Characterization of polybutylene succinate and polylactic acid melt-spun and knitted structures as scaffolds for cellular growth

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Abstract:

Devices produced for regenerative medicine have to undergo numerous tests to be validated, including in vivo tests on animals: in 2022 in Europe, more than eleven millions of animals were used for medical tests [1]. To address this issue, cellular-growth supports are constantly being developed for in-vitro medical tests, for it is well known that cells require materials to adhere to and to grow on, such as biopolymers. This work aims at developing polymeric knitted scaffolds, i.e. artificial equivalents of natural extracellular matrixes, for cell culture, since knitted structures allow to adapt to a large panel of applications of regenerative medicine thanks to high porosity and deformability.

To develop an optimal scaffold to grow fibroblasts cells on, polybutylene succinate (PBS), a cell-compatible appropriate polymer material, was first selected out of literature [2] to be tested and compared to polylactic acid (PLA), more commonly used for medical applications, for its physicochemical properties and cellular affinity. In the optics of characterizing the effect of induced antimicrobial activity on cells development, lignin, a by-product of the paper industry from the biomass, was added to PBS in various proportions. These biopolymers and blends were then implemented through melt spinning process to be knitted and later tested as scaffolds. The materials and obtained yarns were characterized through thermal and physico-chemical analysis to evaluate their compatibility as blends and their capacity to grow cells according to literature.

Surface shape and curvature is also being investigated in parallel through cross-sectional fiber shape, and knitting pattern at larger scale. It has been shown that cells adhere better on convex surfaces, while concave surfaces, as offered by circular cross-sectional fibers, would rather induce their migration [3]. Such surfaces were obtained by melt-spinning trilobed and octalobed PLA fibers, in order to allow cells to get caught in between the lobes of each fiber.

References:

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