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REVIEW ARTICLE

Herbal Drugs from Sudan: Traditional Uses and Phytoconstituents

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ABSTRACT

Sudan folklore medicine is characterized by a unique combination of Islamic, Arabic, and African cultures. In poor communities, traditional medicine has remained as the most reasonable source of treatment of several diseases and microbial infections. Although the traditional medicine is accepted in Sudan, to date there is no updated review available, which focuses on most effective and frequently used Sudanese medicinal plants. Thus, this review aims to summarize the published information on the ethnobotanical uses of medicinal plants from Sudan, preparation methods, phytochemistry, and ethnopharmacology. The collected data demonstrate that Sudanese medicinal plants have been reported to possess a wide range of traditional medicinal uses including different microbial infections, gastrointestinal disorders, malaria, diabetes, rheumatic pain, respiratory system disorders, jaundice, urinary system inflammations, wounds, cancer, and different microbial infections. In most cases, the pharmacological studies were in agreement with traditional uses. Moreover, several bioactive compounds such as flavonoids, saponins, alkaloids, steroids, terpenes, tannins, fatty acids, and essential oils have been identified as active constituents. Although this review demonstrates the importance of ethnomedicine medicines in the treatment of several diseases in Sudan, further researches to validate the therapeutic uses and safety of these plants through phytochemical screening, different biological activity assays, and toxicological studies are still needed.

Key words: Antimicrobial agents, biological activity, medicinal plants, phytoconstituents, Sudan, traditional medicine

INTRODUCTION

Traditional medicine has been used for the treatment of human illnesses since long time and is mainly based on components derived from natural products, from herbs, plants, and animals. Medicinal natural products are very frequently used in Sudan and also are widely consumed in Africa and all over the world. About 80% of the populations in African countries depend on traditional medicine for their primary health care.[1] In Sudan, 90% of Sudan's population depends mainly on traditional medicine since admission to hospitals and obtaining modern synthetic drugs are limited and a high percentage of the population is nomads.[2,3] Sustainability of the use of medicinal plants is an important concern. The demand for medicinal plants is increasing in Africa as the population grows and pressure on medicinal plant resources will become greater than ever. Interest in plant-derived medicines has also increased in the developed countries among the pharmaceutical companies.[4] In contrast, due to their minor side effects, the medicinal plants are widely used to treat many human diseases.[5] The increasing cost of health care and the failure of allopathic medicine to treat some diseases have also participated to the increasing consumption of traditional medicine to fight disease. Until now, there is no pharmacopoeia or formal training for the traditional medical healers in Sudan, and their knowledge is completely based on acquired folklore and local traditions.

Medicinal plants with a long history of safe and efficient use are likely to have a pharmaceutical outcome.[6] However, almost all of the medicinal herbal products are unlicensed and are not required to demonstrate efficacy, safety, or quality. Unknown consequences of some of medicinal plants have been detected. Examples of toxic reactions, allergic reactions, drug interactions, drug contamination, and mistaken plant identities are provided.[7]

This review describes the traditional uses of 48 medicinal plants from Sudan. These plants are distributed into 26 families. The most common families are *Fabaceae* (12 species) followed by *Combretaceae* (4 species), *Capparidaceae* and *Capparaceae* (3 species each), *Meliaceae*, *Asclepiadaceae*, *Anacardiaceae*, and *Malvaceae* (2 species each), and other families are represented with one species each [Table 1]. Different plant parts including leaf, stem, root, fruit, seed and bark, aerial part, and whole plant are used in the preparation of medicines. There is a distinct preference for leaf (25%), fruit (23%), and stem (17%) materials [Figure 1]. Drugs were prepared mostly through decoction (19 species) and maceration (13 species). However, other techniques such as infusion (8 species), poultice and smoke (7 species each), powder and paste (6 species each), directly (2 species), and mucilaginous and dessert (1 species each) are also employed [Figure 2]. Prepared remedies are administered or prescribed in several ways including orally, nasally, or anally. The majority of the species are extensively used in traditional medicine against infections, inflammation, diabetes, bleeding, malaria,

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diarrhea, and digestive disorders. A summary of the most important Sudanese medicinal plants, their botanical families, local names, and traditional usage is presented in Table 1.

The Convention on Biological Diversity (CBD) was opened for signature in 1992 and entered into force in December 1993. It was signed by Sudan in June 1992 and ratified in October 1995, addresses at global level the entire spectrum of biological diversity, the sustainable use thereof and the fair and equitable sharing of the benefits accruing from that use.[71] All plants mentioned in this study are native to Sudan. In this review, we have considered the medicinal plants from the whole Sudan as one single country; however, in July 2011, Sudan was split into two countries (Sudan and South Sudan). The main question now: How will the medicinal plants and forests of the previous United Sudan be divided between the two new countries and which of the two new countries will benefit from legal protection as laid out by CBD?

OVERLAP BETWEEN FOOD AND MEDICINE IN SUDAN

Overlap between food and medicine is a common phenomenon in Sudan. Many plant substances are used as both foods and medicines. For example, the plants *Capsicum frutescens, Ziziphus spina-christi, Cymbopogon proximus, Grewia tenax, Hyphaene thebaica, Hibiscus sabdariffa, Trigonella foenum-graecum, Tamarindus indica*, and *Sesamum indicum* are not only known herbal medicines but also foods, drink, and/or flavorings.[8-11,23,42,52,53,55,59-63,72,73] Moreover, in Sudan and many other countries, foods containing biologically active natural constituents are eaten regularly. For instance, luteolin is a known biologically active flavonoid found in celery, green pepper, thyme, chamomile tea, perilla, carrots, peppermint, olive oil, rosemary, navel oranges, oregano, and other foods.[74,75]

PHYTOCHEMISTRY AND PHARMACOLOGICAL PROPERTIES

The traditional medicinal applications of Sudanese plants have encouraged many pharmacological investigations. Several extracts and purified compounds have been assessed for their biological activities, especially antibacterial, antioxidant, antimalarial, antifungal, anti-inflammatory, anticancer, and antidiabetic activities [Figure 3]. There appears to be an interest in developing novel drugs for many diseases from these plants due to their different classes and high contents of phytoconstituents based on natural products as lead structures. The active components in herbal medicines are directly associated with their ability to treat or prevent ailments. Phenolics, alkaloids, tannins, flavonoids, saponins, and steroids are the most bioactive compounds identified in these plants. Table 2 lists some the available pharmacological studies, bioactive constituents, and assays based on folk knowledge of the most active and frequently used Sudanese medicinal plants.

ANTIMICROBIAL, PHYTOCONSTITUENTS, AND TRADITIONAL MEDICINAL USES OF SOME SELECTED SUDANESE PLANTS

Several pharmacological studies have demonstrated the antimicrobial activities of the medicinal plants, supporting its traditional uses. Phytochemical studies on these plants have demonstrated the occurrence of many classes of bioactive compounds, including flavonoids, terpenes, lignans, proanthocianidines, and chlorogenic acids, among others [Table 2]. In the following section, selected medicinal plants are described in more details with respect to the traditional uses, phytoconstituents, and antimicrobial activities.

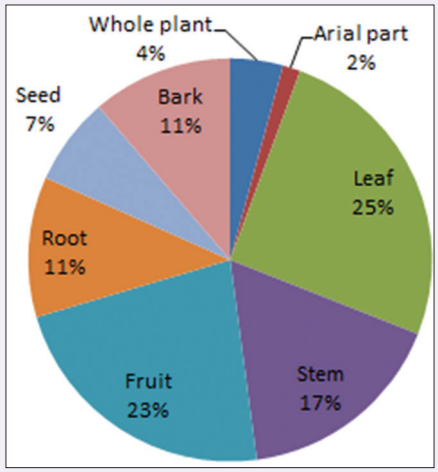

Figure 1: Plant parts used to prepare traditional medicines

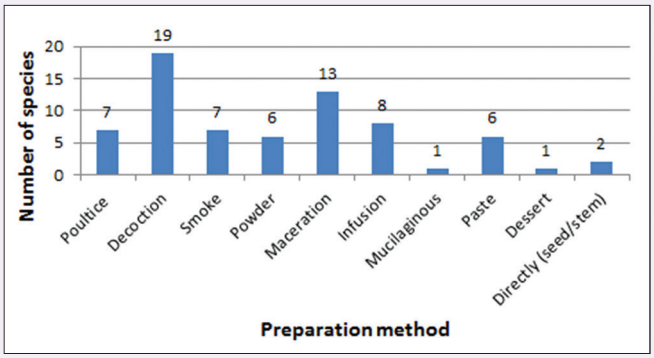

Figure 2: Preparation methods used to practice traditional remedies

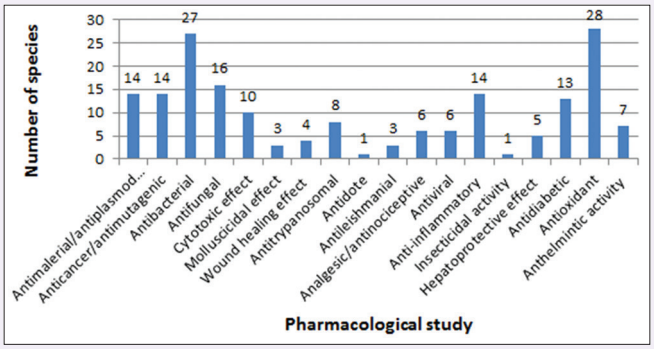

Figure 3: Major pharmacological studies and plant species reported

Azadirachta indica A. Juss. (*Meliaceae*)

Azadirachta indica is widely used in folkloric medicine for the treatment of variety of diseases in remote areas of Sudan. For instance, the decoction of leaves and roots is used for snake, scorpion bites and intestinal spasm, respectively.[8] The infusion of the leaves is used for treating malaria, fever, and jaundice [Table 1].[10] Furthermore, the powder of the dried leaves is mixed with water and taken to treat freckles and to increase appetite.[297,298] *A. indica* has also been scientifically proved for its antibacterial,[129] antiparasitic,[123] neuroprotective,[125] antimalarial,[86,126]

Table 1: Sudanese medicinal plants, their local names, and traditional usage

Plant name	Family	Local Sudanese names	Part used	Preparation	Traditional medicine uses	References
A. javanica (Burm. F.) Juss. Ex Schult	*Amaranthaceae*	Umm Shara	Whole plant	Poultice	For swellings, wounds and as a potent	[8,9]
A. leiocarpus (DC.) Guill. and Perr.	*Combretaceae*	Sahab	Stem bark	Decoction	Against cough, dysentery, and giardiasis	[10]
A. seyal Del.	*Fabaceae*	Al-Talih	Stem	Smoke, decoction	Against jaundice, rheumatic pain and as mouth detergent	[8,11-14]
A. hispidum Schrank.	*Asteraceae*	Hourab Al-Hausa	Arial part	Decoction	Antimalarial	[15,16]
A. senegal (L.) Willd	*Fabaceae*	Al-Hashab	Fruits, stem	Powder	Against diabetes chronic renal failure, ulcers, and diarrhea	[11,17]
A. nilotica (L.) Willd. ex Del.	*Fabaceae*	Al-Garad	Fruits	Maceration, powder, smoke	Antiseptic, malarial, hepatitis C virus, molluscicidal, colds, and pharyngitis	[10,18-22]
A. bracteolata Lam.	*Aristolochiaceae*	Um-Galagil	Fruits, roots	Maceration	Antimalaria, tumor, scorpion bite, and HIV-1	[15,16,23-25]
A. digitata L.	*Bombacaceae*	Al-Gongelez	Fruits	Decoction	Against diarrhea, malaria, cold, and amoebic dysentery	[10,26]
B. senegalensis (Pers.) Lam.	*Capparidaceae*	Al-Mukhait	Leaves, roots, fruits	Powder mixed with milk	Antibacterial, jaundice, urinary system inflammations, bilharzias, and tuberculosis	[8,27,28]
C. decidua (Frosk) Edgew.	*Capparidaceae*	Al-Tundub	Stem	Poultice	Antimalaria, headache, and against jaundice	[8,16,23]
A. polyacantha Willd.	*Fabaceae*	Abu-Sineina/ Kakamoat	Leaves	Smoke, infusion, decoction	Against jaundice, rheumatic pain, dysentery, sexual debility, and schistosomiasis	[10,14]
A. sinkatana Rey.	*Liliaceae*	Al-Sabar	Leaves	Mucilaginous, paste	Against constipation, anthelmintic, skin diseases, colon inflammation, fever, diabetic and hemorrhoids	[29,30]
A. amara (Roxb.) Boiv.	*Fabaceae*	Arrada	Leaves	Paste, decoction	Against jaundice, mouth inflammation, pain, and wounds	[9,14,30]
A. indica A. Juss.	*Meliaceae*	Al-Neem	Leaves, roots	Infusion, decoction	Antimalarial, fever, jaundice, helminthiasis, and skin diseases	[8,10,31,32]
C. occidentalis L.	*Leguminosae*	Al-Soreib	Leaves	Decoction	Antimalarial and jaundice	[8,9,33]
G. villosa Willd.	*Tiliaceae*	Altiko	Roots	Maceration	Against cancer	[10]
C. quadrangularis L.	*Vitaceae*	Al-Salaalaa	Stem	Poultice, smoke	Antimalarial, bone fracture, acne, evil eye, and tuberculosis	[10,34]
C. colocynthis (L.) Schrad.	*Cucurbitaceae*	Al-Handal	Fruits, seeds, roots	Poultice, directly (seeds)	Against eczema, diabetic, constipation, swellings, and scabies	[9,35,36]
C. hartmannianum Schweinf.	*Combretaceae*	Al-Habiel	Bark, stem, leaves	Infusion	Antibacterial, jaundice, wounds, and fever	[8,27]
C. procera (Ait.) Ait. F.	*Asclepiadaceae*	Al-Ushar	Leaves	Infusion, paste	Against jaundice, scorpion bites, thorn injuries, rheumatic and as mouth detergent	[9,11,14]
C. zambesicus Muell-Arg.	*Euphorbiaceae*	Habat Al-Malook	Seeds	Decoction	Antimicrobial, antimalarial, HIV-1 and cough	[15,24,35,37-40]
E. abyssinica L.	*Fabaceae*	Hab Al-Arous	Bark, seeds	Decoction	Antimicrobial, jaundice and rheumatic pain	[10,41]
F. cretica L.	*Zygophyllaceae*	Umm-Shuwaika	Whole plant	Smoke, powder	Against heartburn, muscular pains, spasm and as purgative	[8,9,42]
L. pyrotechnica (Forssk.) DC.	*Asclepiadaceae*	Ajwam	Stem, root	Maceration, smoke	Diuretic and antirheumatic	[9,11]
M. crassifolia Forssk.	*Capparaceae*	Sarah	Stem	Smoke	Antirheumatic	[9]
M. angolensis DC.	*Capparaceae*	Shager-Elzaraf	Leaves	Paste	Against breast tumor	[10]
S. persica L.	*Salvadoraceae*	Al-Miswak/ Arak	Stem, fruits, leaves	Maceration, directly (stem)	Antibacterial, malarial, caries, gingivitis, stomach pain, eye infection, liver swelling, HIV-1, hypertension and as mouth detergent	[24,35,41,43-47]
S. alexandrina Mill. (*C. senna* L.)	*Fabaceae*	Sena-Maka	Leaves, fruits	Decoction	Against constipation and GIT disorders	[11,42,48-50]
K. africana (Lam.) Benth.	*Bignoniaceae*	Um-Shitour	Fruits	Paste, decoction	Against breast tumor, hypertension and diabetes	[10]

Contd..

Table 1: Contd...

