



Antibacterial Activity of Ashwagandha

Dr. Usha Rani Singh, Associate Professor

Department of Chemistry Mahila Vidyalaya P. G. College Lucknow

ursingh04@gmail.com

Abstract

Ashwagandha is widely respected among herbal, naturopaths and holistic practitioners. Ashwagandha used as an adaptogen, a botanical that helps the body fight or resist physical, chemical or biological stress and is used as a nerve tonic. Ashwagandha is compared to *Eleutherococcus senticosus* (Siberian ginseng) and *Panax quinquefolius* (*Panax ginseng*) for its adaptive characteristics. Hence, its common name - 'Indian Ginseng'. Adaptogenic herbs have been used in Ayurvedic medicine traditions for centuries. One of its adaptogenic effects is seen in ashwagandha's ability to reduce cortisol levels in the human body. Cortisol is known as stress hormone – the adrenal glands release it in response to stress. Scientific research has shown that supplementation with ashwagandha has the ability to significantly reduce cortisol levels in the blood, as well as reduce anxiety and improve sleep parameters in people suffering from insomnia. The extensive survey of literature revealed that Ashwagandha has many important alkaloids. The present paper incorporates the study of chemical composition, antibacterial and medicinal properties of Ashwagandha.

Key Words - Ashwagandha, chemical composition, antibacterial and medicinal properties.

Introduction - Ashwagandha is an indigenous Indian herb belonging to the family Solanaceae. Ashwagandha is derived from two words i.e. Ashwa means horse and gandha means smell. Its roots smell similar to horse urine when wet. It is also called by another name as varaha karni because its leaves resemble to pig's ear. In English it is called as winter cherry (Indian ginseng). The botanical name of this herb is *Withania somnifera* is very revered herb of the Indian Ayurvedic system of medicine as a Rasayana (tonic). Ashwagandha is a small to medium sized herb that reaches 1.5 meters in height. It is found in Afghanistan, Sri Lanka, Pakistan and dried area of India ascending up to 1700 meters in Himalayas. It is found in wasteland, cultivated field and open ground throughout India. Well drained sandy loam or light red soil with pH value of 7.5-8.0 is suitable for commercial cultivation It is widely cultivated in Madhya Pradesh and Rajasthan. The production of Ashwagandha roots in India is 2000 tonnes per year. Whereas the demand for root is 7,000 tonnes per annum. Ashwagandha is being cultivated on about 4000 hectares of land in the North East part of Madhya Pradesh. Ashwagandha is being cultivated in Mansa, Neemuch, Javad, Manpura and Mandsaur districts of Madhya Pradesh and Nagaur and Kota districts of Rajasthan. The production of Ashwagandha roots in India is 2000 tonnes per year. Whereas the demand for root is 7,000 tonnes per annum. Ashwagandha is being cultivated on about 4000 hectares of land in the North East part of Madhya Pradesh. Ashwagandha is being cultivated in Mansa, Neemuch, Javad, Manpura and Mandsaur districts of Madhya Pradesh and Nagaur and Kota districts of Rajasthan. twenty-three known species of withania are widely distributed in the dried area of tropical and subtropical zone ranging from the canary Island the Mediterranean region and northern Africa to Southwest Asia.

Botanical Description - Plants of this species are highly branched, straight, evergreen and bushy. Ashwagandha is a small medium sized herb which has a characteristic odour and bitter in taste. It has stout long to tuberous freshly root 30-45 cm long 2.5-3.5 cm thick which are whitish brown in colour and aromatic. Leaves are simple and rounded or oval in shape. Flowers are greenish yellow which are found in clusters in the axils. The fruit is berry. The ripe fruit is rounded orange red in colour and are enclosed in calyx which resembles the red cherries and has milk coagulating properties.



