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Comparative Toxicity Assessment of NaCl and CuSO₄ on Cell Plasticity of Microalga, *Scenedesmus* sp. Chodat

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ABSTRACT

Toxicity is main restrictive factors of plant productivity both in aquatic and terrestrial, natural and anthropically changed environment. Fresh water algae have concerned considerable attention in this respect since they are unpretentious structural organization and short life cycle and can make available indicators for environment monitoring. Thus the study planned to distinguish the toxicity of copper sulphate and sodium chloride on growth and cell plasticity of microalgae species, *Scenedesmus* that isolated from a polluted site of lower Lake of Bhopal, were accordingly evaluated. At concentration of 1.5 mg L⁻¹ CuSO₄ solution, cells become yellow due to the degradation of green pigment whereas NaCl affect only cell size. At concentration 2 to 2.5 mg L⁻¹ of CuSO₄, the coenobium cell become scatter with holes and the cell dimension become 10.1×2.3 to 9×1.6 µm. At the same concentration of NaCl the cell dimension of *Scenedesmus* sp. reduced to 11.4×3.4 to 10.9×2.9 µm. The mean dimension changes due to copper toxicity are 10.2×2.5 µm and NaCl toxicity are 11.4×3.5 µm. From the above result it is clear that the copper sulphate is highly toxic then NaCl that damage the cell plasticity of *Scenedesmus* sp.

Key words: CuSO₄, NaCl, *Scenedesmus* sp., cell dimension

INTRODUCTION

The effect of heavy metal on aquatic organisms is currently attracting wide attention, particularly in studies related to industrial and anthropogenic pollution. Human activity proved to be an elevated level of heavy metals present in the fresh water and among these microelements lead (Pb), cadmium (Cd), mercury (Hg), chromium (Cr), Copper (Cu) are most specific (Farkas *et al.*, 2001) they are considered to be one of the most important pollutants of the aquatic ecosystems due to their environmental persistence and tendency to be concentrated in aquatic organisms (Veena *et al.*, 1997).

Change in the aquatic environmental condition is easily recognized by fast growing unicellular or simple multicellular microorganism which has ability to withstand and cope from the effect heavy metal (NaCl and CuSO₄). Among the heavy metals, copper and sodium is widely prevalent in our environment and was considered as an essential element for all living organisms including plants in small quantities. However, at concentrations slightly higher than those required for growth, it becomes toxic to most life forms (USEPA, 1984; Fargasova *et al.*, 1999; Singh *et al.*, 2007; Sharma and Jaiswal, 2012). The aim of the present study was to evaluate the toxicity of copper sulphate and sodium chloride on plasticity of *Scenedesmus* sp.

Table 1: Salient features of lower lake

Salient features	Lower lake
Longitude	77°24'-77°26' E
Latitude	23°14'30"-23°15'30" N
Catchment area (km ²)	9.6
Submergence area (km ²)	1.287
Maximum depth (m)	9.4
Storage capacity (M.cum)	3.5

MATERIALS AND METHODS

Bhopal, the capital city of Madhya Pradesh India, thrives on its beautiful natural environment provided by low hills and spacious lakes. The Lower lake of Bhopal is enclosed by human settlements from all sides and Lower Lake identified as a sampling station from where surface samples are being collected. The salient features of lower lake are mentioned in Table 1.

The investigated algal strain *Scenedesmus* species was isolated from the sampled plankton collected from the Lower Lake of Bhopal.

The pure cultures of *Scenedesmus* were isolated from water sample collected from a Lower Lake of Bhopal. Small quantities of water sample were kept in sterilized petri dishes enriched with a pinch of a KNO₃.

The samples were exposed to fluorescent light for incubation without any disturbance. The isolation based on bacteriological technique (Stein, 1973; APHA, 1980). The pure culture of algae obtained used to establish stock culture. In present studies Ward and Parrish (1982) were found to be most suitable for algal growth. Hence, the mother cultures and experimental cultures were raised in this medium. The stock solutions were recultured fortnightly. All the cultures were illuminated with daylight fluorescent tube with an intensity of 2000-lux. The ambient temperature ranged from 20-30°C. The pH of the culture medium should be around 7.5. Clean sterilized 200 mL borosil conical flasks were filled with 100 mL culture medium *Scenedesmus* sp. required concentration of NaCl and CuSO₄ was added to the medium with the help of micropipettes.

In toxicity experiment, the sample was supplied with various concentrations of NaCl and CuSO₄ ranging from 0.5-3.0 mg L⁻¹ and metal free medium was used as a control. The time of exposure was 24 h to various ranges of copper and sodium chloride. After every exposure and at each concentration, cell dimension of *Scenedesmus* were measured with the help of micrometry.

RESULTS AND DISCUSSION

Prior to the placement of sample with various salt concentrations, the sample were observed under light microscope to evaluate the actual cell shape and size of *Scenedesmus* sp. through micrometry. Colonies of 4 celled were attached side-by-side and arranged linearly. Cells are oval in shape, 12.5 µm in length and 4.4 µm in width.

