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Revealing Thermal Degradation Characteristics of Distinctive Oligo-and Polisaccharides of Prebiotic Relevance

Authors : Attila Kiss, Erzsébet Némedi, Zoltán Naár

Abstract : As natural prebiotic (non-digestible) carbohydrates stimulate the growth of colon microflora and contribute to maintain the health of the host, analytical studies aiming at revealing the chemical behavior of these beneficial food components came to the forefront of interest. Food processing (especially baking) may lead to a significant conversion of the parent compounds, hence it is of utmost importance to characterize the transformation patterns and the plausible decomposition products formed by thermal degradation. The relevance of this work is confirmed by the wide-spread use of these carbohydrates (fructo-oligosaccharides, cyclodextrins, raffinose and resistant starch) in the food industry. More and more functional foodstuffs are being developed based on prebiotics as bioactive components. 12 different types of oligosaccharides have been investigated in order to reveal their thermal degradation characteristics. Different carbohydrate derivatives (D-fructose and D-glucose oligomers and polymers) have been exposed to elevated temperatures (150 °C 170 °C, 190 °C, 210 °C, and 220 °C) for 10 min. An advanced HPLC method was developed and used to identify the decomposition products of carbohydrates formed as a consequence of thermal treatment. Gradient elution was applied with binary solvent elution (acetonitrile, water) through amine based carbohydrate column. Evaporative light scattering (ELS) proved to be suitable for the reliable detection of the UV/VIS inactive carbohydrate degradation products. These experimental conditions and applied advanced techniques made it possible to survey all the formed intermediers. Change in oligomer distribution was established in cases of all studied prebiotics throughout the thermal treatments. The obtained results indicate increased extent of chain degradation of the carbohydrate moiety at elevated temperatures. Prevalence of oligomers with shorter chain length and even the formation of monomer sugars (D-glucose and D-fructose) might be observed at higher temperatures. Unique oligomer distributions, which have not been described previously are revealed in the case of each studied, specific carbohydrate, which might result in various prebiotic activities. Resistant starches exhibited high stability when being thermal treated. The degradation process has been modeled by a plausible reaction mechanism, in which proton catalyzed degradation and chain cleavage take place.

Keywords : prebiotics, thermal degradation, fructo-oligosaccharide, HPLC, ELS detection
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