TIPAL'03

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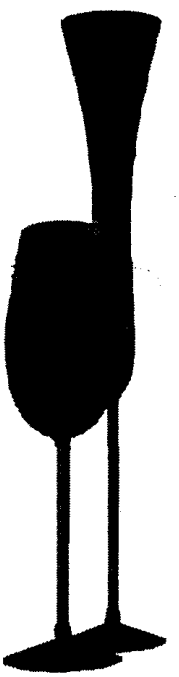
ABSTRACT BOOK



LIBRO DE RESÚMENES

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ETHANOL PRODUCTION FROM LACTOSE RAW MATERIALS WITH RECOMBINANT FLOCCULENT YEAST STRAINS

Lucília Domingues, Nelson Lima, José A Teixeira
Centro de Engenharia Biológica, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal.

Cheese whey is a by-product of dairy industries, which presents rather high pollutant characteristics and is produced in high amounts. Whey disposal has been under consideration for several years. Nowadays, after whey powder and demineralised whey powder, the third major products obtained from cheese whey are whey protein concentrates (WPC) (Horton, 1996). When producing WPC, typically by ultrafiltration, a lactose-rich fraction, the cheese whey permeate, is obtained. Lactose, the largest component in whey, is the most problematic to dispose of economically (Horton, 1996). One of the possible solutions to the lactose problem is lactose alcoholic fermentation. Ethanol is currently produced from whey in some countries (New Zealand, Ireland, EUA). Efforts have been made to improve the productivity for cheese whey permeate alcoholic fermentation to make this process economically attractive. It is our belief that by using high cell density systems with flocculent yeast cells the productivity of alcoholic fermentation of cheese whey permeate can be improved. The use of flocculent cells with an adequate bioreactor design allows for high biomass concentration inside the bioreactor, making possible continuous operation at higher dilution rates and thus higher ethanol productivity. In addition, the downstream processing is greatly facilitated due to cell sedimentation characteristics.

In this work, a flocculent *Saccharomyces cerevisiae* strain with the ability to express both the *LAC4* (coding for β-galactosidase) and *LAC12* (coding for lactose permease) genes of *Kluyveromyces marxianus* was constructed (Domingues et al., 1999a). This recombinant strain is not only able to grow on lactose, but it can also ferment this substrate. Moreover, the flocculating capacity of the strain used in this work gives the process several advantages. On the one hand, it allows for operation in a continuous mode at high cell concentration, thus increasing the system's overall productivity; on the other hand, the biomass concentration in the effluent is reduced, thus decreasing product separation/purification costs.

Alcohol fermentation of lactose was investigated using the constructed flocculent strain. In the range of studied lactose concentrations (5-150 gL^{-1}), total lactose consumption was observed with a conversion yield of ethanol close to the expected theoretical value. For the continuously operating bioreactor, an ethanol productivity of 11 $gL^{-1}h^{-1}$ (corresponding to a feed lactose concentration of 50 gL^{-1} and a dilution rate of 0.55 h^{-1}) was obtained (Domingues et al., 1999b), which is 7 times larger than the continuous conventional systems. The system stability was confirmed by keeping it in operation for 6 months. Alcoholic fermentation of cheese whey permeate was also investigated (Domingues et al., 2001). For the continuous bioreactor operating with cheese whey permeate (having a lactose concentration of 50 gL^{-1}), an ethanol productivity near 10 $gL^{-1}h^{-1}$ (corresponding to 0.45 h^{-1} dilution rate) was obtained, which raises new perspectives for the economic feasibility of whey alcoholic fermentation.

References

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