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RESEARCH ARTICLE

Review on *Solanum trilobatum* Linn

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ABSTRACT

Solanum trilobatum Linn. Is one of the important medicinal plant belongs to the Family: Solanaceae, order: Solanales and Genus: *Solanum* native to India and is found everywhere in Tamil Nadu. It is widely used as an Indian alternative system of medicines like Siddha, Ayurveda herbal medicines and natural home remedy for various conditions like asthma, respiratory problems, cough and cold. It is commonly called as purple fruited pea, eggplant or Thai nightshade and in Tamil as 'Thudhuvalai'. This herb is a thorny creeper that grows in bushes. The entire stem and leaves contain thorns all over the plant. The flowers are purple in colour. *S. trilobatum* is reported to cure numerous diseases viz., Antimicrobial, Anti-diabetic, Hepatoprotective activity, Tuberculosis, Anti-inflammatory, Bronchial Asthma, Antitussive, Cold relief, Antioxidant, Anti-dandruff, Immunomodulatory activity, Anticancer, Phlegmatic Rheumatism, Cytotoxic, Ovicidal activity and Mosquitocidal activity. Phytochemical screening showed the presence of carbohydrates, sobatum, solasodine, tomatidine, disogenin, solainand tannins in leaf, whereas, stem possess carbohydrates, saponins, phytosterols, tannins, flavonoids and cardiac glycosides as major phytochemical groups.

Keywords: Climbing Brinjal, Pharmacological studies, Phytochemical studies, *Solanum trilobatum*, Thudhuvalai.

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1. Introduction

Medicinal plants can serve as a source of novel therapeutic agent due to the presence of diverse bio active compounds like alkaloids, flavonoids, terpenoids, phenolic compounds, glycosides etc., in plants. They are widely used in the humantherapy, veterinary, agriculture, scientific research, etc., Plants are playing an important role in the health of millions of people’s life in India. The World Health Organization estimates, without reliable data, that some 80 percent of the world’s population depends mainly on traditional medicine perhaps some two billion people are largely reliant on medicinal plants. Plants synthesize hundreds of chemical compounds for functions including defence against insects, fungi, diseases, and herbivorous mammals. Numerous phytochemicals with potential or established biological activity have been identified. However, since a single plant contains widely diverse phytochemicals, the effects of using a whole plant as medicine are uncertain. Further, the phytochemical content and pharmacological actions, if any, of many plants having medicinal potential remain unassessed by rigorous scientific research to define efficacy and safety.

2. Plant Description

Solanum trilobatum Linn (Solanaceae), the nightshade, with Family: Solanaceae, order: Solanales and Genus: *Solanum* with 102 genera and nearly 2,500 species. It is a prickly diffuse, bright green perennial herb, woody at the base, 2–3 m height, found native to India and is found everywhere in Tamil Nadu. Abraham Muthukumar (1992) has reported that this plant grows and produces flowers between December and March. The plant having much branched spiny scandent shrubs. Gamble(1921)in his flora has reported this plant to be a climbing under shrub with numerous short, strong and recurved prickles. Leaves are deltoid or triangular, irregularly lobed. Flowers are purplish-blue and white in cymes. Gamble (1921) and Shanmugam (1989) alone have reported this plant to be producing flowers with white colour. But in wild natural habitats white-flower producing plants are uncommon. White flowering plants are superior in their therapeutic properties than the violet flowering plants. Berry are globose, red or scarlet.

Traditional Uses:

Various pharmacologically active compounds which are derived from different parts of plants directly or indirectly can act as lifesaving drugs *Solanum trilobatum* Linn (Family: Solanaceae) is one of the important wild medicinal plant. It has variety of therapeutic properties such as antimicrobial, anti-diabetic, anti-inflammatory, Hepatoprotective, Respiratory problems, Bronchial Asthma etc. The steroid solasoline is present in the leaves, fruits, seeds and stem which are widely used for steroid drug production (ANM Mamun et. al., 2014). The fruit from *solanum trilobatum* having nutritional and mineral composition (Suganthi et al., 2017).They have been shown to possess immune stimulating activity acting at different levels of the immune system (Dhasarathan et al., 2008). The flower is used to treat with rheumatism, constipation and

other gastric problems. The leaves are used to treat dullness in hearing by making ear drops (Akilan et. al., 2014). The leaf extract is used for treatment of cough and cold. The major alkaloids identified in the alcoholic extract from leaves and stem part of *S. trilobatum* has been shown to possess antimicrobial activity against bacteria and fungi.

