Synthesis of Functional Polyesters based on Citric Acid

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Polyesters are highly versatile materials that are of relevance to many different product categories. In view of the current challenges concerning climate change and pollution, they are attractive alternatives to conventional materials. With polyesters, a transition to bio-based and renewable educts has shown to be possible. Also, ester bonds are prone to hydrolysis under the right conditions and several biodegradable polyesters are reported [1]. The focus of the current research project is to synthesize functional polyesters based on citric acid, which is an easily available, cheap and renewable resource.

The chemical structure of citric acid is shown in Figure 1, with its multifunctionality being an interesting feature. In literature, the hydroxy group is reported to be unreactive. Also, the tertiary carboxyl group is described as less reactive than its primary counterparts during esterification. This should enable synthesis of polyester with carboxyl side chains, that are thus available for subsequent functionalization [2]. However, experimental data suggests the latter statement to not be entirely valid. Gelation is observed at a certain reaction time that depends on the monomers and the employed reaction conditions.

During synthesis, the conversion can be monitored by means of nuclear magnetic resonance spectroscopy (NMR). Depending on the utilized diol, reactions of the tertiary COOH group can be observed in ^{1}H and ^{13}C NMR spectra. The molecular weights of the resulting polyester chains as well as branching is investigated via size exclusion chromatography (SEC). Current synthesis procedures lead to broad and multimodal size distributions as shown in Figure 1.

Overall, citric acid-based polyesters can be described as promising materials worth exploring in more detail. With the currently ongoing optimization of their synthesis route and the associated focus on proper characterization, they seem to be viable candidates for biobased and biodegradable special products.

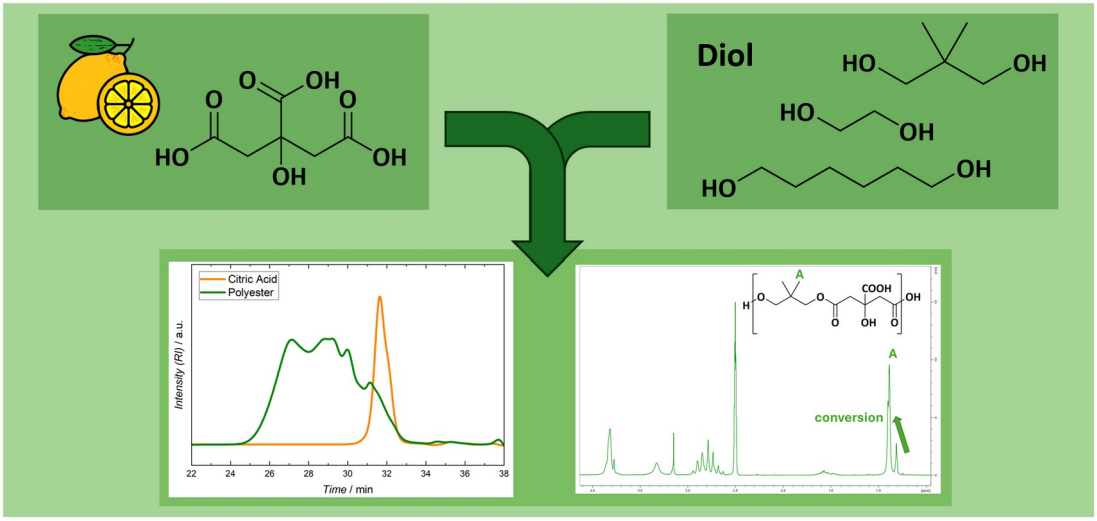

Figure 1: Schematic representation of the synthesis of citric acid-based polyesters.

Keywords: polyester synthesis, citric acid, renewable monomers, functional polyester, biodegradability

References

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