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Determination of geographic provenance of cotton fibres using multi-isotope profiles and multivariate statistical analysis

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The analysis of cotton fibres can be particularly challenging within a forensic science context where discrimination of one fibre from another is of importance. Normally cotton fibre analysis examines the morphological structure of the recovered material and compares this with that of a known fibre from a particular source of interest. However, the conventional microscopic and chemical analysis of fibres and any associated dyes is generally unsuccessful because of the similar morphology of the fibres. Analysis of the dyes which may have been applied to the cotton fibre can also be undertaken though this can be difficult and unproductive in terms of discriminating one fibre from another.

In the study presented here we have explored the potential for Isotope Ratio Mass Spectrometry (IRMS) to be utilised as an additional tool for cotton fibre analysis in an attempt to reveal further discriminatory information. This work has concentrated on un-dyed cotton fibres of known origin in order to expose the potential of the analytical technique.

We report the results of a pilot study aimed at testing the hypothesis that multi-element stable isotope analysis of cotton fibres in conjunction with multivariate statistical analysis of the resulting isotopic abundance data using well established chemometric techniques permits sample provenancing based on the determination of where the cotton was grown and as such will facilitate sample discrimination. To date there is no recorded literature of this type of application of IRMS to cotton samples, which may be of forensic science relevance.