Mineral Oil Hydrocarbons (MOH) in Food

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Mineral Oil Hydrocarbons (MOH) comprise a large group of mixtures of hydrocarbons containing thousands of chemical compounds of different structures and size, derived mainly from crude oil but also produced synthetically from coal, natural gas and biomass.

There are **several possible sources of MOH contamination into food**: mainly food packaging materials, food additives, processing aids and environmental contaminants such as lubricants. The contamination can occur both from raw materials and at various stages of food production, including transportation and storage. On the basis of today's information, the principal food matrices that might be affected by MOH contamination are: dry foods (e.g. flour, cereals, coffee, cocoa powder, milk powder), confectionery, fatty foods (including chocolate), oilseeds, tree nuts, vegetable oils and animal fats.

MOH consist of MOSH and MOAH, acronyms of a complex mixture of chemical compounds:
MOSH mineral oil saturated hydrocarbons—MOSH include open chain and cyclic hydrocarbons. POSH (polyolefin oligomeric saturated hydrocarbons) are oligomers of polyolefins, that can affect the characterisation of MOSH.
MOAH mineral oil aromatic hydrocarbons—MOAH are highly alkylated mono- and/or poly-aromatic hydrocarbons.

The gold analytical approach for **the MOSH/MOAH quantitative analysis** provides for use the LC-GC-FID hyphenate technique. However FID is not a selective detector and does not allow to a characterization of different MOH or detecting typical marker substances.

To avoid false positive, **Neotron has recently developed an application in two-dimensional separation coupled with TOF mass spectrometry** (GCxGC-TOFMS) as confirmatory technique for MOSH and MOAH qualitative characterization to identify typical markers.

References

Up today, no official limits are set for MOH residues in foodstuff in EU. One of the main reference documents is the European Food Safety Authority (EFSA) opinion "Scientific Opinion on Mineral Oil Hydrocarbons in Food" published in 2012, which recommended, as most efficient method for the analysis of these compounds, the high performance liquid chromatography (HPLC) on-line coupled to GC with flame ionization detection (FID).
At EU level, the activities concerning the risk assessment on MOH are constantly developing:
- The European Commission presented in January 2017, the recommendation 2017/84 "on the monitoring of mineral oil hydrocarbons in food and in materials and articles intended to come into contact with food" promoting the Member States to monitor the presence of MOH in foods.
- In February 2019, the EU Commission's Joint Research Centre (JRC) published a "Guidance on sampling, analysis and data reporting for the monitoring of mineral oil hydrocarbons in food and food contact materials".
- In November 2019, the EFSA published the technical report EN-1741 "Rapid risk assessment on the possible risk for public health due to the contamination of infant formula and follow-on formula by mineral oil aromatic hydrocarbons (MOAH)".

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Neotron Proposal

Quantitative analysis of MOSH & MOAH in food

The determination of the MOH is carried out by online LC-GC-FID. The sample to be examined, added with Internal Standards (IS), is extracted with n-hexane and, depending on the matrix, different pre-treatments and purification steps can be applied before the instrumental analysis.
Considering fatty foods or vegetable oils and fats, an hot saponification before the extraction and an epoxidation with m-CPBA after the extraction are applied to minimize the possible interferences due to fatty matters and natural compounds. For the same purpose, also additional clean-up with activated silica or aluminium oxide are applied.

The MOSH and MOAH quantified fractions can be extended beyond C35 to C50, in line with JRC guidance. The limit of quantifications (LQ) for each fraction are 0,5 mg/kg for dry and fatty foods and 2,0 mg/kg for oils and fats. Sometimes particular matrices/samples could require higher LQ.

MOSH as CyCy	MOAH as 1MN
MOSH C10-C16	MOAH C10-C16
MOSH C16-C25	MOAH C16-C25
MOSH C25-C35	MOAH C25-C35
MOSH C35-C40	MOAH C35-C50
MOSH C40-C50	
MOSH C10-C50 (sum)	MOAH C10-C50 (sum)

Sampling

To prevent contamination of the samples during sampling and protect them during transport, we suggest the use of glass or PET containers and the application of aluminium foil.

MOSH/MOAH characterization: GCxGC-TOFMS

Since FID is not a selective detector, as reported in EFSA Opinion of 2012 and in JRC guidance of 2019, additional techniques have to be applied for the verification in case of suspected interferences.
Considering GCxGC one of the most effective way to distinguish the different MOH subclasses, we developed an application in two-dimensional separation coupled with TOF mass spectrometry (GCxGC-TOFMS) as confirmatory technique for MOSH&MOAH qualitative characterization to identify typical markers (e.g. DIPNs, hopanes, steranes) and avoid false positive results.

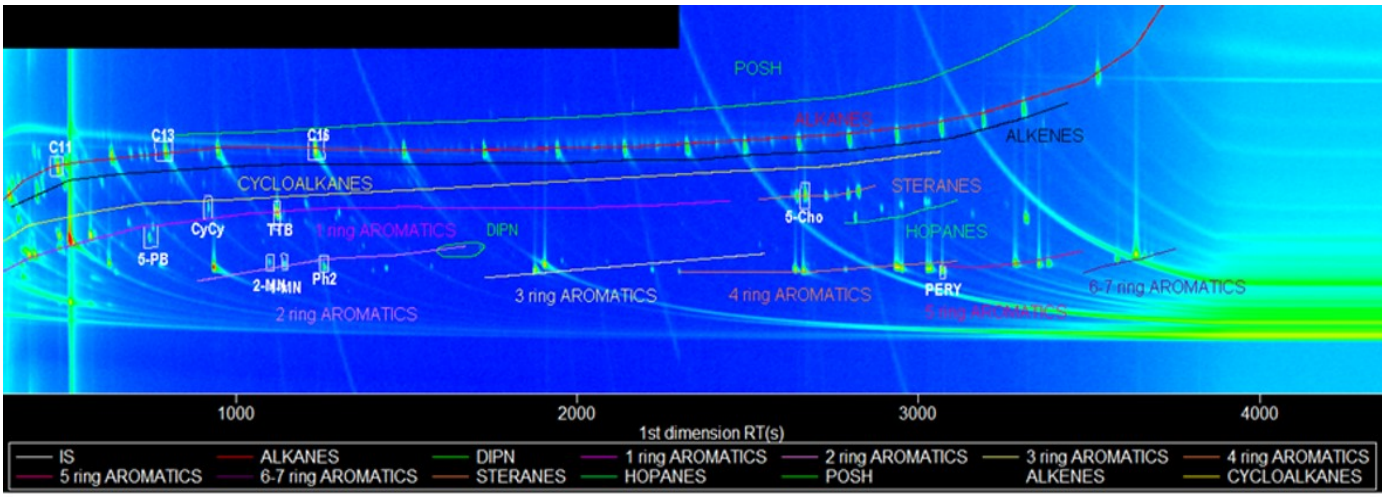

Fig.1: GCxGC-TOFMS chromatogram, where the contour plots of various classes of characteristic markers are highlighted.

Reliability and Innovation:

Neotron collaborates at European work tables for the optimization of methods for the analysis of MOH in different applications: MOAH in Infant Formula organized by JRC and MOH in vegetables oils for the revision of method EN 16995- 2017 organized by ITERG and Max Rubner-Institut.
We participate annually in Proficiency tests organized by DRRR (German Reference Office for Proficiency testing and Reference materials) and DGF-German Society for Fat Science.

"TOGETHER FOR FOOD SAFETY"