

Unveil the toxicologically relevant fraction of mineral oil by on-column GC×GC

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21st GC×GC Symposium

Riva del Garda | May 17-22, 2026





Introduction



Mineral oil *hydrocarbons*:

- Petrogenic origin
- Classified in two main classes:
 - Mineral oil **saturated** hydrocarbons (MOSH)
 - Mineral oil **aromatic** hydrocarbons (MOAH)



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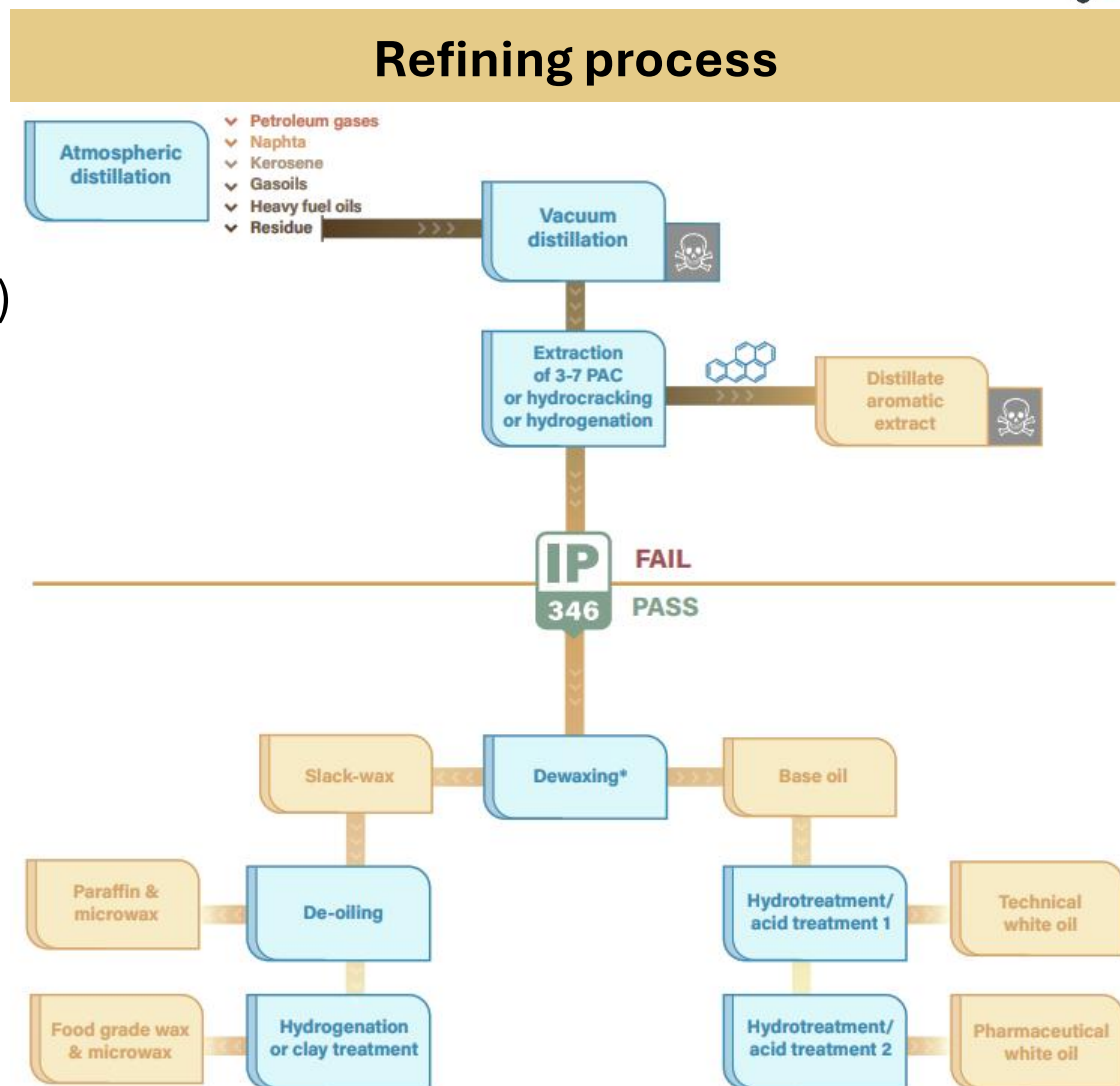
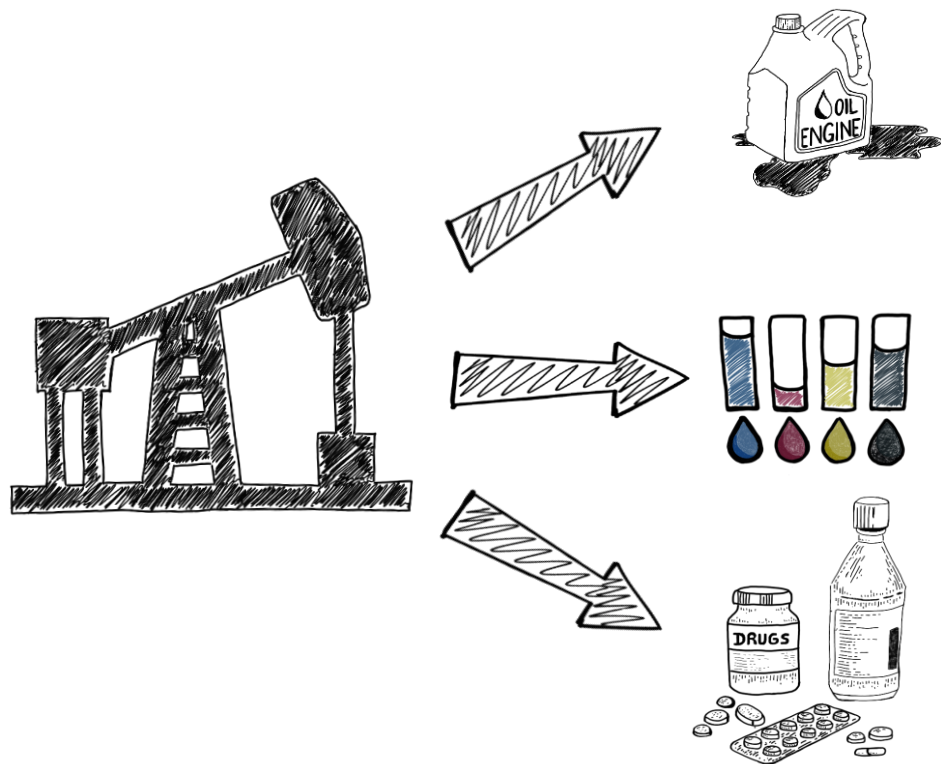


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Concawe. (2017). Mineral oils are safe for human health? https://www.concawe.eu/wp-content/uploads/2017/10/DEF_C_MM_digital.pdf

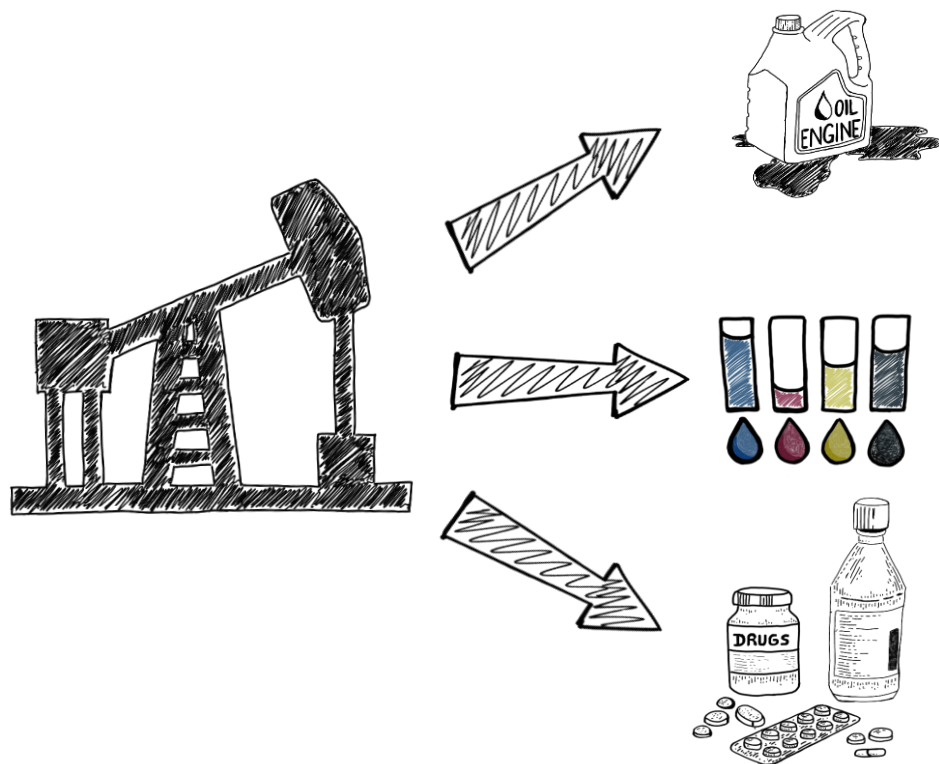


Introduction

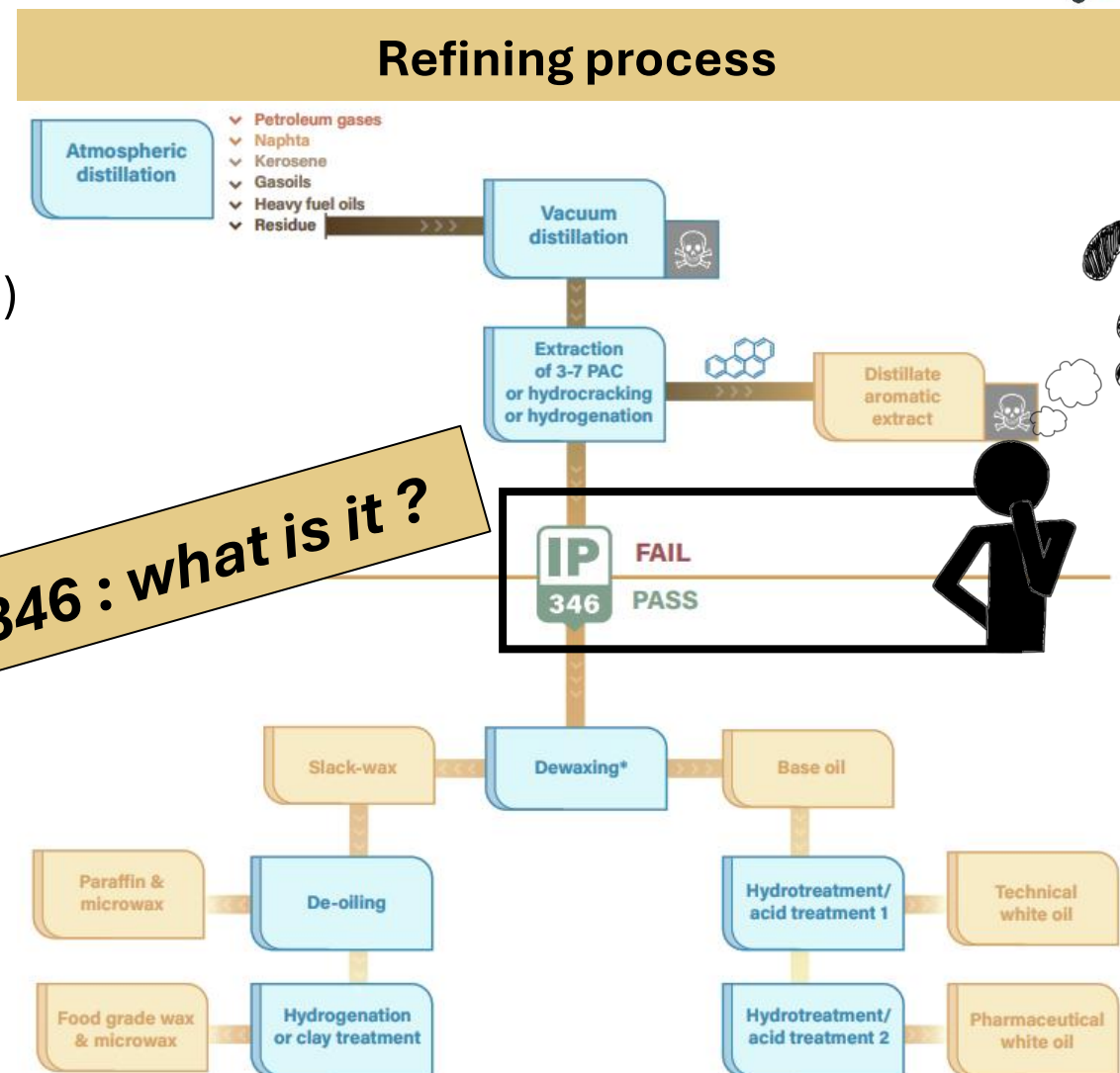


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IP346 : what is it ?





