A152 Spatial Distributions of Carbon and Nitrogen Isotope Ratios in Human Hair From Central and Southern Mexico — Another Indication of Geographical Origin

Chelsey A. Juarez, PhD, Department of Soc & Anthro NCSU, 1911 Bldg, 10 Current Drive, Campus Box 8107, Raleigh, NC 27695-8107*

The goal of this study is to: (1) explore the relationship between carbon ($\partial^{13}C$) and nitrogen ($\partial^{15}N$) isotopes in human hair from traditionally high immigrant sending areas in central and southern Mexico; and, (2) explore the relationship between carbon and nitrogen values in these hair samples and published values from 14 other countries.[1-3]

This presentation will impact the forensic science community by presenting data on regional dietary differences among Mexican states and between Mexico and other countries and will assess the utility of this relationship to act as a predictor of region of origin.

The use of carbon and nitrogen isotopes in human hair, bone, and fingernails has demonstrated the ability to assist in provenance analysis for modern populations.[1-3] In this study, the influence of regional diet to predict region of origin in modern Mexican populations by analyzing carbon and nitrogen isotopes from hair was tested.

The Mexican hair samples consist of 78 samples collected from 12 contiguous states in Central and Southern Mexico, plus 10 samples collected in southeastern North Carolina. Carbon and nitrogen isotopes were measured in duplicate for samples for all locations using an elemental analyzer connected to a Finnigan–Mat Mass Spectrometer at the University of Utah SIRFER laboratory.

All data for $\partial^{13}C$ values are presented on the Vienna Peedee Belemnite (VPDB) scale, and those for $\partial^{15}N$ are presented on the Atmospheric Air (AIR) scale. Analytical precision for $\partial^{13}C$ and $\partial^{15}N$ was 0.1‰ and 0.2‰, respectively. Stable isotope ratios are reported using the standard ∂ notation. Hair values spanned a range from 8.1‰ to 10.5‰ and -23.5‰ to -19.‰ for $\partial^{15}N$ and $\partial^{13}C$ for Mexican locations, respectively. Hair values from North Carolina spanned a range from 8.4‰ to 8.9‰ for $\partial^{15}N$ and -19.2‰ to -16.6‰ for $\partial^{13}C$. A one-way Analysis of Variance (ANOVA) was conducted to determine if the mean values for $\partial^{13}C$ and $\partial^{15}N$ were different for the 12 regions in Mexico and between the Mexican regions and North Carolina. Means for measured $\partial^{13}C$ and $\partial^{15}N$ were statistically significantly different $F\ (7.87) = 9.040$ ($P < 0.05$); $F\ (7.87) = 9.04$ ($P = 0.01$). A Tukey Kramer post hoc analysis revealed that $\partial^{15}N$ values between the Mexican samples were not statistically significantly different, but values between Veracruz and North Carolina were statistically significantly different. Carbon data demonstrated the most promising differentiation. A Tukey Kramer post hoc test for carbon demonstrated within country regional differences with means for Chiapas, Mexico, the Federal District, and Oaxaca all statistically significantly different than Morelos, and Chiapas, Mexico, Oaxaca, and the Federal District all significantly different than North Carolina. The mean value for all combined Mexican states was 9.3‰ for $\partial^{15}N$ and -16.1‰ for $\partial^{13}C$. When mean values for $\partial^{13}C$ for Mexico were compared to published mean values for other countries, there was no statistically significant difference with Brazil or Costa Rica, but there were statistically significant differences between Mexico and 12 other countries.

This study demonstrates both the limitations and potential of carbon and nitrogen isotopes in human hair to distinguish provenance. Carbon isotopes clearly demonstrate regional differences both within Mexico and between Mexico and other locations, albeit more broadly than water isotopes; however, the potential demonstrated here for additional indications of region of origin suggest that carbon and nitrogen isotopes in human hair from Mexico are a reasonable investment in the analysis of region of origin.

Reference(s):

1. Mützel E., Lehn C., Peschel O., Hölzl S., Roßmann A. 2009. Assignment of unknown persons to their geographical origin by determination of stable isotopes in hair samples. *Int J Legal Med.* 123:35–40.
2. Nakamura K., Schoeller D.A., Winkler FJ.,. Schmidt H.L. 1982. Geographical variations in the carbon isotope composition of the diet and hair in contemporary man. *Biol Mass Spectrom.* 9:390–394.
3. Valenzuela L.O., Chesson L.A., O'Grady S.P., Cerling T.E., Ehleringer J.R. 2011. Spatial distributions of carbon, nitrogen and sulfur isotope ratios in human hair across the central United States. *Rapid Commun Mass Spectrom.* 25:861–868.

Provenance, Hair, Isotope

*Presenting Author