Cultivation of Cunninghamella echinulata and Bacillus cereus DYU-Too 12 to Produce Polyunsaturated Fatty Acids

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ABSTRACT

The aim of this study is to optimize the production of polyunsaturated fatty acids (PUFAs) by Cunninghamella echinulata and Bacillus cereus DYU-Too 12. The method of one-factor-at-a-time was used to investigate the effect of cultivating conditions, including the carbon and nitrogen sources, concentrations of glucose and ammonium chloride, temperature, and pH on the microbial growth, lipid accumulation, production of γ-linolenic acid (GLA) and eicosapentaenoic acid (EPA) by Cunninghamella echinulata and Bacillus cereus DYU-Too 12. The central composite design was used to obtain optimal production of PUFAs. After the one-factor-at-a-time method was performed, results showed that Cunninghamella echinulata was best to be cultivated in a medium with 35 g/L glucose and 1 g/L ammonium chloride under 25°C, 100 rpm and pH 7.0, and the highest biomass obtained was 7.05 g/L, the lipid 1.30 g/L and the GLA 602.48 mg/L. Similarly, Bacillus cereus DYU-Too 12 was best to be cultivated in a medium containing 20 g/L glucose and 1 g/L ammonium chloride under 30°C, 100 rpm and pH 7.0, and the highest biomass was 2.65 g/L, the lipid 0.12 g/L and the EPA 35.45 mg/L. A central composite design of three factors, each with two levels, included 16 experiments (8 factorial, 6 compensate and 2 central experiments). The ranges for the ammonium chloride concentration and the pH were the same in both cultures of C. echinulata and Bacillus cereus DYU-Too 12. The concentration of glucose at the central point was 35 g/L for C. echinulata and 20 g/L for Bacillus cereus DYU-Too 12. The 16 experiments were carried out randomly, and the results were analyzed with statistical software, STATISTICA. The optimal cultivating condition for C. echinulata was as follows: glucose 33.82 g/L, ammonium chloride 1.04 g/L and pH 6.02, and the highest biomass reached 7.45 g/L and GLA 937.32 mg/L (96% of the expected result). For Bacillus cereus DYU-Too 12, the optimal condition was: glucose 19.00 g/L, ammonium chloride 0.91 g/L and pH 6.20. The highest biomass obtained was 2.34 g/L and the EPA 29.47 mg/L (96.21% of the expected result).

Keywords : Cunninghamella echinulata ; Bacillus cereus DYU-Too 12 ; γ-linolenic acid ; eicosapentaenoic acid ; centralcomposite design

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