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Review

Woody species from the Mozambican Miombo woodlands: A review on their ethnomedicinal uses and pharmacological potential

Isabel Moura[1*], Jossias Alberto Duvane[2], Maria José Silva[1], Natasha Ribeiro[3] and Ana Isabel Ribeiro-Barros[1]

[1]Plant-Environment Interactions and Biodiversity Lab (Plant Stress and Biodiversity), LEAF- Linking Landscape, Environment, Agriculture and Food, School of Agriculture (ISA), University of Lisbon (ULisboa), Portugal.
[2]Faculty of Sciences, Eduardo Mondlane University, Maputo, Mozambique.
[3]Faculty of Agronomy and Forest Engineering, Eduardo Mondlane University, Maputo, Mozambique.

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Miombo woodlands cover about two thirds of Mozambique national territory. They provide a wide collection of goods and services to the formal and informal economies. A review on the traditional uses of 15 Miombo tree species in human and animal health, as well as the status of research towards the identification of bioactive compounds is presented. Among the 15 species selected, 12 have been screened for their biological activity and/or pharmacological properties and/or toxicity. The information gathered in this work is a key to further exploit potential new uses and future opportunities for research and valorization of the selected species.

Key words: Ethnobotanical, medicinal plants, Miombo woodlands, non timber forest products.

INTRODUCION

Miombo is the most widespread deciduous woodland formation in Africa, stretching across southern Africa in a belt from Angola and the Democratic Republic of Congo in the west to Mozambique in the east, covering an area of about 2.7 km^2 (Campbell, 1996). It is characterized by the dominance of few woody species in the genera *Brachystegia* (Miombo in local languages), *Julbernardia* and *Isoberlinia* (Fabaceae family). However, plant diversity is significant with 8,500 species, half of which are endemic and 4% are trees (Ribeiro, 2007; Dewees et al., 2011).

Species composition and structure of Miombo woodlands vary along a rainfall gradient across the Miombo ecoregion (Campbell, 1996). Consequently, Miombo woodlands are divided into dry and wet according to the zone rainfall. Besides the interest of their biodiversity, Miombo woodlands also play an important environmental role in energy, water and carbon balances (Campbell, 1996). Over the last decades, the ecological dynamics of Miombo has been progressively disturbed by a combination of changes in the global climatic pattern, herbivory/grazing and human activities (Ribeiro, 2007).

*Corresponding author. E-mail: imoura@isa.ulisboa.pt. Tel: +351 213653563.

There is an increased concern that such scenarium may result in a considerable loss of the woodlands, with changes in biodiversity and biomass causing modifications on the pattern of goods and services provided by the ecosystem.

In Mozambique, Miombo woodlands occur north of Limpopo River and occupy approximately two-thirds of the country, dry Miombo being the most common type (White, 1983). Dry Miombo has a structure of an "open forest" with two strata: the upper storey composed of woody vegetation and the lower storey composed of grass and herbaceous elements. The vegetation is floristically poorer than the wet Miombo and is dominated by the presence of *Brachystegia spiciformis*, *B. boehmii* and *Julbernardia globiflora*. Canopy height is generally less than 15 m in height (Ribeiro, 2007).

According to the National Statistics Institute (INE, 2016) about 70% of Mozambican population live in rural areas relying directly upon a variety of products harvested from the woodlands for their daily subsistence as well as for their economic, spiritual and cultural needs (Bruschi et al., 2014). Non-timber forest products (NTFP) have always constituted a large part of the forest economy in developing countries by providing supplementary income to many households. However, the real value of NTFPs, such as wild fruits, honey and medicinal plants is still underestimated and the national Gross Domestic Product does not account for most of them. The raising interest in NTFPs is a result of the search for ways to promote development while at the same time protecting the environment (Kusters and Belcher, 2004).

Medicinal plants are an important part of the culture and traditions of African people (Fennell et al., 2004). Particularly in rural areas people are very dependent on plant medicines as a consequence of the lack of formal health care facilities (Clarke et al., 1996). Roots, leaves and barks of many species from Miombo regions are used to treat common ailments and people are generally very knowledgeable about which plants can be used and how to prepare them (Clarke et al., 1996). In addition to the importance of medicinal plants for local use, they are important sources of income and some are internationally marketed. In the last decades there has been an increased interest in traditional pharmacopoeias with researchers involved in determining the scientific rationale for the plant's usage and also in the discovery of novel compounds of pharmaceutical value (Fennell et al., 2004).

The purpose of this paper is to gather comprehensive information on the uses of 15 tree species from dry Zambezian Miombo, focusing on their applications in human and animal health in Mozambique and also in other countries where these species occurr. It also intends to give an overview of the scientific information concerning the pharmacological potential and safe medicinal use. The information combined in this work will be valuable to further exploit potential new uses and future opportunities for research and valorization of Miombo species as well as to enhance the need for their preservation.

METHODOLOGY

An extensive literature retrieval from scientific journals, books, reports, theses and conference papers was used to obtain the required information. Key words included plant species and recognized author names. Personal contacts were made with Miombo researchers for less accessible literature. Data collected included ethnomedicinal uses and research on biological and pharmacological activities of the selected tree species. Scientific names were validated via The Plant List (www.theplantlist.org).

Selection of tree species

Fifteen tree species from dry Miombo woodlands were selected for this review (Table 1). Across Miombo woodlands these species are used for multiple purposes, such as timber, charcoal and firewood, food, honey collection and raw materials for different activities (Bruschi et al., 2014). The selected species were also identified as the most ecologically important by Ribeiro (2007) in one of the most pristine Miombo areas in Africa, the Niassa National Reserve, located in Northern Mozambique. The area is classified as "dry Zambezian Miombo woodland" with intrusions of East African coastal elements (White, 1983). Additionally, according to Timberlake et al. (2004) the Miombo woodlands in Niassa National Reserve are representative of the woodlands in the ecoregion in terms of vegetation structure and composition.

RESULTS AND DISCUSSION

Overview on ethnobotanical and biocompound research

Ethnomedicine and pharmacology

The 15 selected tree species are used in traditional medicine practices (Table 2) in Mozambique (Ribeiro et al., 2010) and other Southern Africa countries such as Tanzania (Amri and Kisangu, 2012), Namibia (Cheikhyoussef et al., 2011), or Zambia (Chinsembu, 2016). Roots, including root barks, are the plant part mostly referred for medicinal purposes (32% - considering the references cited in this review) followed by leaves and juvenile twigs (30%), stems and stem bark (28%). The use of fruits (2%) and sap (2%) is also referred (Table 2 and Figure 1). Depending on the purpose and the region and/or ethnic group, all plant parts are used, from juvenile twigs to roots.

Most of the selected tree species are used to treat, prevent or alleviate complaints caused by the four main groups of diseases in Africa, which include diarrhea, malaria, sexually transmitted diseases and respiratory ilnesses (including hypertension) (Bandeira et al., 2001). Other applications include the treatment of other frequent illnesses such as mental diseases, rheumatism/arthritis, malnutrition/anemia and parasitic infections (Bandeira et

Table 1. Selected tree species from Mozambican Miombo.

Family	Species
Annonaceae	*Annona senegalensis* Pers.
Apocynaceae	*Diplorhynchus condylocarpon* (Müll.Arg.) Pichon
Combretaceae	*Combretum hereroense* Schinz
Combretaceae	*Combretum zeyheri* Sond.
Combretaceae	*Terminalia stenostachya* Engl. & Diels
Dipterocarpaceae	*Monotes engleri* Gilg
Fabaceae (Leguminosae)	*Brachystegia boehmii* Taub.
Fabaceae (Leguminosae)	*Brachystegia spiciformis* Benth.
Fabaceae (Leguminosae)	*Burkea africana* Hook.
Fabaceae (Leguminosae)	*Dalbergia nitidula* Baker
Fabaceae (Leguminosae)	*Julbernardia globiflora* (Benth.) Troupin
Fabaceae (Leguminosae)	*Pterocarpus angolensis* DC.
Melianthaceae	*Bersama abyssinica* Fresen.
Phyllanthaceae	*Pseudolachnostylis maprouneifolia* Pax
Rubiaceae	*Catunaregam spinosa* (Thunb.) Tirveng.

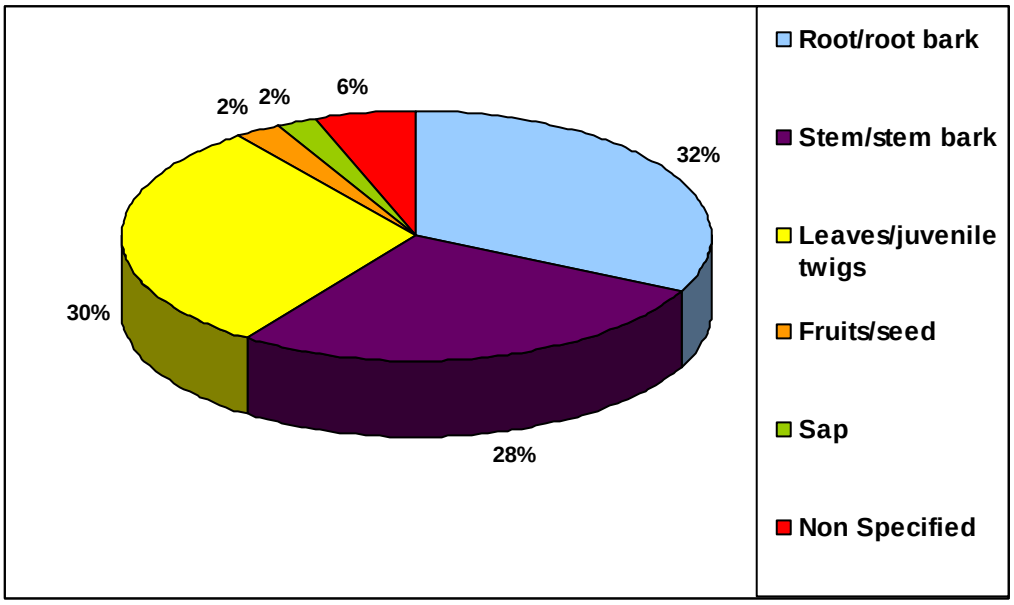

Figure 1. Plant parts used in traditional medicine practices (% of the total references cited in the tables).

al., 2001) as well as wounds and disorders caused by different poisons (Bester, 2006; Ruijter, 2008). Some of the selected plants have been screened for their biological and pharmacological activity (ies) using appropriate *in vitro* and, sometimes, *in vivo* tests (Table 3).

