

Forensic Applications Using a New 5% Diphenylpolysiloxane Stationary Phase for Gas Chromatography

Kristi J. Sellers, Rick Lake, Gary Stidsen and Neil Mosesman

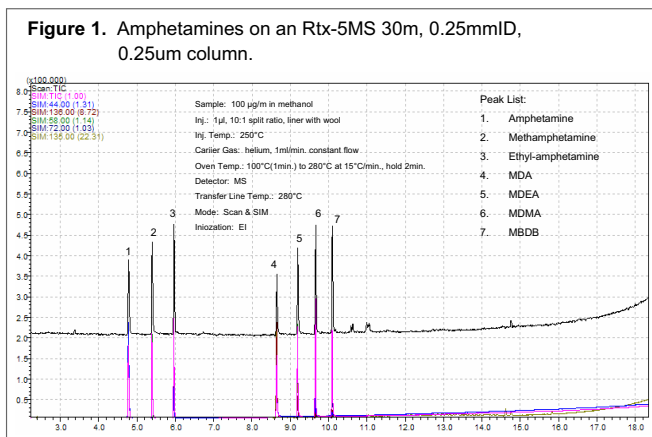
The majority of forensic drug confirmations are analyzed using gas chromatography-mass spectrometry (GC-MS). Forensic drugs that are analyzed using this confirmation method include marijuana, lysergic acid diethylamide (LSD), phencyclidine (PCP), opiates, amphetamines, cocaine, benzodiazepines, barbiturates and gamma-hydroxybutyrate (GHB). A 5% diphenylpolysiloxane is the typical column of choice throughout the toxicological drug testing industry for these analyses. A new GC column deactivation technology has been developed specifically for GC-MS applications. This new 5% diphenylpolysiloxane GC column exhibits low bleed and high inertness for high temperature drug applications. Forensic drug standards at varying concentrations were analyzed using the new 5% diphenylpolysiloxane GC column (30m, 0.25mmID, 0.25µm). These applications illustrate the low bleed and high inertness of this new GC-MS column.

Experimental

For this study, a Shimadzu GC-MS QP2010 Plus was used to analyze amphetamines, cannabinoids, gamma-hydroxybutyrate, barbiturates and benzodiazepines. Standards were prepared at concentrations ranging from 25-1000µg/mL, and on-column concentrations were in the 1-250ng range. Using the Rtx-5MS 30m, 0.25mmID, 0.25µm column, GC-MS methods were developed that maximized resolution while minimizing analysis time. The resulting clinical and forensic chromatography methods are shown using this column, and basic information about the application is included.

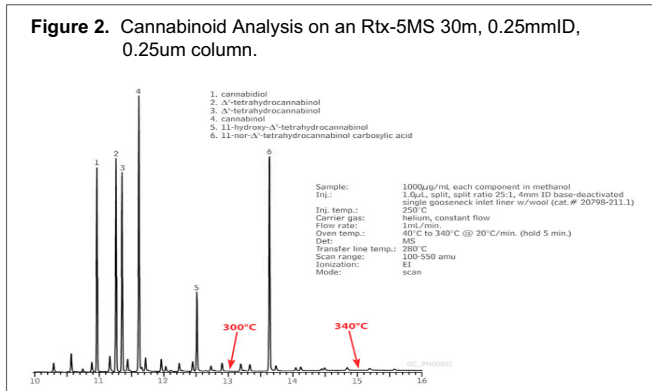
Amphetamines

The abuse of amphetamines is worldwide and, thus, is encountered often in toxicological investigations. Screening for amphetamines in urine is typically accomplished by immunoassay. Positive samples are then confirmed by GC-MS.¹ The GC-MS column, Rtx-5MS, and method developed in this example demonstrates symmetrical peak shapes at 10ng on-column, and an analysis time of about 10 minutes. (Figure 1). Scan and SIM data were collected simultaneously and are also shown in Figure 1.



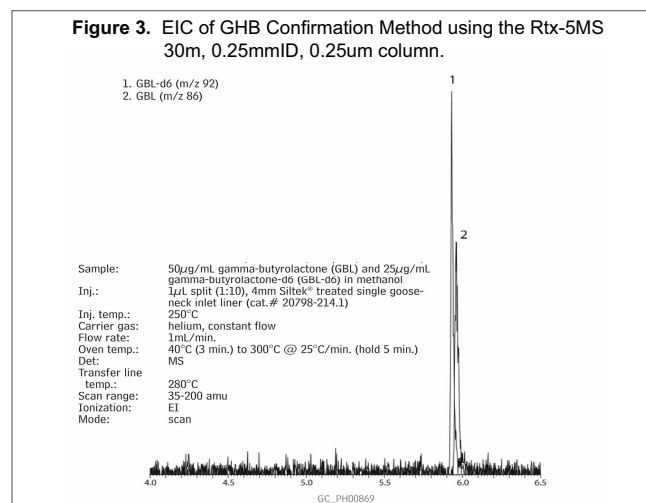
Cannabinoids

Marijuana's common abuse stems from its widespread availability and because it is inexpensive compared to other abused drugs, such as cocaine and heroin. Marijuana use is typically determined by screening for its major metabolite in urine, 11-nor-9-carboxy- Δ^2 -tetrahydrocannabinol (carboxy-THC) using an immunoassay.² When screening results are positive, GC-MS is employed for confirmation using a 5% diphenyl-95% dimethylpolysiloxane stationary phase. Derivatized cannabinoids are shown in Figure 2 using the Rtx-5MS with an analysis time of less than 15 minutes and low bleed at 340°C.



