Monitoring changes in the volatiles composition of bottled and refrigerated cow milk by PTR-MS

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Abstract
The volatile organic compound (VOC) composition of cow milk changes as milk approaches the end of its shelf-life. Microbial activity is the primary catalyst for such changes. The VOC profiles present in the headspace of packaged (HDPE), chilled (4.5 °C), extended shelf-life cow milk samples were analysed in real-time over a period of 18 days using proton-transfer-reaction mass spectrometry (PTR-MS). In addition, milk samples were investigated off-line using gas chromatography – mass spectrometry coupled to solid-phase micro-extraction (SPME-GC-MS) to aid chemical identification of the PTR-MS detected signals.
Skimmed (0.25-0.40 % fat), semi-skimmed (1.40-1.50 % fat), and whole milk (3.18-3.28 % fat) were analysed. In order to determine the relative impact of growth of bacteria such as *Pseudomonas spp.* and subsequent enzymatic processes on VOC production in the milk, sodium azide (NaN_3) was added to replicate aliquots of each milk type to inhibit microbial growth.
PTR-MS was used for static headspace analysis of the VOC composition of milk, and resulting data were compared to total aerobic plate count (APC) values. Statistical multivariate analysis of variance (MANOVA) was carried out to compare the relative influences of milk type, age, and the presence/absence of NaN_3 on VOC profiles.
Several VOCs were observed to increase with milk age in the absence of NaN_3, with the lowest increases observed for whole milk. Variations in the VOC release profiles thus pointed to microbial-induced changes. Indeed, changes in the APC related to changes in the VOC headspace data. VOCs that showed changes relating to microbial activity included alcohols, carboxylic acids, ketones, aldehydes, sulphides and carboxylic acid esters. Such VOC are assumed to arise from breakdown of sugars, proteins and lipids as a result of metabolic activity of post-pasteurization contaminant bacteria, particularly *Pseudomonas spp.*

Milk producers frequently use total bacterial numbers to determine the end of shelf-life, while consumers rely on an assessment of the milk's sensory qualities, mainly odour, to determine if the milk is still suitable to consume. The proposed methodology thus provides an example of potential analytical detection of milk spoilage, and consequent loss of quality, by detection of volatile markers at trace levels.

Biography

Dr. Erika Zardin is an environmental chemist (MSc, University of Venice, Italy) and was awarded a PhD in analytical chemistry from the University of Western Australia (Perth, WA). Since 2011 she is a research associate at the Fraunhofer Institute for Process Engineering and Packaging (Sensory Analytics Department) and a post-doctoral fellow at the Department of Food Chemistry, Faculty of Chemistry and Pharmacy (University of Erlangen-Nuremberg).

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