

Ethnobotanical plants and their tradomedicinal values: A review

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Abstract

Since ancient times, plants with medicinal properties possessing no or little toxicological potentials have been relevant for the treatment of several diseases and healing purposes. Medicinal plants serve as important therapeutic agents and valuable resources for manufacturing numerous modern and traditional medicines. Many developing nations still rely on herbal remedies as their mainstay of health-care. This review study is aimed to report the trado-medicinal values of some ethnobotanical plants commonly used in traditional formulations as well as the scientific investigations of these plants for their acclaimed use in traditional practices. Essential phytochemicals and bioactive compounds of these plants are also reviewed.

Keywords: Ethnobotanical plants; Traditional medicine; Phytochemicals; Antioxidants; Alternative medicine

1. Introduction

Medicinal plants have been a major and essential resource in trado-medicine and modern drugs for treating and managing several human diseases and ailments [1]. Traditional medicine is the most easily accessible and affordable source of treatment in the primary health care system, most especially in rural and poor communities. In recent years, the use of traditional medicine derived from plants has received considerable interest due to the diversity and biological activities of naturally occurring secondary metabolites derived from plants, and the development of new and sensitive techniques to detect, isolate, purify and characterize plants' biologically active natural compounds [2, 3].

Several medicinal plants have been scientifically evaluated and validated for their applications in the management and treatments of several diseases and disorders like malaria, nephrolithiasis, liver problems, kidney pain, oedema, worm infestation, nausea, bronchial, jaundice and gastrointestinal disorders, rheumatism, muscle swelling, insect bites, ulcers, diabetes, and so on. Some of these important medicinal plants include *Artemisia annua*, *Ficus vallis-choudae*, *Bouea macrophylla*, *Aspalathus linearis*, *Synedrella nodiflora* and *Nauclea latifolia* etc. [3-6]; they are reviewed in this work.

Tracing of the medicinal value of plants and their bioactive substances that generate a definite physiologic action on the human body have been achieved through phytochemical screening [7, 8]. Some important bioactive compounds in plants are the glycosides, flavanol, alkaloids, flavonoids, saponins, cardenolides, tannins, proanthocyanidins and polyphenolic compounds. These compounds are valued for their antioxidants and enzymes inhibiting activities and desirable for their roles in disease prevention and therapy [3, 9, 10].

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2. Traditionally used Medicinal Plants and their Values

2.1. *Artemisia annua* L.

Artemisia annua L. is herbaceous perennial herb also known as sweet wormwood belonging to the family *Asteraceae*. It is of Asia origin and widely dispersed throughout the world temperate region. It is widely applied in folklore medicine. *A. annua* is traditionally used to treat fevers, remove intestinal worms, gush menstruation, repel intestinal gases, treat hemorrhoids and boils, etc. [11]. The plant shows promising ethnopharmacological activities such as antifungal, antipyretic, antiplasmodia, anti-inflammatory and antioxidant [11]. *A. annua* is famously known for its application in treatment of malaria. It is the primary source of artemisinin, a sesquiterpene lactone possessing antimalarial activity. For the production of artemisinin, the plant is cultivated on a large scale in countries like Vietnam, China, Turkey, Iran, Afghanistan, Madagascar and Australia. Artemisinin based Combination Therapies (ACTs) comprising artemisinin, its derivatives like artemether, arteether, etc, and few long acting drugs like lumefantrine and amodiaquine are effectively used worldwide for the treatment of malaria caused by *Plasmodium falciparum* [11-13]. Various species of *Artemisia*, including *A. annua*, are characterized with essential oils that exhibit strong bio-herbicidal and insecticidal activities [6, 14, 15, 17, 18].



Figure 1 *Artemisia annua* leaves

2.2. *Ficus vallis-choudae* Delile

Ficus vallis-choudae D. is a tropical tree of the *Moraceae* family, with white latex [19]. *Ficus vallis-choudae* is known as a riverine fig tree. It is widely distributed in Tropical African countries like Nigeria, Senegal, Cameroon, Sudan, Malawi and Ethiopia [20]. According to Oliver [21], the leaves and young leafy stems are used as local drug for nausea, bronchial, jaundice and gastrointestinal disorders. The figs are edible and mostly appreciated by children in some parts of Africa [20]. The bark extracts of *Ficus vallis-choudae* in organic media have been reported to possess anticonvulsant and antifungal activities as well as anti-inflammatory and antinociceptive effects [4, 22, 23].



