Quality Assessment of *Withania somnifera* (L.) Dunal by Analyzing Its Functionalities and Elemental Compositions

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1. Introduction

Ashwagandha, *"Withania somnifera"* (L.) Dunal (Solanaceae) commonly known as winter cherry, is one of the most valued medicinal plants in Ayurveda and other traditional systems of medicine. In Ayurveda, *W. somnifera* is regarded as one of the most useful herbs having 'Vata' pacifying properties [1–3]. Plant is widely found in India, Sri Lanka, Iraq, Iran, Syria, Turkey and Africa, as well as in North America [4]. It is act as an herbal tonic, health food in *Vedas* and commonly used in Indian traditional health care systems. The leaves are bitter and used in painful swallowing, anti-inflammatory medicines and ophthalmitis [5]. Some people also use paste of roots and leaves to cure ulcer [6]. The roots of the plant are categorized as rasayanas, which are reputed to promote health and longevity, arresting the ageing process, increasing the capability of the individual to resist adverse environmental factors [7], promote vitality during recovery from chronic diseases [8] and also used to control the pain during arthritic conditions [9]. The leaves are applied locally to tumors and to tuberculous glands. A fomentation of the leaves is used to cure sore eyes, ulcers, and swellings. They are also used as a hypotonic and an anthelmintic [10]. The plant has been reported to have adaptogenic, anticancer, anti-convulsant, immunomodulatory, antioxidative and neurological effects [11, 12]. It is also considered efficacious in the treatment of arthritis, geriatric, behavioural and stress-related problems.

Withaferin A, chemically characterized as 4β, 27-dihydroxy-5β-6β-epoxy-1-oxotriaza-2, 24-dienolide, is one of the main withanolidal active principles isolated from the plant (Fig. 1). Withaferin A inhibits cyclooxygenase-2 (COX-2) but not cyclooxygenase-1 (COX-1) [13], desired flora non-ulcerating anti-inflammatory/chemotherapeutic drug. Withaferin A has also been reported to have immune suppressive action on B-lymphocyte proliferation [14]. Other withanolides, including glycosylated ones present in medicinalplants are reported to have antioxidant, immunomodulatory and other activities [15–17]. Some withanolides are known to have quinine reductase induction-mediated protective activity against chemical carcinogenesis [18]. A variety of mono- and poly-herbal preparations are commercially sold in India.

![Withaferin A](https://example.com/withaferin_a.png)

**Fig. 1** Some withanolides of Ashwagandha (*Withania somnifera*)

The present study was, therefore, undertaken to make an assessment of the quality as well as the element quantity of genuine and commercial samples of *W. somnifera* using the spectral investigations.

2. Experimental Methods

2.1 Collection of Plant Materials

The plant chosen for this present study namely *W. somnifera* (Solanaceae) was collected from Salem district, Tamil Nadu, India in July 2010 and authenticated by Dr. V. Chelladurai, Research Officer (Botany), Hindu College, Tirunelveli. The plant is being widely used in the ayurvedic system for the treatment of various disorders. Therefore several mono- and poly-herbal products of *W. somnifera* are commercially available in the Indian market. Hence there is an emergent necessity to analyze the quality retain of commercial products from its genuine real samples. In this present work the commercial sample *W. somnifera* available from southern part of India and genuine real samples available in the Western-Ghats South-East region are tested for its chemical constituents qualitatively as well as quantitatively. The analysis FT-IR, UV-Vis and SEM-EDAX has been adopted to study the functional presence and elemental presence of *W. somnifera*. The results revealed minor variations in the content of both *W. somnifera* samples.
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2.2 Extraction
About 5 grams of the root powder of the plant samples were extracted with 95% methanol (1:10 w/v) for 48 hours with constant stirring individually. Suspensions were filtered through Whatman No. 1 filter paper to retain the clear solution. The pooled extracts were vacuum evaporated below 50 °C, the residues were stored at 4 °C separately.

2.3 Instrumentation
The IR measurements were recorded for methanolic extract of the plant samples in the transmittance mode Range: 4000 to 400 cm⁻¹ by using Perkin-Elmer-Spectrum RXI FT-IR (RXI FT-IR) instrument individually. Ultra Violet-visible spectroscopy analyses were carried out by UV-visible spectrophotometer JASCO V-530 in the range of 200 nm – 1100 nm, with the scanning speed of 400 nm/min for both samples. The morphology examination of dried powder samples were analyzed with Scanning Electron Microscope (SEM) HITACHI-S-3400N model fitted with an energy dispersive X-ray analyzer (EDAX) allows a qualitative detection and localization of elements in the samples. The SEM enables a direct observation of the surface microstructures of the plant samples.

3. Results and Discussion
The obtained FT-IR spectra for both GS and MS W. somnifera are shown in Fig. 2 and Fig. 3. From Fig. 2 the FT-IR spectrum of GS W. somnifera is having very strong peaks at 3328 cm⁻¹ and 1022 cm⁻¹. Also it shows the strong peaks at the frequencies 2944 cm⁻¹, 2832 cm⁻¹, 1448 cm⁻¹, 1115 cm⁻¹ and 623 cm⁻¹. The peaks at 3328 cm⁻¹ and 623 cm⁻¹ that the peaks cover the entire region with a very broad peak. The peak at 3328 cm⁻¹ is responsible for C=O-C stretching frequency and 1115 cm⁻¹ responsible for C=C functional groups. The stretching frequency for C=O has obtained at 1737 cm⁻¹. The C-H stretching frequency obtained at 1448 cm⁻¹ responsible for the plane asymmetric stretch. The parallel and perpendicular stretching frequencies are obtained at 2944 cm⁻¹ and 2832 cm⁻¹. The similar observations were obtained for MS W. somnifera (Fig. 3), i.e., the O-H stretching frequencies at the broad area at 3330 cm⁻¹; the C-H stretching frequencies at 2943 cm⁻¹, 2831 cm⁻¹ and 1448 cm⁻¹; the C-O-C and C=O stretching frequencies at 1022 cm⁻¹ and 1112 cm⁻¹ respectively. The obtained results from both figures ensured the presence of withanolides in studied sample.

The UV-Vis spectra of both GS and MS W. somnifera are shown in Fig. 4. The maximum absorptions obtained at the λ_max value of 218 nm (n-π*, π-π*), 283 nm (n-π*, π-π*) and 322 nm (n-π*) for GS and the λ_max value of 219 nm (n-π*, π-π*) and 279 nm (n-π*, π-π*) for MS of W. somnifera. The results indicates that the presence of C=C, C=O and C-O functional grouped compounds in the samples. These results are correlated with our FT-IR spectral reports. The quality of the W. somnifera herbal is retaining its own medicinal properties in both samples.
4. Conclusion

The GS and MS of *W. somnifera* have been employed for their quality and elemental quantity analysis. The results clearly imply that the both samples are retaining its organic compositional values and correspondingly its medicinal values obviously. There is a small variations in their elemental compositions. These variations can originate from several factors that include: (i) diversified bioreources of heterogeneous nature from the wild and/or under cultivation, (ii) physiological and ecological variations in plantations, (iii) harvest and post-harvest operations, (iv) processing of biomass, (v) manufacture process for product, (vi) unregulated and often non-descript supplementations, etc.

References


