Simultaneous determination of gamma-hydroxybutyric acid (GHB) and gamma-butyrolactone (GBL) in beverages

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Ion Chromatography

Summary

Psychoactive gamma-hydroxybutyrate (GHB) and its prodrug gamma-butyrolactone (GBL) are substances that are increasingly abused as date-rape and recreational (party) drugs. Since the non-controlled GBL converts into the illicit GHB both in-vivo and in-vitro, their legal distinction is of crucial importance.

For the forensic determination of illegally added GHB and GBL in commonly consumed beverages, this work presents a simple and sensitive method that employs direct-injection ion chromatography combined with spectrophotometric detection. In the range of 10 to 200 mg/L, five-point calibration curves for GHB and GBL yield correlation coefficients of 0.9998 and 0.9997, respectively. Spiking experiments in which GHB and GBL were added to alcoholic beverages and non-alcoholic fruit juices showed no matrix effects. The method allows to trace GHB-GLB interconversion, whether in-vivo or in-vitro lactone cleavage or intramolecular GHB esterification, and thus complies with pertinent requirements of law enforcement agencies.

Introduction

Criminal records all over the world report of cases with victims that were made defenseless by means of so-called KO drops followed by Drug-Facilitated Sexual Assault (DFSA) or Drug-Facilitated Crimes (DFC). In most cases the drops were added to the victim's food or drink. The anesthetic effect is due to the gamma-hydroxybutyric acid (GHB), a synthetically produced central nervous system depressant. At low doses, GHB has a euphoric effect and is increasingly abused as a recreational narcotic. Often alcohol and GHB consumption go together, not least because the hypnotic effect is enhanced. In therapeutics, this compound is used as a sleep-inducing drug or tranquilizer whose dispensation is strictly controlled by law in most countries. Since the ban on GHB, gamma-butyrolactone (GBL), the intramolecular ester of GHB, which is a freely available chemical, is used as a substitute. In the human body, the precursor GBL is immediately converted to GHB by lactonase enzymes in the blood. Consequently, the prodrug GBL is increasingly used to bypass GHB restriction laws. For law enforcement the distinction between GHB and GBL is decisive. Up to now, detection of GHB occurred via GC-MS, a method that is both demanding and expensive.

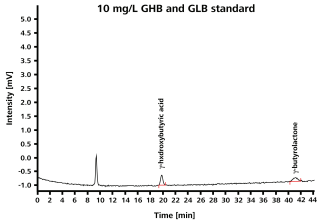
The poster describes a straightforward and fast ion-chromatographic method that allows determination of GHB and GBL in one run. The two substances are separated on a RP phase using an eluent based on perchloric acid and detected in the UV detector after chemical suppression with LiCl.

Instrumentation

- 850 Professional IC Anion – MCS
- 863 Compact IC Autosampler
- Lambda 1010 UV/VIS Detector
- 771 Compact IC Interface

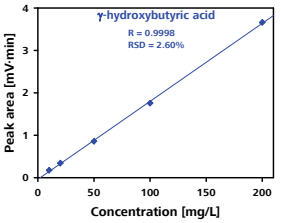
System characteristics

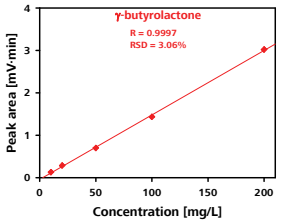
a) Chromatographic determination



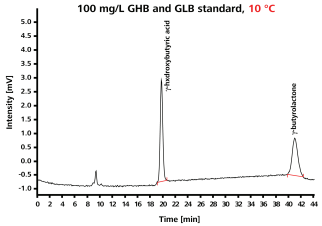
Sample:	10 mg/L standard
Columns:	ProntoSil 120-5-C18 AQ Guard Metrosep Organic Acids – 250
Column temp.:	10 °C
Eluent:	0.5 mmol/L perchloric acid in ultrapure water
Flow:	0.45 mL/min
Loop:	20 µL
Wavelength:	205 nm

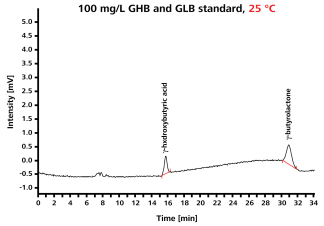
b) Linearity

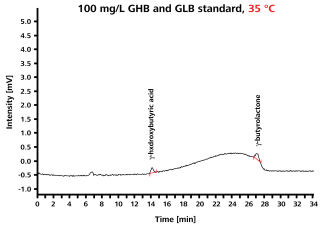




c) Temperature dependence

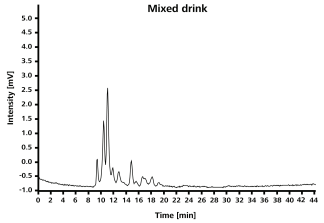


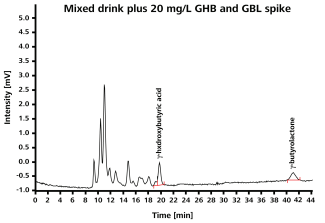




Spiked beverages

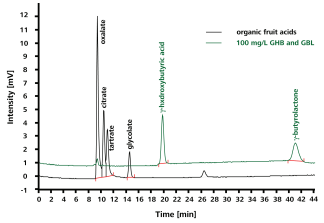
a) Alcoholic beverages

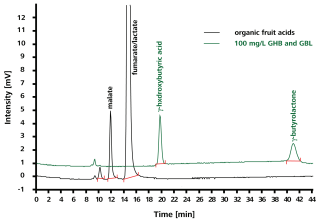




The cocktail was prepared by mixing 80 mL of extra dry Martini with 20 mL of grapefruit juice. After a 1:200 dilution (v/v) with ultrapure water, two aliquots – with and without a 20 mg/L GHB and GLB spike – were subsequently injected.

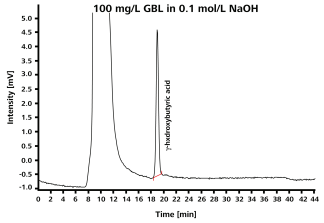
b) Common non-alcoholic fruit juices

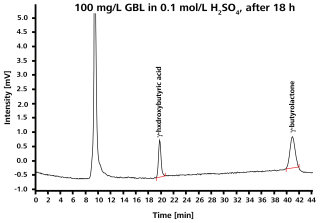


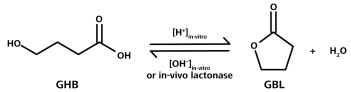


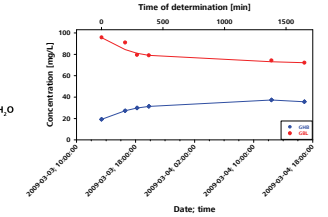
GHB-GBL interconversion

In a sodium hydroxide solution or in blood, GBL is completely converted into GHB. Under acidic conditions, both compounds form an equilibrium.









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