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Review Article

Ashwagandha: The Wonder Drug

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ABSTRACT

Withania Somnifera has been used in Ayurveda medicine system since ancient times. Withania Somnifera is a popular Indian medicinal plant belonging to family Solanaceae nightshade. It is also known as Ashwagandha, Indian ginseng and Winter cherry. It is an adaptogen, a drug that can help increase our resistance to stress. Withania Somnifera have many different pharmacological activities such as anti-inflammatory, antimicrobial, antioxidant, antidiabetic, anti-tumour, anti-ageing, Anti-oxidant, Antifungal, Antibacterial, Musculotropic Activity, Anticonvulsant activity, Antiviral activity, Macrophage-activating effect, neuroprotective, stress/anxiety, athletic performance, cognition, diabetes, insomnia and male infertility. Ashwagandha is generally considered to be safe, with a few minor possible side-effects, although care should be taken with other therapies. Withania Somnifera It is used for various kinds of diseases and specially used as a nerve tonic. Pretreatment with Withania Somnifera showed significance protection against stress induced gastric ulcers. WS have anti-tumor effect on Chinese Hamster Ovary (CHO) cell carcinoma. It was also found effective against urethane induced lung-adenoma in mice. In some cases of uterine fibroids, dermatosarcoma, long term treatment with WS controlled the condition. It has a Cognition Promoting Effect and was useful in children with memory deficit and in old age people loss of memory. It was also found useful in neurodegenerative diseases such as Parkinson's, Huntington's and Alzeimer's diseases. It has GABA mimetic effect and was shown to promote formation of dendrites. It has anxiolytic effect and improves energy levels and mitochondrial health. It is an anti-inflammatory and anti-arthritic agent and was found useful in clinical cases of Rheumatoid and Osteoarthritis. The biologically active chemical constituents of Withania Somnifera include alkaloids like isopelletierine, anaferine, cuseohygrine, anahygrine, etc., steroidal lactones like withanolides, withaferins and saponins, Sitoindosides and acylsteryl glucosides, amino acids, volatile oil, starch, reducing sugars.

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INTRODUCTION

The name *"Ashwagandha*" describes the smell of its root, meaning "like a horse." By definition, Ashwa means horse. (1) *Withania Somnifera* is a popular Indian medicinal plant belonging to family *Solanaceae. It* is also known as *Indian ginseng* and *Winter cherry. Ashwagandha* is one of the most valuable plants in the traditional Indian systems of medicine. The medicinal products are derived from plant parts such as stem, bark, leaves, fruits and seeds have been part of Phyto medicine that produce a definite physiological action on human body but mostly the roots have been used traditionally and have been subject to modern medical research.(2) *Ashwagandha* have different pharmacological activities such as anticancer, infertility, antidiabetic, cardioprotective, sleep disorders, improve stress resilience, reduce anxiety, diuretic, narcotic, hypnotic, hypothyroidism, and enhance muscle strength, recovery for stress management, tuberculosis, antihelmintic, cognitive function, and physical performance, swelling, external pains, syphilis, haemorrhoids, eyesores, boils, edema, obsessive-compulsive disorder, astringent, insomnia, bronchitis, asthma, ulcers, emaciation, dementia, anti-inflammatory, antibacterial immune modulatory, anti-ageing.(3) The main phytochemical constituents of W. somnifera are withanolides, a group of triterpene lactones that include withaferin A, alkaloids, steroidal lactones, tropine, and cuscohygrine. Forty withanolides, twelve alkaloids, and various sitoindosides have been isolated from this plant species. Because these withanolides are structurally similar to the ginsenosides of Panax ginseng, *W. somnifera* is commonly referred to as "*Indian ginseng". (4)* Most of the chemical constituents are present in root. *Ashwagandha* roots contain crude fibre 21.0 to 25.0 %, starch 6.09 to 9.46 mg/tannins 0.39 to 0.82 mg/g, minerals K, Mn, Na, Fe, Zn, Cu,Al, Ca, Cd & Ni, total sugars 2.52 to 9.52 mg/g, reducing sugars 0.15 to 2.10 mg/g and non-reducing sugars 2.37 to 7.62mg/g .(5) *Withania Somnifera* is also cultivated for medicinal purposes. *Withania Somnifera* is naturally native to India, but it is also cultivated in other areas such as the Mediterranean countries, Africa, Canary Islands, Cape of Good Hope and Australia. (6) *W. Somnifera* is cultivated in many of the drier regions of India. It is also found in Nepal, Sri Lanka, China, and Yemen. It prefers dry stony soil with sun to partial shade. It can be propagated from seeds in the early spring or from greenwood cuttings in the later spring. (7)

Plant Profile:

Scientific classification:

- **Kingdom:** Plantae
- **Clade:** Tracheophytes
- **Clade:** Angiosperms
- **Clade:** *Eudicots*
- **Clade:** *Asterids*
- **Order:** *Solanales*
- **Family:** *Solanaceae*
- **Genus:** *Withania*
- **Species:** *W. somnifera*

Binomial name: *Withania somnifera(L.) Dunal*

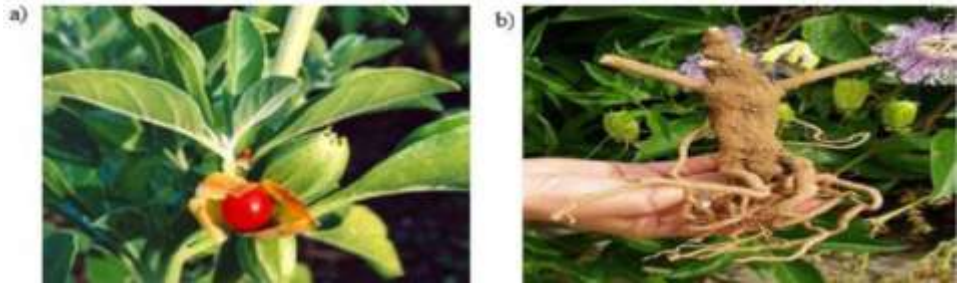
Synonyms*:*

- *Alicabon somniferum (L.) Raf.*
- *Larnax morrisonii (Dunal) Miers*
- *Physalis alpini J.Jacq.*
- *Physalis flexuosa L.*
- *Physalis scariosa Webb & Berthel.*
- *Physalis somnifera L.*
- *Physaloides somnifera (L.) Moench*
- *Withania arborescens Dunal*
- *Withania chevalieri A.E.Gonç.*
- *Withania kansuensis Kuang & A. M. Lu*

