

Kinetic modeling of bacteriocin-like inhibitory substance secretion by *Pediococcus acidilactici* Kp10 and its stability in food manufacturing conditions

ABSTRACT

This paper deliberates the modelling and validation of bacteriocin-like inhibitory substance (BLIS) secretion by *Pediococcus acidilactici* Kp10 at different agitation speeds in a stirred tank bioreactor. A range of models namely the re-parameterised logistic, Luedeking-Piret and maintenance energy were assessed to predict the culture performance of the said bacterium. Growth of *P. acidilactici* Kp10 was enhanced with increased agitation speed up to 600 rpm while BLIS secretion was maximum at 400 rpm but decreased at higher agitation speed. Growth of *P. acidilactici* aptly subscribed to the re-parameterised logistic model while BLIS secretion and lactose consumption fitted well with the Luedeking-Piret model. The models revealed a relationship between growth of the bacterium and BLIS secretion. Bacterial growth and BLIS secretion were largely affected by the agitation speed of the stirred tank bioreactor which regulated the oxygen transfer to the culture. BLIS secretion by *P. acidilactici* Kp10 was however enhanced in oxygen-limited culture. The study also assessed BLIS from the perspective of its stability when subjected to factors such as temperature, pH and detergents. Results showed that BLIS produced by this strain was not affected by heat (at 25-100 °C for 20 min and at 121 °C for 15 min), surfactant (Tween 40, 60 and 80 and urea), detergents (up to 1% SDS), organic solvents (50% each of acetone, methanol and ethanol) and stable in a wide range of pH (2-10). The above information are pertinent with reference to commercial applications of this bacterial product in food manufacturing which invariably involve various sterilization processes and subjected to a wide pH range.

Keyword: Bacteriocin-like inhibitory substance; Fermentation; Biokinetics; Agitation speed; Logistic equation; Luedeking–Piret equation