Evaluation of mineral oil hydrocarbons in various types of unprocessed meat using LC-GC×GC-FID/MS

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Background: Mineral oil hydrocarbons (MOH) are a complex mixture of liposoluble environmental and processing contaminants of petrogenic origin. They are usually divided according to their molecular structure in saturated (MOSH) and aromatic (MOAH) and the analytical technique considered as routine is LC-GC-FID. However, different compounds inside MOSH and MOAH may pose different toxicological risks to humans depending on their structure [1], which has increased the interest on the use of more advanced techniques, notably LC-GC×GC-FID for a deeper characterization of the type of MOSH and MOAH present in food matrices [2].

Aim: To optimize a method to determine MOH in meat and that can provide a more detailed characterization, particularly of the MOSH profile (*i.e.,* open and cyclic alkanes) possibly accumulated during the animal life, as requested by the EFSA [1]

Experimental design:

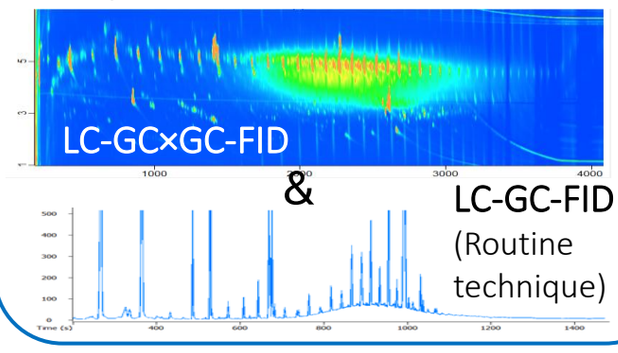
Optimization of sample preparation

Homogenized meat samples → *Subjected to* → Microwave-assisted saponification and extraction(MASE) *Comparison [3] & [4]* → *Evaluated in terms of*:

- Internal standards (ISs) distribution (n =3 per type of meat)
- Recovery (n =4 per level of MOH studied)

Validation of LC-GC×GC-FID

Comparison of results



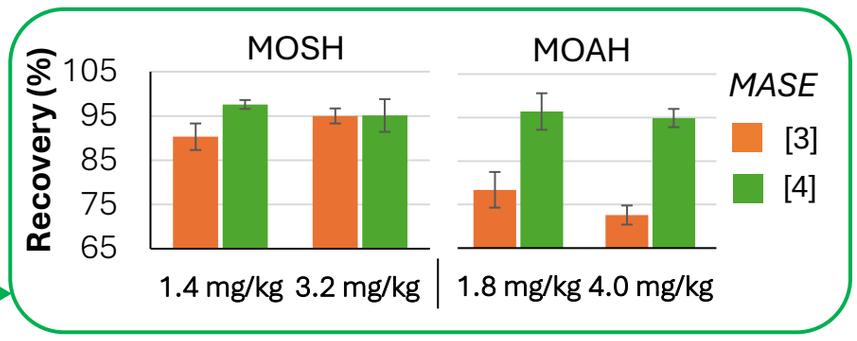
Analysis of MOH in meat

- 5 types of unprocessed meat were considered
- 30 samples (6 per each type) purchased from local supermarkets (Walonie, Belgium)

Results and discussion:

Optimization of sample preparation

The optimal MASE was the one using 2M KOH in EtOH:H_2O (1:1,v:v) [4], as it led to a similar distribution of the different ISs between phases after saponification and to adequate MOSH and MOAH recoveries

