Full Length Research Paper

A review for selecting medicinal plants commonly used for malaria in Uganda

Clement O. Ajayi¹, Anthony A. Elujoba², Félicien M. Kasali¹, Mercy G. Tenywa¹, Hedmon Okella¹, Anke Weisheit¹, Casim U. Tolo¹ and Patrick E. Ogwang¹

¹Pharm-Biotechnology and Traditional Medicine Center, Mbarara University of Science and Technology, P. O. Box 1410, Mbarara, Uganda.  
²Department of Pharmacognosy, Faculty of Pharmacy, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria.

Received 25 July, 2020; Accepted 15 September, 2020

The menace of current cases of parasite resistance to antimalarial drugs, non-availability and accessibility, and the high costs of pharmaceutical products contribute to the high rate of medicinal plants consumption in the treatment of malaria in Uganda. Different ethnobotanical surveys on medicinal plants with antimalarial properties have been conducted across different geographical regions in Uganda in order to identify and select the most commonly used antimalarial plants as candidates in the proposed national herbal pharmacopoeia. The available literature on the medicinal plants used against malaria in the western, central, eastern and northern geographical regions in Uganda was selected from reputable journals using various citation databases as guides. The commonly used antimalarial plants in the regions were searched using relevant journals on previously established ethno-botanical survey. They were then ranked in order of percentage frequency of appearance in the literature from surveys across the country. Fifteen medicinal plants were selected in this way from several antimalarial plants cited. Vernonia amygdalina and Azadirachta indica appeared most (100%), followed by Carica papaya, Mangifera indica and Hoslundia opposita with 80% appearance each across the 4 regions. The medicinal plants from this review were therefore ranked as the most used for treatment of malaria in Uganda and therefore, could be recommended for herbal pharmacopoeial standards development.

Key words: Antimalarial, medicinal plants, antiplasmodial, herbal pharmacopoeial standards.

INTRODUCTION

Malaria remains one of the major health challenges in developing countries despite the efforts of different organizations including the World Health Organization (WHO), West African Health Organization (WAHO), Centers for Disease Control and Prevention (CDC), the African Union's Scientific, Technical and Research Commission (AU/STRC) among others to control and eradicate it (WHO, 2018). It was reported that 219 million cases of malaria occurred worldwide in 2017 and 92% of these cases...
were from African region with 435,000 mortalities. This malaria endemic region was followed by the South-East Asia Region with 5% and the Eastern Mediterranean Region with 2% (WHO, 2017, 2018). The Uganda Malaria Reduction Strategic Plan (UMRSP) reported malaria cases of 1 out of 3 out-patient visits to health facilities and 50% of the in-patient pediatric mortalities are associated with malaria disease yearly (MoH, 2016). The setback to malaria fight has been attributed to non-availability of effective vaccine, resistance to pyrethroid-treated mosquito nets, high costs of antimalarial drugs and the recent widespread chloroquine-resistant \textit{Plasmodium falciparum} (WHO, 2018).

In malaria chemotherapy, medicinal plants have always played a leading role in drug discovery and such drugs are used in natural form or synthesized or act as structural models for semi-synthetic antimalarial drugs. Quinine was first time isolated from \textit{Cinchona} bark against malaria in the early 18\textsuperscript{th} century and became a skeleton from which chloroquine (resochin), mefloquine and other similar antimalarial drugs were later synthesized (Achan et al., 2011).

The most successful battle against the sudden appearance of chloroquine-resistant \textit{P. falciparum} led to the isolation of artemisinin from the Chinese \textit{Artemisia annua}. Its synthetic chemical derivatives (e.g. artemether, dihydroartemisinin and artemunate) are now combined with existing antimalarial drugs to artemisinin-based combination therapy (ACT) such as artemetamethether-lumefantrine, artemunate-amodiaquine, etc. which are referred to as ACT (Chen, 2014). Currently, ACTs remain the recommended choice of drugs for malaria despite recent reports on the \textit{P. falciparum} resistance in Greater Mekong subregion (GMS) including Cambodia, Lao People’s Democratic Republic, Vietnam, Thailand and Myanmar (WHO, 2018), etc.

Historically (from \textit{Cinchona} to \textit{Artemisia}), the plant kingdom remains the source for antimalarial drug discovery. Similar history has shown many current therapeutic drugs (e.g. digoxin, reserpine, morphine, etc.), at conventional health care levels for the management of other diseases from medicinal plants. According to the World Health Organization, 60% of the world’s population depends on traditional medicine and 80% of the people in developing countries depend entirely on traditional medicine practices due to their accessibility, folkore and affordability for their primary health care needs (Chikezie and Ojiako, 2015).

The high acceptance of medicinal plants therefore requires the needs for their national standards which guarantee the consistence, definite identification, reproducible safety, efficacy and qualities as a valuable scientific reference for drug authorities, manufacturers, general public and researchers (WHO, 2011). These plants are normally selected based on their frequent used across the country. This review exercise aimed at compiling the most used medicinal plants for malaria in Uganda with a view to developing their national standards which will subsequently be used to develop their herbal monographs.

**METHODOLOGY**

**Literature data collection for the selection of antimalarial medicinal plants**

The plants were searched through different search engines including Google Scholar, Institute for Scientific Information, PubMed, Scopus, Hinarl, Scientific Information Database, etc., using antimalarial plants, antiplasmodial, malaria endemic, ethnopharmacology and Uganda regions as the keywords.

In this progression, different ethno-botanical survey articles on antimalarial plants in a particular region were first compiled and then ranked based on their frequency of occurrence in literature within the same region. Thereafter, their physical occurrences in the literature from other geographical regions of Uganda were considered. The antimalarial plants, found occurring in at least 2 out of the 4 regions (Central, Eastern, Northern and Western Uganda) and those mentioned in PROMETRA records (Association for the Promotion of Traditional Medicine), Uganda, East Africa, were selected. The following formula was applied to the plant collected prior to their ranking:

**Formula:** $(x/N) \times 100$

Where, \(x\) is the total number of appearances ascribed to each antimalarial plant across the regions, while \(N\) (5) is the total number of regions together with PROMETRA antimalarial plants.

A comprehensive literature search was thereafter carried out to review the extent of previous studies on each of the selected plants.

**RESULTS AND DISCUSSION**

Fifteen medicinal plants belonging to 12 families were found to be commonly used for the control of malaria in Uganda among which 4 species (\textit{Bidens pilosa} L., \textit{Tithonia diversifolia} (Hems.), \textit{A. Gray}, \textit{Vernonia amygdalina} and \textit{V. lasiopus} O. Hoffm) belonged to the family Asteraceae. \textit{V. amygdalina} Del. leaf and \textit{Azadirachta indica} A. Juss. (Meliaeaceae), being the most used across Uganda with 100% appearance, were followed by \textit{Carica papaya} L. (Caricaeace), \textit{Hoslundia opposita} Vahl (Lamiaeaceae) and \textit{Mangifera indica} L. (Anacardiaceae) with 80%. \textit{B. pilosa} L., \textit{Cymbopogon citratus} (DC.) Stapf. (Poaceae), \textit{Justicia betonica} L. (Acanthaceae), \textit{Markhamia lutea} (Benth.) K. Schum. (Bignoniaceae), \textit{Moringa oleifera} Lam. (Moringaceae), \textit{T. diversifolia} (Hems.) \textit{A. Gray}, \textit{V. lasiopus} O. Hoffm showed 60% appearances while \textit{Aristolochia elegans} Mast. (Aristolochiaceae), \textit{Cajanus cajan} (L.) Huth (Fabaceae) and \textit{Toddalia asiatica} (L.) Lam. (Rutaceae) gave 20% appearance representing the least commonly used antimalarial plants across Uganda.

Adia et al. (2014) studied some medicinal plants used...
for the treatment of malaria by PROMETRA in Central Uganda; about 75% of the traditional medical practitioners (TMPs) of Uganda were interviewed from Mpiigi and 25% from Butambala District. Eighty-six medicinal plants from 39 families were reportedly used in the treatment of malaria ailment by the TMPs out of which 32% belonged to Asteraceae, followed by Lamiaceae (24%), Euphorbiaceae (12%) and Poaceae 10%. Out of these, V. amygdalina was the most recorded plant. These plants, used by TMPs, were either used individually (in mono-component remedies) or in combination (in multi-component preparations). The leaf and root are the morphological parts most frequently used and prescribed by the TMPs (Adia et al., 2014).

Tugume et al. (2016) conducted an ethnobotanical survey on medicinal plants used for various ailments in Baganda, Banyarwanda, Basoga, Bagiso, Bakiga, Banyankole, Bagwere and Batooro tribes from Naluvule, Bukuku, Buwoola and Kala gala villages which were mostly Bantu ethnic groups from Central Uganda. The study reported 190 species (from 61 families) in which 20 species were listed for antimalarial herbal remedy and out of which the following 6 species were commonly used in other regions: A. elegans, H. opposita, J. betonica, M. lutea, V. amygdalina and V. lasiopous. In the Central Uganda region, V. amygdalina was highly classified as the most important species in the treatment of malaria. The remedies for malaria treatment were either prepared as decoctions (Table 1) or infusions, each containing single plants or in combination with other plants (Tugume et al., 2016).