Plant name	Family	Local Sudanese names	Part used	Preparation	Traditional medicine uses	References
C. glandulosa Forssk.	*Capparaceae*	Kurmut	Whole plant	Poultice	Against swelling and rheumatic pain	[8,9,14,42]
K. senegalensis (Desr.) A. Juss.	*Meliaceae*	Mahogany	Stem bark	Decoction, maceration	Antimalarial, diabetes, hepatic inflammation, sinusitis, skin diseases, stomach complaints, and trachoma	[10,11]
D. melanoxylon Guill. and Perr	*Fabaceae*	Al-Babanous	Leaves	Infusion	Against heart pain and rheumatic pain	[8,14]
T. brownii Fresen.	*Combretaceae*	Al-Sobagh	Bark, stem	Maceration	Against cough, bronchitis, back pains, and rheumatic pain	[9,11,51]
C. proximus (Hochst. ex A. Rich) Stapf.	*Poaceae*	Mahareb	Leaves	Decoction	Against renal colic, fever, spasm, prostate inflammation and helminthiasis	[30,52]
G. tenax (Forssk.) Fiori.	*Tiliaceae*	Godeim	Fruits	Powder, maceration, infusion, poultice	Antimalarial, skin diseases, and for anemia	[9,53,54]
S. birrea (A. Rich.) Hochst.	*Anacardiaceae*	Humeid	Stem bark	Powder	Antihelminthics, spasm, diarrhea, and wounds	[10,11,14]
H. thebaica (L.) Mart.	*Arecaceae*	Doum	Fruits	Maceration	Against splenomegaly, trachoma, and wounds	[11,55]
G. bicolor Juss.	*Malvaceae*	Basham Al-Bayad	Roots	Decoction, poultice	Against pustular skin lesions and to facilitate labor	[56]
G. senegalensis J. F. Gmel.	*Combretaceae*	Gubeish	Leaves, roots	Maceration	Antimalarial, fever, leprosy, dysentery, respiratory infections, GIT disorders, chest infection, and rheumatic pain	[8,57,58]
B. salicifolia Oliv.	*Capparidaceae*	Tella	Bark	Maceration	Against cough and malaria	[51]
H. sabdariffa L.	*Malvaceae*	Karkade	Sepals	Maceration, decoction	Against hypertension, colds, fever, antispasmodic and antimicrobial	[30,59-61]
T. foenum-graecum L.	*Fabaceae*	Hilba	Seeds	Decoction, dessert	Against stomach ailments, diabetic, as food additive and to increase lactating and contraceptive	[62]
T. indica L.	*Fabaceae*	Ardeb	Fruits	Infusion	Against constipation, fever, malaria and jaundice	[10,23,63]
O. insignis Del.	*Anacardiaceae*	Tugul	Bark, roots	Decoction	Against pharyngitis and stomach ache	[10,51]
C. obtusifolia L.	*Fabaceae*	Kawal	Leaves	Paste	Diuretic, anti-HIV-1 and jaundice	[24,25,64]
B. aegyptiaca (L.) Del	*Balanitaceae*	Al-Laloub	Fruits, seeds, leaves	Maceration	Against constipation, jaundice, dysentery, rheumatic pain, diabetic, helminthics, tumors, and wounds	[8,9,14,42,65-67]
O. basilicum L.	*Lamiaceae*	Al-Rehan	Fruits, leaves	Infusion	Against jaundice and as demulcent	[8,9]
A. senegalensis Pers.	*Annonaceae*	Giishta	Fruits, leaves	Decoction	Against sleeping sickness, anticancer, anthelmintic, and arthritis	[68-70]

HIV-1=Human immunodeficiency virus type 1, GIT=Gastrointestinal, *A. javanica=Aerva javanica*, *A. leiocarpus=Anogeissus leiocarpus*, *A. seyal=Acacia seyal*, *A. hispidum=Acanthospermum hispidum*, *A. nilotica=Acacia nilotica*, *A. Senegal=Acacia Senegal*, *A. bracteolata=Aristolochia bracteolata*, *A. digitata=Adansonia digitata*, *B. senegalensis=Boscia senegalensis*, *C. decidua=Capparis decidua*, *A. polyacantha=Acacia polyacantha*, *A. sinkatana=Aloe sinkatana*, *A. amara=Albizia amara*, *A. indica=Azadirachta indica*, *C. occidentalis=Cassia occidentalis*, *G. villosa=Grewia villosa*, *C. quadrangularis=Cissus quadrangularis*, *C. colocynthis=Citrullus colocynthis*, *C. hartmannianum=Combretum hartmannianum*, *C. procera=Calotropis procera*, *C. zambesicus=Croton zambesicus*, *E. abyssinica=Erythrina abyssinica*, *F. cretica=Fagonia cretica*, *L. pyrotechnica=Leptadenia pyrotechnica*, *M. crassifolia=Maerua crassifolia*, *M. angolensis=Maerua angolensis*, *S. persica=Salvadora persica*, *S. alexandrina=Senna alexandrina*, *K. Africana=Kigelia Africana*, *C. glandulosa=Cadaba glandulosa*, *K. senegalensis=Khaya senegalensis*, *D. melanoxylon=Dalbergia melanoxylon*, *T. brownii=Terminalia brownii*, *C. proximus=Cymbopogon proximus*, *G. tenax=Grewia tenax*, *S. birrea=Sclerocarya birrea*, *H. thebaica=Hyphaene thebaica*, *G. bicolor=Grewia bicolor*, *G. senegalensis=Guiera senegalensis*, *B. salicifolia=Boscia salicifolia*, *H. sabdariffa=Hibiscus sabdariffa*, *T. foenum-graecum=Trigonella foenum-graecum*, *T. indica=Tamarindus indica*, *O. insignis=Ozoroa insignis*, *C. obtusifolia=Cassia obtusifolia*, *B. aegyptiaca=Balanites aegyptiaca*, *O. basilicum=Ocimum basilicum*, *A. senegalensis=Annona senegalensis*, *C. senna=Cassia senna*

anti-inflammatory,[127] acaricidal,[121] and antinociceptive[127] effects. Several bioactive compounds have been isolated from different parts of *A. indica* [Table 2]. Nimbin and nimbidin representing the main phytoconstituents isolated from the seed of the plant, which have showed several biological properties including antibacterial, antifungal, and anti-inflammatory.[130]

Khaya senegalensis (Desr.) A. Juss. (*Meliaceae*)

Khaya senegalensis is extensively used as a traditional medicine in rural areas of Sudan for various ailments [Table 1]. Abuzeid *et al*.[299] described that chloroform extracts of the bark and leaf of *K. senegalensis* exhibited a significant inhibitory effect on *Mycobacterium tuberculosis*. Strong antibacterial activities for different bark extracts against *Salmonella enterica, Staphylococcus aureus, Streptococcus pyogenes, Salmonella typhi, Shigella dysenteriae, Klebsiella pneumoniae*, and *Pseudomonas aeruginosa* [Table 2] were also reported.[210] In addition, the plant has anti-inflammatory, antidiarrheal, antioxidant, antidiabetic, anticancer, and anthelmintic activities.[205,206,208,209] The observed biological activities might be due to the presence of saponins, tannins, flavonoids, terpenoids, alkaloids, anthroquinones, limonoids, khayanolides, and *p*-anilinophenol, which have been identified in this plant [Table 2].

Table 2: Main phytochemistry constituents, bioactivity, and pharmacological studies based on folk knowledge of the most active Sudanese medicinal plants

Plant scientific name	Phytochemistry constituents	Pharmacological activity/assay	References
A. javanica (Burm. F.) Juss. Ex Schult	3-Hydroxy-4 methoxybenzaldehyde, ursolic acid, (E)-*N*-(4-hydroxy-3-methoxyphenethyl)-3-(4-hydroxy-3-ethoxyphenyl) acryl amide, ecdysteroids, β-ecdysone, 5-β-2-deoxyintegristerone A, 24-epi-makisterone A, isorhamnetin 3-*O*-β-[4‴-*p*-coumaroyl-α-rhamnosyl (1→6) galactoside]	Enzyme inhibition for ulcer (+)[p] Antibacterial activity (ADM)[c] *E. coli* (+) *K. pneumonia* (+) *P. aeruginosa* (+) *S. aureus* (+) *S. typhi* (−) *S. epidermidis* Methicillin-resistant *S. aureus* (+) Antifungal (−)[c]	[76-79]
A. leiocarpus (DC.) Guill. and Perr.	Alkaloids, tannins, flavonoids, saponins, phlobatannins, terpenes, ellagic, gentisic and gallic acids	Anthelmintic effect against *H. contortusc* Egg hatch inhibition (+) Larval development viability (+) Anthelmintic effect[c] *O. ochengi* (+) *C. elegans* (+) Anthelmintic effect[c] *Strongyloïdes papillosus* (+) *G. pachyscelis* (+) *Cooperia curticei* (+) *Oesophagostomum columbianum* (+)	[80-85]
A. seyal Del.	Gum arabic: Complex polysaccharides containing calcium, magnesium, potassium salts, protein, gallic, ellagic and chlorogenic acids	Antimalarial activity (−)[c] Brine shrimp toxicity (−)[c]	[12,86-89]
A. hispidum Schrank.	Phytosterols, lactones sesquiterpenoids beta-caryophyllene, α-bisabolol, germacrene D	Antiplasmodial activityc Growth inhibition assay (*P. falciparum*) (+) Antibacterial activity (ADM and BMM)[c] *E. coli* (−) *S. aureus* (−) Molluscicidal effect[c] *B. peregrine* (+) Antitrypanosomal activity[c] *T. brucei brucei* (+) Antileishmanial activity[c] *L. mexicana mexicana* (+)	[90-94]
A. senegal (L.) Willd	Gum arabic, *n*-alkanes, fatty alcohols, fatty acids	Antibacterial activity (ADM and BMM)[c] *E. coli* (−) *S. aureus* (+) *S. typhi* (−) Antifungal activity (ADM) *C. albicans* (+) *A. niger* (+)	[87-89,95,96]

Contd..

Table 2: Contd...

Plant scientific name	Phytochemistry constituents	Pharmacological activity/assay	References
A. nilotica (L.) Willd. ex Del.	Alkaloids, flavonoids, tannins and saponins, gallic acid, kaempferol, umbelliferone, niloticane	Antibacterial activity (ADM and BMM)[c] *E. coli* (+) *S. aureus* (+) *S. typhi* (+) Antifungal activity (ADM)[c] *C. albicans* (+) *A. niger* (+) Antimutagenic activity (+)[p] Cytotoxic activity (+)[p] Antioxidant activity (DPPH) (+)[p] Anti-inflammatory activity (+)[c]	[18-20,95,97,98]
A. bracteolata Lam.	Alkaloids, saponins, glycosides, steroids, tannins; phenolics, aristolochic acid, leucasin	Wound healing effect (+)[c] Antidote activity (+)[p]	[99,100]
A. digitata L.	Terpenoids, flavonoids, sterols, vitamins, amino acids, carbohydrates, lipids, isopropyl myristate, nonanal, procyanidins, tannins, phlobatannins, cardiac glycosides, saponins	Analgesic effect (+)[c] Antipyretic activity (+)[c] Antibacterial activity (MIC)[c] *E. coli* (+) *P. aeruginosa* (−) *B. subtilis* (+) *Salmonella* sp. (+) *B. anthracis* (+) Antifungal activity[c] *C. albicans* (−) *Mucor* sp. (−) Antiviral activity (MIC) (+)[c] Anti-inflammatory activity (+)[c]	[101-107]
B. senegalensis (Pers.) Lam.	Glucosinolates, glucocapparin, protein, carbohydrates, fatty acids: palmitic, stearic, and linoleic acids	Insecticidal activity[c] *C. serratus* (+) *C. maculatus* (+)	[28,108-110]
C. decidua (Frossk) Edgew.	Fatty acids, flavones, alkaloids, isothiocyanate glucoside	Antihemolytic activity (+)[c] Antidiabetic activity (+)[c] Hepatoprotective effect (+)[c] α-Amylase inhibitory assay (+) α-Glucosidase inhibitory assay (+) Antibacterial activity (MIC)[p/c] *B. cereus* (+) *K. pneumonia* (+) *E. coli* (+)	[111-113]
A. polyacantha Willd.	Amino acids, tannins, phenolics	Anthelmintic assay[c] *C. elegans* (+) Antimalarial activity[c] *P. falciparum* (−)	[84,85,114-116]
A. sinkatana Rey.	Anthraquinones, monosaccharides, anthrones, aloin, aloinoside, microdontin	Antidiabetic activity[p/c] Hemoglobin-δ-gluconolactone assay (+) BSA assay (+)	[29,117,118]
A. amara (Roxb.) Boiv.	Budmunchiamine A, steroids, alkaloids, saponins, tannins, cardiac glycosides, carbohydrates, flavonoids, terpenoids, glycosides, quinones	Antifungal activity (MIC)[p] *A. flavus* (+) Antifungal activity (MIC)[c] *Fusarium laceratum* (+) *A. flavus* (−) Antibacterial activity (MIC)[c] *S. faecalis* (+) *P. vulgaris* (−)	[119,120]

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Table 2: Contd...

Plant scientific name	Phytochemistry constituents	Pharmacological activity/assay	References
A. indica J.Juss.	Nimbidin, nimbin, nimbolide, gedunin, mahmoodin, octadecanoic acid-3,4-tetrahydrofuran diester, azadirachtin, limonoids, triterpenoids, tetranortriterpenoids, azadirachtolide, aeoxyazadirachtolide, polysaccharides, condensed tannins: gallic acid, gallocatechin, epicatechin, catechin, epigallocatechin	Brine shrimp toxicity (−)[c] Antiparasitic activity[p/c] *S. scabiei* (+) *Myobia musculi Schranck* (+) *Myocoptes musculinus Koch* (+) Neuroprotective effects (+)[c] Antimalarial activity[c] *P. falciparum* (+) Anti-inflammatory (+)[p] Antinociceptive (+)[p] Antibacterial activity (ADM)[c] *E. coli* (−) Acaricidal activity *S. scabiei var. cuniculi* (+)[p]	[32,86,121-130]
C. occidentalis L.	Emodin, chrysophanol, saponins, flavonoids, tannins, resins, anthraquinones, cardiac glycosides, chrysoeriol, essential oils, funiculosin, quercetin, rhein, rubrofusarin, sitosterols, tannins, xanthorine	Anthelmintic activity[c] *H. gallinarum* (+) *R. tetragona* (+) *Catatropis* sp. (+) Anti-inflammatory (+)[p] Anticancer[c] Chymotrypsin inhibitory activity (+) Hepatoprotective effect (+)[c] Antioxidant (DPPH) (+)[c] Antibacterial activity[c] *B. subtilis* (+) *E. coli* (−) *P. aeruginosa* (−) *S. aureus* (−)	[131-137]
G. villosa Willd.	Harman, harmine, harmol, harmalol, harmaline, monosaccharides, hydrocarbons, sterols, α-amyrin, uvaol, ursolic acid, hydroxyuvaol, quinovic acid, β-sitosterol-3-*O*-glucoside	Anticancer (+)[c] Antioxidant (DPPH) (+)[c]	[138-142]
C. quadrangularis L.	Steroids, terpenoids, quercetin, resveratrol, sterols, Vitamin C, tannins, iridoids 6-*O*-[2,3-dimethoxy]-trans-cinnamoyl catalpol, 6-*O*-meta-methoxy-benzoyl catalpol, iridoid picroside, quadrangularin A, pallidol, quercitrin, β-sitosterol, β-sitosterol glycoside	Antihemorrhoid effect (+)[c] Fatty liver disease (+)[c] Antibacterial activity[c] *B. subtilis* (+) *B. cereus* (+) *S. aureus* (+) Antioxidant (DPPH) (+)[c] Antiviral activity[c] HSV 1 and HSV 2 (+)	[143-148]
C. colocynthis (L.) Schrad.	Tannins, saponins, cucurbitacins, cucurbitacin glucosides, phenolic acids: ferulic, vanillic, *p*-coumeric, gallic and *p*-hydroxy benzoic acids, chlorogenic acid, flavonoids: quercetin, myricetin, catechin	Anticancer activity (+)[p] Antioxidant (DPPH) (+)[c] Antidiabetic (+)[c] Hypolipidemic (seed bowder) (+) Antibacterial[c] *S. aureus* (+) Anti-inflammatory activity (+)[c] Analgesic activity (+)[c]	[36,149-154]

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Table 2: Contd...

Plant scientific name	Phytochemistry constituents	Pharmacological activity/assay	References
C. hartmannianum Schweinf.	Flavonoids, phenanthrene, tannins, unsaturated sterol, triterpenes, saponins, carbohydrates	Antimalarial activityc *P. falciparum* (+) Antiviral activity[c] HIV-1 reverse transcriptase inhibitory assay (+) Anticancer activity[c] Tyrosine kinase inhibitory assay (+) Antitrypanosomal activity[c] *Trypanosoma brucei rhodesiense* (−) *T. cruzi* (−) Antioxidant (DPPH) (+)[c] Anticercarial activity (+)[c]	[34,155-158]
C. procera (Ait.) Ait. f.	Phenolics, flavonoids, flavonoid glycosides, latex, cardenolides, triterpenoids, alkaloids, resins, anthocyanins, tannins, saponins	Antioxidant (DPPH) (+)[c] Antibacterial activity (ADM and MIC)[c] *B. pumilus* (+) *E. coli* (−) Antifungal activity[c] *A. niger* (−) *F. oxysporum* (+) Anthelmintic activity[c] *H. contortus* (+)	[159-162]
C. zambesicus Mull-Arg.	Diterpenoids, crotozambefurans, crotonadiol, abiatane diterpenoids, quinines, triterpenoids, flavonoids, labdane, clerodane, trachylobane diterpenes, quercetin-3-*O*-β-6″ (p-coumaroyl) glucopyranoside-3'-methyl ether, tiliroside, apigenin-6-*C*-glucoside	Antimalarial activityc *P. falciparum* (+) Anticancer activity[c] Tyrosine kinase inhibitory assay (+) Antiviral activity[c] HIV-1 reverse transcriptase inhibitory assay (−) Antidiabetic activity (+)[c] Kidney protective effect (+)[c] Antioxidant (DPPH) (+)[p] Anti-inflammatory (−)[c] Analgesic (+)[c] Antipyretic (+)[c]	[34,38,39,163-166]
E. abyssinica L.	Alkaloids: erythraline, erysodine, erysotrine, 8-oxoerythraline and 11-methoxyerysodine, abyssinone –V Coumestan: Erythribyssin N, benzofurans: erythribyssin F, erythribyssin H, sigmoidin K, isosojagol, eryvarin Q, erypoegin F, eryvarin R	Anticancer activity[c] Tyrosine kinase inhibitory assay (+) Antibacterial activity (ADM)[c] *B. megaterium* (+) Antitrypanosomal activityc *T. brucei brucei* (+) Cytotoxic activity (+)[c/p] Anti-HIV-1 (+)[c/p] Activity against M. tuberculosis (+)[c] Antimalarial activity[p] *P. falciparum* (+) Antidiabetic activity (+)[p]	[34,167-171]
F. cretica L.	Triterpenene, saponins, saponins glycosides, linoleic acid, methyl triacontanoate, taraxerol, β-amyrin acetate, oleanolic aldehyde acetate, octacosonic acid, triacontanoic acid, taraxerone	Anticancer activity[c] Potato disc assay (+) Brine shrimp toxicity (+)[c] Antibacterial activity (ADM)[c] *A. tumefaciens* (−) Endocrinological effects (+)[p] Antihemorrhagic effect[c] *N. naja karachiensis* (+)	[172-179]

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Table 2: Contd...

