


3-MCPDE, Glycidyl Esters & Acrylamide in Food



Trade Consultation Forum
22nd February, 2019

Background

Surveys of Consumer Council (contaminants/food items)

- aroused public concerns
- contaminants
 - fatty acid esters of 3-monochloropropane-1,2-diol (3-MCPDE)
 - glycidyl esters (GE)
 - acrylamide
- food items
 - edible oil (Issue 489, Jul 2017);
 - butter and its analogues (Issue 498, Apr 2018);
 - cookies, puff pastry & egg rolls (Issue 507, Jan 2019)

Fatty Acid Esters of 3-monochloropropane-1,2-diol

**(3-monochloropropane-1,2-diol Ester)
(3-MCPDE)**

What is 3-MCPDE?

3-MCPDE

- primarily found in refined fats and oils
- a process contaminant

It is formed

- from diacylglycerols (DAG)
 - ◆ in the presence of water, chlorinated compounds at high temperature
- during the deodorisation step of oil refining

Source of 3-MCPDE in Food

Major source in food

- refined vegetable oils
- different oils
 - ◆ different levels of 3-MCPDE
- palm oil
 - ◆ highest

Levels in refined oils

- palm oil > walnut oil > safflower oil > sunflower oil > soya bean oil > rapeseed oil

Toxicity of 3-MCPDE

3-MCPDE

- a source of 3-MCPD in food
- main concern
 - ◆ release 3-MCPD after ingestion

3-MCPD may affect

- kidney
- central nervous system
- male reproductive system of rats

IARC classifies 3-MCPD

- group 2B agent
- “possibly carcinogenic to humans”

Overseas Study

EFSA (2016)

➤ 3-MCPDE levels in oil and fats:

- ◆ mean middle bound (MB)
 - 1034 $\mu\text{g/kg}$
- ◆ Highest
 - “palm oils and fats” : 2912 $\mu\text{g/kg}$
- ◆ other non-palm oils and fats
 - 48-867 $\mu\text{g/kg}$
- ◆ margarines and related fats
 - 408 $\mu\text{g/kg}$

Local Study

Risk Assessment Study by CFS (2012)

- “Fatty Acid Esters of 3-monochloropropane-1,2-diol in Food”
 - ◆ Mean in fats and oils: 390 µg/kg
 - ◆ Highest in “grape seed oil”: 1180 µg/kg
 - ◆ Other non-grape seed oil : 10 - 570 µg/kg
 - ◆ Mean in biscuits: 440 µg/kg
- ◆ Average and high consumers
 - unlikely to experience major toxicological effects of 3-MCPD

Overseas Recommendations and Standards

JECFA (2016)

- a provisional maximum tolerable daily intake (PMTDI)
- 3-MCPD and 3-MCPDE singly or in combination
 - ◆ 4 µg/kg bw/day

Overseas Recommendations and Standards

Codex

- 3-MCPD in “liquid condiments containing acid hydrolyzed vegetable proteins (acid HVP)”
 - ◆ a maximum level (ML) of 0.4 mg/kg
- drafting a code of practice
 - ◆ for reduction of 3-MCPDE in refined oils & food products made with refined oils
 - ◆ good manufacturing practice (GMP) in oil milling and refining
 - ◆ selection and use of refined oils in food products made from these oils

Overseas Recommendations and Standards

EU

- regulatory ML of 3-MCPD
 - ◆ 20 µg/kg in hydrolysed vegetable protein
 - ◆ 20 µg/kg in soy sauce

(Source: Commission Regulation (EU) 2018/290)

Glycidyl Esters (GE)



Glycidyl Esters (GE)

GE in foods

- concern of recent years
- after ingestion
 - ◆ GE is broken down to glycidol
 - ◆ considered harmful to health
- overseas food safety authorities
 - ◆ start to take action to control the level of GE in food

What are GEs?

