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Pharmacognostic and Nootropic Aspects of *Withania Somnifera*: A Potential Herbal Drug as Memory Enhancer

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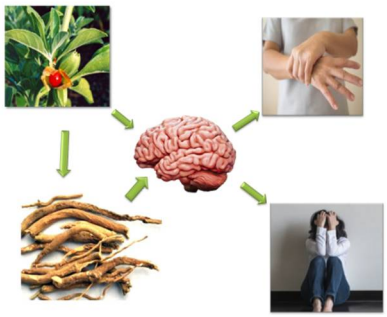
Abstract: ***Withania somnifera is a well-known herbal drug commonly used in India and Indian subcontinent. It contains a spectrum of diverse phytoconstituents that are responsible for number of significant biological effects. Various parts of plants especially roots are rich in source of active phytoconstituents. In the current COVID-19 situation, various national and international agencies are suggesting the use of plant for increasing immunity as well as memory booster. The drug is mainly used in the management of brain related disorders such as anxiety, depression, stress, etc. The mainly used as memory enhancer as it increases the neurogenesis process in the brain. In present paper, we have covered the pharmacognosy, phytochemistry, and therapeutic applications of the plant related to the brain.***

Keywords: Withania somnifera; Memory enhancer; Roots; Stress.



Graphical abstract

I. INTRODUCTION

Despite of the availability of the *anglo-Indian* medicines, popularity of herbal drugs remained unaffected. This might be due to their wider acceptance and long history. Common public in India still using herbal medicines People across the world were depend upon the products and plants obtained from the nature. In India, even today, people mostly from villages and tribal areas are depends on medicinal plants [1]. Plants or products thereof has become an integral part of our life. In the light of COVID-19 situation, WHO encouraging the people across the world to use medicinal plants. Some of the medicinal plants that are commonly used are *Withania somnifera, Hypericum perforatum, Aloe barbadensis, Oroxylum indicum, Capsicum annuum,* etc [2-23].

Withania somnifera, also known as Indian Ginseng and Ashwagandha, is one of the most widely used medicinal plant across the world. Indian name Ashwagandha is derived from the sankrit language. In Sanskrit language, ashwagandha means horse's smell probably originated from the odor of its root, which resembles that of sweaty horse. The reason behind its popularity is the plant possesses enormous activities and is enrich source of energy. Almost every therapeutic activity is shown by this plant. In USA and most of the European countries, physicians prescribes tablet formulations or powder of *W. Somnifera* as an adjuvant medicine. The drug is capable of imparting long life, youthful vigor, and good intellectual powers [24].

The drug is clinically used for the treatment of loss of memory, nervous exhaustion, insomnia, consumption, etc. These traditional uses imply that Ashwagandha may possibly be useful at improving neurodegenerative diseases. Indeed, this herbal drug has been reported to exert various pharmacological effects such as anti-neuropsychiatric, Parkinson's disease, anxiety, cognitive and neurological disorders, immunomodulatory, anti-inflammatory, anti-tumor and anti-oxidant effects [25].

The drug also used to inhibit the development of tolerance and dependence on chronic use of various psychotropic drugs. Ashwagandha is commonly available as a churna, a fine powder that can be mixed with water, ghee or honey. In this review, we describe effects of Ashwagandha extracts, phytoconstituents of Ashwagandha (mainly withanolides: steroidal lactones with ergostane skeleton), its derivatives in the context of neurodegenerative diseases and potential therapeutic applications of the plant [26].

II. TAXONOMICAL CLASSIFICATION [27]

Kingdom: Plantae
Subkingdom: Tracheobionta, Vascular plants;
Super division: Spermatophyta, Seeds plants;
Division: Angiosperma
Class: Dicotyledons
Order: Tubiflorae
Family: Solanaceae
Genus: Withania
Species : *Withania somnifera*

III. SYNONYMS [28]

Language	Name	Language	Name
Sanskrit:	*Ashwagandha*	Tamil:	*Amukkura, amkulang, amukkuram-kilangu*
English:	*Winter Cherry*	Karnataka:	*Viremaddlinagadde, Pannaeru,*
Hindi:	*Punir, asgandh*	Konkani:	*Fatarfoda*
Bengali:	*Ashvagandha*	Punjabi:	*Asgand, isgand*
Gujrati:	*Ghodakun, Ghoda, Asoda*	Marathi:	*Asgund, asvagandha*
Telgu:	*Pulivendram*	Rajasthani:	*Chirpotan*

IV. BOTANICAL DESCRIPTION

Plant is a small, woody shrub that grows about two feet in height. An erect, evergreen, tomatoes shrub, 30-150 cm high, found throughout the drier parts of India in waste places and on bunds. Roots are stout fleshy, whitish brown; leaves simple ovate, glabrous, those in the floral region smaller and opposite; flowers inconspicuous, greenish or lubrid-yellow, in axillary, umbellate cymes; berries small, globose, orange-red when mature, enclosed in the persistent calyx; seeds yellow, reniform. The roots are the main portions of the plant used therapeutically. The bright red fruit is harvested in the late fall and seeds are dried for planting in the following spring [29-32].

