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BIOREMEDIATION STUDY OF DAIRY EFFLUENT BY USING *SPIRULINA PLATENSIS*

Satish D. Kulkarni* Tejashri Auti and Satish Saraf**

1. Department of Environmental Science, New Arts commerce and Science College, Ahmednagar-414001, India

2.Department of Zoology, Prathishtan Mahavidyalaya, Paithan, Aurangabad

ABSTRACT: Industrial pollution has been and continues to be a major factor causing the degradation of the environment around us, affecting the water we use, the air we breathe and the soil we live on. The exponential increase in industrialization. Spirulina Platensis cultivation in wastewater system is applicable for highly populated countries like India where waste is generated in high quantities and pose environmental problem. Spirulina Platensis species for domestic wastewater treatment was published in the year 1974 (Kosaric et al., 1974). Spirulina Platensis species were grown on large scale using secondary effluent of domestic wastewater treatment plant. According to Olguin et al., (2001) Spirulina Platensis has potential to reduce BOD of high carbon containing wastewater due to its mixotropic nature. The present study was concluded that the Spirulina platensis was cultivated on different concentration of dairy effluent yield better growth than control set and very efficient in COD/Phosphate/EC removal in all concentration. Study observed that chlorophyll, protein and carbohydrate content increases in Spirulina by using various concentration of dairy effluent as an alternative feed.

Keywords: Dairy effluent, *Spirulina Platensis*, Bioremediation, biomass growth

***Corresponding Author: Dr. Satish D. Kulkarni** Ph.D.

Department of Environmental Science, New Arts commerce and Science College, Ahmednagar-414001, India. *Email Address: satishdkulkarni@gmail.com

1. INTRODUCTION

Bioremediation has been successfully applied for cleanup of soil, surface water, groundwater, sediments and ecosystem restoration. It has been unequivocally demonstrated that a number of xenobiotics including nitro-glycerin (explosive) can be cleaned up through bioremediation. Bioremediation is generally considered to include natural attenuation (little or no human action), bio-stimulation or bio-augmentation, the deliberate addition of natural or engineered microorganisms to accelerate the desired catalytic capabilities. Thus bioremediation, Phytoremediation and rhizoremediation contribute significantly to the fate of hazardous waste and can be used to remove these unwanted compounds from the biosphere (Ma *et al.,* 2011 and Schroeder *et al.,* 2004). Industrial pollution has been and continues to be a major factor causing the degradation of the environment around us, affecting the water we use, the air we breathe and the soil we live on. The exponential increase in industrialization is not only consuming large areas of agriculture lands, but simultaneously causing series environmental degradation. Water originating from various industries is finding their space in agriculture. The challenge is to properly incorporate the disposal of the wastes in a controlled management programme so that the applied industrial solid wastes do not contribute any problem of pollution to soil, soil microbes and environment (Reichert *et al*., 2006). In India, National Environmental Engineering Research Institute (NEERI), Nagpur has developed a technique of cultivating algae in sewage oxidation pond systems. National Botanical Research Institute (NBRI), Lucknow and Central Food Technological Research Institute (CFTRI), Mysore has established centers for mass production of "Single Cell Protein" from cynobacteria. At the NBRI, SCP is produced on sewage, which is further utilized as animal feed. Therefore, in the light of protein shortage, microorganisms offer many possibilities for protein production. (Roth *et al.,* 1981). algae on sewage serves the dual purpose of cleaning up potential environmental pollution, while at the same producing valuable protein. *Spirulina Platensis* cultivation in wastewater system is applicable for highly populated countries like India where waste is generated in high quantities and pose environmental problem. The wastes are added into the digester to settle down the solid particles. The liquid effluent is used as a source of the nutrients and added in artificially constructed ponds. *Spirulina Platensis* is found to grow better in sewage amended with sodium carbonate or sodium bicarbonate and nutrients in different proportion and in diluted sewage. When full growth of *Spirulina Platensis* is over, it is screened from the pond and added to aquaculture to feed fish or dried in a small solar drier for animal feed (Vijayan *et al.,*

1988). Initial studies using *Spirulina Platensis* species for domestic wastewater treatment was published in the year 1974 (Kosaric et al., 1974). In this study, *Spirulina Platensis* species were grown on large scale using secondary effluent of domestic wastewater treatment plant. According to Olguin *et al*., (2001) *Spirulina Platensis* has potential to reduce BOD of high carbon containing wastewater due to its mixotropic nature.