Of the 15 plants selected for this study, 12 (80%) have proven biological and pharmacological activities (Table 3). In some cases, isolation of the active compounds and pharmacological tests provided scientific validation.

Annonaceae

***Annona senegalensis*:** *A. senegalensis* is known by its great medicinal value in Mozambique and other African countries. Different parts of the plant, from leaves to stem bark and roots are used in the management of a wide range of ailments ranging from gastrointestinal disturbances and respiratory system disorders to sexually transmitted diseases (Table 2). Antidiarrheal and antibacterial properties of *A. senegalensis* stem bark,

Table 2. Uses of 15 tree species from Miombo woodlands, in human and animal traditional health systems in Africa.

Family, scientific name	Part(s) used and use(s)	References
Annonaceae		
Annona senegalensis Pers.	Non specified: Diarrhea, respiratory system diseases, sexual complaints	Bandeira et al. (2001)
	Non specified: Sexually transmitted diseases/AIDS	Fumane et al. (2003)
	Juvenile twigs with leaves: Abdominal pain (decoction); head ache (pounded) Leaves: Colds (pounded); dysentery (infusion) Roots: Female sterility (infusion) Roots, flowers: Eye pain	Indjai et al. (2010)
	Stem bark, leaves, roots: Stomach ache, intestinal worms (macerated); cough (infusion or decoction); tuberculosis (macerated or cooked); fever (decoction)	Bruschi et al. (2011)
	Roots, leaves: Eye ache, wounds (crushed or pounded)	Amri and Kisangau (2012)
	Leaves: Stomach upset in babies (porridge) Stem bark: Edema, stomach problems, easy giving birth (decoction) Roots: Stomach problems, infertility, aphrodisiac, pregnancy pains, fever, edema (decoction)	Mahawasane et al. (2013)
Apocynaceae		
Diplorhynchus condylocarpon (Müll.Arg.) Pichon	Leaves: Headache (topic); upset stomach Roots: Blackwater fever (suspension); diarrhea (infusion); snakebite antidote; emetic; cough and tuberculosis (vapor) Fruits: Chronic cough, tuberculosis (vapor) Sap: Remedy for screw-worm	Bester (2006)
	Leaves: Headache, gastric problems Roots: Rectal prolapse, diabetes, testicle inflammation, sore eyes, facilitate giving birth (decoction) Root bark: Indigestion, diarrhea, fever, snakebites, infertility, venereal diseases (decoction); pain in the digestive system (powder in porridge) Sap: Heal cuts	Ruijter (2008)
	Leaves: Diarrhea (infusion)	Chinsembu et al. (2015)
	Stem bark: Malaria (cold infusion)	Ngarivhume et al. (2015)
Combretaceae		
Combretum hereroense Schinz	Young stems, roots: Coughs, diarrhea, tuberculosis, gonorrhea (decoction)	Chinsembu et al. (2015)
	Stem bark, leaves, roots: Coughs, colds, infertility, venereal diseases, diarrhea and dysentery, sores and wounds	Cock and Van Vuuren (2015)
	Leaves: Gonorrhea, chlamydia symptoms in men (suspension in water)	Chinsembu (2016)
Combretum zeyheri Sond.	Roots: Baby delivery, hernia	Luoga et al. (2000)
	Roots, leaves: Diarrhea (decoction or powdered and mixed with porridge); cancer (decoction)	Fyhrquist et al. (2002)
	Non specified: Eye cleaning	Ribeiro et al. (2010)
	Stem bark, leaves, roots: Rectal prolapse, cough, diarrhea, anemia, abdominal ulcers, anal eczema, body pains, stomach ache, wounds, dysentery, infertility, snakebite, hemorrhoids	Augustino et al. (2011)
	Leaves: Skin fungal infections (pounded)	Chinsembu et al. (2015)

Table 2. Contd.

Terminalia stenostachya Engl. & Diels	Leaves, roots: Agitated patients (leaves - bath; roots - maceration)	Agostinho et al. (2009)
	Root: Managing HIV/AIDS patients (decoction)	Mbwambo et al. (2011)
	Rosette leaf: Abdominal disorders, pain, bilharziosis, cancer, coughs and colds, dysentery, diarrhea, fever, venereal diseases, heart disorders, hypertension, jaundice, diabetes, antiseptic	Cock (2015)
Dipterocarpaceae		
Monotes engleri Gilg	Stem bark: Wounds and rash (infusion or decoction) Leaves: Leprosy	Lemmens. (2010)
Fabaceae (Leguminosae)		
Brachystegia boehmii Taub.	Roots: Agitated patients (vapor)	Agostinho et al. (2009)
	Leaves, roots: Snakebite antidote	Augustino et al. (2011)
	Root bark: Sexually transmitted diseases (crushed, mixed with cold water)	Maroyi (2011)
	Leaves: Back pain, dysmenorrhea	Sanogo (2011)
Brachystegia spiciformis Benth.	Stem bark: Agitated patients (maceration) Roots: Agitated patients (bath)	Agostinho et al. (2009)
	Roots: Dysentery, diarrhea (infusion); conjunctivitis (decoction)	Orwa et al. (2009)
	Stem bark, leaves, roots: Snakebite antidote, cough	Augustino et al. (2011)
	Roots: Ear ache, child fever (infusion)	Amri and Kisangau (2012)
Burkea africana Hook.	Stem bark: Headache, migraine, dizziness, pain, inflammation and thrush, antineuralgic, wound-healing, tooth-cleaning agent	Mathisen et al. (2002)
	Leaves, stem bark: Agitated patients Stem bark: Diarrhea Roots: Abdominal complaints, male sexual impotence	Agostinho et al. (2009)
	Roots: Stomach pain; tooth ache (decoction)	Nonyane and Masupa (2010)
	Root bark: Stings and bites antidote, cutaneous and sub-cutaneous parasitic infections, convulsion, pulmonary troubles	Yaro et al. (2010)
	Stem bark: Headache, pain killer	Augustino et al. (2011)
	Roots: Asthma, tuberculosis	Bruschi et al. (2011)
	Leaves: Circumcision Roots: HIV/AIDS	Semenya et al. (2013)
	Stem bark: Diarrhea, tuberculosis (decoction)	Chinsembu et al. (2015)

Table 2. Contd.

Dalbergia nitidula Baker	Leaves: Applied to snakebites (chewed); rubbed on abscesses Stem bark: Wound dressing, ulcers Roots: Toothache (infusion of pounded roots); malaria and cough (decoctions and infusions); epilepsy (pounded and administered in soup); emetic; aphrodisiac. Caution is needed because the roots are highly toxic	Lemmens (2007)
	Leaves: Agitated patients (bath) Roots: Agitated patients (infusion)	Agostinho et al. (2009)
	Leaves: Malaria (concoction)	Moshi et al. (2010)
Julbernardia globiflora (Benth.) Troupin	Stem: Leprosy (ground and smoked) Stem bark: Conjunctivitis (decoction); contraction of the vaginal canal (infusion); constipation, laxative; treatment for diarrhea in cattle Leaves: Snakebite antidote (rubbed) Roots: Depression, stomach problems (decoction)	Jimu (2010)
	Stem bark: Cough (chew); snakebite antidote (massage)	Augustino et al. (2011)
Pterocarpus angolensis DC.	Non specified: Malaria	Lukwa et al. (2001)
	Non specified: Ringworm, stabbing pains, eye problems, malaria, blackwater fever, stomach problems, increase breast milk supply	Aubrey (2003)
	Stem bark: Treatment for general illness, gallsickness, intestinal worms, *blackleg* in livestock	Luseba and Van der Merwe (2006)
	Stem bark, leaves, roots, fruits: Anemia, cough, diarrhea, snakebite antidote	Augustino et al. (2011)
	Non specified: Cough, colds, pain-killer, bleeding	Cheikhyoussef et al. (2011)
	Stem bark: Earache (infusion) Roots: Infertility in women (crushed and mixed with hot water); menorrhagia Sap: Sore eyes	Maroyi (2011)
	Stem bark: Hernia (decoction)	Amri and Kisangau (2012)
Melianthaceae		
Bersama abyssinica Fresen.	Leaves: Convulsion, snakebite antidote (pounded)	Kitula (2007)
	Growing shoots: Burns, ulcers, to clean wounds Leaves: Feverish pains, loss of appetite, debility, jaundice and leprosy (decoctions); convulsions and snakebites, (pounded and mixed with water); eye drop (leaf sap); migraine, headache and colds (powder); diabetes Leaves, stem bark, roots: Abdominal pain, colic, diarrhea, cholera, intestinal worms, amoebiasis, dysentery, rabies, syphilis, gonorrhea, malaria (decoction) Stem bark: Cancer and rheumatism (decoction); diabetes Stem bark (powdered), leaves (chewed): Aphrodisiac Stem bark (poultice); leaves, roots (decoction): Lumbago Roots: Hemorrhoids and epilepsy (decoction).	Bosch (2008)
	Bark: Vermifugue	Focho et al. (2009)

Table 2. Contd.

