American Journal of
Environment Studies
(AJES)

Effect of Hyperthermia on Photosynthetic Pigments of Some Selected Fern Taxa of Sitamata Wild Life Sanctuary, Rajasthan

Sharma Vinay and Bhawnani Jaya

AJP

American Journal of Environment Studies
ISSN 4520-4738 (Online)
Vol.5, Issue 2, pp 1 - 10, 2022

www.ajpojournals.org

Effect of Hyperthermia on Photosynthetic Pigments of Some Selected Fern Taxa of Sitamata Wild Life Sanctuary, Rajasthan

Sharma Vinay[1] and Bhawnani Jaya[2]

[1]Department of Botany, ASM Institute of Excellence, Asind, Bhilwara

[2]Department of Zoology, ASM Institute of Excellence, Asind, Bhilwara

Emails: vinaysharma337@gmail.com, jayabhawnani2013@gmail.com

Abstract

Rajasthan, the state is situated in the north western part of India and covers as area of 3, 42, 274 sq.km. Despite the hostile climatic conditions of the state, pteridophytes which otherwise known as shade and moisture loving plants. Sitamata wild life sanctuary is located at southwest region of Rajasthan. Different species of pteridophytes in this region exhibit significant variation in thermal stability of their photosynthetic pigments of some pteridophytic flora of Sitamata wild life sanctuary, Rajasthan. Studies reveal that total chlorophyll contents are maximum in *Ceratopteris thallictroides* and *Selaginella repanda* and minimum in *Ampelopteris prolifera*. The other species range between these two. Total carotenoid contents were found maximum in *Cheilanthes bicolor* and minimum in *Selaginella repanda.* These observations suggest that species with greater resistance to drought possess higher quantity of carotenoids and show lesser degradation in their chlorophyll pigments during stress conditions. Thus, *Ampelopteris prolifera, Cheilanthes bicolor* and *Christella dentata* are most resistant to heat and drought conditions while *A. capillus-veneris, Ceratopteris thallictroides* and *Selaginella repanda* are the least resistant taxa to heat and drought conditions.

Keywords: *Thermal stability, photosynthetic pigments, carotenoids, chlorophyll content*

1.0 INTRODUCTION

The dry and hot climate of Rajasthan display abundant growth of pteridophytes from end of July to mid October after which these start to dry up, the photographs of selected fern taxa were shown in figure1. Sharma *et al*. (1977) have established the importance of chlorophyll stability index as an important factor for heat and drought resistance in plants. A higher chlorophyll stability index indicates higher capacity for heat and drought resistance. Studies on photosynthetic pigments shows that total chlorophyll contents are maximum in *Ceratopteris thallictroides* and *Selaginella repanda* and minimum in *Ampelopteris prolifera*. The other species range between these two. Total carotenoid contents were maximum in *Cheilanthes bicolor* and minimum in *Selaginella repanda.* These observations support the findings of Rathode and Sharma (1991) who concluded that aquatic and shade loving plants have more amounts of chlorophylls and less of carotenoids while reverse are true in drought resistant types. Analysis of photosynthetic pigments in some pteridophytes was studied in ratnagiri district of Maharashtra suggested that changes were found in amount of chlorophyll pigments during formation of sporangia (Masal et al., 2010). Some Physiological studies including photosynthetic pigments like total chlorophylls, carotenoids, polyphenol, major organic and inorganic constituents of pteridophytic flora of Lohgad area of Maharashtra was studied by Gavade et al. (2015). The effect of arsenic (As) on photosynthesis of *Pteris cretica* studied by Zamanova et al. (2021) who reported that increasing doses of Arsenic decreases of net photosynthesis , Transpiration rate and photosynthetic pigments.

