

Pharmacognostic study of *Sphaeranthus indicus* Linn.: A Review

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ABSTRACT

Sphaeranthus indicus Linn. has the vernacular name of, "Mundi" and "East Indian globe-thistle, family Asteraceae. It is a spreading aromatic herb. It is indigenous at Rater of Chhindwara District, M.P and even found in most of the moist damp places of tropical zones of Garhwal Himalaya. The herbs contain a deep cherry coloured essential oil and a bitter alkaloid Sphaeranthine. It also contains many other active ingredients, namely, eudesmenolide-7 α -hydroxy eudesm-4-en-6, 12-olide, 2-hydroxycostic acid, β -eudesmol, ilicic acid, methychavicol, α -ionone, d-cadinene, α -terpinene, citral, geraniol, geranyl acetate, sphaerene, indicusene and sphaeranthol. The herb has been investigated for many diseases and used in ethnomedicne. The review of this medicinal plant can revealed some important and valuable information with respect to pharmacognostical, phytochemical and pharmacological aspects. The main objective of this paper is to gather some valuable information with respect to its standardization, which has been done along with active ingredients by some researchers.

Key Words: *S. indicus*, Mundi, Gorakhmundi, Flavonoids, Alkaloids, Pharmacological uses, Ethnomedicine.

INTRODUCTION

Sphaeranthus indicus Linn, commonly known as Gorakhmundi, is a spreading aromatic herb, distributed throughout in India upto 1500 m from Kumaon hills to Sikkim on the Himalayas chiefly on damp habitats.¹ It is used in the treatment of various diseases, such as, dysentery, epileptic, leucoderma, urinary discharges, insanity, anthelmintic.² In this present paper, the author aims to provide informative review about the plant on morphology, microscopy, phtyochemisty and pharmacology with some new informative aspects.

Biological source³

Botanical Name: *Sphaeranthus indicus* Linn.

Synonym: *Sphaeranthus hirtus* Willd, *Sphaeranthus mollis* Roxb.

Family: Asteraceae (Compositae)

Vernacular names^{2,3}

Sanskrit: Mundi, Sravani, Bhumikadamba

Assamese: Kamadarus

Bengali: Surmuriya, Mudmudiya

English: East Indian globe-thistle

Gujrati: Gorakhmundi

Hindi: Mundi, Gorakhmundi

Kannada: Mudukattanagida, Karande

Malayalam: Manni

Marathi: Mundi, Gorakhmundi

Oriya: Bhuikadam

Punjabi: Gorakhmunda

Tamil: Karandai

Telugu: Bodasarumu Badataramu

Urdu: Mundi

Beng: Chagulnadi

Taxonomic Classification⁴

Kingdom: *Plantae*

Subkingdom: *Viridaplantae*

Phyllum: *Tracheophyta*

Subphyllum: *Euphyllophytina*

Infraphyllum: *Radiatopses*

Class: *Magnoliopsida*

Subclass: *Asteridae*

Superorder: *Asteranae*

Order: *Asterales*

Family: *Asteraceae*

Genus: *Sphaeranthus*

Species: *indicus*

Occurrence and distribution

It is widely occurring at Rater of Chhindwara district, M.P. It is also found in the moist damp places of tropical zones of Garhwal Himalaya.⁵

Macroscopic study

It is an annual, prostrate-decumbent, procumbent-ascending, glandular, villous, tomentose, aromatic herbs, a height of 30-60 cm. Stems are narrowly winged along with wing toothed. Leaves are sessile, 2.5-5 x 1.5-2 cm, obovate-oblong, acute to rounded at tip, glandular-villous on both surfaces; apex are

lanceolate, oblong or oblong –spathulate, obtuse-mucronate; base are semi-amplexicaul; margin are acutely serrate, double dentate at some places, presence of glands and sessile; Peduncles are 2-6 cm long which are glandular and pubescent, with a compound purple head. Flowers are in globular shape, composed of capitula 13 mm (d), globose or ellipsoid and purplish in color with involucre bracts, in which outer bracts having capitula 3 mm long, linear, apiculate, ciliate and glandular whereas inner bracts- capitula 3 mm long, linear-oblongate and acuminate.⁶ Flowers and Fruits are matured during March-June.⁷

Microscopic study

Root: Epidermis is a single layered, rectangular cell followed by secondary cortex composed of oval to tangentially elongated, thin walled, parenchymatous cells having aerenchyma. The secondary phloem consists of thin walled, oval to polygonal cells, presence of large number of scattered lignified phloem fibers. The central portion is occupied by lignified, secondary xylem containing vessels which are pitted, presence of simple starch grains, round to oval with concentric striations and distinct hilum of 13 to 27 μ (d) present in the secondary cortex.

Stem: Epidermis consists of a single layered cell covered with thick cuticle. The cortex composed of 4 to 6 layers of oval –polygonal, thin walled, parenchymatous cells. The endodermis is a single layered consists of barrel shaped cells, followed by lignified pericyclic fibers arranged in discontinuous ring. The secondary phloem containing groups of cellulosic fibers which are scattered in this zone. The secondary xylem composed of spiral thickening or simple pitted vessels. Pith is present in a very wide portion, composed of oval to polygonal, and thin walled parenchymatous cells.

