APPLICATION NOTE

Ultrapure water essential for direct determination of bisphenol A by HPLC-MS/MS

Abstract

Until recently, bisphenol A (BPA) was widely used in the manufacture of polycarbonate plastics and epoxy resins, and the risks associated with BPA remain highly controversial. As a result, numerous determinations of trace BPA are now carried out, creating the need for robust analytical processes. High performance liquid chromatography-tandem mass spectrometry (HPLC-MS/MS) offers extremely high sensitivity for BPA detection, often with a detection limit of below 2 ppt, making it essential to use ultrapure water throughout the analytical process. A range of ELGA® pure water systems have been tested for this application, and offer effective removal of BPA to below the detection limit of HPLC-MS/MS.

Introduction

Bisphenol A (BPA) has been used in the commercial production of polycarbonate plastics and epoxy resins for over 50 years and, until recently, was widely used throughout the chemical, plastics, and food and beverage industries despite being a known endocrine disrupter[1]. The potential hazards associated with the small amounts of unreacted BPA in polycarbonates and epoxy resins remain highly controversial[2], and recent legislation banning the use of BPA for plastic manufacture in many countries has created a need for fast, reliable and highly sensitive techniques for its detection. Direct analysis in aqueous samples or extracts is preferred, as this has the advantage of minimizing the risk of contamination or low recovery rates, requiring analytical techniques capable of determining parts per trillion (ppt) levels of BPA.

HPLC-MS/MS offers the specificity and sensitivity required for routine BPA screening, often with a detection limit of below 2 ppt. The exceptional sensitivity of this technique makes the use of ultrapure water throughout the analytical process vital, requiring a reliable water purification system to avoid erroneous results.

Experimental

To determine the suitability of ELGA PURELAB® water purification systems for BPA analysis, water samples from four different instruments from the PURELAB range (Table 1) were submitted for independent BPA analysis at the Institute for the Dynamics of Environmental Processes (CNR) in Venice, Italy. All units were set up in ELGA's central R&D facility, and were cleaned and operated for a set period prior to use. Samples were taken in glass bottles which had been pre-cleaned by rinsing in ultrapure water and heating to 450 °C.

Sample number	Water purification system
1	PURELAB Classic fed from a Micra
2	PURELAB flex 2 fed from PURELAB Option S
3	PURELAB flex 3
4	PURELAB Ultra fed from a PURELAB Option Q

Table 1: Details of samples submitted for BPA analysis.

Method

Samples were analyzed by HPLC-MS/MS, using the method described by Sangiorgi *et al* [3] and the following instrument set-up:

1) HPLC

Column:	Synergi™ Hydro-RP, 4.6x50 mm (Phenomenex)
Mobile phases:	A = H_2O, B = MeOH,
Injection volume:	100 µl
Chromatographic run:	0 mins: 50 % B; 2-7 mins: 100 % B; 9-15 mins: 50 % B

2) Mass spectrometry

Instrument:	API 4000 triple quadrupole mass spectrometer (Applied Biosystems)
Acquisition:	MRM (multiple reaction monitoring)
Ion source:	ESI in negative ion mode
Transition used for quantification:	227.0>132.8

Results

The example ion chromatogram in Figure 1 shows the suitability of the method for detection of ppt levels of BPA. A standard calibration curve from 5 to 1,000 ppt BPA was generated, as shown in Figure 2, demonstrating good reproducibility up to 50,000 ppt BPA (summarized in Table 2), with a calculated detection limit of 1.8 ppt.

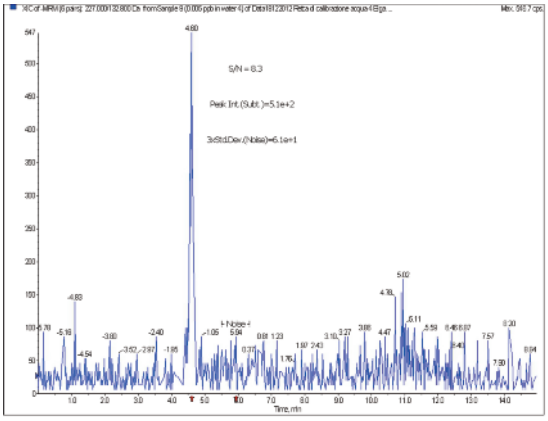

Figure 1: Bisphenol A signal for 5 ppt standard in ultrapure water.

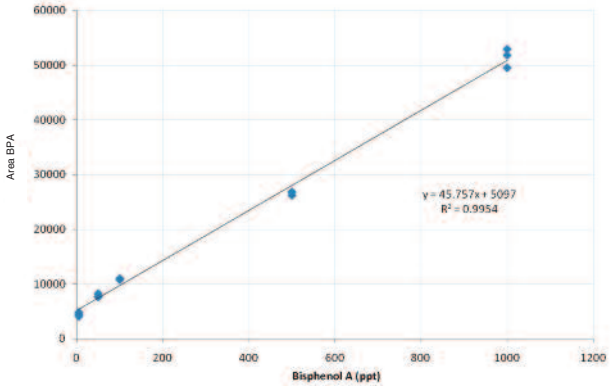

Figure 2: Calibration curve for 5 to 1,000 ppt bisphenol A.

