AGRINFO

MINERAL OIL HYDROCARBONS IN FOOD

AN INTRODUCTION TO UPCOMING EU REGULATION

AUGUST 2024

Funded by the European Union

DISCLAIMER

This publication has been developed by the AGRINFO programme, implemented by COLEAD and funded by the European Union. This publication has been produced with the financial support of the European Union. Its contents are the sole responsibility of COLEAD and can under no circumstances be regarded as reflecting the position of the European Union.

This publication is part of a collection of COLEAD resources, which consists of online and offline educational and technical tools and materials. All of these tools and methods are the result of more than 20 years of experience and have been developed progressively through COLEAD's technical assistance programmes, notably in the framework of development cooperation between the OACPS and the EU.

The use of particular designations of countries or territories does not imply any judgement on the part of COLEAD concerning the legal status of these countries or territories, their authorities and institutions or the delimitation of their frontiers.

The content of this publication is provided in a "currently available" form. COLEAD makes no warranty, direct or implied, as to the accuracy, completeness, reliability or suitability of the information at a later date. COLEAD reserves the right to change the content of this publication at any time without notice. The content may contain errors, omissions or inaccuracies, and COLEAD cannot guarantee the accuracy or completeness of the content.

COLEAD cannot guarantee that the content of this publication will always be current or suitable for any particular purpose. Any use of the content is at the user's own risk and the user is solely responsible for the interpretation and use of the information provided.

COLEAD accepts no liability for any loss or damage of any kind arising from the use of, or inability to use, the content of this publication, including but not limited to direct, indirect, special, incidental or consequential damages, loss of profits, loss of data, loss of opportunity, loss of reputation, or any other economic or commercial loss.

This publication may contain hyperlinks. Links to non-COLEAD sites/platforms are provided solely for the information of COLEAD staff, its partner-beneficiaries, its funders, and the general public. COLEAD cannot and does not guarantee the authenticity of information on the Internet. Links to non-COLEAD sites/platforms do not imply any official endorsement of, or responsibility for, the opinions, ideas, data, or products presented on those sites, or any guarantee as to the validity of the information provided.

Mention of specific company or product names (whether or not indicated as registered) does not imply any intention to infringe proprietary rights and should not be construed as an endorsement or recommendation by COLEAD.

This publication is publicly available and may be freely used provided that the source is credited and/or the publication remains hosted on one of COLEAD's platforms. However, it is strictly forbidden for any third party to state or imply publicly that COLEAD is participating in, or has sponsored, approved, or endorsed the manner or purpose of the use or reproduction of the information presented in this publication, without prior written consent from COLEAD. The use of the contents of this publication by any third party does not imply any affiliation and/or partnership with COLEAD.

Similarly, the use of any COLEAD trademark, official mark, official emblem, or logo, or any other means of promotion or advertising, is strictly prohibited without the prior written consent of COLEAD. For more information, please contact COLEAD at network@colead.link.

Funded by
the European Union

KEY POINTS

Mineral oil hydrocarbons (MOH) are a complex mixture of chemical compounds derived from petroleum. During the production and processing of food, MOH can find their way into the food supply chain from the environment or during harvest, transport, or processing. MOH in food can accumulate in the body, and may damage DNA and cause cancer. To prevent such risks, the European Union (EU) intends **in 2025** to introduce rules that will limit the presence of MOH in food and reduce risks to EU consumers. As the EU regulation of MOH under discussion is among the first worldwide, actors throughout the food chain and competent authorities in non-EU countries will need to keep informed.

The new rules will particularly require attention and possible action from certain sectors: **cereal products, rice, nuts, spices, dried herbs, chocolate, coffee, tea,** and **vegetable oils.** Several suppliers currently have no or limited data on the presence of MOH in their products. To avoid future trade disruption, suppliers of these products are recommended to urgently:

- **undertake analysis** to identify any presence of MOH
- **assess potential sources** of contamination, and
- **develop strategies** to reduce this presence.

Once present in raw materials, MOH cannot be removed during food processing.

This Guide provides a simple introduction to MOH, their origins and effects, the regulatory intentions of the EU, the sectors most affected, and actions required by sectors to prepare for compliance with new rules.

