Analysis of Atrazine in Drinking Water at the ppb Level Using New Agilent Reversed Phase LC Columns

Application

Environmental

Author

Rongjie Fu
Agilent Technologies, Inc.
412 Ying Lun Road
Pu Dong, Shanghai 200131
China

Abstract

The herbicide atrazine was analyzed in drinking water samples using the new Agilent reversed phase columns, Agilent TC-C18(2) and HC-C18(2). These columns provided good resolution from interfering or coeluting compounds as well as highly symmetrical peaks and a high performance result. The limit of detection (LOD) is 0.5 ng, which meets China's drinking water standards. The method on these new columns is very suitable for atrazine analysis in drinking water.

Introduction

Atrazine, which is one of the triazine herbicides (structure shown in Figure 1), is a widely used herbicide for control of broadleaf and grassy weeds in the U.S. and some other countries. Atrazine is highly persistent in soil and is leached directly from the soil into groundwater, surface water, and drinking water. Atrazine has potential short-term and long-term health effects. Short-term potential health effects include heart, lung, and kidney congestion, as well as low blood pressure and muscle spasms. Potential health effects from longterm exposure at low levels include weight loss, retinal degradation, cardiovascular damage, and, potentially, even cancer. Therefore, actions have been taken to control this compound and require measuring amounts in drinking water. The maximum contamination level (MCL) regulated by the EPA (U.S. Environmental Protection Agency) is 3 ppb [1]. In China's new drinking water standards, the MCL is set at 2 ppb [2].

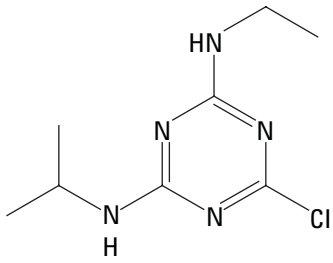

Figure 1. Structure of atrazine.

The HPLC method shown here was developed to meet the requirements for atrazine analysis in drinking water in China's new drinking water standards. We chose AccuBond C18 SPE sample cartridges for sample preparation instead of traditional liquid-liquid extraction because of the concentration effect on the atrazine. After water enrichment, the sample was then analyzed with Agilent TC-C18(2) and HC-C18(2) columns, which provide symmetrical peak shape and high sensitivity. It's a simple, fast, and high recovery method that is fit for quality control of drinking water.

Experimental

Standards for Calibration Curve

Accurately weigh 0.01 g atrazine standard and dissolve in methanol to a volume of 100 mL. This is a stock standard solution of 100 µg/mL. Dilute aliquots of the stock standard solution with

methanol into a series of standard solutions of 0, 0.05, 0.1, 0.5, 1.0, and 5 µg/mL.

Sample Preparation

We used the sample preparation method described by Yang et al. [3]. An AccuBond C18 SPE cartridge (Agilent p/n 188-1356) was used to extract the water sample and concentrate the atrazine in the water. Each cartridge was washed with 5-mL aliquots of methanol and reagent water successively, and the cartridge was kept wet after the reagent water wash. The entire sample was vacuum filtered through the cartridge at a flow rate 5 mL/min. The cartridge was washed with 5 mL reagent water and allowed to drain after washing. The sample was eluted from the cartridge with 5-mL portions of methanol and evaporated with a stream of N_2 to a volume of 1 mL. Following the same procedure, 50 mL of reagent water and tap water spiked with 5 ppb standard were treated to get the recovery sample.

HPLC Conditions

Instrument	Agilent 1200SL with DAD
Columns	Agilent TC-C18(2) (p/n: 588935-902) and HC-C18(2) (p/n: 588915-902), 4.6 mm × 150 mm, 5 µm
Mobile phase	55% Methanol:45%Water
Flow rate	1 mL/min
Wavelength	254 nm
Temperature	40 °C
Injection volume	10 µL

Results and Discussion

The standard solutions were analyzed by injecting 10 µL of each of the standard solutions in methanol onto the Agilent TC-C18(2) and HC-C18(2) columns. The calibration curve resulting from these standard injections on the TC-C18(2) column is shown in Figure 2. The method shows excellent linearity, being very close to 1.0 (0.9998). The chromatograms from the standard atrazine injections (Figure 3) show high performance and symmetrical peaks. Some differences in retention were seen on the two columns, which have different carbon loads (the HC-C18(2) has a load of 17% and the TC-C18(2) has a lower load of 12%). These differences impact retention, and nonpolar and moderately polar compounds are typically more retained on the HC-C18(2) column compared with the TC-C18(2) column. The mobile phase for this method used 55% methanol, which is suitable for both columns, but the TC-C18(2) provided a slightly shorter analysis time at just over 7 minutes. We therefore chose the TC-C18(2) for this method.

