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BLENDS OF POLY-3-HYDROXYBUTYRATE AND POLY-ε-CAPROLACTONE: MORPHOLOGY, PROPERTIES AND BIOCOMPATIBILITY

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Abstract. The use of biocompatible and biodegradable polymers is essential for modern biomedicine. One of the approaches to improving the mechanical properties of pure polymers is to obtain mixtures based on them. A series of films was obtained from blends of poly-3-hydroxybutyrate (PHB) and poly-ε-caprolactone (PCL). The structure, physical, mechanical and biological properties of the films were investigated, depending on the ratio of the components. The microscopic structure of films was determined by the main component of the blend: the films were porous with a predominance of PHB and relatively smooth with a predominance of PCL. The highest values of elongation at break (229–269%), as well as the local maximum values of tensile strength (14–15 MPa) are noted for mixtures with a PHB content of 5–25%. At a PHB content of 25% and 75%, local maxima of Young's modulus are observed (507 and 655 MPa, respectively). When the ratio of the components in the mixture was equal (50:50 by weight), the films were heterogeneous and had the lowest total indicators of mechanical strength (ultimate strength and elongation at break were 3 MPa and 15.5%, respectively). A study of the biocompatibility of mixed films in a culture of NIH 3T3 mouse fibroblasts based on the results of DAPI staining and determination of the number of adhered cells in the MTT test showed the absence of cytotoxic action, as well as high adhesion and cell proliferation, in some cases exceeding the data for films from pure PHB and PCL. This demonstrates the suitability of PHB-PCL mixtures for the production of cell carriers for tissue engineering and other reconstructive technologies.

Table 1. Properties of films from PHB and PCL blends

PHB/PCL, %	Tensile strength, MPa	Young's modulus, MPa	Elongation at break, %	MTT, 7 days, cells × 10^5/cm^2
100/0	20.1 ± 3.6	3147 ± 67	1.48 ± 0.07	2.18±0.47
95/5	29.6 ± 5.2	2690 ± 196	2.02 ± 0.07	3.37±0.64
90/10	22.3 ± 4.4	1815 ± 199	4.35 ± 0.46	2.91±0.29
75/25	8.3 ± 1.3	655 ± 63	35.0 ± 2.2	3.40±0.35
50/50	3.1 ± 0.5	194 ± 22	15.5 ± 1.2	3.52±0.89
25/75	14.8 ± 2.1	507 ± 33	229.2 ± 9.6	4.14±0.71
10/90	14.8 ± 1.8	361 ± 23	255.1 ± 14.3	2.32±0.24
5/95	13.9 ± 2.3	234 ± 19	268.8 ± 18.5	2.52±0.44
0/100	9.4 ± 1.1	238 ± 14	129.9 ± 22.4	2.93±0.42

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