B171 The Identification of a Novel Fragmentation Pathway of Synthetic Cathinones

J. Tyler Davidson, MS, West Virginia University, Morgantown, WV 26505; Zachary J. Sasiene, BS, West Virginia University, Morgantown, WV 26506; Younis F. Abiedalla, PhD, Auburn University, Auburn, AL 36830; Randall Clark, PhD, Auburn University, Auburn, AL 36849; Glen P. Jackson, PhD, West Virginia University, Morgantown, WV 26506-6121*

Learning Overview: After attending this presentation, attendees will know about a novel fragmentation pathway observed through protonated tandem mass spectra of synthetic cathinones. Attendees will also learn the concepts of Multistage Mass Spectrometry (MS^n) and isotopic labeling for structural elucidation and will gain a sense of the similarities and differences between the fragmentation behavior of drugs that are fragmented under different conditions, such as Electron Ionization (EI), Electrospray Ionization with Collision-Induced Dissociation (ESI-CID-MS), and Direct Analysis in Real-Time (DART) ionization with triple quadrupole mass spectrometry.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing a better understanding of the fragmentation of synthetic cathinones under different ionization and fragmentation conditions. Additionally, the identification of a novel fragmentation pathway(s) for the generation of the tropylium ion (m/z 91) and the methylenedioxy derivative (m/z 135) with the use of MS^n and isotopic labeling helps clarify confusion about the origin of these ions.

Hypothesis: The central hypothesis is that the combination of MS^n mass spectrometry and isotopic labeling will result in the identification of an unexplained fragmentation pathway(s) for the generation of the tropylium ion for synthetic cathinones. The authors hypothesize that the ionization conditions, fragmentation conditions and substituent groups will affect the propensity for the formation of the tropylium ion along this novel pathway.

Methods/Results: Analyses involved the identification of a novel fragmentation pathway for the generation of the tropylium ion (*m/z* 91) or methylenedioxy derivative (*m/z* 135) using a combination of MS^n mass spectrometry and isotopic labeling. The compounds PV8, α-PVP, ^{13}Cα-PVP (carbonyl carbon labeled), 3,4-MDPV, and 3,4-MDPV-d8 (pyrrolidine labeled) were analyzed using: (1) a Thermo Finnigan TSQ Quantum triple quadrupole mass spectrometer operated with both ESI and DART ionization sources, (2) a Thermo Scientific LTQ Velos Pro with HESI ionization source, and (3) an Agilent Technologies 7890B GC/5977A MS.

Preliminary results indicate that ESI and DART ionization sources produce similar tandem mass spectra, because both ion sources start with intact protonated molecular ions. Tandem mass spectra, either from in-source CID, beam-type CID or ion trap CID show the tropylium ion, or corresponding methylenedioxy derivative, in all samples analyzed. However, under traditional EI fragmentation, the abundance of the tropylium ion is negligible. The DART and ESI data were collected on the triple quadrupole using in-source CID to produce pseudo MS^3 spectra. However, pseudo MS^3 spectra were not able to definitively prove the mechanism proposed through this work, so MS^n was performed using the LTQ Velos Pro linear ion trap.

The proposed mechanism begins with the loss of the pyrrolidine ring from the $[M+H]^+$ precursor. A gamma hydrogen shift leads to a carbon skeleton rearrangement involving a cyclobutone ring fused with the benzene ring. The bicyclic structure then rearranges to eliminate a CO neutral and produce the tropylium ion. Particularly novel is that when the CO neutral is lost, the oxygen from the carbonyl group appears to be equally likely to leave with the original carbonyl carbon or with the carbon atom adjacent to it. These pathways have been proven through ^{13}C isotopic labeling and the observation of tropylium ions at both *m/z* 91 and *m/z* 92. The mechanism is observed for α-PVP, PV8, and 3,4-MDPV.

Fragmentation Mechanisms, Isotope Labeling, Multistage Mass Spectrometry (MS^n)