A96 Identification of Gamma-Hydroxybutyrate (GHB), Gamma-Butyrolactone (GBL), and 1,4-Butanediol (1,4-BD) Using Trimethylsilyl Derivatization

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After attending this presentation, attendees will learn how to trimethylsilyl derivatize GHB (gamma hydroxybutyrate), which is a controlled (Schedule I) drug and in turn positively identify it, separately from GBL (gamma-butyrolactone), which is not controlled, using a typical GC-MS (gas chromatograph-mass spectrometer). 1,4-butanediol (1,4-BD) is also included in the derivatization reaction, because 1,4-BD is used to manufacture GHB and sometimes comes in a mixture with GHB and GBL. Because these drugs usually come spiked in aqueous solutions like wines and soda, a simple extraction procedure is also included which precedes the actual derivatization reaction.

This presentation will impact the forensic science community by teaching the utility and versatility of the technique of trimethylsilyl derivatization of drugs like gamma-hydroxybutyrate (GHB) a Schedule I drug. From an identification point-of-view, this drug has become a headache for crime laboratories worldwide, because it converts to GBL (gamma-butyrolactone), which is not controlled, under high temperatures in a typical GC-MS (gas chromatograph-mass spectrometer). This problem can be easily solved by employing this simple, fast, efficient, and user-friendly technique.

GHB has been in literature since 1874. In the 1960's, it was developed as an anaesthetic in the field of medicine. In addition, this four-carbon molecule is purported to have anabolic properties and also induces sleep. This and several other reasons prompted the Food and Drug Administration in 1990, to issue a warning against the use of GHB. A decade later, the sale and synthesis of GHB was stringently controlled and the drug was placed in Schedule I by the Controlled Substances Act. This in turn led to an increase in the illegal synthesis of GHB. Recently, it has been increasingly used as a "date rape" drug. Cases of GHB use in the United States have gone from 56 in 1994 to 3,340 in 2001, especially among the youth.

For trimethylsilyl derivatization, ~2 mg each of GHB, GBL, and 1,4- BD was mixed with 50 ml ethyl acetate. Then a 50 ml mixture of BSTFA+TMCS (in a ratio of 99:1) was added to it. The reaction mixture was incubated at room temperature for ~30 min. Then 1-2 ml of the reaction mixture was subjected to GC-MS analysis. The excess derivatization reagents and ethyl acetate in the reaction mixture had retention times (RT) in the GC ranging from ~0.5 to ~3.0 min.

Trimethylsilyl-derivatized GHB appeared at ~6.0 min. Underivatized GHB, after converting to GBL at high temperatures has a RT of ~3.3 min. Due to its characteristic dragging on the column, the RT for underivatized 1,4-BD ranged between 3.6 - 4.0 min. Derivatized 1,4-BD had a RT of

5.5 min. The major ionic fragments of the derivatized GHB on the mass spectrometer (MS) fully corroborated with theoretical calculations, which are *m/z* 73, 117, 147, and 233. Underivatized GHB, after converting to GBL, had the following major ionic fragments *m/z* 42, 56, and 86. The major ionic fragments monitored for derivatized and underivatized 1,4- BD were *m/z* 73, 116, 147, 219, and *m/z* 42, 57, and 71, respectively.

To date, this is a straight forward, simple and accurate method for identifying GHB from GBL. Due to its closed ring structure, GBL is immune to derivatization. However, this technique can be effectively used to derivatize specifically GHB, even in a mixture of GHB and GBL. The mass spectra of derivatized and underivatized 1,4-BD is entirely different from that of GHB and GBL and the presence of 1,4-BD in the mixture does not hinder the identification of GHB. This technique of trimethylsilyl derivatization becomes more attractive in the fact that, after the derivatization reaction, there is no need to extract the derivatized or underivatized products from the finished derivatization reaction before the GC-MS analysis because the retention times in a GC and the resulting mass spectra of the derivatization reagent, BSTFA (N,*O*-bis(trimethylsilyl) trifluoroacetamide) are quite different when compared to that of the derivatized and underivatized products. More over, the whole reaction and its analysis on a GC-MS takes less than an hour, which makes it quite attractive for a fast paced drug laboratory.

The law enforcement agencies submit cases containing wines and soda, purportedly spiked with these drugs whose usage is becoming more common in night club parties. Because the derivatizing agent is incompatible with aqueous solutions like soda and wines, a very robust, simple, and high recovery extraction procedure is also included, which delivers pure drugs that are derivatization ready before the actual derivatization reaction. This ultimately leads to the identification of these drugs.

Gamma-Hydroxybutyrate (GHB), Gamma-Butyrolactone (GBL), Trimethylsilyl Derivatization

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