiaceae	Leaves	EtOH		*pf D6*	32 at 15.867	Egypt	Shimaa *et al.* [68]
Camellia sinensis	Theaceae	Leaves	EtOH		*pf D6*	44 at 15.867	Egypt	Shimaa *et al.* [68]
Cartagena ipecacuanha	Rubiaceae	Root	EtOH		*pf D6*	70 at 15.867	Egypt	Shimaa *et al.* [68]
Cassia tora	Caesalpiniaceae	Aerial part	MeOH	5.2	*Pf3D7*		Sudan	El-Tahir *et al.* [69]
Chenopodium murale	Chenopodiaceae	Leaves	EtOH		*pf D6*	39 at 15.867	Egypt	Shimaa *et al.* [68]
Cichorium endivia	Asteraceae	Leaves	EtOH		*pf D6*	44 at 15.867	Egypt	Shimaa *et al.* [68]
Cichorium intybus	Asteraceae	Leaves	EtOH		*pf D6*	42 at 15.867	Egypt	Shimaa *et al.* [68]
Cinnamomum cassia	Lauraceae	Bark	EtOH		*pf D6*	44 at 15.867	Egypt	Shimaa *et al.* [68]
Citrullus colocynthis	Cucurbitaceae	Seed	Pet ether/ chlorof (1:1)		*pf*	97.96 at 500	Sudan	Ahmed *et al.* [66]
Citrus reticulate	Rutaceae	Leaves	EtOH		*pf D6*	33 at 15.867	Egypt	Shimaa *et al.* [68]
Conyza dioscoridis	Compositae	Leaves	EtOH		*pf D6*	38 at 15.867	Egypt	Shimaa *et al.* [68]
Corchorus olitorius	Tiliaceae	Leaves	EtOH		*pf D6*	37 at 15.867	Egypt	Shimaa *et al.* [68]
Croton zambesicus	Euphorbiaceae	Fruit	Pet ether/ chlorof (1:1)		*pf*	82.35 at 500	Sudan	Ahmed *et al.* [66]
Curcuma aromatic	Zingebracea	Rhizomes	EtOH		*pf D6*	52 at 15.867	Egypt	Shimaa *et al.* [68]
Cymbopogon proximus	Poaceae	Leaves	EtOH		*pf D6*	47 at 15.867	Egypt	Shimaa *et al.* [68]
Cymbopogon schoenanthus	Asteraceae	Aerial part	MeOH		*Pfk1*	100 at 8.00	Sudan	Intisar *et al.* [65]
Cyperus alopecuroides	Cyperaceae	Leaves	EtOH		*pf D6*	28 at 15.867	Egypt	Shimaa *et al.* [68]
Cyperus rotundus	Cyperacea	Leaves	EtOH		*pf D6*	44 at 15.867	Egypt	Shimaa *et al.* [68]
Daucus carota	Apiaceae	Leaves	EtOH		*pf D6*	41 at 15.867	Egypt	Shimaa *et al.* [68]
Desmostachia bipinnata	Poaceae	Leaves	EtOH		*pf D6*	44 at 15.8	Egypt	Shimaa *et al.* [68]
Emblica officinalis	Phyllanthaceae	Leaves	EtOH		*pf D6*	100 at 15.867	Egypt	Shimaa *et al.* [68]
Eruca sativa	Brassicaceae	Leaves	EtOH		*pf D6*	33 at 15.867	Egypt	Shimaa *et al.* [68]
Ficus carica	Moraceae	Leaves	EtOH		*pf D6*	36 at 15.867	Egypt	Shimaa *et al.* [68]
Gardenia jovis tonatis	Rubiaceae	Stem bark	MeOH	4.3/49	*3D7 and Dd2*		Sudan	El-Tahir *et al.* [70]
Gardenia lutea	Rubiacene	Fruit	Pet ether/ chlorof (1:1)		*pf*	97.67 at 500	Sudan	Ahmed *et al.* [66]
Gardenia lutea	Rubiaceae	Stem bark	MeOH	5.2/3.3	*3D7 and Dd2*		Sudan	El-Tahir *et al.* [70]
Glycyrrhiza glabra	Fabaceae	Roots and rhizomes	EtOH		*pf D6*	49 at 15.867	Egypt	Shimaa *et al.* [68]
Helianthus annus	Poaceae	Seed	MeOH		*Pfk1*	100 at 4.00	Sudan	Intisar *et al.* [65]
Hibiscus sabdariffa	Malvaceae	Flowers calyx and epi-calyx	EtOH		*pf D6*	34 at 15.867	Egypt	Shimaa *et al.* [68]
Hyphaene thebaica	Arecaceae	Fruits	EtOH		*pf D6*	35 at 15.867	Egypt	Shimaa *et al.* [68]
Lawsonia inermis	Lythraceae	Leaves	EtOH		*pf D6*	0 at 15.867	Egypt	Shimaa *et al.* [68]
Lupinus termis	Fabaceae	Seeds	EtOH		*pf D6*	0 at 15.867	Egypt	Shimaa *et al.* [68]
Malva parviflora	Malvacea	Leaves	EtOH		*pf D6*	50 at 15.867	Egypt	Shimaa *et al.* [68]
Mentha longifolia	Labiatae	Leaves	EtOH		*pf D6*	47 at 15.867	Egypt	Shimaa *et al.* [68]
Morus alba	Moraceae	Leaves	EtOH		*pf D6*	29 at 15.867	Egypt	Shimaa *et al.* [68]
Nigella sativa	Ranuneulaceae	Seed	Pet ether/ chlorof (1:1)		*pf*	100 at 500	Sudan	Ahmed *et al.* [66]
Opuntia ficus indica	Cactaceae	Leaves	EtOH		*pf D6*	52 at 15.867	Egypt	Shimaa *et al.* [68]
Origanum majorana	Lamiaceae	Leaves	EtOH		*pf D6*	41 at 15.867	Egypt	Shimaa *et al.* [68]
Peganum harmal	Nitrariaceae	Seed	EtOH		*pf D6*	70 at 15.867	Egypt	Shimaa *et al.* [68]
Phaseolus vulgaris	Papilionaceae	Leaves	EtOH		*pf D6*	41 at 15.867	Egypt	Shimaa *et al.* [68]
Phragmites communis	Poaceae	Leaves	EtOH		*pf D6*	0 at 15.867	Egypt	Shimaa *et al.* [68]

(Cond..)

Table 3: *(Continued...)*

Plant	Family/common name	Part use	Solvents	IC_{50} (μg/ml)	P.strain	P.inhibion at conc	Country	References
Pimpinella anisum	Umbelliferae	Fruits	EtOH		*pf D6*	44 at 15.867	Egypt	Shimaa *et al.* [68]
Polgonum glabrium	Polgonaceae	Leaf	EtOH	6.6	*P. fk1*		Sudan	Khadiga *et al.* [71]
Psidium guajava	Myrtaceae	Leaves	EtOH		*pf D6*	50 at 15.867	Egypt	Shimaa *et al.* [68]
Pulicaria crispa	Asteraceae	Whole	Pet ether/ chlorof (1:1)		*pf*	96.65 at 500	Sudan	Ahmed *et al.* [66]
Punica granatum	Lythraceae	Fruit	EtOH		*pf D6*	96 at 15.867	Egypt	Shimaa *et al.* [68]
Quercus infectoria	Fagaceae	Galls	EtOH		*pf D6*	100 at 15.867	Egypt	Shimaa *et al.* [68]
Ricinus communi	Euphorbiaceae	Leves	EtOH		*pf D6*	40 at 15.867	Egypt	Shimaa *et al.* [68]
Salix subserrata	Salicaceae	Leaves	EtOH		*pf D6*	0 at 15.867	Egypt	Shimaa *et al.* [68]
Senna alexandrina	Fabaceae	Fruit	MeOH		*Pfk1*	100 at 2.0	Sudan	Intisar *et al.* [65]
Sesamum indicum	Pedaliaceae	Leaves	EtOH		*pf D6*	0 at 15.867	Egypt	Shimaa *et al.* [68]
Sesbania sesban	Leguminosae	Leaves	EtOH		*pf D6*	0 at 15.867	Egypt	Shimaa *et al.* [68]
Solenostema argel	Ascepiadaceae	Leaf	Pet ether/ chlorof (1:1)		*pf*	98.82 at 500	Sudan	Ahmed *et al.* [66]
Solenostemma argel	Apocyanaceae	Leaves	EtOH		*pf D6*	43 at 15.867	Egypt	Shimaa *et al.* [68]
Sonchous cornatus	Asteraceae	Aerial shoots	MeOH	340	*pfDd2*		Sudan	El-Tahir *et al.* [70]
Spinacia oleracea	Chenopodiaceae	Leaves	EtOH		*pf D6*	2 at 15.867	Egypt	Shimaa *et al.* [68]
Tamarindus indica	Fabaceae	Fruit	EtOH		*pf D6*	0 at 15.867	Egypt	Shimaa *et al.* [68]
Tamarindus indica	Caesalpiniaceae	Fruit/stem bark	MeOH	>500/10	*Pf3D7*		Sudan	El-Tahir *et al.* [69]
Tamarix nilotica	Tamaricaceae	Leaves	EtOH		*pf D6*	8 at 15.867	Egypt	Shimaa *et al.* [68]
Thymus vulgaris	Lamiaceae	Leaves	EtOH		*pf D6*	0 at 15.867	Egypt	Shimaa *et al.* [68]
Tilia cordata	Tiliaceae	Leaves	EtOH		*pf D6*	3 at 15.867	Egypt	Shimaa *et al.* [68]
Tinospora bakis	Menispermaceae	Whole	Pet ether/ chlorof (1:1)		*pf*	92.94 at 500	Sudan	Ahmed *et al.* [66]
Trifolium alexandrinum	Leguminosae	Leaves	EtOH		*pf D6*	0 at 15.867	Egypt	Shimaa *et al.* [68]
Withania somnifera	Solanaceae	Leaves	EtOH		*pf D6*	15 at 15.867	Egypt	Shimaa *et al.* [68]
Zingiber officinale	Zingebracea	Rhizome	EtOH		*pf D6*	38 at 15.867	Egypt	Shimaa *et al.* [68]
Zizyphus spina-christi	Rhamnaccae	Leaves	EtOH		*pf D6*	0 at 15.867	Egypt	Shimaa *et al.* [68]