The work of Ssegawa and Kasenene (2007) on the medicinal plants of Sango bay area covered: Kaiso, Malabigambo, Namalala, Tero West, Tero East and Kigona forest blocks. One hundred and eighty-six medicinal plants were reported from which 21 plant species were recorded for malaria treatment in this area while in southern part of Uganda, a total of 39 were said to be commonly used for malaria. Among these medicinal plants, A. elegans, A. indica, M. lutea, M. oleifera, V. amygdalina and V. lasiopous were the only species used in the other regions for malaria. Tabutu (2008) studied the medicinal plants used for malaria in selected villages from Budiope County in Eastern Uganda which comprised Busambira and Buseete villages of Kinambogo Parish in the Kamuli district of Eastern Uganda. In his work, 27 medicinal plant species, mainly young leaves, parts of shrubs or trees (singly or in combination), belonging to 16 families, were reportedly used for antimalarial remedies in that County, either as decoctions or infusions (Table 1). The parts are collected and used fresh at no specific time of the day or season. Out of the 27 species reported by Tabutu (2008), 5 species (A. indica, C. cajan, M. indica, M. oleifera and V. amygdalina) were commonly used in other regions of Uganda.

Philip et al. (2017) also studied ethnobotanical survey on medicinal plants used for malaria in Butebo County in the eastern region of Uganda which comprised five sub-Counties: Kakoro, Kabwangasi, Petete, Butebo and Kibale in Pallisa District. In his study, 50 respondents were interviewed, comprising 10 from each sub-County from which 33 plant species belonging to 23 families were reported. Among the 33 medicinal plant species reported, 6 plants were commonly used in other regions which included: A. indica, B. pilosa, C. papaya, C. citratus and M. indica.

In the survey conducted by Anywar et al. (2016), 90 respondents interviewed in three different villages were mainly farmers some of whom are traditional medical practitioners. Twenty medicinal plants from 15 families were reportedly being used for preventing and treating malaria in Cegere sub-County of Uganda and these are mainly herbs. Twelve of the plants are used for the management of malaria, eight for prevention while two are for both prevention and treatment. These plants predominantly belong to Asteraceae and Fabaceae families, and are mostly used as decoctions or infusions (Table 1). The leaves of A. indica, H. opposita, C. papaya, T. diversifolia and M. oleifera (also root) were similarly found useful in antimalarial therapy in other parts of Uganda. The study of Opio et al. (2017) on survey of antimalarial plants in Abukamola, Angeta, Oculoko and Omarari areas of Alebtong District reported 43 antimalarial plants out of which only 3 plants are used in other regions for malaria treatment while other antimalarial plants listed in Alebtong DISTRICT are either used for other ailments or do not appear in other regions.

Kamatenesi et al. (2011) reported 71 medicinal plants used for different ailments in Ngai and Otwal Sub Counties of Oyam District, including four (Acacia hockii De Wild, C. cajan, Ocimum basilicum L., and V. amygdalina) of the listed plant species used for malaria and only two plants (C. cajan and V. amygdalina) appeared in other regions. Hamill et al. (2000) recorded medicinal plants used for general ailments in three districts of south-western Uganda: Rukungiri, Kisoro and Kabale districts of Baganda kingdom. In the first part of the report, 48 plant species were reported from which 6 species were commonly used for malaria in other regions. In the second part among Baganda people of south-western Uganda, all the medicinal plants studied were summed up to 168 with additional 8 species commonly used for malaria (Hamill et al., 2003).

Katumba et al. (2007) studied medicinal plants used for malaria in Mbarara municipality and Rwampana County from where 20 medicinal plants were reported, out of which 19 species were identified with their leaves or roots being used as decoctions or infusions (Table 1), either individually or in combination. Four of the plant species namely, M. indica, T. assiatica, V. amygdalina and V. lasiopous, commonly used for malaria treatment in this
### Table 1. Selected commonly used antimalarial plants in Uganda and their biological activities.

| Species (family)         | Regions (Languages) | Local name | Habit          | Part used | Preparation | Ethnomedicinal uses                                      | Pharmacology                                                                 | Chemical Constituents                       | Toxicity                                                      | References                                                                                       |
|--------------------------|--------------------|------------|----------------|-----------|-------------|------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------------------------------------------|
| **Aristolochia elegans** | W, C              | Musuja welaba (Banyankole) | Shrub         | Leaf, stem root | Decoction | Malaria, asthma, scorpion bite, toothache and rheumatic pain | Anti-venom, cytotoxic, antibiotic, insecticidal, anticholinergic, expectorant, antitussive, antihistamine, detoxicant, antiprotozoal, antipyretic, antipyogenic | Flavonoids, anthraquinones, alkaloids, saponins, tannins, coumarins, steroids | Necrosis of tubular epithelial cells, focal parenchymal hemorrhages, mild to moderate hepatocellular degeneration at 5000 mg/kg | Hussein and El-Sebahy, 1974; Rastrelli et al., 1997; Gadhi et al., 2001; Murillo et al., 2001; Wu et al., 2002; Hari et al., 2003; Shi et al., 2013; Stangeland et al., 2011; Jimenez-Arellanes et al., 2012; Zamilpa et al., 2014; |
| **Azadirachta indica A. Juss. (Meliaceae)** | Pr, C, E, N, W | Neem | Tree | Leaf | Decoction | Inflammation, malaria, infections, fever, skin diseases, dental disorders, diarrhoea, peptic ulcer | Antibacterial, antimicrobial, antiviral, antifungal, antitussive, antileukemic, anti-inflammatory, antipyretic, antitumor, immunosuppressive, hepatoprotective, antimalarial, antidiabetic, anticancer, antiparasitic antiangiogenic | Diterpenoids, Triterpenoids: limonoids, gedunin and its derivatives. Alkaloids, Flavonoids. Phenolic compounds: quercetin, kaempferol, myricetin. Proteins, amino acids, carbohydrates and tannins | Stem-bark: ethanol extract toxic to liver and kidney at > 100 mg/kg. Neem oil: mild damages on the liver and kidney at 177 mg/kg with regeneration after withdrawal | Tidjani et al., 1989; Stone, 1992; Hamill et al., 2000, 2003; Tabuli, 2008; Shirmer et al., 2009; Mbaya et al., 2010; Stangeland et al., 2011, 2012; Wang et al., 2013; Adia et al., 2014; Jamra et al., 2014; Mahirajan et al., 2014; Prashanth and Krishnaiah, 2014; Yan et al., 2015; Kamatenesi et al., 2011; Anwar et al., 2016; Opio et al., 2017; Philip et al., 2017; Sinha et al., 2017 |
| **Bidens pilosa L. (Asteraceae)** | Pr, E, W | Ssere (Rukiga/Luganda)/K Shrub alala (Rukiga) | Shrub | Whole plant | Decoction | Pain relief, fever, diabetes, infections, inflammation, flu | Antimicrobial, anti-inflammatory, anti-asthmatic, anti-allergic, anti-cancer, anti-diabetic, anti-inflammatory, anti-parasitic, anti-angiogenic | Sterols, terpenoids, flavonoids, essential oil | LC_{50}=21.09 mg/mL | Geisserger and Séquin, 1991; Zulueta et al., 1995; Brandão et al., 1997; Wang et al., 1997; Brandão et al., 1998; Alvarez et al., 1999; Pereira et al., 1999; Ubilas et al., 2000; Chang et al., 2001; Khan et al., 2001; Chiang et al., 2003; 2003; Kusano et al., 2003; Motsei et al., 2003; Qin et al., 2003; Andrade-Neto et al., 2004; Dong et al., 2004; Oliveira et al., 2004; Wu et al., 2004; 2007; Grombone-Guaratini et al., 2005; Rojas et al., 2006; Chang et al., 2007; Deba et al., 2008; Horiuichi and Seyama, 2008; Kviecinski et al., 2008; Chien et al., 2009; Hsu et al., 2009; Kumari et al., 2009; Tobinaga et al., 2009; Pharm et al., 2010; Asimwe et al., 2013; Cortés-Rojas et al., 2013; Wu et al., 2013; Adia et al., 2014; da Silva et al., 2014; Fotso et al., 2014; Wachira et al., 2014; Philip et al., 2017 |
| Plant Name | Locality | Type | Part | Mode 
|-----------|----------|------|------|------|
| Cajanus cajan (L.) Huth | E, W | Shrub | Leaf | Decoction |
| Entondaiwa (Banyankole) | Nikolimbo | | | |
| Carica papaya L. | Pr, E, N, W | Tree | Leaf | Decoction |
| Amapapali (Rukiga)/Mapapali | (Luganda)/Paapali | essajja (Banyankole) | | |
| Kamunye (Rukiga/Luganda)/Iku | (Banyankole) | | | |
| Hostundia opposita Vahl | Pr, C, N, W | Shrub | Leaf | Decoction |
| Kamunye (Rukiga/Luganda)/Ilu | Essahowie (Banyankole) | | | |

**Table 1. Cont’d**

- **Cajanus cajan** (Fabaceae) - Ulcer, diarrhea, pain, diabetes, cough, sore, dysentery, hepatitis, measles, malaria, irregular menstrual period.
- **Entondaiwa (Banyankole)** - Antiplasmodial, hypoglycemic, hypolipidemic, hypoglycemic, antihypertensive.
- **Carica papaya L.** (Caricaeace) - Anti-inflammatory, antitumor, antiinflammatory, antioxidant.
- **Amapapali** (Rukiga) - Vitamins A, B & C.
- **Cajanus cajan** (L.) Huth - Anticancer, antibacterial, antifungal, antioxidant.
- **Hostundia opposita** Vahl - Antiinflammatory, antitumor, antimicrobial.

