CASE REPORT

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Isopropanol Interference with Breath Alcohol Analysis: A Case Report

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ABSTRACT: The presence of interfering substances, particularly acetone, has historically been a concern in the forensic measurement of ethanol in human breath. Although modern infrared instruments employ methods for distinguishing between ethanol and acetone, false-positive interferant results can arise from instrumental or procedural problems. The case described gives the analytical results of an individual arrested for driving while intoxicated and subsequently providing breath samples in two different BAC Verifier Datamaster infrared breath alcohol instruments. The instruments recorded ethanol results ranging from 0.09 to 0.17 g/210 L with corresponding interferant results of 0.02 to 0.06 g/210 L over approximately three hours. Breath and venous blood specimens collected later were analyzed by gas chromatography and revealed in the blood: isopropanol 0.023 g/100 mL, acetone 0.057 g/100 mL and ethanol 0.076g/100 mL. Qualitative analysis of the breath sample by GCMS also showed the presence of all three compounds. This individual had apparently consumed both ethanol and isopropanol with acetone resulting from the metabolism of isopropanol. An important observation is that the breath test instruments detected the interfering substances on each breath sample and yet they did not show tendencies to report false interferences when compared with statewide interferant data.

KEYWORDS: toxicology, breath alcohol analysis, interfering substances, acetone, isopropanol, ethanol, infrared

The presence of interfering substances in quantitative breath alcohol determination has been a forensic concern for some time. In view of most driving while intoxicated (DWI) statutory language, the objective is to accurately quantitate ethanol and prevent interference from numerous organic compounds arguably present in human breath, albeit at trace levels [*1,2*]. Historically, the potential interferant of greatest concern has been acetone, however, forensic scientists are now being asked more frequently to address the possibility and

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consequences of the presence of many other materials of endogenous or environmental origin.

The employment of infrared breath alcohol testing methods has revived concerns due to reduced specificity for ethanol compared to wet chemistry methods. Instrumental design features (for example, surface chemistry, multiple filters, etc.) along with appropriate testing protocol and human biological considerations have been incorporated to address the concern, resulting in methods that are highly selective for ethanol. Several workers have addressed these issues in recent years [*3–12*].

This report documents a case in the state of Washington where the BAC Verifier Datamaster infrared breath alcohol instrument (National Patent Analytical Systems, Inc., Mansfield, OH) is utilized to enforce a 0.10 g/210 L "per se" statute. A two filter method for distinguishing between ethanol and acetone (3.44 μm and 3.37 μm) is used along with a 15 min observation period, duplicate sampling, internal standard, simulator standard and two digit truncation. The BAC Verifier Datamaster uses a mathematical algorithm whereby if an apparent ethanol equivalent of ≥ 0.01 g/210 L is detected, due to an altered absorbance ratio, it will be subtracted from the ethanol value. The reported results become the level of apparent ethanol equivalent due to interference, (≥ 0.01 g/210 L) together with the corresponding reduced ethanol value.

Case Report

A white male, age 34, was arrested for driving while intoxicated (DWI) and transported to the county jail for administration of breath alcohol analyses in duplicate per established protocol promulgated in the Washington Administrative Code. A roadside Pre-Arrest Breath Test (PBT) employing the Alco-Sensor III (Intoximeters Inc., St. Louis, MO) had resulted in 0.135 g/210 L. The first evidential breath alcohol test administered one hour later (Table 1), using the BAC Verifier Datamaster resulted in 0.16 g/210 L with an associated 0.04 g/210 L interferant. At this point the officer requested assistance from one of the authors (J.K.E.) resulting in several subsequent analyses voluntarily provided on two different Datamaster instruments. The results of replicate analyses are seen in Table 1 where all times are referenced from the roadside PBT analysis. All simulator standards performed

TABLE 1—*Summary of breath alcohol and interferant results.*

Time[a] (h)	Instrument[b]	Net Ethanol[c] g/210 L	Interference g/210 L
0	PBT	0.135	—
1.0	DM 1	0.16	0.04
1.2	DM 1	0.17	0.02
1.2	DM 1	0.15	0.05
1.6	DM 2	0.13	0.06
1.6	DM 2	0.13	0.06
1.8	DM 2	0.15	0.05
1.8	DM 1	0.14	0.05
1.9	DM 1	0.11	0.04
4.1	DM 1	0.09	0.05
4.1	DM 1	0.10	0.05
4.2	Breath sample collected		
5.3	Blood sample collected		

[a] Time following the initial PBT analysis. 0 represents 11:27 a.m.

[b] DM 1 and DM 2 denote two different Datamaster instruments.

[c] "Net Ethanol" refers, in the case of the Datamaster, to the two digit truncated result after subtracting for the presence of an interferant.

in association with complete evidential analyses were within the acceptable limits of 0.090 to 0.110 g/210 L.

Following replicate breath sampling, the individual voluntarily provided a preserved breath sample into a mylar balloon (2 L) 4.2 h after the roadside PBT analysis. In addition, a venous blood sample was provided 5.3 h after the PBT analysis (Table 1). Blood sampling occurred at a local hospital where an attending emergency room physician examined the individual, noting only signs and symptoms consistent with ethanol intoxication.

Neither the arresting officer nor the breath test technician noticed any unusual behavior or odor of substances other than that typically associated with the consumption of ethanol. When arrested, the individual had an open container apparently containing an alcoholic beverage.