DCM: Dichloromethane, MeOH: Methanol, EtOH: Ethanol, HO: Hydroxide, AQS: Aqueous, pf: *Plasmodium falciparum*, IC_{50}: Inhibitory concentration 50%

Table 4: *In vitro* antimalarial activities of plants from East African

Plant	Family/common name	Part use	Solvents	IC_{50} (μg/ml)	Parasite	Country	References
Cassia abbreviata	Caesalpiniaceae	Roots	DCM/MeOH	40.0/>100	*3D7*	Mozambique	Ramalhete *et al.* [72]
Tabernaemontana elegans	Apocynaceae	Leaves	n-hex/DMC/et/MeOH	59/26.9/>100/>100	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
cTrichilia eMeOHica	Meliaceae	Seed	n-hex/DMC/et/MeOH	>100	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
AcAcaacia karroo	Fabaceae	Aerial parts	n-hex/DMC/et/MeOH	99/60/20.2/>100	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
Acokanthera oppositifolia	Apocynaceae	Leaves	Hex/DCM/MeOH	>50/19.5/>50	*FcB1*	Kenya	Sylvain *et al.* [73]
Acokanthera schimperi	Apocynaceae	Stems/leaves	Hex/DCM/MeOH	31.5/9.8/>50	*FcB1*	Kenya	Sylvain *et al.* [73]
Alangium chinense	Alangiaceae	Aerial parts	Hex/DCM/MeOH	>50/6.15/2.8	*FcB1*	Kenya	Sylvain *et al.* [73]
Aristolochia elegans	Aristolochiaceae	seed	MeOH/DCM	>50	*3D7 P.f*	Rwanda	Muganga *et al.* [74]
Schefflera actinophylla	Araliaceae	Leaves	n-hex/DMC/et/MeOH	32.5/36.3/41.7/>100	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
AAloe parvibracteata	Aloaceae	Leaf	n-hex/DMC/et/MeOH	>100	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
Bridelia cathartica	Euphorbiaceae	Roots	n-hex/DMC/et/MeOH	99/>100/44	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
Cadaba farinosa	Capparaceae	Aerial parts	Hex/DCM/MeOH	>50/6.2/>50	*FcB1*	Kenya	Sylvain *et al.* [73]
Carissa edulis	Apocynaceae	Stem bark	Eth/MeOHh	26.37/>50	*PfD6*	Kenya	Ayuko *et al.* [75]
Cassia abbreviate	Fabaceae	Stem bark	n-hex/DMC/et/MeOH	>100/40/>100/>100	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
Cassia occidentalis	Fabaceae	Roots	n-hex/DMC/et/MeOH	19.3/59.9/31.9/88.2	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
Conyza aegyptiaca	Asteraceae	Leaf	MeOH/DCM/AQS	22.7/36.8/>50	*3D7 P.f*	Rwanda	Muganga *et al.* [74]
Crossopteryx febrifuga	Rubiaceae	Aerial parts	n-hex/DMC/et/MeOH	0/44.4/0/>100	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
Fuerstia africana	Lamiaceae	Leaf	MeOH/DCM	6.9/40.2	*3D7 P.f*	Rwanda	Muganga *et al.* [74]
Kigelia africana	Bignoniaceae	Leaves	Eth/MeOHh	13.5/25.7	*PfD6*	Kenya	Ayuko *et al.* [75]
Leonotis leonurus	Lamiaceae	Aerial parts	n-hex/DMC/et/MeOH	>100/45.4/38.4/>100	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
Lippia javanica	Verbenaceae	Root	Eth/MeOHh	12.12/1.35	*PfD6*	Kenya	Ayuko *et al.* [75]
Markhamia lutea	Bignoniaceae	Leaf	MeOH/DCM	>50/29	*3D7 P.f*	Rwanda	Muganga *et al.* [74]
Maytenus heterophylla	Celastraceae	Root	Eth/MeOHh	18.9/13.07	*PfD6*	Kenya	Ayuko *et al.* [75]
Microglossa pyrifolia	Asteraceae	Leas	MeOH/DCM/AQS	4.2/1.5	*3D7 P.f*	Rwanda	Muganga *et al.* [74]
Microglossa pyrifolia	Asteracceae	Leaves	Eth/MeOHh	14.7/1.59	*PfD6*	Kenya	Ayuko *et al.* [75]
Mitragyna rubrostipulata	Rubiaceae	Stem	MeOH/DCM	>50/39.9	*3D7 P.f*	Rwanda	Muganga *et al.* [74]
Momordica balsamina	Cucurbitaceae	Aerial parts	n-hex/DMC/et/MeOH	>100/35.5/1.0/46.9	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
Parkinsonia aculeata	Caesalpiniaceae	Aerial parts	n-hex/DMC/et/MeOH	24.5/26.3/36.4/54.9	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
Periploca linearifolia	Asclepiadacae	Stem bark	Eth/MeOHh	25.7/1.6	*PfD6*	Kenya	Ayuko *et al.* [75]

(Cond..)

Table 4: *(Continued...)*

Plant	Family/common name	Part use	Solvents	IC_{50} (μg/ml)	Parasite	Country	References
Pittosporum tobira	Pittosporaceae	Aerial parts	n-hex/DMC/et/MeOH	34.4/44.6/4.8/>100	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
Plumbago auriculata	Plumbaginaceae	Aerial parts	n-hex/DMC/et/MeOH	45.9/40.2/53.8/80.0	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
Rumex abyssinicus	Polygonaceae	Root	MeOH/DCM/AQS	>50/4.3	*3D7 P.f*	Rwanda	Muganga *et al.* [74]
Rumex bequaertii	Polygonaceae	Root	MeOH/DCM/AQS	>50	*3D7 P.f*	Rwanda	Muganga *et al.* [74]
Schizozygia coffaeoides	Apocynaceae	Stems	Hex/DCM/MeOH	19.75/9.70/>50	*FcB1*	Kenya	Sylvain *et al.* [73]
Scolopia zeyheri	Flacourtiaceae	Aerial parts	Hex/DCM/MeOH	>50/7.5/>50	*FcB1*	Kenya	Sylvain *et al.* [73]
Senna didymobotrya	Fabaceae	Twig	n-hex/DMC/et/MeOH	57.6/92/>100/56	*3D7 P.f*	Mozambique	Ramalhete *et al.* [72]
Solanecio mannii	Asteraceae	Leaf	MeOH/DCM	21.6/18.2	*3D7 P.f*	Rwanda	Muganga *et al.* [74]
Strychnos henningnsii	Strychnaceae	root	Eth/MeOHh	25.0/1.07	*PfD6*	Kenya	Ayuko *et al.* [75]
Strychnos usambarensis	Strychnaceae	root	Eth/MeOHh	15.65/23.82	*PfD6*	Kenya	Ayuko *et al.* [75]
Terminalia mollis	Combretaceae	Leaf	MeOH/DCM	>50	*3D7 P.f*	Rwanda	Muganga *et al.* [74]
Tithonia diversifolia	Asteraceae	Fruit	MeOH/DCM	8.1/1.1	*3D7 P.f*	Rwanda	Muganga *et al.* [74]
Toddalia asiatica	Rutaceae	Roots	Hex/DCM/MeOH	10/5.75/39	*FcB1*	Kenya	Sylvain *et al.* [73]
Trimeria grandifolia	Flacourtiaceae	Leaf	MeOH/DCM	>50	*3D7 P.f*	Rwanda	Muganga *et al.* [74]
Zanthoxylum chalybeum	Rutaceae	Stem	MeOH/DCM	42.5/41.5	*3D7 P.f*	Rwanda	Muganga *et al.* [74]

DCM: Dichloromethane, MeOH: Methanol, EtOH: Ethanol, HO: Hydroxide, AQS: Aqueous, pf: *Plasmodium falciparum*, IC_{50}: Inhibitory concentration 50%

