Process for production of bioethanol using *Saccharomyces cerevisiae* supported on calcium alginate beads coated with chitosan using citric acid.

Leonardo A. K. Oura*, Taciani S. Bella de Jesus, Lucidio C. Fardelone, José R. Nunhez, Gustavo, P. Valença, José A. R. Rodrigues, Paulo J. S. Moran

Abstract

The production of bioethanol using immobilized cells of *Saccharomyces cerevisiae* in calcium alginate beads coated with chitosan furnished excellent yields in bioethanol production, 80.5-95.7%, and the use of citric acid and additional calcium chloride in medium promote more stability of beads.

Key words:

Bioethanol, *Saccharomyces cerevisiae*, Calcium alginate.

Introduction

Bioethanol production using immobilized microbial cells in continuous systems have been studied because offers advantages, such as biocatalyst reuse, reduced production time, simplified separation of product and high productivity¹⁻³.

In this work, we report the fermentation process using immobilized cells of *S. cerevisiae* in calcium alginate beads using acetic acid and citric acid to prepare coated beads with chitosan. The preparation beads process was carried out using different concentrations of CaCl_2 (0.05, 0.1, 0.2 and 0.3 M) to maintain the stability of the beads against calcium leaching of the alginate matrix. The processes developed furnished ethanol in high yield and the addition of CaCl_2 in fermentation medium promoted the best stability of alginate beads and due to non-disruption of beads in the fermentation.

Results and Discussion

The performance of fermentation process using immobilized *S. cerevisiae* in calcium alginate beads coated with chitosan, prepared with traditional process using HAc and new method developed using citric acid, was compared by using free cells in same conditions. The fermentation processes were carried out using 3g of weight yeast cells (immobilized and free cells, respectively), 105 g/L of glucose (concentration determined by HPLC), as carbon source, pH 6, using orbital shaker at 120 rpm, 30°C, 24 h.

Bioethanol and glucose concentrations in the fermentative process are shown in Image 1 and the yields, final concentration and residual of glucose in Chart 1. The yield is defined as the amount of ethanol produced in relation to the maximum ethanol conversion of carbon source (glucose).

Image 1. Bioethanol production using immobilized *S. cerevisiae* in calcium alginate beads coated with chitosan.

Chart 1. Bioethanol production using immobilized *S. cerevisiae* in calcium alginate beads coated with chitosan.

<i>S. cerevisiae</i> ^a	CaCl_2 (M)	Residual Glucose 24h (g/L)	Bioethanol 24h (g/L)	Yield (%)
Ca-ABC-CA	0.05	5.4	44.0	78.1
Ca-ABC-CA	0.1	1.7	46.8	80.5
Ca-ABC-CA	0.2	0	48.0	81.2
Ca-ABC-CA	0.3	0	48.3	81.8
Ca-ABC-CA ^b	0.1	11.2	54.6	95.5
Ca-ABC-HAc	0.1	0.00	53.6	95.7
FC		0.26	35.0	62.7

^a Ca-ABC-CA = Calcium Alginate beads coated with chitosan using citric acid; Ca-ABC-HAc = Calcium Alginate beads coated with chitosan using HAc; FC = Free cells. ^b With addition of 5 g of CaCl_2 in the fermentative broth.

The results furnished high yields in bioethanol (>80%) when used *S. cerevisiae* immobilized in calcium alginate beads using citric acid for coated with chitosan and 95.5% when CaCl_2 is added in the bioreactor. Therefore, this study suggests that the beads robustness allows potential application in a continuous process.

Conclusions

The fermentation process results show that it was possible to obtain high concentration of bioethanol using immobilized cells. The addition CaCl_2 in medium and use the citric acid instead of acetic acid in the process of coating calcium alginate beads with chitosan, avoid the cell adaptation phase to 8h, and promoted a high bioethanol production. The process developed have potential to application in a continuous process.

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