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A REVIEW ON THE PHYTOCHEMICAL, PHARMACOLOGICAL, AND NEUROPROTECTIVE PROFILE OF CONVOLVULUS PROSTRATUS (SHANKHPUSHPI)

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Abstract:

The current review discusses in detail the traditional uses, phytochemical composition, pharmacological activities, structure-activity relationships, extraction techniques, and formulation development of Convolvulus prostratus, commonly known as Shankhpushpi. The plant contains a wide variety of bioactive compounds, including alkaloids like convolamine and convolvine, flavonoids such as kaempferol and scopoletin, sterols like β-sitosterol, and fatty acids, carbohydrates, and proteins. The collective contribution of these constituents to the plant has been well-documented regarding its nootropic, neuroprotective, anxiolytic, antioxidant, and hypolipidemic activities.

The review describes in detail the mechanisms underlying these actions, especially focusing on pathways related to neurodegenerative diseases: the inhibition of β-amyloid aggregation, modulation of tau protein phosphorylation, enhancement of cholinergic transmission, and activation of endogenous antioxidant enzymes. Such mechanisms support the growing scientific interest in C. prostratus as a potential therapeutic agent for conditions like Alzheimer's disease and cognitive decline. The paper further elaborates on the structure-activity relationships of major phytoconstituents, outlining commonly used extraction approaches such as successive solvent extraction and methanolic maceration. Advances in formulation development, aimed at enhancing bioavailability and standardization, are reviewed. The present review compiles traditional knowledge and contemporary scientific findings and emphasizes the therapeutic potential of Shankhpushpi and encourages future research efforts targeting standardized preparations with rigorous clinical validation.

Keywords:- *Shankhpushpi, Memory enhancer, Neuro degenerative, Natural Products, Convolvulus prostrates.*

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INTRODUCTION:

Convolvulus prostratus Forssk. (syn. Convolvulus pluricaulis), commonly known as Shankhpushpi, is a perennial, prostrate herb belonging to the family Convolvulaceae. The name "Shankhpushpi," derived from Sanskrit words shankh (conch) and pushpa (flower), refers to its shell-shaped blossoms. The plant is characterized by small elliptic to lanceolate leaves and white to light blue flowers that are usually solitary or occur in pairs in the upper axils. It thrives under xerophytic conditions, particularly in northern India, growing abundantly on wastelands during September and October. Steam distillation of the fresh plant yields a pale yellow essential oil with a greenish hue and a distinctive odor.

Traditionally, Shankhpushpi has been valued as a Medhya Rasayana in Ayurveda for its ability to enhance memory, intellect, and concentration—qualities especially relevant in today's competitive academic environment. It is regarded as a tonic for the nervous system and is used to treat disorders such as bronchitis, asthma, epilepsy, and fever in children. The plant's oil promotes hair growth, while its use in skincare supports nourishment and complexion enhancement. Pharmacological investigations have demonstrated that ethanolic extracts of C. prostratus reduce total serum cholesterol, triglycerides, phospholipids, and non-esterified fatty acids, reflecting its hypolipidemic and cardio protective potential. Additional studies also highlight its anti-ulcer and anti-hyperthyroid effects, likely mediated through modulation of liver enzyme activity.

Collectively, these findings affirm Shankhpushpi's traditional reputation as a potent cognitive enhancer and therapeutic herb with multifaceted pharmacological properties, making it a promising subject of modern phytopharmacological research.

Scientific classification

Kingdom: Plantae
Division Magnoliophyta
Class: Manoliopsida
Order: Solanales
Family: Convolvulaceae
Genus: Convolvulus
Species: prostratus
Common Name: Shankapushpi

Traditional Uses of Convolvulus prostratus (Shankapushpi)

Herbal medicines have been used in India for centuries to promote health, longevity, and immunity, as well as to manage various disorders such as anxiety, insomnia, epilepsy, diabetes, and heart diseases. Convolvulus prostratus (Shankhpushpi) is one such traditional herb valued for its rejuvenating and therapeutic effects. It is known to enhance strength, digestion, complexion, and voice, while also acting as an anthelmintic and remedy for respiratory, urinary, and uterine ailments. The leaves and flowers possess hypotensive properties and are traditionally used to treat anxiety and neurosis. Ethnobotanical evidence from tribal communities in Madhya Pradesh and Uttar Pradesh highlights its use against dysentery, skin diseases, hypertension, and depression. Non-toxic and safe for long-term use, the herb contributes to improved health and weight gain. In Ayurveda, Shankhpushpi is classified as a Medhya Rasayana, a rejuvenative tonic that nourishes both body and mind, delays aging, enhances intelligence, and strengthens disease resistance by balancing the Kapha, Vata, and Pitta doshas. Herbalists further suggest that its calming effect is due to regulation of stress hormones such as cortisol and adrenaline**.**

