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Application of PHA-based bioplastics in nanomaterials

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Natural polyesters, in particular, polyhydroxyalkanoates (PHA), can be regarded as some of the most promising polymers obtained from renewable sources suitable as drug carriers. They degrade completely without releasing toxic side products. The purpose of this work was to investigate the possibility for the preparation of functionalized PHA-based nanoparticles and PHA-fibrous materials containing natural extracts with antimicrobial effect. Biotechnologically produced PHA on waste frying oil (900 kDa) was used. Liposomes/PHB particles were used for encapsulation of water and oil plant extracts. Size and stability was determined using DLS. PHB nanofibers were prepared via three different techniques: electro-spinning, force-spinning and wet spinning. Using wet spinning patented technology unique microfibers with sub-micron structure containing nanopores and micropores structure in the whole cross section being of diameter 200 nm – 1 μm were obtained (Fig. 1). Particles and fibers (individually and in combined form) were functionalized with selected natural extracts and examined via SEM, FLIM and FTIR-ATR methods. For antioxidant activity and releasing of active substances spectrophotometric determination was used. Antimicrobial properties of prepared particles, extracts and fibers were examined using the bacterial and fungal test systems. Cytotoxicity of selected samples was tested with MTT assay. The performed microbiological screening and MTT cell viability studies revealed that predominantly cinnamon- and clove-containing nanofibrous materials were effective in suppressing the growth of the G+ bacteria *Serratia marcescens* and the G- bacteria *Escherichia coli* as well as yeast strain *Candida glabrata*. All PHA materials displayed good short- and long-term stability. No cytotoxicity against human keratinocytes was observed up to 8% of oil extracts. The obtained materials are promising for antibacterial and antifungal wound dressing applications as well as for local treatment in cosmetics.

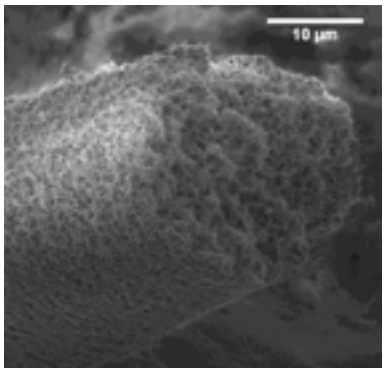

Figure 1: SEM picture of the PHB fibre with the sub-micron structure done according to the Example 7 – the whole fibre

Biography

Ivana Marova works as Professor of Biochemistry at Faculty of Chemistry, Brno University of Technology in Brno (Czech Republic). Her scientific research is focused on microbial biotechnology, biochemistry, food chemistry and nanotechnology. After years of experience in research and teaching both in university and hospital institutions she with her collaborators has patented the biotechnological production PHA-based bioplastics on waste frying oil (PS3835CZ). This patent was licensed and, as HYDAL technology, circular and fully ecological biotechnology was awarded as the only Czech technology by "Frost and Sulliwan 2014 Technology Innovation Award". At this time, the HYDAL technology is further developed by I Marova team. Low-end applications (folia; food package) as well as high-end applications (fibers, particles and 3D printed materials for biomedicine, pharmacy and cosmetics) are developed.

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