FORENSIC IDENTIFICATION OF CANINE HAIRS: IS HETEROPLASMY SIGNIFICANT?

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DNA typing of samples from animals has contributed to homicide investigations and convictions in the United States and Canada. Animal hairs are the most frequent animal-derived sample recovered by crime scene investigators. These hairs are usually telogen hairs and lack sufficient nuclear DNA for STR typing. Like humans, the mitochondrial control region of dogs has two hypervariable regions (HV1 and HV2) that can be used for individual identification. Heteroplasmy is a biological phenomena in which samples from the same individual may vary or be ambiguous in their mitochondrial sequence, usually at just one base position. The issue of heteroplasmy has been raised in legal cases in which human mitochondrial matches have been used for identification. The degree to which heteroplasmy may complicate the match between an evidence hair and reference sample has yet to be investigated in canines.

In order to generate a canine mitochondrial database, primers were designed to amplify the entire canine mitochondrial control region analogous to 16000 bp to 400 bp of the Andersen human mitochondrial genome. A total of 399 dogs, representing 100 different dog breeds as well as mixed breed dogs were analyzed. Fifty polymorphic positions were detected and 68 unique haplotypes were characterized. The frequencies of haplotypes varied from 18.2% to 0.003%. Approximately 50% of dogs had a haplotype frequency ranging from 9 to 18.2% while 50% of dogs had a haplotype frequency less than or equal to 5%. Approximately 25% of dogs have relatively rare haplotypes (frequencies less than 1%). A separate study was undertaken to ascertain whether heteroplasmy was detectable in canine hair samples and, if so, to what degree. Ten hairs each from 10 dogs of different breeds and ages were sequenced for the canine HV1 region. Results from the study are important for the continued validation of canine mitochondrial haplotyping in future forensic investigations.

Canine mitochondrial typing has been admitted as evidence in two kidnapping/homicide trials. In California in 2002, eight-year old Danielle Van Dam was kidnapped from her home; her body was found some weeks later. Authorities believed the Van Dam's neighbor, David Westerfield, had kidnapped the victim and transported her in his motor home, ultimately disposing of her body. In addition to DNA and fingerprints from Danielle, police found dog hairs in the motor home, on a quilt sent to the dry cleaner, and in the lint trap of Westerfield's dryer. The haplotype of the Van Dam's dog matched the hairs and had a population frequency of 9%. David Westerfield was convicted.

In Florida in 2003, Brent Huck was accused of the kidnapping and murder of Misty April Morse. The victim was found bound with tape that contained dog hairs. The mitochondrial haplotype of the hairs matched the suspect's dog. The match, in addition to several critical lines of evidence, led to Brent Huck's conviction.

DNA typing of animal-derived samples opens new possibilities for linking suspects to crime scenes or victims. The close relationship between people and their pets is a potentially valuable source of evidence to the observant investigator. The value of such evidence will be determined by the scientific validation of both its power and its limitations.