Phytochemical Constituents

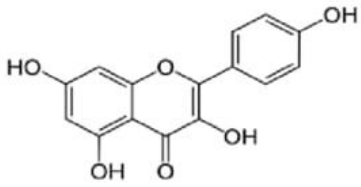
There are various chemical constituents isolated from Shankhpushpi like Carbohydrates-D-glucose, rhamnose, maltose, sucrose and starch. It also contains protein, amino acids and the alkaloids-convolvine, convosine, subhirsine and convolvidine along with fatty acid and wax constituents, hydrocarbons, aliphatic and sterol and certain other bio-chemicals [1]

1. Carbohydrates: D-glucose, maltose, rhamnose, sucrose, starch and other carbohydrates [2, 3]
2. Fatty acids/ Volatile oil/ Fixed oil: Fatty alcohols [4] and hydrocarbons, 30.9% myristic acid, 66.8% palmitic acid and 2.3% linoleic acid and hextriacontane [5,6,7,8,9].
3. Protein and Amino acids: Proteins and amino acids are also isolated from the plant.
4.Phenolic/Glycosides/Triterpenoid/Steroids:

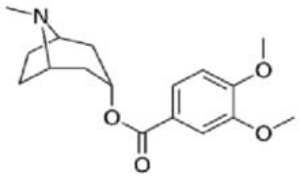
Deshpande et al., reported a chemical examination of the whole plant of C. pluricaulis and found the

presence of scopoletin, β-sitosterol and ceryl alcohol [10, 11]

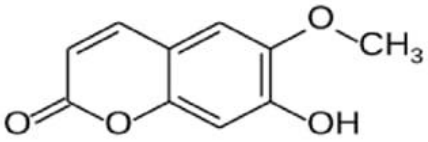
5. Choloroform fraction of this contains 20-oxodotriacontanol, tertratriacontanoic acid and 29-oxodotriacontanol, flavonoid-kampferol, steroids-phytochemical [4]. CP-1 is a phytochemical marker that has been isolated and characterized by the HPTLC technique [7, 8, 9, and 12]



