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REVIEW ARTICLE

Sphaeranthus indicus Linn- A Phytopharmacological review

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ABSTRACT:

The medicinal plants are widely used by the traditional medicinal practitioners for curing various diseases in their day to day practice. In traditional system of medicine, different parts (Leaves, stem, flower, seeds and even whole plant) of *Sphaeranthus indicus* Linn have been used to treat various diseases. It has also been suggested to possess recommended as antidiabetic, hepatoprotective, anti-inflammatory, antioxidant, antihyperlipidemic, anxiolytic, anticonvulsion, antipyretic, psychotropic, anti diarrhoeal activity. According to ayurveda it is used laxative, digestible tonic, and as anthelmintic. The active constituents present in *Sphaeranthus indicus* L. have been found to be largely responsible for the therapeutic potentials. The pharmacological studies reported in the present review confirm the therapeutic value of *Sphaeranthus indicus* L. The results of the above studies support the use of this plant for human and animal disease therapy and reinforce the importance of the ethno botanical approach as a potential source of bioactive substances.

Keywords: *Sphaeranthus indicus* L., ethno botanical approach, active constituents

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INTRODUCTION

Herbal medicines are in great demand in the developed as well as developing countries for primary healthcare because of their wide biological and medicinal activities, higher safety margins and lesser costs. *Sphaeranthus indicus* is a plant species belonging to the genus Sphaeranthus, family Asteraceae. It is a spreading aromatic herb with spreading glandular hairy stem and branches with purple or pink flowers. Stems with toothed wing, leaves alternate, toothed. Flowers are terminal, globose, violet head inflorescence. It is also known as East Indian globe thistle (English), Mundi, gorkhmundi (Hindi Bengali, Marathi & Gujrati), Adakkamaniyan (Malayalam) boddatarupa, boddasoramu (Telugu). The Sanskrit word mundi literally mean that which cuts off or wards off. In ancient scriptures it is mentioned to be one of the best herbs, used as medhya rasayana – intellect promoting herb. It has various synonyms in Samhitas like sravani, tapodhana, pavani, bhiksu, tikta, sravana sirsaka etc. Another bigger variety of this plant is called as vahamundi, which has few synonyms like lobhaniya and chhinna granthinika. Mundi is a very potent rejuvenative useful in vata diseases. Along with, being a nervine in property is used in mental debility, epilepsy, migraine etc, with great benefit.

Species identity Taxonomy:

Current Name: *Sphaeranthus indicus*

Family: Asteraceae

Sanskrit Synonyms:

Hapusha, Mundi, Sravani, Alambusha, kadambapushpi

Common Names

Sanskrit: Mahamundi

Hindi Bengali, Marathi & Gujrati: Gorkhmundi

Telugu: Boddatarupa, boddasoramu

Tamil: kotakk aranthai

Malayalam: Adakkamaniyan

Punjabi: Kham adrus

Ayurvedic Properties

Rasa: Madhura, Tikta

Guna: Lakhu

Virya: Ushna

Vipaka: Madhura

General properties

Mundi is pungent, bitter and sweet in taste, pungent in the post digestive effect and has hot potency. It alleviates kapha and vata doshas. It possesses light and dry attributes. It is a nervine, diuretic, vermicide and a blood purifier. It is used in various diseases like skin affections, filariasis, epilepsy, anemia, obesity, diseases of the anal and canal and vagina etc.

Botanic Description

A spreading aromatic herb with spreading glandular hairy stem and branches with purple or pink flowers. Stems with toothed wing, leaves alternate, toothed. Flowers are terminal, globose, violet head inflorescence.

