Chemical modification of films from biosynthetic poly-3-hydroxybutyrate aimed to improvement of their surface properties

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Abstract.
Polyhydroxyalkanoates (PHAs), polyesters of microbiological origin, are used to develop different biomedical scaffolds. However, they have a relatively high hydrophobicity, in some cases preventing normal cell adhesion. The aim of this work was to increase the hydrophilicity and biocompatibility of polymer films from the poly-3-hydroxybutyrate (PHB), the most common representative of PHAs, by its chemical treatment. Two approaches were used.
In the first case, the PHB surface was treated with solutions of oxidants (H_2O_2), reducing ($NaBH_4$) or hydrolytic agents (NH_3, HNO_3, H_2SO_4, NaOH). Measurement of hydrophilicity (the polar component of surface free energy, PSFE) of the matrices showed its increase. NaOH was the most active agent (PSFE increased from 1.6 mN/m to 7.3 mN/m). Adhesion and metabolic activity of the NIH 3T3 fibroblast cells generally correlated with the values of PSFE of the treated films.
In the second case, the films were sequentially subjected to NaOH solution (to hydrolyze the polymer surface and obtain residues of crotonic acid), bromine water (to form bromoalkyl groups from crotonic acid residues) and ammonia or triethylamine (to attach amino groups to the polymer surface). There was noted a PSFE increase up to 5.5 mN/m and 10.5 mN/m when using triethylamine and ammonia, respectively. Activity and adhesion of fibroblasts was also improved.
So, the possibility of effectively changing the surface characteristics of PHA films by chemical treatment has been shown.
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