



Health Benefits and Medicinal Potency of *Withania somnifera*: A Review

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Abstract :-

Withania somnifera, a commonly used herb in Ayurvedic medicine. Although the review articles on this plant are already published, this review article is presented to compile all the updated information on its phytochemical and pharmacological activities, which were performed by widely different methods. Studies indicate ashwagandha possesses antioxidant, anxiolytic, adaptogen, memory enhancing, antiparkinsonian, antivenom, antiinflammatory, antitumor properties. Various other effects like immunomodulation, hypolipidemic, antibacterial, cardiovascular protection, sexual behaviour, tolerance and dependence have also been studied. These results are very encouraging and indicate this herb should be studied more extensively to confirm these results and reveal other potential therapeutic effects. Clinical trials using ashwagandha for a variety of conditions should also be conducted.

Key Words:- Winter cherry, *Withania somnifera*, cultivation, value addition, uses

Introduction:- *Withania somnifera* (WS), also known as ashwagandha, Indian ginseng, and winter cherry, it has been an important herb in the Ayurvedic and indigenous medical systems for over 3000 years. The roots of the plant are categorised as rasayanas, which are reputed to promote health and longevity by augmenting defence against disease, arresting the ageing process, revitalising the body in debilitated conditions, increasing the capability of the individual to resist adverse environmental factors and by creating a sense of mental wellbeing.

It is in use for a very long time for all age groups and both sexes and even during pregnancy without any side effects. Historically, the plant has been used as an antioxidant, adaptogen, aphrodisiac, liver tonic, antiinflammatory agent, astringent and more recently to treat ulcers, bacterial infection, venom toxins and senile dementia. Clinical trials and animal research support the use of WS for anxiety.

cognitive and neurological disorders, inflammation, hyperlipidemia and Parkinson's disease. WS chemopreventive properties make it a potentially useful adjunct for patients undergoing radiation and chemotherapy. Recently WS is also used to inhibit the development of tolerance and dependence on chronic use of various psychotropic drugs.

❖ Vernacular Names

- **Arabic** : Kaknaj-e-Hindi
- **Bengali**:Ashvaganda, Asvagandha
- **English** : Winter cherry
- **Gujarati** : Asan, Asana, Asado, Asundha, Ghadaasoda
- **Hindi** : Asgandh, Punir
- **Malayalam** : Amukkiram, pevetti
- **Marathi** : Askandha, Kanchuki, Tilli
- **Odiya** : Ashgandha
- **Persian** : Kaknaj-e-Hindi, Asgand Nagaori
- **Sanskrit**:Ashvagandha, Ashvakandika, Gandhapatri
- **Tamil** : Amukkira, Asubam, Asuvagandi, Asvagandhi
- **Telugu** : Asvagandhi, Penneru, Dommadolu
- **Urdu** : Asgand, Asgand Nagori



❖ TAXONOMY

- **Kingdom** : Plantae
- **Subkingdom** : Tracheobionta
- **Superdivision** : Spermatophyta
- **Division** : Magnoliophyta
- **Subclass** : Magnoliopsida
- **Order** : Solanales
- **Family** : Solanaceae
- **Genus** : Withania
- **Species** : *Withania somnifera*

❖ TAXONOMICAL CLASSIFICATION

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

Botanical description

Withania somnifera is a small, erect, branched, evergreen, tomentose woody shrub that grows up to 150-170 cm tall and is found throughout the drier parts of India in waste places and on bunds. Roots are stout, fleshy and whitish brown in colour. Leaves simple, petiolate, elliptic-ovate to broadly ovate, entire, exstipulate, cunate or oblique, glabrous, up to 10 cm long, those in the floral region are smaller and opposite. Flowers inconspicuous, greenish or lurid-yellow, pedicellate, 4-6 mm in diameter, axillary, umbellate cymes occurring in 5-25 clusters. Berries are small, globose, bright orange-red when mature, 5 mm in diameter, enclosed in the persistent calyx containing numerous seeds. Seeds are small, smooth, yellow, reniform, 2 mm long, 1.5-2 mm wide and 0.5 mm thick.

