

## K24 The Discovery of Gamma-Butyrolactone (GBL) in JUUL® E-Liquids

Alaina Holt, BS\*, North Chesterfield, VA 23235; Michelle R. Peace, PhD, Virginia Commonwealth University, Richmond, VA 23284; Justin L. Poklis, BS, Virginia Commonwealth University, Richmond, VA 23219-0613; Caroline O. Cobb, PhD, Virginia Commonwealth University, Richmond, VA 23284

**Learning Overview:** The goal of this presentation is to discuss the dangers of vaping. After attending, attendees should be able to recognize the significance of unlabeled components, including GBL, in e-liquids and their implications to the forensic community.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by informing attendees of the presence of GBL in JUUL® products and its implications in forensic science.

**Background/Introduction:** GBL is a List I chemical because, while it has legitimate industrial uses, it can also be used to manufacture Gamma-Hydroxybutyrate (GHB), a controlled substance. Both are recreationally abused as club drugs and are used in drug-facilitated crimes, especially date-rape scenarios. GBL is a chemical with a variety of recognized industrial uses; it is a common solvent, flavoring agent, and is used in the manufacturing of other chemicals and pharmaceuticals. It is taken as a drug for a multitude of reasons, such as improving athletic performance, sexual performance/pleasure, and sleep and has also been used for relieving stress and depression, inducing relaxation, releasing growth hormone, and trimming body fat.

The presented study documents the discovery of GBL in e-liquid from “pod-mods” made by JUUL®. Though GBL has documented use as a flavorant, the discovery of GBL in e-liquids is alarming. There is a general lack of human clinical studies regarding the efficacy and safety of GBL ingestion. Another alarming consideration is the lack of any studies regarding inhalation of GBL and what effect this route of administration has on humans.

**Hypothesis:** The objective of this study was to evaluate the chemical composition of two e-liquids before use in a human clinical study designed to compare vaping an e-liquid with only nicotine to one that contains nicotine and Cannabidiol (CBD). The unexpected identification of GBL necessitated quantification.

**Methods:** JUUL® samples were provided by the Behavioral Health Research Lab at Virginia Commonwealth University and purchased from a number of local retail outlets as well as directly from JUUL® online. Samples were screened using Direct Analysis in Real Time-Mass Spectrometry (DART®-MS) followed by a 1:100 dilution in methanol analyzed by Gas Chromatography/Mass Spectrometry (GC/MS). A liquid chromatography-triple quadrupole mass spectrometry method was employed for the quantification of GBL.

**Results:** DART®-MS and GC/MS analysis of the JUUL® pod e-liquid resulted in the identification of propylene glycol, vegetable glycerin, and nicotine along with benzoic acid and several compounds assumed to be flavoring agents: beta-damascenone, veratraldehyde, and triethyl citrate. Also identified were veratraldehyde propylene glycol acetal (a flavorant-propylene glycol adduct) and GBL. Evaluated samples were found to contain an average of 0.37mg/mL GBL.

**Conclusion/Discussion:** The compounds identified included carriers, nicotine, and flavorants, plus GBL. Quantification of the unlabeled GBL can potentially elucidate pharmacological and/or toxicological implications of inhaling these products. The presence of GBL in e-liquids at any concentration is a cause for concern. GBL is a Class I chemical. Also troublesome is the lack of studies regarding the effects of inhalation of GBL, which is a more direct route of administration. GBL is extremely potent, with reported doses ranging from 1–12mL when high-purity GBL is ingested orally. Finally, e-liquids often contain alcohol, with concentrations as high as 25%. GBL has been shown to have severe consequences when ingested with other drugs, including alcohol, due to drug interactions.

*This project was supported in part by the National Institute of Justice [2018-75-CX-0036] and National Institute of Health [P30DA033934, U54DA036105]. The opinions, findings, and conclusions or recommendations expressed in this publication/program/exhibition are those of the author(s) and do not necessarily reflect those of the Department of Justice.*

### GBL, JUUL®, Mass Spectrometry