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Development of an Analytical Method for the Reconstruction of Historic Smells through GC-MS-O and Sensory Evaluation

Volatile organic compounds (VOCs) released by heritage objects not only reveal their material composition and state of preservation but also constitute their characteristic scents. In recent years, the study of heritage smells has attracted growing attention, highlighting their value in interpreting history and expanding cultural engagement (Bembibre, Barratt, Vera, & Strlič, 2017).

To characterise the olfactory profile of historical materials, both chemical and olfactory information are essential. These are obtained through gas chromatography coupled with mass spectrometry and olfactory detection (GC-MS-O), complemented by sensory analysis by a panel of trained assessors (Paolin et al., 2025). Our research aims to study and reconstruct historical smells by correlating chemical data with olfactory descriptors.

The reconstruction process begins with an assessment of the olfactory relevance of identified compounds calculated using odour activity values (OAVs), i.e., the ratios between compound concentrations and their odour detection thresholds. This ensures that only relevant odorants are considered. These results are compared with the odorants detected as 'strong' during GC-O analysis and their corresponding compounds. These are then cross-validated and aligned with the olfactory descriptors defined through sensory panel evaluations. Once the correspondence between chemical and sensory descriptors is established, the key compounds and their OAVs are used to develop the reconstructed mixtures.

As a case study, we examined the headspace of a historic perfume from the 1940s. The reconstruction process begins with a minimal set of five key compounds and is progressively expanded. GC-MS-O analysis identified 15 principal odorants, including linalool, linalool oxide, p-cymene, eucalyptol, and camphor, which contribute to its floral and fresh character. Each stage of the reconstruction was validated through panel assessments and GC-MS analysis to ensure both sensory and compositional similarity to the original sample.

This methodology provides a robust framework for the preservation and reconstruction of heritage scents, offering museums and cultural institutions new opportunities to present olfactory heritage and enhancing visitor immersion and engagement.

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References

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