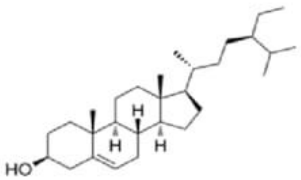
Kaempferol



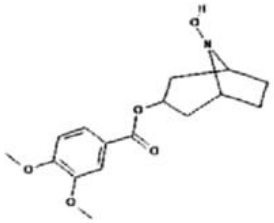
Convolamine



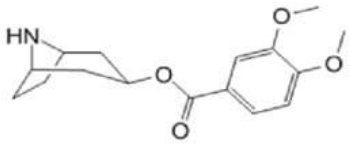
Scopoletin



β-sitosterol



Convoline

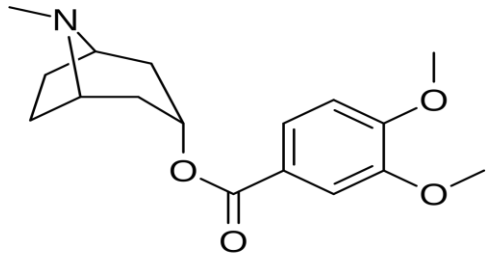


Convolvine

Table 1: Mechanism of actions and Uses of Chemical Constituents

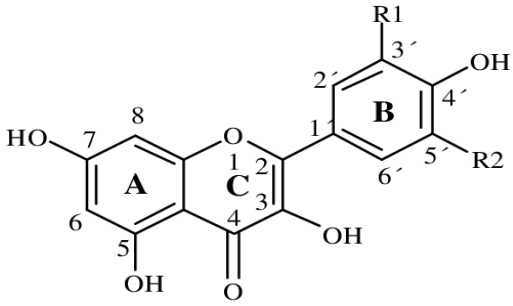
Chemical Constituents	Mechanism of Action	Uses
Kaempferol	It increases acetylcholine levels, which are important for memory and learning.	Nootropic, reduce anxiety, treat insomnia, treatment of hyperthyroidism
Convolamine	By inhibiting acetylcholinesterase, the drug increases acetylcholine levels, thereby boosting the cholinergic neurotransmission necessary for optimal learning and memory function.	Neurodegenerative, treating epilepsy, stress related conditions
Scopoletin	By inhibiting acetylcholinesterase, the drug increases acetylcholine levels, thereby boosting the cholinergic neurotransmission necessary for optimal learning and memory function.	Anti-inflammatory, neuroprotective, cognitive enhancement
β -sitosterol	i. Competes with cholesterol for absorption in the intestines, reducing cholesterol uptake. ii. Modulates inflammatory pathways by affecting prostaglandins and cytokines. iii. Induces apoptosis and inhibits proliferation in certain cancer cells. iv. v. Enhances immune response and provides antioxidant protection.	Treatment of heart diseases, rheumatoid arthritis, hair loss, lowering cholesterol levels
Convoline	Convoline improves memory and cognition by blocking the M2 and M4 muscarinic acetylcholine receptors, which in turn boosts vital cholinergic neurotransmission.	Concentration and treatment of anxiety, insomnia, alzheimer's disorder, epilepsy
Convolvine	Convolvine improves memory and cognition by blocking the M2 and M4 muscarinic acetylcholine receptors, which in turn boosts vital cholinergic neurotransmission.	Anti-ulcer, hypotensive, hypolipidemic effects. Treatment of alzheimer's, epilepsy

Structure Activity Relationship
Convolamine



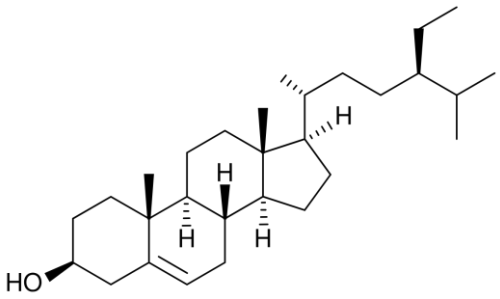
Convolamine's neuroprotective and sigma-1 receptor modulatory effects rely on its methylated tropane nitrogen and benzoate ester group. The methyl group is vital for receptor binding, while the benzoate ester enhances stability and selectivity. Structural changes like demethylation, hydroxylation, or N-oxidation reduce its activity. Together, these groups allow convolamine to fit into the receptor's hydrophobic pocket, enabling positive allosteric modulation and supporting its neuroprotective potential in neurodegenerative disorders.[43]

kaempferol



The presence of a 3-hydroxyl group on the C-ring is especially important in the biological activity of flavonoids, especially for the anti-inflammatory actions and enzyme inhibitory effects. Together, the presence of a C2–C3 double bond, a C4 ketone, and hydroxyl groups at positions 3, 5, 7, and 4′ also increase antioxidant activity and modulation of enzymes, while sugar attachment at the 3-position (i.e., a rhamnose) decreases activity. [44]

β –sitosterol



The compound resembles cholesterol but has an additional ethyl group at C-24, enhancing its affinity for target proteins. The 3β-hydroxyl group is essential for bioactivity, while the planar sterol ring structure is vital for interactions with cellular proteins and membranes. Although the C-24 ethyl substitution improves binding, it is not essential for activity.[43,44,45,46]

Extraction Methods

1. Successive Solvent Extraction Method or Sequential Solvent Extraction Method

The extraction of phytochemical constituents was carried out using the Successive Solvent Extraction Method. The powdered plant material was successively extracted with solvents of increasing polarity—petroleum ether, benzene, chloroform, ethyl acetate, ethanol, and water. Each extraction was performed sequentially to ensure the complete isolation of both non-polar and polar compounds. The obtained extracts were then concentrated by evaporating the solvents under reduced pressure. [13, 14]

The Successive Solvent Extraction Method was selected to achieve comprehensive extraction of phytoconstituents according to their polarity. Sequential use of solvents with increasing polarity facilitates efficient isolation of both non-polar and polar compounds, thereby enhancing the yield and representation of bioactive components present in the plant material**.** [15, 16, 17]