1. WHAT ARE MINERAL OIL HYDROCARBONS?

Mineral oil hydrocarbons (MOH) are chemical compounds derived from crude oil but also produced synthetically from coal, natural gas, and biomass. They occur in two forms:

- mineral oil **aromatic** hydrocarbons (**MOAH**)
- mineral oil **saturated** hydrocarbons (**MOSH**).

MOH can enter food as a result of the way the food is handled throughout the supply chain, or from the environment. The most significant sources are:

- *Agricultural contamination:* fuel or lubricants can leak from farm machinery; pesticides may contain paraffin oils or mineral oils.

- *Environmental contamination*: exhaust gases from power plants, motor engines, and heating burners can come into direct contact with raw materials, or settle on the soil and be taken up by plants.

- *Packaging of raw materials*: when raw materials are transported prior to processing, they may come into contact with mineral oils. Jute sacks, in particular, are known to be a potential source of mineral oils, as mineral oils are used in their manufacturing.

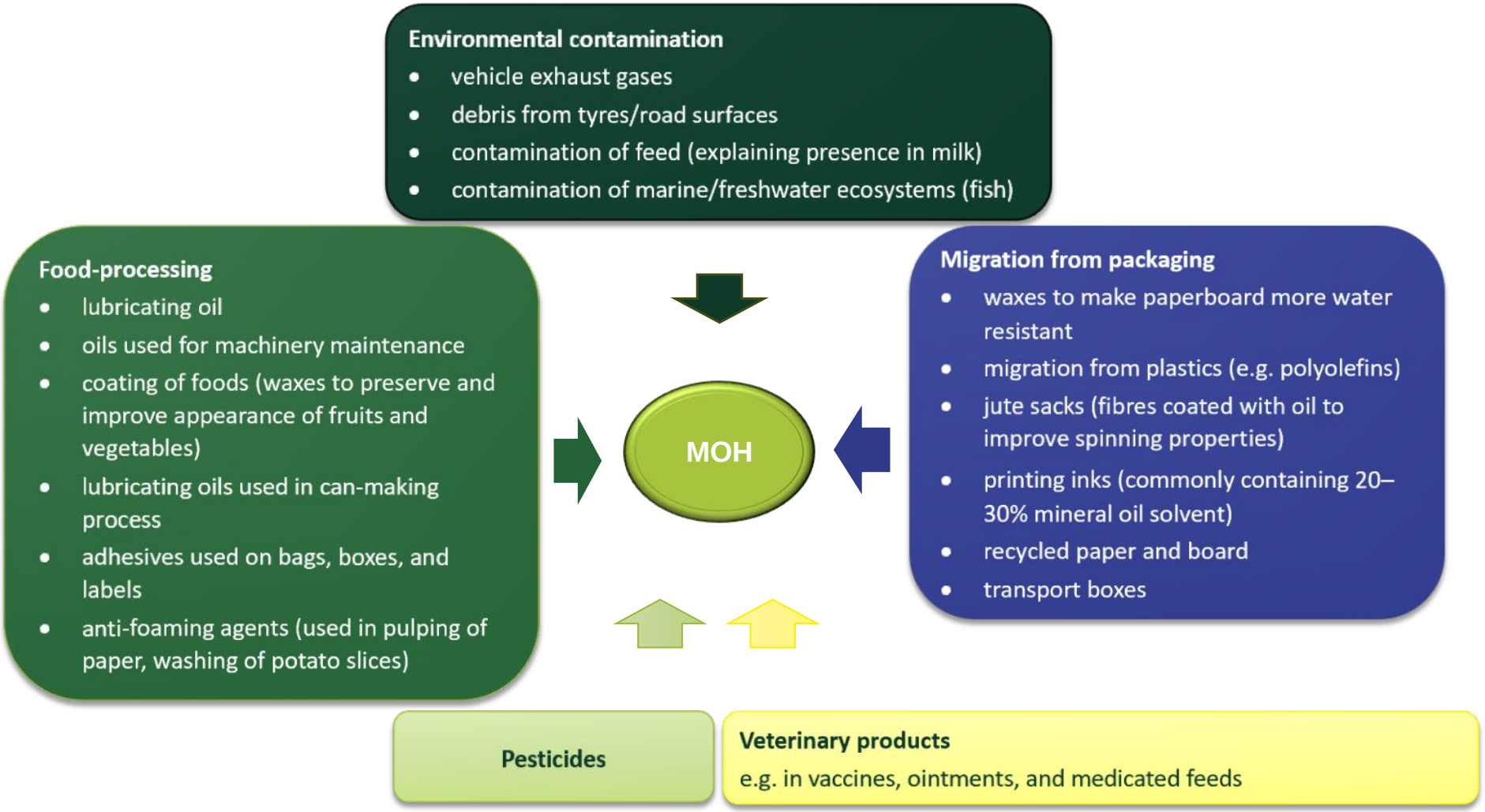
- *Lubricants*: lubricants that are intended for use ("food grade") in food processing machinery nevertheless contain mineral oils that come into contact with the food during processing.

