CASE REPORT

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Ethyl Chloride: Possible Misidentification As Ethanol

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ABSTRACT: Ethyl chloride, in a blood sample, was identified as ethanol on three out of six occasions using headspace gas chromatography. The peak matching tolerance (PMT) for ethanol was set at approximately 0.500 min ±0.0225 min. Three test results fell within the PMT for ethanol. The retention time (RT) for these test results was 0.44 min, and the relative retention time (RRT) was 0.478 min. Three test results, however, fell outside the PMT for ethanol. Two had RTs of 0.48 min and RRTs of 0.523 min, and one had a RT of 0.44 min and a RRT of 0.476 min. To prevent ethyl chloride from being identified as ethanol, the PMT was changed to approximately 0.500 min ±0.012 min.

Mixture samples containing deionized water, ethyl chloride and ethanol were tested with the new PMT. Ethyl chloride and ethanol coeluted, forming one peak that was identified as ethanol. The peak areas of the two compounds in mixture were additive and gave falsely elevated ethanol results. The RT of the samples was 0.45 min and the RRT was 0.492 min ±0.005 min. Carrier gas flow rate was decreased, lengthening the RTs and RRTs, but this failed to separate the two compounds.

KEYWORDS: toxicology, ethyl chloride, ethanol, chromatographic analysis

Ethyl chloride has been used in medicine for many years as a local anesthetic, but recently this compound has also become a substance of abuse [*1*]. There are several reported cases of ethyl chloride abuse through inhalation; one by Nordin et al. [*2*], one by Hes et al. [*3*], and one by Hersh [*4*]. Daily inhalation of ethyl chloride over several months can produce severe psychological and neurological symptoms, but total recovery is observed after suspension of ethyl chloride inhalation [*3*]. Ethyl chloride can be purchased without prescription in "head shops" and other underground establishments selling drug paraphernalia. It is sold as an aroma spray under the trade name "Ethyl Gas" or "Ethyl Gaz" (Fig. 1).

Case History

Our laboratory received a blood sample drawn from an individual charged with possession and/or use of toluene. The sample was screened and found to be negative for toluene as well as cocaine, phencyclidine, opiates, and methamphetamine. The sample

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FIG. 1—*Canister of "Ethyl Gaz" aroma spray.*

was then tested for ethanol using headspace gas chromatography. The first and second test results were 0.00% and 0.08% blood alcohol concentration (BAC). Because of the discrepancy in test results, a third and fourth test were run, yielding results of 0.00% and 0.08% BAC. A fifth and sixth test were run, yielding results of 0.05% and 0.00% BAC.

After examining all six chromatograms, it became evident that the compound being identified was not ethanol. Ethanol had a retention time (RT) of 0.46 min and a relative retention time (RRT) of 0.502 min ±0.002 min. However, the unknown compound had a retention time of 0.44 min and relative retention time of 0.478 min ±0.002 min (RT is the length of time it takes a compound to travel through the column; RRT is a calculated value based on the compound retention time relative to that of the internal standard).

The police report was then obtained from the arresting agency. The arrestee had in his possession several cans of "Ethyl Gas" (ethyl chloride or choroethane) aroma spray, which he admitted inhaling prior to the arrest.

Materials and Methods

Three different gas chromatographs were used during the six analyses. Two instruments were Perkin Elmer Sigma 2000 auto-inject headspace gas chromatographs. One instrument was equipped with a SUPELCO 0.30% carbowax, 60/80 carbopack "C" column, and the other was equipped with a SUPELCO 0.20% carbowax, 60/80 carbopack "C" column. The third instrument was a Perkin Elmer 8500 auto-inject headspace gas chromatograph equipped with a 0.30% carbowax, 60/80 carbopack "C" column. All instruments had flame ionization detectors operating at a temperature of 190°C. Nitrogen was used as the carrier gas at a flow rate of 30 mL/min. Air and hydrogen were set at 300, and 30 mL/min, respectively. The Sigma 2000's were programmed for an equilib-

rium temperature of 60°C, a transfer temperature of 125°C, and an oven temperature of 110°C. The 8500 was programmed for an equilibrium temperature of 61°C, a transfer temperature of 90°C, and an oven temperature of 100°C. N-propanol in deionized water was used as an internal standard. Chromatography data were obtained using the LCI 100 Laboratory Computing Integrator.

The compound had a shorter RT and RRT than ethanol on the instruments equipped with the 0.30% carbowax column. It had a longer RT and RRT than ethanol on the instrument equipped with a 0.20% carbowax column.

Ethanol in deionized water, ethyl chloride in deionized water, and mixture samples of deionized water, ethanol and ethyl chloride were tested using a Perkin Elmer Sigma 2000 equipped with a SUPELCO 0.30% carbowax column. The PMT was set at 0.500 min ±0.012 min.