Introduction



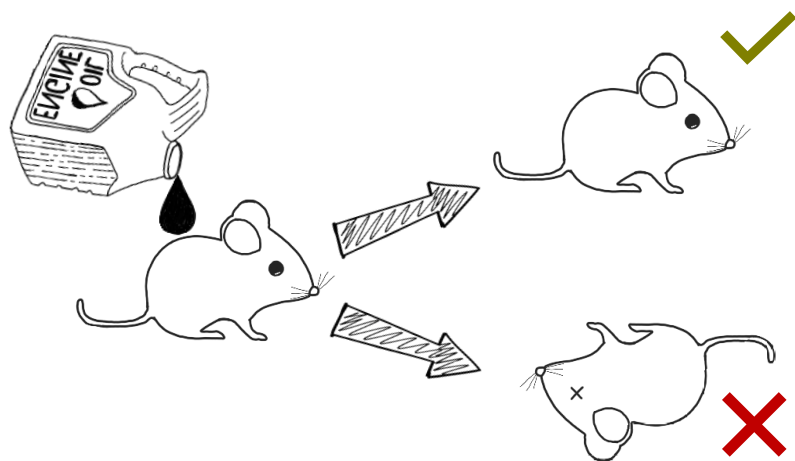
- Developed by Shell in the late 70s
- Assess the carcinogenicity of an oil based on a gravimetric measurements !



Introduction



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- Correlated with mouse skin painting assays



Oil composition with **few** or no MOAH ≥ 3 rings

Oil composition **richer** in MOAH ≥ 3 rings



Introduction

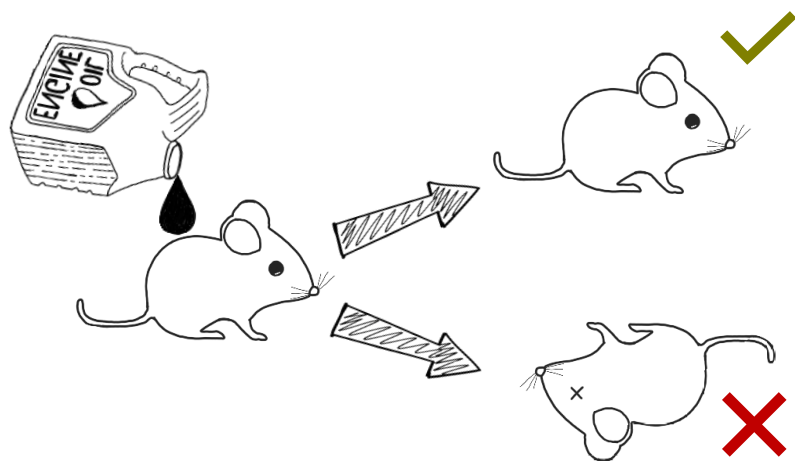


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EFSA opinion

≥3 aromatic ring MOAH are associated with genotoxic and carcinogenic properties

(EFSA 2023, Update of the risk assessment of mineral oil hydrocarbons in food)



Oil composition with **few** or no MOAH ≥ 3 rings

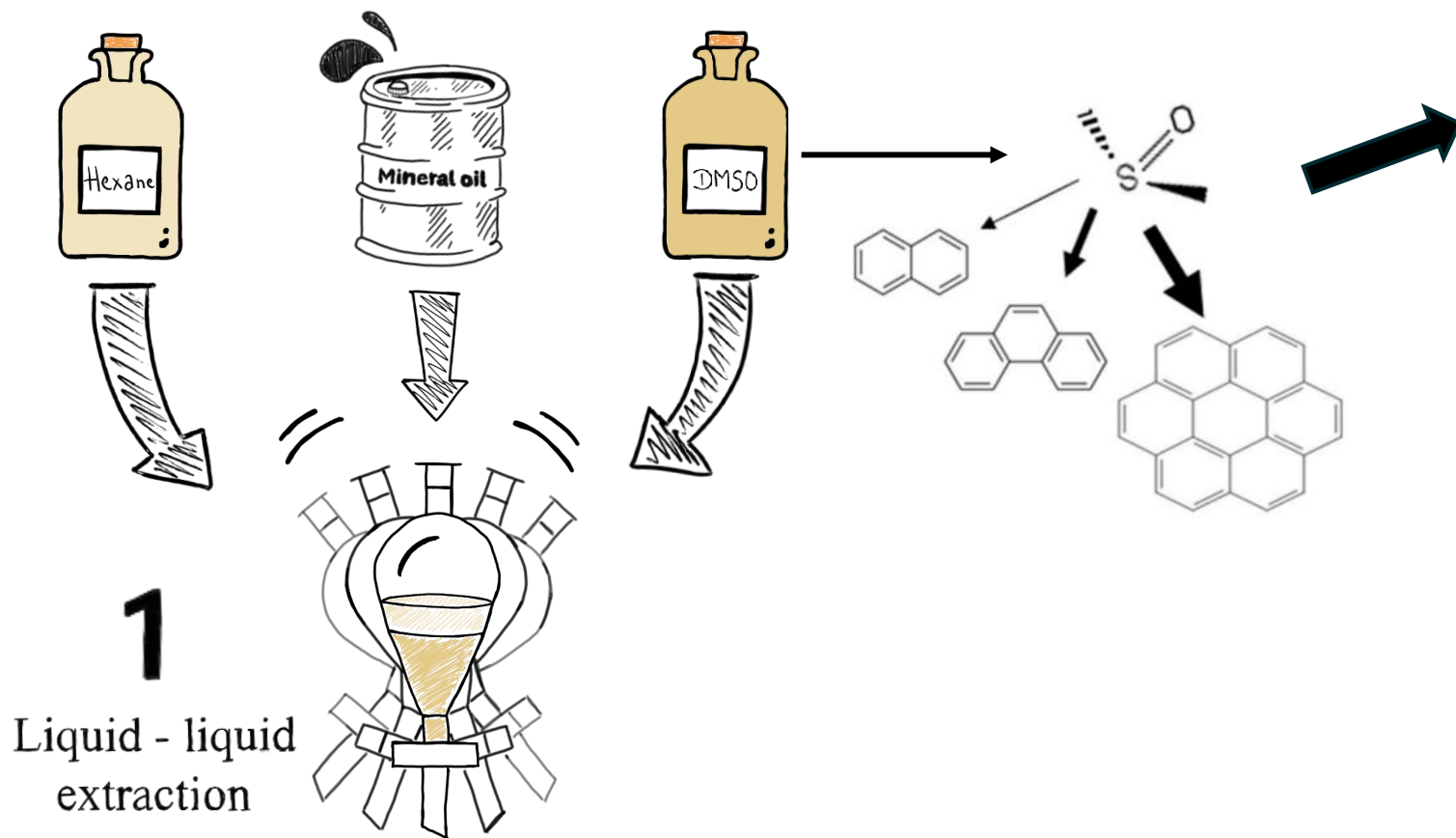
Oil composition **richer** in MOAH ≥ 3 rings

But how did they discover this correlation ?



