Valorization of chestnut shells for hydrogen production by *Clostridium butyricum* fermentation

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Abstract

Chestnut shell s (CS) is an agronomic waste generated from the peeling process of the chestnut fruit. It is well-known that the extract of CS contains high amounts of tannins, which are polyphenolic antioxidants[1], but this agronomic residue also contains about 36% sugars in form of polysaccharides, and no utilization of chestnut shells as potential source of fermentable sugars has been considered so far. As consequence, this waste represents an interesting exploitable source for monosaccharides production, and in this study we evaluated the potential of biohydrogen production from CS hydrolyzate.

CS (5% w/v) were soaked in ammonium hydroxide (10% v/v) at 70°C for 22h to remove lignin, and then subjected to saccharification of the cellulose and xylan fractions for 72h at 50°C, pH 5.0 by enzymatic cocktail prepared with commercial enzymes. The resulting CS hydrolyzate was detoxified with activated charcoal, and used as carbon and energy source in fermentations by *C. butyricum*. After 72 hours 83.6% of the initial glucose and xylose were consumed, yielding 1.92 $mol.mol^{-1}$ of H_2. The ratio of H_2/CO_2 in the biogas produced was 1.3, and the hydrogen volumetric production rate attained 449 $ml.l^{-1}day^{-1}$. These results demonstrate the adequacy of CS for the biological production of hydrogen.

The strategy proposed in this work for CS upgrading holds a promise for future optimization of the physical-chemical/enzymatic treatments and detoxification process and bioconversion yield.

1) Vázquez et al. *Ind Crops Prod* (2009) **29**, 364-370.

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