Mineral Oils in Food

Origin, analysis and regulations concerning MOSH, MOSH analogues and MOAH

Today mineral oil is found in a wide variety of foodstuffs as it can enter food commodities as well as processed products anywhere along the food processing and trade chain. Potential sources are fuels, exhaust fumes, lubricant oils, surface treatment agents, batching oils, packaging materials etc.

Food manufacturers and distributors as well as analytical laboratories are faced with enormous challenges when trying to elucidate the source and point of contamination.

MOSH, MOSH analogues and MOAH

The mineral oil fraction of concern consists mainly of complex mixtures of hydrocarbons (C10 up to C50) mainly of fossil origin.

Mineral oils of technical grade are composed of mineral oil saturated hydrocarbons (MOSH) as well as up to 50% mineral oil aromatic hydrocarbons (MOAH).

Contrary to the structurally related and cancerogenic PAH, MOAH are a complex mixture of compounds with differing and mainly unknown toxicities.
In addition to the mineral oil fractions MOSH and MOAH, the so called POSH (polyolefinic oligomeric saturated hydrocarbons) as well as PAO (poly alpha olefins) move more and more into the spotlight. POSH are oligomeric substances, potentially migrating from plastic packagings (PE and PP). PAO are synthetic isoparaffins used e.g. in synthetic lubricants and adhesives. POSH and PAO belong to the group of so-called MOSH analogues.

Assessments and measures

Already in 2009, the German Federal Institute for Risk Assessment (BfR) has issued a warning regarding the direct contact of large surface dry foods with recycled cardboard.
In 2017, the European Union issued a recommendation on the monitoring of mineral oil hydrocarbons. Associated guidelines for sampling and analytical criteria were published by the Joint Research Center (JRC) of the EU Commission in 2019 and updated in 2023.

In addition, the Food Federation Germany together with the Working Group of the Federal States on Consumer Protection has developed orientation values for mineral oil hydrocarbons (MOH) in foodstuffs, which are continuously expanded. These values are aimed at compliance with good manufacturing practice and are not legally binding. Specific guideline and orientation values have also been developed in other countries of the European Union.

In September 2023, the European Food Safety Authority (EFSA) has published an updated risk assessment for MOAH stating that the genotoxicity of MOAH is related to the presence of MOAH with 3 or more aromatic rings. However, since little is known about the composition of MOAH in food, further data must be collected for a final evaluation of MOAH.

Maximum Levels & Monitoring

In 2022, the EU Standing Committee on Plants, Animals, Food and Feed (SC PAFF) published a harmonised approach for handling findings of MOAH in food. Foods with MOAH levels above certain guidance levels (originally defined as LOQs by the JRC Technical Report from 2019) should be withdrawn from the market.

At the end of 2023 the EU proposed these guidance values as potential maximum levels for MOAH (C10-C50) in a draft regulation, that is to be included in Regulation (EU) 2023/915 in the future:

- Products ≤ 4% fat/oil: 0.5 mg/kg
- Products > 4% and ≤ 50% fat/oil: 1.0 mg/kg
- Products > 50% fat/oil: 2.0 mg/kg

In addition, a maximum level for MOAH for food additives via Regulation (EU) No. 231/2012 and a Monitoring Recommendation for MOSH are currently being discussed.

Analysis

The Eurofins experts from the Competence Centre for Organic Contaminants of the Food and Feed Testing Laboratories in Germany have long-term experience with the analysis of mineral oils from food matrices. The online-HPLC-GC-FID technique enables the separate quantification of MOSH/MOSH analogues and MOAH within one chromatographic run. The pattern of the obtained chromatograms contains additional information about the source of contamination. The separation of MOSH and MOSH analogues is impossible due to their structural resemblance.

Results can be qualitatively confirmed by an additional LC-GC-MS measurement. The establishment of an LC-GCxGC-MS technique for further characterisation of the mineral oil is under development.

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