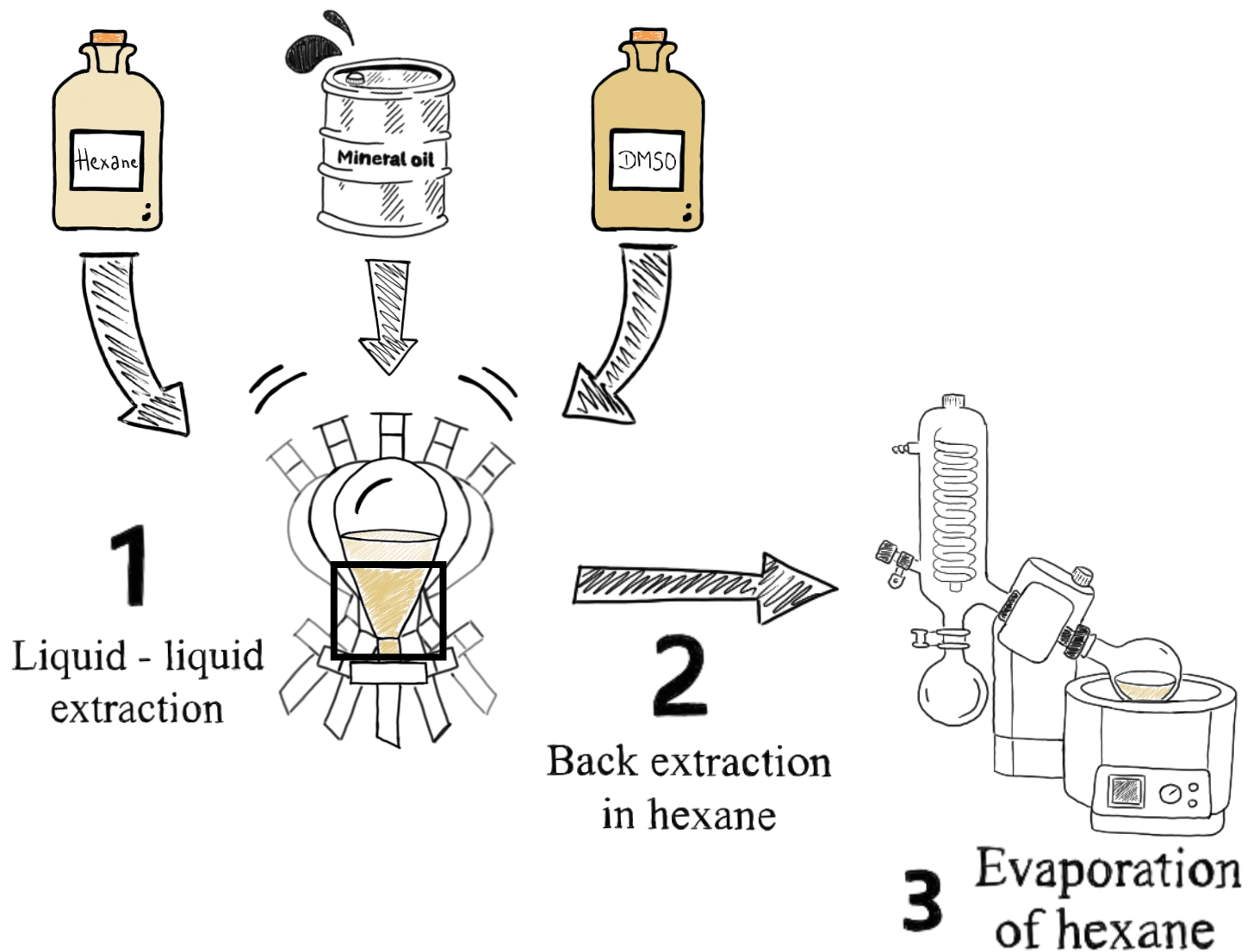


Introduction – IP 346 principle



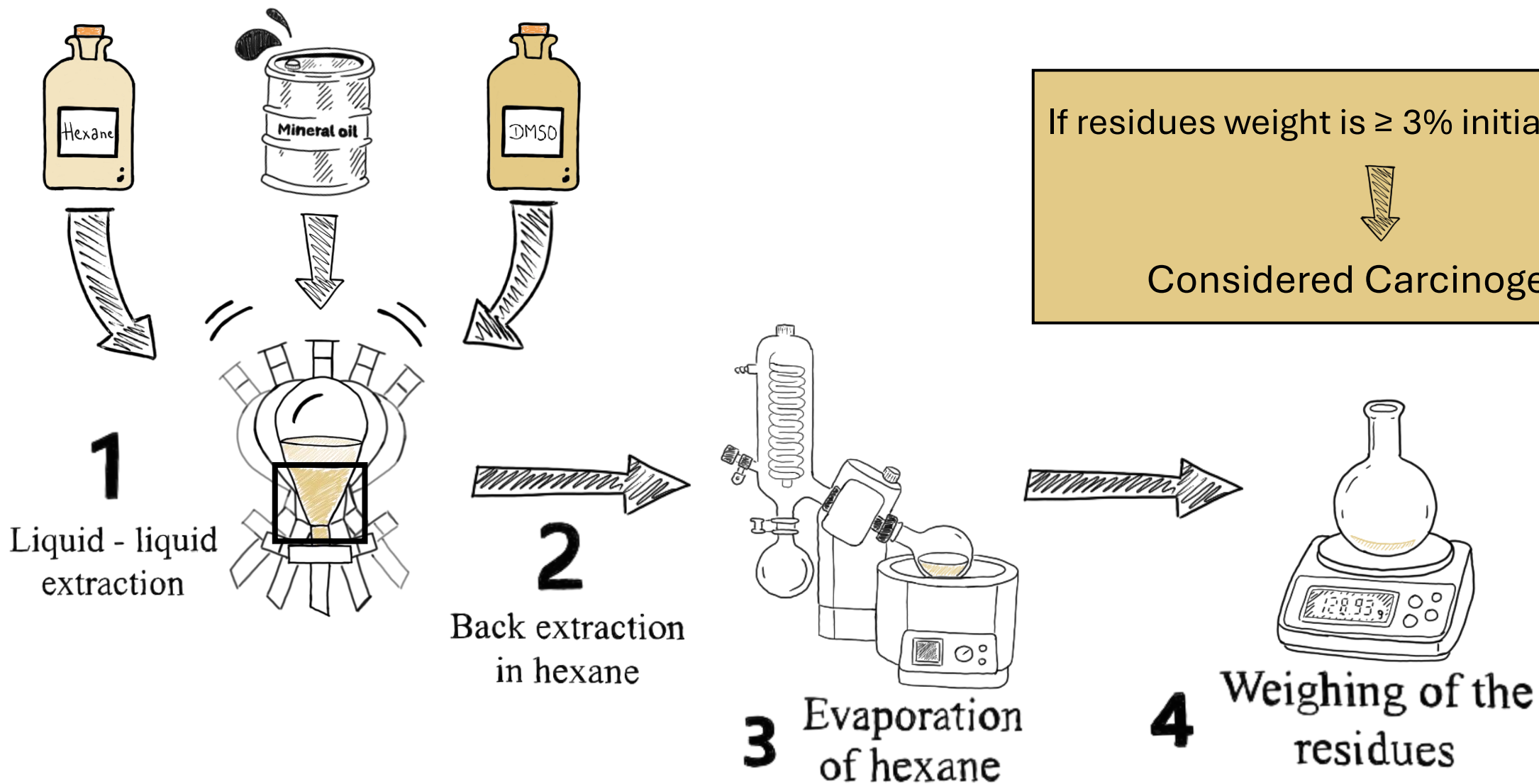


Introduction – IP 346 principle





Introduction – IP 346 principle



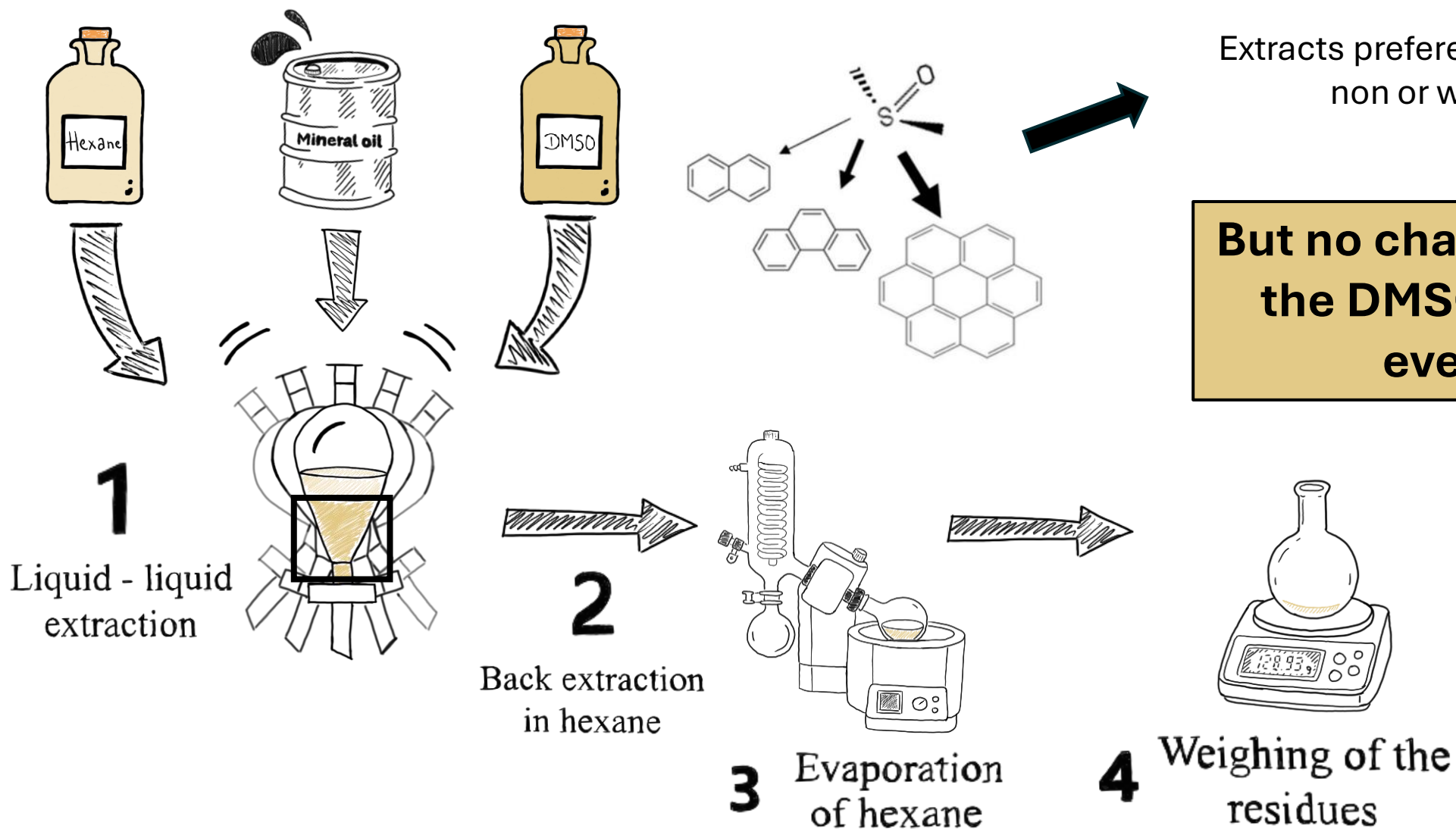
If residues weight is $\geq 3\%$ initial oil weight



Considered Carcinogenic



Introduction – IP 346 principle

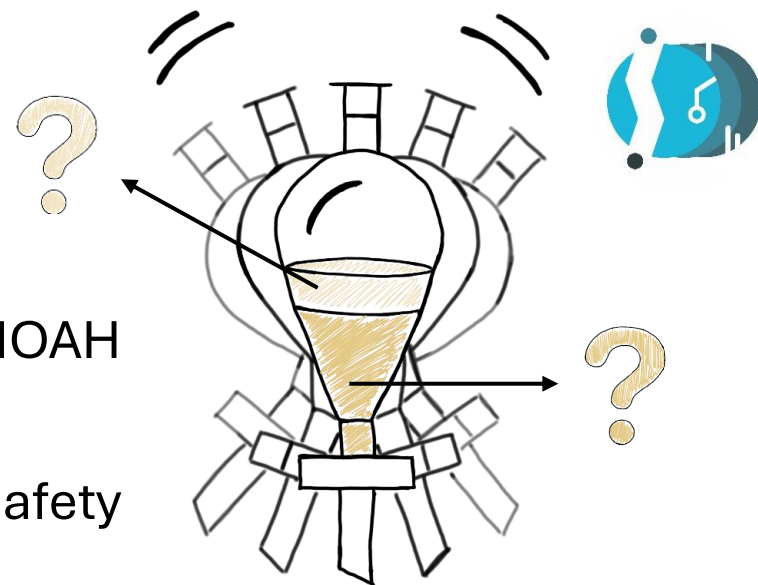




Goals

Main objectives:

- Characterise the DMSO and organic phases in terms of MOAH composition.
- Bridging the gap between industrial requirements and food safety ones.
 - Industrial side: IP346 → if no MOAH ≥ 3 rings ➡ 
 - Food safety perspective → if any kind of MOAH (even 1-2 rings) ➡ 