2. MATERIALS AND METHODS

Collection of *Spirulina Platensis* culture :*Spirulina Platensis* culture was collected from Krishi Vigyan Kendra, Babhaleshwar, and 60 km away from Ahmednagar city. *Spirulina platensis* mother culture about 100ml was provided in clean and dry plastic bottle.

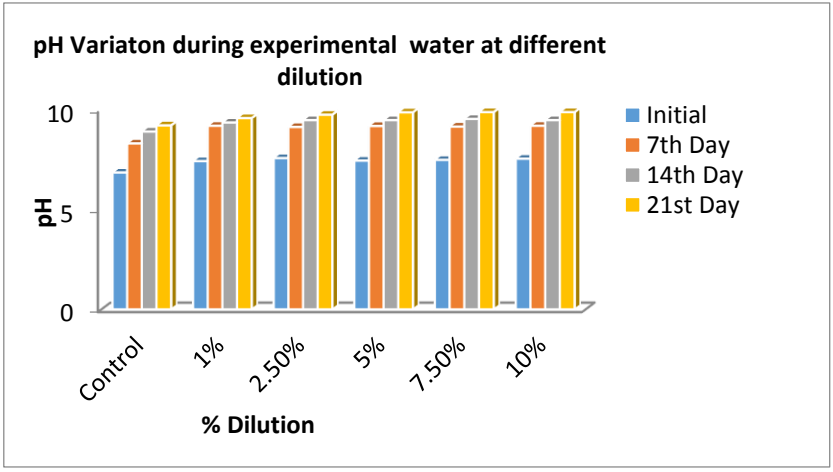
Collection of Dairy Effluent : The dairy effluent was collected in clean and dry 5-liter plastic can (stopper) from the effluent discharge point of Malaganga dairy farm, Nighoj, Tal-Parner, Dist-Ahmednagar. The effluent was collected immediately after milk processes in the morning and then it was brought to laboratory and taken for analysis.

Enrichment of *Spirullina platensis:* The *Spirulina Platensis s* pure culture was further propagated in an NCIM growth medium with 8-10 days incubation period. NCIM media was autoclaved at 15-psi pressure for 15min at 121^0C, salt $NaHCO_3$ autoclaved separately. pH of the medium was adjusted in the range of 8-9 and all the sterile condition were maintained. Then 5ml of the pure culture of *Spirulina Platensis* was inoculated in the media. The flask was kept for incubation for 8-10 days.

