

摘 要

舞菇 (*Grifola frondosa*) 為一種食藥用的真菌，代謝產物—多醣體，有抗腫瘤和保肝的療效，而以具有 β -1,3- 及 β -1,6- 為鍵結的葡聚醣，最具有藥理功效，故對於如何以人工培養舞菇並獲得多醣體值得加以探討。本研究以搖瓶及發酵槽培養的方式來探討舞菇菌絲生長及其多醣體的產量。

舞菇在搖瓶實驗發現 glucose、fructose、sucrose 及 corn starch 四種碳源中，以 30g/L 的 corn starch 能得到最好的菌絲生長及多醣體產量。氮源以 6g/L 的 corn steep powder (CSP)，就菌體及胞外多醣體的產量而言，優於 yeast extract 與 malt extract，但胞內多醣體含量則是 CSP 及 malt extract 是一樣的。培養基初始 pH 值以 pH 6 有較佳的多醣產量，可得到菌絲乾重 1.93mg/mL、胞內多醣 1.28mg/mL 以及胞外多醣 10.69mg/mL 的產量，pH5 的效果次之。

以 7L 的攪拌式發酵槽經過十四天的培養，發現三種通氣量中 (0.5, 1.0, 1.5vvm)，以 1.0 vvm 可以得到最佳的菌絲重量 1.43 mg/mL，胞內多醣 1.49mg/mL，以及胞外多醣 14.25mg/mL 的產量；以 1.5 vvm 所得的多醣體含有最多胞外 β -1,3-D-glucans 含量 111.90 μ g/mL LE；以 1.0 vvm 則可以得到胞內多醣體中最多的 β -1,3-glucans 的含量 10.45 μ g/mL LE。

以 7L 的氣舉式發酵槽經過十四天的培養，以 0.5 vvm 可以得到最佳的菌絲重量 1.33 mg/mL，以及胞外多醣 12.69mg/mL 的產量；IPS 以 1.0 vvm 的 1.41 mg/mL 較佳，所以氣舉式發酵槽中以 0.5vvm 是比較好的選擇，三種通氣量中，1.5 vvm 所測得的多醣體含有最多胞外 - 1,3 - glucans 含量 40.14 μ g/mL LE，以及胞內多醣體中最多的 - 1,3 - glucans 的含量 11.56 μ g/mL LE。

經由凝膠透過層析法(Gel permeation chromatography)方法分析其分子量，舞菇多醣體經由七天發酵後，在攪拌式發酵槽中 EPS 是以 0.5 vvm 最大 2.0×10^6 Da，IPS 是以 0.5 vvm 所得到的分子量最大 5.0×10^5 Da，1.5 vvm 的分子量差距最多， 5.3×10^3 Da 到 4.8×10^5 Da；氣舉式發酵槽多醣體分子量經過七天的發酵，EPS 以 0.5 vvm 最大 3.5×10^5 Da，但是分佈差距也最大；IPS 的分子量以 1.0 vvm 所產生的分子量 3.5×10^5 Da 為最大。

關鍵字：舞菇、多醣體、- 1,3 - D - glucan、氣舉式發酵槽、攪拌式發酵槽。

Abstract

Grifola frondosa is an edible medicinal fungi with medicinal effect in anti-tumor and liver protecting. The polysaccharide produced by the fungi having the chemical structure of α -1 \rightarrow 3- and α -1 \rightarrow 6-glucans, is believed to have biological and pharmaceutical activities. Therefore, research in the cultivating *Grifola frondosa* for biomass and its polysaccharide production is in high demand.

Results show that shake flask fermentation the most suitable carbon source was corn starch at concentration of 30 grams per liter of medium for the polysaccharide production, as compared to glucose, fructose and sucrose, where the biomass, exo-polysaccharide (EPS) and intra-polysaccharide (IPS) were 1.70 mg/mL, 7.74 mg/mL and 1.12 mg/mL, and the use of corn steep powder is better than yeast extract and malt extract as N-source. At pH 6 is the best among 4 tested initial pH in fermentation media to have mycelium dry weight (MDW) 1.93 mg/mL EPS, 10.69 mg/mL, and 1.28 mg/mL IPS.

The 7 liter stirred tank fermentor (STF) studies indicate, aeration rate at 1.0 vvm favors the maximum production in 1.43 mg/mL of MDW, 14.25 mg/mL EPS, and 1.49 mg/mL IPS after eight days in the 7 liter fermentor while 1.5 vvm obtained the highest

α -1 \rightarrow 3-glucans, 111.90 μ g/mL LE in the EPS.

The 7 liter the air-lift fermentor (ALF) studies, aeration at 0.5 vvm favors the production of the mycelium (1.33 mg/mL) and EPS (12.69 mg/mL), while IPS was best with 1.0 vvm (1.41 mg/mL). The

α -1 \rightarrow 3-glucans content, in the EPS were similar in all these aeration rate in ALF (40.14 μ g/mL LE), but were higher in IPS (11.56 μ g/mL LE), with the 1.5 vvm aeration the best.

The molecule weight (MW) of the polysaccharide after days 7

of fermentation, as analysed by gel permeation chromatography (GPC) was the highest in the STF with 0.5 vvm (EPS: 2.0×10^6 Da; IPS: 5.0×10^5 Da). After days 7 of fermentation on the air-lift fermentor was the EPS highest MW 3.5×10^5 Da with 0.5vvm, and IPS highest MW 3.5×10^5 Da with 1.0vvm.

KEYWORDS: *Grifola frondosa*, polysaccharide, -1→3-glucans, stirred tank fermentor, air-lift fermentor.