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Review Article

# Stress relieving activity of *Withania Somnifera*

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ABSTRACT

*Withania somnifera* is a valuable medicinal plant in the Solanaceae family. It is commonly known as *Ashwagandha,* Indian ginseng, Winter Cherry and is widely distributed around the globe. The plant is used traditionally for its ameliorative properties against a human medical condition like cancer, diabetes, asthma, hypertension, stress, etc. Stress is a state of mental or emotional strain or tension, which can lead to underperformance and adverse clinical changes. *Ashwagandha* is considered a potent adaptogen and anti-stress agent that could has some potential to improve the physical and mental condition of a person. This review mainly focuses on anti-stress property of *Withania somnifera*.



## 1. Introduction

*Withania somnifera (WS)* also called by Ashwagandha, Indian ginseng and winter cherry. The literal meaning of *Ashwagandha* is Smell of Horse, is so named for two reasons. One; the fresh root emits the smell of horse and second; there is a commonly held belief that a person consuming extracts of the herb may develop the strength and vitality similar to that of a horse. It has been an important herb in the Ayurvedic and indigenous medicinal systems for over 3000 years. And it is referred as royal herb because of its multifarious rejuvenating effect on the human body.[1,2]

Stress is a condition arising from external physical or mental overload. It can make a person feel anxious, nervous, or otherwise less capable of full and normal response to environmental demands. Prolonged exposure to stress can imbalance the mental and physiological state of a person, thereby leading to other illnesses like depression, high blood pressure, cardiac diseases and metabolic disorders.[2] Adaptogens are herbs that improve an individual's ability to cope with stress. These herbs in times of increased stress, normalize the physiological process of the body and help the body adapt to changes. A recent definition of an adaptogen is, "a class of metabolic regulators, which increase the ability of an organism to adapt to environmental factors and avoid damage from such factors".[3]

### 1.1. Taxonomy of Withania somnifera (WS)

1. Kingdom: Plantae
2. Subkingdom: Tracheobionta
3. Super-division: Spermatophyta
4. Division: Angiospermae
5. Class: Dicotyledons
6. Order: Tubiflorae
7. Family: Solanaceae
8. Genus: *Withania*
9. Species: S*omnifera Dunal.*[1]

### 1.2. Botanical description

WS is a small woody shrub that grows up to two feet in length and is found throughout drier parts of India. Roots are stout, fleshy, whitish brown and are the main

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parts of the plant used therapeutically. Leaves are simple, ovoid, hairless or smooth, those in the floral region smaller and opposite; flowers are inconspicuous, greenish or lurid-yellow, in axillary, umbellate chymes; berries are small, globose, orange-red when mature, enclosed in the persistent calyx; seeds yellow, reniform. Fruits are bright red harvested in the late fall, and seeds are dried for planting in the following spring.[4]

#### *1.2.1. Parts used*

Whole plant, roots, leaves, stem, green berries, fruits, seeds, bark are used.[4]

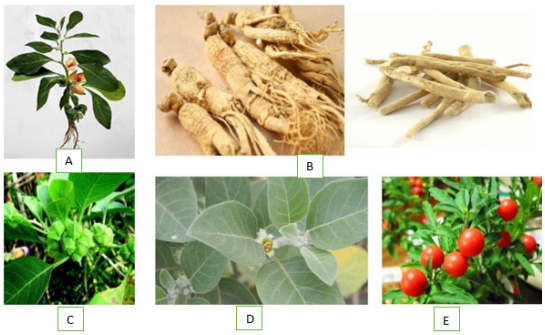


**Fig. 1:** (a) *Withania somnifera* plant (b) Root (c) Green berries (d) Leaves (e) Fruits[5]

### *1.3. Vernacular names*

**Table 1:** Vernacular names of *Withania somnifera.*[6]

| Languages | Names |
|---|---|
| Kannada | Angaberu |
| English | Winter cherry |
| Hindi | Asgandh, Punir |
| Sanskrit | Ashvagandha, Gandhrapatri, Turangigandh |
| Tamil | Amukkaram kizargu Amukkuran, Kilangee, Amukkira |
| Telgu | Pannerugadda, Pulivendram |
| Urdu | Asgand Nagori |
| Bengali | Ashvagandha, Asvagandha |
| Gujarati | Asgandha, Asundha, Asana, Ghodakun |
| Marathi | Askagandha, Askandhatilli |
| Arabic | Kakanj Hindi |
| Persian | Asgandh nagori, Kaknjae Hindi |

