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## ASHWAGANDHA - A POTENT REGENERATIVE TONIC: SCIENTIFIC REVIEW AND UPDATE

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### ABSTRACT

*Ashwagandha is also known Indian ginseng, or winter cherry. It is one of the important herbs in the Ayurvedic and indigenous medical systems of medicine since long time. The roots of the plant are categorized as Rasayanas and described to promote health and longevity by augmenting defenses against disease, arresting the ageing process, revitalizing the body in debilitated conditions, and thus creating a sense of wellbeing. Ashwagandha contains mainly alkaloids (withanine, withasomnin, steroidal lactones (Withanoloids), and glycosides (Sitoindosides). It possesses analgesic, mildly sedative, anti-inflammatory and anabolic activities, and it is useful in stress, strain, fatigue, pain, skin diseases, diabetes, gastrointestinal disease, rheumatoid arthritis, and epilepsy, chronic fatigue syndrome and even during pregnancy without any side effects. The present review describes the general pharmacognostic features, phytochemistry, biopotential, methods of analysis, market potential and regulatory status of Ashwagandha.*

**Keywords** – Ashwagandha, *Withania somnifera*, Roots, Indian Ginseng, Ayurveda.

### 1. INTRODUCTION

Ashwagandha (*Withania somnifera*, family-Solanaceae) is commonly known as “Indian Winter cherry” or “Indian Ginseng”. Ashwagandha (*Withania somnifera*) is widely used in *Ayurveda*, a traditional system of medicine in India, and is considered an “adaptogen,” an herb that protects the body from stress and helps the body address the effects of stress. Ashwagandha has been shown to decrease cortisol levels in persons under chronic stress, restore healthy adrenal function, and normalize the sympathetic nervous system<sup>1,2</sup>. Ashwagandha possesses analgesic, mildly sedative, anti-inflammatory and anabolic activities, and it is useful in stress, strain, fatigue, pain, skin diseases, diabetes, gastrointestinal disease, rheumatoid arthritis, and epilepsy, chronic fatigue syndrome and even during pregnancy without any side effects. Ashwagandha root extract is used to treat sexual weakness, erectile dysfunction, and performance anxiety in men and has been advocated to ameliorate diminished sexual desire in women and in all forms of sexual dysfunction<sup>3-6</sup>.

It is one of the most important herbs of Ayurvedic system of medicine and is used for millennia as a Rasayana for its wide-ranging health benefits. *Rasayana is described as an herbal or metallic preparation that promotes a youthful state of physical and mental health and expands happiness.* These types of remedies are given to small children as tonics and are also taken by the middle-aged and elderly to increase longevity. Among the ayurvedic Rasayana herbs, Ashwagandha holds the most prominent place. It is known as “Sattvic Kapha Rasayana” Herb. Most of the Rasayana herbs are adaptogen / anti-stress agents.

Ashwagandha is commonly available as a churna, a fine sieved powder that can be mixed with water, ghee (clarified butter) or honey. It enhances the function of the brain and nervous system and improves the memory. It improves the function of the reproductive system promoting a healthy sexual and reproductive balance. Being a powerful adaptogen, it enhances the body's resilience to stress. Ashwagandha improves the body's defense against disease by improving the cell-mediated immunity. It also possesses potent antioxidant properties that help protect against cellular damage caused by free radicals <sup>7,8</sup>.

The present review describes the general pharmacognostic features, phytochemistry, biopotential, methods of analysis, market potential and regulatory status of Ashwagandha.

## **2. 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 <sup>9</sup>.

## **3. BOTANICAL CHARACTERS**

The botanical characteristics of the Ashwagandha root are as follows:

### **3.1 Macroscopic / Organoleptic Characters**

Ashwagandha roots (Fig. 1) are 10-20 cm long and 6-12 mm in diameter, with a few (2 to 3) lateral roots of slightly smaller size; straight, unbranched.

**Color:** Yellowish brown or light brown. Outer surface is buff to gray yellow with longitudinal wrinkles and in the center soft, solid mass with scattered pores.

**Odor:** Characteristic.

**Taste:** Bitter and acrid <sup>10</sup>.

### **3.2 Microscopic Characters**

#### **3.2.1 Transverse section**

The cork cells isodiametric and nonlignified. Intercellular spaces are present in the phloem parenchyma while it is absent in xylem parenchyma. Simple, reniform and oval starch grains found in the parenchyma of the cortex and vascular region.

The young roots have less secondary tissue and prominent cortex. Primary xylem is tetrarch. In matured roots, the cork cells are isodiametric and non-lignified. As the roots increase in diameter it produces more secondary tissue which has more of ray parenchyma cells.

