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PHARAMACOLOGICAL ACTIVITIES OF SELECTED MEDICINAL PLANTS - A REVIEW

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ABSTRACT

The focuses on the medicinal plants were increased all over the world due to its immense potential in controlling several diseases from ancient civilization. The present review documented on the Morphological distribution, Phytochemicals, Traditional medicine and Pharmacological activities in selected medicinal plants. Medicinal plants under the review are *Plumbago zeylanica, Curculigo orchioides, Tinospora cordifolia, Semecarpus anacardium* and *Asparagus racemosus* which contribute in several poly herbal formulations. The pharmacological effects may be mainly due the presence of its principle active components and several secondary metabolites.

Keywords: Medicinal plants, antioxidants, Phytochemistry, Secondary metabolite.

INTRODUCTION

Medicinal plants are from the dawn of civilization to combat diseases and have been considered as a valuable and cheap source of unique phytoconstiutents for the human society. They are used extensively in the development of drugs against various diseases [1]. In the ethno medical advance, credence is given to written or oral information on medicinal use of the plant and based on the information for the plants collected and evaluated for the drug discovery process [2]. A retrospective analysis of the NCI program described that the proportion of active medicine was substantially based on taxonomy [3]. In the last few decades, the field of herbal medicine is getting popularized in both developed and developing countries. This is because the herbal medicines are cheap, natural origin with higher safety margins and lesser or no side effects [4].

Selected plants under the review

Plumbago zeylanica

Taxonomical description

Kingdom: Plantae
Family : Plumbaganaceae
Order: Plumbaginales
Genus: *Plumbago*
Species: *zeylanica*

Morphological description

The plant is an evergreen small, perennial shrub which grows upto the height of 3-4 feet. The leaves are simple, alternate, oblong, spirally arranged, hairy margin, pointed to the tip. The flowers are white in color, 10-25 cm long [5] .The fruits are like a small cocklebur with glue on the soft spines. The root is stout, cylindrical, blackish red in color with a pungent odor [6].

Traditional medicine

Plumbago zeylanica has been reported to be used in variety of folk medicine in Africa and Asia. Traditionally, *P. zeylanica* is used to kill intestinal parasites, anemia due to stagnant blood, external as well as internal trauma and malignant furunculous scabies [7]. In India it is usually used to treat fever or malaria. It is used as an irritant of the skin in the treatment of leprosy, dyspepsia, piles, diarrhea and skin diseases [8]. It has been specially recommended in the treatment of rheumatism [9].

Phytochemistry

Based on the literature survey several phytochemicals isolated are Naphthoquinones, Binapthoquinones [10], Coumarins, Steroid glycosides [11], Di-phenyl sulfone [12], Carboxylic acid and Esters [13], Triterpenoids [14], Meroterpenes [15], Sugars [16] etc.,

The root is the chief medicinal property of the plant that contain several alkaloids such as plumbagin, a natural napthaquinone (5-hydroxy-2-methyl-1,4-aphthoquinone),chitranone, zeylanone, plumbazeylanone, 2- methyl naphthaquin, dihydrosterone, lupeol and teraxesterol.

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Pharmacological activity

The root of this plant and its constituents are accredited with several therapeutic properties including anti atherogenic, cardiotonic, hepatoprotective, neuro protective and central nervous system stimulating properties [17].

Antidiabetic activity

The ethanolic extract of root of *P. zeylanica* offers a strong hypoglycemic effect and antioxidant protection in streptozotocin induced diabetic rats [18].

Antiallergic properties

The antiallergic properties of the 70% ethanol extract from *Plumbago zeylanica* stem (EPZ) were investigated. EPZ inhibits mast cell-dependent immediate allergic reactions, which is probably mediated by histamine from mast cells via elevating intracellular cAMP level and thus weaken the inflammatory action of mediators [19].

Antihyperlipidaemic activity

In hyperlipidaemic rabbits plumbagin, isolated from roots of *P. zeylanica* reduced the serum cholesterol and Low Density Lipoproteins. Plumbagin treated hyperlipidaemic subjects prevented the accumulation of triglycerides and cholesterol in liver and aorta and lowered atheromatous plaques of thoracic and abdominal aorta [20].