Table 5: Anti-malarial activity of plants from Central Africa

Plant	Family	Part use	Solvents	Parasite	IC_{50} (μg/ml)	P.inhibition	Country	References
Entandrophragma angolense	Meliaceae	Stem bark	Hex/MeOH	*pf W2*	33.4/26.2		Cameroon	Jean *et al.* [80]
Achromanes difformis	Araceae	Leaf	Chloroform/MeOH (1:1)	*pf F32*		114 at 10	Cameroon	Harikrishna *et al.* [81]
Albizia zygia	Mimosaceae	Stem	MeOH		1.10		Cameroon	Lenta *et al.* [82]
Alchornea cordifolia	Euphorbiaceae	Leaf	AQS	*Pfk1*	4.84		Congo	Muganza *et al.* [76]
Alchornea floribunda	Euphorbiaceae	Leas root	AQS	*Pfk1*	20.80		Congo	Muganza *et al.* [76]
Alstonia boone	Apocynaceae	Stem	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Anisopappus chinensis	Asteraceae	Whole	MeOH/DCM/AQS	*pf3D7*	8.82/6.53/76.51		Congo	Lusakibanza *et al.* [77]
Anisopappus chinensis	Asteraceae	Whole plant	MeOH	*pf3D7*	8.82		Congo	Frédérich *et al.* [83]
Annona muricata	Annonaceae	Leaf	chloroform/MeOH (1:1)	*pf F32*		46.6 at 10	Cameroon	Harikrishna *et al.* [81]
Anonidium mannii	Annonaceae	Stem	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Artocarpus communis	Moraceae	Leaf	MeOH	-	4.00		Cameroon	Boyom *et al.* [83]
Autranella congolensis	Sapotaceae	Stem	AQS	*Pfk1*	35.45		Congo	Muganza *et al.* [76]
Boscia angustifolia	Capparaceae	Leaf	DCM/MeOH		107.9/37.6		Mali	Bah *et al.* [48]
Calycobolus	Convolvulaceae	Stem	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Caralluma tuberculata	Asclepiadaceae	Leaf	EtOH/P.eth/ISal		9.7/2.5/2.7		Congo	Tona *et al.* [46]
Cassia occidentalis	Caesalpiniaceae	Leaf	EtOH/P.eth/ISal		2.8/1.5/186		Congo	Tona *et al.* [46]
Cleome rutidosperma	Cleomaceae	Leaf	chloroform/MeOH (1:1)	*pf F32*		12.3 at 10	Cameroon	Harikrishna *et al.* [81]
Copaifera religiosa	Fabaceae	Back	DCM/MeOH	*pf FCB*	13.4/500.7		Gabon	Lekana-Douki *et al.* [84]
Cymbopogon citratus	Poaceae	Leaf	Chloroform/MeOH (1:1)	*pf F32*		42 at 10	Cameroon	Harikrishna *et al.* [81]
Dalhousiea africana	Leguminosae	Leaf	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Drypetes gossweileri	Euphorbiaceae	Stem	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Enantia chlorantha	Annonaceae	Stem	AQS	*Pfk1*	7.77		Congo	Muganza *et al.* [76]
Enantia chlorantha	Annonaceae	Stem/stem bark	MeOH	*Pfk1*	4.79/2.06		Cameroon	Boyom *et al.* [83]
Entandrophragma palustre	Meliaceae	Stem	MeOH/DCM/AQS	*pf3D7*	15.8/17.6/>100		Congo	Lusakibanza *et al.* [77]
Entandrophragma palustre	Meliaceae	Stem bark	MeOH	*pf3D7*	15.84		Congo	Frédérich *et al.* [83].
Euphorbia hirta	Dilleniaceae	Whole plant	EtOH/P.eth/ISal		2.4/1.2/2.6		Congo	Tona *et al.* [46]
Frostyrax lepidophyllus	Huaceae	Root	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Garcinia kola	Clusiaceae	Stem bark	EtOH/P.eth/ISal		2.9/1.6/41.7		Congo	Tona *et al.* [46]
Garcinia punctata	Clusiaceae	Stem	AQS	*Pfk1*	36.56		Congo	Muganza *et al.* [76]
Harungana madagascariensis	Clusiaceae	Stem	AQS	*Pfk1*	9.64		Congo	Muganza *et al.* [76]
Isolona hexaloba	Annonaceae	Stem	AQS	*Pfk1*	15.28		Congo	Muganza *et al.* [76]
Jatropha curcas	Euphorbiaceae)	Root	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Mammea africana	Clusiaceae	Stem	AQS	*Pfk1*	28.57		Congo	Muganza *et al.* [76]
Mangifera indicus	Anacardiaceae	Leaf	Chloroform/MeOH (1:1)	*pf F32*		46.1 at 10	Cameroon	Harikrishna *et al.* [81]
Manniophyton fulvum	Euphorbiaceae	Leaf/root	AQS	*Pfk1*	22.44/>64		Congo	Muganza *et al.* [76]
Massularia acuminata	Rubiaceae	Stem	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Melia azedarach	Meliaceae	Leaves	MeOH/DCM	*pf3D7*	55.13/19.14		Congo	Lusakibanza *et al.* [77]
Melia azedarach	Meliaceae	Leaves	MeOH	*pf 3D7*	44.62		Congo	Frédérich *et al.* [83]

(Cond..)

Table 5: *(Continued...)*

Plant	Family	Part use	Solvents	Parasite	IC_{50} (μg/ml)	P.inhibition	Country	References
Mellotus appositofolius	Euphorbiaceae	Leaf	Chloroform/ MeOH (1:1)	*pf F32*		40 at 10	Cameroon	Harikrishna *et al.* [81]
Morinda morindoides	Rubiaceae	Leaf	EtOH/P.eth/ISal		94.2/1.8/15.3		Congo	Tona *et al.* [46]
Musanga cecropioides	Cecropiaceae	Stem	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Napoleona vogelii	Lecythidaceae	Stem	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Ocimum gratissimum	Lamiaceae	Leaf	AQS	*Pfk1*	7.25		Congo	Muganza *et al.* [76]
Penianthus longifolius	Menispermaceae	Root	AQS	*Pfk1*	27.10		Congo	Muganza *et al.* [76]
Physalis angulata	Solanaceae	Whole	MeOH/DCM/ AQS	*pf3D7*	1.27/1.96/ 23.10		Congo	Lusakibanza *et al.* [77]
Physalis angulata	Solanaceae	Whole plant	MeOH	*P.f3D7*	1.27		Congo	Frédérich *et al.* [77]
Picralima nitida	Apocynaceae	Stem	AQS	*Pfk1*	36.76		Congo	Muganza *et al.* [76]
Picralima nitida	Apocynaceae	Seed	Hex/MeOH	*pf W2*	129.6/10.9		Cameroon	Jean *et al.* [80]
Piper guineense	Piperaceae	Leaf/root/stem	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Piper umbellatum	Piperaceae	Leaf	chloroform/ MeOH (1:1)	*pf F32*		36.2 at 10	Cameroon	Harikrishna *et al.* [81]
Piptadeniastrum africanum	Leguminosae	Stem	AQS	*Pfk1*	6.11		Congo	Muganza *et al.* [76]
Polyalthia oliveri	Annonaceae	Stem	MeOH	-	4.30		Cameroon	Boyom *et al.* [83]
Polyalthia suaveolens	Annonaceae	Leaf/root back/ stem	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Pyrenacantha klaineana	Cacinaceae	Leaf	AQS	*Pfk1*	5.46		Congo	Muganza *et al.* [76]
Quassia africana	Simaroubaceae	Leaf/root back	AQS	*Pfk1*	0.46/1.27		Congo	Muganza *et al.* [76]
Schumanniophyton magnificum	Rubiaceae	Stem bark	Hex/MeOH	*78.1/ 28.7*	pf W2		Cameroon	Jean *et al.* [80]
Scorodophloeus zenkeri	Leguminosae	Root/stem back	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Staudtia kamerunensis	Myristicaceae	Stem back	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Strychnos icaja	Loganiaceae	Root	MeOH/DCM/ AQS	*pf3D7*	0.69/0.84		Congo	Lusakibanza *et al.* [77]
Strychnos icaja	Loganiaceae	Root bark	MeOH	*pf3D7*	0.69		Congo	Frédérich *et al.* [83]
Symphonia globulifera	Clusiaceae	Leaf	MeOH		4.1		Cameroon	Lenta *et al.* [82]
Tefracera pogge	Dilleniaceae	Leaf	EtOH/P.eth/ISal		36.9/1.7/21.8		Congo	Tona *et al.* [46]
Tetrapleura tetraptera	Leguminosae	Fruit/stem back	AQS	*Pfk1*	>64		Congo	Muganza *et al.* [76]
Tetrapleura tetraptera	Fabaceae	Back	MeOH	*pf FCB*	13.1		Gabon	Lekana-Douki *et al.* [84]
Thomandersia hensii	Acanthaceae	Leaf	AQS	*Pfk1*	41.12		Congo	Muganza *et al.* [76]
Thomandersia hensii	Acanthaceae	Stem bark	Hex/MeOH	*pfW2*	53.9/68.2		Cameroon	Jean *et al.* [80]
Triclisia dictyophylla	Menispermaceae	Leaf	Aqueous	*Pfk1*	5.13		Congo	Muganza *et al.* [76]

DCM: Dichloromethane, MeOH: Methanol, EtOH: Ethanol, HO: Hydroxide, AQS: Aqueous, ISal: Isoamyl alcohol, pf: *Plasmodium falciparum*, IC_{50}: Inhibitory concentration 50%

malarial symptoms rather than exerting direct antiplasmodial activity [61].

Anti-malarial Activity of Plants from North Africa

Appreciable amounts of plants were found in north Africa, out of the 79 plants found in this region only 4 plants had IC_{50} > 5 μg/ml (highly active), although IC_{50} not documented, 100% inhibition were documented for methanol extract from *Helianthus annus* seed at 4 μg/ml and methanol fruit extracts of senna alexandrina at 2 μg/ml [65], the activities demonstrated by this plants could be considered highly active if compared with the WHO guideline. However, Pet ether/chloroform extract from *Aerva javanica*, *Aristolochia bracteo-lata*, *Gardenia lutea*, *Citrullus colocynthis*, and *Nigella sativa* from Sudan show 100% parasite inhibition at 500 μg/ml [66]. Despite the significant parasite inhibition demonstrated by these plants, there activities could be classified under not active due to large dose of extract. A total of 23 compounds were isolated from north African plant, this extracts demonstrate interesting and varied antiplasmodial activities, however, the most noticeable activities is 3',4',7-trihydroxyflavone (IC_{50} = 0.078 μg/ml) from *Albizia zygia* against *Pfk1* [67].

Anti-malarial Activity of Plants from East Africa

Only 44 plants from East Africa were reviewed for *in vitro* activities against malarial parasite. 15 plants extracts reviewed from this region had IC_{50} > 5 μg/ml (highly active), 4 extracts had IC_{50} = 5-15 μg/ml (promising active), 32 extract had IC_{50} = 15-50 μg/ml (moderate active), while others were inactive (IC_{50} > 50 μg/ml).

Anti-malarial Activity of Plants from Central Africa

The majority of the plants grown in this region show very poor activities against *Plasmodium* parasite.

