

Ashwagandha: An Ayurveda Miracle

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Abstract: *Amongst the most popular, widely consumed, and established ayurvedic herb "Ashwagandha" (Withaniasomnifera) for more than 3000 years, belonging to the Solanaceae family commonly found in Indian Subcontinents. In modern Ayurveda, these considered adaptogens are widely consumed over the world in the domain of nutraceuticals. Numerous bioactive have been analytically extracted by various methods like High - Pressure Liquid Chromatography (HPLC), Thin Layer Chromatography (TLC), and many more. These bioactives have been researched and clinically proven to have anti - inflammatory, immunomodulatory, relaxation, cardiorespiratory, and antioxidant properties. This article describes multiple human benefits of ashwagandha, its parts, and chemical constituents along with the clinical studies.*

Keywords: Withaniasomnifera (Ashwagandha), Withanolides, HPLC, Adaptogen, Modern Ayurveda

1. Introduction

W. somnifera (Ashwagandha), often known as "Indian ginseng" or winter cherry in English, belonging to Solanaceae family is one of the most prominent ayurvedic medicinal herbs with a variety of curative benefits.

With international recognition as a adaptogen, the therapeutic usefulness, availability of secondary metabolites, economic viability, efficacy, and accessibility of ayurvedic medicinal plants have all led to their global adoption.

Ashwagandha, as an ayurvedic medication, and for its bioactives has been used for medical purposes for more than 3000 years.

The bioactive substances in *W. somnifera* have anti - inflammatory, immunomodulatory, relaxation, cardiorespiratory and antioxidant properties.

Based on numerous laboratory tests and analyses, over 35 chemical components [1] has been discovered from the roots of *W. somnifera*. Since then, Ashwagandha based formulations has been mentioned as a treatment for arthritis, anxiety, tumours, tuberculosis, leukoderma, bronchitis, backache, fibromyalgia, menstrual issues, hiccups, chronic liver disease, etc.

Since Ayurveda has been practised for over 5000 years and is based on the Vedic hypothesis that there are common principles underlying the microcosm (the individual) and macrocosm (the universe), Based on these principles, numerous Granthas like SamithaGranthas, CikitsaGranthas, Nighantus have stated the significance of medications made from *W. somnifera* and its for ages. throughout the history of Ayurveda [2].

Ashwagandha is typically sold in the market in the form of a churna, which is a finely sieved powder that can be combined with water, ghee (clarified butter), or honey.

There have been several improvements made to ashwagandha churna in contemporary Ayurveda, including shilajit, Gokhru, Vidarikand, and many more [3].

Its effectiveness as an adaptogen, which strengthens the body against stress and boosts cell - mediated immunity, has been scientifically established.

All biologically active substances are used to treat various human illness symptoms.

Alkaloids and steroidal lactones are the primary components of ashwagandha, according to chemical analysis. Withania is the primary component of the different alkaloids. The chemical components are discussed in further detail.

1.1. Macroscopic Parts of *W. somnifera*

W. somnifera is an undershrub that is 30 - 150 cm tall, upright, grey, branched, and has a strong unpleasant odour. *Withania* has upright, brownish - dark stems that can have few or no leaves on the lowest portion of the stem. The leaves are simple, alternate (opposite on flowering branches), with gently wavy margins and 5–20 mm long petioles that are typically broadly oblong in shape. Flowers are often single or found in few - flowered cymes, tiny, greenish, axillary, monoecious or bisexual. Typically, seeds are many, discoid, reniform, and yellow.

The fruit is a round, hairless berry that is 5 - 8 mm in diameter, swollen, and covered in a persistent calyx that turns orange - red to scarlet when ripe, as seen in the fig (b). The fruit is filled with several kidney - shaped, light brown, numerous seeds that have been compressed into a rough, netted surface. Strong, thick roots with secondary branches that resemble fibres that grow from the primary root and have an unpleasant, bitter flavour are present.

