



B16 GHB Free Acid: More on Issues of Interconversion With Isolation and Spectroscopic Characterization of Forensic Analysis

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The detection and spectroscopic characterization of GHB (gamma-hydroxybutyric acid) free acid are presented and discussed in relation to forensic analysis. After attending this presentation, the participant will be familiar with the occurrence of GHB free acid in forensic evidence, will understand the limitations of current analytical approaches with respect to detecting GHB free acid and discriminating between GHB free acid and its salts, will learn about a successful approach to the isolation and spectroscopic characterization (IR, ¹HNMR) of GHB free acid for forensic analysis, and will gain an understanding of the aqueous solution chemistries of GHB and GBL derived from a multitechnique-based (IR, ¹HNMR, HPLC-UV) study of the effects of solution pH.

Clandestine manufacture of GHB typically produces GHB salts. The most commonly encountered salt has been the sodium salt, although potassium salts and sodium/potassium salt mixtures have also been encountered. GHB salts may occur as relatively pure solids, wet pastes, or in solution. Although GHB has frequently been encountered as a salt, GHB free acid has been encountered in forensic evidence according to one of two general scenarios: (1) from the "spiking" or "lacing" of acidic aqueous beverages with GHB salts; (2) from the conversion of GBL (gamma-butyrolactone) to GHB in acidic aqueous-based GBL products or spiked beverages. GHB free acid has not been encountered in isolated or neat form.

Analytical methods that have been reported for the detection and identification of GHB in forensic analysis include GC-MS, LC-UV, LC-MS, and IR. However, there have been no reports of analytical methods or approaches to discriminate between GHB salts and the free acid. In GC-MS analysis, GHB is typically derivatized (BSTFA) for detection; discrimination between the free acid and salts is lost with the addition of pyridine or other organic bases during the derivatization process. In LC-UV or LC-MS analysis, the ability to discriminate is lost due to the use of acidic buffers in the mobile phase, or to the facile conversion between GHB free acid and anionic forms during the mass spectral experiment.

Previous reports of GHB analysis using IR have involved one or more of GHB's salts. Although GHB free acid is known to occur in large proportions in acidic aqueous-based GBL products, its infrared spectrum is largely masked in measurements made on the neat products. This scenario may lead to apparent discrepancies in the detection of GHB free acid in forensic samples analyzed by IR vs. other analytical techniques. The discrimination between GHB salts and free acid is made more difficult because analytical standards or reference materials for GHB free acid are not commercially available. Although it is well known that GHB free acid will exist in aqueous acidic solutions in equilibrium mixtures with GBL, isolation of the free acid from the lactone has not been reported. Moreover, the literature describing the properties of GHB free acid in its pure state or neat form is extremely limited.

In this work, small amounts (ca. 1 mg quantities) of GHB free acid were prepared for use as a reference material. GHB free acid was produced instantaneously in solution by reacting the sodium salt with a stoichiometric amount of hydrochloric acid, and subsequently isolated in its neat form. It was necessary to tightly control the amount of acid added in order to avoid either formation of lactone (GBL) in the presence of excess acid, or incomplete conversion of the salt to the free acid under limited acid conditions. Both infrared (IR) and proton nuclear magnetic resonance (¹HNMR) spectroscopy were used to verify the identity of the reference material, to discriminate between GHB free acid and salt, and to check for formation of GBL. High performance liquid chromatography with ultraviolet detection (HPLC-UV) was used to determine the yields of free acid produced from the salt and to monitor for presence of the lactone.

As a further basis for the understanding of the occurrence of GHB free acid in forensic samples, the aqueous solution chemistries of GHB and GBL were studied as a function of solution pH. Simultaneous measurements were made on freshly prepared GHB or GBL solutions using IR, ¹HNMR, and HPLC-UV. These measurements enabled the determination of the exact chemical species (free acid, anion, lactone) present in solution as a function of pH. Both the IR and ¹HNMR spectra were shown to track the changing proportions of GHB free acid and anion, which occur as a function of pH, while also detecting the presence of lactone which rapidly forms in low pH GHB solutions. Using these approaches, the detection of the free acid in actual forensic samples is presented, and apparent discrepancies in the detection of GHB free acid may be avoided.

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