Abstract

Lipase production from *Rhizopus oryzae* NRRL 3562 was modeled and optimized using response surface methodology integrated evolutionary and swarm intelligence based approaches. The proposed approaches bring about an increased lipase activity of 15 U/gds by overcoming the local optima problem as compared to One variable at a time approach. The optimum conditions proposed by particle swarm optimization for lipase production from *R. oryzae* NRRL 3562 were 35.58 ^{o}C, liquid to solid ratio of 1.49, pH of 5.28 and 4.83 days of incubation time for obtaining maximum lipase activity of 96.78 U/gds. Modeling and optimization of the lipase extraction from the fermented biomass, through RSM coupled evolutionary and swarm intelligence based approach resulted in an enhanced recovery of more than 20 U/gds with respect to the one variable at a time approach.

Relative activity of lipase was significantly (more than 150%) enhanced in presence of Tween-80. Among different immobilization techniques (adsorption, covalent attachment and entrapment) the covalently immobilized lipase on celite exhibited an enhanced stability towards temperature and pH. The immobilized lipase of *R. oryzae* NRRL 3562 was successfully employed in the transesterification of edible/non edible/waste oils. The fuel properties of crude oils were enhanced by lipase mediated transesterification and the results obtained thereof were compared with ASTM D675 standards. Covalently immobilized lipase from *R. oryzae* NRRL 3562 was effectively used to synthesize octyl acetate and methyl butyrate in a solvent free system, and RSM–integrated evolutionary and swarm intelligence based approaches were used to model and optimize the synthesis of flavour esters.

Keywords: *Rhizopus oryzae* NRRL 3562 lipase; Modeling; Optimization; Response surface methodology; Evolutionary algorithm; Particle swarm optimization; Immobilization; Biodiesel; Flavour esters; Solvent-free synthesis.