- *Withania microphysalis Suess*
- *Withania morisonii Dunal*
- *Withania mucronata Chiov.*
- *Withania obtusifolia Täckh.*
- *Withania sicula Lojac.*

Description:

This species is a short shrub growing 35–75 cm (14–30 in) tall. Tomentose branches extend radially from a central stem. Leaves are dull green, elliptic, usually up to 10–12 cm (3.9–4.7 in) long. The flowers are small, green and bell-shaped. The ripe fruit is orange-red. (8)



Roots:

Roots are use in the treatment of asthma, bronchitis, leukoderma, tuberculosis, liver problems, heart disorders, and arthritis. Act as an antibacterial, antitumor, antioxidant, immunomodulatory, and neurotic regenerator and Show adaptogenic activity, nootropic effect, hypothyroid activity, herbicidal potential, abortifacient astringent, aphrodisiac, and emmenagogue,

Leaves:

Leaves are used in the treatment of ulcers, painful swelling, external pains, syphilis, haemorrhoids, eyesores, boils, and edema. Act as aphrodisiac, anti-inflammatory, diuretic, hepatoprotective, anti-arthritic, anti-cancerous, and pesticidal.

Seeds:

Act as a diuretic, narcotic, and hypnotic.

Fruits:

Treatment of ulcer and tuberculosis and act as antihelmintic.

Whole plant:

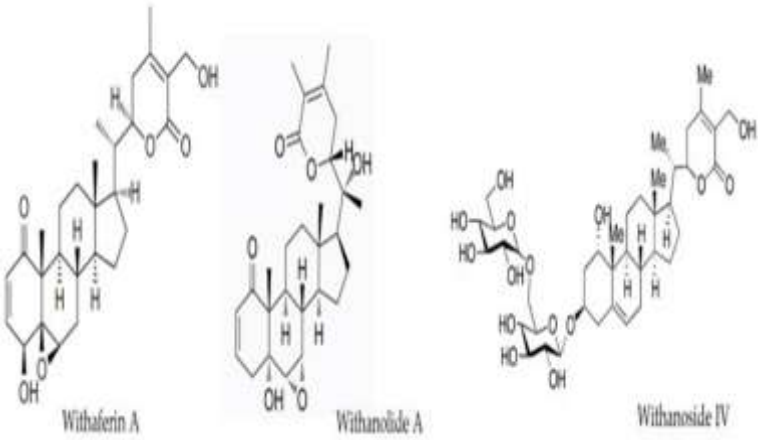
Whole plant act as an antidote, insecticidal, larvicidal, antioxidant, immunomodulatory, neurotic regenerator, adaptogenic hepatoprotective, and cardioprotective. (9)

Phytochemistry:

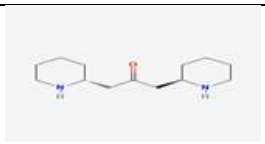
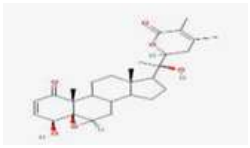
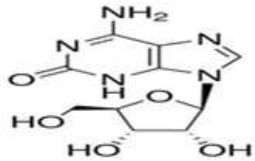
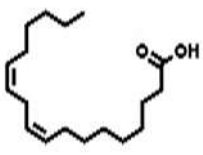
Alkaloids, steroids, terpenoids, and other phytochemicals that have long been used in food and traditional medicine are abundant in plants with the extraction of withaniol, somnirol, somnitol, withanic acid, phytosterol, ipuranol, and alkaloids from alcoholic extracts of leaves and roots. The alkaloids that were identified as somniferine, somnine, somniferinine, withamine, withanmine, pseudowithamine, and withanaminine were isolated in the aforementioned investigation.(10) Ashwagandha is characterized by a rich phytochemical composition.

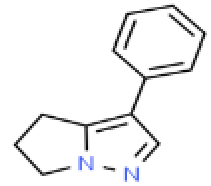
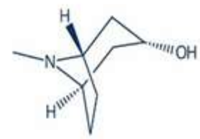
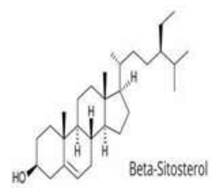
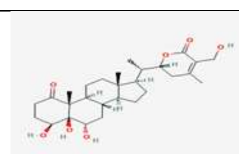
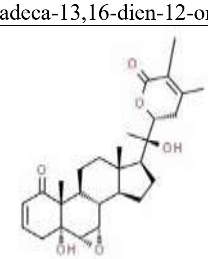
The raw material has a varied chemical component composition depending on where it is found. Witanolides and alkaloids are its active

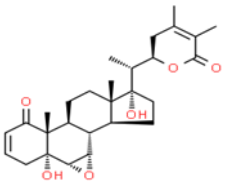
ingredients, which are essential to its pharmacological effect.(11)



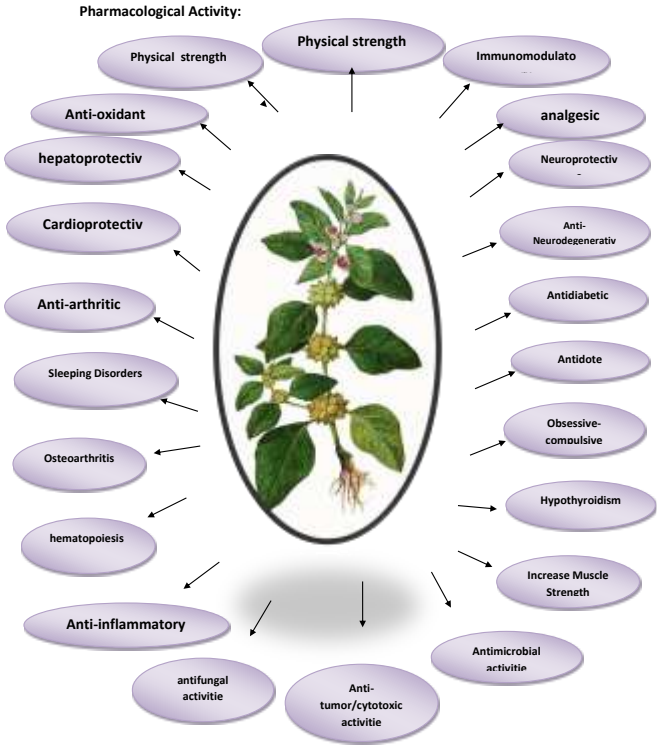
Phytochemistry of various parts of Withania Somnifera:

Sr No	Source	Name of Extract	Chemical constituent isolated	Structure	Pharmacological activity	Reference
1	**Leaves**	Methanolic	Anaferine (bis (2-piperidylmethyl) ketone), tropine, isopelletierine, 3α-tigloyloxtropine, pseudotropine, cuscohygrine, 3-tropyltigloate, anahygrine, hygrine, dl-isopelletierine, mesoanaferine, somniferine, choline, hentriacontane, withanine; withananine, withasomnine, visamine, ashwagandhine, and pseudowithanine	 1,3-di-(2R)-piperidin-2-ylacetone	Treatment of ulcers,painful swelling, external pains, syphilis, hemorrhoids, eyesores, boils, and edema Act as aphrodisiac, anti-inflammatory, diuretic, hepatoprotective, anti-arthritic, anti-cancerous, and pesticidal	(12)
				 22-hydroxy ergostane-26-oic acid 26, 22-lactones		
		Alcoholic	Withanolide D, N, O, P	 Ergosta-5,24-dien-26-oic acid, 3-((6-o-beta-D- glucopyranosyl-beta-D-glucopyranosyl)oxy)-1,20,22-trihydroxy-, sigma-lactone, (1alpha,3beta,22R)		
		Methanolic	Withanolides			
		Alcoholic	Withanolides G–M			
		Alcoholic	Withanolide F,T, and U			
		Butanol	Withanoside IV, physagulin, and withanoside VI Butanol			
2	**Fruits**	Oils	Linoleic acid, palmitic acid, tetracosanoic acid, elaidic acid, and oleic acid		Treatment of ulcer and tuberculosis Act as antihelmintic	
		Methanolic	Withanamides A-I			

				9Z,12Z)-9,12-Octadecadienoic		
3	**Roots**	Alcoholic Alcoholic Methanolic Benzene, ethyl acetate Petroleum ether, Butanol Methanolic Methanolic Methanolic	Withasomnine Withanolide A Pseudotropine, isopelletierine, 3α-tigloyloxtropine tropine, dl-isopelletierine-3-tropyltigloate, cuscohygrine, anaferine, hygrine, anahygrine, somniferine, mesoanaferine, choline, withanine, visamine, withananine, hentriacontane, withasomnine, along with pyrazole derivatives pseudowithanine and ashwagandhine Withasomniferol A, B, and C β-sitosterol and d-glycoside Withanoside IV and withanoside VI Ashwagandhanolide Withanosides I, II, III, IV, V, VI, and VII Physagulin D and coagulin Q	 3-Phenyl-5,6-dihydro-4H-pyrrolo[1,2-b]pyrazole 10183-74-1  3β-Tropanol; 1αH,5αH-Tropan-3β-ol  17- (5-Ethyl-6-methyl heptane-2-yl)-10,13- dimethyl-2,3,4,7,8,9,11,12,14,15,16,17-dodecahydro-1H-cyclopenta [a]phenanthren-3-ol	Treatment of asthma, bronchitis, leukoderma, tuberculosis, liver problems, heart disorders, and arthritis Act as an antibacterial, antitumor, antioxidant, immunomodulatory, and neurotic regenerator Show adaptogenic activity, nootropic effect, hypothyroid activity, herbicidal potential, abortifacient astringent, aphrodisiac, and emmenagogue,	
4	**Stem bark**	Ethanolic	Withasomnilide, somniferanolide, somniferawithanolide, withasomniferanolide, and somniwithanolide	 1R,2R,4R,6S,7S,9S,10S,11R-6-[(1R)-1-[(2R)-4,5-dimethyl-6-oxo-3,6-dihydro-2H-pyran-2-yl]ethyl]-1,9-dihydroxy-7,11-dimethyl-5-oxapentacyclo [8.8.0.0^{2,7}.0^{4,6}.0^{11,16}]octadeca-13,16-dien-12-one	Act as antibacterial, antitumor, and herbicidal	
5	**Whole plant**	Methanolic Aqueous,	Withaniol, acylsteryl glucosides, starch, reducing sugars, hantreacotane, ducitol, aspartic acid, proline, tyrosine, alanine, glycine, glutamic acid, cystine, tryptophan, withaniol, starch, acylsteryl glucosides, hantreacotane, ducitol 6α-chloro-5β,17α-dihydroxywithaferin A	 5α,6α,7α,22R-6,7-Epoxy-5,20,22-trihydroxy- 1-oxo-ergosta-2,24-dien-26-oic acid δ-lactone.	Act as an antidote, insecticidal, larvicidal, antioxidant, immunomodulatory, neurotic regenerator, adaptogenic hepatoprotective, and cardioprotective	

		methanolic Aqueous	6α-chloro-5β hydroxywithaferin A, (22R)-5β-formyl-6β,27-dihydroxy-1-oxo-4-norwith-24-enolide, withaferin A, 2,3-dihydrowithaferin A, 3-methoxy-2,3-dihydrowithaferin A, 2,3-didehydrosomnifericin, withanone, withanoside IV, and withanoside X Withanone and tubacapsenolide F	 (1S,2S,4S,5R,10R,11S,14S,15S,18S)-15-[(1R)-1-[(2R)-4,5-dimethyl-6-oxo-2,3-dihydropyran-2-yl]ethyl]-5,15-dihydroxy-10,14-dimethyl-3-oxapentacyclo[9.7.0.02,4.05,10.014,18]octadec-7-en-9-one		
		Ethanolic	Withasomniferin-A and iso-sominolide, and sominone			
		Alcoholic	Viscosalactone B			

Pharmacological Activity:



Anti-oxidant and hepatoprotective activities:

W. somnifera was utilising a large unilamellar vesicle model to determine their antioxidant capacity. The findings revealed that at a concentration of 0.5-1 µg/ml, withanamides (A-I) extracted from the plant fruits considerably slowed down lipid peroxidation. Withanoside V was also observed to have strong free radical scavenging activity at a concentration of 10 µg/ml. In W. somnifera glycowithanolides have anti-oxidant properties, the extracts lessened the hepatotoxicity caused by iron. (13)The liver marker enzymes (alanine transaminase, aspartate transaminase, and alkaline phosphatase) and urea, ammonia, and lipid peroxidation products (hydroperoxides,

thiobarbituric acid reactive compounds) reflecting hepatoprotective potential were all impacted by the root powder. In hyperammonemia, the plant affected the concentration of lipid peroxidation products and liver indicators, elevating the level of hepatic protection. The regulating mechanisms of alkaloids, withanolides, flavonoids, urea, and chemicals related to urea may mediate the hepatoprotective action. (14)

Cardioprotective Properties:

Withania somnifera treatment showed decreased glutathione levels as well as decreased activity of enzymes such as superoxide dismutase, catalase, creatinine phosphokinase, and lactate dehydrogenase. Significant drops were also observed in lipid peroxidation levels. Withania somnifera cause necrosis by isoprenaline, these findings suggest that Withania somnifera has a cardioprotective effect. Withania somnifera rise in lipoperoxidation, an oxidation-antioxidation imbalance, and severe cardiac necrosis. According to histopathological investigations, administering Withania somnifera greatly lessens the ischemia-induced damage to the heart. Due to its anti-apoptotic qualities and ability to restore the oxidative equilibrium, ashwagandha has a cardioprotective effect. Low dosages of withaferin A were found to have a cardioprotective effect. Phosphorylation of AMP-activated protein kinase (AMPK) and increased Bcl-2/Bax ratio (AMPK). The cardioprotective effects of withaferin A were limited to modest doses of 1 mg/kg. It was ineffective to administer larger doses (5 mg/kg). (15)

Anti-arthritic:

In contrast to hydrocortisone sodium succinate, withaferin A caused animals with arthritic condition to gain more body weight. The plant leaves' alcoholic extract demonstrated notable anti-inflammatory properties by preventing the activation of Iκβ kinase, which is responsible for triggering NFκβ, as a result of tumour necrosis. The extract was shown to contain withaferin A, the only withanolide that may prevent the activation of Iκβ kinase by triggering cell cycle seizures during the Go/G1 and G2/M phases and reducing the production of regulatory proteins, chloroform and aqueous leaf extracts were studied for their ability to decrease cell proliferation. (16)

Anti-inflammatory:

The use of withaferin through its inhibition of NFκβ activation and targeting of cysteine-179 IKKβ, an extract and purified form of *W. Somnifera* demonstrated anti-inflammatory action. Since Withanolides are present, different methanolic fractions of the whole plant extract maintained an anti-inflammatory effect that was on par with hydrocortisone sodium succinate (5 mg/kg of body weight). The plant's capacity to reduce inflammation may also stem from delayed hypersensitivity and lymphocyte proliferation, contingent on the type of inflammation model used, such as adjuvant-induced arthritis, carrageenan-induced arthritis, or cotton pellet granuloma inflammation. (17)

Osteoarthritis/analgesic activities:

The aqueous root extract of *Ashwagandha* on nitric oxide-induced cartilage degradation in individuals with chronic osteoarthritis. Additionally, the cell culture line SH-SY5Y was treated with peroxisome proliferator-activated receptor γ antagonist (5 and 10 μM) and W. somnifera (1.00 mg/ml of methanolic root extract) to assess the protective effect on ε-opioid and peroxisome proliferator-activated receptor γ receptor. The study conducted on cell culture indicates that GW-9662's inhibition of peroxisome proliferator-activated receptor γ receptor

contributes to the down-regulation of ε-opioid m-RNA, hence increasing the availability of the μ-opioid receptor for analgesic impact. (18)

Neuroprotective and Anti-Neurodegenerative Effects:

Ashwagandha in Alzheimer's Disease:

The ageing population issue has long been recognised, and it also implies a significant increase in the percentage of people suffering from dementia illnesses. Dementia is a syndrome with a complicated aetiology that is characterised by a variety of symptoms stemming from a brain disease, usually with a chronic and progressive course. This disorder affects higher cortical processes like orientation, memory, understanding, learning capacity, and emotional regulation. Neurodegenerative diseases that disintegrate the central nervous system produce damage that cannot be healed. In Alzheimer's disease, abnormal deposits of β-amyloid protein are observed in the brain. It has a neurotoxic effect when it assumes a fibrillar form because it generates free radicals and interferes with neurons' ability to transfer glucose. Cell death and damage are possible outcomes of this. Clusters of hyperphosphorylated τ proteins encircle the β-amyloid core of the senile plaque in Alzheimer's disease.

The physiological stabilisation of microtubules is facilitated by τ proteins working in concert with other proteins. Elderly plaque formation is accompanied by inflammatory response cells known as microglia, which work to destroy and dissolve the plaque as well as any damaged or dead neurons. Microglia cells produced toxins Isolated from ashwagandha, withaferin A appears to have potential as an Alzheimer's disease therapeutic component. It works by inhibiting the accumulation of τ protein and decreasing the aggregation of β-amyloid. Furthermore, withaferin A suppresses pro-inflammatory and oxidative molecules while also regulating the expression of heat shock proteins (HSPs), which increase in response to stress. To assess withaferin A's safety and confirm its neuroprotective advantages in the treatment of Alzheimer's disease, more investigation is required [10]. Moreover, it has been noted that the production of amyloid β and the expression of genes connected to neuroinflammatory molecules associated with NF-κB are significantly decreased by withaferin A, which is obtained from ashwagandha extract. (19)

Beauveria bassiana, a fungus, bio converted extract of Withania somnifera in a different investigation. Withaferin A was then converted into cysteine and glutathione derivatives, which were thoroughly characterised and purified. Withaferin A's glutathione derivative, CR-777, has been demonstrated to have neuroprotective properties and to be a useful drug in defending against a variety of neuronal stresses. One of the most significant ingredients in ashwagandha is withanolide A, which is known to inhibit neurodegenerative processes in Parkinson's and Alzheimer's diseases. Nevertheless, the demonstration of withanolide A's capacity to cross the blood-brain barrier (BBB) was made very recently. In a separate investigation, vitanolide A was given orally to adult mice at three different doses: 1 mg/kg, 5 mg/kg, and 10 mg/kg. By administering the test drug intranasally, it was possible for it to enter.

