

## 摘要

樟芝(*Antrodia cinnamomea*)為台灣一種特有的藥用真菌，具有提昇人體免疫力及保肝的多種功能。野生牛樟生長緩慢且不易取得，近年來使用固態或液態培養，期能以較穩定的品質及較合理的價格供應保健食品市場的需求。本實驗採用液態培養，探討不同培養條件(不同碳源及氮源、不同碳源濃度及培養基不同初始 pH 值的調整)以搖瓶培養及不同通氣量及攪拌速度在發酵槽培養，對樟芝菌絲體(mycelia)及多醣體(polysaccharides)的生產及多醣品質之影響。

試驗結果顯示在搖瓶培養方面，以葡萄糖及玉米澱粉為碳源和以 peptone 及 corn steep powder 為氮源，採用玉米澱粉(3%)和 peptone(0.5%)時，可得到最多菌絲乾重、胞外(EPS)及胞內多醣(IPS)分別為 1.20 mg/ml、17.48 mg/ml 和 0.22 mg/ml，及最佳多醣品質指標包含 EPS 及 IPS 之  $\beta$ -1,3-glucan 含量分別為 8.80  $\mu$ g/ml LE、1.12  $\mu$ g/ml LE 及分子量  $3.76 \times 10^5$  Da；在不同碳源濃度試驗(1%、2%及3%)中，則以玉米澱粉 2 %時，可得到最多菌絲乾重、胞外(EPS)及胞內多醣(IPS)分別為 0.80 mg/ml、9.21 mg/ml 及 0.13 mg/ml，最佳多醣品質包含 EPS 及 IPS 之  $\beta$ -1,3-glucan 含量分別為 11.62  $\mu$ g/ml LE 及 2.68  $\mu$ g/ml LE；測試不同初始 pH 值時，以初始 pH 值未調整(約 5.3)可得到最大菌絲乾重、EPS 及 IPS 分別為 0.85 mg/ml、14.02 mg/ml 及 0.07

mg/ml,最佳多醣品質包含 EPS 及 IPS 之  $\beta$ -1,3-glucan 含量分別為 11.06  $\mu$ g/ml LE 及 2.54  $\mu$ g/ml LE。

在 5 公升的攪拌式發酵槽，進行不同的攪拌及通氣培養條件，以全程維持在 100 rpm, 1.0 vvm，的生產效果最佳，可得到 EPS 及 IPS 產量分別為 22.06 mg/ml 及 0.28 mg/ml, 多醣品質指標包含 EPS 及 IPS 之  $\beta$ -1,3-glucan 含量分別為 21.81  $\mu$ g/ml LE、2.92  $\mu$ g/ml LE 及分子量  $1.48 \times 10^4$  Da。

關鍵詞：樟芝、多醣體、玉米澱粉、 $\beta$ -1,3-glucan

## Abstract

*Antrodia cinnamomea* is an important Chinese medicinal fungus, and is a unique species only grown in Taiwan. It has many functional properties in human body, especially for promoting immune system and protecting liver. As it is growing slowly in the wild, supply of *A. cinnamomea* with stable product quality at reasonable price is in high demand. Research on the methods of artificial cultivation for this fungus is necessary. Our research is interested in attempting to utilize cheaper fermentation substrates for production of this organism, with emphasis on the productivity and quality of the microbial polysaccharides. This study was carried out by submerged fermentation of *A. cinnamomea*. Culture conditions which including different carbon and nitrogen sources, and different initial pH of fermentation medium in shake flasks. Effects of aeration and stirring in the fermentor were also investigated.

The shake flask studies showed that using of corn starch and peptone combination as carbon and nitrogen sources had the best results in production of biomass, the contents of exo-polysaccharide (EPS) and intra-polysaccharide (IPS), with a concentration of 1.20 mg/ml, 17.48 mg/ml, 0.22 mg/ml, respectively in the fermentation broth. The content of  $\beta$ -1,3-glucan in EPS and IPS were 8.80  $\mu$ g/ml LE, 1.12  $\mu$ g/ml LE respectively, and had a molecular weight of  $3.76 \times 10^5$  Dalton for EPS. Maximum results were obtained from the medium containing substrate concentration of 2% corn starch and unadjusted initial pH, where the biomass, EPS and IPS contents were 0.85 mg/ml, 14.02 mg/ml, 0.07 mg/ml, respectively, as compared to 1% and 3% starch and initial pH at 3, 4, 5 and 6. And  $\beta$ -1,3-glucan of EPS and IPS are 11.06  $\mu$ g/ml LE and 2.54  $\mu$ g/ml LE, respectively.

The results from a 5 liter stirred tank fermentor ran with three different culture conditions showed that it was most suitable at 100 rpm, aeration rate 1.0 vvm throughout the fermentation period, with regard to production and quality of the polysaccharides. EPS and IPS were 22.06 mg/ml, 0.28 mg/ml, respectively. The  $\beta$ -1,3-glucan of EPS and IPS were 21.81  $\mu$ g/ml LE and 2.92  $\mu$ g/ml LE. The exo-polysaccharides had molecular weight of  $1.48 \times 10^4$  Dalton.

Key word : *Antrodia cinnamomea*, fermentation, polysaccharide, corn starch,  $\beta$ -1,3-glucan