To evaluate the reproducibility of this method on the TC-C18(2) column, 5 ng of atrazine was injected 10 times. The reproducibility of the peak area is 2.7% and of the retention times is 0.03%; therefore, the TC-C18(2) column provided excellent reproducibility.

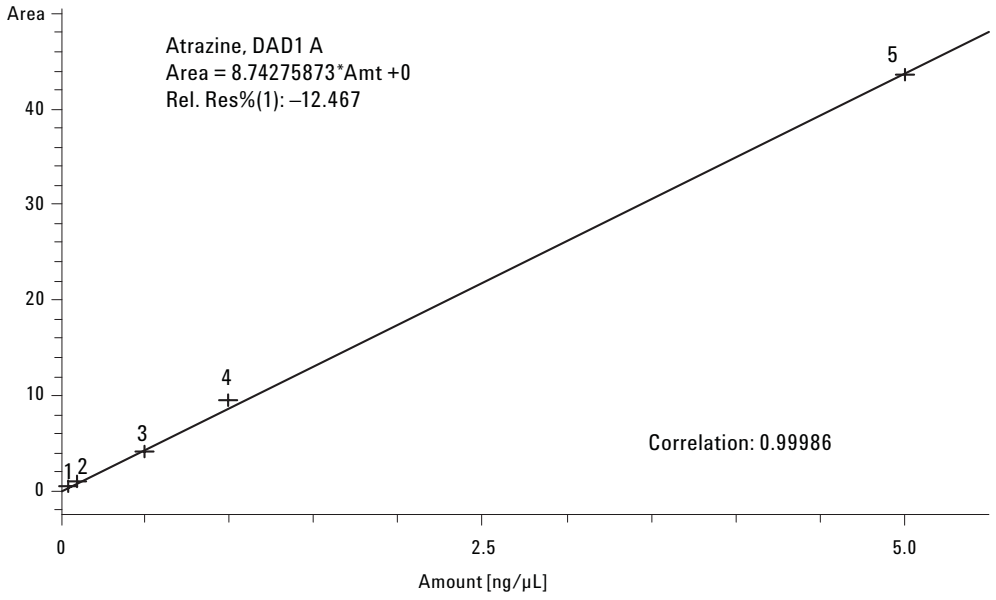

Figure 2. Calibration curve of atrazineon on TC-C18(2) and HC-C18(2), 4.6 mm × 150 mm, 5 µm columns.

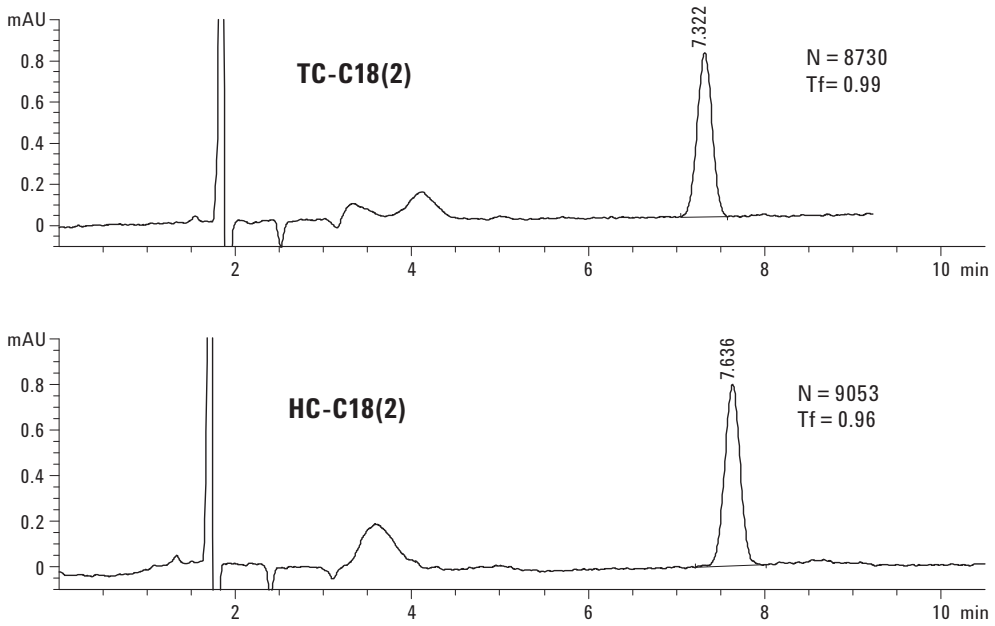

Figure 3. Chromatogram of atrazine standard on TC-C18(2) and HC-C18(2), 4.6 mm × 150 mm, 5 µm columns.