Figure 2 *Ficus vallis-choudae* leaves and fruit

2.3. *Sorghum bicolor* L.

Sorghum bicolor is commonly known as *Sorghum*. It is the fifth most commonly consumed cereal crop by human after rice, wheat, corn, and barley. The majority (about 65%) of cultivated *Sorghum* is commonly used to make animal feeds and industrial products, while about 35% of it is directly consumed by humans. It is a plant that is well grown across Asia, Africa and America. It is a member of the plant family Poaceae and is well-known for its diverse phytochemical composition possessing antioxidant properties and effectiveness in cholesterol control [24]. In trado-medicine, the stem is used to treat anaemia and blood related ailments; it also possess both an anti-malarial and anthelmintic properties [25].



Figure 3 *Sorghum* (*Sorghum bicolor*)

2.4. *Theobroma cacao*

Theobroma cacao is a tree usually cultivated in some West African Countries like Ghana and Nigeria, and predominantly cultivated in Brazil for its industrial value. It belongs to the family Malvaceae and is popularly called Cocoa tree. The seed is the main source of chocolate; the ash from pod from the pod is used as source of lye for soap making. Cocoa butter extracted from the seed of cocoa is used in cosmetics and formulations for skin care products.



Figure 4 *Theobroma cacao* plant

The seed of cocoa has been evaluated for its phytochemicals and has been found to contain a high content of important bioactive compounds like phenolics, flavonoids and theobromine which are important antioxidants [26]. Chocolate was found useful for healthy function of the spleen and stimulating other digestive functions. In the 17th and 18th centuries, chocolate was recommended or mixed into medications for various kinds of diseases and ailments, to enhance digestion, reinforce mental performance, improve fertility and as an antidepressant remedy [27]. Cocoa products are also rich in methylxanthines such as caffeine and theophylline which are known possess both negative and positive health effects. For instance, caffeine intake has been reported to have negative effects on mental and reproductive health while, its supplementation enhanced net hepatic glucose uptake through increment of glucose-6- phosphate production in the liver [27]. Insufficient iron in the diets results to iron deficiency anaemia, a condition in which the red blood cells

becomes low in hemoglobin and correspondingly carry less oxygen [28]. In Nigeria, a mix of *Sorghum bicolor* sheath and *Theobroma cacao* stem bark extracts of water and/or alcohol are used to treat anaemia.

2.5. *Centaurea austro-anatolica*

Centaurea austro-anatolica is a 30-60 cm tall perennial herb with branches, tomentose and hairy leaves as well as pink flowers. The plant belongs to the family Asteraceae. It mostly grows in Antalya and Muğla Provinces in Turkey [29]. While several species of the genus *Centaurea* are widely applied in ethnomedicines for the treatment of diarrhoea, diabetes, hypertension, microbial infections, rheumatism and ulcers [30-32], there is little or no report on any medicinal uses of *C. austro-anatolica* in folklore medicines in Antalya, Muğla or Konya provinces. There is a report on GC-MS based volatile component analysis and antimicrobial activity assessment of *C. austro-anatolica* [32].



Figure 5 *Centaurea austro-anatolica* plant

2.6. *Fraxinus excelsior* L.

Fraxinus excelsior L. also known as European ash or common ash is widely distributed in Europe and usually cultivated as an ornamental plant in Canada, New Zealand and United States. It belongs to the Olive family Oleaceae. *Fraxinus excelsior* is a large tree that grows up to 40 m tall, with ascending branches, pale grey smooth bark, serrated and stalkless; flowers usually open before the leaves unfold; flattened seeds of about 2-5 cm long in bunches and ripen individually [33].



