Screen More Drugs with the Agilent GC/MS Toxicology Analyzer with a High Efficiency Source

Application Note

Forensic Toxicology

Authors

Melissa Churley and

Luis Cuadra-Rodriguez

Agilent Technologies, Inc.

Introduction

Broad-range screening for drugs in biological samples requires full-spectrum identification confirmation for an unlimited number of targets, as well as spectral identification of nontargets. The Agilent GC/MS Toxicology Analyzer uses Deconvolution Reporting Software (DRS), the Forensic Toxicology Database Library and, when configured with the Agilent 5977B Mass Selective Detector, a high efficiency source (HES). In combination, these technologies screen a greater number of targets at low concentrations while reducing analysis time.

Agilent Technologies

Screen at Lower Concentrations with the High Efficiency Source

Improved screening capability with the HES was demonstrated using human serum, as seen in Table 1. Negative serum, 2 mL, was extracted using the Agilent Bond Elut Certify general drug screen method M2721 [1]. The extract was reconstituted in 0.1 mL methanol and spiked with the GC/MS Toxicology Checkout Mixture (p/n 5190-0471) to yield 10 to 1,000 ng/mL (in vial) of underivatized standards.

Table 1. Lowest injected amount of drugs in spiked serum extract detected with AMDIS using a minimum match factor of 75.

	HES (HES autotune)			Extractor (etune)		
	Minimum amount injected (pg) AMDIS score > 75	AMDIS Score	Equivalent concentration in serum (ng/mL)*	Minimum amount injected (pg) AMDIS score > 75	AMDIS Score	Equivalent concentration in serum (ng/mL)*
Amphetamine	500	94	25	500	75	25
Nicotine	50	92	2.5	50	81	2.5
MDA	500	77	25	500	76	25
MDMA	500	85	25	500	83	25
MDEA	10	76	0.5	500	97	25
Meperidine	10	85	0.5	50	85	2.5
Phencyclidine	50	83	2.5	500	90	25
Methadone	50	87	2.5	500	89	25
Cocaine	50	77	2.5	500	94	25
SKF-525a	50	77	2.5	100	81	5
Codeine	100	88	5	500	90	25
Diazepam	50	90	2.5	50	81	2.5
Hydrocodone	100	91	5	500	90	25
Tetrahydrocannabinol	50	75	2.5	100	78	5
Oxycodone	50	80	2.5	500	83	25
Flunitrazepam	500	88	25	500	75	25
Diacetylmorphine	100	79	5	1,000	83	25
Fentanyl	50	85	2.5	50	77	2.5
Alprazolam	100	76	5	1,000	85	50
Verapamil	50	84	2.5	500	90	25
Strychnine	500	86	25	500	77	25
Trazodone**	> 1,000	(71)	> 50	> 1,000	(68)	> 50

Drugs found at lower concentrations using the HES versus the extractor source are highlighted. Tuning conditions are in parentheses.

* Assumes 100% recovery from a 2 mL serum sample, reconstitution of extract in 0.1 mL and 1 µL injected.

** The amount of injected trazodone required to achieve a score of 75 exceeds 1,000 pg.

The benzodiazepines oxazepam, lorazepam, temazepam, nitrazepam, and clonazepam were not found at 1,000 pg.

The synthetic opioid fentanyl was added to the checkout mixture. Drug target compounds screened in serum, such as methadone, cocaine, hydrocodone, THC and others, can now be positively identified using full-scan mode at lower concentration (for example, 5 ng/mL for hydrocodone). The HES maximizes the number of ions that are created in the source and transferred into the quadrupole analyzer, which equates to more signal, and thus better sensitivity (Figure 1). This increase in response translates into more drug targets found during the screening process with good library matches.

NIST Searchable Spectra with Isomer Differentiation

The forensic chemist is required to identify the drug of abuse with the highest degree of scientific certainty. To some extent, the issue of cocaine isomer determination has reinforced the requirement for methods of high specificity [2]. The 5977B GC/MSD with HES allows for the strict spectral integrity that is required to differentiate between cocaine isomers and obtain NIST searchable spectra for detected drugs (Figure 2).

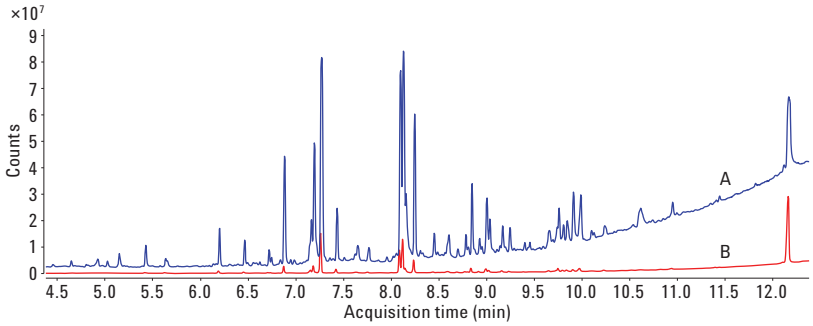

Figure 1. Overlay of TICs of 500 pg standard in serum using A) HES autotune, and B) extractor source etune.