	Root: Bronchitis (crushed mixed with cold water); febrile illness (concoction)	Mesfin et al. (2009)
	Bark: Tonsillitis	Mirutse et al. (2009)
	Root bark: Aphrodisiac, diabetes (decoction)	Keter and Mutiso (2012)
	Leafy stem tip: Wounds (squeezed)	Abera (2014)
	Stem bark: Snakebite, liver disease	Kidane et al. (2014)
	Leaves and twigs: Diarrhea, constipation	Lulekal et al. (2014)
	Leaves: Ascariasis (roundworm)	Chekole et al. (2015)
	Seeds: Dandruff, wound, skin burn, scabies	Teka et al. (2015)
Phyllanthaceae		
Pseudolachnostylis maprouneifolia Pax	Bark: Diarrhea	Ratshibvumo (2008)
	Leaves : Cough, fever (decoction) Bark: Dizziness, vomiting (infusion) Roots: Stomach-ache and abdominal problems (decoction); pneumonia (smoke). Bark: diarrhea, pneumonia, tuberculosis, anemia (in porridge or drunk); leprosy; abdominal pain, gonorrhea and female sterility (infusion); nosebleed, wounds, headache (powdered) Leaves and roots: Hematuria in cattle (infusion)	Schmelzer (2008)
	Stem bark, leaves and roots: Stabbing sensations, diarrhea, snakebite antidote	Augustino et al. (2011)
Rubiaceae		
Catunaregam spinosa (Thunb.) Tirveng.	Roots: Convulsions, epilepsy (infusion)	Sobiecki (2002)
	Non specified: Sexually transmitted diseases/AIDS; headaches	Fumane et al. (2003)
	Leaves: Agitated patients	Agostinho et al. (2009)
	Roots, bark: Infertility, gonorrhea, hernia, stomach ache, convulsion, abortion	Augustino et al. (2011)
	Stem bark, roots: Aphrodisiac, gynecological ailments, febrile complaints, fever, epilepsy, arthritis	Ndhlala et al. (2013)

namely against *Escherichia coli* and two species of *Salmonella* responsibles for serious gastrointestinal disorders have been reported (Suleiman et al., 2008; Awa et al., 2012) (Table 3). Root bark also revealed high antibacterial activity (Okoye et al., 2012b) and anticonvulsant properties with pronounced hypnotic and muscle relaxant effects in mice (Okoye et al., 2010). Kaureonic acid (a diterpenoid) was identified as the possible phytoconstituent responsible for antibacterial effects and also for anticonvulsant properties (epilepsy and febrile seizures) of the root bark (Konate et al., 2012; Okoye et al., 2012b, 2013), whose extracts proved to be safe at lower doses tested (Okoye et al., 2012a). Cytotoxicity against some human tumor cell lines was detected in essential oils from leaves (Ahmed et al., 2010). These oils also presented cytotoxicity in brine shrimp lethality (Ahmed et al., 2010). Leaf and stem bark extracts showed great potential against trypanosomiasis (Ogbadoyi et

al., 2007; Ugwu et al. 2011). Fractions of leaf methanolic extract neutralized lethal toxicity induced by the viper *Echis ocellatus* venom (Emmanuel et al., 2014). Leaves and stem bark showed some anthelmintic properties that may support the use of this plant by local farmers in traditional animal healthcare (Alawa et al., 2003). Promising ovicidal, larvicidal and pupicidal activity against malarial and filarial mosquito vectors was detected in fractions of leaf extracts by Lame et al. (2015).

Apocynaceae

***Diplorhynchus condylocarpon*:** *D. condylocarpon* is used in traditional medicine to treat ailments such as diarrhea, cough and tuberculosis and headache (Table 2). Scientific studies revealed the presence of alcaloids in both stem and root bark and aqueous root extracts were reported as sympatholytic (Ruijter, 2008).

Combretaceae

Species of the Combretaceae family are amongst the most widely used plants for traditional medicinal purposes in southern Africa (Cock and Van Vuuren, 2015). Many species of *Combretum* and *Terminalia* genera are used for their antibacterial, antifungal, antiprotozoal, antiviral, antidiarrheal, analgesic, antimalarial, antioxidant, anti-inflammatory and anticancer activities (Cock, 2015).

Combretum* spp.*: African traditional healers use leaves, stem bark and roots of *C. hereroense* to treat a number of ailments (Table 2). Indications are often related to treat infections. Leaf extracts of the *C. hereroense* and *C. zeyheri* inhibited the growth of *Staphylococcus aureus*, *Enterococcus faecallis, Pseudomonas aeruginosa* and *E. coli* isolates (Cock and Van Vuuren, 2015). Antibacterial activity against *Mycobacterium fortuitum* and *S. aureus* was also detected in stem-bark extracts of *C. hereroense* (Fyhrquist et al., 2004). Leaves, stem bark and fruits of both species presented antifungal activity against different *Candida* spp. (Cock and Van Vuuren, 2015; Fyhrquist et al., 2004; Mangoyi et al., 2015; Masoko et al., 2007; Mutasa et al., 2015; Runyoro et al., 2013). Anti-inflammatory activities (inhibition of hematopoietic prostaglandin D2 synthase) were detected in leaves of both species (Chimponda and Mukanganyama, 2015; Eloff et al., 2001; McGaw et al., 2001). Leaf extracts of *C. hereroense* were also referred as anthelmintic (McGaw et al., 2001). Potential anticancer activity in *C. hereroense* leaf extracts (McGaw et al., 2001) and cytotoxicity against a human cancer cell line in *C. zeyheri* stem bark extracts (Nibret et al., 2010) were reported. Antiproliferative activity of bloodstream form of *Trypanosoma brucei* was also reported for stem bark extracts of *C. zeyheri* (Madamombe-Manduna et al., 2015). Leaf extracts of this species also revealed strong antioxidant activity (Chirisa and Mukanganyama, 2016). Toxicity tests were negative for *C. hereroense* leaf extracts (Cock and Van Vuuren, 2015). These scientific studies partially validate the usage of Combretaceae in traditional systems and many therapeutic properties of the Combretaceae may be attributable to their antimicrobial activity.

***Terminalia* spp.:** *Terminalia* is a genus comprising 200 to 250 species widely used in traditional medicine systems (Table 2). The last decade has seen a large increase in the number of studies into the use of *Terminalia* species as therapeutic agents. Several species used in Ayurvedic medicine, such as *T. arjuna*, *T. bellerica*, *T. catappa* and *T. chebula*, have received much recent attention (Cock, 2015). *Terminalia* species are used for their antibacterial, antifungal, antiprotozoal, antiviral, antidiarrheal, analgesic, antimalarial, antioxidant, anti-inflammatory and anticancer activities. Wound healing and cardiovascular effects have also been credited to some species (Cock, 2015). *T. stenostachya* was found to exhibit antimicrobial activity against *S. aureus*, *S. epidermidis*, *Baccillus subtilis* and *Enterobacter aerogenes* (Fyhrquist et al., 2002). Root, stem bark and leaf extracts showed considerable activity against a wide range of microorganisms (Mbwambo et al., 2011). The antibacterial activity exhibited by the extracts specifically against some *Mycobacterium* spp., indicate that these extracts could be effective against *M. tuberculosis* (Mbwambo et al., 2011). Leaves and fruit extracts exhibited activity against *M. smegmatis* (Fyhrquist et al., 2014) and stem bark and leaf extracts showed activity against three species of *Candida* (Fyhrquist et al., 2004). According to Mbwambo et al. (2011) the whole antiprotozoal, antifungal and antimicrobial activity shown by the extracts of *T. stenostachya* corroborate well with the traditional uses for treatment of HIV/AIDS-associated secondary infections, like tuberculosis, malaria, stomach ulcers and candidiasis. Stem bark extracts exhibited cytotoxic activity against human cancer cell lines (Fyhrquist et al., 2006). The brine shrimp test results have shown that stem bark, root and leaf extracts had mild and/or no toxicity (Mbwambo et al., 2011).

Dipterocarpaceae

Monotes engleri: Few authors refer the use of *M. engleri* in traditional medicine (Table 2). However, some studies were carried out concerning the potential medicinal properties of this species. Meragelman et al. (2001) isolated flavonoids exhibiting HIV-inhibitory activity from leaf extracts of *M. engleri* and antifungal activity against *Candida albicans* was reported by Kenez et al. (2008).

Table 3. Phytochemical and pharmacological studies on 12 tree species from Miombo woodlands.

Family, scientific name	Part(s) used and reported biological/pharmacological activities(s)	Bioactive compound(s)isolated and/or identified	References
Annonaceae			
Annona senegalensis Pers.	Leaves, stem bark: Anthelmintic		Alawa et al. (2003)
	Leaves: Antitrypanosomal	Leaves: Tannin, phlobatanin and saponin	Ogbadoyi et al. (2007)
	Stem bark: Antidiarrheal		Suleiman et al. (2008)
	Leaves (essential oil): Cytotoxicity against cancer cell lines.	Leaves (essential oil): Seventy three compounds identified	Ahmed et al. (2010)
	Root bark: Anticonvulsant	Root bark: Alkaloids, resins, glycosides, carbohydrate, reducing sugars, flavonoids, terpenoids, saponins and tannins	Okoye et al. (2010)
	Stem bark: Antitrypanosomal	Stem bark: Alkaloids, saponins, tannins and flavonoids	Ugwu et al. (2011)
	Root bark: Antibacterial	Root bark: Kaurenoic acid	Okoye et al. (2012b)
	Stem bark: Antibacterial		Awa et al. (2012)
	Root bark: Anticonvulsant		Konate et al. (2012)
	Root bark: Toxicity evaluation		Okoye et al. (2012a)
		Leaves, root bark: Six alkaloids isolated and identified	Fofana et al. (2013)
	Root bark: Anticonvulsant	Root bark: Kaurenoic acid	Okoye et al. (2013)
	Leaves: Anti-venom		Emmanuel et al. (2014)
	Leaves: Mosquitocidal		Lame et al. (2015)
Apocynaceae			
Diplorhynchus condylocarpon (Müll.Arg.) Pichon	Roots: Sympatholytic	Stem, root bark: Alkaloids	Ruijter (2008)
Combretaceae			
Combretum hereroense Schinz	Leaves: Anti-inflammatory		Eloff et al. (2001)
	Leaves: Anti-inflammatory, anthelmintic; potential anticancer activity		McGaw et al. 2001)
	Stem bark: Antimicrobial	Seventeen phenolic constituents including four phenanthrenes	Fyhrquist et al. (2002)
	Stem bark: Antifungal		Fyhrquist et al. (2004)
	Leaves: Antifungal		Masoko et al. (2007)
	Fruit: Antibacterial		Katerere et al. (2012)
	Leaves: Antibacterial, antifungal		Cock and Van Vuuren (2015)
	Roots: Antioxidant		Madamombe-Manduna et al. (2015)
Combretum zeyheri Sond.	Leaves: Anti-inflammatory		Eloff et al. (2001)
	Leaves: Anti-inflammatory		McGaw et al. (2001)
	Stem bark, roots, fruits: Antimicrobial		Fyhrquist et al. (2002)
	Stem bark: Antifungal		Fyhrquist et al. (2004)

Table 3. Contd.