Figure 6 *Fraxinus excelsior* plant

The bark is used to treat arthritis, dysentery, gout, diarrhoea, rheumatism, sores, swelling and wounds. It is essential substitute for quinine in malaria treatment. Its leaves are highly medicinal and taken as a laxative, diuretic, and recommended for the treatment of fever, rheumatism, gout, stones, constipation, jaundice, nephrolithiasis, liver problems, kidney pain, oedema, cervical pain, worm infestation and urinary stones; and externally for wounds and leg

ulcers [34-39]. The plant sap is a useful antidote for snake bites. The investigated phytochemical studies on the leaves showed the presence of essential bioactive compounds like coumarins, iridoids, rutin, kaempferol and quercetrin- 3-O-glucoside, seco-iridoids, their respective 3-O-rhamnoglucosides, betulin, β -sitosterol, betulinic acid and ursolic acid [34, 38, 40, 41].

2.7. *Senna sulfurea* (Collad.)

Senna sulfurea (Collad.) which is known as glossy sulphur-flowered senna, glaucous cassia, kalamona, and smooth senna, is distributed in India, Sri Lanka, Australia, Polynesia, south eastern Asia, Gabon and China. It is a member of the family Caesalpiniaceae and is commonly planted as ornamental plant due to its beautiful flowers. It grows up to 3 m high. Its young shoots are hairy and later become hairless. It's an evergreen, perennial shrub or small tree, with 15-30cm leaves, 3.5-6.5 cm leaf stacks; yellow flowers and flat strap shaped pods with black shiny seeds [42]. The leaves find folksforic application in curing of blennorrhagia when mixed with milk and sugar. The bark and leaves contain antioxidants that are useful to relieve diabetes and are used to treat dysentery and gonorrhoea [42, 43]. The flowers and pods are purgative; the pods are prepared and used an antiseptic to manage skin diseases [42].



Figure 7 *Senna sulfurea* plant

2.8. *Prosopis cineraria* (L.) Druce

Prosopis cineraria (L.) Druce, also known as called as Indian mesquite and sponge tree, is widely distributed in Asian countries like India, Iran, Afghanistan, Oman, Sri Lanka, Saudi Arab, Pakistan and Yemen. It is member of the family Leguminosae and grows up to 5 m tall tree, with bipinnate leaves consisting of 7-14 leaflets on each of one to three pinnae.



Figure 8 *Prosopis cineraria* leaves

The tree is characterized by its thorny branches along the internodes; small, creamy-yellow flowers; seeds in pods. The bark is considered as an abortifacient, anthelmintic, laxative, refrigerant, tonic and vermifuge, used to treat anxiety, asthma, bronchitis, dysentery, dyspepsia, fever, leprosy, leucoderma, muscle tremors, piles, rheumatism and tremors [44]. A leaf paste is applied to cure boils, blisters, sores and mouth ulcers. Smoke from the leaves is suggested for eye troubles [45]. The plant material is used to treat snake bite and scorpion sting. The wood ash is rubbed over the skin to remove hair. [46]. A pod extract is used to relieve earache, toothache and fractured bone pain [47].

2.9. *Bouea macrophylla* Griffith

Bouea macrophylla belongs to the *Anacardiaceae* family and is related to mangoes [48, 49]. It is commonly known as the Mariam Plum or Plum Mango. It also has been shown as an evergreen and a perennial tree that grows up to 25 meters of height, highly seasonal and is widely distributed in South East Asia including Malaysia, Indonesia, Laos, Thailand, Java, Myanmar, and Sumatra [50]. The leaves and fruits are edible, popularly eaten in local communities of Sabah, Malaysia and Sarawak [51]. The plant is widely cultivated in Malaysia for shade as well as for ornamental purpose [50]. Traditionally, almost all parts (seeds, unripe and ripe fruits, and leaves) of the plant have been used for various culinary purposes [49]. Ripe fruits of *B. macrophylla* have sweet taste and have found various applications in preparing snacks, beverages and jellies. On the other hand, unripe fruits with sour taste are used as vegetable [48]. In Indonesia and Malaysia, the tender leaves of the plant are used as a raw vegetable in the preparation of salads [50]. A successful study has been undertaken to show the phytochemical constituents of *B. macrophylla* Griffith as well as its antioxidant activity [52].



Figure 9 *Bouea macrophylla* leaves and fruits

2.10. *Myrtus communis* L.