**Table 1. Cont’d**

- **Cajanus cajan** (Fabaceae) - No biochemical, haematological and histopathological abnormalities at < 1500 mg/kg. Increase in kidney weight at 3000 mg/kg.
- **Entondaiwa (Banyankole)** - Vitamins A, B & C.
- **Carica papaya L.** (Caricaeace) - Bark aqueous extract showed deleterious effects on both the seminiferous tubules and testicular interstitial at 100 mg/kg.
- **Amapapali** (Rukiga) - Anti-inflamatory, antitumor, antimicrobial.
- **Cajanus cajan** (L.) Huth - No hepatotoxic effect.
- **Hostundia opposita** Vahl - No hepatotoxic effect.

**Table 1. Cont’d**

- **Cajanus cajan** (Fabaceae) - Flavonoids, monoterpenoids, 5,7-dimethoxy-6-methylflavone.
- **Entondaiwa (Banyankole)** - Hostundiol, euxaphic, pyrone, 1,8-cineole.
- **Carica papaya L.** (Caricaeace) - Saponins, alkaloids, flavonoids, tannins, essential oils.
- **Amapapali** (Rukiga) - Saponins, steroids, phenols, fixed oils and fats.
- **Cajanus cajan** (L.) Huth - Flavonoids, alkaloids, saponins, reducing sugars.
- **Hostundia opposita** Vahl - Saponins, alkaloids, flavonoids, essential oils.

**Table 1. Cont’d**

- **Cajanus cajan** (Fabaceae) - No biochemical, haematological and histopathological abnormalities at < 1500 mg/kg. Increase in kidney weight at 3000 mg/kg.
- **Entondaiwa (Banyankole)** - Vitamins A, B & C.
- **Carica papaya L.** (Caricaeace) - Bark aqueous extract showed deleterious effects on both the seminiferous tubules and testicular interstitial at 100 mg/kg.
- **Amapapali** (Rukiga) - Anti-inflamatory, antitumor, antimicrobial.
- **Cajanus cajan** (L.) Huth - No hepatotoxic effect.
- **Hostundia opposita** Vahl - No hepatotoxic effect.

**Table 1. Cont’d**

- **Cajanus cajan** (Fabaceae) - Flavonoids, monoterpenoids, 5,7-dimethoxy-6-methylflavone.
- **Entondaiwa (Banyankole)** - Hostundiol, euxaphic, pyrone, 1,8-cineole.
- **Carica papaya L.** (Caricaeace) - Saponins, alkaloids, flavonoids, tannins, essential oils.
- **Amapapali** (Rukiga) - Saponins, steroids, phenols, fixed oils and fats.
- **Cajanus cajan** (L.) Huth - Flavonoids, alkaloids, saponins, reducing sugars.
- **Hostundia opposita** Vahl - Saponins, alkaloids, flavonoids, essential oils.
| Plant Name                        | Part Used          | Extract Preparation | Main Uses                                      | Secondary Uses                                      | Constituents                                                                 | References                                                                 |
|----------------------------------|--------------------|---------------------|------------------------------------------------|----------------------------------------------------|-----------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Justicia betonica (Acanthaceae)  | C, Pr, W, C        | Whole plant, leaf   | Decoction                                       | Asthma, dysentery, cough, leucorrhea, jaundice, pain, malaria                    | Antibacterial, antiviral, analgesic, anti-inflammatory, antitumor            | Kanchanapoom et al., 2004; Subbaraju et al., 2004; Namukobe et al., 2011; Katuura et al., 2007; Stangeland et al., 2011; Asiimwe et al., 2013; Bbosa et al., 2013; Gangabhavani and Ravishankar, 2013; Adia et al., 2014; Parvatkar et al., 2017 |
| Mangifera indica (Anacardiaceae) | E, W, C, Pr        | Leaf, stem, bark    | Decoction                                       | Asthma, dysentery, cough, leucorrhea, jaundice, pain, malaria                    | Antibacterial, antiviral, analgesic, anti-inflammatory, antitumor            | Chatterjee and Pakrashi, 1994; Nuñez-Sellés et al., 2002; Garcia et al., 2003; Sairam et al., 2003; Schieber et al., 2003; Bbosa et al., 2013; Gangabhavani and Ravishankar, 2013; Adia et al., 2014 |
| Markhamia lutea (Bignoniaceae)   | C, W, Pr           | Root                | Decoction                                       | Antiviral, antitrypanosomal, antimalarial activities                              | Cyclotranter triterpenoids: musambins A, B & C. Glycosides: musambiosides A, B & C. | Kernan et al., 1998; Hamill et al., 2000; Lacroix et al., 2003; Dang et al., 2002; Nikkon et al., 2003; Anwar et al., 2007; Tabuti 2008; Sreelatha and Padma, 2009; Awodele et al., 2010; Adejumo et al., 2012; Awodele et al., 2012; Adedapo et al., 2015; Al-malki and El-Rabey, 2015; Kayode and Afolaran, 2015; Kamatenesi et al., 2011; Anywar et al., 2016; Dzotam, et al., 2016; Lamou et al., 2016; Nayak et al., 2016; Igado et al., 2017; Martinez-Gonzalez et al., 2017; dos Santos et al., 2018 |
| Moringa oleifera Lam. (Moringaceae)| C, N, E            | Leaf                | Decoction                                       | Constipation, headache, arthritis, genito-urinary diseases, diabetes, hypertension, typhoid fever | Antimicrobial, antiviral, antinociceptive, anti-inflammatory, analgesic, antioxidant, antitumor | Cáceres et al., 1991; Hamill et al., 2000; Diallo et al., 2001; Dang et al., 2002; Nikkon et al., 2003; Anwar et al., 2007; Chinmoy, 2007; Tabuti 2008; Atawodi et al., 2010; Adejumo et al., 2012; Awodele et al., 2012; Awodele et al., 2012; Adedapo et al., 2015; Al-malki and El-Rabey, 2015; Kayode and Afolaran, 2015; Kamatenesi et al., 2011; Anywar et al., 2016; Dzotam, et al., 2016; Lamou et al., 2016; Nayak et al., 2016; Igado et al., 2017; Martinez-Gonzalez et al., 2017; dos Santos et al., 2018 |
| Plant Name                  | Region | Type   | Part     | Habitat         | Use                                                                 | Chemical Constituents                                                                 |
|----------------------------|--------|--------|----------|-----------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| *Tithonia diversifolia*    | Pr, N, W | Shrub  | Leaf     | Infusion        | Malaria, diabetes, diarrhoea, liver diseases, stomach-ache, wounds snakebite | Antimalarial, antiplasmodial, antidiabetic, antihyperglycemic, antimicrobial, antitumor, anti-inflammatory, analgesic activities |
| *Vernonia amygdalina*      | Pr, C, E, N, W | Shrub | Decoction | Aqueous extract | Malaria, schistomiasis, amoebic dysentery and gastrointestinal problems | Antimalarial, antiparasitic, antineoplastic, antimicrobial, antitumor, anti-inflammatory activities |
| *V. lasiopus*              | Pr, W, C | Leaf/root | Infusion |                 | Stomach-ache, gastrointestinal problems, worms, malaria, scabies, venereal disease, sore, and purgative               | Antiprotozoal, antimalarial, antimicrobial, antiplasmodial and cytotoxic activities. Elementary oxides, epivernodal and lasiopulide |

**Table 1.** Cont’d

- Pr = PROMETRA, C = Central, E = Eastern, N = Northern, W = Western region.
region were also commonly used in other regions of the country.

The results of interview on about 28 traditional birth attendants (TBAs) by Stangeland et al. (2011) in the Nyakayoko sub-County of Mbarara District on medicinal plants commonly-used for malaria, have revealed 56 plant species from 23 families. The leaf part was found to be most widely used but the plants in this sub-County were either used individually or in combination (Table 1). All the medicinal plants used for antimalarial remedies were reported to be commonly used in other regions except, B. pilosa, M. indica and M. oleifera which did not appear in the report of Stangeland (2011).