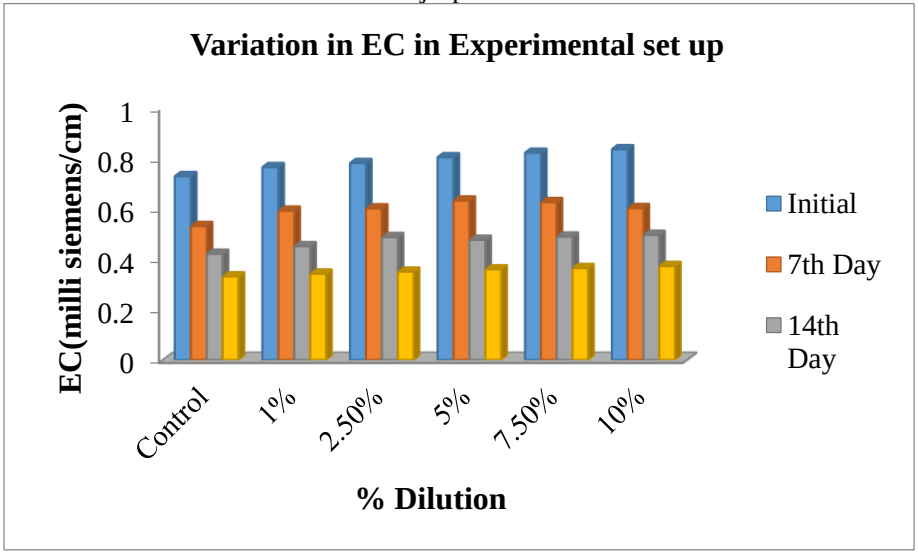
Experimental Setup: The experiment was done in glass aquarium (length-30cm, width-20cm & total capacity-12 liters) containing 3000ml each dilution separately for 21 days under laboratory condition. The whole process of treatment was carried out at room temperature and under 24-hour photoperiod by using 25-watt bulb in each aquarium to maintain the optimum condition for the *Spirulina Platensis* to be cultured. During the experiment process, the contents in the aquarium were stirred by glass rod daily 6-7 time. The physico-chemical parameters was measured at three different periods (7^{th}, 14^{th}, 21^{st} day) and growth parameters of *Spirulina Platensis* were measured after harvesting in 21^{st} day.The chemical parameter like, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Chemical oxygen demand (COD), Phosphate, (APHA,1998) and Growth parameters like, biomass density, Chlorophyll a, chlorophyll,b, total chlorophyll, Protein (Lowry et al.)and Carbohydrates (Anthron Method) were estimated.

3. RESULTS AND DISCUSSION

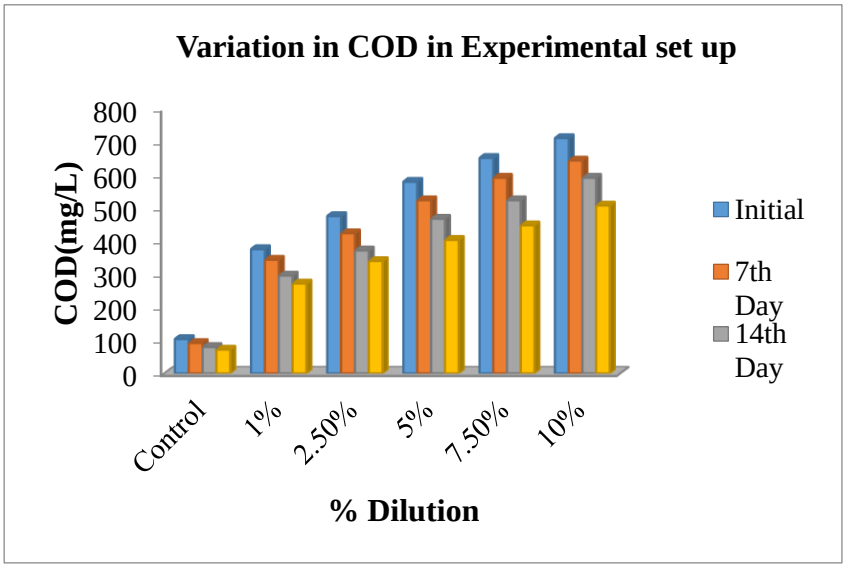
Dairy effluent does not contain toxic compounds or pathogenic bacteria; but it can contain the high amount of oil, oxygen demanding waste and total suspended matter, which pollutes the water. *Spirulina Platensis* cultivation on dairy effluent reduces this problem. In present study, *Spirulina Platensis was* cultivated in laboratory under controlled conditions (glass aquarium, 24 hours lighting) on different concentration of dairy wastewater. The effect of this treatment on physico-chemical parameters and growth parameters were measured. pH of the water is the measure of H^+ ion activity of the water system. It indicates whether the water is acidic, neutral or alkaline in nature. The pH of the effluent after *Spirulina platensis* cultivation increased up to 9.5-10(25-35%) this may be due to increase in carbonate content. Wetzel et al (1968) investigated that the increase in photosynthetic rate leads to the consumption of greater quantities of biocarbonates resulting in the formation of more and more carbonates raising the pH of wastewater. Increase of pH and alkalinity in treated effluent was result of photosynthetic activity of algae.



