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Supercritical CO2 assisted impregnation of ibuprofen on medium-chain-length polyhydroxyalkanoates (mcl-PHA)

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PURPOSE OF THE ABSTRACT

In this work, we propose the utilization of supercritical carbon dioxide (scCO2) to impregnate ibuprofen into a medium chain length polyhydroxyalkanoate (mcl-PHA) which was produced by Pseudomonas chlororaphis subs. aurantiaca (DSM 19603) using glycerol as sole carbon source. The obtained biopolymer was composed of 5 monomers, namely 3-hydroxydecanoate (50 wt%), 3-hydroxyoctanoate (17 wt%), 3-hydroxytetradecanoate (17 wt%), 3-hydroxydodecanoate (13 wt%) and 3-hydroxyhexanoate (3 wt%). Characterization of the physical and thermal properties of the polymer showed that it had a low melting temperature of 45 ºC and was also highly amorphous, with a crystallinity degree of 27 %. Besides this, the mcl-PHA also presented adhesive properties and biocompatibility, hence being a good candidate for biomedical applications. For the impregnation tests different conditions of pressure (15 and 20 MPa) and impregnation time (30 min, 1 h and 3 h) were tested, however the temperature used was kept constant, at 40 ºC. It was observed that the highest content of ibuprofen in the mcl-PHA was obtained for the experiments conducted at 20 MPa, for 1h (90.8 ± 6.5 mg of ibuprofen/gPHA) with an impregnation rate of 89 mg/(g.h). Moreover, DSC analysis proved that the scCO2 processed mcl-PHA samples suffered a plasticizing effect, as shown by the decrease of 6.5 ºC in the glass transition temperature at 20 MPa. Changes in the degree of crystallinity of the polymer were also observed. The release of ibuprofen from the mcl-PHA matrix followed a type II release profile which was expected for polymeric matrixes and that allows to maintain a constant concentration of the active pharmaceutical ingredient (API) in the blood stream. This study has demonstrated that the mcl-PHA produced by P. chlororaphis has a great potential for the development of novel topical drug delivery systems.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

medium-chain-length polyhydroxyalkanoates | supercritical carbon dioxide | ibuprofen | impregnation

BIBLIOGRAPHY