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REVIEW

Mini Review: Natural Neurological Benefits of Indian Squash

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A B S T R A C T

Indian squash, commonly known as Tinda, is a lesser-known member of the Cucurbitaceae family, traditionally utilized in both culinary practices and Ayurvedic medicine across the Indian subcontinent. While historically valued for its digestive and anti-inflammatory properties, recent pharmacological investigations have begun to uncover its potential neurological benefits. Preliminary in vivo and in vitro studies indicate that extracts of Indian Squash (*P. fistulosus)* exhibit significant antioxidant, anxiolytic, anticonvulsant, and neuroprotective activities, suggesting its possible role in modulating central nervous system (CNS) function. These effects are believed to be mediated by a diverse spectrum of bioactive phytochemicals, including flavonoids, alkaloids, terpenoids, and phenolic acids. Several of these compounds may influence key neurotransmitter systems such as GABAergic and serotonergic pathways, contributing to the observed neuroactivity. This mini review consolidates the current state of knowledge surrounding the neuropharmacological potential of Indian Squash, examining its phytochemical composition, proposed mechanisms of action, and pharmacological profiles. Additionally, the review highlights the value of bio-guided fractionation approaches in identifying active constituents and underscores the need for rigorous mechanistic and clinical studies. Bridging traditional ethnomedicinal knowledge with modern neuropharmacological research may open new avenues for the development of plant-based therapeutics targeting neurological disorders.

Keywords: Indian squash, Neuroprotection, Natural Remedies, Antioxidants

INTRODUCTION

The increasing global interest in plant-based therapies has drawn attention to lesser-known ethnomedicinal plants with potential neurological benefits. Indian Squash, commonly known as Indian squash or Tinda, is a seasonal gourd belonging to the Cucurbitaceae family. Widely cultivated and consumed in the Indian subcontinent, it holds a notable place in traditional Ayurvedic and Unani medicine, where it has been used for its purported digestive, anti-inflammatory, diuretic, and cooling properties [1][2]. Despite its culinary popularity, Indian Squash remains relatively underexplored in modern pharmacological research. Recent studies have begun to uncover the neuropharmacological potential of Indian Squash (*P. fistulosus)*, particularly its antioxidant, anxiolytic, and neuroprotective properties [3][4]. These effects are of considerable interest in the context of neurodegenerative and neuropsychiatric disorders, where oxidative stress, neurotransmitter imbalance, and inflammation play pivotal roles in disease progression [5]. Preliminary phytochemical screenings have identified a variety of bioactive constituents in Indian Squash, including flavonoids, alkaloids,

saponins, and phenolic compounds [2][6] many of which are known to influence central nervous system (CNS) pathways [7].

Given the growing burden of neurological disorders and the limitations of existing pharmacotherapies, there is a pressing need to investigate alternative treatments derived from natural sources. This mini review aims to consolidate existing pharmacological data on Indian Squash, explore its phytochemical constituents, and assess its potential as a neurotherapeutic agent. Additionally, it emphasizes the importance of integrating traditional knowledge with modern scientific approaches to better understand and utilize this underutilized plant in the field of neurological health.

Phytochemical Composition and Traditional Uses

Indian Squash (*P. fistulosus)* commonly referred to as Tinda, has been a staple in traditional Indian systems of medicine such as Ayurveda and Unani. Traditionally, various parts of the plant including the fruit, seeds, and leaves have been used to treat a variety of ailments. These include digestive disorders, urinary tract infections, inflammation, liver ailments, and general debility [8, 9]. The fruit is considered cooling, light, and diuretic, and is frequently included in diets aimed at pacifying *pitta* and *vata* imbalances according to Ayurvedic principles [10]. Modern phytochemical investigations have begun to validate some of these traditional claims. Preliminary screenings of the fruit, seeds, and leaves have revealed a wide array of bioactive compounds, notably:

- **Flavonoids** (e.g., quercetin, kaempferol): known for antioxidant, anti-inflammatory, and neuroprotective effects.
- **Alkaloids**: some of which may influence neurotransmitter systems and CNS activity.
- **Triterpenoids and Saponins:** associated with anti-inflammatory and adaptogenic properties.
- **Phenolic acids** (e.g., gallic acid, caffeic acid): potent antioxidants that can modulate oxidative stress and neuronal function.
- **Sterols and fatty acids:** identified in seed oils, potentially contributing to membrane stabilization and neuroprotection [11, 12, 13].