American Journal of Environment Studies
ISSN 4520-4738 (Online)
Vol.5, Issue 2, pp 1 - 10, 2022
www.ajpojournals.org

Figure 1: Showing photographs of *Ampelopteris prolifera, Christella dentata, Cheilanthes bicolor, Selaginella repanda, Adiantum capillus-veneris, Ceratopteris thallictroides*

2.0 MATERIAL AND METHODS

About 1gm of fresh leaves of mature plants was homogenized in 15 ml of 80% acetone. After centrifugation, the supernatant was used for quantitative analysis of photosynthetic pigments.Quantitative estimation of chlorophyll a, chl.b, total chlorophylls and total carotenoids was done following the method suggested by Robbelen (1957). Optical densities were recorded at 663 and 645 nm for chlorophylls and at 430 nm for total carotenoid contents using Systronics Spectrophotometer 106. Amount of chlorophylls and carotenoids were calculated as per the following formulae.

$$\text{Chl a (mg/gm fresh wt.)} = \frac{12.3 \times OD\ 663 - 0.86 \times OD\ 645}{a \times 1000 \times w} \times V$$

$$\text{Chl b (mg/gm fresh wt.)} = \frac{19.3 \times OD\ 645 - 3.6 \times OD\ 663}{a \times 1000 \times w} \times V$$

$$\text{Total chlorophylls (mg/gm fresh wt.)} = \frac{20.2 \times OD645 + 8.02 \times OD663}{a \times 1000 \times w} \times V$$

$$\text{Total carotenoids (mg/gm fresh wt.)} = \frac{4.75 \times OD\ 430 - (\text{Chl a} + \text{Chl b}) \times 0.226}{a \times 1000 \times w} \times V$$

V = Volume of solvent (Acetone) in which the Fresh material was crushed.

a = Length of light path in the cell which is usually 1 cm.

W = Fresh weight of material in gms. This was crushed.

To determine heat and drought resistance of the selected taxa, thermal treatments of 40°and 45°C were given to 1 gm fresh leaves in 20 ml distilled water (Sullivan, 1967) in a water bath for 1h, 2h, 3h and 4h time duration along with controls at room temperature. The leaves were then homogenized in 10 ml of 80% Acetone. Photosynthetic pigments (total chlorophylls and total carotenoids) were measured according to Robbelen's method (1957) by Systronics spectrophotometer 106, set at 100% transmittance using pure acetone as a blank. Optical densities were recorded at 650 nm and 430 nm respectively. Total chlorophyll contents and percentage degradation of total chlorophylls and carotenoids were calculated as per the following formulae:

$$\text{Total chlorophyll (mg/gm fresh wt)} = \frac{\text{OD 650 X V}}{\text{a X 34.5 X W}}$$

$$\text{\% degradation of total chlorophyll /carotenoids} = \frac{\text{A - B}}{\text{A}} \text{ X } 100$$

A = Total chlorophyll/carotenoids in control.

B = Total chlorophyll/carotenoids in treated plant.

A study of chlorophyll a, chlorophyll b, total chlorophyll and total carotenoids in leaves of mature plants of selected species of pteridophytes occurring in Sitamata wild life sanctuary, Rajasthan has been carried out. Photographs and data have been presented figure 1 and in table 1, respectively.

Table 1: Photosynthetic pigments (mg/gfw) in leaves of some pteridophytic taxa of Sitamata Wild Life Sanctuary, Rajasthan.

S.NO	Species	Chl a	Chl b	Total Chl	Total Carotenoids
1	*Selaginella repanda*	2.05	1.15	3.20	0.13
2	*Adiantum capillus- veneris*	0.98	0.46	1.44	0.38
3	*Ampelopteris prolifera*	1.21	0.19	1.40	0.43
4	*Ceratopteris thallictroides*	2.32	1.54	3.86	0.21
5	*Cheilanthes bicolor*	1.05	0.39	1.44	0.46
6	*Christella dentate*	1.20	0.59	1.79	0.39

3.0 RESULTS

Treatment of 1-4 hours at 40ºC lead to higher total chlorophyll content degradation in *Ceratopteris thallictroides* followed by *A. capillus-veneris* and *Selaginella repanda* while in *Christella dentata*, *Cheilanthes bicolor* and *Ampelopteris prolifera* it was comparatively low. A temperature treatment of 45ºC for 1-4 hours lead to further loss of total chlorophyll content which was comparatively more in *A. capillus-veneris*, *Ceratopteris thallictroides* and