CNS activity

In rats the effects of 50% ethanol extract from *P. zeylanic*a roots were tested on locomotoric behavior and central dopaminergic activity. The extracts significantly raised the spontaneous motility of the animals. The root extracts enhanced the spontaneous ambulatory activity without inducing stereotypic behavior [17].

Antileishmanial activity

The study by Mishra discloses strong *in vitro* antileishmanial activity of 2-methyl-5 (3'-methyl-but-2'-enyloxy)-[1, 4] naphthoquinone isolated from *Plumbago zeylanica* [21].

Anticancer activity

The ethanolic extract of *Plumbago zeylanica* Linn possess significant anticancer activity and also reduces the level of lipid peroxidation. This is mainly due to higher content of terpenoids and flavonoids in Ehrlich ascites carcinoma in animal model.

The anticancer effect of plumbagin was investigated *in vivo* using NB4 tumor xenograft in NOD/SCID mice. The results indicate that plumbagin has potential as a novel therapeutic agent for myeloid leukemia [22]. Plumbagin exerted anticancer activity by the induction of apoptosis on non-small cell lung carcinoma cells by modulating the pro-survival and pro-apoptotic signaling pathway [23].

Semecarpus anacardium

Taxonomical description

Kingdom: Plantae
Family: Anacardiaceae
Order: Sapindales
Genus: *Semecarpus*
Species: *anacardium*

Morphological Description:

It is a moderate-sized deciduous tree grows upto 3500 ft height [24]. Leaves are simple, alternate, oblong, long , rounded at the apex coriaceous glabrous. The flowers are greenish white, in panicles. The nut is about 2.5 cm long, ovoid and smooth lustrous black. The fruit ripens appears ovoid or oblong drupe shining black. The bark is grey in color and exudes an irritant secretion on incising [25].

Phytochemistry

The most significant components of ***S. anacardium*** Linn. are bhilwanols, phenolic compounds[26], biflavonoids [27], Glycosides and sterols[28]. Other components isolated are Anacardoside [29], Semecarpetin [30], Semecarpuflavanone [31], Anacarduflavone [32] etc.,

Traditional medicine

In traditional medicine, *Semecarpus anacardium* is used to treat ailments including skin infections and non-infectious conditions of the skin. It also been used to treat ringworms, psoriasis, eczema and corns.

Seeds are generally boiled in milk and the milk is consumed to treat several ailments. Externally, the oil is applied on wounds to prevent pus formation, better healing of wounds in glandular swellings and filariasis [33]. Traditional ayurvedic practitioners used this herb to cure reproductive complaints (low sperm count and painful menstruation). It is also effective for nervous complaints (forgetfulness, dementia and psychological trauma). The herb has been used to support digestion and improve the appetite [34].

Pharmacological activity

Antihyperlipidaemic activity

The cardiac activity of *Semecarpus anacardium* (SA) generally reduces the tissue and serum hyperlipidemia by the inhibition of intestinal cholesterol absorption coupled with peripheral disposal thus possessing anti-atherosclerotic activity [35].

CNS activity

Farooq *et al*. evaluated the therapeutic effect of SA nuts, extracted with milk, mainly for its locomotor and nootropic activities in experimental animal models. The extract showed a slight CNS depressant effect on 150 mg/kg [36].

Antiatherogenic effect

Atherosclerosis is the developmental imbalance between the pro-oxidants and antioxidants. To prevent such condition, antioxidant therapy is beneficial. Sharma *et al*. demonstrated the cardiac activity of SA, as it generally reduces the serum and tissue hyperlipidemia level by the

inhibition of intestinal cholesterol absorption. This coupled with peripheral disposal thus possessing anti-artherosclerotic activity. It is possible that the beneficial antiatherogenic effect may be related to its antioxidant, anticoagulant, hypolipidemic and platelet anti-aggregation properties [35].

Anti-inflammatory activity

The different solvent extracts of fruits of SA were tested to study the anti-inflammatory activity by carrageenan-induced paw edema in albino rats. The results showed significant anti-inflammatory activity comparable to aspirin (reference standard) [37].

Immunomodulatory activity

The immunomodulatory potency, antioxidative, glucose level restoring and mineral regulation properties of SA nut extract in hepatocellular carcinoma induced by aflatoxin B_1 in animals [38].

Antiarthritic activity

The antiarthritic activity was proved in the chloroform extract of *Semecarpus anacardium* nuts significantly reduced acute carrageenan-induced paw edema in rats and also active against the secondary lesions produced by adjuvant-induced arthritis [39].

