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Review Article

Indian Medicinal Plants with Multiple Pharmacological Efficacies: A Comprehensive Review

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Abstract

Medicinal herbs have long been utilized by numerous countries, ethnic groups, and cultures across the globe to treat various diseases since ancient times. A variety of phytochemicals, including alkaloids, tannins, carotenoids, proteins, chlorophyll, phytosterols, glycosides, phenols, flavonoids, and diterpenes, as well as minerals, vitamins and other crucial nutrients are abundantly found in medicinal plants. Medicinal plants and herbs are very useful for developing new drugs due to their potent pharmacological properties. Traditional Indian system of medicines consists of a wealth of information on medicinal plants, which contributed to developing therapies for communicable and non-communicable diseases. The present review summarizes the pharmacological characteristics such as antimicrobial, antioxidant, antiinflammatory, antidiabetic, anticancer, antiulcer, hepatoprotective and cardioprotective effects of some valuable medicinal plants and herbs.

Keywords: Indian medicinal plants; Bioactive constituents; Pharmacological efficacies.

Introduction

Traditional medicinal plants are used to cure a variety of acute and chronic diseases without having a significant negative impact on human health. Medicinal plants are a gift from nature to humans that helps them live healthy and disease-free lives. The use of plant-based health products has dramatically expanded recently in both developed and developing nations, which has caused an exponential rise in the demand for herbal products globally. The remarkable natural resources of medicinal plants include a wide range of phytochemicals, including tannins, carotenoids, flavonoids, polyphenols, alkaloids, glycosides, terpenoids, steroids, minerals, and vitamins as well as other essential nutrients. These phytochemicals have potent antioxidant, antimicrobial, anticancer, antiinflammatory, antidiabetic, antiulcer, anti-hypertensive, antipyretic and other biological activities.[1] The WHO estimates that traditional medicine is used by around 80% of the world's population. Around the globe, more than 80,000 plants are used as medicines and the majority of them have been used historically for many years. Traditional medicinal plants are now receiving substantial attention from modern medical research or the healthcare treatment system.[2]

The Indian Traditional System of Medicine is among the oldest medical systems in the world and it has been fundamental in providing medical treatment to human civilization from its origin. India is the only country with independently recognized traditional medicine systems, including Ayurveda, Yoga, Unani, Siddha, and homoeopathy (AYUSH). All of these systems use an integrated approach to therapy and their pharmacological modalities are based on natural substances derived from plants or animals. [3] In rural India, almost 80% of the population mainly depends on conventional medications. Around 45,000 medicinal plants are found in India, mainly in the Andaman and Nicobar Islands, the Western Ghats, and the Eastern Himalayas. Around 3000 plants have been officially documented as having medicinal value, but traditional practitioners use more than 6000.[4] These plants have been shown to have diverse pharmacological and biological activities.

The main goal of this review is to collect information about the therapeutic and pharmacological activities of forty Indian medicinal plants. The data presented in this review may be used as a guide to formulate new and effective medicinal drugs.

Materials and Methods

For this review work, informations have been collected from the various sources of publication vehicle, including Elsevier, SciFinder, Pubmed, Springer, Science Direct, Scirus, Google Scholar, Scopus, Web of Science and peer-reviewed journals.

Major Indian medicinal plants

Calotropis procera L.

Calotropis procera Linn is an Apocynaceae family mentioned in Ayurveda. It occurs commonly in India, Indonesia, Malaysia, and China. Folk medicine uses the entire parts of the plant. Numerous pharmacological effects have been observed, including antimicrobial, antioxidant, antiinflammatory, anti-angiogenic, anticancer, antidiabetic, analgesic, anthelmintic, antipyretic, hypolipidemic, cardiovascular, gastric, hepatic and renal protective, antidiarrheal, anticonvulsant and antifertility activities.[5] This plant has been reported to have several active compounds including phenols, alkaloids, tannins, terpenoids, sugars, flavonoids, saponins, glycoside, cardenolides and steroids such as calotoxin, calotropin, calactin, caoutchouc, trypsin, syriogenin, uzarigenin, proceroside and uscharin.[6] According to Yesmin*et al*.,[7]aqueous, and methanolic extracts of *C. procera* have been reported to possess antibacterial activity against both gram-positive (*S.epidermidis, S.aureus, S.pyogenes and S.saprophyticus*) and gram-negative (*P.shigelloides, S.dysenteriae, V.cholerae, S.flexneri, S.boydii, S.typhi, P.aeruginosa and S.sonnei*) bacteria. Roy *et al.*, [8] observed that daily oral dry latex at 100 and 400 mg/kg decreased blood sugar and increased hepatic glycogen contents dose-dependently. It also raised hepatic levels of endogenous antioxidants, including catalase, glutathione, and superoxide dismutase and decreased thiobarbituric acid reactive substance in alloxan-induced diabetic rats. According to Ahmad *et al.,*[9]*C. procera* extract administered to diabetic rats had significantly lower blood glucose levels than those in the control group. Oliveira *et al.*, [10] observed that laticifer proteins derived from *C.procera* had selective cytotoxic effects on human cancer cell lines. In *in vivo* studies utilizing rats transplanted with sarcoma 180, laticifer proteins significantly decreased tumor growth (51.83%) and increased animal survival time. In a study carried out by Babu *et al.*,[11] the methanolic extract of *C. procera* roots has a significant antiinflammatory effect in albino Wistar rats against carrageenan-induced paw oedema and cotton pellet-induced granuloma. The latex of the leaves of *C.procera* is used to cure various diseases, including leucoderma, tinea capitis in children, rabies, fever, eczema, leprosy elephantiasis, asthma and rheumatism. The flowers contain flavonoids, which are used in the treatment of asthma, colds, catarrh, intestinal worms, tumors and inflammations.[12]

Ocimum basilicum L.

Ocimum basilicum L., often known as sweet basil, is a plant widely distributed in tropical, subtropical, and temperate climatic zones of India, West Asia, Africa, Pakistan, Nepal, Sri Lanka, and other nations. It belongs to the Lamiaceae family. Due to its widespread availability, this plant may be readily obtained and employed for its many protective uses in daily life. Numerous pharmacological actions of this plant including antimicrobial, insecticidal, antioxidant, antiinflammatory, anticancer, hepatoprotective, anti-osteoporotic, cardioprotective, neuroprotective, and immunomodulators have been well documented.[13] According to Dasgupta *et al.*,[14] *O.basilicum* extract has shown antioxidant properties by enhancing the status of antioxidant enzymes and significantly lowering lipid peroxidation. Significant amounts of rosmarinic acid are present in *O.basilicum* extracts, which is considered to be the reason for their antioxidant effects.[15] The antioxidant effects are also due to its linoleic acid, methyl eugenol, methyl cinnamate,α-cadinol, estragole, α-bergamotene, anthocyanins and phenolic acids.[16] According toMoghaddam *et al.,*[17] and Issazadeh *et al.*,[18] *O.basilicum* leaves essential oil showed strong antibacterial capabilities against *E. coli, P. aeruginosa, and S. aureus* as well as antifungal activity against *A.niger, A. fumigatus, and P. chrysogenum.* In research by Bayala *et al.*,[19] the essential oil of *O.basilicum* showed antiinflammatory efficacy by inhibiting the lipoxygenase enzyme. The *O.basilicum* extract's antiinflammatory effect reduces the expression of genes for proinflammatory cytokines, such as TNF-α, IL-6, and IL-β.Bae *et al.*,[20] reported that the *O.basilicum* essential oil has shown analgesic activity when tested in inflammatory pain model mice. The extract of *O.basilicum* has strong cancer preventive properties as it can stimulate drug detoxification enzymes, including glutathione S-transferase and DT-diaphorase.[14] Abd El-Azim *et al.*,[21] pointed out the presence of phenolic compounds in *O.basilicum* extracts which showed a potent cytotoxic impact on liver cancer (HEPG2) and colon cancer (HCT116) cell lines. Rehan *et al.,* [22] reported that the methanolic extract of *O.basilicum* fractions was shown to promote apoptosis. This remarkable result may be attributable to the presence of epicatechin and cinnamic acid derivatives in these fractions. According to Akhtar *et al.*,[23] *O.basilicum* methanolic and aqueous extracts reduced the ulcer index observed in an aspirin-induced stomach ulcer in a rat model. Such prominent antiulcer action is mainly attributed to the presence of eugenol, linalool, anthocyanins, 1,8-cineone and methyl eugenol.

Terminalia arjuna L.

Terminalia arjuna (Family: Combretaceae) is one of the most well-known medicinal plants in indigenous systems of medicine for treating diseases. It has been used to treat anaemia, ulcers, cardiomyopathy, ischemic, myocardium necrosis, atherosclerosis, venereal and viral infection, hypercholesterolemia and hepatic failure. It also possesses antimicrobial, antioxidant, antiallergic, antitumoral, antifertility, and anti-HIV activities. Polyphenols, triterpenoids, flavonoids, tannins, saponins, minerals, sterols and amino acids (histidine, tyrosine, tryptophan and cysteine) are the major constituents of *T.arjuna* extracted from various organic solvents such as benzene, hexane, acetone, dichloromethane, chloroform, butanol, ethyl acetate, methanol, ethanol and ether.[24-27] According to Aneja *et al.*,[28] reported that the leaves and bark extracts of *T. arjuna* have shown antimicrobial activity against pathogens that cause ear infections such as *S.aureus, P.mirabilis, P.aeruginosa*, *Acinetobacter sp., E.coli,* and *C.albicans*. *T. arjuna* bark aqueous extract showed strong antimicrobial activity. Viswanatha *et al.,* [29] reported that the alcoholic extract of *T.arjuna* stem bark demonstrated potent antioxidant activity against DPPH, superoxide radicals scavenging assays and the lipid peroxidation assay. Gauthaman *et al.,*[30] showed that the dried bark of *T.arjuna* contains a high concentration of antioxidant compounds that prevent oxidative stress in rats with ischemic cardiac injury. Parmar *et al.*, [31] showed that the bark extract of *T. arjuna* can prevent thyroid function, which lowers the fat levels in the heart and liver of albino rats. Ram *et al.*, [32] reported that ethanolic plant extracts showed hypolipidemic activities.

Gymnema sylvestre L.

