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Biochemical Composition of Roots of *Withania somnifera* (L.) Dunal

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Abstract: Contents of soluble protein, total amino acids, reducing sugars, non-reducing sugars, starch were examined in fresh roots of five selective accessions viz. AGB-002, AGB-009, AGB-015, AGB-025 and AGB-030 of *Withania somnifera* (L.) Dunal while crude fiber was analyzed in dry roots during young and maturity stages. All the five accessions followed a uniform pattern of maximum biochemical constituent accumulation during maturity. The accession AGB-002 appears to be more efficient in accumulation and synthesis of biochemical constituents during the two stages of root growth.

Key words: Biochemical constituents, crude fiber, proteins, sugars, *Withania somnifera*

INTRODUCTION

Withania somnifera (L.) Dunal belonging to family Solanaceae is an important medicinal plant used in traditional Indian system of medicine through the restoration of a healthy balance of life forces (Sharma, 1983; Shukla and Thakur, 1991). In view of its wide range of clinically proven biological activities *W. somnifera* (local name ashwagandha) is one of the best known and most researched Ayurvedic herbs. This holds a place in the Ayurvedic traditions similar to Korean Ginseng in Chinese therapies. For that reason, *Withania somnifera* has been often referred to as the Indian Ginseng. Most of its biological activities have been attributed to the presence of group of compounds referred as withanolides. The roots and leaves of *Withania* are used as drugs. Most of the herbal medicine available is derived from the roots of the plant. The commercial success largely depends on quality and yield of root which is the product of commerce. The process of root growth and development has been studied in *W. somnifera*, the information on the physicochemical constituents is lacking. So far no published report could be obtained as regards the biochemical screening of this plant. The purpose of this study therefore was to evaluate the biochemical composition.

MATERIALS AND METHODS

Five divergent accessions of *Withania somnifera* were obtained from various locations in India having different geographical co-ordinates. These accessions were grown in sandy loam having a pH of 7.4 with good drainage during the second week of July at cultivated field of Regional Research Laboratory, Jammu and utilized as experimental material, coded as AGB (Ashwagndha germplasm bank). AGB-002 from Bikaner-Rajasthan, AGB-009 from Amritsar-Punjab, AGB-015 from Dabur-Gajiabad, AGB-025 from Neemuch-Madhya Pradesh and AGB-030 from Bhopal-Madhya Pradesh. Protein content was estimated following the method Lowry *et al.* (1951). The colour intensity was measured at 750 nm. The results were expressed in terms of mg protein per g fresh roots. Free amino acid content in fresh roots was estimated by Ninhydrin method of Lee and Takahasi (1966) with some modifications. Reducing sugars and non-reducing sugars in fresh roots were estimated in fresh roots by Lane and Eynon method as per Rangana (1977). Starch in fresh roots was estimated by Acid hydrolysis according to McCready *et al.* (1950). Crude fiber content was analysed in dry roots using Maynard (1970). The data in Table 1 is represented as mean±SEM. (Standard error of mean) of quadruplicates (Panse and Shukhatme, 1985).

RESULTS AND DISCUSSION

The present study carried out on the plant specie revealed the presence of phytochemical constituents as soluble protein, total amino acids, reducing sugars, non-reducing sugars, starch and crude fiber in the selected morphotypes grown under similar sets of environmental conditions and quantitative estimation studied is

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Table 1: Biochemical constituents of roots at 150 DAP and 210 DAP of selected morphotypes of *Withania somnifera*

