

## ASWAGANDHA - A CRITICAL REVIEW

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### ABSTRACT

**Objective:** The objective of this paper is to compile the information on *Aswagandha* from various Ayurvedic textbooks, research papers and reports. **Design:** This review is in a descriptive format and consists of all relevant publications on *Aswagandha* that were identified through an organized search in major computerized medical databases and Ayurvedic texts. The therapeutic properties are compiled based on the useful part and important chemical constituents. **Results:** Studies indicate that *Aswagandha* possesses properties such as anti-inflammatory, anti-tumor, anti-stress, antioxidant, immunomodulatory, hepatoprotective, anti-parkinsonism, hemopoetic effects. It also exerts a positive influence on the endocrine, cardiopulmonary, and central nervous systems. Toxicity studies reveal that *Aswagandha* appears to be a safe compound. **Conclusion:** Preliminary studies have established *Aswagandha*, *Withania somnifera* exhibit a range of therapeutic effects with little or no associated toxicity. These results are quite inspiring and indicated the need of further extensive studies on this herb to confirm these properties and other potential therapeutic effects.

**Keywords:** *Aswagandha*, *Withania somnifera*, anti-inflammatory, antiparkinsonism, antioxidant, anti-stress.

### INTRODUCTION

Nature acts as a major repository for new and novel therapeutics<sup>1</sup>. According to the World Health Organization (WHO) report, about 4 billion people of the world presently use herbal medicines for their primary healthcare as an alternative system of medicine<sup>2</sup>. Ayurvedic classics have a unique source of medicinal plants and immense traditional knowledge of herbal medicine for the treatment of various diseases<sup>3</sup>. *Aswagandha* is an important drug mentioned in the Ayurvedic literature with enormous medicinal value. The roots of the plant are described with *rasayana karma*, which are proved to promote health and longevity by enhancing the defense mechanism, slowing

the ageing, rejuvenating the body in debilitated conditions and by creating a sense of mental wellbeing<sup>4</sup>.

*Aswagandha* is also mentioned in *Samhitas* such as *Charaka Samhita*, *Susruta Samhita* and *Nigantus* viz., *Astanga Nigantu*, *Dhawanthari Nigantu*, *Sodhala Nigantu* on their therapeutic applications. The objective of this paper is to review the available literature on *Aswagandha* (*Withania somnifera*) which have a proven therapeutic potential. Present study compiled the ayurvedic literatures, taxonomical features, phytochemistry, and pharmacological properties of this drug.

**Aswagandha****Basonym**

*Aswagandha-* *aswagandhasyevagandho*  
*asyaadhavaaswasyevagandhotsaah:* (kaamavega:)  
*sevanenasa*<sup>5</sup> |

Having smell like that of horse and promotes sexual potency like that of horse.

**Main synonyms and Interpretation**

*Asakandha-* *aswasyamedramivakandamoolasya*<sup>5</sup> | - Root resembles penis of aswa; *Aswaavarohaka:- aswagandhaavruksha:*<sup>5</sup> | - Having smell like that of horse and promotes sexual potency like that of horse; *Kanchuka- kaci-pratibandhanayo:*<sup>5</sup> | - Retains semen; *Kaamaroopini- kaamammanonjamroopamasyatasya*<sup>6</sup> | - Promotes complexion; *Gandhapatri- gandhayuktapatramasya*<sup>5</sup> | - Leaves having smell like that of horse; *Putrada- putramgarbhamdadatisevanenaiti*<sup>6</sup> | - Increases the potency and quality of sukra thereby increasing the chance of progeny; *Balada- balamdadati | poshtikebaladaasmruta*<sup>5</sup> | - Promotes strength; *Vrusha- prajananasaamarthyam*<sup>5</sup> | - Promotes sexual potency; *Hayahwaya- haya: hayagandhoasyataya aswa: | aswagandhaayam*<sup>5</sup> | - It is known by the title of horse because of having the smell of horse.

