Biodiesel from wastewater: lipid production in high rate algal pond receiving disinfected effluent

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ABSTRACT

The production of different species of microalgae in consortium with other micro-organisms from wastewaters may represent an alternative process, to reduce the costs, for obtaining biofuels. The aim of this study was to evaluate the influence of pre-ultraviolet disinfection (UV) in the production of lipids from biomass produced in high rate ponds. Two high rate algal ponds were evaluated: a pond that received domestic sewage without disinfection and the other receiving domestic sewage previously disinfected by UV radiation (uvHRAP). The UV disinfection did not lead to significant differences in fatty acid profile and total lipid productivities, although it increased algal biomass concentration and productivity as well as lipid content. Moreover, the overall biomass concentrations and productivities decreased with the UV disinfection, mostly as a consequence of a loss in bacterial load. We thus conclude that uvHRAP disinfection may represent a potential strategy to promote the cleaner and safer growth of algal biomass when cultivated in consortium with other micro-organisms. Mainly regarding the use of wastewater as culture medium, together with a cheaper production of lipids for biodiesel, pre-disinfection may represent an advance since extraction costs could be significantly trimmed due to the increase in lipid content.

Key words | bioenergy, domestic sewage, fatty acid, microalgae, ultraviolet disinfection

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INTRODUCTION

The cultivation of microalgae for biofuels production is an extremely promising issue, since it represents a method to diversify sources of energy, and also is a potential renewable and carbon-neutral alternative to petroleum fuels, as is any biofuel derived from oil crops (Chisti 2007; Batten *et al.* 2013). However, the production of algal biomass is still costly, which is one of the main challenges for its use on a large scale (Ozkan *et al.* 2012). To resolve this issue, the use of wastewater as a growth medium can eliminate the competition with agriculture for space, water and nutrients for microalgae production, with the added benefit of contributing to a closed loop process, adding value to the process, towards no waste generation, contributing to an increasingly greener biotechnology.

The production of algal biomass for energy purposes by reusing water can be made in high rate algal ponds (HRAPs), which are at the same time used for treating the effluent (Craggs *et al.* 2011). The production of microalgae in consortium with other micro-organisms may also contribute to the reduction of the costs involved in the process of obtaining biofuels, since it presents competitive advantages such as less influence of environmental fluctuations and easier harvesting and processing of the biomass (Pires *et al.* 2013). Conversely, competition between algae and bacteria for nutrients and space may represent a negative factor for the production of algal biomass and lipids from wastewater (Peccia *et al.* 2013). Cho *et al.* (2011) concluded after laboratory studies that a pre-treatment to remove micro-organisms can be applied for the efficient production of algal biomass. Santiago *et al.* (2013) showed that disinfection by ultraviolet (UV) radiation may be an effective pre-treatment to enhance the production of algal biomass using HRAPs with domestic sewage as growth medium.

The objective of this study was to evaluate the influence of UV pre-disinfection on the lipid productivity of a high rate

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