Antioxidant Activity and Neuroprotection

Oxidative stress is a central pathological feature of various neurological disorders, including Alzheimer's disease, Parkinson's disease, epilepsy, and anxiety-related conditions. Excessive generation of reactive oxygen species (ROS) leads to cellular damage, mitochondrial dysfunction, lipid peroxidation, and eventual neuronal death. As such, antioxidants play a critical role in preserving neural integrity and function [14, 15]. Studies on Indian Squash have demonstrated its promising antioxidant activity, attributed primarily to its rich content of polyphenols, flavonoids, and other reducing agents. Ethanolic and methanolic extracts of the fruit and seeds have shown strong free radical scavenging ability in *in vitro* assays such as DPPH (2,2-diphenyl-1-picrylhydrazyl), ABTS (2,2'-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid), and FRAP (ferric reducing antioxidant power) [16,17,18]. In animal models, oral administration of Indian Squash (*P. fistulosus)* fruit extract significantly attenuated oxidative stress markers in the brain. Notably, it reduced malondialdehyde (MDA) levels while increasing the activity of endogenous antioxidant enzymes, including superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx) [19]. These findings suggest that the plant exerts protective effects against oxidative neurodegeneration. The neuroprotective potential of Indian Squash (*P. fistulosus)* may also be linked to its ability to stabilize neuronal membranes and modulate cellular redox balance. Phytoconstituents such as quercetin, gallic acid, and caffeic acid identified in Indian Squash (*P. fistulosus)* have been previously shown to cross the blood-brain barrier and protect neurons from oxidative and excitotoxic insults [20]. Additionally, antioxidant mechanisms may complement other neuroactive pathways, such as GABAergic and serotonergic modulation, thereby providing a multifaceted defense against neuronal damage. These properties position Indian Squash (*P. fistulosus)* as a strong candidate for further investigation as a natural neuroprotective agent, particularly in the management of oxidative stress-related neurodegenerative conditions.

Mechanistic Insights and Future Directions

Although preliminary findings highlight the neuropharmacological potential of Indian Squash and similar botanicals, detailed mechanistic studies remain scarce. Comprehensive investigations into receptor-binding

affinities, modulation of key neurotransmitter systems (such as GABAergic, serotonergic, and dopaminergic pathways), and the long-term impact of chronic administration are essential to establish pharmacodynamic profiles. Bio-guided fractionation offers a strategic approach to isolate and characterize bioactive compounds contributing to neuroactivity. Despite encouraging preclinical results, the absence of human clinical trials presents a significant barrier to therapeutic translation. Rigorous clinical evaluation is necessary to confirm safety, efficacy, and dosage parameters in human populations. Furthermore, integrating pharmacological insights with ethnomedicinal knowledge may reveal synergistic interactions among plant constituents, potentially leading to the discovery of multi-target natural therapeutics for neurological disorders.

CONCLUSION

Indian squash is an underutilized yet promising plant with growing scientific recognition for its neurological benefits. Traditionally used in Indian medicine for its calming, digestive, and anti-inflammatory effects, modern pharmacological studies have begun to validate its antioxidant, anxiolytic, neuroprotective, and anticonvulsant activities. These effects are largely attributed to its rich phytochemical profile, including flavonoids, phenolic acids, alkaloids, and essential fatty acids. The plant's antioxidant properties play a crucial role in counteracting oxidative stress, a major contributor to neurodegenerative and neuropsychiatric disorders. Emerging preclinical studies suggest that Indian Squash **(***P. fistulosus)* may modulate neurotransmitter systems and protect neuronal integrity, positioning it as a potential natural therapeutic agent for conditions such as anxiety, epilepsy, and cognitive decline. However, despite encouraging findings, the current body of evidence remains limited to preliminary pharmacological and phytochemical studies. Detailed mechanistic investigations, receptor-level interactions, chronic toxicity assessments, and well-designed clinical trials are urgently needed to establish its safety and efficacy in humans. Furthermore, bio-guided fractionation and standardization of active constituents will be essential for developing targeted plant-based therapeutics. Bridging traditional ethnobotanical knowledge with contemporary neuropharmacological research could unlock new therapeutic avenues and contribute to the development of safer, more holistic treatments for neurological health.

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