Anticancer activity

The biochemical basis of anticarcinogenesis potency of *Semecarpus anacardium* was studied using Aflatoxin-B1 induced hepatic carcinoma in rats [40]

Nephrotoxicity

Prabhu *et al*. studied the antimutagenic effect of SA under **in vivo** condition. The action of SA oil extract has definite beneficial role against mitomycin-C induced mutagenic role [41]. In other study, Krishnarajua *et al*. found that aqueous extracts of SA was found to be effective when screened for the cytotoxicity activity using brine shrimp lethality test [42].

Curculigo orchioides

Taxonomical description

Kingdom: Plantae
Family: Hypoxidaceae
Order: Asparagales
Genus: *Curculigo*
Species: *orchioides*

Morphological description

It is a perennial shrub having short or elongated fleshy roots. Leaves are 6 to 18 inch in length and half to one and half inch broad. It is speared shaped and bears stripes on it. The apex of the leaves is rooting. Flowers are 1 inch in length, half to two-third inch in diameter, shiny and are just above the ground. Fruit is half inch in length, capsulated, ovate in shape contains 1 to 4 seeds in it. Seeds are shiny, oblong in shape, one-eighth inch long, striped and sharp at the apex and base. Rhizome is 1 feet in length and is pulpy [43].

Phytochemistry

The rhizome has been reported to contain different types of compounds such as Curculigoside A_C [44],Curculigosaponins A_M [45], Orcinol glycoside [46], 2, 6-dimenthoxyl benzoic acid [47] and Orchiosides A and B [48], Tannin, Resin and alkaloid [49].The secondary metabolites from the rootstock has been identified as 5, 7-dimethoxy glucopyranoside (flavones glycoside) and also numerous fatty acids from *C. orchioides* root oil [50]. They are palmitic, oleic, linolenic, linoleic, arachidic and behenic acid.

Curculigoside (phenolic glycoside) from the rhizomes and its structure has been elucidated as 5-hydroxy- 2-0-b-d-glucopyranosyl benzl 1, 2, 6-dimethoxy benzoate [51](Misra *et al.*, 1984). The dried rhizomes of *Curculigo orchioides* yielded phenolic glycosides, curculigoside, orcinol-beta-D-glucoside, cycloartane saponins, curculigosaponin G and curculigosaponin I.

Traditional medicine

The plant has been named as safed musli in ayurvedic formulations. The juice of the plant tuber mixed with the juice of *Allium sativum* used to cure blindness and white spot on the eye ball. Rhizomes have been reported to be useful in asthma [52].The plant also holds the reputation of being a demulcent, diuretic, tonic and aphrodisiac.

Rhizomes are prescribed in the treatment of piles, jaundice, asthma, diarrhea and gonorrhea [43]. Rhizomes have been claimed for the anti diabetic properties in various studies [53]. It is claimed to be a medical cure for piles, asthma, jaundice, diarrhoea, colic, gonorrhea and to be a aphrodisiac [54].

Pharmacological activity

Anticonvulsant and antioxidant

Ethanolic extract of *C.orchioides* has been reported to have anticonvulsant, sedative and androgen-like effect and also adaptive effects (hypoxia and hyperthermia) [55]. Methanolic extract of *Curculigo orchioides* (MEC) was investigated using carbon tetrachloride (CCl_4)-intoxicated rat liver as the experimental model reported the antioxidant property [56].

Anti-inflammatory and Antihepatoxic activity

The efficacy of methanolic extract of *C. orchioides* in combating oxidative stress by hepatic damage [57].The study was performed by Sae-kang ku and his colleagues to examine the effects of *Curculigo orchioides* (curculiginis rhizome) on acute reflux esophigitis (RE) in rats that are induced by pylorus and forestomach ligation operation. Anti-inflammatory and protective effects of the extract of *C. orchioides* could decrease the severity of reflux esophagitis and control esophageal mucosal damage [58].

Estrogenic activity

Ethanolic extract of rhizome possesses estriogenic activity as it showed a significant increases the vaginal cornification, uterine wet weight ($p<0.01$), uterine glycogen content ($p<0.01$) and a proliferation changes [59].