Leaf: It consists of lower epidermis, mesophyll and upper epidermis. Epidermis is a single layered, followed by 4 to 6 layered thin strips of collenchymas and 3 to 4 layered parenchyma cells, present on both surfaces. Glandular trichomes composed of 2 or 3 cells high, uni or biseriolate stalk, having a multicellular head whereas uniseriate covering trichomes with 2 to 5 cells are present on both surfaces. Mesophyll

composed of oval to polygonal thin walled parenchymatous cells. Presence of anisocytic stomata present on both surfaces.

Powder characteristics

Powder is greyish yellow in colour. Microscopically, it shows the presence of oval to polygonal thin walled fragments of aerenchyma cells and thin walled, elongated epidermal cells. Occasionally, glandular trichomes and anisocytic stomata are seen. Presence of vessels with spiral and pitted thickening. Fibers are short with thick walled, lignified along with wide lumen and blunt tips having a small pits. Starch grains are simple, oval to round, elliptical in shape with centric hilum and striations are present⁸ (Morphology and Microscopy as shown in Figure 1-4.^{9,10}).

Medicinal properties and uses

- Herb is generally used as tonic, deobstruent, alternative, aphrodisiac¹¹; used in nervous debility as well as in eye troubles. Seeds are useful in asthma, bronchitis, cough, fever, pertussis and decoction used in insomnia.¹²
- Decoction of herb is used in cough and other chest related troubles; and also credited with antituberculosis properties. Herb is also used as a fish-poison and it is stuffed into holes of crabs to kill them. Even leaves are eaten as a pot-herb.¹³
- A paste of the herb mixed with oil is good in painful swellings and pruritus. It is also useful in strangury, diabetes, leprosy, fever, cough, pectoralgia, cough, gastropathy, hernia, haemorrhoids, helminthiasis and dyspepsia. Oil prepared from root is useful in scrofula. The powdered leaves are good for skin diseases and are considered as a nervine tonic.³
- Root is acrid, bitter and sweet in taste and highly efficacious as diuretic, febrifuge, expectorant and stomachic.
- Root bark are ground into powder, is a valuable remedy in bleeding piles; also used as paste for local application.