The plant *Gymnema sylvestre* (Family: Asclepiadaceae) is found all over the globe. According to a literature review, the plant has several critical pharmacological properties, including antiinflammatory, anti-obesity, hypolipidemic, antibacterial, antioxidant, diuretic, hypoglycemic, and antihelmintic. It is used to treat many diseases like bronchitis, asthma, leucoderma, haemorrhoids, dyspepsia, constipation, jaundice, and cardiopathy. *G.sylvestre* contains saponins, stigmasterol, gymnemic acid, quercetin, resins, albumin, chlorophyll, tartaric acid, butyric acid, anthraquinone, formic acid derivatives, inositol alkaloids, paraben, lignin, calcium oxalate, choline, betaine, and trimethylamine, Gurmarin, gymnemic acids anthraquinones, and their derivatives.[33-35] Li *et al.,* [36] showed that *G. sylvestre* significantly lowered blood glucose levels in Type II diabetic patients. Additionally, in diabetic patients, *G. sylvestre* decreased LDL levels, cholesterol, triglycerides, and

glucose. *G. sylvestre* can decrease cholesterol because it can inhibit pancreatic lipase activity. According to David *et al.*, [37] *G.sylvestre* inhibited the growth of *S.aureus, B.cereus*, *E. coli*, *C.albicans, Candida kefy* and *Candida krusei*. *G.sylvestre* leaf extract was used in the biosynthesis of silver and gold nanoparticles, and these particles significantly inhibited the growth of Hep2 cells.[38] Agrawal *et al.*, [39] reported that *G.sylvestre* extract decreased tumor incidence and the total number of papillomas in the experimental model. Arun *et al.*,[40] pointed out that the gymnemic acid from *G.sylvestre* ethanolic leaf extract prevents prostaglandin production and ulcer formation. According to Ahirwal *et al.*,[41] *G.sylvestre* methanolic extract showed a strong immunosuppressive effect by reducing the growth of CD3 and CD19 lymphocytes and by the production of the cytokines IL-2, IL-4 and interferon-γ.

Achyranthes aspera L.

Achyranthes aspera is an erect perennial plant in the Amaranthaceae family. The plant and its components have historically been used to treat several diseases, such as snake bites, renal dropsy, haemorrhoids, dysentery, asthma, skin eruptions, stimulating labour pain, nose bleeding, dilating blood vessels and diuretics. Many secondary metabolites, including alkaloids, saponins, flavonoids, glycosides, steroids, essential oils, fatty acids and tannins, play an important role against many diseases. In particular, the presence of secondary metabolites such as oleanolic acid, achyranthine, spinasterol, ecdysterone, achyrantheric acid, apigenin, corrosolic acid, ursolic acid and betaine plays a significant role in exhibiting the diverse pharmacological and therapeutic effects, such as antiinflammatory, cerebro-protective, periodontitis, antiepileptic, anxiolytic, antidepressant, bronchodilator, anti-venom and hepato-protective activities. Achyranthine is a water-soluble alkaloid from *A.aspera* and has been shown to have blood vessel dilatation and hypotension effects.[42,43] Previous studies have shown that the saponins found in the seeds of *A.aspera* have a better capacity to scavenge ABTS free radicals.[44] Numerous studies revealed the *A.aspera* sensitivity to the antibacterial effects against *B.subtilis, K.pneumoniae, M.luteus, P.aeuroginosa, S.aureus, E.coli, chloerasuis,* and *S.pyogenes* and antifungal action against *F.oxysporum, R.solani, S.rolfsii, Alternaria sp., S.cerevisae, C.albicans, A.nigricans, F.oxysporum, Candidia sp.* and *Penicillium sp.*[45-47] According to Omidiani *et al.*,[48] study, the anticancer activity of *A.aspera* leaves, stem, and root using a variety of extracts (ethyl acetate, acetone, ethanol, and methanol extracts) demonstrated excellent cytotoxicity against HeLa cancer cells. Among all extracts, ethanolic extract demonstrated a strong anticancer effect. Anand *et al.,*[49] isolated three phytoconstituents (corrosolic acid, achyrantheric acid and ursolic acid) extracted from the root of *A.aspera*, which showed potent anticancer activity against HT-29 (colon cancer cell line). Vijayaraj *et al.,*[50] reported that oral administration of *A.aspera* seed extract reduced sugar levels in Streptozocin (STZ)-induced diabetic rats. *A.aspera* capacity to reduce cholesterol may be mediated by the rapid excretion of bile acids, which in turn decreases cholesterol absorption.[51] The ethanolic leaves extract of *A.aspera* exhibited significant anti-inflammatory effect in carrageenan-induced paw oedema.[52]

Vitex negundo L.

Vitex negundo is an aromatic plant from the Verbenaceae family. Many conventional medicinal systems, including Ayurveda, Siddha, and Unani, employ it to treat many problems, such as arthritis, swellings, eyesores, headaches, catarrhal fever, dysmenorrhea, syphilitic skin disease and rheumatism. This plant has a wide variety of chemical components, including volatile oil, flavonoids, diterpenes, triterpenes, glycosides, sesquiterpenes, iridoid glycosides, lignan, and derivatives of stilbene. The extracts of *V.negundo* have a wide range of pharmacological effects, including antipyretic, antiinflammatory, antibacterial, antioxidant, anti-arthritic, analgesic, antitumor, anti-amnesic, antitubercular, anxiolytic, nephroprotective, anti-HIV, antieosinophilic, and anti-snake venom.[53,54] Kulkarni *et al.*,[55] reported that the methanolic extract of *V.negundo* has shown potent antioxidant activity. Gangwar *et al.*, [56] investigated that the ethanolic root extract of *V.negundo* had a more significant antiinflammatory impact when tested on carrageenan-induced paw edoema. Singh *et al.,*[57] reported the antibacterial action of *V.negundo* when tested against harmful microbes such *E. coli, B. substilis, S. aureus, K. pneumoniae, M. luteus,* and *C.albicans*. Chitra *et al.*,[58] reported that increasing the dosage of ethanolic leaf extract of *V.negundo* had significant anticancer activity in Swiss albino mice with Dalton's ascetic lymphoma. Janakiraman *et al.*, [59] studied the beneficial effect of methanolic extracts of *V.negundo* leaves on male albino rats with cisplatin-induced nephrotoxicity. The findings of this investigation demonstrated that *V.negundo* protected the rats against the harmful effects of cisplatin.

Andrographis paniculata L.

Andrographis paniculata, also known as Kalmegh, is a valuable plant belonging to the Acanthaceae family that has been traditionally utilized in India and Southeast Asia to treat several diseases. It contains various bioactive compounds, including diterpenoids, flavonoids, polyphenols, etc. Andrographolide and diterpene lactone is the primary active component of Andrographis paniculata.[60] *A.paniculata* contains rich source of 14-deoxy-11-oxoandrographolide,14 deoxy-11, 14 deoxyandrographolide, homoandrographolide, andrographosterol, andrographone, neoandrographolide, andrographane, andrographosterin, stigmesterol, andrograpanin, α-sitosterol, andrographin, dihydroxy-di-methoxyflavone and andrographolide.[61] Studies have shown this plant possesses various pharmacological properties, including antioxidant, antibacterial, antiviral, antidiabetic, anticancer, antihepatotoxic, cardiovascular, and immunomodulatory effects. It is utilized to treat urinary tract infections, cholera, the common cold, influenza, acidity, ulcers, dysentery, liver problems, gonorrhea, bites, and fertility problems.[62] Researchers found that different extracts of the plant roots, leaves, and stems were effective against a variety of bacteria, including *S.aureus, B.subtills, E.coli, M.smegmatis, P.aeruginosa, K.pneumoniae E.cloacae, P.vulgaris* and *S.typhimurium.*[61] According to Yu *et al.*,[63]andrographolide from *A.paniculata* can stimulate glucose uptake and decrease plasma glucose in STZ-induced diabetic rats. Sheeja *et al.*,[64] research observed that a methanolic extract of *A.paniculata* reduced carrageenan-induced inflammation as compared to a control animal. Banerjee *et al.*,[65] found that *A.paniculata* compounds had immune-protective and antiviral properties. Mishra *et al.*,[66] observed *A.paniculata* methanolic extract showed antimalarial activity against Plasmodium berghei, a parasite that causes malaria.

Boerhaavia diffusa L.

Boerhaavia diffusa, also known as Punarnava, is a perennial herbaceous plant belonging to the Nyctaginaceae family. This plant possesses various pharmacological activities such as antimicrobial, antioxidant, antiinflammatory, antiproliferative, anticancerous, antidiabetic, immunomodulatory, immunosuppressive, analgesic, antiestrogenic, antistress, adaptogenic, hepatoprotective, anticonvulsant and antifibrinolytic. India uses *B. diffusa* in Ayurveda and Arab nations in Unani medication to treat diabetes, kidney disease, heart tonic, stress, obesity, asthma, heartburn, stomach pain, inflammation, jaundice, splenomegaly, and congestive heart failure.[67] ß-sitosterol, punarnavine, liriodendrin, boerhavine, punarnavoside, arachidic acid, behenic acid and potassium nitrate are the main phytochemical components in the whole

plant.[68] Umamaheswari *et al.,*[69] showed the antibacterial activity of *B.diffusa* leaves against the gram-positive (*M. luteus, B. subtilis, S. aureus,* and *S. faecalis)* and gram-negative (*P.aeruginosa, E.coli, K.pneumoniae, S.typhii, P.vulgaris, S.flexneri*, *S.marcescens,* and *V.cholera*) bacteria. Venkatesh *et al.*,[70] examined the antioxidant and liver-protecting effects of alcoholic and water extracts of *B. diffusa* against thioacetamide-induced hepatoprotective rats. These *B.diffusa* alcoholic and aqueous extracts protected the liver and neutralized free radicals dose-dependently. According to a report by Bharali *et al.*,[71] the chemopreventive effect of *B.diffusa* was evaluated on male Swiss albino mice with DMBA-induced skin papillomas. The findings showed that *B.diffusa* extract might be helpful against tumors due to an increase in the activity of liver phase I and phase II system enzymes as well as antioxidant enzymes activities. *Nisha et al*.,[72] investigated the antidiabetic and antihyperlipidemic effects of the whole *B.diffusa* extract on Wistar rats with type 2 diabetes induced by STZ. This research showed that *B.diffusa* extracts effectively reduced diabetes and hyperlipidemia in rats.

Tribulus terrestris L.

