HYPERSPECTRAL IMAGING: 
A NEW TECHNIQUE FOR AGING BLOWFLY PUPAE

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Blowflies (Diptera: Calliphoridae) are the predominant taxa used to indicate time since death (minPMI) as they are among the first insects colonising remains after death. The developmental duration of blowflies is driven by temperature and specimen age is determined using reference data detailing temperature-dependent developmental timeframes for specific life stages. Problematically, where the duration between stages is lengthy, for instance between pupal formation and adult fly eclosion, error can be introduced to the minPMI estimate. At present optimal estimation of age between life stages, particularly between pupal formation and adult fly eclosion generally involves destructive and/or invasive techniques. Ultimately non-destructive and non-invasive techniques are needed that allow for the specimen to remain intact and be used for later re-analysis.

Such invasive techniques include morphological examination of developmental changes using a conventional light microscope, histological staining, scanning electron microscopy (SEM), micro-computed and optical coherence tomography and gene expression analysis. However, these techniques are labour intensive, require expensive equipment and involve a high degree of specialist expertise to interpret results.

This research employed for the first time hyperspectral imaging (HSI) to age blowfly pupae. HSI consists of the acquisition of imaging data in which each pixel is associated with a detailed reflectance profile. Under controlled experimental conditions it is assumed that different target objects, such as blowfly pupae of different age or species, will reflect light differently based on their difference in physical structure and biochemical composition of the cuticle.

This work developed a predictive model for determining pupal age for two blowfly species, Calliphora dubia Maquart and Chrysomya rufifacies Maquart at two temperatures (24\degree C and 30\degree C), correlated with the morphological changes occurring during pupal metamorphosis. HSI is a promising technology in forensic entomology being non-destructive, non-invasive, suitable for both live and preserved specimens, portable (field or laboratory based), rapid and cheap.