H101 Aging Blow Fly Pupae Using Hyperspectral Imaging: Another Tool in the Forensic Toolbox

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After attending this presentation, attendees will understand the effectiveness of hyperspectral imaging in aging pupae and the advantages of this technology for entomological determination of the minimum Postmortem Interval (minPMI).

This presentation will impact the forensic science community by demonstrating the potential of hyperspectral imaging as a non-invasive and reliable technology for the accurate estimation of pupal age in forensic investigations.

Forensic entomology has been a useful tool for crime scene investigators for the best part of a century in the western world. There have been numerous cases where entomology has played a crucial role in helping to work out the details of a crime or unattended death. Estimating minPMI is still one of the most fundamental questions following a death and the application of the developmental rates of insects associated with a corpse and time frames of insect succession onto decomposing remains is a common basis for such calculations in legal situations. Blow flies are the predominant taxa used to indicate minPMI as they are among the first insects colonizing remains after death. The developmental duration of blow flies and other forensically relevant insects is strongly driven by temperature; and, specimen age is determined using reference data detailing temperature-dependent developmental time frames for specific life stages encompassing egg, larval instars, pupation, and eclosion. Problematically, there are almost no established methods which allow precise estimation of the age of a specimen beyond identification of the start and end of the life stage collected. Thus, where the duration between stages is lengthy, for instance between pupal formation and adult fly eclosion, considerable error can be introduced to the minPMI estimate. Only limited external morphological indicators of the puparia are identifiable externally and there exists a preference within many legal systems for non-invasive techniques whereby evidence remains unchanged and available for review and/or supplemental analysis.

Hyperspectral imaging was employed to discriminate between subtle differences in the reflectance characteristics of pupae. Conventional imaging and spectroscopy are integrated within hyperspectral imaging systems to obtain both spatial and spectral information from an object. Hyperspectral imaging is a promising alternative technology in the field of forensic entomology as it is non-destructive, non-invasive, suitable for both live and preserved specimens, portable (not restricted to laboratory), rapid, and comparatively cheap. As such, hyperspectral imaging is fast emerging as a valuable tool in forensic investigations with a wealth of untapped potential. Reflectance-based methodologies have been used to successfully analyze a wide range of biological phenomena in arthropods (e.g., vision in honey bees and orb-webbing spiders, courtship and territorial displays among fiddler crabs). Furthermore, hyperspectral imaging has been used to identify species (e.g., tobacco budworms and corn earworms) and to age species (e.g., midges). At present, no study has reported on the use of hyperspectral imaging as a tool in forensic entomology. This work developed a predictive model for determining pupal age for two blow fly species, *Calliphora dubia* and *Chrysomya rufifacies* (Diptera: *Calliphoridae*) at two developmental temperatures (24°C and 30°C). This was correlated with the morphological changes occurring during pupal metamorphosis. Furthermore, hyperspectral imaging was able to distinguish between different aged pupae that appear similar to the human eye. The potential of hyperspectral imaging analysis in forensic case work is extensive and will be discussed.

Hyperspectral Imaging, Blow Flies, Aging