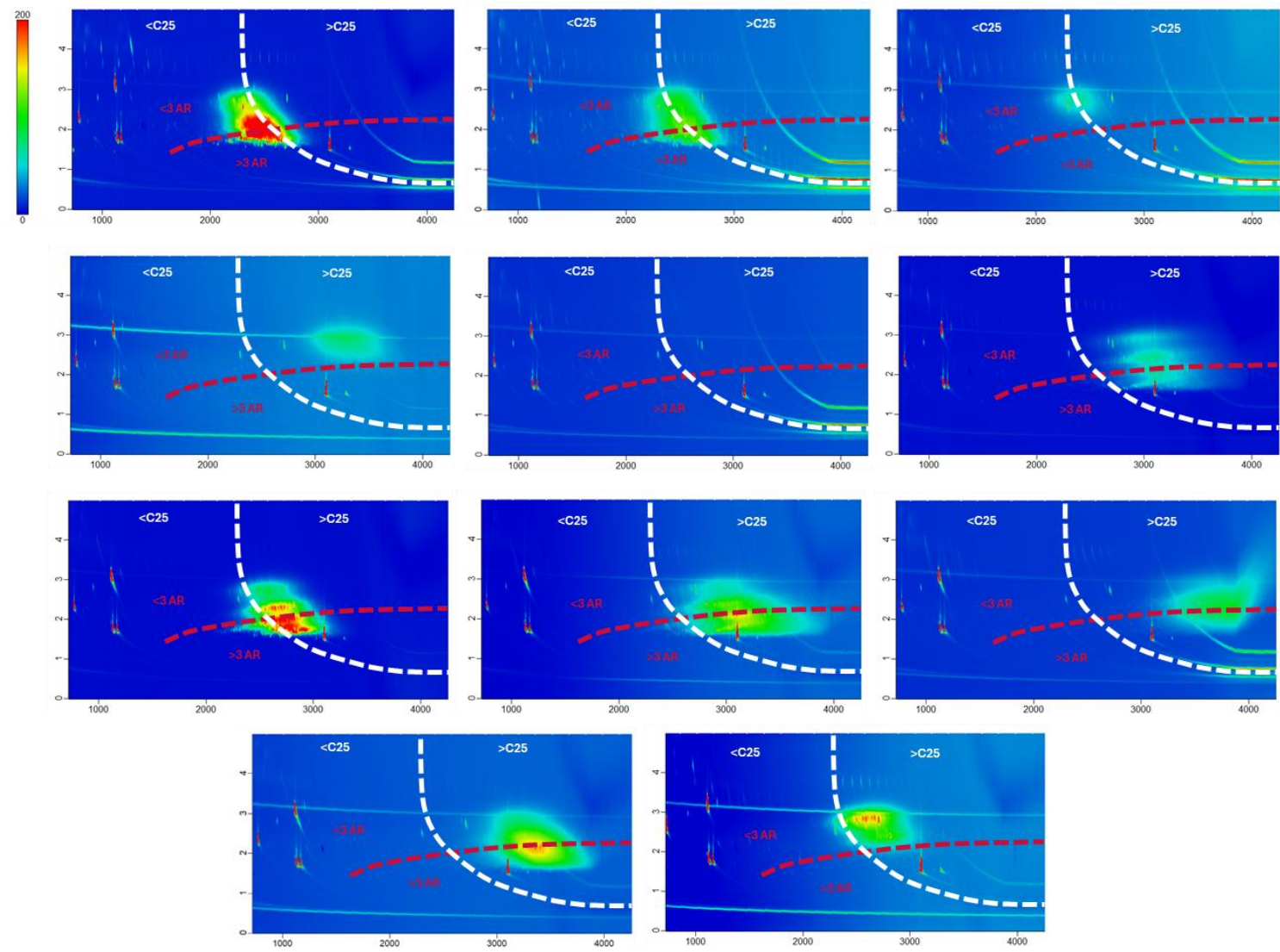
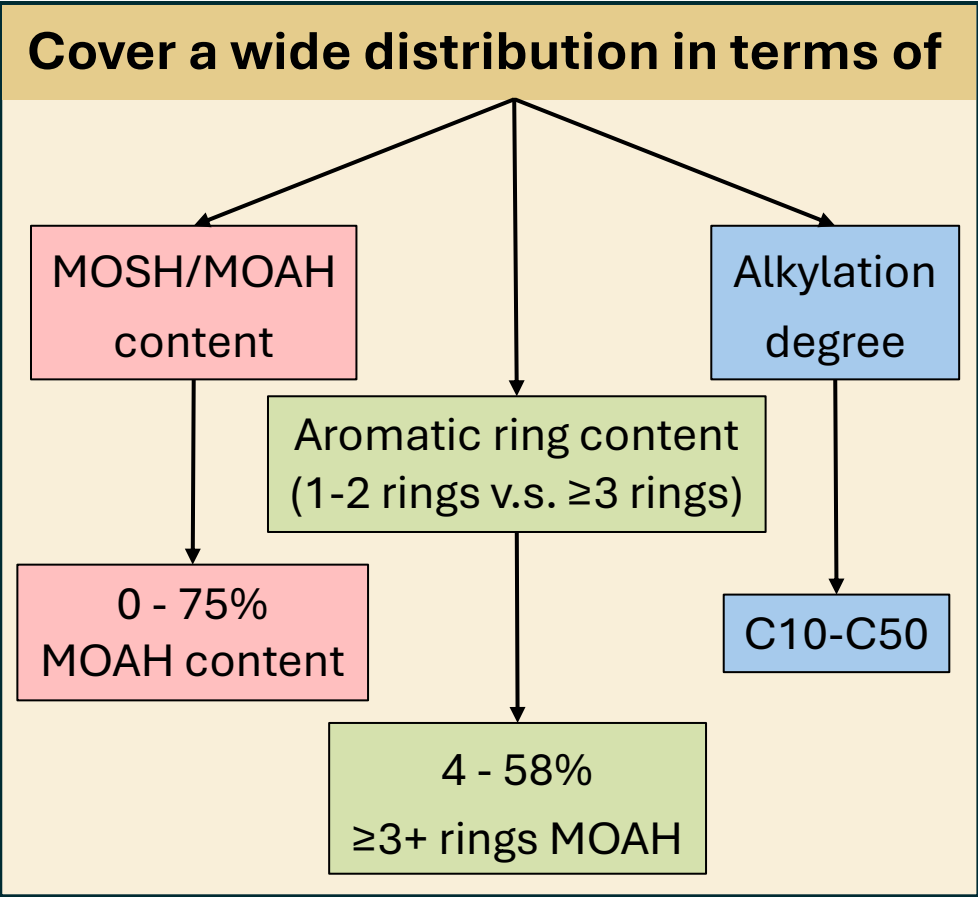


Strategy:

- Replace gravimetric measurement with GC×GC using on-column large-volume injection
- Miniaturize the method for lab capacity
- Implement UV measurement of extracts (used by European Pharmacopoeia for some mineral oils)

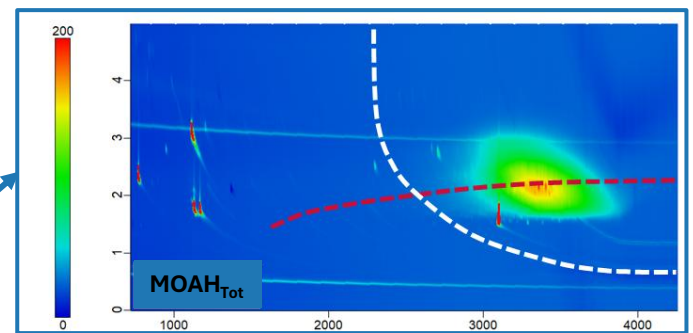
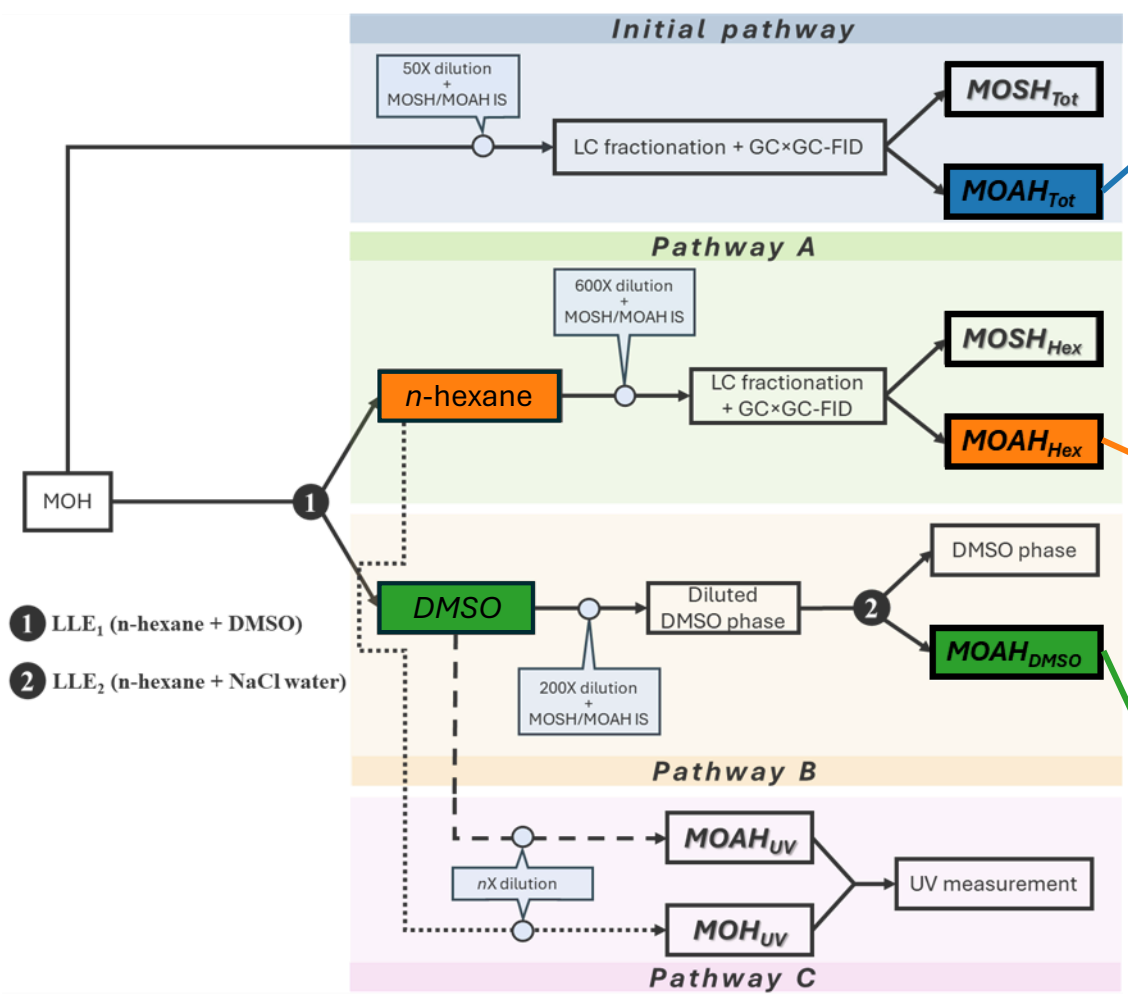


Any kind of mineral oil you said ?

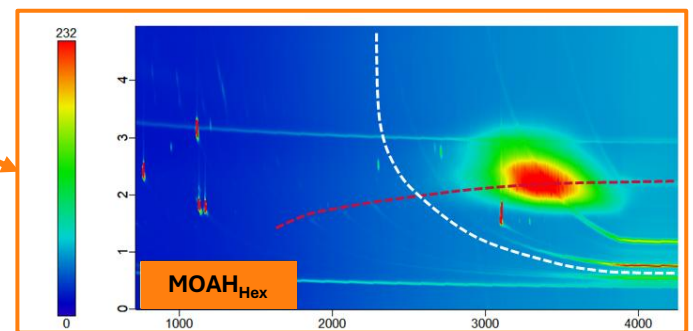




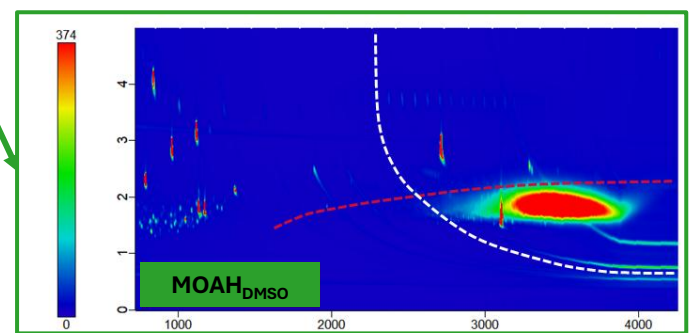
What resulted from the analyses ?