## 2. Distribution

WS is the most widespread species in the genus, found naturally in drier regions extending from the Mediterranean through tropical Africa, South Africa and from the Cape Verde Islands to the Middle East, Canary and Arabia, Afghanistan, Baluchistan, Pakistan, Sri Lanka, China, Nepal, and India. In India, the plant is widely distributed in the drier parts, especially in Gujarat, Maharashtra, Punjab, Uttar Pradesh, Rajasthan and West Bengal. In the warmer parts of Europe, the plant is cultivated in gardens and has become a naturalized weed in South Australia and New South Wales.[7–9]

### *2.1. Nutritional composition*

**Table 2:** Nutritional composition of dehydrated *Ashwagandha.* $[10]

| Nutrients | Amount |
|---|---|
| Energy (kcal) | 216 |
| Carbohydrate (g) | 49.9 |
| Protein (g) | 3.9 |
| Fat (g) | 0.3 |
| Crude fiber (g) | 32.3 |
| Ash (g) | 4.41 |
| Moisture (%) | 7.45 |
| Iron (mg) | 3.3 |
| Calcium (mg) | 23 |
| Total-carotene ($\mu$g) | 75.7 |
| Vitamin – C (mg) | 3.7 |

[Proximate analysis, minerals, and vitamin content of dehydrated medicinal herbs powder per 100 g].

### *2.2. Phytochemistry*

The laboratory investigation has concluded that root of *WS* contains over 35 phytoconstituents[11] and Withanolides is a group of steroidal lactones which is responsible for pharmacological activity of root of *WS.*[12] Phytochemical analysis has discovered the existence of diverse chemical constituents in different parts of *W. somnifera.* The root contains Reducing sugar, Starch, Glycosides, Withaniol acid and eight bases such as Withanine, Withananine, Withananinine, Pseudowithanine, Withasomnine, Somniferine, Somniferinine and Somnine. The Fresh WS plant contains Palmitic acid, Myristic acid, Linoleic acid, Hextriacontane, Volatile oils, Fatty acids, and fatty alcohols.[13–15]

**Table 3:** Chemical constituents present in different parts of *Withania somnifera*[16].

| Sl no. | Compounds | Chemical constituents |
|---|---|---|
| 1 | Alkaloids | Withanine, Withaninine, Pseudo-Withanine, Withasomine, Somniferine, Tropeltigloate, Somniferinine, Somninine, Nicotine, Tropine, Pseudo-Tropine, 3-a-gloyloxytropine, Choline, Cuscohygrine, Isopelletierine, Anaferine, Anahydrine, Scopoletin, Visamine |
| 2 | Steroids | Cholesterol, b-sitosterol, Stigmasterol, Diosgenin, Stigmastadien, Sitoinosides (VII, VIII, X, X) |
| 3 | Steroidal lactones | Withaferin A, Withanone, Withanolide (A, E, F, G, H, I, J, K, L, M |
| 4 | Flavonoids | Quercetin, Kaempferol |
| 5 | Salts | Anahygrine, Anaferine, Cuscohygrine, Pseudotropine, Tropine |
| 6 | Nitrogen-containing compounds | Somnitol, Somnisol, Withanol |

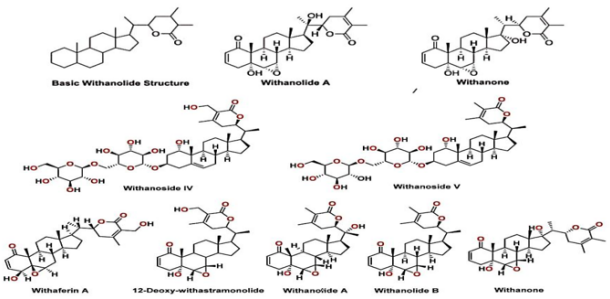


**Fig. 2:** Chemical constituents present in different parts of Withania somnifera[17].

## 2.3. Stress relieving activity of Withania somnifera

### 2.3.1. Human studies

Chandrasekhar et al., described a prospective, randomized double-blind, placebo-controlled study of safety and efficacy of a high-concentration full-spectrum extract of *Withania somnifera* root in reducing stress and anxiety in adults. Adults with perceived stress scale score (PSS) = 14 were treated with high-concentration full-spectrum WS root extract in the form of capsule (300 mg) twice a day for 60 days. On $60^{th}$ day the measurements of morning serum cortisol and stress scale responses were performed and evaluated. The results of the study showed a significant reduction (P<0.0001) in scores on all the stress-assessment scales and substantially reduction in serum cortisol level.[18]