withania somnifera Roots

withania somnifera Fruits

Chemical Composition - chemical composition of withania somnifera is of great importance. The main biologically active constituents are alkaloids i.e., Ashwagandhine, Cuseohygrine, Anahygrine, isopelletierine, anaferine, torpine etc. Steroidal compounds such as withanine, steroidolactones, withaferin A, Withanolides A-Y, withasomniferin-A, withasomidienone, withasominferols A-C, withanone etc. other constituents include saponins¹ (sitoindoside VII and VIII) and withanolides with a glucose at carbon 27 (sitonidoside IX and X).² Withania somnifera contains active ingredients like steroidal alkaloid and lactones known as Withanolides. Withanolides-A and Withanolides-D are the two main Withanolides that contributes most of the biological activity of Withania somnifera³. 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 stress⁴. Many of its constituents support immunomodulatory actions⁵. The aerial parts of Withania somnifera yielded 5-dehydroxy withanolide-R and withasomniferin-A⁶. The oil extracted from the root is composed of two constituents. Water soluble i.e., some sugar and water insoluble part contain fatty acid with other vital substance. The oil which is extracted from this herb is also rich in tannin, glucose, potassium nitrate and more form of alkaloids.

Antibacterial Activity - The most important compounds i.e., withaferine and Withanolides were isolated from methanolic extract of the root of Withania somnifera. The methanolic extract was further subfractionated assigns various solvent and the butanol subfraction was possessed maximum inhibitory activity against a spectrum of bacteria including Salmonella.⁷ The aqueous extract of Withania somnifera inhibited the growth of gram-negative bacteria Neisseria gonorrhoea⁸. Both aqueous as well as alcoholic extract of the plant root and leaves were found to possess strong antibacterial activity against a range of bacteria as revealed by in vitro Agar well diffusion method. The antibacterial activity of Withania somnifera chloroform, acetone,

methanolic and ethanolic root, stem and leaves extracts were also evaluated and found that acetone extract was most effective followed by methanolic and ethanolic extract against some pathogenic bacteria such as *Bacillus subtilis*, Methicillin resistant *Staphylococcus aureus* (MRSA), *Staphylococcus aureus*, *Staphylococcus pyogenes*, *E. feacales*, *Escherichia coli* *Pseudomonas aeruginosa* and *Klebsiella pneumosa*. The ethanolic and methanolic extract of *Withania somnifera* root did not respond against the *Klebsiella pneumosa* and MRSA. The Acetone methanolic and ethanolic extract of *Withania somnifera* might be exploited as natural drug for the treatment of several infectious diseases caused by pathogenic organisms.⁹ The Methonal and the hexane component of both the leaves and root extracts have potent antibacterial activity against *Salmonella typhus*. The antibacterial activity of different part of *Withania somnifera* in hexane, toluene, isopropyl alcohol, acetone and ethanolic extracts were evaluated¹⁰. The above extracts of *Withania somnifera* inhibited some important bacterium like *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Raodeltella plentia* and *Enterobacterium aerores*. Due to the inhibitory effect of *Withania somnifera* to these bacteria it has a broad-spectrum bioactive nature. The excellent antibacterial activity was found for isopropyl alcohol and Acetone extract. It was also observed that *Withania somnifera* plant extracts are usually more active against gram positive bacteria than gram negative bacteria¹¹. The anti-bacterial activities of the ethanol, ethyl acetate, dichloromethane and hexane extract of *Withania somnifera* plant were tested on clinically isolated bacterial pathogen such as *Bacillus subtilis*, *Staphylococcus aureus*, *Staphylococcus pyogenes*¹² and *Escherichia coli*. The whole plant extract of *Withania somnifera* (ethyl acetate) inhibit gram positive bacteria *Bacillus subtilis* and *Staphylococcus aureus*. However, the inhibitory activity was very low in hexane extract in comparison to ethanol and dichloromethane extract. Same pattern was also observed with gram positive bacteria *Escherichia coli* and *Pseudomonas aeruginosa*. No inhibitory effect has been noted for hexane extract. This study showed that *Withania somnifera* plant has potent antibacterial properties. This study also indicates that both alcoholic as well as ethyl acetate extract possessed strong antibacterial activity while hexane and dichloromethane fraction was not very effective. Highest antibacterial activity was recorded for root extract in isopropyl alcohol and followed by stem extract in toluene extract against *Staphylococcus aureus*¹⁰. Thus, it might be exploited as natural drug for the treatment of several infectious diseases caused by pathogenic microorganism i.e., *Staphylococcus pyogenes*, *E. feacales*, *Escherichia coli* *Pseudomonas aeruginosa* and *Klebsiella pneumosa*. The Withanolides Steroidollactone which are extracted in acetone, methanol and ethanol range polar solvent are potent inhibitor of bacterial growth because water is the most polar solvent and Withanolides can be extracted in water properly⁸.

