

FOOD ANALYSIS

HIGH SENSITIVITY ANALYSIS OF TRACE ORGANIC POLLUTANTS IN MUSSEL TISSUE USING THE 7010 TRIPLE QUADRUPOLE MASS SPECTROMETER

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ABSTRACT

This Application Brief demonstrates the higher sensitivity achievable with the Agilent 7010 Triple Quadrupole GC/MS System for the analysis of Organo-chlorine pesticides (OCPs), Polyaromatic Hydrocarbons (PAHs) and Polychlorinated biphenyls (PCBs).

INTRODUCTION

In April 2011, Agilent Technologies published an application note [1] detailing the extraction and analysis of marine mussel tissue for the determination of trace levels of OCPs, PAHs and PCBs. The analysis employed the Agilent 7000B GC/MS/MS system for the routine monitoring of mussel tissue in accordance with the Clean Seas Environmental Monitoring Program (CSEMP) down to the required limit of detection (LOD) of 0.1 µg/Kg.

To comfortably achieve the required LOD, the analysis on the 7000B was performed using a 10 µL solvent vent injection. Agilent introduced the 7010 GC/MS/MS Instrument at ASMS in May 2014. The 7010 incorporates a novel EI High Efficiency Source (HES) and provides the lowest Instrument Detection Limit (IDL), proven at installation, of any GC/MS/MS system currently available.

This Application Brief repeats the analysis documented in the 2011 Application Note and demonstrates a significant performance improvement when comparing the results from the 7000B to the Agilent 7010 Triple Quadrupole GC/MS System. Not only were like-for-like 10 µL solvent vent mode injections compared, but also 0.5 µL injections on the 7010 system using cold splitless injection mode..



GC/MS Configuration

- 7693A Automated Liquid Sampler
- 7890B gas chromatograph with CO₂ cooled Multimode Inlet (MMI) and pressure controlled tee for post-column back flush
- Agilent 7010 Triple Quadrupole GC/MS System



Agilent Technologies

Analysis Conditions

Conditions were exactly as documented in the referenced application note. The only deviations were the conditions for the 0.5 μL cold splitless injections on the Agilent 7010 Triple Quadrupole GC/MS System:

Injection volume : 0.5 μL from a 5 μL syringe

Injection mode : Cold splitless

Injection temperature : 50 deg C (0.02 minutes), then 600 deg C/min to 325 deg C

RESULTS

Comparative Responses

To demonstrate the comparative performance of the 7000B and the Agilent 7010 Triple Quadrupole GC/MS System, the responses of the 0.4 $\text{pg}/\mu\text{L}$ calibration standard injected on the 7000B (10 μL solvent vent) and the 7010 (10 μL solvent vent and 0.5 μL cold splitless) for the quantitative transitions for the four HCH isomers; *op*- and *pp*-DDE; PCB-153 and PCB-138; and Benzo(e)pyrene, Benzo(a)pyrene and Perylene are shown in Figures 1, 2, 3 and 4, respectively.

Note that the analyte peaks elute a few seconds earlier on the 7000B system but this aids clarity for comparison purposes.

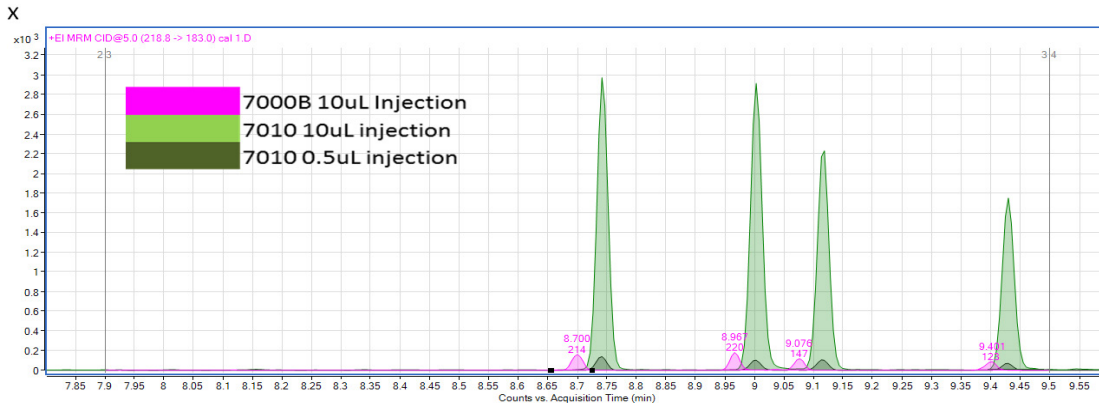


Figure 1. Comparative responses of the 4 HCH isomers on the 7000B and Agilent 7010 Triple Quadrupole GC/MS System for the 0.4 $\text{pg}/\mu\text{L}$ calibration standard.

