Assessment of anaerobic digestion of food waste at psychrophilic conditions and effluent post-treatment by microalgae cultivation

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Abstract: Anaerobic digestion (AD) of food waste (FW) has become of great interest in recent years due to the high organic removal rates and positive net energy balance. However, two key issues should be highlighted. On the one hand, AD effluent still needs to be purified in order to meet ecologically acceptable requirements for direct disposal. On the other hand, AD plants have been mainly based on mesophilic and thermophilic temperatures, which may represent an important economic barrier for extending AD to small- and medium-sized plants. Hence, the aim of this paper is to assess the AD of FW at low temperature and the post-treatment of anaerobic digestate by using microalgae cultivation at laboratory scale. This study explores an economical alternative for small- and medium-size treatment plants loaded with FW. Inoculum and FW were physical and chemically characterized, and 5-L glass batch reactors in triplicate were used for determining the biochemical methane potential. The chemical oxygen demand (COD), biogas production and its composition were measured until the end of batch tests. The post-digestate was assessed as cultivation media for the microalgae Scenedesmus sp. by varying the dilution rate with fresh water. After 15 days, microalgae was harvested and the liquid fraction was assessed in accordance with the Chilean legal requirements. Although AD of FW at psychrophilic temperature leads to a lower biogas yield, the COD was reduced up to 97.5%, microalgae was successfully cultivated in all post-digestate dilutions, and some of them allowed the use of effluent for irrigation. Graphic abstract: [Figure not available: see fulltext.].

Anaerobic digestion

Biogas

Food waste

Microalgae

Psychrophilic range

Scenedesmus sp

Algae

Batch reactors

Biogas

Chemical oxygen demand

Effluent treatment

Effluents

Microorganisms

Temperature

Biochemical methane potential

Food waste

Legal requirements

Micro-algae

Microalgae cultivation

Psychrophilic range

Scenedesmus sp

Thermophilic temperatures

Anaerobic digestion