Improvements in biochemical markers and a decrease in neurotransmitter levels that were abnormally high due to prior ischemia were also seen. In brain tissues, the maximum dose (10 mg/kg) dramatically decreased morphological damage, apoptosis, and necrosis. Not only humans, but animals can also suffer from

neurodegenerative illnesses, and in both situations, the disease's pathophysiology and progression are remarkably similar. Memory loss and reduced motor performance are the results of degenerative changes in the brain that occur in Canine Cognitive Dysfunction (CCD), an age-dependent disease. Aging-related oxidative brain damage is observed in both humans and dogs. Research using human embryonal neuroblastoma SK-N-SH cells demonstrated the antioxidant qualities of ashwagandha extract (substantially lowering. Additionally, it altered cholinergic transmission, which may have a positive effect on the treatment of Alzheimer's disease and cognitive dysfunction in dogs by preventing acetylcholinesterase activity. Furthermore, it has been observed that withaferin A, in the form of ashwagandha extract, effectively inhibits the expression of genes associated to neuroinflammatory molecules that are connected to NF-κB, as well as the creation of amyloid β. (20)

Ashwagandha Use in Parkinson's Disease:

In Parkinson's disease, the degeneration of the dopaminergic neurons of the nigrostriatal system is observed. This leads to an imbalance between dopamine's inhibitory action and acetylcholine and glutamic acid's excitatory action. Factors that induce the degeneration of nigrostriatal cells like Genetic conditions, Endo- and exogenous toxic factors, Neuroinfectious, Oxidative stress, Reduced growth factors.

Men are significantly more likely than women to get the condition, and while the exact explanation is unknown, it is believed that oestrogen's protective function may be the reason. A study with rats that had Parkinson's disease brought on by 6-hydroxydopamine was carried out. The rats were given an oral *Withania somnifera* extract for three weeks at doses of 100, 200, and 300 mg/kg body weight, prior to receiving an injection of 6-hydroxydopamine into the striatum. Administration of ashwagandha was shown to significantly reduce lipoperoxidation, increase glutathione concentration, increase the activities of superoxide dismutase and catalase, glutathione S-transferase, glutathione reductase, and glutathione peroxidase, as well as catecholamines, dopamine D2 receptor binding, and tyrosine hydroxylase expression.(21)

The effects of Withania somnifera vary depending on the dosage given, despite the fact that it greatly improves biochemical parameters in Parkinson's disease. Furthermore, treatment of a standardised methanol extract of ashwagandha root was found to reverse impairments linked to Parkinson's disease in a study done on fruit flies. When compared to the control group, ashwagandha extract treatment improved metabolic markers and decreased motor impairment in Parkinson's disease-ridden mice. Oral administration of Withania somnifera extract (100 mg/kg, i.p.) to mice has been reported to normalise the levels of lipoperoxidation indicators in the striatum of the mice and enhance the levels of dopamine (DA), homovanillic acid (HVA), and 3,4-dihydroxyphenylacetic acid (DOPAC).(22)

Ashwagandha in the Treatment of Huntington's Disease:

The disorder known as Huntington's is uncurable. Only the symptoms are treated by current drugs, which also halt the disease's course. Due to the disease's autosomal dominant inheritance pattern, half of the progeny should theoretically carry the disease-causing allele. Huntingtonin undergoes a conformational shift into its insoluble form due to a mutation in the IT15 gene, which codes for the huntingtin (htt) protein on chromosome 4. The mutant huntingtin protein's N-terminal region, which has enlarged polyglutamine repeats, builds up and accelerates the death of neurons.

Dopamine, GABA, serotonin, and acetylcholine become unbalanced as a result.

One strong neurotoxin is 3-Nitropropionic acid (3-NP). It causes complex II of the mitochondrial electron transport chain to become inhibited, which results in a moma energy deficit. It also causes oxidative and nitrosative stress and causes biochemical and neurobehavioral alterations that are very similar to those seen in Huntington's disease. Intraperitoneal injection of 3-NP was used to intentionally produce Huntington's disease symptoms in an animal model. Because of the plant's antioxidant qualities, it was shown that long-term administration of ashwagandha extract improved biochemical markers and motor performance. Lipoperoxidation was reduced, lactate and nitrate dehydrogenase levels were down, superoxide dismutase and catalase levels were increased, and the mitochondrial complex was unblocked.

There were dose-dependent effects at 100 and 200 mg/kg. The advantageous effects of withaferin A, which is extracted from ashwagandha, were shown in another study conducted on mice. An indication of ageing and a characteristic of many neurological illnesses, such as Huntington's disease, is a cell's incapacity to maintain proteostasis. Withaferin A delays the onset of the disease and activates the heat shock response in this mouse model to improve the compromised proteostasis. Withaferin A treatment for Huntington's disease resulted in noticeably extended lifespans for the mice, as well as the restoration of behavioural and motor impairments, including a decrease in body weight. The enhancement of striatal function in the mouse brain, the activation of heat shock, and the decrease in mutant huntingtin aggregates were all verified by biochemical investigations. Furthermore, withaferin A considerably. (23)

Antidote activity:

Neuro, cyto, and enzymatic poisons are the components of snake venom. W. somnifera has recently been shown to have antidote qualities against arsenic-induced toxicity. The snake venom's hydroxymidases enzyme aided in the poisons' spread throughout the victims' extracellular matrix tissues. A glycoprotein isolated from W. somnifera was investigated using the zymogram assay, and it was found to function as a hyaluronidase inhibitor against the venom of Daboia russelii (viper) and Naja naja (cobra). The enzymatic toxin phospholipase A-2, which is found in cobra venom, was also shown to be inhibited by the extracts. In another study, the whole plant extract of W. somnifera was used to counteract the harmful effects of the venom of Naja naja that were caused by PLA-2. (24)

Immunomodulatory activity and haematopoiesis:

The plant's pure sitoindoside IX and X were tested at dose rates ranging from 100–400 g/mouse to evaluate the immunomodulatory impact on the central nervous system as anti-stress drugs. The peritoneal macrophages' substantial activation, mobilisation, and phagocytosis were found to have an impact on the lysosomal enzymes that the macrophages released. More proof that sitoindosides lessened the cognitive function deficits in the elderly population was obtained. The immunomodulatory impact of plant root powder was assessed both in vitro and in vivo, and its strong suppression of mitogen-induced lymphocyte proliferation with postponed maturation. (25)