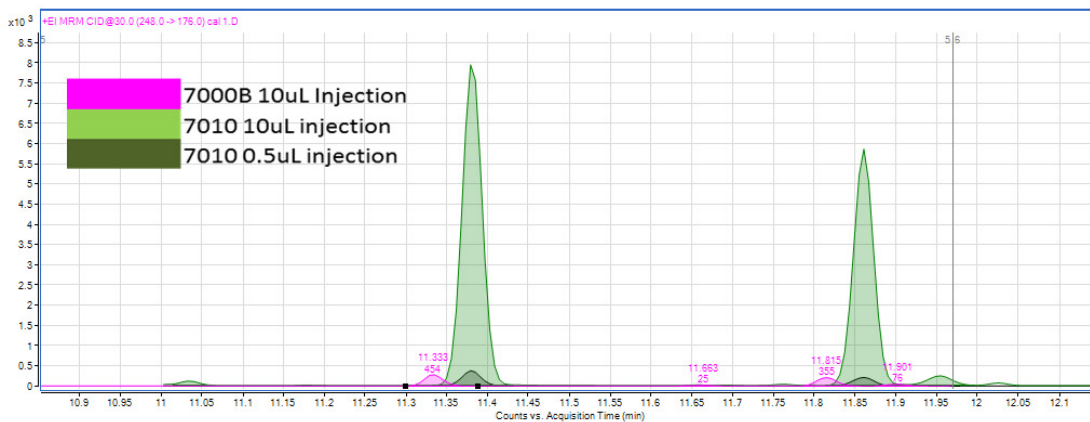


Figure 2. Comparative responses of *op*- and *pp*-DDE on the 7000B and 7010 GC/MS/MS systems for the 0.4 $\text{pg}/\mu\text{L}$ calibration standard.

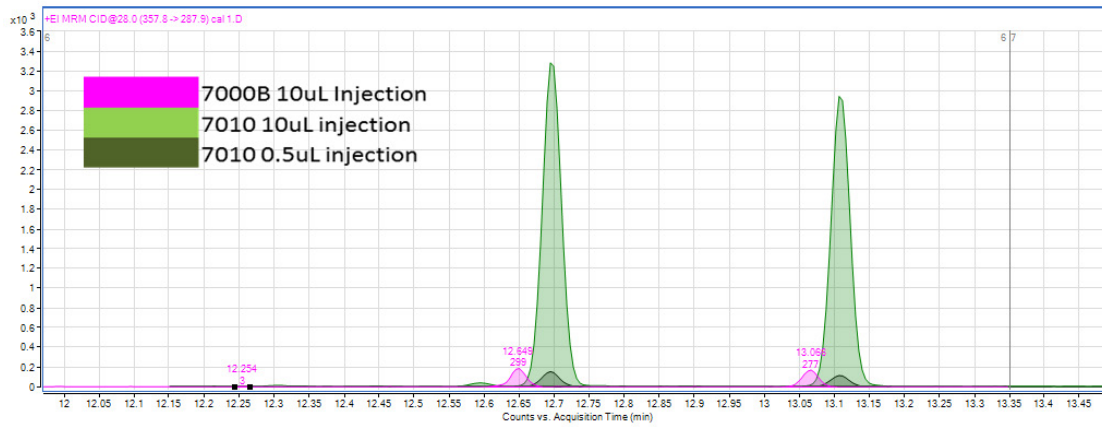


Figure 3. Comparative responses of PCB-153 and PCB-138 on the 7000B and Agilent 7010 Triple Quadrupole GC/MS System for the 0.4 pg/μL calibration standard.