Total MOAH in the sample



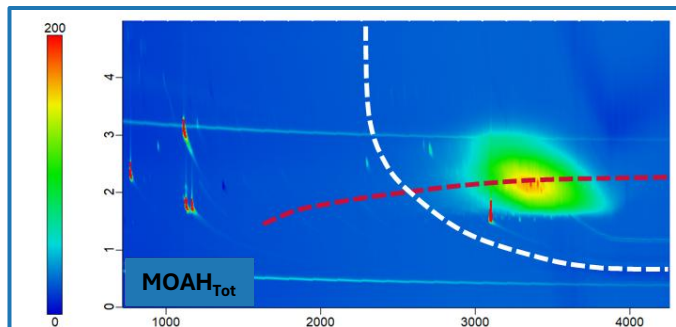
MOAH partitioned in the Hexane phase



MOAH partitioned in the DMSO phase

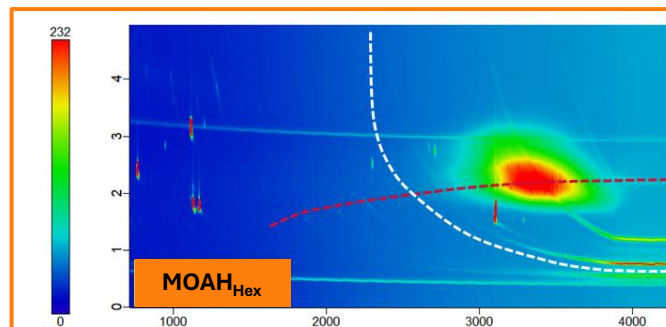


What resulted from the analyses ?



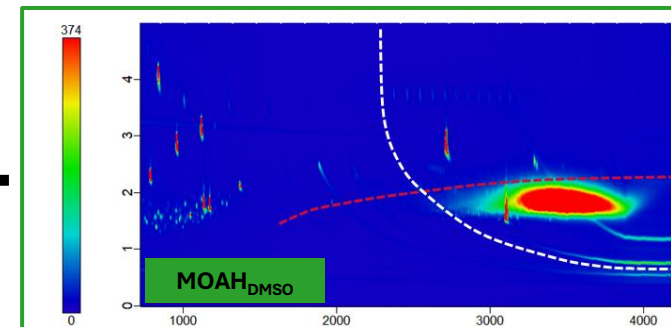
Total MOAH in the sample

=



MOAH partitioned in the Hexane phase

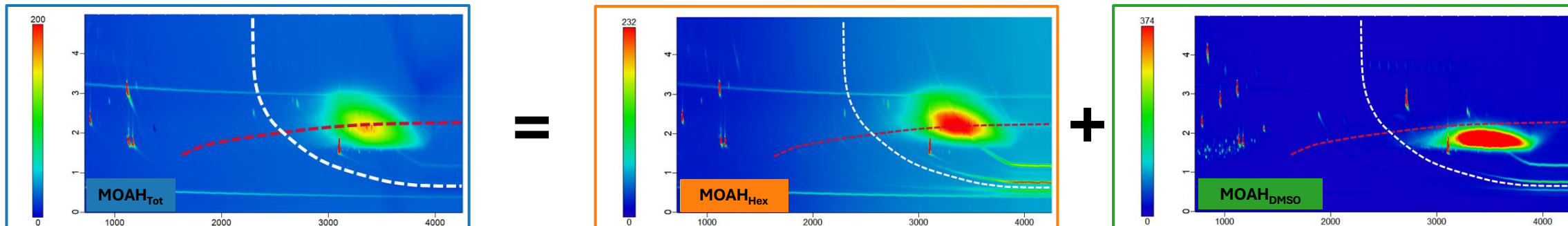
+



MOAH partitioned in the DMSO phase



What resulted from the analyses ?



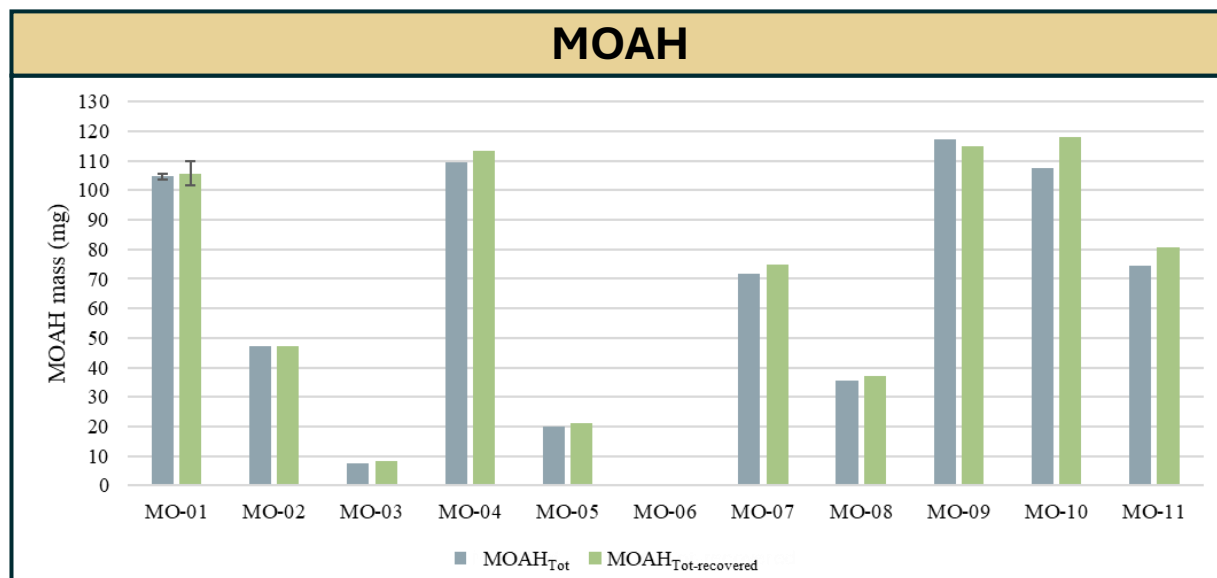
Total MOAH in the sample

=

MOAH partitioned in the Hexane phase

+

MOAH partitioned in the DMSO phase



Good mass recoveries of the initial MOAH mass.

- ✓ Regardless of aromatic ring distribution
- ✓ Regardless of the alkylation degree

→ 98-110% mass recovery !

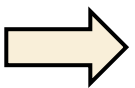
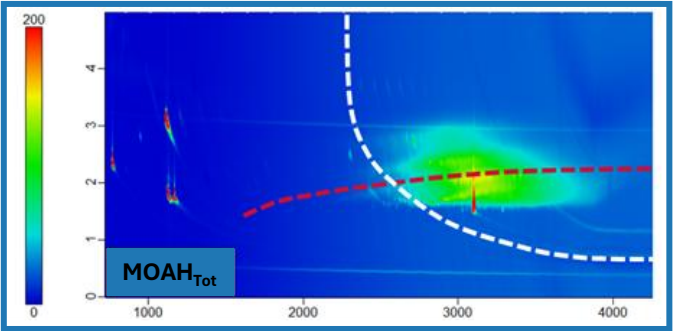
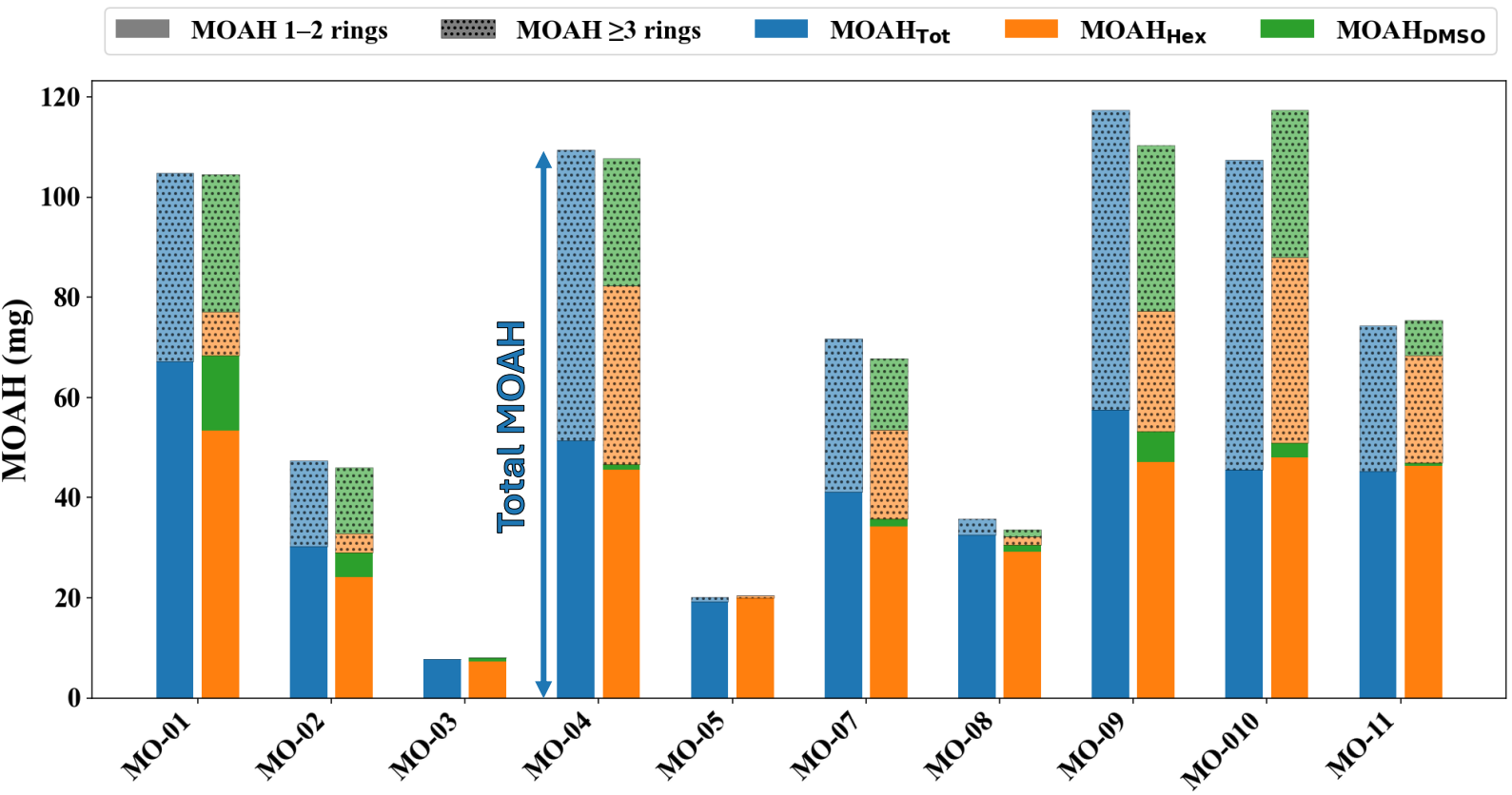
→ All MOAH content present in these fractions



What resulted from the analyses ?



