

Analysis of Ethanol in Blood with the Agilent 7820A GC and 7697A Headspace Sampler

Application Note

Forensic

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Abstract

The Agilent 7820 GC and 7697A headspace sampler is an economical instrument configuration for measuring ethanol in blood. The full EPC control from auto sampler to detector ensures good repeatability and simple-to-use operation, which is ideal for a routine QA/QC lab. According to the national standard [1], drunk driving is defined as the concentration of ethanol in the blood of 80 mg/100 mL or more, while drinking and driving is defined as the concentration of ethanol in the blood of 20 mg/100 mL or more. To meet this quantitative requirement, the calibration curve for the method was generated in a wide range of 10 mg/100 mL to 160 mg/100 mL, so that both limits could be identified.



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Introduction

The amount of alcohol-related traffic accidents and fatalities has steadily increased over the past decade. The Chinese government recently put a drunk driving law into effect. For law enforcement purposes, blood alcohol content is used to define intoxication, and provide a justifying measure of violation. As law enforcement agencies have taken significant steps to catch drunk drivers, the need has risen for a reliable, fast, and accurate blood alcohol test. This application note provides a simple, reliable, and fast solution that meets the latest national standards for measuring the ethanol content in blood [2].

Experimental

Table 1. Typical GC Conditions

Inlet settings	200 °C, split ratio: 10:1
Column	DB-ALC2 0.32 mm × 30 m, 1.2 µm (p/n 123-9234)
Column flow (N ₂)	12 mL/min, constant flow
Oven temp program	40 °C (7 min)
	Temperature: 250 °C
FID setting	H ₂ flow: 40 mL/min
	Air flow: 400 mL/min
	Make up (N ₂): 45 mL/min
Data acquisition rate	20 Hz

Table 2. Typical HS Conditions

Temperatures	
Oven	85 °C
Loop	85 °C
Transfer line	100 °C
Times	
GC cycle time	15 min
Press equilb time	0.1 min
Vial equilb time	15 min
Inject time	0.5 min
Vial	
Fill mode	Flow-limited press
Ramp rate	20 psi/min
Fill pressure	15 psi
Final pressure	10 psi
Fill flow	50.00 mL/min
Final hold	0.05 min
Fill mode	Advanced
Vent after extraction	No

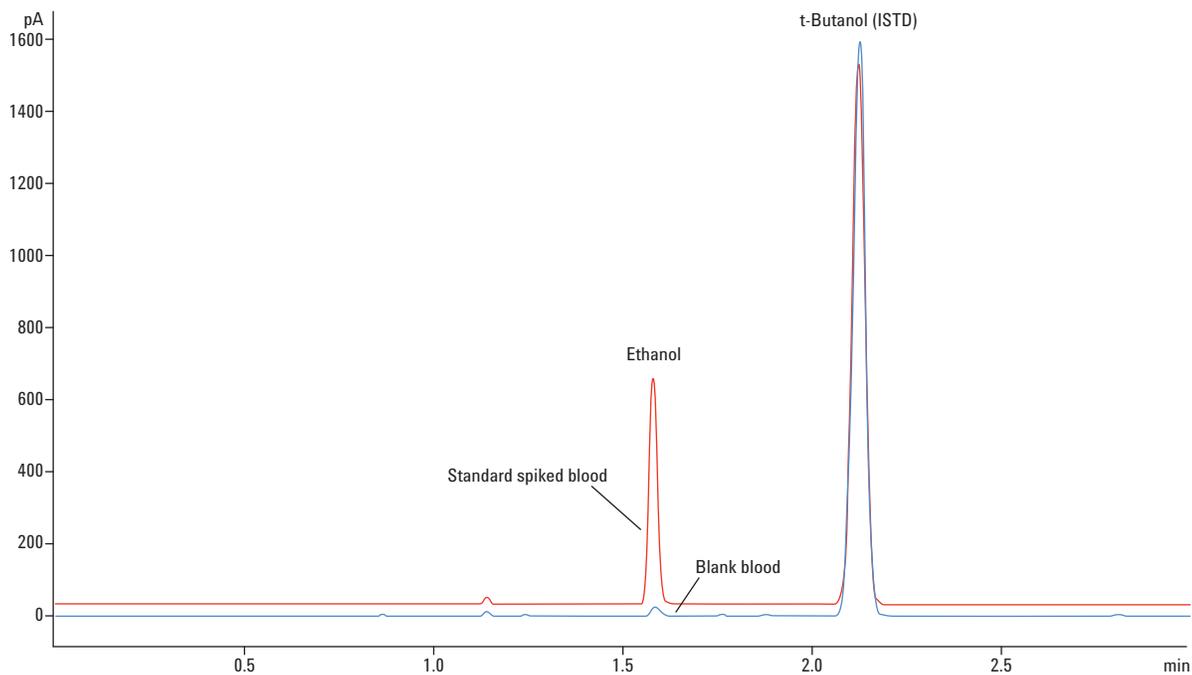


Figure 1. Overlapped chromatograms of blank blood sample and ethanol spiked blood sample (ethanol spiked concentration is 40 mg/100 mL, t-Butanol is the internal standard).

Results

Chromatogram

Figure 1 shows the overlapped chromatograms of blank blood sample and ethanol spiked blood sample. The ethanol spiked blood sample is prepared by adding ethanol water solution into 0.49 mL blank blood sample in 20 mL headspace vial. T-butanol is added into the headspace vial as internal standard. The retention times of ethanol and t-butanol are confirmed by individual headspace injections before real sample analysis.

