Chemical Incorporation of Antioxidants into a Biodegradable Polymer for Controlled Release

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Introduction

Reactive oxygen species (ROS) in life organisms are produced as well as antioxidants, which are bioactive compounds that can counteract the effect of such harmful species. Under UV light and other stress situations, natural inhibitors aren't enough to react with ROS, causing redox misbalance and aging. In order to replace these antioxidants, we will show the development of a biodegradable and biocompatible catechol-based poly (anhydride-esters). This polymer is designed to break down and release controllably the antioxidant after hydrolysis of anhydride and ester bonds.

Results and Discussion

In order to synthesize the biocompatible polymer, catechol was reacted with glutaric anhydride by ring opening. The diacid thus formed was acetylated and the acylation product was used to synthesize catechol glutaric poly(anhydride-ester) via melt-condensation, as described in figure 1.

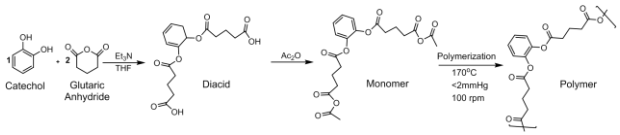

Figure 1. Scheme of catechol-glutaric poly (anhydride-ester) synthesis.

Unlike some systems in which the bioactive is simply mixed into a polymer, this system demonstrates the chemical incorporation of the bioactive into polymer backbone by Infrared Spectroscopy (FT-IR), proton Nuclear Magnetic Resonance (1H-RMN), Gel Permeation Chromatography (GPC) and Mass Spectroscopy (MS). For further characterization, thermal properties were elucidated by Thermogravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC). Release studies were performed by HPLC. A slow and controlled releasing profile was observed, i.e. 0.5% of the loaded catechol was released over 20 days.

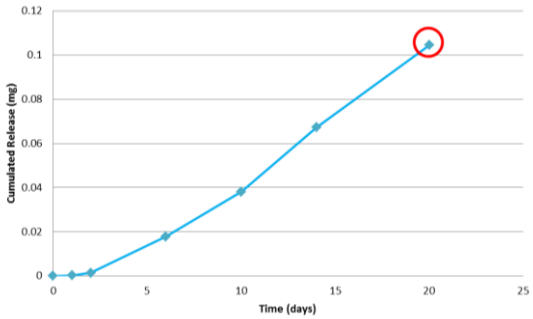

Figure 2. Catechol release profile over 20 days.

The catechol released from the polymer synthesized at day 10 and 20 had their antioxidant activity analyzed by 2,2-diphenyl-1-pycrylhydrazyl (DPPH) assay. It shows that the catechol released still have antioxidant activity as expected.

Conclusion

In this work we designed a drug delivery system in which the antioxidant Catechol was 33% loaded into a polymer backbone. Once the release profile had a slow rate, it could not be used for sun scream applications, but the antiseptics properties of the bioactive can be explored. It also serves as model for develop new drug delivery systems with different bioactive and release rates.

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