Short Communication

Ultrasonic and thermal pretreatments to enhance the anaerobic bioconversion of olive husks

A. Gianico a,⇑, C.M. Braguglia a, D. Mescia b, G. Mininni a

a Cnr, Istituto di Ricerca Sulle Acque, Area della Ricerca di Roma 1, Monterotondo (Roma), Italy
b Asja Ambiente Italia S.p.A., via Ivrea 70, Rivoli (TO), Italy

HIGHLIGHTS

• Ultrasonic and thermal pretreatments on olive husks were carried out.
• Both treatments resulted effective in dissolving COD and polyphenols.
• Significant gain in biogas and VS removal due to sonication of mixed wastes.
• Thermal pretreatment had detrimental effects on digestion performances.

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ABSTRACT

Olive husks, typical solid by-products from the olive oil industry, were selected to carry out anaerobic digestion tests. Before digestion, olive husks were subjected to ultrasonic or thermal pretreatments in order to release the organic matter into solution. Both sonication and thermal pretreatment allowed to solubilize the particulate matter with 22% and 72% increase in soluble organics of olive husks, respectively. Nevertheless, such pretreatments caused the release of unwanted molecules in solution, with the related risks of inhibition of the methanogenic process.

Biochemical Methane Potential (BMP) tests on olive husks mixed with olive-mill wastewater and dairy wastewater, either pretreated or not, showed that ultrasound pretreatment resulted in 15% increase in volatile solids reduction and a 13% increase in biogas production, while after thermal pretreatment no benefits were observed.

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1. Introduction

Huge amounts of organic wastes are produced as by-products from the agro-food industries. A sustainable management of these residues could be achieved by diverting a portion of food waste from landfills, maximizing the recovery of valuable compounds.

The importance of olive oil industry in Mediterranean countries is well known, as is the environmental concern related with the final disposal of the residues, such as the olive husks (OH). In these countries, two- and three-phase systems based on olive-pomace centrifugation are traditionally implemented (Alburquerque et al., 2004). The liquid phase is composed of olive oil and olive mill wastewater (OMW), consisting of the water content of the olives combined with the water used for olive processing (Tziotzios et al., 2007). The OMWs are characterized by high organic loads and a substantial quantity of plant nutrients (N, P, K, Ca, Mg and Fe) that could increase soil fertility and crops production (Montemurro et al., 2009). The organic components of OMWs are sugars, lipids, organic acids, alcohols, tannins, nitrogen compounds, polyphenols, and a dark pigment formed from catechol-melanin polymers. Anaerobic digestion is one of the most promising technologies for disposing OMWs recovering energy, but could be hindered by low pH and by the presence of bacterial growth inhibitors such as polyphenolic compounds, polysaccharides, proteins and aromatic molecules (Roig et al., 2006).

Olive husks (OH) are solid by-products obtained from the extraction of olive oil and consist of pieces of skin, pulp, stone and olive kernel. The major ingredients are polysaccharides, proteins, fatty acids, ligno-cellulosic polyalcohols, polyphenols and other pigments (Karantonis et al., 2008). Due to the seasonality of the olive mill industries, the amounts of organic residues generated may therefore give rise to storage problems or render digestion not cost-effective. A non-seasonal organic residue is the dairy industry wastewater (DW) constituted by milk whey, sheet and buttermilk. This residue, characterized by high concentrations of soluble organic matter, is particularly suitable to be anaerobically digested; the only disadvantage is the presence of fats and casein that could inhibit non-acclimated microorganisms and reduce methanogenesis (Perle et al., 1995). Mechanical (ultrasounds)