	Leaves: Antifungal		Masoko et al. (2007)
	Stem bark: Antitrypanosomal, cytotoxicity against cancer cell line		Nibret et al. (2010)
	Leaves: Antifungal	Leaves: Isolation of five triterpenoids	Runyoro et al. (2013)
	Antiallergic and inflammatory		Chimponda and Mukanganyama (2015)
	Leaves: Antifungal	5-hydroxy-7, 4'- dimethoxyflavone.	Mangoyi et al. (2015)
	Leaves: Antifungal		Mutasa et al. (2015)
	Leaves: Antioxidant		Chirisa and Mukanganyama (2016)
Terminalia stenostachya Engl. & Diels	Stem bark: Antibacterial		Fyhrquist et al., 2002
	Leaves, stem bark: Antifungal		Fyhrquist et al. (2004)
	Stem bark: Cytotoxic against cancer cell lines		Fyhrquist et al. (2006)
	Leaves, stembark, roots: Antibacterial, mild and/or no toxicity (brine shrimp test)		Mbwambo et al. (2011)
	Leaves, fruits: Antibacterial		Fyhrquist et al. (2014)
		Triterpenes, flavonoids, tannins	Cock (2015)
Dipterocarpaceae			
Monotes engleri Gilg	Leaves: HIV-inhibitory	Leaves: Six flavonoids isolated	Meragelman et al. (2001)
	Antifungal	Two O-prenylated flavanone derivatives were isolated	Kenez et al. (2008)
Fabaceae (Leguminosae)			
Brachystegia boehmii Taub.	Leaves: Antibacterial		Chitemerere and Mukanganyama (2011)
	Leaves: Anti-inflammatory		Chirisa and Mukanganyama (2016)
Burkea africana Hook.	Stem bark: Antioxidant	Proanthocyanidins	Mathisen et al. (2002)
	Root bark: Anticonvulsant		Yaro et al. (2010)
	Leaves: Analgesic and anti-inflammatory	Alkaloids, cardiac glycosides, flavonoids, tannins, saponins, steroids and terpenoids.	Danjuma (2011)
	Roots: Antibacterial		Mbatchou et al. (2011)
	Stem bark: Antidiarrheal	Stem bark: Flavonoid cardiac glycosides, tannins and triterpenes.	Tanko et al. (2011)
	Stem bark: Antioxidant		Cordier et al. (2013)
	Root bark: Antibacterial		Tor-Anyiin and Anyam (2013)
	Leaves: Antioxidant, anti-inflammatory and anticholinesterase		Dzoyem and Eloff (2015)
	Root bark: Sedative and anxiolytic	Root bark: Saponins, flavonoid, aglycones, tannins, anthraquinones, cardiac glycosides, unsaturated steroids and triterpenes	Yaro et al. (2015)

Table 3. Contd.

Dalbergia nitidula Baker	Leaves: Antibacterial, antioxidant; low cytotoxicity		Dzoyem et al. (2014)
Pterocarpus angolensis DC.	Stem, stem bark, leaves: Anthelmintic		Molgaard et al. (2001)
	Seeds: Antibacterial		Steenkamp et al. (2004)
	Stem bark: Antibacterial and anti-inflammatory; lack of mutagenicity		Luseba et al. (2007)
	Stem bark, leaves: Anthelmintic, antibacterial and cytotoxic		McGaw et al. (2007)
	Antibacterial		Obi et al. (2007)
	Stem bark: Antibacterial	Stem bark: Epichatechin and derivatives	Samie et al. (2009)
	Stem bark: Antibacterial Leaves, stem bark: Antifungal, HIV-1 reverse transcriptase inhibitory		Mulaudzi et al. (2011)
	Leaves, stem bark: Anti-inflammatory		Mulaudzi et al. (2013)
	Stem bark, roots: Antibacterial	Stem bark, roots: Tannins and saponins	Munodawafa et al. (2013)
Melianthaceae			
Bersama abyssinica Fresen.	Root bark: Anti-HIV		Asres et al. (2001)
	Root bark: Antibacterial		Geyid et al. (2005)
	Roots: Antibacterial		Bolou et al. (2011)
	Roots: Antibacterial and antifungal		Lulekal et al. (2014)
	Leaves and twigs: Antioxidant, anticancer		Tauchen et al. (2015)
Rubiaceae			
Catunaregam spinosa (Thunb.) Tirveng.	Stem bark: Anticancer activity	Stem bark: Two novel norneolignans, three known neolignans	Gao et al. (2010)
	Stem bark: Antifeedant	Stem bark: Seven triterpenoid saponins, including four new compounds, catunarosides A–D (**1**–**4**), and three known compounds, swartziatrioside (**5**), aralia-saponin V (**6**), araliasaponin IV (**7**)	Gao et al. (2011)
	Leaves: Antioxidant and anti-inflammatory; protection of DNA plasmid *in vitro*.		Shailasree et al. (2014)

Fabaceae (Leguminosae)

***Brachystegia* spp.:** *Brachystegia boehmii* and *B.spiciformis* are referred in the literature as being used in traditional medicine (Table 2). Extracts from *B. boehmii* leaves exhibited bacteriostatic activity against *S. aureus*, *P. aeruginosa*, *E. coli*, *Bacillus cereus* and *B. subtilis* (Chitemerere and Mukanganyama, 2011) and significant anti-inflammatory activity (Chirisa and Mukanganyama, 2016). However, the potential of these species for medicinal use is poorly exploited.

Burkea africana: *B. africana* is used in traditional African medicine for the management of different health conditions (Table 2). *B. africana* is known to be rich in antioxidant sources and high levels of polyphenols and antioxidants have been reported in stem bark extracts (Cordier at al., 2013). Mathisen et al. (2002) investigated the bark of *B. africana* for antioxidant and radical scavenging activity. Hydroethanol bark extract showed excellent antioxidant, radical scavenging and 15-

lipoxygenase inhibitor activity. The active constituents were identified as proanthocyanidins and the effects, to a large extent, were attributed to the presence of profisetinidin-type proanthocyanidins (Mathisen et al., 2002). However, some cytotoxicity was observed, requiring further isolation and purification of polyphenolic-rich fractions aiming to identify and to eliminate cytotoxic elements (Cordier et al., 2013). Such refinement could increase the potential of the polyphenolic-rich fraction of stem bark to be used as an antioxidant supplement for oxidative stress-related disorders (Cordier et al., 2013). According to Tanko et al. (2011), *B. africana* stem bark extracts possess pharmacological activity against diarrhea. Root bark methanol extracts revealed the presence of saponins, flavonoids, aglycones, tannins, antraquinones, cardiac glycosides, unsaturated steroids and triterpenes (Yaro et al., 2015) and showed anticonvulsant properties (Yaro et al., 2010, 2015). Roots also revealed antibacterial activity against *Salmonella typhi* (Mbatchou et al., 2011) and root bark against *S. aureus* and *E. coli* (Tor-Anyiin and Anyam, 2013). Danjuma et al. (2011) showed that methanol leaf extracts of *B. africana* contained phytochemical constituents with analgesic and anti-inflammatory activities, and had the potential to be used in the management of pain and inflammatory conditions. Dzoyem and Eloff (2015) confirmed the anti-inflammatory, anticholinesterase and antioxidant activity of *B. africana* leaf extracts. According to these authors, the results obtained validated the use of leaf extracts of this plant in South African traditional medicine against inflammation and might be of value in the management of various diseases emerging from oxidative stress and related degenerative disorders.

Dalbergia nitidula: The genus *Dalbergia* has been shown to possess various pharmacological activities including analgesic, antipyretic, antimicrobial, antioxidant, anti-inflammatory, antidiarrheal, antiulcerogenic, antigiardial, antiplasmodial, antifertility, cancer chemopreventive as well as larvicidal and mosquito repellent properties (Mutai et al., 2013). The occurrence of isoflavones, isoflavanones (including the rare flavonoid 3-hydroxiso-flavanone), neoflavones, sterols, anthraquinones, cinnamyl esters and triterpenes in this genus have been reported (Mutai et al., 2013; Vasudeva et al., 2009). So far, few species have been screened for their biological activity (Vasudeva et al., 2009). Leaves and roots of *D. nitidula* were reported to be used in traditional medicine in east and southern Africa (Table 2). Leaf extracts of *D. nitidula* showed a low cytotoxicity and high antimicrobial and antioxidant activity, representing a promising candidate for pharmaceutical industry (Dzoyem et al., 2014).

Julbernardia globiflora: Although roots, barks and leaves of *J. globiflora* have been recorded to be toxic, various plant parts are used in traditional African medicine, mainly externally (Table 2). To our knowledge no pharmacological studies were carried out to validate ethnomedicinal uses of this species.