Chemical constituents

Different parts of the plant contain a number of chemical compounds. Some of them are listed below:

- **Alkaloids** :-ashwagandhine, anahygrine, anaferine, cuscohygrine, tropine, isopelletierine, pseudotropine, [3]-tigloyloxtropine, 3- tropyloxyloate, disopelletierine, hygrine, mesoanaferine, choline, somniferine, withanine, withanane, hentriacontane, visamine, withasomnine etc.
- **Steroidal compounds**:- ergostane
- **Steroidal lactones** withaferin A, withanolides A-Y, withasomniferin-A, withasomidienone, withasomniferols A-C, withanone etc.
- **Saponins**:- containing an additional acyl group: sitoindoside VII and VIII
- **Withanolides**:- with a glucose at carbon 27: sitoindoside IX and X
- **Withanolide glycosides** :-withanosides I, II, III,IV, V, VI and VII
- **Pyrazole derivatives** :-pseudowithanine and ashwagandhine Apart from these contents plant also contains chemical constituents like withaniol, acylsteryl glucosides, starch, reducing sugar, hantreacotane, ducitol, a variety of amino acids including aspartic acid, proline, tyrosine, alanine, glycine, glutamic acid, cystine, tryptophan, and high amount of iron.

Cultivation and Collection

The morphological and therapeutic properties of *Withania somnifera* depend on its sources. Basically, it is reported that the plants from different sources vary in their morphological and therapeutic properties. *Withania somnifera* is grown as late rainy season crop. Actually semitropical areas are suitable for its cultivation as a rainfed crop. Now-a-days, the cultivation is mainly done in Madhya Pradesh, where about 2000 hectares are under cultivation. The propagation is done by seeds. The propagation is done towards June-July. Nitrogenous fertilizers can be used for the formation of small roots. Harvesting is initiated which lasts upto march. The roots are collected by uprooting the plant.

Soil and climate

In India, it is distributed from 23°N-33°N, from 180-1700 m above mean sea level. The semi-arid tropical areas receiving 500-750 mm rainfall are suitable for cultivation of this crop. It requires dry season during its growing period. One or two late winter rains are conducive for proper development of roots. The crop grows well in well-drained sandy, sandy loam or light textured red/black soils having a pH of 7.5-8.0.

Pests and diseases

A number of leaf eating pests (mites, aphids, beetles) and diseases (seedling blight, leaf blight, die back etc.) are reported on Ashwagandha. A combination of 0.5% Malathion and 0.3% Kelthane foliar sprays at 15 days intervals controls the pests. Similarly, seed treatment with Thiram/Mancozeb and spraying of 0.3% Mancozeb or Copperoxychloride control the fungal diseases. Organically grown plants are sprayed with botanical pesticides such as neem products, custard apple leaf decoction, cow urine, garlic + chillies extract etc. as a prophylactic measure to protect the crop from pests and diseases.

Harvesting

The crop is ready for harvest 180-210 days after planting. In some regions 150-180 days old crop is harvested. Drying out of leaves and reddening of berries judge the maturity of the crop. The entire plant is pulled out and cutting the stem 1-2 cm above the crown, separates the roots. The roots are cleaned and either cut into 7-10 cm long pieces and dried or dried as a whole in the sun and stored. Berries are hand plucked, dried, threshed and the seeds are stored for the next crop.

Grading of roots

The dried roots are beaten with a club to remove adhering soil and to break off thin, brittle, lateral rootlets. Lateral branches, root crown and stem remains are carefully trimmed with a knife. Root pieces are then sorted out into following grades.

- 1) **A grade** Root pieces up to 7 cm in length, 1-1.5 cm in diameter, solid cylindrical with smooth external surface and pure white from inside.
- 2) **B grade** Root pieces up to 5 cm in length, 1 cm or less in diameter, solid, brittle and white from inside.
- 3) **C grade** Solid root pieces up to 3-4 cm in length, 1 cm or less in diameter.
- 4) **D grade** Small root pieces, semisolid or hollow, very thin, yellowish inside and < 1 cm in diameter of late farmers are grading the roots into 7 or more grades.

Pharmacological Activity

Hypoglycaemic activity

Several studies demonstrated that Ashwagandha reduces blood sugar levels. A test tube study found that it increased insulin secretion and improved peripheral tissue sensitivity to insulin. One study revealed that people with schizophrenia, those treated with *Withania somnifera* for 4 weeks had an average reduction in fasting blood sugar levels of 13.5 mg/dl, compared to a 4.5 mg/dl reduction in those who received a placebo¹⁷. Transina, one ayurvedic formulation which contain Ashwagandha as active ingredient have been reported to decrease streptozotocin (STZ)-induced hyperglycaemia in rats. This hypoglycaemic effect may be attributed to pancreatic islet free radical scavenging activity because the hyperglycaemic activity of STZ is a consequence of decrease in pancreatic islet cell superoxide dismutase (SOD) activity leading to the accumulation of degenerative oxidative free radicals in islet beta cells¹⁸.