Anti-inflammatory effect due to Withaferin - Withaferin A and 3-b-hydroxy-2,3-dihydrowithanolide F isolated from *Withania somnifera* show promising antibacterial, antitumoral, immunomodulating and anti-inflammatory properties¹³.

Anti-arthritis effect - Ashwagandha is an analgesic that soothes nervous system from pain response¹⁴. The powerful anti-arthritis properties^{15,16} of Ashwagandha are now widely accepted and documented; it is furthermore found to be effective as antipyretic as well as analgesic also.

Medicinal Properties - The important part of *Withania somnifera* herb is root and leaves which are used as drugs¹⁷. Roots are also used in constipation, senile debility, rheumatism, nervous exhaustion, loss of memory, loss of muscular energy and spermatorrhoea³. Roots of this herb are



categorized as rasayanas. Rasayanas is defined as any herb food which is actively confirmed youthfulness and cure diseases if taking is proper way. The leaves of the plant used as an antihelmenthic. Fruits are locally applied to tumors, tubercular glands, carbuncle and ulcer. Ashwagandha is an herb which increase physical endurance and help in rejuvenation of normal system. The roots of ashwagandha have been described to have potent aphrodisiac, sedative and energy enhancing tonic properties in Ayurvedic medicine. The root extracts are effective and shown beneficial effect in the treatment of various problem such as arthritis, male sexual dysfunction, stress, gametic problem, cough and rheumatism^{18,19}. It also has anti-inflammatory, anti-tumor, anti-stress and antioxidant mind boosting and immune enhancing properties.^{20,21}

Conclusion - The available scientific data and survey of literature support the conclusion that Ashwagandha is a real potent regenerative tonic Rasayana of Ayurveda due to its multiple pharmacological actions like anti-arthritis, anti-stress, neuroprotective, antitumor, analgesic and anti-inflammatory etc. It is useful for different types of diseases like Parkinson, memory loss, dementia, stress induced diseases, malignoma and others. Ashwagandha is used as a household remedy by Indians, who consider it as the best tonic for children and old people, and as aphrodisiac by young people. It is one of the supreme nervine tonics of Ayurveda, the most ancient system of Medical Sciences. Clinical experience showed that besides the enumerated neurological conditions, brain strokes causing paralysis and neuronal deficit also improve in the long-term treatment with *Withania somnifera*. We are also using it in all forms of cancer including lung cancers and prostate, especially in last stages, giving the patients lot of health benefits. Ashwagandha has many important alkaloids such as withaferine, withanolide etc. which have great antibacterial activity and used in medicinally were isolated mainly from the root extract of *Withania somnifera*. It is also revealed that alcoholic and methanolic extract has more antibacterial properties in comparison to chloroform or hexane. Thus, the above findings clearly indicate that the traditional use of Ashwagandha has a logical and scientific basis. Large scale clinical studies are needed to prove the clinical efficacy of this herb, especially in neuronal disorders, stress related diseases and cancers.

References

1. Mishra LC, Singh BB, Dagenais S. (2000) Scientific basis for the therapeutic use of *Withania somnifera*. (Ashwagandha): A review. *Altern Med. Rev.* 5:334–346
2. Ganzera M., Choudhary M.I. and Khan I.A. (2003) Quantative HPLC analysis of Withanolides in *Withania somnifera* fitoteria. 74 (1-2):67-68.
3. Harikrishnan B., Subramanian P and Subash S., (2008) Effect of *Withania somnifera* root powder on the level of circulatory lipid peroxidation and liver marker enzyme in chronic hyperammonemia. *E.J. Chem.* 5:872-877.
4. Bhattacharya SK, Goel RK, Kaur R, Ghosal S. (1987) Anti - stress activity of Sitoindosides VII and VIII. New Acylsterylglucosides from *Withania somnifera*. *Phytother Res.* 1:32–37.
5. Ghosal S, Srivastava RS, Bhattacharya SK, Upadhyay SN, Jaiswal AK, Chattopadhyay U. (1989) Immunomodulatory and CNS effects of sitoindosides IX and X, two new glycowithanolides form *Withania somnifera*. *Phytother Res.* 2:201–206.