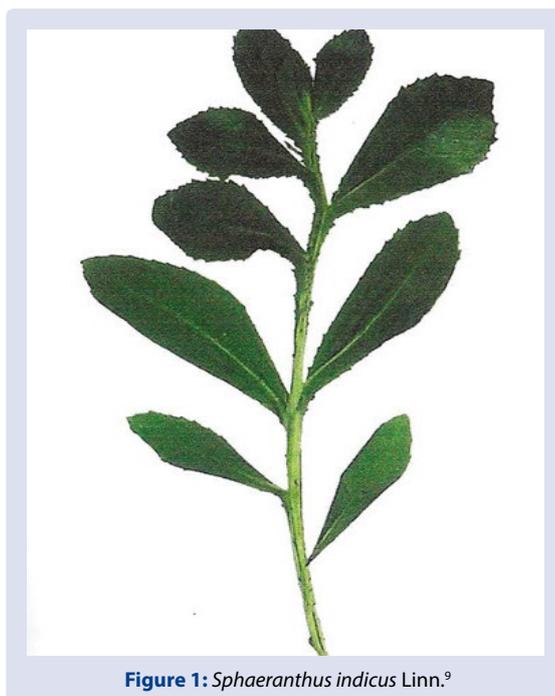


Figure 1: *Sphaeranthus indicus* Linn.⁹

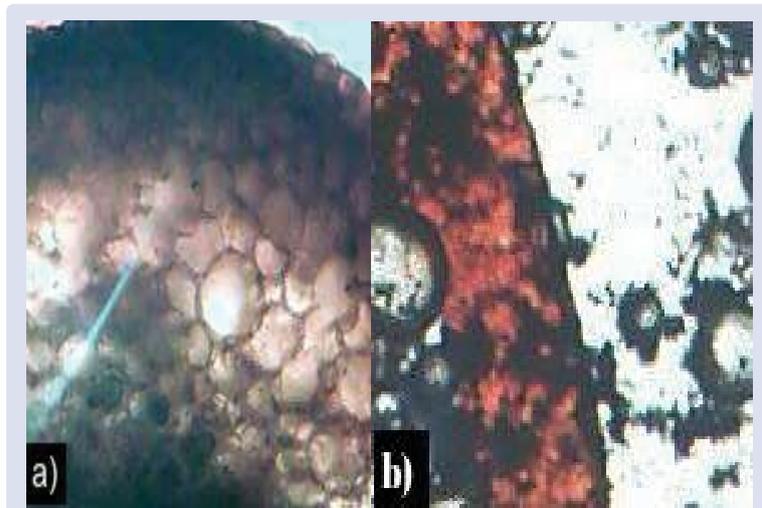


Figure 2: Microscopy of root of *S. indicus*.¹⁰

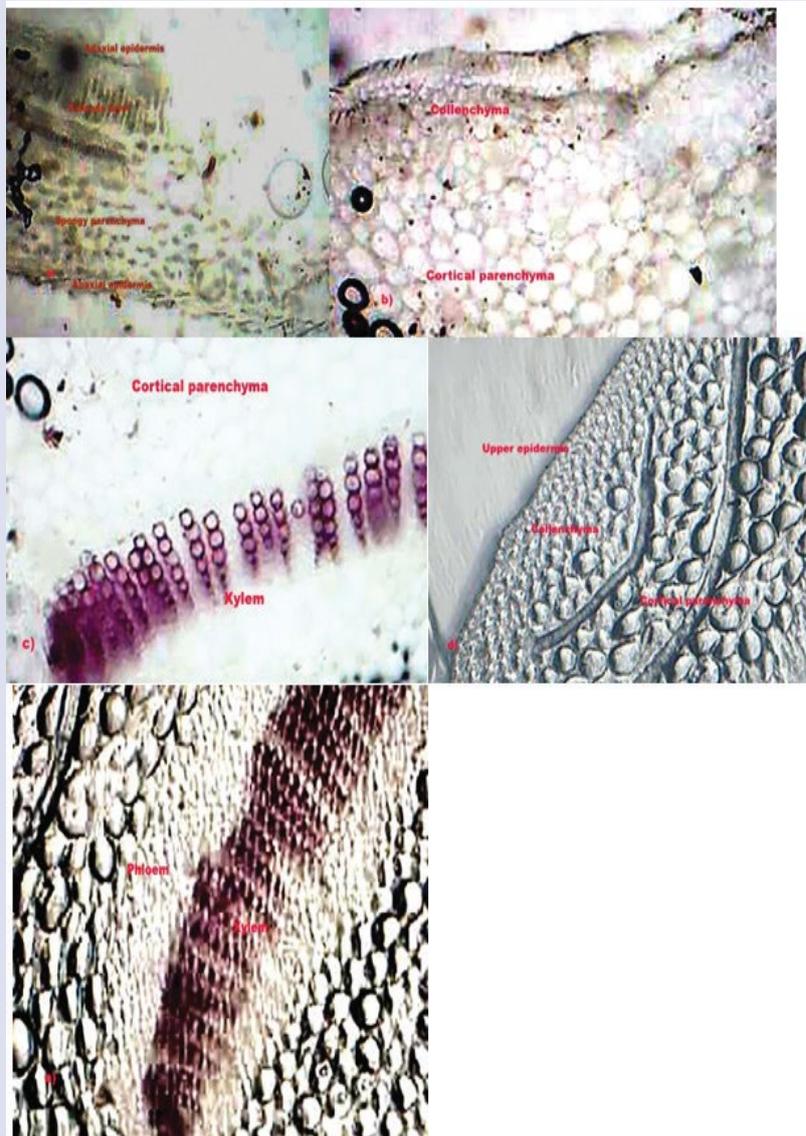


Figure 3: Microscopical characteristics of *S. indicus* leaf.⁹

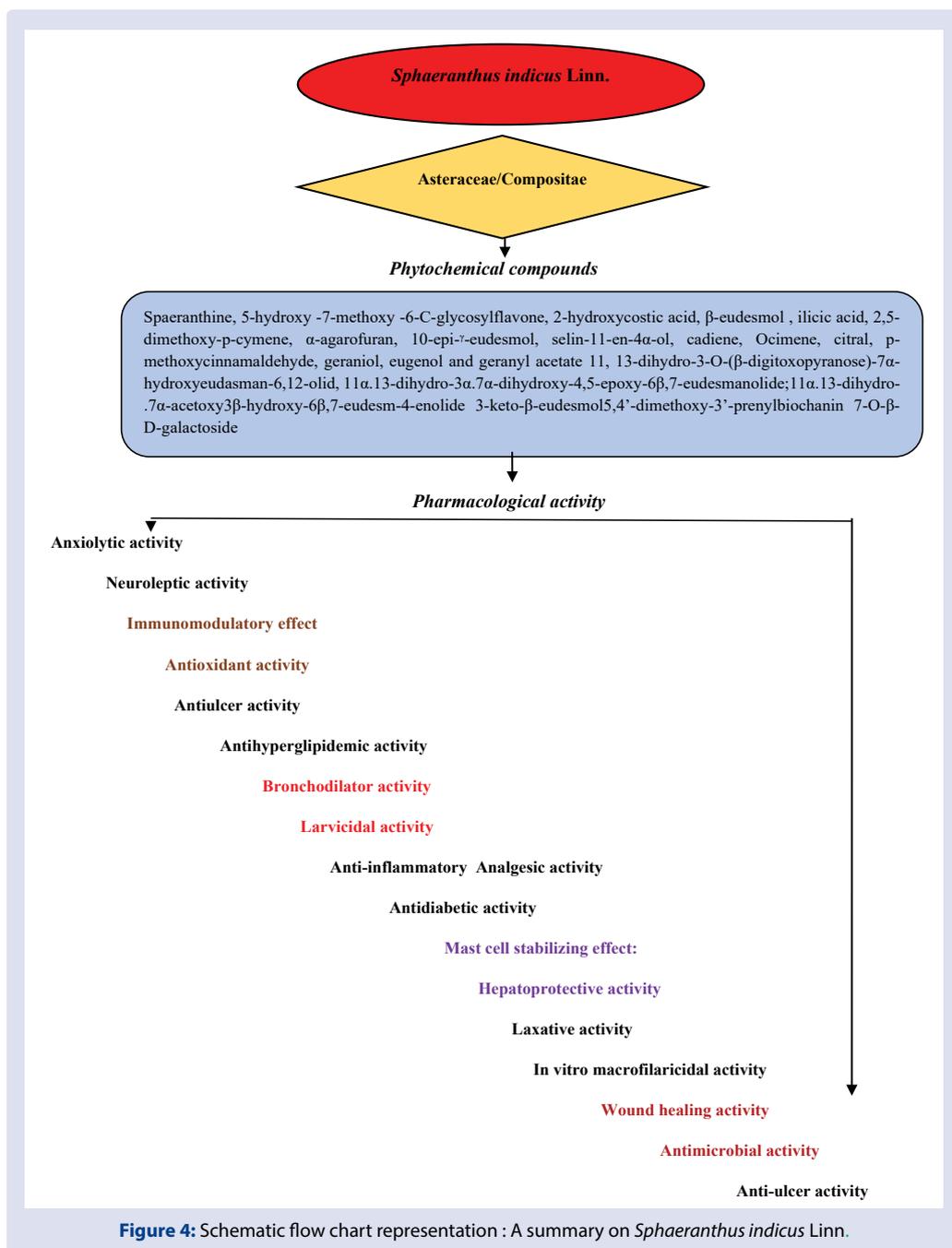


Figure 4: Schematic flow chart representation : A summary on *Sphaeranthus indicus* Linn.

- Flowers (flower heads) are highly esteemed as alternatives, depuratives, refrigerants, tonics and blood –purifiers in skin diseases.¹⁴ They are swallowed to cure conjunctivitis.¹⁵

Ethnobotanical uses

- The plant with cumin is useful in stomachic; with honey it is given for cough; and ground with oil, it is used to cure itch. The bark of the young plant is made into a kind of confection by ribbing it up with clarified butter, flour and sugar; a portion of this taken daily is said to be a good tonic, and to prevent the hair turning white or falling off.¹²
- Leaves are dried in the shade and powdered are used in doses of 20 grains twice a day in chronic skin diseases as antisiphilitic and nervine tonic. Root is used as a stomachic and anthelmintic in doses of about 40 grains daily in the form of powder.¹⁴

- Decoction of the whole plant is used as diuretic in urethral discharge.¹⁵
- An oil prepared from the root, by steeping it in water, and then boiling in oil of sesamum until all the water is expelled, taken fasting every morning for 41 days in doses of 2 dirhems, is said to be a powerful aphrodisiac in the neck with benefits and also a good remedy in jaundice.¹⁶

