Frequently Asked Questions about 3-MCPD and GE

3-MCPD stands for 3-monochloropropanediol, and GE for glycidyl fatty acid esters. 3-MCPD is the most commonly occurring group of contaminants known as chloropropanols. First identified as a contaminant of acid-hydrolysed vegetable proteins and soy sauce, it was later found in other foods[1].

GEs are processing induced contaminants primarily found in refined fats and oils, and foods containing fats and oils. Both substances are considered to be of concern to public health and it is recommended to minimise the amount consumed.

1. Why are 3-MCPD and GE considered contaminants?

- In 2016, the European Food Safety Authority[2] (EFSA)'s expert panel on contaminants first assessed the potential risks of 3-MCPD and GE.
- Consumption levels of 3-MCPD in food are considered safe for most consumers but there is a potential health concern among high consumers in younger age groups. In the worst case scenario, infants receiving formula only may slightly exceed the safe level.
- High consumption levels of GEs in food are a concern for public health because they are genotoxic and carcinogenic, i.e. they can damage DNA and cause cancer.

2. Are these contaminants found in palm oil and other vegetable oils?

- All vegetable oils[3], including rapeseed oil, soybean oil, coconut oil, sunflower seed oil, and palm oil, as well as margarines and processed foods may contain these contaminants as a by-product of food processing, particularly processing that involves high-temperature refining at above 200°C.
- These by-products can be minimised or eliminated entirely through changes to how food is produced.

3. How are 3-MCPD and GE introduced during food production?

- 3-MCPD and GE are compounds formed during food production and preparation at high temperatures.
- The high temperature used in the deodorisation process leads to the formation of 3-MCPD; deodorisation removes unwanted taste and odour to meet customer quality and safety specifications.
- GE is formed from diacylglyceride (DAG) compounds at temperatures of 230 °C or higher.

[1] https://www.ifst.org/resources/information-statements/3-monochloropropane-diol-3-mcpd-3-mcpd-esters-and-glycidyl-esters
[2] http://www.efsa.europa.eu/
[3] https://www.efsa.europa.eu/en/press/news/process-contaminants-vegetable-oils-and-foods

Golden Agri-Resources (GAR) Ltd
108 Pasir Panjang Road, #06-00, Golden Agri Plaza, Singapore 118535
T: +65 6590 0800 | F: +65 6590 0887
goldenagri.com.sg sustainability@goldenagri.com.sg
golden-agri-resources-ltd @GAR_Sinarmas @sinarmas_agri
@GARSinarmasagri Sinar Mas Agribusiness and Food

4. What consumption levels do EU authorities consider safe today?

- In September 2020, the European Commission adopted its latest regulation on the maximum levels of 3-MCPD, 3-MCPD fatty acid esters and GE[4].
- The maximum levels of 3-MCPD and its fatty acid esters, and the new maximum levels of GE in young-child formula, fish oil, and oils from other marine organisms, enter into force from 1 January 2021.
- The maximum levels of 3-MCPD for vegetable oils and fats and fish oils for the consumers, or for use as food ingredients, are:

Category	Maximum level (µg/kg)
Oils and fats from coconut, maize, rapeseed, sunflower, soybean, palm kernel and olive oils (composed of refined olive oil and virgin olive oil) and mixtures of oils and fats with oils and fats from this category only	1,250µg/kg
Other vegetable oils (including pomace olive oils), fish oils and oils from other marine organisms and mixtures of oils and fats with oils and fats only from this category	2,500µg/kg

*µg/kg = Micrograms per kilogram

- Because of the potential health concern among high consumers in younger age groups, foods for children have different limits. The adopted maximum level of 3-MCPD and its fatty acid esters are as follows:

Category	Maximum level (µg/kg)
For vegetable oils and fats used for baby food, processed cereal-based food for infants and young children, and young-child formulas	750µg/kg
Powder infant and young-child formula, follow-on formula and foods for special medical purposes	125µg/kg
Liquid infant and young-child formula, follow-on formula and foods for special medical purposes	15µg/kg