2. Methanolic Extraction via Maceration and Freeze Drying

All Shankhpushpi samples were ground into a coarse powder and accurately weighed. Ten grams of the powdered material were transferred into an appropriately sized volumetric flask, and 100 mL of methanol was added. The mixture was subjected to shaking on a mechanical shaker for 5–6 hours, then left undisturbed overnight at room temperature (25 ± 2°C). The extract was filtered, and the extraction procedure was repeated two more times using fresh methanol to ensure exhaustive extraction. The combined methanolic extracts were filtered through Whatman No. 1 filter paper. The filtrates were pooled and concentrated under reduced pressure using a rotary evaporator at 45°C. The

concentrated extract was then freeze-dried using a lyophilization system. [18]

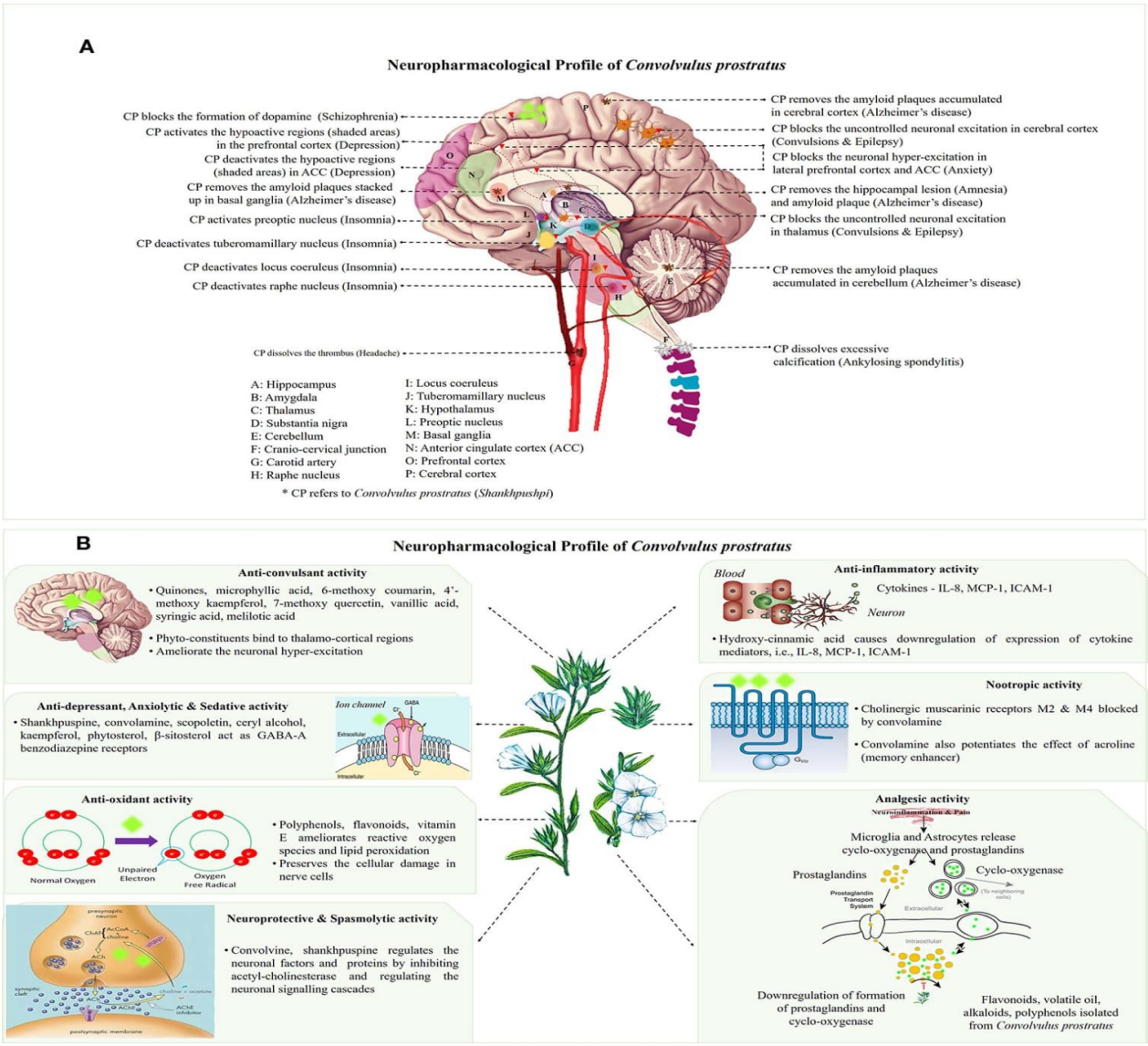
Pharmacology

This herb is widely used in traditional medicine for numerous ailments. A decoction of the whole plant with milk is commonly used to treat conditions like amnesia, neurological disorders, and syphilis, helping with issues such as memory loss, depression, stress, and ADHD. The leaves are used intact for ailments like anorexia, asthma, bronchitis, and urinary diseases, while leaves and flowers together are applied for anxiety and bone fractures.