Pterocarpus angolensis: Traditionally, all parts of the *Pterocarpus angolensis* are used for medicinal purposes (Table 2). The bark with its blood-red, gummy, resinous exudate is used as a powerful astringent, e.g. to treat diarrhea, heavy menstruation, nose bleeding, headache, stomach-ache, parasitic worms, sores and skin problems (Takawira-Nyenya, 2005). Pharmacological studies on *P. angolensis* revealed antibacterial activity of seeds (Steenkamp et al., 2004), stem bark, roots and leaf extracts (Luseba et al., 2007; Mulaudzi et al., 2011; Samie et al., 2009) and antifungal activity of leaf and bark extracts (Mulaudzi et al., 2011). The latter also showed HIV-1 reverse transcriptase inhibitory activity (Mulaudzi et al., 2011) as well as anthelmintic effects (McGaw et al., 2007; Molgaard et al., 2001). Anti-inflammatory activity was also detected in stem bark extracts (Mulaudzi et al., 2013). Samie et al. (2009) demonstrated the presence of epichatechin and derivatives (with strong antibacterial activities but generally weak activities against *Entamoeba histolytica*) in stem barks.

Melianthaceae

Bersama abyssinica: Bark, leaf and root decoctions of *B. abyssinica* are widely taken to treat a range of health disorders including intestinal worms (Table 3). However, all plant parts are poisonous; therefore dosage is critical for internal use (Bosch, 2008). Ethanol extracts of leaves and twigs revealed antiproliferative activity against Hep-G2 carcinoma cell lines (Tauchen et al., 2015). Methanol extract of the root bark exhibited potent inhibition of HIV-1 replication (Asres et al., 2001). Root and root bark extracts showed antibacterial and antifungal activities (Bolou et al., 2011; Geyid et al., 2005; Lulekal et al., 2014).

Phyllanthaceae

Pseudolachnostylis maprouneifolia: Stem bark, roots and leaves of *P. maprouneifolia* are used to treat pulmonary and abdominal disorders (Augustino et al., 2011; Schmelzer, 2008). Other medicinal uses include venereal diseases, dizziness, wounds and snakebites (Augustino et al., 2011; Schmelzer, 2008). Many important medicinal uses against different infectious ailments have been reported for *P. maprouneifolia*. However, to our knowledge, much remains to exploit in order to understand the medical potentialities of this species.

Rubiaceae

Catunaregam spinosa: *C. spinosa* (also known as *Randia dumetorum*) is used in African an Asian traditional

medicinal practices (Table 2). It is considered as a usual drug of choice for Ayurvedic physicians as a result of the different therapeutic properties like emetic, antipyretic, anti-inflammatory, antiallergic, anthelminthic, immunomodulatory, analgesic and wound healing to mention a few (Prakash, 2015). *C. spinosa* extracts mainly contains glycosides, triterpenoid glycoside and saponins (Prakash, 2015). Triterpenoid saponins were isolated from stem bark extracts (Gao et al., 2010, 2011) and two of the compounds isolated (catunaregin and epicatunaregin) exhibited moderate inhibition against the mammary cancer F10 cell line (Gao et al., 2010). Leaf extracts showed antioxidant and anti-inflammatory activities, human cyclooxygenase (COX)-2 inhibitory effects and a prominent protection of DNA (Shailasree et al., 2014). Antifeedant activity against the pest *Plutella xylostella* was detected in components (triterpenoid saponins) of the stem bark (Gao et al., 2011). *C. spinosa* use should be treated with caution, as studies have shown that it can cause damage to genetic material (Fennell et al., 2004).

DISCUSSION

Miombo woodlands are very important to informal and formal economies in Mozambique and other southern Africa countries, providing valuable sources of wood; edible plant products and mushrooms; fiber and related products; insect products (honey and bee wax, edible insects); medicinal plants, among others. The important wood products obtained from Miombo woodland include timber, firewood, charcoal, materials for fencing and making farm tools, household and handicraft items (Clarke et al., 1996). The high collection of woody resources leads to their over-exploitation, negatively impacting plant diversity and conservation of the Miombo ecosystem. Charcoal production is a very important forestry activity in Africa and one of the major factors responsible for high rates of deforestation. The charcoal market is the largest among the forestry products in Mozambique, rural communities depending exclusively on firewood for cooking, while in suburban areas charcoal is the major source of energy for cooking (Salomão and Matose, 2008).

However, Miombo woodland provide a wide range of other products that appear in smaller quantities, including medicines and wild foods, which provide a living for several families (Clarke et al., 1996). There is a growing interest on how non-wood forest products can contribute to livelihood security and to generate income. Miombo ecosystem remains an untapped source of natural bioactive molecules, such as pharmaceuticals, nutraceuticals, cosmetics or agrochemicals. Nowadays there are new and niche emerging markets for forest products as a result of consumer demand for “green” and “fair trade” products (Dewees et al., 2011) and the commercialization of products derived from indigenous plants may provide additional income to rural communities. Research on ethnobotany can bring value to local knowledge and contribute to put natural resources at the service of those communities. Interest in medicinal plants has been expanding globally due to their importance to basic healthcare, local markets and industry. There has been an increasing effort to isolate and characterize new active ingredients from plants, as many conventional drugs fail due to the development of resistance. For major diseases such as cancer, some good examples of efficient remedies obtained from plants are already available.

An impressive number of modern drugs have been isolated from plants, often based on their ethnomedical use. The inclusion of plants with pharmacological potential in the human diet may also contribute to diminish the need for medicines (WHO, 2003). Miombo tree species, namely Caesalpinoideae (Fabaceae) and Combretaceae, are often rich in phenolic compounds. A diet rich in antioxidants is associated with a decreased incidence of chronic diseases. High antioxidant levels have also been shown to act as a preventive measure against the development of degenerative disease such as cancer, cardiovascular diseases, neural degeneration, diabetes and obesity (Cock, 2015). Some of the species already described can be highlighted for their therapeutical interest: *A. senegalensis*, *C. hereroense*, *C. zeyheri*, *B. africana*, *P. angolensis* and *B. abyssinica*. A considerable number of studies concerning chemical composition, pharmacological action and toxicity have been conducted with promising results against important ailments, such as parasitic, bacterial and fungal infections, as anticonvulsants, antioxidants and anti-inflammatories (Table 3). *T. stenostachya* is also a species with potential for the pharmaceutical industry as it has shown a wide range of antibacterial activity, specifically against mycobacteria, indicating that it may be a good source of antimicrobial compounds and is worth further development (Mbwambo et al., 2011). It is also important to highlight less studied species such as *J. globiflora, P. maprouneifolia* and *D. condylocarpon* which are widely used in traditional medicine and need detailed phytochemical and pharmacological studies.

Particular attention should be given to species with strong potential to treat major diseases, e.g. *M. engleri*, *B. abyssinica* and *P. angolensis* (anti-viral) (Asres et al., 2001; Meragelman et al., 2001; Mulaudzi et al., 2013); *A. senegalensis*, *C. zeyheri*, *T. stenostachya* and *C. spinosa* (anti-tumoral) (Ahmed et al, 2010; Fyhrquist et al., 2006; Gao et al., 2010; Nibret et al., 2010); *Burkea africana* (glaucoma) (Dzoyem and Eloff, 2015). Attention should also be given to potentially new eco-friendly pesticides providers such as *Annona senegalensis* (Lame et al., 2015) and *Catunaregam spinosa* (Gao et al., 2011). The safety and efficacy of traditional medicine has been demonstrated by its long historical use. However, much

remains to be studied. Besides the quality of the natural products there must be safety guarantees concerning toxicity and knowledge about e.g. secondary effects, interactions, counter-indications, mutagenicity and also the existence of pharmacological studies and clinical experimentation proving their efficacy (Fennell et al., 2004). Attention must also be given to the collection of medicinal plants and other non-timber forest products, as wide-spread harvesting puts pressure on natural populations. Little research has been done on sustainable harvesting rates for non-wood products (Shackleton and Clarke, 2011). Impacts from fruit removal, provided no damage is done to the trees, seem small (Shackleton and Clarke, 2011). However, according to Bruschi et al. (2014), reproductive ability of the species, including seed production and seed dispersal, can be of critical importance in population dynamics, and should be taken into consideration in the context of sustainable harvesting of useful plants. For example, *Brachystegia*, *Julbernardia*, and other Caesalpinioideae such as *P. angolensis* show an extremely low capacity for seed dispersal and produce short-lived seeds thus reducing the community resilience. *P. angolensis* is included in the IUCN Red List of Threatened Species, in the category lower risk/near threatened (World Conservation Monitoring Centre 1998).

Harvesting of the bark for different uses such as medicines, rope fiber or for making beehives can be highly destructive for the trees. The growing interest in medicinal plants from both international industry and local markets requires management of tree bark harvesting from natural forests in order to prevent inappropriate exploitation of target species (Delvaux et al., 2009). A number of methods for reducing the negative impact of bark harvesting have been proposed and tested, these include: the use of leaves to obtain medicinal products rather than bark; obtaining bark from woody material that has already been cut; improved harvesting methods that prevent ring barking and reduce fungal infection (Shackleton and Clarke, 2011). Bark regrowth response of a selected number of medicinal tree species as a basis for the development of optimal bark harvesting method is also being studied (Delvaux et al., 2009).

Conclusions

The 15 tree species selected for this review are used in traditional medicine practices in Mozambique and other countries from the ecoregion. Twelve species have proven biological and pharmacological activities. In most cases, isolation of the active compounds and/or pharmacological tests provided scientific validation. Most of the species are rich in anti-inflammatories and antioxidants, which are known to prevent several chronical and degenerative diseases. Besides that many are described as promising sources of therapeuticaal agents against important ailments, such as parasitic, bacterial and fungal infections and six revealed potential anti cancer activity. The information gathered in this paper reflects the richness of the natural and cultural heritage from the Miombo woodlands. Local Knowledge Systems (LKS) have an immeasurable value in community health, nutrition, education, cultural heritage and conservation, and when integrated with scientific knowledge constitute one of the pillars of bio-based socio-economic development. However, much is still to be investigated to unravel the potential of these tree species for multipurpose uses. In parallel, the development of adequate conservation strategies and *ex-situ* tree propagation methods will be of utmost importance to ensure the sustainable use of those resources.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests.