The cells are nearly square in shape and in rows. Cells are filled with starch grains, small vascular bundles with one or two vessels and few fibers found in the secondary xylem. Intercellular spaces are present in phloem parenchyma while it is absent in xylem parenchyma. Fibers absent in phloem and present in xylem. Starch grains, simple, reniform and oval, normally found in parenchyma of the cortex and vascular region.

**3.2.2 Powder:** Nearly white in color, xylem vessels with scalariform and pitted thickenings. Xylem parenchyma is having bordered pits. Plenty of starch grains varying in size, circular or oval in shape, singular and sometimes compound, 2-3 grains <sup>11-13</sup>.

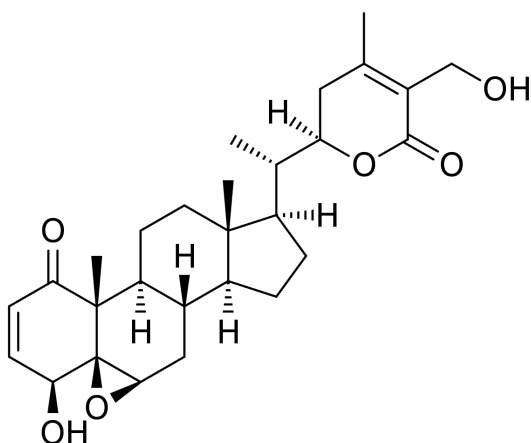


**Fig. 1: Photograph of Ashwagandha roots**

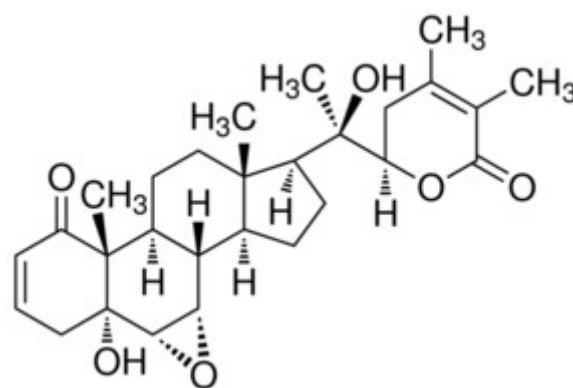
#### 4. PHYTOCHEMISTRY

The active chemical constituents of Ashwagandha include alkaloids (isopelletierine, anafierine, cuseohygrine, anahygrine, etc.), steroidal lactones (withanolides, withaferins) and saponins <sup>14</sup>. Sitoindosides and acylsterylglucosides in Ashwagandha are anti-stress agents. Active principles of Ashwagandha, for instance the sitoindosides VII-X and Withaferin-A, have been shown to have significant anti-stress activity against acute models of experimental stress <sup>15</sup>. Many of its constituents support immunomodulatory actions <sup>16</sup>. The aerial parts of *Withania somnifera* yielded 5-dehydroxy withanolide-R and withasomniferin-A <sup>17</sup>.

Majority of the constituents are Withanolides, steroidal lactones with ergostane skeleton include withanone, withaferin A, withanolides-I, II, III, A, D, E, F, G, H, I, J, K, L, M, WS-I, and S, withasomidienone, withanolide-C and alkaloids (total 0.2%) e.g. cuseohygrine, anahygrine, tropine, pseudotropine, anafierine, isopelletierine, 3-tropyltigloate <sup>18-22</sup>. The chemical structure of Withaferin-A and Withanolide-A are represented in Fig. 2 and Fig.3.



**Fig. 2. Chemical structure of Withaferin-A**



**Fig. 3: Chemical structure of Withanolide-A**

## 5. BIOPOTENTIAL OF ASHWAGANDHA

Being the most used and extensively studied adaptogen, a large volume of literature is available for Ashwagandha <sup>23</sup>. This herb has been studied as adaptogenic, antioxidant, anticancer, anxiolytic, antidepressant, cardioprotective, thyroid modulating, immunomodulating, antibacterial, antifungal, anti-inflammatory, neuroprotective, cognitive enhancing and hematopoietic agent. *Ashwagandha* contains a range of constituents like withanolides, sitoindosides and other alkaloids that are pharmacologically and medicinally important. These chemicals protect cells from oxidative damage and disease <sup>24-27</sup>. Results from a battery of tests, conducted to identify the anti-stress activity of sitoindoside VII and sitoindoside VIII implied that both sitoindosides produce anti-stress activity. Sitoindoside IX and X were tested in rats for immunomodulatory and central nervous system effects related to stress, memory, and learning. A significant reduction was noticed in the incidence of stress-induced gastric ulcers <sup>15,16</sup>.

The leaves are bitter and are recommended in fever, painful swellings. The flowers are astringent, depurative, diuretic and aphrodisiac. The seeds are anthelmintic and combined with astringent and rock salt remove white spots from the cornea. *Ashwagandharishta* prepared from it is used in hysteria, anxiety, memory loss, syncope, etc. It also acts as a stimulant and increases the sperm count <sup>28</sup>.

