sharp, increasing in number posteriorly from 3 to 7 rows; vomerine teeth also in several rows, mandibles with a single row of teeth. A median interorbital pore, paired pores on head near snout and behind eye respectively. 28 overlapping branchiostegal rays visible on either side in a specimen of length 230 mm TL. Colour brown above, lighter below.

Distribution : Indo-Pacific : Zanzibar to Kosi Bay and Coromandel Coast.

Discussion : The specimens collected from Yanam, belong to the Indo - Pacific species *Cirrhimuraena playfairii* (Gunther), which can be easily distinguished from its congeners *C. inhacae* Smith (McCosker & Castle, 1986) also from the African coast and the three other species, *C. tapeinopterus* Blkr., *C. chinensis* Kaup and *C. chilopogon* (Blkr). from the Indo-Australian Archipelago (Weber and de Beaufort, 1916) by its very slender body, smaller pectorals and the number of rows of teeth in the upper jaw. It also differs from the fringed lip eel *Brachysomophis cirrhocheilus* (Blkr.) from Sri Lanka (Munro, 1955) in the absence of papillae on the lower lips. However, a few differences were observed in the morphometric characters of the specimens from Yanam *viz.* the pectorals are very short, 3.82 — 6.61 in head Vs. 3.5 — 3.8 in typical *C. playfairii* and the number of teeth rows are more 3-7 Vs. 3-4.

Zoological survey of India,
Southern Regional Station, Chennai

K. Rema Devi
M. S. Ravichandran

References

McCosker, J. E. and P. H. J. Castle, 1986. Ophichthidae, pp. 176—186 In *Smiths' Sea Fishes*, Edited by Margaret M. Smith and Phillip C. Heemstra.

Munro, I. S. R, 1955. *The Marine and freshwater Fishes of Ceylon.* Dept. of External affairs, Canberra. 349 pp.

Weber, M. and L. F. De Beaufort, 1916. *The Fishes of the Indo-Australian Archipelago,* Leiden, Vol. III, 455 pp.

EFFECT OF TRACE ELEMENTS ON THE RATE OF CARBON PRODUCTION IN MARINE PHOTYPLANKTON AT DIFFERENT TEMPERATURE

Abstract

The alteration in trace metal (Cu. Mn and Zn) toxicity was assessed in terms of rate of carbon production at different temperature in two unicellular algae *Synechocystis salina*, Wislouch and *Isochrysis galbana* Parke. The rate of carbon production was maximum at 15°C for *S. salina* and at 30°C for *I. galbana*. Metal toxicity increased at higher temperature (40°C) by inhibiting carbon production to a larger extent.

Many of the trace elements are normal constituents of marine organisms and are essential for their metabolism. However, at higher concentrations, these elements become toxic. Copper, manganese and zinc play specific roles in algal nutrition. Only a few reports lay emphasis on the modification of metal toxicity at different temperture. Mandelli (1969) has discussed copper accumulation rates on growth and survival of algae in different thermal regimes. Uptake of ^{65}Zn in *Dunaliella tertiolecta* and toxicity of zinc to *Nitzchia linearis* were investigated by Patrick (1971). The present study deals with the role of temperature in modifying metal toxicity in *Synechocystis salina*. Wisoluch and *Isochrysis galbana* Parke.

The first author expresses gratitude to ICAR / UNDP for offering the Senior Research fellowship to undertake this research work.

The two unicellular algae *Synchocystis salina* Wistouch (blue green alga) and *Isochrysis galbana* Parke (golden yellow flagellate) were grown in Miquel's medium under a light intensity of 34.61 x 10^{15} quanta cm^{-2} x sec^{-1}, photoperiod of 10:14 hrs and a salinity of 15-20‰ for *S. salina* and 30—35‰ for *I.galbana*. Cultures from the logarithmic phase were used for toxicity tests.

