H78 Crystallins Aging Process and Related Post-Translational Modifications (PTMs) in Determination of Human Age

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After attending this presentation, attendees will learn that forensic chemists can use the techniques presented here to identify the age of unknown deceased persons by using state-of-the-art technology.

This presentation will impact the forensic science community by presenting a method for determining human age by Post-Translational Modifications (PTMs) in lens crystallins as a novel forensic method for fast and potentially accurate age determination of unknown deceased persons.

The increase in the proportion of D-isomer of Aspartic Acid (Asp) relative to the natural occurring L-isomer (i.e., racemization) has been widely used in archaeology and geochemistry as a tool for dating; however, its application in forensic science is has been limited. Among the methods available to identify the age of the deceased is the analysis of the D/L-Asp ratio in human teeth; however, this can take a long time due to the fact that the samples must be dissolve. In comparison, the human eye lens is relatively easy and quick to analyze and could be used as a complementary technique to already existing methods. Among the applications of this dating method is the age determination of unknown casualties of mass disasters.

Human lens protein crystallins have shown extraordinary potential as biological clocks; over the human lifetime, the lens accumulates these proteins with no turnover. This key characteristic indicates that in healthy people most PTMs of crystallins are mainly due to aging. In this study, several important PTMs will be investigated, including deamidation, racemization, and aggregation (disulfide bond formation). Racemization primarily occurs in aspartic acid, while deamidation is one of the most frequently occurring PTMs of asparagine and glutamine. Moreover, disulfide bond formation leads to the formation of water insoluble proteins resulting in protein precipitation and cataracts.

At this stage, this study has used carp eye lens as a model to develop techniques for detecting eye protein PTMs. The developed method for crystallins analysis will be then applied to human crystallins in collaboration with George Washington University Medical School.

To extract the crystallins, decapsulated lenses were homogenized and dissolved in buffer. For deamidation and aggregation studies, proteins were analyzed by sodium dodecyl sulfate-polyacrylamide gel electrophoresis and desirable bands were cut, reduced, alkylated, and digested by different enzymes including trypsin. The digested solution was analyzed using nano-liquid chromatography with tandem mass spectrometry.

The presented method for determining human age by PTMs in lens crystallins gives forensic scientists a method for fast and potentially accurate age determination of unknown deceased persons.

Dating Human, Eye Lens, Proteomics