

Medicinal Uses of Chemical Extracts from *Withania somnifera* and Its Antimicrobial Activity: A Mini-Review

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Abstract

Withania somnifera is an important medicinal plant used in Pakistan from the old time by the herbalists in making different medicines. The history of this plant comes from Unani and Ayurvedic system. Ethnopharmacological and chemical research on *Withania somnifera* proves that plant extracts have a wide range of applications. The *Withania somnifera* mostly utilized for its anti-inflammatory effect, anti-cancer, antibacterial, antifungal, cardiovascular effects and for various other activities as well. Its chemical constituents also showed an awesome antibacterial activity against *Escherichia coli*, *Pseudomonas fluorescens*, *Bacillus subtilis*, *Staphylococcus aureus*, *Xanthomonas axonopodis* and *Puccinia malvacearum*. Still, a well conducted biological research for several applications of this plant is required. The variability in chemistry of this plant seems important, so future studies and research on the pharmacological activities of these plant extracts should provide more chemical profile which will increase their validity.

Keywords: Medicinal uses, Chemical extracts, Ethnopharmacological, Antimicrobial activity, *Withania somnifera*.

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INTRODUCTION

Withania somnifera is a common medicinal plant famous for its ethnopharmacological properties and is known as "Prince of Herbs" in Ayurveda (Kirtikar and Basu, 1980; Teli *et al.*, 2014). This plant is present in Pakistan, Iran, Afghanistan, India, Spain, parts of the Middle East Africa and the Canary Islands. In Pakistan, *W. somnifera* is falling under criteria A of endangered category (Aslam *et al.*, 2017). *Withania somnifera* belong to family solanaceae, which also include the medicinal plant of *Withania coagolans*. The local and traditional names are different, because of traditional utilization. The most common name is Asghandh in Urdu, 'Akri' or 'Puni-ke-bij' in Hindi, 'Spiubajja' in Afghan, 'Tukhme-kaknaje-hidi' in Persian, 'Khamjira' in Punjabi and 'Punirband' or 'Punir- ja –fota' in Sindhi (Naz, 2002). The entire plant is utilized for ethnopharmacological activities (Khodaei *et al.*, 2012).

Withania somnifera is an evergreen Shrub 30-75 cm in height. Its leaves are 10cm long, simple and ovate. Flowers are green or yellow and fruits are globose berries about

8mm in diameter and at maturity orange red in color (Uddin *et al.*, 2012). *W. somnifera* is very important tropical medicinal plant (Yang *et al.*, 2007). *Withania somnifera* also known as Indian Ginseng because of its wide range of medicinal uses. About 95 medicinal products are formed from this plant (Rai *et al.*, 2001). This plant species is also used as source of fuel, for cooking and heating during winter. It is also widely used as a fodder plant (Bano *et al.*, 2013).

Ethno-pharmacological Investigation

Numerous reports have presented ethno pharmacological research on *Withania somnifera* which showed its importance in pharmacology. A large number of phytochemical extracts are obtained from roots of this plant, including volatile oil, alkaloids, amino acids and withaniol (Uddin *et al.*, 2012). These chemical extracts are used as sedative and hypnotic purpose (Khare, 2007). Leaves of this plant contain steroidal lactones, withanolides possessing antibacterial, anti-fungal and antitumor properties (Devi *et al.*, 1993). *Withania somnifera* extracts

are widely used for therapeutic properties including anti-arthritis, anti-cancer, anti-aging, anti-inflammatory, immunoregulatory, chemoprotective, cardioprotective, and recovery from neurodegenerative disorders (Rasool and Varalakshmi, 2006; Scartezzini and Speroni, 2000; Aggarwal *et al.*, 1999; Singh *et al.*, 2015). Although a large number of plant species have been investigated for their chemical and antimicrobial activity. A very precise investigation was undertaken to notice the native flora for antifungal activity and also for antibacterial activity.

Chemical Constituents

The pharmacological activities are due to the occurrence of diverse secondary metabolites which includes alkaloids, flavanol glycosides, glycowithanolides, sterols, steroidal lactones (withanolides), and phenolics (Chaurasiya *et al.*, 2012). Withanolides is one of the most important chemical obtained from this plant (Figure 1 a-c). The withanolides contains C-28 steroidal nucleus along

with C-9 side chain and with a six membered lactone ring (Padmawar, 2001). Eich (2008) reported 350 withanolides in totally 56 solanaceae species. Beside family solanaceae, withanolides were also reported in certain *Tacca* spp. (Hung *et al.*, 2004). It was also reported in some aquatic species and *Ajuga* species e.g. *Ajuga parviflora* Benth. (Family Lamiaceae) (Khan *et al.*, 2010). *Withania somnifera* steroids are derived from sterol and composed of steroid alkaloid, esterase, ecdysteroids, amino acids and glycoside (Kreis and Muller-Uri, 2010).

Withanolids are classified into two major groups.

1. Withanolides having an unorganized skeleton structure
2. Withanolides having an organized carboxylic skeleton

This important alkaloid (withanoloides) is 1st distributed on peculiar behavior of chemotype of *Withania somnifera* plant depending on the region from where they are collected.