GE is processing contaminants

- primarily found in refined fats and oils
- foods containing fats and oils

It is formed

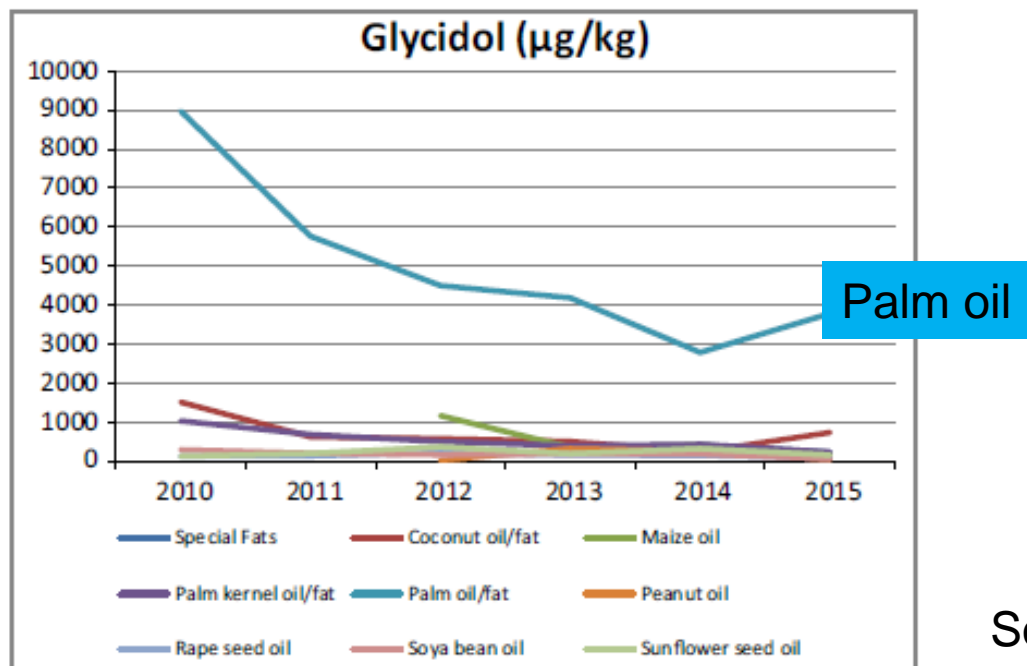
- during deodorization (oil refining)
- from diacylglycerols (DAG)
- under elevated temp. ($>240^{\circ}\text{C}$) and time



Source of GE in Food

Refined vegetable oils

- Palm oil generally contains higher level of GE



Source:
EFSA (2016)

Levels of glycidol in vegetable oils in EU

Toxicity of GE

Effects of glycidol in animal studies:

- Neurotoxicity
- Renal toxicity
- Anti-fertility effects
- Genotoxicity
- Carcinogenicity



IARC classifies glycidol

- Group 2A agent
- “probably carcinogenic to humans”

Overseas Studies

GE in fats and oils

- major contributors
 - ◆ refined vegetable oils
- different vegetable oils
 - ◆ level varies
- EFSA (2016):
 - ◆ mean (middle bound) in fats and oils: 1176 $\mu\text{g/kg}$
 - ◆ highest in “palm oils and fats”: 3955 $\mu\text{g/kg}$
 - ◆ other non-palm oils and fats: 15 - 650 $\mu\text{g/kg}$
 - ◆ margarines and related fats: 361 $\mu\text{g/kg}$

Overseas Recommendations and Standards

JECFA

- glycidol
 - ◆ genotoxic and carcinogenic
 - ◆ not appropriate to establish a health-based guidance value
 - ◆ recommended to implement appropriate efforts to reduce concentrations of GE and glycidol in fats and oils

Overseas Recommendations and Standards

Codex

- GE or glycidol
 - ◆ not established standards in food
- drafting a code of practice
 - ◆ for reduction of GE in refined oils and food products made with refined oils
- included recommendations on
 - good manufacturing practice (GMP) in oil milling and refining
 - selection and use of refined oils in food products made from these oils

Overseas Recommendations and Standards

EU

- established regulatory maximum levels in GE for 4 types of foods in 2018

	Foodstuffs ⁽¹⁾	Maximum level (µg/kg)
4.2	Glycidyl fatty acid esters expressed as glycidol	
4.2.1.	Vegetable oils and fats placed on the market for the final consumer or for use as an ingredient in food with the exception of the foods referred to in 4.2.2	1 000
4.2.2.	Vegetable oils and fats destined for the production of baby food and processed cereal-based food for infants and young children ⁽³⁾	500
4.2.3	Infant formula, follow-on formula and foods for special medical purposes intended for infants and young children (powder) ⁽³⁾ ⁽²⁹⁾	75 until 30.6.2019 50 as from 1.7.2019
4.2.4	Infant formula, follow-on formula and foods for special medical purposes intended for infants and young children (liquid) ⁽³⁾ ⁽²⁹⁾	10,0 until 30.6.2019 6,0 as from 1.7.2019 ⁹

(Source: Commission Regulation (EU) 2018/290)

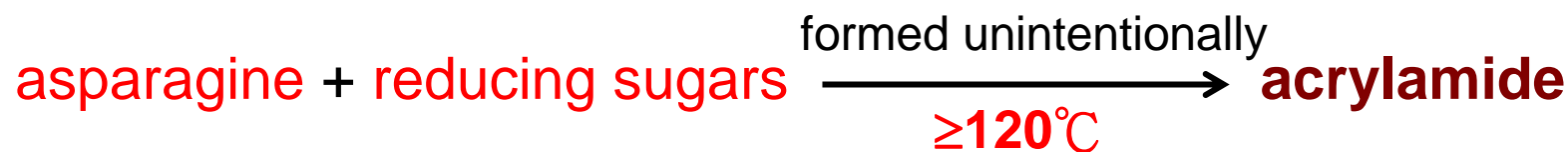
Acrylamide



Acrylamide

Sources

- an industrial chemical; manufacture of polyacrylamides
- in 2002, discovered in food
 - ◆ free amino acid (asparagine), reducing sugars (glucose and fructose) in food



