

The Scent of the Sample: Unveiling Identity via HS techniques combined with GC×GC-MS

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Comprehensive sample characterization is a fundamental requirement across diverse scientific disciplines. Whether determining geographical origin, identifying processing markers, or discovering diagnostic biomarkers, the analytical strategy must be strictly fit-for-purpose. In this context, the volatile profile of a sample acts as a unique chemical fingerprint that can unveil its true identity. However, extracting this information requires a synergy between precise analytical workflows and robust data processing.

Conventional analytical methods often rely on destructive sampling or require significant sample volumes. These constraints are often prohibitive for high-value biological specimens or longitudinal kinetic studies where repetitive analysis of the same sample is required. Furthermore, intensive sample preparation introduces the risk of chemical artifacts and "preparation bias," potentially compromising the integrity of the results.

To address these challenges, headspace (HS) sampling offers a non-destructive, cost-effective, and "clean" alternative that captures the volatile identity of a sample without affecting the matrix.

This contribution evaluates the performance of Thermal Desorption (TD) and Solid Phase Microextraction (SPME) when hyphenated with comprehensive two-dimensional gas chromatography-mass spectrometry (GC×GC-MS). Drawing on case studies from plant science, food chemistry, and packaging materials, we compare the analytical performances of each approach. Ultimately, we demonstrate how the marriage of non-invasive sampling and high-resolution separation provides a powerful toolset for modern characterization and authentication challenges.