

Achieving Low-ppb Bisphenol Quantitation with the Agilent InfinityLab Pro iQ Mass Detector

Authors

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Abstract

Bisphenols are common components in consumer-product plastics, making reliable trace-level quantification essential for quality control and safety assessments. Traditional HPLC/UV workflows may struggle with the selectivity and sensitivity required to measure these compounds in complex polymer matrices. This application note demonstrates a robust and sensitive LC/MS method for bisphenol analysis using the Agilent InfinityLab Pro iQ single quadrupole mass detector and Agilent Infinity II HPLC system. By leveraging selected ion monitoring (SIM), the method achieves as low as 0.2-parts-per-billion quantitation with excellent linearity, stability, and reproducibility in dissolved-plastic extracts. The results show how laboratories can confidently expand their analytical capability for bisphenols using a simple, accessible mass detection workflow.

Introduction

Bisphenols are widely used as monomers, curing agents, and additives across consumer-product plastics (for example, housings, containers, synthetic-leather coatings) and manufacturing materials. Because free and weakly bound bisphenols can migrate or be released from polymer matrices during a product's lifetime, trace-level quantification supports quality control (QC), material selection, and product stewardship. Increasing regulatory safety expectations emphasize trace detection and verification in complex matrices, driving the design of easy-to-run workflows that balance sensitivity, selectivity, and robustness.

Conventional HPLC with ultraviolet (UV) detection is reliable and widely deployed, but analytical sensitivity in polymer extracts may be limited by matrix interferences or insufficient selectivity when target analytes coelute with extractable components. These challenges are amplified in real-world plastic extracts containing oligomers, plasticizers, dyes, and other coextracted species that suppress or confound UV response. A mass-based detection strategy using selected ion monitoring (SIM) specifically targets *m/z* "channels", improving selectivity, signal-to-noise, and detection limits.

This application note describes a practical single quadrupole LC/MS workflow and 'method scaffold' using the Agilent InfinityLab Pro iQ mass detector operated in SIM mode for the trace analysis of bisphenols in polymer extracts. The analysis focuses specifically on a subset of bisphenols identified as analytically challenging due to their high bromination, steric complexity, or extended aromatic structures. By optimizing the workflow around these difficult species first, the resulting method demonstrates sufficient robustness to accommodate both specialty bisphenols and more common members of the class such as BPA, BPF, and BPS with minimal adaptation.

Experimental

Equipment

This experiment was conducted using the following instrument configuration:

- Agilent InfinityLab Pro iQ Series mass detector with Agilent Jet Stream (AJS) source
- Agilent 1290 Infinity II bio binary pump (G7120A)
- Agilent 1290 Infinity II bio multisampler (G7167B)
- Agilent 1290 Infinity II bio column compartment (G7116B)

Chemicals and standards

Table 1. Chemicals and standards analyzed.

Molecule Name	Abbr.	Formula	MW (g/mol)	CAS Number
Bisphenol A	BPA	C ₁₅ H ₁₆ O ₂	228.29	80-05-7
Bisphenol A-(diphenyl-d8)	BPA-d8	C ₁₅ D ₈ H ₈ O ₂	236.34	92739-58-7
Hexabromocyclododecane	HBCDD	C ₁₂ H ₁₈ Br ₆	641.7	25637-99-4
Bisphenol TMC	BPTMC	C ₂₁ H ₂₆ O ₂	310.43	129188-99-4
Tetrabromobisphenol A	TBBPA	C ₁₅ H ₁₂ Br ₄ O ₂	543.87	79-94-7
Bisphenol PH	BPPH	C ₂₇ H ₂₄ O ₂	380.48	24038-68-4
Bisphenol BP	BPBP	C ₂₅ H ₂₀ O ₂	352.43	1844-01-5
Bisphenol Z	BPZ	C ₁₈ H ₂₀ O ₂	268.35	843-55-0

HPLC parameters

Table 2. HPLC conditions and gradient program used for bisphenol analysis.

