



## HYPERTHERMIA AND CELL MEMBRANE PERMEABILITY IN SOME COMMON FERNS OF RAJASTHAN

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Effect of hyperthermia on cell membrane permeability in species of *Adiantum* L. and *Cheilanthes* Swartz from Rajasthan has been investigated. *Cheilanthes bicolor* (Roxb.) Fraser-Jenkins (*C. farinosa* auct. India non (Forsk.) Kaulf.) has been found to exhibit the highest membrane stability measured in terms of leaching of sugars and proteins in response to higher temperature while the least membrane stability has been observed in *A. capillus-veneris* L. Other taxa ranging in between these two.

**Key words:** Hyperthermia, Membrane permeability, Rajasthan ferns.

Pteridophytes require low temperature for their optimum growth. In spite of xeric and hostile climate, a good number of ferns occur in various part of Rajasthan (Gena 1998). Higher plants are known to manifest a wide spectrum of thermal tolerance. Many of the metabolic changes triggered are concerned with heat injury while a few are associated with heat tolerance. Very few efforts have been made to investigate the variability in thermal tolerance of the pteridophytic taxa (Sharma et al. 1977, Bohra et al. 1979, Yadav & Bhardwaja 1983, Yadav & Bhardwaja 1994, Kothari & Yadav 2003). Factors responsible for heat and drought resistance in plants can not be identified in absence of such studies. The present paper deals with the effect of hyperthermia on cell membrane permeability in widely distributed species of *Adiantum* and *Cheilanthes* occurring in Rajasthan. The material of *A. incisum* was collected from Harney Mahadev (Bhilwara), of *A. capillus-veneris* from Mainal (Chittorgarh) while that of *A. philippense* and *C. bicolor* from Ranakpur (Pali).

### MATERIALS & METHODS

Fresh leaves of mature plants of *Adiantum*

*capillus-veneris*, *A. incisum*, *A. philippense* and *Cheilanthes bicolor* were taken as experimental material. Thermal treatment of 40°C and 45°C were given according to Sullivan (1967). Observations were made of membrane permeability after an interval of 1h, 2h, 3h and 4h temperature treatments. Efflux of soluble sugars and proteins was taken as the criterion of membrane permeability (Kaloyears 1958). Sugars and proteins were measured according to Yem & Willis (1964) and Lowry et al. (1951) respectively.

### RESULTS

The results as shown in Table 1 indicate that the leaching of sugars and proteins being highest in *A. capillus-veneris* at 1h, 2h, 3h and 4h temperature treatments of 40°C and 45°C. Values for leaching of sugars and proteins in *Cheilanthes bicolor* were found to be least at all temperature treatments. This clearly indicate that *C. bicolor* exhibits maximum resistance to higher temperatures. Further, *A. incisum* shows more efflux of sugars and proteins than *A. philippense*.

Leaching of sugars in *A. capillus-veneris* was recorded to be 21.41% at 1 h treatment of 40°C which is three times of the values recorded in *C. bicolor* (7.63%). The leaching of sugars in *A. capillus-veneris* at 4 h treatment of 45°C temperature was found to be 89.70% while these were 50.36% in *C. bicolor*. The values of efflux of sugars in *A. incisum* and *A. philippense* fall in between these two.

In respect of leaching of proteins, it is 23.12% in *A. capillus-veneris* and 8.26% in *C. bicolor* at 1h treatment of 40°C temperature. The leaching of proteins in *C. bicolor* at 4h treatment of 45°C has been

found to be 54.17% while *A. capillus-veneris* shows highest percentage (94.34%) of leaching of proteins at 4h treatment of 45°C temperature. *A. incisum* and *A. philippense* range in between.

## DISCUSSION

Membrane damage is regarded to be a primary cause of thermal injury in plants (Berry et al. 1975). A positive correlation between membrane stability

Table - 1

Effect of hyperthermia on cell membrane permeability in leaves of some fern taxa of Rajasthan for specified period of time (values represented as % of control)

S. No.	Species	Locality		40°C				45°C			
				1 h	2 h	3 h	4 h	1 h	2 h	3 h	4 h
1.	<i>Adiantum capillus veneris</i>	Mainal (Chittorgarh)	Sugar	21.41	29.02	41.12	72.19	33.24	48.56	69.46	89.70
			Protein	23.13	29.21	47.33	69.18	40.73	55.15	74.17	94.34
2.	<i>A. incisum</i>	Harney Mahadev (Bhilwara)	Sugar	15.42	25.23	38.92	44.33	20.81	32.70	43.38	59.62
			Protein	14.63	27.16	46.44	54.76	22.19	37.23	44.03	64.93
3.	<i>A. philippense</i>	Ranakpur (Pali)	Sugar	13.14	20.92	29.73	39.56	17.36	29.18	40.62	53.25
			Protein	14.92	19.18	31.26	40.04	16.92	32.67	42.18	59.72
4.	<i>Cheilanthes bicolor</i>	Ranakpur (Pali)	Sugar	7.63	16.91	24.52	30.71	13.84	25.11	37.33	50.36
			Protein	8.26	18.32	27.17	36.42	17.63	32.70	38.90	54.17

and thermal tolerance has been observed in Sorghum (Sullivan 1967) and in some ferns of Rajasthan (Kaur & Yadav 1985, Yadav & Bhardwaja 1994, Kothari & Yadav 2003). In the present study also thermal treatment led to damage in membrane permeability as evident by efflux of sugars and proteins. *Cheilanthes bicolor* exhibits maximum resistance to higher temperature with the highest degree of membrane stability while *A. capillus-veneris* shows poor membrane stability under similar conditions. *A. incisum* and *A. philippense* range between these two. *Cheilanthes bicolor* with highest degree of membrane stability occurs widely in Rajasthan and withstands the drier conditions for a longer period in nature. *Adiantum capillus-veneris* occurs alongwith water channels only. It exhibits poor membrane stability and disappear immediately with the onset of drier conditions in nature. Cell membrane in *A. incisum*

and *A. philippense* is comparatively more stable than *A. capillus-veneris*. These observations support the view that the survival and growth periods of fern species is linked to their differential tolerance to the successively increasing temperatures of the habitat (Yadav & Bhardwaja 1983, 1994, Kothari & Yadav 2003).

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