EC was maximum at 10% concentration of dairy effluent i.e. 0.836 milli siemen/cm and minimum at control set i.e. 0.729 milli Siemens/cm (before *Spirulina Platensis* treatment). On 21st day the EC increase with increasing concentration and showed a perfect positive correlation. *Spirulina Platensis* decreased conductivity in all concentrations. Maximum decrease in EC after *Spirulina Platensis* treatment was 55.71% in 7.5% concentration of dairy effluent and minimum reduction was 54.59% in control set.



In present study, show maximum COD in 10% concentration of dairy effluent i.e.712mg/L and minimum COD i.e.104mg/L in Control set (before Spirulina Platensis treatment). Maximum reduction of COD after *Spirulina Platensis* treatment was 31.28% in 7.5% concentration of dairy effluent and minimum reduction was 27.65% in 1% concentration of dairy effluent.



Kshirsagar *et al.,* (2010) studied the feasibility of Pharmaceutical wastewater treatment using saline water algae *Spirulina Platensis* . Results showed good reduction in COD/BOD, Sulphates and Chlorides. Phosphorus is a major nutrient required for the growth of algae and determines its primary productivity. Mostert and Grobbelaar, 1981 have indicated the essential role of phosphorus in maintaining high production rates of microalgae mass cultures.

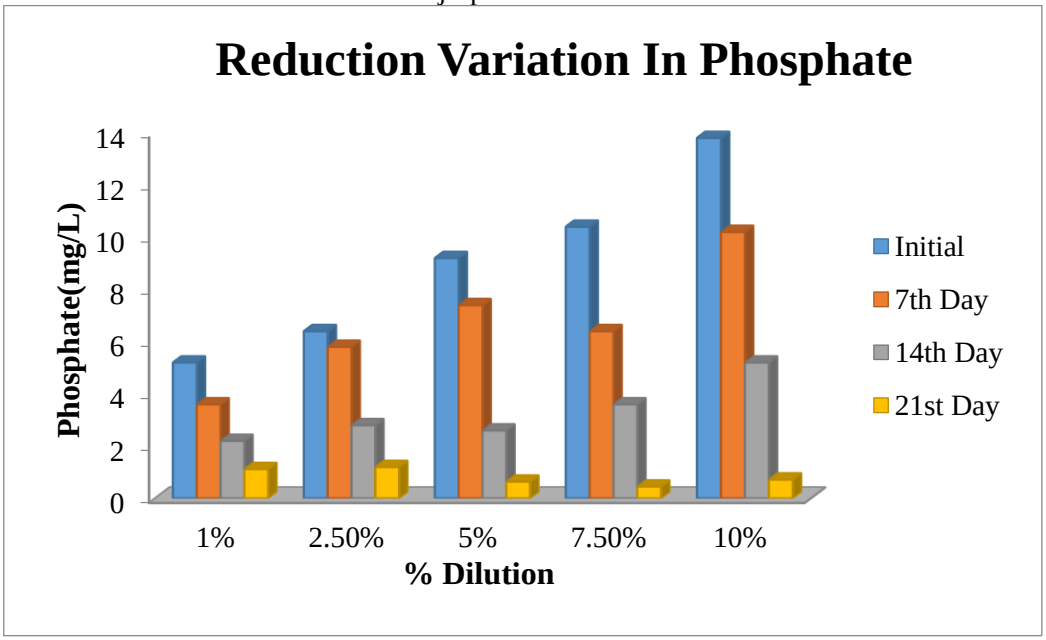
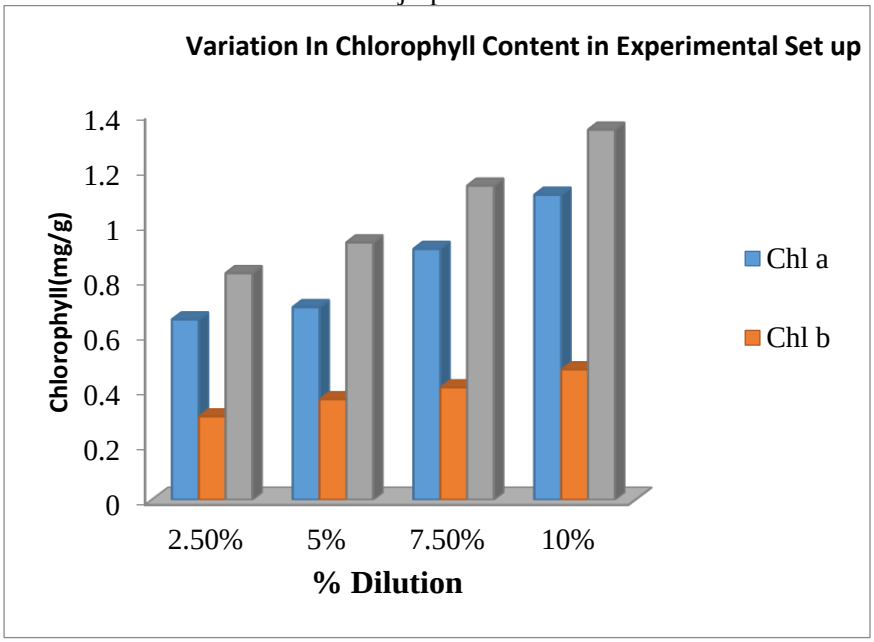


