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Phytoplankton copper requirement under iron limited condition in the coastal Bay of Bengal

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Copper, a redox reactive transition metal, plays a vital role in many cellular redox reactions. Recent investigations show that many eukaryotic microorganisms including marine and coastal diatom utilize copper to perform a high affinity iron acquisition mechanism and the requirement of copper increases with decreasing iron concentrations. However, very less information is available about the role of copper in diatom physiology. Here we report for the first time about the copper utilization by coastal diatom during iron limited condition in the Bay of Bengal coast. The diatom Chaetoceros gracilis was isolated from the Visakhapatnam coast and was grown in different copper concentrations (15nM -1000nM). The concentration of total chlorophyll, the growth rate, the concentration of biogenic silica, the ratio of biogenic silica to particulate organic carbon and the ratio of total chlorophyll to particulate organic carbon were found to be increased with increasing copper concentration up to 125nM and decreased thereafter reaching a minimum value at 1000nM. [U+F064]13C of Particulate organic carbon varied inversely with increasing copper concentrations indicating the signature of enhanced carbon fixation which is in agreement with the enhanced biomass and growth rate. However, to get a better understanding about the role of copper behind the enhanced growth, we had incubated the cells simultaneously in iron replete, copper replete and in varying copper concentration in presence of 200nM of iron. Surprisingly, in all cases significant enhancement in growth and biomass production was observed. The cells grown in only iron and added with copper showed very similar increase whereas, in presence of iron increasing copper concentration did not show any enhancement effect. Increased growth and biomass production in response to iron addition shows that phytoplankton growth is limited by iron in the study area. Furthermore, this observation indicates that in case of iron limitation the coastal diatom perform a high affinity iron acquisition mechanism where copper plays a vital role. Down regulation of high affinity iron acquisition mechanism was indicated by unaltered growth when copper was added in presence of iron. Collectively, our present study shows that copper likely plays an important role in the physiology of coastal diatom apart from the toxicological studies conducted earlier. A detailed investigation is needed to understand the high affinity iron acquisition mechanism existing in coastal diatom from the study area.