EVALUATION OF SISAL JUICE AS POTENTIAL CARBON SOURCE FOR BACTERIAL CELLULOSE PRODUCTION

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ABSTRACT

Bacterial cellulose (BC) is a versatile biodegradable material of great technological potential. In this study, we evaluated the influence of initial sugar concentration, pH, different nitrogen sources, and cultivation time on the production of BC using sisal juice, an agroindustrial waste, as fermentative substrate. The higher production of BC was obtained after static cultivation of the bacteria for 10 days using the sisal juice with 15 $g \cdot L^{-1}$ of sugars, pH 5, and 7.5 $g \cdot L^{-1}$ of yeast extract. In comparison to the synthetic medium (HS), cellulose production yield in optimized sisal culture was 3 times higher, proving it as a suitable substrate for BC production.

INTRODUCTION

Bacterial cellulose presents unique properties, as high mechanical strength, high crystallinity, biocompatibility, high porosity, ultrafine fiber network, and high water holding capacity. Such features make BC an outstanding material for technological applications in biomedical areas, food industry, composites production, and others (Lin, 2013).

BC can be obtained by cultivating bacteria of the genus *Gluconacetobacter* in media with sugar and organic nitrogen in low energy consumption processes. It is possible to use agro-industrial wastes as alternative culture media for BC production (Lin, 2013). In many cases, it is possible to achieve similar or higher mass production than the yield of synthetic media. The use of alternative carbon sources in fermentative processes is important because it may reduce the environmental impact from the disposal of agro-industrial wastes, reduce the final cost of the technological product, and add value to the involved supply chains. Therefore, the aim of this work was to develop a process for BC production in static cultivation using sisal juice as substrate.

RESULTS AND CONCLUSIONS

Raw sisal juice presents a pH around 4.48 and contains nitrogen (0.62 $g.L^{-1}$), phenolic compounds (1.73 $g.L^{-1}$), and sugars (15.05 $g.L^{-}1$, corresponding to 82% of glucose). Thus, it is a suitable nitrogen and carbon source for fermentation.

Strain *G. hansenii* ATCC 23769 synthesized cellulose throughout the studied intervals of sugar concentration and yeast extract (YE) supplementation. Sugar concentration at 15 $g.L^{-1}$ and supplementation with 7.5 $g.L^{-1}$ of YE presented the highest BC production and yield (Figure 1).

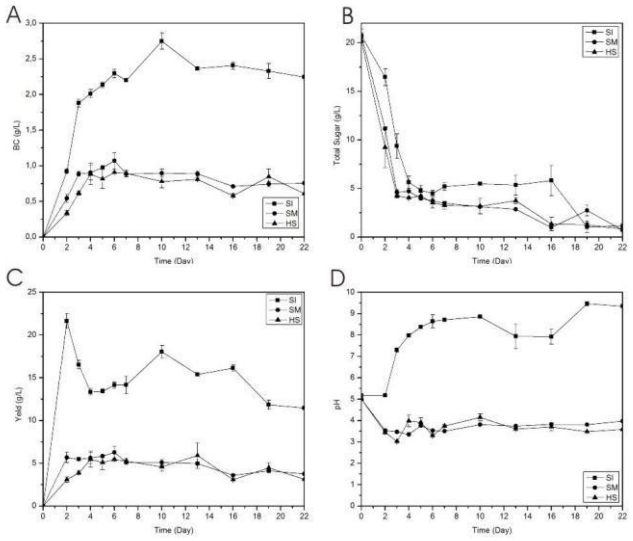

Fig. 1 BC production (A), sugar consumption (B), yield (C), and pH variation (D) during 22 days of fermentation by *G. hansenii* ATCC 23769 in SI (supplemented sisal medium), SM (synthetic medium containing a C/N ratio similar to SI medium), and HS (Hestrin-Schramm medium).

Figure 1 shows the results of sugar consumption, yield, and pH during 22 days of culture in tested media. In all media, the cellulose production increased over time (Fig. 1A) as sugar content decreased (Fig. 1B), indicating the relationship between substrate consumption and product formation. In SI medium, the yield reached 21.65% in the second day with gradual decrease in the following days. SM and HS cultures showed similar trend, reaching a yield around 5.5% by the fifth day (Fig. 1C). The pHs of the SM and HS media decreased throughout time because of the production and accumulation of organic acids in the broth. However, the pH of SI medium increased to 8.3 (Fig. 1D). The naturally present antioxidant phenolic compounds in the sisal juice may have contributed to inhibit organic acids accumulation in the broth (Keshk, 2006), increasing the BC production in sisal medium.

In general, the cellulose production yield in optimized sisal culture was 3 times higher in comparison to standard medium, showing that sisal juice is a very promising substrate for BC production.

ACKNOWLEDGMENTS

This research was financially supported by the fellowships: FUNCAP, CNPq, and CAPES.

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