Botanical Description & Synonyms:

Botanical name : *Solanum trilobatum* Linn.
 Family : Solanaceae
 Order : Solanales
 Genus : *Solanum*
 Class : Magnoliopsida



Fig 1: *Solanum trilobatum* Linn

Tamil	Cinkarantakam, Ilaimulaimatu, Kanakattukkatipati, Naripputtu, Nittidar, Thoodhualai, Valanatikkoti, Sandunayattan, Surai.
Kannada	Ambu sonde balli, Habbu sunde gida, Mullu kaaka munchi
Malayalan	Putharichunda, Putricunta, Puttacunta, Tudavalam, Tutavalam
Sanskrit	Alarka, vallikantakaarika, kantakaari-lat
Telugu	Alarkapatramu, Kondavuchinta, Mullamusthe, Oochintakura, Thigemull musta, Utchinta.
Marathi	Mothiringnee, Thoodalam.
Oriya	Bryhoti
English	Climbing Brinjal
Hindi:	Kantakaari-Latta.

Distribution:

Southern India, Ceylon Deccan, S.M. (San Marino)Country in Europe, Western Indian Peninsula, Malay Peninsula India, China, and Andaman Islands.

Siddha Properties:

From ancient period this herb is used by roasting in oil or pure ghee and making a powder on it. Thuthuvalai kashayam or legiyam reduces the congestion of nose and chest. Consuming the juice of the plant with honey is used for respiratory problems like carcinoma, dyspnoea and anorexia. Most common recipes in siddha are Thuthuvalai candy, legiyam, rasam and chooranam.

Preliminary Phytochemical Screening:

Phytochemical screening of various extracts such as chloroform, ethanol and water of *S. trilobatum* revealed the presence of secondary metabolites like Steroids, tri

terpenoids, sugars, Reducing sugars, phenolic compounds, tannins, anthroquinone, amino acids and Saponins. Phytochemical analysis of dried powder of *S. Trilobatum* leaves showed the presence of carbohydrates, saponins, phytosterols and tannins, whereas the stem portion possess carbohydrates, saponins, phytosterols, tannins, flavonoids and cardiac glycosides. Alkaloides such as soladunalinidine and tomatidine were isolated from the leaf and stem of *Solanum* species. *S. trilobatum* contains chemical compounds like Sobatum, -solamarine, solasodine, solaine, glycoalkaloid and diosogenin.

3. Pharmacological Studies

Antimicrobial Properties:

Aqueous methanol and n-butanol extract of aerial parts of *s.trilobatum* produces good antimicrobial activity against Gram (+) and Gram (-) bacteria (Swapna latha P et al., 2006). In this study, the antimicrobial potential of ethanol, acetone and ethyl acetate extracts of leaves, fruits and flowers of *Solanum trilobatum* and pure saponin extracted from the leaves against bacterial strains (*Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*) (Krishnan K et al., 2008).

Antibacterial Properties:

In vitro studies of chloroform, methanol, petroleum ether and water leaf extracts were carried out on eight bacterial strains (*Staphylococcus aureus*, *Bacillus subtilis*, *Streptococcus pyrogens*, *Salmonella typhi*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, *Escherichia coli*, *Proteus vulgaris*) showed good inhibitory activity compared with standard antibiotics like streptomycin. (Asirvatham Doss et al., 2008).

Tannin isolated from methanolic extract of leaf of *s.trilobatum* produces good antibacterial activity by agar disc diffusion method. Minimum inhibitory concentration of the tannins ranged between 1.0 and 2.0 mg/ml while the minimum bactericidal concentration ranged between 1.5 and 2.0 mg/ml (Doss A et al., 2009). The green synthesis of silver nanoparticles (AgNPs) by using the leaf extract of medicinally valuable plant *Solanum trilobatum*. Antibacterial activity of synthesized silver nanoparticles was done by agar well diffusion method against different pathogenic bacteria (Vanaja M et al., 2014).

Anti-diabetic Properties:

Antidiabetic activity of water extract of *Solanum trilobatum* (Linn.) in alloxan monohydrate induced diabetic rat models. In addition, changes in body weight, serum lipid profiles and liver glycogen levels assessed in the extract treated diabetic rats were compared with diabetic control and normal animals. Significant results were observed in the estimated parameters (Doss A et al., 2008). Antihyperlipidaemic effect on aqueous extract of leaves of *solanum trilobatum* Linn. against streptozotocine induced diabetic rats. Repeated administration of the leaves extract of *S.trilobatum* (100mg and 200mg/kg b.w) for 21 days resulted in significant reduction in serum and tissue triglycerides, cholesterol, free fatty acids and phospholipids in STZ diabetic rats. (Kumar Ganesan et al., 2013).