The amount of α-esterase positive cells, bone marrow cellularity, and blood cell count were all increased by the extract. Recent research has revealed that phytochemicals including

daucosterol, withasomniferol-A, withaferin-A, 2,3-dihydrowithaferin-A-3-β-O-sulfate, and β-sitosterol modulate several immune processes through interactions between proteins and bioactive targets. A combination of sitoindosides IX, X, glycol, and anolides extracted from the plant were found to statistically increase the immunomodulatory effect by activating lysosomal enzymes and macrophages in a related investigation. (26)

Treatment of Hypothyroidism:

Thyroid disorders are just one of the many ailments that cause serious issues in the twenty-first century. In clinical practice, hypothyroidism is the most prevalent kind. Thyroid disease impairs glucose metabolism, which *Ashwagandha* extract modulates and decreases blood levels of thyroid hormones. One of the few iodine-free medicinal plants is *Ashwagandha*. The thyroid gland produces the hormones T3, T4, and TSH in response to stimulation from iodine. On the other hand, research indicates that ashwagandha is more successful in treating subclinical hypothyroidism than severe hypothyroidism. In spite of this, it can supplement traditional therapy. Withaferin A is the compound that primarily increases thyroid function. Comparing eight weeks of ashwagandha medication to a placebo, there was a significant improvement in blood TSH, T3, and T4 levels. As a result, research suggests that ashwagandha therapy may help people with subclinical hypothyroidism return their thyroid indicators to normal. (27)

Increase muscle and physical strength:

It has been demonstrated that taking *Ashwagandha* supplements can greatly improve muscle strength and accelerate the processes involved in muscle regeneration. The stability of plasma creatine kinase levels revealed that the patients taking ashwagandha supplements had far less exercise-induced muscle myocyte damage. Athletes receiving *Ashwagandha* showed an improvement in their quality of life (this was looked into based on results from the DALDA—Daily Analysis of Life). Based on their scores on the Recovery Stress Questionnaire (RESTQ), it was predicted that treated athletes recovered from exercise more quickly than the placebo group, showing signs of less fatigue and more energy. In the treated group, there was also a noticeable rise in antioxidant levels. Throughout the investigation, no negative effects were noted, suggesting that this plant is safe for use. Furthermore, an aqueous extract of Withania somnifera successfully promoted fat accumulation and strengthened muscles. Ashwagandha recovered muscle-damaging by workout with faster muscle strength. (28)

The Ashwagandha also decrease the DHEA-S and morning cortisol levels. There was a rise in testosterone levels in men. The levels of testosterone in women remained unchanged. A significant reduction in PSS (perceived stress scale) scores was observed. Ashwagandha may lessen the hypothalamic-pituitary-adrenal (HPA) axis's activity. The HPA axis indirectly raises the concentrations of cortisol and DHEA in response to a stressor. Dehydroepiandrosterone, or DHEA, is a steroid hormone that is included in the group of hormones known as the "hormones of youth" together with growth hormone because their release declines noticeably with age. The highest concentrations of DHEA occur between the ages of 20 and 30. Many psycho-physical and psychosexual issues are brought on by reduced levels of DHEA in both men and women going through menopause. Furthermore, DHEA controls the concentration of sex hormones by acting as a precursor to them. It has been observed that treating sexual dysfunction that arises after menopause and andropause with DHEA

administration can be beneficial for both genders. (29)

Antimicrobial and antifungal activities:

W. somnifera leaf/root extract was administered orally, it demonstrated bacteriostatic effects against S. typhimurium that were comparable to those of the standard medication, chloramphenicol. However, the butanolic sub-fraction of the methanolic root/leaf extract of the plant demonstrated significant antibacterial potential against Salmonella typhimurium. Six bacterial strains, including Staphylococcus aureus, Bacillius subtilis, Escherichia coli, and Raoultella planticola. The extracts exhibited varying degrees of antibacterial and fungistatic activity; however, aqueous leaf extract shown the best activity against R. planticola. Potential antibacterial and antifungal agents were found in a variety of plant extracts and pure chemicals. The plant's leaves and roots were extracted using methanol, diethyl ether, and n-hexane, and their antibacterial ability against S. typhimurium and E. coli was evaluated using the agar plate diffusion assay. Significant antibacterial activities were demonstrated by the extract based on methanol and hexane. When Tibrim was given in combination with the plant's methanolic and hexane extracts, its antibacterial activity significantly increased. (30)

At a dosage of 10 µg/ml, the growth of Enterococcus species and E. coli was suppressed by a methanolic extract of roots. At concentrations ranging from 10-100 µg/ml, the development of Gram-positive (S. aureus) and Gram-negative (E. coli) bacterial strains was suppressed by the methanolic extract of roots, leaves, and bark. Methanoic extracts from leaves and roots were tested at a concentration of 100 µg against a variety of fungi, including A. flavus, D. turcica, and F. verticillioides, with nystatin serving as a positive control. For the fungal strains, the zone of greatest inhibition was observed to be between 7 and 14 mm. At a dosage of 1-2 mg/ml, a methanolic extract of the leaves inhibited the growth of S. aureus and Enterococcus species. Plant root extracts in the forms of acetone, methanol, ethanol, and chloroform showed notable microbicidal activity against K. pneumonia and S. aureus. Plant extracts from the leaves, stems, and roots were tested for their antifungal ability against F. crown at a concentration of 100 mg/100 ml of solvent. The aforementioned plant sections' aqueous and organic solvent extracts showed maximum inhibition at a range of 5–45 mm when compared to the positive control, dimethyl sulphoxide (DMSO). (31)

Anti-tumor/cytotoxic activities:

In Ashwagandha withaferin A considerably inhibited the growth of colon and breast cancer cell lines more successfully than the well-known anticancer medication doxorubicin. By inhibiting invasion, increasing apoptosis, and reducing osteoclastogenesis, blocking NFκβ activation sites may entail constitutive or inducible suppression mechanisms. Outstanding antileukemic action was demonstrated by withanolide D, which was extracted from W. somnifera leaves. The presence of 2,1-oxo-functionality in ring A, 5, and 6β-epoxy or 5α-chloro-6β hydroxy groups in ring B against human head, breast, and neck squamous cancer cell lines was validated by anti-proliferative activity in accordance to the structure-activity relationship for Withanolides. 50% ethanolic root, stem, and leaf extract was tested for its cytotoxic effects in vitro against several human cancer cell lines, including those from the prostate, lungs, colon, and neuroblastoma.