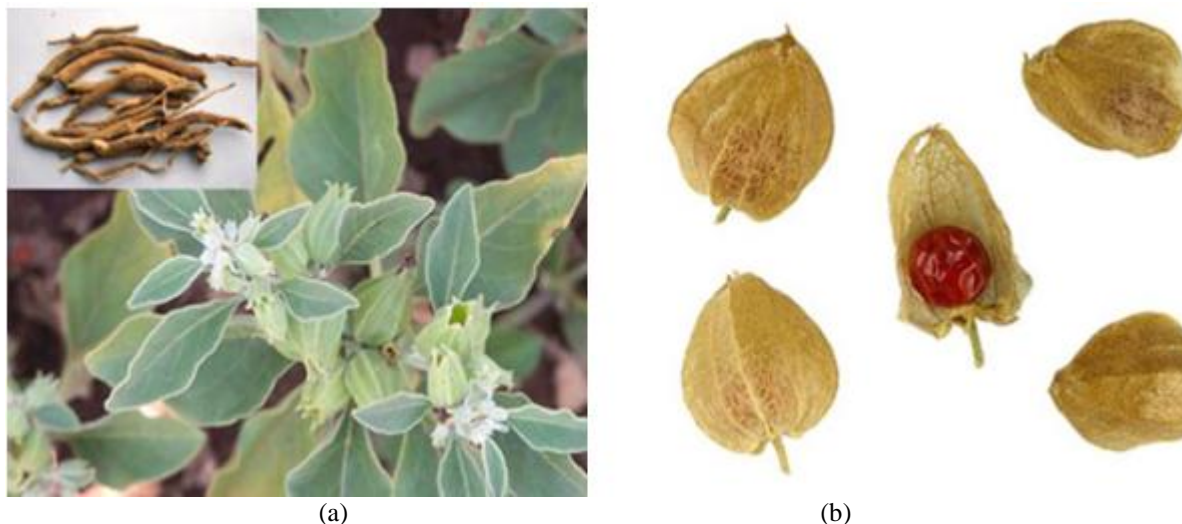


Figure 1: (a): Withania somnifera plant habit and roots and (b) Fruits and seeds [4].

1.2 Cultivation

The genus *Withania* possesses a natural occurrence, most probably in the drier and humid areas, spread from the Mediterranean region to throughout the tropical region.

In India, Ashwagandha as a medium or small undershrub grows in dry regions with majorly used parts root, leaf, and seed [5].

The stems of *Withania* are brownish dark colour and erect, sometimes leaves are absent or less on the lower part of the stem. Flowers are generally small, greenish, axillary, monoecious or bisexual, and solitary or in few - flowered cymes. Seeds are normally many, discoid, reniform, and yellow.

2. Chemical Constituents

Ashwagandha a potent herb, got its adaptogenic and therapeutic effects through the various bioactives found in

the parts of the herb. Among the major groups of bioactives present in *W. somnifera* are attributed to the presence of withanolides, a group of steroidal lactones present in the roots [5]. In Ayurveda, *Withania* is widely recognized as a great aphrodisiac, sedative, rejuvenative, and having life - prolonging effects. However, later research have shown that withania is also a potent general energy - enhancer and memory booster.

As mentioned under laboratory analysis, more than 35 chemical constituents contained in the roots of *W. somnifera* [5].

The biologically active chemical constituents are alkaloids, steroidal lactones, saponins, and withanoloides. And according to the study conducted, among these much of Ashwagandha's pharmacological activity has been attributed to two main withanolides, withaferin A and withanolide D.

After chemical analysis, following are the chemical constituents that can be extracted from *W. somnifera*.

Table 1: Lists the chemical constituents that can be extracted from *W. somnifera*

Alkaloids	Anaferine	Steroidal Lactones	Withaferin - A	Steroids	Cholesterol
	Anahygrine		Withanone,		β - sitosterol
	Cuscohygrine		WS - 1		Stigmasterol
	Scopoletin		Withanolide E		Diosgenin
	Withanine		Withanolide F		Stigmastadien
	Withaninine		Withanolide G		Sitoinosides VII
	Somniferine		Withanolide H		Sitoinosides VIII
	Tropeltigloate		Withanolide I		Sitoinosides IX
	Somniferinine		Withanolide J		Sitoinosides X
	Somninine		Withanolide K		Withanol
	Nicotine		Withanolide L	Somnisol	
	Visamine		Withanolide M	Somnitrol	
	Withasomine		Cuscohygrine	Cuscohygrine	
	Pseudotropine		Anahygrine	Anahygrine	
Flavonoids	Kaempferol Quercetin	Salts	Tropine	Salts	Tropine
			Pseudotropine		Pseudotropine
			Anaferine		Anaferine

W. somnifera (Ashwagandha) has bioactives present in most of the parts including - Stems, leaves but the root of *W. somnifera* (Ashwagandha) contains the largest concentration of bioactive substances, including alkaloids, starch, sugar

reduction, hentriacontane, glycosides, dulcital, withniol acid, and a neutral molecule.