Out of 67 plants found to have been studied for anti-plasmodial (*in vitro*) activity in Central African, only 17 extracts from the plants demonstrate high antiplasmodial activity (IC_{50} value < 5 μg/ml). The most noticeable activities was demonstrated by AQS leaf extract of *Quassia africana* IC_{50} = 0.46 μg/ml [76] and methanol root back extract from *Strychnos icaj*a, IC_{50} = 0.69 μg/ml [77]. How ever 15 out of the 17 isolated compounds from central Africa were highly active (IC_{50} value < 5 μg/ml) against *Plasmodium*, the most

Table 6: Anti-malarial activity of isolated compounds from African plant

Compounds	Plant species	Family	Part used	Solvent	Pstrain	IC_{50} µg/ml	Country	References
1,2-didehydroancistrobertsonine D	*Ancistrocladus robertsoniorum*	Ancistrocladaceae	Leaves	MeOH	*PfK1/pf NF54*	1.4/5.0	Kenya	Bringmanna *et al.* [86]
1,3-deacetyldeoxyhavenensin	*Khaya anthotheca*	Meliaceae	Seed	Petroleum ether	*pf K1*		Uganda	Obbo *et al.* [87]
13_-*epi*-dioxiabiet-8 (14)-en-18-ol	*Hyptis suaveolens*	Lamiaceae	Leaf	Pet ether	*Pf*	0.1	South Africa	Chukwujekwu *et al.* [60]
1H-indole-5-carbaldehyde	*Monodora angolensis*	Annonaceae	Stem/root bark	-	*Pf K1*	>21	Tanzania	Nkunya *et al.* [88]
2,3,6-trihydroxy benzoic acid	*Sorindeia juglandifolia*	Anacardiaceae	Met	-	*Pf W2*	16.5	Cameroon	Raceline *et al.* [89]
2,3,6-trihydroxy methyl benzoate	*Sorindeia juglandifolia*	Anacardiaceae	Met	-	*Pf W2*	13	Cameroon	Raceline *et al.* [89]
2,6-dihydroxyfissinolide	*Khaya senegalensis*	Meliaceae	Back	-	*3D7*	0.12	Nigeria	Khalid *et al.* (1998)
3-(1,1-dimethyl-but-2-enyl)-5-(3-methyl-but-2-enyl)-1H-indole	*Isolona cauliflora*	Annonaceae	Stem/root bark	-	*Pf K1*	>21	Tanzania	Nkunya *et al.* [88]
3′,4′,7-trihydroxyflavone	*Albizia zygia*	Leguminosae	Back	DCM/MeOH.	*PfK1*	0.078	Sudan	Abdalla and Laatsch [67]
3-geranylindole	*Monodora angolensis*	Annonaceae	Stem/root bark	-	*Pf K1*	>21	Tanzania	Nkunya *et al.* [88]
3-O-methylfisetin (3′,4′, 7-trihydroxy-3-methoxyflavone	*Albizia zygia*	Leguminosae	Back	DCM/MeOH	*PfK1*	>0.078	Sudan	Abdalla and Laatsch, [67]
4′,7-dihydroxyflavanone	*Albizia zygia*	Leguminosae	Back	DCM/MeOH	*PfK1*	>0.078	Sudan	Abdalla and Laatsch, [67]
4-[3-(1,1-dimethyl-but-2-enyl)-1H-indol-5-yl]-but-3-en-2-one or caulidine B	*Isolona cauliflora*	Annonaceae	Stem/root bark	-	*Pf K1*	>21	Tanzania	Nkunya *et al.* [88]
4_-hydroxy-5,6,7,3_, 5_-pentamethoxyflavone	*Ageratum conyzoide*	Asteraceae	Aerial parts	MeOH	*Pfk1*	3.59	Sudan	Nour *et al.* [90]
5-(3-methyl-2-butenyl)-1H-indole and 5-(3-methylbuta-1, 3-dienyl)-1H-indole	*Isolona cauliflora*	Annonaceae	Stem/root bark	-	*Pf K1*	>21	Tanzania	Nkunya *et al.* [88]
5,6,7,3_,4_,5_-hexamethoxyflavone	*Ageratum conyzoide*	Asteraceae	Aerial parts	MeOH	*Pfk1*	2.99	Sudan	Nour *et al.* [90]
5,6,7,5_-tetramethoxy 3_, 4_-methylenedioxyflavone	*Ageratum conyzoide*	Asteraceae	Aerial parts	MeOH	*Pfk1*	4.26	Sudan	Nour *et al.* [90]
5,6,7,8,3_,4_, 5_-heptamethoxyflavone (5_-methoxynobiletine)	*Ageratum conyzoide*	Asteraceae	Aerial parts	MeOH	*Pfk1*	>5	Sudan	Nour *et al.* [90]
5,6,7,8,5_-pentamethoxy-3_, 4_-methylenedioxyflavone (eupalestin)	*Ageratum conyzoide*	Asteraceae	Aerial parts	MeOH	*Pfk1*	4.57	Sudan	Nour *et al.* [90]
6-(3-methyl-2-butenyl)-1H-indole-	*Monodora angolensis*	Annonaceae	Stem/root bark	-	*Pf K1*	>21	Tanzania	Nkunya *et al.* [88]
6-(3-methyl-but-2-enyl)-1, 3-dihydro-indol-2-one	*Monodora angolensis*	Annonaceae	Stem/root bark	-	*Pf K1*	21	Tanzania	Nkunya *et al.* [88]
6-(3methylbuta-1, 3-dienyl) 1H-indole	*Monodora angolensis*	Annonaceae	Stem/root bark	-	*Pf K1*	>21	Tanzania	Nkunya *et al.* [88]
6-(4-oxo-but-2-enyl)-1H-indole	*Monodora angolensis*	Annonaceae	Stem/root bark	-	*Pf K1*	>21	Tanzania	Nkunya *et al.* [88]
7,8,3′,5′-tetramethoxyisoflavan-1′,4′-quinone	*Abrus precatorius*	Fabaceae	Whole plant	DCM/MeOH (1:1)	*PfK1*	8.9	South Africa	Yoshie *et al.* [91]
7,9-dimethoxy-2, 3-methylenedioxybenzophenanthridine	*Zanthoxylum rubescens*	Rutaceae	Stem bark	MeOH: water (1:1)	*3D7/FCM29*	72.2/92.4	I.Coast	Penali *et al.* [92]
7-deacetylkhivorin	*Khaya anthotheca*	Meliaceae	Seed	Petroleum ether	*pf K1*	1.37	Uganda	Obbo *et al.* [87]
Abruquinone I	*Abrus precatorius*	Fabaceae	Whole plant	DCM/MeOH (1:1)	*PfK1*	20.4	South Africa	Yoshie *et al.* [91]
Abruquinone B	*Abrus precatorius*	Fabaceae	Whole plant	DCM/MeOH (1:1)	*PfK1*	4.1	South Africa	Yoshie *et al.* [91]
Abruquinone B	*Abrus precatorius*	Fabaceae	Aerial part	-	*Pfk1*	1.50	Nigeria	Limmatvapirat *et al.* [93]
Abruquinone G	*Abrus precatorius*	Fabaceae	Aerial part	-	*Pfk1*	1.50	Nigeria	Limmatvapirat *et al.* [93]
Abruquinone G	*Abrus precatorius*	Fabaceae	Whole plant	DCM/MeOH (1:1)	*PfK1*	>20	South Africa	Yoshie *et al.* [91]
Abruquinone H	*Abrus precatorius*	Fabaceae	Whole plant	DCM/MeOH (1:1)	*PfK1*	8.0	South Africa	Yoshie *et al.* [91]

(Cond..)

