

A Comparative Study on the Efficiency of *Chlorella vulgaris* and *Scenedesmus quadricauda* in Reduction of Phosphate from Coffee Processing Wastewater

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ABSTRACT

Phosphorus is a macro nutrient which is essential for the growth and development of aquatic plants. However, increase in the concentration of phosphate leads to eutrophication in water bodies. In the present investigation a comparison was made between micro algal strains *Chlorella vulgaris* and *Scenedesmus quadricauda* to evaluate their efficiency for removal of phosphate from coffee processing wastewater. In 25% dilution phosphate reduced by 98% using *Chlorella vulgaris* and 95% using *Scenedesmus quadricauda*. Results showed that both the algae were effective in reduction of phosphate. Further, it was

observed that *Chlorella vulgaris* removed phosphate more effectively.

Keywords Coffee processing wastewater, *Chlorella vulgaris*, *Scenedesmus quadricauda*, Phosphate.

INTRODUCTION

Water is getting polluted with a wide variety of pollutants and contaminants from various activities. The quantity and quality of wastewater discharged into natural water bodies indicates need for different approaches to the management of water quality (Kshirsagar 2013). Coffee is an important commercial crop cultivated in southern parts of India. Wastewater released during processing of coffee beans in wet process are the main source of organic pollution in environment. Coffee wastewater is rich in sugars, pectin, high concentrations of suspended solids, dissolved solids and elevated nutrient (Woldesenbet

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et al. 2014), hence it is very essential to treat prior release to natural water bodies.

Bioremediation technology serves as a potential tool to remove pollutants from contaminated site by natural biological activity (Dhanushree and Kousar 2018) which is less expensive than other technologies. Microalgae play a very significant role in natural water purification, thus they are known as pollutant scavengers. Use of microalgae in wastewater treatment has been very effective. In the present study, the potential use of *C. vulgaris* and *S. quadricauda* was investigated for their potential to reduce phosphate from coffee processing wastewater.

MATERIALS AND METHODS

Collection of wastewater : The coffee wastewater sample was collected from a Coffee Processing Unit near Malligenahalli, Chikmagalur District of Karnataka State, India.

Analytical methods : Phosphate concentration in the coffee processing wastewater was analyzed before and after treatment using the standard methods (APHA 2009).

Isolation and identification of microorganisms : The algal species was isolated locally and grown in BBM (Bold's Basal Medium). Pure culture of *Chlorella vulgaris* and *Scenedesmus quadricauda* was maintained and identified on the basis of its morphological characteristics.

Experimental set-up : The wastewater was diluted using distilled water to different concentrations viz. 25%, 50% and 75%. Raw wastewater was designated as 100% concentration. The wastewater was filtered through Whatman No.1 filter paper; 200 ml of coffee wastewater samples of each dilution was inoculated with 20 ml algal isolate in a 250 ml conical flask and kept under illumination. The conical flask containing wastewater without introducing algal isolate was kept as control. The aerobic treatment under aseptic condition was maintained in laboratory scale and treatment was conducted for a period of seven days in triplicates. The reduction in phosphate before and

Table 1. Concentration of phosphate before and after treatment with *Chlorella vulgaris* and *Scenedesmus quadricauda*.

Dilutions	Before treatment (mg/L)	After treatment with <i>Scenedesmus quadricauda</i> (mg/L)	After treatment with <i>Chlorella vulgaris</i> (mg/L)
Control	19.8 ± 0.2	18.44 ± 0.03	18.44 ± 0.03
100%	19.8 ± 0.2	4.43 ± 0.3**	2.19 ± 0.09**
75%	19.06 ± 0.25	3.33 ± 0.2**	1.57 ± 0.06**
50%	18.23 ± 0.11	2.7 ± 0.2**	1.12 ± 0.1**
25%	17.16 ± 0.35	2.14 ± 0.18**	0.47 ± 0.05**

after treatment with the study alga was compared with control.

