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SCREENING OF ESTROGENIC COMPOUNDS IN CONSUMER-ELECTRONICS PLASTICS BY LIQUID CHROMATOGRAPHY NANOFRACTIONATION-BIOACTIVITY DETECTION AND MASS SPECTROMETRY

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The chemical safety of consumer products is an issue of emerging concern. Plastics are widely used, e.g. as casings of consumer electronics (TVs, computers, routers, etc.), which are present in houses and offices in continuously increasing numbers and are known to contain a variety of chemical additives. Plastic leachates have been reported to exert aquatic toxicity which varied with the type of plastic and the weathering conditions.[1,2] More specifically, estrogenic activity has been reported in leachates from polycarbonate and epoxy resins used as food contact materials that are known to contain bisphenol A (BPA) as an unpolymerized residue.[3,4] More recently, also plastic leachates made up of other polymers (the so-called BPA-free plastics) have been reported to exert estrogenic activity too, although individual chemicals were not identified.[5,6] A recent study of our research group reported that plastic casings of electronic equipment contain a variety of phthalates, UV filters, antioxidants, flame retardants and related compounds.[7] Among these chemicals, some phthalates (e.g. butyl benzyl phthalate, dibutyl phthalate), antioxidants (e.g. 2-hydroxy- 4-methoxybenzophenone, 2,2′-dihydroxy-4-methoxybenzophenone) and flame retardants (e.g. triphenyl phosphate) have been reported to be estrogenic.

In this study, we investigated the estrogenic activity of components of plastics coming from electronics' casings. A recently developed fractionation platform for effect-directed analysis (EDA) was used.[8] The platform combines liquid chromatography (LC) with high resolution time-of-flight mass spectrometry (TOFMS) in parallel with a human cell (VM7Luc4E2) gene reporter assay via nanofractionation for the detection of estrogenic compounds. The platform allows reconstruction of bioassay chromatograms that can directly be correlated to the parallel obtained MS chromatograms, allowing straightforward pinpointing of accurate masses of estrogenic compounds. Results were obtained within a single fractionation cycle, resulting in a drastic decrease of total analysis time, and thus increase in throughput compared to traditional EDA studies. Four out of eight of the analysed plastics samples showed presence of estrogenic compounds. Based on the MS results these were assigned to bisphenol A (BPA), 2,4-di-tert-butylphenol and a possible bisphenol A analog. Flame retardants that were present in the analyzed samples, did not show any estrogenic response in the human cell-based bioassay. However, bisphenol A and the suspected analog could be present as an impurity of the flame retardants BDP, TBBPA and TBBPA-based polymers. In general, we could conclude that plastic casings from consumer electronics contained estrogenic compounds. Consequently, these common consumer products could constitute a source of estrogenic contamination for human exposure indoors but also at primitive electronic waste recycling sites.

References

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