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Wet-Spun Cellulose Acetate/Polycaprolactone Fibers Modified with Essential Oils for Infection Control †

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Abstract: Essential oils (EOs), which are complex biomolecules composed of volatile compounds, are being analyzed as tools to fight bacterial infections. Here, we report the modification of biodegradable wet-spun microfibers composed of cellulose acetate (CA) and polycaprolactone (PCL) with EOs, aiming at their localized, controlled release. Cinnamon leaf oil (CLO), cajeput oil (CJO), and clove oil (CO) were selected from a group of 20 EOs according to their minimal inhibitory concentration (MIC) against *Staphylococcus aureus* (<22.4 mg/mL) and *Escherichia coli* (<11.2 mg/mL). CA/PCL prepared at 10% and 14%wt in a 3/1 ratio in acetic acid and acetone were processed in the form of microfibers by wet-spinning at an extrusion rate of 0.5 mL/h directly into an ethanol coagulation bath. EOs were functionalized at the surface of the microfibers by physisorption. Here, microfibers were immersed in ethanol solutions containing EOs at 2xMIC and ampicillin (control antibiotic at 2xMIC, as well). After 72 h of immersion, fibers contained ampicillin at MIC but only 14%, 66% and 76% of MIC for CLO, CO and CJO, respectively. Incorporation was confirmed by UV-Visible spectroscopy, Fourier-transform infrared spectroscopy (FTIR) and thermogravimetry (TGA). Unloaded and loaded microfibers were characterized as uniform and homogeneous. Time-kill kinetics antimicrobial studies (ASTM-E2149-01) were conducted on the loaded fibers revealing their capability to eliminate more than 99.9% microbial cells after 24 h culture. Data showed that, even at small amounts, the EO-modified microfibers were effective against the bacteria *S. aureus* and *E. coli*. Considering the amount immobilized, CLO-containing fibers were deemed the most effective from the group, suggesting a superior affinity of the EOs active groups towards the CA/PCL matrix. These results indicate that CA/PCL microfibers loaded with EOs can be easily produced and applied in scaffolds for biomedical applications.

Keywords: microfibers; biocompatible polymers; essential oils; surface modification; bactericidal effect; localized biomolecule action