Phytochemistry

A novel flavonoid C-glycoside 5-hydroxy -7-methoxy -6-C-glycosylflavone was isolated from the aerial part of the plant.¹⁷ An alkaloid, Spaeranthine and volatile oil by steam distillation, isolated from the S, indicus.¹⁸ 7α-hydroxyeudesm-4-en-6,12-olid (sesquiterpene lactone), 2-hydroxycostic acid (sesquiterpene acid), β-eudesmol and ilicic acid have been isolated from the

acetone extract of *S.indicus*. The hydrodistilled essential compound, 2,5-dimethoxy-p-cymene (18.2%), α -agarofuran (11.8%), 10-epi-7-eudesmol (7.9%) and selin-11-en-4 α -ol (12.7%) were isolated and identified by GC and GC/MS.¹⁹ Essential oil to the tune of 0.06-0.08% obtained from the capitula of *S.indicus*.²⁰ The major constituents were cadiene, Ocimene, citral, p-methoxycinnamaldehyde, geraniol, eugenol and geranyl acetate.²¹ A bicyclic sesquiterpene lactone has been isolated from the petroleum ether extract of the aerial part of the plant and found to possess strong antimicrobial activity against *Staphylococcus aureus*, *S. albus*, *E. coli*, *Fusarium* species, *Helminthosporium* species.²² Two new eudesmanolides, 11 α ,13-dihydro-3 α ,7 α -dihydroxyeudesm-4-en-6 α ,12-olide and 4-en-6 β ,7 α -eudesmanolide, isolated from the aerial part of *S. indicus*.²³ 11 α ,13-dihydro-3 α ,7 α -dihydroxyfrullanolide and 2 α -hydroxycostic acid, a new eudesmanolide isolated from the aerial part of the plant. 7-hydroxyeudesmanolides²⁴ and two sesquiterpenoids, cryptomeridiol, 4-epicryptomeridiol isolated from the plant.²⁵