3. Bioactives and Health Benefits

Many clinical trials has been conducted on animals as well as humans, to determine the efficacy of the bioactives

available in ashwagandha against Anxiety, Neuro diseases, stress, infections and even cancers.

Following are the list of curable diseases that suppressed under consumption of Ashwagandha based supplement with following constituents:

Table 2: Different Types of Curable Disease After Application of Different Bioactive Molecules of Withania Somnifera

Sr. No.	Curable Disease	Bioactive molecules	Reference
1	Oxidative stress	Withanolide	[6]
2	Alzheimer's disease	Withanolides	[7]
		Sitoindosides VII-X	[6]
		Withanoside I	[6]
		Withanoside	[6]
		Withanolide sulfoxide	[8]
3	Neurodegenerative disease	Withanoside IV	[9]
		Withanolide A	[10]
		withanoside VI	
4	Microbial disease	Withanolides	[11]
5	Cancer	Withaferin A	[12]
		Withanolide A	[12]
		withanoside IV	[13]
		withanoside VI	[14]
6	Bacterial disease	Withaferin A	[15]
		withanolide D	
7	Stress relief	Sitoindosides VII and VIII	[16], [17]
8	Amnesia	Sitoindosides VII-X	[18]
		withaferin - A	
9	Poor immunity	Withanolide A	[18]

4. Human Based Clinical Trial for W. somnifera

The chemical constituents present in the ashwagandha has been studied and applied over several years to determine the efficacy. The studies have been conducted not only on

animals but also on humans as subjects, to understand there benefits. Based on these experiments in current generation what we call the modern ayurveda, various formulations has been developed over time to cure the unsoundness and concerns of human.

Table 3: Few of the trails taken on Human with all the symptoms mentioned

Sr. No	Body unsoundness	Summary	References
1	Anxiety and mental Health	The sample comprised 39 subjects, of whom 20 received the experimental drug and 19 received placebo. patients were advised to take two tablets twice daily. At 2 and 6 weeks follow - up, data from approximately 85% of patients in each group were available for analysis. Statistical trends favouring the drug were observed at both time points	[18]
2	Sexual Wellness	The treatment with W. somnifera effectively reduced oxidative stress, as assessed by decreased levels of various oxidants and W. somnifera significantly improved the activity of Seminal Plasma SOD and catalase and the level of glutathione, eventually reducing the levels of lipid peroxides LPO and protein carbonyl groups in infertile men.	[19]
3	Oxidative Stress		
4	Cancer	100 patients with breast cancer in all stages undergoing either a combination of chemotherapy with oral Withania somnifera. Withania somnifera root extract was administered to patients in the study group at a dose of 2 g every 8 hours, throughout the course of chemotherapy. Results: Withania somnifera has potential against cancer - related fatigue, in addition to improving the quality of life.	[20]
5	Cardiorespiratory Endurance	40 elite cyclists were chosen randomly and were equally divided into experimental and placebo groups. The experimental group received 500 mg capsules of aqueous roots of Ashwagandha twice daily for eight weeks and remaining were placebo group received starch capsules. There was significant improvement in the experimental group in all parameters. Major positive result was observed cardiorespiratory endurance.	[21]
6	Bipolar disorder	60 euthymic subjects with DSM - IV bipolar disorder were enrolled in an 8 - week study of WSE (500 mg/d) as a procognitive agent. W. somnifera extract appears to improve auditory - verbal working memory, a measure of reaction time, and a measure of social cognition in bipolar disorder.	[22]

4.1. Classical formulations of ashwagandha

Table 4: Formulations created with different with proven effects on certain body unsoundness