	Accessions									
	AGB-002		AGB-009		AGB-015		AGB-025		AGB-030	
Parameters	150 DAP	210 DAP	150 DAP	210 DAP	150 DAP	210 DAP	150 DAP	210 DAP	150 DAP	210 DAP
Soluble protein (mg g^{-1})	7.2±0.76	9.5±0.55	6.9±0.67	9.2±0.73	3.5±0.08	6.7±0.31	2.90±0.06	5.20±0.65	3.45±0.31	6.71±0.52
Total amino acid (mg g^{-1})	3.46±0.01	4.83±0.03	3.28±0.01	4.16±0.02	2.82±0.01	3.32±0.02	1.30±0.03	2.51±0.01	1.71±0.02	3.05±0.02
Reducing sugars (mg g^{-1})	1.2±0.02	2.10±0.07	0.15±0.002	0.78±0.001	0.62±0.003	1.25±0.01	0.31±0.001	1.25±0.06	0.21±0.001	0.31±0.001
Non-reducing sugars (mg g^{-1})	6.0±0.36	7.62±0.81	2.37±0.03	4.93±0.02	5.50±0.03	7.0±0.21	5.40±0.09	6.05±0.10	2.33±0.03	3.0±0.01
Starch (mg g^{-1})	8.87±0.25	9.46±0.08	6.09±0.13	7.98±0.20	6.37±0.06	8.25±0.15	6.41±0.13	9.37±0.51	6.91±0.09	9.05±0.13
Crude fiber (%)	34.0±2.23	32.7±2.95	23.0±1.15	32.0±1.42	26.0±1.50	34.0±1.83	22.0±1.24	38.7±1.93	27.0±1.75	33.0±1.63
Root yield per plant (g)	6.20±0.21	25.3±1.26	5.02±0.89	17.3±1.06	2.80±0.32	5.20±0.62	1.0±0.03	4.8±0.21	1.78±0.02	5.30±0.21

summarized in Table 1. Higher activity of some biochemical attributes and root yield was recorded in AGB-002 as compared to other accessions in both the stages. Lowest activity of these parameters estimated was observed in accession AGB-025.

Measured activity of soluble protein, total amino acids, reducing sugars, non-reducing sugars and starch in roots was found to be involved in root development and composition showing increasing trend in activities measured in the selected five accessions at maturity stage i.e., 210 DAP (Days After Planting). Young roots (150 DAP) showed low amount of protein. Protein content recorded the lowest in AGB-025 while it was found to be highest in AGB-002 ranging from 2.90 to 9.5 mg g^{-1} at both the stages. Increase protein content was observed at maturity stage which indicated structural protein requirement for growth and metabolism of roots. Higher protein content was substantiated with increase in amino acid content. Reducing sugars, non-reducing sugars and starch contents were also found to vary between 0.21 to 2.10 mg g^{-1}, 2.33 to 7.62 mg g^{-1} and 6.09 to 9.46 mg g^{-1} respectively on the fresh weight basis. Carbohydrates and starch are reported to be involved in various physiological stages (Brevendan *et al*., 1977). A significant increase in sugar contents in roots during the maturity period could be an indication of the accumulation of these as storage compounds. It is well documented that the underground parts in the dicot plants act as carbohydrate storage organs and have much greater weight than the shoots (Mooney and Billings, 1960; Scott and Billings, 1964). Jenner (1970) reported higher accumulation of starch observed was correlated to its conversion from Photosynthates. Bulk deposition of starch occurred at 210 DAP in all the cultivars.

Crude fiber content reported to range between 22-38.7% when analyzed in dry roots. The higher fiber content was observed in the matured roots. Fiber content of the roots is one of the important quality traits for marketing of this medicinal crop. Roots with less fiber content are mostly preferred and exploited for commercial purpose. Delayed harvesting might have resulted in higher production of fibrous content. On comparing crude fiber content in root samples of all the five accessions, AGB-025 exhibited maximum fiber content (38.7%) followed by AGB-015 (34.0%), AGB-030 (33.0%), AGB-002 (32.7%) and AGB-009 (32.0%).

Highest root yield 25.3 gm was observed in AGB-002 at the maturity stage of the plant. Increase in root yield in five selected accessions is closely associated with biochemical attributes. Positive correlation between root yield and these parameters could possibly be used for selection of high root yielding accessions as root is the commercial product of interest. Also the estimation of these biochemical attributes is informative for finding distinctness among different morphotypes. Proteins, carbohydrates, amino-acids being the direct gene products reflect the genomic composition of cultivars accurately and therefore ideal for finding distinctness. The study, therefore, has provided some biochemical basis for such a potential plant commonly used in herbal medicine.

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