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REFERENCES

Abera B (2014). Medicinal plants used in traditional medicine by Oromo people, Ghimbi District, Southwest Ethiopia. J. Ethnobiol. Ethnomed. 10:40.

Agostinho AB, Cuinica DF, Chelene I, José AE (2009). Doenças mentais: seu tratamento através de plantas medicinais e práticas tradicionais. Maputo: Conselho Científico de Etnobotânica, Ministério da Ciência e Tecnologia, reg. Nº 6009/RLINLD/2009 (in Portuguese).

Ahmed AL, Bassem SM, Mohamed YH, Gamila MW (2010). Cytotoxic essential oil from *Annona sengalensis* Pers. leaves. Pharmacogn. Res. 2:211-214.

Alawa C, Adamu A, Gefu J, Ajanusi O, Abdu P, Chiezey N, Alawa J, Bowman D (2003). In vitro screening of two Nigerian medicinal plants (*Vernonia amygdalina* and *Annona senegalensis*) for anthelmintic activity. Vet. Parasitol. 113(1):73-81.

Amri E, Kisangau DP (2012). Ethnomedicinal study of plants used in villages around Kimboza forest reserve in Morogoro, Tanzania. J. Ethnobiol. Ethnomed. 8:1.

Asres K, Bucar F, Kartnig T, Witvrouw M, Pannecouque C, de Clercq E (2001). Antiviral activity against human immunodeficiency virus type 1 (HIV-1) and type 2 (HIV-2) of ethnobotanically selected Ethiopian medicinal plants. Phytother. Res. 15(1):62-69.

Aubrey A (2003). *Pterocarpus angolensis* DC. Available at: www.plantzafrica.com/plantnop/pterocarpangol.htm

Augustino S, Hall JB, Makonda FBS, Ishengoma RC (2011). Medicinal resources of the Miombo woodlands of Urumwa, Tanzania: Plants and its uses. J. Med. Plants Res. 5(27):6352-6372.

Awa EP, Ibrahim S, Ameh DA (2012). GC/MS analysis and antimicrobial activity of diethyl ether fraction of methanolic extract from the stem bark of *Annona senegalensis* Pers. Int. J. Pharm Sci. Res. 11:4213-4218.

Bandeira SO, Gaspar F, Pagula FP (2001). Ethnobotany and healthcare in Mozambique. Pharm. Biol. 39:70-73.

Bester SP (2006). *Diplorhynchus condylocarpon* (Müll.Arg.) Pichon. Available at: http://www.plantzafrica.com/plantcd/diplorhycond.htm

Bolou GEK, Bagre I, Ouattara K, Djaman AJ (2011). Evaluation of the antibacterial activity of 14 medicinal plants in Cote d'Ivoire. Trop. J. Pharm. Res. 10(3):335-340.

Bosch CH (2008). *Bersama abyssinica* Fresen. In: Schmelzer GH, Gurib Fakim A (eds), Plant resources of tropical Africa. Wageningen: PROTA Foundation. Available at: https://www.prota4u.org/database/protav8.asp?g=pe&p=Bersama+abyssinica+Fresen

Bruschi P, Mancini M, Mattioli E, Michela M, Signorini MA (2014). Traditional uses of plants in a rural community of Mozambique and possible links with Miombo degradation and harvesting sustainability. J. Ethnobiol. Ethnomed. 10:59.

Bruschi P, Morganti M, Mancini M, Signorini MA (2011). Traditional healers and laypeople: a qualitative and quantitative approach to local knowledge on medicinal plants in Muda (Mozambique). J. Ethnopharmacol. 138:543-563.

Campbell B (1996). The Miombo in transition: Woodlands and welfare in Africa. Bogor: Center for International Forestry Research (CIFOR). Available at: http://www.cifor.org/publications/pdf_files/Books/Miombo.pdf

Cheikhyoussef A, Shapi M, Matengu K, Ashekele HM (2011). Ethnobotanical study of indigenous knowledge on medicinal plant use by traditional healers in Oshikoto region, Namibia. J. Ethnobiol. Ethnomed. 7:10.

Chekole G, Asfaw Z, Kelbessa E (2015). Ethnobotanical study of medicinal plants in the environs of Tara-gedam and Amba remnant forests of Libo Kemkem District, northwest Ethiopia. J. Ethnobiol. Ethnomed. 11:4.

Chimponda T, Mukanganyama S (2015). Evaluation of selected Zimbabwean plant extracts as inhibitors of hematopoietic postaglandin D_2 synthase. J. Herbs Spices Med. Plants. 21:243-258.

Chinsembu K (2016). Ethnobotanical study of medicinal flora utilised by traditional healers in the management of sexually transmitted infections in Sesheke District, Western Province, Zambia. Ver. Bras. Farmacogn. 26:268-274.

Chinsembu KC (2016). Ethnobotanical study of medicinal flora utilised by traditional healers in the management of sexually transmitted infections in Sesheke District, Western Province, Zambia. Rev. Bras. Farm. 26(2):268-274.

Chinsembu K, Hijarunguru A, Mbangu A (2015). Ethnomedicinal plants used by traditional healers in the management of HIV/AIDS opportunistic diseases in Rundu, Kavango East Region, Namibia. S. Afr. J. Bot. 100:33-42.

Chirisa E, Mukanganyama S (2016). Evaluation of in vitro anti-inflammatory and antioxidant activity of selected Zimbabwean plant extracts. J. Herbs Spices Med. Plants 22:157-172.

Chitemerere TA, Mukanganyama S (2011). *In vitro* antibacterial activity of selected medicinal plants from Zimbabwe. Afr. J. Plant Sci. Biotechnol. 5:1-7.

Clarke J, Cavendish W, Coote C (1996). Rural households and Miombo woodlands:use, value and management. In: Campbell B (ed), Miombo in transition:Woodlands and welfare in Africa, Center for International Forestry Research (CIFOR), Bogor. pp. 101-135.

Cock IE (2015). The medicinal properties and phytochemistry of plants of the genus *Terminalia* (Combretaceae). Inflammopharmacology 23(5):203-229.

Cock IE, Van Vuuren SF (2015). A comparison of the antimicrobial activity and toxicity of six *Combretum* and two *Terminalia* species from Southern Africa. Pharmacogn. Mag. 11:208-218.

Cordier W, Gulumian M, Cromarty AD, Steenkamp V (2013). Attenuation of oxidative stress in U937 cells by polyphenolic-rich bark fractions of *Burkea africana* and *Syzygium cordatum.* BMC Complement. Altern. Med. 13:116.

Danjuma NM, Sani AA, Yaro AH, Ahmad A, Zezi AU, Hussaini IM (2011). Preliminary evaluation of methanol leaf extract of *Burkea africana* Linn for analgesic, anti-inflammatory and antioxidant effects. J. Pharmacol. Trop. Ther. 1:7-11.

Delvaux C, Sinsin B, Darchambeau F, Van Damme P (2009). Recovery from bark harvesting of 12 medicinal tree species in Benin, West Africa. J. Appl. Ecol. 46:703-712.

Dewees P, Campbell B, Katerere Y, Sitoe A, Cunningham AB, Angelsen A, Wunder S (2011). Managing the Miombo woodlands of Southern Africa: Policies, incentives, and options for the rural poor.Washington DC: Program on Forests (PROFOR).

Dzoyem J, Eloff J (2015). Anti-inflammatory, anticholinesterase and antioxidant activity of leaf extracts of twelve plants used traditionally to alleviate pain and inflammation in South Africa. J. Ethnopharmacol. 160:194-201.

Dzoyem JP, McGaw LJ, Eloff JN (2014). *In vitro* antibacterial, antioxidant and cytotoxic activity of acetone leaf extracts of nine under-investigated Fabaceae tree species leads to potentially useful extracts in animal health and productivity. BMC Complement. Altern. Med. 14(1):1-16.

Eloff JN, Jager AK, Van Staden J (2001). The stability and the relationship between anti-inflammatory activity and antibacterial properties of southern African *Combretum* species. S. Afr. J. Sci. 97:291-293.

Emmanuel A, Ebinbin A, Amlabu W (2014). Detoxification of *Echis ocellatus* venom-induced toxicity by *Annona senegalensis* Pers.. J. Complement. Integr. Med. 11:93-97.

Fennell CW, Lindsey KL, McGaw LJ, Sparg SG, Stafford GI, Elgorashi EE, Grace OM, Van Staden J (2004). Review: Assessing African medicinal plants for efficacy and safety: pharmacological screening and toxicology. J. Ethnopharmacol. 94:205-217.

Focho D, Newu M, Anjah M, Nwana F, Ambo F (2009). Ethnobotanical survey of trees in Fundong, Northwest Region, Cameroon. J. Ethnobiol. Ethnomed. 5:17.

Fofana S, Ziyaev R, Diallo S, Camara M, Aripova S (2013). Alkaloids of *Annona senegalensis*. Chem. Natl. Compd. 49:587-588.

Fumane J, Cândido A, Barbosa F, Boana C, Dungo J, Mateus R, Bandeira B, Acha V, Gaspar F (2003). Pesquisa etnobotânica de plantas medicinais utilizadas pelos praticantes de medicina tradicional no tratamento de doenças associadas ao HIV/SIDA. Projecto Kulhuvuka. Maputo: Fundação para o Desenvolvimento da Comunidade (FDC) (in Portuguese).

Fyhrquist P, Laakso I, Garcia Marco S, Julkunen-Tiitto R, Hiltunen R. (2014). Antimycobacterial activity of ellagitannin and ellagic acid derivate rich crude extracts and fractions of five selected species of *Terminalia* used for treatment of infectious diseases in African traditional medicine. S. Afr. J. Bot. 90:1-16.

Fyhrquist P, Mwasumbi L, Haeggström CA, Vuorela H, Hiltunen R, Vuorela P (2002). Ethnobotanical and antimicrobial investigation on some species of *Terminalia* and *Combretum* (Combretaceae) growing in Tanzania. J. Ethnopharmacol. 79:169-177.

