APPLICATION NOTE

Liquid Chromatography

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UHPLC SEPARATION AND DETECTION OF BISPHENOL A (BPA) IN PLASTICS

Introduction

The BPA or bisphenol A (Figure 1) has become well know over the past year as concerns for its effect on human health and well being have been raised. The concerns over BPA began with baby bottles and spread to include other types of bottles.

BPA is used in the production of two very common polymers PVC and Polycarbonate. PVC, Polyvinyl chloride, is used in many different products including building materials, medical devices and children's toys. BPA is used in PVC production as a polymerization inhibitor, residual BPA may remain after the polymerization is complete. Polycarbonate is another very commonly used plastic. It has very desirable properties for both optical clarity and heat resistance. BPA is an important monomer in the production of polycarbonate polymer, not all of the BPA is consumed in the production and may leach out of the polymer. Recently, many applications of polycarbonate have been replaced with new copolymers, such as co-polyester, to eliminate BPA.

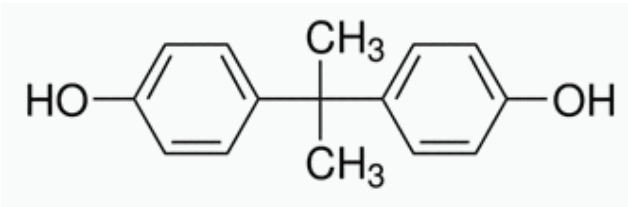

Figure 1: Structure of Bisphenol A (BPA).

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As a result of the health concerns over human exposure to BPA this molecule is now monitored in specific products, including baby bottles and other children's products. Simple and robust test methods are needed to determine the presence and amount of BPA in plastic materials. This paper will present the extraction and HPLC analysis of children's products for BPA.

Figure 2: Children's toy samples analyzed for BPA in this application note.

Experimental

The study presented here includes extraction of BPA from a toy matrix and analysis with UHPLC. The extraction procedure used here is intended to simulate the contact routes through which children are likely to encounter BPA. Two different extraction techniques were used to analyze BPA in samples (30 g sample used for each extraction). The first extraction method immersed the sample in 1 L of water, at 40 °C for 24 hours (EN 14372). The second immersed the sample with 1 L HCl (0.07 M) at
37 °C for 2 hours. Following extraction the samples were analyzed with a PerkinElmer Flexar™ FX-10 UHPLC system including a PerkinElmer Series 200a Fluorescence detector. The separation was performed on a Brownlee Validated C8 Column (see Table 1).

Table 1: HPLC Conditions for the Analysis of BPA

HPLC System	PerkinElmer Flexar FX-10 UHPLC
Injection Volume	50 µL
Column	PerkinElmer C8 (150 mm x 4.6 mm, 5 µm)
Mobil Phase	Methanol/Water (65/35)
Flow Rate	1 mL/min
Detector Wavelength	Excitation – 275 nm / Emission – 313 nm
Detector Response Time	0.1 sec
PMT, Em BDW	Super High, Wide
Run Time	15 min

Results

The BPA analyzed with the given LC conditions eluted at 5.43 mins (Figure 3). The UHPLC system was calibrated across a range of 1 – 50 ppb (µg/L) BPA (Table 2).

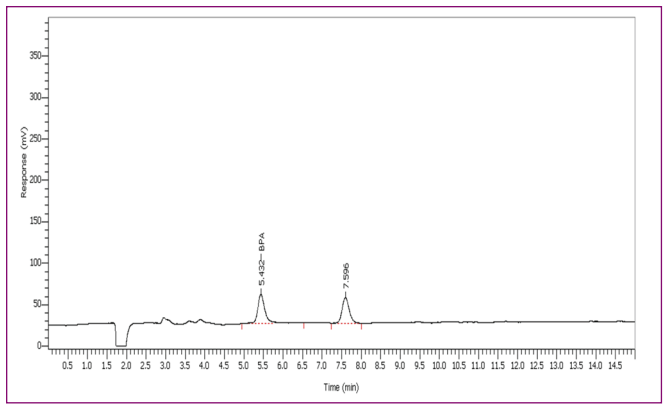

Figure 3: BPA calibration standard at 1 ppb.

Table 2: Table for the analysis of BPA across the range of 1 – 50 ppb (µg/L).

Concentration	Response
1 ppb	54163
10 ppb	378051
20 ppb	820335
40 ppb	1548750
50 ppb	1957851
r^2	0.9993

The limit of quantitation (LOQ) for BPA with the method presented here is 1 ppb. The signal to noise at the LOQ is approximately 10:1. The response across the calibration range fit a linear calibration with an r^2 value of 0.9993. Blanks analyzed between standards and samples showed the system was free from any BPA contamination or carryover.

BPA in the extracts of the toy samples were quantified using the calibration curve generated during standard analysis (Table 3). Figure 4 shows the chromatogram of the water extract of the toy dwarf sample.

Table 3: Results from toy sample analysis.

Sample	Extraction Type	µg/L	µg/g
Cube	water	2.04	0.068
Cube	HCl	ND	ND
Die	water	3.35	0.111
Die	HCl	1.56	0.052
Dwarf	water	4.32	0.144
Dwarf	HCl	1.78	0.059

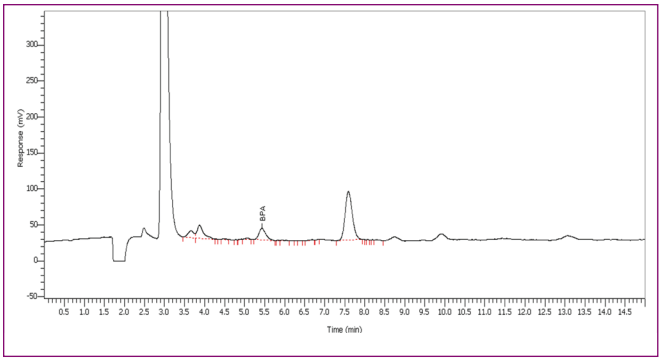

Figure 4: Analysis of toy dwarf for BPA using water.

The extraction procedure which heated the toy for 24 hours in water at 40 ˚C extracted a significantly higher amount of BPA from the matrix than the extraction in acid. BPA was found in all three water extractions within the calibration range of the standard curve.

Conclusion

As health concerns over exposure to BPA are raised, its analysis in plastics is becoming very important. The PerkinElmer Flexar FX-10 UHPLC system provides a sensitive and robust platform for this analysis. Demonstrated here was a calibration of BPA across a range of 1 – 50 ppb with a chromatographic run time of less than 10 minutes. This analysis was applied to 3 toy samples and BPA was identified in each sample.

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