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응용 자료

Systematic Toxicological Screening Using the ACQUITY UPLC I-Class/Xevo TQ-S micro

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For forensic toxicology use only.

This is an Application Brief and does not contain a detailed Experimental section.

Abstract

To evaluate the performance of previously published methodology using the Xevo TQ-S micro.

Benefits

A simple, sensitive UPLC-MS method for forensic toxicology screening of compounds in various biological matrices.

Introduction

Forensic toxicology laboratories require reliable screening techniques that can detect a wide variety of toxicants in highly complex biological matrices, such as ante and postmortem specimens. The original Waters systematic toxicological screening method used the Waters Alliance 2695 Separations Module in conjunction with the Waters/Micromass ZQ Single Quadrupole Mass Spectrometer.[1] In 2009, this approach was migrated to the ACQUITY TQD System to deliver the same comprehensive toxicological screening capabilities in half the time.[2] The solution was further developed over subsequent years to provide a full scan screening method and associated toxicology libraries, capable of screening for >950 drug substances and metabolites in 15 minutes. This method has been successfully and routinely used in toxicology laboratories worldwide.[3,4] Owing to the popularity of this methodology, in 2013, this solution was transferred to the ACQUITY UPLC I-Class System and Xevo TQD.[5] The release of the Xevo TQ-S micro allows for further evolution of this successful solution.[6]

Experimental

Test substance

Bio-Rad S10 Liquichek Urine Toxicology Quality Control human urine was obtained from Bio-Rad, Hemel Hempstead, UK.

Sample preparation

The reference urine (250 µL) was extracted using a simple liquid–liquid extraction protocol. Following removal of the upper organic layer and evaporation of the organic solvent, samples were reconstituted in 50 µL of mobile phase A and transferred to a Waters Total Recovery vial.

LC conditions

System:	ACQUITY UPLC I-Class
Column:	ACQUITY UPLC HSS C_{18}, 100Å, 1.8 µm, 2.1 mm x 150 mm
Column temp.:	50 °C
Sample temp.:	10 °C
Injection volume:	10 µL
Wash solvent:	Acetonitrile/water (95:5 v/v)
Purge solvent:	5 mM ammonium formate pH 3.0
Flow rate:	0.4 mL/min
Mobile phase A:	5 mM ammonium formate pH 3.0
Mobile phase B:	Acetonitrile containing 0.1% formic acid

MS conditions

MS system:	Xevo TQ-S micro
Ionization mode:	ESI+
Capillary voltage:	3.0 KV

Source temp.:	150 °C
Desolvation temp.:	400 °C
Desolvation gas:	800 L/Hr
Cone gas:	20 L/Hr
Cone voltages:	50 V to 125 V in 15 V increments (preconfigured in provided MS method)
Acquisition range:	*m/z* 80–650

Results and Discussion

Combining the ACQUITY UPLC I-Class System with the Xevo TQ-S micro allows this established UPLC-MS screening methodology to be used on the latest generation of Waters mass spectrometers.

Figure 1. ACQUITY UPLC I-Class System and Xevo TQ-S micro.

The technique uses in-source collision induced fragmentation at various cone voltages followed by library matching using the ChromaLynx Application Manager. Previous analysis of mixtures of drug substances using the Xevo TQ-S micro indicated that the cone voltages required to produce comparable fragmentation patterns were higher than those used with the previous generation mass spectrometers (e.g. Xevo TQD), therefore modified libraries were prepared and evaluated. Figure 2 shows a comparison of spectra obtained on the two platforms, highlighting the additional 30 V applied to the cone for each function on the Xevo TQ-S micro.