Selaginella repanda. These species thus, show more thermal decay in total chlorophyll content compared to *Ampelopteris prolifera, Christella dentata* and *Cheilanthes bicolor. Ampelopteris prolifera, Cheilanthes bicolor* and *Christella dentata* show maximum degradation of total carotenoids after 4 hours treatment at 45ºC. This percentage of total carotenoid content degradation was recorded to be minimum in *Adiantum capillus-veneris, Ceratopteris thallictroides, Ampelopteris prolifera* and *Selaginella repanda.* Maximum percentage of total carotenoid degradation at 40ºC was observed in *Cheilanthes bicolor, Ampelopteris prolifera and Christella dentata* and it was to beminimum in *Adiantum capillus-veneris, Ceratopteris thallictroides,* and *Selaginella repanda.*

4.0 CONCLUSION

Inverse relationship in the degradation pattern of the two different types of photosynthetic pigments namely chlorophylls and carotenoides at higher temperatures is evident in ferns and fern allies of Sitamata forest of Rajasthan. Thermal decay in photosynthetic pigments is a limiting factor for plant growth and supra optimal conditions (Mothos, 1964). Bohra *et al. (*1979) and Yadav & Bhardwaja (1983) concluded that xerophytic species of ferns possess higher carotenoid contents and show lesser degradation of chlorophylls. This fits in well with the known functions of the carotenoids-protection of plants from photosensitised oxidation of chlorophyll pigments (Krinsky, 1966). The highest chlorophylls were found in gametophyte of *Adiantum flabellatum* and the highest carotenoids was obtained from the gametophyte of *Cheilanthus albomarginata* (Asia bibi et al., 2019).These observations suggest that species with greater resistance to drought possess higher quantity of carotenoids and show lesser degradation in their chlorophyll pigments during stress conditions similar observations have been made by Kothari and Yadav (2003). Pareek *et al.* (2005) and Tripathi *et al.* (2005) on some ferns and fern allies of Rajasthan. Thus, *Ampelopteris prolifera, Cheilanthes bicolor* and *Christella dentata* with higher degradation in carotenoids and greater stability in chlorophyll pigments are most resistant to heat and drought conditions while *A. capillus-veneris, Ceratopteris thallictroides* and *Selaginella repanda* with higher degradation in chlorophyll pigments are the least resistant taxa to heat and drought conditions.

Total chlorophyll contents among ferns and fern allies were found to be highest in *Ceratopteris thallictroides* (3.86mg/gfw) and lowest in *Ampelopteris prolifera* (1.40 mg/gfw). Highest amount of total carotenoids has been observed in Cheilanthes *bicolor (*0.46 mg/gfw) and lowest in *Selaginella repanda* (0.13 mg/gfw). These observations suggest that species with greater resistance to drought possess higher quantity of carotenoids. Thus, *Cheilanthes bicolor* and *A. prolifera,* which withstand the unfavourable conditions for longer period, contain higher quantity of carotenoids.

5.0 DISCUSSION

Among various metabolic changes underlying the mechanism of heat and drought tolerance of these taxa, mention may now be made of the effect of hyperthermia on total chlorophylls and carotenoids. The data have been presented in Table 2-3. A perusal of Table 2 reveals that different species exhibit significant variations in thermal stability of their photosynthetic pigments. Thus, an hour's treatment at 40^0C led to maximum chlorophyll degradation in *Ceratopteris thallictroides* (22.37%) followed by *A. capillus-veneris* with (18.63%), *S. repanda* (18.13%) and *Cheilanthes bicolor* it was (9.78%) while the minimum chlorophyll degradation was recorded in *Christella dentata* (3.62%). However, 4 hour's treatment at 40^0 C showed highest degradation of total chlorophyll contents in *Adiantum capillus-veneris* (61.99%) and Ceratopteris *thallictroides* (61.14%) and the lowest in *Ampelopteris prolifera*