Figure 4 shows a chromatogram for a 0.5-ng atrazine injection. The signal-to-noise ratio is 3:1, so the LOD of this method is about 0.5ng which meets China's new drinking water standards.

An AccuBond C18 SPE cartridge was used in this method to extract trace atrazine in the water sample. The average recovery achieved is 88.2% (n = 3, RSD = 4.1%). This sample preparation method is simple and fast, and a low volume of organic solvents was consumed, making it an economical sample preparation method as well.

The chromatograms of reagent water and tap water and their spiked samples are shown in Figures 5 and 6. All the potential interfering compounds in reagent and tap water are well separated from the target compound atrazine; therefore, the method selectivity was also very good.

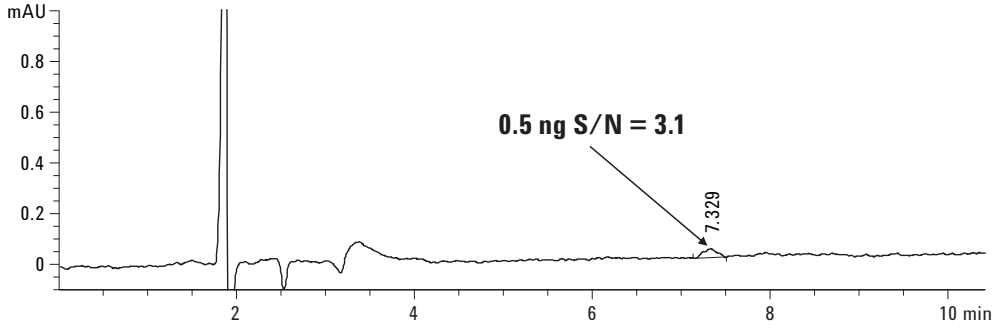

Figure 4. Chromatogram of standard with 0.5-ng injection on TC-C18(2), 4.6 mm × 150 mm, 5 µm columns.