Tribulus terrestris belongs to the Zygophyllaceae family and has long been used to cure various diseases in Indian and Chinese medicinal systems. The plant contains a wide range of chemical components likes terrestribisamide, tribulusterine, N-p-coumaroyltyramine, 25R spirost-4-en-3,12-dione, terrestriamide, aurantiamide acetate, hecogenin, xanthosine, fatty acid ester, vanillin, ferulic acid, β-sitosterol, p-hydroxybenzoic acid, harmine, N-trans-cafeoylyramine and N-transcoumaroyltyramine.[73] *T.terrestris* has excellent pharmacological properties such as antibacterial, antidiabetic, antiinflammatory, anticancer, diuretic, aphrodisiac, antiurolithic, hepatoprotective, immunomodulatory, analgesic, antispasmodic, anthelmintic, larvicidal, anticariogenic, hypolipidemic, and cardiotonic activities.[74] Studies have shown that the aqueous and methanolic extracts of *T. terrestris* had effective antimicrobial activity against *Klebsiella spp., E.coli, P.aerunginosa, S.typhi, E.faecalis* and *C.albicans*.[75] Abdulqawi *et al*.,[76] found that an aqueous extract of *T. terrestris* fruit inhibited lipid peroxidation in rats using the ferric thiocyanate method. Oh *et al.,*[77] demonstrated that an ethanolic extract of *T. terrestris* inhibited the lipopolysaccharide-stimulated production of cyclooxygenase2 and inducible nitric oxide synthase in RAW264.7 cells. It also inhibited the expression of proinflammatory cytokines, including TNF-α and IL-4, in macrophage cell lines. Consequently, the ethanolic extract inhibited the production of inflammatory mediators and cytokines, which could be helpful for various inflammatory diseases. Samani *et al.*,[78] revealed the hypoglycemic and hypocholesterolemic effects of *T.terrestris*. According to Reshma *et al.*,[79] reported that the methanolic extract of *T.terrestris* fruits protected myocardial ischemia in both *in vitro* and *in vivo* models.

Morinda citrifolia L.

Morinda citrifolia (Family: Rubiaceae) is commonly called noni. It is traditionally used as a medicinal treatment for many problems, including fever, cough, skin disease, gastritis, respiratory infections, urinary and menstrual tract problems, diabetes, and venereal diseases. It has various pharmacological effects, including antibacterial, antidiabetic, antioxidant, anticancer, anthelminthic, analgesic, antiinflammatory, and immunostimulant.[80] This plant fruit contains 90% water, and the dry matter is mostly soluble solids, proteins, and dietary fibres. The fruit's main vitamins are ascorbic acid and provitamin.[81]Jayaraman *et al.*,[82] found that *M.citrifolia* fruit extracts were effective against *L.lactis, S.aureus, B.subtilis, S.thermophilus, P.aeruginosa, S.typhi, E.coli, T.mentagrophytes, V.harveyi, K.pneumonia, S.paratyphi A, S.flexneri, A.hydrophila, V.cholera, C.violaceum, E.faecalis,* and *Fusarium, Penicillium, Mucor* and *Rhizopus species.* Algenstaedt *et al.,*[83]concluded that the daily consumption of *M.citrifolia* fruit juice have the potential to regulate elevated blood sugar levels in patients with type 2 diabetes. *M.citrifolia* inhibited the growth of breast, colorectal and lung cancer cells.[84,85] Saminathan *et al.*,[86] reported that noni juice treatment increased the levels of antioxidant enzymes and significantly decreased lipid peroxidation levels in the N-methyl-N-nitrosourea(NMU) treated group as compared to the NMU alone treated group. Uma *et al.,* [87] evaluated noni juice's neuroprotective effects on scopolamine-induced memory loss rats. They suggested that noni juice may be a valuable therapeutic possibility for preventing or treating Alzheimer's disease.

Justicia adhatoda L.

J. adhatoda belongs to the Acanthaceae family, a well-known plant utilized in Ayurvedic and Unani remedies. It has been commonly used to treat fever, bronchitis, asthma, tuberculosis, and cough. *J.adhatoda* contains many phytochemicals, such as quinazoline, vasicinone, 7-hydroxyvasicine, vasicinolone, 3-deoxyvasicine, vasicine, vasicol, vasicoline, adhatodine, adhvasinone, vasicinol, anisotine, hydroxypeganine, kaempferol, quercetin, vitamin C, amino acids, carotene, astragalin, apigenin, quercetin, kaempferol, vitexin, behenic, sitosterol, arachidic, cerotic, lignoceric, linoleic, betaine, alkanes, minerals and carbohydrate.[88] Rashmi *et al*.,[89] reported the antimicrobial activity of methanolic leaf extracts of *J.adhatoda* against *S.aureus, S.pyogenes, S.marcescens, K.pneumoniae, E.coli, P.aeruginosa, C.albicans, C.neoformans* and *A.flavus*. The water extract has proven efficient against microbial flora isolated from gingivitis patients.[90]According to Basit *et al*.,[91] *J. adhatoda* enhanced the activities of antioxidants, while attenuating the production of malondialdehyde and inducible nitric oxide synthase activities in Carrageenan-induced paw edema model. Kumar *et al.*,[92] *J.adhatoda* leaf extract showed a potent anticancer effect in MCF-7 cells. Oral administration of ethanolic extract of *J.adhatoda* leaves showed significant reduction of blood glucose levels in alloxan-induced hyperglycemic rat models.[93] *J. adhatoda* exerted anti-asthmatic effects by directly stabilizing mast cells, inhibiting the enzymes lipoxygenase/cyclooxygenase, or reducing platelet-activating factor.[94] Shrivastava *et al.,*[95] found that the leaf powder of this plant had a significant antiulcer action in rats with ulcers induced by ethanol.

Mucuna pruriens L.

Mucuna pruriens belongs to the Fabaceae family. This plant is used in Ayurveda to treat several problems and diseases, including cough, dog and snake bite, madness, bone fractures, pain, pleuritic, scorpion sting, ringworm, sores and syphilis, constipation, oedema, fever, Parkinson's disease, tuberculosis and menstruation disorders. It has potent pharmacological properties like antimicrobial, antioxidant, antidiabetic, antiinflammatory, anticholestrolemic and aphrodisiac effects. *M. pruriens* seeds contain high concentrations of L-DOPA. It also contains some other amino acids, glutathione, lecithin, gallic acid and beta sitosterol, dimethyl tryptamine (DMT), 5-hydroxy tryptamine(serotonin), bufotenine, nicotine, 5-methoxy-N,N-dimethyltryptamine and beta-carboline.[96,97] Previous research has shown that *M.pruriens* methanol extract has potent antibacterial activity against *B.cereus, P.syringae, S.aureus, E.carotovora, P.vulgaris, P.acruginosa, P. marginalis,* and *X.campestris*. Furthermore, it shows a potent antifungal effect against *F.oxysporum, C.lunata, R.solani, T.phaseolina, P.expansum* and *U.pomaydis*. [98] Kumar *et al.,*[99] reported that an ethyl acetate and methanolic extract of *M. pruriens* had a potent antioxidant and free radical scavenging activity due to its high phenolic content. Rachsee *et al.*,[100] observed that *M. pruriens* seed extract markedly reduced the production of inflammatory

mediators in Lipopolysaccharide(LPS)-stimulated BV2 microglial cells, such as nitric oxide (NO), IL-1β, IL 6, and TNF-α. Seetharamaiah et al.,[101] concluded that *M.pruriens* seed extract has shown antineoplastic effects against human colorectal adenocarcinoma cells. Bhaskar *et al.,*[102] examined the hypoglycemic effect of *M.pruriens* seed aqueous extract in both normal rats and diabetic rats induced by STZ. In normal rats and STZ-induced diabetic rats, the aqueous extract of *M. pruriens* seeds lowered blood glucose levels for two hours after injection of 100 and 200 mg/kg bw.

Neolamarckia cadamba L.

Neolamarckia cadamba belongs to the Rubiaceae family and is a widely used Ayurvedic treatment for various diseases, such as diabetes, diarrhoea, fever, cough, inflammation, mouth ulcers, urinary tract infections, haemoptysis, wounds, vomiting and pimples. This plant has many biological active components like, alkaloids, glycoside, flavonoids, anthraquinone, tannins, phenols, terpenoids, secoiridoids, sterol, and anthocyanins. It also contains cadambagenic acid, quinovic acid, β- sitosterol, cadambine, cadamine, isocadamine, 3β-dihydrocadambine, 3β-isodihydrocadambine, aminocadambine A & B1, neolamarckines A & B, chlorogenic acid & B-sitosterol. It possesses antidiabetic, antioxidant, antimicrobial, anthelmintic, antihepatotoxic, antilipidemic, antimalarial, analgesic, antipyretic and antiinflammatory.[103,104] According to *Islam et al.*,[104] the crude extract of *N.cadamba* exhibited strong antioxidant and free radicals scavenging activity. The different crude extracts such as ethanol, ethyl acetate, petroleum ether and aqueous of the stem bark of *N.cadamba* have shown potent antimicrobial activities against *S. aureus, B. pumilus, P.aeruginosa, E. coli, B. subtilis, B. cereus, Y. enterocolitica, L. innocua* and *C.albicans*.[105,106] Bussa *et al.*,[107] observed that oral administration of stem bark of ethanolic extract of 0.5 g/kg body weight exhibited a significantly reduced hyperglycemia in alloxan-induced diabetic rats. Das *et al.*,[108] tested the hepatoprotective activity of hydroalcoholic extract of *N.cadamba* stem bark in Swiss albino mice using chloroform and iron overdose hepatotoxicity. The research demonstrated *N.cadamba's* hepatoprotective effect in both hepatotoxicity models, and the activity is probably due to its potent antioxidant and iron-chelating properties. Razali *et al.*,[109] reported that *N.cadamba* has shown anticancer properties in MCF-7 by inducing apoptosis and cell cycle arrest. Hai-Lian Yua *et al*.,[110] observed that the *N.cadamba* ethyl acetate fraction showed antiinflammatory effects by terminating the release of inflammatory mediators.

Physalis minima L.

Physalis minima, also known as Ground cherry, is an annual plant species in the Solanaceae family. It has anticancer, antioxidant, antibacterial, antidiabetic, analgesic, antiinflammatory, antipyretic, smooth muscle relaxing, and immune-boosting properties.Flavonoids, steroid alkaloids, sugars, catechol, ellagic acid, gallic acid, cardiac glycosides, catechins, cyclopentane, vitamin C, free amino acetamide, stearic acid, octadecanoic, and linoleic acids, palmitic acid are among the bioactive components of *P.minima* that are linked to health benefits. *P.minima* has a variety of folkloric applications, such as diuretic, purgative, restore flaccid breasts, kidney stone, earache, splenomegaly, snake and scorpion envenomation, bronchial asthma, diabetes, dysuria, and swellings, fever, digestive problems, and toothache.[111,112] It has shown antimicrobial activity against *B. cereus, B. subtilis, E. aerogenes, Citrobacter sp., E. coli, P. aeruginosa, S. aureus, K. pneumoniae,* and *P. fluorescens*.[113] According to Khan *et al.*,[114] study the crude chloroform and methanol fraction of the entire plant have considerable antipyretic, antiinflammatory and analgesic properties in experimental animals. The methanol, aqueous, ethyl acetate, acetone and chloroform extracts of *P.minima* leaves and stem efficiently scavenged free radicals and showed potent antioxidant activity.[115] Sathish Kumar et al.,[116] found that *P.minima* extract had strong alpha-glucosidase inhibitory action which could help to lower blood glucose levels after maltose administration to rats. According to Leong *et al.*,[117] the chloroform extract of *P. minima* showed significant cytotoxic activities against the NCIH23 (human lung cancer) cell line after 24, 48, and 72 hours of incubation. Tammu *et al.,*[118] discovered that *P.minima* leaf methanolic extract had potent antiulcer action in induced ulcer models. Joseph *et al.*,[119] reported that ethanolic extract of *P.minima* fruits prevented D-galactose-induced Alzheimer's disease in an experimental rat model.

