Enhancing headspace sorbent analysis for target analysis in food by vacuum-assisted headspace and/or multi-cumulative trapping

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Societal advancements necessitate the development of analytical methodologies that are more rapid, cost-effective, precise, and resource efficient. One approach to achieving these improvements is the implementation of miniaturized techniques, which can eliminate solvent usage, significantly reduce sample volume requirements, and minimize waste generation. The introduction of solid-phase microextraction (SPME) in 1990 represented a pivotal milestone in the miniaturization of sample preparation, offering enhanced ease of handling and improved analyte concentration capabilities. Thirty-five years later, numerous miniaturized techniques were developed and are now widely utilized in routine analysis, facilitating the extraction of compounds with diverse chemical properties from a variety of matrices.

With regard to SPME specifically, further advancements have been made in aspects such as the type and volume of sorbent materials used. Consequently, indirect sample analysis through headspace techniques offers significant advantages by minimizing matrix-related interferences, enhancing selectivity, and extending the lifespan of both the extraction material and the analytical instrument. However, this approach may be less suitable for the analysis of less volatile molecules. This limitation can be overcome by performing the extraction under vacuum conditions, which enhances the overall mass transfer of compounds into the headspace, thereby facilitating their subsequent uptake by extraction media. Besides, the use of multiple-cumulative trapping, an approach consisting of performing multiple headspace extractions (from the same or multiple vials) with a sorbent, desorbing the analytes trapped at each extraction into an intermediate trap before releasing what immobilized in the trap into the chromatographic system. This approach can either favor the extraction of the less-volatile (extraction from the same vial) or generate a multiplicative response (when extracted from multiple vials).