MO-10



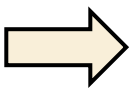
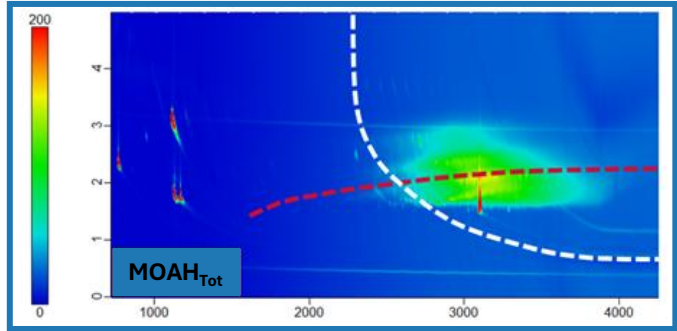
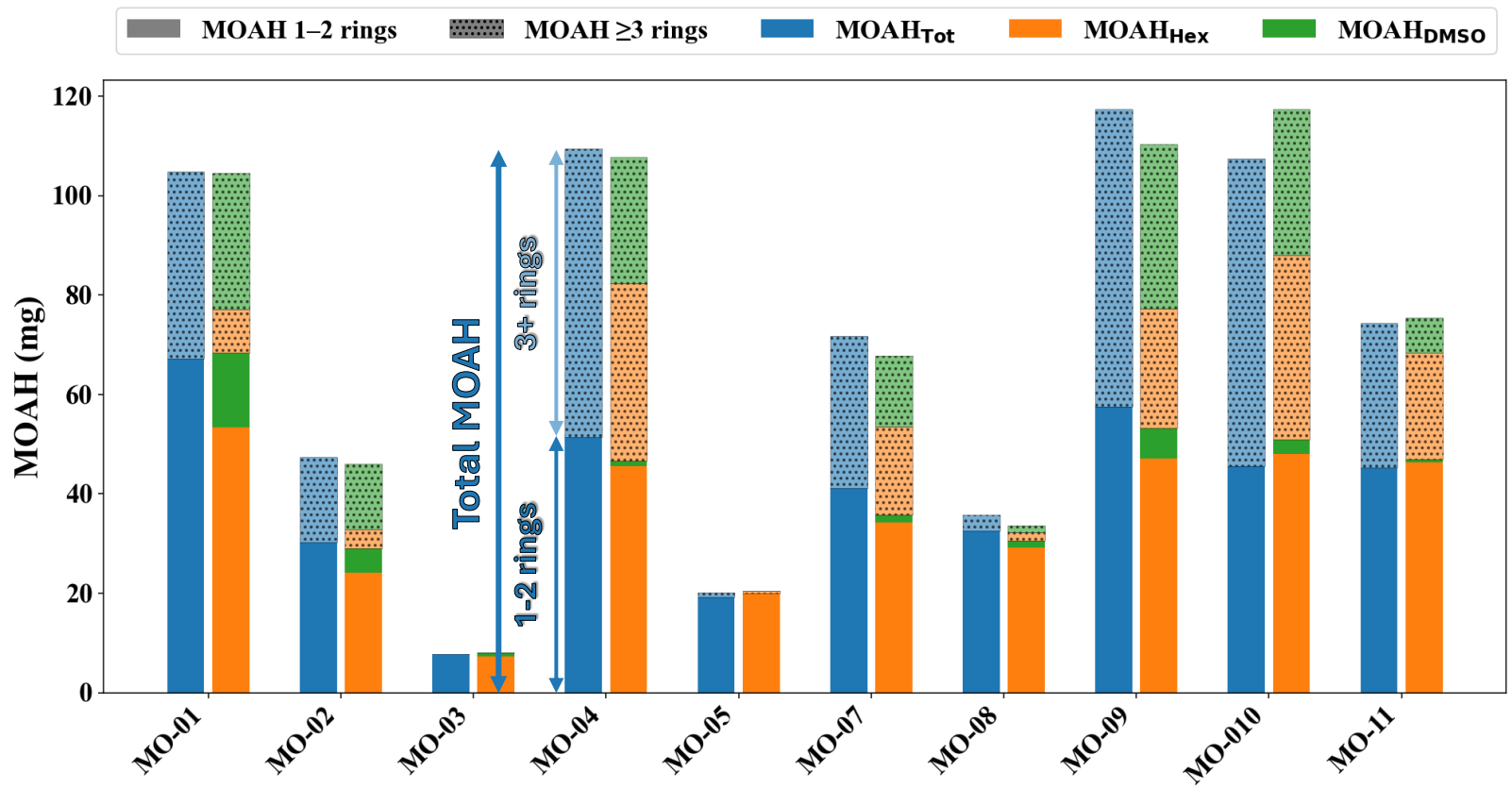
Concentration of ≥ 3 rings MOAH with no or low alkylation degree !



What resulted from the analyses ?



MO-10



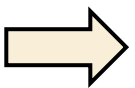
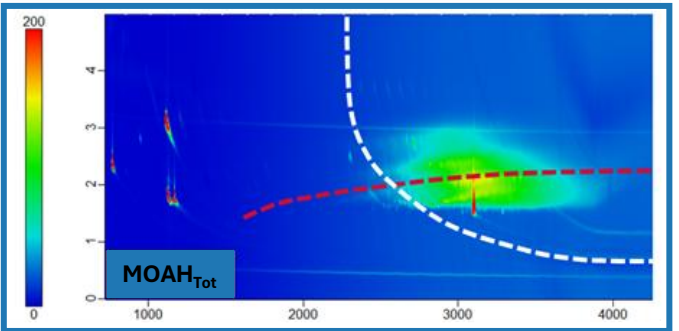
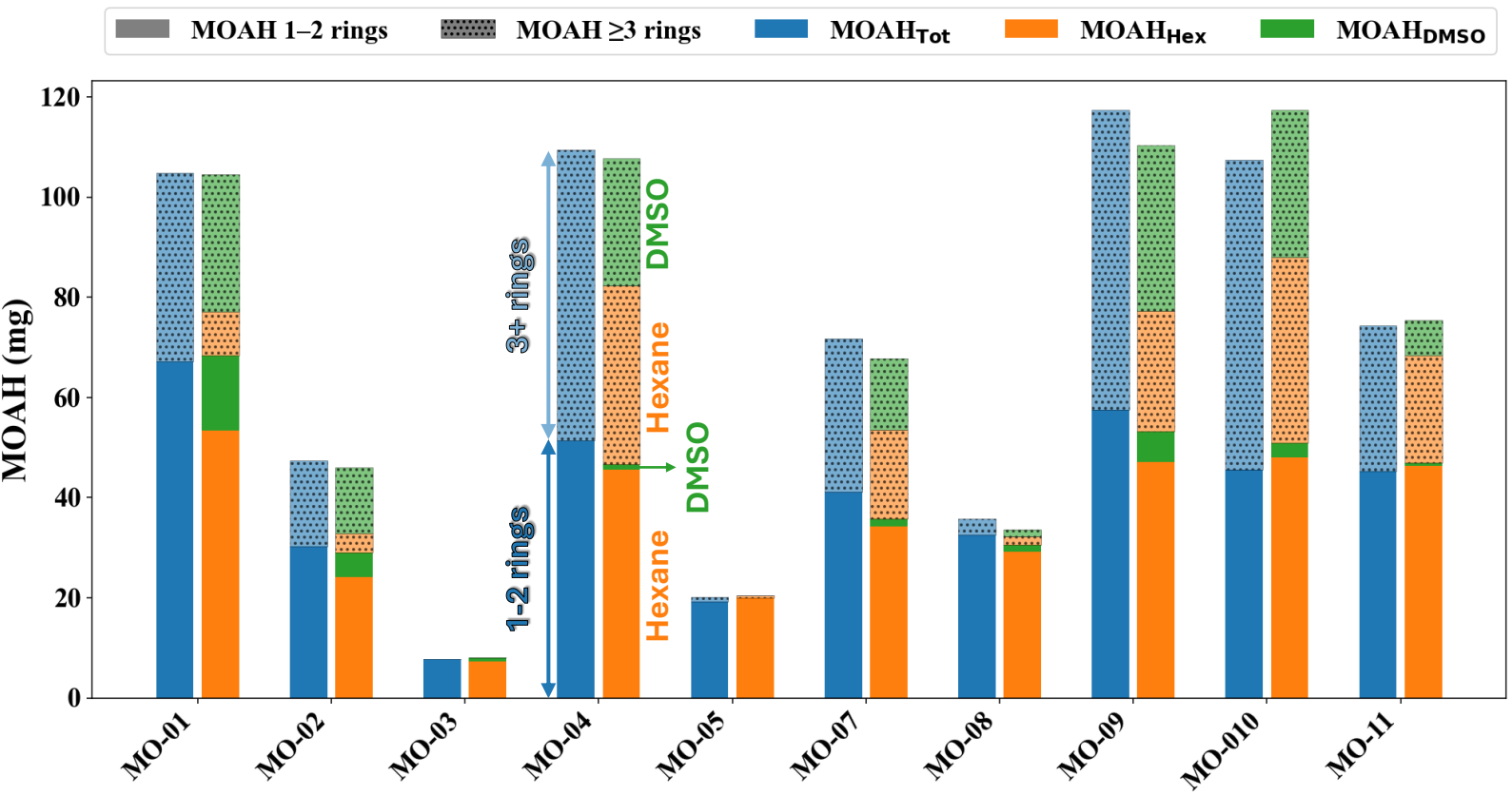
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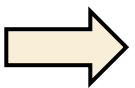
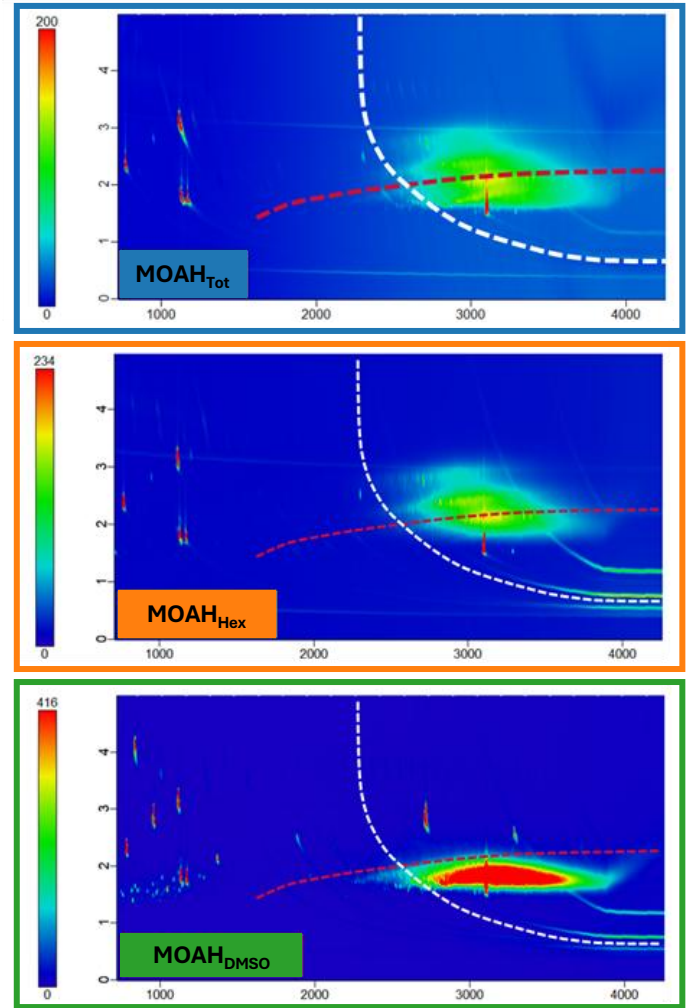
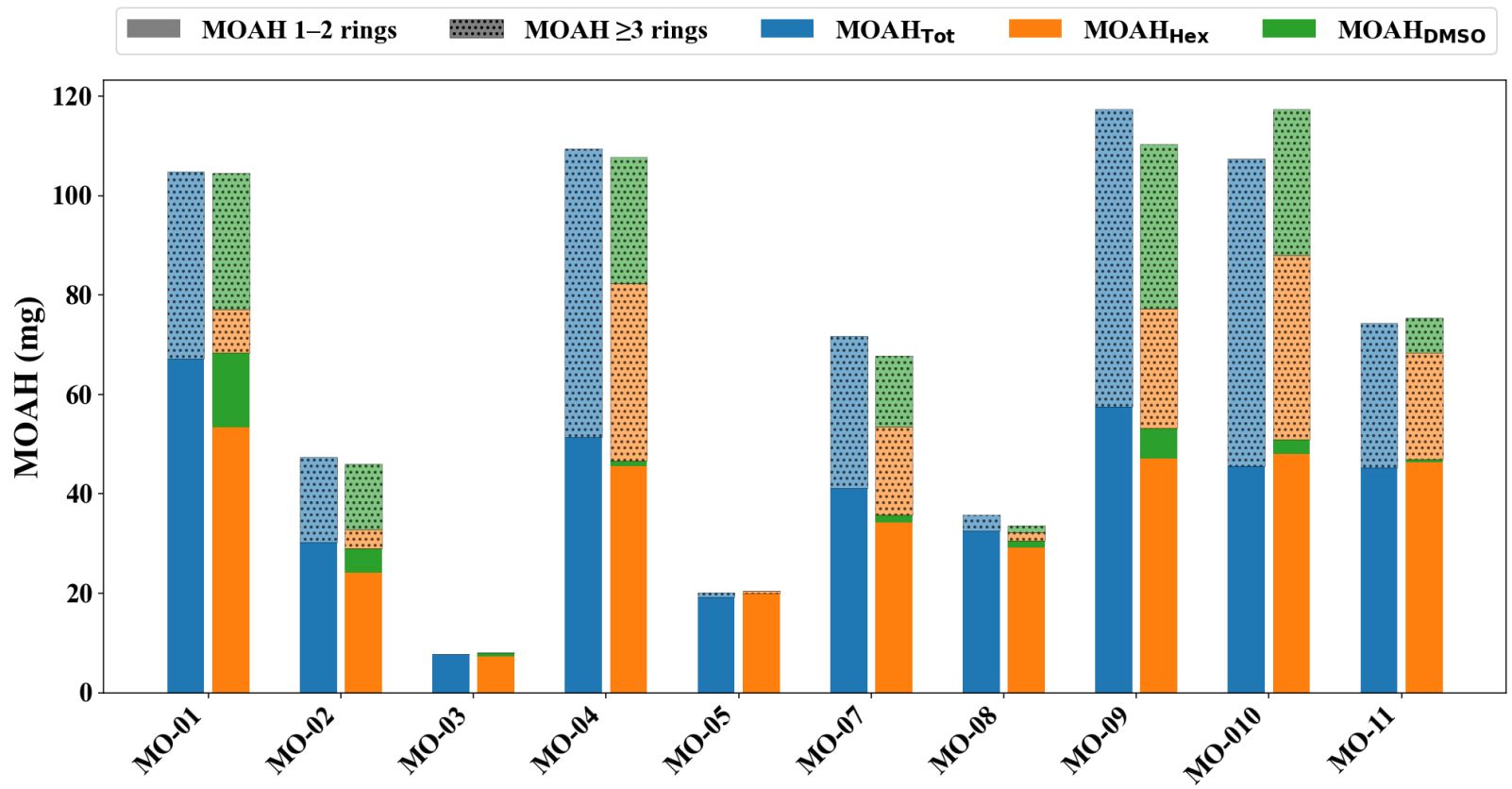
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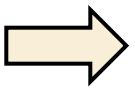
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MO-10