Table 6: *(Continued...)*

Compounds	Plant species	Family	Part used	Solvent	P.strain	IC_{50} µg/ml	Country	References
Akuammicine	*Picralima nitida*	Apocynaceae	Seed	EtOH	*D6*	0.45	Nigeria	Okokon *et al.* [27]
Akuammigine	*Picralima nitida*	Apocynaceae	Seed	EtOH	*W2*	0.530	Nigeria	Okokon *et al.* [27]
Akuammine	*Picralima nitida*	Apocynaceae	Seed	EtOH	*W2*	0.73	Nigeria	Okokon *et al.* [27]
Alstonine	*Picralima nitida*	Apocynaceae	Seed	EtOH	*D6*	0.95	Nigeria	Okokon *et al.* [27]
Ancistrobertsonine A	*Ancistrocladus robertsoniorum*	Ancistrocladaceae	Leaves	MeOH	*PfK1/pf NF54*	15.9/23.7	Kenya	Bringmanna *et al.* [86]
Ancistrobertsonines B	*Ancistrocladus robertsoniorum*	Ancistrocladaceae	Leaves	MeOH	*PfK1/pf NF54*	9/>23.0	Kenya	Bringmanna *et al.* [86]
Ancistrobertsonines C	*Ancistrocladus robertsoniorum*	Ancistrocladaceae	Leaves	MeOH	*PfK1/pf NF54*	4.5/10.1	Kenya	Bringmanna *et al.* [86]
Ancistrobertsonines D	*Ancistrocladus robertsoniorum*	Ancistrocladaceae	Leaves	MeOH	*0/4.8*	0/4.8	Kenya	Bringmanna *et al.* [86]
Ancistrobrevine B	*Ancistrocladus robertsoniorum*	Ancistrocladaceae	Leaves	MeOH	*PfK1/pf NF54*	20/4.7	Kenya	Bringmanna *et al.* [86]
Annonidine F	*Monodora angolensis*	Annonaceae	Stem/root bark	-	*Pfk1*	21	Tanzania	Nkunya *et al.* [88]
Arborinine	*Teclea trichocarpa*	Rutaceae	Leaves	MeOH	*Pfk1*	1.61	Kenya	Mwangi *et al.* [94]
Bis[6-(5,6-dihydrochelerythrinyl)] ether	*Zanthoxylum rubescens*	Rutaceae	Stem bark	MeOH: AQS (1:1)	*3D7/FCM29*	15.3/14.9	I.Coast	Penali *et al.* [92]
Cajachalcone	*Cajanus cajan*	Fabaceae	Leaves	Ethyl acetate	*Pfk1*	2.0	Nigeria	Ajaiyeoba *et al.* [95]
Cassiarin A	*Cassia siamea*	Fabaceae	Leaves	Ammonium acetate	*Pfk1*	0.020	Nigeria	Oshimi *et al.* [96]
Castalagin	*Terminalia avicennoides and Anogeissus leiocarpus*	Combretaceae	Stem bark	Met	*3D7/K1*	10.57/9.63	Nigeria	Shuaibu *et al.* [36]
Chelerythine	*Zanthoxylum chalybeum*	Rutaceae	Root bark	EtOH	*Pf 3D7*	1.35	Rwanda	Muganga *et al.* [74]
Chrysopentamin	*Strychnos usambarensis*	Loganiaceae	Leaves	EtOAc	*Pf 3D7*	579	Rwanda	Frédérich *et al.* [97]
Cinerin II	*Chrysanthemum cinerariifolium*	Asteraceae	Flower	n-hexane	*PfK1*	5.8	South Africa	Yoshie *et al.* [91]
Cryptolepine	*Cryptolepis sanguinolenta*	Periplocaceae	Root	Aqueous	*Pfk1*	0.44	Nigeria	Augustine *et al.* [98]
Cryptolepine	*Sida acuta*	Malvaceae	Leaf	Met	*Pfk1*	0.114	Nigeria	Frederich *et al.* [99]
Cryptolepine	*Cryptolepis sanguinolenta*	Periplocaceae	Leaves	EtOH	*Pfk1*	0.23	Guinea-Bissau	Paulo *et al.* [100]
Cryptolepinoate	*Cryptolepis sanguinolenta*	Periplocaceae	Roots	EtOH	*Pfk1*	<23	Guinea-Bissau	Paulo *et al.* [100]
Cryptolepinoic acid	*Cryptolepis sanguinolenta*	Periplocaceae	Roots	EtOH	*Pfk1*	<23	Guinea-Bissau	Paulo *et al.* [100]
Cynaropicrin	*Vernonia mespilifolia*	Asteraceae	Leaves	DCM/MeOH	*Pf NF*	1.56	South Africa	Makoka *et al.* [62]
Dioncopeltine A	*Triphyophyllum peltatum*	*Dioncophyllaceae*	Stem bark	DCM-NH3	-	0 (*in vivo*) 50 mg/kg	I.Coast	Francois *et al.* [101]
Dioncopeltine A	*Triphyophyllum peltatum*	*Dioncophyllaceae*	Stem bark	DCM-NH3	-	49 (*in vivo*) 50 mg/kg	I.Coast	Francois *et al.* [101]
Dioncophylline B	*Triphyophyllum peltatum*	*Dioncophyllaceae*	Stem bark	DCM-NH3	-	47 (*in vivo*) 50 mg/kg	I.Coast	Francois *et al.* [101]
Dioncophylline C	*Triphyophyllum peltatum*	*Dioncophyllaceae*	Stem bark	DCM-NH3	-	100(*in vivo*) 50 mg/kg	I.Coast	Francois *et al.* [101]
Eburnamine	*Pleiocarpa mutica*	Apocynaceae	Root	MeOH	*Pfk1*	163.3	Ghana	Jonathan *et al.* [35]
Ellagic acid	*Alchornea cordifolia*	Euphorbiaceae	Leaf	Eth	*FcM29*	0.08	Nigeria	Banzouzi *et al.* [30]
Ellagic acid	*Terminalia avicennoides and Anogeissus leiocarpus*	Combretaceae	Stem bark	Met	*3D7/K1*	12.14/11.2	Nigeria	Shuaibu *et al.* [36]
Emodin	*Cassia siamea*	Fabaceae	Stem bark	Ethylacetate	*Pfk1*	5.00	Nigeria	Ajaiyeoba *et al.* [102]
Fagaronine	*Fagara zanthoxyloides*	Rutaceae	Root	Aqeou	*3D7*	0.018	Nigeria	Kassim *et al.* [29],
Feruraldehyde	*Keetia leucantha*	Rubiaceae	Twigs	DCM	*P.f 3D7*	>100	Benin	Bero *et al.* [103]
Flavogallonic acid	*Terminalia avicennoides and Anogeissus leiocarpus*	Combretaceae	Stem bark	Met	*3D7/K1*	8.889/ 8.35	Nigeria	Shuaibu *et al.* [36]
Fr2	*Terminalia avicennoides and Anogeissus leiocarpus*	Combretaceae	Stem bark	Met	*3D7/K1*	9.98/ 21.83	Nigeria	Shuaibu *et al.* [36]
Gedunin	*Azadiracta indica*	Meliaceae	Leaf	Met	*W2*	0.02	Nigeria	Saxena *et al.* [28]
Gedunin	*Khaya grandifoliola*	Meliaceae	Stem back	Met	*W2*	1.25	Nigeria	Agbedahunsi *et al.* [104]
Grandifolione	*Khaya anthotheca*	Meliaceae	Seed	Petroleum ether	*pf K1*	0.73	Uganda	Obbo *et al.* [87]

(Cond..)

Table 6: *(Continued...)*

Compounds	Plant species	Family	Part used	Solvent	P.strain	IC_{50} µg/ml	Country	References
Guieranone A	*Guiera senegalensis*	Combrataceae	Root	DCM	*PfW2*	1.29	B.Faso	Julien *et al.* [105]
Harmalan	*Guiera senegalensis*	Combrataceae	Root	DCM	*PfW2*	22.43	B.Faso	Julien *et al.* [105]
Harman	*Guiera senegalensis*	Combrataceae	Root	DCM	*PfW2*	3.29	B. Faso	Julien *et al.* [105]
Hydroxybenzaldehyde	*Keetia leucantha*	Rubiaceae	Twigs	DCM	*P.f*	>100	Benin	Bero *et al.* [103]
Hydroxycryptolepine	*Cryptolepissanguinolenta*	Periplocaceae	Leaves	Chlorophorm	*Pf K1*	<23	Guinea-Bissau	Paulo *et al.* [100]
Isostrychnopentamine	*Strychnos usambarensis*	Loganiaceae	Leaves	EtOAc	*pf FCA 20*	120	Rwanda	Frédérich etal., 2004
Jasmolin I	*Chrysanthemum cinerariifolium*	Asteraceae	Flower	n-hexane	*PfK1*	5.3	South Africa	Yoshie *et al.* [91]
Jasmolin II	*Chrysanthemum cinerariifolium*	Asteraceae	Flower	n-hex	*PfK1*	5.0	South Africa	Yoshie *et al.* [91]
Jatrorrhizine	*Penianthus longifolius*	Menispermaceae	Stem bark	-	*PfK1*	0.35	Cameroon	Bilda *et al.* [79]
Kopsinine	*Pleiocarpa mutica*	Apocynaceae	Root	MeOH	*PfK1*	>200	Ghana	Jonathan *et al.* [35]
Lemairamide	*Zanthoxylum rubescens*	Rutaceae	Stem bark	MeOH: water (1:1)	*3D7/FCM29*	89.7/101.1	I.Coast	Penali *et al.* [92]
Liriodenine	*Glossocalyx brevipes*	Siparunaceae	Leaf	-	*Pf D6*	2.37	Cameroon	Mbah *et al.* [106]
Lup-20 (29)-en-3-ol	*Albizia zygia*	Leguminosae	Back	DCM/MeOH	*PfK1*	>0.078	Sudan	Abdalla and Laatsch, [67]
Lupeol	*Cassia siamea*	Fabaceae	Leaf	Ethylacetate	*Pfk1*	5.00	Nigeria	Ajaiyeoba *et al.* [102]
Melicopicine	*Teclea trichocarpa*	Rutaceae	Leaves	MeOH	*Pfk1*	12.45	Kenya	Mwangi *et al.* [94]
Methyl canadine	*Zanthoxylum chalybeum*	Rutaceae	Root bark	EtOH	*Pf 3D7*	2.01	Rwanda	Muganga *et al.* [74]
Nitidine	*Zanthoxylum chalybeum*	Rutaceae	Root bark	EtOH	*Pf 3D7*	0.17	Rwanda	Muganga *et al.* [74]
N-nornitidine	*Zanthoxylum rubescens*	Rutaceae	Stem bark	MeOH: water (1:1)	*3D7/FCM29*	Inactive	I.Coast	Penali *et al.* [92]
Normelicopicine	*Teclea trichocarpa*	Rutaceae	Leaves	MeOH	*Pfk1*	4.45	Kenya	Mwangi *et al.* [94]
Oleanolic acid	*Keetia leucantha*	Rubiaceae	Twigs	DCM	*P.f 3D7*		Benin	Bero *et al.* [103]
palmitine	*Penianthus longifolius*	Menispermaceae	Stem bark	-	*Pfk1*	0.23	Cameroon	Bilda *et al.* [79]
Picraline	*Picralima nitida*	Apocynaceae	Seed	EtOH	*W2*	0.66	Nigeria	Okokon *et al.* [27]
Picranitidine	*Picralima nitida*	Apocynaceae	Seed	EtOH	*W2*	0.038	Nigeria	Okokon *et al.* [27]
Picratidine	*Picralima nitida*	Apocynaceae	Seed	EtOH	*D6*	0.017	Nigeria	Okokon *et al.* [27]
Pleiocarpamine	*Pleiocarpa mutica*	Apocynaceae	Root	MeOH	*pf K1*	17.6	Ghana	Jonathan *et al.* [35]
Pleiocarpine	*Uvaria chamae*	Apocynaceae	Root	MeOH	*pf K1*	>200	Ghana	Jonathan *et al.* [35]
Pleiomutinine	*Pleiocarpa mutica*	Apocynaceae	Root	MeOH	*pf K1*	5.2	Ghana	Jonathan *et al.* [35]
Punicalagin	*Terminalia avicennoides and Anogeissus leiocarpus*	Combretaceae	Stem bark	Met	*3D7/K1*	9.42/8.779	Nigeria	Shuaibu *et al.* [36]
Pyrethrin I	*Chrysanthemum cinerariifolium*	Asteraceae	Flower	n-hexane	*PfK1*		South Africa	Yoshie *et al.* [91]
Pyrethrin II	*Chrysanthemum cinerariifolium*	Asteraceae	Flower	n-hexane	*PfK1*	4.0	South Africa	Yoshie *et al.* [91]
Quindoline	*Cryptolepis sanguinolenta*	Periplocaceae	Leaves	EtOH	*Pf K1*	<23	Guinea-Bissau	Paulo *et al.* [100]
Samaderines B	*Quassia indica*	Simaroubaceae	Stem	-	*PFK1*	0.071	Nigeria	Kitagawa *et al.* [26]
Samaderines E	*Quassia indica*	Simaroubaceae	Stem	-	*PFK1*	0.210	Nigeria	Kitagawa *et al.* [26]
Samaderines X	*Quassia indica*	Simaroubaceae	Stem	-	*PFK1*	0.015	Nigeria	Kitagawa *et al.* [26]
Samaderines Z	*Quassia indica*	Simaroubaceae	Stem	-	*PFK1*	0.071	Nigeria	Kitagawa *et al.* [26]
Schkuhrin I	*Schkuhria pinnata*	Asteraceae	Whole	DCM/MeOH	*Pf NF-54*	2.05	South Africa	Makoka *et al.* [62]
Schkuhrin II	*Schkuhria pinnata*	Asteraceae	Whole	DCM/MeOH	*Pf NF*	1.67	South Africa	Makoka *et al.* [62]
Scopoletin	*Keetia leucantha*	Rubiaceae	Twigs	DCM	*P.f 3D7*	>100	Benin	Bero *et al.* [103]
Simalikalactone D	*Quassia amara*	Simaroubaceae	Stem		*FcB1*	0.010	Nigeria	Bertani *et al.* [25]
Skimmianine	*Teclea trichocarpa*	Rutaceae	Leaves	MeOH	*Pfk1*	5.60	Kenya	Mwangi *et al.* [94]
Stigmasterol	*Keetia leucantha*	Rubiaceae	Twigs	DCM	*P.f 3D7*	>100	Benin	Bero *et al.* [103]
Strychnopentamine	*Strychnos usambarensis*	Loganiaceae	Leaves	EtOAc	*117*	pf FCA 20	Rwanda	Frédérich *et al.* [97]
Tagitinin C	*Tithonia diversifola*	Asteraceae	Leaves	-	*FCA*	0.330	Nigeria	Goffin *et al.* (2002)
TCA1	*Cassia alata*	Caesalpiniaceae	Leaves	DCM	*P.f*	0.94	Congo	Kayembe *et al.* [78]
TCA2	*Cassia alata*	Caesalpiniaceae	Leaves	DCM	*P.f*	0.23	Congo	Kayembe *et al.* [78]