Asimwe et al. (2014) reported the use of medicinal plants by the local communities in Western Uganda around Ibanda, Isingiro, Kiruhura and Mbarara districts. The study was conducted on herbalists and traditional birth attendants based on the knowledge, skills, and practices in the use medicinal plants. Out of 231 medicinal plants from 73 families reported as remedies for different ailments, 22 plants were commonly used for malaria in the area and only 5 species (C. cajian, H. opposita, J. betonica, V. amygdalina and V. lasiopus) were commonly used in other geographical regions (Table 1). The leaf or other morphological parts were prepared individually or in combination with other plants as decoction or infusion.

Namukobe et al. (2011) reported 131 plant species from 121 genera, used for different ailments in Kibale National Park which include four parishes (Hiima, Kahangi, Kaswa and Sebitoli) in Hakibale sub-County of Kabarole district. Twenty of the listed plant species are used for malaria out of which only 3 (J. betonica, M. indica and V. amygdalina) are commonly used in other regions for malaria while others are either used for ailments other than malaria or not appearing at all for other regions. Meanwhile, antimalarial and other pharmacological activities of some of the selected medicinal plants have been established and reported as shown in Table 1 with some of their active ingredients, being reported. Also, reports on the safety of some of these plants have been reported with some showing degenerative effects such as nephro-/hepato-toxicity, vacuolar degeneration, necrosis, etc. (Adebayo et al., 2009; Elufioye et al., 2009; Passoni et al., 2013). This review exercise is necessary to select the plants that are commonly used as antimalarial across the country in order to develop their national standards by taking into consideration their botany, safety, efficacy and chemistry.

Conclusion

Through the literature search, fifteen medicinal plants were selected as the most commonly used in Uganda for the treatment of malaria out of many medicinal plants reported in ethnobotanical surveys across the regions and these plants could be standardized for pharmacopoeial inclusion.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Achini J, Talisuma AO, Erhart A, Yeka A, Tibenderana JK, Baliraine FN, Rosenthal PJ, D’Alessandro U (2011). Quinine, an old anti-malarial drug in a modern world: role in the treatment of malaria. Malaria Journal 10(144):1-12.

Asimwe M, Nwosu CO, Adegbe RIS (2009). Anti-trypanosomal effects of aqueous extract of Ocimum gratissimum (Lamiaceae) leaf in rats treated with Trypanosoma brucei brucei. African Journal of Traditional, Complementary and Alternative Medicine 6(3):262-267.

Adebayo JO, Balogun EA, Oyeleke AA (2009). Toxicity study of the aqueous extract of Tithonia diversifolia leaves using selected biochemical parameters in rats. Pharmaceutical Research 1:143-147.

Adejuwo OE, Kolapo AL, Folarin AO (2012). Moringa oleifera Lam. (Moringaceae) grown in Nigeria: in vitro anti-sickling activity on deoxygenated erythrocyte cells. Journal of Pharmacy and Bioallied Sciences 4(2):118-123.

Ademola IO, Ellof JN (2011). Anthelmintic activity of acetone extract and fractions of Vernonia amygdalina against Haemonchus contortus eggs and larvae. Tropical Animal Health and Production 43:521-527.

Adeneye AA, Agbaje EO (2007). Hypoglycemic and hypolipidemic effects of fresh leaf aqueous extract of Cynbopogon citratus Stapf. in rats. The Journal of Ethnopharmacology 112:440-444.

Adia MM, Anywar G, Byamukama R, Kamatenesi-Mugisha M, Sekagya Y, Kakudiki EK, Kiremire BT (2014). Medicinal plants used in malaria treatment by PROMETRA herbalists in Uganda. The Journal of Ethnopharmacology 155(1):580-588.

Agboola OO, Stephen O, Olowooyo JO, Ajao AA, Aregbesola O (2016). Chemical composition and antimicrobial activities of essential oil extracted from Tithonia diversifolia (Asteraceae) flower. Journal of Bioreources and Bioproducts 1:169-176.

Aguiyi JC, Obi CI, Gang SS, Igweh AG (2000). Hypoglycaemic activity of Ocimum gratissimum in rats. Fitoterapia 71:444-446.

Ajaiyeoba EO, Abiodun OO, Falade MO, Ogbole NO, Ashidi JS, Happi CT, Akinboye DO (2006). In vitro cytotoxicity studies of 20 plants used in Nigerian antimalarial ethnomedicine. Phytochemistry 13:295-298.

Ajao AA, Motettee AN (2017). Tithonia diversifolia (Hems.) A. Gray, (Asteraceae: Heliantheae), an invasive plant of significant ethnopharmacological importance: A review. South African Journal of Botany 113:396-403.

Ajila CM, Aalami M, Leelavathi K, Prasada Rao UJS (2010). Mango peel powder: A potential source of antioxidant and dietary fiber in...
macaroni preparations. Innovative Food Science and Emerging Technologies 11:219-224.

Akorie FOB, Fung LWM (1992). Antisickling Activity of Hydroxybenzoic Acids in Cajanus cajan. Planta Medica 58:317-320.

Alawa CBI, Adamu AM, Gefe JO, Ajanusu OJ, Abdu PA, Chiezy NP, Alawa JN, Bowman DD (2003). In vitro screening of two Nigerian medicinal plants (Vernonia amygdalina and Annona senegalensis) for anthelmintic activity. Veterinary Parasitology 113:73-81.

Al-maki AL, El-Rabey HA (2015). The antidiabetic effect of low doses of Moringa oleifera Lam. seeds on streptozotocin induced diabetes and diabetic nephropathy in male rats. BioMed Research International http://dx.doi.org/10.1155/2015/381040.

Alvarez A, Pomar F, Sevilla MA, Montero MJ (1999). Gastric antisecretory and antulcer activities of an ethanolic extract of Bidens pilosa L. var. radiata Schult. Bip. Journal of Ethnopharmacology 67:333-340.

Amidu and Macicathimurum S (1998). Evaluation of the hypoglycaemic effect of Cajanus cajan (seeds) in mice. Indian Journal of Experimental Biology 36:1032-1033.

Anand S, Rajan MV, Venkateshbabu P, Chandra PS, Rajmohan C, Rasekh P, Janardhan K, Shrivastava S, Rahul R, Mann A, Ganeshkumar C (2012). Antioxidant and antimicrobial activities of ethanolic extract of Moringa oleifera Lam using real time PCR. Open Dentistry Journal 10:165-166.

Andrade-Neto VF, Brandão MGL, Oliveira FO, Casali VWD, Njaine B, Zalis MG, Oliveira LA, Krettli AU (2004). Antimalarial activity of Bidens pilosa L. (Asteraceae) ethanol extracts from wild plants collected in various localities or plants cultivated in humus soil. Phytotherapy Research 18:634-639.

Anthoney ST, Jackie OK, Miyogo E, Lasiti TT (2016). Bioassay screening of the ethanolic extract of Tithonia diversifolia leaves on selected microorganisms. International Journal of Bioassays 5:4794-4798.

Anwar F, Latif S, Ashraf M, Gilani AH (2007). Moringa oleifera: A food plant with multiple medicinal uses. Phytotherapy Research 21:17-25.

Anvari GA, van’t Klooster CIEA, Wilcox M, Nalumansi PA, de Jong J, Rwaburidoni P, Kiremire BT (2016). Medicinal plants used in the treatment and prevention of malaria in Gecere sub-county, northern Uganda. Ethnobotany Research and Applications 14:505-516.

Ashafa OAT, Orekoyo LO, Yakubu MT (2012). Toxicity profile of ethanolic extract of Azadirachta indica stem bark in male wistar rats. Asian Pacific Journal of Tropical Biomedicine 2(10):811-817.

Asimwe S, Namutebi A, Bör-garlsson A, Mugisha MK, Öyrem-Origa H (2014). Documentation and consensus of indigenous knowledge on medicinal plants used by the local communities of western Uganda. Journal of Natural Product and Plant Resources 4(1):34-42.

Atangwo IJ, Ebung GE, Ahmad M, Yam MF, Asmawi MZ (2013). Antioxidant versus anti-diabetic properties of leaves from Vernonia amygdalina Del. growing in Malaysia. Food chemistry 141:3428-3434.

Atawodi SE, Atawodi JC, Idakwo GA, Pfundstein B, Haubner R, Wurtele G, Bartsch H, Owen RW (2010). Evaluation of the polyphenol content and antioxidant properties of methanol extracts of the leaves, stem, and root barks of Moringa oleifera Lam. Journal of Medicinal Food. 13:710-716.

Awodele O, Adekunle I, Odoma S, Teixeira JA, Oluseye V (2012). Toxicological evaluation of the aqueous leaf extract of Moringa oleifera Lam. (Moringaceae). Journal of Ethnopharmacology 139(2):330-336.

Awoku G, Gyan B, Bugyel K, Adjei S, Mahama R, Addo P, Otuv-Nyakoa L, Wiedru EK, Nyarko A (2012). Toxicity potentials of the nutraceutical Moringa oleifera at supra-supplementation levels. Journal of Ethnopharmacology 139(1):265-272.