Anti osteoporotic activity

The ethanolic extract of the plant showed potential antiosteoporosis activity as it prevented bone loss in the trabecular bone of the tibia in ovariectomized rats [60].

Antiasthmatic activity

Ethanol extract of *Curculigo orchioides* showed effectiveness against histamine-induced contraction. *Curculigo orchioides* showed significant protection at lower doses while further increase in the dose level showed reduced activity [61].

Anti cancer activity

The anticancer activity of *C. orchioides* in indigenous system of medicine as a tonic and also reported as an ayurvedic food supplement against DMBA (dimethyl benz anthracene) induced mammary tumours [62].

Immunostimulant activity

The methanolic extract of the rhizome has been shown to enhance the phagocytic activity of macrophages. The pure glycoside fraction of the rhizome has been found to stimulate immune response by acting both on macrophages and lymphocytes [63]. Immunostimulant activity of *C. orchioides* has also demonstrated [64].

Asparagus racemosus

Taxonomical description

Kingdom: Plantae
Family: Asparagaceae
Order: Asparagales
Genus: *Asparagus L.*
Species: *racemosus*

Morphological description:

A. racemosus is plant with a woody stem has needle like leaves with small white flowers [65], Scandant, much branched spinous under shrub with tuberous, short root, stock bearing numerous fusiform tuberous roots, thick leaves reduced to minute chaffy scales & spines. Cladodes acicular 2-6 hate, falcate finely acuminate flower white, berries 7mm in diameter, globose, 1-seeded, red [66].

The air dried roots are tuberous, elongated and tapering at both the ends, up to 30-100 cm long. The fresh roots are fleshy and white in color; while on drying it become shrinked, longitudinal ridges appeared and the color turned to light brown. Outer surface of the fresh root is soft and contains epidermal hairs. Taste is mucilaginous, fracture brittle. Roots are cylindrical, fleshy tuberous straight or slightly curved, tapering towards the base and swollen in the middle, white buff colour,5- 15cm in length 1-2 cm diameter [67].

Phytochemistry

Steroidal saponins, known as shatvarins. Shatvarin I-VI compounds are present.

Shatvarin I is the chief glycoside with the combination of 3-glucose and rhamnose moieties attached to sarsapogenin [68]. Shatavarin V, Asparinins, Asparosides, Curillins, Curillosides have also been reported [69].Furan compound-Racemofuran [70]. Flavonoids- Glycosides, hyperoside, rutin and quercitin are present in flower and fruits[71]. Polycyclic alkaloid- Aspargamine A, a cage type pyrrolizidine alkaloid[72].

The isolation and characterization of asparagamine-polycyclic alkaloid [73], a new 9, 10-dihydrophenanthrene derivative named racemosol and kaempferol were also isolated from the ethanolic root extract of *A. racemosus* [74].

Pharmacological activity

The plant has several pharmacological properties like antioxidant, immunostimulant, antidyspepsia and antitussive effects [75].

Antiabortifacient activity

The Antiabortifacient activity of *A.racemosus* roots are recommended in cases of threatened abortions. This activity is due to Shatavarin-I [74]. The polycyclic alkaloid asparagamine A is also reported to have an antioxytocic action, showing an antiabortifacient affect [76].

Immunomodulating property

Immunomodulating property of *A. racemosus* has been shown to protect the rat and mice against experimental induced abdominal sepsis [77].

Anticancer activity

The anticancer activity of shatavarins (containing shatavarin IV) isolated from the roots of *A.racemosus* (Wild) exhibited significant effect *in vitro* and *in vivo* in experimental models [78].

Antiulcer activity

A. racemosus was more effective in reducing gastric ulcer in indomethacin-treated gastric ulcerative rats [79].

Analgesic and antidiarrhoeal properties

The evaluation of analgesic and antidiarrhoeal properties of the ethanol extract of whole plant of *A. racemosus* carried out by Karmakar *et al.* The study showed that analgesic activity of the plant increased the mean latent period and decreased the frequency of defecation[80].

Notropic effect

A. racemosus root extract has been reported to generate positive ionotropic and chronotropic effect on frogs heart with lower doses and cardiac arrest with higher doses [81].Alcoholic extract of root of *A. racemosus* has been shown to significantly reduce the enhanced levels of transaminase and alkaline phosphatase in $CC1_4$-induced hepatic damage in rats [82].