**Vargeekarana**

*Charaka Samhita- Balya, Brumhaneeya, Maduraskanda*<sup>7</sup>; *Susrutha Samhita- Urdwabhagahara*<sup>8</sup>; *Bhavaprakasa Nigantu- Gudoochyadi varga*<sup>9</sup>; *Kaiyadeva Nigantu- Oshadi varga*<sup>10</sup>; *Raja Nigantu- Satahvadi varga*<sup>11</sup>; *Madanapala Nigantu- Abhayadi varga*<sup>12</sup>; *Dhanvanthari Nigantu- Gudoochyadi varga*<sup>13</sup>; *Saligrama Nigantu- Godoochyadi varga*<sup>14</sup>; *Sodala Nigantu- Gudoochyadi varga*<sup>15</sup>; *Niganthu Adarsh- Kantakaryadi varga*<sup>16</sup>; *Priya Nigantu- Satapushpadi varga*<sup>17</sup>

**Taxonomy**<sup>19</sup>

**Order:** Tubiflorae; **Family:** Solanaceae; **Genus:** Withania; **Species:** somnifera

This plant is distributed throughout the dry areas of India, Balochistan, Ceylon- Mediterranean regions, Canaries and Cape of Good Hope. It is a perennial branched erect under shrub of 0.3-1.5 m height. Stem

is erect and branches are terrete, herbaceous above, woody below.

**Part Used-** Root, Leaves, seeds<sup>20</sup>.

**Dosage-** 3-6 g of the drug in powder form<sup>18</sup>.

**Important phytochemical constituents**

**Root-** The roots are reported to contain amino acids, alkaloids, volatile oil, steroids, starch, reducing sugars, hentriacontane, dulcitol, glycosides, withanol, an acid, and a neutral compound<sup>21</sup>; **Steroid alkaloids-** Roots contain steroidal alkaloids with variety of therapeutic efficacy such as isopelletierine, anaferine, cuscohygrine, anahygrine, tropine, pseudotropine, anaferine, isopelletierine, withananine, withananine, pseudo-withanine, somnine, somniferine, somniferine (Basic alkaloids), 3-trotylglolate (Neutral alkaloids), withanine, withasomnine, and visamine<sup>21</sup>; **Steroid lactones (withanolides)-** withanolides, withaferins<sup>22</sup>; **Free amino acids-** aspartic acid, glycine, tyrosine, alanine, proline, tryptophan, glutamic acid, and cystine<sup>23</sup>; **Others:** resin, fat, Iron, coloring matters, a reducing sugar, phytosterol, Ipuranol and a mixture of saturated and unsaturated acids.

**Leaves-** Contains 12 Withanolides, 5 unidentified alkaloids, many free amino acids, chlorogenic acid, glycosides, glucose, condensed tannins, and flavonoids<sup>23</sup>. Withanolides—a group of C28 steroids characterized by a 6-membered lactone ring in the 9-carbon atom side chain. Withanolides— Withaferin A[(4 $\beta$ ,5 $\beta$ ,6 $\beta$ ,22R)-4,27-Dihydroxy-5,6:22,26diepoxyergosta-2,24-diene-1,26-dione]<sup>23</sup>;

**Fruits-** The green berries contain amino acids, a proteolytic enzyme, condensed tannins, and flavonoids. They have a high fraction of free amino acids which include proline, valine, tyrosine, alanine, glycine, hydroxyproline, aspartic acid, glutamic acid, cystine and cysteine<sup>23</sup>; **Shoots-** The tender shoots are abundant in crude protein, calcium and phosphorous, and are not fibrous. They are reported to contain scopoletin<sup>23</sup>.

**Rasa panchaka**<sup>9, 10, 11, 12, 13, 16, 17</sup>

The Ayurvedic pharmacological properties of root were explained in the different Ayurvedic texts is described in the table 1

