Migration of linear and cyclic polyester oligomers from polyester-phenolcoatings into food and food simulants

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Background

Food contact materials (FCM) made of metal, such as tin cans or closures for baby food, are often lacquered with a coating to protect against corrosion and a possible transfer of undesirable metal ions into food. As an alternative formulation to the established but potentially hazardous epoxy-phenol-coating based on bisphenol A (BPA), polyester-phenol-coatings are widely used. However, these coatings can also release substances with unknown toxicological potential into food in direct contact. Especially oligomers formed by polyester monomers are in focus.

In this study, an analytical concept for the identification and determination of polyester oligomers releasable from a commercial coating, used in closures for baby food, into food and food simulants is presented.

Polyester monomers: determination of carboxylic acids (LC) & polyols (GC) subsequent to hydrolysis from polyester resins (raw materials available) → monomer profile → prediction of probable linear and cyclic oligomers

Risk assessment of polyester oligomers

Polyester oligomers are esters of mostly polyvalent carboxylic acids and polyols. Risk assessment of monomers is based on legal specific migration limits (SML), often derived from toxicological studies. No toxicological studies or legal limits exist for polyester oligomers. Therefore, risk assessment is performed by the exposure based TTC concept (threshold of toxicological concern). Linear polyester oligomers are concerned with a threshold of 30 µg/kg bw & day (Cramer class I), cyclic oligomers are evaluated with 1.5 µg/kg bw & day (Cramer class III)[1].

Identification of oligomers in extracts from polyester resins → verification of predictable oligomers

Application of TTC concept to migrate from polyester-coating → exposure based evaluation

Quantification of oligomers

HPLC-UV (232 nm) external calibration with commercial reference substance BHET

Release of polyester oligomers “Migrants”, “Leachables” & “Extractables”

Conclusion

Linear and cyclic polyester oligomers can migrate from polyester-phenol coatings in relevant amounts into food and food simulants. When aqueous food simulants were used, effects of hydrolysis occur.

Determination of monomer profiles after complete hydrolysis is a valuable tool to predict probable polyester oligomers as well as to estimate the release of total polyester related content into food and food simulants.

Tentative identification of predicted linear and cyclic polyester oligomers can be performed by HPLC-ESI-MS. Quantification of identified oligomers via HPLC-UV is based on external calibration with BHET and requires chromatographic separation.

TTC limits for known substances can be transformed into analytical thresholds by estimation of exposure. Monitoring of threshold values in screening methods can be carried out with the aid of universal detectors.

References