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# Enhancing MOSH/MOAH analysis with the CHRONECT™ Workstation – A fully automated approach

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## CHRONECT™ Workstation Automated workflow

- Residues of mineral oil hydrocarbons (MOSH and MOAH) are ubiquitous in food and food-contact materials. These residues arise from sources such as recycled cardboard, printing inks, and processing machinery. These mineral oil hydrocarbons fall into two distinct classes: MOSH, the saturated fraction, and MOAH, the aromatic fraction. MOAH might carry genotoxic potential.
- Analyzing MOSH and MOAH is challenging for several reasons. Complex sample matrices contain natural interferences, such as squalene and plant-derived alkanes, that obscure the target signals. Traditional manual preparation is time-consuming, error-prone, and produces elevated blank values. Incomplete extraction or cleanup can easily lead to an incorrect estimation of the MOAH fraction, compromising sensitivity and selectivity.
- The CHRONECT™ Workstation MOSH/MOAH addresses these issues by combining liquid chromatography, gas chromatography, and flame ionization detection into one fully automated system. The specially selected modular components enable automatic sample preparation with saponification, dual extraction and cleanups for both fractions.
- Its optimized automated workflow (AWF) handles extraction, cleanups, AlOx and performic acid epoxidation (using 1-chlorobutane with 30% $H_2O_2$, patent pending) without human intervention. This eliminates cross-contamination and manual errors. As a result, the limits of quantitation are as low as 1 mg/kg for both MOSH and MOAH under protocols that align with DIN EN 16995, DGF C-VI 22, and ISO 20122:2024. The system's superior selectivity effectively removes interferences and enables direct quantification across a broad range of food matrices, including fats, oils, infant formula, and more.
- Its high-throughput capability (processing up to 30 samples per day with minimal supervision), reduced solvent consumption, and lower operator exposure result in significant efficiency gains and cost savings. Faster turnaround times and robust, regulatory-compatible data evaluation position the CHRONECT Workstation MOSH/MOAH at the forefront of MOSH/MOAH analysis and food safety testing.

**Fully automated robotic sample preparation** → **Performic acid epoxidation** (1-ClBu + 30% H2O2) for MOAH → **Optional online AlOx clean-up for the MOSH** → **LC-GC-FID Dual channel analysis**

## Technical highlights

### Automated LC-GC-FID coupling:

The system couples HPLC to GC. Heated valves ensure complete evaporation of the solvent transferred from the HPLC and prevent carryover. Two FID channels allow simultaneous, reliable quantification of MOSH and MOAH.

### Advanced Epoxidation and Purification:

- Performic Acid Epoxidation: The automated protocol in 1-chlorobutane (conducted at 65 °C for 20 minutes) minimizes interfering olefins, even in tricky samples.
- Online Aluminum Oxide (AlOx) Purification: This optional step automatically removes natural alkanes from the MOSH fraction, ensuring accurate "hump" quantification. Thanks to the online approach, MOSH and MOAH can still be analyzed in the same GC run.

### Efficient Robotic Sample Handling:

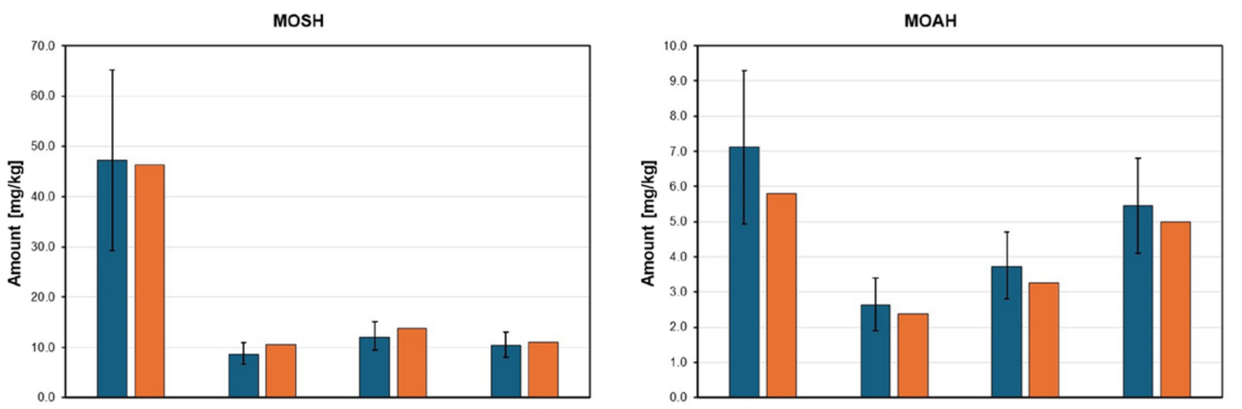
- Optimized Tools: Specialized septa, needles, and tools eliminate the need for expensive decappers at the robotic system and deliver a contamination-free sample preparation.
- Dual Extraction After Saponification: The protocol follows ISO 20122:2024 by ensuring complete extraction - even for larger alkylated bicyclic MOAH - preventing underestimation of the MOAH fraction.