<b>Table. 1:</b> The Ayurvedic pharmacological properties of root explained in the different Ayurvedic texts							
Nigantu	Bp.N	R.N	P. N	Ni.R	D.N	Mp.N	Kai. Ni
Rasa	Tikta, Kashaya	Katu, tikta	Tikta	Kinchitkatu, tuvara	Kashaya, tikta	Tikta, kashaya	Tikta, kashaya
Guna				Laghu			
Veerya	Usna	Usna	Usna	Usna	Usna	Usna	Usna
Vipaka							
Karma	Vatakaphahara, balya, rasayani, atisukrala, sophia, switra, kshayahara	Vatahara, balya, kasa, swasa, kshayavrana hara	Vatahara, balya, vrushy, rasayani	Jaravyadhinasaka, dhaturudhikara, balada, kantiprada, sareerapushitikari, vrushya, vatakaphahara, swasa, kasa, vrana, swetakuhta, visha, krumi, sophia, kshata, kshaya, kantuhara	Vatakaphahara, visha, vrana, kshayahara, Kanti, veerya, balaprada	Vatakaphahara, balya, rasayani, atisukrala, sophia, switra, kshayahara	Vatakaphahara, vrushya, rasayani, Balapushtiprada, kasa, vrana, sophia, kandu, visha, switra, krumi, swasa, kshata, kshaya

### Specific action (mentioned in *Sarngadhara* and *Charaka samhita*)

*Sarngadhara- Sukrala*<sup>24</sup>

*Charaka- Balya, Brumhaneeya, Madura skanda*<sup>7</sup>

### Amayigaprayoga with details of administration

- In *Granthi, Ganda, Apaci*, the external application of paste of *aswagandha* is mentioned<sup>15</sup>.
- In *Swasa, Kshara* is advised to be taken with honey and ghee<sup>25</sup>.
- In *Granthivisarpa*, the part is advised to be applied with warm paste of *aswagandha*<sup>25</sup>.
- In *Vatavyadhi, ghruta* prepared with *kashaya, kalka* of *Aswagandha* along with *ksheera* is advised for *vatavyadhi, mamsavardhana* (*Cakradatta-Vatavyadhiadhikara*)<sup>26</sup>.
- In *Vandyatwa, Aswagandha kashaya* added with *milk* and *ghruta* is advised to be taken internally<sup>27</sup>.
- In *Karsya, Aswagandhachoorna* is advised to be given with *milk* or *ghrutaortaila* or *sukhambu* for one month<sup>28</sup>.
- In *Nidranasa choorna* of *Aswagandha* is advised to be given with *sita* and *sarpi*<sup>29</sup>.
- In *Kshaya, Aswagandhachoorna, pippali, sita* in equal quantities is advised to be taken internally with *ghruta* and *madhu*<sup>30</sup>.

### Important formulations in each Kalpana

Important formulations in the form of *kashaya, choorna, gulika* etc of *Aswagandha* are described below

**Kashaya-MaharasnadiKashaya,**

*AswagandadiKashayam*<sup>31</sup>, *Amrutadi Kashayam* (*Vatikaootrakruchra*)<sup>32</sup>;

**Choorna-**

*Aswagandhadichoorna, Rasnadichoorna*<sup>31</sup>;

**Gulika-** *Yogarajaguggulu*<sup>31</sup>;

**Lehyam-** *Jeerakadilehyam* (*1 niska, Rajayakshma*), *adanakameswarilehyam*

(*Chaturjatarasayana, Suklakara*),

*Madhusnuhirasayana* (*1 karsa, prabhatakalasevitam, deepanam, balapradam, sarvadhaturvivardhanam*)<sup>31</sup>;

**Arista-** *Aswagandharishtam* (*50 pala- Aswagandha, 1/2 pala- panam, Moorcha, apasmruti, sosha*)<sup>31</sup>,

*Balarisahtam* (*100 pala, vataroga*),

*Saraswatharishtam* (*1 karsha, sishyanamupakarartham dhanwatharinirmitham*)<sup>31</sup>;

**Asava-** *Lavangasava* (*1 pala, prameha, dhatukshaya*)<sup>31</sup>;

**Tailam-**

*Astadasatikaprasarnitailam* (*3 pala*),

*Ekadasatikaprasarinitaila* (*3 pala*),

*Trisatiprasarinitaila* (*100 pala, Vataroga, pumsatwa*),

*Saptasatikaprasarinitaila* (*100 pala, vividhavataroga*)