Myrtle (*Myrtus communis* L.) is a plant that belongs to the Myrtaceae family, a shrub native to the western Asia and Mediterranean countries [53]. It is commonly known as myrtle. Historically, ancient Mediterranean populations used myrtle for its aromatic and ornamental values [53]. Myrtle fruits have a long history of application as a food ingredient in place of pepper; as a spice for meat cooking and tendering; as food integrators (because of its high vitamin contents) [54]. The fruit decoction or infusion of this plant is used in folk medicine as hypoglycemic, stomachic, anti-microbial agent, and to treat cough and oral diseases [54]. It is also used to treat constipation, for appetizing, anti-hemorrhagic and externally for wound healing [54]. In recent years, the greater part of myrtle produced in the Mediterranean area are used for preparation of liqueur [56]. The nutraceutical and antioxidant properties of *M. communis* have made it found applications in cosmetic, food and pharmaceutical [57, 58]. Many studies have been reported on the essential oil composition of the plant [59-64]. The pharmacological values of this essential oil have been explored in recent years. The plant is found to possess anti-microbial properties, anti-hyperglycemic and antioxidant activities [5, 61-63, 65-68].



Figure 10 *Myrtus communis* leaves and flowers

2.11. *Premna mucronata* Roxb

Premna mucronata Roxb commonly known as, “Ganiar”, “Bari arani”, “Agnimatha”, “Agethu” and “Agyon”, is a low bushy tree (with trunk up to 1.2 m height) of great ethnobotanical value belonging to the family Verbenaceae. Furthermore, *P. mucronata* is a medicinal and aromatic plant and one of the important ingredients of “Dashamula” herbal preparation [69]. The bark finds application in curing boils while the leaves have been applied externally to treat dropsy as diuretic [70, 71]. Savasani et al. [72] reported that *P. mucronata* showed cardioprotective activity in myocardial infarction due to its antioxidants composition. It also possesses larvicidal properties Renjana and John [73]. Antimicrobial, hypocholesteremics and wound healing ability as well as anti-inflammatory activities have been demonstrated by this plant [74-76]. Recent studies showed that its essential oil has remarkable antifeedant properties [71, 74]



Figure 11 *Premna mucronata* Roxb

2.12. *Annona mucosa* Jacq

Annonaceae is a group of shrubs, aromatic trees and lianas that occur mainly in subtropical and tropical and [77]. It exhibits a pan tropical distribution with 40 genera and about 900 species in the Neotropical region [78]. Despite its diversity, *Annonaceae* constitutes one of the lesser phytochemically investigated tropical plant families [79]. It is one of the best natural products with insecticidal properties, especially due to the high level of allelochemicals that accumulate in different parts of the plant [78]. Several species of the genus *Annona* have been used in traditional medicine for pest control and the treatment of various ailments. For instance, *Annona muricata* L. leaves are widely used in the treatment of diarrhea and arthritis [80]. *Annona mucosa* (Fig. 12) is a medicinal species from the family *Annonaceae*, a fruit tree that grows well in different habitats though native in Atlantic and Amazon forests [81]. *Annona mucosa* grows to a height ranging from 1 m to 4 m, has brown hairy twigs with 1 to 3 flowers forming together in the leaf axils. The fruit (usually 15 cm in diameter) is conical or heart-shaped and is [82]. *Annona mucosa* Jacq leaves are extensively applied against

fleas and other insects [77]. *Annona reticulata* Linn whole plant is used to control of fever, treat ulcers, and diarrhoea [83]. *Annona squamosa* L. fruits, leaves and roots are used to overcome fainting and hysteria and relief for vomiting; the plant is used as an expectorant and to treat spinal disease [84]. Phytochemicals like flavonol, flavonoids and glycosides have been isolated from various parts of the plant [85]

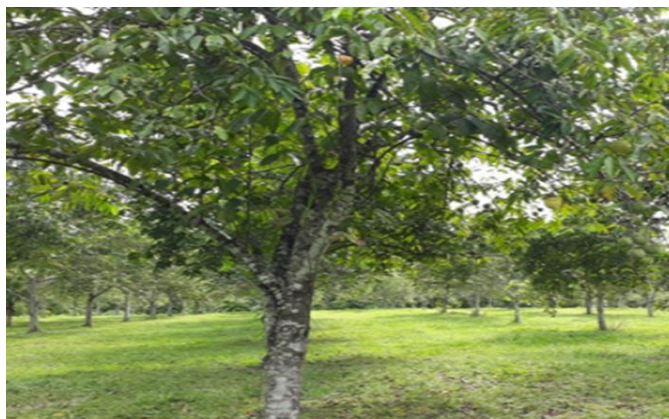


Figure 12 The photograph of *Annona mucosa* trees

2.13. *Ficus exasperate* Vahl.

