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# Continuous alcoholic fermentation in high cell density airlift bioreactor using flocculating yeast

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One of the most common ways to improve the productivity of a fermentation process is the use of high cell density systems. In practice, such a system usually represents a three-phase (gas-liquid-solid) dispersion operating in a continuous mode. The interest for these biosystems has been increasing because they seem to be a very promising alternative to the traditional batch fermentation with freely suspended cells. The cells are usually immobilised on a carrier or, in a simpler and cheaper way, they are self-aggregated forming flocs. High cell density biosystems have many specific advantages: higher volumetric productivity, higher product concentration and substrate conversion, easy separation of biocatalyst (cells) from the liquid medium, utilization of the same biocatalyst (cells) for extended periods of process time and a minimised risk of contamination.

Cheese whey, as a by-product of dairy industry, represents a significant environmental problem due to very high values of BOD and COD. One of the most profitable manners of bioutilization of cheese whey is a production of potable ethanol from lactose contained in whey. To take advantage of a continuous high cell density system, flocculating yeast can be used. However, the available flocculating yeast strains of *Sacharomyces cerevisae* unfortunately did not possess the ability to metabolize lactose. Using a recombinant strain of *Sacharomyces cerevisae* containing genes (β-galactosidase and lactose permease) for hydrolysis of lactose to galactose and glucose this problem can be solved.

The main goal of this study was to investigate the feasibility of utilization of a genetically modified flocculating strain for ethanol production from lactose. A continuous airlift bioreactor (CALR) due to the advantageous combination of sufficient mixing, low shear stress and satisfactory flocs suspension at low power input was chosen for carrying out fermentation runs. The optimal bioreactor design suggested according to a previous study with a model three-phase system was applied to two reactors of different scale (6 and 50 L) in order to observe scale-up affects of the bioprocess. The effect of dilution and air flow rates and biomass concentration on the bioprocess operation was investigated.

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