*Chandanaditaila, Triphaladitaila,*

*Dhanwantaramtaila* (*Sarvavatavikara*),

*Narayanataila* (*10 pala, vataroga*),

*Mahanarayanataila* (1/2 pala, vataroga), *Puvankuruntaladiavanakenna* (2 kazhanju, two times, swasa, jwara), *Prabhanjanavimardhanataila* (2 pala, Aseetivatarogansudarunan), *Balaaswagandhalakshaditaila* (Sarvajwara, unmada), *Mashaditaila* (1 karsa, vataroga, pakshaghata, ardita), *Mahamashaditaila* (Pakshaghata, hanustambha), *Lakshadi* (Sarvajwara, kshaya, unmada), *Vilwampachotyadienna* (Sarvaamayapaha).. *Kushtaditaila* (internal adm, urustambha)<sup>31</sup>;

**Ghrutam-** *Aswagandhadighrutam*, *Mahakushmandaghruta*, *Vastyamayanthakaghruta*, *varahyadighruta*, *Sasavasadighruta*, *Sarvaamayanthakaghruta*, *Sukumaramghruta*<sup>31</sup>;

**Taila-** *Narayanataila* (Aswagandha- 10 pala, Vataroga), *Lakshaditailam* (Aswagandha- 1 karsha), *Satavaritailam* (1/2 palam, Vandyatwa)<sup>31</sup>

### Substitutes and Adulterants

Classical substitute for *Kakoli* and *Ksheerakakoli*<sup>33</sup>.

### Research works

#### Toxicity studies

In acute toxicity studies, oral LD50 of *W.somnifera* was found to be >2000mg/kg body weight. The 14<sup>th</sup> day observation and weekly bodyweight assessment revealed no toxic effects in rats. There was no abnormal behaviour shown by the rats during these 14 days of observations<sup>34</sup>. In the sub-acute toxicity study, all the animals survived 28 days. Physical and behavioural examination did not reveal any treatment related adverse effects at the dose of 500mg/kg/day, 1000mg/kg/day and 2000 mg/kg/day<sup>34</sup>.

#### In- vitro studies

##### Root

#### Antibiotic activity

*W. somnifera* revealed the antibacterial activity against *Bacillus subtilis*, *E. Coli*, *P. Flourescens*, *E. Aerogens*, *K.pneumoniae*, *R.planticola* and *A. Tumefaciens*<sup>35</sup>

#### Anti-tumour Activity

The ethanolic extract of root showed invitro cytotoxicity against five human cancer cell lines such as PC-3, DU-145 (Prostrate), HCT-15 (colon), A-549 (lung), IMR-32 (neuroblastoma)<sup>36</sup>.

### Antioxidant and Free Radical Scavenging Activity

Antioxidant activity was evaluated by DPPH radical scavenging assay, ferrous reducing power, nitric oxide radical scavenging activity, Fe<sup>2+</sup> chelating activity assay, superoxide anion and hydrogen peroxide radical scavenging activity. The result of the study suggested that indigenous root showed more activity than the exported root<sup>37</sup>.

### Antimycobacterial

When tested by MIC method, aqueous extracts of different concentrations of *W. somnifera* revealed consistent reduction in activity against M.TB. It was observed that the increase in anti-mycobacterial activity by *W. somnifera* was dose dependent and the increase in anti-mycobacterial activity was significant in 3rd day and in which extends up to the 7th day. The highest antibacterial activity of M.TB was found in *W.somnifera* (1.0 mg/mL) which is 64.47% inhibition and least activity inhibits in lower dose of 0.01 mg/mL which observed 17.88%<sup>38</sup>.

### In- Vivo studies

#### Root

#### Anti-inflammatory activity

The effect of *W. somnifera* root powder with a dosage of 1000 mg/ kg, orally daily for 15 days revealed a reduction in the paw swelling and bony degenerative changes in Freund's adjuvant-induced arthritis in rats by radiological examination. The reductions were better than those produced by the reference drug, hydrocortisone (15 mg/kg)<sup>40</sup>.

#### Antitumour activity

Withaferin A, withanolide D & E exhibited significant antitumour activity in vivo against Ehrlich ascites carcinoma, Sarcoma 180, Sarcoma Black (SBL), and E 0771 mammary adenocarcinoma in mice with doses 10, 12, 15 mg/kg body-weight. Growth of Ehrlich ascites carcinoma was completely arrested in more than half the mice which survived for 100 days without the evidence of growth of the tumour<sup>41</sup>.

