Development and validation of a method for congener analysis in serum and application to a pilot experiment addressing endogenous 1-propanol

Verena Angerer and Volker Auwärter

Institute of Forensic Medicine, University Medical Center Freiburg, Germany

UNIVERSITÄTS KLINIKUM FREIBURG

IRM Institute of Forensic Medicine
Forensic Toxicology

Introduction

Congener alcohol analysis is a useful tool for testing the plausibility of a claim of drinking alcohol after a criminal act but before blood sampling ("Nachtrunk"). The major components for the assessment are 1-propanol and isobutanol and also their concentration ratio. As a result it can be essential in some cases to know if endogenous 1-propanol production occurs in the presence of elevated blood ethanol concentrations.

Materials and methods

Method development was done with a Perkin Elmer GC equipped with a capillary column (Restek RTX®-502.2, 60 m, 0.53 mm ID, 3 µm film thickness) and an FID detector. For sample work-up 0.5 mL serum was used and *t*-butanol served as an internal standard. To increase vapor pressure, 1 g sodium sulfate was added to each vial. The method was validated according the guidelines of GTFCh for congener analysis.

Pilot test

A male person (42 years, 75 kg) drank 400 mL vodka (Grasovka, 40 vol%), mixed with Bitter Lemon within about 3 h. Serum samples were obtained every 1.5 hours over a 10 h period. Furthermore, both vodka and bitter lemon were analysed for congener alcohols.

Results and discussion

Method validation demonstrated sufficient selectivity and specificity of the method. A linear relationship between the response and the concentration was confirmed by Mandel test (99% significance). Weighting was not necessary (homoscedasticity of variance was given for all analytes). The intra- and interday precision were in the range of ±15%. Accuracy was in the range of ± 30% (± 40% near the LOD) and fulfilled the requirements. The limits of detection and the lower limits of quantification are listed in Table 1.

Table 1: LOD and LLOQ

	1-butanol	1-propanol	2-butanol	2-methyl-1-butanol	3-methyl-1-butanol
LOD [mg/L]	0.02	0.01	0.01	0.01	0.02
LLOQ [mg/L]	0.05	0.04	0.03	0.05	0.05
	acetone	isobutanol	isopropyl alcohol	methyl-ethylketone	methanol
LOD [mg/L]	0.07	0.01	0.02	0.02	0.06
LLOQ [mg/L]	0.24	0.05	0.05	0.05	0.25

Both bitter lemon and vodka did not contain detectable amounts of 1-propanol or isobutanol. The maximum BAC reached in the experiment was 1.63‰ (4.5 h after start of drinking). The maximum 1-propanol serum concentration during the experiment was measured about seven hours after start of drinking and reached 0.58 mg/L (BAC at this time 1.26‰). In the phase of ethanol resorption, the rate of 1-propanol formation increased very fast and went through a maximum shortly before the BAC-maximum (see Fig. 1)

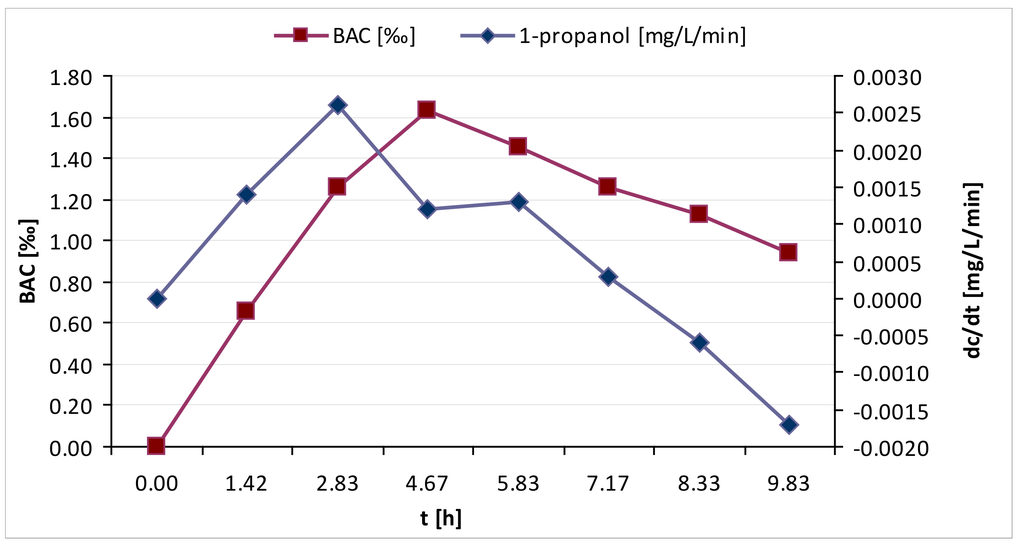

Fig. 1: BAC and production velocity (dc/dt) of 1-propanol over time (start of drinking at t = 0)

Conclusion

A method for analysing alcohol congeners in serum was successfully validated and applied to a pilot experiment. Significant formation of endogenous 1-propanol was shown in the presence of ethanol. As the concentration of endogenous 1-propanol appears to depend on the BAC and may vary interindividually, more research needs to be done. However, in forensic cases experts should be aware of such potential interference, particularly when high BAC before the incidence can not be excluded.

References

- GTFCH (2009)Toxichem Krimtech, Band 76, Heft 3, 2009, S. 185-208
- GTFCH (2010), Toxichem Krimtech, Band 78, Heft 1, 2010, S. 16-22
- Bonte, W. (1987), Begleitstoffe alkoholischer Getränke – Biogenese, Vorkommen, Pharmakologie, Physiologie und Begutachtung, Verlag Max Schmidt-Römhild, Lübeck

Acknowledgement

The authors would like to thank the laboratory stuff of the Institute of Forensic Medicine, Freiburg (Germany) for assistance.

Contact

Verena Angerer
University Medical Center Freiburg
Institute of Forensic Medicine
Forensic Toxicology
Albertstr. 9, 79104 Freiburg, Germany
verena.angerer@uniklinik-freiburg.de
Phone: ++49-761-203-6849