黑曲霉固态发酵苹果渣产木聚糖酶的工艺优化研究

Optimization of solid-state fermentation conditions with apple pomace for production of xylanase by Aspergillus niger

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中文摘要：

为了获得有较高酶活值的低成本木聚糖酶产品，试验以苹果渣和棉粕为基料研究了黑曲霉（Aspergillus niger SL-05）固态发酵产木聚糖酶的最佳条件。初步试验结果表明：以棉粕和苹果渣（1∶1）作为基础氮源和碳源得到的发酵曲的酶活值最高。通过Plackett-Burman试验筛选出了对产酶影响显著的3个因素：尿素、KH2PO4、含水率。进一步试验采用二次回归正交旋转试验设计研究了自变量（尿素、KH2PO4、含水率）对黑曲霉SL-05产酶的影响，通过响应面分析获得了产酶的最佳条件。模型的方差检验显示总回归达到了显著水平($P<0.05$)，失拟性检验不显著，说明模型适合并且预测尿素、KH2PO4、含水率对产酶的影响非常有效。在最佳条件（基料棉粕和苹果渣比例为1∶1，第2氮源尿素2.6%，无机盐KH2PO4 0.09%，速效碳源葡萄糖2%，含水率62.9%，30℃培养60 h）下，分别获得了5662、30000 U/g的木聚糖酶和纤维素酶的高酶活发酵干曲。以廉价的工农业废料作为基本培养基获得了有较高酶活的产品，经济优势明显。

英文摘要：

To obtain xylanase with high activity and low cost, optimization of medium composition for the production of extracellular xylanase by Aspergillus niger SL-05 was investigated in solid-state fermentation using statistical experimental designs. The results of preliminary experiments showed that culture medium containing apple pomace and cottonseed meal (1∶1) as carbon and nitrogen sources supported xylanase production with maximal enzyme activity. Three significant factors, urea, KH2PO4, and initial moisture contents that influence xylanase production were selected using Plackett-Burman design. Further experiment was carried out using design of rotation-regression-orthogonal combination to study the influences of process variables on xylanase production. 2.6% Urea, 0.09% KH2PO4 and 62% initial moisture content obtained by the response surface plot were optimum for xylanase production. The analysis of variance for models shows that the tested model is statistically significant ($P<0.05$) and lack of fit is not significant, indicating that they are appropriate and can be used to predict the effects of urea, KH2PO4 and initial moisture contents on enzyme production. Under the optimized conditions as follows: ratio of apple pomace and cottonseed meal 1∶1, urea content 2.6%, KH2PO4 content 0.09%, glucose content 2%, initial moisture content 62.9%, fermented at 30℃ for 60 h, 5662 and 30000 U/g of xylanase and cellulase were produced, respectively. This study innovatively developed a fermentation medium and process to utilize inexpensive agro-industrial wastes to produce a high yield of xylanase.

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