CYTOTOXICITY OF THE NEW BIODEGRADABLE POLYLACTIDE FIBRES FOR TISSUE REPAIR AND REGENERATION

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Introduction

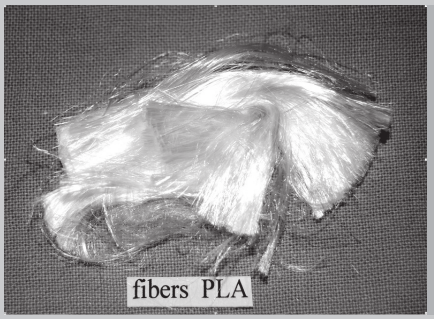

FIG.1. Poly(lactic acid) (PLA) fibers used in the study

There is still a need for new polymeric materials for tissue repair and repair [1,2].

Poly(lactic acid) (PLA) is a linear aliphatic thermoplastic polyester derived from 100% renewable sources such as corn. The polymer is used broadly in textile applications.

PLA fibres meet the requirements of nonwovens sector for hygiene and medical application.

PLA fiber is compostable. The natural tissues are supported by fibrous structure, therefore fibrous biodegradable PLA fibres with controlled structure, molecular weights may be promising materials for regenerative medicine. This paper reports on the cytotoxicity evaluation of a new PLA fibers.

Materials and methods

The PLA fibres were prepared by a two-step melt-spinning process using a laboratory units at Institute of Biopolymer and Chemical Fibres (Lodz, Poland). The PLA polymer used in this study is NatureWorks Polymer 6201D, fiber grade polymer with nominal MFI=15-30 g/10min, a NatureWorks LLC product. During spinning PLA fiber is coated with Estesol PF 790, a spin-finish supplied by Bozzetto GmbH. The oil pick-up is 0.62%.

After drawing and cutting process the fibres with linear density 2,3 dtex, tenacity 35 cN/tex, elongation 44% were obtained.

Cytotoxicity Test

Cell cultures L929 (ATCC CCL1) was used for the cytotoxicity study in vitro. The mouse fibroblast-like cell line was maintained in Eagle's medium with 10% c.s., antibiotics (100U/ml penicillin and 100 µg/ml streptomycin) and 2mM L-glutamine. The cells were seeded in the tubes, 1 ml of $2x10^6$ cells/ml in the culture medium Eagle'a and were incubated with extracts from polymers with addition of 2 % bovine serum for 24h, 48h and 72h at 37°C in the atmosphere of 5% CO_2 in air. Cell growth, morphology and viability (on the basis of exclusion of Trypan Blue Staining) were used as parameters to determine the cytotoxicity of the materials. As a control material PE HD (USP) was used as positive control- phenol.

Material	Morphology of cells	Mean cell count		Level of toxicity
		Total amount	Dead %	
Fibres PLA	No found	$9,6•10^5$	1	0
PE HD	No found	$9.6•10^5$	2	0
Phenol	Morphological changes	$3.1•10^5$	100	3
L929-control cells	No found	$1.0•10^6$	1	0

TABLE 1. Cytotoxicity activity of biomaterials on mouse fibroblast-like cells L929 after 72hours, in vitro