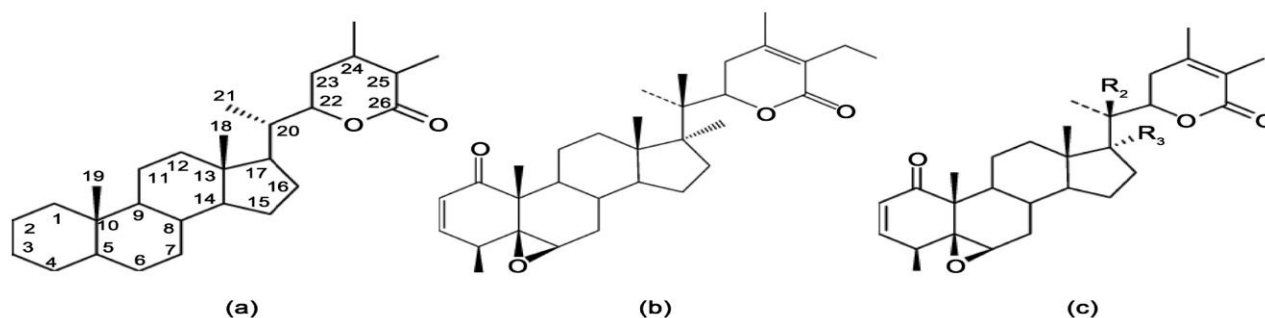


Fig. 1. Chemical structure of (a) Withanolide (b) Withaferin A (c) Withanolide A (Mirjalili *et al.*, 2009)

Medicinal Significance

Withania somnifera is probably one of the most studied plants in the *Withania* genus from a medicinal point of view. *W. somnifera* has been used as remedies of various disorders including Rheumatoid arthritis pain, Asthma, Anticancer, Antipyretic (Kirtikar and Basu, 1980; Khare, 2007). The antimicrobial activity of the root and other vegetative parts like leaves has been shown experimentally. The withaferin A stopped the growth of many gram positive bacteria, aerobic bacilli and other pathogenic fungi (Abou-Douh, 2002). It showed its strong activity against *Micrococcus pyogenes* while show less efficacy against *Bacillus subtilus* and moderate antibacterial activity against *Pseudomonas aeruginosa* and *Staphylococcus aureus* (Ali *et al.*, 2001). The extract of this plant also showed a strong activity against *Entamoeba histolytica* (Rastogi and Mehrotra, 1998). Withaferin A showed a strong antimicrobial activity due to presence of lactone ring which are unsaturated. Lactone showed a strong therapeutic function (Uddin *et al.*, 2012). Withaferin A showed strong anti-inflammatory activities. Beside this, it

also showed strong anti-arthritis activities, because of biological active steroid, of which withaferin A is main component (Khare, 2007). It was noted to suppress arthritic syndrome and other toxicity effects. Oil extract from the fruits of *W. somnifera*, volatile oil showed significant activity against *Staphylococcus aureus* (Khan *et al.*, 2010). *W. somnifera* was also reported as anti-stressor in rats using stress of cold water swimming (Uddin *et al.*, 2012). Those animals which were treated by *Withania somnifera* drugs showed best stress tolerance (Archana and Namasivayam, 1999). The treatment with *W. somnifera* drugs with various drugs in experimental animals exposed to various biological, physical and chemical stresses were found to provide protection against these stresses (Rege *et al.*, 1999). This plant is also important regarding the cure of many disorders. Different parts of this plant are utilized in cancer, arthritis, asthma, aging, liver disorder, inflammation, neurological disorders, and various other intestinal infections (Atta-ur-Rahman *et al.*, 1998; Singh *et al.*, 2015). Ashwagandha showed stimulatory effects, both in vitro in addition to in vivo on the assembly of cytotoxic T

lymphocytes and illustrated the potential to suppress tumor growth (Davis and Kuttan, (2002). The chemo-preventive activity of plant is due to the antioxidant or free radical scavenging action of the extract (Prakash *et al.*, 2002). In a previous study different compounds were isolated from the leaves of *Cyphostemma digitatum* and *Dracaenaceae* resin (Al- Mahweety, 2016a; Al- Mahweety, 2016b). Various disorders are prevalent in Pakistan as reported in previous studies (Ashraf *et al.*, 2016; Iqbal *et al.*, 2016a; Iqbal *et al.*, 2016b; Toor *et al.*, 2016; Muhammad *et al.*, 2013; Ali *et al.*, 2015; Ahsan *et al.*, 2016). Medicinal plants are an important cure for different diseases. Medicinal plants can contribute hugely to the traditional medicines through providing ingredients for drug or having played central roles in the drug discoveries (Kalim *et al.*, 2016; Hussain *et al.*, 2016).

CONCLUSION

This review has been compiled to highlight sufficient information about the medicinal significance of *W. somnifera*, being most important medicinal plant. There is need to provide awareness among people about the significance of herbal plants. Molecular and biotechnological approaches should be used to manufacture more products and sustainable use of *W. somnifera* in future.

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CONFLICT OF INTEREST

The authors verify having no interest in competition and have no conflicts of interest.

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