V. ORIGIN AND DISTRIBUTION

Plant grows abundantly throughout India, especially in Madhya Pradesh, Uttar Pradesh, Punjab and North Western parts of India like Gujarat and Rajasthan. It can be found growing in Africa, the Mediterranean, Congo, South Africa, Egypt, Morocco, Jordan and Pakistan [33-34].

VI. PARTS USED

Whole plant, roots, leaves, stem, green berries, fruits, seeds, bark are used as a crude drug for various purpose **(Fig. 1)** [35].

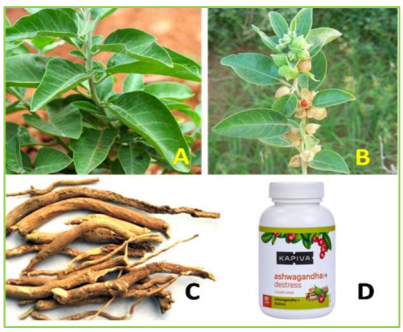


Fig. 1: Plant (A) with fruits (B), roots (C) and marketed formulation (D).

VII. PHYTOCHEMISTRY

Various studies reported that most of the chemical constituents are present in the roots of the plant. The total alkaloidal content of the Indian roots has been revealed to vary between 0.13 and 0.31%. The leaves primarily contain withaferin A, a steroidal lactone is the most important withanolide. The fruits contain amino acids, a proteolytic enzyme, condensed tannins, and flavonoids. They contain a high ratio of free amino acids which are proline, valine, tyrosine, alanine, glycine, hydroxyproline, aspartic acid, glutamic acid, cystine and cysteine. Shoots primarily contain scopoletin and also they contain protein, calcium and phosphorous. Stem and bark consist of number of condensed tannins, flavonoids and free amino acids. The major biochemical constituents present in the root are shown in **Table 1** [36-45].

Table 1: Phytoconstituents of roots.

Class	Phytoconstituents
Alkaloids	Withanine, withananine, withasomnine, somniferine, tropeltigloate, somniferinine, somninine and nicotine somnine, somniferinine, withananine, pseudo-withanine, tropine, pseudo-tropine, 3-a-gloyloxytropane, choline, cuscohygrine, isopelletierine, anaferine
Steroidal lactones	Withaferin-A, withanone, withanolide-E, withanolide-F, withanolide-A, withanolideG, withanolide-H, withanolide-I, withanolide-J, withanolide-K, withanolides L, withanolide-M
Steroids	Cholesterol, b-sitosterol, stigmasterol, diosgenin, stigmastadien, sitoinosides VII, sitoinosides VIII, sitoinosides IX, sitoinosides X
Salts	Cuscohygrine, anahygrine, tropine, pseudotropine, anaferine
Flavonoids	Kaempferol, quercetin
N- containing compounds	Withanol, somnisol, and somnitol

VIII. BRAIN RELATED EFFECTS

A. Anxiety and Depression

Extracts of Ashwagandha produce GABA-like activity which may account for the herbs anxiolytic actions. The bioactive constituents produce calming effect. Excessive neuronal activity can lead to restlessness and insomnia, but GABA inhibits the number of nerve cells that the fire in brain and helps to induce sleep, uplift mood and reduce anxiety. It also exhibited an antidepressant effect and as a mood stabilizer [46-48].

B. Chronic Stress

Drug is a very popular herb for reduce stress. Chronic stress (CS) can result in a number of adverse physiologic conditions including cognitive deficit, immune suppression, sexual dysfunction, gastric ulceration, irregularities in glucose homeostasis, and changes in plasma corticosterone levels. Drug inhibited stress-induced gastric ulcer more effectively as compared to the standard drug ranitidine. Administration of ashwagandha with other drugs was found to offer protection against f biological, physical and chemical stressors [49-52].

C. Nootropic Effect

Ashwagandha may improve brain function, memory, reaction times and the ability to perform tasks. The bioactive components like Sitoindosides VII-X and withaferin isolated from aqueous methanol extract of roots slightly enhanced acetylcholinesterase (AchE) activity in the lateral septum and globus pallidus, and decreased AchE activity in the vertical diagonal band. These changes were accompanied by enhanced M1-muscarinic-cholinergic receptor binding in lateral and medial septum as well as in frontal cortices, whereas the M2- muscarinic receptor-binding sites were increased in a number of cortical regions including cingulated, frontal, parietal, and retrospinal cortex.

Daily administration of drug for 6 days significantly improved memory consolidation On the basis of some findings, it is suggested that drug exhibits a nootropic-like effect [53-57].

