World Academy of Science, Engineering and Technology
International Journal of Nutrition and Food Engineering
Vol:17, No:10, 2023

Modeling of the Fermentation Process of Enzymatically Extracted Annona muricata L. Juice

Authors : Calister Wingang Makebe, Wilson Agwanande Ambindei, Zangue Steve Carly Desobgo, Abraham Billu, Emmanuel Jong Nso, P. Nisha

Abstract : Traditional liquid-state fermentation processes of Annona muricata L. juice can result in fluctuating product quality and quantity due to difficulties in control and scale up. This work describes a laboratory-scale batch fermentation process to produce a probiotic Annona muricata L. enzymatically extracted juice, which was modeled using the Doehlert design with independent extraction factors being incubation time, temperature, and enzyme concentration. It aimed at a better understanding of the traditional process as an initial step for future optimization. Annona muricata L. juice was fermented with L. acidophilus (NCDC 291) (LA), L. casei (NCDC 17) (LC), and a blend of LA and LC (LCA) for 72 h at 37 °C. Experimental data were fitted into mathematical models (Monod, Logistic and Luedeking and Piret models) using MATLAB software, to describe biomass growth, sugar utilization, and organic acid production. The optimal fermentation time was obtained based on cell viability, which was 24 h for LC and 36 h for LA and LCA. The model was particularly effective in estimating biomass growth, reducing sugar consumption, and lactic acid production. The values of the determination coefficient, R2, were 0.9946, 0.9913 and 0.9946, while the residual sum of square error, SSE, was 0.2876, 0.1738 and 0.1589 for LC, LA and LCA, respectively. The growth kinetic parameters included the maximum specific growth rate, μm, which was 0.2876 h-1, 0.1738 h-1 and 0.1589 h-1, as well as the substrate saturation, Ks, with 9.0680 g/L, 9.9337 g/L and 9.0709 g/L respectively for LC, LA and LCA. For the stoichiometric parameters, the yield of biomass based on utilized substrate (YXS) was 50.7932, 3.3940 and 61.0202, and the yield of product based on utilized substrate (YPS) was 2.4524, 0.2307 and 0.7415 for LC, LA, and LCA, respectively. In addition, the maintenance energy parameter (ms) was 0.0128, 0.0001 and 0.0004 with respect to LC, LA and LCA. With the kinetic model proposed by Luedeking and Piret for lactic acid production rate, the growth associated and non-growth associated coefficients were determined as 1.0028 and 0.0109, respectively. The model was demonstrated for batch growth of LA, LC, and LCA in Annona muricata L. juice. The present investigation validates the potential of Annona muricata L. based medium for heightened economical production of a probiotic medium.

Keywords : L. acidophilus, L. casei, fermentation, modelling, kinetics
Conference Title : ICFSN 2023 : International Conference on Food Science and Nutrition
Conference Location : New York, United States
Conference Dates : October 09-10, 2023