Ficus Linn. genus, belongs to the family Moraceae which consists of over 800 species of and shrubs trees a shrubs and trees throughout tropical and warm temperate regions. They are well-known all over the world as “fig plants or fig trees” [86, 87, 88]. The specie *Ficus exasperate* Vahl. is an evergreen forest tree that grows up to 20 m height and widely distributed in Zambia, Mozambique, northern Angola, Ethiopia, Senegal and central African countries [89]. It is popularly known as “sand paper tree” due to its leaves’ scabrous surface. The leaves is widely used as an abrasive for polishing hard surfaces such as furniture and utensils [90-92] *Ficus exasperata* Vahl. is a useful medicinal plant of biological values for the treatment of many diseases in different parts of Africa. In Cameroonian folk medicine, the leaves are used in the treatment of malaria, hemorrhoids and diarrhea when the water extract is administered orally [93-95]. In Ivory Coast, the viscid sap is used for the treatment of sores and stomach pains [96]. Studies on the stem barks, leaves and root extracts of *F. exasperata* have shown the promising antimicrobial potentials of the plant [86, 97]. Anti-inflammatory, anti-nociceptive and antipyretic activities of the hydro-alcoholic extract of the plant’s leaves have been reported [98]; while the stem-bark hydro-alcoholic extract showed antiulcerogenic, antioxidant, hypotensive, lipid lowering and hypoglycaemic activities [91]. The plant is rich in phytochemicals namely alkaloids, flavonoids and tannins among others [90].



Figure 13 *Ficus exasperate* leaves

2.14. *Triclisia subcordata* (Oliv)

Triclisia subcordata (Oliv) is a flowering plant in the Menispermaceae family. It is predominantly found west tropical African countries including Ivory Coast, Nigeria, Senegal, Ghana, Sierra Leone and Togo [99]. The plant primarily serves as rope used for tying purposes while the importance of the species however rest with their medicinal applications. The root extract finds folksforic applications in the treatment of ulcer, snake bite, diarrhea, malaria, and pyorrhea, anemia joint pains, swelling of extremities, rheumatic pains and hypertension in Nigeria [100, 101]. The plant has also been evaluated for its enzymes inhibition activities, antiulcer, antihistamine, antimicrobial, antioxidant, anticancer, and antidiabetic activities [8, 10, 15, 102-104]



Figure 14: *Triclisia subcordata* (Oliv)

2.15. *Aspalathus linearis* (Brum.f Dahlg.)

Aspalathus linearis (Brum.f Dahlg.) which is globally known as rooibos is a plant belonging to the family Leguminosae that grows naturally in the Cederberg Mountains in the western parts of the Western Cape Province, South Africa. The rooibos plant has gained transition from being a wild resource to become a plant of great economic and biological importance [105]. Rooibos is cultivated and usually processed to tea. After harvesting, the plant material may be subjected to a fermentation process which involves bruising and oxidizing it in open air. The processed tea is usually referred to as fermented rooibos, while the unprocessed tea is referred to as unfermented or “green” rooibos Joubert and De Villiers [106] with total production including unfermented rooibos was in excess of 14,000 tons [107]. Rooibos tea is believed to possess antispasmodic properties, as well as ability to relieve digestive troubles among others [108, 109]. Rooibos have a unique flavonoid composition, containing rare compounds as previously described. Both the fermented and unfermented rooibos possess good antioxidant activities and *tyrosinase* inhibitory activity as an indication of having diverse health promoting properties, especially to solving problems associated with oxidative stress [3]. The plant contains essential bioactive phytochemicals like flavonoids flavonol, phenolics, tannins and flavanols [3, 110, 111]