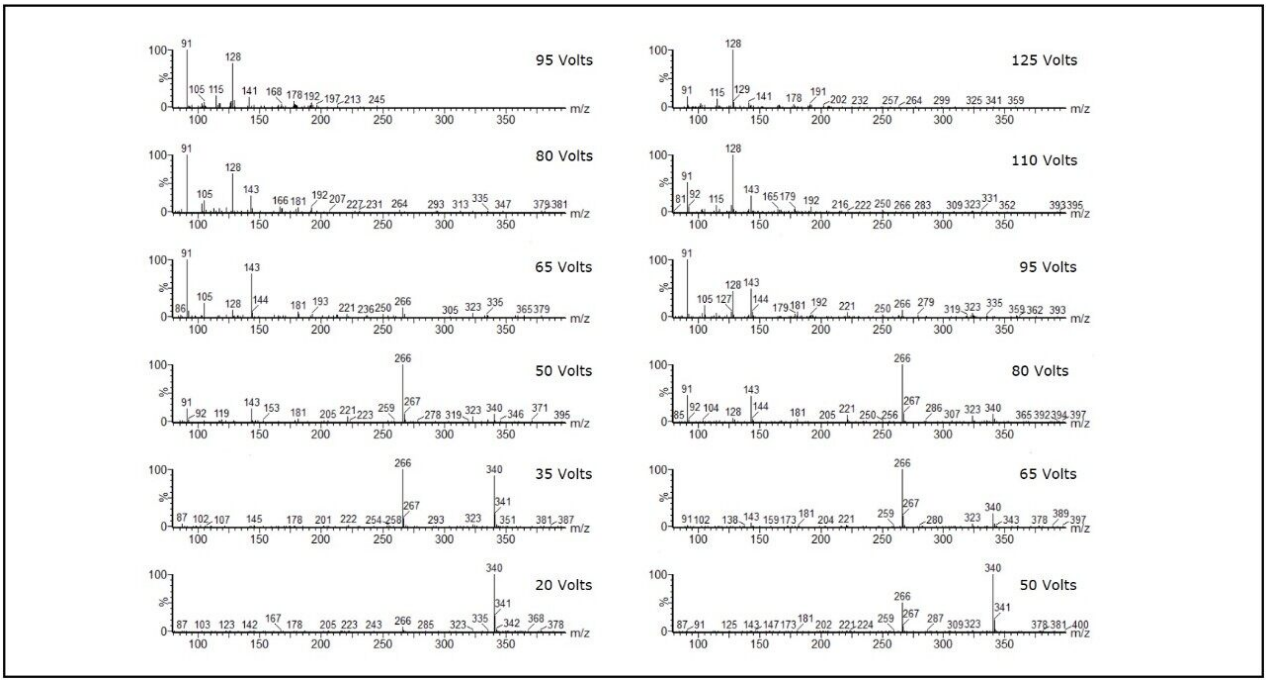

Figure 2. Comparison between the fragmentation patterns obtained using the Xevo TQD (left panel) and the Xevo TQ-S micro (right panel) for propoxyphene in the Bio-Rad S10 Liquichek Urine Toxicology Quality Control reference urine. the Xevo TQD (left panel) and the Xevo TQ-S micro (right panel) for propoxyphene in the Bio-Rad S10 Liquichek Urine Toxicology Quality Control reference urine.

A selection of the information available in the ChromaLynx results browser for the extracted urine sample is shown in Figure 3.