General Uses

The whole plant and flowers have great medicinal value and are used for medicinal purpose. The plant is used both, internally as well as externally. The application of the paste of its whole plant externally is beneficial in conditions associated with edema and pain, like arthritis, filariasis, gout and cervical adenopathy. Internally mundi is useful in vast range of diseases. The leaves juice mixed with black pepper powder, is an effective remedy for migraine. Mundi is a keen stimulant for digestive system. It works well as an appetizer, digestant, laxative vermicide and liver stimulant, hence, beneficial in anorexia, dyspepsia, constipation, worm infestations, piles, splenomegaly and hepatitis. It is also used internally in gout; it relieves the blocked phlegm in bronchial asthma, cough and eases the problem. It is a drug of choice for vata diseases. Mundi is extremely useful in epilepsy, mental debility and as a nervine tonic. The medicated oil of its roots is salutary as an aphrodisiac. The fresh juice of roots is given along with equal amount of buttermilk in treating tumours. Mundi is also useful in fever, diabetes, urinary ailments and dermatoses. It is a blood purifier and stimulant to the heart, hence used in cardiac debility, associated with edema.

CHEMICAL CONSTITUENTS IN *SPHAERANTHUS INDICUS*

An alkaloid, Sphaeranthine, has been isolated from *Sphaeranthus indicus*. A volatile oil, obtained by steam distillation of the fresh plant, has also been obtained. The isolation and purification of these two principles are described and their physical and chemical properties reported.

A novel flavonoid C-glycoside, 5-hydroxy-7-methoxy-6-C-glycosylflavone, was isolated from the aerial part of *Sphaeranthus indicus*. Its structure was elucidated by spectroscopic methods.

Two new eudesmanolides, along with one known eudesmanolide and two sesquiterpenoids, cryptomeridiol and 4-epicryptomeridiol, have been isolated from *Sphaeranthus indicus*. The structures of the new compounds have been established by spectral methods, and in one case by chemical correlation.

Chemical constituents of the flowers of *Sphaeranthus indicus* (Compositae), which afforded four new sesquiterpenes one new sesquiterpene glycoside, one known sesquiterpene, and one known steroid. The new compounds were identified as 11a, 13-dihydro-3a-(B-glucopyransoyl), 7a-hydroxyfrullanolide, 11a, 13-dihydro-7a-hydroxy-13-methoxyfrullanolide, 7a-hydroxyeudesm-4-ene-6, 12-B-olide, 11a, 13-dihydro-7a-13-dihydroxyfrullanolide, 11a-13-dihydro-3a-7a-dihydroxyfrullanolide while the known are caryophyllene-a-oxide and 24S-stigmasta-5, 22E-diene-3B-ol.

7 alpha -hydroxyfrullanolide, 7 alpha -hydroxyeudesmanolide, and dihydrocholesterol were isolated from the *Sphaeranthus indicus* extract.

BIOLOGICAL AND PHARMACOLOGICAL ACTIVITIES OF *SPHAERANTHUS INDICUS*

Anti-inflammatory Activity

The anti-inflammatory activity was studied in carrageenan induced acute inflammation and Formalin induced chronic inflammation and Cotton Pellet-Induced Granuloma Sub-Acute Inflammation. The various extracts at a dose of 200 mg/kg and 400 mg/kg body weight showed

comparable anti-inflammatory activity was studied in carrageenan induced acute inflammation, Formalin induced chronic inflammation and Cotton Pellet-Induced Granuloma Sub-Acute Inflammation in Rats.

The present experimental protocols showed that the *Sphaeranthus indicus* (Whole Plant) individually elicited a significant anti-inflammatory activity in carrageenan (acute), cotton pellet granuloma (sub-acute) and Formalin (Chronic) induced paw edema rat models. The anti-inflammatory activities of all extracts of *Sphaeranthus indicus* Linn are validated through acute, sub-acute and chronic inflammatory models in rats. In all the three models of the anti-inflammatory effects against carrageenan, cotton pellet and Formalin induced paw edema in rats are in a dose dependent manner. The activities of all extracts are comparable with Diclofenac sodium and hence it is useful in the treatment of inflammation associated disease like arthritis. The anti-inflammatory activity possessed by the *Sphaeranthus indicus* Whole Plant extracts is being reported for the first time. The phytochemical investigation of the plant revealed the presence of flavonoids, terpenoids, and carbohydrates. The flavonoids are known to possess anti-inflammatory activity by inhibiting the cyclooxygenase responsible for synthesis of inflammatory prostaglandin. Thus it can be concluded that, the anti-inflammatory activity of the *Sphaeranthus indicus* extracts is attributed to the kinin and prostaglandin biosynthesis enzyme inhibiting property of flavonoids present. Through a series of studies, there is no doubt that the *Sphaeranthus indicus* Linn is very useful in the treatment of inflammation and inflammation associated diseases like arthritis.