Anti-Inflammatory Properties:

Methanolic extract of *S. trilobatum* Leaf were investigated for anti-inflammatory activity with acute and chronic models. In the doses of 100, 200 and 300 mg/kg exhibited significant ($P < 0.05$) anti-inflammatory activity in all the models tested. The methanolic extract of *S. trilobatum* Linn. at 300 mg/kg showed maximum inhibition of 54.44% in carrageenan-induced rat paw oedema while the standard drug indomethacin was 57.08% after 3 hrs of carrageenan injection. On the other hand at 100, 200 and 300 mg/kg inhibited with dextran, histamine and serotonin-induced rat paw oedema significantly and dose dependently compared with control group. In the chronic inflammatory model, at a dose of 200 and 300 mg/kg inhibited the granuloma weight by 22.65%, whereas the indomethacin inhibited 28.37% (Pandurangan A et al., 2014).

Antioxidant Properties:

A chloroform extract of *Solanum trilobatum* was analysed and compared with reference antioxidants for its in vitro anti-oxidative properties such as scavenging of \cdot , \cdot -diphenylpicrylhydrazyl (DPPH) and superoxide radicals, protection to deoxyribose degradation, reducing power, as well as inhibition of lipid peroxidation. The chloroform extract was found four times effective than catechin. This was able to prevent the formation of OH \cdot -induced malondialdehyde (MDA) in rat liver homogenate (Sini H et al., 2004). The methanolic extract of *Solanum trilobatum* (ST) is cytotoxic and exerts an inhibitory effect on tumor growth and in the present study, its role on the antioxidant status of N-diethylnitrosamine (DEN) induced and phenobarbital (PB) promoted hepato carcinogenesis (Shahjahan M et al., 2005). Anti-oxidant activity in hairy root cultures of *Solanum trilobatum* L. The antioxidant activity of the extracts from hairy root cultures, based on the scavenging activity of 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging activity (Shilpa J et al., 2014).

Immunomodulatory Activity:

Aqueous extract of leaves of *S. trilobatum* Linn (*Solanaceae*) was pharmacologically validated for its immune modulatory properties in experimental animals. Oral administration of extract at dose of 100, 200 & 400mg/kg significantly increased in percentage neutrophil adhesion ($P < 0.001$). The Delayed Type Hypersensitivity also showed a dose dependent activity ($P < 0.001$). Further, a dose related increase in hemagglutination antibody titre was observed with different doses as compared to control group. Carbon clearance test was conducted to establish phagocytic activity of reticuloendothelial system after treatment with aqueous extract. Phagocytic index was significantly increased after the administration of *S. trilobatum* compared to control group ($P < 0.001$). These findings suggested that the immunostimulatory activity of *S. trilobatum* influences by potentiating humoral as well as cellular immunity.

The effect of crude extract, water and hexane soluble fractions of *Solanum trilobatum* leaves administered intraperitoneally on the specific immune response, nonspecific immunity and disease resistance in *Oreochromis*

mossambicus. The functional immunity in terms of percentage mortality and Relative Percent Survival (RPS) was assessed by challenging the fish with live *A. hydrophila*. All the doses of three fractions except 32 mg kg⁻¹ of crude extract and 800 mg kg⁻¹ of water soluble fraction significantly enhanced the primary and secondary antibody responses (Divyaganeswari M et al., 2008).

Mosquitocidal Properties:

The larvicidal and pupicidal activities of methanol extract of *Solanum trilobatum* (*S. trilobatum*) leaf extracts against *Aedes aegypti* (*Ae. aegypti*), *Culex quinquefasciatus* (*Cx. quinquefasciatus*) and *Anopheles stephensi* (*An. stephensi*). The larvicidal and pupicidal was determined at five different concentrations of 50, 100, 150, 200 and 250 ppm (Selvaraj Premalatha et al., 2013). Acetone extract of *Solanum trilobatum* leaves was evaluated for its ovicidal activity on the mosquito species *Culex quinquefasciatus* and *Culex tritaeniorhynchus*, by exposing eggs ranging in age from 0 to 18 h to concentrations of 50–200 ppm of the extract, and assessing their percent hatchability. A 100-ppm dose of the extract killed all of the eggs from both species aged between 0 and 6. The 50- and 75-ppm concentrations were also highly effective against young eggs; the effect declined in older eggs (Rajkkumar S et al., 2004).