The root in combination with other drugs is prescribed for snake venom as well as in scorpion-sting. It also helps in leucorrhoea, boils, pimples, flatulent colic, worms, and piles <sup>29</sup>.

## 6. ANALYSIS OF ASHWAGANDHA

Various analytical methods have been reported in previously published literatures for qualitative and quantitative analysis of various phytoconstituents of Ashwagandha. Analytical methods for Estimation of Withaferin A are discussed below:

*Gauttam and Kalia* <sup>30</sup> developed HPTLC method for simultaneous estimation of vicine, trigonelline and withaferin A using silica gel 60 F-254 aluminium backed TLC plates of 0.2mm layer thickness as stationary phase pre-derivatized with 0.02M sodium acetate and n-butanol:acetic acid: water (5:1:5) as mobile phase, scanned at wavelength of 235nm. The linearity was in the range of 100-600ng/band with correlation coefficient of 0.999.

*Rajendra et al.* <sup>31</sup> carried out HPLC estimation of withaferin – A and boswellic acid using Lichosorb C18 RP column (250x4.6mm, 5µm particle size) as stationary phase and acetonitrile: methanol: orthophosphoric acid (55:45:1) as mobile phase at flow rate of 1.2ml/min and monitored at 224nm. The gel shows the presence of about 95-105% of the amount of withaferin A in them against 100% of expected value.

*Chaurasiya et al.* <sup>32</sup> developed RP-HPLC method for the simultaneous analysis of nine withanolides using a linear binary gradient solvent system comprising methanol and water containing 0.1% acetic acid. Both photodiode array and evaporative light scattering detection were used to profile the extract compositions and to quantify the withanolides therein. The method has been validated with respect to various parameters of performance with correlation coefficient of 0.950.

## 7. MARKET

### 7.1 Importance in the trade

In the US market, the vast majority of ashwagandha supplements are sold in the Natural Channel. Sales in the two major retail channels combined have steadily increased from an estimated US \$4.53 million in 2014 to an estimated \$12.24 million in 2017, corresponding to an annual sales increase of ca. 39% <sup>33</sup>.

## 7.2 Market dynamics

While ashwagandha has a longstanding history of use in traditional Indian medicine systems, interest in the benefits of ashwagandha roots and root extracts in Australia, Europe, and North America has only recently started to emerge. Sales of ashwagandha dietary supplements have seen double-digit growth over the past years (Table 1). Current growth is said to be driven by the increased awareness of benefits, such as stress relief and increase in energy, and the increased support of benefits from published clinical studies. The increasing demand has created pressure for increased cultivation, which is lagging the demand, according to a 2015 review article on conservation and sustainability of the plant <sup>34,35</sup>.

## 8. REGULATORY STATUS OF ASHWAGANDHA

As per United States Pharmacopoeia (USP), Ashwagandha Root is the dried mature roots of *Withania somnifera* (L.) Dunal (Fam. Solanaceae). It contains NLT 0.3% of withanolides, calculated on the dried basis as the sum of withanolide aglycones, calculated as withanolide A, and withanolide glycosides, calculated as withanoside IV.

Presently Ashwagandha root, powder, extracts and its formulations like-Capsules, tablets are widely used. In India it is used as ayurvedic medicines, food supplements and has traditional use also. Ashwagandha is used as Food supplement in EU, as Dietary supplement in USA. Standard of the drug varied widely country to country e.g. Total alkaloids content is not less than 0.2 percent as per monograph as mentioned in The Ayurvedic Pharmacopoeia of India where as withanolide content is not less than 0.3 percent as per USP monograph of Ashwagandha Root.

Monograph of Ashwagandha Root (*Withania somnifera*) as prescribed in the American Herbal Pharmacopoeia is quite exhaustive including Analytical, Quality Control and Therapeutic Monograph. The monograph includes full nomenclature and history; macroscopic and microscopic identification; commercial sources and cultivation; and analytical guidance and information on constituents. Monograph of Ashwagandha Root was published in The Ayurvedic Pharmacopoeia of India and The Herbal Pharmacopoeia which are required to be more exhaustive <sup>36,37</sup>.

## 5. CONCLUSION

Ashwagandha is a commonly used herb in Ayurvedic system of medicine. The extensive survey of literature revealed that Ashwagandha is an important source of many pharmacologically and medicinally important phytoconstituents. Literature survey revealed that ashwagandha possesses antioxidant, anxiolytic, adaptogen, memory enhancing, antiparkinsonian, antivenom, anti-inflammatory and antitumor properties. Various other effects like immunomodulation, hypolipidemic, antibacterial, cardiovascular protection, sexual behavior, 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.

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