S. No	Classical Formulation	Accompanying Ingredients	Medicinal use	References
1	Kshar of Ashwagandha	Kshar of Ashwagandha, to be consumed with honey and ghee	For Asthma	[4]
2	Ashwagandha kshirapaka	Cow milk, Ashwagandha	Nourishing, weight gain, muscular growth	[5], [4]
3	Ashwagandha di leha	Sugar, Ashwagandha, Pippali, ghee, honey	For treatment of body wasting	[5]
4	Body scrub of Ashwagandha powder	With water	For treatment of body wasting	[5]
5	Ashwagandha ghruta	Ashwagandha kwatha, kalka [paste], milk	muscle mass building action	vatavyadhichikitsa Verse 90, p 141, [4]
6	Ashwagandha kshirapaka	Ashwagandha, milk, to be consumed with ghee, or oil and water	Body weight increasing and nourishing	vatavyadhichikitsa Verse 141 - 145, p 145
7	. Ashwagandha kalka	Paste of roots and warm water	Heart disease	Nighantu adarsh, Part 2, Chaukhambha Bharati Academy, Varanasi, first edition, 1985, 136 - 139
8	Ashwagandha powder	Roots of Ashwagandha	Rejuvenator, anti -aging, Insomnia, heart disease	Nighantu adarsh, Part 2, Chaukhambha Bharati Academy, Varanasi, first edition, 1985, 136 - 139

5. HPLC Analysis of *W. somnifera*

As discussed before, more than 35 chemical constituents are present in *W. somnifera*, which contribute and play their role in pharmaceutical supplements against various diseases and problems with negative lifestyle.

These bioactive can be extracted and quantified using various lab scale techniques like column chromatography, Thin layer Chromatography (TLC), High - Performance Liquid Chromatography (HPLC), and many more [4].

A study was carried out for the determination of withaferin A and withanolide D from different parts of *W. somnifera*, i. e. roots, stem and leaves [23].

Marker Compounds which were quantified for the study was:

Withaferin A

Withanolide D

For testing, separation was performed at 50°C which significantly reduced the separation time and the column backpressure, with no decrease in peak resolution.

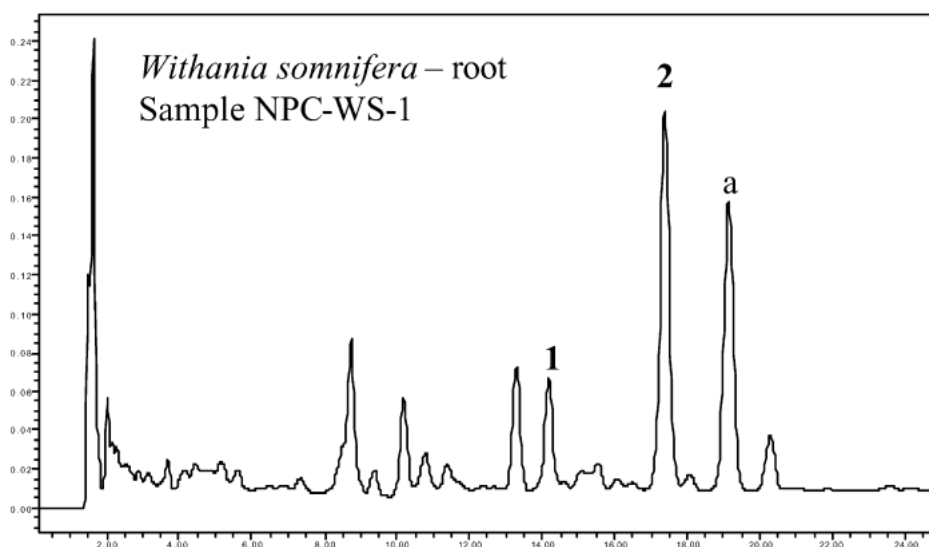


Figure 2 (a): level of Withaferin A and Withanolide D from Root sample.