- The EU's maximum level of GE and products containing them are:

Category	Maximum level (µg/kg)
Vegetable oils and fats for the final consumer or for use as an ingredient in food, except for the baby food and processed cereal-based food for infants and young children, and of virgin olive oils	1,000µg/kg
Vegetable oils and fats for the production of baby food and processed cereal-based food for infants and young children	500µg/kg
Powder infant formula, follow-on formula and foods for special medical purposes	50µg/kg
Liquid infant formula, follow-on formula and foods for special medical purposes	6µg/kg

[4] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R1322&from=EN

5. Besides the EU, who is else concerned about MCPD and GE levels in food?

The Codex Alimentarius Commission[5] (commonly referred to as Codex) is the body established to develop, harmonise and implement international food standards under the Joint FAO/WHO Food Standards Programme.

In July 2019, the Codex adopted a Code of Practice (COP) for the reduction of 3-MCPD and GE in refined oils and food products made with refined oils[6]. The COP provides guidance on how producers and users can reduce 3-MCPD and GE levels through good practices in agriculture, manufacturing and oil selection in food products.

Governments around the world refer to the Codex food standards to protect the health of their domestic consumers.

6. What is GAR doing to reduce 3-MCPD and GE?

GAR is implementing several mitigation strategies to reduce 3-MCPD and GE. Together with food manufacturers, we are using new internationally approved identification methods to test for these substances.

At the same time, we have been actively working on installing and testing new mitigation technologies. Our tests show that our palm oil can meet requirements of food manufacturers, including the stringent specifications set by international brands and producers of infant formula.

For more information, please contact:
Ian Suwarganda
Head of Policy & Advocacy
ian.suwarganda@goldenagri.com.sg
+65 6590 0857

[5] http://www.fao.org/fao-who-codexalimentarius/news-and-events/news-details/en/c/1204499/
[6] http://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXC%2B79-2019%252FCXC_079e.pdf

MOSH and MOAH

1. What are MOSH and MOAH?

MOSH stands for Mineral Oil Saturated Hydrocarbons. They are paraffin-like, open-chained, commonly branched hydrocarbons (e.g. alkanes) and naphthene-like cyclic hydrocarbons (cycloalkanes). MOAH stands for Mineral Oil Aromatic Hydrocarbons. They include hydrocarbons mainly consisting of highly alkylated mono- and/or poly-aromatic rings[1].

2. Why are MOSH and MOAH considered contaminants?

- MOSH and MOAH are generally not present in the original raw ingredient – in this case Fresh Fruit Bunches (FFB) – and therefore are introduced at some point into food through one or more production steps
- The input routes of mineral oils are varied and extend across food production stages from raw materials, storage, and transportation, production, to packaging materials
- The main sources of MOSH and MOAH contamination are adhesives, printer inks and packaging materials, specifically those made from recycled materials
- Other sources of these contaminations include machine and hydraulic oils that are used to produce and package food
- In production processes, mineral oils are used as lubricants for machinery and as release agents in packaging. A release agent prevents the bonding between the packaging surface and its content, for instance, meat in plastic wrapping.
- The general environment, such as exhaust gases from combustion engines and emissions from the energy supply and industrial plants, may lead to unavoidable contamination of food raw materials with Mineral Oils Hydrocarbons (MOHs).

3. Are these contaminants found in palm oil and other vegetable oils?

- Oils and fats, including palm oil, olive oil, sunflower oil, and rapeseed oil are susceptible to contamination with MOSH and MOAH due to their lipophilic properties[2].