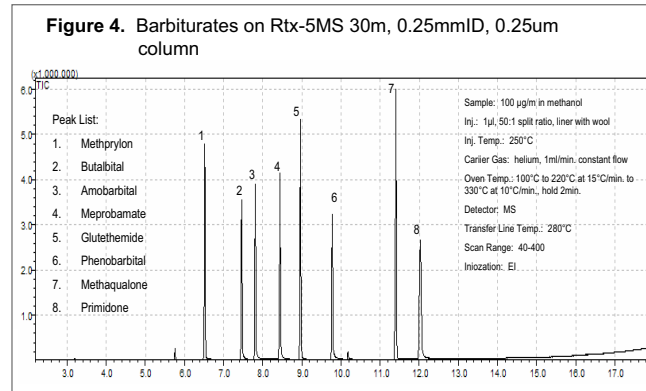
Gamma-hydroxybutyrate (GHB)

Currently, GHB is regulated as a federally controlled Schedule I drug. The rise in the use of GHB and GHB-type products as recreational drugs is primarily due to their euphoric and sedative properties. 1,4-butanediol and gamma-hydroxybutyrolactone (GBL) are quickly metabolized to GHB after ingestion and are analyzed as such. Because GHB is endogenous in humans and has a half-life of one hour or less after ingestion, it is very important to collect biofluids quickly for toxicological investigation. Analytical methods for GHB usually employ GC and MS for quantification and confirmation. Methodology developed by the FBI Chemistry Unit establishes a headspace GC-FID screening procedure followed by confirmation and quantification by headspace GC-MS.³ We have adapted the Rtx-BAC1 and Rtx-BAC2 columns to the screening method and the Rtx-5MS column to the confirmation method. Figure 3 shows the confirmation method using the Rtx-5MS column.



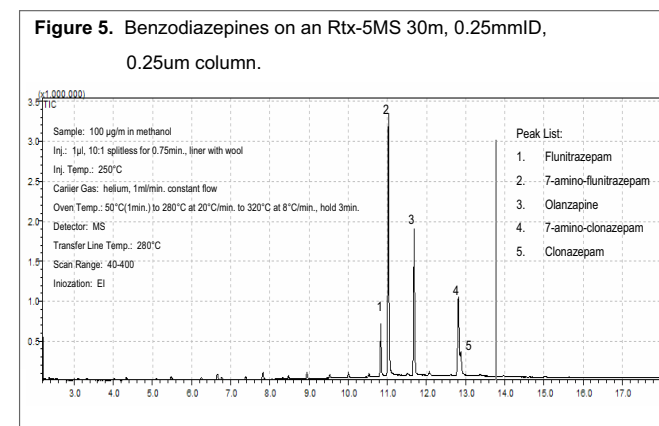
Barbiturates

Barbiturates are typically determined for forensic and therapeutic reasons. These popular sedative hypnotics are identified and quantified using GC-MS after positive screening results are obtained. Figure 4 shows underivatized barbiturates analyzed on the Rtx-5MS column. Low bleed at 330°C, reliable peak shape and a short analysis time are produced.



Benzodiazepines

Benzodiazepines have hypnotic, tranquilizing and anticonvulsive properties and are commonly found in toxicology testing. GC-MS is one analytical technique that can be employed to identify and quantify benzodiazepines in biological matrices.⁴ Figure 5 exhibits a few parent drugs and their metabolites. The Rtx-5MS column used in the analysis provides reliable peak shape and low bleed at high temperatures, above 300°C. The analysis shows an analysis time of about 13 minutes and excellent response at 10ng on-column.



Conclusions

For many forensic applications, only one GC capillary column is needed, a 5% diphenyl-95% dimethylpolysiloxane stationary phase. This GC column is widely used for most drug analysis methods (acidic, neutral and basic drugs) and is considered the gold standard for those methods. The data shown in the above applications verifies that this column is ideal for most forensic drug analyses.

References

- Huang, Z. and S. Zhang, *J. Chrom. B.*, 792 (2003), pp. 241-247.
- F. Smith and J. Siegel, *Handbook of Forensic Drug Analysis*, Elsevier Academic Press, 2005, pp. 98-151.
- LeBeau, M.A., M.A. Montgomery, M.L. Miller, and S.G. Burmeister, *J. Anal. Toxicol.* 24 (6): 421-428 (Sept. 2000).
- He, W., N. Parissis, and T. Kiratzidis, *J. Forensic Sci.*, 43 (5): 1061-1067 (1998).

Clinical/Forensic Applications