Anti-diabetic activity

The effect of single oral administration of petroleum ether extracts of *Sphaeranthus indicus* flower head. Experimental studies reveals that the petroleum ether extracts from *Sphaeranthus indicus* flower head (50, 100 and 200 mg/kg) orally administered produced a significant decrease in the blood glucose level in the model of alloxan-induced diabetes in rats. Maximum reduction in cytotoxic action of alloxan is mediated by reactive oxygen species, with a simultaneous massive increase in cytosolic calcium concentration, leading to a rapid destruction of beta cells. Experimental studies reveal that the petroleum ether extracts from *Sphaeranthus indicus* flower head (50, 100 and 200 mg/kg) orally administered produced a significant decrease in the blood glucose level in the model of alloxan-induced diabetes in

rats. It also proves the traditional claim with regard to *Sphaeranthus indicus* for its anti-diabetic activity.

Hepatoprotective activity.

The methanolic extract of *Sphaeranthus indicus* was observed to exhibit hepatoprotective effect as demonstrated by a significant decrease in liver function markers and also serum bilirubin concentrations and by preventing liver histopathological changes in rats induced with hepatotoxicity. Moreover, the methanolic extract of *Sphaeranthus indicus* enhanced the activities of antioxidant enzymes (SOD, CAT, and GPx) and diminished the amount of lipid peroxides against acetaminophen induced hepatotoxicity in these animals, suggesting the reduction of oxidative stress in this scenario plays a role in mechanism of its hepatoprotective effect. acetaminophen-induced hepatotoxicity. In the present study, the data suggested that high dosage of acetaminophen in the liver could lead to decreased level of anti-oxidant enzymes (SOD, CAT, GPx) and present a significant level of hepatotoxicity in the course of treatment. However, the methanol extract of *Sphaeranthus indicus* could raise the level of SOD, CAT, and GPx against the –induced oxidative stress mediated by ROS and RNS. Furthermore, the level of MDA was increased in the group receiving acetaminophen administration, but pretreatment with the methanol extract of *Sphaeranthus indicus* reduced the amount of MDA. This result indicated the decreasing the formation of lipid peroxidation is also one of the event of preventing the oxidative toxicity by acetaminophen. In conclusion the present study has demonstrated that methanolic extract of *Sphaeranthus indicus* has hepatoprotective effect against acetaminophen-induced hepatotoxicity in rats. Interestingly the more active hepatoprotective compound of *Sphaeranthus indicus* appears to exist in methanolic extract and not more in aqueous fraction, which could include flavonol and flavonoid. The enhanced level of antioxidant enzymes and reduced amount of lipid peroxides are suggested to be the major mechanism of *Sphaeranthus indicus* methanolic extract in preventing the development of liver damage induced by acetaminophen.

Psychotropic activity.

The hydroalcoholic extract of *S. indicus* having some potent neuropharmacological activity. The hydroalcoholic extract of *Sphaeranthus indicus* significantly reduced spontaneous motor

activity and prolonged pentobarbital induced hypnosis. It might be working as mild neurosedative agent. The hydroalcoholic extract of *Sphaeranthus indicus* also reduced exploratory behavior and decrease the sedative activity.

Anxiolytic activity

The animals receiving extracts or diazepam (1mg/kg) showed an increase in the time spent, percent entries and total entries in the open arm of the elevated pulse maze (EPM); increased ambulation, activity in the center and total locomotion in the open field test (OFT) and decreased fighting bouts in the foot-shot induced aggression suggesting anxiolytic activity. Petroleum ether extract (10mg/kg), alcoholic extract (10mg/kg) and water extract (30mg/kg) of the flowers of *Sphaeranthus indicus* resulted in prominent activity in the mice. Petroleum ether extract (10mg/kg) resulted in more prominent anxiolytic activity in the EPM and OFT than ethanolic and water extracts but was less than as produced by diazepam (1mg/kg).

