

Phytochemical Study of the Plant *Withania somnifera* against Various Diseases

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Abstract: *Withania somnifera* or ashwagandha is commonly used as a folk medicine for the treatment of various diseases. It is a natural source of withanolides (steroidal lactones), a phytochemical which are used as ingredients in many formulations prescribed for a variety of diseases. It act as a sedative, diuretic, anti-inflammatory, generally used for increasing energy, endurance, and acts as an adaptogen that exerts a strong immunostimulatory and an anti-stress agent. Ashwagandha is used for treating cold and coughs, ulcers, emaciation, diabetes, conjunctivitis, epilepsy, insomnia, senile dementia, leprosy, Parkinson's disease, nervous disorders, rheumatism, arthritis, intestinal infections, bronchitis, asthma, impotence and a suppressant in HIV/AIDS patients. According to Indian Herbal System (Ayurveda), Ashwagandha is considered one of the most important herbs and the best adaptogenic. In new of above the following review discusses the presence of phytochemicals which enhance the pharmacological value of *W. somnifera*.

Keywords: anti-inflammatory, diuretic, phytochemical, withanolides, *Withania somnifera*,

I. Introduction

Plant-derived drugs remain an important resource, especially in developing countries, to combat serious diseases. Approximately 60% to 80% of the world's population still relies on traditional medicines for the treatment of common illness. Medicinal plants are also cheaper and more accessible to most of the population in the world. Medicinal plants have regained a wide recognition due to an escalating faith in herbal medicine in the last few decades contributed by its lesser side effects compared to allopathic medicine [1], [2].

Withania somnifera is popularly known as Ashwagandha or Winter Cherry and Indian ginseng is considered one of the most important herbs in Ayurvedic indigenous medical systems for over 3000 years and is commonly used in Indian traditional health care systems[3]. It is a perennial plant belonging to the order *Solanaceae*[4].

Phytochemicals (from the Greek word phyto, meaning plant) are biologically active, naturally occurring chemical compounds found in plants which provide more health benefits to humans than those attributed to macronutrients and micronutrients. In general, the plant chemicals that protect plant cells from environmental hazards such as pollution, stress, drought, UV exposure and pathogenic attack are known as phytochemical. They protect plants from disease and damage and contribute to the plant's color, aroma and flavor. Phytochemical accumulate in different parts of the plants, such as in the roots, stems and leaves. These compounds are known as secondary plant metabolites and have biological properties such as antioxidant activity, antimicrobial effect, modulation of detoxification enzymes, stimulation of the immune system, decrease of platelet aggregation, modulation of hormone metabolism and anti cancer property[5].

II. Biology of the Plant

Taxonomical Classification

The plant belongs to Division-Angiosperma, Class- Dicotyledons, Order- Tubiflorae, Family- *Solanaceae*, Genus -*Withania* and Species- *somnifera*[6].

Withania somnifera is a small, woody shrub in the *Solanaceae* family that grows about two feet in height. It can be found growing in Africa, the Mediterranean, and India. An erect, evergreen, tomentose 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. Parts used: Whole plant, roots, leaves, stem, green berries, fruits, seeds and bark[6].

In India Rajasthan, Punjab, Haryana, Uttar Pradesh, Gujarat, Maharashtra and Madhya Pradesh are the major Ashwagandha producing states of the country. In Madhya Pradesh alone it is cultivated in more than 5000 hectare. The estimated production of Ashwagandha roots in India is than 1500 tonnes and the annual requirement is about 7000 tonnes which necessitates the increase in its cultivation and higher production[7].

Phytochemicals: Chemical Constituents of *Withania somnifera*

The whole plant as well as specific parts (roots, stems, leaves) of plant extract and its active constituents have been used for the treatment of larger number of human ailments. The main constituents of ashwagandha are alkaloids and steroidal lactones. Withanine, somniferine, somnine, somniferinine, withananine, pseudo-withanine tropane, pseudo-tropine, choline, anaferine, anahydrine, isopelletierine are chemical constituents present in it. The leaves contain steroidal lactone, which are commonly called as "Withanolides". Withaferine A has been receiving good deal of attention because of its antibiotic and anti-tumor activity. The paste prepared out of its leaves is used for curing inflammation of tubercular glands. Fruits and seeds are diuretic in nature[8]. The green berries contain amino acids, a proteolytic enzyme, condensed tannins, and flavonoids. They contain a high proportion of free amino acids which include proline, valine, tyrosine, alanine, glycine, hydroxyproline, aspartic acid, glutamic acid, cystine and cysteine. The presence of a proteolytic enzyme *chamase*, in the berries may be responsible for the high content of the amino acid. The tender shoots are rich in crude protein, calcium and phosphorous, and are not fibrous. They are reported to contain scopoletin. The stem of the plant contains condensed tannins and flavonoids. The bark contains a number of free amino acids[9].

***Withania somnifera*: As a Medicinal Herb**

Withania somnifera is considered to be one of the best rejuvenating agents in Ayurveda. Its roots, seeds and leaves are used in Ayurvedic and Unani medicines. *Withania somnifera* root drug finds an important place in treatment of rheumatic pain, inflammation of joints, nervous disorders and epilepsy. Dried roots are used as tonic for hiccup, cold, cough, female disorders, as a sedative, in care of senile debility etc. Leaves are applied for carbuncles, inflammation and swellings. Leaf juice is useful in conjunctivitis. It has anti-inflammatory, anti-tumor, anti-stress, antioxidant, mind-boosting, immune-enhancing, and rejuvenating properties. It's root has also been noted to have sex-enhancing properties[10].