- *Food additives*: certain waxes, emulsifiers, and technical aids for preventing flour dust or cheese coatings may contain mineral oils.

- *Packaging of foods*: mineral oils can be present in additives used in the production of food contact materials (adhesives, plastics, metal cans, paper and cardboard food contact materials). Mineral oils may also be present in recycled packaging materials. These cannot always be removed during recycling and may enter the food when it comes into contact with the packaging.

Figure 1 summarises the potential sources of MOH contamination identified by the European Food Safety Authority (EFSA).

Figure 1: Potential sources of MOH contamination. Source: based on EFSA (2023)[1]



[1] EFSA (2023) Update of the risk assessment of mineral oil hydrocarbons in food. *EFSA Journal*, 21(9): 8215.

2. WHY REGULATE?

The primary focus of EU regulators is on mineral oil aromatic hydrocarbons (**MOAH**). These can contain genotoxic substances that can damage DNA in cells and may cause cancer.[2] Therefore the basic aim is to eliminate MOAH from the food chain. This means they should be undetectable (lower than the limit of quantification, LOQ).

Current exposure to mineral oil saturated hydrocarbons (MOSH) does not raise concerns for human health, but there is uncertainty about their long-term accumulation.[3] As increased levels of MOSH could potentially be a risk, levels in food should be kept low.

EU action on MOH in food is not new. Over time, the EU has gradually been stepping up initiatives to reduce risks associated with MOH (see Timeline below).

EU Action on MOH - Timeline

2012	EFSA concludes that some MOAH are considered mutagenic and carcinogenic, and more monitoring of foods is required.
2017	European Commission recommends that EU Member States and food businesses submit monitoring data to EFSA to establish a single database (Recommendation (EU) 2017/84).
October 2019	Foodwatch publishes a report showing a quantified presence of MOAH in 16 different baby milk products from different EU Member States.
June 2020	EU Member States approve a Joint Statement agreeing to take measures where MOAH exceed 1 mg/kg per MOH C-fraction in infant formula and follow-on formula. (Statement of June 2020).
December 2021	Foodwatch published a report on mineral oils in a range of processed foods.
April and October 2022	The EU Members States agree to take enforcement action (market withdrawals and, if necessary, market recalls) against concentrations of MOAH in all foods at levels above the agreed limits of quantification (Statement of April 2022 and clarifications of October 2022).
July 2023	EFSA publishes its updated risk assessment on MOH.
Last quarter 2023	EU Member States start work on establishing maximum levels based on EFSA risk assessment.

[2] EFSA (2023).
[3] EFSA (2023).

3. HOW DOES THE EU INTEND TO REGULATE?

Currently there are no maximum limits for MOH in EU legislation.

In relation to mineral oil aromatic hydrocarbons (MOAH), the EU Member States agreed in April 2022[4] that when they check food products during official food controls, they will use the following limits of quantification (LOQ) to determine whether action is needed:

Fat/oil content of food (%)	LOQ (mg/kg)
≤4	0.5
>4, ≤50	1
>50	2

Where the concentrations of MOAH in food products exceed the LOQs, competent authorities agreed to to take further action, for example, to withdraw or recall products from the market. Food businesses are expected to undertake their own controls using the same LOQs.