Plant scientific name	Phytochemistry constituents	Pharmacological activity/assay	References
L. pyrotechnica (Forssk.) DC.	Flavonoids, flavonoids glycosides: kaempferol-3-*O*-α-l-rhamnopyranosyl (1′″→6″)-*O*-β-D-glucopyranoside, kaempferol-3-*O*-β-D-rhamnopyranosyl (1′″→6″)-*O*-β-D-glucopyranoside, texasin-7-*O*-β-D-glucopyranoside, kaempferol-3-*O*-β-D-glucopyranoside, kaempferol, carbohydrates, glycosides, saponins, pregnane glycocides, alkaloids: pyridine, pyrrole, pyrazine and indole types	Antibacterial activity (ADM)[c] *S. aureus* (+) *S. epidermidis* (+) Anticancer activity[c] Potato disc assay (+) Antioxidant (DPPH and ABTS)[c] Anti-inflammatoryc Lipoxygenase inhibitory activity (+)	[180-184]
M. crassifolia Forssk.	Linoleic acid, 1, 23 dimethoxy tricosa-6-one, triacontane, ceryl alcohol, lupeol palmitate, lupeol acetate, β -sitosterol palmitate, α-amyrin, 6-N-methyl-9-β-D-glucoside adenine, 3,4,5,-trimethoxyphenol-1-*O*-β-D-glucopyranoside, guaiacylglycerol, ionol glucoside	Antibacterial activity (ADM)[c] *P. aeruginosa* (−) Antimalarial activity[c] *P. falciparum* (−) Antitrypanosomal activity[c] *T. brucei brucei* (−) *T. cruzi* (−) Antileishmanial activityc *L. infantum* (−)	[185-190]
M. angolensis DC.	Tannins, saponins, flavonoids, cardiac glycosides, alkaloids: l-stachydrine and l-3-hydroxystachydrine	Anxiolytic effect (+)[c] Sedative effect (+)[c] Antioxidant (DPPH) (+)[c] Antibacterial activity (ADM)[c] *S. aureus* (+) *S. pyogenes* (+) *C. ulcerans* (+) *B. subtilis* (+) *E. coli* (+) *S. typhi* (−) *K. pneumonia* (−) *P. aeruginosa* (+) *N. gonorrhoeae* (−) Antifungal activity[c] *C. albicans* (+)	[191-194]
S. persica L.	2-acetyl-3-methylindole, sodium 1-*O*-benzyl-β-d-glucopyranoside-2-sulphate (salvadoside), 5,5′-dimethoxylariciresinol 4,4′bis-*O*-β-d-glucopyranoside (salvadoraside), syringin, liriodendrin, sitosterol 3-*O*-glucopyranoside	Antimalarial activity[c] *P. falciparum* (+) Antioxidant (DPPH) (+)[c] Antitrypanosomal activity[c] *T. brucei rhodesiense* (−) *T. cruzi* (−) Antifungal activity[c] *M. violaceum* (−)	[34,45,46,155]
S. alexandrina Mill. (*C. senna* L.)	Anthranoids, madagascin (3-isopentenyloxyemodin), 3-geranyloxyemodine	Laxative effect[p/c] Cytotoxic activity (−)[p/c] Carcinogenic effect (−)[c]	[195-198]
K. Africana (Lam.) Benth.	Limonoids, alkaloids, lapachols, phenolic acids, irridoids, flavonoids, naphthoquinones, steroids	Antioxidant (DPPH) (+)[c] Anticandidal activity *C. albicans* strains (+)[p] Antiulcerogenic (+)[c]	[199-202]
C. glandulosa Forssk.	Alkaloids, terpenes, sterols, flavonoids: kaempferol-4′-phenoxy- 3,3′,5′-trimethylether, rhamnocitrin-4′- (4-hydroxy-3-methoxy) phenoxy-3-methyl ether, rhamnocitrin-3-*O*-neohesperoside-4′-*O*-rhamnoside, 4-methoxy-benzyldehyde, kaempferol-3-methylether, stachydrine	Anti-inflammatory activity (+)[p] Antioxidant (DPPH) (+)[p]	[203,204]

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Table 2: Contd...

Plant scientific name	Phytochemistry constituents	Pharmacological activity/assay	References
K. senegalensis (Desr.) A. Juss.	Saponins, tannins, aldehyde, phlobatannins, flavonoids, terpenoids, alkaloids, cardiac glycoside, anthroquinones, limonoids, khayanolides, p-anilinophenol	Anti-inflammatory activity (+)[c] Antidiarrheal effects (+)[c] Antioxidant (DPPH) (+)[p] Antibacterial activity (ADM/MIC)[c] *S. enterica* (+) *S. aureus* (+) *S. pyogenes* (+) *S. typhi* (+) *S. dysenteriae* (+) *K. pneumonia* (+) *P. aeruginosa* (+) Anticancer activity (+)[p] MCF-7, SiHa and Caco-2 Anthelmintic activity (+)[c] Antidiabitic activity (+)[c]	[205-210]
D. melanoxylon Guill. and Perr	Flavonoids, terpenes, alkaloids, steroidal saponins, tannins, phenols, quinines	Antimalarial activity[p] *P. falciparum* (−) Antibacterial activity (ADM)[c] *B. subtilis* (+) *E. coli* (+) *K. pneumonia* (−) *P. aeruginosa* (+) *Salmonella typhimurium* (−) *S. aureus* (+) *Y. pestis* (−) Antifungal activity[c] *C. albicans* (+) *A. niger* (+)	[211-213]
T. brownii Fresen.	Terminalianone, triterpenoids, ellagic acid derivatives	Antibacterial activity (ADM)[c] *S. aureus* (+) *E. coli* (+) *P. aeruginosa* (+) *K. pneumonia* (+) *S. typhi* (+) *B. anthracis* (+) Antifungal activity[c] *C. albicans* (+) *C. neoformans* (+) Brine shrimp toxicity (−)[c]	[214-216]
C. proximus (Hochst. ex A. Rich) Stapf.	Essential oils: Piperitone, elemol, eudesmol, terpineol, limonene	Anti-inflammatory activity (−)[e] Antibacterial activity (ADM)[e] *B. cereus* (+) *S. choleraesuis* (+) Antioxidant (DPPH) (+)[c] Antifungal activity[e] *C. albicans* (−) *C. utilis* (−) *S. cerevisiae* (−)	[217,218]
G. tenax (Forssk.) Fiori.	Flavonoids, flavonoid glycosides, phenolic acids; β-sitosterol, β -sitosteryl acetate, β-amyrin, β-amyrin acetate; 5 α, 8 α-epidioxyergosta-6,22-diene-3 β-ol; 5 α, 8 α-epidioxyergosta-6,9 (11),22-trien-3 β-ol, α-taraxerol, betulin, stigmasterol, oleanolic acid, stigmasterol 3-*O*-β-D-glucoside	Hepatoprotective effect (+)[c] Antibacterial activity (ADM)[c] *S. aureus* (−) *S. typhi* (−) *S. dysenteriae* (−) *V. cholerae* (−) *E. coli* (−)	[219-221]

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Table 2: Contd...

Plant scientific name	Phytochemistry constituents	Pharmacological activity/assay	References
S. birrea (A.Rich.) Hochst.	Procyanidins, tannins, alkaloids, quercetin 3-*O*-α- (5"-galloyl)-arabinofuranoside, epicatechin derivatives	Antioxidant (DPPH) (+)[c] Antioxidant activity[p] Trolox equivalent antioxidant capacity assay (+) Antidiabetic activity[c] Antibacterial activity (ADM)[c] *B. subtilis* (+) *E. coli* (+) *K. pneumonia* (+) *S. aureus* (+) *Antidiarrheals* activity (+)	[155,222-225]
H. thebaica (L.) Mart.	Minerals, proteins, fatty acids, essential oils, linoleic acid, saponins, coumarins, hydroxycinnamates, flavonoids	Antioxidant (DPPH) (+)[c] Antihypertensive effect (+)[c] Antibacterial activity (ADM)[c] *S. aureus* (+) *B. subtilis* (+) *L. monocytogenes* (−) *E. coli* (−) *P. aeruginosa* (+) *S. typhi* (+) Antifungal activity[c] *A. niger* (+) *C. albicans* (+)	[226-229]
G. bicolor Juss.	Tannines, triterpenoids: lupeol, etulin, β-sitosterol, β-sitosterol-3-*O*-glucoside; alkaloids: harman, 6-methoxyharman, 6-hydroxyharman	Anthelmintic assay[c] *C. elegans* (+) Antibacterial activity (ADM)[c] *P. aeruginosa* (+) *E. coli* (+) *S. aureus* (+) *B. subtilis* (+)	[56,84,230]
G. senegalensis J.F.Gmel.	Resins, alkaloids, tannins, saponins, glycosides, terpenes, galloylquinic acids, flavonoids: catechin, myricitrin, rutin, quercetin	Antioxidant (DPPH) (+)[c] Antitrypanosomal activity[c] *T. brucei brucei* (+) Antimalarial activity[c] *P. falciparum* (+) Acaricidal activity[c] *H. anatolicum* (+)	[126,155,231-234]
B. salicifolia Oliv.	Boscialin, boscialin 4'-*O*-glucoside, flavonoids: rhamnocitrin 3-*O*-β-neohesperidoside, rhamnetin 3-*O*-β-neohesperidoside, rhamnocitrin 3-*O*-β-glucopyranoside, rhamnetin 3-*O*-β-glucopyranoside	Antimalarial activity[c] *P. falciparum* (+) *P. berghei* (+)	[235-237]
H. sabdariffa L.	Organic acids: Hydroxycitric acid, hibiscus acid; phenolic acids: Protocatechuic acid, chlorogenic acids, anthocyanins, polysaccharides, flavonoids	Antibacterial activity[p] *S. aureus* (+) *K. pneumonia* (+) *P. aeruginosa* (+) *A. baumannii* (+) Antifungal activity[c] *C. albicans* (−) Antipyretic activity (+)[c] Anti-inflammatory activity (+)[c] Antioxidant (DPPH) (+)[c] Antidiabetic activity (+)[c] Anticancer activity (+)[c] Antihypertensive activity (+)[c] Hepatoprotective effect (+)[c]	[61,98,238-246]

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Table 2: Contd...

Plant scientific name	Phytochemistry constituents	Pharmacological activity/assay	References
T. foenum-graecum L.	Tannin, protein, lipids, glycolipids, phospholipids	Antidiabetic activity (+)[c] Wound healing activity (+)[c] Larvicidal activity (−)[c]	[247-252]
T. indica L.	Polysaccharides, phenolic acids, flavonoids, anthocyanidins, tannins	Antimalarial activity (−)[c] Brine shrimp toxicity (−)[c] Wound healing effects (+)[c] Antioxidant (DPPH) (+)[c] Anti-snake venom effects (+)[c] Immunomodulatory effects (+)[p] Antidiabetic activity (+)[c]	[86,253-258]
O. insignis Del.	Triucallane triterpenes, alk (en) yl phenols, macrolide, 6-pentadecylsalicylic acid, tannins, flavonoids, cardiac glycosides, steroids, alkaloids	Anthelmintic effect (+)[c] Cytotoxic activity (+)[c] Antifouling activity (+)[p] Antileishmanial[c] *L. donovani* (−) Antitrypanosomal[c] *T. brucei brucei* (+) Antioxidant (DPPH) (+)[c] Brine shrimp toxicity (+)[c] Antibacterial activity (MIC)[c] *E. coli* *S. typhi* *V. cholerae* *K. pneumonia*	[259-267]
C. obtusifolia L.	Polysaccharides: galactomannan, homogalacturonan; anthraquinones, benzyl-β-resorcylate glycosides, flavonoids, triterpenoids, anthrones	Antioxidant (DPPH) (+)[c] Hypolipidemic activity (+)[c] Neuroprotective effect (+)[c] α-Amylase activity (−)[c] Lipase activity (−)[c] Protease activity (+)[c] Antitumor activity (+)[p] Antihypertensive effect (+)[c] Laxative effect (+)[c] Antidiabetic activity (+)[c]	[268-275]
B. aegyptiaca (L.) Del	Balanitins, saponins, yamogenin glycosides, ascorbic acid, coumarins, alkaloids, flavonoids, flavonoid glycosides: isorhamnetin-3-*O*-robinobioside, isorhamnetin-3-*O*-rutinoside	Molluscicidal activity (+)[c] Antioxidant (DPPH) (+)[c] Anticancer activity (+)[c] Antidiabetic activity (+)[c] Larvicidal activity (+)[c] Anti-inflammatory (+)[c/p] Antinociceptive (+)[c/p]	[276-281]
O. basilicum L.	Phenolic acids: rosmarinic, chicoric, caffeic and caftaric acids; anthocyanins, polysaccharides Essential oils: methyl chavicol, eugenol, linalool, camphor and methyl cinnamate	Antioxidant[c] ORAC assay (+) and DPPH (+) Antimalarial activitye *P. falciparum* (+) Antibacterial activity (ADM and MIC)[e] *S. aureus* *E. coli* *B. subtilis* *P. multocida* Antifungal activity (ADM and MIC)[e] *A. niger* *M. mucedo* *F. solani* *B. theobromae* *Rhizopus solani*	[282-290]

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Table 2: Contd...

Plant scientific name	Phytochemistry constituents	Pharmacological activity/assay	References
A. senegalensis Pers.	Alkaloids, sapogenins, tannins, flavonoids, terpenes: germacrene D, β-caryophyllene, α-humulene	Antitrypanosomal activity[c] *T. brucei brucei* (+) Antidiabetic activity (+)[c] Antioxidant (DPPH) (+)[c] Detoxification effect (+)[c]	[70,291-296]

[p]Assays carried out for isolated compounds, [c]Assays carried out for plant crude extracts, [e]Assays carried out for plant essential oils. ADM=Agar diffusion method, BMM=Broth macrodilution method, DPPH=1,1-Diphenyl-2-picrylhydrazyl radical, MIC=Minimum inhibition concentration, HSV 1=Herpes simplex-virus typ 1, HSV 2=Herpes simplex-virus typ 2, ABTS=2,2-Azino-bis (3-ethylbenzothiazoline-6-sulfonate), ORAC=Oxygen radical absorbance capacity, HIV-1=Human immunodeficiency virus type 1, BSA=Glucose–bovine serum albumin, *A. javanica=Aerva javanica*, *A. leiocarpus=Anogeissus leiocarpus*, *A. seyal=Acacia seyal*, *A. hispidum=Acanthospermum hispidum*, *A. nilotica=Acacia nilotica*, *A. Senegal=Acacia Senegal*, *A. bracteolata=Aristolochia bracteolata*, *A. digitata=Adansonia digitata*, *B. senegalensis=Boscia senegalensis*, *C. decidua=Capparis decidua*, *A. polyacantha=Acacia polyacantha*, *A. sinkatana=Aloe sinkatana*, *A. amara=Albizia amara*, *A. indica=Azadirachta indica*, *C. occidentalis=Cassia occidentalis*, *G. villosa=Grewia villosa*, *C. quadrangularis=Cissus quadrangularis*, *C. colocynthis=Citrullus colocynthis*, *C. hartmannianum=Combretum hartmannianum*, *C. procera=Calotropis procera*, *C. zambesicus=Croton zambesicus*, *E. abyssinica=Erythrina abyssinica*, *F. cretica=Fagonia cretica*, *L. pyrotechnica=Leptadenia pyrotechnica*, *M. crassifolia=Maerua crassifolia*, *M. angolensis=Maerua angolensis*, *S. persica=Salvadora persica*, *S. alexandrina=Senna alexandrina*, *K. Africana=Kigelia Africana*, *C. glandulosa=Cadaba glandulosa*, *K. senegalensis=Khaya senegalensis*, *D. melanoxylon=Dalbergia melanoxylon*, *T. brownii=Terminalia brownii*, *C. proximus=Cymbopogon proximus*, *G. tenax=Grewia tenax*, *S. birrea=Sclerocarya birrea*, *H. thebaica=Hyphaene thebaica*, *G. bicolor=Grewia bicolor*, *G. senegalensis=Guiera senegalensis*, *B. salicifolia=Boscia salicifolia*, *H. sabdariffa=Hibiscus sabdariffa*, *T. foenum-graecum=Trigonella foenum-graecum*, *T. indica=Tamarindus indica*, *O. insignis=Ozoroa insignis*, *C. obtusifolia=Cassia obtusifolia*, *B. aegyptiaca=Balanites aegyptiaca*, *O. basilicum=Ocimum basilicum*, *A. senegalensis=Annona senegalensis*, *E. coli=Escherichia coli*, *K. pneumonia=Klebsiella pneumonia*, *P. aeruginosa=Pseudomonas aeruginosa*, *S. aureus=Staphylococcus aureus*, *S. typhi=Salmonella typhi*, *S. epidermidis=Staphylococcus epidermidis*, *P. falciparum=Plasmodium falciparum*, *B. peregrine=Biomphalaria peregrine*, *T. brucei=Trypanosoma brucei*, *L. Mexicana=Leishmania mexicana*, *C. maculatus=Callosobruchus maculatus*, *B. cereus=Bacillus cereus*, *A. flavus=Aspergillus flavus*, *S. faecalis=Streptococcus faecalis*, *P. vulgaris=Proteus vulgaris*, *S. scabiei=Sarcoptes scabiei*, *H. gallinarum=Heterakis gallinarum*, *R. tetragona=Raillietina tetragona*, *T. cruzi=Trypanosoma cruzi*, *B. pumilus=Bacillus pumilus*, *F. oxysporum=Fusarium oxysporum*, *B. megaterium=Bacillus megaterium*, *M. tuberculosis=Mycobacterium tuberculosis*, *A. tumefaciens=Agrobacterium tumefaciens*, *N. naja karachiensis=Naja naja karachiensis*, *L. infantum=Leishmania infantum*, *S. pyogenes=Streptococcus pyogenes*, *C. ulcerans=Corynebacterium ulcerans*, *N. gonorrhoeae=Neisseria gonorrhoeae*, *M. violaceum=Microbotryum violaceum*, *S. enterica=Salmonella enterica*, *S. dysenteriae=Shigella dysenteriae*, *Y. pestis=Yersinia pestis*, *C. neoformans=Cryptococcus neoformans*, *S. choleraesuis=Salmonella choleraesuis*, *C. utilis=Candida utilis*, *S. cerevisiae=Saccharomyces cerevisiae*, *P. berghei=Plasmodium berghei*, *A. baumannii=Acinetobacter baumannii*, *L. donovani=Leishmania donovani*, *P. multocida=Pasteurella multocida*, *M. mucedo=Mucor mucedo*, *F. solani=Fusarium solani*, *B. theobromae=Botryodiplodia theobromae*, *C. senna=Cassia senna*

Ocimum basilicum L. (*Lamiaceae*)

Ocimum basilicum is considered as one of the major genera of the *Lamiaceae* family. It grows in several regions all over the world. In Sudan, *O. basilicum* grows in the wild and is also cultivated in Northern and Central Sudan.[30] Traditional healers in the remote areas of Sudan use *O. basilicum* in the form of infusion against jaundice and as demulcent.[8,9] The essential oil of the plant is used in perfumery and in food industry as flavoring agent, as well as in dental and oral products.[300,301] *O. basilicum* has shown several biological properties, including antimicrobial, antimalarial, and antioxidant activities.[282,284,288] These pharmaceutical activities could be attributed to essential oil constituents, such as eugenol, linalool, camphor, methyl chavicol, and methyl cinnamate [Table 2].

