B60 Differentiation of Isobaric and Isomeric Fentanyl Analogs by Gas Chromatography/Mass Spectrometry (GC/MS)

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Learning Overview: After attending this presentation, attendees will understand the differentiation of isobaric and isomeric fentanyl analogs using Gas Chromatography/Mass Spectrometry (GC/MS).

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing the GC/MS data of 60 compounds grouped into the different structural and geometric (cis-trans) isomeric forms of fentanyl analogs. A scheme for separating and identifying each of the components will also be presented.

Fentanyl, a powerful pharmaceutical grade opioid, has been used for decades to treat pain. Numerous fentanyl-type compounds began to emerge in the illicit market beginning in 2015. To date, a wide variety of fentanyl analogs, such as cyclopropyl fentanyl and 3-methylfentanyl, have been identified by forensic practitioners. Isobaric and isomeric analogs of fentanyl pose challenges for identification and differentiation of these compounds in forensic casework.

In this study, 60 of fentanyl analogs, including structural and geometric isomers, were analyzed by GC/MS. GC/MS conditions: column, Restek, Rtx-5 MS, 30 m × 0.32 mm I.D., 0.5 µm film thickness (Phase composition, Crossbond 5% diphenyl / 95% dimethyl polysiloxane, similar columns: DB-5MS); oven temperature, 100°C (1min hold) and programmed up to 300°C at a rate of 20°C/min; injection port temperature, 300°C; carrier gas, helium at the rate of 2.0mL/min; sample injection, split mode with the split ratio of 15:1; ionization, Electron Ionization (EI); electron energy, 70 eV; the transfer line temperature was 300°C, and the source temperature was 230°C. Each solution was prepared by dissolving 1mg of each component in 1mL of HPLC-grade methanol. 1.0µL injection of each 1.0mg/mL solution was analyzed.

Extracted Ion Chromatogram (EIC) function was used to select key fragments of the fentanyl analogs. Relative retention time (RRT) was used to minimize the impact of retention time variation. RRT is expressed as the ratio of retention time of a compound to the internal standard. Fentanyl was introduced as an internal standard and mixed in all samples. The combination of RRT and EIC were used to identify each component.

Five positional or geometric isomers of the fluoro substituted 3-methyl fentanyl were separated by slowing the temperature ramp to 3°C/min. Similar groups were also separated by GC/MS. Oven temperature was determined to be critical to achieve successful separation. By slowing down the rate of the oven temperature program, complete chromatographic separation and baseline resolution of more than 1.5 was achieved.

To determine if the tuning of the mass spectrometer influenced the ratio of the characteristic fragment ions various tuning types, such as the Standard Spectra Autotune (S-tune) and Low Mass tune, were examined. The effects of the alternate tuning methods on Cyclopropyl fentanyl and crotonyl fentanyl will be presented.

Fentanyl, Isomer Determination, GC/MS