Antinociceptive Properties:

Solasodine a steroidal glycoalkaloid, is considered as a potential alternative to diosgenin for the synthesis of various steroidal drugs. It can be isolated from the roots of *Solanum trilobatum* Linn, anti-nociceptive activity conducted by several experimental murine models, viz. the writhing, formalin, and hotplate tests used at doses of 2, 4, and 8 mg/kg, this steroidal alkaloid caused a significant and dose-dependent decrease in the nociception induced by an intraperitoneal injection of acetic acid ($p < 0.001$). It also led to a significant reduction of the painful sensation caused by formalin in both phases of the formalin test ($p < 0.001$). Furthermore, the alkaloid produced a significant increase in the reaction time in the hot plate test ($p < 0.001$) (Annamalai Pandurangan et al., 2010).

Hepatoprotective Properties:

Hepatoprotective effect of an aqueous leaf extract of *S. trilobatum* extract was examined against lead acetate Swiss albino mice. The oral administration of the above extract for 30 days against lead acetate affected mice significantly increased the levels of antioxidants (SOD, CAT, GPx) and decreased the level of lipid peroxidation (LPO). The results of the present study, for the first time, provide clear evidence of defense provided by *S. trilobatum* extracts against lead acetate induced toxicity in brains of albino mice.

Protective action of *Solanum trilobatum* extract (STE) was evaluated by us in an animal model of hepatotoxicity induced by carbon tetrachloride (CCl₄) Group I was normal control group; Group II, the hepatotoxic group was given CCl₄; Groups III-V received different doses of plant extract with CCl₄. Liver marker enzymes were assayed in serum and antioxidant status was assessed in liver tissue. Lipid peroxidation (LP) was increased significant in liver tissue in the CCl₄ treated rats (group II) while the activities of

glutathione peroxidase (GPx), catalase (CAT) and superoxide dismutase (SOD) were decreased. STE treatment led to the recovery of these levels to near normal (Shahjahan M et al., 2004).

Anti-Dandruff Properties:

Solanum trilobatum Linn extract were prepared by both conventional and homogenization method. Silver nanoparticles were produced under sunlight, microwave and room temperature. The best results were obtained with sunlight irradiation, exhibiting 15–20 nm silver nanoparticles having cubic and hexagonal shape. In this study we report antibacterial activity against various Gram negative (*Klebsiella pneumoniae*, *Vibrio cholerae* and *Salmonella typhi*) and Gram positive (*Staphylococcus aureus*, *Bacillus cereus* and *Micrococcus luteus*) bacterial strains. Screening was also performed for any antifungal properties of the nanoparticles against human pathogenic fungal strains (*Candida albicans* and *Candida parapsilosis*). These nanoparticles when mixed with shampoo enhance the anti-dandruff effect against dandruff causing fungal pathogens (*Pityrosporum ovale* and *Pityrosporum folliculitis*) (Gaurav Pant et al., 2012).

4. Results and Discussion

The survey of literature revealed that the *Solanum trilobatum* having effective pharmacological activities such as antimicrobial, antidiabetic, mosquitocidal, anti-dandruff, hepatoprotective, antioxidant, anti-inflammatory, immunomodulatory properties. It having important medicinal phytochemical compounds such as saponins, phytosterols, tannins, soladunalinidine, tomatidine, Sobatum, -solamarine, solasodine, solaine, glycoalkaloid and diosgenin. *Solanum trilobatum* extract was prepared into silver nanoparticles and mixed with shampoo act as effective anti-dandruff agent because it having antimicrobial properties. Steroidal hormone solasodine was present in this plant effective for hepatoprotective and haemolytic activity. The results from this review are quite promising for the use of *S. trilobatum* as a multipurpose medicinal agent, while *S. trilobatum* has been used successfully in Siddha medicine for centuries, more clinical trials should be conducted to support its therapeutic use. Moreover, the therapeutic potential of the plant should also be checked when used in combination with other herbal drugs.

5. Conclusion

Ethno botanical and traditional uses of natural compounds, especially of plant origin received much attention in recent years as they are well tested for their efficacy and general believed to be safe for human use. Traditionally, plants are used in the treatment of many infections and systemic disorders. More than hundreds of chemical compounds are derived from plants which have medicinal values due to their health-enhancing and therapeutic properties are referred as herbs. Thorough screening of literature available on *S. trilobatum* depicted the fact that it is a popular remedy among the various ethnic groups Siddha and Ayurvedic properties.

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