Calotropis procera (Ait.) Ait. f. (*Asclepiadaceae*)

Conventionally, in Sudan, *Calotropis procera* is used in the form of infusion to treat jaundice, thorn injuries and as mouth detergent, while the paste of the plant is used against scorpion bits and rheumatic pain [Table 1]. *C. procera* has shown antibacterial, antioxidant, antifungal, and anthelmintic activities.[157,159-161] Saponins, tannins, alkaloids, flavonoids classes of compounds are likely to contribute to the reported effects.[162]

Hibiscus sabdariffa L. (*Malvaceae*)

H. sabdariffa is considered one of the medicinal plants having great interest among all Sudanese communities. It has been used in ethnomedicine as herbal drinks in cold and hot beverages and as an herbal medicine. *H. sabdariffa* natural habitat is Southern Sudan, but it is cultivated in many parts of the Sudan. The maceration and decoction of the plant are used against hypertension, colds, fever and as antispasmodic and antimicrobial agent [Table 1]. In addition, *H. sabdariffa* calyces are boiled with sugar to produce a drink known as "Karkade." Pharmacological studies have demonstrated that *H. sabdariffa* extracts showed antibacterial,[240] antioxidant,[242] antidiabetic,[244] anticancer,[60,245] antihypertensive,[246] antipyretic,[241] anti-inflammatory,[98] and hepatoprotective effects.[243] However, the plant extract did not inhibit the growth of fungus *Candida albicans*.[240] The interesting biological effects might be associated with the presence of phenolic acids, organic acids, and anthocyanins reported in different parts of the plant.[61]

Ziziphus spina-christi (L.) Desf. (*Rhamnaceae*)

Z. spina-christi is a tropical tree of Sudanese origin. The plant has very interesting historical and religious aspects. It is repeatedly mentioned in Muslim as well as Christian traditions and was recorded by pilgrims visiting the Holy Land on numerous occasions. The boiled water extracts of the leaves of *Z. spina-christi* are used by Muslims in the cleaning of a dead body before burial suggesting antibacterial properties. In addition, the plant has been used in mummification by the ancient Egyptians.[302,303] It has been suggested that the plant material referred to in the Bible as the "bramble" or "thorns" (Judges 9; 14-15), "thorns" (Matthew 27:27-29), and "crown of thorn" (John 19:5) might have been derived from *Z. spina-christi*.[304,305] The Holy Quran mentions the Lote tree (Cedar) 3 times (XXXIV: 16; LIII: 13-18; LVI: 28-32), which was frequently identified as *Z. spina-christi*. Accordingly, this species is highly respected throughout the Middle East, has been widely used as a food and as medicinal as well as an environmental protection plant since ancient times, and is still in use until now.[305-307]

Z. spina-christi is commonly used in ethnomedicine for the treatment of many illnesses such as digestive disorders, weakness, hepatic disorders, obesity, urinary problems, diabetes, skin infections, fever, diarrhea, or insomnia.[308,309] In Sudanese ethnomedicine, the leaves of *Z. spina-christi*

are used for the treatment of malaria.[23] In addition, Michel *et al*. reported an antidiabetic activity of the leaves of *Z. spina-christi* due to their saponin and polyphenol contents,[310] which was supported in pharmacological studies by Glombitza *et al*., indicating that extracts of *Z. spina-christi* leaves or its main saponin glycoside, christinin-A, improved glucose utilization in diabetic rats.[311] Furthermore, *Z. spina-christi* leaves and fruits are reported to possess antibacterial activity,[312,313] as well as antifungal activity on plant pathogens.[314] In addition, Adzu *et al*. found that root bark extracts showed significant antinociceptive activity in mice and rats.[315]

The phytochemical studies of the *Z. spina-christi* have demonstrated that peptide and cyclopeptide alkaloids such as spinanine-A, tanines, essential oil such as geranyl acetate, methyl hexadecanoate, and methyl octadecanoate, sterols such as β-sitosterol, triterpenoid sapogenins, and saponins such as betulinic acid, flavonoids such as rutin and quercetin derivatives are the main phytoconstituents of this plant.[316,317]

Mimosa pigra L. (*Fabaceae*)

Mimosa pigra (giant sensitive plant) is a woody shrub, native to the American tropics. Besides its native area, it is very invasive and damaging and affecting agriculture and conservation. In particular, it is problematic in Australia, Africa, and Southeast Asia.[318] It has been introduced to Sudan and its neighboring countries.[319] Apart from this, *M. pigra* is used in the traditional medicine in tropical Africa, Indonesia, Madagascar, and South America for heart problems, head colds, diarrhea, toothaches, eye medicine, and its antimicrobial activity.[320,321] Rakotomalala *et al*. demonstrated the beneficial effect of the leaves of the plant for pulmonary hypertension.[322]

Different phytochemistry constituents including tryptophan, myricetin 3-*O*-rhamnoside, quercetin 3-*O*-hexoside, quercetin 3-*O*-pentoside, quercetin 3-*O*-rhannoside, kaempferol 3-*O*-rhamnoside, kaempferol, apigenin, acacetin, quercetin 3-rutinoside, quercetin 3, 7-dirhamnoside, kaempferol 3,7-dirhamnoside and luteolin 7-arabinoside, quercetin 7-methyl ether, and saponin have been previously described as occurring in *M. pigra*.[322-324]

Ixora coccinea L. (*Rubiaceae*)

Ixora coccinea is a flowering plant native to India and Sri Lanka. *I. coccinea* is used in traditional Sudanese and ayurvedic medicinal systems for the treatment for diarrhea, fever, headache, skin diseases, eye trouble, wounds, sores, and ulcers.[325] Recent reports show that *I. coccinea* has antioxidant,[326] antibacterial,[327] anticancer,[328] analgesic, anti-inflammatory,[329] antidiarrheal,[330] hepatoprotective,[331] cardioprotective,[332] antimutagenic,[333] wound healing,[334] and anticancer activities.[335] *I. coccinea* is a source of peptides,[336] triterpenoids,[337] and fatty acids.[338] Recently, we have reported different phenolics in the stem and leaves of *I. coccinea* including chlorogenic acids, proanthocyanidins, flavonoids, and flavonoid glycosides,[339] in addition to the similar bioactive compounds identified previously.[340]

Ambrosia maritima L. and *Sonchus oleraceus* L. (*Asteraceae*)

Ambrosia maritima and *Sonchus oleraceus*, two multipurpose medicinal plants, are widely distributed weed in Sudan, Senegal, and neighboring countries.[341,342] These plants are extensively used to treat several diseases including virus infections across the African continent.[22,341,342] In Sudan and other countries, *A. maritima* dried herb is used for treatment of hypertension, diabetes, bronchial asthma, spasms, frequent urination, urinary tract infections, and elimination of kidney stones.[17,343,344] This plant is also applied as a molluscicidal component for controlling of the intermediate hosts of Fasciola and Schistosoma.[345] Moreover, some authors have previously reported the antiviral and antifungal activities of *A. maritima*.[22,341] On the other hand, the vegetative shoots of *S. oleraceus* have been frequently used by traditional healers to treat diabetes, diarrhea, pneumonia, and hepatitis.[342,346] Moreover, the plant has cholagogue, laxative, and emollient properties.[347] The antidiabetic, antibacterial, anti-inflammatory, and antioxidant properties of *S. oleraceus* were also reported.[342,348-351] Several bioactive phytoconstituents have been identified in *A. maritima* and *S. oleraceus* including phenols, flavonoids, proanthocyanidins, alkaloids, tannins, terpenes, and steroids.[341,349,351-356]

CONCLUSIONS

In this review, we have showed that local people in Sudan are still relying on traditional medicines to treat several diseases and microbial infections. The information collected in this article demonstrated the existing traditional uses of the most important Sudanese medicinal plants and summarized recent research into the phytochemistry and pharmacology of these plants. The extracts and isolated compounds have been found to possess various biological activities, particularly in the area of antimicrobial, antidiabetic, anticancer, anti-inflammatory, and antioxidant. Although increasing interest has encouraged more studies on the phytochemistry and pharmacology of the Sudanese medicinal plants, there are still many parts where the present knowledge could be improved, for instance, systematic toxicity and safety evaluation, the detailed quantitative data for the bioactive compounds and investigation the structure activity relationships of the isolated and purified active compounds. Moreover, most of the pharmacological studies on medicinal plants have been carried out *in vitro*. Thus, the effectiveness of plant extracts and isolated compounds needs to be further investigated for their efficacy and safety using *in vivo* assays; consequently, benefits could be fairly shared among Sudanese local peoples according to the CBD. It is concluded that traditional medicine should be considered seriously in future researches and projects designed to produce lead compounds and/or biologically active molecules from plant sources.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Maroyi A. Traditional use of medicinal plants in south-central Zimbabwe: Review and perspectives. J Ethnobiol Ethnomed 2013;9:31.
2. Elegami AA, El-Nima EI, El Tohami MS, Muddathir AK. Antimicrobial activity of some species of the family *Combretaceae*. Phytother Res 2002;16:555-61.
3. Koko WS, Galal M, Khalid HS. Fasciolicidal efficacy of *Albizia anthelmintica* and *Balanites aegyptiaca* compared with albendazole. J Ethnopharmacol 2000;71:247-52.
4. Hostettmann K, Marston A, Ndjoko K, Wolfender JL. The potential of African plants as a source of drugs. Curr Org Chem 2000;4:973-1010.
5. Basgel S, Erdemoglu SB. Determination of mineral and trace elements in some medicinal herbs and their infusions consumed in Turkey. Sci Total Environ 2006;359:82-9.
6. Tabuti JR. Herbal medicines used in the treatment of malaria in Budiope County, Uganda. J Ethnopharmacol 2008;116:33-42.
7. Ernst E. Harmless herbs? A review of the recent literature. Am J Med 1998;104:170-8.

8. El Ghazali GB, El Tohami MS, El Egami AB. Medicinal plants of the Sudan. Part III. Medicinal plants of the White Nile Province. Sudan: Khartoum University Press; 1994.
9. El Ghazali GE, El Tohami MS, El Egami AA, Abdalla WE, Galal M. Medicinal plants of the Sudan part IV. Medicinal plants of North Kordofan. Kkartoum, Sudan: National Council for Research; 1997.
10. Musa MS, Abdelrasool FE, Elsheikh EA, Ahmed LA, Mahmoud AL, Yagi SM. Ethnobotanical study of medicinal plants in the Blue Nile State, South-eastern Sudan. J Med Plants Res 2011;5:4287-97.
11. El Ghazali GE, Abdalla WE, Khalid HE, Khalafalla MM, Hamad AA. Medicinal plants of the Sudan part V. Medicinal plants of Ingassana area. Khartoum, Sudan: National Council for Research; 2003.
12. Mueller-Harvey I, Reed JD, Hartley RD. Characterization of phenolic compounds, including flavonoids and tannins, of ten Ethiopian browse species by high performance liquid chromatography. J Sci Food Agric 1987;39:1-14.
13. Mangan JL. Nutritional effects of tannins in animal feeds. Nutr Res Rev 1988;1:209-31.
14. El Ghazali GE, Bari EA, Bashir AK, Salih AM. Medicinal plants of the Sudan part II. Medicinal plants of Eastern Nuba Mountains. Khartoum, Sudan: National Council for Research; 1987.
15. El-Kamali HH, El-Khalifa KF. Treatment of malaria through herbal drugs in the Central Sudan. Fitoterapia 1997;68:527-8.
16. El-Tahir A, Satti GM, Khalid SA. Antiplasmodial activity of selected Sudanese medicinal plants with emphasis on *Acacia nilotica*. Phytother Res 1999;13:474-8.
17. Hilmi Y, Abushama MF, Abdalgadir H, Khalid A, Khalid H. A study of antioxidant activity, enzymatic inhibition and *in vitro* toxicity of selected traditional Sudanese plants with anti-diabetic potential. BMC Complement Altern Med 2014;14:149.
18. Singh R, Singh B, Singh S, Kumar N, Kumar S, Arora S. Anti-free radical activities of kaempferol isolated from *Acacia nilotica* (L.) Willd. Ex. Del. Toxicol *In Vitro* 2008;22:1965-70.
19. Singh R, Singh B, Singh S, Kumar N, Kumar S, Arora S. Umbelliferone – An antioxidant isolated from *Acacia nilotica* (L.) Willd. Ex. Del. Food Chem 2010;120:825-30.
20. Eldeen IM, Van Heerden FR, Van Staden J. *In vitro* biological activities of niloticane, a new bioactive cassane diterpene from the bark of *Acacia nilotica* subsp. kraussiana. J Ethnopharmacol 2010;128:555-60.
21. Ayoub SM. Molluscicidal properties of *Acacia nilotica*. Planta Med 1982;46:181-3.
22. Hussein G, Miyashiro H, Nakamura N, Hattori M, Kakiuchi N, Shimotohno K. Inhibitory effects of sudanese medicinal plant extracts on hepatitis C virus (HCV) protease. Phytother Res 2000;14:510-6.
23. El-Kamali HH, El-Khalifa KF. Folk medicinal plants of riverside forests of the Southern Blue Nile district, Sudan. Fitoterapia 1999;70:493-7.
24. Hussein G, Miyashiro H, Nakamura N, Hattori M, Kawahata T, Otake T, *et al*. Inhibitory effects of Sudanese plant extracts on HIV-1 replication and HIV-1 protease. Phytother Res 1999;13:31-6.
25. Elkhalifa KF, Ibrahim MA, Elghazali G. A survey of medicinal uses of Gash Delta vegetation, Eastern Sudan. Saudi J Biol Sci 2006;13:1-6.
26. Kinghorn AD, Chai HB, Sung CK, Keller WJ. The classical drug discovery approach to defining bioactive constituents of botanicals. Fitoterapia 2011;82:71-9.
27. Almagboul AZ, Bashir AK, Salih AK, Farouk A, Khalid SA. Antimicrobial activity of certain Sudanese plants used in folkloric medicine screening for antibacterial activity (V). Fitoterapia 1988;59:57-62.
28. Kim TR, Pastuszyn A, Vanderjagt DJ, Glew RS, Millson M, Glew RH. The nutritional composition of seeds from *Boscia senegalensis* (Dilo) from the Republic of Niger. J Food Composit Anal 1997;10:73-81.
29. Viljoen AM, Wyk BV, Newton LE. The occurrence and taxonomic distribution of the anthrones aloin, aloinoside and microdontin in *Aloe*. Biochem Syst Ecol 2001;29:53-67.
30. Khalid H, Abdalla WE, Abdelgadir H, Opatz T, Efferth T. Gems from traditional North-African medicine: Medicinal and aromatic plants from Sudan. Nat Prod Bioprospect 2012;2:92-103.
31. Siddiqui BS, Afshan F, Gulzar T, Hanif M. Tetracyclic triterpenoids from the leaves of *Azadirachta indica*. Phytochemistry 2004;65:2363-7.
32. Ragasa CY, Nacpil ZD, Natividad GM, Tada M, Coll JC, Rideout JA. Tetranortriterpenoids from *Azadirachta indica*. Phytochemistry 1997;46:555-8.
33. Tona L, Ngimbi NP, Tsakala M, Mesia K, Cimanga K, Apers S, *et al*. Antimalarial activity of 20 crude extracts from nine African medicinal plants used in Kinshasa, Congo. J Ethnopharmacol 1999;68:193-203.
34. Ali H, König GM, Khalid SA, Wright AD, Kaminsky R. Evaluation of selected Sudanese medicinal plants for their *in vitro* activity against hemoflagellates, selected bacteria, HIV-1-RT and tyrosine kinase inhibitory, and for cytotoxicity. J Ethnopharmacol 2002;83:219-28.
35. El-Kamali HH, Khalid SA. The most common herbal remedies in central Sudan. Fitoterapia 1996;67:301-6.
36. Tannin-Spitz T, Grossman S, Dovrat S, Gottlieb HE, Bergman M. Growth inhibitory activity of cucurbitacin glucosides isolated from *Citrullus colocynthis* on human breast cancer cells. Biochem Pharmacol 2007;73:56-67.
37. Abo KA, Ogunleye VO, Ashidi JS. Antimicrobial potential of *Spondias mombin*, *Croton zambesicus* and *Zygotritonia crocea*. Phytother Res 1999;13:494-7.
38. Ngadjui BT, Abegaz BM, Keumedjio F, Folefoc GN, Kapche GW. Diterpenoids from the stem bark of *Croton zambesicus*. Phytochemistry 2002;60:345-9.
39. Ngadjui BT, Folefoc GG, Keumedjio F, Dongo E, Sondengam BL, Connolly JD. Crotonadiol, a labdane diterpenoid from the stem bark of *Croton zambesicus*. Phytochemistry 1999;51:171-4.
40. Block S, Baccelli C, Tinant B, Van Meervelt L, Rozenberg R, Habib Jiwan JL, *et al*. Diterpenes from the leaves of *Croton zambesicus*. Phytochemistry 2004;65:1165-71.
41. Neuwinger HD. African Traditional Medicine: A Dictionary of Plant Use and Applications. Stuttgart: Medpharm Scientific Publishers; 2000. p. 1-589.
42. El Ghazali GE. Medicinal plants of the Sudan part I. Medicinal plants of Erkawit. Khartoum, Sudan: National Council for Research; 1986.
43. Darout IA, Albandar JM, Skaug N. Periodontal status of adult Sudanese habitual users of miswak chewing sticks or toothbrushes. Acta Odontol Scand 2000;58:25-30
44. Emslie RD. A dental health survey in the Republic of the Sudan. Br Dent J 1966;120:167-78.
45. Malik S, Ahmad SS, Haider SI, Muzaffar A. Salvadoricine: A new indole alkaloid from the leaves of *Salvadora persica*. Tetrahedron Lett 1987;28:163-4.
46. Kamel MS, Ohtani K, Assaf MH, Kasai R, Elshanawani MA, Yamasaki K, *et al*. Lignan glycosides from stems of *Salvadora persica*. Phytochemistry 1992;31:2469-71.
47. Hardie J, Ahmed K. The miswak as an aid in oral hygiene. FDI World 1995;4:5-8, 10.
48. Oshio H, Imai S, Fujioka S, Sugawara T, Miyamoto M, Tsukui M. Investigation of rhubarbs 3. Newpurgative constituents, sennosides E and F. Chem Pharm Bull 1974;22:823-31.
49. Oshio H, Tsukui M, Matsuoka T. Isolation of l-ephedrine from "pinelliae tuber". Chem Pharm Bull (Tokyo) 1978;26:2096-7.
50. Wu QP, Wang ZJ, Fu MH, Tang LY, He Y, Fang J, *et al*. Chemical constituents from the leaves of *Cassia angustifolia*. Zhong Yao Cai 2007;30:1250-2.
51. Abd Alla AA. Antimicrobial activity of four medicinal plants used by Sudanese traditional medicine. J Forest Products & Industries 2013;2:29-33.
52. El-Askary HI, Meselhy MR, Galal AM. Sesquiterpenes from *Cymbopogon proximus*. Molecules 2003;8:670-7.
53. Mohammed Elhassan GO, Yagi SM. Nutritional composition of *Grewia* species (*Grewia tenax* (Forsk.) Fiori, *G. flavescens* Juss and *G. villosa* Willd) fruits. Adv J Food Sci Technol 2010;2:159-62.
54. Salih MH. Investigation of certain plants used in Sudanese folk medicine. Fitoterapia 1980;51:143-8.
55. Elegami AA, Almagboul AZ, Omer ME, El Tohami MS. Sudanese plants used in folkloric medicine: Screening for antibacterial activity. Part X. Fitoterapia 2001;72:810-7.
56. Jaspers MW, Bashir AK, Zwaving JH, Malingré TM. Investigation of *Grewia bicolor* Juss. J Ethnopharmacol 1986;17:205-11.
57. Mahmoud EH, Khalid SA. 5-methyldihydroflavasperone, a dihydronaphthopyran from *Guiera senegalensis*. Phytochemistry 1997;46:793-4.
58. Fiot J, Sanon S, Azas N, Mahiou V, Jansen O, Angenot L, *et al*. Phytochemical and pharmacological study of roots and leaves of *Guiera senegalensis* J.F. Gmel (*Combretaceae*). J Ethnopharmacol 2006;106:173-8.
59. Lin HH, Chen JH, Kuo WH, Wang CJ. Chemopreventive properties of *Hibiscus sabdariffa* L. on human gastric carcinoma cells through apoptosis induction and JNK/p38 MAPK signaling activation. Chem Biol Interact 2007;165:59-75.
60. Tseng TH, Hsu JD, Lo MH, Chu CY, Chou FP, Huang CL, *et al*. Inhibitory effect of *Hibiscus* protocatechuic acid on tumor promotion in mouse skin. Cancer Lett 1998;126:199-207.
61. Da-Costa-Rocha I, Bonnlaender B, Sievers H, Pischel I, Heinrich M. *Hibiscus sabdariffa* L. – A phytochemical and pharmacological review. Food Chem 2014;165:424-43.
62. Nour AA, Magboul BI. Chemical and amino acid composition of fenugreek seeds grown in Sudan. Food Chem 1986;22:1-5.
63. Havinga RM, Hartl A, Putscher J, Prehsler S, Buchmann C, Vogl CR. *Tamarindus indica* L. (*Fabaceae*): Patterns of use in traditional African medicine. J Ethnopharmacol 2010;127:573-88.