- ◆ high temperature ($>120^{\circ}\text{C}$), e.g. frying, baking, roasting

Acrylamide

Sources

- asparagine + reducing sugars + high temperature (120°C)
- food with higher acrylamide
 - ◆ potato chips, crisps, coffee,
 - ◆ pastries, cookies, bread, rolls and toasts
- food is boiled
 - ◆ little / no formation of acrylamide

Toxicity of Acrylamide

Toxicity

- humans ---- nervous system toxicity (high dose)
- animals ---- reproductive and developmental problems
- Animals ---- genotoxic and carcinogenic

IARC (1994)

- group 2A
- "probably carcinogenic to humans"

Epidemiological studies

- no consistent evidence to show
- association of **cancer** (in humans) with

level of dietary
exposure to
acrylamide

Overseas Studies

EFSA (2015)

- dietary exposures
 - ◆ average consumer : 0.4 to 1.9 $\mu\text{g/kg bw/day}$
 - ◆ high consumer : 0.6 to 3.4 $\mu\text{g/kg bw/day}$
- main dietary contributors
 - ◆ potato fried products
 - ◆ soft bread
 - ◆ coffee
 - ◆ biscuits, crackers, crisp bread
 - ◆ other products based on potatoes

Past Local Studies

- Acrylamide in Food (2003)
- Acrylamide in Fried Fritters (2003)
- Acrylamide in Fried and Baked Food (2006)
- Acrylamide in Some Popular Foods (2010)
- Dietary Exposure to Acrylamide of Hong Kong Adult Population (2010)
- The 1st HK Total Diet Study (TDS): Acrylamide (2013)

(https://www.cfs.gov.hk/english/programme/programme_rafs/programme_rafs_fc_01.html)

(https://www.cfs.gov.hk/english/programme/programme_firm/programme_tds_1st_HKTD_S_report6_Acrylamide.html)

Results from the TDS

Dietary exposure

- average consumer : 0.21 $\mu\text{g/kg bw/day}$
- high consumer : 0.54 $\mu\text{g/kg bw/day}$
- lower than that in EU and other western countries
- comparable to Mainland China
- the exposure levels
 - ◆ still indicate a **health concern** among the local population
- Major contributor of local population
 - ◆ stir-fried vegetables

Recommendations and Standards

JECFA

- exposure should be “as low as reasonably achievable”
- it is not possible to make a recommendation on how much of any specific food containing the substance is safe to eat

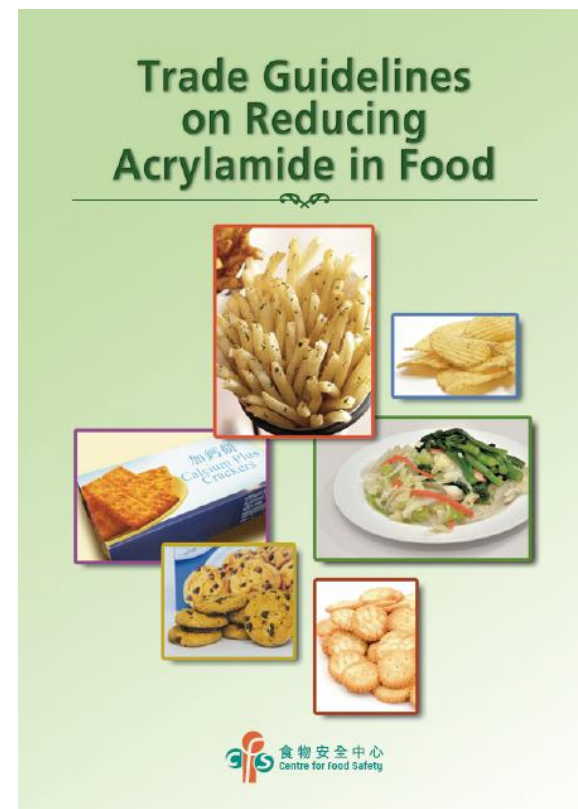
Recommendations and Standards

Codex and other jurisdictions

- acrylamide
 - ◆ not established standards in food
- Codex Code of Practice (2009)
 - ◆ gives guidance to national authorities and manufacturers to prevent and reduce formation of acrylamide in potato products and cereal products
- many national authorities are implementing monitoring programme

Trade Guidelines (CFS)

- Issued in 2011
 - recommendations to trade to minimise the formation of acrylamide in food, especially in potato and cereal based products
- Updated in 2013
 - incorporate advice on cooking vegetables



Useful Links

CFS Trade Guidelines on Reducing Acrylamide in Food (updated 2013)

- https://www.cfs.gov.hk/english/food_leg/files/Acrylamide_E_New_3.pdf

Codex Code of Practice for the Reduction of Acrylamide in Foods (2009)

- http://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCAC%2BRCP%2B67-2009%252FCXP_067e.pdf

Useful Links

Draft Codex Code of Practice for the Reduction of 3-monochloropropane-1,2-diol Esters (3-MCPDE) and Glycidyl Esters (GE) in Refined Oils and Food Products Made with Refined Oils (in Appendix VI, page 59)

- http://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FMeetings%252FCX-735-12%252FREPORT%252520%2528FINAL%2529%252FREP18_CFe.pdf

~The End~