MOH Content in Olive Pomace Oils

Wenceslao Moreda

Introduction

1 MOH Issue Timeline

The MOH issue has been present since 2008, affecting olive pomace oil since 2010.

2 Sector's Response

The sector has been proactive in analyzing the situation and adopting necessary measures when appropriate.

3 Studies and Communication

Numerous studies have been conducted, shared with DG Sante and EFSA, and disseminated through associations to encourage implementation of HACCP to avoiding risks.

4 OPO Concentration Concerns

Olive pomace oils (OPO) present higher concentrations than those established in the Commission's Recommendation.

Origin

1

Presence in Fruit

n-alkanes are present throughout the olive fruit, with low concentrations of MOSH and MOAH below the LOQ of the analytical method (HPLC-GC-FID on-line).

2

Endogenous MOH

MOSH found mainly in the woody shell can be considered endogenous, as per Gómez-Coca *et al.* 2016.

3

MOAH Origin

MOAH can be also considered endogenous because the analysis shows chromatographic profiles and carbon atoms ranges similar to MOSH as in Gómez-Coca *et al.* 2023, indicating a shared origin, not contamination.

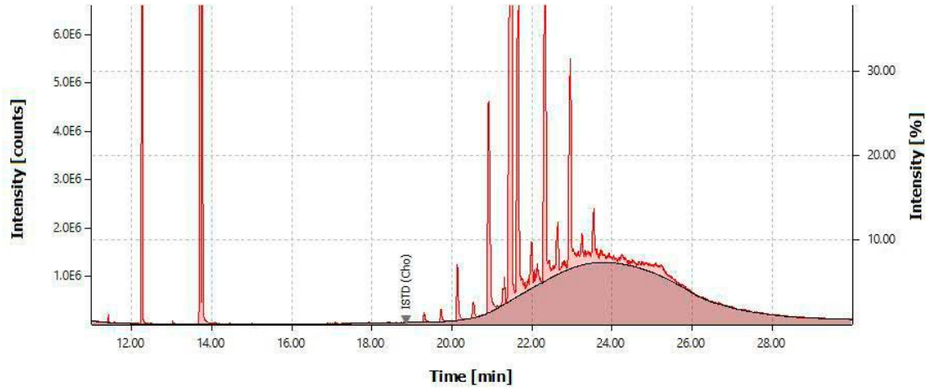
4

Extraction Impact

The extraction process using hexane increases MOH concentration in the oil by 40-50 times, because all MOH present in the pomace is concentrated in up to 2% of oil.

R. B. Gómez-Coca, M. C. Pérez-Camino & W. Moreda (2016) Saturated hydrocarbon content in olive fruits and crude olive pomace oils, Food Additives & Contaminants: Part A, 33:3, 391-402, DOI: 10.1080/19440049.2015.1133934
R. B. Gómez-Coca, M. C. Pérez-Camino & W. Moreda (2023) The Mineral Oil Hydrocarbon Paradox in Olive Pomace Oils. Foods, 12, 434. https://doi.org/10.3390/foods12030434