Asparagus racemosus L.

Asparagus racemosus belongs to the Liliaceae family and is mainly cultivated in tropical and subtropical areas of India. Various medicinal and therapeutic properties of this plant have been reported in traditional medicinal systems like Ayurveda, Siddha, and Unani, which include antibacterial, antioxidant, antiinflammatory, antidiabetic, antispasmodic, antiallergic, anti-neoplastic activities, anti-immunomodulatory, antipyretic, antimalarial, anti-leprotic, anti-abortifacient, antistress, ulcerogenic, anti-diarrhoeal, analgesic and hepatoprotective and enhances immune response. It is widely used in cancer, diabetes mellitus, kidney disorders, depression, oedema, chronic fevers, infertility, infection (bacterial or fungal) epilepsy, controlling cholesterol levels, liver cancer, increasing milk secretion in nursing mothers, stomach ulcers and regulating sexual behaviours. The main bioactive components found in the plant are steroid saponins (shatavarin I-VI and disogenin) and flavonoids (quercetin, kaepfrol, rutin, and hyperosides). Trace elements, including copper, zinc, potassium, manganese, calcium, cobalt and selenium, are present.[120,121] According to Kamat *et al.*, [122] *A.racemosus* extract has shown protection against γ-radiation-induced membrane damage caused by free radicals in rat liver mitochondria. *A.racemosus* exhibited antibacterial and antifungal activity against *E.coli, B.subtilis, S.sonnei, S.dysenteriae, V.cholerae, S.flexneri, S.typhimurium, S.typhi, P.putida, S.aureus* and *Candida.*[123,124] Mitra *et al.,*[125] reported that shatavarins IV isolated from *A.racemosus* showed potent anticancer activity against MCF-7, A-498, and HT-29 cell lines. Mangal *et al.*,[126] research reported that the root of *A.racemosus* has more antiulcerogenic action than ranitidine hydrochloride. *A.racemosus* prevented the damage of stomach mucosa by inhibiting the release of gastric hydrochloric acid. Hannan *et al.,*[127] observed that ethanolic root extract of *A.racemosus* lowered blood glucose levels in rats. Ahmad *et al*.,[128] reported that the oral administration of methanolic extract of *A.racemosus* root protected rats from lipopolysaccharide-induced liver injury.

Table 1: Pharmacological and therapeutic activities of important Indian medicinal plants.

S. no	Plant name	Family	Pharmacological &therapeutic activities	Ref.
1.	*Curcuma longa*	Zingiberaceae	Antimicrobial, antioxidant, antiallergic, antiseptic, anticarcinogenic and antidiabetic activities. It also improves digestion, dissolves gallstones, and prevents Alzheimer's disease.	[129]
2.	*Ocimum sanctum*	Lamiaceae	Antimicrobial, antiinflammatory, antidiabetic, antitussive, antipyretic, antioxidant and anti-arthritic properties. It is also used to treat malaria, heart disease, asthma, hepatitis, tuberculosis, snakebite antidote, and genitourinary disorders.	[130]
3.	*Azadirachta indica*	Meliaceae	Antimicrobial, antiinflammatory, antioxidant, anticancer, antifertility antimalarial and neuroprotective properties. It is also used to treat rheumatism, asthma, fever, worm tuberculosis, diarrhoea, jaundice, dysentery, promote healing, measles, smallpox, inflamed gums, and urinary diseases.	[131]
4.	*Abutilon indicum*	Malvaceae	Antibacterial, antioxidant, anticancer, antiasthmatic, antidiabetic and hepatoprotective properties. It is also used for toothache and in treating gonorrhoea.	[132]
5.	*Aegle marmelos*	Rutaceae	Antihyperglycemic, antidyslipidemic, antibacterial, antioxidant and antiinflammatory properties. It is also used to treat jaundice, fever, asthma, and Alzheimer's disease.	[133]
6.	*Averrhoa bilimbi*	Oxalidaceae	Antioxidant, antimicrobial, antiinflammatory, anticoagulant activities and used to treat diarrhoea, hepatitis, bilious colic, whooping, scurvy, fever, obesity, cough, and hypertension.	[134]
7.	*Mentha piperita*	Lamiaceae	It possesses antimicrobial, antioxidant, antipyretic, antiinflammatory, anticancer, anti-parasitic, antidiarrheal, and antitussive properties. It is also used to treat diarrhoea, gum problems, hyperacidity, anemia, bronchitis, Irritable bowel syndrome, Crohn's disease, bad breath, tuberculosis, eczema, acne, anxiety, and gallbladder and liver diseases.	[135]
8.	*Allium sativum*	Amaryllidaceae	It has antioxidant, antiinflammatory, anticancer, antidiabetic, antimicrobial, cardioprotective and anti-hypertensive activities.	[136]
9.	*Carica papaya*	Caricaceae	Wound healing, nephro-protective, antiinflammatory, anticancer, antimalarial, anthelmintic, antimicrobial, antidiabetic and analgesic properties. It is also used to prevent dengue fever, menstrual pain, skin problems, arthritis and dyspepsia.	[137]
10.	*Valeriana wallichii*	Valerianceae	Antioxidant, antibacterial, anti-inflammatory and neuroprotective effects.	[138]
11.	*Cuminum cyminum*	Apiaceae	Antimicrobial, antiinflammatory, antioxidant, anti-platelet, antidiabetic, anticancer, hypotensive, bronchodilatory, anti-amyloidogenic and antiosteoporotic properties. It is also used to treat jaundice, lung diseases, nosebleeds, menstrual pains, diarrhea, and digestive problems, stimulates saliva production, bile excretion, increases breast milk production, used in menstrual cramps, and treats insomnia and fever.	[139]
12.	*Mentha spicata*	Lamiaceae	Antibacterial, antifungal, antidiabetic, antioxidant, hepatoprotective, cytotoxic, anti-inflammatory, antigenotoxic, potential and antiandrogenic activities. It is also used to treat asthma and blood dysentery, and improve memory and digestion.	[140]
13.	*Nigella sativa*	Ranunculaceae	Antimicrobial, antiinflammatory, anticancer, antihyperlipidemic, anti-hypertensive, antidiabetic, gastro-protective, wound healing, antioxidant and analgesic activities. It is also used to treat respiratory, digestive tract, kidney, liver, and cardiovascular-related diseases, as well as asthma; externally, its oil is used as an antiseptic and anaesthetic.	[141]
14	*Senna auriculata*	Fabaceae	Antioxidant, antimicrobial, antidiabetic, antipyretic and antihyperglycemic activities. It is an effective inhibitor of □glucosidase enzyme properties.	[142]

15.	*Citrus limon*	Rutaceae	Antimicrobial, antioxidant, antiinflammatory, anticarcinogenic, antipyretic, diuretic, and antiulcer activities. It is also used to treat fever, scurvy, urinary diseases, liver disorders, and high blood pressure.	[143]
16.	*Solanum surattense*	Solanaceae	Antioxidant, anti-androgenic, hypocholesterolemic, hemolytic, anticancer, antibronchitic, antiischaemic and antidiabetic activities. It is widely used to treat cardiovascular diseases.	[144]
17.	*Clerodendrum phlomidis*	Lamiaceae	Antioxidant, antidiabetic, antiinflammatory, anticancer, antidiarrheal, antimicrobial and properties. It is also used to treat nervous disorder, rheumatism, urinary problems, asthma, coughs, elephantiasis, febrifuge, venereal infections and malaria.	[145]
18.	*Syzygium cumini*	Myrtaceae	Antidiabetic, antimicrobial, antihyperlipidaemic, antioxidant, hepatoprotective, antiulcer, antiarthritic, anti-inflammatory, antipyretic, neuropsychopharmacological, nephroprotective and antidiarrhoeal activities.	[146]
19.	*Datura metel*	*Solanaceae*	Antimicrobial, antioxidant, antiproliferative, antiiabetics, anticancer, antiinflammatory and hypoglycemic activities. It is also used to treat psoriasis, skin ulcers, bronchial asthma, cough, convulsion, diarrhoea and chronic bronchitis.	[147]
20.	*Heliotropium indicum*	Boraginaceae	Antiinflammatory, antioxidants, antitumor, antiulcer, antifertility, analgesic, diuretics and antimicrobial properties. It is also used to treat skin infections, stomach problems, poisonous animal bites, nervous disorders, cure wounds, eye problems, malaria, kidney stones and gum and worm infections.	[148]
21.	*Trigonella foenum-graecum*	Fabaceae	Antioxidant, antidiabetic, hypolipidemic, antiulcer, antimicrobial, and antiinflammatory activities. It is also used to reduce menstrual cramps, treat sexual problems, dysentery, stomach disturbances, respiratory infections, fever and hormonal disorders	[149]
22.	*Murraya koenigii*	Rutaceae	Antioxidant, antidiabetic, antiinflammatory, antitumor, neuro-protective, anticancer, antimicrobial, antidiarrheal, gastro-protective and antidepressant properties. It is also used to treat anemia, respiratory problems, eye vision problems, toothache, hyperlipidemia and nausea.	[150]
23.	*Withania somnifera*	Solanaceae	Antidiabetic, antiarthritic, analogstic, neuro-protective, antitumor, antiulcer, antioxidant and antimicrobial activities. It is also used to treat Parkinson's disease, bronchial asthma, chronic fever, dysentery, insect bites, gastric, cardiovascular, hepatic disorders, nervous exhaustion, insomnia, male infertility, and fibromyalgia.	[151]
24.	*Moringa olifera*	Moringaceae	Antioxidants, cardio-protective, anti-proliferation, hepatoprotective, hypotension, hypolipidemic, antiinflammatory and antimicrobial activities. It is also used to treat ear and eye infections, toothache, cold, HIV, typhoid, malaria, indigestion, diarrhoea, skin diseases and snake bite.	[152]
25.	*Aloe barbadensis*	Asphodelaceae	Angiogenic, antiinflammatory, antidiabetic, anticancer, antimicrobial and antioxidant effects. It is also used to treat skin injuries.	[153]

Conclusion

The present review thus explores the medicinal properties of some important medicinal plants that are used in Indian traditional medicine. The present review opens the avenue for researchers to scientifically validate these medicinal plants as promising candidates for the treatment of various ailments.