Data analysis : Statistical analysis was carried out using one -way ANOVA followed by Turkey's t-test. The difference in mean values at $p < 0.05$ or $p < 0.01$ was considered as statistically significant. Statistical analysis was performed using Graph Pad Prism version 5.01.

RESULTS AND DISCUSSION

Phosphate removal in different concentrations of coffee wastewater for 7 days treatment period is enumerated in Table 1. The results are expressed as Mean ± SD which is statistically significant when compared with control. The effluent was diluted with distilled water before use to increase the transmission of light and to enhance the efficiency of the organisms in the treatment process. Microalgae isolated from natural environments could adapt better to obtain good results. In the present study, *Chlorella vulgaris* and *Scenedesmus quadricauda* were isolated locally and efficiency of both the species in the reduction of phosphate was investigated.

Coffee wastewater possesses higher concentration of phosphate before treatment viz. 19.8 ± 0.2 , 19.06 ± 0.25 , 18.23 ± 0.11 and 17.16 ± 0.35 in 100%, 75%, 50% and 25% dilution respectively. The phosphate reduction observed after treatment was 18.44 ± 0.03 , 2.19 ± 0.09 , 1.57 ± 0.06 , 1.12 ± 0.1 and 0.47 ± 0.05 in 100%, 75%, 50% and 25% dilutions respectively using *Chlorella vulgaris*. The efficiency of *Scenedesmus quadricauda* to remove phosphate after

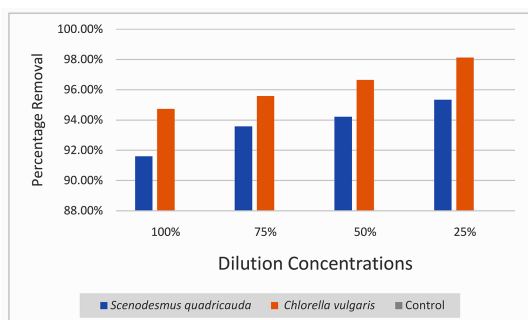


Fig. 1. Percentage removal of phosphate before and after treatment with *Chlorella vulgaris* and *Scenedesmus quadricauda*.

treatment was observed as follow 4.43 ± 0.3 , 3.33 ± 0.2 , 2.7 ± 0.2 and 2.14 ± 0.18 in 100%, 75%, 50% and 25% dilution respectively, whereas in control phosphate concentration was 18.44 ± 0.03 .

Figure 1 indicates that the removal of phosphate tends to increase with increase in dilution of coffee processing waste water. Further, *Chlorella vulgaris* reduced phosphate more efficiently than *Scenedesmus quadricauda*.

Related study was reported by Singh et al. (2017) that the removal of total phosphorus tended to increase with higher initial dilutions of urban wastewater using *Chlorella vulgaris*. Approximately, 93.4, 97.8 and 98.4% was removed from the growth medium containing 10%, 20% and 30% of urban wastewater respectively. Similarly, Xiao et al. (2011) studied the removal of total phosphorus concentration in 25% digested wastewater which showed upto 95.8% removal using *Scenedesmus quadricauda*. In the present study, removal of phosphate upto 98% was observed in 25% dilution using *Chlorella vulgaris*, 95% using *Scenedesmus quadricauda* and in control

the reduction of phosphate observed was only 11.7% (Fig. 1). Hence, it is evident that both the species are highly efficient in reducing phosphate effectively and *Chlorella vulgaris* performed better.

CONCLUSION

The present investigation involves the study of phosphate removal by *Chlorella vulgaris* and *Scenedesmus quadricauda* which were isolated locally. The study showed that, *Chlorella vulgaris* exhibited better efficiency than *Scenedesmus quadricauda* in phosphorus removal. Furthermore, the dilution of coffee waste water enhances the growth and efficiency of the organisms. It is evident that incorporating microalgae in nutrient removal of coffee waste water is an effective, economical and eco-friendly approach for removal of pollutants.

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