64. Dirar HA. Kawal, meat substitute from fermented *Cassia obtusifolia* leaves. Econ Bot 1984;38:342-9.
65. Beit-Yannai E, Ben-Shabat S, Goldschmidt N, Chapagain BP, Liu RH, Wiesman Z. Antiproliferative activity of steroidal saponins from *Balanites aegyptiaca*: An *in vitro* study. Phytochem Lett 2011;4:43-7.
66. Gnoula C, Mégalizzi V, De Nève N, Sauvage S, Ribaucour F, Guissou P, *et al*. Balanitin-6 and -7: Diosgenyl saponins isolated from *Balanites aegyptiaca* Del. display significant anti-tumor activity *in vitro* and *in vivo*. Int J Oncol 2008;32:5-15.
67. Sarker SD, Bartholomew B, Nash RJ. Alkaloids from *Balanites aegyptiaca*. Fitoterapia 2000;71:328-30.
68. Igweh AC, Onabanjo AO. Chemotherapeutic effects of *Annona senegalensis* in *Trypanosoma brucei* brucei. Ann Trop Med Parasitol 1989;83:527-34.
69. Gbile ZO, Adesina SK. Nigerian flora and its pharmaceutical potential. J Ethnopharmacol 1987;19:1-16.
70. Bako S, Bakfur M, John I, Bala E. Ethiiomedicinal and phytochemical profile of some savanna plant species in Nigeria. Int J Bot 2005;1:147-50.
71. Gurib-Fakim A. Medicinal plants: Traditions of yesterday and drugs of tomorrow. Mol Aspects Med 2006;27:1-93.
72. Anilakumar KR, Pal A, Khanum F, Bawa AS. Nutritional, medicinal and industrial uses of sesame (*Sesamum indicum* L.) seeds – An overview. Agric Conspectus Sci 2010;75:159-68.
73. Neuwinger HD. African Ethnobotany: Poisons and Drugs: Chemistry, Pharmacology, Toxicology. Germany: Chapman and Hall; 1996. p. 864-5.
74. López-Lázaro M. Distribution and biological activities of the flavonoid luteolin. Mini Rev Med Chem 2009;9:31-59.
75. Shimoi K, Okada H, Furugori M, Goda T, Takase S, Suzuki M, *et al*. Intestinal absorption of luteolin and luteolin 7-O-beta-glucoside in rats and humans. FEBS Lett 1998;438:220-4.
76. Khan AW, Jan S, Parveen S, Khan RA, Saeed A, Tanveer AJ, *et al*. Phytochemical analysis and enzyme inhibition assay of *Aerva javanica* for ulcer. Chem Cent J 2012;6:76.
77. Mufti FU, Ullah H, Bangash A, Khan N, Hussain S, Ullah F, *et al*. Antimicrobial activities of *Aerva javanica* and *Paeonia emodi* plants. Pak J Pharm Sci 2012;25:565-9.
78. Saleem M, Musaddiq S, Riaz N, Zubair M, Ashraf M, Nasar R, *et al*. Ecdysteroids from the flowers of *Aerva javanica*. Steroids 2013;78:1098-102.
79. Saleh NA, Mansour RM, Markham KR. An acylated isorhamnetin glycoside from *Aerva javanica*. Phytochemistry 1990;29:1344-5.
80. Ademola IO, Eloff JN. *In vitro* anthelmintic effect of *Anogeissus leiocarpus* (DC.) Guill. & Perr. leaf extracts and fractions on developmental stages of *Haemonchus contortus*. Afr J Tradit Complement Altern Med 2011;8:134-9.
81. Salau AK, Yakubu MT, Oladiji AT. Cytotoxic activity of aqueous extracts of *Anogeissus leiocarpus* and *Terminalia avicennioides* root barks against Ehrlich ascites carcinoma cells. Indian J Pharmacol 2013;45:381-5.
82. Ndjonka D, Abladam ED, Djafsia B, Ajonina-Ekoti I, Achukwi MD, Liebau E. Anthelmintic activity of phenolic acids from the axlewood tree *Anogeissus leiocarpus* on the filarial nematode *Onchocerca ochengi* and drug-resistant strains of the free-living nematode *Caenorhabditis elegans*. J Helminthol 2014;88:481-8.
83. Soro D, Koné WM, Bonfoh B, Dro B, Toily KB, Kamanzi K. *In vivo* anthelmintic activity of *Anogeissus leiocarpus* Guill & Perr (*Combretaceae*) against nematodes in naturally infected sheep. Parasitol Res 2013;112:2681-8.
84. Waterman C, Smith RA, Pontiggia L, DerMarderosian A. Anthelmintic screening of Sub-Saharan African plants used in traditional medicine. J Ethnopharmacol 2010;127:755-9.
85. Mugedo JZ, Waterman PG. Sources of tannin: Alternatives to wattle (*Acacia mearnsii*) among indigenous Kenyan species. Econ Bot 1992;46:55-63.
86. Nguta JM, Mbaria JM. Brine shrimp toxicity and antimalarial activity of some plants traditionally used in treatment of malaria in Msambweni district of Kenya. J Ethnopharmacol 2013;148:988-92.
87. Phillips GO, Williams PA. Handbook of Hydrocolloids. 2nd ed. Cambridge: Woodhead Publishing Ltd.; 2000. p. 450.
88. Glicksman M, Sand R. Gum Arabic. New York: Industrial Gums; 1973. p. 198-263.
89. Islam AM, Phillips GO, Sljivo A, Snowden MJ, Williams PA. A review of recent developments on the regulatory, structural and functional aspects of gum arabic. Food Hydrocoll 1997;11:493-505.
90. Araujo LB, Silva SL, Galvao MA, Ferreira MR, Araujo EL, Randau KP, *et al*. Total phytosterol content in drug materials and extracts from roots of *Acanthospermum hispidum* by UV-VIS spectrophotometry. Rev Bras Farmacogn 2013;23:736-42.
91. Koukouikila-Koussounda F, Abena AA, Nzoungani A, Mombouli JV, Ouamba JM, Kun J, *et al*. *In vitro* evaluation of antiplasmodial activity of extracts of *Acanthospermum hispidum* DC (*Asteraceae*) and *Ficus thonningii* Blume (*Moraceae*), two plants used in traditional medicine in the Republic of Congo. Afr J Tradit Complement Altern Med 2012;10:270-6.
92. Ganfon H, Bero J, Tchinda AT, Gbaguidi F, Gbenou J, Moudachirou M, *et al*. Antiparasitic activities of two sesquiterpenic lactones isolated from *Acanthospermum hispidum* D.C. J Ethnopharmacol 2012;141:411-7.
93. Alva M, Popich S, Borkosky S, Cartagena E, Bardón A. Bioactivity of the essential oil of an argentine collection of *Acanthospermum hispidum* (Asteraceae). Nat Prod Commun 2012;7:245-8.
94. Bero J, Hannaert V, Chataigné G, Hérent MF, Quetin-Leclercq J. *In vitro* antitrypanosomal and antileishmanial activity of plants used in Benin in traditional medicine and bio-guided fractionation of the most active extract. J Ethnopharmacol 2011;137:998-1002.
95. Saini ML, Saini R, Roy S, Kumar A. Comparative pharmacognostical and antimicrobial studies of *Acacia* species (*Mimosaceae*). J Med Plants Res 2008;2:378-86.
96. Ali HA, Mayes RW, Hector BL, Orskov ER. Assessment of n-alkanes, long-chain fatty alcohols and long-chain fatty acids as diet composition markers: The concentrations of these compounds in rangeland species from Sudan. Anim Feed Sci Technol 2005;121:257-71.
97. Kaur K, Michael H, Arora S, Härkönen P, Kumar S. *In vitro* bioactivity-guided fractionation and characterization of polyphenolic inhibitory fractions from *Acacia nilotica* (L.) Willd. ex Del. J Ethnopharmacol 2005;99:353-60.
98. Dafallah AA, al-Mustafa Z. Investigation of the anti-inflammatory activity of *Acacia nilotica* and *Hibiscus sabdariffa*. Am J Chin Med 1996;24:263-9.
99. Shirwaikar A, Somashekar AP, Udupa AL, Udupa SL, Somashekar S. Wound healing studies of *Aristolochia bracteolata* Lam. with supportive action of antioxidant enzymes. Phytomedicine 2003;10:558-62.
100. Sakthivel G, Dey A, Nongalleima KH, Chavali M, Rimal Isaac RS, Singh NS, *et al*. *In vitro* and *in vivo* evaluation of polyherbal formulation against Russell's Viper and Cobra Venom and screening of bioactive components by docking studies. Evid Based Complement Alternat Med 2013;2013:781216.
101. Chauhan JS, Kumar S, Chaturvedi R. A new flavanonol glycoside from *Adansonia digitata* Roots. Planta Med 1984;50:113.
102. Shukla YN, Dubey S, Jain SP, Kumar S. Chemistry, biology and uses of *Adansonia digitata*: A review. J Med Aromat Plant Sci 2001;23:429-34.
103. Cisse M, Sakho M, Dornier M, Diop CM, Reynes M, Sock O. Characterization of the baobab tree fruit and study of its processing into nectar. Fruits 2009;64:19-34.
104. Shahat AA. Procyanidins from *Adansonia digitata*. Pharm Biol 2006;44:445-50.
105. Ramadan A, Harraz FM, El-Mougy SA. Anti-inflammatory, analgesic and antipyretic effects of the fruit pulp of *Adansonia digitata*. Fitoterapia 1994;65:418-22.
106. Masola SN, Mosha RD, Wambura PN. Assessment of antimicrobial activity of crude extracts of stem and root barks from *Adansonia digitata* (*Bombacaceae*) (African baobab). Afr J Biotechnol 2009;8:5076-83.
107. Selvarani V, James BH. Multiple inflammatory and antiviral activities in *Adansonia digitata* (Baobab) leaves, fruits and seeds. J Med Plants Res 2009;3:576-82.
108. Gueye MT, Seck D, Ba S, Hell K, Sembene M, Wathelet J, *et al*. Insecticidal activity of *Boscia senegalensis* (Pers.) Lam ex Poir. on *Caryedon serratus* (Ol.) pest of stored groundnuts. Afr J Agric Res 2011;6:6348-53.
109. Seck D, Lognay G, Haubruge E, Wathelet JP, Marlier M, Gaspar C, *et al*. Biological activity of the shrub *Boscia senegalensis* (PERS.) LAM. ex Poir. (*Capparaceae*) on stored grain insects. J Chem Ecol 1993;19:377-89.
110. Salih OM, Nour AM, Harper DB. Chemical and nutritional composition of 2 famine food sources used in Sudan, mukheit (*Boscia senegalensis*) and maikah (*Dobera roxburghi*). J Sci Food Agric 1991;57:367-77.
111. Zia-Ul-Haq M, Cavar S, Qayum M, Imran I, de Feo V. Compositional studies: Antioxidant and antidiabetic activities of *Capparis decidua* (Forsk.) Edgew. Int J Mol Sci 2011;12:8846-61.
112. Ali SA, Al-Amin TH, Mohamed AH, Gameel AA. Hepatoprotective activity of aqueous and methanolic extracts of *Capparis decidua* stems against carbon tetrachloride induced liver damage in rats. J Pharmacol Toxicol 2009;4:167-72.
113. Upadhyay RK, Ahmad S, Tripathi R, Rohtagi L, Jain SC. Screening of antimicrobial potential of extracts and pure compounds isolated from *Capparis decidua*. J Med Plants Res 2010;4:439-45.
114. Ali NE, Awad Elkarim AM, Fageer A, Nour AA. Physicochemical characteristics of some *Acacia* gums. Int J Agric Res 2012;7:406-13.

