

Lactic acid production in a recycle batch reactor using immobilized *Lactobacillus casei* and its downstream processing

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Abstract

Lactic acid is a product with wide industrial applications, among the most important being its use as a preservative and acidulant in foods and as a precursor for polymers like poly (lactic acid). In this study an attempt was made to compare the production of lactic acid by free and immobilized cells. Batch fermentations with free cells of *Lactobacillus casei* were carried out in a fermentor at 42° C and pH 6.0. The fermentation using immobilized cells was carried out in recycle batch reactor. Whey based medium was developed by treating with an endoprotease, and supplementing with 2.5gl⁻¹ of yeast extract and 0.18 mM Mn²⁺ ions. The fermentation set-up comprised of a column packed with *L.casei* immobilized polyethyleneimine- coated foam glass particles; pora-bact A connected with a stirred tank reactor vessel for recirculation to control pH. For recycle batch fermentations using the immobilized cells, the sugar concentration of the medium was increased to 100gl⁻¹ by the addition of glucose. The average lactic acid productivity in the immobilized system was 4.5gl⁻¹h⁻¹ while that for free cells was 2.9gl⁻¹h⁻¹. Different nutritional and process parameters such as yeast extract concentration, presence of lactose, increasing the culture medium volume and flow rate were studied for the immobilized system. Small fraction of lactose with glucose enhanced complete sugar utilization by the organism and conversion to lactic acid. Hydrolyzed proteins in whey are better source of nitrogen than yeast extract for *L.casei*. The effect of biochemical parameters such as temperature, pH, initial sugar concentration and end product inhibition were studied during fermentations with immobilized and free cells. For maximum lactic acid production with complete substrate utilization the optimum temperature, initial sugar concentration and pH were 42° C, 100gl⁻¹ and 6.0 respectively. The initial addition of lactic acid to the medium at the start of the process resulted in severe inhibition as compared to its gradual build up. The overall reactor productivity was higher in by immobilized system compared to free cell fermentation. Lactic acid was purified by traditional precipitation method as calcium lactate and using Amberlite IRA- 400 resin. Pure lactic acid was obtained from clarified and decolourised broth by ion-exchange chromatography.