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PHYTOCHEMISTRY AND PHARMACOLOGICAL PROFILE OF TRADITIONALLY USED MEDICINAL PLANT *ARGYREIA SPECIOSA* (LINN. F.)

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ABSTRACT

Argyreia speciosa (Linn. f.) (Family: Convolvulaceae, Synonyms: *Argyreia nervosa*) is used in the traditional Ayurvedic systems of medicine as well as in local health folklore. It is commonly known as Vidhaara in Hindi and Hawaiian Baby Woodrose and Elephant creeper in English. It is the large climber and seen throughout India up to an altitude of 500 m. *A. speciosa* possess various pharmacological activity such as anti-aging, gastroprotective, analgesic & anti-inflammatory, aphrodisiac, antiviral, antidiabetic, anticonvulsion, antioxidant, antidiarrheal, antiulcer, central nervous system depressant, nematocides, nootropic, anticancer and many more. Apart from this numerous phytoconstituents have been isolated from *A. speciosa*. Its seeds principally contain lysergamides, eragine and isoeragine which responsible for its hallucinogenic properties. The present paper efforts bring to light the available literature on *A. speciosa* with respect to traditional, ethnobotanical, phytoconstituents and review of different pharmacological activities.

Keywords: Argyreia speciosa, Vidhaara, Anti-aging, Hallucinogen, Ethnobotanical

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INTRODUCTION

Argyreia speciosa, is widely distributed plant species in India. It is commonly known as Elephant creeper, Samundar ka pat and Vryddhadaru. It is found throughout in India up to altitude of 500 m. It is great climber with big ovate-cordate leaves found growing native in north-eastern Himalaya, Dehradun, Konkan, Rajasthan, Mysore, and Bengal[1]. *A. speciosa* usually appreciated for its aesthetic merit. It is grown as an ornamental and decorative plant because its leaves are heart shape, green color and flowers are look like rose-purple[2]. *A. speciosa* is a very valuable plant in the Ayurvedic system. In 'Rasayan' drug it has been used for the treatment of various neurological diseases. It has been also reported in indigenous medicine system that *A. speciosa* has given for chronic gonorrhea, ulcer, severe pain in urinary bladder (strangury), gleets, male sexual disorder. The plant leaves also possess the therapeutic activity against several skin diseases such as eczema, itching, ringworm and systemically in skin abscess. In addition, it also used as a rubefacient and local skin stimulant. In Rajasthan, some tribal's used leaves to prevent the conceived in females[3].

Its root taste is bitter and having the multiple uses like as a brain tonic, diuretic, aphrodisiac, rheumatism. In other hands for persistent cold & cough, and in resulting fever, root paste with *Grewia hirsute*, *Asparagus racemosus* and *Hemidesmus indicus* prescribed for immediate relief.

Its seven times root powder is macerated throughout 7 days with tubers juice of *Asparagus racemosus* as nervine tonic. It promotes intellect, strengthens body

and counteracts influences of age. In addition one of its preparation known as Ajmodadi Churna used for unilateral paralysis, dysentry and rheumatic ailments[4,5].

A. speciosa seed exhibited potential psychedelic, antihypertensive and spasmolytic activity. Seed consisted of the various neuropharmacological active constituents which are the isomer of lysergic acid diethylamide (LSD) such as lysergacidamide and lysergacidethylamide. Due to this reason, the seed has been the misuse of psychomotor agitation, an orientation of disturbances and anxiety[6].

Due to the presence of numerous active phytoconstituents in *A. speciosa*, which used continuously since antiquity for the treatment of various diseases includes neurological, wound healing, aphrodisiac, immunomodulatory, hepatoprotective, antidiabetic, antiviral and many more.

