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Sustainable synthesis of amino acid based three-component surfactants via Diels-Alder reaction with myrcene

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PURPOSE OF THE ABSTRACT

Surfactants based on amino acid commonly exhibit environmental friendly and mild properties, but are often structurally limited to acylation or alkylation of the N- or C-terminus. Linking hydrophobic dienes and amino acids via Diels-Alder-reaction using anhydrides broadens this structural diversity. Employing dienes and linkers of varying structure allows easy modification of the hydrophobic chain, while the natural occurring amino acids allow a selection of hydrophilicity and charge from a toolbox of twenty different head groups. Application of myrcene from pine-trees with platform chemicals maleic anhydride or citraconic anhydride as linkers gives access to a structurally diverse set of fully bio-based surfactants. The synthesis and characterization of these surfactants with a range of amino acids will be shown.

Microwave-assisted reaction conditions allowed fast and selective synthesis of fatty-acid-like two-component structures and subsequent anhydride-opening condensation with the N-terminus of the amino acid proceeded easily in aqueous solution. By this method, natural occurring amino acids were converted with very good yields of up to 90 %. Initial physicochemical characterization revealed that the addition of the amino acid head-group significantly enhances the molecules amphiphilic character; in dependency of the amino acid resulting in weak to strong amphiphilicity. Foam build up and reduction of surface tension was observed; however, foam stability was often low. Upon reducing the pH-value to skin-friendly pH 5.6, significantly more stable foam was produced. Application of polar, cationic amino acids arginine and lysine resulted in higher foam stability and best surface activity.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS
surfactants | amino acids | Diels-Alder | myrcene

BIBLIOGRAPHY