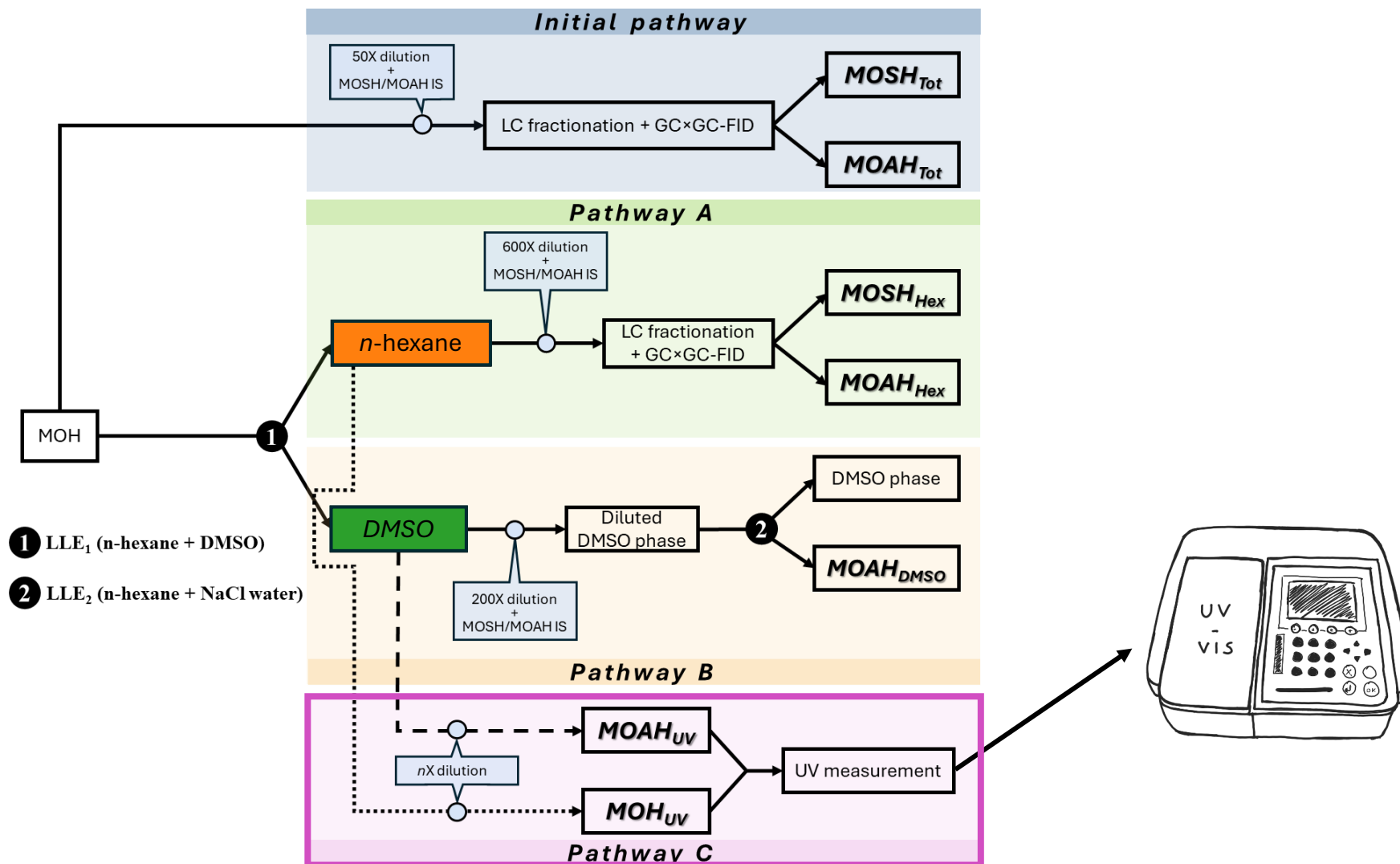
Concentration of ≥ 3 rings MOAH with no or low alkylation degree !



What is toxicologically evaluated corresponds mainly to ≥ 3 rings MOAH !

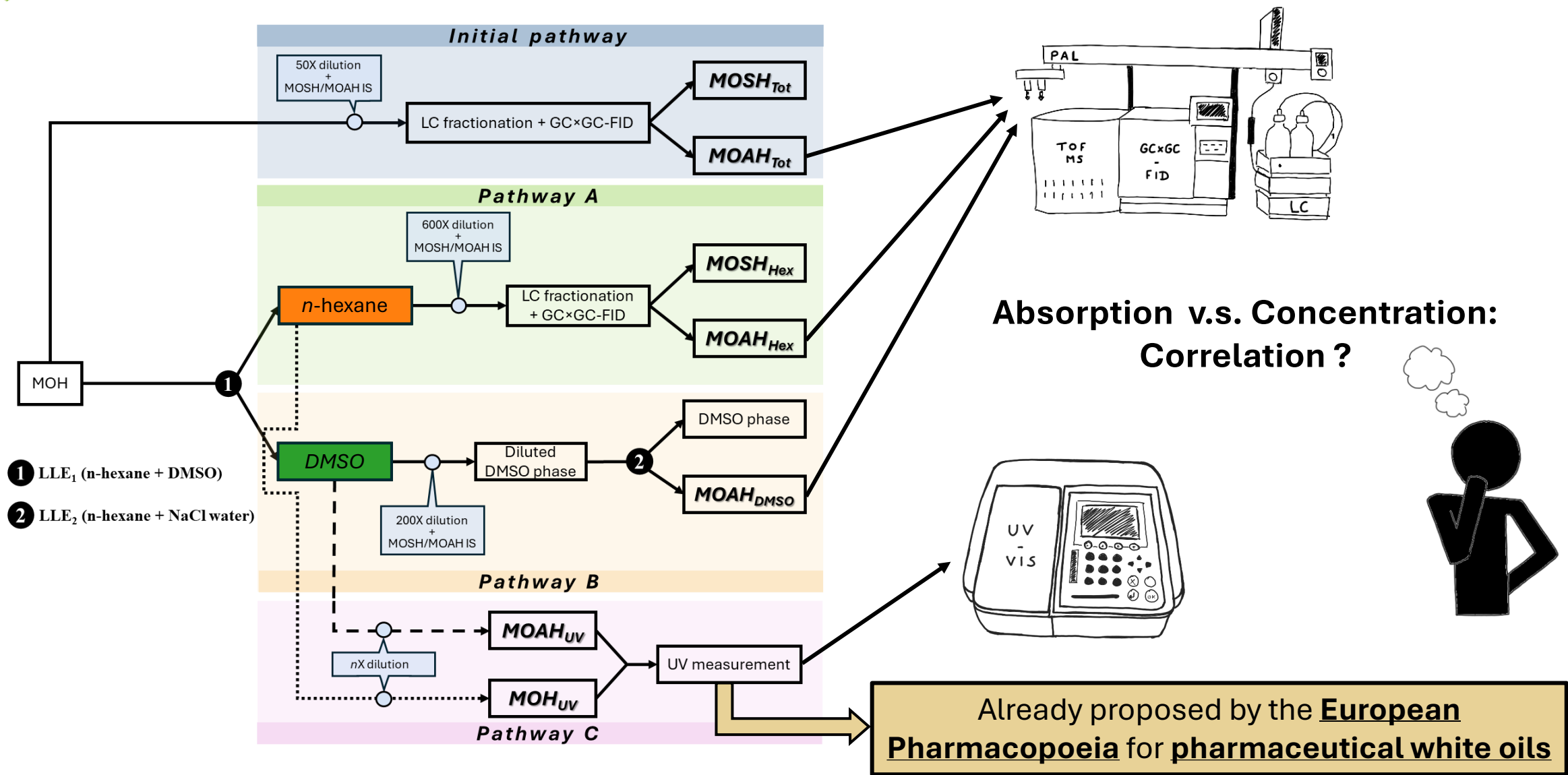


UV for MOAH quantification ?