4. How do MOSH and MOAH enter into food?

- MOSH and MOAH are the terms used for mineral oil hydrocarbons which can migrate into foods during production and transportation
- The contamination risks depend on many factors, such as
    - Food properties;
    - MOSH/MOAH concentration in the contamination source;
    - Type, intensity and duration of the contact and the temperature

---

1 https://www.fooddrinkeurope.eu/wp-content/uploads/publications_documents/Preventing_transfer_of_undesired_Mineral_Oil_Hydrocarbons_into_food_FoodDrinkEurope_BLL_Toolbox.pdf

2 https://www.sgsgroup.de/-/media/local/germany/documents/flyers-and-leaflets/agri/sgs_faq_mosh_moah_en_0218.pdf

Golden Agri-Resources (GAR) Ltd
108 Pasir Panjang Road, #06-00, Golden Agri Plaza, Singapore 118535
T: +65 6590 0800 | F: +65 6590 0887
goldenagri.com.sg sustainability@goldenagri.com.sg
golden-agri-resources-ltd @GAR_Sinarmas @sinarmas_agri

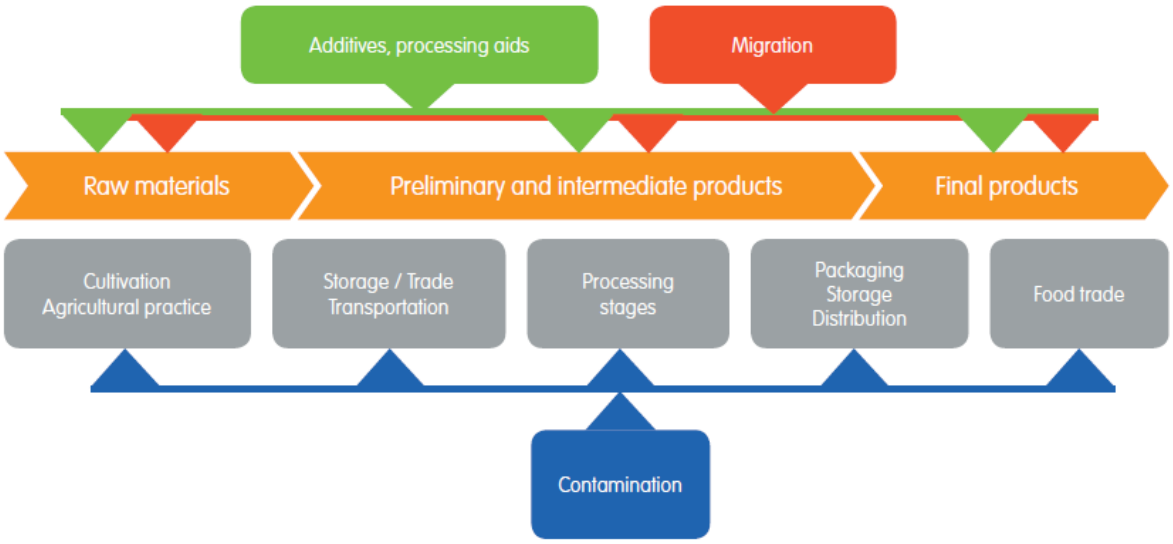

Illustration of the process of MOSH and MOAH entry into food[3]

5. What are the maximum levels of MOSH and MOAH in foods?

Research to-date has focused on food contamination from packaging, for example printed ink, paper, carton and cardboard materials. While there is no regulatory global standard that sets out maximum levels for MOSH and MOAH, some European authorities have outlined the recommendations below.

5.1. European Monitoring

- In 2017, the European Commission (EC) adopted recommendation EU 2017/84 on the monitoring of Mineral Oil Hydrocarbons (MOHs) in food and in Food Contact Materials. Food Contact Materials are all materials intended to come into contact with food, including packaging and containers. These can be made from plastics, paper, rubber, and metal[4].
- The EC requested that Member States, manufacturers, processors, and distributors of food contact materials, monitor the presence of MOH in food during 2017 and 2018.
    - The monitoring covers animal fat, bread and rolls, biscuits and cakes, breakfast cereals, confectionary including chocolate and cocoa, fish meat and products, ices and desserts, oilseeds, pasta, and many more.