MOAH Origin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Intensity [%]
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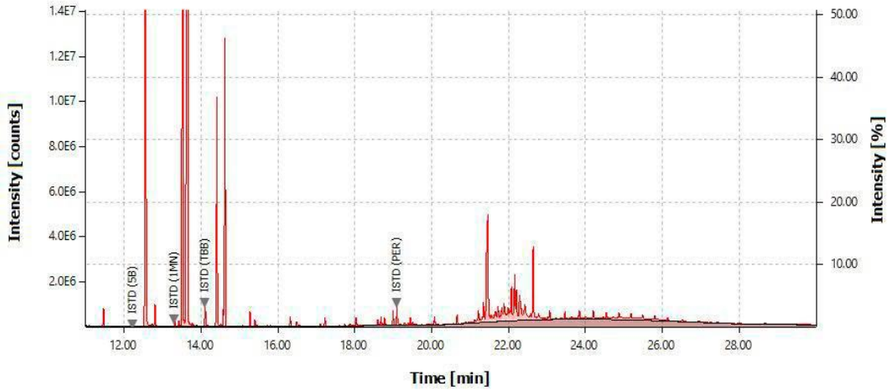
ISTD (Cho)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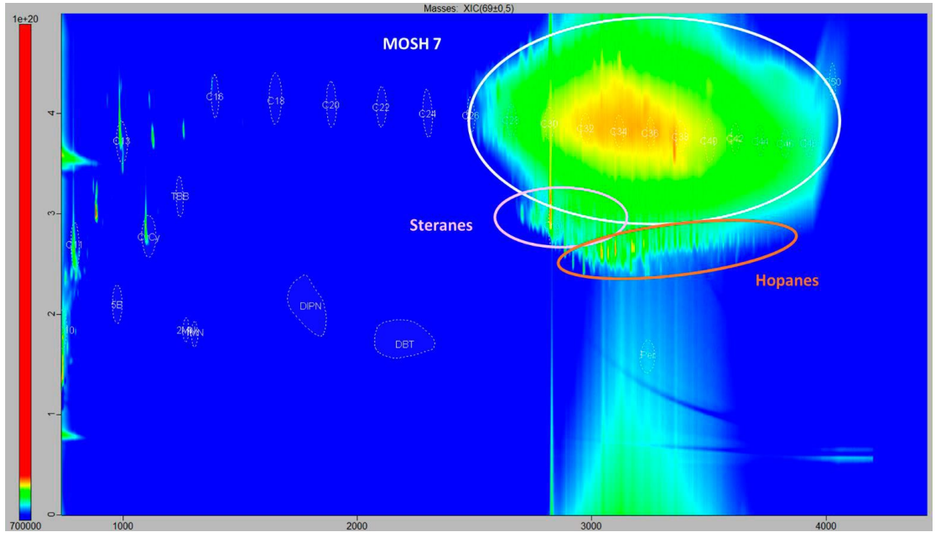
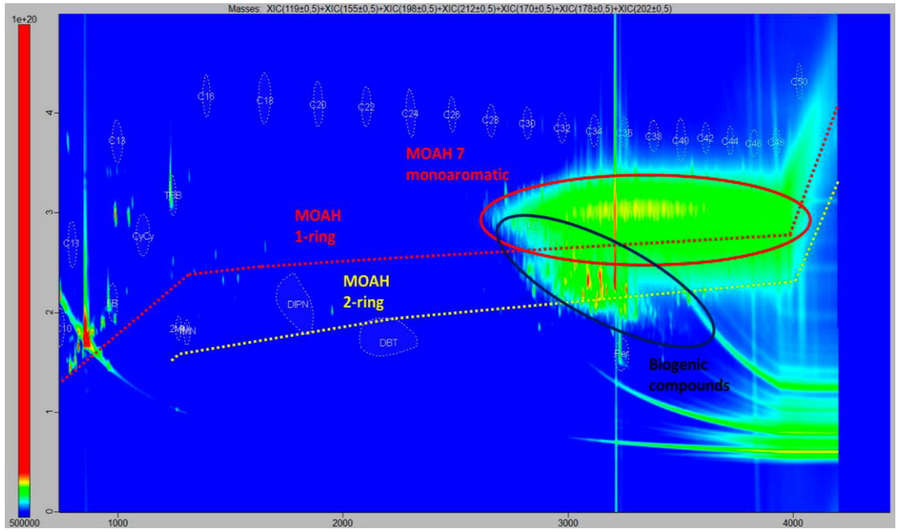
ISTD (1MN)
ISTD (TBB)
ISTD (PER)


Masses XIC(69±0.5)
MOSH 7
Steranes
Hopanes


Masses XIC(119±0.5)+XIC(155±0.5)+XIC(198±0.5)+XIC(212±0.5)+XIC(170±0.5)+XIC(178±0.5)+XIC(202±0.5)
MOAH 7
monoaromatic
MOAH
1-ring
MOAH
2-ring
Biogenic
compounds

