Ashwagandha (Withania somnifera) – a herb with versatile medicinal properties empowering human physical and mental health

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Abstract
Introduction. Ashwagandha is a rasayana of Ayurveda system of medicines. It is a real potent regenerative tonic possessing several pharmacological properties like neuro-protective, anti-stress, anti-arthritic, antitumor, analgesic and anti-inflammatory. Objective. To illustrate applications and limitations of Ashwagandha in detail. Materials and method. Data was collected from various review and research publications. Literature review involved animal studies and human studies. Emphasis was given on versatility of medicinal properties. Results. Ashwagandha plays an important role in improving quality of life and performance at work and possess several pharmacologic actions. Each part of this herb i.e. from root to fruit possess medicinal properties. Conclusions. Ashwagandha possesses wide variety of therapeutic uses in each and every system of human body. The plant has also been widely studied for its various pharmacological activities like antioxidant, anxiolytic, adaptogen, memory enhancing, antiparkinsonian, anti-inflammatory, antitumor properties. Irrespective of such large network of benefits this herb has some limitations of use in certain situations.

Key words
Ashwagandha, active constituents, therapeutic uses, herb, Ayurveda

Key message
Ashwagandha being a natural herb possess numerous medicinal benefits for the human body. It can be easily cultivated in home lawns thereby increasing its socio-economical utility. The herb is enriched with many unidentified, unbelievable and miraculous properties

INTRODUCTION

Winter cherry, Indian ginseng, and Ajagandha, Queen of Ayurveda, called by so many names, Withania somnifera Dunal (Ashwagandha; Family-Solanaceae), is a plant used in ayurvedic medicine in the traditional system and indicated for the management of several neurological disorders. Ashwagandha (ASH) is a Rasayana of Ayurveda – a real potent regenerative tonic possessing several pharmacological properties, such as neuro-protective, anti-stress, anti-arthritic, antitumour, analgesic and anti-inflammatory [1]. Fresh root of the Ashwagandha herb ‘smells like horse’ so-called Ashwagandha, because there is the belief that anyone who consumes the herb is given the power and strength of a horse) [1, 2, 3]. It is also referred to as a ‘royal herb’ possessing multiple therapeutic effects in the different human body systems: immune system, neurological and endocrinal system, the aerobic energy-production system, as well as the reproductive system [3, 4]. The presented study depicts the miraculous role of Ashwagandha in Ayurveda possessing versatile medicinal properties empowering human physical and mental health.

Versatile roles of Ashwagandha. Ashwagandha as a whole plant including each part serves therapeutic uses (Table 1). Several therapeutic properties of Ashwagandha are associated with presence of chemical constituents in the herb (Table 2). In the era of evidence-based medicine research and innovation is a practical phenomenon [5]. Ashwagandha has been also used successfully in ayurvedic research.

Rasayana
Ashwagandha as a herb promotes the health of body and brain by increasing stress tolerance and reinforcing the immune system. Ashwagandha is available as churna, a fine powder that can be mixed with water or ghee honey which has various medicinal benefits. It improves the memory and increases the function of the central nervous system (CNS) [5, 6]. This miraculous benefit of the herb has been proved by a study in which the Morris water maze test was conducted to assess the effect of W. somnifera, where rats pre-treated with the herb showed significant alterations towards normal in comparison to control groups (disease group) [7–10]. The Morris water maze test and maze test were also used in a study to assess the effect of W. somnifera on 3-NP (3-nitropropionic acid) induced Huntington’s disease (HD) [11]. In both tests the Morris water maze and maze test, W. somnifera (100 and 200 mg/kg) treatment for two
Table 1. Benefits of individual part of Ashwagandha herb