Withaferin A demonstrated anti-angiogenic efficacy in vivo by blocking the transcription factors that promote the development of vascular endothelial cells. Physagulin D, withaferin A,

sitoindoside IX, 4-(1-hydroxy-2, 2-dimethylcyclpropanone), 2,3-dihydrowithaferin A, physagulin D (1H6)The antiproliferative activity of -β--glucopyranosyl-(1→4)-β -glucopyranoside, 2,3-dihydrowithaferin A, 24,25-dihydro-27-desoxywithaferin A, 27-O-β--glucopyranosylphysagulin D, 27-O-β--glucopyranosylviscosalactone B, 4,16-dihydroxy-5β, 6β-epoxyphysagulin D, withanoside IV, and viscosalactone B isolated from alcoholic leaf extract were evaluated for their antiproliferative activity on NCI-H460 (lungs), HCT-116 (colon), MCF-7 (breast).Withaferin A and its derivatives, viscosalactone B and 27-O-glucoside derivatives, were demonstrated to have significant anti-proliferative action.(32)

Withaferin A's protective effect on red blood cell integrity was evaluated by measuring membrane-bounded enzymatic activity, osmotic fragility of red blood cells, and glycol-conjugates in dimethylbenzanthracene-induced oral carcinogenesis. It was found that orally administering withaferin-A (20 mg/kg body weight) to golden hamsters for 14 weeks completely prevented the development of tumours. Different plant parts' aqueous and alcoholic extracts demonstrated anti-carcinogenic potential by reducing NFκβ activity, which in turn prevented intercellular tumour necrosis in malignant cell lines.

W. somnifera roots were used to extract an anti-cancerous protein fraction that shown efficacy against the human MDA-MB-231 breast cancer cell line. In the breast cancer cell line, the protein fraction's activity was mediated by a mitochondria-based apoptosis mechanism that was dependent on reactive oxygen species. W. somnifera root extract (ethanolic) was given to leukemic THP-1 and peripheral blood mononuclear cells during 24 to 72 hours at a concentration of 0.05–0.4 mg/ml. The findings demonstrated that leukemic THP-1 and PMBC viability increased following a 24-hour therapy. On the other hand, peripheral blood mononuclear cell viability is still elevated at 30 µg/ml of the extract after 72 hours (200), even with a drop in leukemic THP-1 and a 50% suppression of cell growth for HT-29, HCT-15, SW620, 502, 713, Colo-205, A549, HOP-62, and Hep-G2 cell lines. (33)

MARKET FORMULATION OF ASHAVGHANDHA:

Sr. No.	Product	Manufacturer	Product Type	Ashwagandha Content	Status Health Benefits
1	**Ashwagangharista**	Baidynath Ayurved Bhawan	Polyherbal	1.70g/ 30ml	Nervic tonic, memory and cognition improvement,
2	**Stresswin**	Baidynath Ayurved Bhawan	Polyherbal	200mg/ 425mg capsule	relieves mental stress, natural sleep inducer and recovery from nervous disease
3	**Himalya ashwagandha**	The Himalaya drug company vaidynath ayurved Bhawan	Mono herbal extract	250mg/ 250mg capsules polyherbal 200mg/425mg capsule	Stress management, Reduction in anxiety ,strain and stress relives from disturb sleep ,mental alertness and relief stress and strain during menopause
4	**Himalya massage oil**	The Himalaya drug company	Polyherbal	100mg/ 500mg capsule	Vigour and vitality promotion

5	**Vitalplux**	Mukthi pharma	Polyherbal	1.166gm/ 10gm	Recovery from impotence, recovery from general weakness, fatigue
6	**Amrutha Kasthuri**	Pankaj Kasthuri herbal India ltd.	Polyherbal	2gm/ 15gm	Neurasthenia convalescence
7	**streescom**	Devour India ltd.	Monoherbal extract	300mg/ capsule	Relief anxiety neurosis, physical and mental stress relief from depression
8	**Brento**	Zandu Pharmaceutical works Ltd.	Polyherbal	100mg/ capsule	Nervic tonic

CONCLUSIONS:

In Ayurvedic system of medicine Ashwagandha is being used since ages for the betterment of human health. In modern medicine many experiment has been conducted to search the potential of Ashwagandha. Which are discussed in the present article this exhibit the wonderful profile of Ashwagandha plant and its benefit all the years for a positive impact on the many system in humans' beings and in the vast study of Ashwagandha . It is necessary to mention that this Indian ginseng is beneficial for all type of diseases and to improve the general health of many individual further in view of above content it is also recommend that various studies must be conducted to established the more useful aspect of Ashwagandha in daily life of human beings.

REFERENCES

1. Singh N., Bhalla M., de Jager P., Gilca M. An overview on Ashwagandha: A Rasayana (rejuvenator) of Ayurveda. Afr. J. Tradit. Complement. Altern. Med. 2011;8:208–213. doi: 10.4314/ajtcam.v8i5S.
2. Langade D., Kanchi S., Salve J., Debnath K., Ambegaokar D. Efficacy and Safety of Ashwagandha (Withania somnifera) Root Extract in Insomnia and Anxiety: A Double-blind, Randomized, Placebo-controlled Study. Cureus. 2019;11:e5797. doi: 10.7759/cureus.5797.
3. Połumackanycz M., Forencewicz A., Wesołowski M., Viapiana A. Ashwagandha (Withania somnifera L.)—The plant with proven health-promoting properties. Farm. Pol. 2020;76:442–447. doi: 10.32383/farmpol/127824.
4. "Ashwagandha". Drugs.com. 4 December 2023. Retrieved 4 April 2024.
5. P.K. Khanna, A. Kumar, A. Ahuja and M.K. Kaul, Asian J. Plant Sci.,5, 1061 (2006)
6. Mirjalili M.H., Moyano E., Bonfill M., Cusido R.M., Palazón J. Steroidal lactones from Withania somnifera, an ancient plant for novel medicine. Molecules. 2009;14:2373–2393. doi: 10.3390/molecules14072373.
7.]Deni., Bown (1995). Encyclopedia of herbs & their uses. Montréal: RD Press. ISBN 0888503342. OCLC 32547547.
8. Ashwagandha". Drugs.com. 4 December 2023. Retrieved 4 April 2024
9. Stearn, W. T. (1995). Botanical Latin: History, Grammar, Syntax, Terminology and Vocabulary (4th ed.). Timber Press. ISBN 978-0-88192-321-6.
10. John J. Therapeutic potential of Withania somnifera: A report on phyto-pharmacological properties. Int. J. Pharm. Sci. Res. 2014;5:2131–2148.