| | Outline ISO 20122 ~ DGC C-VI 22 (20) | Online automated variant* |
|---|---|---|
| **Dissolution** | 3 g + IS + 30 mL hexane/ethanol | 1 g + IS + KOH + 13 mL hexane/ethanol |
| **Saponification extraction** | Saponify 10 mL with KOH<br>**2nd extraction with 5 mL hexane** | Saponify the complete solution<br>2nd extraction with 5 mL hexane |
| **Cleanup** | Silica Cleanup with hexane/DCM | Not required |
| **Evaporation** | Evaporated volume to 1 mL | Evaporate volume to 1 mL |
| **Epoxidation** | *m*CPBA in ethanol or performic acid in hexane | Performic acid in $CHCl_3$ / 1-ClBu |
| **Evaporation** | Evaporate volume to ~300 µL | Evaporate to dryness<br>Reconstitute in 1.5 mL hexane |
| **Injection** | 50 - 100 µL<br>Optional online AlOx Cleanup | 200 - 400 µL<br>Optional online AlOx Cleanup |

*M. Nestola, 2022 (doi.org/10/1016/j.chroma.2022.463523).

## Applicability for other matrices

The measurements shown in the diagram were obtained using a 2 g sample in 9 ml of a mixture of ethanol and hexane, with an epoxidation time of 10 minutes.



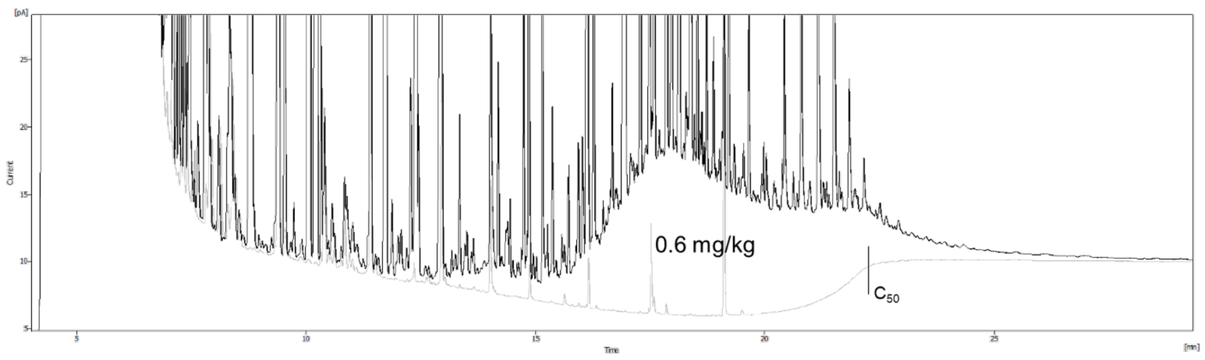




Data provided by Chemisches Institut Burkon

## Sensitivity

Sunflower oil from a German ring trial (Mean: 0.63 mg/kg)

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## Innovative solutions with the CHRONECT™ Workstation MOSH/MOAH

### Optimized Automated Workflow (AWF):

- Seamless Integration with CHRONOS™: The workflow is synchronized with the CHRONOS control software to enable an optimized sample processing routine using a SingleHead Robot.
- Versatile Matrix Handling: Successfully validated for a wide range of food matrices - not just fats and oils - ensuring robust performance across diverse applications.
- High Throughput: Capable of processing 30 samples per day - with a capacity up to 60 - without compromising sensitivity.

### Superior Epoxidation Protocol:

- Innovative 1-ClBu Method: The workflow uses performic acid in 1-chlorobutane for epoxidation with 30% $H_2O_2$ (patent pending), achieving the best removal of MOAH interferences. In contrast, 50% $H_2O_2$ in hexane leads to more interference.

### Enhanced Sample Handling:

- 20 mL Vials for Increased Sensitivity: The system uses 20 mL vials, which allows the analysis to start with a sample size of 1 to 2 g. After saponification, the organic extracts can be combined and evaporated in a single step, which overcomes the limitations of 10 mL vials.
- Automated Evaporation: An integrated evaporation step in the workflow ensures complete use of the extracts, resulting in higher sensitivity. In addition, the automated evaporation station has a washing unit, which prevents carry-over even with highly contaminated samples.

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