(Cond..)

Table 6: *(Continued...)*

Compounds	Plant species	Family	Part used	Solvent	P.strain	IC_{50} µg/ml	Country	References
TCA3	*Cassia alata*	Caesalpiniaceae	Leaves	DCM	*P.f*	0.44	Congo	Kayembe *et al.* [78]
TCA4	*Cassia alata*	Caesalpiniaceae	Leaves	DCM	*P.f*	0.52	Congo	Kayembe *et al.* [78]
Terchebulin	*Terminalia avicennoides and Anogeissus leiocarpus*	Combretaceae	Stem bark	Met	*3D7/K1*	8.89/8.49	Nigeria	Shuaibu *et al.* [36]
Tetrahydroharman	*Guiera senegalensis*	Combrataceae	Root	DCM	*PfW2*	8.56	Burkina Faso	Julien *et al.* [105]
TOG1	*Ocimum gratissimum*	Lamiilaceae	Leaves	DCM	*P.f*	0.32	Congo	Kayembe *et al.* [78]
TOG2	*Ocimum gratissimum*	Lamiilaceae	Leaves	DCM	*P.f*	0.27	Congo	Kayembe *et al.* [78]
TOG3	*Ocimum gratissimum*	Lamiilaceae	Leaves	DCM	*P.f*	1.41	Congo	Kayembe *et al.* [78]
TOG4	*Ocimum gratissimum*	Lamiilaceae	Leaves	DCM	*P.f*	3.96	Congo	Kayembe *et al.* [78]
TOG5	*Ocimum gratissimum*	Lamiilaceae	Leaves	DCM	*P.f*	0.44	Congo	Kayembe *et al.* [78]
TOG6	*Ocimum gratissimum*	Lamiilaceae	Leaves	DCM	*P.f*	0.65	Congo	Kayembe *et al.* [78]
TOG7	*Ocimum gratissimum*	Lamiilaceae	Leaves	DCM	*P.f*	0.52	Congo	Kayembe *et al.* [78]
Urosilic acid	*Morinda lucida*	Rubiaceae	Leaves	-	*Pf*	3.1	Nigeria	Cimanga *et al.* [55]
Ursolic acid	*Keetia leucantha*	Rubiaceae	Twigs	DCM	*P.f 3D7*	14.8	Benin	Bero *et al.* [103]
Vanillin	*Keetia leucantha*	Rubiaceae	Twigs	DCM	*P.f 3D7*	>100	Benin	Bero *et al.* [103]
Zanthomamide	*Zanthoxylum rubescens*	Rutaceae	Stem bark	MeOH: water (1:1)	*3D7/FCM29*	133.8/149.9	I.Coast	Penali *et al.* [92]
α-Amyrin	*Teclea trichocarpa*	Rutaceae	Leaves	MeOH	*Pfk1*	0.96	Kenya	Mwangi *et al.* [94]
β–Sitosterol	*Teclea trichocarpa*	Rutaceae	Leaves	MeOH	*Pfk1*	8.20	Kenya	Mwangi *et al.* [94]

DCM: Dichloromethane, MeOH: Methanol, EtOH: Ethanol, HO: Hydroxide, AQS: Aqueous, ISal: Isoamyl alcohol, pf: *Plasmodium falciparum*, IC_{50}: Inhibitory concentration 50%

Table 7: *In vivo* antiplasmodial activities of African plants

Plants	Family	Part	Dose (mg/kg)	Solvent	Model	% Inhibition	Survival days	Parasite	Country	References
Pyrenacantha staudtii	Icacinaceae	Leaf	100/200/500	Aqueous	Sup	61/63.4/58.0		p.b	Nigeria	Olorunniyi and Morenikeji [107]
Morinda lucida	Rubiaceae	Root	400	Met	Cur	-	29	p.b	Nigeria	Umar *et al.* [108]
Phytolacca dodecandra	Phytolacaceae	Leaves	100/200/400	Meth	Cur	18/50/55		p.b	Ethiopia	Adinew [109]
Olea europaea	Oleaceae	Leaf	40/80/120	Etha		30/55/80	-	p.b	Nigeria	Akanbi [110]
Acacia auriculiformis	Fabaceae	Leaf	350/700/1050	Eth	Sup	69/72/76	15/18/20	p.b	Nigeria	Okokon *et al.* [111]
Acacia nilota	Leguminoseae	Roots	300	Hex/EtlC/MeOH	Cur	71/50/66	-		Nigeria	Jigam *et al.* [112]
Adansonia digitata	Malvaceae	Stem bark	100	AQS/org	Sup	60.47/32.90	20	p.b	Kenya	Musila *et al.* [113]
Ageratum conyzoides	Asteraceae	Leaf	100/200/400	AQS	Sup	70.49/82.20/89.87		p.b	Nigeria	Victoria *et al.* [114]
Ageratum conyzoides	Asteraceae	Leaves	400	AQS/hex/chlo	Sup	89.87/61.74/52.61		p.b	Nigeria	Victoria *et al.* [114]
Alstonia boonei	Apocynaceae	Root back	200	Met	Sup/prop/cur	62.2/58.8/66.4	-	p.b	Nigeria	Onwusonye and Uwakwe [115]
Amaranthus spinosus	Amaranthaceae	Stem	200	Water	Sup	789.36	-	p.b	Burkina Faso	Hilou *et al.* [116]
Anthocleista grandiflora	Gentianaceae	Stem bark	300/500/700	Met	Supprsive	14/32/68		p.b	Nigeria	Odeghe *et al.* [116]
Anthocleista vogelii	Loganiaceae	Stem	100/200/400	Eth	Sup	48.5/78.5/86.6%		p.b	Nigeria	Lebari *et al.* [117]
Artocarpus altilis	Moraceae	Stem bark	ED50	-	Pro/sup/cur	ED50214.2/ 227.2/310.2	-	p.b	Nigeria	Adebajo *et al.* [118]
Aspilia africana	Asteraceae	Leaf	100/200/ 400 mg/kg	Eth	Suppressie	79.42/84.28/92.23	22/25/28 days	p.b	Nigeria	Christian *et al.* [119]
Aspilia africana	Asteraceae	Leaf	100/200/400	Et	Sup	22/25/28	-	p.b	Nigeria	Akuodor *et al.* [121]

(Cond..)