The whole plant also plays a role in managing arthritis, blood disorders, edema, emesis, snake bites, wounds, and constipation. For headaches, a powder of the plant mixed with sugar and milk is taken twice daily. In sexual debility, it is ground with water and consumed with honey or sugar for 21 days. Menorrhagia and stomachache are treated using a paste or powdered form of the plant mixed with milk. Additionally, the herb is used to relieve fever (pyrexia), heartburn (pyrosis), vertigo, and worm infestation. In traditional practice, the combination of the herb with cumin and milk is particularly valued for promoting relaxation, improving memory, and supporting overall neurological health. [19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34]

The aqueous root extract of Convolvulus prostratus (CP) shows significant neuroprotective and anxiolytic activities. It inhibits acetylcholinesterase and oxidative stress in scopolamine- and aluminium chloride–induced neurotoxicity in rats, while maintaining Na^+/K^+ ATPase activity and mRNA levels of key neuronal markers (M1 receptor, ChAT, NGF-TrkA). CP also reduces tau protein expression, helping prevent Alzheimer's-related neuronal damage. The phytochemicals like convolvine are likely responsible for these effects.

For anxiolytic activity, ethanolic, chloroform, and methanolic extracts (200–400 mg/kg) increase open-arm activity in mice and modulate serotonergic and dopaminergic pathways, reducing obsessive-compulsive behavior. The effect may relate to the herb's GABA-A–benzodiazepine agonists such as convolamine and scopoletin. [23, 35]



Mechanism of Action

Anti-Amyloidogenic Activity:

Extracts of Shankapushpi have been shown to inhibit β-amyloid (Aβ) generation in neuronal cell models expressing Alzheimer's-associated APP mutations, without affecting total APP expression. This inhibitory effect is thought to occur via up regulation of amyloid-degrading enzymes such as insulin-degrading enzyme (IDE) and neprilysin, thereby reducing amyloid plaque formation.

Tau Protein Modulation:

In Drosophila models of Alzheimer's disease, aqueous extracts of Shankapushpi have demonstrated the ability to decrease tau protein accumulation and attenuate tau-induced oxidative stress. This action helps prevent the formation of neurofibrillary tangles—one of the pathological hallmarks of Alzheimer's disease.

Antioxidant and Anti-Inflammatory Effects:

Shankapushpi is rich in bioactive compounds including polyphenols, flavonoids (such as quercetin, kaempferol, and scopoletin), and vitamin E. These constituents scavenge reactive oxygen species (ROS), inhibit lipid peroxidation, and enhance the activity of endogenous antioxidant enzymes such as catalase, superoxide dismutase (SOD), and glutathione reductase. Through these mechanisms, Shankapushpi provides significant protection against oxidative and inflammatory neuronal damage, both of which play crucial roles in

the progression of Alzheimer's pathology. [36, 37, 38, 39, 40]

CONCLUSION:

Shankhpushpi, known as Convolvulus prostratus, possesses great potential as a natural therapeutic agent in the treatment of neurodegenerative disorders. The reason lies in its diversified phytochemical profile, comprising alkaloids like convolvine and convolamine, flavonoids such as kaempferol and scopoletin, sterols like β-sitosterol, coumarins, fatty acids, and carbohydrates. These phytoconstituents together provide anti-amyloidogenic, antioxidant, anti-inflammatory. Such mechanisms help to reduce the accumulation of β-amyloid, modulate tau protein abnormalities, protect neuronal integrity, and enhance cognitive function-key pathways relevant to neurodegenerative conditions like Alzheimer's disease.Further support for the therapeutic promise of Shankhpushpi lies in the alignment of traditional Ayurvedic uses with modern pharmacological findings. Nevertheless, its clinical potential still remains underexplored. Further molecular mechanism studies, isolation of bioactive compounds, pharmacokinetics, optimisation of dosages, long-term safety, and well-designed clinical trials will be required. Extract standardization and integrative neurochemical research are expected to play an important role in validating Shankhpushpi as an evidence-based intervention for prevention and management of neurodegenerative disorders.

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