(37.81%). Other species are ranging between these two. A temperature treatment of 45^0C for four hours led to further loss of total chlorophyll content which was comparatively more in *Adiantum capillus-veneris* (75.19%) and *Ceratopteris thallictroides* (70.60 %). These two texa show more thermal decay in total chlorophyll contents compared to *Cheilanthes bicolor* (47.00%), *Ampelopteris prolifera* (47.23%) and *Christella dentata* (51.11%). Data pertaining to carotenoid contents in response to specified periods of temperature treatment are presented in table-3. It may be observed from these data that *Cheilanthes bicolor* (13.51%), *Ampelopteris prolifera* (11.93%), *Christella dentata* (9.93%) and *Adiantum capillus-veneris* (9.92%) show higher degradation in carotenoid contents after 1-hour treatment at 40^0C. This percentage of total carotenoid content degradation was recorded to be lower in species of *Ceratopteris* and *Selaginella*. Almost similar pattern of carotenoid degradation has been observed at different time duration at 40^oC and 45^0C temperature treatment.

ACKNOWLEDGEMENTS

Authors are thankful to botany department of MLV Govt. College, Bhilwara for providing infrastructure and research facilities. We also appreciate Dr. Shahdab Husssain for his guidance and moral support.

REFERENCES

Alston in Proc. (1945).*Nat. Inst. Sci*., India, **11**: 217,

Asia, B. Shabbir, E. Sidra, R. Saima, A., (2019). Morphology and pigment content of sporophytes and gametophytes of ten fern species. *Bangladsh J. Bot*, 48(4): 951-956,

Bhardwaja, T. N. & Takkar, T. (1981). Systematics and evolutions of Marsileaceae with special referance to the Australion forms. *Abst. XIII International Botanical Congress*, Sydney: 280.

Benniamin, A. Irudayaraj, V. & Manickam, V. S. (2008). How to identify rare and endangered fern and fern allies. *Ethnobotanical leaflets*. **12**:108-117.

Bhardwaja T.N, Gena, C. B, and Verma, S. (1987). Status survey of pteridophytic Flora of Rajasthan with special reference to Endangered Fern and Fern allies. *Indian Fern J*. **4**:47-52.

Bir S.S., (1988). Evolutionary Trends in the Pteridophytic Flora of India. Presidential Address, Sect. of Botany 75th Indian Sci. Congr. Assoc. Session, Pune (India). : 1-56

Bir, S.S. & Vasudeva, S.M. (1972). Ecological and Phytogeographical observation on the pteridophytic flora of Pachmarhi hills (Central India). J. Indian Bot. Soc**. 51** : 297-304.

Bir, S.S. & Verma, S.C. (1963). Ferns of Mt. Abu. *Res. Bull.* (NS). Punjab Univ. **14**: 187-202.

Bir, S.S. (1987a). A Pteridophytic flora of India: Rare and endangered elements and their conservation. *Indian Fern. J.* **4**: 95-101.

Bir, S.S. (1987b). Pteridology in India. *Indian fern. J.* **4**: 104-150.

Bir, S.S. (2003). Name Changes and New Taxa Published from India in Pterdophytes. *Indian Fern.J.* **20**: 105-179.

Bir, S.S., Suman, R. & Verma, S.C. (1986). Pteridophytic flora of Simla Hills (North Western Himalayas), Families Osmundaceae, Adiantaceae & Cryptogrammaceae *Indian fern J.* **3**: 22-37.

Bir, S.S., Satija, C.K. & Bir, P. (1982). Ecology, distribution and phytogeography of Indian members of Polypodiaceae. *Aspects of Pl. Sci*. **6**: 1-24.

Bir, S.S., Vasudeva, S.M., Kachroo, P. & Singh, Y. (1991). Pteridophytic flora of North Eastern India V. Ecological distributional & Phytogeographical account. *Indian fern J.* **8**: 98-139.

