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# Effect of organic loading rate on anaerobic digestion of thermally pretreated *Scenedesmus* sp. biomass

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## HIGHLIGHTS

- Increasing the organic loading rate did not affect anaerobic digestion performance.
- *Scenedesmus* sp. biofuel production is hindered by its cell wall.
- Storage time of *Scenedesmus* sp. biomass affected organic matter hydrolysis.
- *Scenedesmus* sp. thermal pretreatment was beneficial for anaerobic digestion.

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## ABSTRACT

Biogas production is one of the means to produce a biofuel from microalgae. Biomass consisting mainly of *Scenedesmus* sp. was thermally pretreated and optimum pretreatment length (1 h) and temperature (90 °C) was selected. Different chemical composition among batches stored at 4 °C for different lengths of time resulted in organic matter hydrolysis percentages ranging from 3% to 7%. The lower percentages were attributed to cell wall thickening observed during storage for 45 days. The different hydrolysis percentages did not cause differences in anaerobic digestion. Pretreatment of *Scenedesmus* sp. at 90 °C for 1 h increased methane production 2.9 and 3.4-fold at organic loading rates (OLR) of 1 and 2.5 kg COD $m^{-3}$ $day^{-1}$, respectively. Regardless the OLR, inhibition caused by organic overloading or ammonia toxicity were not detected. Despite enhanced methane production, anaerobic biodegradability of this biomass remained low (32%). Therefore, this microalga is not a suitable feedstock for biogas production unless a more suitable pretreatment can be found.



## 1. Introduction

Microalgae are a promising feedstock for the production of biodiesel and bioethanol; however, the generation of these biofuels only extracts part of the energy stored in the biomass. According to Lardon et al. (2009), oil cakes discarded after biodiesel production still contained 35–73% of the energy present in the biomass. Therefore, anaerobic digestion of these cakes would decrease costs by providing heat and electricity. Likewise, bioethanol production only ferments the carbohydrate fraction while lipids and proteins can still be used for other purposes.

Production of biogas requires pretreatment of the biomass in order to disrupt the cell wall of the microalgae (González-Fernández et al., 2012a). In the present study, thermal pretreatment was evaluated for enhancing anaerobic biodegradation. Methane production at organic loading rates of 1 and 2.5 kg COD $m^{-3}$ $day^{-1}$, was applied to a semi-continuously fed reactor. In addition to organic matter degradation, nitrogen mineralization and potential inhibitions by organic overloading and free ammonia were assessed.

## 2. Methods

### 2.1. Feedstock and inocula

Biomass containing mainly *Scenedesmus* sp. microalgae was grown at 20 °C in synthetic Z-8 nutrient broth (Staub, 1961). Continuous illumination with fluorescent lamps (Edison, 58 W) was employed. The photobioreactor consisted of an open plastic bag of 0.2 $m^3$. Air flow of 12 L $min^{-1}$ was provided for mixing. When the absorbance (680/800 nm) of the culture reached a plateau (after approximately two weeks), the biomass was allowed to settle by gravity.

The inoculum for anaerobic digestion was granular sludge collected at a sugar factory in Marseille (France). When operating

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