TAXONOMICAL CLASSIFICATION

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Solanales
Family: Convolvulaceae
Genus: Argyreia Lour
Species: Argyreia speciosa

Figure 1: *Argyreia speciosa*: A-Green foliage of two year plant; B-Flowering stage, C-Seed

PHYTOCONSTITUENTS

A. speciosa contains various chemical constituents such as alkaloids (mainly ergoline), flavonoids, lipids, triterpenoids, saponin and steroids. The seeds mainly consisted of various fatty oils such as palmitic glycosides, stearic, oleic, linoleic and linolenic acid. It also contains some amount of free amino acid like glycine, leucine, phenylalanine, glutamic and α-aminobutyric acid[7]. In seed, serotonin (5HT) agonist like compound, LSD and its isomer also present which was accountable for its psychotropic property. Recently in the western hemisphere youngsters has been abused of this plant hence it's also known as "legal highs" or "biogenic drugs"[8].

Principally roots contain the Tetradecanyl palmitate, stigma steryl p-hydroxy cinnamate, hexadecanyl p-hydroxy cinnamate, quercetin and caffeic acid. Recently 6-methoxy coumarin-7-O-α-D-glucopyranoside (coumarin glucoside) also isolated by the researchers[9].

The phytochemical investigation revealed the presence of kaempferol, quercetin, kaempferol 3-O-L-rhamnopyranoside, 7, 8, 3′, 4′, 5′-penta hydroxyl flavone and 5-O-β-D-glucopyranoside in *A. speciosa* leaves[10].

ETHNOBOTANICAL USES

Dried root powder with an alcoholic drink (3:1) used by Lodhas for the cure of gonorrhea. In addition cow milk and root powder (1:2) used for the treatment of dysuria (painful urination). In the Western Ghats, Palliyar tribes given roots extract for gastrointestinal complications. Santals community practice leaf on skin abscess. *Pongamia pinnata* seed oil with green fresh leaf juice used by Oraons for controlling the obesity and anemia. *A. speciosa* extract also used by some tribes for syphilitic and other male sexual problems cases. It also exhibits the beneficial effect in smallpox. In Lakhimpur, the tuber paste is employed in gastric ulcer[11,12]. In Wayanad district of Kerala, Kurichiyas tribes used leaf, flower and root parts for treating the cough and rheumatoid arthritis[13]. Munda tribes practiced root powder, chilled milk and misri for the various ailments[14].

PHARMACOLOGICAL ACTIVITIES

Wound healing activity

Young leaves of *A. speciosa* are used for wound healing. An ointment, developed by adding ethanol, ethanol-water, and water extracts were applied topically on mice skin for 14 days after induction of wound. The ethanolic and water extract of *A. speciosa* have shown significant wound healing activity in both incision and excision wound model. In another hand, water extract was found to be more potent. Results say that it significantly increased the rate of wound contraction, breaking strength, hydroxyl prolin content, and reduced epithelization point[15]. Treatment with leaves ethanolic extract ointment (15% w/w) of *A. nervosa* was showed significant wound healing effect in normal and diabetic rats[16].

Nootropic activity

A. nervosa is commonly known as Vridha daraka. It's commonly used in Ayurveda for neurological problems, on that behalf various researcher prooved nootropic and memory enhancing property of *A. nervosa*. Aqueous root extract at a dose of 100 and 200 mg/kg improved memory and successfully reverse memory loss induced by various agents such as diazepam and scopolamine. Along with this brain acetylcholine esterase activity also improved which is confirmed by significant nootropic activity[17]. Effect of hydroalcoholic extract of *A. speciosa* root (200 mg and 400 mg/kg), on learning and memory were also studied in mice using Radial arm maze and Morris water maze test. Piracetam used as the standard drug[18].