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Concentration of BPA (ppt)	Area BPA	RSD (%)
2	1.98E+03 1.83E+03 1.80E+03	5.16
5	4.11E+03 4.82E+03 4.43E+03	7.98
50	8.25E+03 7.63E+03 7.70E+03	4.32
100	1.08E+04 1.10E+04 1.09E+04	0.92
500	2.68E+04 2.62E+04 2.68E+04	1.30
1,000	4.95E+04 5.18E+04 5.29E+04	3.38
10,000	4.05E+05 4.61E+05 4.72E+05	8.06
50,000	2.48E+06 2.40E+06 2.39E+06	2.04

Table 2: Reproducibility data for standard calibration curve.

Results

Example ion chromatograms for the samples are shown in Figures 3 and 4, and the measured BPA concentrations for all samples were below the detection limit of the analytical technique.

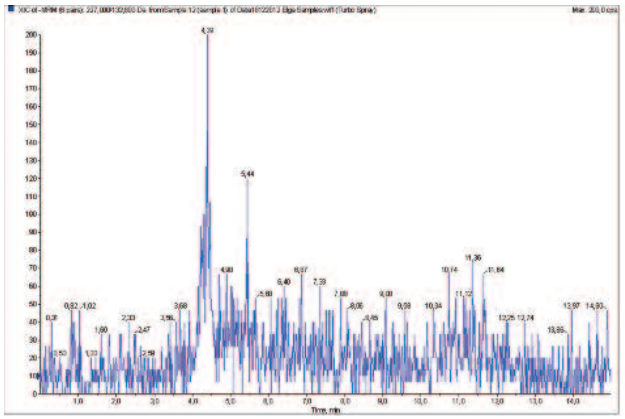

Figure 3: Bisphenol A determination for Sample 1.

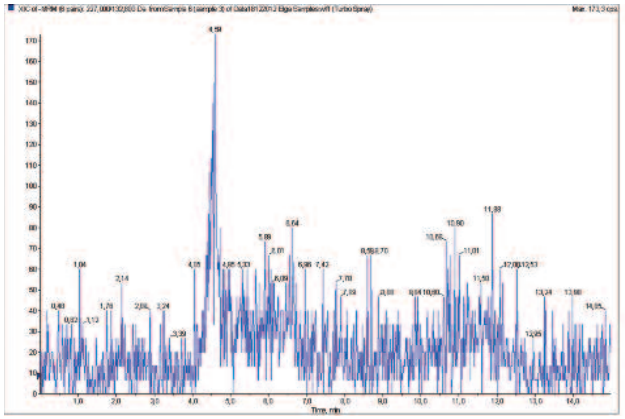

Figure 4: Bisphenol A determination for Sample 3.

Conclusion

This study clearly demonstrated the suitability of the ELGA PURELAB water purification systems for use in BPA determination by HPLC-MS/MS. None of the water samples tested contained detectable levels of BPA, virtually eliminating the risk of BPA contamination of aqueous samples or extracts for direct analysis.

To find out more about ELGA LabWater's water treatment technologies and solutions for analytical applications, visit **www.elgalabwater.com**

References

1. Rubin, BS. Bisphenol A: An endocrine disruptor with widespread exposure and multiple effects. *J. Steroid Biochem. Mol. Bio*, 2011, **127**: 27-34
2. Beronius, A; Rudén, C; Håkansson, H and Hanberg, A. Risk to all or none? A comparative analysis of controversies in the health risk assessment of bisphenol A. *Reprod Toxicol*, 2009, **29**(2): 132–146
3. Sangiorgi, G.; Ferrero, L; Ferrini, B.S; Lo Porto, C; Perrone, M.G; Zangrando, R; Gambaro, A; Lazzati, Z; Bolzacchini, E. Indoor airborne particle sources and semi-volatile partitioning effect of outdoor fine PM in offices. *Atmos Environ*, 2013, **65**, 205-214

About ELGA LabWater

ELGA LabWater manufactures supplies and services water purification systems for use in laboratories, and which meet the water requirement specifications for general laboratory, healthcare and clinical grades of water. ELGA offices and distributors are located in more than 60 countries worldwide. ELGA is the global laboratory water brand name of Veolia Water Solutions & Technologies.

Veolia Water Solutions & Technologies, subsidiary of Veolia Water, is a leading design & build company and a specialized provider of technological solutions in water treatment. Veolia Water Solutions & Technologies recorded revenue of €2.4 billion in 2012. www.veoliawaterst.com

Veolia Water, the water division of Veolia Environnement, is the world leader in water and wastewater services. Specialized in outsourcing services for municipal authorities, as well as industrial and service companies, it is also one of the world's major designers of technological solutions and constructor of facilities needed in water and wastewater services. With 89,094 employees, Veolia Water provides water service to 100 million people and wastewater service to 71 million. Its 2012 revenue amounted to €12.078 billion. www.veoliawater.com

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