11. Dutta R., Khalil R., Green R., Mohapatra S.S., Mohapatra S. Withania Somnifera (Ashwagandha) and Withaferin A: Potential in Integrative Oncology. Int. J. Mol. Sci. 2019;20:5310. doi: 10.3390/ijms20215310.
12. Saleem S, Muhammad G, Hussain MA, Altaf M, Bukhari SN. Withania somnifera L.: Insights into the phytochemical profile, therapeutic potential, clinical trials, and future prospective. Iranian Journal of Basic Medical Sciences. 2020 Dec;23(12):1501.
13. Bhattacharya SK, Satyan KS, Chakrabarti A. Effect of Transina (TR), an ayurvedic herbal formulation, on pancreatic islet superoxide dismutase (SOD) activity in hyperglycaemic rats. Ind J Exp Bio. 1997;3:297–299.
14. Jayaprakasam B, Strasburg GA, Nair MG. Potent lipid peroxidation inhibitors from Withania somnifera fruits. Tetrahed. 2004;60:3109–3121.
15. Atal CK, Dhar KL, Gupta OP, Raghunathan K. Pharmacognosy and phytochemistry of Withania somnifera (Linn) Dunal (Ashwagandha) New Delhi: Central Council for Research in Indian Medicine and Homeopathy; 1975.
16. Gupta A, Singh S. Evaluation of anti–inflammatory effect of Withania somnifera root on collagen–induced arthritis in rats. Pharma Bio. 2014;52:308–320.
17. Khare CP. Indian Medicinal Plants–An Illustrated Dictionary First Indian Reprint. New Delhi: Springer (India), Pvt. Ltd; 2007. pp. 717–718.
18. Githaiga BM, lelmen E, Mwangi EM, Waithaka PN. Effects of Withania somnifera root extract on serotonin secretion in suiz albino mice. J Pharm Bio Sci. 2018;6:109–113.
19. Tiwari S., Atluri V., Kaushik A., Yndart A., Nair M. Alzheimer's disease: Pathogenesis, diagnostics, and therapeutics. Int. J. Nanomed. 2019;14:5541–5554. doi: 10.2147/IJN.S200490.
20. Mukherjee S., Kumar G., Patnaik R. Withanolide a penetrates brain via intra-nasal administration and exerts neuroprotection in cerebral ischemia reperfusion injury in mice. Xenobiotica. 2020;50:957–966. doi: 10.1080/00498254.2019.1709228.
21. Zając M., Jelińska A., Muszalska I.C. Chemia Leków z Elementami Chemii Medycznej dla Studentów Farmacji i Farmaceutów. Uniwersytet Medyczny im. Karola Marcinkowskiego; Poznan, Poland: 2018.
22. RajaSankar S., Manivasagam T., Sankar V., Prakash S., Muthusamy R., Krishnamurti A., Surendran S. Withania somnifera root extract improves catecholamines and physiological abnormalities seen in a Parkinson's disease model mouse. J. Ethnopharmacol. 2009;125:369–373. doi: 10.1016/j.jep.2009.08.003.
23. Rojas N.G., Cesarini M.E., Peker G., Da Prat G.A., Etcheverry J.L., Gatto E.M. Review of Huntington's Disease: From Basics to Advances in Diagnosis and Treatment. J. Neurol. Res. 2022;12:93–113. doi: 10.14740/jnr721.
24. Javaid A, Shafique S, Shafique S. Herbicidal activity of Withania somnifera and Datura Alba against Rumex Dentatus. J Agr Res. 2009;47:37–45.
25. Iuvone T, Esposito G, Capasso F, Izzo A. Induction of nitric oxide synthase expression by Withania somnifera in macrophages. Life Sci. 2003;72:1617–1625.
26. Ghosal S, Lal J, Srivastava R, Bhattacharya SK, Upadhyay SN, Jaiswal SK, et al. Immunomodulatory and CNS effects of sitoindosides IX and X, two new glycowithanolides from Withania somnifera. Phytother Res. 1989;3:201–206.

27. Sharma A.K., Basu I., Singh S. Efficacy and Safety of Ashwagandha Root Extract in Subclinical Hypothyroid Patients: A Double-Blind, Randomized Placebo-Controlled Trial. J. Altern. Complement. Med. 2018;24:243–248. doi: 10.1089/acm.2017.0183.
28. Wankhede S., Langade D., Joshi K., Sinha S.R., Bhattacharyya S. Examining the effect of Withania somnifera supplementation on muscle strength and recovery: A randomized controlled trial. J. Int. Soc. Sports Nutr. 2015;12:1–11. doi: 10.1186/s12970-015-0104-9.
29. Choudhary B., Shetty A., Langade D.G. Efficacy of Ashwagandha (Withania somnifera [L.] Dunal) in improving cardiorespiratory endurance in healthy athletic adults. Ayu. 2015;36:63–68. doi: 10.4103/0974-8520.169002.
30. Rawat V., Bisht P. Antibacterial activity of Withania somnifera against Gram-positive isolates from pus samples. Ayu. 2014;35:330. doi: 10.4103/0974-8520.153757.
31. Mwitari P.G., Ayeka P.A., Ondicho J., Matu E.N., Bii C.C. Antimicrobial Activity and Probable Mechanisms of Action of Medicinal Plants of Kenya: Withania somnifera, Warbugia ugandensis, Prunus africana and Plectrunthus barbatus. PLoS ONE. 2013;8:e65619. doi: 10.1371/journal.pone.0065619.
32. Mwitari P.G., Ayeka P.A., Ondicho J., Matu E.N., Bii C.C. Antimicrobial Activity and Probable Mechanisms of Action of Medicinal Plants of Kenya: Withania somnifera, Warbugia ugandensis, Prunus africana and Plectrunthus barbatus. PLoS ONE. 2013;8:e65619. doi: 10.1371/journal.pone.0065619.
33. Jawarneh S., Talib W.H. Combination of Ashwagandha Water Extract and Intermittent Fasting as a Therapy to Overcome Cisplatin Resistance in Breast Cancer: An in vitro and in vivo Study. Front. Nutr. 2022;9:863619. doi: 10.3389/fnut.2022.863619.

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