E75 Time-Dependent Changes in Human and Chicken Bones in Soil Examined by Infrared (IR), Raman, Inductively Coupled Plasma/Optical Emission Spectroscopy (ICP/OES), and Organic Elemental Analysis

Matthew J. Danker, BS, 2450 Lake Road, #907, Huntsville, TX 77340; Donovan C. Haines, PhD, Sam Houston State University, Box 2117, Huntsville, TX 77341; and Joan A. Bytheway, PhD, Sam Houston State University, College of Criminal Justice, Box 2296, Huntsville, TX 77341-2296*

After attending this presentation, attendees will better understand how changes in the organic composition of bone buried with associated muscle and tissues decays as measured by several important analytical techniques.

This presentation will impact the forensic science community by providing an extended data set that builds upon previous literature showing linear time-dependent changes in the organic content of bone as measured by Raman spectroscopy.[1] For applicability in a forensic context, this study examined bones exposed to an outdoor environment in contrast to the previous study that was conducted in an indoor, controlled environment.

Human bone consists of approximately 70% inorganic material and 30% organic material. The inorganic material is mostly the composite hydroxyapatite, which is comprised of calcium and phosphate. This links to the organic material, collagen, and the combined composite gives the bone its strength. Collagen is the predominant organic material within bone but other organic materials, including support proteins and lipids, have been established. In forensic science, the process by which bone decomposes within a soil environment is known as diagenesis. Diagenesis effectively alters the proportions of organic and inorganic components within bone by the exchange of chemical components from the soil to the bone or vice versa. A study found that the relationship between the organic matrix and inorganic matrix of bone samples have shown a linear change over the space of three months by Raman spectroscopy.[1] In another study, inorganic concentrations of calcium, phosphate, potassium, and several others were measured in various soil samples where human decomposition had occurred.[2]

In this experiment, bone samples from chickens and humans, with associated tissue and muscle, were sectioned with a saw and scalpel. The bone and associated soft tissue samples were then buried in an outdoor piney wood environment at the Southeast Texas Applied Forensic Science (STAFS) Facility, Sam Houston State University, Huntsville, TX, at a depth of six inches. The samples were harvested at 2-week intervals for 12 weeks. The bone samples were then studied by IR and Raman spectroscopy to determine the ratios of organic to inorganic material. Soil samples were taken at the same time intervals. The soil samples were taken at three sites for each bone sample: the surface soil above the buried bone, soil immediately adjacent to the bone, and an area in the same environment where no known human decomposition had occurred. The soil samples were analyzed by elemental analyzer for the amount of carbon and nitrogen present in the soil to test the amount of organic material and by ICP/OES to measure the inorganic components in the soil. The ICP/OES and IR instrumentation and support were provided by the Texas Research Institute of Environmental Studies (TRIES), Sam Houston State University, Huntsville, TX.

ICP/OES and the element analyzer preliminary analyses of soil with pre-existing human burial sites at the STAFS facility found there was a significant difference between soil in which decomposition had occurred and virgin soil. Time-dependent results for ongoing experiments measuring the leaching of bone components into soil will be presented.

In conclusion, this study provides preliminary analysis of time dependency of human and turkey bone decomposition via IR, Raman, ICP/OES, and organic element analysis. Future studies will deconvolute the organic components involved using additional analytical techniques including Gas Chromatography/Mass Spectrometry (GC/MS) of bone lipids that may migrate into the soil.

Reference(s):

1. McLaughlin G., Lednev I.K. Potential Application of Raman spectroscopy for determining burial duration of skeletal remains. *Anal Bioanal Chem* 2011, 401, 2511-2518.
2. Aitkenhead-Peterson, J.A., Owings C.G., Alexander M.B., Larison N., Bytheway J.A. Mapping the lateral extent of human cadaver decomposition with soil chemistry. *Forensic Sci Int.* 2012, 216, 127-134.

Decomposition, Diagenesis, Analysis