To reinforce its action the EU is now intending to establish legal maximum levels on MOAH at the level of the LOQs established above.

For a few specific cases, the food sector has provided data demonstrating that, when using best available practices, concentrations of MOAH below the LOQ cannot yet be achieved. Discussions are ongoing towards a progressive way for achieving concentrations of MOAH below the LOQ for these products. All sectors impacted by the presence of MOAH should develop a clear action plan to address sources of contamination.

As regards mineral oil saturated hydrocarbons (MOSH), the EU is not currently considering establishing maximum levels in law. However, as there is concern that increased exposure to MOSH could lead to health concerns, there are discussions about recommending "indicative levels". These are levels that would require operators to investigate the source of contamination and take steps to reduce levels of MOSH.

4. HOW ARE MAXIMUM LIMITS SET?

Maximum levels for all contaminants under EU law are set

> "*at a strict level, which is reasonably achievable by following good agricultural, fishery and manufacturing practices and taking into account the risk related to the consumption of the food. In the case of a possible health risk, maximum levels for contaminants should be set at a level, which is as low as reasonably achievable (ALARA). Such an approach ensures that food business operators apply measures to prevent and reduce the contamination as much as possible in order to protect public health*." [Regulation (EU) 2023/915, introductory recital (2)]

In its 2023 evaluation, EFSA considered 6,120 samples with data on MOAH submitted by European countries and food associations, 90% of which were submitted after 2017 (when the Commission recommended more extensive monitoring). More data has been submitted for some products than others (see Annex I).

[4] European Commission (2022) Summary Report of the Standing Committee on Plants, Animals, Food and Feed: Section Novel Food and Toxicological Safety of the Food Chain, 21 April.

5. WHICH FOOD SECTORS MAY BE MOST AFFECTED BY A NEW EU REGULATION?

All food sectors will have to comply with MOAH maximum levels. Suppliers to the EU market in all sectors should undertake a review of products at various steps in the supply chain.

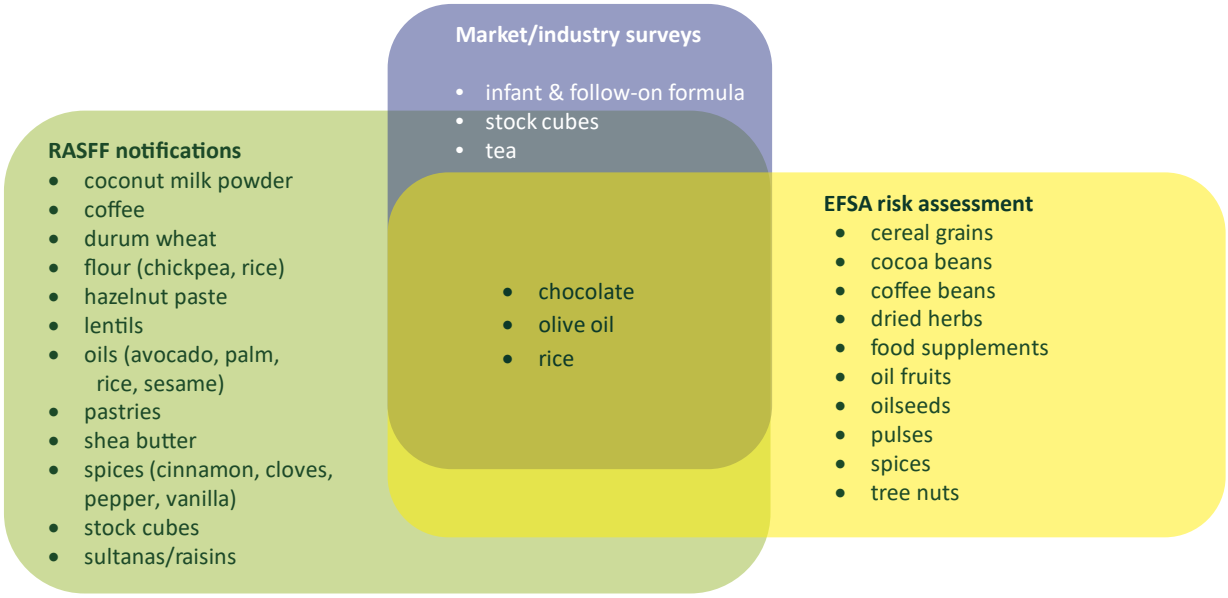
Certain food products have been identified as likely to contain higher levels of MOH. In 2017, the Commission recommended monitoring specific products.[5]