A new antifungal eudesmanolide glycoside 11, 13-dihydro-3-O-(β -digitoxopyranose)-7 α -hydroxyeudasman-6,12-olide has been isolated.²⁶ 11 α ,13-dihydro-3 α ,7 α -dihydroxy-4,5-epoxy-6 β ,7-eudesmanolide; 11 α ,13-dihydro-7 α -acetoxy-3 β -hydroxy-6 β ,7-eudesm-4-enolide²⁷ and 3-keto- β -eudesmol-5,4'-dimethoxy-3'-prenylbiochanin 7-O- β -D-galactoside, a new isoflavone glycoside isolated from the leaves of *S.indicus*.²⁸ 7-hydroxyfrullanolide, an antimicrobial sesquiterpene lactone isolated from *S.indicus* Linn.²⁹ Methyl chavicol, α -ionone, d-cadiene, p-methoxycinnamaldehyde, α -terpinene, citral, geraniol, geranyl acetate, β -ionone, sphaerene, indicusene, sphaeranthol as essential oil and β -sitosterol, n-triacontanol, phenyl urethane, n-pentacosane isolated from the oil.³⁰

Pharmacological activity

Anxiolytic activity: At doses of 200 and 500 mg/kg, p.o., the hydroalcoholic extract of *Sphaeranthus indicus*.

resulted in decrease in locomotor activity and central nervous depressant activity in mice. It also increased the immobility time in the forced swimming test at an oral dose of 500 mg/kg but did not significantly modify the activity in tail suspension test. The same doses of SIE were used to protect rats against MES-induced convulsions and mice against PTZ-induced convulsions.³¹ In other study, the petroleum ether extract of flowers of *S.indicus* Linn. has been found to possess significant result against anxiolytic activity than ethanolic or water extracts but was less as compared to diazepam (1 mg/kg).³²

Neuroleptic activity: Neuropharmacological effects of the hydroalcoholic extract of *S.indicus* (100, 200 and 500 mg/kg, p.o.) were studied against spontaneous motor activity, pentobarbital-induced sleeping time, motor coordination and exploratory behavior in mice, in which significant results were observed. It also antagonized apomorphine-induced stereotypy in mice, produced catalepsy and also potentiated haloperidol-induced catalepsy in rats.³³ In other study, the petroleum ether, methanol and aqueous extracts at 100, 200 and 400 mg/kg, p.o. showed significant results in various models like motor coordination, locomotor activity, cognitive behavior, anxiety, haloperidol induced catalepsy, sodium nitrite induced respiratory arrest, hypoxia stress induced neurotoxicity and convulsion induced by pentylenetetrazol and maximum electroshock.³⁴ The plant proved to possess anticonvulsant, anxiolytic and antistress activity.³⁵ Ethanolic root extract at 200 and 400 mg/kg, i.p. significantly reduced the duration of seizures produced by maximal electroshock and delayed the latency of seizures produced by pentylenetetrazole and picrotoxin.³⁶

Immunomodulatory effect: The petroleum ether extract from the flower heads of *S.indicus* was found to be effective in increasing phagocytic activity, hemagglutination antibody titer and delayed type hypersensitivity in mice at a dose of 200mg/kg.³⁷ In other study, the

methanolic extract of *S.indicus* (100, 200 and 400 mg/kg) (MESI) was evaluated for immunomodulatory activity (humoral immunity and cellular immunity) with antigen challenge by sheep RBCs in healthy wistar albino rats. The dose of 100 mg/kg b.w. of extract showed significant increase in the circulating antibody titer and the number of plaque forming cells in the spleen as compared to 200 and 400 mg/kg b.w.³⁸ It was also found that MESI showed significant increase in the Delayed type hypersensitivity (DTH) response, restoration of histological parameters, and increase in lymphocytes and rosettes formation in T-cell population at dose of 400 mg/kg b.w. Even immunomodulatory activity of herbal formulation containing methanolic extracts of flower heads of *S.indicus*, rhizomes of *Curculigo orchioides* and fruits of *Piper nigrum* was also studied on humoral (Haemagglutination antibody titre) and cellular immunity (Delayed type hypersensitivity) in mice.³⁹ Sphaeranthanolide, a new sesquiterpene glycoside, isolated from the flowers of *S.indicus* exhibited immune stimulating activity.⁴⁰

Antioxidant activity: The methanol extracts obtained from leaf, flower, stem, root of *S.indicus* were evaluated for antioxidant (using DPPH, Hydroxyl radical, Nitric oxide, Superoxide anion and Hydrogen peroxide assay) and antibacterial activity. The flower extract and leaf extract were exhibited highest scavenging activity at 150 μ g/ml concentrations and all the extracts of *S.indicus* produced minimum zones of inhibitions against human pathogenic species.⁴¹ In other study, the ethyl acetate extract showed significant reducing activity as compared to petroleum ether, chloroform and methanol extracts. The petroleum ether and chloroform extract exhibited significant activity against *Klebsiella pneumoniae*, *Proteus mirabilis*, *Salmonella typhimurium* and *Staphylococcus epidermidis* with MIC of 0.07 mg/ml and 0.15-0.3 mg/ml respectively. Ethyl acetate extract showed significant activity with MIC of 0.07 mg/ml against *K.pneumoniae* whereas methanol extract exhibited moderate to least activity against test bacteria with MIC of 0.31-5 mg/ml.⁴² The ethanolic extract of the root of *S.indicus* (EESIR) (100 and 200 mg/kg) was also studied for antidiabetic, antihyperlipidemic and in vivo antioxidant activity in streptozotocin induced type (STZ-induced) 1 diabetic rats. It revealed significant reduction in blood glucose and increase in body weight in STZ-induced diabetic rats as compared to diabetic control rats. At a dose of 200mg/kg, the EESIR treatment in diabetic rats produced significant increase in superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) and decrease in thiobarbituric acid reactive substances (TBARS) levels as compared to diabetic control rats.⁴³