| Part of plant and its applications | Active constituents | Therapeutic uses | Ref |
|-----------------------------------|---------------------|------------------|-----|
| Root                              | methanol, hexane and diethyl ether extract, alkaloid and steroids percentage in the roots are reported to contain starch, reducing sugars, glycosides, dulcitol, wit Hansel, an acid and a neutral compound. The amino acids reported from the roots include aspartic acid, glycine. | Regarded as a tonic, aphrodisiac, narcotic, diuretic, anhelicomic, astrigent, thermogenic and stimulant. It is commonly used in emaciation of children (when given to children along with milk, it is the best tonic), debility from old age, rheumatism, vitiated conditions of vata, insomnia, nervous breakdown, goiter, leucoderma, constipation, etc. Also used as local application in carbuncles, ulcers and painful swellings. A paste is formed after crushing roots with water, which is applied to the joints to reduce the inflammation. In combination with other drugs is also indicated for snake venom as well as in scorpion stings. It also useful for pimples, flatulent colic, worms, piles leucorrhoea and boils. | [2, 8] |
| Leaves                            | methanol, hexane and diethyl ether extract, Withaferin-A | Leaves taste bitter and are indicated in painful swellings and fever. | |
| Flowers and seeds                 | Ashwagandha Arishtha prepared from seeds is used for anxiety, memory loss, syncope, and hysteria. It also acts as a stimulant, thus increasing the sperm count. Flowers are deputative, diuretic and aphrodisiac, astrigent. Seeds are anhelicomic and in combination with rock salts are useful in removing white spots from the cornea. | | |

Table 2. Chemical constituents of Ashwagandha

| Chemical constituent | Therapeutic role | Mechanism | Reference |
|----------------------|------------------|-----------|-----------|
| Triethylene glycol (TEG) | sleep induction. | TEG promotes physiological sleep i.e. naturally occurring sleep in healthy individuals. | [3] |
| Withanolides          | anti-cancer activity, neuroprotection and anti-stress activity, recovery from amnesia, anti-mutagenic. | • slows down the growth of lung, colon, breast and cancer cells; • acts as growth inhibitor in human tumour cell lines counteracting mutagenic effect; • improves cellular immune response to mitogens; • reverses paclitaxel-induced neurotoxicity; • respected as a natural source of potent radiosensitizer in chemotherapy; • useful in melanoma-induced metastasis. | |
| Sitoindoside, withanolides | protects cells from oxidative damage and disease. | • eliminates free radicals from immune system; has a good effect in iron overload and lead toxicity; • prevents neuroleptic-induced extra-pyramidal side-effects; • increases natural antioxidants in the brain; • stimulates the immune system through nitric oxide production in macrophage. | |
| Sitoindoside VII and sitoindoside VIII, sitoindoside IX and X | anti-stress activity, stress-induced gastric ulcer. | • used as ginseng in chronic stress models; • protects from stress-induced neuronal degeneration; • helps in achieving a better state to fight against stress. | |
| Sitoindoside IX and X | immunomodulatory and central nervous system effects with impact on memory, stress and learning. | used as Medhya Rasayanas Medhya (mind and mental/intellectual capacity) this cognition-promoting action of the herb as Medhya Rasayanas is observed best in cases of compromised memory post head injury, or after prolonged illness, and in geriatrics or in case of children | |
| Glycowithanolides withaferin-A and stioidosides VII-X isolated from the roots | significantly reversed ibotenic acid induced cognitive defects. | L-dopa found in Ashwagandha enhances memory via cholinergic channels; stabilizes mood and improves learning ability. | [2, 8] |

weeks significantly restored 3-NP induced memory loss. Neurodegenerative disorders cause memory loss and *W. Somnifera* has been found to improve learning ability with potential protection against memory loss. In one study, the effect of the herb on cognitive dysfunction induced by reserpine was investigated by using plus maze learning task *Withania somnifera* root extract (50 and 100 mg/kg/day for one month) significantly improved the long-term memory and learning ability in reserpine-treated animals, compared to those treated only with reserpine [12, 13].

*Withania somnifera* leaf extract has been found to ease cognitive dysfunction by showing improved hippocampal plasticity in a high fat diet (HFD) induced obesity model. *Ashwagandha* has been found to significantly improve working memory by preventing the memory related cognitive impairments and locomotor coordination in high fat diet rats. During locomotor coordination studies it was observed that HFD rats showed deficiency in interest and strength, whereas ASH treated low fat diet extract (LFDE) and high fat diet extract (HFDE) rats performed similarly to low fat diet (LFD) rats, indicating their normal neuromuscular coordination. Findings from the behavioural studies revealed that HFD regimen caused locomotor and neuro-muscular dysfunction, and ASH proved the potential to improve motor performance and body balance in rats on an HFD regimen [14].

