Lactic acid fermentation of a combined agro-food waste substrate

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Lactic acid (LA) is a versatile chemical with a wide range of applications in chemical, food, pharmaceutical, cosmetic and polymer industries. Currently, lactic acid world consumption is continually increasing mostly due to expansion of the application range of biodegradable polymers such as poly-lactides. Economic feasibility is of prime importance in choosing a raw material for fermentative LA production. Utilization of industrial distillery stillage, waste water from bioethanol production as a cheap and abundant substrate could be sustainable and environmentally friendly approach. Since the stillage is poor in fermentative sugars, but rich in nitrogen source, its combination with other sugar rich waste substrate or industrial by-product could be effective in the fermentation.

In this study, two agro-food industrial by-products, distillery stillage from bioethanol production on wasted potato (obtained from Reahem Ethanol Plant, Srbobran, Serbia) and sugar beet molasses (obtained from Alpis Ethanol Plant, Kovin, Serbia) were assayed together as a potential substrate for LA and biomass production by three different strains of lactic acid bacteria (*Lactobacillus rhamnosus* ATCC 7469, *Lactobacillus salivarius* ATCC 11741 and *Lactobacillus paracasei* NRRL B-4564). The effect of initial sugar concentration on lactic acid production and growth of lactic acid bacteria (LAB) was also evaluated.

Among these three strains, *Lactobacillus paracasei* NRRL B-4564 was selected as the most promising for lactic acid fermentation on the combined media (Mladenović *et al*, 2015). It has showed a pronounced ability to convert sucrose to LA in comparison to other tested bacteria. The highest lactic acid productivity of 1.42 g L^{-1} h^{-1} and yield of 0.91 g g^{-1} were achieved in batch fermentation at initial sugar concentration of 56.74 g L^{-1}. However, the highest number of *L. paracasei* cells of 5.3×10^{9} CFU mL^{-1} was achieved at somewhat higher initial sugar concentration of 78.22 g L^{-1}. LA yield and LA productivity obtained on the combined waste substrate are mostly higher or comparable to the results of previous studies performed on the stillage or other waste substrates. Further improvement of the process productivity was obtained by utilizing a fed-batch fermentation mode, while cell immobilization for the purpose of the cell recycle should also be considered and explored (Djukić-Vuković *et al*, 2013).

The results obtained in this study indicated that the substrate based on distillery stillage and sugar beet molasses could provide adequate fermentable sugars (sucrose) and valuable nutrients for growth of fastidious LAB and LA production. The external addition of expensive nutrients such as yeast extract or other similar sources of nitrogen, vitamins and minerals was unnecessary.

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