Analysis of Migrant Compounds from Food Packaging: Application to Disposable Tableware and Risk Analysis

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Abstract

Substance migration from nine types of disposable plates made from cardboard, polystyrene (PS), and polypropylene (PP) have been studied. Migration tests were performed in four food simulants over 10 days at 40°C. Simulant extracts were analyzed using SPME-GC-MS and UPLC-QTOF-MS to identify and (semi)quantify volatile and non-volatile migrants, respectively.

Introduction

In modern society, disposable tableware is increasingly popular at events, especially children's parties, and convenient because it is easy to clean, inexpensive and lightweight. Additionally, there is a wide variety of colors, designs, and themes to decorate these events which imply the use of different additives, adhesives, inks and/or antioxidants that might migrate into food along with non-intentionally added substances (NIAS). Each of these substances can be taken by consumers causing a risk to their health. (Nerin et al. 2013)

To ensure safety, European legislation requires compliance with Regulation (EU) No 10/2011 on plastic materials intended for food contact and the UNE-EN 14338:2004 standard for paper and cardboard. This legislation mandates the identification of substances in these materials that could migrate into food and pose risks to consumers, through specific migration tests.

Advanced analytical techniques now enable effective and reliable identification of these compounds at low concentrations (Nerín et al. 2022) (Aznar, Domeño, Nerin 2023)

Nevertheless, non-targetted analysis is a challenging issue and specific softwares to process all the generated data like MS-DIAL are highly valuable tools (Tsugawa et al. 2015).

Aims

The objective is to identify and quantify migrants released from these materials in different use conditions depending on the liquid type, temperature, time, and repeated use. Moreover, a detailed guide for data processing with MSDIAL was developed.

Method

Food simulants were 10% and 95% ethanol, 3% acetic acid, and Tenax to cover. Identification and (semi)quantification was done with MS-DIAL software, designing a workflow, and modifying commercial spectral libraries for improved processsing. Furthermore, the toxicity of each compound was searched in the literature or estimated with Toxtree by Cramer classification to assess the possible toxicological risk.

Conclusiones

Styrene monomers were released from PS plates. In all samples, plasticizers such as diethyl phathalete, dibutyl phthalate and diisobutyl phathalate. Ink migration was confirmed thanks to compounds like 1,7-di-iso-propylnaphthalene, benzophenone and 2,6-diisopropylnaphthalene. Many alkylbenzenes were identified like p-xylene, o-xylene, ethylbenzene, and propylbenzene. Additionally, 2,4-Di-tert-butylphenol, an antioxidant, was identified. Further (semi)quantification of these compounds is mandatory to acknowledge the risk health.

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Figure 1. Disposable plates made of polypropylene (PP), polystyrene (PS) and cardboard (From left to right)

Figure 2. MS-DIAL software identification features for data processing