D. Anti-parkinsonian Properties

Parkinson's disease is a neurodegenerative disease characterized by the selective loss of dopamine neurons of the substantia nigra pars compacta. Drug inhibited catalepsy and provide hope for treatment of Parkinson's disease. An Anti-parkinsonian effect of extract has been reported due to potent antioxidant, antiperoxidative and free radical quenching properties in various diseased conditions. Chronic treatment with root extract for a period of 4 weeks to reserpine treated animals significantly and dose dependently reduced the vacuous chewing movements and tongue protrusions. Administration of drug also showed an enhancement in phagocytic activity of peritoneal macrophages result in confirms the immunomodulatory activity [58-63].

IX. ANALYSIS OF *WITHANIA SOMNIFERA*

There are many analytical tools that are used for the analysis of various pharmaceutical formulations, herbal formulations, crude drugs and their extracts [64-82]. These methods includes Uv-spectrophotometry, gas chromatography, HPLC, HPTLC, etc [83-103].

X. CONCLUSION

Thus the drug *Withania somnifera* could be used as memory enhancer. Clinical studies of drug proved it as wonder drug for almost all types of memory related problems.

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A. Disclosure of Conflict of Interest

The author declares no conflict of interest.

B. Disclosure of Conflict of Interest

The author declares no conflict of interest.

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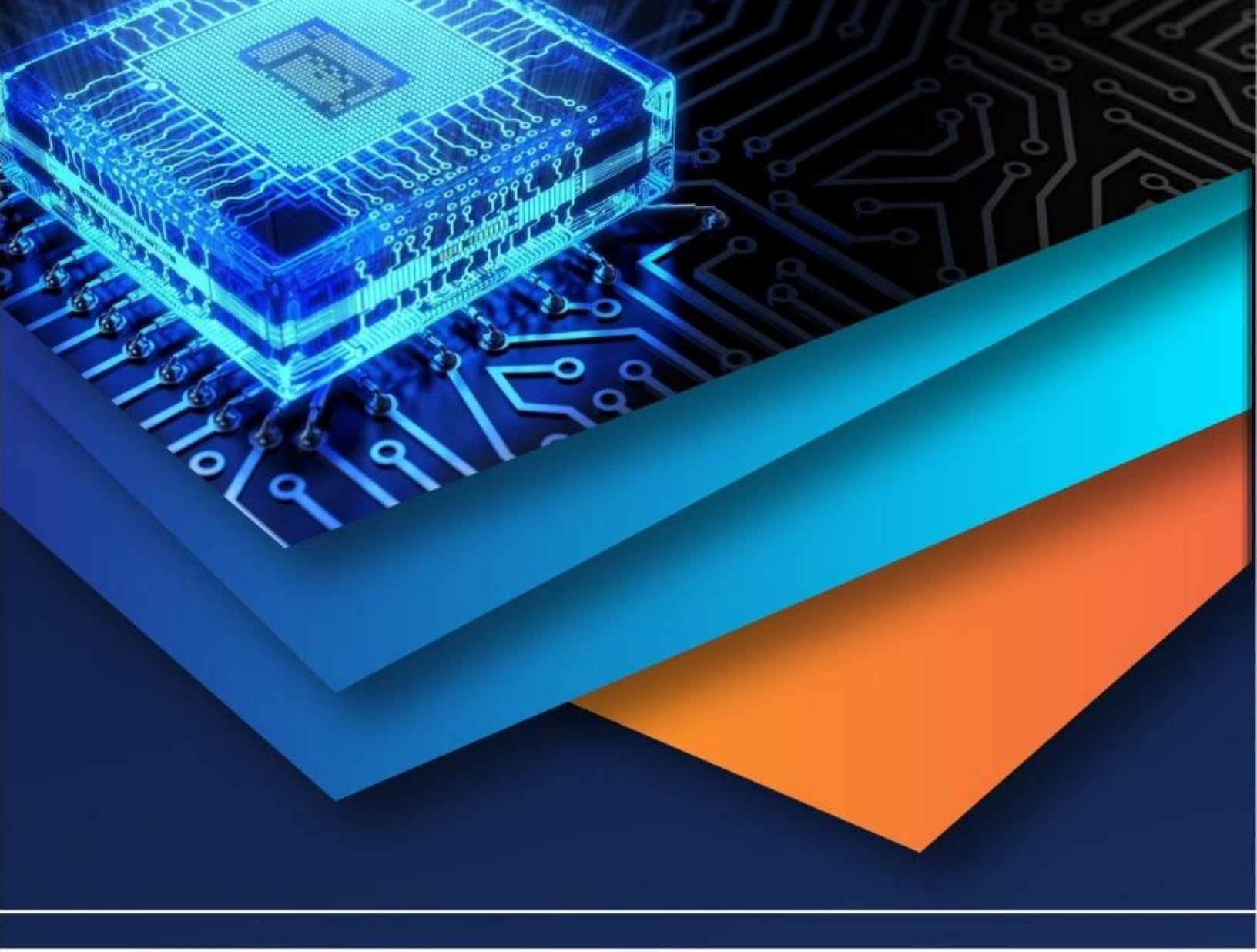

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