115. Rubanza CD, Shem MN, Otsyina R, Bakengesa SS, Ichinohe T, Fujihara T. Polyphenolics and tannins effect on *in vitro* digestibility of selected *Acacia* species leaves. Anim Feed Sci Technol 2005;119:129-42.
116. Gessler MC, Nkunya MH, Mwasumbi LB, Heinrich M, Tanner M. Screening Tanzanian medicinal plants for antimalarial activity. Acta Trop 1994;56:65-77.
117. Elhassan GO, Adhikari A, Yousuf S, Hafizur Rahman M, Khalid A, Omer H, *et al.* Phytochemistry and antiglycation activity of *Aloe sinkatana* Reynolds. Phytochem Lett 2012;5:725-8.
118. Grace OM, Dzajic A, Jager AK, Nyberg NT, Onder A, Ronsted N. Monosaccharide analysis of succulent leaf tissue in *Aloe*. Phytochemistry 2013;93:79-87.
119. Thippeswamy S, Mohana DC, Abhishek RU, Manjunath K. Efficacy of bioactive compounds isolated from *Albizia amara* and *Albizia saman* as source of antifungal and antiaflatoxigenic agents. J Verbrauch Lebensm 2013;8:297-305.
120. Praveen P, Thippeswamy S, Mohana DC, Manjunath K. Antimicrobial efficacy and phytochemical analysis of *Albizia amara* (Roxb.) Boiv. an indigenous medicinal plant against some human and plant pathogenic bacteria and fungi. J Pharm Res 2011;4:832-5.
121. Chen ZZ, Deng YX, Yin ZQ, Wei Q, Li M, Jia RY, *et al.* Studies on the acaricidal mechanism of the active components from neem (*Azadirachta indica*) oil against *Sarcoptes scabiei* var. cuniculi. Vet Parasitol 2014;204:323-9.
122. Melwita E, Ju Y. Separation of azadirachtin and other limonoids from crude neem oil via solvent precipitation. Sep Purif Technol 2010;74:219-24.
123. Tabassam SM, Iqbal Z, Jabbar A, Sindhu ZU, Chattha AI. Efficacy of crude neem seed kernel extracts against natural infestation of *Sarcoptes scabiei* var. ovis. J Ethnopharmacol 2008;115:284-7.
124. dos Santos AC, Rodrigues OG, de Araojo LV, dos Santos SB, de C Guerra RM, Feitosa ML, *et al.* Use of neem extract in the control of acariasis by *Myobia musculi* Schranck (Acari: Miobidae) and *Myocoptes musculinus* Koch (Acari: Listrophoridae) in mice (*Mus musculus* var. albina L.). Neotrop Entomol 2006;35:269-72.
125. Abdel Moneim AE. *Azadirachta indica* attenuates cisplatin-induced neurotoxicity in rats. Indian J Pharmacol 2014;46:316-21.
126. Yerbanga RS, Lucantoni L, Ouédraogo RK, Da DF, Yao FA, Yaméogo KB, *et al.* Transmission blocking activity of *Azadirachta indica* and *Guiera senegalensis* extracts on the sporogonic development of *Plasmodium falciparum* field isolates in *Anopheles coluzzii* mosquitoes. Parasit Vectors 2014;7:185.
127. Soares DG, Godin AM, Menezes RR, Nogueira RD, Brito AM, Melo IS, *et al.* Anti-inflammatory and antinociceptive activities of azadirachtin in mice. Planta Med 2014;80:630-6.
128. Kurimoto S, Takaishi Y, Ahmed FA, Kashiwada Y. Triterpenoids from the fruits of *Azadirachta indica* (*Meliaceae*). Fitoterapia 2014;92:200-5.
129. Aslam F, Rehman K, Asghar M, Sarwar M. Antibacterial activity of various phytoconstituents of Neem. Pak J Agric Sci 2009;46:209-13.
130. Biswas K, Chattopadhyay I, Banerjee RK, Bandyopadhyay U. Biological activities and medicinal properties of neem (*Azadirachta indica*). Curr Sci 2002;82:1336-45.
131. Kundu S, Roy S, Lyndem LM. Broad spectrum anthelmintic potential of *Cassia* plants. Asian Pac J Trop Biomed 2014;4:S436-41.
132. Patel NK, Pulipaka S, Dubey SP, Bhutani KK. Pro-inflammatory cytokines and nitric oxide inhibitory constituents from *Cassia occidentalis* roots. Nat Prod Commun 2014;9:661-4.
133. Ahmad I, Bashir K, Mohammad IS, Wajid M, Aziz MM. Phytochemical evaluation and bioactive properties of different parts of *Cassia occidentalis* plant extracts. Asian J Chem 2013;25:9945-8.
134. Chatterjee S, Chatterjee SN, Karmakar S. Evaluation of the role of *Cassia occidentalis* extracts as antimicrobial agents. J Pure Appl Microbiol 2012;6:1433-6.
135. Bhagat M, Saxena AK. Evaluation of *Cassia occidentalis* for *in vitro* cytotoxicity against human cancer cell lines and antibacterial activity. Indian J Pharmacol 2010;42:234-7.
136. Jafri MA, Jalis Subhani M, Javed K, Singh S. Hepatoprotective activity of leaves of *Cassia occidentalis* against paracetamol and ethyl alcohol intoxication in rats. J Ethnopharmacol 1999;66:355-61.
137. Kudav NA, Kulkarni AB. Chemical investigations on *Cassia occidentalis* Linn.: II. Isolation of islandicin, helminthosporin, xanthorin and NMR spectral studies of cassiollin and its derivatives. Indian J Chem 1974;12:1042-4.
138. Hussein Ayoub SM, Babiker AI. Screening of plants used in Sudan folk medicine for anticancer activity. Fitoterapia 1984;55:209-12.
139. Bashir AK, Ross MF, Turner TD. The alkaloids of *Grewia villosa* root. Fitoterapia 1987;58:141-2.
140. Dudai N, Raz A, Hofesh N, Rozenzweig N, Aharon R, Fischer R, *et al.* Antioxidant activity and phenol content of plant germplasm originating in the Dead Sea area. Isr J Plant Sci 2008;56:227-32.
141. Bashir AK, Turner TD, Ross MS. Phytochemical investigation of *Grewia villosa* roots 1. Fitoterapia 1982;53:67-70.
142. Bashir AK, Ross MS, Turner TD. Phytochemical investigation of *Grewia villosa* roots 2. Fitoterapia 1982;53:71-4.
143. Sapsrithong T, Kaewprem W, Tongumpai S, Nusuetrong P, Meksuriyen D. *Cissus quadrangularis* ethanol extract upregulates superoxide dismutase, glutathione peroxidase and endothelial nitric oxide synthase expression in hydrogen peroxide-injured human ECV304 cells. J Ethnopharmacol 2012;143:664-72.
144. Adesanya SA, Nia R, Martin MT, Boukamcha N, Montagnac A, Pais M. Stilbene derivatives from *Cissus quadrangularis*. J Nat Prod 1999;62:1694-5.
145. Chidambaram J, Carani Venkatraman A. *Cissus quadrangularis* stem alleviates insulin resistance, oxidative injury and fatty liver disease in rats fed high fat plus fructose diet. Food Chem Toxicol 2010;48:2021-9.
146. Kashikar ND, George I. Antibacterial activity of *Cissus quadrangularis* Linn. Indian J Pharm Sci 2006;68:245.
147. Singh G, Rawat P, Maurya R. Constituents of *Cissus quadrangularis*. Nat Prod Res 2007;21:522-8.
148. Balasubramanian P, Jayalakshmi K, Vidhya N, Prasad R, Sheriff AK, Kathiravan G, *et al.* Antiviral activity of ancient system of ayurvedic medicinal plant *Cissus quadrangularis* L. (Vitaceae). J Basic Clin Pharm 2009;1:37-40.
149. Chen JC, Chiu MH, Nie RL, Cordell GA, Qiu S ×. Cucurbitacins and cucurbitane glycosides: Structures and biological activities. Nat Prod Rep 2005;22:386-99.
150. Hussain AI, Rathore HA, Sattar MZ, Chatha SA, Ahmad F, Ahmad A, *et al.* Phenolic profile and antioxidant activity of various extracts from *Citrullus colocynthis* (L.) from the Pakistani flora. Ind Crops Prod 2013;45:416-22.
151. Dallak M. *In vivo*, hypolipidemic and antioxidant effects of *Citrullus colocynthis* pulp extract in alloxan-induced diabetic rats. Afr J Biotechnol 2011;10:9898-903.
152. Rahbar AR, Nabipour I. The hypolipidemic effect of *Citrullus colocynthis* on patients with hyperlipidemia. Pak J Biol Sci 2010;13:1202-7.
153. Najafi S, Sanadgol N, Nejad BS, Beiragi MA, Sanadgol E. Phytochemical screening and antibacterial activity of *Citrullus colocynthis* (Linn.) Schrad against *Staphylococcus aureus*. J Med Plants Res 2010;4:2321-5.
154. Marzouk B, Marzouk Z, Haloui E, Fenina N, Bouraoui A, Aouni M. Screening of analgesic and anti-inflammatory activities of *Citrullus colocynthis* from Southern Tunisia. J Ethnopharmacol 2010;128:15-9.
155. Taha E, Mariod A, Abouelhawa S, El-Geddawy M, Sorour M, Matthaeus B. Antioxidant activity of extracts from six different Sudanese plant materials. Eur J Lipid Sci Technol 2010;112:1263-9.
156. Ali HA, Ahmed OI, Khalid SA. LC/PDA/ESI-MS/MS metabolites profiling, radical scavenging and antimicrobial activities of *Combretum hartmannianum* Schweinf. Planta Med 2009;75:1078.
157. Albagouri AH, Elegami AA, Koko WS, Osman EE, Dahab MM. *In vitro* anticercarial activities of some Sudanese medicinal plants of the family Combretaceae. J For Prod Ind 2014;3:93-9.
158. Anderson DM, Bell PC. Studies on uronic acid materials: Part 50. Analytical and structural features of the gum exudate from *Combretum hartmannianum* Schweinf. Carbohydr Res 1976;49:341-9.
159. Ahmad N, Anwar F, Hameed S, Boyce MC. Antioxidant and antimicrobial attributes of different solvent extracts from leaves and flowers of akk [*Calotropis procera* (Ait.) Ait. F.)]. J Med Plants Res 2011;5:4879-87.
160. Silva MC, da Silva AB, Teixeira FM, de Sousa PC, Rondon RM, Honório Júnior JE, *et al.* Therapeutic and biological activities of *Calotropis procera* (Ait.) R. Br. Asian Pac J Trop Med 2010;3:332-6.
161. Iqbal Z, Lateef M, Jabbar A, Muhammad G, Khan MN. Anthelmintic activity of *Calotropis procera* (Ait.) Ait. F. flowers in sheep. J Ethnopharmacol 2005;102:256-61.
162. Salunke BK, Kotkar HM, Mendki PS, Upasani SM, Maheshwari VL. Efficacy of flavonoids in controlling *Callosobruchus chinensis* (L.) (*Coleoptera*: *Bruchidae*), a post-harvest pest of grain legumes. Crop Prot 2005;24:888-93.
163. Ofusori DA, Komolafe OA, Adewole OS, Obuotor EM, Fakunle JB, Ayoka AO. Effect of ethanolic leaf extract of *Croton zambesicus* (Mull. Arg.) on lipid profile in streptozotocin-induced diabetic rats. Diabetol Croat 2012;41:69-76.

164. Okokon JE, Nwafor PA, Noah K. Nephroprotective effect of *Croton zambesicus* root extract against gentimicin-induced kidney injury. Asian Pac J Trop Med 2011;4:969-72.
165. Aderogba MA, McGaw LJ, Bezabih M, Abegaz BM. Isolation and characterisation of novel antioxidant constituents of *Croton zambesicus* leaf extract. Nat Prod Res 2011;25:1224-33.
166. Okokon JE, Nwafor PA. Antiinflammatory, analgesic and antipyretic activities of ethanolic root extract of *Croton zambesicus*. Pak J Pharm Sci 2010;23:385-92.
167. Nasimolo J, Kiama SG, Gathumbi PK, Makanya AN, Kagira JM. Erythrina abyssinica prevents meningoencephalitis in chronic *Trypanosoma brucei* brucei mouse model. Metab Brain Dis 2014;29:509-19.
168. Mohammed MM. Anti-HIV-1 and cytotoxicity of the alkaloids of *Erythrina abyssinica* Lam. growing in Sudan. Nat Prod Res 2013;27:295.
169. Bunalema L, Kirimuhuzya C, Tabuti JR, Waako P, Magadula JJ, Otieno N, *et al*. The efficacy of the crude root bark extracts of *Erythrina abyssinica* on rifampicin resistant *Mycobacterium tuberculosis*. Afr Health Sci 2011;11:587-93.
170. Kebenei JS, Ndalut PK, Sabah AO. Synergism of artemisinin with abyssinone-V from *Erythrina abyssinica* (Lam. ex) against *Plasmodium falciparum* parasites: A potential anti-malarial combination therapy. J Med Plants Res 2011;5:1355-60.
171. Nguyen PH, Nguyen TN, Dao TT, Kang HW, Ndinteh DT, Mbafor JT, *et al*. AMP-activated protein kinase (AMPK) activation by benzofurans and coumestans isolated from *Erythrina abyssinica*. J Nat Prod 2010;73:598-602.
172. Zaki MA, Abd Slam RM, Hetta MH, Muhammad I. Reversed phase centrifugal preparative chromatography for the isolation of triterpenene saponins glycosides from *Fagonia cretica*. Planta Med 2012;78:1269.
173. Hussain A, Zia M, Mirza B. Cytotoxic and antitumor potential of *Fagonia cretica* L. Turk J Biol 2007;31:19-24.
174. Asif Saeed M, Wahid Sabir A. Effects of *Fagonia cretica* L. constituents on various haematological parameters in rabbits. J Ethnopharmacol 2003;85:195-200.
175. Abdel-Khalik SM, Miyase T, Melek FR, el-Ashaal HA. Further saponins from *Fagonia cretica*. Pharmazie 2001;56:247-50.
176. Saeed MA, Khan Z, Sabir AW. Effects of *Fagonia cretica* L. constituents on various endocrinological parameters in rabbits. Turk J Biol 1999;23:187-97.
177. Lam M, Wolff K, Griffiths H, Carmichael A. Correction: An aqueous extract of *Fagonia cretica* induces DNA damage, cell cycle arrest and apoptosis in breast cancer cells via FOXO3a and p53 expression. PLoS One 2014;9:e102655.
178. Razi MT, Asad MH, Khan T, Chaudhary MZ, Ansari MT, Arshad MA, *et al*. Antihaemorrhagic potentials of *Fagonia cretica* against Naja naja karachiensis (black Pakistan cobra) venom. Nat Prod Res 2011;25:1902-7.
179. Anjum MI, Ahmed E, Jabbar A, Malik A, Ashraf M, Moazzam M, *et al*. Antimicrobial constituents from *Fagonia cretica*. J Chem Soc Pak 2007;29:634-9.
180. Munazir M, Qureshi R, Arshad M, Gulfraz M. Antibacterial activity of root and fruit extracts of *Leptadenia pyrotechnica* (*Asclepiadaceae*) from Pakistan. Pak J Bot 2012;44:1209-13.
181. Moustafa AM, Khodair AI, Saleh MA. Potato disc bioassay and cytotoxic effect of *Leptadenia pyrotechnica*: Comparative study of diverse extracts. Pak J Biol Sci 2011;14:882-6.
182. Khasawneh MA, Elwy HM, Hamza AA, Fawzi NM, Hassan AH. Antioxidant, anti-lipoxygenase and cytotoxic activity of *Leptadenia pyrotechnica* (Forssk.) decne polyphenolic constituents. Molecules 2011;16:7510-21.
183. Moustafa AM, Khodair AI, Saleh MA. GC-MS investigation and toxicological evaluation of alkaloids from *Leptadenia pyrotechnica*. Pharm Biol 2009;47:994-1003.
184. Moustafa AM, Khodair AI, Saleh MA. Isolation, structural elucidation of flavonoid constituents from *Leptadenia pyrotechnica* and evaluation of their toxicity and antitumor activity. Pharm Biol 2009;47:539-52.
185. Cook JA, Vanderjagt DJ, Pastuszyn A, Mounkaila G, Glew RH. Nutrient content of two Indigenous plant foods of the Western Sahel: *Balanites aegyptiaca* and *Maerua crassifolia*. J Food Composit Anal 1998;11:221-30.
186. Al Sahli AA, Abdulkhair WM. Inhibition of beta-lactamase enzyme of *Pseudomonas aeruginosa* by clavulanic acid of *Rumex vesicarius* L. Afr J Agric Res 2011;6:2908-15.
187. Ibraheim ZZ, Ahmed AS, Ramadan MA. Lipids and triterpenes from *Maerua crassifolia* growing in Egypt. Saudi Pharm J 2008;16:69-74.
188. Abdel-Sattar E, Maes L, Salama MM. *In vitro* activities of plant extracts from Saudi Arabia against malaria, leishmaniasis, sleeping sickness and Chagas disease. Phytother Res 2010;24:1322-8.
189. Ramadan MA, Ibraheim ZZ, Abdel-Baky AM, Bishay DW, Itokawa H. Minor constituents from *Maerua crassifolia* Forssk growing in Egypt. Bull Pharm Sci Assiut Univ 1999;22:109-15.
190. Ibraheim ZZ. A new ionol glucoside from *Maerua crassifolia* Forssk grown in Egypt. Bull Pharm Sci Assiut Univ 1995;18:27-31.
191. Malami I, Hassan SW, Alhassan AM, Shinkafi TS, Umar AT, Shehu S. Report: Anxiolytic, sedative and toxicological effect of hydromethanolic stem bark extract of *Maerua angolensis* DC. in Wister rats. Pak J Pharm Sci 2014;27:1363-70.
192. Meda NT, Bangou MJ, Bakasso S, Millogo-Rasolodimby J, Nacoulma OG. Antioxidant activity of phenolic and flavonoid fractions of *Cleome gynandra* and *Maerua angolensis* of Burkina Faso. J Appl Pharm Sci 2013;3:36-42.
193. Ayo RG, Audu OT, Amupitan JO, Uwaiya E. Phytochemical screening and antimicrobial activity of three plants used in traditional medicine in Northern Nigeria. J Med Plants Res 2013;7:191-7.
194. Delaveau P, Koudogbo B, Pousset J. Alkaloids in *Capparidaceae*. Phytochemistry 1973;12:2893-5.
195. Mengs U, Mitchell J, McPherson S, Gregson R, Tigner J. A 13-week oral toxicity study of senna in the rat with an 8-week recovery period. Arch Toxicol 2004;78:269-75.
196. Hietala P, Marvola M, Parviainen T, Lainonen H. Laxative potency and acute toxicity of some anthraquinone derivatives, senna extracts and fractions of senna extracts. Pharmacol Toxicol 1987;61:153-6.
197. Lydén-Sokolowski A, Nilsson A, Sjöberg P. Two-year carcinogenicity study with sennosides in the rat: Emphasis on gastro-intestinal alterations. Pharmacology 1993;47 Suppl 1:209-15.
198. Epifano F, Fiorito S, Locatelli M, Taddeo VA, Genovese S. Screening for novel plant sources of prenyloxyanthraquinones: *Senna alexandrina* Mill. and *Aloe vera* (L.) Burm. F. Nat Prod Res 2015;29:180-4.
199. Jabeen B, Riaz N, Saleem M, Naveed MA, Ahmed M, Tahir MN, *et al*. Isolation and characterization of limonoids from *Kigelia africana*. Z Naturforsch B 2013;68:1041-8.
200. Akanni OO, Owumi SE, Adaramoye OA. *In vitro* studies to assess the antioxidative, radical scavenging and arginase inhibitory potentials of extracts from *Artocarpus altilis*, *Ficus exasperate* and *Kigelia africana*. Asian Pac J Trop Biomed 2014;4 Suppl 1:S492-9.
201. Sidjui LS, Zeuko'o EM, Toghueo RM, Note OP, Mahiou-Leddet V, Herbette G, *et al*. Secondary metabolites from *Jacaranda mimosifolia* and *Kigelia africana* (*Bignoniaceae*) and their anticandidal activity. Rec Nat Prod 2014;8:307-11.
202. Dos Santos MM, Olaleye MT, Ineu RP, Boligon AA, Athayde ML, Barbosa NB, *et al*. Antioxidant and antiulcer potential of aqueous leaf extract of *Kigelia africana* against ethanol-induced ulcer in rats. EXCLI J 2014;13:323-30.
203. Mohamed GA, Ibrahim SR, Al-Musayeib NM, Ross SA. New anti-inflammatory flavonoids from *Cadaba glandulosa* Forssk. Arch Pharm Res 2014;37:459-66.
204. Gohar AA. Flavonol glycosides from *Cadaba glandulosa*. Z Naturforsch C 2002;57:216-20.
205. Ishaq FN, Zezi AU, Olurishe TO. *Khaya senegalensis* inhibits piroxicam mediated gastro-toxicity in wistar rats. Avicenna J Phytomed 2014;4:377-84.
206. Ibrahim MA, Koorbanally NA, Islam MS. Antioxidative activity and inhibition of key enzymes linked to type-2 diabetes (alpha-glucosidase and alpha-amylase) by *Khaya senegalensis*. Acta Pharm 2014;64:311-24.
207. Abdelgaleil SA, Okamura H, Iwagawa T, Sato A, Miyahara I, Doe M, *et al*. Khayanolides, rearranged phragmalin limonoid antifeedants from *Khaya senegalensis*. Tetrahedron 2001;57:119-26.
208. Zhang H, Wang X, Chen F, Androulakis XM, Wargovich MJ. Anticancer activity of limonoid from *Khaya senegalensis*. Phytother Res 2007;21:731-4.
209. Ademola IO, Fagbemi BO, Idowu SO. Evaluation of the anthelmintic activity of *Khaya senegalensis* extract against gastrointestinal nematodes of sheep: *In vitro* and *in vivo* studies. Vet Parasitol 2004;122:151-64.
210. Sale M, De N, Doughari J, Pukuma M. *In vitro* assessment of antibacterial activity of bark extracts of *Khaya senegalensis*. Afr J Biotechnol 2008;7:3443-6.
211. Mutai P, Heydenreich M, Thoithi G, Mugumbate G, Chibale K, Yenesew A. 3-Hydroxyisoflavanones from the stem bark of *Dalbergia melanoxylon*: Isolation, antimycobacterial evaluation and molecular docking studies. Phytochem Lett 2013;6:671-5.
212. Gundidza M, Gaza N. Antimicrobial activity of *Dalbergia melanoxylon* extracts. J Ethnopharmacol 1993;40:127-30.
213. Donnelly DM, Oreilly J, Whalley WB. Neoflavanoids of *Dalbergia melanoxylon*. Phytochemistry 1975;14:2287-90.
214. Mbwambo ZH, Moshi MJ, Masimba PJ, Kapingu MC, Nondo RS. Antimicrobial activity and brine shrimp toxicity of extracts of *Terminalia brownii* roots and stem. BMC Complement Altern Med 2007;7:9.
215. Negishi H, Maoka T, Njelekela M, Yasui N, Juman S, Mtabaji J, *et al*. New chromone