Conflict of interest

The author declares that there is no conflict of interest.

References

[1] Poddar S, Sarkar T, Choudhury S, Chatterjee S, Ghosh P. Indian traditional medicinal plants: A concise review. Int. j. botany stud.2020;5(5):174-90.

[2] Rajcevic N, Bukvicki D, Dodos T, Marin PD. Interactions between natural products—A review. Metabolites. 2022;12(12):1256. https://doi.org/10.3390/metabo12121256

[3] Adhikari PP, Paul SB. History of Indian traditional medicine: a medical inheritance. Asian J. Pharm. Clin. Res.2018;11(1):421-26. http://dx.doi.org/10.22159/ajpcr.2018.v11i1.21893

[4] Singh S. A review on some medicinal plant species with the most traditional medicinal usage in India.Int. J. Biol. Innov. 2023; 5(1): 55-62. https://doi.org/10.46505/IJBI.2023.5103

[5] Mali RP, Rao PS, Jadhav RS. A review on pharmacological activities of Calotropis procera. J. drug deliv. ther. 2019;9(3-s):947-51. https://doi.org/10.22270/jddt.v9i3-s.2870

[6] Shrivastava A, Singh S, Singh S. Phytochemical investigation of different plant parts of Calotropis procera. Int. j. sci. res. publ. 2013;3(3):1-4.

[7] Yesmin MN, Uddin SN, Mubassara S, Akond MA. Antioxidant and antibacterial activities of Calotropis procera Linn. Am Eurasian J Agric Environ Sci.2008;4(5):550-3.

[8] Roy S, Sehgal R, Padhy BM, Kumar VL. Antioxidant and protective effect of latex of Calotropis procera against alloxan-induced diabetes in rats. J. Ethnopharmacol.2005;102(3):470-3. https://doi.org/10.1016/j.jep.2005.06.026

[9] Ahmad MB, Gwarzo MY, Anwar S. Antioxidative and anti-hyperglycaemic effect of calotropis procera in alloxan induced diabetic rats. J. Med. Plant Res.2016;10(5):54-8. https://doi.org/10.5897/JMPR2014.5704

[10] Oliveira JS, Costa-Lotufo LV, Bezerra DP, Alencar NM, Marinho-Filho JD, Figueiredo IS, Moraes MO, Pessoa C, Alves AP, Ramos MV. In vivo growth inhibition of sarcoma 180 by latex proteins from Calotropis procera. Naunyn-Schmiedeb. Arch. Pharmacol.2010;382:139-49. https://doi.org/10.1007/s00210-010-0525-6

[11] Babu AS, Karki SS. Antiinflammatory activity of various extracts of roots of Calotropis procera against different inflammation models. Int J Pharm Pharm Sci. 2011;3(3):191-4.

[12] Wadhwani BD, Mali D, Vyas P, Nair R, Khandelwal P. A review on phytochemical constituents and pharmacological potential of Calotropis procera. RSC Adv. 2021;11(57):35854-35878. https://doi.org/10.1039/D1RA06703F

[13] Dhama K, Sharun K, Gugjoo MB, Tiwari R, Alagawany M, Iqbal Yatoo M, Thakur P, Iqbal HM, Chaicumpa W, Michalak I, Elnesr SS. A comprehensive review on chemical profile and pharmacological activities of Ocimum basilicum. Food Rev. Int.2023;39(1):119-47. https://doi.org/10.1080/87559129.2021.1900230

[14] Dasgupta, T.; Rao, A. R.; Yadava, P. K. Chemomodulatory Efficacy of Basil Leaf (Ocimum Basilicum) on Drug Metabolizing and Antioxidant Enzymes, and on Carcinogen-induced Skin and Forestomach Papillomagenesis. Phytomedicine. 2004, 11(2–3), 139–151. https://doi.org/10.1078/0944-7113-00289

[15] Jayasinghe C, Gotoh N, Aoki T, Wada S. Phenolics composition and antioxidant activity of sweet basil (Ocimum basilicum L.). J Agric Food Chem. 2003;51(15):4442-9. https://doi.org/10.1021/jf034269o

[16] Shiwakoti S, Saleh O, Poudyal S, Barka A, Qian Y, Zheljazkov VD. Yield, composition and antioxidant capacity of the essential oil of sweet basil and holy basil as influenced by distillation methods. Chem. Biodivers. 2017;14(4):e1600417. https://doi.org/10.1002/cbdv.201600417

[17] Moghaddam AM, Shayegh J, Mikaili P, Sharaf JD. Antimicrobial activity of essential oil extract of Ocimum basilicum L. leaves on a variety of pathogenic bacteria. J. Med. Plants Res. 2011;5(15):3453-6.

[18] Issazadeh K, MAJID KP, Massiha A, Bidarigh S, Giahi M, ZULFAGAR MP. Analysis of the Phytochemical Contents and Anti-microbial Activity of Ocimum basilicum L.Int. J. Med. Microbiol. 2012;2:141-147.

[19] Bayala B, Bassole IH, Gnoula C, Nebie R, Yonli A, Morel L et al. Chemical composition, antioxidant, anti-inflammatory and anti-proliferative activities of essential oils of plants from Burkina Faso. PLoS one. 2014;9(3):e92122. https://doi.org/10.1371/journal.pone.0092122

[20] Bae AH, Kim G, Seol GH, Lee SB, Lee JM, Chang W, Min SS. Delta- and mu-opioid pathways are involved in the analgesic effect of Ocimum basilicum L in mice. J Ethnopharmacol. 2020;250:112471. https://doi.org/10.1016/j.jep.2019.112471

[21] Abd El-Azim MH, Abdelgawad AA, El-Gerby M, Ali S, El-Mesallamy AM. Phenolic compounds and cytotoxic activities of methanol extract of basil (Ocimum basilicum L.). J. Microb. Biochem. Technol. 2015;7(4):182-5. http://dx.doi.org/10.4172/1948-5948.1000202

[22] Rehan T, MacEwan D, Shah N, Rehan T, Tahira R, Murad S, et al. Apoptosis of leukemia cells by Ocimum basilicum fractions following TNF alpha induced activation of JNK and caspase 3. Current Pharmaceutical Design. 2019;25(34):3681-91. https://doi.org/10.2174/1381612825666191011100826

[23] Akhtar MS, Munir M. Evaluation op the gastric antiulcerogenic effects of Solanum nigrum, Brassica oleracea and Ocimum basilicum in rats. J.ethnopharmacol. 1989;27(1-2):163-76. Akhtar MS, Munir M. Evaluation op the gastric antiulcerogenic effects of Solanum nigrum, Brassica oleracea and Ocimum basilicum in rats. J.ethnopharmacol. 1989;27(1-2):163-76. https://doi.org/10.1016/0378-8741(89)90088-3

[24] Anka ZM, Singh VS, GIMBA S. The pharmacological activities of various extracts from Terminalia arjuna bark: A review.Int. j. curr. med. pharm. res.2011;5(12(A)). http://dx.doi.org/10.24327/23956429.ijcmpr201912xxx

[25] Mandal S, Patra A, Samanta A, Roy S, Mandal A, Mahapatra TD, Pradhan S, Das K, Nandi DK. Analysis of phytochemical profile of Terminalia arjuna bark extract with antioxidative and antimicrobial properties. Asian Pac J Trop Biomed. 2013;3(12):960-6. https://doi.org/10.1016/S2221-1691(13)60186-0

[26] Amalraj A, Gopi S. Medicinal properties of Terminalia arjuna (Roxb.) Wight & Arn.: A review. J Tradit Complement Med. 2016;7(1):65-78. https://doi.org/10.1016/j.jtcme.2016.02.003

[27] Row LR, Murty PS, Rao GS, Sastry CS, Rao KV. Chemical examination of Terminalia species. XII. Isolation & structure determination of arjunic acid, a new trihydroxytriterpene carboxylic acid from Terminalia arjuna bark. Indian J. Chem. 1970;8:716-721.

[28] Aneja KR, Sharma C, Joshi R. Antimicrobial activity of Terminalia arjuna Wight & Arn.: An ethnomedicinal plant against pathogens causing ear infection. Braz. J. Otorhinolaryngol.2012;78(1):68-74. https://doi.org/10.1590/S1808-86942012000100011

[29] Shastry Viswanatha GL, Vaidya SK, Ramesh C, Krishnadas N, Rangappa S. Antioxidant and antimutagenic activities of bark extract of Terminalia arjuna. Asian Pac. J. Trop. Med.2010;3(12):965-70. https://doi.org/10.1016/S1995-7645(11)60010-2

[30] Gauthaman K, Maulik M, Kumari R, Manchanda SC, Dinda AK, Maulik SK. Effect of chronic treatment with bark of Terminalia arjuna: a study on the isolated ischemic-reperfused rat heart. J. Ethnopharmacol. 2001;75(2-3):197-201. https://doi.org/10.1016/S0378-8741(01)00183-0

[31] Parmar HS, Panda S, Jatwa R, Kar A. Cardio-protective role of Terminalia arjuna bark extract is possibly mediated through alterations in thyroid hormones. Pharmazie. 2006;61(9):793-5.

[32] Ram A, Lauria P, Gupta R, Kumar P, Sharma VN. Hypocholesterolaemic effects of Terminalia arjuna tree bark. J. Ethnopharmacol. 1997;55(3):165-9. https://doi.org/10.1016/S0378-8741(96)01493-6

[33] Khan F, Sarker MMR, Ming LC, Mohamed IN, Zhao C, Sheikh BY et al. Comprehensive Review on Phytochemicals, Pharmacological and Clinical Potentials of Gymnema sylvestre. Front Pharmacol. 2019;10:1223. https://doi.org/10.3389/fphar.2019.01223

[34] Tiwari P, Mishra BN, Sangwan NS. Phytochemical and pharmacological properties of Gymnema sylvestre: an important medicinal plant. Biomed Res Int. 2014;2014:830285. https://doi.org/10.1155/2014/830285

[35] Kanetkar P, Singhal R, Kamat M. Gymnema sylvestre: A Memoir. J Clin Biochem Nutr. 2007;41(2):77-81. https://doi.org/10.3164/jcbn.2007010

[36] Li Y, Zheng MI, Zhai X, Huang Y, Khalid A, Malik A, Shah P et al. Effect of Gymnema sylvestre, Citrullus colocynthis and Artemisia absinthium on blood glucose and lipid profile in diabetic human. Acta Pol Pharm. 2015;72(5):981-5.

