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OPTIMIZATION OF BIOETHANOL PRODUCTION FROM PRICKLY PEAR OF OPUNTIA FICUS-INDICA AT HIGH TEMPERATURES

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Abstract

The cost of saccharine and starchy biomasses represents approximately 60% of first-generation bioethanol production costs. Inputs, seeds, crop irrigation, and crop transportation are important energy factors to consider. To find alternative substrates to costly and food competing biomasses, we explored an agro-biological resource that is drought resistant and tolerant to a wide range of soil and climatic conditions: Prickly pear (*Opuntia ficus-indica*).

This work aims to optimize the production of first-generation bioethanol by *Kluyveromyces marxianus* YMEK23, a thermoresistant yeast strain, from prickly pear juice; a substrate rich in sugars (98g L^{-1}). The use of the Box-Behnken experimental design showed that the fermentation temperature and the medium pH are the main parameters influencing ethanol production. The impact of these factors was modeled in a second-degree polynomial equation. The results showed that the maximum amount of ethanol produced was 41 g L^{-1} obtained at 37°C and a pH of 5. However, supplementing nitrogen has a limited impact on ethanol production.

The kinetics of batch fermentation under optimum conditions showed a very active fermentation metabolism of *K. marxianus* on this substrate, translated by an early and exponential production of ethanol as well as a rapid consumption of sugars. The maximum amount of ethanol 41 g L^{-1} was reached after only 16 hours of fermentation.

The high yield of ethanol obtained 0.43 g g^{-1} makes prickly pear biomass an attractive and economical substrate for the production of bioethanol compared with the conventional substrates currently used by the biofuel industry.

Keywords: Bioethanol, Box-Behnken experimental design, *kluyveromyces marxianus*, prickly pear, thermoresistant yeast

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