Determination of Bisphenols in Honey

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Problem statement:
Plastics are everywhere, and bisphenol A (BPA), a common ingredient in polycarbonate polymer and epoxy resins has become ubiquitous such that human and animal exposure to it is unavoidable. The principle route of human/animal ingestion is via contaminated food. Confronted by tightening regulations, producers are turning to BPA alternatives (BPs), which are structural analogues of some BPA alternatives also have estrogenic activity, while their presence in the environment and foodstuffs, e.g. honey, are only now beginning to be investigated.

Objective:
The aim of this study was to develop a validated analytical method for the simultaneous analysis of eleven BPs including BPA, BPAP, BPB, BPC, BPE, BPF, TMBPA, BPS, BPZ, DHBP and HPP in honey samples at trace levels (ng/g honey).

Materials and Method

Sample preparation

- **Honey (10 g) in water (100 mL)**
- **Filtration (1.2 μm)**
- **SPE**
  - Oasis HLB (3cc, 60 mg)
  - 0.5 mL MeCN
  - 3 x 1 mL EtAc
- **Derivatisation**
  - MTBSTFA 1%TBDMS in EtAc
  - 16 h at 60 °C

**GC/MS**

- **Calibration:** 0.25 – 30 ng/g honey
- **Column:** HP-5ms Ultra Inert; 30 m x 250μm x 0.25; He (1ml/min)
- **Injection:** 1 μL
- **Oven:** 120°C to 200°C(2) to 280°C(5) to 310°C(20)(3)
- **MS:** 70eV; SIM mode (see above*)
- **Blanks:** with and without honey (n = 3)

Sample Origin

- Sample 1: EU & non-EU
- Sample 2: China
- Sample 3: non-EU
- Sample 4: China
- Sample 5: Slovenia
- Sample 6: Italy

Results

- Linearity of R² > 0.95 over the working concentration range for all BPs
- Repeatability (RSD): Instrument: < 9.9% for all BPs (n = 3) Method: < 16% (n = 3)
- LOD: ≤ 0.548 ng/g honey for all BPs
- LOQ: ≤ 1.83 ng/g honey for all BPs

- **BPAP in Analyzed Honey Samples**

- **BPA detected in all 6 analysed samples (0.677 – 102 ng/g honey)**
- **Samples 3, 4, 5 and 6 contained BPA between LOD and LOQ**
- **BPC occurs in 3 samples (3.43 – 37.1 ng/g honey)**
- **2 samples contained BPF (2.35 – 8.32 ng/g honey)**
- **1 sample contained BPB (8.32 ng/g honey)**
- **1 sample contained BPAP (3.21 ng/g honey)**
- **Sample 6 contained the highest number of analysed BPs: BPA, BPF, BPC and BPAP**

Conclusions

- Based on the exposure from observed maximum levels of BPA in honey there is little risk to consumer health (exposure < TDI 4 μg/kg bw/day)
- Cumulative health effects of these substances should be explored
- Further work will include the analysis of more honey samples and the search for the origin of contamination with the detected BPs (e.g. food contact materials)

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