Aphrodisiac activity

The ethnobotanical clues link *A. nervosa* having aphrodisiac property. The root, flower and to some degree, the leaf of the plant showed an increase in the mounting behavior of mice. The root alcohol extract (200 mg/kg) stimulated mounting behavior of male mice in a dose-dependent way. Moreover, the number of males was found to be higher between the pups fathered through the herbal drug-pretreated mice compared to those by the control mice[19]. Early it was clinically proved by Jayatilak that a preparation (Speman) of various herbal extracts like *orchis mascula, Hygrophila spinosa, Lactuca scariola, Macuna pruriens, Parmelia parlata, A. speciosa, Tribulus terrestris* and *Leptadenia reticulate* increased the secretory function of the male patient prostate. Along with this Speman also increases in the citric acid content, an activity of maltase with the increase in the degradation of glycogen in seminal plasma of administered patients. The drug Speman has the similar action on the prostatic function to androgen[20]. Drug "Fortege" is produced from *Withania somnifera, Mucuna pruriens, A. speciosa, Leptadenia reticulata* and *Anacyclus pyrethrum* is used for correcting prevalent male sexual disorders. Fortege has been examined to against Lanthanum induced infertility. Mice administered with Fortege showed the normal weight of seminal vesicle, fructose content, sperm number, and motility regained at 21st day of exposure[21].

Immunomodulatory effect

Gokhle and colleagues proved the immunomodulatory activity of *A. speciosa*. In this study, they were used root (ethanolic) extract at dose of 50, 100 and 200 mg/kg in mice. Results shows that extracts significantly potentiated the delayed-type hypersensitivity reaction provoked both by sheep red blood cells (SRBC) and oxazolone[22].

Hepatoprotective activity

Treatment with, *A. nervosa* methanolic extract (200 and 400 mg/kg) of root significantly lower serum alanine aminotransferase, aspartate aminotransferase and alkaline phosphatase levels in CCl4-treated rats[23]. Suspensions of ethyl acetate and ethanol of *A. speciosa* (200 and 400 mg/kg) successfully prevented the alterations of serum biochemical parameters such as SGOT, SGPT, ALP, cholesterol, total bilirubin levels ($p < 0.001$) when compared to CCl4 treated animals. Histopathological examination showed that CCl4 treated group induces ballooning degeneration and centrilobular necrosis. While *A. speciosa* treated rat reverse all above mention pathological changes[24].

Analgesic and anti-inflammatory activity

Bachhav and colleagues recently studied the analgesic and anti-inflammatory action of *A. speciosa*. The methanolic root extract at various dose levels significantly decreases the number of acetic acid-induced writhing when compared to control animals. In another hand extract at 100 and 300 mg/kg dose attenuate the carrageenan-induced paw edema in the rat[25]. The fresh leaf ethanolic extract of *A. nervosa* (100, 200 and 400 mg/kg) shows the promising results on acetic acid-induced writhing and hot plate model. The results obtained from 400 mg/kg were nearly similar to standard drug aspirin[26]. Lalan also proved the protective role of methanolic extract of *A. speciosa* against different pain models[27]. The whole aerial part from *A. nervosa* was studied for its anti-inflammatory activity. In carrageenan-induced paw edema, it was observed that the ethyl acetate extract and methanol extract produced significant decreases in the paw volume. The methanolic extract (300 mg/kg) showed potent anti-inflammatory activity comparable to ibuprofen. The author fails to explore the exact phytoconstituents for its activity[28].

Antipyretic activity

Jeet claimed that whole aerial part extract from *A. nervosa* showed significant antipyretic activity ($p < 0.05$) against yeast induced pyrexia in rats. According to author *A. nervosa* exhibited antipyretic activity probably by inhibition of prostaglandin synthesis in the hypothalamus[29]. The hydro-alcoholic root extract of *A. speciosa* exhibited significant antipyretic activity ($p < 0.05$), while acetone, chloroform and methanol fraction failed to produce the therapeutic effect[30].

Antidiabetic activity

For evaluating the hypoglycemic activity, aerial parts of *A. speciosa* were used by the researcher. Alloxan treated rat showed the high level of glucose and lipid profile in the blood sample while group co-treated with extract

correct all the alteration significantly. As per the investigation, the antioxidant property is responsible for its antidiabetic effect[31].

Effect of ethanolic and aqueous extracts of *A. speciosa* on blood glucose and lipid profile was investigated in normoglycemic and Streptozotocin (STZ)-induced diabetic animals. In oral glucose and sucrose tolerance test, treatment with *A. speciosa* (100 and 200 mg/kg) and Glidenclamide (10 mg/kg) significantly improved the glucose and sucrose tolerance in normal animals. In addition, separate treatment for 15 days followed in significant reduction in serum glucose, 30.39% (100 mg/kg) and 33.21% (200 mg/kg)[32].