Linearity

Five levels of ethanol water solution are prepared in 100 mL flasks with concentrations of 500 mg/100 mL, 1,000 mg/100 mL, 2,000 mg/100 mL, 4,000 mg/100 mL and 8,000 mg/100 mL. Then 10 μ L of ethanol water solution is added into 0.49 mL blank blood sample in 20 mL headspace vial. The final concentrations of ethanol standard blood samples are: 10 mg/100 mL, 20 mg/100 mL, 40 mg/100 mL, 80 mg/100 mL and 160 mg/100 mL. One hundred microliter of t-butanol with concentration of 200 mg/100 mL is added in each vial as internal standard. Figure 2 shows the calibration curve for five levels.

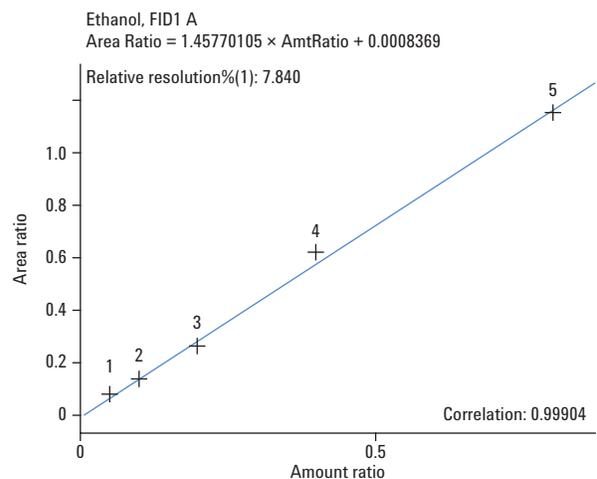


Figure 2. Calibration curve of ethanol standards in blood sample.

Repeatability

Five spiked blood samples were analyzed with the concentration of 60 mg/100 mL. The repeatability results are shown in Table 3.

Table 3. RSD(%) Results of Five Spiked Blood Samples Analysis

Peak Area	1	2	3	4	5	RSD(%)
Ethanol	1752	1570	1604	1575	1615	4.6
t-Butanol (ISTD)	3778	3651	3608	3693	3716	1.7

Retention Time	1	2	3	4	5	RSD(%)
Ethanol	1.581	1.581	1.580	1.580	1.580	0.03
t-Butanol (ISTD)	2.121	2.121	2.120	2.120	2.121	0.03

Conclusion

An Agilent 7820A GC configured with a 7697A headspace sampler provides a fast and economical solution for the analysis of ethanol in blood. The headspace sampler provides very simple sample preparation, while the EPC control and automatic injection provides excellent repeatability for both retention time and peak area.

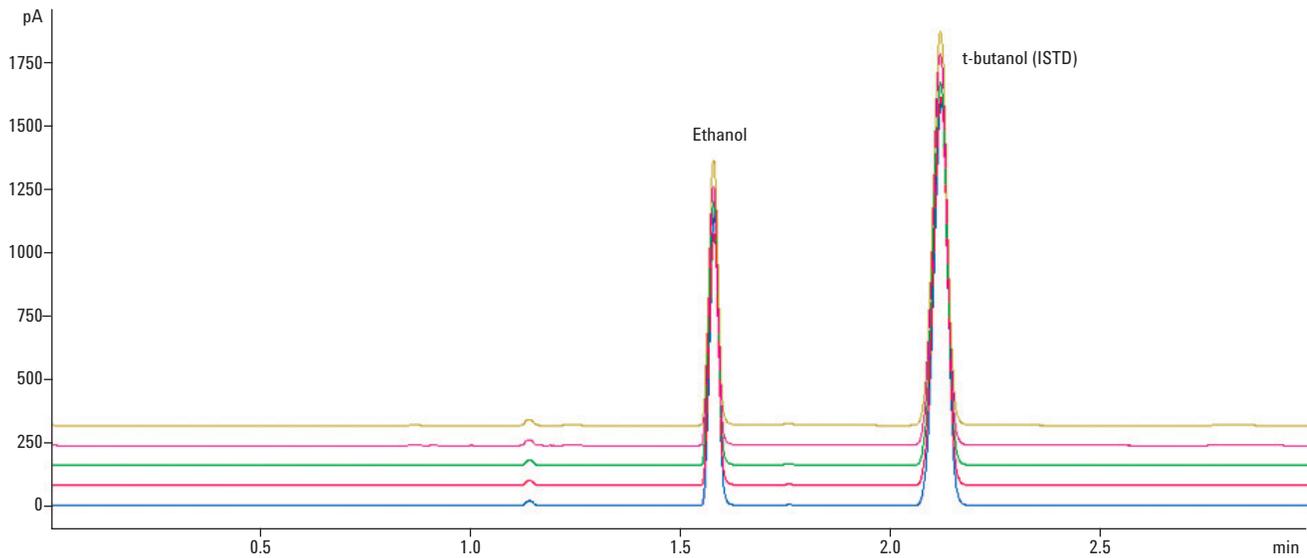


Figure 3. Repeatability—60mg/100/mL ethanol standards spiked in blood sample (5 runs).

References

1. GB19522-2004 Blood-breath alcohol concentration and examination for driving.
2. GA/T842-2009 Analysis method for ethanol concentration in blood.

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Printed in the USA
May 7, 2013
5990-9021EN



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