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Abstract

Lignocellulosic-based nanoparticles loaded with essential oils against Staphylococcus aureus and Pseudomonas aeruginosa – mediated infections †

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Infected diabetic foot ulcers (DFUs) are a frequent and costly complication of diabetes, with limb amputation being highly prevalent worldwide. Even if treated, recurrence is frequent, with pathogen clearance and degenerated tissue recovery being increasingly more difficult each time. Persistent pathogens such as Staphylococcus aureus and Pseudomonas aeruginosa are the main microbial inhabitants of infected DFUs, often gaining antimicrobial-resistance to treatment [1]. Nanoparticle (NP)-mediated therapies may overcome this problem, as they are able to carry and protect loads from biodegradation, be internalized by the cell, and release the load(s) in a controlled manner [2, 3]. As payloads, plant-derived essential oils (EOs) exert quick and strong bactericidal action. This work proposes EO-encapsulation into polyelectrolyte complexed (PEC) NPs fabricated with natural, renewable, and bactericidal polymers [quaternized cellulose (QC) and carboxymethyl lignin (CML)] [4]. The antimicrobial activity of laurel, oregano and dill EOs was screened for the first time against reference strains of S. aureus and P. aeruginosa, by minimum inhibitory concentration (MIC) and time-kill kinetics, up to 24 h of incubation [1, 5]. Glycidyltrimethylammonium chloride was added to microcrystalline cellulose to obtain QC. CML was obtained through reaction with monochloroacetic acid to softwood kraft lignin and served as anionic counterpart. At optimized pH and ionic strength, EOs were added to the anionic polyion before complexation, then added to polycation and ultrasonicated to form EO-loaded QC/CML PEC NPs. Dialysis and condensation purified NP dispersions, and the release profile of loaded EOs was monitored by UV-Visible spectroscopy. Antimicrobial activity of loaded PEC NPs was confirmed through the determination of agar diffusion and time-kill kinetics assays, similarly to Antunes et al. [1]. Preliminary data pointed out the potential of EO-loaded PECs to work as a therapeutic alternative to conventional strategies, or treatment adjuvant, to fight some of the pathogens colonizing DFUs.

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