Table 7: *(Continued...)*

Plants	Family	Part	Dose (mg/kg)	Solvent	Model	% Inhibition	Survival days	Parasite	Country	References
Azadiracta indica	Meliaceae	Leaf/back	800	AQS	Sup	79.6/68.2	-	*Py*	Nigeria	Isah *et al.* [122]
Bombax buonopozense	Bombacaceae	Leaf	200/400/600	Met	Sup/cur	65/78/86	25/28/29	p.b	Nigeria	Akuodor *et al.* [120]
Bridelia ferruginea	Euphorbiaceae	Bark	400	Methanol	Pro/sup/cura	-	26/16/27	p.b	Nigeria	Kolawole and Adesoye, [123]
Byrsocarpus coccineus	Connaraceae	Leaf	100, 200 and 400	Met	Cur/sup	81/88/92	20/22/26	p.b	Nigeria	Joseph *et al.* [124]
Calpurnia aurea	Fabaceae	Leaf	60	Hydromethanol	Sup, cur and pro	51.15, 47.77 and 36.8%	9.6/10/8	p.b	Ethiopia	Mebrahtu *et al.* [125]
Canthium glaucum	Rubiaceae	Root	100 mg/kg/day	Aq/org	Sup	31.98/43.76	20	p.b	Kenya	Musila *et al.* [113]
Cassia singueana	Fabaceae	Root	50/100/150/200	MeOH		48.22/66.51/79.06/80.45			Nigeria	Adzu *et al.* [126]
Cassia singueana	Fabaceae	Roots	50/100/200	MeOH	Sup	48/66/79	-	p.b	Nigeria	Adzu *et al.* [126]
Cassia singueana	Fabaceae	Bark	200/400/800	EtOH	Sup	37/72/90		p.b	Nigeria	Lydia *et al.* [127]
Catha edulis	Celasteraceae	Leaf	1000	MeOH	Supp	13.7		p.b	Ethiopia	Tsige *et al.* [128]
Chrozophora senegalensis	Euphorbiaceae	Whole	75	EtOH	Sup	51.80%	-	p.b	Nigeria	Jigam *et al.* [129]
Chrysophyllum albidum	Sapotaceae	Bark	1000/1500	MeOH	Sup	74.20/62.90%		p.b	Nigeria	Adewoye *et al.* [127]
Cissampelos mucronata	Menispermaceae	Leaf	200	EtOH	Sup/cur/pro	68.4/60.0/73.7%	-	p.b	Nigeria	Katsayal and Obamiro, [128]
Clerodendrum violaceum	Verbenaceae	Leaf	13	EtOH	Supp	100 after 21 days		p.b	Nigeria	Balogun *et al.* [129]
Crateva adansonii	Capparaceae	Leaves	200/400/600	MeOH	Cur	0.00/37.71/40.41			Nigeria	Tsado *et al.* [130]
Croton macrostachyus	Euphorbiaceae	Leaf	200/400	MeOH	Sup	39/69	6/7 days	p.b	Ethiopi	Laychiluh *et al.* [131]
Croton zambesicus	Clusiaceae	Root	81/57/57	EtOH/n-Hex/DCM	Sup	86.18/57.88/75.39	-	p.b	Nigeria	Okokon and Nwafor, [132]
Cryptolepis sanguinolenta	Apocyanaceae	Leaf	36	AQS	Sup	25	-	p.b	Nigeria	Augustine *et al.* [98]
Cymbopogon citratus	Poaceae	Leaf	200/400/800	EtOH	Sup/cur/pro	82,84,99/66,74,83/43,56,70	-	p.b	Nigeria	Uraku *et al.* [133]
Cymbopogon citrutus	Poaceae	Bark	200/400/800	EtOH	Sup	50/77/100	-	p.b	Nigeria	Lydia *et al.* [127]
Dicliptera verticillata	Acanthaceae	Leaf	290/580/870	Ethanol	Sup	59.14/70.67/83.66	--	p.b	Nigeria	Ettebong *et al.* [134]
Dodonaea angustifolia	Sapindaceae	Seed	600	AQS/met	Cur	62.02/86.21%	11.3/11.25	-	Ethiopia	Andualem, [135]
Dodonaea angustifolia	Sapindaceae	Seed	100 mg/kg	AQS/butanol	Sup	35.79/48.6		p.b	Ethiopia	Berhan *et al.* [136]
Eleucine indica	Poaceae	Leave	600	Etha	Sup/pro	64.67/56.34	27	p.b	Nigeria	Ettebong *et al.* [137]
Enantia chlorantha	Annonaceae	Stem bark	-	-	Sup	317.9	-	p.b	Nigeria	Adebajo *et al.* [118]
Entada abyssinica	Fabaceae	Leaves	600	AQS/met		39.2/66.4	11.45/11.65		Ethiopia	Andualem, [135]
Faidherbia albida	Fabaceae	Stem bark	100/200/400	Eth	Sup	24/72/89	-	p.b	Nigeria	Sulaiman *et al.* [137]
Ficus platyphylla	Moraceae	Stem bark	300	Ethanol	Sup	43.50	28	p.b	Nigeria	Isma'il *et al.* [138]
Flacourtia indica	Flacourtiaceae	Leaves	100	AQS/org	Sup	0.2/87	7/8.6	pf ANKA	Kenya	Caroline *et al.* [139]
Hoslundia opposita	Lamiaceae	Roots	100	AQS/org	Sup	90/41	9.2/9.6	pf ANKA	Kenya	Caroline *et al.* [139]
Hyptis spicigera	Lamiaceae	Leaf	200/400/800	Eth	Sup/cur/pro	55,83 and 94/82, 96,96/53, 57, 70		p.b	Nigeria	Uraku *et al.* [133]
Hyptis suaveolens	Lamiaceae	Leaf	10/25/50	Eth	Sup/cur	22.39 and 6.06/33.69 and 10.22/42.76 and 18.03		p.b	Nigeria	Dawet *et al.* [140]
Languas galanga	Zingiberaceae	Rhizome	400	Methanol	Sup/cur/pro	65/67/52		p.b	Nigeria	Abdulelah *et al.* [141]
Launaea cornuta	Asteraceae	Leaf	100 mg/kg/day	AQS/org	Sup	38.13/31.04	0	p.b	Kenya	Musila *et al.* [113]
Lecaniodiscus cupanioides	Sapindaceae	Root	50/150/250	AQS	Sup	70/10/20%	17/19/17 days	p.b	Nigeria	Nafiu *et al.* [142]
Lippia multiflora	Verbanaceae	Leaf	200/400	Meta	Cur	13.35% and 50.94		p.b	Nigeria	Jigam *et al.* [143]
Momordica balsamina	Cucurbitaceae	Leaf	200/600	Hexane/ethylacetat/met	Sup	13.78 and 9.41/28.08 and 27.29/45.21 and 53.07		p.b	Nigeria	Jigam *et al.* [144]
Morinda lucida	Rubiaceae	Leaves	200	Eth/meth/pet chl	Sup	63/68/72	-	p.b	Nigeria	Cimanga *et al.* [55]
Morinda lucida	Rubiaceae	Root	100/200/400	Met	Sup/cur	56/59/67	18/20/23	p.b	Nigeria	Umar *et al.* [145]
Morinda morindiodes	Rubiaceae	Leaf/stem/root	100	Met/AQS	Sup	-	21.5 and 17.5/16.5/19.5 and 21.5	p.b	Nigeria	Soniran *et al.* [146]

(Cond..)

Table 7: *(Continued...)*

Plants	Family	Part	Dose (mg/kg)	Solvent	Model	% Inhibition	Survival days	Parasite	Country	References
Moringa oleifera	Moringaceae	Seed	50/100/ 200 ml/kg	n-hexane/ ethanolic		61%/70%/97% (n-hexane) and 61%/65%/100%(eth)		p.b	Nigeria	Olasehinde *et al.* [147]
Murraya koenigii	Rutaceae	Leaf	ED50	-	Pro/sup/cur	ED50195.6/287.1/252.4	-	p.b	Nigeria	Adebajo *et al.* [118]
Nauclea latifolia	Rubiaceae	Root	ED50	-	Pro/sup/cur	ED50189.4/279.3/174.5	-	p.b	Nigeria	Adebajo *et al.* [118]
Ocimum basilicum	Lamiaceae	Leaf	200/400/800	Eth	Sup/cur/pro	50,58,76/61,69,82/34,45,60		p.b	Nigeria	Uraku *et al.* [133]
Ocimum gratissimum	Lamiaceae	Leaves	100	AQS/org	Sup	17/88	8.2/9.6	pf ANKA	Kenya	Caroline *et al.* [139]
Olea europaea	Oleaceae	Root	40/80/120	Eth	Cur	33.4%, 59.0% and 79.1%	-	p.b	Nigeria	Osheke *et al.* [148]
Otostegiaintegrefolia	Lamiaceae	Leaf	800	Met/aqueous/ chloroform	Sup	56.77/44.45/39.16	-	p.b	Ethiopia	Solomon, [149]
Paullinia pinnata	Sapindaceae	Leaves	12.5/25/50	Ethanol	Cur	53/69/69	-	p.b	Nigeria	Maje *et al.* [150]
Pedilanthus tithymaloides	Euphorbiaceae	Latex	25/5/10% w/v		Cur	36.29/69.35/79.03	-	p.b	Nigeria	Adzu *et al.* [151]
Phyllanthus fraternus	Euphorbiaceae	Leaf	50/100/200	Aqueous	Cur	77.23%, 85.15% and 86.39%	-	p.b	Nigeria	Matur *et al.* [152]
Pseudocedrala kotschyi	Meliaceae	Leaf	100-400	Etha	Sup	71/90/91	-	p.b	Nigeria	Akuodor *et al.* [153]
Pseudocedrela kotschyi	Meliaceae	Leaf	200	Eth/teeth/aqueous	Supp	39.43/26.99/28.36	-	p.b	Nigeria	Dawet and Yakubu, [154]
Quassia amara	Simaroubaceae	Leaves	200	Hex	Sup	0.05 p.density	-	p.b	Nigeria	Ajaiyeoba *et al.* [155]
Quassia undulata	Simaroubaceae	Leaves	200	Hex	Sup	0.16 p.density	-	p.b	Nigeria	Ajaiyeoba *et al.* [155]
Salacia senegalensis	Celestraceae	Leaves	1000/1200/ 1400	Meth	Sup/pro/cur	66.47 and 80.33/66.57 and 75.41/64.90 and 82.72	-	p.b	Nigeria	Adumanya *et al.* [156]
Smilax krausiana	Smilaceae	Root	72	Ethano	Sup/pro	62.68/51.6	-	p.b	Nigeria	Jude *et al.* [156]
Solanum incanum	Solanaceae	Leaves	100	Aqe/org	Sup	14/31	8.8/8	pf ANKA	Kenya	Caroline *et al.* [139]
Sphenocentrum jollyanum	Menispermaceae	Root/leaf	200 mg/kg	Met		74.4/54.1		p.b	South Africa	Olorunnisola and Afolayan, [157]
Spilanthes uliginosa	Compositae	Leaf	200/400/800	EtOH	Sup/cur/pro	50,58 and 76/59, 70, 80/ 32, 47, 55		p.b	Nigeria	Uraku *et al.* [133]
Stachytarphets cayennensia	Verbenaceae	Leaf	90/80/170	EtOH	Sup	64/77/78		p.b	Nigeria	Okokon *et al.* [158]
Striga hermonthica	Orobanchaceae	Whole	400	Met	Sup	68.5	-	p.b	Nigeria	Okpako and Ajaiyeoba, [39]
Tapinanthus sessilifolius	Lorantheciae	Leaf	400	Met	Sup	51.3	-	p.b	Nigeria	Okpako and Ajaiyeoba, [39]
Tetrapleura tetraptera	Fabaceae	Fruit	900	EtOH	Sup	76.37	-	p.b	Nigeria	Okokon *et al.* [159]
Trichilia emetica	Meliaceae	Leaves	300	Hexane/methanol	Sup	79.19/95.83	-	p.b	Nigeria	Sulaiman *et al.* [137]
Trichilia emetica	Meliaceae	Leaf	300	Hex/MeOH	Sup	79.19/95.83		p.b	Nigeria	Ijeoma *et al.* [160]
Uvariopsis congolana	Amaranthaceae	Stem/leaf		MeOH		4.47/4.57		p.b	B.Faso	Hilou *et al.* [116]
Vernonia amygdalina	Asteraceae	Leaf	200/400/600	Met	Sup	17.15/35/58.24	-	p.b	Nigeria	Madaki [161]
Zanthoxylum chalybeum		Stem bark	100	Aq/org	Sup	44.93/27.56	20	p.b	Kenya	Musila *et al.* [113]

DCM: Dichloromethane, MeOH: Methanol, EtOH: Ethanol, HO: Hydroxide, AQS: Aqueous, ISal: Isoamyl alcohol, pf: *Plasmodium falciparum*

noticeable compounds were TCA1 to TCA4 isolated from DCM leaf extract of *Cassia alata* and TOG1 to TOG7 isolated from DCM extracts of *Ocimum gratissimum* from Congo [78], as well as palmitine from stem bark extract of *Penianthus longifolius* from Cameroon [79], all these compounds excerpt there *in vitro* antimalarial activities with $IC_{50} < 1$ μg/ml.

