DOI: 10.25205/978-5-4437-1691-6-44

DOWNSTREAM PROCESS FOR MODIFIED BACTERIAL CELLULOSE PRODUCTION WITH AN INCREASED FUNCTIONAL PROPERTIES FOR TEXTILE INDUSTRY*

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Abstract

Bacterial cellulose as a promising biomaterial might be used in various industries. Due to the presence of biodegradability and biocompatibility properties, bacterial cellulose can serve as an alternative to animal-derived textiles. The paper considers biotechnological approaches to the downstream process of bacterial cellulose production with functional properties similar to leather products.

The growing needs in the market of textile goods require new approaches to the creation of not only manufacturing technologies, but also the strategies of seeking novel materials as alternatives to traditional ones. The promising biomaterials, such as bacterial cellulose and its derivatives in the form of biopolymers, appear in the latest research and technological trends. Due to the ecological aspects of the possibility of leather replacement the novel approaches to bacterial cellulose produced are needed to be considered [1].

The bioprocess of bacterial cellulose production was based on microbiological synthesis of biomaterial, such as the upstream process of stationary surface cultivation of *Komagataeibacter xylinus* (byScoby LLC, Saint Petersburg), in batch mode during 10 days. In this case, the classical approaches for upstream production were not modified. The obtained biomass was applied for several series groups in the design of the experiments plan. The following development belongs to the ex-situ approach of production optimization implying the post-cultivation processing of the bacterial cellulose, including the subsequent steps of material mercerization, washing, plastification, hydrophobization and drying. In the frame of design factors, there were parameters for variation, such as concentration of plastifying agent (glycerol) from 2.0 % to 10.0 % and hydrophobic agent (saturated fatty acid) from 1.0 to 4.0 %. The achieved properties corresponded to the organoleptic profile of leather materials and were subjected to subsequent testing. The final yield of bacterial cellulose production in accordance with the suggested downstream process amounted to the (3,8 ± 0,5) g/L (by air-dry weight) [2, 3].

The processed materials were tested with genuine and artificial leather for several criteria, such as tensile strength, tear resistance, thermostability and water adsorption. The final results demonstrated the relative resemblance of modified bacterial cellulose to leather materials. The value of tear resistance of the final product exceeded the leather materials that proved to be a sufficient alternative of modified bacterial cellulose over the analogues.

As a result, comparatively similar physico-chemical and rheological properties were achieved. This biotechnological approach of downstream production might be further scaled up to the industrial level of manufacturing (more than 50 L cultivation). Moreover, the implementation of in-situ modification technology to this process would enhance the total production yield highlighting the considerable potential to technological transfer.

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* The research was funded by Foundation for Assistance to Small Innovative Enterprises (grant № 1379ГССС15-L87988 from 01.09.2023).