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 — 6.6P in head Vs. 3.5 — 3.8 in typical *C. playfairii* and the number of teeth rows are more 3-7 Vs. 3-4.

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**REFERENCES**


**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 temperature. 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 *Synecocystis salina*. Wisoluch and *Isochrysis galbana* Parke.

The present study deals with the role of temperature in modifying metal toxicity in *Synecocystis 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 *Synecocystis 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>
<thead>
<tr>
<th>Metal</th>
<th>Conc. (ppm)</th>
<th>20°C</th>
<th>25°C</th>
<th>30°C</th>
<th>35°C</th>
<th>40°C</th>
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<tbody>
<tr>
<td>Cu</td>
<td>0.050</td>
<td>3.84</td>
<td>14.40</td>
<td>6.22</td>
<td>5.14</td>
<td>3.40</td>
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<td>0.100</td>
<td>3.16</td>
<td>12.26</td>
<td>6.01</td>
<td>4.94</td>
<td>2.95</td>
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<tr>
<td></td>
<td>0.150</td>
<td>2.52</td>
<td>08.32</td>
<td>5.60</td>
<td>4.32</td>
<td>2.20</td>
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<tr>
<td>Mn</td>
<td>0.050</td>
<td>2.91</td>
<td>11.85</td>
<td>6.11</td>
<td>5.26</td>
<td>3.24</td>
</tr>
<tr>
<td></td>
<td>0.100</td>
<td>3.62</td>
<td>12.60</td>
<td>6.72</td>
<td>5.30</td>
<td>3.56</td>
</tr>
<tr>
<td></td>
<td>0.150</td>
<td>4.14</td>
<td>13.16</td>
<td>7.08</td>
<td>5.82</td>
<td>3.60</td>
</tr>
<tr>
<td>Zn</td>
<td>0.020</td>
<td>3.76</td>
<td>11.94</td>
<td>5.96</td>
<td>4.98</td>
<td>3.04</td>
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<td>0.050</td>
<td>4.02</td>
<td>13.36</td>
<td>6.54</td>
<td>5.42</td>
<td>3.28</td>
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<td>0.070</td>
<td>3.40</td>
<td>10.25</td>
<td>5.18</td>
<td>4.80</td>
<td>2.30</td>
</tr>
<tr>
<td>Control</td>
<td>2.64</td>
<td>11.24</td>
<td>5.80</td>
<td>4.89</td>
<td>2.25</td>
<td></td>
</tr>
</tbody>
</table>

An automatic temperature control system was fabricated for conducting experiments under different temperature (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 millipore membrane filters (0.45 µm) before supplementing to the culture medium. The rate of photosynthetic activity was determined by 14C 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.

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 guadricandana*, 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.

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