Antiulcer activity: The ethanol extracts of *S.indicus* whole plant showed significant reduction in gastric volume, free acidity, total acidity and ulcer index at 250 mg/kg and 500 mg/kg b.w. The ulcer protection activity of the extract was found to be 82.9% and 85.3% as compared to the standard drug ranitidine 92.6% and proved to possess significant dose dependent anti-ulcer activity.⁴⁴

Antihyperlipidemic activity: The alcoholic extract of flower heads of *S.indicus* was investigated in atherogenic diet induced hyperlipidemia and showed significant increase in the level of high-density lipoprotein after eight days of 500 mg/kg of drug, p.o, daily proving its potential protective role in atherosclerosis.⁴⁵

Bronchodilator activity: The methanolic extract of *S.indicus* Linn showed significant protection ($p < 0.001$) against histamine induced acute bronchospasmin in guinea pigs as compared to its various fractions.⁴⁶

Larvicidal activity: The four different extracts (hexane, diethyl ether, dichloromethane and ethyl acetate) of seven plants containing leaves of *Abutilon indicum*, *Cleistanthus collinus*, *leucas aspera*, *Murraya koenigii*, *Hyptis suaveolens*, *Citrullus colocynthis* and *Sphaeranthus indicus* were investigated and found to be effective against the early third instar

larvae of *Anopheles stephensi*. Similarly, the leaf extracts of *S.indicus*, *Cleistanthus collinus* and *Murraya koenigii* were also investigated against the third instar larvae of *Culex quinquefasciatus* at 250, 500, 750 and 1000 ppm respectively and showed significant mortality of filarial vector.^{47,48}

Anti-inflammatory and analgesic activity: The anti-inflammatory activity of ethanolic extract of *S.indicus* was evaluated at a dose of 300 mg/kg and 500 mg/kg by measuring the mean decrease in hind paw volume after the sub planter injection of carrageenan and found that at the end of one hour the inhibition of paw edema was 42.66 and 50.5% respectively. The analgesic activity was also studied against acetic acid induced writhing response showed the percentage of protection of 62.79 and 68.21.⁴⁹ Ethanolic extract of *S.indicus* at 100, 200 and 400mg/kg exhibited dose dependent and significant anti-inflammatory activity in acute (carrageenan induced hind paw edema) and chronic (cotton pellet granuloma formation) model of inflammation in albino rats respectively.⁵⁰ In other study, the ethanol and petroleum ether extracts showed significant effect at doses of 200 and 400 mg/kg against carrageenan induced acute inflammation, Formalin induced chronic inflammation and Cotton Pellet induced granuloma respectively.⁵¹ Methanol extract of *S.indicus* reduced aortic lesion area in high fat fed LDL mice and hyperlipidemic hamsters at 100, 300 mg/kg/day and 200 mg/kg/day by 22% and 45% respectively, but not able to altered the lipid profile in both animal models. The activity was comparable to that of a standard agent Fenofibrate decreased aortic lesions by 26% and 84% in LDL mice and hyperlipidemic hamsters, which was driven by massive reductions in proatherogenic lipoproteins.⁵² It has been found that petroleum ether, chloroform and ethanol extract showed significant analgesic activity at a dose of 200 mg/kg and 400 mg/kg in albino rats against Eddy's hot plate, Tail immersion and Brewer's yeast induced pyrexia method as compared to the standard diclofenac sodium drug respectively.⁵³ The ethanol extracts of whole plant of *S.indicus* Linn. showed significant increase in activity and percentage protection at 250 mg/kg and 500 mg/kg b.w. when used in tail immersion method in rat models.⁵⁴

Antidiabetic activity: Oral administration of alcoholic extract of *S.indicus* for 15 days in rats resulted in significant decrease in blood glucose levels, increase in hepatic glycogen and plasma insulin levels and also showed significant improvement in oral glucose tolerance test, when compared to Glibenclamide as a reference standard drug.⁵⁵ Ethyl acetate, methanol and hydroalcoholic extracts of *S.indicus* were found to be produced significant antihyperglycaemic activity in alloxan induced diabetic rats at a dose of 200 mg/kg when taken orally for 15 days, using Glibenclamide as standard. The methanol extract significantly decreased the lipid peroxides and showed antioxidant activity.⁵⁶ Methanol extract of *S.indicus* at a dose of 300 mg/kg b.w when given orally showed significant decrease in glycosylated hemoglobin (HbA1c), serum total cholesterol, triglyceride and markedly increased HDL cholesterol and magnesium levels. It also restored the altered body weight to near normal state.⁵⁷ Oral administration of flower head petroleum ether extracts at a dose of 200 mg/kg found to show significant reduction in blood glucose level.⁵⁸