6. Atta-ur-Rahman, Samina-Abbas, Dur-e-Shahwar, Jamal SA, Choudhary MI, Abbas S. (1991) New withanolides from *Withania* spp. *Journal of Natural Products*.56:1000–1006.
7. Kulkarni S.K., and Ninan I., (1997) Inhibition of morphine, tolerance and dependence by *Withania somnifera* in mice. *J. Ethnopharmacol.*57 (3):213-217.
8. Kambizi L., and Afolayan A.J., (2008) Extract from *Aloe ferox* and *Withania somnifera* inhibit *Candida albicans* and *Neisseria gonorrhoea*. *Afri. J. Biotechnol.*7:12-15.
9. Rizwan H., Abdula A., Hazzami AI and Moubayed NMS. (2012) Antibacterial potential of *Withania somnifera* L. against human pathogenic bacteria. *Afr. J. Mic. Res.* 6(22):4810-4815.
10. Sigariya P., Kumar P., and Mourya KK. (2012) antibacterial and antifungal potential of some polar solvent extracts of ashwagandha (*Solanaceae*) against the nosocomial pathogen. *Int.J. Green phar.*6:17-22
11. Sigariya P., Mourya KK and Kumar P., (2011) Preliminary phyto- profile and Pharmacological evaluation of some extracts of *Cenchrus grass* against selected pathogen. *J.Pharm. Sci. Res.* 3:1387-1393.
12. Shanthi S., Priyanka D. and Shalini P. (2011) In Vitro evaluation of Antibacterial Activity of crude extract of *Withania somnifera* (*Ashwagandha*) to Bacterial pathogen. *J. Bacteriology.* 3:194-199.
13. Budhiraja RD, Sudhir S. (1987) Review of biological activity of withanolides. *JSIR.* 46:488–491.
14. Twaij HAA, Elisha EE, Khalid RM. (1989) Analgesic studies on some Iraqi medicinal plants. *International Journal of Crude Research.* 27:109–112.
15. Singh N, Singh SP, Nath C, Kohli RP, Bhargava KP. (1984) 5th Sepal Congress of Rheumatology. Bangkok: Anti-stress plants as anti-rheumatic agents; p. 37.
16. Singh N. A (1986) pharmacological evaluation of some Ayurvedic crude plant drugs as anti-stress agents and their usefulness in some stress diseases of man. *Ann Nat Acad Ind Med.* 2(1):14–26.
17. Khanna P.K., Kumar A., Ahuja A. and Kaul MK. (2006) Biochemical composition of root of *Withania somnifera* (L) *Deunol. Asian J. Plant Sci.*5:1061-1063.
18. Ahmed A.E., Fathalla M.H., Salah A.G, Agmon A. N., Salan A.G., Monsour I.S. and Essan A. (2010) Antitumor effects of *marrubium vulgare* and *Withania somnifera* extract on carbon tetrachloride induced hepatotoxicity in rat. *J. B. Clin. Pharm.* 1 :247-254.
19. Mahesh B. and Satish S. (2008) Antimicrobial activities of some important medicinal plant against plant and human pathogen. *World J. Agri. Sci.* 4:839-843.
20. Rai M., Jogee P.S., Agarkar G., Dos Santos C.A. (2016) Anticancer activities of *Withania somnifera*: Current research, formulations, and future perspectives. *Pharm. Biol.* 54:189–197.
21. Gannon J.M., Brar J., Rai A., Chengappa K.N.R. (2019) Effects of a standardized extract of *Withania somnifera* (*Ashwagandha*) on depression and anxiety symptoms in persons with schizophrenia participating in a randomized, placebo-controlled clinical trial. *Ann. Clin. Psychiatry.*31:123–129.