

Abstract

Volatile organic compounds (VOCs) present within heritage institutions can originate from objects, furnishings, visitors and staff, as well as from olfactory exhibitions. Historically, these emissions have been studied primarily as risk factors, to define material composition, conservation history, or degradation pathways. Identifying indoor volatiles is crucial, as reactive species can trigger adverse health effects in humans or promote the degradation of heritage objects in surrounding collections. However, this work focuses on the value of these volatiles in establishing comprehensive chemical and olfactory profiles, as volatile compounds are directly responsible for an object's characteristic smell. As emissions vary by material, state of conservation, and age, several heritage objects were examined.

The aim of this work was to develop an analytical pipeline for the sampling, analysis, reproduction, and validation of the smells of heritage objects. To validate this methodology, it was applied to objects from the National Museum of Slovenia, the reference collection of the Heritage Science Laboratory Ljubljana, and the Egyptian Museum in Cairo. Gas chromatography coupled with mass spectrometry and an olfactory detector (GC–MS/O) was applied for qualitative and quantitative analysis of the volatile compounds emitted by the objects. The conjunction with the olfactory port allows for the targeted identification of odour-active compounds, i.e. molecules present in concentrations high enough to be perceived by the human nose, and thus contribute to the overall smell. By combining chemical and olfactory data, a comprehensive olfactory profile of each object was obtained. Applying a sensomics-based approach, compounds essential for the olfactory profile were selected by determining the odour activity values (OAV), and combining this with sensory analysis of the holistic smell, which then guided the reproduction of the smell. Crucially, the goal was to reproduce the current smell emitted by the object rather than the original one, thereby establishing a methodology transferable across different heritage objects.

The final step of this pipeline was the validation process to ensure the similarity between the reproduced smell and the original. In the case study of the historical perfume flask, this was achieved by combining chemical analysis, omission tests, and sensory assessment by a panel of trained and untrained panellists. The sensory results were confirmed by statistical analysis, using a combination of analysis of variance, Euclidean distance metrics, and paired t-tests to quantitatively evaluate the fidelity of the reproduced smell.

Lastly, the use of these smells as part of olfactory exhibitions is discussed in terms of indoor air quality. By analysing selected commercial scents for museums, the research focused on identifying which new volatiles are introduced into heritage environments and comparing the findings with current guidelines on indoor volatile concentrations.