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PRODUCTION OF *ASPERGILLUS NIGER* SPORES IN SUBMERGED FERMENTATION

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PRODUCTION OF *Aspergillus niger* SPORES IN SUBMERGED FERMENTATION

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Fungal spores are widely used in bioindustry as inoculum for fermentation process, starter culture for biofertiliser and also biopestisides. The spores are normally produced via solid state fermentation when face with difficulty in the fermentation harvest process in order to control the consistent production of quality spores. The possibility of producing large amount of spores using small scale bioreactor in submerged fermentation was investigated in this study. The quality of spores and the kinetic of their germination are greatly influenced by the qualitative and quantitative description of the fermentation culture. Submerged conidiation occur the best in the absence or exhaustion of nitrogen, when carbon supply is assimilable. During cultivation, low concentration of carbon sources is also required as higher concentration above critical level will force the fungi to stay in vegetative form. This study focused on investigation the suitability of several carbon and nitrogen sources for production of *Aspergillus niger* FPC5003 spores in submerged shake flask culture. Among the carbon sources (glucose, sago corn and

soluble starch) and nitrogen sources (yeast extract, bactopeptone, $(NH_4)_2SO_4$, $NaNO_3$, and $NH_4S_2O_4$) tested, sago starch and yeast extract provide better option for spores production. During the experiments, different concentrations were used in the media. The spores production gave the highest yield (9.06×10^5 spores/mL) when cultivated in the media with 10g/L sago starch and 0.3g/L yeast extract. The spores production showed and increased of ten fold (1.26×10^6 spores/mL) when fed-batch culture being applied with sequential addition of carbon source under the critical level. The optimum production of *A. niger* FPC5003 spores can be achieved by providing suitable carbon and nitrogen sources and single temperature shift strategy during fermentation under provided condition, the final spores count obtained (6.09×10^7 spores/mL) was about 232% higher than when temperature was maintained at 30°C throughout the process (9.06×10^5) spores/mL).

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENGHASILAN SPORA *Aspergillus niger* DI DALAM FERMENTASI TERAMPAI

Oleh

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Spora fungi digunakan dengan meluas sebagai permulaan untuk porses fermentasi, kultur pemula untuk pembajaan-bio dan racun-bio. Spora fungi kebiasaannya dihasilkan melalui fermentasi keadaan pepejal di mana masalah seperti kesusahan dalam proses kawalan untuk penghasilan yang konsisten dan spora yang berkualiti. Kemungkinan untuk menghasilkan jumlah spora yang besar menggunakan bioreaktor skala kecil dengan fermentasi terampai dikaji dalam penyelidikan ini. Kualiti dan kinetik penumbuhan spora dipengaruhi oleh kualitatif dan kuantitatif proses fermenatasi. Keadaan yang paling sesuai untuk keadaan terampai adalah dalam ketiadaan atau kehabisan nitrogen dan di dalam kehadiran bekalan karbon yang habis digunakan. Kepekatan sumber karbon yang rendah dan kepekatan sumber karbon di atas paras kritikal didalam kultur akan menyebabkan sel dalam keadaan vegetatif. Di dalam penyelidikan ini, beberapa sumber karbon dan nitrogen yang sesuai telah diuji untuk penghasilan spora *Aspergillus niger* FPC5003 di dalam kultur kelalang goncang terampai. Antara sumber karbon (glukosa, kanji sagu, kanji jagung dan kanji larut) dan

sumber nitrogen (organik dan tak-organik), kanji sagu dan ekstrak yis dibuktikan yang terbaik. Spora yang tertinggi (9.06×10^5 spores/mL) dihasilkan dengan formulasi medium yang mengandungi 10g/L kanji sagu dan 0.3g/L ekstrak yis. Menggunakan teknik fermentasi sekelompok- selanjar untuk meningkatkan hasil spora, dimana penambahan sumber karbon di bawah paras kritikal telah dijalankan, teknik ini memberikan 10 kali ganda dalam penghasilan spora (1.26×10^6 spores/mL). Sumber karbon dan nitrogen yang terbaik dan strategi perubahan suhu telah menghasilkan spora *A. niger* FPC5003 yang optimum. Di dalam eksperimen ini, bilangan spora terakhir yang diperolehi (6.09×10^7 spores/mL) adalah hampir 232% lebih tinggi daripada yang didapati di dalam kultivasi yang mana suhunya ditetapkan pada 30˚C sepanjang proses (9.06×10^5 spores/mL).

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DECLARATION

I declare that the thesis is my original work except for quotation and citation which have been duly acknowledged. I also declare that it has not been previously and is not concurrently submitted for any other degree at Universiti Putra Malaysia or other institution.

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