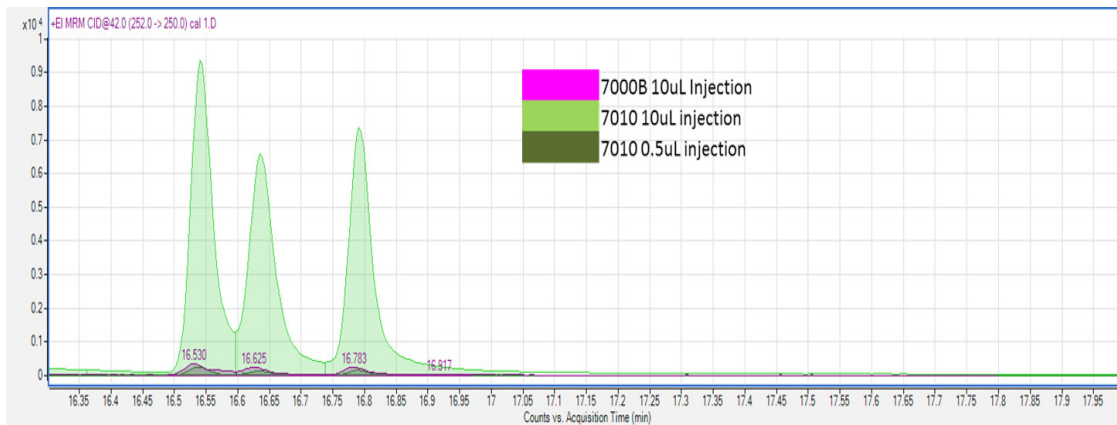


Figure 4. Comparative responses of Benzo(e)pyrene, Benzo(a)pyrene and Perylene on the 7000B and Agilent 7010 Triple Quadrupole GC/MS System for the 0.4 pg/μL calibration standard.

Comparative Calibration Curves

Example calibration curves for g-HCH, PCB-138 and Benzo(a)pyrene are shown in Figures 5, 6 and 7, respectively. The calibration curves for the 7000B are over the range 0.4 – 200 pg/μL (10μL solvent vent injection). For the 7010 the calibration curves are over the range 0.04 – 400 pg/μL (0.5μL cold splitless injection).

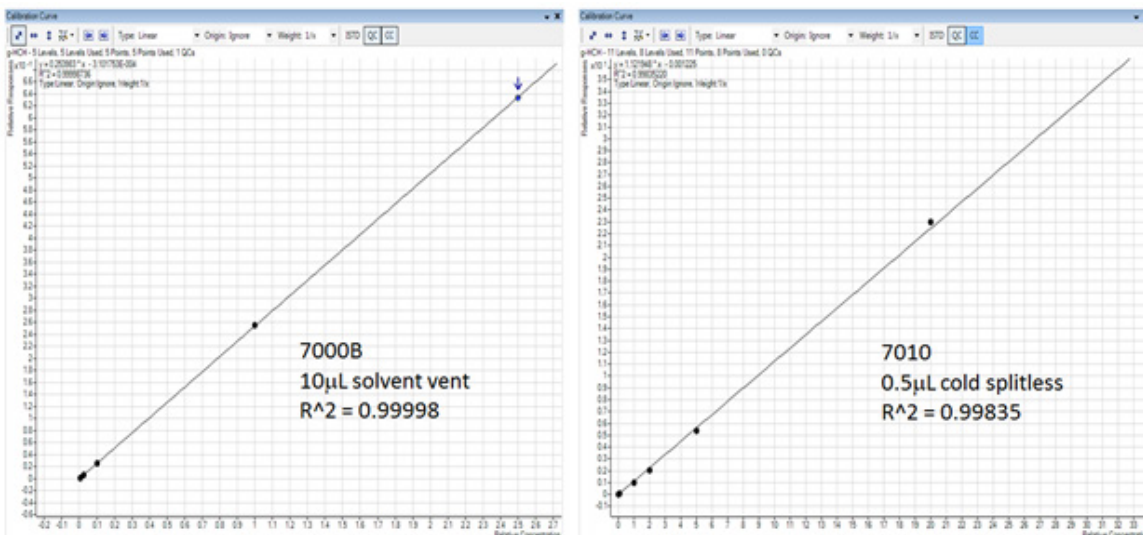


Figure 5. Calibration curves for g-HCH. 7000B calibration range 0.4 – 200 pg/μL; 7010 calibration range 0.04 – 400 pg/μL