Mast cell stabilizing effect: The ethanol extract at 150 mg/kg and 300 mg/kg and ethyl acetate extract at 100 mg/kg, 150 mg/kg and 300 mg/kg showed slightly better protection of mast cell degranulation 77-86% and stabilizing activity 77-88% as compared to standard drug Ketotifen 75% and 69% in sheep serum model respectively.⁵⁹

Hepatoprotective activity: Ethanol extract obtained from aerial parts of *S.indicus* L. at 300 mg/kg was investigated for hepatoprotective activity against paracetamol induced liver damage in rats. It showed a significant protection and reduction in the serum markers.⁶⁰ Protective effect of aqueous extract was evaluated at 400 mg/kg b.w in rats and

showed significant reversal of all elevated serum enzyme like SGOT, SGPT, ALP, total protein and total bilirubin to normal state when compared to paracetamol induced liver toxicity.⁶¹ Methanol extract was investigated for its hepatoprotective and antioxidant activity against carbon tetrachloride induced liver damage in rats using Livomyn as reference drug. The biochemical parameters like ALT, AST, ALP, SOD, CAT, GST levels were significantly reverted back to normal levels.⁶²

Laxative activity: The oral administration of 2 g of *S.indicus*, three times a day for 40 days showed statistically significant improvement on various parameters like hard stool, incomplete evacuation, excessive staining, lower abdomen fullness and gas collection and proved to possess laxative activity.⁶³

In vitro macrofilaricidal activity: The methanol extracts of some medicinal plants namely, *Centratherum anthelminticum*, *Cedrus deodara*, *S.indicus* and *Ricinus communis* were proved to possess *in vitro* macrofilaricidal activity at 1-10 mg/ml against worm motility assay in adult *Setaria digitata*, the cattle filarial worm.⁶⁴

Wound healing activity: Herbal formulation comprises of 2%w/w alcoholic extract of flower head of *S.indicus* was found to possess wound healing property by providing better tissue formation and protection against microbial invasion.⁶⁵ *In vivo* application of a cream containing ethanol extract of aerial parts of *S.indicus* Linn. on the paravertebral area of six excised wounded models once a day for 15 days in guinea pigs showed significant increase in the rate of wound contraction and the period of epithelialization as compared to neomycin.⁶⁶

Anti-ulcer activity: The ethanol extracts of *S.indicus* whole plant at 250 mg/kg and 500 mg/kg b.w showed significant reduction in gastric volume, free acidity, total acidity and ulcer index in aspirin plus pylorus ligation method. The ulcer protection of the extract was found to be 82.9% and 85.6% as compared to Ranitidine 92.6% as standard drug.⁶⁷

Antimicrobial activity: n-hexane extract obtained from flowers and aerial parts of *S.indicus* showed minimum inhibitory concentration of 0.15 and 1.25 mg/ml against *Candida albicans*, using broth micro dilution method at concentrations range from 5 to 0.039 mg/ml and revealed to possess antibacterial and antifungal activity.⁶⁸ The leaves were screened for *in vitro* antibacterial activity by agar well diffusion assay and showed varying degrees of inhibition on tested microorganisms.⁶⁹ Similarly, the ethanol leaf extract was evaluated for antimicrobial, antibacterial and antifungal activity using *in vitro* disc (concentration of 1.25, 2.5 and 5 mg/disc) and broth tube dilution method. It showed significant MIC of 0.5, 2.5 and 5/ml against *B. subtilis* and *S.aureus* whereas 0.5 and 5/ml against *Candida* and *Aspergillus niger* respectively.⁷⁰ The plant extract showed significant inhibition zone against *E. coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa* and *Acetobacter*. The activity was compared with Kanamycin as standard drug.⁷¹ A new eudesmanolide glycoside 11, 13-dihydro-3-O-(β -digitoxopyranose)-7a-hydroxyeudesman-6,12-olide isolated from *S. indicus* Linn proved to possess antifungal activity.⁷² The methanol extract possess significant inhibitory effect (65% at $p < 0.05$) against *Microsporum gypseum* when compared to positive control Ketoconazole (49%) at 0.1 g/ml concentration.⁷³

Antidiarrhoeal activity: The ethanol and aqueous extracts showed significant anti diarrhoeal and antienteropooling activity at a dose of 200 and 400 mg/kg. It showed decrease in propulsion of charcoal meal through the gastrointestinal tract significantly and inhibited the PGE2 induced intestinal fluid accumulation.⁷⁴

S.indicus was found to be claimed as skin disease preventive plant.⁷⁵

Anticancer activity: The petroleum ether extract induced apoptosis through the mitochondrial γ -dependent pathway in HL-60 cells when determined by sulfohodamine B assay. β -sitosterol and

7-hydroxyfrullanolide isolated from *S.indicus* are considered to be potent anticancer compound.⁷⁶

Traditional system of medicine

In siddha system of medicine, *S. indicus* is used in the name of Kottaikkarantai. It is used as one of the ingredients in the siddha preparation, "Veezhi Ennai (or Veezhi oil)."