derivative terminalianone from African plant *Terminalia brownii* Fresen (*Combretaceae*) in Tanzania. J Asian Nat Prod Res 2011;13:281-3.

216. Machumi F, Zhang J, Midiwo JO, Jacob MR, Khan SI, Tekwani BL, *et al.* Antiparasitic and antimicrobial constituents from *Terminalia brownii*. Planta Med 2013;79:861.
217. Al-Taweel AM, Fawzy GA, Perveen S, El Tahir KE. Gas chromatographic mass analysis and further pharmacological actions of *Cymbopogon proximus* essential oil. Drug Res (Stuttg) 2013;63:484-8.
218. Selim SA. Chemical composition, antioxidant and antimicrobial activity of the essential oil and methanol extract of the Egyptian lemongrass *Cymbopogon proximus* Stapf. Grasas Aceites 2011;62:55-61.
219. Ahmed E, Sharif A, Hussain S, Malik A, Hassan MU, Munawar MA, *et al.* Phytochemical and antimicrobial studies of *Grewia tenax*. J Chem Soc Pak 2011;33:676-81.
220. Al-Said MS, Mothana RA, Al-Sohaibani MO, Rafatullah S. Ameliorative effect of *Grewia tenax* (Forssk) Fiori fruit extract on CCl4-induced oxidative stress and hepatotoxicity in rats. J Food Sci 2011;76:T200-6.
221. Malik F, Hussain S, Mirza T, Hameed A, Ahmad S, Riaz H, *et al.* Screening for antimicrobial activity of thirty-three medicinal plants used in the traditional system of medicine in Pakistan. J Med Plants Res 2011;5:3052-60.
222. Mousinho NM, van Tonder JJ, Steenkamp V. *In vitro* antidiabetic activity of *Sclerocarya birrea* and *Ziziphus mucronata*. Nat Prod Commun 2013;8:1279-84.
223. McGaw LJ, Jager AK, van Staden J. Antibacterial, anthelmintic and anti-amoebic activity in South African medicinal plants. J Ethnopharmacol 2000;72:247-63.
224. Watt JM, Breyer-Brandwijk MG. The Medicinal and Poisonous Plants of Southern and Eastern Africa. Being an Account of their Medicinal and Other Uses, Chemical Composition, Pharmacological Effects, and Toxicology in Man and Animal. 2nd ed. Edinburgh: E. & S. Livingstone Ltd.; 1962. p. 1457.
225. Braca A, Politi M, Sanogo R, Sanou H, Morelli I, Pizza C, *et al.* Chemical composition and antioxidant activity of phenolic compounds from wild and cultivated *Sclerocarya birrea* (*Anacardiaceae*) leaves. J Agric Food Chem 2003;51:6689-95.
226. Hsu B, Coupar IM, Ng K. Antioxidant activity of hot water extract from the fruit of the Doum palm, *Hyphaene thebaica*. Food Chem 2006;98:317-28.
227. Cook JA, Vanderjagt DJ, Pastuszyn A, Mounkaila G, Glew RS, Millson M, *et al.* Nutrient and chemical composition of 13 wild plant foods of Niger. J Food Composit Anal 2000;13:83-92.
228. Sharaf A, Sorour A, Youssef M, Gomaa N. Some pharmacological studies on *Hyphaene thebaica* mart fruit. Qual Plant Mater Veg 1972;22:83.
229. Mohamed AA, Khalil AA, El-Beltagi HE. Antioxidant and antimicrobial properties of kaff maryam (*Anastatica hierochuntica*) and doum palm (*Hyphaene thebaica*). Grasas Aceites 2010;61:67-75.
230. Osuga IM, Maindi CN, Abdulrazak SA, Nishino N, Ichinohe T, Fujihara T. Potential nutritive value and tannin bioassay of selected *Acacia* species from Kenya. J Sci Food Agric 2007;87:1533-8.
231. Mound LA, Dahiya N, Yerbanga RS. Systematic relationships of *Vuilletia* and *Senegathrips* (*Thysanoptera, Phlaeothripinae*) from galls on the West African shrub *Guiera senegalensis*. Zootaxa 2014;3811:146-8.
232. Ibrahim MA, Mohammed A, Isah MB, Aliyu AB. Anti-trypanosomal activity of African medicinal plants: A review update. J Ethnopharmacol 2014;154:26-54.
233. Osman IM, Mohammed AS, Abdalla AB. Acaricidal properties of two extracts from *Guiera senegalensis* J.F. Gmel. (*Combrataceae*) against *Hyalomma anatolicum* (Acari: Ixodidae). Vet Parasitol 2014;199:201-5.
234. Ficarra R, Ficarra P, Tommasini S, Carulli M, Melardi S, Di Bella MR, *et al.* Isolation and characterization of *Guiera senegalensis* J.F.Gmel. active principles. Boll Chim Farm 1997;136:454-9.
235. Gathirwa JW, Rukunga GM, Njagi EN, Omar SA, Mwitari PG, Guantai AN, *et al.* The *in vitro* anti-plasmodial and *in vivo* anti-malarial efficacy of combinations of some medicinal plants used traditionally for treatment of malaria by the Meru community in Kenya. J Ethnopharmacol 2008;115:223-31.
236. Pauli N, Sequin U, Walter A. Boscialin and boscialin 4′-*O*-glucoside, 2 new compounds isolated from the leaves of *Boscia salicifolia* Oliv. Helv Chim Acta 1990;73:578-82.
237. Walter A, Sequin U. Flavonoids from the leaves of *Boscia salicifolia*. Phytochemistry 1990;29:2561-3.
238. Müller B, Franz G. Hibiscusbluten-eine schleimdroge? Regensburg: Deutsche Apotheker Zeitung; 1990. p. 130.
239. Liu K, Tsao S, Yin M. *In vitro* antibacterial activity of roselle calyx and protocatechuic acid. Phytother Res 2005;19:942-5.
240. Tolulope M. Cytotoxicity and antibacterial activity of methanolic extract of *Hibiscus sabdariffa*. J Med Plants Res 2007;1:9-13.
241. Reanmongkol W, Itharat A. Antipyretic activity of the extracts of *Hibiscus sabdariffa* calyces L. in experimental animals. Songklanakarin J Sci Technol 2007;29:29-38.
242. Mohd-Esa N, Hern FS, Ismail A, Yee CL. Antioxidant activity in different parts of roselle (*Hibiscus sabdariffa* L.) extracts and potential exploitation of the seeds. Food Chem 2010;122:1055-60.
243. Ali B, Mousa H, El-Mougy S. The effect of a water extract and anthocyanins of *Hibiscus sabdariffa* L. on paracetamol-induced hepatoxicity in rats. Phytother Res 2003;17:56-9.
244. Peng C, Chyau C, Chan K, Chan T, Wang C, Huang C. *Hibiscus sabdariffa* polyphenolic extract inhibits hyperglycemia, hyperlipidemia, and glycation-oxidative stress while improving insulin resistance. J Agric Food Chem 2011;59:9901-9.
245. Lin H, Chan K, Sheu J, Hsuan S, Wang C, Chen J. *Hibiscus sabdariffa* leaf induces apoptosis of human prostate cancer cells *in vitro* and *in vivo*. Food Chem 2012;132:880-91.
246. Inuwa I, Ali BH, Al-Lawati I, Beegam S, Ziada A, Blunden G. Long-term ingestion of *Hibiscus sabdariffa* calyx extract enhances myocardial capillarization in the spontaneously hypertensive rat. Exp Biol Med (Maywood) 2012;237:563-9.
247. Alarcon-Aguilara FJ, Roman-Ramos R, Perez-Gutierrez S, Aguilar-Contreras A, Contreras-Weber CC, Flores-Saenz JL. Study of the anti-hyperglycemic effect of plants used as antidiabetics. J Ethnopharmacol 1998;61:101-10.
248. Hemavathy J, Prabhakar JV. Lipid composition of fenugreek (*Trigonella foenum-graecum* L) seeds. Food Chem 1989;31:1-7.
249. Moorthy R, Prabhu KM, Murthy PS. Mechanism of antidiabetic action, efficacy and safety profile of GII purified from fenugreek (*Trigonella foenum-graecum* Linn) seeds in diabetic animals. Indian J Exp Biol 2010;48:1119-22.
250. Kocak A, Kokten K, Bagci E, Akçura M, Hayta S, Bakoglu A, *et al.* Chemical analyses of the seeds of some forage legumes from Turkey. A chemotaxonomic approach. Grasas Aceites 2011;62:383-8.
251. Sumitra M, Manikandan P, Suguna L, Cehittar G. Study of dermal wound healing activity of *Trigonella foenum-graecum* seeds in rats. J Clin Biochem Nutr 2000;28:59-67.
252. Harve G, Kamath V. Larvicidal activity of plant extracts used alone and in combination with known synthetic larvicidal agents against *Aedes aegypti*. Indian J Exp Biol 2004;42:1216-9.
253. Bin Mohamad MY, Akram HB, Bero DN, Rahman MT. Tamarind seed extract enhances epidermal wound healing. Int J Biol 2011;4:81.
254. Sandesh P, Velu V, Singh RP. Antioxidant activities of tamarind (*Tamarindus indica*) seed coat extracts using *in vitro* and *in vivo* models. J Food Sci Technol 2014;51:1965-73.
255. Ushanandini S, Nagaraju S, Harish Kumar K, Vedavathi M, Machiah DK, Kemparaju K, *et al.* The anti-snake venom properties of *Tamarindus indica* (leguminosae) seed extract. Phytother Res 2006;20:851-8.
256. Sreelekha TT, Vijayakumar T, Ankanthil R, Vijayan KK, Nair MK. Immunomodulatory effects of a polysaccharide from *Tamarindus indica*. Anticancer Drugs 1993;4:209-12.
257. Maiti R, Jana D, Das UK, Ghosh D. Antidiabetic effect of aqueous extract of seed of *Tamarindus indica* in streptozotocin-induced diabetic rats. J Ethnopharmacol 2004;92:85-91.
258. Sudjaroen Y, Haubner R, Würtele G, Hull WE, Erben G, Spiegelhalder B, *et al.* Isolation and structure elucidation of phenolic antioxidants from Tamarind (*Tamarindus indica* L.) seeds and pericarp. Food Chem Toxicol 2005;43:1673-82.
259. Ng'ang'a MM, Hussain H, Chhabra S, Langat-Thoruwa C, Krohn K. Chemical constituents from the root bark of *Ozoroa insignis*. Biochem Syst Ecol 2009;37:116-9.
260. Abreu PJ, Liu Y. Ozoroalide, a new macrolide from *Ozoroa insignis*. Fitoterapia 2007;78:388-9.
261. Liu Y, Abreu P. Tirucallane triterpenes from the roots of *Ozoroa insignis*. Phytochemistry 2006;67:1309-15.
262. Rea AI, Schmidt JM, Setzer WN, Sibanda S, Taylor C, Gwebu ET. Cytotoxic activity of *Ozoroa insignis* from Zimbabwe. Fitoterapia 2003;74:732-5.
263. Molgaard P, Nielsen SB, Rasmussen DE, Drummond RB, Makaza N, Andreassen J. Anthelmintic screening of Zimbabwean plants traditionally used against schistosomiasis. J Ethnopharmacol 2001;74:257-64.
264. He WD, Van Puyvelde L, Bosselaers J, De Kimpe N, Van der Flaas M, Roymans A, *et al.* Activity of 6-pentadecylsalicylic acid from *Ozoroa insignis* against marine crustaceans. Pharm Biol 2002;40:74-6.
265. Sawadogo WR, Le Douaron G, Maciuk A, Bories C, Loiseau PM, Figadere B, *et al. In vitro*

antileishmanial and antitrypanosomal activities of five medicinal plants from Burkina Faso. Parasitol Res 2012;110:1779-83.