Bohra, D.R., Soni, S.R. & Sharma, B.D. (1980). Survey on the pteridophytic flora of Rajasthan. *Geobios.* **7**: 334 – 336

Botanical Survey of India, (1983). Flora and Vegetation of India- an outline. Botanical Survey of India, Howrah, Pp. 24.

Campbell, D.H. (1907). Studies on the ophioglossaceae. *Am. Nat.* **41**: 139-159.

Champion H.G. & Seth, S.K. (1968). A revised survey of forest types of India, Delhi.

Choudhary, B.L. & Dulawat, C.S. (2006). Distribution of Fern-Allies in Sitamata Wild Life Sancturry, Rajasthan. *Indian Fern. J.* **23**: 75-82.

Das, S. (2000). Taxonomy, conservation stretegies of bipinnate species of fern genus *Asplenium* L. in India. *Indian Fern J.* **17**: 109-128.

Das, S. (2007). Taxonomic revision of Indian species of *Pteris* L. with simple-pinnate fronds. *Indian Fern Journal*. **24**: 60-70.

Dixit, R.D. (1984). A census of the Indian pteridophytes. F I *India series.* **4** BSI.

Dixit, R.D. (1989). Ecology and taxonomy of pteridophytes of Madhya Pradesh *Indian Fern J.* **6**: 140-159

Dixit, R.D. & Singh, S. (2004). Enumeration of the rare, endangered & endemic pteridophytes from central India. *Indian Fern J.* **21**: 96-108.

Gavade, V. V., Prashanth, M. S., kadam, P. S. (2015). Physiological studies in pteridophytes of Lohgarh area, Pune, India. *Bioscience research Bulletin*. **31** (1,2), 13-20.

Gena, C.B. & Bhardwaja, T.N. (1984). Three new species of *Isoetes* L from Rajasthan India. *J. Bombay Nat. Hist. Soc.* **81**: 165-168.

Gena, C.B. (1998). Systematics and Taxonomy of Pteridophytes of Rajasthan. *Indian Fern. J.* **15**: 139-148.

Gena, C.B., Bhardwaja, T.N. & Sen, S. (1981). Distribution and ecological studies on Rajasthan species of *Isoetes* L. *Indian fern J.* **4**: 51-54.

Gupta, K. M. & Bhardwaja, T. N. (1957). Indian marsileas: Their morphiology and systematics on the examination of some collection of Marsilea in India. *J. Bombay nat. Hist. Soc.* **54**: 550-567.

Gupta, K.M. (1962). *Marsilea Botanical Monograph* 2. CSIR, New Delhi. 1-113.

Harsh, R. & Sharma, B.D. (1994). Pteridophytes of Rajasthan: Phytochemistry of *Azolla pinnata* Brown. *Indian Fern. J.* **11**: 150-152.

Holttum, R.L. (1938). The ecology of tropical Pteridopihytes In: F.R. Verdoom (ed.) *Manual of Pteridology*: Haugue Nijhoff, 420-450.

Leena, K.R. & Madhusoodanan, P.V. (1992). Ecology and distribution of the Thelypteroid ferns of South India. *Indian fern J.* **9:** 174-183.

Mahabale, T.S. & Kharadi, R.G. (1946). On some ecological features in the vegetation of Mt. Abu. *Nat. Acad. Sci.* **16**: 53.

Mahabale, T.S. (1962). Species of Ophioglossum in India. Their taxonomy and phylogeny. *Bull Bot Surv. India* **4**: 71-84

Manickam, V. S., Harikrishanan, S. & Benniamin, A. (2004). Additions to the pteridophytic flora of the Sirumalai hills, South India. *Indian Fern J.* **21**: 126-132.

Manickam, V. S. & Irudayaraj, V. (1992). Cytology of ferns of the Western ghat south India. Today & Tommorow Printers and Publishers, New Delhi.

