B19 A Characterization of the Vapor Profiles of Fentanyl and Synthetic Opioids for Instrumental and Canine Detection

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Learning Overview: After attending this presentation, attendees will better understand the methods used for headspace analysis as well as similarities and differences in the vapor signatures of differing fentanyl and fentanyl-related samples.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by describing the research to determine the vapor signatures of fentanyl and related analogs.

Fentanyl is a Schedule II synthetic opioid, approved for use as a painkiller and anesthetic, and known for its strong analgesic and euphoric properties. In recent years, there has been an escalation in fentanyl abuse as indicated by a 65% increase in fentanyl reports submitted to the National Forensic Laboratory Information System (NFLIS) from 2016 to 2017, making fentanyl the fifth most-frequently identified drug at crime labs by NFLIS in 2017, and drug seizures have continued to increase through 2019.[1,2] The ability to detect bulk product as it crosses our borders and prior to its street distribution is an important part of defeating the problem. However, the high potency of fentanyl is of great danger to users as well as law enforcement officers. Since ingestion of milligram amounts can cause an overdose, many enforcement agencies instruct their officers to avoid any direct contact with material suspected of containing fentanyl.[3]

Given this current environment, providing a safe and effective method for field detection of fentanyl and related substances for law enforcement officers and first responders is imperative. To minimize the risk, non-contact detection methods such as vapor detection are preferred. Vapor detection has the benefit of being non-contact and non-intrusive, although vapor sampling is only feasible when the target vapor is present at concentrations high enough to be detected. Though the low volatility of target analytes such as pharmaceuticals can limit instrumental vapor detection, this can be overcome through preconcentration sampling, such as using Solid Phase Microextraction (SPME). Biological detectors such as canines are other examples of highly efficient field vapor detectors and are frequently used in the detection of low volatility analytes such as explosives and narcotics. Canine detectors overcome low vapor availability by detecting the odors *associated* with the parent molecule instead of the parent molecule itself. The collection of Volatile Organic Compounds (VOCs) associated with the parent material can be referred to as its vapor signature.

SPME was used to extract volatiles from the headspace of solid fentanyl samples with analysis by Gas Chromatography/Mass Spectrometry (GC/MS). Following method optimization, the headspaces of fentanyl samples, to include pharmaceutical-grade as well as street exhibits, were measured. Analysis also included a lot-to-lot comparison of the pharmaceutical-grade material, in addition to evaluation to fentanyl analogs. Finally, forced degradation experiments, including thermal, oxidative, and acid degradation, were carried out to determine the origin of the analytes making up fentanyl's vapor signature.

A number of analytes were identified in the headspace of solid fentanyl. Analytes making up the vapor signature of fentanyl included benzaldehyde, pyridine, aniline, N-phenylpropanamide, and N-Phenyl-4-Piperidinone (NPP). In future research, the identified vaporous analytes will be used as targets for detection.

Reference(s):

1. Drug Enforcement Administration, DEA-DCT-DIR-007-20 (Dec. 2019).
2. U.S. Customs and Border Patrol. *CBP Enforcement Statistics Fiscal Year 2020*. Retrieved from https://www.cbp.gov/newsroom/stats/cbp-enforcement-statistics on 07 July 2020.
3. Drug Enforcement Administration, DEA-DCT-DIR-040-17 (Oct. 2017).

Fentanyl, Opioid Detection, Headspace Analysis