A9 Organic Staining on Bone

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After attending this presentation, attendees will understand the taphonomic process of organic staining on bone deposited in aqueous environments, with different organic materials introduced for extended intervals.

This presentation will impact the forensic science community by displaying taphonomic data of color staining, which will aid in investigations when questions arise concerning the environment in which remains were deposited and what type/species of plant material have made contact with the bones.

Organic staining results largely from tannins leaching from plant materials, including wood and leaves, and therefore can be seen on bone deposited in wooden coffin environments or on terrestrial surfaces. This study hypothesized that the degree of staining observed on skeletal elements would increase as the length of exposure to the organic matter increased and that different plant materials would leave different degrees or colorations of staining.

The skeletal elements consisted of 150 commercially available pig (*Sus scrofa*) femora that had the epiphyses removed and were completely defleshed. The total sample was divided into three groups with differing conditions and/or types of organic material introduced. Some were buried in a marshy environment within wooden boxes constructed of ten wood types commonly utilized in coffin construction throughout American history: chestnut (*Castanea*), walnut (*Juglans*), cherry (*Prunus*), soft maple (*Acer*), mahogany (*Swietenia*), yellow pine (*Pinus*), poplar (*Populus*), cedar (*Cedrus*), oak (*Quercus*), and spruce (*Picea*). Additional femora were deposited in plastic containers lined with the same wood types as above and filled with tap water. An additional five control bones were deposited in a container with tap water. Five additional bones were placed in a container with commercial tannic acid. The final group of femora was deposited on the ground surface surrounded by four types of dead vegetation: evergreen pine needles, northern red oak leaves (*Quercus rubra*), sugar maple leaves (*Acer saccharum*), and acorns.

The bones were removed once a month from their experimental environments and left overnight to dry to allow for the color to be recorded. The level of staining that manifested on the osseous material was recorded qualitatively using a Munsell Color Chart and a 40-watt daylight light bulb. The color staining was recorded after two months upon initiation of the study and every following month until the study's completion. After the color staining was recorded, the bones were returned to their experimental environments, and this process was repeated throughout the study.

In all of the experimental environments, staining was present after two months of contact with the organic materials and the color darkened or expanded across the bone surface with each data collection. Both groups exposed to the wood types displayed staining across the entire bone surface with a mixture of colors expressed. Over time, a few colors became dominant while minor colors were only expressed along the margins of the bone or as small patches along the shaft. As the buried boxes began to break down, which is commonly observed in coffin burials, soil was able to infiltrate the boxes and contact the bones. This resulted in multiple shades of brown (10YR 4/3; 10YR 3/3) to be present in the staining across bones in multiple wood types. The bones in the plastic containers

with wood exhibited a larger variation in color staining, likely due to a higher concentration of tannins restricted to a smaller area around the bones. The staining ranged from red (10R 5/4) for bones with the mahogany to brown (7.5YR 5/3) for bones with the cedar to even dark gray (10YR 4/1) or black (10YR 2/1) on bones with the walnut. The bones in plant matter differed from the other two groups in that the organic staining was sporadic, often with large areas of very pale brown (10YR 7/3) or yellowish brown (10YR 6/4) coloration and with smaller patches of darker brown shades (10YR 4/3; 10YR 5/2).

The results from this study indicate that staining can manifest on bone within a relatively short time frame once skeletonization occurs and a variety of colorations or degrees of staining can manifest based on the plant material. This research will aid in the determination of which types of organic material have contacted osseous remains and the potential environments in which they were deposited.

Bone Staining, Munsell, Taphonomy