Parameter	Value										
Analytical Column	Agilent ZORBAX Rapid Resolution High Definition Eclipse Plus C18, 50 × 2.1 mm, 1.8 μm (p/n 959757-902)										
Column Temperature	40 °C										
Sampler Temperature	4 °C										
Mobile Phase A	0.2 mM ammonium fluoride (AF) in water										
Mobile Phase B	Methanol										
Flow Rate	0.4 mL/min										
Injection Volume	10 μL										
Needle Wash	70% methanol in water										
Gradient Program	<table border="0"> <tr> <td>Stage</td> <td>Length and description</td> </tr> <tr> <td>Initial conditions</td> <td>2 min; ~40–50% B for analyte focusing</td> </tr> <tr> <td>Elution ramp</td> <td>4–5 min; Increase organic to ~95–98% to elute late-retention bisphenols</td> </tr> <tr> <td>Column flush</td> <td>1–2 min; hold at high organic</td> </tr> <tr> <td>Re-equilibration</td> <td>1–2 min; return to initial conditions</td> </tr> </table>	Stage	Length and description	Initial conditions	2 min; ~40–50% B for analyte focusing	Elution ramp	4–5 min; Increase organic to ~95–98% to elute late-retention bisphenols	Column flush	1–2 min; hold at high organic	Re-equilibration	1–2 min; return to initial conditions
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LC/MS parameters

Table 3. LC/MS parameters used for bisphenol analysis.

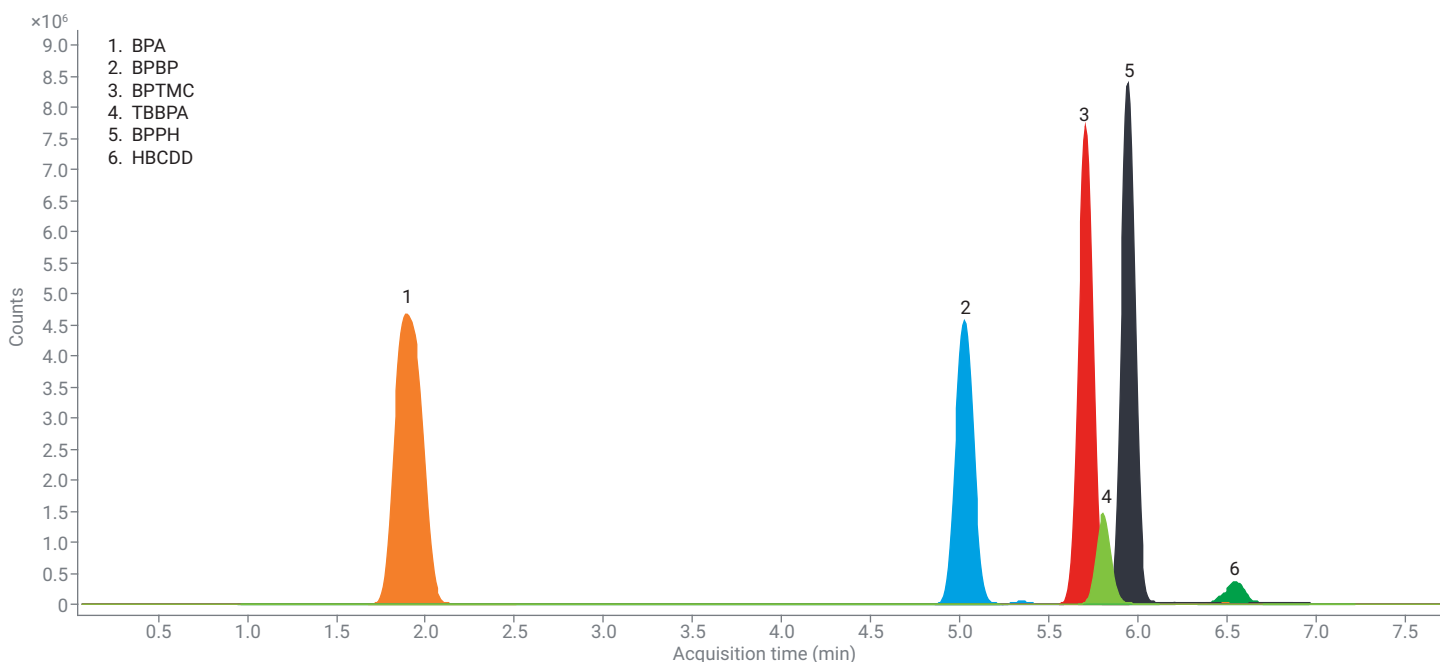
Parameter	Value								
MS	Agilent InfinityLab Pro iQ Plus single quadrupole mass spectrometer								
Ion Source	Agilent Jet Stream Technology ion source (AJS)								
Drying Gas Flow	12 L/min								
Drying Gas Temperature	250 °C								
Nebulizer Pressure	35 psi								
Capillary Voltage	3,500 V								
Sheath Gas Flow	11 L/min								
Sheath Gas Temperature	330 °C								
Nozzle Voltage	1,000 V								
Gain Factor	1								
Time Table	<table border="0"> <tr> <td>Time (min)</td> <td>Valve</td> </tr> <tr> <td>0</td> <td>To waste</td> </tr> <tr> <td>1</td> <td>To MS</td> </tr> <tr> <td>7</td> <td>To waste</td> </tr> </table>	Time (min)	Valve	0	To waste	1	To MS	7	To waste
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0	To waste								
1	To MS								
7	To waste								