#### Immunomodulatory Activity

*Aswagandha* showed a significant modulation of immune reactivity in animal models. Root extract of *W.somnifera* was found to prevent myelo-suppression in mice treated with three immunosuppressive drugs viz. cyclophosphamide, azathioprin, and prednisolone.

Treatment with *Aswagandha* was found to significantly increase Hb concentration, RBC count, platelet count, and body weight in mice. Administration of *Aswagandha* extract was found to significantly reduce leucopenia induced by cyclophosphamide (CTX) treatment<sup>42</sup>.

#### **Anti-stress/Adaptogenic Activity**

Anti-stress effect of *W.somnifera* was studied in rats using cold water swimming stress test. Root powder was given in the dosage of 100 mg/kg orally as an aqueous suspension every day for consecutive seven days before the swimming test in water at 10°C. The swimming test also showed increase in total swimming time, indicating better stress tolerance in rats. The alcohol extract of *W. somnifera* (100 mg/ kg, two times daily orally on day 1, 4 or 7) lessened stress-induced increases in blood urea nitrogen levels, blood lactic acid, and adrenal hypertrophy, but did not affect changes in thymus weight and hyperglycemia in rats<sup>43</sup>.

#### **Anticonvulsant Activity**

Administration of *Aswagandha* root extract was found to lessen jerks and clonus in 70% and 10% animals respectively with a dosage of 100mg/kg and reduction was evident from EEG wave pattern. The protective effect of *Aswagandha* extract in convulsions has been stated to involve GABAergic mediation<sup>44</sup>.

#### **Hepatoprotective Activity**

Withaferin A at the dose of 10mg/kg exhibited significant hepatoprotective effect against CCl<sub>4</sub>-induced hepatotoxicity in rats<sup>45</sup>.

#### **Neuropharmacological Activity**

The root extract of *W. Somnifera* showed prolonged hypotensive, bradycardiac and respiratory stimulant activities in dogs. The total alkaloids produced a calming and a gentle depressant effect (tranquillizer-sedative type) on the CNS in several experimental animals<sup>46</sup>. The drug elevated the level of acetylcholine receptor capability in the cortical muscarinic indicates the cognition-enhancing and memory improving effects of extract from *W. Somnifera*<sup>47</sup>.

#### **Hypolipidemic effect**

*W. somnifera* root powder decreased total lipids, cholesterol and triglycerides in hypercholesteremic animals. It also significantly increased plasma HDL-cholesterol levels, HMG-CoA reductase activity and

bile acid content of liver. A comparable trend also stated in bile acid, cholesterol and neutral sterol excretion in the hypercholesteremic animals with WS administration<sup>48</sup>.

#### **Antiparkinsonism effect**

Rats were previously treated with the *W. Somnifera* extract orally for 3 weeks. On day 21, 6OHDA(6-Hydroxy dopamine) was infused into the right striatum. Three weeks after 6-OHDA injections, rats were evaluated for neurobehavioral activity. The animals were killed after 5 weeks lessening for the estimation of lipidperoxidation, reduced glutathione content, activities of glutathione-S-transferase, glutathione reductase, GPX, SOD and CAT, catecholamine content, dopaminergic D2 receptor binding and tyrosine hydroxylase expression. *W. Somnifera* extract inverted all the parameters significantly in a dose-dependent manner<sup>49</sup>.

#### **Clinical trial**

##### **Anti-ageing Effect**

Double-blind clinical trial was carried out to study the effect of *W. Somnifera* on the prevention of ageing in 101 normal healthy males in 50-59 years age group. Root powder at a dose of 0.5 g was given orally three times a day for 1 year. Results showed statistically significant increase in Hb, RBC, hair melanin, and seated stature in treated group in comparison to placebo group. Decrease in serum cholesterol was more in treated group than in placebo group<sup>46</sup>.