Fyhrquist P, Mwasumbi L, Hæggström C, Vuorela H, Hiltunen R, Vuorela P (2004). Antifungal activity of slected species of *Terminalia*, *Pteleopsis* and *Combretum* (Combretaceae) collected in Tanzania. Pharm. Biol. 42:308-317.

Fyhrquist P, Mwasumbi L, Vuorela P, Vuorela H, Hiltunen R, Murphy C, Adlercreutz H (2006). Preliminary antiproliferative effects of some species of *Terminalia*, *Combretum* and *Pteleopsis* collected in Tanzania on some human cancer cell lines. Fitoterapia 77:358-366.

Gao G, Luo X, Wei X, Qi S, Yin H, Xiao Z, Zhang S (2010). Catunaregin and epicatunaregin, two norneolignans possessing an unprecedented skeleton from *Catunaregam spinosa.* Helv. Chim. Acta. 93:339-344.

Gao G, Lu Z, Tao S, Zhang S, Wang F, Li Q (2011). Triterpenoid saponins with antifeedant activities from stem bark of *Catunaregam spinosa* (Rubiaceae) against *Plutella xylostella* (Plutellidae). Carbohydr. Res. 346:2200-2205.

Geyid A, Abebe D, Debella A, Makonnen Z, Aberra F, Teka F, Kebede T, Urga K, Yersaw K, Biza T, Mariam BH, Guta M (2005). Screening of some medicinal plants of Ethiopia for their anti-microbial properties and chemical profiles. J. Ethnopharmacol. 97:421-427.

Indjai B, Catarino L, Mourão D (2010). Mezinhos de Orango - Plantas medicinais e pessoas da ilha da Rainha Pampa. Bissau: IBAP (in Portuguese).

National Statistics Institute, Mozambique (INE) (2016). Available at: http://www.ine.gov.mz/

Jimu L (2010). *Julbernardia globiflora* (Benth.) Troupin. In: Brink M, Achigan-Dako EG (eds), Plant resources of tropical Africa. Wageningen: PROTA Foundation. Available at: www.prota4u.org/search.asp

Katerere DR, Gray AI, Nash RJ, Waigh RD (2012). Phytochemical and antimicrobial investigations of stilbenoids and flavonoids isolated from three species of Combretaceae. Fitoterapia 83:932-940.
Kenez A, Lestar Z, Lenkey B, Antus S (2008). Synthesis and structure-activity relationship study of monotesone-A, an antifungal component of *Monotes engleri*. Nat. Prod. Res. 22:383-392.
Keter LK, Mutiso PC (2012). Ethnobotanical studies of medicinal plants used by traditional health practitioners in the management of diabetes in lower eastern province, Kenya. J. Ethnopharmacol. 139:74-80
Kidane B, van Andel T, van der Maesen LG, Asfaw Z (2014). Use and management of traditional medicinal plants by Maale and Ari ethnic communities in southern Ethiopia. J. Ethnobiol. Ethnomed.. 10:1-27.
Kitula RA (2007). Use of medicinal plants for human health in Udzungwa Mountains Forests: a case study of New Dabaga Ulongambi Forest Reserve, Tanzania. J. Ethnobiol. Ethnomed. 3:7.
Konate A, Sawadogo WR, Dubruc F, Caillard O, Ouedraogo M, Guissou IP (2012). Phytochemical and anticonvulsant properties of *Annona senegalensis* Pers. (Annonaceae), plant used in Burkina folk medicine to treat epilepsy and convulsions. Br. J. Pharmacol. Toxicol. 3:245-250.
Kusters K, Belcher B (2004). Forest products, livelihoods and conservation: case studies of non-timber forest product systems. Volume 1 - Asia. Available at: www.cifor.org/ntfpcd/pdf/NTFP-Asia-R.PDF
Lame Y, Nukenine EN, Simon Pierre DY, Elijah AE, Esimone CO (2015). Laboratory evaluations of the fractions efficacy of *Annona senegalensis* (Annonaceae) leaf extract on immature stage development of malarial and filarial mosquito vectors. J. Arthropod-Borne Dis. 9:226-237.
Lemmens RHMJ (2007). *Dalbergia nitidula* Welw. ex Baker. In: Louppe D, Oteng-Amoako AA, Brink M (eds), PROTA (Plant Resources of Tropical Africa Wageningen, Netherlands. Available at: http://uses.plantnet-project.org/en/Dalbergia_nitidula
Lemmens RHMJ (2010). *Monotes kerstingii* Gilg. In: Lemmens RHMJ, Louppe D, Oteng-Amoako AA (eds), Plant resources of tropical Africa. Wageningen: PROTA Foundation. Available at: http://uses.plantnet-project.org/en/Monotes_kerstingii_(PROTA)
Lukwa N, Mutambu SL, Makaza N, Molgaard P, Furu P (2001). Perceptions about malaria transmission and control using anti-malaria plants in Mola, Kariba, Zimbabwe. Niger. J. Nat. Prod. Med. 5:4-7.
Lulekal E, Rondevaldova J, Bernaskova E, Cepkova J, Asfaw Z, Kelbessa E, Kokoska L, Van Damme P (2014). Antimicrobial activity of traditional medicinal plants from Ankober District, North Shewa Zone, Amhara Region, Ethiopia. Pharm. Biol. 52:614-620.
Luoga EJ, Balkwill K, Witkowski E (2000). Differential utilization and ethnobotany of trees in kitulanghalo forest reserve and surrounding communal lands, eastern Tanzania. Econ. Bot. 54:328-343.
Luseba D, Elgorashi EE, Ntloedibe NT, Van Staden J (2007). Antibacterial, anti-inflammatory and mutagenic effects of some medicinal plants used in South Africa for the treatment of wounds and retained placenta in livestock. S. Afr. J. Bot. 73:378-383.
Luseba D, Van der Merwe D (2006). Ethnoveterinary medicine practices among Tsonga speaking people of South Africa. Onderstepoort J. Vet. Res. 73:115-122.
Madamombe-Manduna I, Mthakathi N, Mashele S, Chitondo R, Matavele-Chissumba R (2015). Free radical scavenging activity of Mozambican plant extracts. S. Afr. J. Bot. 98:185.
Mangoyi R, Midiwo J, Mukanganyama S (2015). Isolation and characterization of an antifungal compound 5-hydroxy-7,4'-dimethoxyflavone from Combretum zeyheri. BMC Complement. Altern. Med. 15:405.
Maroyi A (2011). An ethnobotanical survey of medicinal plants used by the people in Nhema communal area, Zimbabwe. J. Ethnopharmacol. 136:347-354.
Masoko P, Picard J, Eloff J (2007). The antifungal activity of twenty-four southern African *Combretum* species (Combretaceae). S. Afr. J. Bot. 73:173-183.
Mathisen E, Diallo D, Andersen O, Malterud K (2002). Antioxidants from the bark of *Burkea africana*, an African medicinal plant. Phytother. Res. 16:148-153.
Mbatchou VC, Aggrey I, Oyelude EO (2011). *In vitro* growth inhibitory activity of secondary metabolites from the roots of *Burkea africana* and *Combretum adenogonium* on *Salmonella typhi.* Can. J. Pure Appl. Sci. 5:1623-1629.
Mbwambo Z, Erasto P, Nondo R, Innocent E, Kidukuli A (2011). Antibacterial and cytotoxic activities of Terminalia stenostachya and Terminalia spinosa. Tanzan. J. Health Res. 13:119-124.
McGaw L, Rabe T, Sparg S, Jäger A, Eloff J, Van Staden J (2001). An investigation on the biological activity of Combretum species. J. Ethnopharmacol. 75:45-50.
McGaw L, Van der Merwe D, Eloff JN (2007). In vitro anthelmintic, antibacterial and cytotoxic effects of extracts from plants used in South African ethnoveterinary medicine. Vet. J. 173:366-372.
Meragelman K, McKee T, Boyd M (2001). Anti-HIV prenylated flavonoids from *Monotes africanus*. J. Nat. Prod. 64:546-548.
Mesfin F, Demissew S, Teklehaymanot T (2009). An ethnobotanical study of medicinal plants in Wonago Woreda, NNPR, Ethiopia. J. Ethnobiol. Ethnomed. 5:28.
Mirutse G, Zemede A, Zerihun W (2009). Medicinal plants of the Meinit ethnic group of Ethiopia: An ethnobotanical study. J. Ethnopharmacol. 124:513-521.
Molgaard P, Nielsen SB, Rasmussen DE, Drummond RB, Makaza N, Andreassen J (2001). Anthelmintic screening of Zimbabwean plants traditionally used against schistosomiasis. J. Ethnopharmacol. 74:257-264.
Moshi MJ, Otieno DF, Mbabazi PK, Weisheit A (2010). Ethnomedicine of the Kagera Region, north western Tanzania. Part 2: The medicinal plants used in Katoro Ward, Bukoba District. J. Ethnobiol. Ethnomed. 6:19.
Mulaudzi RB, Ndhlala AR, Kulkarni MG, Finnie JF, Van Staden J (2011). Antimicrobial properties and phenolic contents of medicinal plants used by the Venda people for conditions related to venereal diseases, Research Centre for Plant Growth and Development, South Africa. J. Ethnopharmacol. 135:330-337.
Mulaudzi RB, Ndhlala AR, Kulkarni MG, Finnie JF, Van Staden J (2013). Anti-inflammatory and mutagenic evaluation of medicinal plants used by Venda people against venereal and related diseases. J. Ethnopharmacol. 146:173-179.
Munodawafa T, Chagonda LS, Moyo SR (2013). Antimicrobial and phytochemical screening of some Zimbabwean medicinal plants. J. Biol. Active Prod. Nature 3(5-6):323-330.
Mutai P, Heydenreich M, Thoithi G, Mugumbate G, Chibale K, Yenesew A (2013). 3-Hydroxy isoflavanones from the stem bark of *Dalbergia melanoxylon*: isolation, antimycobacterial evaluation and molecular docking studies. Phytochem. Lett. 6:671-675.
Mutasa T, Rumbidzai M, Mukanganyama S (2015). The Effects of *Combretum zeyheri* leaf extract on ergosterol synthesis in *Candida albicans*. J. Herbs Spices Med. Plants 21:211-217.
Ndhlala AR, Ncube B, Okem A, Mulaudzi RB, Van Staden J (2013). Invited Review: Toxicology of some important medicinal plants in southern Africa. Food. Chem. Toxicol. 62:609-621
Ngarivhume T, Van't Klooster C I, de Jong JT, Van der Westhuizen JH (2015). Medicinal plants used by traditional healers for the treatment of malaria in the Chipinge district in Zimbabwe. J. Ethnopharmacol. 159:224-237.
Nibret E, Ashour ML, Rubanza CD, Wink M (2010). Screening of some Tanzanian medicinal plants for their trypanocidal and cytotoxic activities. Phytother. Res. 24:945-947.
Nonyane F, Masupa T (2010). *Burkea africana* Hook. Available at: www.plantzafrica.com/plantab/burkeaafricana.htm
Obi CL, Ramalivhana J, Samie A, Igumbor EO (2007). Prevalence, pathogenesis, and antibiotic susceptibility profiles, and in vitro activity of selected medicinal plants against *Aeromonas* isolates from stool samples of patients in the Venda region of South Africa. J. Health Popul. Nutr. 25:428-435.
Ogbadoyi E, Abdulganiy A, Adama T, Okogun J (2007). In vivo trypanocidal activity of *Annona senegalensis* Pers. leaf extract against *Trypanosoma brucei brucei*. J. Ethnopharmacol. 112:85-89.
Okoye TC, Akah PA, Ezike AC, Okoye MO, Onyeto CA, Ndukwu F, Ohaegbulam E, Ikele L (2012a). Document heading: Evaluation of the acute and sub acute toxicity of *Annona senegalensis* root bark extracts. Asian Pac. J. Trop. Med. 5:277-282.

