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Research Article

EFFECT OF SELECTED ALGAL SPECIES IN COD REDUCTION OF SEWAGE WATER

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ABSTRACT

Large amount of sewage water generated in communities finds its ultimate disposal/release (either direct or indirect) into soil, agriculture land or water bodies. Such release lead to environmental pollution and variation in physiochemical parameter of soil or water into which such polluted water loaded with organic ,inorganic components, heavy metals, other toxic components is released. Several alternatives have been reported to control/ detoxify such polluted water.Utilization of algae species for treatment of polluted water has gained momentum in recent past owing to theirfast growth and inherent potential to detoxify polluted water. In the present, study of for algae species *Scenedesmus abundans, Chlorella singulais, Chlorella minutissima* and *Chlorella sorokiniana* were cultivated in sewage water collected from Kehri village are and all selected algae species were simultaneously cultured in BBM medium (which served as control). All the four algae species exhibited enhanced growth in sewage water as compared to culture medium and all algae species were found to reduce COD of polluted water. Among the four algae species *C. minutissima* was found to possess maximum growth rate among the four algae species. Findings of present study reveals the selected algae species can be effectively employed on large scale for treatment of polluted water.

INTRODUCTION

Due to the ever-increasing population and growth in many areas like industrialization, different types of wastes like domestic, industrial, medicinal, agro-chemical wastes have been generated in large quantities into the environment. Due to the release of these different types of wastes, organic and inorganic pollution have become a major concern. As a result of constant increase in environmental pollution of which release of polluted water / effluent has been a prime cause efforts has been made to control and minimize pollution alongwith development of practices for treatment of polluted water. Among several measures utilization of microalgae species for treatment of waste / polluted water has been reported to be an efficient and effective method (Delrue *et al* 2015, Prabha *et al* 2016, Chalivendra and Saikumar 2014). Due to the ability of microalgae to absorb the organic compounds and removal of heavy metals, they offer solutions for the tertiary and quaternary treatments of the waste water (Abdel-Raouf *et al* 2012). Sewage water contains various organic compounds and heavy metals which when released into larger water bodies may cause eutrophication. Microalgae can utilize these organic substances present in the sewage water for their growth, thus reducing the organic and other heavy pollutant contents in the waste water. (Rathod 2015). Alongwith this there are several advantages associated with cultivation of microalgae species their photosynthetic ability, rapid growth rate, efficient carbondioxide fixation. The present study was conducted to analyze the growth kinetics of selected algae species in sewage water.

MATERIAL AND METHODS

For the present study domestic sewage water was collected from the local region of Dehradun. Sewage sample were collected in sterile transparent glass bottles and stored at temperature below 30°C, in department of biotechnology, Uttaranchal university and was utilized as study sample for the present study. Four algae species namely *Scenedesmus abundans* (A1), *Chlorella singularis* (A2), *Chlorella minutissima* (A3) and *Chlorella sorokiniana* (A4) were selected and were cultured in Bold's Basal Medium (BBM) which served as control medium for the present work.

Growth of Algae in Sewage Water

In independent set of experiments all the four algae species, A1, A2, A3 and A4 were cultured separately into transparent, sterile culture bottles containing domestic sewage water. About

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0.1gm algae culture were added to 200 ml of sewage sample. Each experiment was conducted in triplets. The culture flasks were kept under constant light for photosynthesis to occur rapidly and allow algae to grow. Measurement of growth of algae was measured through measuring optical density (OD). Initial optical density (OD) was recorded after one hour of inoculation followed by regularly recording optical density (OD) at an interval of approximately 2-3 days. OD was recorded using UV-visible spectrophotometer 680nm. Growth curve was plotted based on optical density recorded for all the four algae species in control as well as sewage water.

Calculation of Algal Biomass and COD

Chemical Oxygen Demand (COD) is the amount or the measurement of dissolved oxygen required to oxidize the organic and inorganic compounds present in the reaction mixture. The four algae species which were each cultured in the sewage water were centrifuged and the supernatant was taken for the measurement of COD. The final biomass of algae species was also biomass were also taken using the weighing balance to verify the algal growth by the increase in the weights of the algae biomass and obtain a comparative data as to which algae species exhibited maximum growth in sewage sample compared to that of control.

For calculation of COD 5ml of the sample was taken in a reagent bottle and 3ml of Potassium Dichromate solution was added to it along with 6ml of conc. Sulphuric acid (H_2SO_4). A magnetic bead was inserted into the reagent bottle and after closing the lid tightly, the bottle was kept on a magnetic stirrer at a temperature of 150° C with constant stirring for 2 hours. The sample was then transferred to a conical flask and 2 drops of Ferroin indicator was added. The sample was then titrated against standard ferrous ammonium sulphate solution until the sample colour turned to reddish brown colour. The COD was calculated using the formula as:-

$$\text{COD} = \frac{(A-B)Nx8000}{\text{Volume of sample}}$$

Where, A is the volume of FAS used to titrate the blank solutions, B is the volume of FAS used to titrate the treated samples. The above mentioned steps were performed to check the COD of the sewage water. The, COD of the samples inoculated with the four algae species is then calculated for each after 4 days, to check whether the COD has decreased after treatment with the algae. If the COD has decreased after comparison with the COD of the untreated sewage water, it indicates that the algae species has consumed the organic and inorganic nutrients present in the sewage water for their growth. This also indicates that bioremediation of the sewage water has occurred using the microalgae species (A1, A2, A3, A4).