Table 4. LC/MS acquisition parameters used for bisphenol analysis.

	Scan Range/SIM (m/z)	Scan/Dwell Time (ms)	Fragmentor V	Polarity
Full Scan	100–650	176	120	Negative
BPA	227	6	120	Negative
BPA-d8	235	6	120	Negative
BPBP	351	6	100	Negative
BPTMC	309	6	190	Negative
TBBPA	541	6	120	Negative
	543	6	120	Negative
	545	6	120	Negative
BPPH	379	6	160	Negative
HBCDD	638.7	6	110	Negative
	640.7	6	110	Negative
	642.7	6	130	Negative
BPZ	267	6	110	Negative

Results and discussion

For each listed analyte in Table 1, selected ion monitoring (SIM) on the Pro iQ mass detector demonstrates excellent performance for the selective detection of bisphenols in dissolved polymer extracts, including species considered analytically challenging (Figure 1). Simultaneous full scan between m/z 100–650 enabled the detection of "new" bisphenol components to be added to the target list or for retrospective analysis of the resulting data.

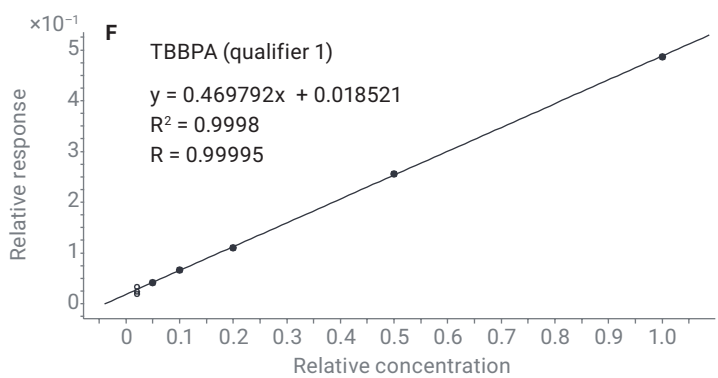
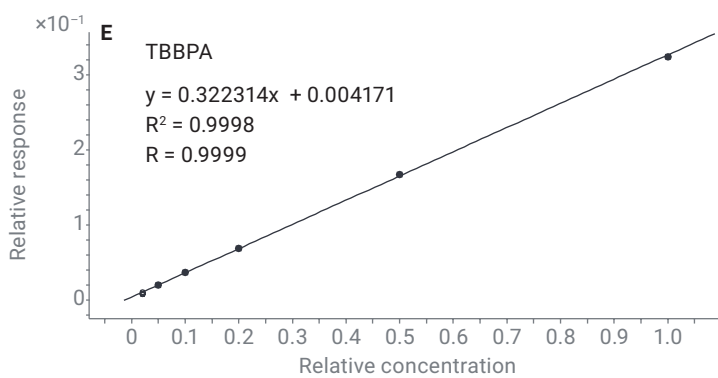
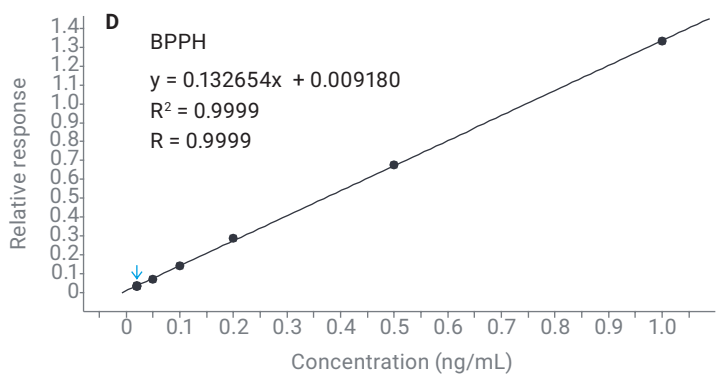
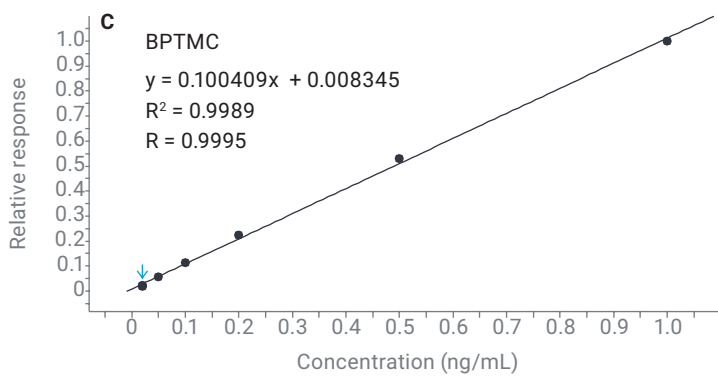
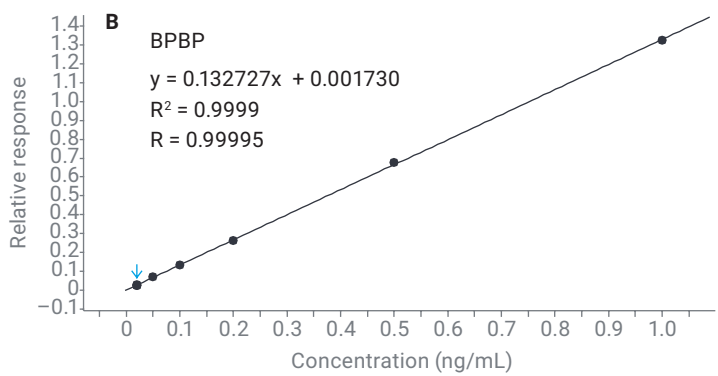
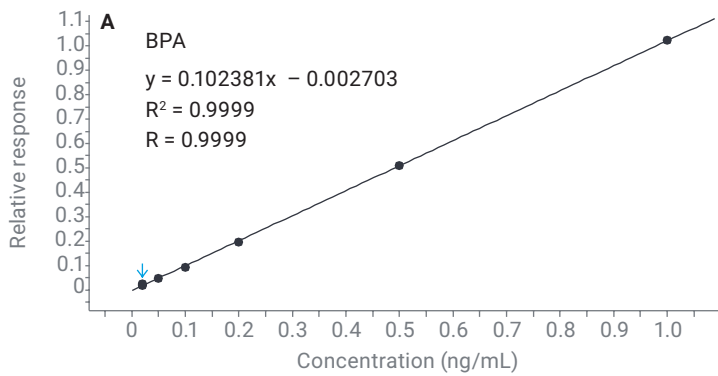
**Figure 1.** Selected ion monitoring (SIM) chromatograms of bisphenols.