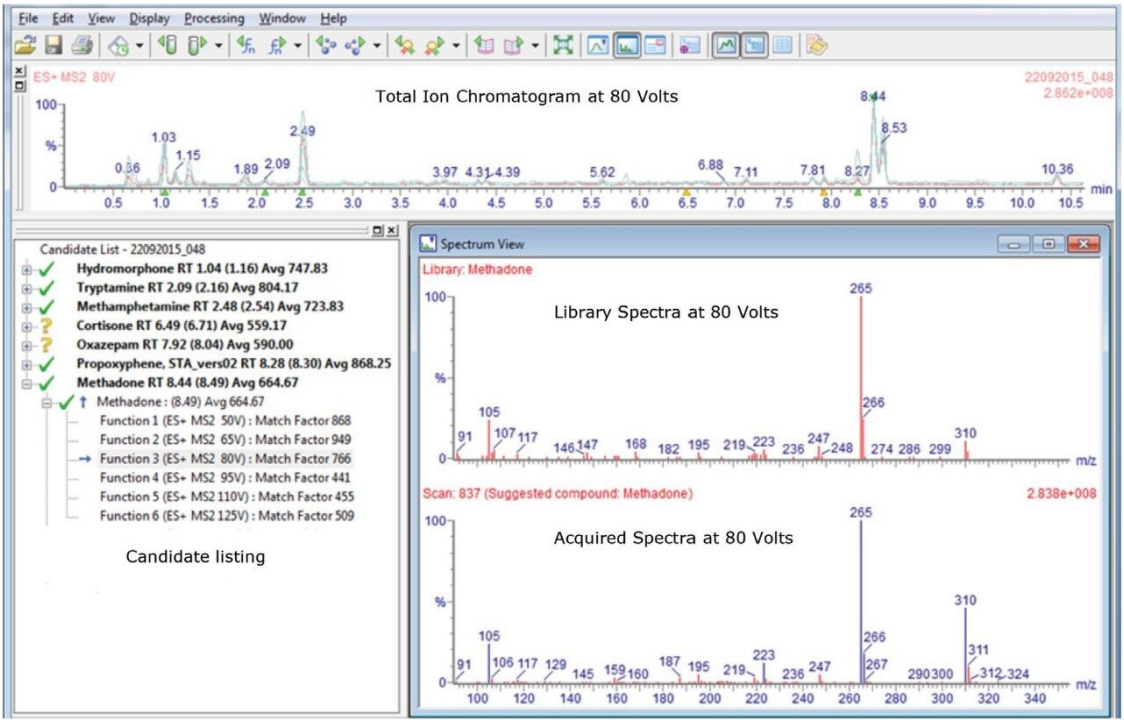

Figure 3. ChromaLynx browser displaying selected information for the analysis of the Bio-Rad S10 Liquichek Urine Toxicology Quality Control urine, highlighting the identification of methadone.

Conclusion

The Xevo TQ-S micro is a tandem mass spectrometer designed to provide rapid, reliable, and reproducible data to deliver consistent low levels of quantitatio over a wide dynamic range. We have shown that the highly successful systematic toxicological screening method can be transferred to the Xevo TQ-S micro by altering the acquisition method to take into account the different energy applied in the source. In conjunction with amended libraries, the Xevo TQ-S micro platform performs to the same high level as previous Waters MS platforms. The Xevo TQ-S micro is a highly versatile instrument for use in toxicology, providing the user with both broad qualitative full scan MS and targeted MRM-based screening capabilities as well as high sensitivity quantitative detection on the same instrument platform.

References

1. Humbert L, Lhermitte M, and Grisel F. General Unknown Screening for Drugs in Biological Samples by LC/MS. 2007. Waters Application Note, 720001552EN.
2. Lee R, Roberts M, Paccou A, and Wood M. Development of a New UPLC/MS Method for Systematic Toxicological Analysis. 2009. Waters Application Note, 720002905EN.
3. Humbert L, Grisel F, Richeval C, and Lhermitte M. Screening of Xenobiotics by Ultra-Performance Liquid Chromatography-Mass Spectrometry Using In-Source Fragmentation at Increasing Cone Voltages: Library Constitution and an Evaluation of Spectral Stability. *Journal of Analytical Toxicology* 2010; 34: 571–580.
4. Rosano T, Wood M, and Swift T. Postmortem Drug Screening by Non-targeted and Targeted Ultra-Performance Liquid Chromatography-Mass Spectrometry Technology. *Journal of Analytical Toxicology* 2011; 35: 411–423.
5. Roberts M and Wood M. Forensic Toxicology Screening Using the ACQUITY UPLC I-Class System with the Xevo TQD. 2013. Waters Application Note, 720004602EN.
6. Xevo TQ-S micro Product Brochure. 2014. Waters Marketing Brochure, 720005046EN.

This is a proof of principle demonstration of an analytical method, which may include examples of typical results that can be achieved with the stated configuration. This method represents a basic starting point from which users should perform their own in-house validation.

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ChromaLynx <https://www.waters.com/513759>

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