Analyses of preserved breath and venous blood samples were performed at the Washington State Toxicology Laboratory. The Mylar balloon, containing approximately two liters of breath, was emptied through a silica trap (Tox Traps, PA). The contents of the trap were placed in a sealed vial with water (1 mL), heated to 60°C with the headspace vapor (500 μL) analyzed qualitatively by gas chromatography/mass spectrometry (GCMS). GCMS was performed on a Hewlett Packard 5890/5971 gas chromatograph with a mass selective detector. The column was a 30m 5% phenyl methyl silicone column (alltech) operated isothermally at 40°C. The breath sample was found to contain ethanol, acetone and isopropanol.

The blood was analyzed qualitatively by GCMS as described above, and quantitatively in duplicate by headspace gas chromatography (GC) using a 6 foot glass column packed with 60/80 Carbopak/5% carbowax 20M (Supleco, PA) operated isothermally at 78°C. The sample was checked for the presence of interferences with the same elution time as n-propanol. None were found and n-propanol was used as the internal standard. The blood sample was found to contain ethanol (0.076 g/100 mL), acetone (0.057 g/100 mL), and isopropanol (0.023 g/100 mL).

Discussion

Examination of results from 39,479 duplicate evidential breath tests (each with BrAC $\geq$ 0.01 g/210 L) performed in 1992 revealed that 1.2% recorded an interferant on one (but not both) of the duplicate tests administered under the protocol used in Washington. A physiological explanation for the presence of an interferant on one breath sample but not on the second provided within two minutes is difficult to rationalize. The cause is more likely to be instrumental rather than the presence of an actual interferant. Moreover, in our experience, the occurrence of interference on one or more breath samples can often be shown to be instrument specific. Even more rare is the occurrence of duplicate breath measurements on a subject showing the presence of interference on both breath samples, occurring on approximately 0.17% (n = 66) of all duplicate tests for 1992. Again, many of these apparent interferences can be shown to be instrument specific, leaving only a handful in which a true interferant might be reasonably concluded to be present. The case described here is clearly one of these, and is important because of the wealth of information subsequently collected.

In cases where interfering substances other than alcohols are invoked to account for a portion of the breath alcohol reading, the PBT result can provide an important reference value. The PBT unit is based on a fuel cell design, and is specific for alcohols, giving no reading for even enormous concentrations of esters, ethers, ketones, aldehydes, hydrocarbons, aromatics, and halogenated hydrocarbons. The results of a timely, properly performed PBT test, while not carrying many of the protections of the evidential test (mouth alcohol detection, sampling control, duplicate analysis, external standard, internal standard, multiple

blank tests) is unquestionably of help in corroborating the results of an evidential test, when the role of these other compounds is raised.

From the standpoint of instrument reliability it is important to note that on the subject tested in this case, each instrument detected the presence of the interferant on every sample provided. An evaluation of the database on Datamaster 1 (DM1) for approximately nine months revealed 1.5% of analyses as having one or more associated interferant results (not including those tests reported here). Datamaster 2 (DM2) had interferant results on 0.67% of its analyses over a 14 month period (again not including those tests on the subject in this case). Neither of these instruments showed an exaggerated tendency to give false interferant results compared to the total percentage, on 170 instruments statewide.

Considering the toxicological aspects of this case, the results of these tests clearly indicate that this individual had consumed ethanol and isopropanol, although when questioned about this the subject denied having drunk anything but beer.

Short chain alcohols such as methanol and isopropanol compete with ethanol for alcohol dehydrogenase (ADH), the main metabolic system for alcohol elimination. When ethanol is present in amounts in excess of other alcohols, it slows their rate of metabolism, and thus slows the rate of generation of toxic by-products such as formaldehyde from methanol or acetone from isopropanol. This slowed metabolism assists in minimizing toxic effects, as it allows a larger fraction of the parent compound to be excreted unchanged [*13*]. Isopropanol has about twice the CNS potency of ethanol, and its toxicity is associated with CNS depression caused both by itself and its metabolite, acetone.

Acetone in a subject's blood can be accounted for in one of three ways: ingestion of acetone, ingestion of isopropanol, or as a result of diabetes mellitus in which acetone is generated endogenously by enhanced fatty acid metabolism. Acetone is eliminated predominately in the urine and breath, but is also slowly metabolized to acetate and formic acid [*13*]. Normal blood acetone levels in healthy subjects range from 0.001 to 0.005 g/100 mL. Jones [*14*] has noted an apparent discrepancy between what reportedly toxic levels of acetone from 0.020 to 0.030 g/100 mL, and concentrations exceeding 0.200 g/100 mL, which have been reported in non-fatal isopropanol ingestion. In evaluating blood acetone levels it is essential to consider the origins of the acetone. In diabetic subjects, acetone in the blood and on the breath is associated with low intracellular and high blood sugar, and the medical consequences, including disorientation, confusion, unconsciousness, coma and death, are more likely correlated with the abnormal sugar levels than with elevated blood acetone levels.

This subject was clearly intoxicated, but apparently in good health otherwise. The 0.057 g/100 mL blood acetone level, while indicative of a serious and possibly life threatening condition when a result of diabetes, is in this case, and reportedly in many others not inherently dangerous.

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