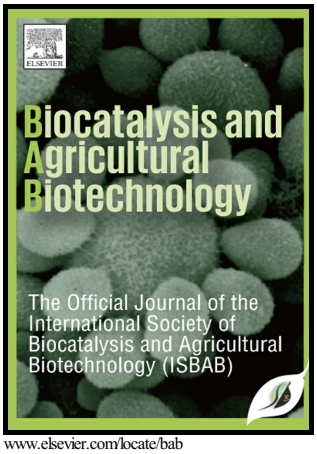

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Mathematical modeling of lactic acid fermentation in bioreactor with carob extract

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Abstract

In this study, nonlinear sixteen mathematical models including Gompertz (G), generalized Gompertz (GG), modified Gompertz (MG), re-modified Gompertz (RMG), logistic (L), generalized logistic (GL), modified logistic (ML), re-modified logistic (RML), Richards (R), generalized Richards (GR), modified Richards (MR), re-modified Richards (RMR), Stannard (S), Baranyi (B), Weibull (W), and Morgan-Mercer-Flodin (MMF) were applied to fit cell growth, product formation, and sugar consumption of batch lactic acid (LA) fermentation in stirred tank bioreactor with carob extract. To determine the modeling success, root-mean-square-error (RMSE), mean-absolute-error (MAE), R^2, slope, bias factor (BF), and accuracy factor (AF) were used. Results indicated that the best model for cell growth was MMF model (RMSE=0.24 g/L, MAE=0.16 g/L, R^2=1.00, Slope=1.06, BF=1.04 and AF=1.16). For product formation, the best models selected were RMG (RMSE=1.33 g/L, MAE=1.00 g/L, R^2=0.99, Slope=0.95, BF=0.94 and AF=1.11) and RMR (RMSE=1.33 g/L, MAE=1.01 g/L, R^2=0.99, Slope=0.96, BF=0.94 and AF=1.12) models. As for sugar consumption, B model was the best model for estimation of experimental data (RMSE=0.88 g/L, MAE=0.52 g/L, R^2=1.00, Slope=1.00, BF=1.00 and AF=1.01). Additionally, the most successful models that predict experimental kinetic data were GG, GL, S, and W models. Consequently, the best models selected could be used for more progress of LA production process in bioreactor with carob extract.