Origin

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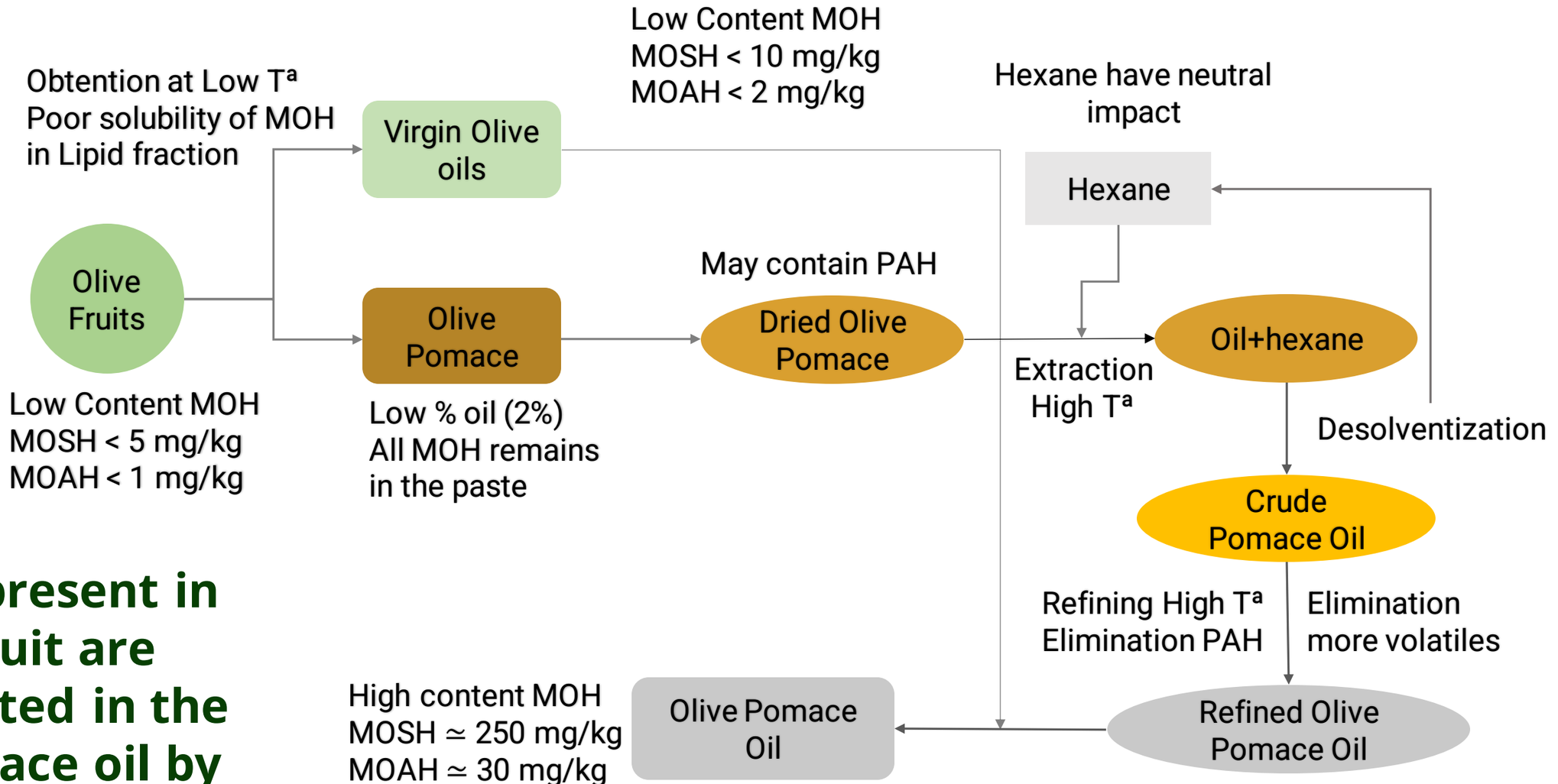

All MOH present in olive fruit are concentrated in the olive pomace oil by 50 times

Mitigation

Industrial Integrity

The concentration in OPO aligns with material balances, not resulting from contamination in the industrial process.

Hexane's Role

Hexane used in obtention does not increase MOH concentration, considered to have a neutral impact.

TODAY Refining Limitations

Today reduction of MOH during refining is impossible without altering other parameters; but...

New refining test at laboratory level

A new round of refining tests at the prototype level are being carried out, with encouraging results. Planned in a pilot plant with vacuum and temperature conditions different from those used in the previous tests

Production

Commercial OPO may have up to 250 mg/kg of MOSH and up to 30 mg/kg of MOAH due to concentration during the production.

Impact of Hexane

Samples	MOSH (ppm)						MOAH (ppm)				
	C10-C16	C17-C24	C25-C35	C36-C40	C41-C50	Total	C10-C16	C17-C24	C25-C35	C36-C50	Total
Hexane 01	4.35	10.32	6.97	2.81	1.43	**25.88**	2.17	2.32	7.51	0.25	**12.25**
Hexane 04	3.65	4.46	4.80	5.66	2.90	**21.47**	1.71	1.52	3,22	0.30	**6.75**
Hexane 01R	2.22	2.75	10.62	5.14	3.21	**23.94**	2.67	1.78	5.98	0.67	**11.10**
Hexane 04R	2.71	4.96	4.55	5.78	2.87	**20.87**	1.23	2.06	3.06	0.19	**6.54**

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TODAY Refining Limitations

Today reduction of MOH during refining is impossible without altering other parameters, but...