[37] David BC, Sudarsanam G. Antimicrobial activity of Gymnema sylvestre (Asclepiadaceae). J. Acute Dis.2013;2(3):222-5. https://doi.org/10.1016/S2221-6189(13)60131-6

[38] Nakkala JR, Mata R, Bhagat E, Sadras SR. Green synthesis of silver and gold nanoparticles from Gymnema sylvestre leaf extract: study of antioxidant and anticancer activities. J Nanopart Res. 2015;17:1-5. https://doi.org/10.1007/s11051-015-2957-x

[39] Agrawal RC, Soni S, Jain N, Rajpoot J, Maheshwari SK. Chemopreventive effect of Gymnema sylvestre in Swiss albino mice. Int. J. Sci. Res. Publ. 2016;6(1):78-83.

[40] Arun LB, Arunachalam AM, Arunachalam KD, Annamalai SK, Kumar KA. In vivo anti-ulcer, anti-stress, anti-allergic, and functional properties of gymnemic acid isolated from Gymnema sylvestre R Br. BMC Complement Altern Med. 2014;14:70. https://doi.org/10.1186/1472-6882-14-70

[41] Ahirwal L, Singh S, Dubey MK, Bharti V, Mehta A, Shukla S. In vivo immunomodulatory effects of the methanolic leaf extract of Gymnema sylvestre in Swiss albino mice. Arch. Biol. Sci.2015;67(2):561-70. https://doi.org/10.2298/ABS141027018A

[42] Raju SK, Kumar S, Sekar P, Murugesan M, Karthikeyan M, Elampulakkadu et al. Therapeutic and Pharmacological Efficacy of Achyranthes aspera Linn.: An Updated Review. J. drug deliv. ther.2022;12(3):202-14. https://doi.org/10.22270/jddt.v12i3.5468

[43] Goyal BR, Goyal RK, Mehta AA. PHCOG rev.: plant review phyto-pharmacology of Achyranthes aspera: a review. Pharmacogn Rev. 2007;1(1):143-50.

[44] Pandey G, Rao CV, Gupta SS, Verma KK, Singh M. Antioxidant and antibacterial activities of leaf extract of Achyranthes aspera Linn.(Prickly Chaff Flower). European j. med. Plants.2014;4(6):695. https://doi.org/10.9734/EJMP/2014/8786

[45] Ndhlala AR, Ghebrehiwot HM, Ncube B, Aremu AO, Gruz J, Šubrtová M, et al. Antimicrobial, Anthelmintic Activities and Characterisation of Functional Phenolic Acids of Achyranthes aspera Linn.: A Medicinal Plant Used for the Treatment of Wounds and Ringworm in East Africa. Front Pharmacol. 2015;6:274. https://doi.org/10.3389/fphar.2015.00274

[46] Qadir MI, Khan TJ, Abbas G, Ahmad B, Janbaz KH, Ali M. Antibacterial activity of Vacuum liquid chromatography (VLC) isolated fractions of chloroform extracts of seeds of Achyranthes aspera. J. Chem. Soc. Pak.2012;34(3). https://link.gale.com/apps/doc/A294567937/AONE?u=anon~d4a2aec1&sid=googleScholar&xid=f4f305e8

[47] Prasad SH, Swapna NL, Anthonamma K, Rajasekhar D. Antimicrobial activity of Achyranthes aspera and Aerva lanata leaf and callus extracts. Biosci. Biotechnol. Res. Asia.2016;6(2):887-91. https://www.biotech-asia.org/?p=9118

[48] Omidiani N, Datkhile KD, Barmukh RB. Anticancer potentials of leaf, stem, and root extracts of Achyranthes aspera L. Not Sci Biol. 2020;12(3):546-55. https://doi.org/10.15835/nsb12310764

[49] Anand M, Ranjitha J, Alagar M, Selvaraj V. Phytoconstituents from the roots of Achyranthes aspera and their anticancer activity. Chem Nat Compd. 2017;53:189-91. https://doi.org/10.1007/s10600-017-1946-y

[50] Vijayaraj R, Kumar KN, Mani P, Senthil J, Jayaseelan T, Kumar GD. Hypoglycemic and antioxidant activity of Achyranthes aspera seed extract and its effect on streptozotocin induced diabetic rats. Int J Biol Pharm Res. 2016;7:23-8.

[51] Khanna AK, Chander R, Singh C, Srivastava AK, Kapoor NK. Hypolipidemic activity of Achyranthus aspera Linn in normal and triton induced hyperlipemic rats. Indian J. Exp. Biol.1992;30(2):128-30.

[52] Vetrichelvan T, Jegadeesan M. Effect of alcohol extract of Achyranthes aspera Linn. on acute and subacute inflammation. Phytother Res. 2003;17(1):77-9. https://doi.org/10.1002/ptr.1070

[53] Neha B, Jannavi R, Sukumaran P. Phyto-pharmacological and biological aspects of vitex negundo medicinal plant-A review. J. Pharm. Res. Int. 2021;33(29A):17-32.

[54] Singh Y, Mishra P, Kannojia P. Morphology, phytochemistry and pharmacological activity of Vitex negundo: an overview. J. drug deliv. ther. 2020;10(3-s):280-5. https://doi.org/10.22270/jddt.v10i3-s.4173

[55] Kulkarni RR, Virkar AD, D'mello P. Antioxidant and antiinflammatory activity of Vitex negundo. Indian J. Pharm. Sci. 2008;70(6):838. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3040892/

[56] Gangwar AK, Ghosh AK, Saxena V. Anti-inflammatory activity of ethanolic extract of Vitex negundo linn roots. Int. J. Herb. Med.2015;2(6):01-2.

[57] Singh P, Mishra G, Jha KK, Garg VK, Khosa RL. Chemical composition and antimicrobial activity of essential oil of leaves of Vitex negundo Linn.(Verbenaceae). International. J. Chem. Tech. Res. 2010;2:1686-90.

[58] Chitra V, Sharma S, Kayande N. Evaluation of anticancer activity of Vitex negundo in experimental animals: An in vitro and in vivo study. Int J PharmTech Res. 2009;1(4):1485-9.

[59] Janakiraman M, Jeyaprakash K. Nephroprotective effect of Vitex negundo linn. on cisplatin induced nephrotoxicity in male albino rats. World J Pharm Pharm Sci. 2015:706-15. https://www.wjpsonline.com/index.php/wjps/article/view/nephroprotective-vitex-negundo-cisplatin-induced-nephrotoxicity

[60] Gonde DP, Bhole BK, Kakad KS. Andrographolide, diterpenoid constituent of Andrographis paniculata: Review on botany, phytochemistry, molecular docking analysis, and pharmacology. Ann Pharm Fr. 2023:S0003-4509(23)00111-6. https://doi.org/10.1016/j.pharma.2023.10.001

[61] Roy S, Rao K, Bhuvaneswari CH, Giri A, Mangamoori LN. Phytochemical analysis of Andrographis paniculata extract and its antimicrobial activity. World J. Microbiol. Biotechnol.2010;26:85-91. https://doi.org/10.1007/s11274-009-0146-8

[62] Bharati BD, Sharma PK, Kumar N, Dudhe R, Bansal V. Pharmacological activity of Andrographis paniculata: a brief review. Pharmacologyonline. 2011;2(1):10.

[63] Yu BC, Chen WC, Cheng JT. Antihyperglycemic effect of andrographolide in streptozotocin-induced diabetic rats. Planta medica. 2003;69(12):1075-9. https://doi.org/10.1055/s-2003-45185

[64] Sheeja K, Shihab PK, Kuttan G. Antioxidant and anti-inflammatory activities of the plant Andrographis paniculata Nees. Immunopharmacol Immunotoxicol. 2006;28(1):129-40. https://doi.org/10.1080/08923970600626007

[65] Banerjee S, Kar A, Mukherjee PK, Haldar PK, Sharma N, Katiyar CK. Immunoprotective potential of Ayurvedic herb Kalmegh (Andrographis paniculata) against respiratory viral infections–LC–MS/MS and network pharmacology analysis. Phytochem. Anal.2021;32(4):629-39. https://doi.org/10.1002/pca.3011

[66] Mishra K, Dash AP, Swain BK, Dey N. Anti-malarial activities of Andrographis paniculata and Hedyotis corymbosa extracts and their combination with curcumin. Malar. J.2009;8(1):1-9. https://doi.org/10.1186/1475-2875-8-26

[67] Gour R. Boerhaavia Diffusa Linn Plant: A Review–One Plant with Many Therapeutic Uses. Int.J Pharm. Sci. Med.2021;6(4):25-41. https://doi.org/10.47760/ijpsm.2021.v06i04.003

[68] Mahesh AR, Kumar H, Ranganath MK, Devkar RA. Detail study on Boerhaavia diffusa plant for its medicinal importance-A Review. Res J Pharm Sci. 2012;1(1):28-36.

[69] Umamaheswari A, Nuni A, Shreevidya R. Evaluation of antibacterial activity of Boerhaavia diffusa L. leaves. Int. J. Green Pharm. 2010;4(2).75-78. https://doi.org/10.4103/0973-8258.63879

[70] Venkatesh P, Dinakar A, Senthilkumar N. Screening of hepatoprotective and antioxidant activity of alcoholic and aqueous extracts of Boerhaavia diffusa and anisochilus carnosus. Int. J. Pharm. Pharm. Sci. 2013;5(2):208-11.

[71] Bharali R, Azad MR, Tabassum J. Chemopreventive Action of Boerhaavia Diffusa on DMDA-induced Skin Carcinogenesis in Mice. Indian J. Physiol. Pharmacol. 2003;47(4):459-64.