266. Coulibaly AY, Hashim R, Sulaiman SF, Sulaiman O, Ang LZ, Ooi KL. Bioprospecting medicinal plants for antioxidant components. Asian Pac J Trop Med 2014;7S1:S553-9.
267. Haule EE, Moshi MJ, Nondo RS, Mwangomo DT, Mahunnah RL. A study of antimicrobial activity, acute toxicity and cytoprotective effect of a polyherbal extract in a rat ethanol-HCl gastric ulcer model. BMC Res Notes 2012;5:546.
268. Huang Y, Chow C, Tsai Y. Composition, characteristics, and *in vitro* physiological effects of the water-soluble polysaccharides from *Cassia* seed. Food Chem 2012;134:1967-72.
269. Ju MS, Kim HG, Choi JG, Ryu JH, Hur J, Kim YJ, *et al*. Cassiae semen, a seed of *Cassia obtusifolia*, has neuroprotective effects in Parkinson's disease models. Food Chem Toxicol 2010;48:2037-44.
270. Patil UK, Saraf S, Dixit VK. Hypolipidemic activity of seeds of *Cassia tora* Linn. J Ethnopharmacol 2004;90:249-52.
271. Cong Q, Shang M, Dong Q, Liao W, Xiao F, Ding K. Structure and activities of a novel heteroxylan from *Cassia obtusifolia* seeds and its sulfated derivative. Carbohydr Res 2014;393:43-50.
272. Shang M, Zhang X, Dong Q, Yao J, Liu Q, Ding K. Isolation and structural characterization of the water-extractable polysaccharides from *Cassia obtusifolia* seeds. Carbohydr Polym 2012;90:827-32.
273. Chen X, Tong L, Chu Y, Wang X, Zhang L, Ma X, *et al*. Identification and characterization of anthraquinones in *Cassia tora* L. by liquid chromatography connected with time of flight mass spectrometry and ion trap mass spectrometry. Asian J Chem 2013;25:7840-2.
274. Vadivel V, Kunyanga CN, Biesalski HK. Antioxidant potential and type II diabetes-related enzyme inhibition of *Cassia obtusifolia* L.: Effect of indigenous processing methods. Food Bioprocess Technol 2012;5:2687-96.
275. Wu X, Ruan J, Yang VC, Wu Z, Lou J, Duan H, *et al*. Three new acetylated benzyl-beta-resorcylate glycosides from *Cassia obtusifolia*. Fitoterapia 2012;83:166-9.
276. Dawidar AE, Mortada MM, Raghib HM, Abdel-Mogib M. Molluscicidal activity of *Balanites aegyptiaca* against *Monacha cartusiana*. Pharm Biol 2012;50:1326-9.
277. Amadou I, Le G, Shi Y. Effect of boiling on the cytotoxic and antioxidant properties of aqueous fruit extract of desert date, *Balanites aegyptiaca* (L) Delile. Trop J Pharm Res 2012;11:437-44.
278. Liu HW, Nakanishi K. The structures of balanitins, potent molluscicides isolated from *Balanites aegyptiaca*. Tetrahedron 1982;38:513-9.
279. Kamel MS, Ohtani K, Kurokawa T, Assaf MH, el-Shanawany MA, Ali AA, *et al*. Studies on *Balanites aegyptiaca* fruits, an antidiabetic Egyptian folk medicine. Chem Pharm Bull (Tokyo) 1991;39:1229-33.
280. Wiesman Z, Chapagain BP. Larvicidal activity of saponin containing extracts and fractions of fruit mesocarp of *Balanites aegyptiaca*. Fitoterapia 2006;77:420-4.
281. Speroni E, Cervellati R, Innocenti G, Costa S, Guerra MC, Acqua SD, *et al*. Anti-inflammatory, anti-nociceptive and antioxidant activities of *Balanites aegyptiaca* (L.) Delile. J Ethnopharmacol 2005;98:117-25.
282. Flanigan PM, Niemeyer ED. Effect of cultivar on phenolic levels, anthocyanin composition, and antioxidant properties in purple basil (*Ocimum basilicum* L.). Food Chem 2014;164:518-26.
283. Javanmardi J, Khalighi A, Kashi A, Bais HP, Vivanco JM. Chemical characterization of basil (*Ocimum basilicum* L.) found in local accessions and used in traditional medicines in Iran. J Agric Food Chem 2002;50:5878-83.
284. Zheng W, Wang SY. Antioxidant activity and phenolic compounds in selected herbs. J Agric Food Chem 2001;49:5165-70.
285. Kwee EM, Niemeyer ED. Variations in phenolic composition and antioxidant properties among 15 basil (*Ocimum basilicum* L.) cultivars. Food Chem 2011;128:1044-50.
286. Yili A, Yimamu H, Bobakulov KM, Qin HS, Qing ZH, Aisa HA. Isolation and characteriyation of a polysaccharide from *Ocimum basilicum* seeds. Chem Nat Comp 2014;50:710-1.
287. Giachino RR, Sonmez C, Tonk FA, Bayram E, Yuce S, Telci I, *et al*. RAPD and essential oil characterization of Turkish basil (*Ocimum basilicum* L.). Plant Syst Evol 2014;300:1779-91.
288. Akono Ntonga P, Baldovini N, Mouray E, Mambu L, Belong P, Grellier P. Activity of *Ocimum basilicum*, *Ocimum canum*, and *Cymbopogon citratus* essential oils against *Plasmodium falciparum* and mature-stage larvae of *Anopheles funestus* s.s. Parasite 2014;21:33.
289. Hussain AI, Anwar F, Hussain Sherazi ST, Przybylski R. Chemical composition, antioxidant and antimicrobial activities of basil (*Ocimum basilicum*) essential oils depends on seasonal variations. Food Chem 2008;108:986-95.
290. Simon JE, Quinn J, Murray RG. Basil: A source of essential oils. Advances in New Crops. Portland: OR Timber Press; 1990. p. 484-9.
291. Aderbauer B, Clausen PH, Kershaw O, Melzig MF. *In vitro* and *in vivo* trypanocidal effect of lipophilic extracts of medicinal plants from Mali and Burkina Faso. J Ethnopharmacol 2008;119:225-31.
292. Atawodi SE. Comparative *in vitro* trypanocidal activities of petroleum ether, chloroform, methanol and aqueous extracts of some Nigerian savannah plants. Afr J Biotechnol 2005;4:177-82.
293. Nébié RH, Yaméogo RT, Bélanger A, Sib FS. Chemical composition of leaf essential oil of *Annona senegalensis* Pers. from Burkina Faso. J Essent Oil Res 2005;17:331-2.
294. Okine LK, Nyarko AK, Osei-Kwabena N, Oppong IV, Barnes F, Ofosuhene M. The antidiabetic activity of the herbal preparation ADD-199 in mice: A comparative study with two oral hypoglycaemic drugs. J Ethnopharmacol 2005;97:31-8.
295. Potchoo Y, Guissou I, Lompo M, Sakie E, Yaro B. Antioxidant activity of aqueous methanol and ethyl acetate extract of leaves of *Annona senegalensis* Pers from Togo versus the one originates from Burkina Faso. Int J Pharmacol 2008;4:120-4.
296. Emmanuel A, Ebinbin A, Amlabu W. Detoxification of *Echis ocellatus* venom-induced toxicity by *Annona senegalensis* Pers. J Complement Integr Med 2014;11:93-7.
297. Murad W, Azizullah A, Adnan M, Tariq A, Khan KU, Waheed S, *et al*. Ethnobotanical assessment of plant resources of Banda Daud Shah, District Karak, Pakistan. J Ethnobiol Ethnomed 2013;9:77.
298. Sultana S. Indigenous knowledge of folk herbal medicines by the women of district Chakwal, Pakistan. Ethnobotanical Lealf 2006;2006:26.
299. Abuzeid N, Kalsum S, Koshy RJ, Larsson M, Glader M, Andersson H, *et al*. Antimycobacterial activity of selected medicinal plants traditionally used in Sudan to treat infectious diseases. J Ethnopharmacol 2014;157:134-9.
300. Bhasin M. *Ocimum taxonomy*, medicinal potentialities and economic value of essential oil. J Biosph 2012;1:48-50.
301. Suppakul P, Miltz J, Sonneveld K, Bigger SW. Antimicrobial properties of basil and its possible application in food packaging. J Agric Food Chem 2003;51:3197-207.
302. Lucas A. "Cedar"-tree products employed in mummification. J Egypt Archaeol 1931;17:13-21.
303. Baumann BI. The botanical aspects of ancient Egyptian embalming and burial. Econ Bot 1960;14:84-104.
304. Musselman LJ. Trees in the Koran and the Bible. Unasylva 2003;54:45-6.
305. Dafni A, Levy S, Lev E. The ethnobotany of Christ's Thorn Jujube (*Ziziphus spina-christi*) in Israel. J Ethnobiol Ethnomed 2005;1:8.
306. Farooqi MI. Plants of the Qur'an. Lucknow: Sidrah Publishers; 1997.
307. Saied AS, Gebauer J, Hammer K, Buerkert A. *Ziziphus spina-christi* (L.) Willd.: A multipurpose fruit tree. Genet Resour Crop Evol 2008;55:929-37.
308. Kirtikar KR, Basu B. Indian Medicinal Plants. 2nd ed. Delhi: Periodical Expert Book Agency; 1984.
309. Han BH, Park MH. Folk Medicine: The Art and the Science. Washington, DC: The American Chemical Society; 1986. p. 205.
310. Michel CG, Nesseem DI, Ismail MF. Anti-diabetic activity and stability study of the formulated leaf extract of *Zizyphus spina-christi* (L.) Willd with the influence of seasonal variation. J Ethnopharmacol 2011;133:53-62.
311. Glombitza KW, Mahran GH, Mirhom YW, Michel KG, Motawi TK. Hypoglycemic and antihyperglycemic effects of *Zizyphus spina-christi* in rats. Planta Med 1994;60:244-7.
312. Moghadam MS, Maleki S, Darabpour E, Motamedi H, Nejad SM. Antibacterial activity of eight Iranian plant extracts against methicillin and cefixime restistant *Staphylococcous aureus* strains. Asian Pac J Trop Med 2010;3:262.
313. Nazif NM. Phytoconstituents of *Zizyphus spina-christi* L. fruits and their antimicrobial activity. Food Chem 2002;76:77-81.
314. Hadizadeh I, Peivastegan B, Kolahi M. Antifungal activity of nettle (*Urtica dioica* L.), colocynth (*Citrullus colocynthis* L. Schrad), oleander (*Nerium oleander* L.) and konar (*Ziziphus spina-christi* L.) extracts on plants pathogenic fungi. Pak J Biol Sci 2009;12:58-63.
315. Adzu B, Amos S, Wambebe C, Gamaniel K. Antinociceptive activity of *Zizyphus spina-christi* root bark extract. Fitoterapia 2001;72:344-50.
316. Shahat AA, Pieters L, Apers S, Nazeif NM, Abdel-Azim NS, Berghe DV, *et al*. Chemical and biological investigations on *Zizyphus spina-christi* L. Phytother Res 2001;15:593-7.
317. Sudhersan C, Hussain J. *In vitro* clonal propagation of a multipurpose tree, *Ziziphus spina-christi* (L.) Desf. Turk J Bot 2003;27:167-71.
318. Shanungu GK. Management of the invasive *Mimosa pigra* L. in Lochinvar National Park, Zambia. Biodiversity (Ottawa) 2009;10:56-60.

319. Heard TA, Julien M, Mcfadyen R, Cullen J. Biological Control of Weeds in Australia. Melbourne: CSIRO Publishing; 2012. p. 378-97.
320. Grosvenor PW, Supriono A, Gray DO. Medicinal plants from Riau Province, Sumatra, Indonesia. Part 2: Antibacterial and antifungal activity. J Ethnopharmacol 1995;45:97-111.
321. Rosado-Vallado M, Brito-Loeza W, Mena-Rejon GJ, Quintero-Marmol E, Flores-Guido JS. Antimicrobial activity of *Fabaceae* species used in Yucatan traditional medicine. Fitoterapia 2000;71:570-3.
322. Rakotomalala G, Agard C, Tonnerre P, Tesse A, Derbre S, Michalet S, *et al*. Extract from *Mimosa pigra* attenuates chronic experimental pulmonary hypertension. J Ethnopharmacol 2013;148:106-16.
323. Yusuf UK, Abdullah N, Bakar B, Itam K, Abdullah F, Sukari MA. Flavonoid glycosides in the leaves of *Mimosa* species. Biochem Syst Ecol 2003;31:443-5.
324. Englert J, Weniger B, Lobstein A, Anton R, Krempp E, Guillaume D, *et al*. Triterpenoid saponins from *Mimosa pigra*. J Nat Prod Lloydia 1995;58:1265-9.
325. Satayavati GV, Raina MK, Sharma M. Medicinal plants of India. *Ixora coccinea* Linn. New Delhi: ICMR; 1976. p. 92-5.
326. Torey A, Sasidharan S, Latha LY, Sudhakaran S, Ramanathan S. Antioxidant activity and total phenolic content of methanol extracts of *Ixora coccinea*. Pharm Biol 2010;48:1119-23.
327. Latha PG, Abraham TK, Panikkar KR. Antimicrobial properties of *Ixora coccinea* L. (*Rubiaceae*). Anc Sci Life 1995;14:286-91.
328. Latha PG, Panikkar KR. Inhibition of chemical carcinogenesis in mice by *Ixora coccinea* flowers. Pharm Biol 2000;38:152-6.
329. Bhattacharya A, Kar DR, Sengupta A, Ghosh G, Mishra SK. Evaluation of antiinflammatory and analgesic activity of *Ixora coccinea* flower extract. Asian J Chem 2011;23:4369-72.
330. Maniyar Y, Bhixavatimath P, Agashikar NV. Antidiarrheal activity of flowers of *Ixora coccinea* Linn. in rats. J Ayurveda Integr Med 2010;1:287-91.
331. Shyamal S, Latha PG, Suja SR, Shine VJ, Anuja GI, Sini S, *et al*. Hepatoprotective effect of three herbal extracts on aflatoxin B1-intoxicated rat liver. Singapore Med J 2010;51:326-31.
332. Momin FN, Kalai BR, Shikalgar TS, Naikwade NS. Cardioprotective effect of methanolic extract of *Ixora coccinea* Linn. leaves on doxorubicin-induced cardiac toxicity in rats. Indian J Pharmacol 2012;44:178-83.
333. Wongwattanasathien O, Kangsadalampai K, Tongyonk L. Antimutagenicity of some flowers grown in Thailand. Food Chem Toxicol 2010;48:1045-51.
334. Selvaraj N, Lakshmanan B, Mazumder PM, Karuppasamy M, Jena SS, Pattnaik AK. Evaluation of wound healing and antimicrobial potentials of *Ixora coccinea* root extract. Asian Pac J Trop Med 2011;4:959-63.
335. Latha PG, Panikkar KR. Cytotoxic and antitumour principles from *Ixora coccinea* flowers. Cancer Lett 1998;130:197-202.
336. Lee CL, Liao YC, Hwang TL, Wu CC, Chang FR, Wu YC. Ixorapeptide I and ixorapeptide II, bioactive peptides isolated from *Ixora coccinea*. Bioorg Med Chem Lett 2010;20:7354-7.
337. Zachariah R, Sudhakaran Nair CR, Velayudha Panicker P. Anti-inflammatory and antimitotic activates of lupeol isolated from the leaves of *Ixora coccinea* Linn. Indian J Pharm Sci 1994;56:129-32.
338. Yadava RN. Analysis of the fixed oil from the roots of *Ixora coccinea* Linn. Asian J Chem 1989;1:307-8.
339. Jaiswal R, Karar MG, Gadir HA, Kuhnert N. Identification and characterisation of phenolics from *Ixora coccinea* L. (*Rubiaceae*) by liquid chromatography multi-stage mass spectrometry. Phytochem Anal 2014;25:567-76.
340. Idowu TO, Ogundaini AO, Salau AO, Obuotor EM, Bezabih M, Abegaz BM. Doubly linked, A-type proanthocyanidin turner and other constituents of *Ixora coccinea* leaves and their antioxidant and antibacterial properties. Phytochemistry 2010;71:2092-8.
341. Abdelgaleil SA, Badawy ME, Suganuma T, Kitahara K. Antifungal and biochemical effects of pseudoguaianolide sesquiterpenes isolated from *Ambrosia maritima* L. Afr J Microbiol Res 2011;5:3385-93.
342. Teugwa CM, Mejiato PC, Zofou D, Tchinda BT, Boyom FF. Antioxidant and antidiabetic profiles of two African medicinal plants: *Picralima nitida* (*Apocynaceae*) and *Sonchus oleraceus* (*Asteraceae*). BMC Complement Altern Med 2013;13:175.
343. AbouZid S, Orihara Y. Polyacetylenes accumulation in *Ambrosia maritima* hairy root and cell cultures after elicitation with methyl jasmonate. Plant Cell Tissue Organ Cult 2005;81:65-75.
344. Ghazanfar SA. Handbook of Arabian Medicinal Plants. Boca Raton: CRC Press; 1994.
345. Singh SK, Yadav RP, Singh A. Molluscicides from some common medicinal plants of eastern Uttar Pradesh, India. J Appl Toxicol 2010;30:1-7.
346. Yin J, Heo S, Jung MJ, Wang M. Antioxidant activity of fractions from 70% methanolic extract of *Sonchus oleraceus* L. Food Sci Biotechnol 2008;17:1299-304.
347. Guarrera PM. Food medicine and minor nourishment in the folk traditions of Central Italy (Marche, Abruzzo and Latium). Fitoterapia 2003;74:515-44.
348. McDowell A, Thompson S, Stark M, Ou Z, Gould KS. Antioxidant activity of puha (*Sonchus oleraceus* L.) as assessed by the cellular antioxidant activity (CAA) assay. Phytother Res 2011;25:1876-82.
349. Yin J, Kwon GJ, Wang MH. The antioxidant and cytotoxic activities of *Sonchus oleraceus* L. extracts. Nutr Res Pract 2007;1:189-94.
350. Conforti F, Sosa S, Marrelli M, Menichini F, Statti GA, Uzunov D, *et al*. The protective ability of Mediterranean dietary plants against the oxidative damage: The role of radical oxygen species in inflammation and the polyphenol, flavonoid and sterol contents. Food Chem 2009;112:587-94.
351. Jimoh FO, Adedapo AA, Afolayan AJ. Comparison of the nutritive value, antioxidant and antibacterial activities of *Sonchus asper* and *Sonchus oleraceus*. Rec Nat Prod 2011;5:29-42.
352. Singh S. Phytochemical investigation of *Sonchus oleraceus* leaves and *Citrullus colocynth* root. J Herb Med Toxicol 2010;4:159-62.
353. Badawy ME, Abdelgaleil SA, Suganuma T, Fuji M. Antibacterial and biochemical activity of pseudoguaianolide sesquiterpenes isolated from *Ambrosia maritima* against plant pathogenic bacteria. Plant Prot Sci 2014;50:64-9.
354. Salib JY, Michael HN. Three new flavonoids from aerial parts of *Ambrosia maritima* L. Nat Prod Commun 2007;2:1117-9.
355. Nagaya H, Nagae T, Usami A, Itokawa H, Takeya K, Omar AA. Cytotoxic chemical constituents from Egyptian medicinal plant, *Ambrosia maritima* L. Nat Med 1994;48:223-6.
356. Bernardi L, Buchi G. The structures of ambrosin and damsin. Experientia 1957;13:466-8.