

E91 The Investigation of Ancestral Origins Using Human Cranial Hair

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After attending this presentation, attendees will gain a different perspective of the amino acids that are present in human cranial hair from individuals of different ancestral origins and will recognize the vital characteristics that could potentially allow for human individualization using hair.

This presentation will impact the forensic science community as it sheds valuable insight on an unbiased method for hair analysis. This research may assist investigators in determining the ancestral origin of individuals using their hair samples on a more objective level compared to conventional forensic hair analyses.

Human hair is often collected at a crime scene, and Microscopic Hair Comparison (MHC) is typically performed, along with DNA analysis, if possible. Unknown samples are microscopically assessed and compared to those of known origin to identify distinct morphological characteristics. Although MHC is a useful screening tool, it relies heavily on the experience and knowledge of the examiner. Hence, it is more subjective and the significance of the results can easily be overstated, leading to flawed testimonies. On the other hand, DNA analysis is a confirmatory test, but results from hair are not always consistent. This is because nuclear DNA degrades rapidly during hair keratinization and is only present in the hair root. Alternatively, mitochondrial DNA (mtDNA) can be used to generate genetic profiles from samples with no root attached as it is found on the hair shaft; however, the amount of mtDNA recovered varies in each case and depends on the individual. Thus, DNA analysis using hair may not be possible in certain cases.

Unfortunately, MHC and DNA analyses are limited options that could serve as roadblocks and potentially reduce the evidentiary value of hair. Therefore, additional studies are necessary to explore other comprehensive techniques. This research utilizes a more objective approach for hair analysis, notably to assist in the differentiation of ethnic origins without the heavy scrutiny and subjective nature of MHC. Hair is mostly composed of proteins and, therefore, contains a large amount of amino acids that can provide information specific to the donor. Considering this, ratios of three amino acids — serine, phenylalanine, and threonine — were utilized to investigate differences in hair from donors of different ancestral origins.

With consent, hair fibers from four regions of the head were collected from three individuals of the Mongoloid, Caucasoid, and Negroid anthropological groups. All samples were washed to remove surface contaminants, ground, and digested to break proteins down into amino acids. Finally, samples were derivatized to increase sample volatility and analyzed by Gas Chromatography/Mass Spectrometry (GC/MS). Chromatographic data was obtained using scan mode, the integrated peak areas were measured, and various amino acid ratios were calculated for all individuals. Results indicate that two ratios, serine to phenylalanine and threonine to phenylalanine, are different in all three samples. The greatest difference in both ratios was between individuals of Mongoloid and Negroid descent. These results imply that certain amino acid ratios may vary among people of different ethnic origins and that this method is potentially useful in distinguishing individuals of different ethnic backgrounds in cases in which MHC is insufficient or DNA analysis cannot be performed.

Hair Proteins, Amino Acids, GC/MS