Important ayurvedic formulations

Navaratnarāja, Mṭgānka Rasa, Arka Mutṭī, Guduchyadi taila, Vatagajankusha rasa, Muditika churna, Guduchi taila.

Ayurvedic therapeutic uses

Gaṅṭamālā, Apaci, Kuṭṭha, Kṭmi, Pāṭṭu, Slipada, Medaroga, Apasmarā, Kasa, Mutrakrcchra, Tvaka Roga, Stana Saithalya, Yonirogā, Āmāṭisara, Āmaroga, Vātaroga, Gudaroga, Plihāroga, Chardi, Āmavāta, Gātradurgandhya, Sūryāvarta, Ardhāvabhāvabhedaka.

Dose: 3-6 g of the drug.⁷⁷

CONCLUSION

From the literature survey, it is proved that the plant, *Sphaeranthus indicus* Linn. has been evaluated for phytochemical compounds and pharmacological activities. However, the plant has wide range of therapeutic uses; therefore, more clinical and pharmacological studies should be conducted to consider in new drug formulations.

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AUTHORS CONTRIBUTION

Sonia Singh wrote the manuscript. The rest of the coauthors has commented and discussed their opinions with the same. And then it has been reframed and finalized into comprehensive mode.

CONFLICTS OF INTEREST

There is no conflict of interests with the publication of this review paper.

ABBREVIATIONS

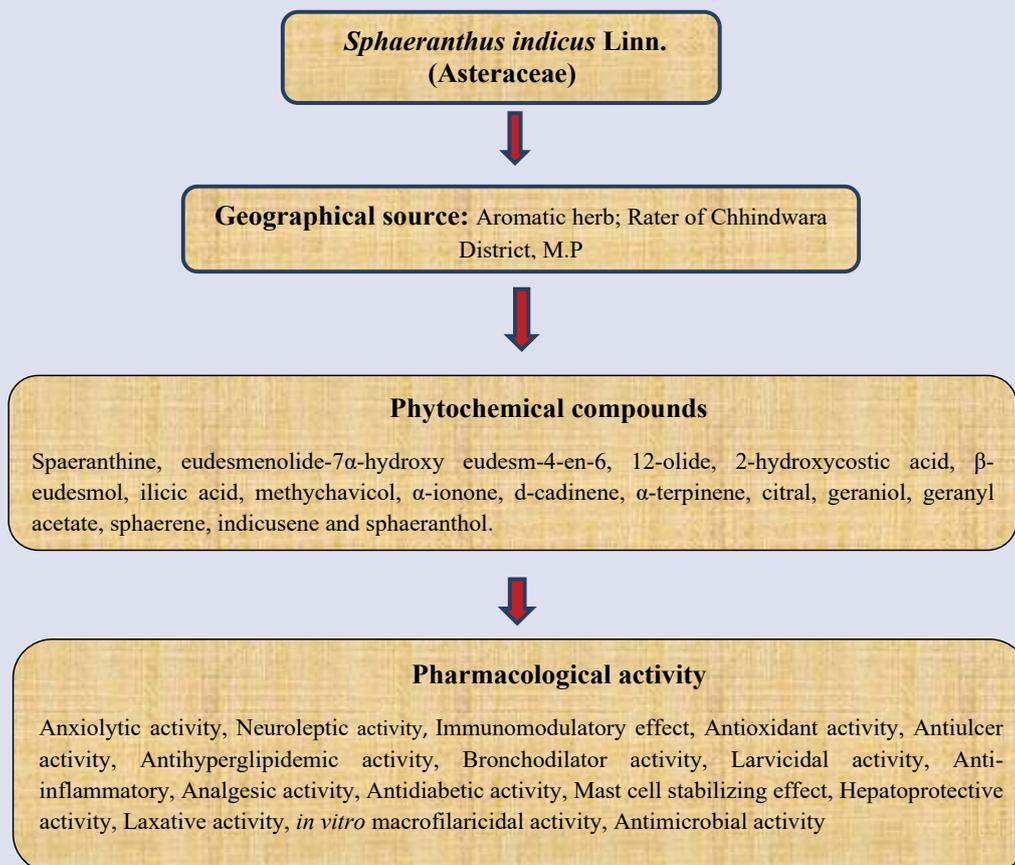
ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; ALP: Alkaline phosphate; b.w: Body weight; CAT: Catalase; cm: Centimeter; d: Diameter; DPPH: 2,2-diphenyl-1-picrylhydrazyl; GC: Gas chromatography; GST: Glutathione S-transferase; HDL: High density lipoproteins; ip: Intraperitoneal; kg: Kilogram; LDL: Low-density lipoproteins; MS: Mass spectroscopy; MESI: Methanol extract of *S.indicus*; MIC: Minimum inhibitory concentration; mg: Milligram; m: Meter; mm: Millimeter; p.o: Drug administered orally; RBCs: Red blood cells; SIE: Ethanol extract of *S.indicus*; SOD: Superoxide dismutase; %: Percentage.

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GRAPHICAL ABSTRACT



SUMMARY

The reviewed manuscript requires more informative research which can explore their proper applications. It needs to add more updated pharmacological activities to enhance the broad spectrum of therapeutic usage to be considered for new drug formulations.

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