Masal, V.P., Sheikh S.D, Dongare, M., (2010). Photosynthetic pigments in some pteridophytes of ratnagiri district (MS) India. *BIOINFOLET*, **7** (3) 230-232

Mehra, P.N. & Bir, S.S. (1960 b). Cytological observation on the Himalayan species of the *Athyrium* & comments on the evolutionary status of genus. *Amer. Fern. J.* **50**: 276-295.

Mehra, P.N. & Bir, S.S. (1964). Pteridophytic flora of Darjeeling and Sikkim Himalayas. *Res. Bull. (NS) Punjab Uni. Sci.* **15**: 69-182.

Mital, P.L. (1968). Ferns and fern-allies of Rajasthan. *J. Bombay Nat. Hist. Soc.* **88**: 31-42.

Panigrahi, G. & Patnaik, S.N. (1968). Studies on the Polypodiaceae in Eastern India. Distribution and ecology. *J. Indian Bot. sci.* **47**: 1-8.

Pant, S & Samant, S.S. (2006). Diversity and Distribution Pattern of the Pteridophytes of Mornaula Reserve Forest of Kumaun in Western Himalaya. *Indian Fern J.* **23**:19-27.

Pande, P. C. and Pande, H.C. (1991). Pteridophytic flora of Kumaun Himalaya. Additions and corrections. *Indian Fern J.* **8**: 24-30.

Pareek, P, Meena, D.K. & Sharma, V. (2006). Distribution of some Leptosporangiate ferns of Rajasthan. Pteridophytic flora of Rajasthan-present status Proc. National Con. on Biodiversity Cons. MLV College, Bhilwara. 21-22 Sept.06 Page 80-83.

Raja, P., Manickam, V.S. & Gopalkrishnan, S. (1992). Ecophysiological studies on the ferns of Kothayar and Palni Hills. *Ind. Fern J.* **9**:138-143.

Seth, M.K., Kumari, Anjana, Bhandari, Ajai & Khullar, S.P. (2002). Common Pteridophytes of Simla (Himachal Pradesh), N.W. Himalaya III: Polipodiaceae Loxogrammaceac, Cryptogrammaceae, Sinopteridaceae and Osmundaceae. *Indian Fern J.* **20**: 10-33.

Seth, M.K., Seth, A. & Negi, H. C. (2004). Pteridophytic flora of Kinnaur, Himachal Pradesh part-1: A general account of Kinnaur District & eight species belonging to suborder pteridineae of order pteridales. *Indian Fern J.* **21**: 45-62.

Sharma, B.D., Bohra D.R., (1977). Year round Pteridophytic flora of Mount Abu. *Geobios.* **4**: 102-103

Sharma, B.D. & Purohit, S.N. (1985). Ferns and fern allies of Rajasthan leaf Water deficit in relation to resurrection habit. *Indian Fern J.* **2**:57-67.

Sharma, S.N., Gena, C.B. & Verma, S. (1988). A Survey of pteriodopytic flora of Haroti plateau, Rajasthan, India. *Indian fern J.* **5**: 58-62.

Stewart, R.R. (1945). The ferns of Kashmir. *Bull. Torrey Bot. Cl.* **72**: 137-142.

Srivastava, G.K. (2005). Systematics, biogeography & diversification of Indian quillworts (*Isoetes* L) *J. Indian Bot. Soc.* **84**: 1-11.

Sutaria, R.N. (1941). Flora of Mt. Abu. J. Bombay Univ. 9 (5): 64-68.

USDA (United State Department of Agriculture) Hard book No. 60, (1954). Diagnosis and improvement saline and alkali soils IBH publ co. New Delhi.

Tryon, R.M. & Tryon, A.F. 1982). Fern and allied plants with special reference to Tropical America Springer Verlag New York, Neidelberg Berlin.

Vasudeva, S.M. and Bir, S.S. (1987). Ecological and Texonomical observation on the pteridophytic flora of Tamia hills and patal Kot valley (Dist. Chhindwara) Madhya Pradesh, Central India. *Indian Fern J.* **4**: 1-13

Verma, S.C.(1956). Cytology of *Ophioglossum. Curr.Sci* **25**:398-399

Verma, S.C. & Mani Selivan P (2001). A check list of ferns of Kalka & kasauli hills from N W Himalaya with some comments *Indian Fern J.* **18**(1-2) : 102-110.

