COPPER TOXICITY TO ALGAE (CHLORELLA VULGARIS)

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ABSTRACT: The present work was carried out to observe the effect of copper on Algae under controlled conditions. Temperature was kept constant at 26°C. pH and light illumination were also kept constant. Under these conditions the effect of copper was observed on chlorophyll contents, growth rate, protein production, and LDH enzyme activity (Lactic Dehydrogenase). The amount of copper was varied from 1 to 12 P.P.M. Both the chloride and E.D.T.A. complex of copper chloride rather than E.D.T.A. Bristol media and Chu. No 10 was used as growth media. The cells were analyzed to see the effect of copper on chlorophyll contents and metabolic activities, it was observed that maximum metabolic activity were present in the batch containing 5 P.P.M. copper chloride as copper source. Beyond this amount the metabolic activities of algal cells starts decreasing ultimately decreasing cell growth with high protein production, LDH activity was observed in this batch. Minimum growth was observed in the batch containing 12 P.P.M. copper.

INTRODUCTION

Algae being a very good source of proteins needs certain trace elements for it growth [1]. The most important trace elements in this connection is copper [2]. However a definite amount of the metals present in growth media is taken up by the algal cells [3]. If an excessive amount of copper is present it causes toxicity to algae damaging the cell wall [4]. There are conflicting reports wither the copper is taken up as copper ions or as its up take complex [4]. However if the copper is present as in equimoler concentration, its up take is much more higher than that of their complexes like E.D.T.A. (Ethylene diamine tetra acetate) or T.D.P.A. (Diethyl triamino pentadi acetate) [7]. Copper also takes part in the redox system of algal cells, however its activity is affected by the concentration of other trace elements in working medium [8]. Copper also takes parts in photo systems of algae. On analysis of algal mass, they are found to be an essential part of many proteins. An increase in copper concentration disturbs the vitamins and other nutrients in media [10].

MATERIALS AND METHODS

Algal strain Chlorella Vulgaris taken from Shalimar Gardens Ponds was used as algal culture. Trace metal solution was prepared in distilled water with chlorides and EDTA complexes of copper in twelve flasks containing 1 to 12 P.P.M. of copper solution.

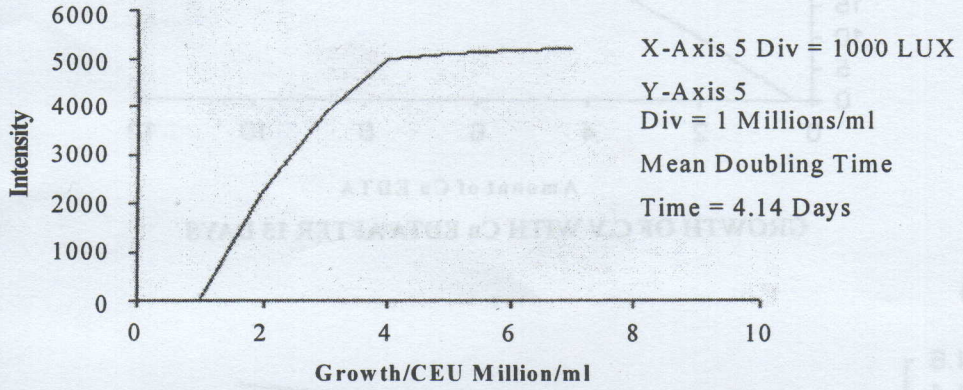
Batch culture was studied in 1-litre Pyrex glass conical flasks. 15 days old culture were selected for analysis. Growth rate was determined by counting cells using Heamocytometer determined growth rate. (Superior No. 644055 West Germany). pH was controlled by pH tablets from 4 to 8, the range in which studies were carried out. Temperature variation was studies by varying No. of tube lights. Total protein Fats, and carbohydrates were determined [5]. While carbohydrates determined with spectrophotometer [9] (Sequa Turner U.S.A.) LHD activity was studied with Neo Dieken Kit (Japan). Amino Acid essay was done with paper chromatography using paper as stationary phase and ether: ethanol as mobile phase. Total nitrogen determine by Kjaldhas method and fats by soxhlet apparatus and carbohydrates by difference.

RESULTS AND DISCUSSION

Twelve sets with copper chloride and twelve with E.D.T.A. complex having copper 1 to 12 P.P.M. in Bristol medium were run. Temperature, pH and light intensity were kept constant. Algal mass was analysed for growth rate chlorophyll contents, proteins, lipids and LHD activity. Maximum metabolic activities were obtained in the batch containing 5 P.P.M. copper as copper chloride in Bristol medium. Beyond this amount copper starts becoming toxic to algal cells decreasing the metabolic functions. Hence 5 P.P.M can be the optimal dosage of copper in this medium after which copper starts becoming toxic. The mean doubling time was 3 days, while 57.4% moisture and 10% proteins and maximum LHD activity was

