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Chemometric software for the automated detection of ignitable liquids in casework fire debris, ongoing developments

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Ongoing research in our group is focused on the development of tools for the rapid, automated identification of ignitable liquids in fire debris. We have previously demonstrated the automated classification of simulated and casework debris samples on the basis of gasoline content. Herein we present current research into the development of a suitable method to simulate fire debris to generate a background matrix that is suitable for the training of chemometric models for ignitable liquids other than gasoline. The simulation method is based on batch pyrolysis of materials under controlled temperatures and atmospheres in a tube furnace. Apart from hopefully generating a more realistic debris matrix without resorting to more expensive options such as the use of large burn cells, this method is also shedding light on the combustion/pyrolysis chemistry of household materials. We are also presenting a prototype classification software client for forensic laboratories developed in collaboration with the Royal Canadian Mounted Police. The software client provides a simple user interface for loading GC-MS data files performing chromatographic alignment and application of models to identify ignitable liquid signatures in the data. The software then reports what (if any) ignitable liquids were found in the debris along with a probability score for the identification and QA/QC reports for the alignment and data quality.

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Distinguishiong between penile and buccal cells using different staining techniques

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The identification of epithelial cells in sexual offenses has faced difficult times over the past two decades in forensic science. For this reason there has been a demand for a method that can conclusively distinguish between epithelial cells, since they have been known to be morphologically similar in their structure according to previous research. This study was aimed to develop a technique using histological staining methods to try to and distinguish between penile and buccal cells from a sexually assaulted victim perspective. 400 samples were collected from male and females and stored according to the Human Tissue Act (2003). The first 20 samples, each cell type was extracted using water, centrifuged then pelleted on to microscopic slides. The slides were then placed onto hotplate at 50°C for 2 minutes to dry and left overnight to cool. Each staining method, Lugol's Iodine, Papanicolaou (Pap) and Haematoxylin and Eosin (H&E) stain was applied to three slides for buccal and penile cells to observe the cells under a high power microscope (400x). Separate 20 samples were smeared onto slides and then stained using the staining procedures. Extracted cells with water did not produce any positive stained cells after staining but smeared cells showed positive stained cells with a total of 515 cells. Lugol's Iodine did not indicate positive stained penile cells but 13 positive stained buccal cells were found. Pap stain had 18 positive stained buccal cells with no positive stained penile cells. H&E had 120 positive stained buccal cells and negative for penile cells. When the two cells were combined, Pap stain showed presence of 71 unknown positive stained cells which could be indication of penile cells and 108 positive stained buccal cells. Cells combined with H&E stain had 185 buccal cells but did not detect any penile cells. These results suggested that Pap stain was a successful histological staining method for distinguishing between penile and buccal cells and could potentially be used in the near future for sexual offenses in forensic casework.

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