In addition to the above findings researcher also proved the Ayurvedic claim of *A. nervosa* as a traditional antidiabetic agent. In this study, 18 rabbits were subjected to *A. nervosa* root powder in the form of suspension (0.56 g/kg) and metformin was used as standard drug. But at the end of the study result were not significant as metformin[33].

Anti-diarrheal agents

Diarrhea is a common disease that is usually reported to the doctor for treatment. *A. speciosa* flower extract (ethanolic) was taken for evaluating the anti-diarrheal activity. The result showed that flower extract at a dose of (50, 100 and 150 mg/kg, orally) dose-dependently inhibit intestinal propulsion. In addition fecal matter and intestinal fluid also significantly reduced (9.97% - 39.58%)[34].

Antimicrobial and antifungal activity

A. nervosa has been recognized as a traditional remedy against several skin infections because of its powerful antimicrobial activity. Present study undertaken the following test organism: *Bacillus amyloliquefaciens, Streptococcus vulgarica, Salmonella typhe, Bacillus subtilis, Micrococcus luteus, Bacillus pumilis and Aspergillus niger*. The MIC value of methanolic and ethanolic extract was found maximum, against *Bacillus megaterium* at 484 µg/ml[35]. In addition, seed oil also possess the antifungal activity against *Aspergillus flavus, Colletotrichum capsici, Cryptococcus neoformans, Alternaria solani, Helminthosporium sp., Colletotrichum dematium, Aspergillus niger, Aspergillus sydowi and Fusarium oxysporum*[36].

Shukla and colleagues isolate the hexadecanyl p-hydroxycinnamate and scopoletin from the root of *A. speciosa*. Both isolated phytoconstituents were found to be effective against the *Alternaria alternate*[37].

Antiviral activity

The fruit's extract of *A. speciosa* also evaluated for its antiviral activity. Author assesses the interferon-like antiviral activity against vaccinia virus in Chorio-allantoic membranes cultures while the plant has failed to shows the protective action against Ranikhet virus[38]. The leaves extract of *A. speciosa* evaluated for anti-HIV activity. Three compounds, 1-hexacosanol, scopoletin and ethyl caffeate isolated from the ethanolic extract and tested on reverse transcriptase (RT) and HIV protease (PR) for anti-HIV effect. The result showed that all isolated compound significantly inhibit HIV RT and HIV PR by 78.71%, 43.35%, and 43.15%, respectively[39].

Nematicidal activity

A. speciosa aqueous (150 µg/ml) and alcoholic (75 µg/ml) extract have shown the anti-filarial activity. Both extract significantly inhibit the spontaneous movements of the entire worm and a nerve-muscle preparation of *Setaria cervi*, characterized by the reduction in tone, amplitude, and rate of contractions[40].

Antiulcer activity

Treatment with two fractions A & B (4.59 and 6.34 mg/kg, p.o.) from *A. nervosa* leaves significantly increased superoxide dismutase (SOD), catalase and glutathione (GSH) antioxidant enzyme levels. Lipid peroxidation and nitrite levels were detected to be lower when compared to the control group. According to authors quercetin and kaemferol were active constituents of the plant for its antiulcer potential[41]. Jaiswal and colleagues recently described that leaf butanolic fraction of *A. speciosa* (50, 100 and 200 mg/kg) showed gastroprotective activity. The fraction exhibited antiulcer activity in aspirin, ethanol, cold-restrain and pylorus ligation induced ulcers. The fraction dose-dependently exhibited the protective effect in aspirin 58.76%, ethanol 58.45%, cold-restrain 78.36% and pyloric ligation 69.04%, respectively. In addition, fraction also increased ($p < 0.001$) gastric mucus. It also significantly decreases the level of SOD, CAT and LPO concentration in treated rat[42].