##### ***Ashwagandha (W. somnifera)* root powder supplementation on the vo2 max. and hemoglobin in hockey players**

Thirty two male hockey players, with a mean age of 17.4 ± 1.7 years and BMI 20.9 ± 2.9 kg/m<sup>2</sup> were undertaken for the study. Subjects were randomly allocated into two groups Group I (n=16):

*W. somnifera* group (experimental group) were given 500 mg capsules of aqueous roots of *Aswagandha* two times daily for eight weeks and Group II (n=16): Placebo (control) group., received starch capsules. VO<sub>2</sub> max. with 12 minute run test and hemoglobin (Hb) of both experimental and control groups were measured before and after the administration of *W. somnifera* and placebo respectively. A significant progress in the VO<sub>2</sub>max and hemoglobin was observed in experi-

mental group who received 500 mg capsules of aqueous roots of *Aswagandha* twice daily for eight weeks<sup>50</sup>.

#### Anti-stress activity

RCT was conducted with 130 participants, out of which 98 completed the study. Participants were randomly allocated into extract group and placebo group. Stress levels were assessed on 0, 30 and 60 day using modified Hamilton anxiety scale. Biochemical and clinical variables were noted on 0 and 60 day. The extract dose at 125mg QD showed significantly decreased Hamilton score, serum cortisol, serum CRP, pulse rate and blood pressure<sup>51</sup>.

#### Management of Sarcopenia

The participants of the RCT within the age group of 55 and 74 years were given 500 mg *W. somnifera* (in capsule) twice daily for 3 months. It has shown a significant role in recovering muscle functioning. The changes in blood creatine kinase levels with the use of this herb imply a possible increase in muscle metabolism or a possible decline in muscle catabolism<sup>52</sup>.

## DISCUSSION

Aswagandha is an ayurvedic medicine with potential therapeutic efficacy. It is the important ingredient of a variety of formulations prescribed for musculoskeletal disorders and for promoting the longevity and wellness of the individuals. All the synonyms of *Aswagandha* emphasize its importance in the usage for *rasayana karma*. Ayurvedic pharmacological properties are mentioned as *tikta, kashaya rasa, laghu guna, usna veerya, madhura vipaka*. *Aswagandha* is also known to possess *balya, brumhana, rasayana* and *vajeekarana karma*<sup>18</sup>. *Aswagandha* is prescribed in the treatment of various diseases such as *vata vyadhi*<sup>26</sup>, *swasa*<sup>25</sup>, *nidranasa*<sup>29</sup>, *granthi, apachi*<sup>15</sup>. It is the ingredient of hundreds of formulations including *kashaya, choorna, arista, asava, taila*<sup>31</sup>. Modern pharmacological studies reveals that *aswagandha* possesses properties such as anti-inflammatory, anti-tumor, anti-stress, anti-oxidant, immunomodulatory, hepatoprotective, anti-parkinsonism, hemopoetic effects.

In this review, an attempt has been made to systematically explain the drug *Aswagandha* starting from its etymology and synonyms. Unlike other reviews on

this drug, we have compiled the information on the classification (*vargheekarana*) of the drug in various *samhitas* and *nigantus*, opinions of their ayurvedic pharmacological properties (*Rasa panchaka*), therapeutic effects (*Amayikaprayoga*), different formulations such as *kashaya, ghruta, taila, choorna* containing *Aswagandha* as its ingredient. In addition to these, chemical constituents of different parts, and pharmacological review including the toxicity as well as clinical studies and in-vitro and in-vivo studies were also compiled.

## CONCLUSION

From the review it was found that, the drug *Aswagandha* is found to possess immense therapeutic efficacy which can be utilized in the management of various disease conditions. This review will help the researchers to study the traditional claims and utilizing the different formulations of this drug in treating various disorders. *Aswagandha* has been explained as best among the drugs explained for *brumhana, balavardhana and sukrajanana*. The studies relating the assessment of pharmacodynamics of ayurvedic pharmacological actions of *Aswagandha* such as *brumhana, sukrala, balya* has to be conducted for explaining its mode of action in various clinical conditions.

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**Source of Support: Nil**

**Conflict Of Interest: None Declared**

How to cite this URL: Remya V et al: Aswagandha- A Critical Review. *International Ayurvedic Medical Journal* {online} 2019 {cited September, 2019} Available from: [http://www.iamj.in/posts/images/upload/1580\\_1587.pdf](http://www.iamj.in/posts/images/upload/1580_1587.pdf)