VI. SUMMARY
SUMMARY

The investigation, “Studies on the toxicity of industrial effluents on phytoplankters” elucidates the advantageous and disadvantageous effects of industrial effluents on five freshwater Chlorophycean microalgae and their impact on waterways. The effluents selected for the present study included the liquid industrial wastes from a distillery, a pulp-paper mill factory and a petrochemical factory manufacturing phenol and acetone. The algal species selected as test organisms were Chlorella ellipsoidea Gerneck, Ankistrodesmus falcatus (Corda.) Ralfs, Scenedesmus bijuga (Turp.) Lagerheim, Haematococcus laccustris (Girod.) Rostafinski and Chlorococcum humicola (Naeg.) Rabenhorst. The impact of different concentrations of each effluent on the population growth, productivity, pigment content, protein and carbohydrate contents of treated algal cells was estimated.

Water samples were collected from different freshwater ponds and pure cultures of the microalgae were raised by serial dilution method. The mother cultures of the algal species were maintained in the laboratory under suitable conditions.
The five different microalgae were exposed separately to different concentrations of each effluent. The different parameters were analysed regularly for a period of 21 days, and the values were compared with the control, which was lacking the effluent. The results obtained were analysed statistically and discussed with previous literature.

The results of the experiments disclosed relative sensitivity of algal species. Lower concentrations of all the effluents stimulated the growth in all algal species tested. 0.1% of effluent showed the optimum results in all the test species. With the petrochemical factory effluent, *Chlorella ellipsoidea* Gerneck showed tolerance even in 0.75% effluent concentration, while others showed growth stimulation up to 0.25% concentration. In the case of pulp-paper mill effluent *Ankistrodesmus falcatus* (Corda.) Ralfs and *Scenedesmus bijuga* (Turp.) Lagerheim exhibited a growth induction up to 0.5% concentration.

The carbon production was adversely affected in the treated microalgae. With the distillery effluent, reduction in carbon production was observed in all treated cells of *Ankistrodesmus falcatus* (Corda). Ralfs. Pulp-paper mill effluent reduced carbon production at all concentration in *Ankistrodesmus falcatus* (Corda.) Ralfs, and *Haematococcus laccustris* (Girod.) Rostafinski. The latter revealed same result with petrochemical factory effluent. Petrochemical factory effluent enhanced carbon production in *Chlorella ellipsoidea* Gerneck, *Scenedesmus bijuga* (Turp.) Lagerheim and *Chlorococcum humicola* (Naeg.) Rabenhorst in all concentrations administered.

The photosynthetic pigment contents, chlorophyll *a*, chlorophyll *b*, chlorophyll *c* and caroteteroid were also altered by the impact of effluents.
Ankistrodesmus falcatus (Corda.) Ralfs revealed reduction in photosynthetic pigments beyond 0.25% concentration of distillery effluent. Increase in photosynthetic pigments was observed in all the algae treated with pulp-paper mill effluent. All the concentrations intensified the pigment content in Chlorella ellipsoidea Gerneck and Ankistrodesmus falcatus (Corda.) Ralfs. Pigment content in Ankistrodesmus falcatus (Corda.) Ralfs displayed enhancement with 1.0% of petrochemical factory effluent. Concentrations higher than 0.5% concentration of the effluent retarded the pigment synthesis.

The protein and carbohydrate content of the treated algal cells enhanced or retarded during the study compared with that of the control depending on the concentrations of the effluents. Higher concentrations of all the effluents retarded the growth, carbon production, pigment content, protein and carbohydrate content in most of the algae.

Statistical analysis of the data had been done using 3-way ANOVA and students t-test. The significance of observed differences was graphically represented in Trellis diagram in terms of t-statistic. In most of the cases, the variations in the response of algae as a result of effluent treatment were highly significant.

In order to assess the impact of effluents on the water quality of the receiving water way, physico-chemical characteristics of water samples were analysed. Water samples were collected from Cochin estuary, Muvattupuzha river and Chitrapuzha river between 7.00 hours and 9.00 hours. Four stations were fixed in each of the waterways for the collection of water samples. The different physico-chemical parameters like temperature, pH, hardness, alkalinity, salinity, free CO$_2$, ...
total dissolved solids, total suspended solids, dissolved oxygen, gross primary production, net primary production, biochemical oxygen demand, chemical oxygen demand, silicate, nitrite, nitrate and phosphate were analysed. Algae present in the sampling stations were also identified.

The analysis revealed fluctuations in physico-chemical parameters between stations and between months and also between water ways. Phytoplankton abundance in the three water bodies also showed variations. Based on the observations of the present investigation the Cochin estuary was found to be the most polluted followed by Chitrapuzha river. Comparing with the above two, the pollution load in Muvattupuzha river was lower. The higher values of physico-chemical parameters revealed the intensity of pollution due to the discharge of effluents along with other anthropogenic discharge.

The observations revealed that all the effluents that were included in the present study, though stimulated the growth at lower concentrations, adversely affected growth and allied functions of the microalgae at higher concentrations. The contamination of the waterways was intensified several times due to the uncontrolled disposal of the different industrial effluents into it. Moreover the wide fluctuations of the different parameters in Cochin estuary highlighted the distinct role of Thanneermukkom barrage in deteriorating the water quality.

.....Ο.....

:: 179 ::