Remenapp et al., described the efficacy of WS supplementation on adult's cognition and mood. Adults with PSS = 14 were treated with WS root and leaf extract (400 mg/d) for 30 days. The results of the study showed that, supplementation (400 mg/day) was safe and it had a positive effect on the participants' cortisol levels, cognitive ability, and self-reported stress, anxiety, depression, and food cravings.[19]

Kumarpillai Gopukumar et al., evaluated the effect of WS root extract on cognitive functions, stress levels, sleep quality, overall well-being, and safety in stressed subjects. Adults having a PSS score of 14 - 24 were treated with one capsule (300 mg) containing aqueous alcohol root extract of *WS* daily after breakfast for 90 consecutive days. The results of the study showed the reduction in PSS score and morning serum cortisol level ($\mu$g/dL).[20]

Deepak Langade et al., described the efficacy and safety of WS root extract in the adults having Insomnia and Anxiety. Insomnia and Anxiety. Adults with PSS > 20 were treated with a capsule containing highest concentration full-spectrum WS root extract 300 mg twice a day with milk or water for 10 weeks. After 10 weeks of treatment, results showed the significant reduction in Hamilton Anxiety Rating Scale (HAM – A) which was used to determine the anxiety and improvement in sleep quality.[21]

Lopresti et al., described an investigation into the stress-relieving and pharmacological actions of an WS ethanol: water extract. Adults with HAM – A is equal to 6 – 17 were treated with 240 mg of a WS extract once in a day for 60 days. Outcomes were measured using the HAM - A, Depression, Anxiety, and Stress - 21 (DASS - 21), and hormonal changes in cortisol and testosterone. The results of the study showed that, WS supplementation was associated with a statistically significant reduction in the HAM - A and a near-significant reduction in the DASS - 21 and was also associated with greater reductions in morning cortisol (P < .001) and decreased in male's testosterone level Table 4.[22]

## 2.4. Animal studies

Priyanka et al., described on adaptogenic and immunomodulatory activity of WS root extract. Kathiawari horses were selected and were given with dose of Ashwagandha root extract (10 gm/animal) with jaggery along with normal diet for 21 days. All horses were subjected to different types of stress on $14^{th}$ day including exercise-induced stress, separation, and noise stress on three different days and similar feeding of the horses were continued till the $21^{st}$ day. Blood sample was collected in heparinized vials from the horses and evaluated, the results of the study showed the decrease in cortisol and epinephrine level and an increase in serotonin.[23]

**Table 4:** The stress relieving activity of *Withania somnifera* root extract on humans.

| Sl. No. | Model | Treatment | Result | Reference |
|---|---|---|---|---|
| 1. | Adults (♀ ♂ ) Age: 18 - 54 yrs PSS = 14 (n = 32) | WSE – (HCFS) 300 mg capsule - 2/d 60 d | ↓ Stress<br>↓ Anxiety<br>↓ Depression<br>↓ Cortisol<br>↓ PSS = 6.16 | 18 |
| 2. | Adults (♀ ♂) Age: 18 – 54 yrs PSS = 14 (n = 20) | WSE - (Aq) 400 mg capsule - 1/d 30 d | ↓ Cortisol<br>↓ Anxiety<br>↓ Depression<br>↓ Food craving<br>↑ Cognitive ability | 19 |
| 3. | Adults (♀ ♂) Age: 20 – 55yrs PSS = 14 – 24 (n = 65) | WSE – (Aq alcohol) 300 mg capsule - 1/d 90 d | ↓ PSS (P < 0.0001)<br>↓ Cortisol (9.01 $\mu$g/dl) | 20 |
| 4. | Adults (♀ ♂) Age: 18 – 55years PSS > 20 (n = 20) | WSE - (HCFS) 300 mg capsule - 2 /d 10 weeks | ↑ Sleep quality<br>↓ HAM-A | 21 |
| 5. | Adults (♀ ♂) Age: 18 – 65yrs HAM-A = 6 -17 (n = 30) | WSE – (Ethanol: Water) 240 mg capsule - 1/d 60 d | ↓ HAM-A<br>↓ DASS-21<br>↓ Cortisol<br>↓ Testosterone in ♂ | 22 |

[WSE – *Withania somnifera* extract, PSS – Perceived stress scale score, SC – Serum cortisol, HAM -A Hamilton Anxiety Rating Scale and DASS - 21 - Depression, Anxiety, and Stress Scale - 21, Aq – Aqueous, HCFS – High concentration full spectrum, d – Days, yrs – years, mg - Milligrams].