Strong linearity ($R^2 \geq 0.9989$) is observed across low-ppb calibration ranges (as low as 0.2–10 ppb) for all analytes and monitored ions (Figures 2A–2J, Table 5). Absolute LC/MS response remains stable across repeated injections, indicating consistent, robust performance (Figure 3). In addition, calculated QC accuracies across injections remained within the predefined acceptance criteria of 70–130% (Figure 4).

Together, these results demonstrate that this method delivers reliable sensitivity, linearity, and quantitative stability for trace-level bisphenol analysis in polymer matrices, while maintaining a workflow compatible with routine quality control screening.

Table 5. Linearity, accuracy, and precision for bisphenol quantitation across repeated injections.

Compound Name	Linear Range (ppb)	R^2	Accuracy (%)	%RSD at LOQ
BPA	0.2–10	0.9999	92–104	9.8
BPBP	0.2–10	0.9999	90–105	11.6
BPTMC	0.2–10	0.9989	93–108	14.8
TBBPA	0.5–10	0.9998	97–102	19.6
TBBPA (Qualifier1)	0.5–10	0.9998	98–101	7.3
TBBPA (Qualifier2)	0.5–10	0.9996	92–106	17.3
BPPH	0.2–10	0.9999	84–109	10.9
HBCDD	0.5–10	0.9999	91–104	14.9
HBCDD (Qualifier1)	0.5–10	0.9995	95–106	19.1
HBCDD (Qualifier2)	0.5–10	0.9995	94–114	18.0