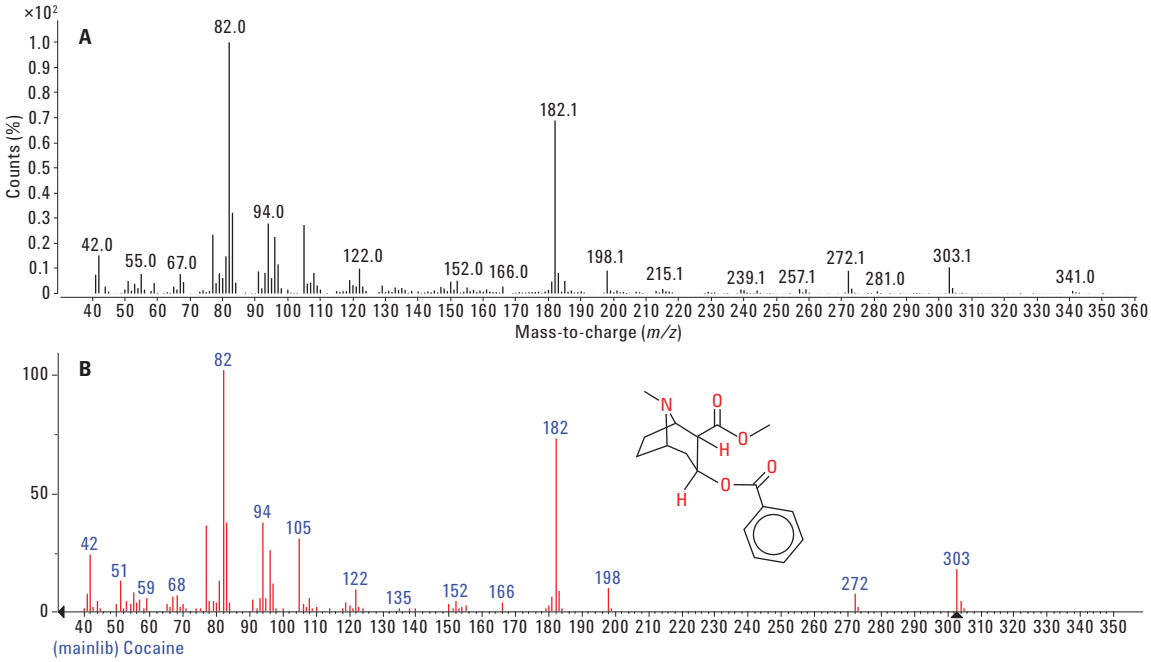

Figure 2. Mass spectrum of 100 pg cocaine spiked in serum (A) compared with NIST spectrum (B). Cocaine is the first hit in NIST. The match factor is 810 (good) [3], and is differentiated from pseudococaine, which has a match factor of 788 (fair). The equivalent concentration is 5 ng/mL based on complete recovery. Excellent NIST library matches (≥900) for cocaine as a first hit are returned at concentrations above this level.

Conclusions

The high efficiency source of the Agilent 5977B GC/MSD greatly enhances the signal of drug targets. Resulting spectra are classical and NIST searchable. When combined with Deconvolution Reporting Software, detection levels during screen analysis approach those using SIM mode with derivatization.

Acknowledgements

The authors thank Bruce Quimby and Fred Feyerherm for productive discussions surrounding this work and also Nathan Contino for his contributions.

References

1. Anon. *Agilent Bond Elut Certify and Certify II Methods Manua*l; Agilent Technologies, Inc. Publication number 5991-4939EN, **2014**. http://www.agilent.com/cs/library/brochures/Bond%20Elut%20Certify%20MethodsManual.pdf
2. Schlesinger, H. L. Topics in the chemistry of cocaine. *B. Narcotics* **1985**, *1*, 63-78. United Nations Office on Drugs and Crime, Vienna, Austria. https://www.unodc.org/unodc/en/data- and-analysis/bulletin/bulletin_1985-01-01_1_page006.html
3. Anon. NIST Standard Reference Database 1A, NIST/EPA/NIH Mass Spectral Library (NIST 14) and NIST Mass Spectral Search Program (Version 2.2), User's Guide. National Institute of Standards and Technology, U.S. Department of Commerce, Gaithersburg, MD, USA. http://www.nist.gov/srd/upload/NIST1aVer22Man.pdf

For More Information

These data represent typical results. For more information on our products and services, visit our Web site at www.agilent.com/chem.

www.agilent.com/chem

For Forensic Use only.
Information is subject to change without notice.

Agilent shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

© Agilent Technologies, Inc., 2015
Printed in the USA
October 14, 2015
5991-6294EN

Agilent Technologies