Archana et al., studied on Antistress effect of WS root**.** The adult Wistar strain rats (n=6) were given with *WS* root extract drug at 100 mg/kg for 7 days. They were subjected to cold water swimming stress. Animals were anesthetizing with ether to collect blood sample; to avoid further stress the blood samples were collected from the jugular vein in heparinised syringes for the estimation of plasma corticosterone. The results of the study showed that, there was a decrease in plasma cortisol and increase swimming time which indicates better stress tolerance.[24]

**Table 5:** The stress relieving activity of *Withania somnifera* root extract on animals.

| Sl. No. | Model | Treatment | Result | Reference |
|---|---|---|---|---|
| 1. | Kathiawari horse (♀ ♂) Age: 5 – 10 yrs Stressed on $14^{th}$ d of treatment | WSE – (HCFS) 10 gm/animal – oral with jaggery 21 d | ↓ Cortisol<br>↓ Epinephrine<br>↑ Serotonin. | 23 |
| 2. | Adult wistar strain albino rats (♀ ♂) (n = 6) Cold water induced stress after the treatment. | WSE – (Aq) 100 mg/kg bw drug oral by intragastric intubation 7 d | ↓ Plasma cortisol<br>↑ Swimming time | 24 |

[WSE – *Withania somnifera* root extract, bw – Body weight, HCFS – High concentration full spectrum, Aq – Aqueous suspension, d – Days, yrs – years, mg – Milligrams, kg – kilograms, gm - grams].

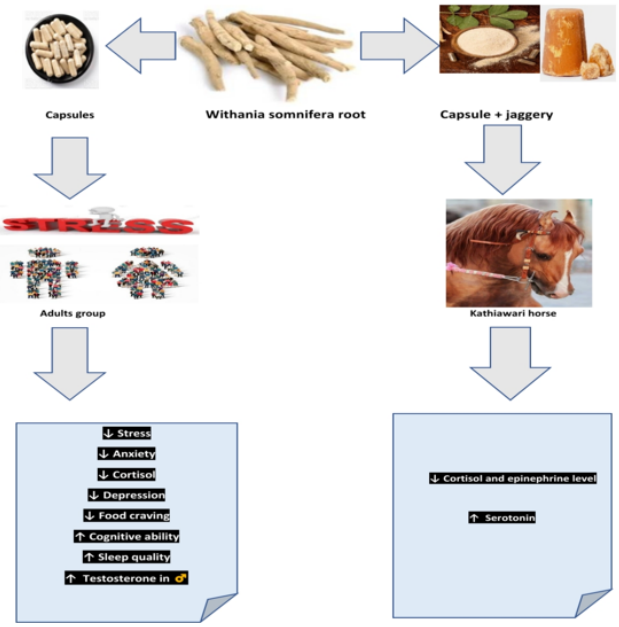


**Fig. 3:** Schematic representation of stress relieving activity of *Withania somnifera.*

## 3. Conclusion

*Withania somnifera* also called as Indian winter cherry, Indian ginseng and *Ashwagandha* is one of the most important herbs used in India as a traditional medicine, with a variety of medicinal effects attributed to its use. It contains various alkaloids, steroidal lactones, and saponins, and has been used for its purported antistress/adaptogenic, antitumor, tonic, anxiolytic, anti-inflammatory, and antiarthritic properties.

The above finding (Tables 4 and 5) suggests that high-concentration full spectrum *Ashwagandha* root extract improves an individual's resistance towards stress and thereby improves self-assessed quality of life. Thus high concentration full-spectrum *Ashwagandha* root extract can be used safely as an adaptogen in adults who are under stress.

## 4. Source of Funding

None.

## 5. Conflict of Interest

None.

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