RESULT AND DISCUSSION

Growth curve obtained for all the four algae species utilized in the present study revealed better growth of all four species in sewage a s compared to their growth in culture medium. This can be attributed to the presence of sufficient amount of nutrient. Growth curves plotted were based upon optical density recorded at regular intervals from the day of inoculation of algae culture into culture medium as sewage sample. Among all the four algae species, *Chlorella singularis* was found to exhibit enhanced growth in sewage as well as culture medium as compared to other algae species in the study. In recent past tremendous amounts of research have been carried out on various algae species owing to their ability to accumulate lipids which can be utilized as biofuel, their bioremediation potential, etc. By far, *Chlorella* species remained to be most commonly utilized algae species due to their rapid growth, ability to adapt to different environmental conditions, etc.,(Kumar *et al* 2013, Salgueiro *et al* 2016, Lim *et al* 2010, Ramirez *et al* 2017, Chan *et al* 2014)

Table 1 depicts final biomass, growth rate of four algae. After incubation of 15 days, the sewage sample containing algal biomass was centrifuged and final biomass of each algae was recorded. *C. minutissima* exhibited maximum biomass of 0.604gm with a growth rate of 0.083 day^{-1}. Final biomass of *Scenedesmuc abundans* was 0.148gm with growth rate of 0.032 day^{-1}. *C. singularis* exhibited a biomass of 0.174gm after 15 days of incubation. Growth rate were 0.042 day^{-1} respectively. *C.sorokiniana* was found to attain a biomass of 0.214gm with growth rate of 0.053 day^{-1}. COD of untreated, freshly collected sewage water was found to be 48 mg/l. After five days of incubation, COD of all four algae species was calculated. *Scenedesmus abundans* was found to reduce COD to 32 mg/lwhereas COD of sewage water inoculated with *C.singularis* was found to reduce to 28 mg/l. Remaining algae species *C.minutissima* and *C.sorokiniana* reduced COD to 16mg/l. Kumar *et al* 2013, reported the reduction in COD by treatment of sewage water with *Chlorella minutissima* and *Scenedesmus* sp.Also, Lim *et al* 2010, Ramirez *et al* 2017, Kassas and Mohammed 2014, Salgueiro *et al* 2016, Bwapwa and Chetty 2017 in their studies reported reduction in COD of effluents obtained from textile industries, acid mine drainage and other domestic and agriculture related waste water upon treatments with *Chlorella* sp., *Muriello sp.,* and *Scenedesmus sp.* Ismail *et al* 2012 in their independent studies reported the reduction of COD as well as reduction in phenolic compounds by treatment of olive mill waste water by microalgae species- *Chlorella vulgaris* and *Spirulina platensis. Chlorella vulgaris, Spirunera maxima* and *Spirulina platensis* were utilised for the treatment of various industrial effluents which showed effective reduction in phosphate (88%) , nitrate(64%) and ammonia (85%) (Chan *et al* 2014, Kumar *et al* 2015 and Hammud *et al* 2014). For the treatment of various industrial effluents and sewage samples, *Chlorella vulgaris, Chlorella kessleri , Chlorella salina, Scenedesmus obliquus* and *Scenedesmus dimorphus* were utilised which resulted in the effective reduction of COD, TDS and removal of phosphate content in the samples (Delrue *et al* 2015, Prabha Y. *et al* 2016, Chalivendra and Saikumar 2014, Kshirsagar 2013, El-Sheekh *et al* 2015).

CONCLUSION

Rapid growth exhibited by algae species *Scenedesmus abundans, Chlorella singulari, Chlorella minutissima* and *Chlorella sorokiniana* in sewage water is much more than their respective growth in culture medium along with depletion in potential to detoxify polluted water which needs to be analysed and applied on large scale

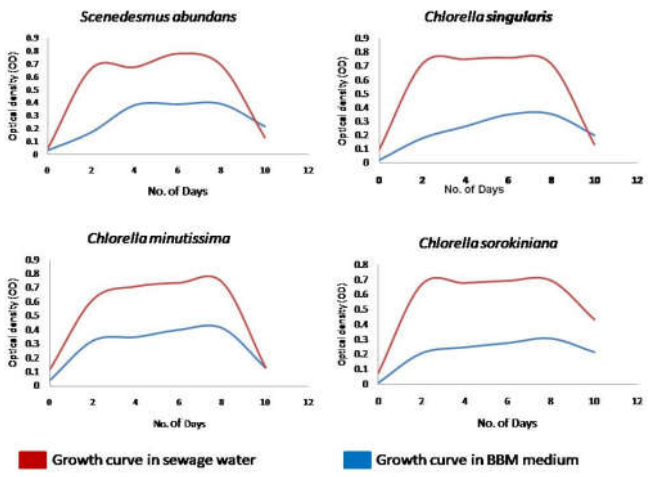

Fig 1 Growth curve of selected algae species in sewage water and culture medium

Table 1 Growth parameters of cultivated algae species in sewage water

Name of algae species	INITIAL WT. (gm)	FINAL WEIGHT (gm)	GROWTH RATE (Day^{-1})
Scenedesmus abundans	0.1	0.148	0.032
Chlorella singularis	0.1	0.174	0.042
Chlorella minutissima	0.1	0.604	0.083
Chlorella sorokiniana	0.1	0.214	0.053

Table 2 Effect of algal species on reduction in COD of sewage water

Sample	Initial COD	COD after treatment with different algal species (mg/l)			
		A1	A2	A3	A4
Sewage water	48	32	36	16	16

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