減低食物中的氯丙二醇脂肪酸酯、縮水甘油脂肪酸酯和丙烯酰胺

Reduce 3-MCPDE, GE & Acrylamide in Food

業界講座

2021年10月25日

Trade Talk

25th October, 2021

食物環境衞生署
Food and Environmental Hygiene Department

背景
Background

- 丙烯酰胺、縮水甘油脂肪酸酯(GE)和氯丙二醇脂肪酸酯(3-MCPDE)
  - 食物加工過程中自然產生
  - 存在於某類食物中是不能完全避免
- 各方（食品規管當局、業界、學者等）
  - 正研究通過改良食物加工技術及條件，以減低這些物質在食物中的含量

- Acrylamide, glycidyl fatty acid esters (GE) and 3-monochloropropane-1,2-diol esters (3-MCPDE)
  - substances naturally produced during food processing
  - inevitable in certain types of food
- Regulatory authorities, industries and academia around the world
  - studying the improvement of food processing technology and conditions to reduce the content of these substances in food

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氯丙二醇脂肪酸酯
3-monochloropropane-1,2-diol Ester (3-MCPDE)

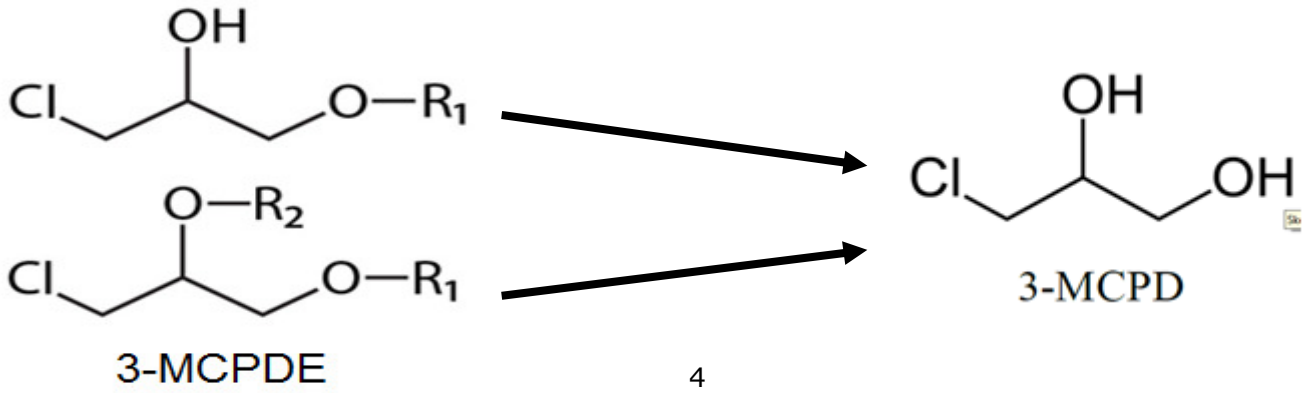
3-MCPDE

3-MCPDE

- 食物中氯丙二醇(3-MCPD)來源之一
- 在人體釋放出有害的3-MCPD

3-MCPDE

- a source of 3-MCPD in food
- release 3-MCPD from 3-MCPDE after ingestion (main concern)



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3-MCPDE

3-MCPD可以影響

- 腎臟，中樞神經系統，雄性大鼠的生殖系統

國際癌病組織(IARC)將3-MCPD分類為：

- 2B組物質（即“或可能令人類患癌”）
- 目前並沒有充分證據證明3-MCPD會令人類患癌

3-MCPD may affect

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

IARC classifies 3-MCPD

- group 2B agent (i.e. “possibly carcinogenic to humans”)
- currently, no sufficient evidence that 3-MCPD can cause cancer in humans

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甚麼是3-MCPDE?
What is 3-MCPDE?

3-MCPDE

- 加工過程污染物
- 主要在精煉油脂中發現

形成過程：

- 精煉過程中，脫臭步驟時形成
- 經高溫加工的某些含脂肪和氯化物的食物

3-MCPDE

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

It is formed:

- during the deodorization step of oil refining
- certain fat- and chloride-containing foods at high temperature

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食物中3-MCPDE的來源
Source of 3-MCPDE in Food

食物中的主要來源

- 精煉油脂
- 不同的油脂3-MCPDE水平不一
- 棕櫚油水平最高

精煉油3-MCPDE的含量:

- 棕櫚油>合桃油>紅花油>葵花籽油>大豆油>菜籽油

Major source in food

- refined vegetable oils
- level varies in different oils
- highest in palm oil

Levels in refined oils:

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

食物環境衞生署
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食安中心以往的風險評估研究
Previous Risk Assessment Study conducted by CFS

- 市民從膳食中攝取3-MCPDE的分量進行評估
- 結果顯示食物中的3-MCPDE不會對市民健康造成不良影響

- Evaluated the dietary intake of 3-MCPDE in local adult population
- Results showed that 3-MCPDE in food will not cause adverse health effects to the general public

食物環境衞生署
Food and Environmental Hygiene Department

建議和標準 – JECFA
Recommendations and Standards - JECFA

- JECFA (2016)
  - 暫定最高每日可容忍攝入量(PMTDI)
  - 3-MCPD和3-MCPDE單獨或組合計：4 µg/kg bw

- JECFA (2016)
  - a provisional maximum tolerable daily intake (PMTDI)
  - 4 µg/kg bw for 3-MCPD and 3-MCPDE singly or in combination.