[72] Nisha M, Vinod BN, Sunil C. Evaluation of Boerhavia erecta L. for potential antidiabetic and antihyperlipidemic activities in streptozotocin-induced diabetic Wistar rats. Future J. Pharm. Sci. 2018;4(2):150-5. https://doi.org/10.1016/j.fjps.2017.12.001

[73] Wu TS, Shi LS, Kuo SC. Alkaloids and other constituents from Tribulus terrestris. Phytochemistry. 1999;50(8):1411-5. https://doi.org/10.1016/S0031-9422(97)01086-8

[74] Chhatre S, Nesari T, Somani G, Kanchan D, Sathaye S. Phytopharmacological overview of Tribulus terrestris. Pharmacogn Rev. 2014;8(15):45. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3931200/

[75] Satvati SA, Shooriabi M, Amin M, Shiezadeh F. Evaluation of the Antimicrobial activity of Tribulus terrestris, Allium sativum, Salvia officinalis, and Allium hirtifolium Boiss against Enterococcus faecalis. Int. J. Enteric Pathog.2017;5(2):63-7. https://doi.org/10.15171/ijep.2017.15

[76] Abdulqawi LN, Quadri SA. Evaluation of Antibacterial and Antioxidant activities of Tribulus terrestris L. Fruits. Res J Pharm Technol. 2021;14(1):331-6. http://dx.doi.org/10.5958/0974-360X.2021.00061.5

[77] Oh JS, Baik SH, Ahn EK, Jeong W, Hong SS. Anti-inflammatory activity of Tribulus terrestris in RAW264. 7 Cells (54.2). J Immunol. 2012;188(1_Supplement):54-2. https://doi.org/10.4049/jimmunol.188.Supp.54.2

[78] Samani NB, Jokar A, Soveid M, Heydari M, Mosavat SH. Efficacy of the hydroalcoholic extract of Tribulus terrestris on the serum glucose and lipid profile of women with diabetes mellitus: A double-blind randomized placebo-controlled clinical trial. J Evid Based Complementary Altern Med.2016;21(4):NP91-7. https://doi.org/10.1177/2156587216650775

[79] Reshma PL, Binu P, Anupama N, Vineetha RC, Abhilash S, Nair RH, Raghu KG. Pretreatment of Tribulus terrestris L. causes anti-ischemic cardioprotection through MAPK mediated anti-apoptotic pathway in rat. Biomed Pharmacother. 2019;111:1342-1352. https://doi.org/10.1016/j.biopha.2019.01.033

[80] Torres MAO, de Fátima Braga Magalhães I, Mondêgo-Oliveira R, de Sá JC, Rocha AL, Abreu-Silva AL. One Plant, Many Uses: A Review of the Pharmacological Applications of Morinda citrifolia. Phytother Res. 2017;31(7):971-979. https://doi.org/10.1002/ptr.5817

[81] Inada AC, Figueiredo PS, Santos-Eichler RAD, Freitas KC, Hiane PA, Castro AP et al. Morinda citrifolia Linn. (Noni) and Its Potential in Obesity-Related Metabolic Dysfunction. Nutrients. 2017;9(6):540. https://doi.org/10.3390/nu9060540

[82] Jayaraman SK, Manoharan MS, Illanchezian S. Antibacterial, antifungal and tumor cell suppression potential of Morinda citrifolia fruit extracts. Int. J. Integr. Biol. 2008;3(1):44-9.

[83] Algenstaedt P, Stumpenhagen A, Westendorf J. The Effect of Morinda citrifolia L. Fruit Juice on the Blood Sugar Level and Other Serum Parameters in Patients with Diabetes Type 2. Evid Based Complement Alternat Med. 2018;2018:3565427. https://doi.org/10.1155/2018/3565427

[84] Lv L, Chen H, Ho CT, Sang S. Chemical components of the roots of Noni (Morinda citrifolia) and their cytotoxic effects. Fitoterapia. 2011;82(4):704-8. https://doi.org/10.1016/j.fitote.2011.02.008

[85] Wang MY, Peng L, Anderson G, Nowicki D. Breast cancer prevention with Morinda citrifolia (noni) at the initiation stage. Funct. Foods Health Dis. 2013;3(6):203-22. https://doi.org/10.31989/ffhd.v3i6.53

[86] Saminathan M, Rai RB, Dhama K, Jangir BL, Suresh S, Ranganath GJet al. Effect of Morinda citrifolia (Noni) fruit juice on antioxidant, hematological and biochemical parameters in N-methyl-N-nitrosourea (NMU) induced mammary carcinogenesis in sprague-dawley rats. Int. J. Pharmacol.2014;10(2):109-19. https://doi.org/10.3923/ijp.2014.109.119

[87] Uma G, Maheswari SU. Neuroprotective effects of polyherbal formulation (Indian) on noni scopolamine induced memory impairment in mice. Int. J. Pharm. Pharm. Sci. 2014;6(1):354-7.

[88] Shamsuddin T, Alam MS, Junaid M, Akter R, Hosen SMZ, Ferdousy S, Mouri NJ. Adhatoda vasica (Nees.): A Review on its Botany, Traditional uses, Phytochemistry, Pharmacological Activities and Toxicity. Mini Rev Med Chem. 2021;21(14):1925-1964. https://doi.org/10.2174/1389557521666210226152238

[89] Rashmi PA, Mathew L. Antimicrobial activity of leaf extracts of Justicia adhatoda L. in comparison with vasicine. Asian Pacific Journal of Tropical Biomedicine. 2012 Jan 1;2(3):S1556-60. https://doi.org/10.1016/S2221-1691(12)60452-3

[90] Patel VK, Venkatakrishna-Bhatt H. In vitro study of antimicrobial activity of adhatoda vasika Linn.(leaf extract) on gingival inflammation--a preliminary report. Indian J Med Sci. 1984; 38: 70-72

[91] Basit A, Shutian T, Khan A, Khan SM, Shahzad R, Khan A, Khan S, Khan M. Anti-inflammatory and analgesic potential of leaf extract of Justicia adhatoda L. (Acanthaceae) in Carrageenan and Formalin-induced models by targeting oxidative stress. Biomed Pharmacother. 2022;153:113322. https://doi.org/10.1016/j.biopha.2022.113322

[92] Kumar S, Singh R, Dutta D, Chandel S, Bhattacharya A, Ravichandiran V, Sukla S. In Vitro Anticancer Activity of Methanolic Extract of Justicia adhatoda Leaves with Special Emphasis on Human Breast Cancer Cell Line. Molecules. 2022;27(23):8222. https://doi.org/10.3390/molecules27238222

[93] Gulfraz M, Ahmad A, Asad MJ, Afzal U, Imran M, Anwar P, et al. Antidiabetic activities of leaves and root extracts of Justicia adhatoda Linn against alloxan induced diabetes in rats. Afr. J. Biotechnol.2011;10(32):6101.

[94] Dangi A, Patel S, Yaduvanshi PS. Phytochemical screening and assessment of Adhatoda vasica (Leaf) for antiasthmatic activity. Panacea j. pharm. pharm. sci. 2015; 4(3):680-704.

[95] Shrivastava N, Srivastava A, Banerjee A, Nivsarkar M. Anti-ulcer activity of Adhatoda vasica Nees. J. Herb. Pharmacother. 2006;6(2):43-9. https://doi.org/10.1080/J157v06n02_04

[96] Sathiyanarayanan L, Arulmozhi S. Mucuna pruriens Linn.-A comprehensive review. Pharmacogn Rev. 2007;1(1):157-162.

[97] Yadav MK, Upadhyay P, Purohit S, Pandey BL, Shah H. Phytochemistry and pharmacological activity of Mucuna pruriens: A review. Int. J. Green Pharm.2017;11(2):69-73.

[98] Rayavarapu AK, DSVGK K. Evaluation of antimicrobial activity of Mucuna pruriens on plant pathogens. Asian J. Biochem. Pharmaceut. Res. 2011, 2(1):593-600.

[99] Kumar DS, Muthu AK, Smith AA, Manavalan R. In vitro antioxidant activity of various extracts of whole plant of Mucuna pruriens (Linn). Int. J. Pharmtech Res. 2010;2(3):2063-70.

[100] Rachsee A, Chiranthanut N, Kunnaja P, Sireeratawong S, Khonsung P, Chansakaow S, Panthong A. Mucuna pruriens (L.) DC. seed extract inhibits lipopolysaccharide-induced inflammatory responses in BV2 microglial cells. J Ethnopharmacol. 2021;267:113518. https://doi.org/10.1016/j.jep.2020.113518

[101] Seetharamaiah S, Muddappa VS, Krishnaswamy MB, Vasappa RK. Antineoplastic Effects of Mucuna pruriens Against Human Colorectal Adenocarcinoma. Appl Biochem Biotechnol. 2023 Jul 3. https://doi.org/10.1007/s12010-023-04598-4

[102] Bhaskar A, Nithya V, Vidhya VG. Phytochemical evaluation by GC-MS and antihyperglycemic activity of Mucuna pruriens on streptozotocin induced diabetes in rats. J. Chem. Pharm. Res. 2011;3(5):689-96.

[103] Pandey A, Negi PS. Traditional uses, phytochemistry and pharmacological properties of Neolamarckia cadamba: A review. J Ethnopharmacol. 2016;181:118-35. https://doi.org/10.1016/j.jep.2016.01.036

[104] Islam T, Das A, Shill KB, Karmakar P, Islam S, Sattar MM. Evaluation of membrane stabilizing, anthelmintic, antioxidant activity with phytochemical screening of methanolic extract of Neolamarckia cadamba fruits. J. Med. Plant Res.2015;9(5):151-8. https://doi.org/10.5897/JMPR2014.5720

[105] Moe NS, Swar AK, Myint SH. A Study on Physicochemical Properties and Antimicrobial Activities of Phytochemical Constituents Extracted from the Stem Bark of Neolamarckia cadamba (Roxb.) Bosser (Ma-u) Maubin Universit Research Journal.2020;11:162-172. http://hdl.handle.net/20.500.12678/0000007109

[106] Pandey A, Negi PS. Phytochemical composition, in vitro antioxidant activity and antibacterial mechanisms of Neolamarckia cadamba fruits extracts. Nat. Prod. Res. 2018;32(10):1189-92. https://doi.org/10.1080/14786419.2017.1323209

[107] Bussa SK, Jyothi P. Antidiabetic activity of stem bark of Neolamarckia cadamba in alloxan induced diabetic rats. Int. J. Pharm. Technol. 2010;2(2):314-24.

[108] Das S, Shakya R, Mazumder A, Bhati K, Das MK. Evaluation of Hepatoprotective Potential of Stem Bark of Neolamarckia cadamba against Chloroform and Over dose of Iron Dextran Induced Hepatotoxicity in Experimental Swiss Albino Mice. Indian J. Pharm. Educ. Res.2022;56(1):191-8. https://doi.org/10.5530/ijper.56.1.22

[109] Razali S, Firus Khan AY, Khatib A, Ahmed QU, Abdul Wahab R, Zakaria ZA. An In Vitro Anticancer Activity Evaluation of Neolamarckia cadamba (Roxb.) Bosser Leaves' Extract and its Metabolite Profile. Front Pharmacol. 2021;12:741683. https://doi.org/10.3389/fphar.2021.741683

[110] Yuan HL, Zhao YL, Qin XJ, Liu YP, Yu HF, Zhu PF et al. Anti-inflammatory and analgesic activities of Neolamarckia cadamba and its bioactive monoterpenoid indole alkaloids. J. Ethnopharmacol. 2020;260:113103. https://doi.org/10.1016/j.jep.2020.113103

[111] Kallianpur SS, Gokarn RA, Rajashekhar N. Identity of Ṭankari (Physalis minima Linn.) in Ayurvedic classics: A literature review. Anc. Sci. Life.2016;36(1):6-11. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5255973/

[112] Lem FF, Yong YS, Goh S, Chin SN, Chee FT. Withanolides, the hidden gem in Physalis minima: A mini review on their anti-inflammatory, anti-neuroinflammatory and anti-cancer effects. Food Chem. 2022;377:132002. https://doi.org/10.1016/j.foodchem.2021.132002

[113] Nathiya M, Dorcus D. Preliminary phytochemical and anti-bacterial studies on Physalis minima Linn. Int. J. Curr. Sci. 2012;2012:24-30.