Figure 15 *Aspalathus linearis* plant

2.16. *Nauclea latifolia* smith

Nauclea latifolia smith is a plant that belongs to the family Rubiaceae; it is an evergreen plant commonly called African peach. It is a multi-stemmed small tree or shrub native to tropical Africa and Asia [112]. *Nauclea latifolia* is a valuable ethnomedicinal plant that is widely spread in the humid tropical rainforest zone or in savannah woodlands of Central and West Africa. *N. latifolia* is commonly known as African peach and is used in traditional medicine in the Western and Eastern sub-region parts of Africa [100, 113]. Various extracts of the plant parts are used for the therapeutic management of hypertension [114]; malaria [115]; prolonged menstrual flow [116]; gonorrhoea, cough, stomach aches, ulcers, dysentery and liver ailments [113, 117]. In West African countries, the plant is commonly used to treat diarrhea, jaundice, dental caries, septic mouth, hypertension, gastrointestinal disorders and diabetes [116, 118, 119]. In addition, it is used to treat sleeping sickness and prolonged menstrual flow in Nigeria [116]. *N. latifolia* is known as 'Africa cinchona' or 'Africa quinine' because of its anti-malarial activity [120]. Cold infusion of the leaves and the stem bark are used as anti-helminthic to regularly deworm animals and as diuretic in Northern Nigeria [121, 122]. The root is a major ingredient in Nigerian tradomedicine for treating respiratory problems such as asthma, bronchitis, cough and cold [123]. The most frequently used plant parts are the roots, followed by the stem, bark, and leaves.



Figure 16 *Nauclea latifolia* plant

2.17. *Vicia faba* L.

Vicia faba L. (broad bean) is a leguminous plant that belongs to the plant family Fabaceae. The plant is rich in polyphenols, with its beans a popular food in many countries. It is an essential winter crop in Mediterranean areas and is mostly a spring crop in other regions of South America and Europe; it is one of the major plant food items among the Nile River populations [124]. Fava beans are nutritious and very high in protein content as in other beans and lentils. The beans are rich in antioxidants, minerals, vitamins, and plant-sterols. Phytochemicals such as genistein and daidzein present in fava beans have been found to protect breast cancer in laboratory animals; β -sitosterol (a phytosterol) helps lower cholesterol levels in the body [125]. However, only the seeds are used in human nutrition, while the whole plant is used animals feed. The plant is used in folk medicine as antihyperlipidemic to control cholesterol [126]. *V. faba* L. seed is found to contain a high number of bioactive compounds such as glycosides (α -galactosides, vicine and convicine), proteins (protease inhibitors, α -amylases, lectins), saponins, tannins and alkaloids [127]. In a research by Boukhanouf et al. [128], immature faba bean fractions showed significantly higher phytochemical contents and displayed a better antioxidant activity than those of mature ones.



Figure 17 *Vicia faba* plant

2.18. *Pterocarpus soyauxii* Taub

Pterocarpus soyauxii Taub (Fabaceae) which is commonly known as African Coral-wood is a popular green vegetable often utilized in the South Eastern part of Nigeria due to its high vitamin C content and unique taste [129, 130]. Crude extract of the leaf could potentially increase white and red blood cells as well as haemoglobin [131]. The plant has found wide tradomedicinal applications in treatment various diseases such as renal infections, hypertension, chronic anaemia, fungal infections and skin diseases [132-134]. Phytochemical investigations of *Pterocarpus soyauxii* Taub revealed the presence of flavonoids, bioflavonoids, ascorbic acid and pterostilbene [135-138].



Figure 18 Fresh leaves of *Pterocarpus soyauxii* plant

2.19. *Withania coagulans* (Stocks) Dunal,

Withania coagulans (Stocks) Dunal, is a native plant to Afghanistan, Iran and Indian. Within the *Withania* genus, *W. coagulans* (Ashutosh booti) and *W. somnifera* (Ashwagandha) are economically significant for their medicinal values and distributed in several regions ranging from east of the Mediterranean region to South Asia. *W. coagulans* is common in many parts of India Afghanistan, Pakistan and Nepal [139]. *W. coagulans* is a rigid grey-to mentose undershrub, 30-120 cm tall; leaves are lanceolate oblong and sometimes ovate, obtuse and thick. flowers are 7-12 mm in diameter and yellow, (Fig. 1). The plant is propagated by seed; its flowering period is from January to April, while its berries ripen in May [139]. *W. coagulans* is used as a blood purifier, an anti-cancer drug, to treat diabetes, cure debility, impotence, insomnia and nervous exhaustion; it is externally applied as a therapy to relieve inflammatory conditions, scabies and ulcers [139]. The plant is used to make oil ointment capable of curing several skin diseases when mixed with