As a whole its medicinal properties are as follows: it has anti-stress, adaptogenic, aphrodisiac, sedative, diuretic, antispasmodic, germicidal and anti-inflammatory action. It serves as a nervine tonic and good hypnotic in alcoholism. It stimulates thyroid activity and acts as a natural nutrient for insomnia. It also enhances anti-peroxidation of liver and immunity against diseases [11].

III. Pharmacological Profile

Anticancer Activity

Withaferin A and withanolide D are reported to be significant anti-tumor and radio-sensitizing withanolides[12]. 1-oxo-5 β , 6 β -epoxy-witha-2-enolide is another constituent of *W. somnifera* reported to reduce the skin carcinoma induced by UV radiations. Withaferin A acts as a mitotic poison arresting the division of the cultured human larynx carcinoma cells at metaphase. It also produced a significant dose dependent retardation of the growth of Ehrlich ascites carcinoma, sarcoma 180, and sarcoma Black and E 0771 mammary adenocarcinoma.

It also inhibited growth of breast, lung, central nervous system and colon cancer cell lines by decreasing their viability in dose dependent manner and therefore holds promise as a chemotherapeutic agent [13].

Anti-inflammatory Properties

Ashwagandha acts as an anti-inflammatory agent through inhibition of complement, lymphocyte proliferation, and delayed-type hypersensitivity[14]. The extracts of *W. somnifera* have shown anti-inflammatory effects in a variety of rheumatological conditions[15]. The extract was found to decrease the glycosaminoglycans content in the granuloma tissue by almost 100 percent and uncoupled the oxidative phosphorylation by significantly reducing the ADP/O ratio in mitochondria of granuloma tissue and increased the Mg²⁺ dependent-ATPase enzyme activity and subsequent reduction in succinate dehydrogenase activity in the mitochondria of the granuloma tissue. The studies relate that cyclooxygenase inhibition may be involved in the mechanism of action of *W. somnifera*[16].

Antioxidant Effects

The brain and nervous system are relatively more susceptible to free radical damage than other tissues because they are rich in lipids and iron, both known to promote the generation of reactive oxygen species[17]. Free radical damage of nervous tissue may be responsible for neural loss in cerebral ischemia and may be involved in aging and neurodegenerative diseases, e.g., epilepsy, schizophrenia, Parkinson's, Alzheimer's and other diseases[18]. The active principles of *W. somnifera*, sitoindosides VII-X and withaferin A (glycowithanolides), are reported to increase levels of endogenous superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPX), and ascorbic acid, with a concomitant decrease in lipid peroxidation. A decrease

in the activity of these enzymes is known to lead accumulation of oxidative free radicals and resulting in degenerative effects[19].

Antistress and Aphrodisiac Activity

Anti-stress activity is associated with glycosides (sitoindosides VII and VIII) present in this plant. The studies conducted by lent support to the usefulness of ashwagandha as an antistress adaptogen[20]. Ashwagandha is also used as a tonic in the treatment of spermatopathia, impotence and seminal depletion and the men who used the herb enjoyed higher vigour performance[21] . The higher concentrations of inorganic elements like Fe, Mg, K and Ni in the roots of this plant play a significant role in the diuretic and aphrodisiac activity of the drug. The decoction of the root boiled with milk and ghee is recommended for curing sterility in women[22].

Anti-arthritic Properties

Ashwagandha powder has been found useful in acute rheumatoid arthritis and reduces the discomfort associated with arthritis. This property has been attributed to the active principle *withaferin A*. Hypotensive effect due to autonomic ganglion blocking action as well as a depressant action on the higher cerebral centers are associated with the extracts of *W. somnifera* . Recently *W. somnifera* was confirmed to be a cardio-protective agent that provides a scientific reason for rationale of the use of this medicinal plant in Ayurveda as Maharashtra[23] .

Effect on Nervous System

Ashwagandha is reported to have the sedative rather than stimulative action on the central nervous system, making it a superior medicine in exhaustion with nervous irritability. Ashwagandha alters the concentration of neurotransmitters that are known to play an important role in brain processes such as memory. The effects on nervous system are associated with Ashwagandholine (root extracts). It potentiates barbiturate-, ethanol- and urethane- induced hypnosis and caused relaxant and antispasmodic effects against various agents that produce smooth muscle contractions in intestinal, uterine, tracheal and vascular muscles[24].

W. somnifera also show an anti-parkinsonian effect on neuroleptic-induced catalepsy by inhibiting haloperidol or reserpine-induced catalepsy attributed to potent antioxidant, anti-peroxidative and free radical quenching properties[25].

Rejuvenating Effect

W. somnifera was reported to possess growth-promoting effect when administered alone in powdered form or in combination with other drugs. The growth promoting activity is attributed to withanolides[26] .

Hypoglycemic and diuretic effects of ashwagandha roots were also assessed in humans. A decrease in blood glucose comparable to that of an oral hypoglycemic drug was observed. Significant increases in urine sodium, urine volume, and decreases in serum cholesterol, triglycerides, and low-density lipoproteins were also recorded[27].

IV. Conclusion

Medicinal plants maintain the health & vitality of individuals & also cure disease, without causing toxicity. The available scientific data support the conclusion that Ashwagandha is a real potent regenerative tonic, due to its multiple pharmacological actions like anti-stress, neuroprotective, antitumor, anti-arthritic, analgesic and anti-inflammatory etc. It is useful for different types of diseases like Parkinson, dementia, memory loss, stress induced diseases, malignoma and others. Thus, the above findings clearly indicate that the traditional use of Ashwagandha has a logical and scientific basis. Although the results from this review are quite promising for the use of this plant as a multi-purpose medicinal agent. Scientific research is required in the field of its rapid and high production. Also molecular profiling of the plant needs to be done. Novel methods are to be developed to increase the phytochemical content of the plant.

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