Results

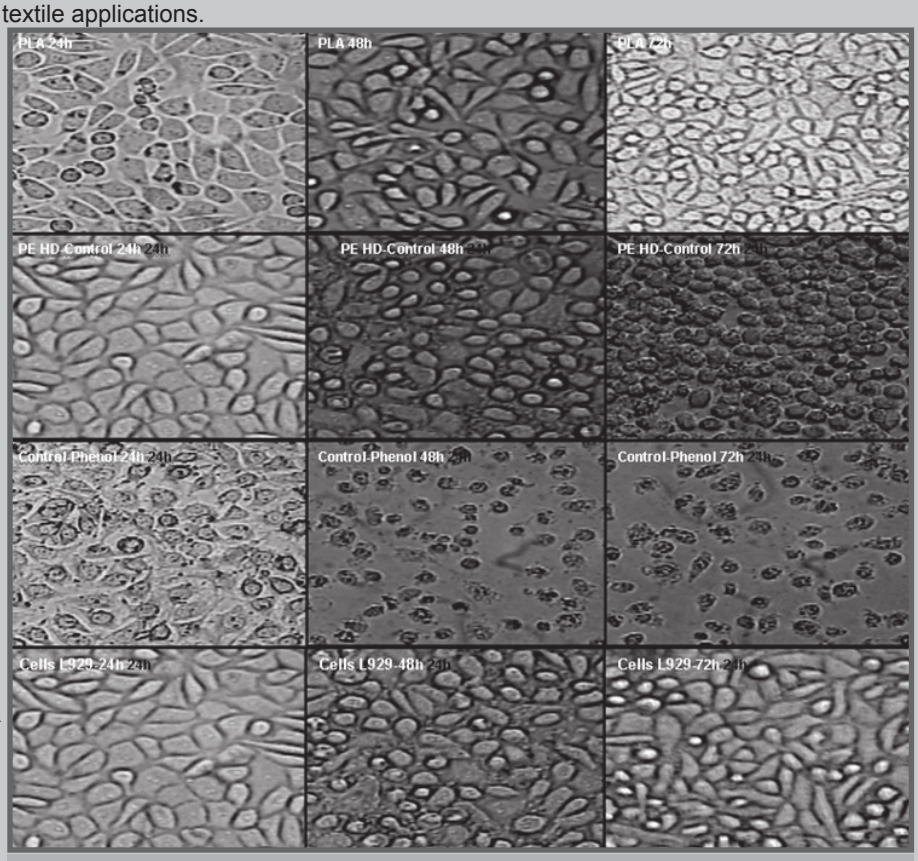

FIG.2. Morphology of L 929 fibroblastoid cell line culture after 24, 48h, 72h hours incubation with extracts from tested materials

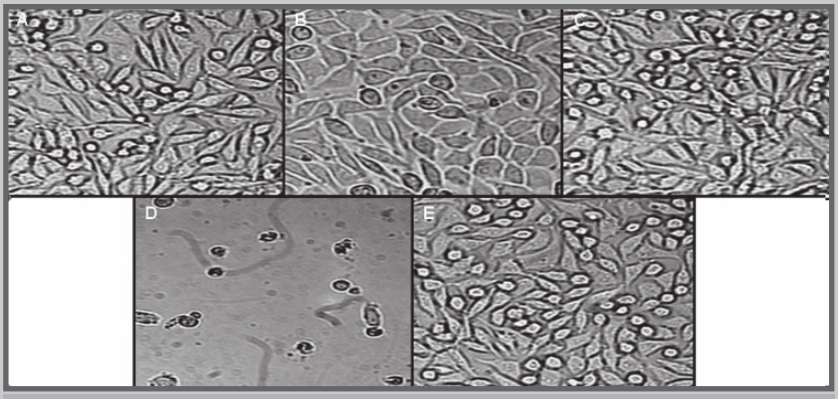

FIG.3. Morphology of L 929 fibroblastoid cell line culture after contact with copolymers (A)PLAGA, (B)BLENDA PLAGA+PHB,(C) PLAGACapr, (D)Phenol(E) Control cells

Discussion & conclusions

Cytotoxicity of new fibers from biodegradable polylactides was tested on mouse fibroblast cultures L929 . No fibroblast cultures after contact with extracts from PLA fibers material showed any damage, the cells had proper morphologies and showed good proliferation in contrast to the control cells. The test results have shown that the polylactide PLA fibers are noncytotoxic and may be promising materials for regenerative medicine.

Acknowledgement

Financial support by the project „Biodegradable fibrous products", POIG.01.03.01-00-007-/08 and EU in the frame of IE OP financed from the ERDF, is gratefully acknowledged.

Piśmiennictwo References

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ADHESION AND GROWTH OF VASCULAR CELLS ON POROUS POLYETHYLENE TEREPHTHALATE SCAFFOLDS

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Abstract

Polymers such as polyethylene terephthalate (PET) have been used for large-caliber vascular prostheses with a relative success but their application is limited in small-caliber grafts. Blood vessel grafts with an internal diameter smaller than 6 mm are prone to fail mainly due to their thrombogenicity and poor haemodynamics. One of the possible solutions of these problems may be reconstruction of the tunica intima and media on the synthetic grafts. For this purpose, special PET foils were prepared. Six-μm thick foils were irradiated by copper ions or fission fragments from a radionuclide etalon source ^{252}Cf and etched by 1M sodium hydroxide to obtain holes of a defined diameter (from 80 to100 nm in foils irradiated by copper ions and from 1.0 to 1.5 μm in foils irradiated by fission fragments) and density ($1x10^6$ cm^{-2} - fission fragments to $5x10^8$ cm^{-2} – copper ions) (FIG.1). Afterward these materials were seeded with vascular smooth muscle cells (VSMC) derived from the rat aorta, or endothelial cells of the line CPAE. Adhesion, proliferation and viability of the cells were monitored after one, three and seven days. The cell proliferation was evaluated by changes in the cell number in several time intervals and construction of growth curves. Determination of cell viability was based on staining of live cells with calcein emitting green fluorescence, and the dead cells with ethidium bromide emitting red fluorescence.

Experiments with the growth of vascular smooth muscle cells and endothelial cells on the PET scaffolds with different pore size showed that endothelial cells prefer pores around 1 μm while VSMC have no preferences concerning the pore size of the polymer scaffolds tested. Although the highest cell population densities were found on the glass coverslips used as control material, the number of cells growing on pristine PET did not differ from the densities on PET foils irradiated by Cu-ions or fission fragments of Cf.

The obtained data showed applicability of our improved polymer foils as supporting scaffolds for vascular cells. In the further step, these porous PET