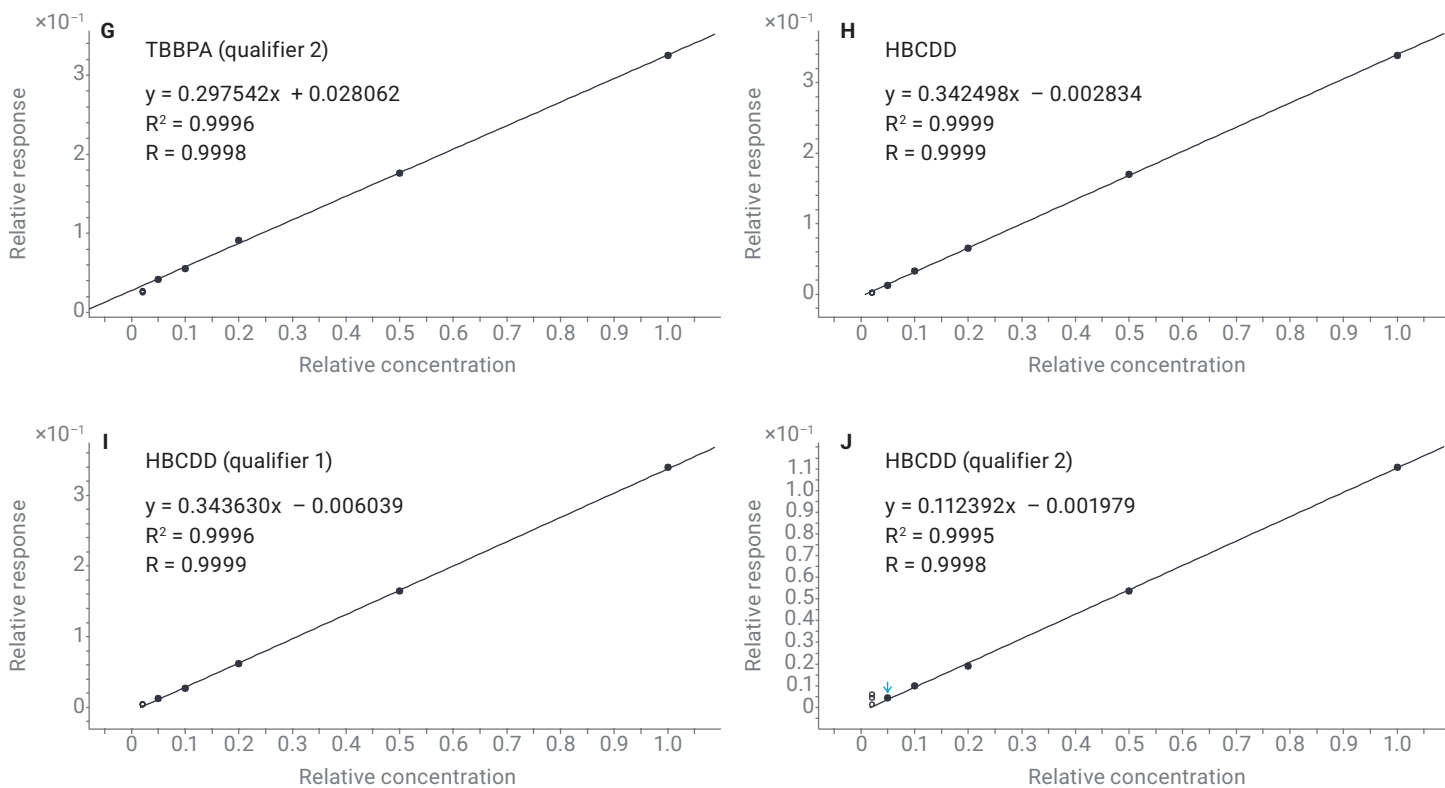


Figure 2. Calibration curves for (A) BPA, (B) BPBP, (C) BPTMC, (D) BPPH, (E) TBBPA, (F) TBBPA (qualifier 1), (G) TBBPA (qualifier 2), (H) HBCDD, (I) HBCDD (qualifier 1), and (J) HBCDD (qualifier 2).

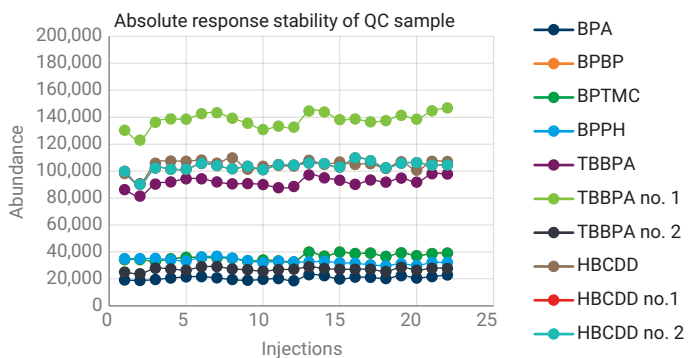


Figure 3. Absolute response stability of bisphenol QC samples across 22 repeated injections over 11 days (two QC injections per day, inserted in the middle and end of a matrix sample sequence).

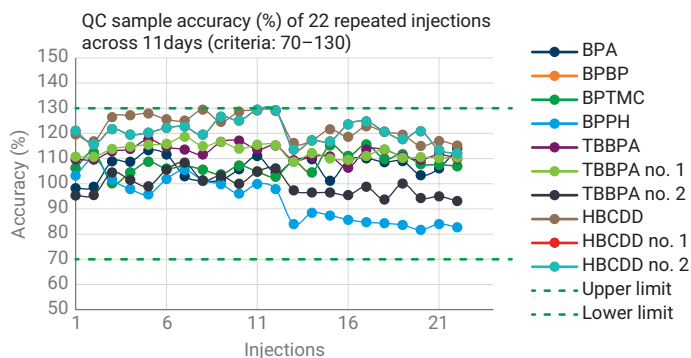


Figure 4. Percent accuracy across repeated injections of bisphenol QC samples.

Conclusion

Under the conditions described in this application note, the Agilent InfinityLab Pro iQ Series mass detector is highly effective at supporting low-ppb bisphenol quantitation across a 0.2–10 ppb calibration range. Data showed a linear response ($R^2 \geq 0.9989$), quantitative accuracy within a $\pm 30\%$ specification range, and stable QC responses over 11 days at 10 ppb. With a general analysis time of ten minutes per sample, this method enables relatively high-throughput screening and routine QC. Collectively, the results indicate that SIM on a single quadrupole mass detector can augment the sensitivity and selectivity of UV-only workflows, while maintaining operational simplicity suitable for routine laboratory use.

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