B143 The Differentiation Between Industrial Hemp and Marijuana Through Colorimetry, Spectroscopy, and Volatile Organic Compound (VOC) Profiles

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Learning Overview: After attending this presentation, attendees will better understand three different approaches to differentiating between industrial hemp product (<0.3% THC) and marijuana.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by suggesting a three-pronged approach to differentiate between industrial hemp and marijuana easily, rapidly, and accurately.

The 2018 Farm Bill permits the cultivation and legal trade of Industrial Hemp in the United States. Hemp is defined as *Cannabis sativa* and any part or derivative of the plant, including seeds, that has a Tetrahydrocannabinol (THC) concentration below 0.3% (w/w). There is now an urgent need to differentiate hemp from marijuana (THC content >0.3%) with a fast and easy-to-use analytical method. A three-pronged approach was investigated in order to find a suitable method(s) for differentiating between hemp (<0.3% THC content) and marijuana.

The first approach was the development of a semi-quantitative color test for the Fast Blue BB (FBBB) reagent and THC reaction producing an easily discernable red color above the 0.3% THC threshold. An extraction procedure was developed that allowed the plant material to be placed in an extraction tube without the need for weighing. In addition, the extraction solvent was able to be placed onto a Capillary Microextraction of Volatiles (CMV) device that was preloaded with FBBB reagent. A deep red color indicated a positive result and the CMV was then desorbed into a Gas Chromatography/Mass Spectrometry (GC/MS) for confirmation and quantitation of the chromophore formed between FBBB and THC.

Recent studies have shown the capability for near-infrared spectroscopy to detect and quantify cannabinoids from *Cannabis sativa* directly from the plant samples.[1,2] Hemp and marijuana were also analyzed using an Infrared (IR) -Tracer 100 Fourier Transform Infrared Spectrophotometer (FTIR) with a Near IR kit attachment (Shimadzu® Corporation) and with the SCIO®. Chemometrics techniques (Principle Component Analysis [PCA], Partial Least Squares Discriminant Analysis [PLSDA]) were used to extract the data from the Near IR spectra obtained and the data sets from the IR-Tracer 100 and the SCIO® were compared to each other. This comparison displayed the ability for hemp and marijuana to be differentiated using the SCIO®.

The third and final method involved differentiating hemp and marijuana using their VOC profile. A previous study in the Almirall lab reported variations in the VOC profiles of hemp products and marijuana.[3] For this study, industrial hemp was purchased from various vendors, and marijuana samples were obtained from local law enforcement. Dynamic headspace sampling was optimized and performed on hemp and marijuana samples to collect and preconcentrate the VOCs onto the CMV. Multivariate analysis was then used to observe if industrial hemp and marijuana could be distinguished using their VOC profile. The results show that marijuana and hemp can be distinguished in this manner.

Reference(s):

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2. Borille, Bruna Tassi, Marcelo Caetano Alexandre Marcelo, Rafael Scorsatto Ortiz, Kristiane De Cássia Mariotti, Marco Flôres Ferrão, and Renata Pereira Limberger. Near Infrared Spectroscopy Combined with Chemometrics for Growth Stage Classification of Cannabis Cultivated in a Greenhouse from Seized Seeds. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* 173 (2017): 318-23.
3. Wiebelhaus, Nancy, D'Nisha Hamblin, Natasha M. Kreitals, and Jose R. Almirall. Differentiation of Marijuana Headspace Volatiles from Other Plants and Hemp Products Using Capillary Microextraction of Volatiles (CMV) Coupled to Gas-chromatography–mass Spectrometry (GC–MS). *Forensic Chemistry* 2 (2016): 1-8.

Cannabis, Hemp, Near IR Spectroscopy