Program

Wastewater and Biosolids Treatment and Reuse: Bridging Modeling and Experimental Studies

June 8-14, 2014
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PHENOLIC WASTES VALORIZATION THROUGH BIOENERGY AND BIOACTIVE COMPOUNDS PRODUCTION

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Key Words: phenolic effluents, anaerobic digestion, biogas, bioactive compounds, agro-industrial wastes

The agricultural and industrial processing activities produce large amounts of waste that are only partially valorised at different value-added levels (spread on land, animal feed, composting), whereas the main volumes are managed as waste of environmental worry (1). These by-products are rich sources of bioactive compounds, including phenolic compounds with high antioxidant activity. Nowadays, the need to replace synthetic antioxidants used in the pharmaceutical, cosmetic and food industries (i.e. BHT, BHA, TBHQ), whose safety has been questioned, has promoted the research on new sources of antioxidant molecules (2). The undervalued by-products obtained from the agriculture or industry could be used as an inexpensive supply of such compounds. Anaerobic digestion is an advantageous process providing energy carrier gas and a flow for agricultural purposes, which can be applied in biogas production as well as in the treatment and conversion of organic effluents. The aim of our research was to develop innovative technologies to obtain bioenergy (biogas) and high added value products (bioactive molecules) from the residues that have in common the presence of phenolic compounds. Three agro-industrial effluents containing significant amounts of phenolic compounds, namely olive mill wastewater (OMW), cork boiling wastewater (CBW) and chestnut wastewater (CW) were considered in this work as cheap sources of natural antioxidants. Experiments operating beneath anaerobic conditions and under mesophilic conditions of temperature (37 ± 1° C) were performed to assess the potential for energy production of the substrates and the ability of the process to remove the organic load and provide valuable molecules for industrial uses, as phenols with antiradical activity (3). Bioactive molecules, sugars and other useful chemical compounds were obtained utilizing eco-friendly extraction processes and were characterized in terms of antiradical activity and phenolic compounds quantification (4). The potential of the antioxidant molecules were assessed before and after the anaerobic digestion stage. Regarding OMW, oleuropein was the main phenolic compound present in the effluent before and after the anaerobic process (about 15 % of the initial value). Other phenolic compounds as gallic acid, hydroxytyrosol, tyrosol, and quercetin were also detected. The main bioactive compound identified in CBW was ellagic acid, with the highest amount detected in the input stream. Phenols such as gallic, caffeic, vanillic, and ferulic acids have also been found (5). The total phenols measured in CW ranging from 25 to 58 μg mL^{-1}, and the *ortho*-diphenol fraction, provided with the highest antioxidant power among the phenolic molecules, corresponded to 83% of the total phenols. The results indicate that the agro-industrial effluents under study could be advantageously valorised in terms of bioactive compounds recovery, and used as low-cost sources of phenolic compounds and natural antioxidants. This work proposal promotes new horizons of research and applications for the development of a more sustainable and competitive agro-industrial sector.

References

(1) Federici F, Fava F, Kalogerakis N, Mantzavinos D (2009) Valorisation of agro-industrial by-products, effluents and waste: concept, opportunities and the case of olive mill wastewaters. J Chem Technol Biotechnol 84 (6), 895-900.
(2) Balasundram N, Sundram K, Samman S (2006) Phenolic compounds in plants and agri-industrial by-products: Antioxidant activity, occurrence, and potential uses. Food Chem 99 (1) 191-203.
(3) La Cara F, Ionata E, Del Monaco G, Marcolongo L, Gonçalves MR, Marques IP (2012) Olive mill wastewater anaerobically digested: Phenolic compounds with antiradical activity. Chemical Engineering Transactions 27, 325–330.
(4) Maurelli L, Ionata E, La Cara F, Morana A (2013) Chestnut shell as unexploited source of fermentable sugars: effect of different pretreatment methods on enzymatic saccharification. Appl. Biochem.Biotechnol 170 (5), 1104-1118.
(5) Marques IP, Gil L, La Cara F (2014) Energetic and biochemical valorization of cork boiling wastewater by anaerobic digestion. Biotechnology for Biofuels 7, 67-77.