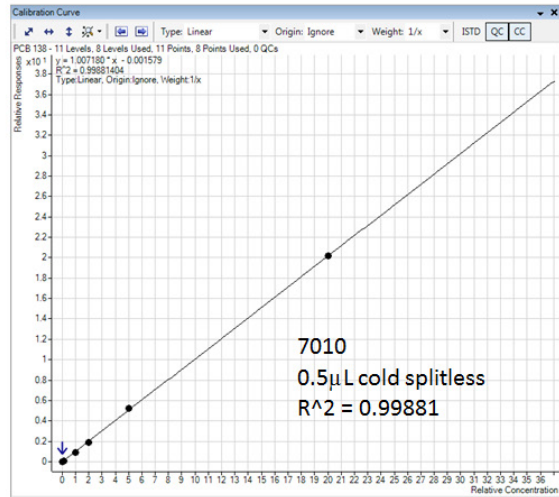
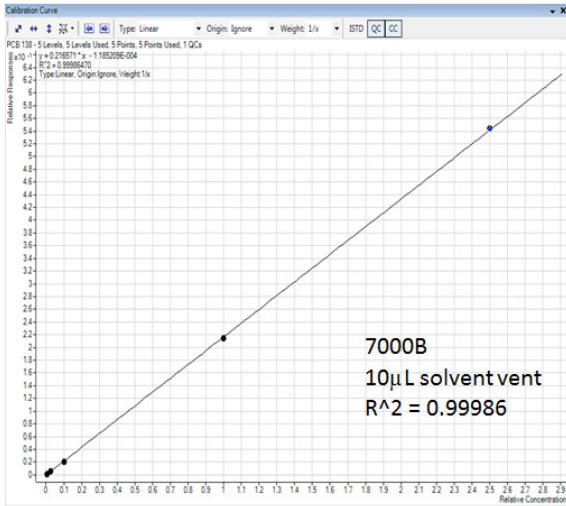


Figure 6. Calibration curves for PCB-138. 7000B calibration range 0.4 – 200 pg/ μ L; 7010 calibration range 0.04 – 400 pg/ μ L

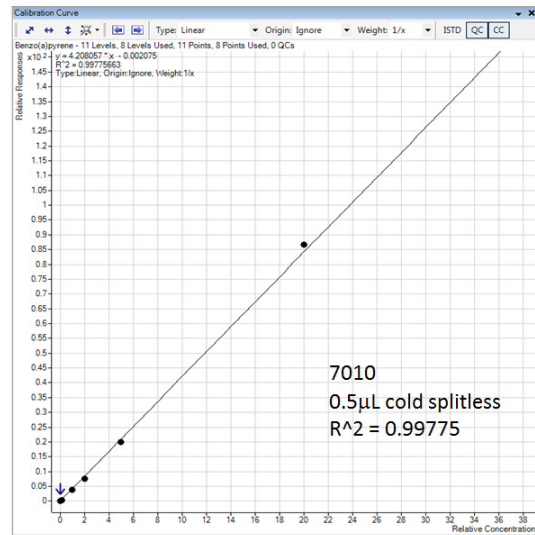
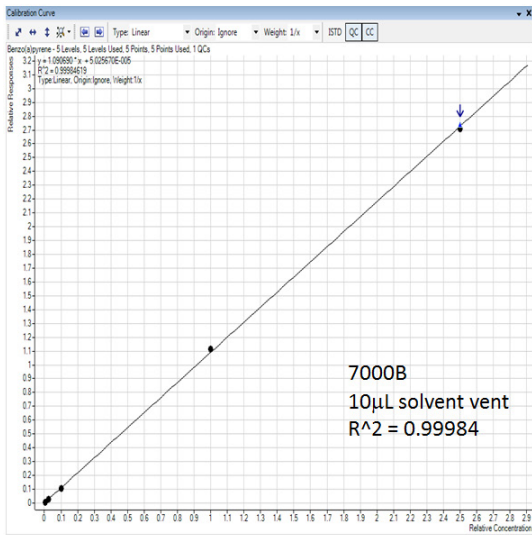


Figure 7. Calibration curves for Benzo(a)pyrene. 7000B calibration range 0.4 – 200 pg/ μ L; 7010 calibration range 0.04 – 400 pg/ μ L

CONCLUSION

Under directly comparative analysis conditions, the Agilent 7010 Triple Quadrupole GC/MS System gave responses in the order of 20x those obtained with the 7000B. For many analytes in this comparison, the response for the quantitative ion on the 7010 for a 0.5µL cold splitless injection was close to, or greater than, the response for the same analyte injected with a 10µL solvent vent injection on the 7000B.

The significant increase in sensitivity of the Agilent 7010 Triple Quadrupole GC/MS System gives analysts more choices in how to improve the analytical performance of their GC/MS/MS systems:

- Keep the amount of sample extracted the same, but inject less sample volume in to the GC/MS/MS thus decreasing the amount of matrix injected with each sample
- Decrease the amount of sample extracted, keeping the injection volume the same. This can result in savings related to sample prep such as solvents, SPE consumables etc.

REFERENCES

[1] Determination of Chemical Contaminants in Marine Shellfish using the Agilent 7000 Triple Quadrupole GC/MS System; Agilent Application note : 5990-7714EN, April, 2011.



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