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Optimizing the Production of Bacterial Cellulose in Surface Culture: Evaluation of Substrate Mass Transfer Influences on the Bioreaction (Part 1)

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Abstract:

The interest in cellulose produced by bacteria from surface cultures has increased steadily in recent years because of its potential for use in medicine and cosmetics. Unfortunately, the low yield of the production process has limited the commercial usefulness of bacterial cellulose. This series of three papers dealing with the production of bacterial cellulose using (batch) surface culture, firstly present a complete and complex analysis of the overall system, which allows a fundamental optimization of the production process to be performed. This material has many applications but the low yield of the process limits its commercial usefulness. In part 1, the effect of the rate of mass transfer of substrate on the microbial process, which is characterized by the growth of the bacteria, product formation, and the utilization of the substrate by the bacteria, is studied. A fundamental model for the diffusion of glucose through the growing cellulose layer is proposed and solved. The model confirmed that the increase in diffusional resistance is indeed significant but other factors will also need to be taken into account.

Key-words: Bacteria, biotechnology, cellulose, mass transfer, optimization, polymerization