During the novel drug development process, assessment of drug effects on psychomotor performance is truly essential. In clinical pharmacological studies psychometric tests are performed to quantitatively document the CNS effects of drugs. Effects of drugs on the central nervous system (CNS) can be assessed in the form of effects on attention, vigilance, cognition, behaviour, and neuro-physiological activity of the brain. *Withania somnifera* improves the brain's cognitive capabilities by increasing the capability of muscarinic receptors [15]. Pingali et al. demonstrated favourable effects of *Withania somnifera* aqueous extract on cognitive and
psychomotor performance in healthy human participants in which several psychometric tests were performed using a computerized psychometric test system [16]. *Withania somnifera* has been found to modulate the neuro-endocrin-immune system and is known as brain tonic rich in antioxidants, especially in the field of Ayurveda. Clinical trials have proved the anti-depressant activity of the herb without causing any sedative effect. It eases the mental stress bundle with resultant optimization of mental and psychomotor performance [17].

Sitoidsides VII-X and withaferin-A derived from leaf and fruit extracts of *Withania somnifera* has been found to increase cortical muscarinic acetylcholine capacity by its cognition-enhancing effect, as seen in animal models and humans [15]. It was found in a randomized, double-blind study that *Withania somnifera* showed improved psychomotor performance in healthy participants with significant improvement in integrated sensorimotor function, auditory reaction time, as well as mental arithmetic as compared to Panax ginseng and placebo in 30 healthy volunteers [18].

### Adaptogen

*Ashwagandha* acts as a plant which helps the body to adapt to stress in order to correct the imbalance among immune and neuroendocrine system. It normalizes the body functions affected by the influence of stress by targeting the hypothalamic-pituitary-adrenal gland axis. *Ashwagandha* decrease cortisol levels in a person under chronic stress, restoring the healthy adrenal function and thus normalizing the sympathetic nervous system [3].

### Somnifera (sleep-inducing)

In a study of effect of alcoholic and water extracts of *Ashwagandha* leaves on the quality and quantity of sleep, significant electroencephalogram (EEG) and electromyogram (EMG) changes were seen in an animal model (mice). Ayurveda, the traditional medicine system of India, also supported that an increase in sleep was observed after administration of extracts from leaf and root in rats, and after oral consumption of the powder obtained from root, leaves or whole plant in humans. Tri-ethylene Glycol (TEG), an active component of *Ashwagandha* leaves, is a potent sleep-inducing small molecule. Sleep regulation has two components viz sleep generation, i.e. frequency of NREM episodes and sleep maintenance duration NREM episodes. TEG is able to generate sleep more frequently, thus increasing the total amount of NREM sleep. TEG also promotes physiological sleep, i.e. naturally occurring sleep in healthy individuals. TEG was found to increase the frequency of NREM sleep episodes, which suggests that it has a potential to generate sleep via targeting the sleep generation mechanism [3].

### Ojas

Ojas is the end condition of properly digested healthy food, and the most refined level of the physical body in contrast to 'Ojakshaya' (decreased Ojas) which refers to a condition similar to AIDS/HIV. Ojas is responsible for a healthy immune system, physical strength, clarity of mind and sense of well-being. It allows consciousness to flow within the body. *Ashwagandha* enhances Ojas. *Ashwagandha* in the form of churna when used on a regular basis helps to improve conditions like senile debility, rheumatism, general debility, nervous exhaustion, brain-fog, low memory, loss of muscular energy and spermatorrhoea. It increases vigour and body energy and helps in rebuilding the body system worn-out as a result of chronic diseases like syphilis and rheumatism [19].

### Improving the quality of life.

*Ashwagandha* plays an important role in improving the quality of life and performance at work. These diseases affecting the quality of life are mentioned in Table 3 along with International Classification of Diseases (ICD) code [20] and various pharmacologic actions and interactions of *Ashwagandha* are listed in Table 4.