Ashwagandh powder [139]. It works as an antidote to scorpion sting (Gupta and Singh, 2018). Different parts of plant are applied to treat rheumatism, ulcers, senile debility and dropsy. The fruits are blood purifier, diuretic, emetic, alterative, hepatoprotective, hypolipidemic, hypoglycemic, milk coagulant, sedative, sweet, stomachic and biliousness, used to treat diabetes, asthma, dyspepsia, skin rashes, intestinal infections, stomachache, strangury and wounds. The fruits extracts alongside *W. somnifera* are used to prepare a composite Ayurvedic medicine 'Liv 52' which is a hepatoprotective herbal formulation [140, 42]. The twigs are chewed for cleaning of teeth and to relief toothache [141]. The flowers water extract is taken to control diabetes [142]. The bitter leaves are alterative and febrifuge. The seeds are diuretic anti-inflammatory and emetic [143, 144]. Studies on antimicrobial, antitumor, antiinflammatory, Antimutagenic, antihyperglycemic, hepatoprotective, cardiovascular, free radical scavenging, immunosuppressive and central nervous system depressant activities of the plant parts have been reported [145-147]. The plant extracts showed the presence of saponins, alkaloids, phenolic compounds, steroids, tannins, proteins, an essential oil, milk-coagulating enzyme, carbohydrates, fatty oil, organic acids and amino acids [140, 148]



Figure 19 *Withania coagulans* plant

2.20. *Zingiber officinale*

The *Zingiber* species are noted for the various biological activities they exhibited. Some *Zingiber* species found growing in Ninh Binh Province was shown to have possessed essential oil [149, 150]. *Zingiber zerumbet* rhizome oil displayed larvicidal activity against *Aedes aegypti*, *Aedes albopictus* and *Culex quinquefasciatus* [151]. . In addition, both *Z. collinsii* and *Z. zerumbet* extracts and essential oils possess larvicidal and antimicrobial properties [152, 153]. *Zingiber officinale* is an evergreen rhizomatous herb forming small clumps (ginger root) that is widely used as spices and in folk medicine. It is commonly known as ginger and belongs to the family Zingiberaceae. The creeping aromatic rhizome (ginger) grows up to 1.5 cm in diameter, internally cream white or yellow and externally light brown. The plant is an herbaceous perennial that has glossy translucent green leaves that are glabrous and false stems made of rolled bases of leaves. It is mostly cultivated in India, China, Nepal, Indonesia, Thailand and Nigeria. Flowering period ranges between July and September. The plant has a numerous phytochemicals responsible for its medicinal properties. The plant is traditionally used to treat arthritis, inflammation, diabetes, bacteria and fungi infections [151].



Figure 20 (a) *Zingiber officinale* plant and

(b) *Zingiber officinale* rhizome (ginger root)

2.21. *Phyllanthus niruri* Linn

Phyllanthus niruri Linn belongs to the family Euphorbiaceae and is an annual herb that is widely spread throughout the subtropical and tropical countries of the world including India and Sri Lanka. It is an important ethnobotanical plant of the Ayurveda system of medicine mentioned in all the relevant ancient Ayurvedic texts [154]. It is commonly found growing as weed in both cultivated and wasteland areas particularly in the rainy season. *P. niruri* Linn is commonly known as, 'Chancapiedra' (stone breaker), 'Gale of the wind' and 'Seed under a leaf' according to its pharmacological activities and morphology [155]. It is stated that the plant's extract is one of the most widely used remedies in Ayurveda system of medicine especially for anaemia, bronchitis, skin diseases, cough, kidney, liver, asthma and urinary tract disorders [156]. *P. niruri* Linn has a growing value as researches have uncovered more of its medicinal properties in recent years [154]. The plant demonstrates antimicrobial, anti-inflammatory and anti-diabetic activities, antiviral activity against hepatitis B virus, litholysis action of kidney and gall bladder stones, hepatoprotective activities, lipid lowering and immunomodulatory activities [157-162].