Results and Discussion

Compounds were identified based on the peak matching tolerance (PMT) for ethanol. Peak matching tolerance (PMT) was defined as the RRT ± the sum of the two method parameters: 1) component tolerance and 2) component % tolerance. The gas chromatographs were programmed for a component tolerance of 0.020 and a component % tolerance of 0.500; therefore, the PMT was approximately 0.500 ±0.0225. On three occasions the compound fell within the PMT for ethanol and was identified as such. The component tolerance and component % tolerance were changed to 0.010 and 0.400 respectively, setting the new PMT for ethanol at approximately 0.500 ±0.012. The compound was then reported as an unknown.

The RTs for ethanol, ethyl chloride and the ethanol/ethyl chloride mixture samples were 0.46 min, 0.44 min, and 0.45 min, respectively. The RRTs for ethanol, ethyl chloride and the ethanol/ethyl chloride mixtures were 0.504 min ±0.002 min, 0.478 min ±0.002 min, and 0.492 min ±0.005 min, respectively. Two samples had RTs of 0.44 min and RRTs of 0.486 min and were not identified as ethanol. Their concentrations were 0.05% ethanol/≃0.08% ethyl chloride, and 0.05% ethanol/≃0.200% ethyl chloride. Ethanol and ethyl chloride in the mixture samples coeluted with only a 0.01 min shift in the RT and a 0.12 min shift in the RRT. The single peak in the chromatogram was without shoulders or tailing, and could easily be misidentified as ethanol alone. The peak areas of the two compounds in mixture were additive. Therefore, the ethanol reading was falsely elevated. It was apparent, however, that ethyl chloride was present in the mixtures because of the difference in RTs and RRTs.

Chromatograms for ethanol, ethyl chloride and an ethanol/ethyl chloride sample mixture are shown in Fig. 2. A summary of the data for these chromatograms is shown in Table 1.

It is a simple matter to determine if ethanol and ethyl chloride are being used in conjunction with each other by evaluating the RTs and RRTs. The problem arises in separating the two compounds. Ethyl chloride has a boiling point of 12.3°C, whereas ethanol has a boiling point of 78.5°C [5]. Our method did not separate these two compounds. Therefore, an accurate ethanol concentration could not be determined. The flow rate of the carrier gas was slowed. This lengthened the RT and RRT of the sample, but did not separate the two compounds. More research is needed to determine a separation technique. The use of a different column, or a change in oven temperature may be able to separate these two compounds. Neither approach was attempted prior to the writing of this paper.

This is the only such case we have encountered in the last two years, even though it was the defendant's third arrest. The first arrest was for driving under the influence and occurred eight months earlier. Two cans of "Ethyl Gaz" aroma spray were found in the

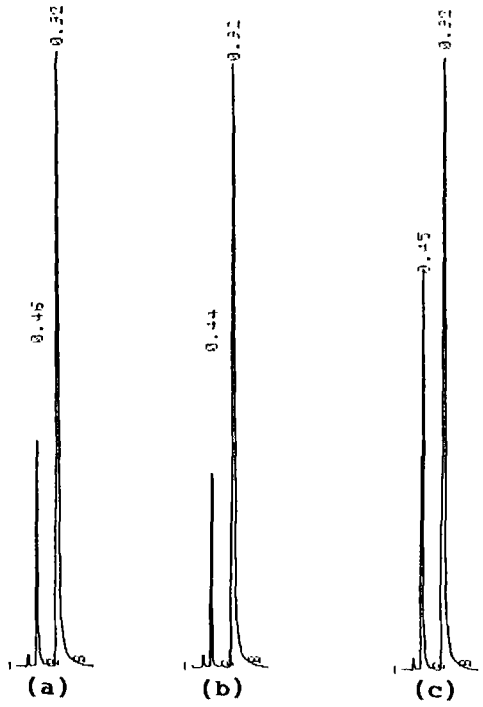

FIG. 2—(a) *Chromatogram of ethanol 0.112% BAC (W/V);* (b) *chromatogram of ethyl chloride ≈0.08% BAC (W/V); and* (c) *chromatogram of ethanol/ethyl chloride mixture—1:1 (ethanol: 0.112% BAC and ethyl chloride: ≈0.08% BAC).*

subject's vehicle. A breath test was administered. One test result of 0.100% BAC was obtained, but the second test was invalid because an interferant was detected. The second arrest, seven months after the first, was for possession and/or use of toluene. Four cans of "Ethyl Gas" aroma spray were found in the subject's vehicle. A blood sample was obtained, which tested negative for toluene and alcohol. After re-examining the chromatograms it was evident that ethyl chloride was present but had been recorded as an unknown.

RTs and RRTs are now monitored very closely for each sample in order to flag the possible presence of ethyl chloride. It is suggested that the PMT of 0.500 min ±0.012 min be narrowed to 0.500 min ±0.006 min. This would record an ethanol/ethyl chloride mixture as an unknown making it easier to spot the possible presence of ethyl chloride.

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TABLE 1—*Summary of the data for the chromatograms in Fig. 2.*

	RT	RRT	Peak Area	%BAC (W/V)
Ethanol	0.46 min	0.504 ± 0.002	216,276	0.112%
Ethyl chloride	0.44 min	0.478 ± 0.002	166,385	≈0.08%
Mixture (1:1)	0.45 min	0.492 ± 0.005	401,852	0.210%

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