E43 An Examination of the Effects of *Salvia divinorum* Fortification on Stable Isotope Ratios

David A. Barajas, BA, Boston University School of Medicine, 72 E Concord Street, R 806, Boston, MA 02118; Todd E. Dawson, PhD, University of California, Berkeley, Dept of Integrative Biology, 3040 Valley Life Science, Bldg 3140, Berkeley, CA 94720-3140; Robert Michener, MS, Boston University Stable Isotope Laboratory, Dept of Biology, 5 Cummington Street, Boston, MA 02215; and Sabra R. Botch-Jones, MS, MA, Boston University School of Medicine, Biomedical Forensic Sciences, 72 E Concord Street, Boston, MA 02118*

After attending this presentation, attendees will understand the principles of stable isotope analysis and its impact on determining the geographic origin of commercially available samples of the plant species *Salvia divinorum.* Attendees will also understand the effect fortification has on stable isotope ratios and how this affects interpretation with regard to predicting the origin of cultivation.

This presentation will impact the forensic science community by revealing how the stable isotope ratios of fortified drug samples do not reflect those of unfortified drug samples. Interpretation of fortified sample stable isotopes results in an incorrect classification of the drug to a region of growth. This presentation will also contain the first known published data on stable isotope ratios of *Salvia divinorum* as it pertains to geographic areas of cultivation.

Salvia divinorum is a plant species found in Oaxaca, Mexico. The leaves of this plant contain the active compound Salvinorin A, which, when smoked, causes the user to experience hallucinogenic effects. Currently, *Salvia divinorum* is not listed as a scheduled drug under the United States' Controlled Substances Act, though some states such as Ohio and Texas have passed laws to prohibit its sale and/or use. Commercially available *Salvia divinorum* products are available in fortified extract concentrations claiming to contain up to 50 times the Salvinorin A concentrations naturally present in *Salvia divinorum*.

Stable isotope ratios of elements such as Carbon (C), Nitrogen (N), Oxygen (O), and Hydrogen (D) reflect the environmental conditions, such as atmospheric carbon dioxide and water stress, which are unique to a geographical region. These isotopes ratios are present in the local plant species of an area; thus, plants can inform researchers as to the elemental makeup of a region, as well as whether the plant was grown indoors or outdoors. In a previous study, Booth demonstrated the effectiveness of using stable isotope ratio data of marijuana for the determination of drug trafficking patterns.[1]

In this experiment, commercially purchased dried leaf samples of *Salvia divinorum* were finely pulverized and analyzed using isotope ratio mass spectrometers. Stable isotope ratios ($\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$, and δD) for *Salvia divinorum* were determined for the geographic regions of Oaxaca, Mexico, and Hawaii, USA. Samples with fortified extracts of 5x, 15x, 35x, and 50x were compared to standard organic leaves. It was determined that the stable isotope ratios were affected by increasing fortification. Analysis of variance of $\delta^{13}C$, $\delta^{15}N$, and $\delta^{18}O$ data demonstrated that fortified leaves resulted in a statistical difference from organic leaves, though this difference did not affect interpretive value. δD showed a statistically significant difference between organic leaves and fortified leaves. Hydrogen demonstrated the greatest variation with fortification and did not reflect its original geographic origin. Fortification displayed the ability to change stable isotope ratios such that the interpretive value of isotope data would no longer be accurate.

Reference(s):

1. Booth A.L., Wooller M.J., Howea T., Haubenstock N. Tracing geographic and temporal trafficking patterns for marijuana in Alaska using stable isotopes (C, N, O and H). *Forensic Science International*. 202 (2010) 45–53

Stable Isotopes, *Salvia divinorum*, Trafficking