B78 The Effects of Degradative Stress on Vapor Analysis of Fentanyl

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Learning Overview: After attending this presentation, attendees will better understand how degradative stress affects the compounds found in the headspace profile of fentanyl.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing information about the origins of the compounds found in the unique headspace profile of fentanyl.

Fentanyl is a Schedule II synthetic opioid with a potency 100 times greater than that of morphine. It was first synthesized in 1960 by Dr. Paul Janssen and is used to treat severe short-term and chronic pain in cancer patients or as an anesthetic.[1,2] According to the Centers for Disease Control (CDC), in 2017, there were 70,000 overdose victims in the United Sates, 30,000 of which were attributed to fentanyl or a related analog, a 45% increase of fentanyl overdoses from 2013.[2] However, with recent restrictions put in place on fentanyl prescriptions, most of the fentanyl abused is purchased illegally. Illegal fentanyl is produced mainly in China and enters the United States via criminal transport organizations from places such as the Caribbean and Mexico. With an increase in the overdose rate, as well as the constant flow of fentanyl into the country, it is important for law enforcement to have a reliable method to detect fentanyl at ports of entry. Furthermore, it is even more pressing for this method to be non-contact to maintain the safety of first responders and other law- and customs-enforcement agents.

Vapor detection, such as by canine or electronic nose, has great potential as a non-contact detection method. Understanding a substance's unique headspace profile is imperative for the development of any vapor detection. For instance, knowledge of the headspace profile can also be utilized to develop safe training aids for canine detectors. This research focused on determination of the origin of the compounds making up the headspace profile of fentanyl. This presentation will describe the use of degradative stress to determine the origin of each compound in the headspace profile of fentanyl.

Solid Phase Microextraction (SPME) followed by analysis using Gas Chromatography/Mass Spectrometry (GC/MS) were used to determine the Volatile Organic Compounds (VOCs) that compose the headspace profile of fentanyl. In order to determine the origin of the VOCs in fentanyl's headspace profile, a series of degradative experiments were performed. Fentanyl samples were subjected to degradation via thermal and oxidative stress. For thermal degradation, the headspace profile was studied at 40°C and ambient (22°C) under dry and humidified conditions. For oxidative degradation, fentanyl samples were placed in either an inert or oxygen-rich environment at either room temperature or 40°C.

Based on these studies, a number of analytes were identified in the headspace profile of fentanyl. These compounds included styrene, benzaldehyde, aniline, N-phenylpropanamide, and N-Phenethyl-4-Piperidone (NPP). Out of these compounds, benzaldehyde was indicative of oxidative degradation. The identification of these VOCs in the headspace of fentanyl and fentanyl undergoing degradation provided essential information of fentanyl's unique headspace signature as well as to the origin of these compounds.

Reference(s):

1. Schulz, William G. Fentanyl: Typical Narcotic. *Chemical and Engineering News* 83, no. 25 (2005). https://cen.acs.org/articles/83/i25/Fentanyl.html.
2. Knierim, Paul E. *Tackling Fentnayl: The China Connection*. 2018. https://www.cdc.gov/nchs/data/databriefs/db294.pdf.

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