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Assessment of pro-oxidant activity of natural phenolic compounds in bio-polyesters

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Abstract

In this work, natural phenolic compounds, such as Vanillic Acid (VA), Ferulic Acid (FA) and Thymol (Th), at very high concentrations, have been considered as pro-oxidant agents for Polylactic acid (PLA). Specifically, thin films of neat PLA and PLA-based systems containing 2 and 3 wt.% of VA, FA and Th have been produced and subjected to accelerated degradation in different environmental conditions. Preliminary characterizations, through rheological, mechanical, optical and morphological analysis, of the formulated PLA-based systems show that the VA and FA, even less the Th, are able to exert a plasticizing action during the processing and subsequently, the PLA crystallinity and rigidity slightly decrease, while, the PLA ductility increase and its optical performance and morphology remain almost unchanged.

To assess the pro-oxidant activity of the considered natural phenolic compounds, thin films of PLA and PLA-based systems containing VA, FA and Th have been subjected to accelerated degradation in different environmental conditions: (i) water-medium hydrolysis, (ii) photo-oxidation upon UVB exposure and (iii) thermo-oxidation upon thermal treatment in oven. All obtained results pointing out that the considered natural compounds, at these high concentrations, exert a clear pro-oxidant activity in PLA during the water-medium hydrolysis and the photo- and thermo-oxidative degradation. Moreover, the VA, FA and Th can be considered as suitable pro-degradant additives for PLA, also in order to control the bio-polyester degradation times.

Keywords: Polylactic acid; Natural phenolic compounds; Pro-oxidant activity; Hydrolysis; Photo- and Thermo-oxidation.

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