Babarinde SA, Akinyemi AO, Usman LA, Odewole AF, Sangodele AO, Iyiola OO (2014). Toxicity and repellency of Hosulindia opposita Vahl (Lamiaceae) leaves essential oil against rust-red flour beetle, Tribolium castaneum Herbst. (Coleoptera: Tenebrionidae). Natural Product Research 28(6):365-371.

Bao XL, Yuan HH, Wang CZ, Fan W, Lan MB (2015). Polysaccharides from Cymbopogon citratus with antiinflammation and immunomodulatory activity. Pharmaceutical Biology 53(1):117-124.

Barroso PTW, de Carvalho PP, Rocha TB, Pessoa FLP, Azevedo DA, Mendes MF (2016). Evaluation of the composition of Carica papaya L. seed oil extracted with supercritical CO2. Biotechnology Reports 11:110-116.

Basha DP, Kuman KP, Teja BB, Subbarao M (2011). Antidiabetic activity on extracts of Mangifera indica in alloxan monohydrate induced diabetic rats. Drug Invention Today 3:165-168.

Bassolé IHN, Lamien-Meda A, Bayala B, Obame LC, Ibibou AJ, Franz C, Novak J, Nebié RI, Dico MH (2011). Chemical composition and antimicrobial activity of Cymbopogon citratus and Cymbopogon giganteus essential oils alone and in combination. Phytomedicine 18:1070-1074.

Bloser GS, Kyegombe DB, Lubega A, Musisi N, Ogwal-Okeng J, Odye O (2013). Anti-Plasmodium falciparum activity of Aloe daweri and Justicia betonica. African Journal of Pharmacy and Pharmacology 7(31):2293-2298.

Belay Y (2011). Study of safety and effectiveness of traditional dosage forms of the seed of Aristolochia elegans Mast. against malaria and laboratory investigation of pharmaco-toxicological properties and chemical constituents of its crude extracts. Annals of Tropical Medicine and Parasitology 4(1):33-41.

Berardinelli N, Fezer R, Conrad J, Beifuss U, Carle R, Schieber A (2005). Screening of mango (Mangifera indica L.) cultivars for their contents of flavanol O- and xanthone C-glycosides, anthocyanins and pectin. Journal of Agricultural and Food Chemistry 53:1563-1570.

Bidia G, Titian VP, Jako B, Bolad A, Berzins K (2004). Antiplasmoidal activity of seven plants used in African folk medicine. Indian Journal Pharmacology 36:245-256.

Blanco MM, Costa CARA, Freire AO, Santos Jr JG, Costa M (2009). Neurobehavioural effect of essential oil of Cymbopogon citrates in mice. Phytomedicine 16:270-277.

Brail GA, Ronchi SN, de Nascimento AM, de Lima EM, Romão W, da Costa HB, Scherer R, Ventura JA, Lenz D, Bissoli NS, Endringer DC, de Andrade TU (2014). Antihypertensive effect of Carica papaya via a reduction in ACE activity and improved baroreflex. Planta Medica 80:1580-1587.

Brandão MGL, Krettli AU, Soares LSR, Nery CGC, Marinucci HC (1997). Antimalarial activity of extracts and fractions from Bidens pilosa and other Bidens species (Asteraceae) correlated with the presence of acetylene and flavonoid compounds. Journal of Ethnopharmacology 57:131-138.

Brandão MGL, Nery CGC, Mamão MAS, Krettli AU (1998). Two methoxylated flavone glycosides from Bidens pilosa. Phytochemistry 48:397-399.

Brousouillais AM, Ferraro GE, Martino VS, Pinzòn R, Coussio JD, Calle AJ (1999). Argentine plants as potential source of insecticidal compounds. Journal of Ethnopharmacology 67:219-223.

Cáceres A, Cabrera O, Morales O, Molinredo P, Mendia P (1991). Pharmacological properties of Moringa oleifera. 1. Preliminary screening for antimicrobial activity. Journal of Ethnopharmacology 35:213-216.

Casasnovara LM, da Silva D, Solà-Penna M, Camargo LMDM, Celestini DdM, Tinoco LW, Costa SS (2014). Identification of choric acid as a hypoglycemic agent from Ocimum gratissimum leaf extract in a bio-monitoring in vivo study. Fitoterapia 93:132-141.

Chang JS, Chiang LC, Chen CC, Liu LT, Wang WC, Lin CC (2001). Antileuemic activity of Bidens pilosa L. var. minor (Blume) Sherff and Houttuynia cordata Thumb. American Journal of Chinese Medicine 29:303-312.

Chang SL, Chiang YM, Chang CLT, Yeh HH, Shyr LF, Kuo YH, Wu TK, Yang WC (2007). Flavonoids, centaurein and centaureadin, from Bidens pilosa, stimulate iNFPression. Journal of Ethnopharmacology 112:233-236.

Chatterjee A, Pakrashi SC (1994). The treatise on Indian medicinal plants. CSIR, new Delhi 3:152-153.

Chavez Quintal P, Gráñez-Flores T, Rodríguez-Buenti I, Gallegos-Tintoré S (2011). Antifungal activity in ethanolic extracts of Carica papaya L. cv. maradol leaves and seeds. Indian Journal of Microbiology 51(1):54-60.
Chen C (2014). Development of phytomedicinal drugs and their application in China: a historical review. Infectious Diseases of Poverty 3(1):1-10.

Chiang LC, Chang JS, Chen CC, Ng LT, Lin CC (2003). Anti-Herpes Simplex virus activity of Bidens pilosa and Houttuynia cordata. American Journal of Chinese Medicine 31(3):355-362.

Chiang LC, Cheng HY, Liu MC, Chiang W, Lin CC (2003). In vitro anti-herpes simplex viruses and anti-adenoviruses activity of twelve traditionally used medicinal plants in Taiwan. Biological and Pharmaceutical Bulletin 26:1600-1604.

Chelii E, Romiti N, Rodeiro I, Santos G (2009). In vitro effects of Mangifera indica and polyphenols derived on ABCB1/P-glycoprotein activity. Food and Chemical Toxicology 47:2703-2710.

Chen SC, Young PH, Hsu YJ, Chen CH, Tien YJ, Shiu SY, Li TH, Yang CW, Marimuthu P, Tsai LFL, Yang WC (2009). Anti-diabetic properties of three common Bidens pilosa variants in Taiwan. Phytochemistry 70:1246-1252.

Chimko YB (2007). Possible role of Moringa oleifera Lam. root in epithelial ovarian cancer. Medscape General Medicine 9:26.

Chukwuocha UM, Fernández-Rivera O, LegorettaHerrera M (2016). Exploring the antimalarial potential of whole Cymbopogon citratus plants. Journal of Ethnopharmacology http://dx.doi.org/10.1016/j.jep.2016.09.056.

Cortés-Rojas DF, Chagas-Paula DA, da Costa FB, Souza CRF, Oliveira WP (2013). Bioactive compounds in Bidens pilosa L. populations: a key step in the standardization of phytopharmaceutical preparations. Revista Brasileira de Farmacognosia 23:28-35.

Costa RS, Carneiro TCB, Cerqueira-Lima AT, Queiroz NV, Alcântara-Neves NA, Pontes-Carvalho LC, Velozo EdS, Oliveira EJ, Figueiredo CA (2012). Ocimum gratissimum Linn. and rosmarinic acid, attenuate eosinophilic airway inflammation in an experimental model of respiratory allergy to Blomia tropicalis. Article in International immunopharmacology 13:126-134.

Cyril-Oluyato CM, Elujoba AA, Durosimmi MA (2009). Antioxidant properties of the fermented mixture of Carica papaya Linn. and Sorgum bicolor (L.) Moench. African Journal of Pharmacy and Pharmacology 3(14):143.

da Silva JJ, Cereide CD, Chavasco JM, Cintra ABP, da Silva CBP, de Mendonça AN, Ishikawa T, Boriollo MF, Chagas-Paula DA (2014). In vitro screening antibacterial activity of Bidens pilosa L. and Annona squarifolia Mart. against oxacillin resistant Staphylococcus aureus (Orsa) from the aerial environment at the dental clinic. Revista do Instituto de Medicina Tropical de Sao Paulo 56(4):333-340.

Dang SY, Jolly CI, Nartey BK (2002). Antihypertensive activity of the total alkaloids from the leaves of Moringa oleifera. Pharmaceutical Biology 40:144-148.

da Silva BCJ, Jung WG, Hossain S, Wimalasena S, Pathirana HNKS, Heo GJ (2017). Antimicrobial property of lemongrass (Cymbopogon citratus) oil against pathogenic bacteria isolated from pet turtles. Laboratory Animal Research 33(2):84-91.

Deba F, Xuan TD, Jasuda M, Tawala S (2006). Chemical composition and antioxidant, antibacterial and antifungal activities of the essential oils from Bidens pilosa Linn. var. radiata. Food Control 19:46-532.