Since 2017, monitoring and reporting have provided further insights into which food sectors should be particularly vigilant. These reports include:

- ***EFSA Opinion*** provides average and (where available) 95th percentile of MOAH in analysed foods on the basis of data provided by food associations and Member State authorities.[6]
- ***Rapid Alert System for Food and Feed (RASFF)*** Member State notifications to the European Commission of foods that pose health risks. An overview of those relating to foods supplied by non-EU countries can be found in Annex II.
- ***Market/industry surveys*** by consumer organisations identify non-compliant products on the marketplace or in controls on raw materials.[7]

Drawing from these reports, Figure 2 provides an overview of foods with a potential risk of exceeding LOQs, where there is a particular need to investigate sources of contamination and review best practices.

Figure 2: Foods with a potential risk of exceeding LOQs (as identified by EFSA, RASSF Alerts and/or market/industry surveys)



[5] Animal fat, bread and rolls, fine bakery ware, breakfast cereals, confectionery (including chocolate) and cocoa, fish meat, fish products (canned fish), grains for human consumption, ices and desserts, oilseeds, pasta, products derived from cereals, pulses, sausages, tree nuts, and vegetable oils, as well as food contact materials used for those products.

[6] EFSA (2023).

[7] Foodwatch (2015), results of tests carried out on 120 products; Foodwatch (2019), results of new tests on infant formula bought in France, Germany, and the Netherlands; Foodwatch (2021) technical report on test results; 60 millions de consommateurs (2023) 'Plasticisers, hydrocarbons… Too many olive oils are polluted!'; THIE (2024), Position on MOSH/MOAH.

6. WHAT ARE THE CHALLENGES FOR MANAGING MOH IN FOOD?

Suppliers in non-EU countries may face the following challenges in preparing for new EU rules.

Identifying of sources of contamination

As there are many potential sources of contamination with MOH, identifying precise sources in specific food sectors is very challenging. Certain sources of mineral oils have been identified and reduced, such as the application of white mineral oils as a lubricant, and migration of mineral oils from paperboard packaging. However, certain forms of environmental contamination may be difficult to avoid. Identifying sources is crucial to developing strategies that will allow sectors to comply with new EU rules, but remains a challenge due to the complex and fragmented nature of the food supply chain and limited analytical capacity in many countries.[8]

Testing

Testing method

EFSA considers that there is a reliable method available for testing: the LC-GC-FID method (coupling liquid and gas chromatography with subsequent flame ionisation detection). In some foods, endogenous substances are available that can interfere with the LC-GC-FID analysis. Therefore for certain foods certain sample preparation steps need to be carried out, in order to remove these endogenous interferences. In some specific cases the interferences cannot be removed completely by the sample preparation steps. In those cases, in case the level is exceeded, a confirmatory analysis should be carried out with two dimensional gas chromatography (GCxGC), in order to distinguish the real MOH from the endogenous substances.

The European Commission's Joint Research Centre has developed guidance on sampling analysis and data reporting for monitoring MOAH.[9]

Availability of testing

Analytical capacity for evaluating MOH is more developed in the European Union than in many non-EU countries. Businesses in non-EU countries may not have access to laboratories accredited for testing MOH nationally or regionally. They may therefore have to rely on shipping samples to the EU for analysis.

Testing costs

As the testing of MOH is not routine, the cost of mineral oil analysis (MOAH and MOSH) in the EU is currently around four to five times the cost of a comparable multiple pesticide analysis. With the introduction of specific legislation on MOH, this cost is expected to reduce significantly over time.

Other issues raised by stakeholders

In response to questions that have been raised by stakeholders in early 2024 about how the EU intends to regulate MOH, the European Commission has published an FAQ document on the draft regulatory measures on mineral oil hydrocarbons (MOHs) in food.

