K30 Method Development and Validation of Dimethylamylamine (DMAA, Methylhexanamine) by Gas Chromatography-Mass Spectrometry

Brittany D. Pasierb, BS, 700 Lower State Rd, Bldg 25, Unit A8, North Wales, PA 19454; Jillian K. Yeakel, MS, 105 Revere Dr, Harleysville, PA 19438; Celeste Metzger, MS, 2300 Stratford Ave, Willow Grove, PA 19090; and Barry K. Logan, PhD, NMS Labs, 3701 Welsh Rd, Willow Grove, PA 19090*

After attending this presentation, attendees will understand how a method was developed and validated for the detection of Dimethylamylamine (DMAA, methylhexanamine) in nutritional supplements and urine samples using Gas Chromatography/Mass Spectrometry (GC/MS).

This presentation will impact the forensic science community by providing a method for the detection of the emerging drug of abuse, and banned stimulant drug DMAA, and raise awareness of its use and presence in over-the-counter supplements and "legal highs."

Marketed as a nasal decongestant in the 1940s, DMAA, also known as methylhexanamine, currently has no recognized medical use. In 2006, the compound began to be added to nutritional supplements such as weight-loss preparations and pre-exercise pills. DMAA is a central nervous system stimulant which in excess produces effects similar to, but not as intense as, amphetamine. Combined with its availability and perceived low toxicity, DMAA is highly susceptible to abuse. DMAA use was recently associated with the death of two United States soldiers, was added to the World Anti-Doping Agency's Prohibited List, and is currently restricted in several countries.

As the compound is restricted in a number of countries worldwide, it is important to have an established, reliable method for its detection. Quantifying the concentration of DMAA in popular nutritional supplements will also benefit the forensic science community to the extent of determining just how potent and dangerous these supplements are to the public.

The objective of this research was to develop and validate a method for the detection of methylhexanamine in nutritional supplements and urine samples using GC/MS.

The analysis of DMAA is more challenging due to its two diastereomers and reactive primary amine group. After reconstitution studies with methanol, acetonitrile, isopropanol, ethyl acetate, and dichloromethane, DMAA was determined to be insufficiently stable for proper analysis on the GC/MS without derivatization. Following time and temperature studies, a successful derivatization method using 4-carbethoxyhexafluorobutyrl chloride (4-CB) that produced the two expected DMAA chromatographic peaks was developed. Extracts were derivatized by addition of 4-CB with ethyl acetate at 70°C for 20 min. Detection was performed by selected ion monitoring by GC/MS, using amphetamine-d5 as an internal standard.

A Liquid-Liquid Extraction (LLE) technique was used to isolate DMAA using concentrated ammonium hydroxide and chloroform/isopropanol/n-heptane (50:17:33) as the organic extraction solvent. The solvent was removed and evaporated at 33°C under a stream of nitrogen gas. Successful calibration curves have been established across the concentration range 1 – 20µg/mL. The curves generated acceptable r^2 values of 0.997 for DMAA peak 1 and 0.998 for DMAA peak 2. Successful calibration curves have also been established across the concentration range of 10 – 100ng/mL. These curves generated acceptable r^2 values of 0.994 and 0.993 for DMAA peak 1 and DMAA peak 2 respectively. In addition, the limit of detection and limit of quantitation were both preliminarily determined to be better than 10ng/mL, which is determined to be acceptable for both the analysis of solid dosage materials and expected concentrations in biological fluids.

The method is being applied to analysis of DMAA in nutritional supplements containing the drug and to biological samples. The presentation will also review the pharmacology of DMAA and reported adverse effects.

DMAA, Supplements, GC/MS

 ** Presenting Author*