

## **Secondary metabolites produced during different seasons in some arid medicinal plants**

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### **ABSTRACT**

*The present study was carried out to evaluate the variations in the total amount of secondary metabolites during different seasons in four important valuable medicinal plants, viz. Barleria prionitis, Boerhavia diffusa, Citrullus colocynthis and Grewia tenax of the Indian Thar desert. Results revealed that maximum amount of secondary metabolites (total alkaloids and phenols) were observed during summer, while minimum in rainy season.*

**Key words:** Alkaloids, phenols, medicinal plants, arid zone

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### **INTRODUCTION**

Desert plant adapts themselves to the harsh environment and survives in high temperature, moisture stress, water scarcity, intense solar radiations, etc. Arid zone with such climatic variability plays an important role in secreting the secondary metabolites. Currently, most pharmaceutically important secondary metabolites are isolated from wild or cultivated plants because their chemical constituents are not economically feasible [1]. Plants have many natural enemies; these include viruses, fungi, worms, insects, bacteria and many herbivorous. Due to their sessile lifestyle plants are unable to avoid these predators upon them and therefore had to evolve mechanisms to protect themselves. Humans consume a wide range of foods, drugs, and dietary supplements that are derived from plants and which modify the functioning of the central nervous system (CNS). In many cases, the effects of phytochemicals (secondary metabolites) on the human CNS might be linked either to their ecological roles in the life of the plant or to molecular and biochemical similarities in the biology of plants and higher animals [2].

Environmental conditions affect the plant growth as well as the formation of secondary metabolites, as they are mostly formed in young and actively growing tissues [3]. Thus the seasonal changes have effect on the physiological parameters. Therefore, the present study was carried out to have a better understanding of plant metabolic products under seasonal influences in four important arid zone medicinal plants, viz. *Barleria prionitis* Linn. [Bajradanti, Acanthaceae], *Boerhavia diffusa* Linn. [Punarnava, Nyctaginaceae], *Citrullus colocynthis* (Linn.) Schrad. [Tumba, Cucurbitaceae] and *Grewia tenax* (Forsk.) Fiori [Gangan, Tiliaceae]. Different parts of these plants are used in curing various diseases such as in urinary troubles, oedema, eye wounds, biliousness, fever, intestinal parasites, constipation, etc.

## MATERIALS AND METHODS

Leaf samples of all four arid medicinal plants were collected randomly in different seasons from respective habitats, viz. University New Campus for *Barleria prionitis*; University Old Campus Sports Ground for *Boerhavia diffusa* (6 km away in north-east direction from the University Campus); Circuit House, Jodhpur for *Citrullus colocynthis* (7 km in north-east direction); and Machia Reserve Park, Jodhpur for *Grewia tenax* (11 km away in north-west direction from the University Campus) during 2007-2009. Fully mature leaves exposed to sunlight were collected randomly during rainy (July-September), winter (December-February) and summer (April-June) seasons which were dried and used for plant analyses. Total alkaloids and phenols were quantified according to Higuchi and Bodin [4] and Sadasivam and Manickam [5], respectively. Experimental results were subjected to analysis of variance [ANOVA; 6] and mean values of two years are presented here.

## RESULTS AND DISCUSSION

The data on total alkaloids and phenols in four desert medicinal plants during different seasons are presented in Table 1. It is evident from this Table that total alkaloids ranged from 0.558-1.839 in *B. prionitis*, 0.294-1.584 in *B. diffusa*, 0.143-1.320 in *C. colocynthis* and 0.152-0.518% dry weight in *G. tenax*, whereas total phenols from 984.045-1689.68 in *B. prionitis*, 1092.48-1720.87 in *B. diffusa*, 1276.02-1625.95 in *C. colocynthis* and 648.783-1464.21  $\mu\text{g g}^{-1}$  dry weight in *G. tenax*. The values for both of these parameters were maximum during summer followed by winter and minimum in rainy season in all four plants. The obtained data for both metabolites in all plants were significant at 95% probability levels, except for total phenols in *G. tenax*, which was non-significant (Table 1).

**Table 1. Seasonal variations in secondary metabolites in four desert medicinal plants (values are the mean of six replicates).**

Plant species	Total alkaloids (% dry wt.)			CD	Total phenols ( $\mu\text{g g}^{-1}$ dry wt.)			CD
	Rainy	Winter	Summer		Rainy	Winter	Summer	
<i>B. prionitis</i>	0.558	0.771	1.839	0.751*	984.045	1088.23	1689.68	451.503*
<i>B. diffusa</i>	0.294	1.178	1.584	0.310*	1092.48	1310.68	1720.87	369.000*
<i>C. colocynthis</i>	0.143	0.598	1.320	0.446*	1276.02	1343.48	1625.95	198.077*
<i>G. tenax</i>	0.152	0.348	0.518	0.177*	648.783	1041.02	1464.21	727.735 <sup>ns</sup>

\* = Significant at  $P < 5\%$  probability level; and ns = non-significant.

The age and the stage of growth of the plant generally have an impact on phenolic contents [7]. Water stress can stimulate the accumulation of phenolic compounds. Deshmukh and Dhumal [8] observed that increase in water stress caused significant increase in polyphenol oxidase activity in *Sorghum bicolor*. According to Sen and Sharma [9] phenolic content increased under water stress by hydrolyzing the glycosides. Verma and Kasera [10], Swami *et al.* [11] and Gehlot *et al.* [12] observed maximum values of total alkaloids and phenols during summer season in *Sida cordifolia*, *Convolvulus microphyllus* and *Withania* species, respectively. The present results also confirm the above observations.

## CONCLUSION

Thus, it is concluded from the present studies that summer season was found to be most favourable for the production of secondary metabolites in these four arid medicinal plants. These secondary metabolites which can have therapeutic actions in humans can be refined to produce herbals.

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