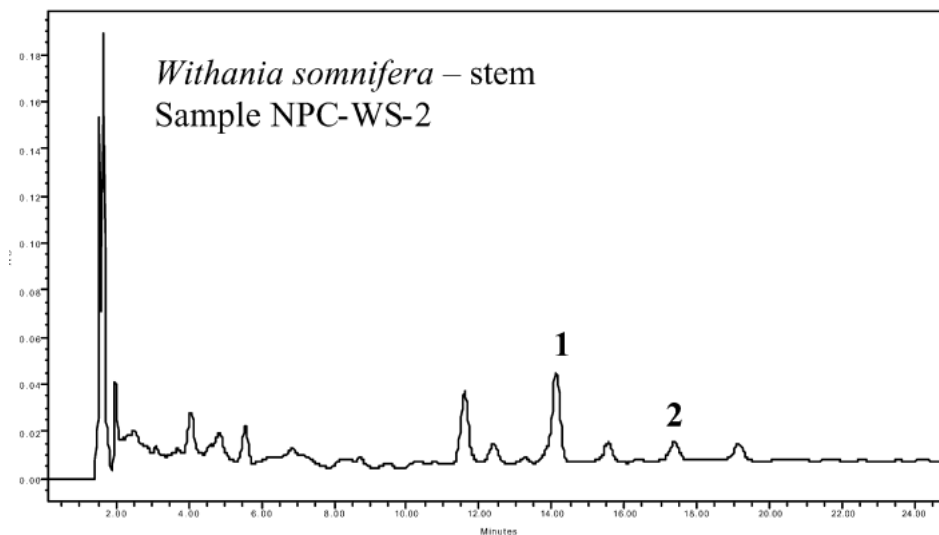


Figure 2 (b): level of Withaferin A and Withanolide D from Stem sample.

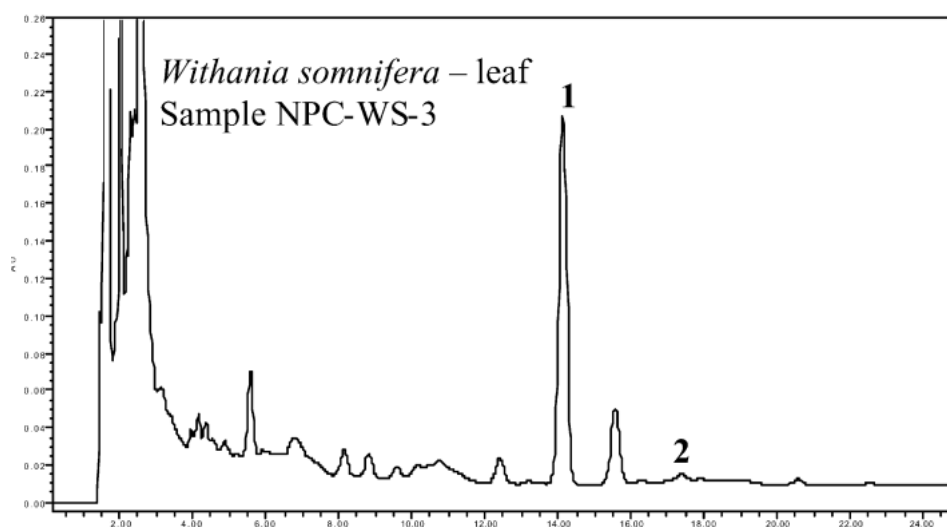


Figure 2 (c): Level of Withaferin A and Withanolide D from Leaf sample.

The presence of 1 and 2 was confirmed in all parts of the plant, but with noticeable variances, by the study of the *W. somnifera*'s root, stem, and leaf. Compound 2 dominated the roots the most. In leaves, where a rather large concentration of 1 was discovered, this compound was only marginal. Stems had the lowest concentration of withanolides 1 and 2 overall.

bound with the traditional approaches of ayurveda with holistic mode of application and consumption, and on international scale it is widely consumed as a nutraceutical and health supplement.

Within our country it has been used as a traditional medicine where various parts of its plant has been used in different parts of the country as mentioned in table.