Tinospora cordifolia

Taxonomical description

Kingdom: Plantae

Family: Menispermaceae
Order: Ranunculales
Genus: *Tinospora Miers*
Species: *cordifolia*

Morphological description

It is an under-shrub, climbs up to 1-3 m high, with stout and creeping root stock. The root occurs in fascicle or clusters at the base of the stem with succulent and tuberous rootlets. The stem is scandent, woody, striate and climbing. The young stem is delicate, brittle and smooth. The spines are long, sub-recurved or straight [83, 84].The flowers are simple or branched racemes of 3 cm long. The pedicel is slender and jointed in the middle. The anthers minute and purple. Perianth lobes white, fragrant and 3 mm in length. The berry is globular or obscurely, three lobbed, purple-reddish [85].

Phytochemistry

Three major groups of compounds include protoberberine alkaloids, terpenoids and polysaccharides [86].Tinosporoside, cardioside, berberine and cordiofolioside were isolated from the plant leaves [87] , 3(a, 4-dihydroxy-3-methoxybenzyl)-4-(4-hydroxy-3-methoxybenzyl)a lignin isolated [88].

Traditional medicine

Powder of *Terminalia chebula* , *Tinospora cordifolia* and *Trachyspermum ammi* in equal quantity is administered orally, once daily with salt for the treatment of cough . Decoction of these drugs is also to be taken for the treatment of cough by the people of Haryana. Paste of *T. cordifolia* and *Piper nigrum* is administered orally once daily for leucorrhoea .The inhabitants of Uttar Pradesh take the juice of stem orally with honey for the treatment of asthma [89]. The tribals of Bombay uses *T. cordifolia* as drug in the treatment of fever, jaundice, chronic diarrhoea and dysentery [90].

Pharmacological activity

Anticonvulsant activity

The anticonvulsant activity of Petroleum ether and ethanol extracts of *Tinospora cordifolia* (TC) was carried out using supramaximal electric shock method in rats. The Ethanolic extract of *Tinospora cordifolia* possesses significant anticonvulsant property [91].

Hypoghlycaemic activity

The mechanism of anti-diabetic activity of TC may be through some peripheral machinery such as increasing the glycogen storage in the liver or decreasing the glucose release from the liver [92].

Anti-inflammatory activity

The decoction of *T. cordifolia* showed anti-inflammatory activity on carrageenin-induced hind paw oedema in rats [93] . The effect of extract of stem of *T. cordifolia* was studied on the contractile response due to various agonists (such as histamine, 5-HT, bradykinin, prostaglandin E_1 and F_{2a}, cholinomimetics and KCl) on smooth muscles [94].

Antiulceration- property

The root of *T. cordifolia* was observed to induce a marked protective action against restrain stress induced ulcerization when compared to diazepam [95].

Anti-psychotropic activity

An herbal psychotropic preparation BR-16A containing *T. cordifolia* was investigated in short term memory paradigms in mice. The results suggest for possibly nootropic action of BR-16A involving cholinergic and GABAergic modulation [96].

Immunobiological activities

T. cordifolia has been studied for their effect on intra-abdominal sepsis to elucidate host defense mechanism to counter infective stress. The results indicate that *T. cordifolia* has immunomodulating properties [97].

Liver disorders

The drug was also studied against the hepatic damage induced by carbon tetra chloride-standard hepatotoxin. It was very effective in preventing fibrous alteration and inducing regeneration by paranchymal tissue [98].

Anti-HIV effects

TC has been shown to demonstrate a decrease in the persistent resistance of HIV virus thus improving the therapeutic effect. An anti-HIV effect of TC was revealed by reduction in eosinophil count, Hb count, stimulation of macrophages and B lymphocytes and polymorphonuclear leucocytes thus, revealing its promising role of application in management of the disease [99].

CONCLUSION

Herbal medicines are popularized as a solution for maintaining health and for the treatment for several diseases rather than allopathic medicine. The plants under the present study reviewed the phytochemicals responsible for several disease and these plants plays the crucial role in the preparation of several polyherbal formulations in siddha, Ayurveda and Unani medicines. The confidence in herbal medicines is backed by their long term usage and less toxicity but its toxicity plays a beneficial role in several diseases including cancer , arthritis etc., Furthermore, the combinations of these plants in controlling major diseases is to be carried out for the non-toxic herbal formulations.

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