B31 Analyzing Gamma-Hydroxybutyrate (GHB) by Fourier Transform Infrared Spectroscopy (FTIR) With Minimal Sample Preparation

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Learning Overview: After attending this presentation, attendees will understand how to detect the Schedule 1 controlled substance GHB and distinguish it from the non-scheduled Gamma-Butyrolactone (GBL) using FTIR.

Impact on the Forensic Science Community: Due to different legal classifications of GHB and GBL, it is imperative that forensic chemists have the tools to distinguish between the two substances. This presentation will impact the forensic science community by demonstrating one such tool, FTIR, to allow for such a distinction.

Typically, forensic drug laboratories often rely on Gas Chromatography/Mass Spectrometry (GC/MS) instrumentation for the separation and detection of controlled substances. However, GHB converts within the high-temperature injection port to the non-scheduled GBL. Due to different legal classifications of these substances, it is imperative that forensic chemists have the tools to distinguishing between the two substances.

One commonly used traditional method of analysis includes derivatization of GHB followed by GC/MS, stabilizing GHB from dehydration cyclization to GBL.[1-3] Derivatization is a somewhat lengthy process and requires the use of a toxic chemical—N,O-Bistrifluoroacetamide (BSTFA). Alternatively, GHB analysis can be performed by liquid-liquid extraction, requiring a firm grasp of solubility of GHB in sample matrix versus extraction liquid.[4] Unfortunately, this approach is complicated by the limited solubility of GHB and often yields too little recovered product to perform a confirmation. Finally, both ^{1}H and ^{13}C Nuclear Magnetic Resonance (NMR) have been reported for the identification of GHB in forensic analysis; however, many forensic laboratories do not have access to this instrumentation.[5]

The DC Department of Forensic Sciences Forensic Chemistry Unit currently uses the BSTFA derivatizing agent to confirm detection of GHB by GC/MS. Therefore, it was important to investigate if another method could be implemented to support routine casework, or at least provide another orthogonal method for confirmation. This research project focused on demonstrating the FTIR method using samples in pure liquid matrices. A consequence of this research was the demonstration of a more rapid and safer preparation method, as well as an efficient detection method for GHB and GBL using FTIR.

A validation of the sample preparation and analytical detection was performed as part of this research project. The validation was based off a previously validated cocaine method (for base vs. salt form) in determining selectivity, matrix effects, precision, limit of detection, and robustness for GHB and GBL. The analysis proved successful in this work, except for complications found in some complex matrices. The different solvents used to study matrix effects were: (1) ethanol, (2) methanol, (3) water, and (4) glycerin. It was discovered that when GHB is mixed in these matrices, the broad hydroxyl peak around 3,300 cm^{-1} provided a challenge in resolution of characteristic functional groups within the spectrum. This effect can be addressed; however, by systematically removing the matrix via nitrogen evaporation. This process was demonstrated with water in the present study, to be expanded upon in future studies to the other matrices. Further, future research will focus on addressing sugar-saturated solutions, as GHB is often knowingly or unknowingly consumed in sugary drinks, such as juice, mixed alcoholic drinks, or sodas.

Reference(s):

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