Williams, S. (1938). Experimental morphology. (eds. F. verdoon) *Manual of Pteridology*, Hague, Mijhoff. 105-140.

Wallace, J., Chapman, M., Sullivan, J. & Bhardwaja, T.N. (1984). Polyphenolics of *Marsileaceae* and their possible phytogenetic utility. *Amer. J. Bot.* **71**: 660-665.

Yadav, B.L. (1986). Interesting anatomical features of fern genus *Ophioglossum* of Rajasthan. Nat. Sym. Biol. Indian pterid. Punjab Univ. Patiala Abst. pp 8-9.

Yadav, B.L., Bhardwaja, T.N. & Gena, C.B. (1989). SEM studies of five species of *Ophioglossum* L. of Rajasthan India. *Phytomorphology*. **39** (2, 3): 209-212.

Yadav, B.L. 1990. Ecological studies on Rajasthan species of *Ophioglossum Indian fern J.* **7**: 44-48.

Yadav, B.L. (1997). Role of some xerophytic ferns in soil conservation Nat. conf. on Envi. and ecodev. of Puskar valley of Rajasthan Abst Vol PP: 76.

Yadav, B.L. & Tripathi, M.K. (2006). Pteridophytic flora of Rajathan - present status Proc. National Con. On Biodiversity Cons. MLV College, Bhilwara 21-22 Sept.06 Page 49-53.

Zemanova, V., Pavlikova, D., Hnilicka, F., Pavlik, M., Zamecnikova, H., Hlavsa, T., (2021). A comparison of the photosynthetic response to arsenic stress in two *Pteris cretica* ferns. *Photosynthetica*. 59 (1), 228-236.

APPENDIX

Table 2: Stability of photosynthetic pigments (total chlorophylls) in leaves of some pteridophytic taxa of Sitamata Wild Life Sanctuary, Rajasthan, at various temperature regimes for a specified period (values represented as % degradation)

S. No.	Species	40°C				45°C			
		1h	2h	3h	4h	1h	2h	3h	4h
1.	*Selaginella repanda*	18.13	24.46	40.67	56.27	22.56	33.93	46.78	63.46
2.	*Adiantum capillus-veneris*	18.63	39.72	52.06	61.99	24.62	43.67	69.11	75.19
3.	*Ampelopteris prolifera*	11.66	16.98	23.30	37.81	12.94	19.59	29.15	47.23
4.	*Ceratopteris thallictroides*	22.37	34.57	53.00	61.14	26.80	42.64	59.94	70.60
5.	*Cheilanthes bicolor*	9.78	14.09	28.15	41.43	13.73	17.71	33.34	47.00
6.	*Christella dentata*	3.62	9.10	19.35	39.18	6.72	13.91	42.29	51.11

Table 3: Stability of photosynthetic pigments (total carotenoids) in leaves of some pteridophytic taxa of Sitamata Wild Life Sanctuary, Rajasthan, at various temperature regimes for specified period. (Values represented as % degradation.)

S. No.	Species	40°C				45°C			
		1h	2h	3h	4h	1h	2h	3h	4h
1.	*Selaginella repanda*	8.67	12.82	21.33	30.25	11.14	16.71	33.14	44.58
2.	*Adiantum capillus-veneris*	9.92	15.58	22.86	26.18	12.22	18.75	26.08	36.17
3.	*Ampelopteris prolifera*	11.93	19.62	26.09	40.24	15.82	23.34	32.91	47.65
4.	*Ceratopteris thallictroides*	6.25	18.12	21.25	29.73	8.75	21.87	26.85	36.87
5.	*Cheilanthes bicolor*	13.51	20.90	30.63	38.73	18.91	29.72	44.14	56.75
6.	*Christella dentata*	9.93	17.57	27.48	36.64	13.74	22.90	33.58	47.20