Dharani N, Rukunga G, Yenesew A, Mbora A, Mwaura L, Dawson I, Jamnadass R (2010). Common Antimalarial Trees and Shrubs of East Africa: a Description of Species and a Guide to Cultivation and Conservation through Use, Dawson I (ed). The World Agroforestry Centre (ICRAF), Nairobi.

Diallo D, Marston A, Terreaux C, Toure Y, Paulsen B (2010). Exploring the antimalarial potential of whole Cymbopogon citratus plants. Journal of Ethnopharmacology 134:31(3):56-62.

Dong L, Yang J, Wang X (2004). Analysis of components of volatile oil from Bidens pilosa. Xinxiang Yixueyuan Xuebao 21:179-180.

dos Santos AO, da Silva FD, Lincesi J, da Silva MB (2018). Antinociceptive, anti-inflammatory and toxicological evaluation of semi-synthetic molecules obtained from a benzylisothiocyanate isolated from Moringa oleifera Lam. in a temporomandibular joint inflammatory hypernociception model in rats. Biomedicine and Pharmacotherapy 96:609-618.

Duke JA (1981). Handbook of legumes of world economic importance. Plenum Press, New York.

Duker-Eshun G, Jaroszewski JW, Asomaning WA, Oppong-Boachie F, Brøgger Christensen S (2004). Antiplasmodial constituents of Cajanus cajan. Phytotherapy Research 18:128-130.

Duraipandiyan V, Ignacimuthu S (2009). Antibacterial and antifungal activity of Flindersia isolated from the traditional medicinal plant, Todalia asiatica (L.) Lam. Journal of Ethnopharmacology 123:494-498.

Dzotam JK, Touani FK, Kuete V (2016). Antibacterial and antibiotic-modifying activities of three food plants (Xanthosoma mafalaf Lam., Moringa oleifera (L.) Schott and Passiflora edulis Sims) against bacteria. BMC Complement Alternative Medicine 16(9):1-8.

Ekeke GI, Shode FO (1990). Phenylenaline is the predominant antiscissic agent in Cajanus cajan seed extract. Planta Medica 56(1):41-43.

Ekenyong CE, Akpan E, Nyoh A (2015). Ethnopharmacology, phytochemistry, and biological activities of Cymbopogon citratus (DC.) Stapf. Extraites. Chinese Journal of Natural Medicine 13(5):0321-0337.

Elujobe TO, Aghedahungini JM (2004). Antimalarial activities of Tithonia diversifolia (Asteraeace) and Crossoperty febriluga (Rubiaceae) on mice in vivo. Journal of Ethnopharmacology 93:167-171.

Elujobe TO, Alatise OI, Fakoya FA, Aghedahungini JM, Houghton PJ (2009). Toxicity studies of Tithonia diversifolia A. Gray (Asteraeace) in rats. Journal of Ethnopharmacology 122:410-415.

Erasto P, Grierson DS, Atolayan AJ (2006). Bioactive sesquiterpene lactones from the roots of Vernonia amygdalina. Journal of Ethnopharmacology 106:117-120.

Ezeonwumelu JOC, Omolo RG, Ajayi AM, Agwu E, Tanayen JK, Adiukwu CP, Oyewale AA, Azu B, Okorua WA, Ogbonna SO (2012). Studies of phytochemical screening, acute toxicity and anti-diarrhoal effect of aqueous extract of Kenyan Tithonia diversifolia leaves in rats. British Journal of Pharmacology and Toxicology 3(5):127-134.

Ezikwe AC, Akah PA, Okoli CC, Chinwe B, Okpala CB (2010). Experimental evidence for the antiadhesive activity of Cajanus cajan leaves in rats. Journal of Basic and Clinical Pharmacy 1(2):81-84.

Ezikwe AC, Akah PA, Okoli CO, Ezechunne NA, Ezequwu S (2009). Carica papaya (paw-paw) unripe fruit may be beneficial in ulcer. Journal of Medicinal Food 12(6):1266-1273.

Fandohan P, Gronlonfin B, Lalaye A, Gbenou JD, Darboux R, Moumouni M (2008). Toxicology and gastric tolerance of essential oils from Cymbopogon citratus, Ocimum gratissimum and Ocimum basilicum in Wistar rats. Food and Chemical Toxicology 46:2493-2497.

Figueirinha A, Cruz MT, Francisco V, Lopes MC, Batista MT (2010). Anti-inflammatory activity of Cymbopogon citratus leaf infusion in lipopolysaccharide-stimulated dendritic cells: contribution of the polyphenols. Journal of Medicinal Food 13(3):681-690.

Fotso AF, Longo F, Desire P, Dijomeni D, Kouam SF, Savinene JP (2014). Analgesic and antiinflammatory activities of the ethyl acetate fraction of Bidens pilosa (Asteraceae). Inflammopharmacology 22:105-114.

Francisco V, Costa G, Figueirinha A, Marques C, Pereira P, Neves BM, Lopes MC, Garcia-Rodriguez C, Cruz MT, Batista MT (2013). Anti-inflammatory activity of Chen Cca in rats. Biomedicine and Pharmacotherapy 35:56-62.

Gadhi CA, Benharref A, Jana M, Brasile AM, Contet-Audonneau N, Fortier B (2001). Antideamathophytic properties of extracts from the leaves of Aristocloia paucinervis Pomei. Phytotherapy Research 15:79-81.

Gangadharan K, Ravishankar K (2013). Evaluation of analgesic and anti-inflammatory activities of ethanolic extract of whole plant Justicia betonica. World Journal of Pharmacy and Pharmacaceutical Sciences 2(6):5218-5228.
calamus L., Kigelia pinnata L., Mangifera indica L. and Tabernaemontana divaricata L. Jurnal of Pharmacy and Bioallied Sciences 4(2):149-154

Khan MR, Khara M, Omoloso AD (2001). Antimicrobial activity of Bidens pilosa, Bischofia javanica, Elmerillia papuanu and Sigestbeia orientalis. Fitoterapia 72:662-665.

Kim H, Banerjee N, Ivanov I, Pfent CM, Prudhomme KR, Bisson WH, Mertens-Talcott SU (2016). Comparison of anti-inflammatory mechanisms of mango (Mangifera indica L.) and pomegranate (Punica granatum L.) in a preclinical model of colitis. Molecular Nutrition Food Research 60(9):1912-1923.

Knodler M, Conrad J, Wenzig EM, Bauer R, Lacorn M, Beifuss U, Schieber A (2008). Anti-inflammatory 5-(11’Z-heptadecenyl)- and 5-(8’Z,11’Z-heptadecadienyl)-resorcinols from mango (Mangifera indica L.) peels. Phytochemistry 69(4):988-993.

Kokwaro JO (1993). Medicinal Plants of East Africa. East African Literature Bureau, Nairobi 212 p.

Koul JL, Koul S, Singh C, Taneja SC, Shammuavel G, Kumpashi H, Saxena AK, Qazi GN (2003). In vitro cytotoxic elenolides from Vernonia lasiopus. Planta Medica 69:164-166.

Kumari P, Misra K, Sisodia BS, Fardi U, Srivastava S, Luqman S, Darokar MP, Negi AS, Gupta MM, Singh SC, Kumar JK (2009). A promising antitumor and antimarial component from the leaves of Bidens pilosa. Planta Medica 75:59-63.

Kupchan SM, Hemingway RJ, Karim A, Wemer D (1969). Tumor inhibitors. XLVII. Vernoldalin and Vernoldin, two new cytotoxic sesquiterpene lactones from Vernonia amygdalina Journal of Organic Chemistry 34:3908-3911.

Kurian JC (2001). Plants that Heal, 2 ed. Oriental Watchman Publishing House Pune, India 37(5):264-300.

Kuroda M, Yokosuka A, Kobayashi R, Jitsuno M, Kando H, Nosaka K, Ishii H, Yamori T, Mimaki Y (2007). Sesquiterpenoids and flavonoids from the aerial parts of Tithonia diversifolia and their cytotoxic activity. Chemical and Pharmaceutical Bulletin 55:1240-1244.

Kusano A, Seyama Y, Usami E, Katayose T, Shibano M., Tsukamoto D, Kusano G (2003). Studies on the antioxidant active constituents of the dried powder from Bidens pilosa L. var. radiata Sch. Nature Medicine 57:100-104.

Kusemijii TO, Osnubi AA, Noronha CC, Okenlawon AO (2010). Effect of aqueous extract of the bark of Carica papaya on testicular histology in Sprague-Dawley rats. Nigerian Quarterly Journal of Hospital Medicine 20(3):133-137.

Kwiecinski MR, Felipe KB, Schoenfelder T, Wiese LPL, Rossi MH, Gonzalez E, Felicio JD, Filho DW, Pedroso RC (2008). Study of the antitumor potential of Bidens pilosa ( Asteraceae) used in Brazilian folk medicine. Journal of Ethnopharmacology 117:69-75.

Lacroix D, Prado S, Dennis Kamoga D, Kasenene J, Namukobbe J, Krief S, Dumontet V, Mourney E, Bodo B, Brunofos N (2011). Antiplasmodial and cytotoxic activities of medicinal plants traditionally used in the village of Kiohima, Uganda. Journal of Ethnopharmacology 133:850-855.