Anticonvulsion activity

As per documentation of Ayurveda the root of *A. speciosa* considered as useful in various nervous disorder. In this context, the author used the hydroalcoholic extract of the root in a different animal model of convulsion. The anticonvulsion effects of 10 days treatment of hydroalcoholic extract (100, 200 and 400 mg/kg) doses were evaluated using pentylenetetrazole and maximum-electroshock induced convulsion model. The results revealed that extract significantly inhibits the seizures and having the potential anticonvulsant effect[43,44].

Central nervous system depressant activity

The hydroalcoholic root extract of *A. speciosa* (100, 200 and 400 mg/kg) were tested for its anxiolytic and locomotion activity. Results showed that *A. speciosa* failed to increase in open arm entry and time spent in open arm. However, it's reduced some degree of locomotion activity[45].

Treatment of skin diseases

Ethnobotanical survey finds that Garo tribal community living in Netrakona district, Bangladesh used whole plant paste for skin diseases and smallpox[46].

Anti obesity activity

The anti-obesity activity of *A. speciosa* root extract was determined by evaluating the body weight, adipose tissue weight, serum leptin, triglycerides and total

cholesterol in the cafeteria-diet rat. Co-treatment with extract (500 mg/kg) for 42 days in rat feeding with cafeteria diet or atherogenic diet significantly reduced in body weight ($p < 0.01$), adipose tissue weight ($p < 0.05$), serum lipid content ($p < 0.01$) and triglycerides ($p < 0.01$). In addition, *A. speciosa* also suppress fatty liver and pancreas lipase activity. The result clearly indicated that plant useful in obesity and metabolic syndrome[47]. The root ethanolic extract (500 mg/kg) of *A. speciosa* was assessed for its effects on rats fed with obesity diet. Results clearly suggest that root extract significantly lower triglycerides, total cholesterol, LDL level and atherogenic index when compared to obesity rats. In addition, it also increases the HDL level in treated rats[48].

Anti-stress activity

A. speciosa root extract (100 and 200 mg/kg) for 7 days given for evaluating the anti-stress activity. Treatment with root extract causes marked decreases in immobility time and an increase in anoxic tolerance time in swimming endurance and anoxic tolerance test. *A. speciosa* also useful in inhibiting the pathological alteration in adrenal gland caused by cold restrained stress. Co-treatment with extract suppresses the humoral immune response to the antigen, immunized by sheep RBCs in mice. The author finds that extract possesses potent anti-stress activity and its immune-stimulating property was responsible for its activity[49].

Anticancer activity

A. speciosa fresh leaves possess the potent gastric anticancer activity in Wistar rats. Cancer induced by N-methyl-N-nitro-N-nitrosoguanidine (100 µg/ml) for 20 weeks. Quercetin isolated from ethanolic leaf extract and administered at dose of 100, 200 and 400 mg/kg. The results indicated that the quercetin therapy dose-dependently stimulates immunity activity in rats and have declared influence on survivin which is an attractive target for the therapy of gastric cancer[50]. Kaur and colleagues find that hydroalcoholic root extract showed decreased HCl-induced lung inflammation in a dose-dependent fashion. The dose of 100 mg/kg, almost entirely abolished the number of neutrophils in broncho-alveolar lavage fluid. It also overcomes the gene expression of acute lung injury-linked pro-inflammatory cytokines such as TNF-α and interleukin-1-β[51].

CONCLUSION

Natural drugs and medications have been the significant role in the traditional system of medicines. In the present paper, we have made an effort to present the traditional uses, phytochemistry, ethnobotanical uses and pharmacological activities. *A. speciosa* consisted of the various phytoconstituents mainly, psychotropic LSD, ergoline alkaloids and its derivatives, coumarin glycosides, kaempferol, quercetin. *A. speciosa* has varied pharmacological potential and was used since early times. It possesses the neuroprotective, wound healing, aphrodisiac, immunomodulatory, hepatoprotective, antidiabetic, antiviral and many other pharmacological activities. Furthermore, purification, isolation, and characterization of active secondary metabolites accountable for numerous pharmacological activities have not still been structurally interpreted, and expect much better planned and collaborative investigation.

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CONFLICT OF INTEREST

The authors report no conflicts of interest.

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