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On to the impact of low cost substrates for BNC production

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Abstract

Bacterial nanocellulose (BNC) is an exopolysaccharide produced by certain acetic acid bacteria. It has high crystallinity, high mechanical strength, high purity and high water-holding capacity. These properties make it useful in making artificial skin (1), electronic paper, composite reinforcement, development of food and cosmetic applications (2). The cost of fermentation media is believed to contribute significantly to the operational costs, especially if synthetic commercial media are used. Hence, much research on BNC production using low-cost substrates has been done focusing on lowering the production costs (3). Also, to meet the requirement for industrial applications, effective large-scale BNC production systems need to be developed, which involves improving the fermentation conditions and identifying high yield BNC-producing strains (4). However, as with many fermentation systems, while promoting the recycling of low value-added products, the use of complex substrates may in fact represent a bottleneck in the BNC fermentation processes. Some of these substrates present, comparatively to synthetic nutrients, high chemical oxygen demand (COD), total and volatile solids (TS and VS), total nitrogen (TN), antimicrobial components (such as phenols) Consequently, these alternative substrates may place an economic problem either downhill, due to the need for wastewaters treatments and/or, uphill, due to the need of substrates pre-treatment.

In this work, the optimization of alternative BNC culture medium (Molasses-Corn Steep Liquor, MOL-CSL), using Response surface methodology – central composite design was used to evaluate the effect of inexpensive and widely available nutrients sources, namely MOL, ethanol (EtOH), CSL and ammonium sulphate on BNC production yield under static culture by *komagataeibacter xylinus* BPR 2001. The optimized parameters for maximum BNC production were: % (m/v): MOL 5.38, CSL 1.91, ammonium sulphate 0.63, disodium phosphate 0.270, citric acid 0.115 and ethanol 1.38 % (v/v). The maximum BNC production yield were 7.5 ± 0.54 g/L versus 1.79 ± 0.04 g/L for MOL-CSL and synthetic medium (HS-EtOH) culture medium, respectively. The resulting wastewater from each culture medium was characterized regarding COD, TN, TS and VS, leading to the conclusion that the wastewaters generated using MOL-CSL are more heavily charged with organic matter, increasing the final costs of BNC production due to the higher costs associated to wastewater treatment. Anaerobic digestion (AD) was studied for wastewater treatment and biogas production from the wastewaters of the BNC fermentation and purification process. Finally, a preliminary Life Cycle Assessment of BNC production was performed and will be presented.

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References

(1) Fontana, J.D., De Sousa, A.M., Fontana, C.K., Torriani, I.L., Moreschi, J.C., Gallotti, B.J., De Souza, S.J., Narcisco, G.P., Bichara, J.A. Farah, L.F.X. (1990). Acetobacter cellulose pellicle as a temporary skin substitute. Applied Microbiology and Biotechnology. 24-25: 253-264.
(2) Jonas, R. & Farah, L.H. (1998). Production and Application of Microbial Cellulose. Polymer Degradation and Stability. 59:101–106.
(3) Keshk, S. & Sameshima, K. (2006). The utilization of sugar cane molasses with/without the presence of lignosulfonate for the production of bacterial cellulose. Applied Microbiology and Biotechnology, 72(2): 291-296.
(4) Vandamme, E. J., De Baets, S., Vanbaelen, A., Joris, K., De Wulf, P. (1998). Improved production of bacterial cellulose and its application potential. Polymer Degradation and Stability, 59:(1–3), 93-99.