Chapter 5
Microbial Volatile Compounds (MVOCs) in Food Industries and Food Safety Applications

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ABSTRACT

Natural, organic, and preservative-free foods are in high demand, and food quality control is essential for ensuring the safety, taste, appearance, and health value of food products throughout the supply chain. Microbial volatile organic compounds (MVOCs) can be used as biomarkers for toxins and spoilage, and some MVOCs can be human carcinogens and neurotoxins. MVOCs are produced by microorganisms such as bacteria and fungi during physiological processes such as lipid oxidation, fermentation, and fruit ripening. They can lead to food spoilage and economic losses by affecting the sensory properties, composition, flavor, shelf life, and safety of foods. Food security is a complex issue that involves many fields, including agriculture, economics, public health, microbiology, chemistry, food engineering, and artificial intelligence. Stakeholders should address the gaps in MVOC detection to revisit and upgrade food regulations. Given the health risks and economic implications, this chapter provides insight into MVOC-associated emerging technologies for regulatory assessments.

Food quality control is essential for ensuring the safety and quality of food products throughout the supply chain (*Food Safety*,). Global food security is a highly appropriate issue, especially the quality control of natural, organic, and preservative-free foods in present-day food science and technology. The growing demand for such products emphasizes the importance of ensuring food safety throughout the supply chain.

Microbial volatile organic compounds (MVOCs) are low-molecular-weight (<300 Da) carbon-containing compounds, that can show food spoilage as rotten properties that can be characterized by high vapor weight (≥0.01 kPa at 20 °C) and a high-to-moderate hydrophobicity (Genva et al., 2019). Volatile organic compounds (VOCs) of microbial origin play a critical role in food spoilage, and their detection and monitoring can be used to improve food quality and control spoilage(Huis in't Veld, 1996). These volatile compounds can lead to food wastage and economic losses as they affect the sensory properties, composition, flavor, shelf life, spoilage, and food safety of products delivered to the consumer (Modi et al., 2021). Various processes, such as lipid oxidation, fermentation, and fruit ripening, produce MVOCs, which can impact food quality. The identification of gas, odorant atoms, and unstable natural compounds in food products has biological, psychological, social, and economic relevance (Lemfack et al., 2014). Volatile compounds, when used as biomarkers, can play an active role in the early detection of food spoilage, leading to improved food safety and quality.

Food security is a complex issue that involves different fields such as agriculture, economics, public health, microbiology, chemistry, food engineering, and artificial intelligence (*Global Food Security*). Several fields of knowledge are working together to develop ways to detect and intercede in complex multispecies communities (Aqsa & Nugroho, 2023). Utilizing MVOCs as biomarkers can lead to early detection of food spoilage using a variety of emerging methods, including promising technologies.

The future of food safety and quality depends on regulatory bodies around the world updating food safety and quality standards (Kamboj et al., 2020). This is of particular importance given the potential health and economic consequences of MVOC-related spoilage or illness. The use of MVOCs for food quality control can revolutionize food safety. A review can help understand the current landscape concerning MVOCs and potential areas for regulatory updates or refinements.

PROBLEM STATEMENT

There is a need to increase the surveillance of microbial volatile compounds to improve food regulations and avoid foodborne illness. More research can help update standardized safety protocols and thresholds for various food products, ensuring consistent quality and safety on a global scale(White et al., 2023). Microbial volatile organic compounds are a diverse group of molecules released during the metabolic processes of fungi, bacteria, and other microorganisms (Weisskopf et al., 2021). Food microbiologists and chemists detect MVOCs as indicators of food spoilage. A rise in the levels of certain MVOCs might indicate the growth of spoilage organisms before any visible signs appear, potentially compromising the shelf life and safety of the product (Lemfack et al., 2018). For example, the production of ethanol and acetone by yeasts and bacteria is a sign of fermentation and spoilage in fruit juices and wine (Liszkowska & Berlowska, 2021). MVOCs are produced by a portion of the total microbial community in both perishable and non-perishable foods (Rering et al., 2020).

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