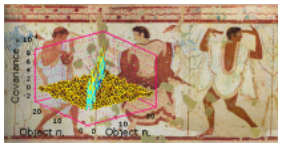

Use of Pattern Recognition for the Organic Residue Analysis by Gas Chromatography Mass Spectrometry of Mortaria and Other Roman Cooking Vessels from Romano-Britain

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Abstract

This report reveals preliminary results on the analysis of GC-MS chromatograms of lipid extraction from mortarium samples and cooking vessels. The research is developed on 105 GC-MS files containing chromatograms of lipid extraction from sampled coming from various locations, principally from U.K. and some from Germany.

Introduction

The mortarium is a shallow spouted bowl containing hard grits fired into the interior surface. It first appears in Britain as a Roman import and is believed to have been used for pounding and mixing commodities to make highly flavoured Roman sauces, rissoles, stews. An alternative use as a dairying vessel has also been postulated. As there is no precedent for this vessel type in Britain prior to the Roman period, its rapid absorption at more rural and unromanised sites as well as more romanised urban and military sites is seen to reflect the transition from native to romanised diet and food preparation techniques. However, it is also possible that despite being incorporated into the 'native' repertoire of vessels, the mortarium was not actually being used for the same purpose and therefore is not synonymous with 'romanised' behaviour.

Through the quantitative and qualitative analysis of total absorbed lipid extracts from mortaria and cooking pots using GCMS, we investigate using chemometrics and analytical chemistry the following.

- What the mortarium was generally used for in Romano-Britain. Was it utilised for the processing of animal fats, dairy products or vegetable materials or mixtures? Were pots reserved for particular commodities or were all used for everything?
- Differences between use of the mortarium at a range of 'romanised' and 'non-romanised' sites. Does the presence of the vessel represent a shift to 'romanised' foodways or was it being used differently?
- Distinction of differences between mortaria and other domestic food preparation vessels (e.g. cooking jars and dishes); also, differences between fabric types produced by different industries (including fine versus coarse wares)
- Differences (primarily quantitative but also qualitative) between samples from different locations within mortaria and cooking pots (which has implications for the method of food preparation in the vessel).

Figure 1 illustrates the location of the sites, principally in United Kingdom but also from Germany.

Materials & Methods

Files, in netcdf format, are collected for every object. The sample files were converted into matrices with uniform dimension of 3,701 x 601 and the RT was linearly interpolated according to scanning rate of 0.6 s/scan. The resulting matrices were subjected to the peak detection algorithm as reported in previous research [1].

Peak detection routine was performed with window size of 100 scans yielding a peak table with its rows correspond to samples and columns denote variables. This peak table was square rooted, normalised and standardised; the variables that present in less than 5 samples were eliminated reducing the dimension to (105 x 2,012).

Fig. 1; Map showing the location of all the Roman sites containing the mortarium samples and cooking vessels

Results

The peak table was subjected to PCA. Score plots of PC2 versus PC1 according to sampling locations and type of samples (mortar and cooking vessels). An observable separation is not evidenced in both score plots. Possibly, the PCs chosen were not very well discriminating the groups. The Fisher weight was performed on the scores of PCs to identify the best discriminating PCs. The T-statistic was performed to investigate the PCs that are best discriminating the type of samples. PC2 and PC3 were ranked the highest implying the best discriminating ability.

Conclusions

Scores plots of PC4 and PC5 demonstrates that samples from Piercebridge are quite different from the others. Considering the favourable conditions of measure, the preservation of lipids in mortaria from Piercebridge was exceptionally good with shreds which had undergone dry and aerobic burial conditions; we can demonstrate that the cooking vessels and mortarium samples could be distinguished fairly well.

Reference

1) S.J. Dixon, R.G. Brereton, H.A. Soini, M.V. Novotny, D.J. Penn, An automated method for peak detection and matching in large gas chromatography-mass spectrometry data sets, J. Chemometr., 20(8-10) (2007) 325-340