New mitigation strategies

All sector is committed to investigate new mitigation strategies to reduce the content in OPO.

Impact of Refining of OPO

Sample	MOSH (ppm)						MOAH (ppm)				
	C10-C16	C17-C24	C25-C35	C36-C40	C41-C50	Total	C10-C16	C17-C24	C25-C35	C36-C50	Total
Crude OPO	2.66	41.41	171.60	36.69	5.43	**257.80**	3.18	7.80	15.31	4.06	**30.35**
Neutralized	3.36	46.32	168.85	41.14	2.28	**261.96**	2.75	6.90	17.26	3.41	**30.32**
Winteriz./Washing	3.06	42.42	178.09	39.23	4.20	**267.00**	2.58	7.52	18.16	3.22	**31,48**
Bleached	3,10	41.30	166.50	36.25	5.86	**253.01**	3.00	6.11	15.66	5.71	**30,48**
Refined	0.00	39.08	134.06	52.17	7.60	**232.92**	2.40	7.23	14.13	4.86	**28.62**

Toxicity

MOSH Toxicity

MOSH have low oral toxicity and are not genotoxic, accumulating in liver, spleen, and adipose tissue, but results of studies cannot be extrapolated to humans.

MOAH Toxicity

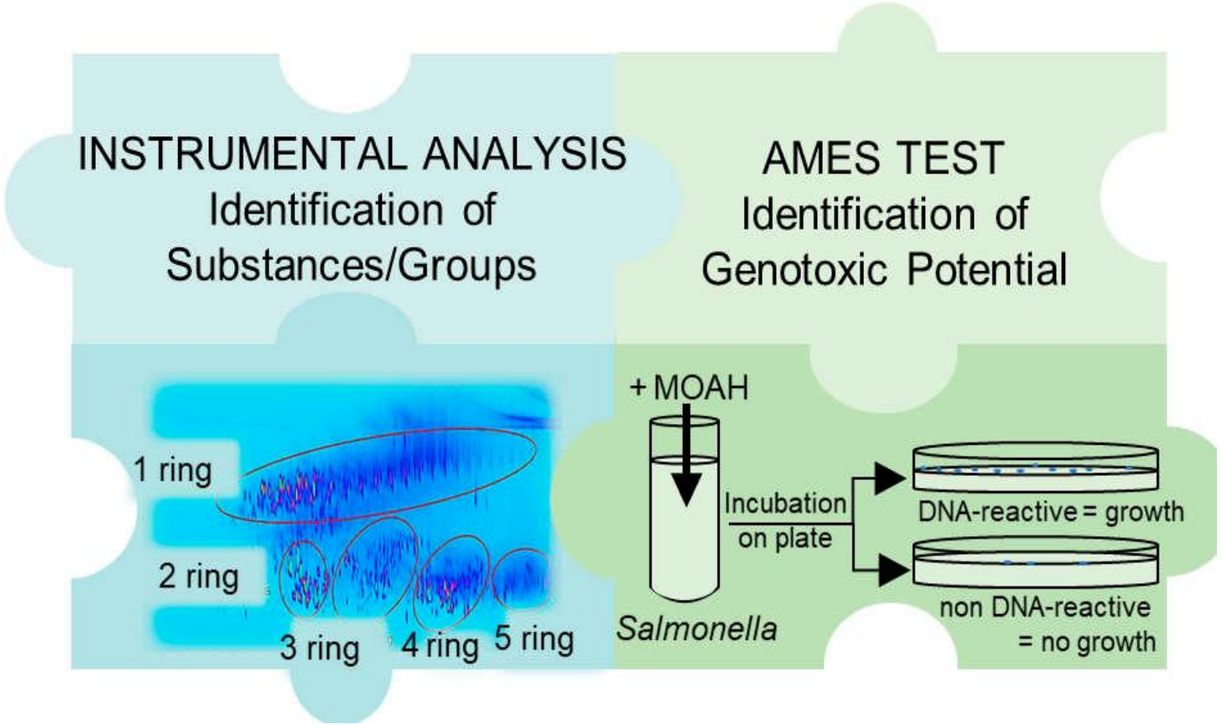
MOAH toxicological studies focus on PAC, not on MOAH. The MOAH in OPO are highly alkylated and are not PAH.