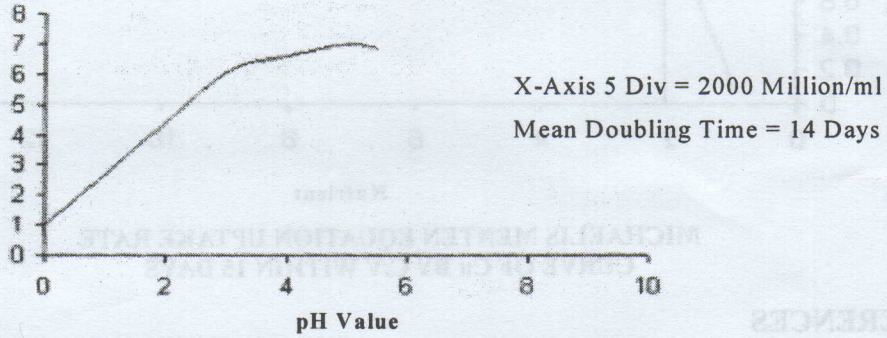
observed in the batch containing 5 P.P.M copper (as evident from the Figure (3). The increase in growth rate was due to the vital role of copper in photo system 1 and 2 and in many vitamins, enzymes and proteins especially in multi copper proteins, Blue and non Blue proteins and in super oxide dismutase. The decrease in cell growth and other activities is due to copper toxicity expanding the algal cell wall.

Figure (1)



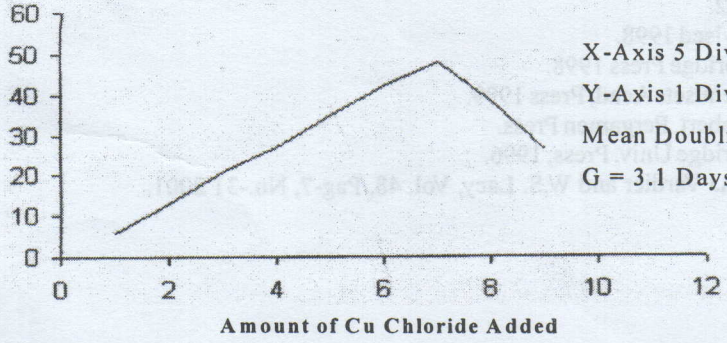
EFFECT OF LIGHT INTENSITY ON CHORELLA VULGARIS

Figure (2)



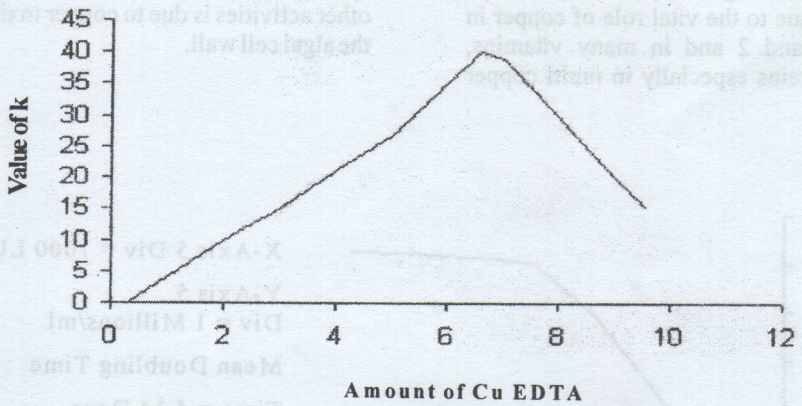
EFFECT OF pH ON THE GROWTH OF C.V IN BRISTOL MEDIS AFTER 15 DAYS

Figure (3)



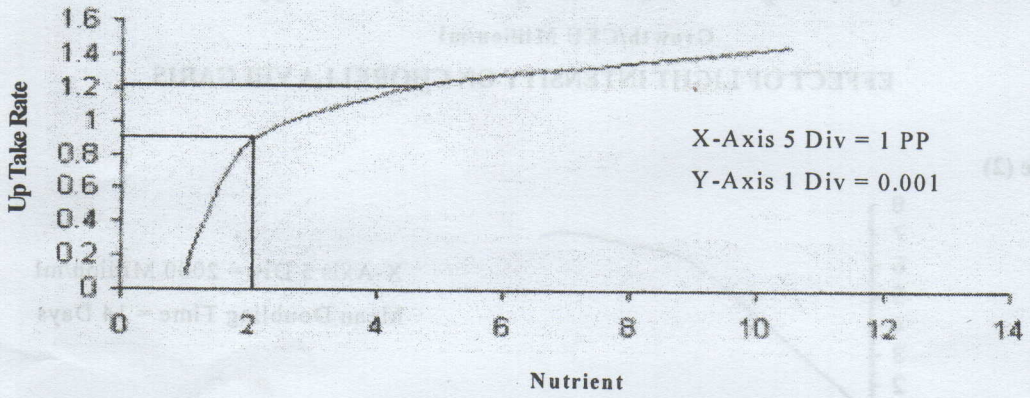
GROWTH OF C.V IN Cu CHLORIDE AFTER 15 DAYS

Figure (4)



GROWTH OF C.V WITH Cu EDTA AFTER 15 DAYS

Figure (5)



MICHAELIS MENTEN EQUATION UPTAKE RATE CURVE OF Cu BY C.V WITHIN 15 DAYS

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