B186 Cannabinoid Vapor Pressure Measurements and Predictions by Porous Layer Open Tubular-Cryoadsorption (PLOT-Cryo)

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After attending this presentation, attendees will be able to apply knowledge of thermophysical properties of cannabis plant compounds Cannabidiol (CBD) and Δ9-Tetrahydrocannabinol (THC) in the design and development of vapor phase, cannabis detection devices.

This presentation will impact the forensic science community by providing insight into how the complex chemistry of cannabinoid compounds complicates breathalyzer development for cannabis detection.

Cannabinoids are large, polar molecules that react with oxygen; thus, thermophysical property data (upon which to base sensor design) for cannabinoid compounds are difficult to measure and find in the literature. Additionally, there are several aspects of THC that make collecting and analyzing it in bodily fluids complex. For one, THC is rapidly metabolized in the body, is excreted in the urine as a glucuronic acid conjugate, and a small portion of THC is stored in adipose tissue and released slowly over long time periods (hours, days, or weeks). Thus, not only is it difficult to measure the thermophysical properties of these compounds, but it is also a measurement challenge to detect the trace amounts of cannabinoids found in exhaled breath.

In this study, the vapor pressure and enthalpies of association of THC and CBD were made possible by the use of the ultra-sensitive, quantitative, trace headspace analysis technique PLOT-cryo.[1-4] The mass collected in the vapor phase will be presented in the form of a van't Hoff equation plot, which expresses the concentration collected as a function of temperature. A linear relationship of the recovered mass as a function of inverse collection temperature reveals the predictive capability of the methodology employed here. The measurements of the vapor pressure data and predictions (based on these measurements) of the Normal Boiling Temperatures (NBTs) and the critical constants will be presented. Additionally, predictions for the vapor pressures at closer to ambient temperatures will be presented. Comparisons of the vapor pressures of both ethanol and n-eicosane will also be discussed.

In conclusion, this study demonstrates that the vapor pressure of cannabinoids at close to ambient temperatures are predicted to be approximately eight orders of magnitude lower than the vapor pressure of ethanol, the rather simple chemical compound that is measured to determine alcohol intoxication. These measurements and predictions lay the foundation for understanding the partitioning of cannabinoids from the blood into the breath, and ultimately pave the way for the design and advancement of breathalyzers in the context of illicit cannabis detection.

Reference(s):

1. Lovestead, T.M. and T.J. Bruno. Determination of Cannabinoid Vapor Pressures to Aid in Vapor Phase Detection of Intoxication. *Forensic Chemistry.* 2017. 5: p. 79-85.
2. Lovestead, T.M. and T.J. Bruno, Detection of poultry spoilage markers from headspace analysis with cryoadsorption on short alumina PLOT columns. *Food Chemistry.* 2010. 121(4): p. 1274-1282.
3. Lovestead, T.M. and T.J. Bruno, Detecting gravesoil with cryoadsorption on short alumina PLOT columns. *Forensic Sci. Int.* 2011. 204: p. 156-161.
4. Lovestead, T.M. and T.J. Bruno, Trace Headspace Sampling for Quantitative Analysis of Explosives with Cryoadsorption on Short Alumina PLOT Columns. *Analytical Chemistry.* 2010. 82(13): p. 5621-5627.

Cannabis, Vapor Pressure, Breathalyzer

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