Antioxidative activity

Lipids and iron are rich components of the brain and nervous system. That's why they are relatively more susceptible to free radical damage than other tissues. Free radical damage of nervous tissue may be involved in normal aging and neurodegenerative diseases, e.g epilepsy, schizophrenia, Parkinson's, Alzheimer's and other diseases. The free radical scavenging enzymes, superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPX) play a very vital role in protective effect on neuronal tissue. Decreased activity of these enzymes leads to accumulation of toxic oxidative free radicals and resulting degenerative effects¹⁹. In one laboratory analysis reported that glycowithanolides of *withania somnifera* were given once daily

for 21 days, dose related increased in all enzymes were observed²⁰. Another study revealed that sitoindosides VII-X and withaferin A actively having antioxidant activity.

Hypolipidaemic activity

Withania somnifera effectively help to improve heart health by reducing cholesterol and triglyceride levels. Animals studies have found that it significantly decreases these blood fats. One experimental study in rats found that it lowered total cholesterol by as much as 53% and triglycerides by nearly 45%. In a 60 day experimental study of chronically stressed adults, the group taking the higher dosage of Ashwagandha experienced a 17% decrease in LDL cholesterol and 11% decrease in triglycerides.

Withania somnifera root powder reduced total lipids, cholesterol and triglycerides in hypercholesteremic animals. On the other hand, significantly increased plasma HDL-cholesterol levels, HMG-CoA reductase activity and bile acid content of liver. In another study with hydroalcoholic extract of fruits of *Withania coagulans* to high fat diet induced hyperlipidemic rats for 7 weeks, significantly reduced elevated serum cholesterol, triglycerides and lipoprotein levels. In one study, six mild non-insulin dependent diabetes mellitus subjects and six mild hypercholesterolemic subjects were treated with the powder of roots of *Withania somnifera* for 30 days. Various parameters were assessed in the blood and urine samples of the subjects. Decrease in blood glucose was comparable to that of an oral hypoglycaemic drug. Significant increase in urine sodium, urine volume, significant decrease in serum cholesterol, triglycerides, LDL and VLDL-cholesterol were observed, indicating that root of *Withania somnifera* is a potential source of hypoglycaemic, diuretic and hypocholesterolemic agents.

Anti-stress activity

Ashwagandha has been shown to reduce stress in both animal and human studies. It is a very popular herb for reduce stress. Anti-stressor effect of ashwagandha was investigated in rats using cold water swimming stress test. One clinical investigation reported that it blocked the stress pathway on rat brain by regulating chemical signaling in the nervous system. Several studies reported that it can effectively reduce symptoms in people with stress. A study conducted by the Institute of Basic Medical Sciences at Calcutta University evaluated the effects of Ashwagandha on chronic stress in rodents. Research results showed that Ashwagandha decreased the frequency and severity of stress-induced ulcers, reversed stress-induced inhibition of male sexual behavior, and inhibition the effects of chronic stress on retention of learned tasks. In one experiment, an aqueous suspension of Ashwagandha root was used at 100mg/kg/oral dosage, resulting prevents/decreases adrenal cortisol and ascorbic acid which occurs due to swimming stress. Ashwagandha has been evaluated for its adaptogenic activity. Administration of ashwagandha with other drugs in experimental animals exposed to a variety of biological, physical and chemical stressors was found to offer protection against these stressors.

Increase fertility in men

Ashwagandha helps increase testosterone levels and significantly boosts sperm quality and fertility in men. In a study of 75 infertile men, the group treated with Ashwagandha had an increase in sperm count and motility.

Antidepressant activity

One experimental study revealed that Ashwagandha may help reduce severe depression. In a 60-day experimental study in stressed adults, those who took 600mg/day reported a 79% reduction in severe depression. At the same time, the placebo group reported a 10% increase.

Nootropic effect

Effects of sitoindosides VII-X and withaferin isolated from aqueous methanol extract of roots of *withania somnifera* were studied on brain cholinergic, glutamatergic and GABAergic receptors in rats. The compounds 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 sites were increased in a number of cortical regions including cingulate, frontal, parietal, and retrosplinal cortex. In a study by Zhao et al withanoside IV induced neurite outgrowth in cultured rat cortical neurons. Oral administration of Withanoside IV significantly improved memory deficits in Abeta-injected mice and prevented loss of axons, dendrites, and synapses. Withanolide IV may ameliorate neuronal dysfunction in Alzheimer's disease and that the active principle after metabolism is somnignone. In another study of reserpine treated animals also showed poor retention of memory in the elevated plus maze task paradigm.