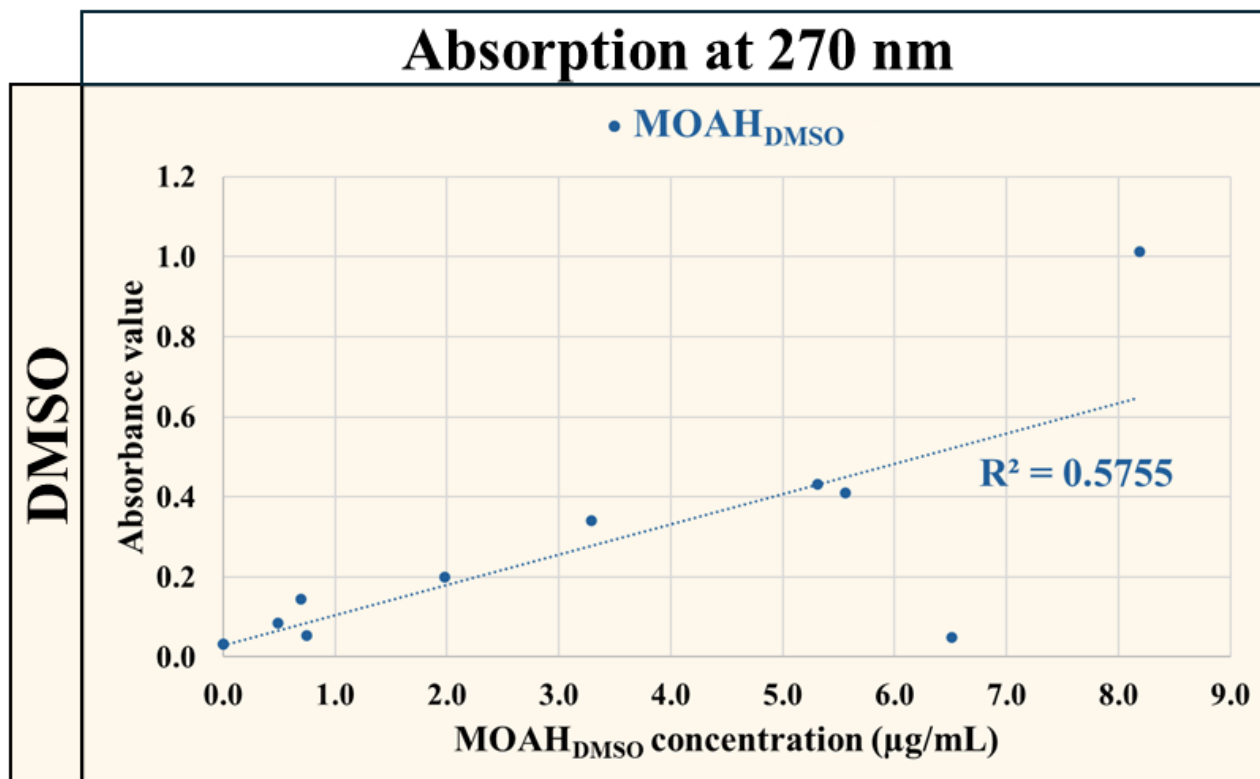


UV for MOAH quantification ?





UV for MOAH quantification ?



MOAH_{DMSO} concentration **V/S** Absorption

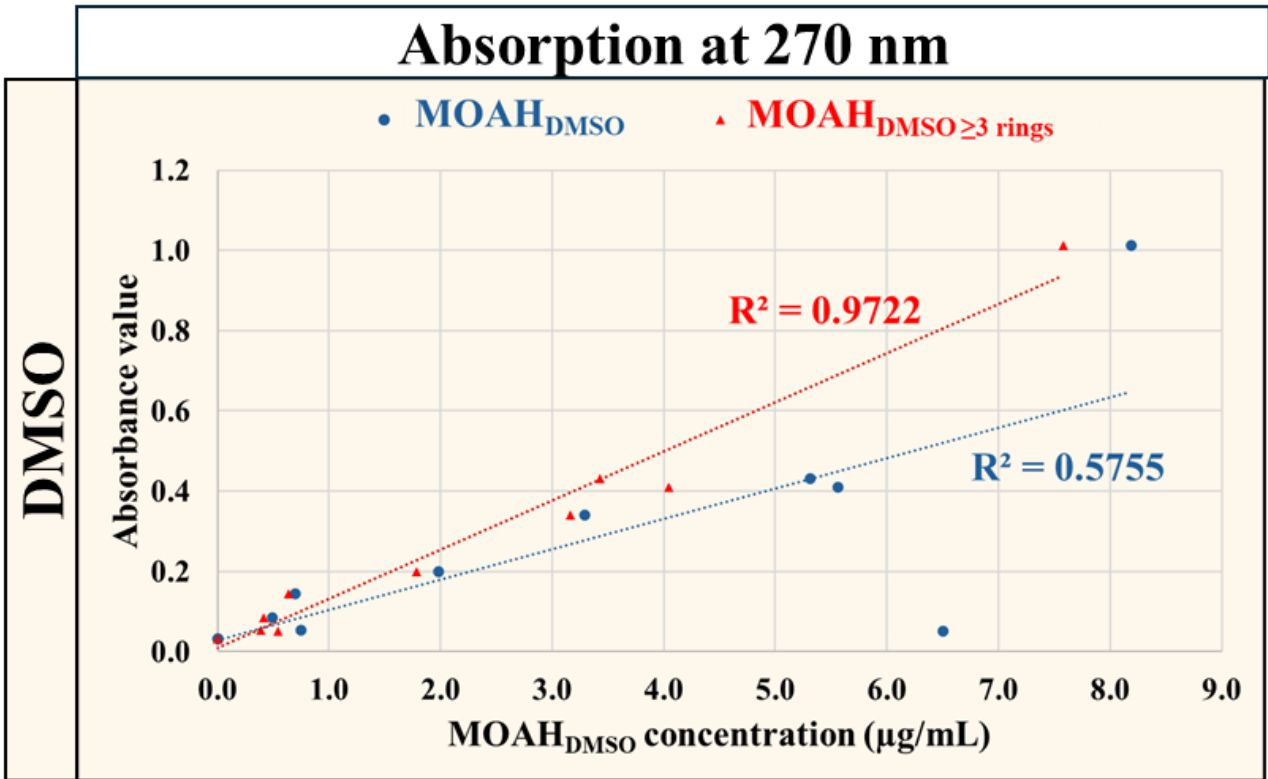
➡ **Correlation !**



N.B. For each curve, each point represent a different oil !



UV for MOAH quantification ?



N.B. For each curve, each point represent a different oil !

$\text{MOAH}_{\text{DMSO} \geq 3 \text{ rings}}$ concentration

V/S

Absorption

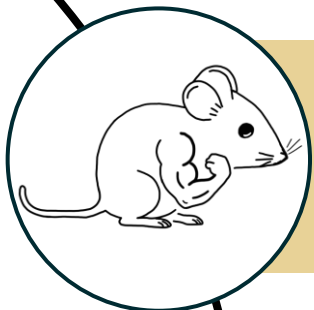
→ Good Correlation !

$\text{MOAH}_{\text{DMSO}}$ concentration **V/S** Absorption

→ Correlation !



Take home message

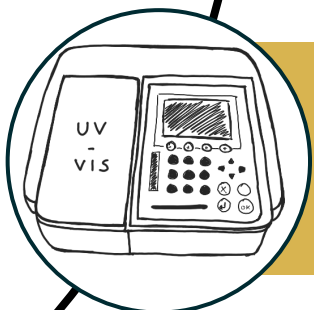


GC×GC is a useful powerful tool
→ *Complement and elucidate the IP346 method toxicological findings*



Bridge between the industry requirements and the food contaminants perspectives

- Industry → IP346 remains the main regulatory reference for industrial compliance
- Food safety → Precautionary approach applied to all MOAH fractions, including 1–2 ring species



GC×GC supports interpretation of UV Signals
→ Able to prove a strong correlation between UV absorption and ≥ 3 rings MOAH
→ European pharmacopoeia method suitable not only for medicinal white oils !



Any questions ? Come to me !



Food Research International

INSIGHT INTO WHAT IP346 MEASURES THROUGH CHARACTERISATION OF
MOAH DISTRIBUTION IN DMSO AND ORGANIC PHASE BY COMPREHENSIVE
TWO-DIMENSIONAL GAS CHROMATOGRAPHY
--Manuscript Draft--

Manuscript Number:	
Article Type:	Research Paper
Section/Category:	Food Toxicology
Keywords:	Mineral oil aromatic hydrocarbons (MOAH); IP346; Dimethyl sulfoxide (DMSO); GC×GC, UV-Vis.
Corresponding Author:	Giorgia Purcaro, PhD University of Liege Faculty of Gembloux Agro-Bio Tech Gembloux, BELGIUM
First Author:	Damien Pierret
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	Aleksandra Gorska
	Juan-Carlos Carrillo
	Giorgia Purcaro, PhD

Submitted → under revision



Shout out to our team, sponsors and grants



Team

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- Aleksandra Gorska – Assistant & PhD candidate
- Andrea Hochegger – Visiting professor
- Damien Eggermont – Assistant & PhD candidate
- Sophie Vancraenenbroeck – Head technician
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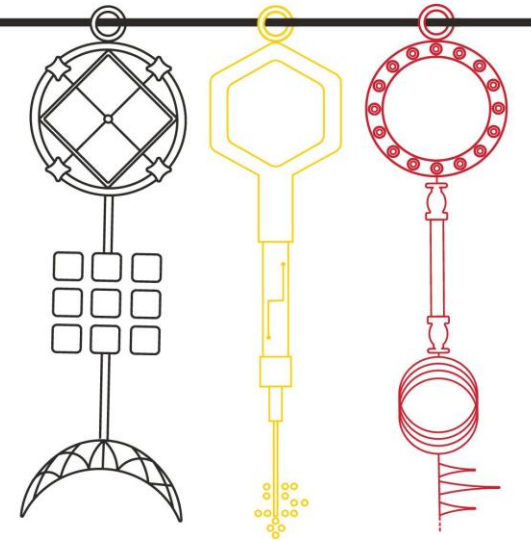


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Shout out to the audience



A big thank you to you all for
your listening and your
attention !

Any questions ?