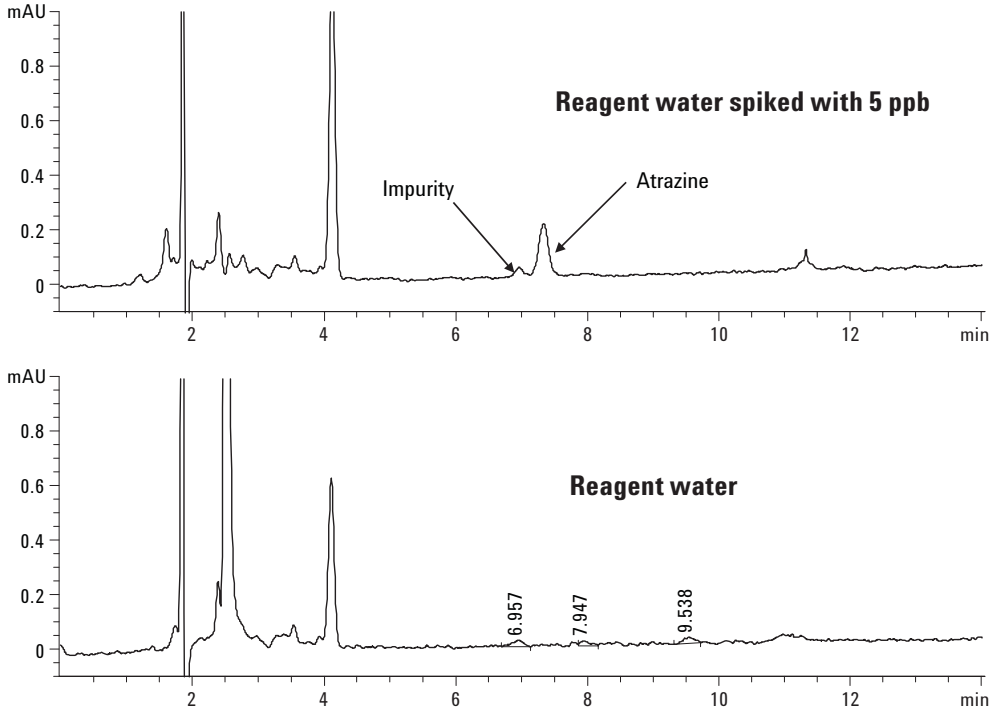

Figure 5. Chromatogram of reagent water and its spiked sample on TC-C18(2), 4.6 mm × 150 mm, 5 µm) columns.

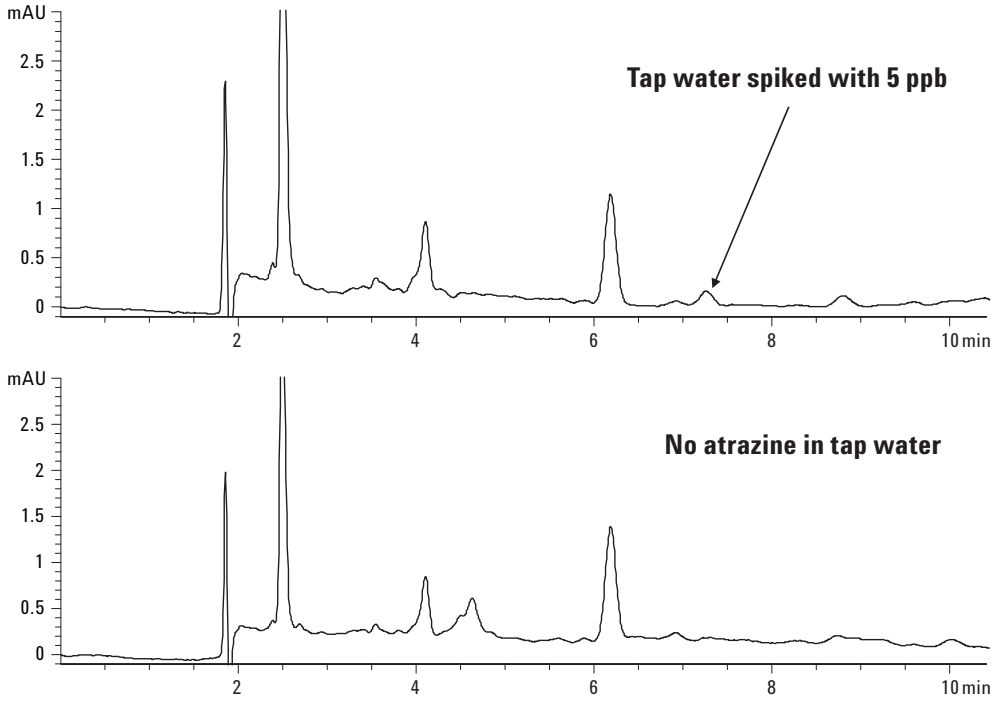

Figure 6. Chromatograms of tap water and its spiked sample on TC-C18(2), 4.6 mm × 150 mm, 5 µm columns.

Conclusions

The herbicide atrazine in drinking water can be easily analyzed at low levels and is well separated from potential interfering compounds in about 7 minutes using a new Agilent TC-C18(2) column. The AccuBond C18 SPE cartridge was used for sample preparation to concentrate the sample and meet the detection limits required of 0.5 ng on column. This total method can be used effectively to measure atrazine in drinking water quickly.

References

1. United States Environmental Protection Agency, "Determination of Chlorinated Pesticides, Herbicides, and Organohalides by Liquid-Solid Extraction and Electron Capture Gas Chromatography," Method 508.1, 1995, EPA Environmental Monitoring Systems Laboratory, Office of Research and Development, Cincinnati, Ohio 45268.
2. Standards of People's Republic of China, Standard Examination Methods for Drinking Water-Pesticides, GB/T 5750.9-2006:26
3. Lifang Yang, et al, "Solid Phase Extraction-HPLC Determination of Atrazine in Drinking Water, Chemical Measure and Analysis," 2007, 16(2):53

For More Information

For more information on our products and services, visit our Web site at www.agilent.com/chem.

www.agilent.com/chem

Printed in the USA
April 1, 2008
5989-8328EN

Agilent Technologies