



Criminalistics Section - 2016

B16 *In Vitro* Experiments Using Human Cadaver Head Hairs to Investigate the Formation Mechanism of Postmortem Hair Root Bands (PMRBs)

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After attending this presentation, attendees will have a better understanding of the biochemical process of hair decomposition and the formation of PMRBs. PMRB is one form of decompositional change presenting as a banded area observed at the proximal end of the root of anagen and early catagen-phase hairs derived from cadavers.¹⁻⁵ It has been demonstrated that these banded areas are gas pockets, as they appear dark in transmitted light microscopy and bright in reflected light microscopy.¹ Although the microscopic characteristics of PMRBs have previously been well investigated, the mechanism for their formation requires further research.¹⁻⁵

This presentation will impact the forensic science community by contributing to the understanding of the potential biochemical mechanism(s) of PMRB formation, the chemical species that may be involved, and the protein composition of both banded and non-banded hairs.

Anagen-phase human head hairs were collected from deceased donors of known postmortem interval at the University of Tennessee, Knoxville Anthropology Research Facility. To determine the conditions under which decomposition was promoted or inhibited, non-banded postmortem hairs were trimmed to approximately 1cm in length from the proximal end and immersed in various solutions for 24 days. A visual qualitative assessment of decomposition was performed for each hair at 100x magnification using transmitted light microscopy, before and after immersion. A hair with no visible signs of decomposition was defined as stage 0 in accordance with Koch et al.; stages 1 and 2 refer to slight and full PMRBs, respectively.⁴

The results from this study support previous findings, indicating that some characteristics of decomposition can be produced when antemortem anagen-phase hairs are submitted to a variety of controlled and uncontrolled (*in vitro*) environmental conditions.⁵⁻¹⁰ Of particular note, an ammonium acetate solution (100mM, pH7.0) was found to accelerate the decomposition process of postmortem anagen head hairs (stage 2), and a sodium azide solution (100mM, pH7.5) and protease inhibitor cocktail (3X, pH3.0) exhibited a suppressing effect on hair decomposition (stages 0 and 1), possibly by inhibiting bacterial growth and slowing down protease activities, respectively.⁵

In addition, the protein composition of banded and non-banded postmortem hairs was characterized using liquid chromatography/tandem mass spectrometry. Preliminary qualitative analysis of protein profiles derived from a pool of 20 hairs with stage 2 bands and 20 hairs without bands reveal that fewer proteins are identified in the banded hairs compared to the non-banded hairs. As expected, the majority of the proteins identified are keratin proteins and keratin-associated proteins. It is worth highlighting that no peptidases were identified among the proteins present in the non-banded hair sample group, unlike the banded hair sample group. Overall, these results suggest that peptidases may play a role in PMRB formation through the digestion of proteins and may result in the production of gases that become entrapped between the hair macrofibers.



Criminalistics Section - 2016

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