[8] Buijtenhuijs, D. and van de Ven, B.M. (2019) Mineral oils in food: a review of occurrence and sources. Dutch National Institute of Public Health.

[9] Bratinova, S. and Hoekstra, E. (2019) Guidance on sampling, analysis and data reporting for the monitoring of mineral oil hydrocarbons in food and food contact materials. Luxembourg: Publications Office of the European Union.

7. HOW TO PREPARE FOR THE EU REGULATION?

MOAH contamination can occur at different steps in the supply chain. These can accumulate to give high levels which that **cannot be removed during processing** once they are in the raw material. Vigilance and coordination will be needed all along the food chain. Non-EU suppliers of food, particularly the sectors highlighted in Section 5, must urgently take action to assess whether the presence of MOAH is below the LOQs listed in Section 3.

For the sectors identified in Section 5, the following actions are recommended.

Mapping the supply chain and potential risk points

The potential sources of contamination are largely known, but their significance may vary greatly depending on the sector, and on national agricultural and transport practices. A first step in addressing MOH contamination is to map out the most relevant sources. As a starting point, the European food industry association, FoodDrinkEurope, and the German food industry association Bund für Lebensmittelrecht und Lebensmittelkunde (BLL) have developed a toolbox that gives detailed sources of MOH (including migration from packaging, transport, and processing contamination, and food additives). [10]

Data collection and analysis

Analysis of food samples at each stage in the supply chain (post-harvest,[11] and before, during, and post-processing) is the most reliable way of identifying possible sources of MOH contamination, and for developing an action plan of mitigation measures. Continual monitoring will be needed to assess the success of proposed mitigation measures.

Action plan

On the basis of data collection and analysis, a series of potential strategies can be developed aimed at reducing the risk of contamination. The FoodDrinkEurope/BLL toolbox[12] provides some examples, but the measures required to address MOH contamination are likely to be extremely specific to the sector[13] and the local context.

Communication and dialogue across the supply chain

As contamination can occur at all stages of the food supply chain, there must be a coordinated response between producers, processors, packaging suppliers, and transporters. Any action plan aimed at reducing contamination must have the involvement and support of all these actors. The public sector may also have a role to play in supporting food monitoring and the development of analytical testing capacity.

[10] FoodDrinkEurope and BLL (2018) Toolbox for preventing the transfer of undesired mineral oil hydrocarbons into food. FoodDrinkEurope and Bund für Lebensmittelrecht und Lebensmittelkunde.

