Experimental study for growth potential of unicellular alga *Chlorella pyrenoidosa* on dairy waste water: An integrated approach for treatment and biofuel production

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This communication presents an integrated approach to study the potential of *Chlorella pyrenoidosa* for treatment of dairy wastewater (DWW) and biofuel extraction. The experiment was set up in two steps. The step-1 of the experiment was designed for treatment of dairy wastewater. The physical and chemical parameters of wastewater quality such as nitrate, phosphate, chloride, fluoride, hardness, etc., were studied. The level of nitrate and phosphate known, agents of eutrophication in water bodies was reduced by 60% and 87% in influent, 49% and 83% in the effluent, respectively. The step-2 of the experiment was designed for biofuel extraction by harvesting the biomass (algal strain) grown in dairy waste water. The result of this study shows that algal strain *C. pyrenoidosa* is not only an agent for mitigation of pollutant load, but it can also be used as potential agent for biofuel production.

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1. Introduction

Dairy industry is one of the major industry have economic importance in various industries of agricultural sector. Among the various milk producing countries, India has attained the first rank in milk production. India is sharing about 13.1% of the total milk produced in the world (Kumbhar Vijay, 2010). There are about 286 large and small scale dairy industries in India responsible for large number of waste production (solid and liquid). Specifically dairy industry is noted as one of the significant contributor to water pollution. Dairy waste is basically biodegradable, but produces undesirable color and odor. It is estimated that about 110 million tonnes of milk and about 275 million tonnes of wastewater are being generated annually from the Indian Dairy Industries by the year 2010 (Kushwaha et al., 2011). Dairy waste water is characterized by strong color, offensive odor, high BOD (40–48,000 mg/l), high COD (80–95,000 mg/l) (Kushwaha et al., 2011) and variable pH (Kothari et al., 2011). It also contains sufficient nutrient like N (14–830 mg/l) and P (9–280 mg/l) required for biological growth (Rico Gutierrez et al., 1991; Gavala et al., 1999). Normally for treatment of dairy wastewater, physical and chemical methods are involved, which are often very costly. There has been an increasing interest in the treatment of dairy waste water (Wang et al., 2010). Most of the studies have concentrated on the use of fungi and bacteria for reducing the organic load of dairy waste water (Tastan et al., 2010; McMullan et al., 2001). In recent years the use of microalgae in treatment and recycling of waste water has attracted great interest due to their central role in carbon dioxide fixation. Waste water is considered to be potentially sustainable growth medium for the algal feedstock (De la Nuee et al., 1992). Algal biomass caused by nutrient leakage can often be traced to large scale operations that process agricultural and animal products (Kebede-Westhead et al., 2006). Recently it has been demonstrated that most of algal species such as *Spirogyra* (Khalaf et al., 2008), *Caulerpa lentillifera* (Marungrueng et al., 2006), *Caulerpa scalpelliformis* (Arvindhan et al., 2007), *Chlorella vulgaris* (Aucner et al., 2004) are effective agents of color removal from the wastewater either by biosorption or bioconversion. Microalgae also have potential to generate significant amount of biomass considered as third generation feedstock and are suitable agent for conversion to biodiesel as they synthesise TAGs (triglycerides). Production of biodiesel from biomass can provide non-polluting and environment friendly source of energy (Barnwal et al., 2005). It is growing concern that the use of food crop for biodiesel and other renewable fuels may be an uneconomical long term solution (Patzek et al., 2005). Algae have higher biomass productivity than the crop plant in terms of land area required for biomass generation and lower cost of growth (Brennan et al., 2010). The potential value of microalgal photosynthesis to produce biofuels is widely recognized in recent years (Hu et al., 2008; Rodolfi et al., 2009). The idea of using microalgae as a source of fuel is not new and it is being taken seriously because of the rising price of petroleum and, more significantly emerging concern about global warming which is associated with burning of fossil fuel (Gavricescu et al., 2005). However efforts are required to reduce the high cost of biofuels. Keeping in view the high cost of biomass production and environmental concerns, the present work is an effort to integrate remediation of dairy waste water...