利用微生物將纖維素廢棄物轉化為生質酒精 = Conversion of cellulosic wastes to ethanol by microorganism

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摘 要

未來將會面臨石油價格的高漲以及由全球性農業(如：五穀、糖和油籽種子)迅速擴展所生產之生質燃料(biofuel)彼此間的潛在問題。然而，由於石油和農業商品之間的衝突，日後可能會導致食物價格大幅的上升。若國家將資源全力發展為生質燃料，那麼將會發生食物短缺並且只能依靠進口的食物來生活，這對於發展中的國家和地區是一項重大的危機。因此，為避免食物價格過度飆漲和營養不良(undernourished)人口的增加，本研究擬以纖維廢棄物作為生產生質燃料之原料。因此，本研究主要目的為利用微生物及物化方法轉化纖維廢棄物變為酒精，結果分為以下四個部份: 第一部分為纖維分解及酒精分解菌株的篩選，本研究由不同來源的活性污泥及動物糞便中篩選兩株具有纖維分解能力較強的菌株(PAN-B01和FAC-B01)，其中PAN-B01菌株是由熊糞便中篩選出具有最佳的纖維分解活性經16S rRNA鑑定為Acinetobacter sp.。此外，在酒精生產菌株的篩選中，我們由酒廠之活性污泥及酒粕中分離出兩株酵母菌株，經實驗證實Zymomonas mobilis具有比酵母菌高的酒精生產能力。因此，往後我們將以Z. mobilis進行酒精生產試驗。 第二部份為利用稀硫酸轉化纖維素變為醣類，纖維的來源有竹子和稻桿粉，其中竹子粉來源為台灣綠竹Bambusa oldhamii Munro (台灣竹林面積廣達 15 萬公頃)；稻稈粉來源為一般稻米稈(台灣稻田面積約27萬公頃)。於不同硫酸濃度(0.1-0.5 M)及溫度(30-100℃)條件下以稀硫酸水解纖維，在水解過程中測定cellobiose, arabinose, glucose, xylose和cellotetraose的濃度，使用Arrhenius數學方法解析於不同溫度下酸水解竹子及稻桿粉變為醣類的動力學參數，結果顯示竹子粉水解成cellotetraose具有最大的活化能(82.1 kJ/mol)；而稻稈粉則是水解成cellobiose具有最大的活化能(31.6 kJ/mol)。 第三部份生物分解纖維部份結果顯示對Acinetobacter sp. (PAN-B01)菌株來說，水解纖維之最佳條件為以Urea作為培養基中氮源操作在150 rpm及pH 7.0的反應條件下；對FAC-B01菌株來說，水解纖維之最佳條件則為以Urea作為培養基中氮源操作在150 rpm及pH 9.0的反應條件下。 第四部份為利用固定化菌體顆粒生產酒精，本研究使用經PVA (polyvinyl alcohol)固定化之Zymomonas mobilis與懸浮的Z. mobilis比較兩者間酒精生產的情形，結果顯示經PVA固定化之菌體其可以生產酒精的溫度可提高至50℃且其酒精耐受度可提高至10% (v/v)以上。此結果顯示固定化菌體可以改善菌體本身對環境的耐受度。

關鍵詞 : 竹子、稻稈、纖維素、酸水解、固定化、酒精生產

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