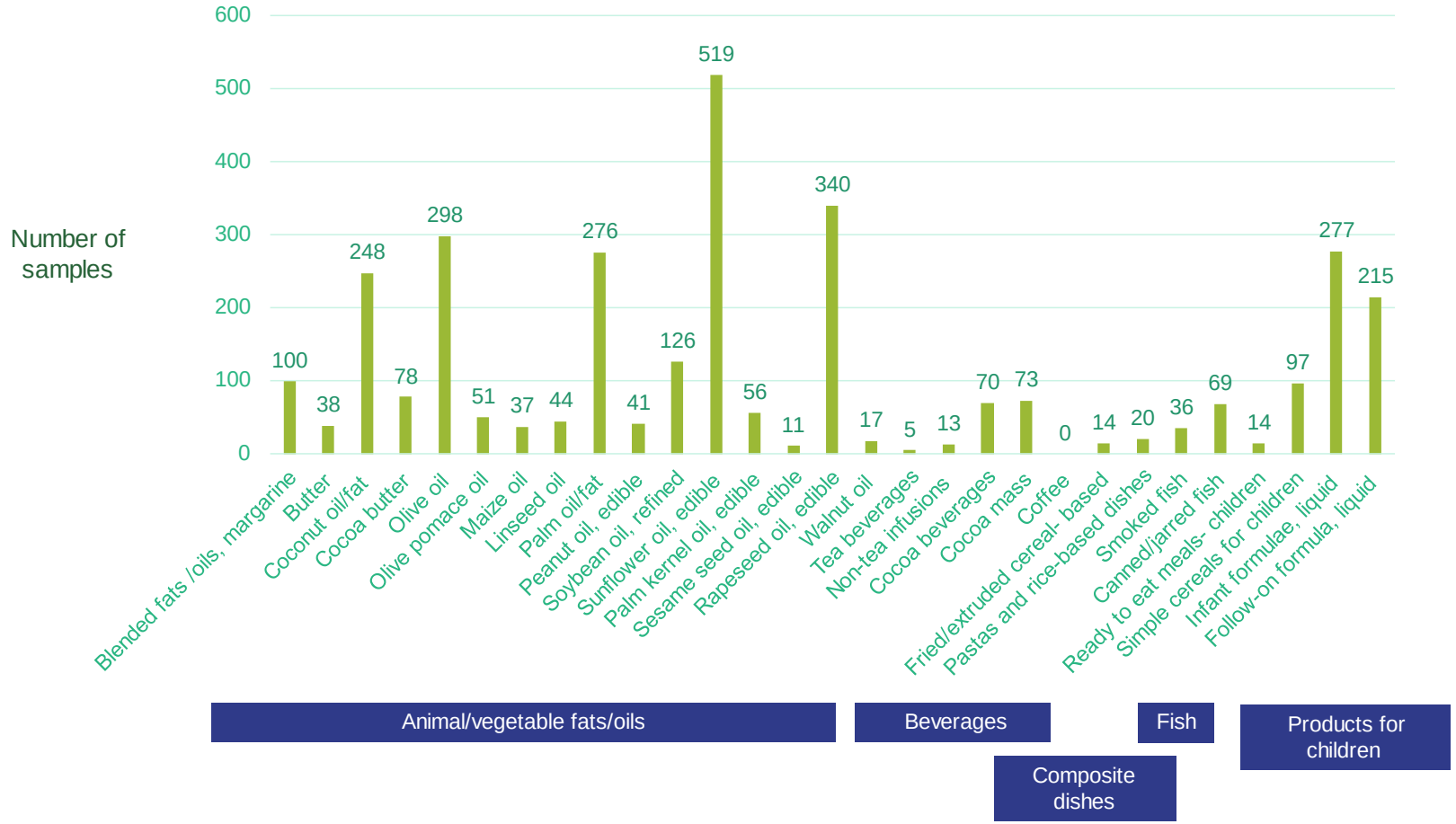
[11] One identified source of contamination is sun-drying crops near to roads, which can increase the risk of MOAH contamination from vehicle exhaust gases.

[12] FoodDrinkEurope and BLL Toolbox (2018).