Antimicrobial activity.

The chloroform extract of *Sphaeranthus indicus* exhibited comparably more activity against *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Klebsiella sp.*, *Candida albicans* and *Cryptococcus neoformans* than the ethanol and petroleum ether extract. The herb is reported to be useful as a tonic to treat indigestion, asthma, leucoderma and dysentery . A novel isoflavone glycoside from leaves and a new sesquiterpene glycoside and sphaeranthanolide were isolated from the flowers of *S. indicus* and it was found to be an immune stimulant. Medicinal information from tribal healers indicated that *S. indicus* is used to treat skin disease, cough and fever. The bark, ground and mixed with whey, is said to be useful in treating piles. In the present study the chloroform extract of leaves showed potent activity against the selected human pathogens and the Thin layer chromatographic separation resulted in an active ingredient 7 hydroxyfrullanolide. This compound has been isolated from *Sphaeranthus indicus* flower part and it is characterized as sesquiterpenes. Since this herb has wide range of medicinal value, this compound can be analysed for treatment of other diseases like skin diseases, cancer etc. and a herbal drug can be produced.

Wound healing activity.

Wounds may be defined as loss or breaking of cellular and anatomic or functional continuity of living tissues. Wound healing involves a highly dynamic integrated series of cellular, physiological and biochemical processes, which occur in living organism. Repair through regeneration is very common in unicellular and the lower metazoan animal groups while it is highly restricted in the higher animals. Wound healing involves different phases such as contraction, epithelization, granulation, collagenation. In excision wound study the test formulation of *sphaeranthus indicus* showed better and fast. The *sphaeranthus indicus* treated group showed much greater contraction of wounds than those treated with neomycin 0.3% w/w as the reference standard. In incision wound study, increase in tensile strength is indicative of improved collagenation, which significantly contributes to better and effective healing with *sphaeranthus indicus* formulations. Interestingly the visual examination of wounds inflicted during “wound healing ability” experiments revealed that the wounds treated with *Sphaeranthus indicus* extracts were relatively clean and free from any inflammatory reaction like swelling and redness. This offers a very interesting dimension to treatment of wounds by *sphaeranthus indicus* extracts.

Antipyretic activity.

The various extracts of whole plant of *Sphaeranthus indicus* at a dose of 200mg/kg and 400mg/kg body weight were investigated for analgesic and antipyretic activity. The petroleum ether, chloroform and ethanol extracts showed significant analgesic activity in both doses ($p < 0.001$ & $p < 0.01$) from 1 hour onwards as compared to standard drug diclofenac sodium. The chloroform and ethanol extracts showed potential significant antipyretic activity ($p < 0.05$) from 1 hour onwards whereas aqueous extracts exhibit activity from 2 hours onward as compared to the standard drug paracetamol amongst various extracts. The significant analgesic and antipyretic activity may be due to the presence of flavonoids. Flavonoids are known to target prostaglandins, which are involved in the late phase of acute inflammation and pain perception.

Bronchodilatory Effect

The methanolic extract of whole plant of *Sphaeranthus indicus* Linn and its various fractions were tested for their bronchodilatory effect against histamine induced acute bronchospasm in

guinea pigs. The methanolic extract and its fractions viz. petroleum ether, benzene, chloroform and ethyl acetate exhibited significant protection against bronchospasm, induced by histamine in guinea pigs. However significant ($p < 0.001$) protection was exhibited by methanolic extract which was comparable with Chlorphenarmine maleate (2mg/kg) included as the standard in the study. The results of present study suggest that, the plant *Sphaeranthus indicus* shows the bronchodilatory activity.

