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Production of functionalized oligo-isoprenoids by enzymatic cleavage

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Abstract:

In this study, we show the proof of concept for the production of defined oligo-isoprenoids with terminal functional groups that can be used as starting materials for various purposes including the synthesis of isoprenoid-based plastics. To this end, we used three types of rubber oxygenases for the enzymatic cleavage of rubber poly[1,4-isoprene]. Two enzymes, rubber oxygenase RoxAXsp and rubber oxygenase RoxBXsp originate from Xanthomonas sp. 35Y; the third rubber oxygenase, latex-clearing protein (LcpK30), is derived from Gram-positive rubber degraders such as Streptomyces sp. K30. Emulsions of polyisoprene (latex) were treated with RoxAXsp, RoxBXsp, LcpK30 or with combinations of the three proteins. The cleavage products were purified by solvent extraction and FPLC separation. All products had the same general structure with terminal functions (CHO-CH₂ and –CH₂-COCH₃) but differed in the number of intact isoprene units in between. The composition and m/z values of oligoisoprenoid products were determined by HPLC-MS analysis. Our results provide a method for the preparation of reactive oligo-isoprenoids that can likely be used to convert polyisoprene latex or rubber waste materials into value-added molecules, biofuels, polyurethanes or other polymers.

Keywords: oligo-isoprenoids, rubber oxygenase, Xanthomonas sp., polyisoprene latex, enzymatic cleavage