5.2. Belgium

- EFSA (European Food Safety Authority)[5] sets MOSH's limits[6] (C_{16}-C_{35}) as follows:

Products	MOSH levels
Milk and milk products	5 mg MOSH/kg
Cereals	15 mg MOSH/kg food
Vegetable products, snacks and desserts	20 mg MOSH/kg food
Products of animal origin, sugar and confectionery	30 mg MOSH/kg

[3] https://www.fooddrinkeurope.eu/wp-content/uploads/publications_documents/Preventing_transfer_of_undesired_Mineral_Oil_Hydrocarbons_into_food_FoodDrinkEurope_BLL_Toolbox.pdf

[4] http://www.efsa.europa.eu/en/topics/topic/food-contact-materials

[5] http://www.efsa.europa.eu/

[6] http://www.favv.be/professionelen/levensmiddelen/mineraleolie/

Fish and fish products	60 mg MOSH/kg food
Spices and herbs	70 mg MOSH/kg food
Animal and vegetable oils	100 mg MOSH/kg food
Vegetables, tree nuts and oil seeds, and egg products	150 mg MOSH/kg food

5.3. Germany

- Germany does not have binding regulation containing legal limits in place
- For findings in food or packaging materials, evaluation may use EU Basic Regulation 178/2004 and framework regulation (EC) No 1935/2004[7] on food contact materials.
- In paper production, the migration level of hydrocarbons (up to C_{20}) corresponding to toxicologically deduced limits are as follows:
  - 12 mg/kg food for C^{10}-C^{16}
  - 4 mg/kg food for C^{17}-C^{20}
- No migration of MOAH into food will be permitted from food contact materials that are produced using recycled materials. This is according to the last (4th) draft of the German "Mineral Oil Regulation" (22th Ordinance amending the Consumer Goods Ordinance) of the Federal Ministry of Nutrition and Agriculture (BMEL) of March 2017[8]
  - The migration of <0.5 mg MOAH/kg food or food simulant is considered "undetectable"

6. What are the health risks from MOSH and MOAH?[9]

MOSH:

- A few short-chain saturated hydrocarbons of the MOSH fraction are known to accumulate in different organs of the body (liver and lymphoid system), causing adverse effects.
- MOSH of C16 to C35 may damage the liver, lymph nodes, and spleen.
- EFSA[10] estimates the quantities of MOSH absorbed daily is between 0.03 and 0.3 mg per kg of body weight.

MOAH:

- MOAH is potentially carcinogenic though there are not sufficient data for the development of limit values[11]MOAH strict minimisation is required with no migration into food

7. What is GAR doing to resolve MOSH and MOAH issues?

- GAR is committed to ensure that our products are safe for consumption.
- Through our investment in state of the art, ISO 17025 accredited R&D and Quality Control (QC) facilities at our refinery in Marunda[12], we continue to improve our practices to ensure we provide high quality products.

[7] https://www.europarl.europa.eu/RegData/etudes/STUD/2016/581411/EPRS_STU(2016)581411_EN.pdf
[8] https://www.bmel.de/DE/Startseite/startseite_node.html
[9] https://www.sgsgroup.de/-/media/local/germany/documents/flyers-and-leaflets/agri/sgs_faq_mosh_moah_en_0218.pdf
[10] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC115694/kjna29666enn_2.pdf
[11] https://www.healthyprinting.eu/workspace/uploads/imagefolder/factsheet-mosh-moah.pdf
[12] https://goldenagri.com.sg/10-facts-about-palm-oil-food-production-at-marunda-rd-centre/

- Our refineries are implementing Quality and Food Safety Management System (ISO 22000/FSSC 22000), and these MOSH/MOAH risks have been taken into consideration in this system.
- We are a leading and committed producer of high quality oils – therefore we share the concerns of other manufacturers working to minimise risk of contaminants.
- In 2019, GAR started an internal study into the MOSH and MOAH issues engaging a third party laboratory in Germany, testing samples from our refineries and investigating potential mitigation options.
- Critically, the study covers our entire supply chain - own refineries, own mills and 3rd party mills - to identify the critical process points where the contaminants are introduced.
- We are keeping interested customers updated on our progress.
- GAR continually monitors for any developments in the industry and with authorities, both domestic and in destination markets.

For more information, please contact:
Ian Suwarganda
Head of Policy & Advocacy
Ian.suwarganda@goldenagri.com.sg
+65 6590 0857