Lacroix D, Prado S, Deville A, Krief S, Dumontet V, Kasenene J, Mourney E, Bories C, Bodo B (2009). Hydropropoxy-cycloactone terpenoids from the leaves of Markhamia lutea, a plant ingested by wild chimpanzees. Phytochemistry 70:1239-1245.

Lai YS, Hsu WH, Huang JJ, Wu SC (2012). Antioxidant and anti-inflammatory effects of pigeon pea (Cajanus cajan L.) extracts on hydrogen peroxide- and lipopolysaccharide-treated RAW264.7 macrophages. Food Function 3:1294-1301.

Lamou B, Taiwe GS, Hamadou A, Houlray J, Avoir MM, Tan PV (2016). Antioxidant and antifatigue properties of the aqueous extract of Moringa oleifera in rats subjected to forced swimming endurance test. Oxidative Medicine and Cellular Longevity http://dx.doi.org/10.1155/2016/3517824.

Li X, Huang G, Zhao G, Chen W, LJ J, Sun L (2013). Two new monoterprenes from Tithonia diversifolia and their anti-inflammatory activity. Natural Products Communications 7(4):351-354.

Linthongambi W, Singh WS (2013). Antimicrobial activities of different solvent extracts of Tithonia diversifolia (Hernemly) A. Gray. Asian Journal of Plant Science and Research 3:50-54.

Luo X, Jiang Y, Fronczek FR, Lin C, Izvibgie EB, Lee KS (2011) Isolation and structure determination of a sesquiterpene lactone (vernonanolide) from Vernonone amygdalina extracts. Pharmaceutical Biology 49(5):464-470.

Machado M, Pires P, Dinis AM, Santos-Rosa M, Alves V., Salgueiro L, Cavaleiro C, Sousa MC (2012). Monoterpenic aldehydes as potential anti-Leishmania agents: Activity of Cymbopogon citratus and citral on L. infantum, L. tropica and L. major. Experimental Parasitology 130(3):223-231.

Mahmudarjan S, Sadakumar J, Kailayalingam R, Manoharan NA, SriVijieendrad S (2014). Screening the antifungal activity of essential oils against decay fungi from palmryah leaf handicrafts. Biological Research 47(35):1-5.

Maldini M, Maksoud SA, Natella F, Montoro P, Petretto GL, Foddi M, De Nicola GR, Chessa M, Pintore G (2014). Moringa oleifera: study of phenolics and glucosinolates by mass spectrometry. Journal of Pharmaceutical and Biomedical Analysis 90:42-48.

Manjey Y., Bhivatamath P. (2015). Anti-inflammatory and antihypertensive effects of aqueous extract of Carica papaya Linn. leaves in alloxan-induced diabetic rats. Journal of Ayurveda and Integrative Medicine 3(2):70-74.

Martínez-González CL, Martínez L, Martínez-Eijz ET, González-Trujano ME, Deíca-Campos M, Ventura-Martínez R, Díaz-Reval I (2017). Moringa oleifera, a species with potential analgesic and anti-inflammatory activities. Biomedicine and Pharmacotherapy 87:482-488.

Matasoyh LG, Matasoyh JC, Wachira FN, Kinyua MG, Muigai AW, Mukiama TK (2008). Antimicrobial activity of essential oils of Ocimum gratissimum L. from different populations of Kenya. African Journal of Traditional CAM 5(2):187-193.

Mayak JS, Deisiane D, Nyagatahe DSP, Alex BLR, Ryan DR, Flavia DP, Paula SFS, Nubia PLT, Sheyla SMDA (2016). Antioxidant effect of plant extracts of the leaves of Tithonia diversifolia (Hemsil.) A. Gray on the free radical DPPH. Journal of Chemical and Pharmaceutical Research 8:1182-1189.

Mbaya AW, Ibrahim UI, ThankGod O, Ladi S (2010). Toxicity and potential anti-trypansomal activity of ethanolic extract of Azadirachta indica (Malieaceae) stem bark. An in vivo and in vitro approach using Trypansom brucei. Journal of Ethnopharmacology 128:495-500.

Melarini P, Campbell W, Elusim P, Smith P (2011). Antiplasmodial properties and bioassay-guided fractionation of ethyl acetate extracts from Carica papaya leaves. Journal of Parasitology Research https://doi.org/10.1155/2011/104954.

Meyer J (2005). Toddalia asiatica (L.) Lam. National Herbarium, Pretoria and South African National Biodiversity Institute, South Africa. http://www.hbp.sanbi.org/fragments/searchfrag.htm.

Ministry of Health (MoH), Republic of Uganda (2016). National Malaria Control Program. http://www.health.go.ug.

Miura T, Nosaka K, Ishii H, Ishida T (2005). Antidiabetic effect of nitobekicho, the herb Tithonia diversifolia, in KK-Ay diabetic mice. Biological and Pharmaceutical Bulletin 28:2152-2154.

Mohamed ISS, Riffín S (2006). The in-vitro antibacterial activity of methanol and ethanolic extracts of Carica papaya flowers and Mangifera indica leaves. Journal of Pharmacological and Toxicological 1:278-283.

Mohan CG, Deepak M, Viswanatha GL, Savinay G, Hanummantharaju V, Rajendra CE, Halemane PD (2013). Anti-oxidant and anti-inflammatory activity of leaf extracts and fractions of Mangifera indica. Asian Pacific Journal of Tropical Medicine 6(4):311-314.

Mohr FBM, Lermen C, Gazim ZC, Gonzales JE, Albertson O (2017). Antifungal activity, yield, and composition of Ocimum gratissimum essential oil. Genetics and Molecular Research 16(1):gmr16019542. Morton JF (1976). The pigeon pea (Cajanus cajan Millsp.), a high protein tropical bush legume. Hort Science 11(1):11-19.

Motsei ML, Lindsey KL, Van Staden J, Jäger AK (2003). Screening of traditionally used South African plants for antifungal activity against Mycosphaerella albicora. African Journal of Biotechnology 2:285-294.

Mujoso SF, Hussein AA, Meyer JM, Fourie B, Muthivi T, Lall N. (2008). Biocatropic compounds from Lippia javanica and Hoslandia opposita. Natural product research 22(12):1047-1054.
Muregi FW, Chhabra SC, Njagi ENM, Lang CC (2003). In vitro antiplasmodial activity of some plants used in Kisii, Kenya against malaria and their chloroquine potentiation effects. Journal of Ethnopharmacology 84:235-239.

Muregi FW, Ishii A, Miyase T, Suzuki T, Kino H, Amano T, Mkoji GM, Terada M (2007). Antimalarial activity of methanolic extracts from plants used in Kenyan ethnomedicine and their interactions with chloroquine (CQ) against a CQ-tolerant rodent parasite, in mice. Journal of Ethnopharmacology 111:190-195.

Murillo AJ, Encarnación DR, Franzblau SG (2001). Antimicrobial and cytotoxic activity of some medicinal plants from Baja California Sur (Mexico). Pharmaceutical Biology 39:445-449.

Muthumani P, Meera R, Devi P, Mohamed SA, Arabath V, Kureh J, Jondiko IJ (2016). A review of evidence and pharmacology. Toxicity and Antimicrobial activities of the compound isolated from chloroform extract of Vernonia lasiopus (Lam.) (Lamiaceae) essential oil. Journal of Ethnopharmacology 173:214-217.

Nakamura N, Nafiu M, Murillo M, Muregi F (2021). Antimalarial activity of Toddalia asiatica L. (Lam.) (Lamiaceae) essential oil and its isolated active diterpene. Pest Management Science 77(1):1-8.

Nakamura N, Nafiu M, Murillo M, Muregi F (2022). The use of Toddalia asiatica L. (Lam.) (Lamiaceae) essential oil against Plasmodium falciparum. Parasites & Vectors 15(1):309.

Nakamura N, Nafiu M, Murillo M, Muregi F (2022). The use of Toddalia asiatica L. (Lam.) (Lamiaceae) essential oil against Plasmodium falciparum. Parasites & Vectors 15(1):309.

Nakamura N, Nafiu M, Murillo M, Muregi F (2022). The use of Toddalia asiatica L. (Lam.) (Lamiaceae) essential oil against Plasmodium falciparum. Parasites & Vectors 15(1):309.

Okon UA, Umoren IU (2017). Comparison of antioxidant activity of insulin, Ocimum gratissimum L., and Vernonia amygdalina L. in type 1 diabetic rat models. Journal of Integrative Medicine 15(4):202-209.

Oliveira FO, Andrade-Neto V, Krettli AU, Brandão MGL (2004). New evidences of antimalarial activity of Bidens pilosa roots extract correlated with polyacetylene and flavonoids. Journal of Ethnopharmacology 93:39-42.

Oliveira RM, Dutra TS, Simionatto E, Ré N, Cassuya CAL, Cardoso CAL (2017). Anti-inflammatory effects of essential oils from Mangifera indica and Melaleuca alternifolia. Genetika i Molecular Research 16(1):gmr1619227.

