

Seasonal Variations in Phytochemical Parameters of *Withania coagulans*

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Abstract: The present paper deals with seasonal variations in leaf pigments, proline, total sugars, crude protein and phosphorus contents in the leaves of *Withania coagulans*. Results revealed that maximum amount of total chlorophylls, carotenoids and crude protein were observed during the rainy season. However, maximum concentrations of total sugars and proline were recorded in winter, while phosphorus was maximum in summer season.

Key words: *Withania coagulans*, leaf pigments, proline, total sugars, crude protein, phosphorus.

Withania coagulans (Stocks) Dunal (Family: Solanaceae) commonly known as *paneer-bandh* in Hindi and vegetable rennet or Indian cheese-maker in English, is an underutilized endangered medicinal plant, distributed in Mediterranean and south Asian regions (Negi *et al.*, 2006). The dried fruits are used in sedative, CNS depressant, anti-bilious, emetic, anti-asthmatic, diuretic, anti-inflammatory, chronic liver troubles, etc. (Khare, 2007). Uncontrolled harvesting and degradation of natural habitats is leading to a extinction of this plant species. UNDP have listed this species as 'Data Deficient' (UNDP, 2008).

The efficiency of the leaves to produce assimilates and its persistence depends largely on the photosynthetic pigments of which chlorophyll is of prime importance and varies with species, plant age and growing season. Carotenoids are supplementary light harvesters. When plants experience the unfavorable environmental conditions such as temperature stress, drought, etc. plant cells protect themselves by accumulating a variety of small organic and electrically neutral molecules such as proline, glycine, betaine, etc. that are collectively referred to as osmoprotectant.

The present study was aimed to obtain a better understanding of adaptive mechanisms in *W. coagulans* under harsh desert environment and to assess how far the environmental factors influence the production of various metabolic products. The fluctuations in leaf pigments, total sugars, proline, crude protein

and phosphorus contents during different seasons constitute main aspects of the present study.

Materials and Methods

Leaf samples of *W. coagulans* were collected from natural habitat located at Chopasani Housing Board, Jodhpur, during 2008 and 2009. The fully mature leaves exposed to direct sunlight were collected randomly during different seasons, viz. rainy (July-September), winter (December-February) and summer (April-June) and analyzed for leaf pigments, proline, total sugars, crude protein and phosphorus. Leaf pigments were estimated according to Arnon (1949), while proline as per Bates *et al.* (1973). The total sugars, crude protein and phosphorus were measured according to Plummer (1971), Peach and Tracey (1955) and Allen *et al.* (1976), respectively. The data were subjected to analysis of variance (ANOVA) as suggested by Gomez and Gomez (1984).

Results and Discussion

The maximum amount of total chlorophylls and carotenoids were observed in rainy, while minimum in summer season (Table 1). Plant growth and development are complicated biological phenomena, which depend upon genetic and environmental variables. Plants regulate various aspects of their growth in a synchronized form with a high degree of organization involving coordination of many components. Sen and Mohammed (1987) observed that *Fagonia cretica* and *Trianthema portulacastrum* exhibited higher chlorophyll contents during rainy followed by winter

Table 1. Phytochemical parameters in *Withania coagulans* during different seasons (values are the mean of six replicates)

Parameters	Seasons			CD
	Rainy	Winter	Summer	
Total chlorophylls (mg g ⁻¹ dry wt.)	0.093	0.055	0.032	0.140**
Carotenoids (mg g ⁻¹ dry wt.)	0.00108	0.00106	0.00083	1.636 ^{ns}
Proline (μg g ⁻¹ dry wt.)	0.283	0.891	0.464	1.705**
Total sugars (mg g ⁻¹ dry wt.)	97.097	125.770	115.148	11.713 **
Crude protein (mg g ⁻¹ dry wt.)	133.853	88.280	100.780	29.711*
Phosphorus (mg g ⁻¹ dry wt.)	159.789	156.798	205.939	8.352**

ns = Non-significant; and * & ** = Significant at P = 5 & 1%, respectively.

and lower during summer season. Kedia *et al.* (2009) reported maximum carotenoids in *Phyllanthus fraternus* during rainy season. In the present study, maximum total chlorophylls and carotenoids in *W. coagulans* were recorded in rainy season, which may be due to formation of new leaves.

Proline content during different seasons varied from 0.28 to 0.89 μg g⁻¹ d. wt., being maximum during winter followed by summer and minimum in rainy season. The higher magnitude of proline accumulation may help plants to tolerate dehydration by maintaining cell turgidity as reported by Ahire *et al.* (2005). *Zygophyllum simplex* and *Trianthema triquetra* exhibited maximum proline during winter and minimum in rainy season (Sen *et al.*, 2002). The maximum proline content during winter may be due to lower minimum and maximum temperatures and rainfall as compared to other seasons (Table 2).

The maximum total sugars were observed during winter followed by summer and minimum in rainy season. The sugar content in leaves increased with age and growth of plants (Mishra and Bhatt, 2004). *Leptadaenia reticulata* exhibited maximum total sugars in winter season (Kasera and Shukla, 2001). Mohammed and Sen (1990) observed that rubra and flava morphs of *T. portulacastrum* accumulated maximum sugar during winter season. These results are in the agreement of the general fact that concentration of water-

Table 2. Mean values of meteorological data during the different seasons at Jodhpur (2008 & 2009)

Parameters	Seasons		
	Rainy	Winter	Summer
Minimum temperature (°C)	26.5	13.9	26.7
Maximum temperature (°C)	36.1	28.0	39.4
Minimum RH (%)	45.0	24.0	25.0
Maximum RH (%)	74.6	53.5	52.3
Total rainfall (mm)	112.7	0.9	42.8
Sunshine (h day ⁻¹)	7.7	8.0	9.3

soluble carbohydrate increased to a peak during temperature stress, i.e. winter season.

Crude protein varied from 88.28 to 133.85 mg g⁻¹ dry wt. during different seasons, being maximum in rainy season. Mohammed *et al.* (2000) reported maximum crude protein during rainy season in *T. triquetra*. The leaves of *Corchorus depressus* also had maximum and minimum values of crude protein during rainy and winter seasons, respectively (Mathur, 2005). The present finding also confirm the above-mentioned results which may be due to higher plant-soil water status during rainy season.

The maximum and minimum phosphorus contents in the present investigation were observed in summer and winter seasons, respectively. Khatun *et al.* (2003) observed that the phosphorus content increased gradually with the advancement of maturity levels in *Moringa oleifera*. Mathur (2005) reported maximum phosphorus in *Blepharis indica* during summer season. The highest amount of phosphorus in summer season may be due to long duration of sunshine hours as compared to other seasons.

Thus, it is concluded that variations exist in these parameters during different seasons with highest amount of total chlorophylls, carotenoids and crude protein were recorded during rainy, while levels of proline and total sugars were maximum in winter season.

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