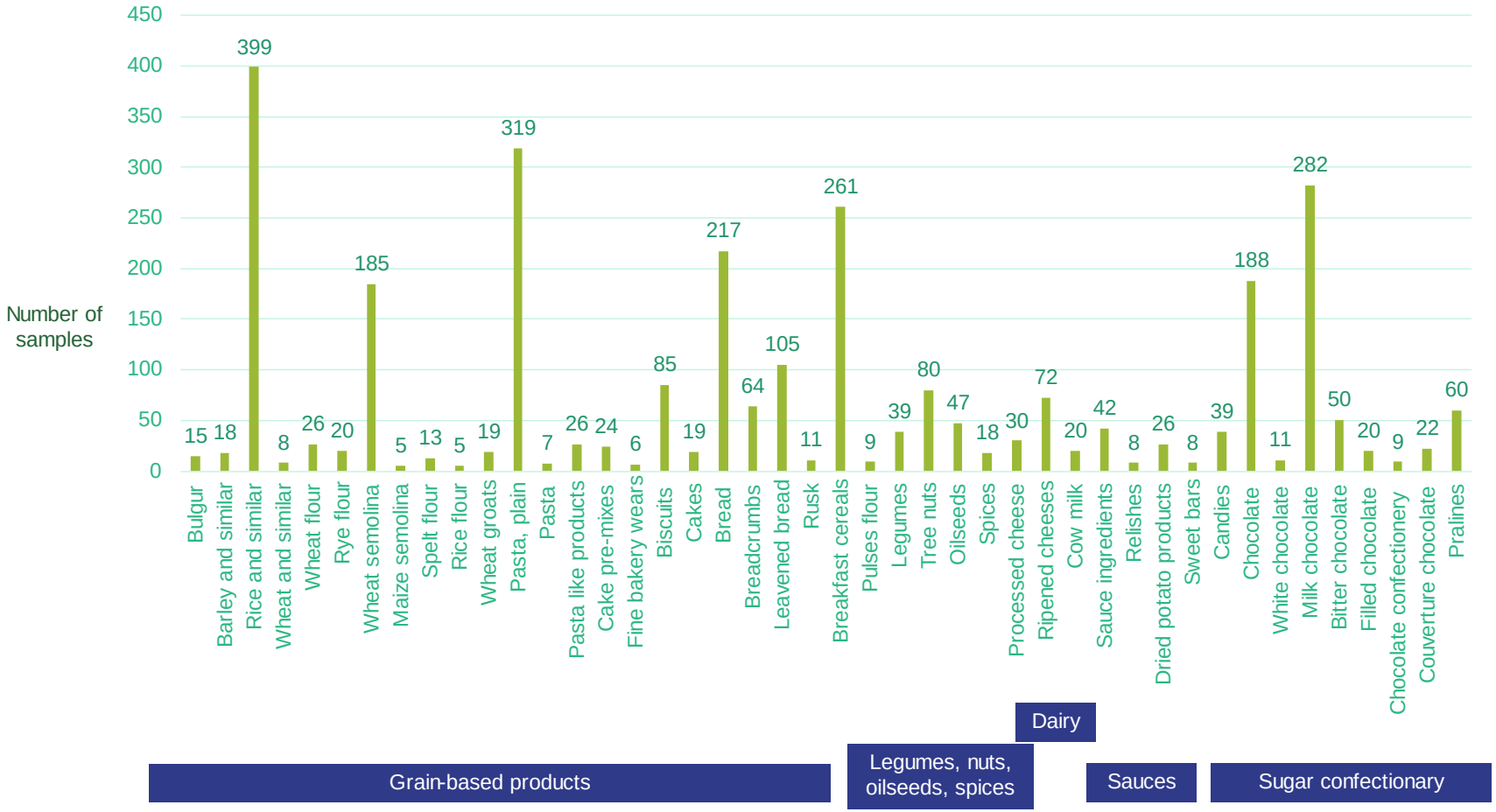
[13] Some European sector associations have developed specific guidance to support the identification of possible contamination, such as FEDIOL (2018) Code of practice for the management of mineral oil hydrocarbons presence in vegetable oils and fats intended for food uses.

ANNEX I

Overview of the number of samples with data on MOAH analysed by EFSA (EFSA risk assessment of mineral oil hydrocarbons in food, Table 9)



Overview of the number of samples with data on MOAH analysed by EFSA (EFSA risk assessment of mineral oil hydrocarbons in food, Table 9) continued



ANNEX II

A. *Overview of RASFF notifications related to MOAH in products of non-EU origin (2020–2024)*

Country	Product
China	Sichuan pepper
Ethiopia	Coffee
Guinea	Palm oil
India	Rice (two alerts)
Iran	Pastries
Jordan	Freekeh (frik)
Madagascar	Cloves
	Vanilla powder
Morocco	Stock cubes
Pakistan	Rice (three alerts)
Papua New Guinea	Vanilla
Thailand	Coconut milk
	Rice oil (three alerts)
Türkiye	Red lentils
Ukraine	Sunflower oil

B. *Overview of RASFF notifications related to MOAH in products from EU Member State/non-EU countries (not AGRINFO partner countries) (2020–2024)*

Country	Product
Bulgaria	Sunflower oil
Finland	Puffed corn sweets with chocolate frosting
France	Avocado oil
Germany	Vegetable cubes
Greece	Olive oil
	Extra virgin olive oil
Italy	Hazelnut cocoa spread
	Olive oil (three alerts)
Poland	Spelt porridge
Romania	Potato crisps
Spain	Olive oil (two alerts)
UK	Palm oil
	Chickpea flour
	Sesame oil

GROWING PEOPLE

COLEAD
France – 3, Avenue du Viaduc Bât B3A CP 90761 94550 Chevilly Larue
network@colead.link | www.colead.link