Olivero-Verbel J, Nerio LS, Stashenko EE (2010). Bioactivity against Tribolium castaneum Herbst (Coleoptera: Tenebrionidae) of Cymbopogon citratus and Eucalyptus citriodora essential oils grown in Colombia. Pest Management Science 66:664-668.

Oloyede OI (2005). Chemical profile of unripe papaya pulp. Pakistan Journal of Nutrition 4(6):379-381.

Omoregie EA, Ogbo AB, Ewususi JA (2014). Anti-inflammatory and analgesic potential of aqueous leaf extract of Toddalia diversifolia in rodents. Journal of Natural Sciences Engineering and Technology 13:82-90.

Orwa JA, Jondiko IJ, Minja RJ, Bekunda M (2008). The use of Toddalia asiatica (L) Lam. (Rutaceae) in traditional medicine practice in East Africa. Journal of Ethnopharmacology 115:2257-2262.

Orwa JA, Ng'eny L, Mwikabi KW, Ondicho J, Jondiko IJ (2013). Antimalarial and repellent activities of extracts of Toddalia asiatica (L) Lam. (Rutaceae). Journal of Ethnopharmacology 145(2):587-590.

Orwa JA, Ng'eny L, Mwikabi KW, Ondicho J, Jondiko IJ (2013). Antimalarial and repellent activities of extracts of Toddalia asiatica (L) Lam. (Rutaceae). Journal of Ethnopharmacology 145(2):587-590.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.

Parvatkar P, Kalthur R, Pandey P, Mohamed NS, Seshu K (2014). Inflammatory and analgesic properties of ethanolic extracts of some medicinal plants. Journal of Biological Sciences 15(3):194-199.
Morsch VM, Rocha JBT (2009). Antioxidant effects of different extracts from Melissalinalis, Matricaria recutita and Cymbopogon citratus. Neurochemical Research 34:973-983.

Pham VM, Pham TK, Hoang VL, Phan VK (2010). Flavonoid compounds from the plant Bidens pilosa L. ( Asteraceae). Tax. Chi. Duoc. Hoc. 50:48-53.

Philip K, Elizabeth MM, Cheplogo PK, Samuel KT (2017). Ethnobotanical survey of antimarial medicinal plants used in Butebo County, Eastern Uganda. European Journal of Medicinal Plants 21(4):1-12.

Pierson JT, Monteilh GR, Roberts-Thomson SJ, Dietzgen RG, Gidley MJ, Shaw PN (2014). Phytochemical extraction, characterisation and comparative distribution across four mango (Mangifera indica L.) fruit varieties. [Comparative Study]. Food chemistry 149:253-263.

Pinto LA, Cordeiro KW, Carrasco V, Carolio CA, Cardoso CAL, Argadona EJS, Freitas KD (2014). Antiulcerogenic activity of Carica papaya seeds in Naunyn-Schmiedeberg’s Archives of Pharmacology Doi.10.1007/s00210-014-1069-y.

Prado Y, Merino N, Acosta J, Herrera JA, Luque Y, Hernández I, Prado E, Garrido G, Delgado R, Rodeiro I (2015). Acute and 28-day subchronic toxicity studies of mangiferin, a glucosyl xanthone isolated from Mangifera indica L. stem bark. Journal of Pharmacy Pharmacognosy Research 3(1):13-23.

Pranathan K, Kotha GM (2003). Chemical composition of the leaves of Azadirachta indica Linn (Neem). International Journal of Engineering, Technology Management and Applied Sciences 1(5):21-31.

Pulido KDP, Dulcey AJC, Martinez JHL (2017). New caffeic acid derivative from Tithonia diversifolia (Hems.) A. Gray butanolic extract and its antioxidant activity. Food Chemistry Toxicology https://doi.org/10.1016/j.fct.2017.03.059.

 Qin J, Chen T, Chen S, Lu Q (2003). Analysis of essential oil of Bidens pilosa by GC-MS. Feni Ceshi Xuebao 22:85-87.

Rabelo M, Souza EP, Soares PMG, Miranda AV, Matos FJA, Criddle DN (2003). Antinociceptive properties of the essential oil of Ocimum gratissimum L. (Labiatae) in mice. Brazilian Journal of Medical and Biological Research 36:521-524.

Rachuonyo HO, Ogela PE, Anka W, Nyamai D, Wambani J (2016). In Vitro Antimicrobial Activity of Crude Leaf Extracts from Aloë secundiflora. bulbifere fructescens, Vernonia lasiopus and Tagetes minuta against Salmonella typhi. Journal of Traditional Medicine & Clinical Naturapathy 5:2-4.

Raj MK, Balachandran C, Duraipandiyan V, Agastian P, Ignacimuthu S (2012). Antimicrobial activity of uoloterisol extracted from Toduddalia asiatica (L.) Lam., A traditional medicinal plant. Journal of Ethnopharmacology 140:161-165.

Rastrelli L, Capasso A, Piza C, De Tommasi N, Sorentino L (1997). New protope and benzytetracydropeotoberine alkaloids from Aristolochia constrixta and their activity on isolated guinea pig ileum. Journal of Natural Products 60:1065-1069.

Rojas JJ, Ochoa VJ, Ocampo SA, Muñoz JF (2006). Screening for antimicrobial activity of ten medicinal plants used in Colombian folkloric medicine: a possible alternative in the treatment of non-nosocomial infections. BMC Complement. Alternative Medicine 6(2):1-6.

Ronchi SN, Brasil GA, do Nascimento AM, de Lima EM, Scherer R, Costa HB, de Andrade TU (2015). Phytochemical and in vitro and in vivo biological investigation on the antihipertensive activity of mango leaves (Mangifera indica L.). Therapeutic Advances in Cardiovascular Disease 9(5):244-256.

Sacchetti G, Maletti S, Muzzoli M, Scaglianti M, Manfredini S, Radice M, Bruni R (2005). Comparative evaluation of 11 essential oils of different origin as functional antioxidants, antiradicals and antimicrobials in foods. Food chemistry 91:621-632.

Sagradas J, Gustavo G, Figueirinha A, Castel-Branco MM, Cabrita AMS, Figueiredo IV, Balista MT (2015). Gastroprotective effect of Cymodocea rotundata infusino on acute ethanol-induced gastric lesions in rats. Journal of Ethnopharmacology 173:134-138.

Sairam K, Hemalatha S, Kumar A, Srinivasan T, Ganesh J, Shankar M, Venkataraman S (2003). Evaluation of anti-diarrhoeal activity in seed extracts of Mangifera indica. Journal of Ethnopharmacology 84(1):11-15.

Salimone R, Cheikh-ali Z, Bories C, Poupon E, Champy P (2012). Pyrone and unusually furanone- substituted flavones from the leaves of Hostolunda opposita. Planta Medica 78:1777-1779.

Sánchez-Mendoza ME, Reyes-Ramírez A, Antonio LC, Jiménez LM, RodríguezSilverio J, Arrieta J (2011). Bioassay-guided isolation of an anti-ulcer compound, taglitinin C, from Tithonia diversifolia: role of nitric oxide, prostaglandins and sulfhydrils. Molecules 16:665-674.

Schierle AR, Berardino R, Coss C (2003). Identification of flavonol and xanthone glycosides from mango (Mangifera indica L. Cv. "Tommy Atkins") peels by highperformance liquid chromatography-electrospray ionization mass spectrometry. Journal of Agricultural and Food Chemistry 51:5006-5011.

Severi JA, Lima ZP, Kushima H, Brito AR, Santos LC, Villegas W, Hiruma-Lima CA (2009). Polyphenols with antiulcerogenic action from Mangifera indica seeds in two stages of maturity. Plant Foods Human nutrition 64:303-311.

Ssegawa P, Kasenene JM (2007). Medicinal plant diversity and uses in the Sango bay area, Southern Uganda. Journal of Ethnopharmacology 113:521-540.

Stangeland T, Aiele PE, Katuura E, Lyke KA (2011). Plants used to treat malaria in Nyakayojo sub-county, western Uganda. Journal of Ethnopharmacology 135(2):63-66.

Stone A (1992). The Neem. Science 15(3):255-107.

Subbaraju GV, Kavitha J, Sreelatha N. (2008). Antioxidant activity and total phenolic content of Moringa oleifera leaves in two stages of maturity. Plant Foods Human nutrition 64:303-311.

Ssegawa P, Kasenene JM (2007). Medicinal plant diversity and uses in the Sango bay area, Southern Uganda. Journal of Ethnopharmacology 113:521-540.

Tobinaga S, Sharma MK, Aalbersberg WGL, Watanabe K, Iuchi K, Narui K, Sasatsu M, Waki S (2009). Isolation and identification of a potent antimalarial and antibacterial polyacetylene from Bidens pilosa. Planta Medica 75:624-628.

Trevisan MTS, Silva MGV, Pfundstein B, Spiegelhalder B, Owen RW (2006). Characterization of the volatile pattern and antioxidant
