Artificial neural network modeling studies to predict the yield of enzymatic synthesis of betulinic acid ester

ABSTRACT

3β-O-phthalic ester of betulinic acid was synthesized from reaction of betulinic acid and phthalic anhydride using lipase as biocatalyst. This ester has clinical potential as an anticancer agent. In this study, artificial neural network (ANN) analysis of Candida antarctica lipase (Novozym 435) -catalyzed esterification of betulinic acid with phthalic anhydride was carried out. A multilayer feed-forward neural network trained with an error back-propagation algorithm was incorporated for developing a predictive model. The input parameters of the model are reaction time, reaction temperature, enzyme amount and substrate molar ratio while the percentage isolated yield of ester is the output. Four different training algorithms, belonging to two classes, namely gradient descent and Levenberg-Marquardt (LM), were used to train ANN. The paper makes a robust comparison of the performances of the above four algorithms employing standard statistical indices. The results showed that the quick propagation algorithm (QP) with 4-9-1 arrangement gave the best performances. The root mean squared error (RMSE), coefficient of determination (R2) and absolute average deviation (AAD) between the actual and predicted yields were determined as 0.0335, 0.9999 and 0.0647 for training set, 0.6279, 0.9961 and 1.4478 for testing set and 0.6626, 0.9488 and 1.0205 for validation set using quick propagation algorithm (QP).

Keyword: Artificial neural network; Acylation; Enzymatic synthesis; Candida antarctica lipase; Novozym 435; Betulinic acid