The cultured sample after the treatment of 0.5 mg L⁻¹ of NaCl and CuSO₄ has a diminutive stimulatory effect on the pigment synthesis as compared to control. However, copper sulphate addition considerably reduced the growth parameter (cell length and cell width) of *Scenedesmus* sp. as compared to sodium chloride. Higher concentration of copper shows an inhibitory effect on the growth of *Scenedesmus*.

Toxicity of copper associated with significant decline in phytoplankton biomass (Jordi *et al.*, 2012; Issa *et al.*, 2013) and cell volume of phytoplankton species can be used as indicator of aquatic salinity (Mitra *et al.*, 2012; Acharya and Saify, 2012). At concentration of 1.5 mg L^{-1} CuSO_4 solution, cells become yellow due to the degradation of green pigment because of the accumulation of copper in the cells whereas NaCl at 1.5 mg L^{-1} concentration only reduce the cell size and the coenobium is marginally perforated. Microscopic examination of *Scenedesmus* cell revealed that at low concentration of studied NaCl and CuSO_4 , the four cell aggregates maintain their normal morphological feature and their bright green colour. At high concentration 3 mg L^{-1} of CuSO_4 the studied sample showed a large amount of destructions and deformed cells than NaCl. The present study also reveals the dramatic cell dimension variation ($8 \times 0.8 \text{ }\mu\text{m}$) in *Scenedesmus* sp. at toxicity concentration 3 mg L^{-1} of copper sulphate (Table 2). Similarly the concentration of NaCl at 3 mg L^{-1} the cell dimension become $9.8 \times 2.2 \text{ }\mu\text{m}$ which relevant with the study that the concentration of NaCl above 3 g L^{-1} the *Chlorella vulgaris* could not tolerate the excessive salt concentration level therefore no algal growth was observed (Barghbani *et al.*, 2012). At concentration 2 to 2.5 mg L^{-1} of CuSO_4 , the coenobium cell become scatter with holes and the cell dimension become 10.1×2.3 to $9 \times 1.6 \text{ }\mu\text{m}$ (Table 1). At the same concentration of NaCl the cell dimension of *Scenedesmus* sp. reduced to 11.4×3.4 to $10.9 \times 2.9 \text{ }\mu\text{m}$. The mean dimension changes due to copper toxicity are $10.2 \times 2.5 \text{ }\mu\text{m}$ and NaCl toxicity are $11.4 \times 3.5 \text{ }\mu\text{m}$ (Fig. 1). Increasing concentration of NaCl causes consecutive decrease in total biomass of green algae and cyanobacteria and the effect became more pronounced at high salinity (i.e., 16 PSU) (Chakraborty *et al.*, 2011).

Table 2: Cell dimension measurements of *Scenedesmus* sp. at various concentrations of copper sulphate and sodium chloride treatment

CuSO ₄ and NaCl concentration (mg L ⁻¹)	Effect of CuSO ₄ on cell dimension of <i>Scenedesmus</i> sp. (μm)		Effect of NaCl on cell dimension of <i>Scenedesmus</i> sp. (μm)	
	Length	Width	Length	Width
0.5	12.0	4.0	12.5	4.4
1.0	11.6	3.4	12.3	4.1
1.5	11.0	2.9	12.0	4.0
2.0	10.1	2.3	11.4	3.4
2.5	9.0	1.6	10.9	2.9
3.0	8.0	0.8	9.8	2.2
Mean	10.2	2.5	11.4	3.5

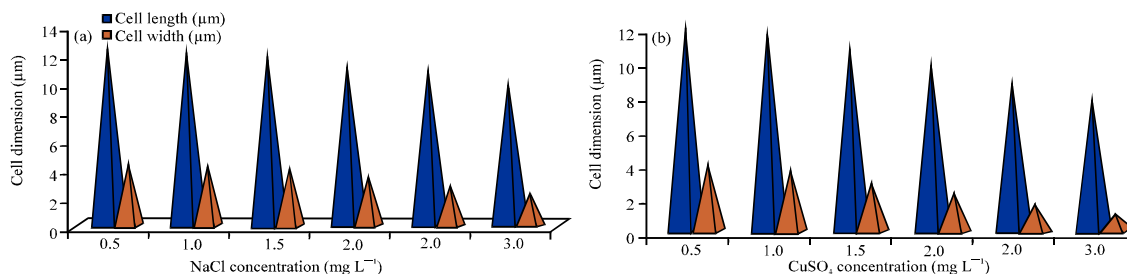


Fig. 1(a-b): Comparative toxicity effect of (a) NaCl, (b) CuSO_4 and on cell dimension of *Scenedesmus* sp.

CONCLUSION

The present study outcome spells that CuSO_4 is more toxic than NaCl at high concentration that damage the cell plasticity of *Scenedesmus* sp.

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