H115 Temperature-Dependent Postmortem Protein Degradation in Pigs

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Learning Overview: The goal of this presentation about temperature-dependent protein degradation and the research regarding postmortem protein decomposition for Postmortem Interval (PMI) estimation is for attendees to gain more information about an innovative method to determine the time since death—a crucial topic in forensics.

Impact on the Forensic Science Community: A precise determination of the time since death is of high importance in forensic routine. Further research in this field is necessary in order to expand the prevailing range of applications in forensic PMI estimation. Especially, analysis of muscle protein degradation has shown its potential to contribute to according mid- and long-term delimitations in practice. This presentation will impact the forensic science community by improving understanding on postmortem protein degradation and its dependency on temperature in particular.

A precise determination of time since death plays a major role in forensic practice. Currently available techniques for the determination of the PMI include the temperature-based method on the cooling behavior of bodies and forensic entomology, which investigates the diversity and development of necrotrophic insects on a dead body. All methods, however, are restricted to specific time periods or must be excluded under certain circumstances. Recently, it has been shown that the analysis of muscle protein degradation has the potential to contribute to the determination of the PMI. An innovative approach, based on biochemical analysis of postmortem protein degradation, has been developed that expands the range of applications in forensic mid- and long-term PMI estimates. In particular, specific time points in the degradation of certain proteins provide reasonable markers for PMI determination. Nevertheless, considerable research is yet required to increase our understanding of protein decomposition and how it is affected by individual and environmental factors in order to provide a broad application of this method. Several factors can alter protein degradation patterns, for instance individual traits (e.g., age, sex, body weight) or environmental circumstances, such as humidity, exposure to sunlight, or ambient temperature, without a doubt the most important factor.

A standardized protein degradation model was developed to biochemically analyze postmortem muscle samples at different ambient temperatures. Dismembered pig hind limbs were stored under controlled conditions at 20°C and 30°C and muscle samples (M. biceps femoris) were regularly collected at predefined time points. Sampling times were calculated according to respective Accumulated Degree Days (ADD; [°d]), which are defined as the product of time and ambient temperature (10 days at 20°C and 6.6 days at 30°C result in 200°d, respectively). This allowed a valid comparison between experiments at different ambient temperatures. All samples were further processed via Sodium Dodecyl Sulphate-Polyacrylamide Gel Electrophoresis (SDS-PAGE), and selected proteins were identified by Western blotting.

Results showed precise, time-dependent degradation patterns of investigated muscle proteins in a predictable manner that were dependent on storage conditions and ambient temperature. Some proteins remained stable over the investigated time course, others showed complete degradation of the native protein band, partly accompanied by (transient) degradation products at distinct PMI phases. Though there were similarities of protein degradation patterns detectable between muscle samples stored at 20°C and 30°C, most proteins showed accelerated degradation kinetics and, in part, additional degradation events at higher environmental temperatures.

This study provides evidence that ambient temperature has a major effect on postmortem protein degradation. It remains to be investigated whether protein degradation patterns vary under low ambient temperatures. Present results, together with an additional storage experiment at ambient temperatures below room temperature, will help to develop a precise model of postmortem protein degradation depending on ambient temperature and time since death.

Protein Degradation, PMI, Temperature

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