Abstract

Bacterial cellulose (BC) produced by microorganisms is a chemical analog of plant cellulose, i.e. a polysaccharide composed of D-glucose molecules linked together by β-1,4-glycosidic bonds. The biobiopolymer is produced, among others, by Gram-negative, aerobic bacteria *Komagataeibacter xylinus*. Bacterial cellulose is a bionanomaterial, often referred to as the „*biomaterial of the future*", which has attracted great interest in many industries in recent years due to its unique properties. Nevertheless, despite the promising research results and the possibility of wide use of BC, it should be borne in mind that the use of this bionanomaterial on a large scale will only be possible when it is easily available, and its production costs will be sufficiently reduced. Unfortunately, in the case of BC, the high costs of the medium and the inefficient process of its production are still the greatest obstacles to the wide application of this biomaterial.

The main aim of the work was to develop a method for producing BC in *K. xylinus* cultures carried out using a medium based on juice from potato tubers, including waste from the starch industry, intended, among others, as a carrier for the immobilization of probiotic microorganisms used in animal breeding and as a gelling agent for *in vitro* plant tissue culture media.

As a result of the conducted research and analyses, it was shown that juice from potato tubers, including waste from the starch industry, is a good production medium for the effective and economically and ecologically beneficial production of BC using *K. xylinus* strains, enabling the production of comparable amounts of this biopolymer, as in the case of using a conventional Hestrin-Schramm medium. As established, the developed medium based on juice from potato tubers, in particular in the form of waste from the starch industry, enables a significant reduction in the costs of the production medium (up to 10-fold in the case of using juice from potato tubers and nearly 100% in the case of using waste from starch industry) and thus the total cost of BC production. It was also established that the efficiency of BC production using the medium based on juice from potato tubers depends on the variety and characteristics of the potato used for its preparation. The most optimal in terms of such use, also taking into account the average yield of tubers and the amount of juice obtained, are primarily edible varieties, including Altesse, Ignacy, Mazur, Owacja, and Tonacja. It was also proven that the efficiency of BC production using a medium based on juice from potato tubers depends on the *K. xylinus* strain used for this purpose. In this context, it was shown that the optimal bacterial strain is ATCC 53524, while relatively large amounts of cellulose were also obtained in cultures

of strains ATCC 53582, ATCC 23767, ATCC 35959, and ATCC 23769. It was also shown that BC produced using media based on juice from potato tubers, in particular varieties allowing for the highest yield, did not show significant differences in physicochemical parameters compared to cellulose obtained using H-S medium, and also did not show cytotoxicity towards fibroblast cells. Moreover, it was established that BC obtained in *K. xylinus* cultures carried out using a medium based on juice from potato tubers provides adequate space for adsorption and proliferation of cells on the surface and inside its structure, and has protective properties against unfavorable environmental conditions related to the presence of simulated gastric juice and bile salts, and thus constitutes a good carrier for the immobilization of probiotic microorganisms. The results obtained in the current study also confirmed that the use of BC, obtained from *K. xylinus* cultures carried out using a medium based on juice from potato tubers, as a gelling agent in *in vitro* plant tissue culture media, is a good alternative to the commonly used agar. For this reason, implementation works are currently underway aiming at gradually replacing agar with the BC in Murashige and Skoog media used in the tissue culture laboratory at the Pomeranian and Masurian Potato Breeding Company in Strzekęcino.

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