African Plants with Ameliorative Effects on Plasmodial-Induced Pathological Changes

Histopathology

Methanol bark extract of *Chrysophyllum albidum* (750-1500 mg/kg/day) exhibited significant antiplasmodial effects both. The extract also ameliorated the liver pathological symptoms of enlarged liver, hepatocellular necrosis, aggregations of periportal mononuclear cell, and Kup-ffer cell hyperplasia that were severe in the untreated mice [129].

Histological study of kidney and pancreas of *P. berghei* infected rat treated with *Mormodiaca charantia* (100 mg/kg) revealed and mild atropy of the glomeruli and mild degeneration of the islet of langerhan as oppose to severe degeneration observed in untreated controls [131]. *Aframomum sceptrum* leaf extract (350 mg/kg) shows moderately brought central vein, hepatic cell with preserved cytoplasm and prominent nucleus as oppose to severe effect expressed by the parasitized untreated mice [163]. Histological study on *P. berghei* parasitized rats treated with methanol extract from leaves of *Acalypha wilkesiana* reveals that the extract may excerpt meso hepatoprotective effect during malarial infection as there were no observable cellular defects on the liver histo-structure as observed in there untreated control [164].

Liver photomicrograph study of *Plasmodium berghei* infectedmice treated with ethanol extract from stem bark of *Ficus platyphylla at* 300 mg/kg shows the clearance of K¨upffer's cells-laden malaria pigment and normal lobular architecture as opposed to the dilated hepatic sinusoids congested with hypertrophied, K¨upffer's cells-laden malaria pigment and parasitized red blood cells that were observed in untrated mice. The extracts also produced chemosuppression of 43.50% and increase the life span of the mice (28 days) [141].

Biochemical parameters

Methanol bark extract of *Chrysophyllum albidum* has been reported to prevented hyperproteinemia due to hyperglobulinaemi in *P. berghei* parasitized mice (Adewoye *et al.*, 2010). According to Ketema *et al.* [128], administration of at 300 mg/kg to *P. berghei* infected rats significantly elevated the activites of serum aspartate aminotransferase (AST), alanine transaminase (ALT) and decrease albumin level compare to the controls. There reports could be translated that administration of that following malarial infection could increase the risk of jaundice or jeopardized the integrity of renal and liver functions.

Recently, Akanbi, [109], investigated AST, ALT, and ALP activities in heart and liver of *P. berghei* parasitized mice treated with *Anogeissus leiocarpus* methanol extract at 100 and 200 mg/kg. There results revealed that the extract at 200 mg/kg was not able to prevent the parasite induced alteration in the organs (heart and liver) ALP, ALT, and AST activities. However, the activities reported at 100 mg/kg were comparable with the normal control mice. These findings could be explained by our earlier discussion, that natural products excert dose dependent effect, the extract A. *leiocarpus* at 100 mg significantly prevented *P. berghei* induced organs damage, this could be an interaction between the infective condition and the constituents of the extract. A. *sceptrum* extract (250 and 350 mg/kg) when administered to *P. berghei* infected mice prevent parasite induced liver damage by preventing the elevations of liver and serum ALP, AST, and ALT, than in parasitized mice. The extract was able to preserve the ALT activity to a comparable level with the normal rat [166]. Methanol leaf extract of A. *wilkesiana* significantlyameliorated parasite-induced oxidative stress as revealed by significant reduction in liver malondialdehyde and reversed effects on reduced superoxide dismutase, glutathione-P (GSH-P), reduced-GSH and catalase as reported in the parasitized untreated rats [164].

Hematology

Balogun *et al.*, 2012 evaluated the effectiveness of *M. charantia* (100 mg/kg) in ameliorating biochemical and histological alteration in malarial and diabetic co-infected rats, and reported that the extracts improved the packed cell volume (PCV), hemoglobin (Hb), and red blood cell (RBC) of the mice comparable with the chloroquine treated mice. According to Balogun *et al.* [129], ethanol leaf extracts from *Clerodendrum violaceum* at 13 mg/kg for 14 days significantly improved the *P. berghei* induced alteration in RBC, PCV, Hb, white blood cell (WBC), and platelet count of infected mice. Methanol leaf extract from Nigerian *Abrus precatorius* at 25-100mg/kg also improve weight gain, RBC, Hb, MCV, and MCH of *P. berghei* infected mice [32]. Methanol extract from *Catha edulis* obtained from Ethiopia, when administered to *P. berghei* infected mice at dose of 300 mg/kg reduced the levels of hematological parameters including platelets count, WBCs and Hb levels [128]. Ethanol extract from leaves of *H. suaveolens* had a dose dependent effect on *P. berghei* in infected mice with chemosuppresion of 10.22% and 33.69% at 25 mg/kg and 42.7% and 18.03% at 50 mg/kg against established and early infection respectively. The extract was however unable to prevent parasite induced anemic condition as indicated by significant reduction in RBC, HB, and PCV of the treated mice [140]. Crude extract from *Croton macrostachyus* prevented weight loss but produce no ameliorative affect on hematocrite of *P. berghei* infected mice [172].

Antiplasmodial Activity of Insect/Products

While more than 95% of African scientist who works on validating the therapeutic claims of natural product against infectious and protozoan disease focused on plants very few documentation [167,168,173, 178], exist on validation of other natural products like insect against malarial disease.

Musca domestica

Adult houseflies (*M. domestica)* are known as carriers of disease, supprisingly in the study of Shittu *et al.* [167], methanol extract from fourth instar stage (maggot) of the fly was able to suppressed *P. berghei* replication, improved mice life span (34 days) and ameliorated parasite induced anemia when evaluated for it antimalarial activities at 600 mg/kg against *P. berghei* parasitized mice. Maggot of housefly has also been reported to be effective against other protozoan disease [18]. This is not supprising as several literatures have documented the therapeutic effects of house fly maggot. Clinically, live maggots has been used to aid wound healing back then in 19th Century (Maggot Debridement Therapy), traditionally it has been reported to be used as antibacterial, antiviral, anti-osteomyelitis, anti-decubial necrosis, antitumor, anti-immunosuppressive agents and also for curing malnutritional stagnation [169-172].

Honey bee

Shittu and Eyihuri [173], evaluated the antiplasmodial effect of bee sting, from their reports *P. berghei* paeasitisized mice were treated with intradermal bee sting. According to their results bee stings produce 56.6% chemosupression and prolong the lifespan to 20 and 15 days for early and established infection, respectively. The hematological studies show that the level of packed cell, the bee sting also improved the PCV, HB, RBC compared to untreated control, the bee sting however was reported to increase the WBC of the mice. Their study justify the traditional believe that mild honey bee attacked could be useful against malarial fever, however, the bee sting induced elevation of WBC reported by Shittu and Eyihuri [170], point out immunostimulatory effect of the constituent release from the bee sting.

Honey and propolis

Although honey from *Apis florea* and *Apis andreniformis*, were reported to excert no significant activity at 10 ug/l when tested against *pfk1* parasitized mice ethanol extract of propolis from the same species exhibit significant activities with IC_{50} value of 4.48 g/ml [174]. Olayemi [178], also administered bee propolis to *P. berghei* parasitize rat at dose of 600 mg/kg and reported that the extract significantly inhibited the parasite replication and improve the PCV of the mice.

Herbal Formulations

UDU

Duru *et al.* [173], studied the effect of "udu," an herbal preparation commonly use to treat malaria by Isiala Mbano people of Imo State, Nigeria on visceral organ, lipid profiles, and weight of rats. There results revealed that the herbal preparation produces no significant effect on organs. However, blood lipid profile parameters were altered in test rats compared with the reference value [176].

Saabmal

Antimalarial herbal formulation called SAABMAL was investigated at 200 and 400 mg/kg against *P. berghei* infected mice in a four days suppressive test. The formulation was able to suppress the (29.39-100%) parasite replication in a dose-dependent fashion. The formulation was also more effective than chloroquine in prolonging the survival time of mice [177].

CONCLUSION AND FUTURE PROSPECTS

This study has documented the list of African natural products with potential antimalaial activities. Some of these natural products demonstrated, high, promising, or low activities against *Plasmodium* species. Some of the plant ameliorated the parasite induced pathological changes while few others did not. The study also shows that natural products from Africa have a considerably huge amount of novel antimalarial compounds that could serve as a lead for the development of new and effective antiplasmodial drugs. It is hoped that pertinent scientist stakeholders will look further into some of these compounds for detailed authentication and subsequent commercialization. However, despite incessant comprehensive and mechanism-orientated assessments of Africa natural products, there is still inadequate information concerning procedures to be adopted for quality control, authentication and standardization of crude plant products. Furthermore, in a view of bridging the gap in knowledge, clinical validation of some of these natural products is of paramount importance.

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