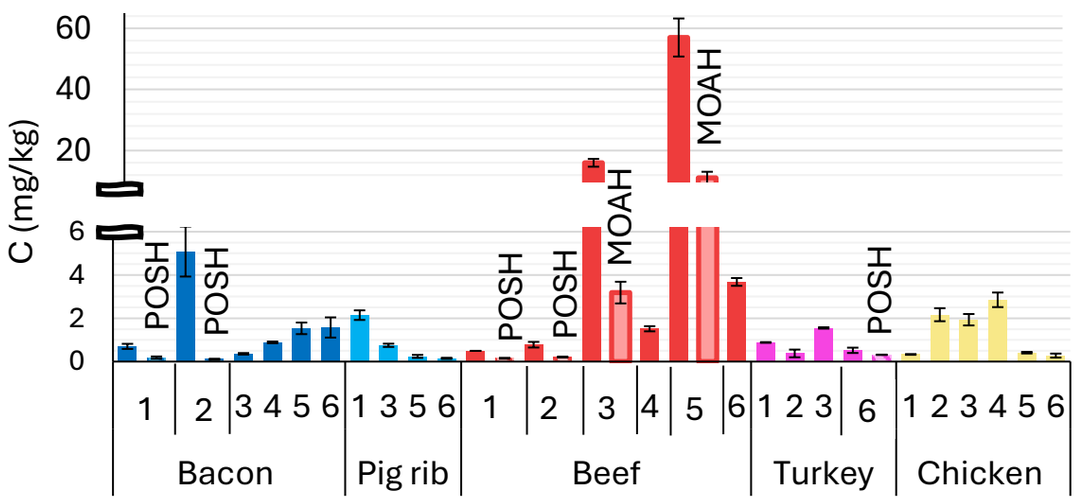


Validation of LC-GC×GC-FID

The use of **LC-GC×GC-FID** and **LC-GC-FID** provided similar results, which was already proven in [5]

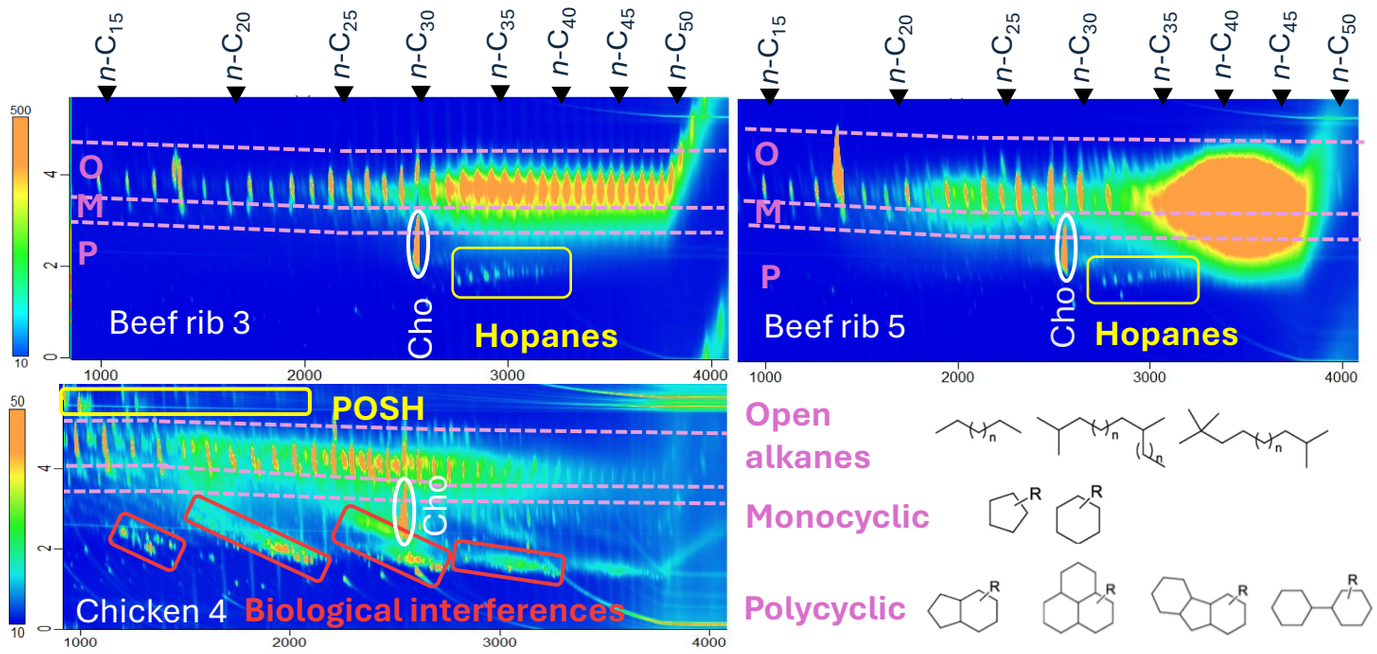
MOSH and MOAH levels in meat

Most of the samples showed MOSH contamination, whereas only two presented quantifiable levels (>0.1 mg MOH/kg meat) of MOAH. The use of GC×GC allowed the separation of polyolefin oligomeric saturated hydrocarbons (POSH) from MOSH and to quantify them separately:



MOSH subclasses in meat

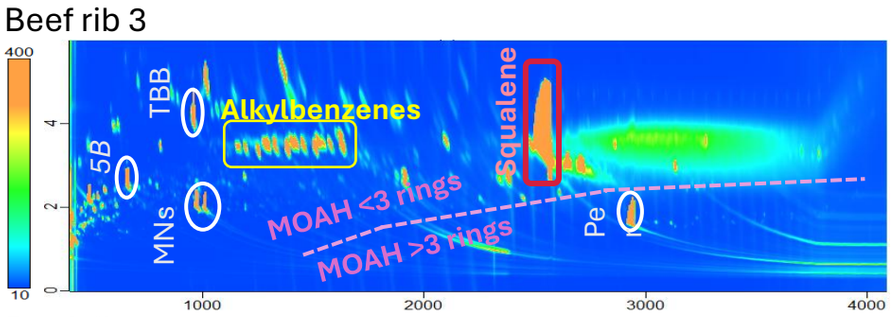
The MOSH subclasses were highly variable among the different meat samples, as it can be observed in the chromatograms obtained for beef rib 3, 5 and chicken 4:



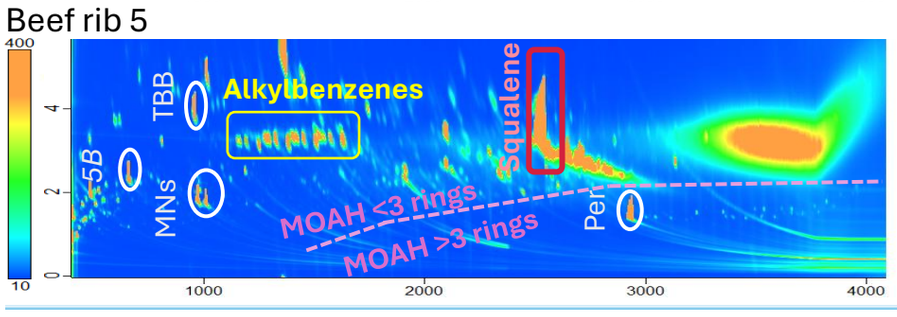
MOAH subclasses in meat

The GC×GC plots of the contaminated samples showed only MOAH with 1-2 rings but also alkylbenzenes:

Beef rib 3



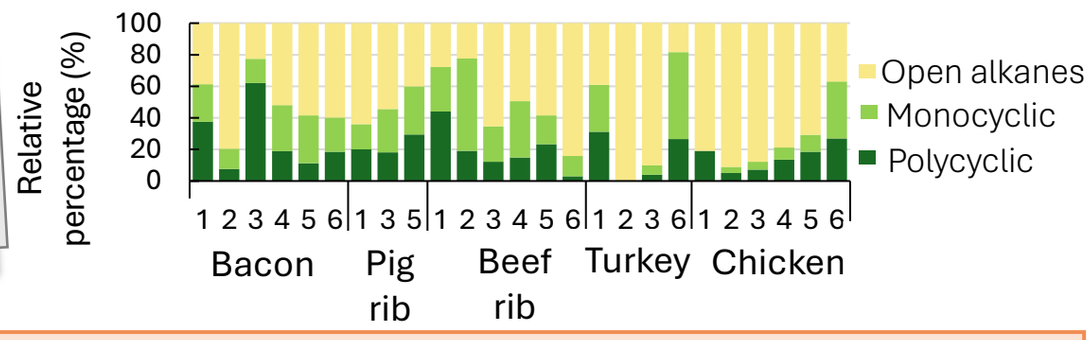
Beef rib 5



Highlighted in MOH chromatograms

- *Subclasses in purple*
- *ISs in white*
- *Interferences in red*
- *Specific types of MOH in yellow*

No correlation between the composition in MOSH subclasses and the type of meat evaluated was found and, generally, MOSH were present mostly as open alkanes:



Conclusions: The LC-GC×GC-FID/MS system led to similar results that LC-GC-FID (routine technique) for MOH analysis but allowed to obtain more detailed information about the contamination profile, allowing to differentiate between MOSH and MOAH subclasses. Meat samples showed variable levels of MOSH and a variable profile (generally open alkanes were the main MOSH type). Only MOAH with 1-2 rings were present in two samples of meat

References: [1] EFSA CONTAM Panel , J. EFSA 21 (2023) 1–143; [2] G. Bauwens, et al., ABC 415 (2023) 5067–5082; [3] P. Albendea, et al., Animals 14 (2024) 1450; [4] G. Bauwens, G. Purcaro Anal. Chim. Acta 1312 (2024) 34278; [5] G. Bauwens, L. Barp, G. Purcaro Green Anal. Chem 4 (2023) 100047

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