Anticancer activity

Animal and test tube studies have shown that it promotes the death of tumour cells and may be effective against several types of cancer. Animal studies have found that Ashwagandha helps induce the apoptosis or "programmed cell death" of cancer cells. It also inhibits the growth of new cancer cells in several ways. Main mechanism behind the anticarcinogenic effect of Ashwagandha is generation of reactive oxygen species (ROS), which are toxic to cancer cells but not normal cells.

Animal studies suggest that it may be beneficial for treating several types of cancer, including breast, lung, colon, brain and ovarian cancer. In one clinical investigation, mice with ovarian tumor treated with Ashwagandha alone or in combination with an anticancer drug had a 70-80% reduction in tumor growth. The treatment also prevented metastasis. Research on animals revealed that the herb decreases the levels of the nuclear factor Kappa B, reduces the intracellular tumor necrosis factor, and enhances apoptotic signaling in cancerous cell lines. The most possible uses of Ashwagandha is its capacity to fight cancers by reducing tumour size. In one study, the herb was evaluated for its antitumor effect in urethane-induced lung tumors in adult male mice. Following administration of Ashwagandha over a period of seven months, the histopathological appearance of the lungs of animals which received the herb was similar to those observed in the lungs of control animals.

Antibiotic activity

The antibiotic activity of the roots as well as leaves has recently been shown experimentally. Withaferin A in concentration of 10µg/ml inhibited the growth of various gram-positive bacteria, acid-fast, aerobic bacilli, and pathogenic fungi. It was active against *Micrococcus pyrogenus* var aureus and primarily inhibited the activity of bacillus subtilis glucose-6-phosphate dehydrogenase. One experimental study reported that Withaferin A inhibited Ranikhet virus 16. The shrub's extract is active against Vaccinia virus and *Entamoeba histolytica*. *Withania somnifera* showed the protective action against systemic Aspergillus infection. This protective activity was probably related to the activation of macrophage function revealed by the observed increases in phagocytosis and intracellular killing of peritoneal macrophages induced by Ashwagandha treatment in mice. Antibiotic activity of Withaferin A is attributed to the presence of the unsaturated lactone ring. It is stronger than penicillin.

Cardioprotective activity

The extract of *Withania somnifera* was evaluated on the cardiovascular and respiratory systems in dogs and frogs. The alkaloids had a prolonged hypotensive, bradycardiac, and respiratory stimulant action in dogs. The cardioinhibitory action in dogs appeared to be due to ganglion blocking and direct cardiodepressant actions. In another study, left ventricular dysfunction was seen as a decrease in heart rate, left ventricular rate of peak positive and negative pressure change and elevated left ventricular end-diastolic pressure in the control group was

recorded. *Withania somnifera* showed strong cardioprotective action in the experimental model of isoprenaline-induced myonecrosis in rats.

Anti-inflammatory activity

Ashwagandha has been shown to increase natural killer cell activity and decrease markers of inflammation. Several animal studies have shown that Ashwagandha helps reduce inflammation. In one experimental study of humans have found that it increases the activity of natural killer cells, which are immune cells that fight against infection. It also helps to reduce markers of inflammation, such as C-reactive protein (CRP)38. Withaferin A showed potent anti-arthritic and anti-inflammatory activities. Anti-inflammatory activity has been attributed to biologically active steroids of which Withaferin A is a major component.

Conclusion

The challenges for Ashwagandha cultivation and business are: Market exploitation of farmers by middlemen, price fluctuations of roots, demand-supply fluctuations of roots, limited exports, patent-ing by foreign companies, changing climatic conditions, long duration of the crop, low root yields, high fibre content of the roots in some locations, pests and diseases infections reducing yield and resulting in plant mortality, labour problems (high cost, non-availability during peak season, unreasonable demands by labour-ers), lack of knowledge about post harvest technology and problems associated with long term storage of roots.

Ashwagandha is a potential medicinal plant that can generate global business to India Inc. Scientific studies on this crop need to be increased by many folds urgently to effectively counter patenting of technologies based on this crop by transnational companies and to put its several medicinal uses by India to the maximum use. Opportunities exist for large scale commercial cultivation of this crop in many districts of Andhra Pradesh and other States of India.

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