Figure 21 *Phyllanthus niruri* leaves

2.22. *Synedrella nodiflora*

Synedrella nodiflora is from the kingdom Plantae, infrakingdom of Streptophyta, subkingdom of Viridiplantae, division of Tracheophyta, subdivision of Spermatophytina, superdivision of Embryophyta, class of Magnoliopsida, order of Asterales, superorder of Asteranae, family of *Asteraceae*, genus of *Synedrella* Gaertn., and species of *Synedrella nodiflora* (L.) Gaertn [163]. *S. nodiflora* is a branched ephemeral herb that can grow up to 80 cm in height. It has a shallow root system that is usually strongly branched. The leaves exist in opposite pairs and are usually 4-9 cm long while the lower part of the stem may root at the nodes, especially in moist conditions.



Figure 22 *Synedrella nodiflora* plant

The presence of various phytochemicals in the leaf extracts of *Synedrella nodiflora* was reported after screening in studies by Amoateng et al. [164]; Amoateng et al. [165]; Popoola et al. [166]. Solvent extracts of *S. nodiflora* have been

shown to contain glycosides, flavonoids, alkaloids, saponins steroids, tannins, phytosterols, triterpenoids gums and reducing sugars [167-170]. The plant is useful for the treatment of various diseases while its leaves are eaten as a vegetable by some livestock and human [166]. A study shows it possess sex hormone activity [171]. The leaves can be used as Pregnant Mare Serum Gonadotrophin supplier in animal husbandry and to improve reproductive parameters in female animals [172]. A study by Popoola et al. [166] showed enzymes (*tyrosinase* and *elastase*) inhibiting activities of the plant and its antioxidant properties to support and validate its acclaimed ethnopharmacological applications.

2.23. *Melanthera scanden* and *Aspilia africana* (Compositae)

Melanthera scanden and *Aspilia africana* (Compositae) are medicinal plants considered to be of great biological importance. *Aspilia africana* (Compositae) is a semi-woody herb that grows up to 2 meters high and widely distributed across tropical Africa [173]. *Melanthera scanden* is a scrambling herb of waste thickets, commonly dispersed in the forested areas and extending widely across tropical Africa. *Melanthera scanden* has similar medicinal uses with *Aspilia africana*. They are known to provide forage for all stock in thicket edges around villages. With haemostatic preparations they are used on cuts and fresh wounds [174, 175]. They are used to draw up exudations from open fresh sores and promote healing as well as curbing inflammation [176, 177]. Antimicrobial, antioxidant, anti-inflammatory, Antidiabetic, hypolipidemic and antiplasmodial activities of the plants have been reported in some studies [175, 178-180]. Both plants contain essential phytochemicals; possess mild antityrosinase and antioxidant capacities that provide clues to further understand their applications in folk medicine.



Figure 23 (a) *Melanthera scanden*



(b) *Aspilia africana* (Compositae)

3. Conclusion

The plants: *Artemisia annua*, *Fraxinus excelsior*, *Sorghum bicolor*, *Ficus vallis-choudae*, *Zingiber officinale*, *Bouea macrophylla*, *Aspalathus linearis*, *Synedrella nodiflora*, *Phyllanthus niruri*, *Ficus vallis-choudae*, *Triclisia subcordata*, *Senna sulfurea*, *Withania coagulans*, *Melanthera scanden*, *Aspilia africana*, *Nauclea latifolia*, *Theobroma cacao*, *Centaurea austro-anatolica*, *Prosopis cineraria*, *Myrtus communis* and *Premna mucronata* Roxb, are widely applied in traditional medicine. Extracts of these plants show a variety of biological therapeutic effects. The plants are cheap and effective source of alternative medicine to conventional synthetic drugs in treatments of diseases and disorders like ulcer, diarrhea, malaria, pyorrhea, anemia, joint pains, swelling of extremities, rheumatic pains, hypertension, skin diseases, cough, kidney, liver, asthma and urinary tract disorders as well as oxidative stress related diseases most especially in developing countries. The plants are rich sources of natural antioxidants. They invariably show antitumor, antinociceptive and antipyretic, antiinflammatory, Antimutagenic, antihyperglycemic, hepatoprotective, antimicrobials, antiplasmodial and larvicidal properties. The dosages and toxicological impacts of the plants on system functioning are not reported in this review and may become a subject of discussion in future reviews.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there are no conflicts of interests.

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