Okoye TC, Akah PA, Okoli CO, Ezike AC, Omeje EO, Odoh UE (2012b). Antimicrobial effects of a lipophilic fraction and kaurenoic acid isolated from the root bark extracts of *Annona senegalensis*. Evid-Based Complement. Altern. Med. 2012:831327.

Okoye TC, Akah PA, Omeje EO, Okoye FB, Nworu CS (2013). Anticonvulsant effect of kaurenoic acid isolated from the root bark of *Annona senegalensis*. Pharmacol. Biochem. Behav. 109:38-43.

Okoye T, Akah P, Omeke C (2010). Evaluation of the anticonvulsant and muscle relaxant effects of the methanol root bark extracts of *Annona senegalensis*. Asian Pac. J. Trop. Med. 3:25-28.

Orwa C, Mutua A, Kindt R, Jamnadass R, Anthony S. (2009). Agroforestree Database: a tree reference and selection guide version 4.0. Available at: http://www.worldagroforestry.org/treedb2/speciesprofile.php?Spid=1382

Prakash TD (2015). Madanaphala (*Randia dumetorum* Lam.): A phyto-pharmacological review. Int. J. Ayurvedic Med. 6:74-82.

Ratshibvumo T (2008). *Pseudolachnostylis maprouneifolia* Pax. Available at www.google.pt/#q=Pseudolachnostylis+maprouneifolia+Pax+plantzafrica

Ribeiro NS (2007). Interactions between fires and elephants in relation to vegetation composition and structure of Miombo wooldands in northern Mozambique. PhD thesis, University of Virginia, USA.

Ribeiro A, Romeiras MM, Tavares J, Faria MT (2010). Ethnobotanical survey in Canhane village, district of Massingir, Mozambique: medicinal plants and traditional knowledge. J. Ethnobiol. Ethnomed. 6:33.

Ruijter A de (2008). *Diplorhynchus condylocarpon* (Müll.Arg.) Pichon. In: Schmelzer GH, Gurib Fakim A (eds), Plant resources of tropical Africa. Medicinal Plants 1. Wageningen: PROTA Foundation/Backhuys Publishers/CTA. pp. 229-230.

Runyoro D, Srivastava S, Darokar M, Olipa N, Joseph C, Matee M (2013). Anticandidiasis agents from a Tanzanian plant, Combretum zeyheri. Med. Chem. Res. 22:258-1262.

Salomão A, Matose F (2008). Towards community-based forest management of Miombo woodlands in Mozambique. In:Dewees P (ed), Managing the Miombo woodlands of southern Africa - Policies, incentives and options for the rural poor, Annex 5. Washington DC: World Bank. pp. 79-100.

Samie A, Housein A, Lall N, Meyer JJ (2009). Crude extracts of, and purified compounds from, *Pterocarpus angolensis*, and the essential oil of *Lippia javanica*: their in-vitro cytotoxicities and activities against selected bacteria and *Entamoeba histolytica*. Ann. Trop. Med. Parasitol. 103:427-439.

Sanogo R (2011). Medicinal plants traditionally used in Mali for dysmenorrhea. Afr. J. Tradit. Complement. Altern. Med. 8:90-96.

Schmelzer GH (2008). *Pseudolachnostylis maprouneifolia* Pax. In Schmelzer GH, Gurib Fakim A (eds), Plant resources of tropical Africa. Medicinal Plants 1. Wageningen: PROTA Foundation/Backhuys Publishers/CTA. pp. 478-479.

Semenya SS, Johannes PM, Christoffel EL (2013). Bapedi phytomedicine and their use in the treatment of sexually transmitted infections in Limpopo Province, South African. Afr. J. Pharm. Pharmacol. 7:250-262.

Shackleton CM, Clarke JM (2011). Silviculture and management of Miombo woodlands to improve livelihood outcomes. In: Dewees P (ed), Managing the Miombo woodlands of southern Africa - Policies, incentives and options for the rural poor, Annex 6. Washington DC: World Bank. pp. 101-132.

Shailasree S, Sampathkumara KK, Niranjana SR, Prakash HS (2014). Bioactive potential of medicinal plants from Western Ghats Region, India. J. Herbs Spices Med. Plants. 20:221-234.

Sobiecki JF (2002). A preliminary inventory of plants used for psychoactive purposes in southern African healing traditions. Trans. R. Soc. S. Afr. 57:1-24.

Steenkamp V, Mathivhaa E, Gouwsb MC, Van Rensburga CEJ (2004). Studies on antibacterial, antioxidant and fibroblast growth stimulation of wound healing remedies from South Africa. J. Ethnopharmacol. 95:353-357.

Suleiman M, Dzenda T, Sani C (2008). Antidiarrhoeal activity of the methanol stem-bark extract of *Annona senegalensis* Pers. (Annonaceae). J. Ethnopharmacol. 116:125-130.

Takawira-Nyenya R (2005). *Pterocarpus angolensis* DC. In: Louppe D, Oteng-Amoako AA, Brink M (eds), Plant resources of tropical Africa. Timbers 1. Wageningen: PROTA Foundation/Backhuys Publishers/CTA. pp. 473-478.

Tanko Y, Iliya B, Mohammed A, Mahdi MA, Musa KY (2011). Modulatory effect of ethanol stem bark extract of *Burkea africana* on castrol oil induced diarrhoeal on experimental animals. Arch. Appl. Sc. Res. 3:122-130.

Tauchen J, Doskočil I, Caffi C, Lulekal E, Maršík P, Havlík J, Van Damme P, Kokoška L. (2015). *In vitro* antioxidant and anti-proliferative activity of Ethiopian medicinal plant extracts. Ind. Crops Prod. 74:671-679.

Teka A, Rondevaldova J, Asfaw Z, Demissew S, Van Damme P, Kokoska P, Vanhove W (2015). In vitro antimicrobial activity of plants used in traditional medicine in Gurage and Silti Zones, south central Ethiopia. BMC Complement. Altern. Med. 15(1):286.

Timberlake J, Golding J, Clarke P (2004). Niassa Reserve botanical expedition June 2003. Report Prepared for SRN. Occasional Publications in Biodiversity, No 12. Bulawayo: Biodiversity Foundation for Africa.

Tor-Anyiin AT, Anyam J (2013). Phytochemical evaluation and antibacterial activity: A comparison of various extracts from some Nigerian trees. Peak J. Med. Plant Res. 1:13-18.

Ugwu BU, Okogun JI, Kabiru AY, Ogbadoyi EO (2011). Evaluation of therapeutic potentials of stem bark extracts of *Annona senegalensis* in experimental *Trypanosoma brucei brucei* infection in mice. Br. J. Pharmacol. Toxicol. 2:63-70.

Vasudeva N, Vats M, Sharma SK, Sardana S (2009). Chemistry and biological activities of the genus *Dalbergia* - A review. Parmahcogn. Rev. 3:307-319.

White F (1983). The vegetation of Africa: A descriptive memoir to accompany the UNESCO/AETFAT/UNSO, Vegetation map of Africa (3 plates), 1:5,000,000. Paris: UNESCO.

World Health Organization (WHO) (2003). Traditional medicine. Fact Sheet 134. Available at www.who.int/mediacentre/factsheets/2003/fs134/en/

World Conservation Monitoring Centre (1998). *Pterocarpus angolensis*. The IUCN Red List of Threatened Species 1998: e.T33190A9759374. Available at: www.iucnredlist.org/details/33190/0

Yaro AH, Anuka JA, Malami S, Yau J, Dansadau US (2010). Anticonvulsant properties of methanol root bark extract of *Burkea Africana* in laboratory animals. J. Pharmacol. Trop. Ther. 1:26-30.

Yaro AH, Malami S, Yau J, Sagoe CN, Anuka JA (2015). Some behavioural studies on methanol root bark extract of *Burkea africana* (Fabaceae) in mice. Bayero J. Pure Appl. Sci. 8:216-219.