Abstract

Bacillus coagulans RK–02 is a sporogenous probiotic bacterium. The growth and sporulation kinetics of this bacterium were characterized by cultivating it in a minimal medium. The growth kinetics data were satisfactorily fitted into the models of Monod (1942), Haldane-Andrews (1965) and Yano (1968) and the kinetic constants were determined. A logistic kinetic model was derived and validated to characterize the dynamics of sporulation and product formation in the stationary phase. The kinetic constants as determined using this model were particularly important for describing intrinsic properties of the culture in stationary phase. Non-linear curve fitting of the experimental data into the mathematical model showed very good correlation with the predicted values for sporulation and lipase production by *Bacillus coagulans* RK–02 culture in minimal media. The kinetic model was also validated by using literature data of sporulation and product formation in stationary phase for other *Bacilli*. Inhibition was observed both for growth and sporulation at higher substrate concentrations. The process conditions for maximum biomass, spore and lipase production were optimized in a laboratory scale fermenter. The optimum process conditions were found to be different for these three responses (biomass, spore and lipase). The validation experiments performed at the optimum conditions resulted in 6.25 gL^{-1} of biomass, 6×10^{12} spores per gram of dry biomass and 13.46 IU lipase, which were higher than those reported earlier. A nutraceutical formulation containing the probiotic endospores, prebiotic, selective vitamins and enzymes was developed. This formulation was found to be nontoxic and effective colonizer in GI tract in animal model. It was found to exert certain health benefit on the consumer (animal model) in terms of LDL cholesterol lowering activities. A sustained release drug delivery formulation using probiotic endospores was also developed and tested.

Keywords: Sporogenous probiotic; *Bacillus coagulans* RK–02; Sporulation; Associated product formation; Kinetic modeling; Process optimization; Nutraceutical formulation; Sustained release drug delivery; Efficacy testing.