### Effects of Ashwagandha observed in other conditions.

**Male sexual dysfunction:** *Ashwagandha* root extract is used to treat sexual weakness, erectile dysfunction, and sexual performance anxiety in men.

**Immunostimulation – immunity stimulating effect through macrophages. Raised antibody titer against Bordetella pertussis strains (combats diphtheria).**

**Reproductive action and rejuvenating effect – increases libido and sexual function.** Supports the female reproductive system, increases ovarian weight and folliculogenesis; a rejuvenative herb in the Indian herbal system.

*Ashwagandha* as a cardiovascular protector protects the cardiovascular system against ischemic and reperfusion injury; useful in focal ischemia, supports anti-atherogenic activity in polyherbal formula [21, 32].

### Pharmacological interactions of Ashwagandha.

**Pregnancy – safety in pregnancy has not been yet fully established for Ashwagandha. Ashwagandha has been reported to be a cause of abortions; therefore pregnant women should not use this herb. It should also not be used with other sedatives or anti-anxiety drugs. Even higher doses are observed to be related with stomach upset, diarrhea and vomiting. However, *Ashwagandha* does not have any significant side-effects [21] and has been found to possess pharmacologic interactions listed in Table 5.**

| Diseases affecting quality of life with ICD code and therapeutic effects of *Ashwagandha* | Reference |
|-----------------------------------------------|-----------|
| Insomnia G47.00 TEG in *Ashwagandha* is able to generate sleep more frequently. | [3, 21–25] |
| Osteoarthritis M19 protects against inflammation and cartilage damage associated with osteoarthritis. | |
| Anxiety F41 anti-anxiety action similar to that of lorazepam, together with effect to ease depression. | |
| Type 2 diabetes E11 helps normalize high blood sugar and improves insulin sensitivity | |
**Effects observed** – a herb with versatile properties. No interactions found. Ashwagandha on Chinese Hamster Ovary (CHO) cells carcinoma. LD50 of 1750 mg (p.o.) in albino mice. Anti-tumour effect on Chinese Hamster Ovary (CHO) cells carcinoma.

**Pharmacologic interactions of Ashwagandha**

| Ashwagandha interaction type | Effects observed | Clinical evidence | Experimental evidence | Mechanism | Reference |
|-----------------------------|------------------|------------------|----------------------|-----------|-----------|
| Anti-diabetic                | blood-glucose lowering effects which may be additive with conventional anti-diabetics | Present          | No interactions found. | Not known | [26–31]   |
| Ashwagandha + methods of measuring serum digoxin levels | digoxin levels might be spuriously elevated when assayed using a fluorescence polarisation immunoassay in patients taking | No interactions found | Present | Known. Some withanolides (major constituents of ashwagandha) are structurally similar to digoxin, and might therefore interfere with the digoxin immunoassay |
| Ashwagandha + Laboratory tests | no interference with in vitro assays for carbamazepine, gentamicin, paracetamol, phenytoin, phenobarbital, procainamide, salicylate, theophylline, tobramycin or valproic acid | No interactions found | No interactions found | No |
| Ashwagandha + Food           | --                | No interactions found | No interactions found | no |
| Ashwagandha + herbal medicines | --               | No interactions found | No interactions found | no |
| Ashwagandha + thyroid and anti-thyroid drugs | increases thyroid hormone levels and found to interfere with the control of hypothyroidism | Present | Present | Unknown |

**CONCLUSIONS**

*Ashwagandha* is a plant used in Ayurveda, the ancient system of Indian medicine. *Ashwagandha* is a rasayana, adaptogen as well as nerve tonic. The plant has also been widely studied for its various pharmacological activities, such as antioxidant, anxiolytic, adaptogen, memory enhancing, anti-parkinsonian, anti-inflammatory, anti-tumour properties. Various other effects, e.g. immunomodulation, hypolipidaemic, antibacterial, cardiovascular protection, and sexual behaviour have also been studied. Although the effects of the herb are quite promising for use as a multi-purpose medicinal agent, several limitations exist in the current literature. There is a need to explore more about the herb, and more clinical trials are required to support its safe therapeutic use.

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