Antihyperlipidemic activity

There was an increase level in the level of serum TC and LDL-c and decrease in the level of cholesterol. HDL in the animal treated with atherogenic diet. Elevated level of blood cholesterol level was the major risk factor for coronary heart disease (CHD) and HDL as cardio protective lipoprotein. Treatment with *Sphaeranthus indicus* extract (500 mg/kg/day) significantly decrease the level of TC and LDL-c. The effect of *Sphaeranthus indicus* extract may be due to increase in the activity of lecithin. Treatment with *Sphaeranthus indicus* extract (500 mg/kg/day) show the reduction in TG level. There was a marked reduction in LDL: HDL-c ratio and atherogenic index. LDL:HDL-c ratio is effective predictor of coronary risk and atherogenic index is most important indicator of CHD at both high and low serum cholesterol level. Alcoholic extract of *Sphaeranthus indicus* shows significant Antihyperlipidemic activity.

Antioxidant activity

DPPH is a relatively stable free radical. The assay is based on the measurement of the scavenging ability of antioxidant towards the stable radical DPPH. *S. indicus* reduce the radical to the corresponding hydrazine when reacts with hydrogen donor in the antioxidant principle. DPPH radicals reacts with suitable reducing agent, the electron becomes paired off and the solution loses color stoichiometrically depending on the number of electron taken up. The total antioxidant capacity of the extract was calculated based on the formation of phosphomolybdenum complex which was measured spectrometrically at 695 nm. It is reported that flavonoids are the natural product which have been shown to possess various biological property related to antioxidant mechanism. The antioxidant property of *Sphaeranthus indicus* is due to the presence of flavonoids and the other constituent present in it.

Mast cell Stabilizing Effect

Ethanol extract of *S. indicus* at the doses of 150 mg/kg and 300 mg/kg and ethyl acetate extract at the dose of 100 mg/kg, 150 mg/kg and 300 mg/kg showed slightly better protection of mast cell degranulation (77-86%) than the standard drug ketotifen (75%) in the sheep serum model. These extracts also showed better mast cell stabilizing activity (77-88%) than the standard drug (69%) when peritoneal mast cells are treated with compound 48/80.

Antidiabetic activity

We have investigated the possible antihyperglycaemic effects of *Sphaeranthus indicus* extract in rats rendered diabetic by nicotinamide (120 mgkg⁻¹ i.p.) and streptozotocin (STZ) (60 mgkg⁻¹ i.p). Fasting plasma glucose levels, serum insulin levels, serum lipid profiles, magnesium levels, glycosylated hemoglobin, changes in body weight and liver glycogen levels were evaluated in normal and diabetic rats. Oral administration of *S. indicus* for 15 days resulted in significant decrease in blood glucose levels and increases in hepatic glycogen and plasma insulin levels. Fasting normal rats treated with the alcoholic extract of *S. indicus* showed significant improvement in oral glucose tolerance test. Glibenclamide was used as a reference standard. The findings demonstrate that the alcoholic *Sphaeranthus indicus* extract may be useful in the treatment of diabetes.

Immunomodulatory activity

The petroleum ether extract from the flower heads of *Sphaeranthus indicus* Linn. was found to be effective in increasing phagocytic activity, hemagglutination antibody titer and delayed type hypersensitivity when tested in mice. Activity of the petroleum extract was tested at five different dosing levels to establish a dose-response relationship. It was found that 200 mg/kg dose was the optimum dose, and at higher doses the activity was either reduced or showed no further increase. The present study, therefore, reveals that the drug shows good promise as an immunomodulatory agent, which acts by stimulating both humoral and cellular immunity as well as phagocytic function.

CONCLUSION

Sphaeranthus indicus is highly regarded as an universal panacea in the Ayurvedic medicine. It is one of the most versatile plants having a wide spectrum of medicinal activities. This versatile medicinal plant is the unique source of various types of compounds having diverse chemical structure. As the global scenario is now changing towards the use of nontoxic plant products having traditional medicinal use, development of modern drugs from *Sphaeranthus indicus* having various medicinal activities.

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