Figure 1: Phosphate Variation in Various Concentrations

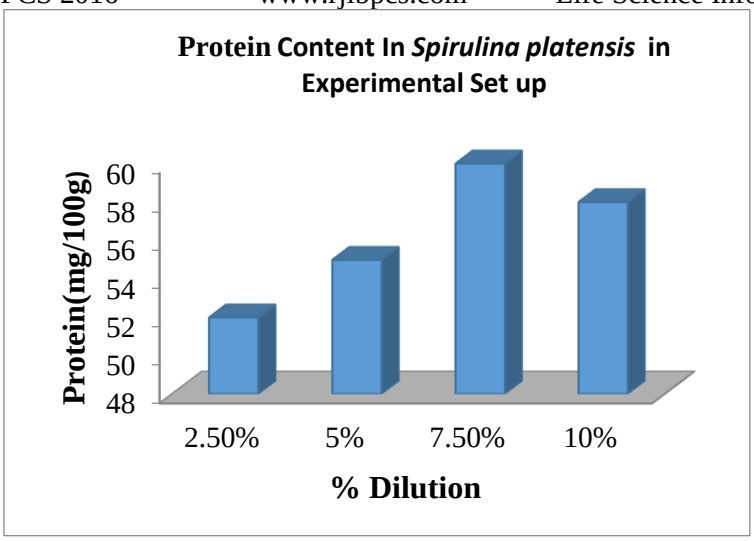
In Present study ,maximum phosphate were observed in 10% concentration of dairy effluent i.e. 13.8mg/L and Minimum in control set i.e. 0.56mg/L (before *Spirulina Platensis* treatment). Maximum reduction of phosphate after *Spirulina Platensis* treatment was 95.67% in 7.5% concentration of dairy effluent and minimum reduction was 78.46% in 1% concentration of dairy effluent. Vijayan *et al.*, (1988) reported the *Spirulina Platensis* is found to grow better in sewage amended with sodium carbonate and nutrients in different proportion and in diluted sewage. Lodi and Binaghi *et al.*, (2003) carried out the experiment in which *Spirulina Platensis s* biomass was used to reduce the contents of nitrate and phosphate in wastewater , it is reported that that all removed nitrate was used for biomass growth (biotic removal) whereas phosphate appeared to be removed mainly by chemical precipitation (abiotic removal).