TABLE 1. *Effect of Cu, Mn and Zn on the rate of carbon production (mgC/1/hr) at different temperatures in S. salina.*

Metal	Concn. (ppm)	20°C	25°C	30°C	35°C	40°C
	0.050	3.84	14.40	6.22	5.14	3.40
Cu	0.100	3.16	12.26	6.01	4.94	2.95
	0.150	2.52	08.32	5.60	4.32	2.20
	0.050	2.91	11.85	6.11	5.26	3.24
Mn	0.100	3.62	12.60	6.72	5.30	3.56
	0.150	4.14	13.16	7.08	5.82	3.60
	0.020	3.76	11.94	5.96	4.98	3.04
Zn	0.050	4.02	13.36	6.54	5.42	3.28
	0.070	3.40	10.25	5.18	4.80	2.30
Control		2.64	11.24	5.80	4.89	2.25

An automatic temperature control system was fabricated for conducting experiments under different temperture (20°C, 25°C, 30°C, 35°C, 40°C) simultaneously. Stock solutions of Cu, Mn, and Zn (spectrosol — BDH) were filter sterilized by passing through millpore membrane filters (0.45 μm) before supplementing to the culture medium. The rate of photosynthetic activity was determined by ^{14}C technique (Steemann Nielsen, 1965).

Very little is known about the impact of temperature of increasing on decreasing the toxic effect of metals on algae. Table 1 and 2. shows the variation in the rate of carbon production at different temperature in *S. salina* and *I. galbana* in different concentrations of Cu, Mn, Zn.

TABLE 2. *Effect of Cu, Mn and Zn on the rate of carbon production (mgC/1/hr) at different temperatures in I. galbana.*

Metal	Concn. (ppm)	20°C	25°C	30°C	35°C	40°C
	0.050	0.981	1.42	7.24	5.60	0.714
Cu	0.100	0.840	1.08	7.06	5.12	0.670
	0.150	0.812	0.94	6.40	4.46	0.502
	0.050	1.08	1.90	7.30	5.42	0.738
Mn	0.100	1.24	2.32	7.50	5.70	0.761
	0.150	1.32	2.24	7.62	5.96	0.810
	0.050	0.974	1.56	7.10	5.76	0.748
Zn	0.100	0.962	1.68	7.32	5.82	0.761
	0.150	0.928	1.02	6.98	5.06	0.620
Control		0.958	1.10	6.84	4.62	0.520

Maximum rate of carbon production was observed at 25°C in 0.02ppm, 0.15ppm Mn and 0.05 ppm Zn for *S. salina* and at 30°C in 0.05ppm Cu, Zn and 0.15ppm Mn for *I. galbana* respectively. The variation in the temperature optima may be due to the fact that the enzymatic process controlling the cell division and photosynthesis are different (Innis and Ingraham, 1978). A reduction in the rate of photosynthesis at higher temperature above 40°C may be due to an increase in the viscosity of protoplasm, denaturation of proteins of nutritional starvation (Hunter *et. al.*, 1957).

Patrick (1971) indicated that the toxicity of zinc to *Nitzchia linearis* increased with increasing temperature from 22°C to 30°C, whereas Cairns *et. al.* (1978) noted contradictory effects of zinc on different algae. For *Cyclotella manaeghiniana*, zinc toxicity increased with increase in temperature as observed in the present study in *S. salina* and *I. galbana* but for *Scenedesmus guadricanda*, zinc toxicity decreased.

Thus, the results suggest, the need for a more intensive research to trace the possible effects and the role of environmental factors in modifying trace metal toxicity on microalgae.

Department of Botany, Lady Doak College, Madurai 625 002.

S. SRISUDHA
P.V. RAMACHANDRAN NAIR*

*Rtd. Joint Director C.M.F.R.I. Cochin

REFERENCES

CAIRNS, J. JR., A. L. SUKENA., A. G. HEATH AND B. C. PARKER, 1978. *Virginia Polytechnic Institute and State University Bull* : 106.

HUTNER, S. H., H. BAKER., S. AURONSON., H. A. NATHAN., RODRIGUEZ., S. LACKWOOD., M. SANDERS AND R. A. A. PETERSON, 1957. *J. Protozool* 4 : 259-269.

INNIS, W. E. AND J. L. INGRAHAM, 1978. In *Microbial life in extreme environments*, D. J. Kushner (de) Acad. Press 73 - 104.

MANDELLI, E. F. 1969. *Cont. in mar. Sci.* 14 : 47 - 57

PATRICK, R. 1971. Report in Water Quality Criteria Washington DC: National Academy of Sciences, National Academy of Engineering (Quoted by Cairns *et. al.* 1978).

STEENANN NIELSEN, E. 1965. *Limnol. Oceanogr.* 10 (supple) : R 247 – R 252.