6. Pharmacology

Considering the availability of Ashwagandha, every place has its way of utilization. May it be in India, people are more

Table 5: Uses of parts of plant (*W. somnifera*) in different states and their ingestion methods

State	Plant Parts	Ingestion Method	Role	Reference
Andhra Pradesh - India	Root	Oral (twice few days)	Combat anemia; increasing sperm count	[24]
Bihar - India	Root	Oral	Diuretic	[25]
Chhattisgarh - India	Root, leaf	Sexual and general weakness, headache, pregnancy care, rheumatism, debility, aging Etc	Oral, topical	[26]
Himachal Pradesh – India	Leaves	Weight loss	Oral, chewed every alternate day for a month	[27]
Himachal Pradesh - India	Seeds	Physical and mental weakness	Oral, with hot water for 10 days, twice a day	[28]
Jharkhand – India	Roots	Venomous snake bite	Oral, 1 mg of the powder is given to the victim 7 times at 3 min gap	[29]
Karnataka - India	Root	Diabetes		[30]
Uttar Pradesh – India	Root, leaves,	Aphrodisiac, sedative, chronic fatigue,	Oral	[31]

	seeds	bone weakness, debility; hypnotic, asthma, anticancer, etc		
Tamilnadu – India	Rhizome	Nervous disorders	Oral	[32]

As its traditional uses were found to be extremely beneficial, the modern sciences also rely on Ashwagandha for various remedies. Many ventures and campaigns have been initiated by the brands and companies to promote the ayurvedic

approaches to cure symptoms. Current Ayurvedic companies that uses the *W. somnifera* in its herbal commercial formulations has been mentioned in the following table.

Table 6: Various Ayurvedic companies and their herbal formulation

Manufacturer	Product	Ingredients	Used as/against	Reference
Dr. Vaidya's	Herbobuild powder	Ashwagandha, Safed musli, Shatavari	Bodybuilding	Website
	Shardardaghna	GoudantiBhasma, Praval Pish, Jatamansighan, Brahmi etc	Migraine	
Baidyanath	Leukonil Tablets	Ashwagandha, Vidhara, Badi Elaichi, Majuphal	Leucorrhoea	Website
	Rhuma Gel, oil, spray, capsule	Blue gum, Ashwagandha, Satavar, Amada, Til	Pain relief	
	Rumartho Gold and Gold plus Capsules	Guggul, Ashwagandha,, Iron Powder, Bishop's Weed, Gold	Rheumatoid arthritis and osteo arthritis	
Dabur	Ashwagandha Churna	Ashwagandha	Stamina and energy	Website
	Stresscom Capsule and Syrup	Ashwagandha root powder	Anxiety, stress and fatigue	
	Ashwagandharishta	Ashwagandha, Mushali, Manjishtha, Haritaki, Haldi	Depression, Anxiety and Stress	
Man Matters	Perform Vitality Tablets	Ashwagandha, Safed musli, L - arginine	Energy and Vigour	Website
Patanjali	Ashwagandha Churna and Capsule	Ashwagandha	Stress reliever	Website
	Glucoshakti	Glucose, Ashwagandha, Satavar, Aloe	Energy booster	
	Ashvashila Capsule	Shilajit, Ashwagandha	Sexual Wellness	
Kapiva	Ashwagandha Gold Capsules	Ashwagandha, Black Musli, Gokshura, Kaunch Beej, shilajit, SwarnBhasma	Stress, anxiety	Website
	Ashwagandha Fizz Effervescent	Sodium Bicarbonate, Citric Acid, ashwagandha, black salt, water, salt	Mental wellbeing	
	Shilajit Gold Resin	Coffee, Ashwagandha, Gokshura, haldi, kali musli, essential oils, etc	Sexual Wellness	

7. Conclusion

Different facets of *W. somnifera* (Ashwagandha) were covered in this paper.

Along with the clinical research based on human and animal experiments addressed, the therapeutic effects of Ashwagandha for Stress, Life longevity, body unsoundness, and several other ailments were described.

On studying the morphological structure of *W. somnifera*, the complete plant has several health benefits, and the alkaloids, flavonoids, lactones, etc. that are extracted from the roots, leaves, and stems have a variety of nutraceutical advantages that have been explored with clinical evidence in the Pubmed database. One of the process of extraction of bioactive through HPLC method is discussed and the quantitative analysis through graphs were presented.

Even though Ashwagandha has been mentioned in Ayurveda for more than 5000 years, its health benefits are still being studied in contemporary Ayurveda. Numerous Granthas have cited its merits, and in - vitro analyses continue to be published in both Indian and international journals. Various upcoming brands follows these ayurvedic norms, and have formulated nutraceutical products to provide alternatives to the laboratory created medicines which may have certain side - effects but with same efficacy.

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