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白酒丢糟的酸酶联合水解糖化工艺

Saccharification for distiller’s grains based on combined hydrolysis with acid and enzyme

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中文摘要:

为充分利用白酒丢糟资源，探讨了酸酶联合水解法对其进行糖化以获得可发酵糖的可行性。以木糖和还原糖浓度为指标，研究温度、固液比、混合酸浓度和时间等因对酸解效果的影响；在此基础上分析纤维素酶对酸解残渣(AHR)的酶解历程，并利用扫描电镜(SEM)、红外光谱(FTIR)和X-衍射(XRD)技术考察不同水解阶段丢糟的结构变化。结果表明，丢糟在温度为100℃、固液比为1:12 g/mL和酸浓度为2.0%的条件下经混合酸水解120 min可获得59.32 g/L还原糖和6.49 g/L木糖，该酸解阶段的半纤维素和维素转化率分别为77.38%和62.50%，木质素溶出率为43.50%。AHR在纤维素酶用量为4000 U/g原料、温度为45 ℃和pH值为4.8的条件下继续作用2.5 h可获得13.27 g/L还原该酶解阶段的纤维素转化率为66.67%，酶解率高达90.73%。结构特性研究表明，水解作用前后的丢糟形貌结构变化明显，孔隙率和比表面积增加，有利于纤维素酶对A纤维结晶区的作用。FTIR和XRD结果显示，水解前后的特征组分所对应的吸收峰强度发生了变化，相对结晶度逐渐提高。白酒丢糟经酸酶联合水解作用转化为可发酵糖有可行性。该研究可为丢糟生物质发酵制备乙醇提供理论基础。

英文摘要:

China is a big country of white spirit production and consumption. When brewing white spirit, large amounts of distiller’s grains (DG) are left over, which are as the byprodu white spirit production. In virtue of high content of cellulose and hemicellulose, DG is a kind of lignocellulosic biomass. In order to make full use of a distiller´s grains (DG), the feasibility of using DG in making fermentable sugars by the two-step hydrolysis method of mixed acid and cellulase was explored. The key parameters of temperature, mixed acid concentrations, solid-liquid ratio and hydrolysis time were studied with the index of the concentrations of reducing sugar and xylose. In addition, the structural characteristics of I different hydrolysis stages were examined by means of scanning electronic microscopy (SEM), infrared spectroscopy (FTIR) and X-ray diffraction (XRD). The results indicated th there was 59.32 g/L reducing sugar and 6.49 g/L xylose in the conditions of temperature 100℃, solid-liquid ratio 1:12 g×mL-1, acid concentrations 2.0% and time 120 min, with the conversions of 77.38% and 62.50% for hemicellulose and cellulose, respectively. There were 13.27 g/L reducing sugars in the enzymatic hydrolysis conditions of cellulase dosage 4 U/g, temperature 45℃, pH value 4.8 and time 2.5 h. The conversion rate and enzymatic hydrolyzation of the cellulose were 66.67% and 90.73%, respectively. The studies of structu characteristics showed that the changes in morphology caused by acid and enzymatic hydrolysis successively were significant in comparison to those of feedstock, resulting in increasing surface exposure and porosity. The disorganized morphological structure of AHR allows for greater accessibility to cellulase, which facilitates enzymatic hydrolysis. Th spectrograms of FTIR and XRD suggested that the characteristic strength peaks for the corresponding typical functional groups of each component were changed and the crystal index of the solid residues were increased, compared with DG. In short, the saccharification process based on the combined hydrolysis of acid and enzyme to produce fermentable sugars was feasible and efficient.

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