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Pretreatment and Bioconversion of Crop Residues

Edited by
Carlos Martín

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Carlos Martín

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Editor
Carlos Martín
Department of Chemistry
Umeå University
Umeå
Sweden

Editorial Office
MDPI
St. Alban-Anlage 66
4052 Basel, Switzerland

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Article

Bioconversion Process of Barley Crop Residues into Biogas—Energetic-Environmental Potential in Spain

Carlos Morales-Polo [1,2,3,*], María del Mar Cledera-Castro [1,2,3], Marta Revuelta-Aramburu [2] and Katia Hueso-Kortekaas [2]

1 Institute for Research in Technology, Comillas Pontifical University, 28015 Madrid, Spain; mcledera@comillas.edu
2 Department of Mechanical Engineering, ICAI School of Engineering, Comillas Pontifical University, 28015 Madrid, Spain; mrevuara@comillas.edu (M.R.-A.); khueso@comillas.edu (K.H.-K.)
3 Rafael Mariño Chair for New Energy Technology, Comillas Pontifical University, 28015 Madrid, Spain
* Correspondence: cmorales@comillas.edu; Tel.: 34-91-542-28-00

Abstract: Barley fields reach 1.7 million hectares in Spain, of which 320,000 are used to produce malt, generating 450,000 tons of crop residue from barley intended for malt production. One way to treat this waste in an environmentally sound, energy-sustainable and economically cost-effective manner is anaerobic digestion. The biogas generated can be used as fuel and as a renewable source of energy (providing a solution to the energy supply problem from an environmental point of view). It has been shown that, when treated along with sludge from a Upflow Anaerobic Sludge Blanket (UASB) reactor, the crop malt residue produces about 1604 NmL of biogas per 100 g; with a content in methane of 27.486%. The development of the process has been studied with a novel indicator, hydrogen generation, and it has been determined that the process takes place in two phases. It has been demonstrated that this solution is beginning to be energy-efficient and therefore to produce energy for external uses in regions that have at least 6000 hectares of planted barley. At best, it can be considered, in a given region, the equivalent of a 115 MW power plant. It could supply energy to 10 thousand homes per year. Therefore, it is considered an energy-efficient solution that com-plies with the Sustainable Development Goals #1, #7, #10, #12 and #13. It guarantees access to energy in isolated areas or with supply problems, and results in a 55.4% reduction in emissions of equivalent-CO_2 (which equals 38,060 tons of equivalent-CO_2 in Spain).

Keywords: barley crop residue; biochemical methane potential; material degradability; anaerobic indicators; biogas feasibility; biogas emissions

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1. Introduction

Agri-food trade in the European Union (EU) is one of the most important in the world economy [1]. In 2019, the EU positioned itself as the world's largest exporter and the second largest importer of agri-food products. The value of exports increased to 14.7 billion euros in 2019 compared to 2018, while import values increased to 10.7 billion euros [2]. Both imports and exports have been growing since 2002, contributing to a monthly trade surplus in the agri-food sector of 4.0 billion euros.

According to EUROSTAT data, the demographic situation in the EU reflects an upward growth; since 2008, the population has increased by 13 million inhabitants [3]. Alongside this population growth, an increase in needs and consumption is associated, especially in the agri-food sector, given the basic need for population feeding, but also in the energy field, as discussed below.

The agri-food industry comprises activities from all economic sectors [1]. The food supply chain (FSC) begins with stages of the primary sector (agriculture and livestock), which generates by-products (i.e., manure, waffle, cornstalk) and food waste and food loss in the form of low-quality products, damaged production, or products with no commercial

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