Growth parameters:

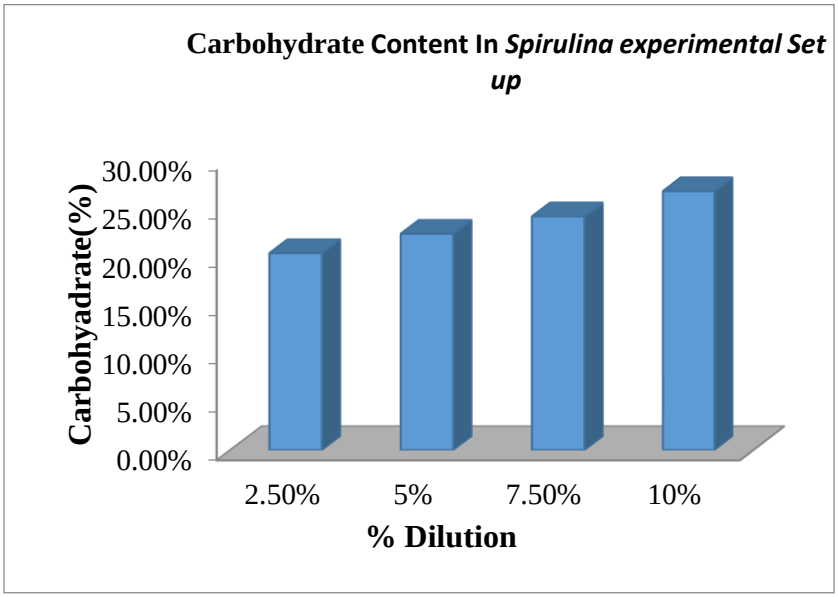
In present study the pure culture contains Optical Density 0.965nm, Total Chlorophyll 1.7176, Protein 40mg/100mg and Carbohydrates 20%. The dairy wastewater contains lot of nutrients for algal growth. The growth of *Spirulina Platensis* was measured by taking optical density (Usharani *et al.*, 2012). It results dairy effluent was found to be highly economical, locally available, eco-friendly, cost effective and highly growth medium for *Spirulina Platensis* . In all concentration of dairy effluent 1%, 2.5%, 5%, 7.5% and 10% *Spirulina Platensis*, grow more than the control set.



The growth of *Spirulina Platensis s* was estimated under laboratory condition through various parameters like chlorophyll, protein, and carbohydrate after 21st day on dry basis and data was presented in a table. The total chlorophyll increases with increase in dairy effluent concentration. Pandey *et al.*, (2010) reported the influence of light intensity and pH for Spirulina Platensis growth; protein and chlorophyll content were increased during experimental period. Choonawala *et al.*, (2004) studied on cultivation of *Spirulina Platensis* sp. in cooling tower brine effluent in order to produce *Spirulina Platensis* in commercially viable quantities. The optimization of growth of *Spirulina Platensis* in Synthetic *Spirulina Platensis* medium and Brine Effluent Medium were studied and turbidity, quantification of chlorophyll produced and dry weight were three parameters that were used to estimate the algal biomass produced and significant result were obtained. The cyanobacterium *Spirulina Platensis* contains 74% dry weight of proteins(Phang *et al*.,2000), along with high concentrations of minerals, pigments , unsaturated fatty-acids and vitamins (Cohen *et al.*, 1997), because of which it is used as a dietary supplement, nutrient source in food, feed and pharmaceutical industries especially in developing countries. The dairy effluent concentration 2.5%, 5%, 7.5% and 10% protein content found 52mg,55mg,60mg and 58mg respectively.



Spirulina Platensis contains Carbohydrate, which tends to fluctuate around 14% of dry weight. The dairy effluent concentration 2.5%, 5%, 7.5% and 10% protein content found 20.4%, 22.4%, 24.2% and 26.8% respectively.



4. CONCLUSION

The present study was concluded that the *Spirulina platensis* was cultivated on different concentration of dairy effluent yield better growth than control set and very efficient in COD/Phosphate/EC removal in all concentration. Study observed that chlorophyll, protein and carbohydrate content increases in *Spirulina* by using various concentration of dairy effluent as an alternative feed.

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CONFLICT OF INTEREST

All authors have no conflicts of interest.

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