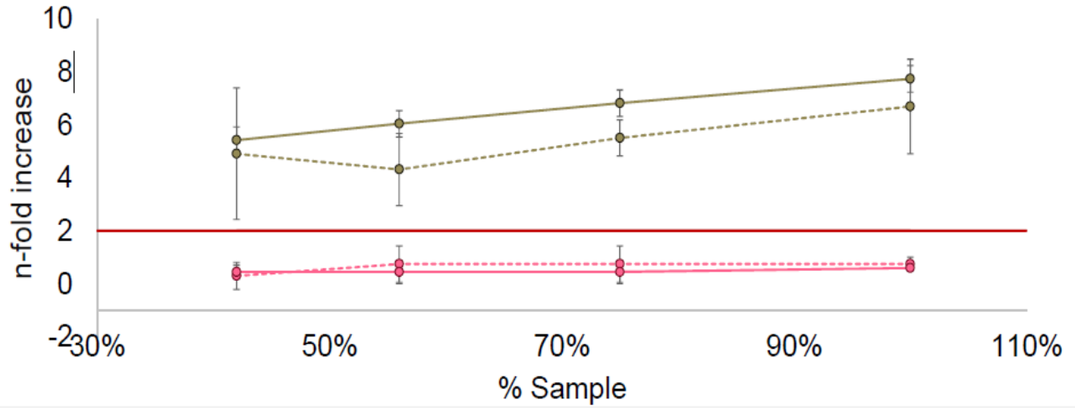
Genotoxicity

The genotoxicity of MOAH depends on their molecular structure, mainly in compounds with 3 to 7 rings. MOAH in OPO have 1 or 2 aromatic rings highly alkylated.

Toxicity

The toxicity of MOAH with 1 or 2 aromatic rings has not been proved, with genotoxicity discarded in studies using Ames test.





Mono- und diaromatics are non-mutagenic.
Tri- und poly aromatics are mutagenic.

Combination of Multidimensional Instrumental Analysis and the Ames Test for the Toxicological Evaluation of Mineral Oil Aromatic Hydrocarbons; A. Hochegger, R. Wagenhofer, S. Savić, E. Mayrhofer, M. Washüttl, and E. Leitner, Journal of Agricultural and Food Chemistry 2022 70 (51), 16401-16409, DOI: 10.1021/acs.jafc.2c05970.

Destruction of the Sector

1 Circular Economy

The production of OPO is integral to the olive oil production cycle, contributing to a circular economy.

2 Environmental Impact

Olive cultivation and its by-products play a significant role in reducing the carbon footprint.

3 Economic Consequences

Without processing pomace for OPO, the olive oil industry faces potential collapse, impacting producing countries economically and socially.

4 Consumption Patterns

OPO is predominantly used in frying, with minimal direct consumption by Europeans.

Analytical Method

Method Uncertainty

The recommended HPLC-GC-FID on-line method has significant uncertainty, leading to legal concerns.

Standardization Issues

Standardized in CEN 16995 and ISO 20222, the method's reliability is questioned due to potential over quantitation from interferences.

Advancements Needed

Adoption of GCxGC-TOF-FID is recommended for more accurate differentiation and quantitation of MOH.

Analytical Method

GCxGC-TOF-FID Advantages

GCxGC-TOF-FID allows the separation and quantitation of MOAH by aromatic rings, providing more reliable results and avoiding over quantitation.

This methodology allows the separation of the native biogenic substances, such as waxes, terpenes, n-alkanes and olefins, which can coelute with the MOH fractions in vegetable oils to avoid over quantitation.

Conclusions

Harvest Processing

80% of the olive harvest is processed by the pomace sector each campaign.

MOAH Rings

MOAH in OPO with 1 and 2 rings are endogenous and not genotoxic.

MOSH Toxicity

EFSA considers MOSH not toxic, challenging the need for a limit.

Analytical Method

dispersion of results between laboratories at a level of 1 to 2 mg/kg in fats and oils not allowing to fix a regulation limit at this level

Improvement of quantitation Method

Adopting the GCxGC-TOF-FID system available on the market, to differentiate MOAH based on their number of rings and separating from interferences or biogenic compounds, resulting in a more reliable result.

Transitional Period

Need of large transitional period for extra research in toxicology, reliable analytical method and new mitigation strategies.

Final Remarks

1

Circular Economy

The olive sector exemplifies the circular economy and bioeconomy, with pomace oil adding significant value.

2

Industry Survival

Removing olive pomace from oil mills could lead to the destruction of the olive sector.

3

Methodological Improvement

Improving quantitation methods for MOSH and MOAH is crucial, with GCxGC-TOF-FID systems offering a solution.

Thank you.