UNIVERSITI TEKNOLOGI MARA

PRODUCTION OF LACTIC ACID FROM CULTIVATION OF *RHIZOPUS ORYZAE* NRRL 395 AND CHARACTERIZATION OF ITS POLYMER DERIVATIVE

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ABSTRACT

In this work, the project is to discover an alternative way to substitute non-biodegradable plastic with biodegradable plastic from poly(L)-lactic acid (PLLA) polyester, using direct polycondensation (DPC) process. The first objective is to determine the growth and morphology of *Rhizopus oryzae* NRRL 395 and its ability to produce L-lactic acid (LLA) from microbial lactic acid fermentation (MLAF) of cassava starch. The second objective is to study the effect of spores concentration, substrate concentration, temperature and time on LLA concentration, yield and productivity in MLAF. The third objective is to characterize the PLLA obtained from DPC process by using Fourier Transform Infrared (FTIR), Thermogravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC) analysis. From these research findings, the *R.oryzae* NRRL 395 fungi has the ability to grow on potato dextrose agar (PDA) at 37°C after 72 hour of incubation period. The *R.oryzae* NRRL 395 fungi also have successfully produce LLA in the MLAF from partially hydrolyzed cassava starch substrate, which was identified from the HPLC and FTIR analysis. From HPLC analysis of the compound of interest in the sample taken from the fermentation broth, LLA was well separated at $t_{R\,=}$ 4.58 min and produced a sharp pointed peak at UV wavelength of 210 nm, at 1.0 mL/min flow rate by using 250 mm C-18 column with mobile phase of 0.001 M orthophosphoric acid, H_3PO_4 (pH 2.5). This indicates the presence of LLA compound in the samples as compared to the LLA standard. From the study of the effect of substrate concentration, the highest LLA concentration, 21.83 g/L was obtained at 96 h from 120 g/L cassava substrate concentration, followed by 100 g/L which produced 18.38 g/L of LLA after 72 h. The highest cassava starch concentration of 140 g/L used had resulted in producing the lowest LLA concentration, which was only 6.19 g/L after 120 h. In terms of the effect of temperature on LLA concentration, the highest LLA concentration was 24.17 g/L at 34°C obtained after 96 h of fermentation time. Nevertheless, it was found that the highest concentration for both T = 37 and 40°C were 22.19 g/L and 24.01 g/L, respectively at 72 h, faster than the highest concentration obtained at T = 34°C (24.17 g/L). Hence, the temperature of 37°C effectively produced 24.01 g/L of LLA in 72 h. In overall, the best operating condition for MLAF is at 37°C after 72 hour of fermentation with 120 g/L cassava substrate concentration. The PLLA was synthesized by DPC method, tested in the presence of stannous octoate (SnO) catalyst and without catalyst. The chemical compound of the synthesized PLLA was characterized by FTIR analysis and compared with the commercial PLA. From the analysis in TGA and DSC, the PLLA thermal properties were compared to the commercial PLA. In conclusion, the chemical compound and thermal properties showed that the PLLA should be improved and further enhanced.

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