[114] Khan MA, Khan H, Khan S, Mahmood T, Khan PM, Jabar A. Anti-inflammatory, analgesic and antipyretic activities of Physalis minima Linn. J Enzyme Inhib Med Chem .2009;24(3):632-7, https://doi.org/10.1080/14756360802321120

[115] Singh SH, Parkash P. Evaluation of anti-oxidant activity of Physalis minima. Chem Sci Trans. 2014;3:1179-85.

[116] Sathis Kumar D, Raju SN, Harani A, Banji D, Rao KN, Banji O. Alpha-Glucosidase Inhibitory And Hypoglycemic Activities Of Physalis Minima Extract. Pharmacogn. J.2009;1(4):273-278.

[117] Leong OK, Muhammad TS, Sulaiman SF. Cytotoxic activities of Physalis minima L. chloroform extract on human lung adenocarcinoma NCI-H23 cell lines by induction of apoptosis. Evid.-based Complement. Altern. Med. 2011;2011:1-10. https://doi.org/10.1093/ecam/nep057

[118] Tammu J, Ramana KV, Thalla S. Antiulcer activity of methanolic extract of Physalis minima leaves. Int. J. PharmTech Res. 2013;5(2): 337-340.

[119] Joseph L, Ravi C. Physalis minima L. Fruit-A Promising Approach To Alzheimer's Disease. Pharmacol. Res. - Mod. Chin. Med.2022;2:100038. https://doi.org/10.1016/j.prmcm.2021.100038

[120] Ratdiya V, Aher A. Asparagus racemosus: a review on pharmacognostic characters, phytochemistry and pharmacological activities. Curr Trends Pharm Pham Chem. 2020;2(3):18-23.

[121] Alok S, Jain SK, Verma A, Kumar M, Mahor A, Sabharwal M. Plant profile, phytochemistry and pharmacology of Asparagus racemosus (Shatavari): A review. Asian Pac J Trop Dis. 2013;3(3):242–51. https://doi.org/10.1016/S2222-1808(13)60049-3

[122] Kamat JP, Boloor KK, Devasagayam TP, Venkatachalam SR. Antioxidant properties of Asparagus racemosus against damage induced by gamma-radiation in rat liver mitochondria. J Ethnopharmacol. 2000;71(3):425-35. https://doi.org/10.1016/S0378-8741(00)00176-8

[123] Patel LS, Patel RS. Antimicrobial activity of Asparagus racemosus wild from leaf extracts–a medicinal plant. Int. j. sci. res. publ. 2013;3(3):2250-3153.

[124] Uma B, Prabhakar K, Rajendran S. Anticandidal activity of Asparagus racemosus. Indian J. Pharm. Sci.2009;71(3):342-3, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2865803/

[125] Mitra SK, Prakash NS, Sundaram R. Shatavarins (containing Shatavarin IV) with anticancer activity from the roots of Asparagus racemosus. Indian J. Pharmacol.2012;44(6):732-6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3523501/

[126] Mangal A, Panda D, Sharma MC. Peptic ulcer healing properties of Shatavari (Asparagus racemosus Willd.).Indian J. Tradit. Knowl.2006:5(2):227-228. http://nopr.niscpr.res.in/handle/123456789/6843

[127] Hannan JM, Ali L, Khaleque J, Akhter M, Flatt PR, Abdel-Wahab YH. Antihyperglycaemic activity of Asparagus racemosus roots is partly mediated by inhibition of carbohydrate digestion and absorption, and enhancement of cellular insulin action. Br. J. Nutr.2012;107(9):1316-23. https://doi.org/10.1017/S0007114511004284

[128] Ahmad MP, Perween T, Singh S, Sinha R, Hussain A, Wahab S, Jha AK. Hepatoprotective activity of aspargus racemosus root extract on lipopolysaccharide induced oxidative stress in rats. Univers. J. Pharm. Res. 2019;4(1):7-11. https://doi.org/10.22270/ujpr.v4i1.232

[129] Iweala EJ, Uche ME, Dike ED, Etumnu LR, Dokunmu TM, Oluwapelumi AE, et al. Curcuma longa (Turmeric): Ethnomedicinal uses, phytochemistry, pharmacological activities and toxicity profiles-A review. Pharmacological Research-Modern Chinese Medicine. 2023;6:100222. https://doi.org/10.1016/j.prmcm.2023.100222

[130] Pandey G, Madhuri S. Pharmacological activities of Ocimum sanctum (tulsi): a review. Int J Pharm Sci Rev Res. 2010;5(1):61-6.

[131] Islas JF, Acosta E, Zuca G, Delgado-Gallegos JL, Moreno-Treviño MG, Escalante B, Moreno-Cuevas JE. An overview of Neem (Azadirachta indica) and its potential impact on health. J. Funct.

Foods.2020;74:104171. https://doi.org/10.1016/j.jff.2020.104171

[132] Sohel MD. Pharmacologicals and phytochemicals potential of Abutilon indicum: A Comprehensive Review. Am. j. biosci.2015;3(2-1):5-11. http://www.sciencepublishinggroup.com/j/ajbio

[133] Rahman S, Parvin R. Therapeutic potential of Aegle marmelos (L.)-An overview. Asian Pac. J. Trop. Dis.2014;4(1):71-7. https://doi.org/10.1016/S2222-1808(14)60318-2

[134] Alhassan AM, Ahmed QU. Averrhoa bilimbi Linn.: A review of its ethnomedicinal uses, phytochemistry, and pharmacology. J. Pharm. Bioallied Sci.2016;8(4):265. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5314823/

[135] Mahendran G, Rahman LU. Ethnomedicinal, phytochemical and pharmacological updates on Peppermint (Mentha × piperita L.)-A review. Phytother Res. 2020;34(9):2088-2139. https://doi.org/10.1002/ptr.6664

[136] El-Saber Batiha G, Magdy Beshbishy A, G Wasef L, Elewa YHA, A Al-Sagan A, Abd El-Hack ME et al. Chemical Constituents and Pharmacological Activities of Garlic (Allium sativum L.): A Review. Nutrients. 2020;12(3):872. https://doi.org/10.3390/nu12030872

[137] Priyadarshi A, Ram B. A review on pharmacognosy, phytochemistry, and pharmacological activity of Carica papaya (Linn.) leaf. Int. J. Pharm. Sci. Res.2018;9(10):4071-8. http://dx.doi.org/10.13040/IJPSR.0975-8232.9(10).4071-78

[138] Jamal G, Parveen R, Khan MA, Srivastava V, Mustafa S, Ahmad S, Husain SA. A Review on Valeriana wallichii: Chemical composition and pharmacological research. Curr. Tradit. Med. 2023 Aug 1;9(4):55-71. https://doi.org/10.2174/2215083808666220914123526

[139] Al-Snafi AE. The pharmacological activities of Cuminum cyminum-A review. IOSR J. Pharm.2016;6(6):46-65.

[140] Mahendran G, Verma SK, Rahman LU. The traditional uses, phytochemistry and pharmacology of spearmint (Mentha spicata L.): A review. J Ethnopharmacol. 2021;278:114266. https://doi.org/10.1016/j.jep.2021.114266

[141] Ahmad A, Husain A, Mujeeb M, Khan SA, Najmi AK, Siddique NA, Damanhouri ZA, Anwar F. A review on therapeutic potential of Nigella sativa: A miracle herb. Asian Pac. J. Trop. Biomed.2013;3(5):337-52. https://doi.org/10.1016/S2221-1691(13)60075-1

[142] Nille GC, Mishra SK, Chaudhary AK, Reddy KRC. Ethnopharmacological, Phytochemical, Pharmacological, and Toxicological Review on Senna auriculata (L.) Roxb.: A Special Insight to Antidiabetic Property. Front Pharmacol. 2021;12:647887. https://doi.org/10.1016/S2221-1691(13)60075-1

[143] Zahr S, Zahr R, El Hajj R, Khalil M. Phytochemistry and biological activities of Citrus sinensis and Citrus limon: An update. J. Herb. Med. 2023;41:100737. https://doi.org/10.1016/j.hermed.2023.100737

[144] Kumar P. A review on the pharmaceutical activity of Solanum surattense. GSC Adv. Res. Rev. 2021;7(3):038-44. https://doi.org/10.30574/gscarr.2021.7.3.0128

[145] Rambhau SS, Ravindra DP, Prasad P, Prabhakharrao DS. Phytochemical & Pharmacological activity of Agnimantha (Clerodendrum phlomidis linn. f)–A review. Int J Ayurvedic Herbal Med. 2014;4:1615-21.

[146] Srivastava S, Chandra D. Pharmacological potentials of Syzygium cumini: a review. J Sci Food Agric. 2013;93(9):2084-93. https://doi.org/10.1002/jsfa.6111

[147] Alam W, Khan H, Khan SA, Nazir S, Akkol EK. Datura metel: A Review on Chemical Constituents, Traditional Uses and Pharmacological Activities. Curr Pharm Des. 2021;27(22):2545-2557. https://doi.org/10.2174/1381612826666200519113752

[148] Roy A. Pharmacological activities of Indian Heliotrope (Heliotropium indicum L.): a review. J. pharmacogn. phytochem.2015;4(3):101-4.

[149] Singh N, Yadav SS, Kumar S, Narashiman B. Ethnopharmacological, phytochemical and clinical studies on Fenugreek (Trigonella foenum-graecum L.). Food Biosci. 2022;46:101546. https://doi.org/10.1016/j.fbio.2022.101546

[150] Balakrishnan R, Vijayraja D, Jo SH, Ganesan P, Su-Kim I, Choi DK. Medicinal profile, phytochemistry, and pharmacological activities of Murraya koenigii and its primary bioactive compounds. Antioxidants. 2020;9(2):101. https://doi.org/10.3390/antiox9020101

[151] Bhasin S, Singh M, Singh D. Review on bioactive metabolites of Withania somnifera.(L.) Dunal and its pharmacological significance. J. Pharmacogn. Phytochem. 2019;8(3):3906-9.

[152] Padayachee B, Baijnath HJ. An updated comprehensive review of the medicinal, phytochemical and pharmacological properties of Moringa oleifera. S. Afr. J. Bot.2020;129:304-16. https://doi.org/10.1016/j.sajb.2019.08.021

[153] Sánchez M, González-Burgos E, Iglesias I, Gómez-Serranillos MP. Pharmacological Update Properties of Aloe Vera and its Major Active Constituents. Molecules. 2020;25(6):1324. https://doi.org/10.3390/molecules25061324