B79 LC/MS Electrospray Applications and the Use of In-Source Collision Induced Dissociation (CID) in the Confirmatory Analysis of Drugs of Abuse

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The primary objective is to present the versatility of LC/MS electrospray ionization for the analysis of drugs of abuse that are routinely encountered by drug chemists.

This presentation will impact the forensic science community by demonstrating how LC/MS has been established as a confirmatory technique for the analysis of drugs of abuse and is complementary to standard gas chromatography mass spectroscopic techniques that have been used for years.

The presentation will focus on the applicability of liquid chromatography mass spectrometry (LC/MS) and the use of in-source collision induced dissociation (CID) as a routine confirmatory technique in the analysis of seized drugs of abuse. The use of electron ionization (EI) gas chromatography mass spectrometry (GC/MS) has been considered the standard in the confirmatory analysis of controlled substances and adulterants encountered in illicit drugs. The capabilities of mass spectrometry has expanded over the years to include softer ionization techniques such as electrospray ionization (ESI) and atmospheric pressure chemical ionization (APCI), making the analysis of drugs by LC/MS more routine.

The complementary technique of LC-ESI-MS provides molecular weight information in the form of a protonated or deprotonated molecular ion depending on the structural functionalities of the compounds of interest and the ionization mode of polarity.

Since electrospray sources yield low fragmentation, spectral specificity can be achieved with a single quadrupole LC/MS via in- source CID. In-source CID occurs when energetic collisions in the electrospray source are induced by colliding ions with a neutral gas such as nitrogen. This is achieved by varying the ion energies in the mid- transport region between the ion transfer capillary exit and the first skimmer. The collision energies are directly proportional to the fragmentor voltage. The ability to dynamically ramp ion energies, in which fragmentor voltages are ramped in unison with the *m/z* scan, is an available option. These processes introduce sufficient internal energy into the protonated or deprotonated molecular ions resulting in more extensive fragmentation providing an additional level of specificity for spectral identification.

The optimization of the chromatographic separation is critical using a single quadrupole LC/MS system since a complete separation of compounds is necessary to maximize fragmentation efficiency. All separations were performed using either a C-18 bonded phase or an ether linked phenyl phase (Phenomenex 15cm X 3.0mm) columns. Mobile phase conditions utilized a 10mM ammonium formate buffer pH3.7 /0.1%formic acid with either acetonitrile or methanol as the organic modifier. Electrospray parameters were optimized via flow injection analysis and collision induced dissociation experiments were performed to optimize fragmentation of compounds studied. Actual case applications will be presented focusing on the most commonly abused licit and illicit drug types encountered at our laboratory. This will include class specific methods for compounds such as phenethylamines, piperazines, anabolic steroids, benzodiazepines, tryptamines, cocaine, opium alkaloids, and common adulterants. Compound specific methods will focus on applications for LSD, psilocybin/psilocin in hallucinogenic mushrooms, fentanyl in heroin, cathinone in khat, thermally labile compounds such as thiamine, aspirin in heroin, creatine/creatinine and the screening of common pharmaceutical tablet preparations.

The availability of the LC/MS has allowed for the analysis of polar, thermally labile, and higher molecular weight compounds not readily analyzed by GC/MS. This technique has become a versatile analytical tool at our laboratory for the confirmatory analysis of seized drugs, and offers a number of advantages for the forensic drug chemist. It possesses the versatility to collect multiple mass spectral signals in a single analysis run at different fragmentor voltages, sensitivity levels exceeding GC/MS, ease of use, and overall ruggedness for high throughput analyses.

LC/MS, Collision Induced Dissociation, Drugs of Abuse

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