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CO2-assisted production of polyethylene glycol / lauric acid microparticles for extended release of Citrus aurantifolia essential oil

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ABSTRACT:

Applications of essential oils as chemotherapeutics are limited because these aromatic oils are generally volatile, insoluble in aqueous media and easily degraded to non-active constituents when subjected to thermal-oxidative processes. The particles from gas-saturated solution (PGSS) technology allows for non-destructive processing of volatile oils into micronized formulations under high pressure and moderate temperature using supercritical carbon dioxide (scCO2). In this study, essential oil from lime (Citrus aurantifolia) with proven antidiabetic activity was processed with polyethylene glycol (PEG) and lauric acid (LA) using scCO2 in a high pressure reactor for 2 h at 120 bar and 45 °C. The polymer-oil mixtures were co-precipitated and micronized through a 500 μm nozzle. PGSS processing of C. aurantifolia oil with PEG and LA yielded roughly spherical microparticles with sizes ∼ 2 μm. Inclusion of the LA and encapsulation of the limonene-rich oil into the PEG particles were confirmed using FTIR and GC/MS respectively. Melting point and heat of fusion of the PEG/LA microparticles were lower when compared with particles produced with PEG only, resulting in higher oil loading capacity and yield. The scCO2-assisted polymeric encapsulation of the volatile oil reduced rapid vaporization and incorporation of LA with the PEG-oil formulation extended the mean release time in simulated physiological solutions. Free radical scavenging and alpha-amylase inhibitory activities of the lime oil were also preserved following encapsulation in the PEG/LA microparticles. In summary, production of PEG/LA microparticles with high yield and loading capacity of bioactive lime essential oil was achieved using the scCO2 encapsulation technology.