食物環境衞生署
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建議和標準 – Codex
Recommendations and Standards - Codex

- 食品法典委員會
  - 3-MCPD標準在“含有酸水解植物蛋白的液體調味品” 最高含量：0.4 mg/kg
  - 2019年推出《減少精煉油和以精煉油製作的食品中氯丙二醇脂肪酸酯及縮水甘油脂肪酸酯的含量的實務守則》
    - 協助業界減低精煉油和相關食品中3-MCPDE的含量
- Codex
  - A maximum level (ML) of 0.4 mg/kg on 3-MCPD in “liquid condiments containing acid hydrolyzed vegetable proteins (acid HVP)”
  - Issued the “Code of Practice for the Reduction of 3-MCPDEs and GEs in Refined Oils and Food Products Made With Refined Oils” in 2019,
    - to provide producers and manufacturers with guidance to reduce formation of 3-MCPDE in refined oils and food products made with refined oils

食物環境衞生署
Food and Environmental Hygiene Department

本港標準
Local Standards

- 2021年，中心修訂了《食物內有害物質規例》（第132AF章），為調味品的3-MCPD含量訂定了最高含量上限
  - 固體調味品: 1 mg/kg
  - 任何其他調味品: 0.4 mg/kg

- In 2021, the CFS amended the Harmful Substances in Food Regulations (Cap. 132 AF) and establish the maximum level for 3-MPCD in condiments
  - Solid condiments: 1 mg/kg
  - Any other condiments: 0.4 mg/kg

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縮水甘油脂肪酸酯 (GE)
Glycidyl Fatty Acid Esters (GE)

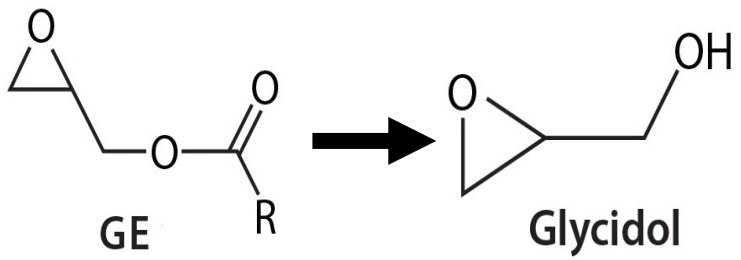
Glycidyl Fatty Acid Esters(GE)
縮水甘油脂肪酸酯(GE)

近年成為關注焦點

- 食物中含有GE
- 進食後：
  - GE在體內分解成縮水甘油(glycidol)
  - 危害健康
- 着手控制食物中GE的含量

Concern in recent years

- presence of GE in foods
- after ingestion:
  - GE is broken down to glycidol in the body
  - considered harmful to health
- action to control the level of GE in food



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什麼是GE？
What are GE?

GE是加工過程污染物

- 主要存在於精煉油脂
- 含油脂的食物

GE is processing contaminants

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

食物環境衞生署
Food and Environmental Hygiene Department

什麼是GE？
What are GE?

形成的條件

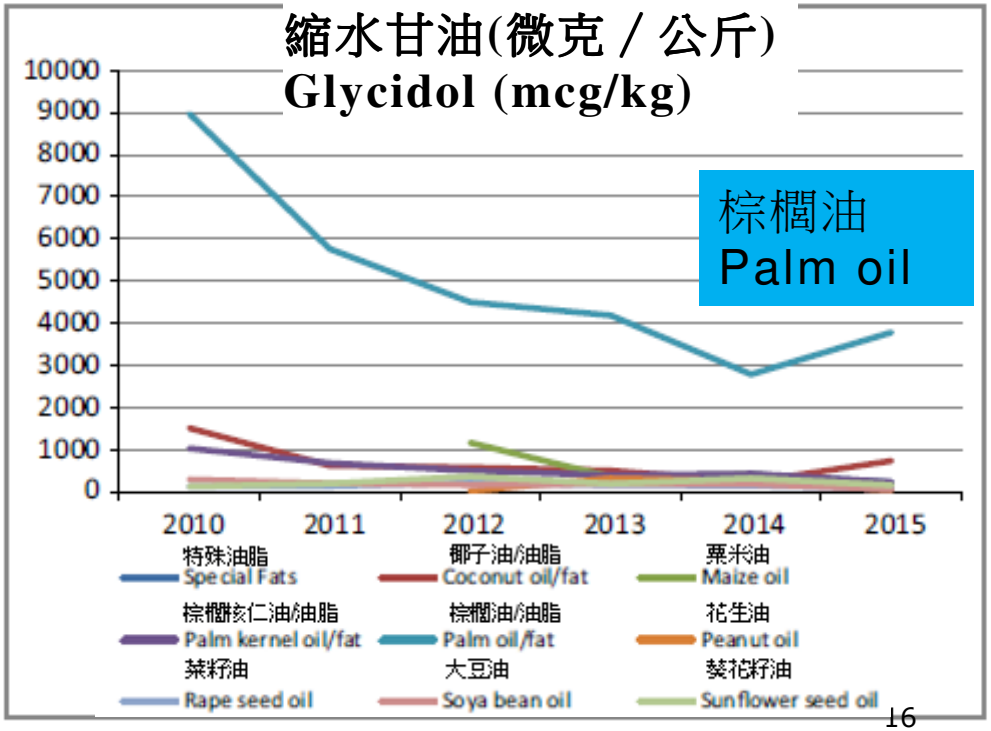
- 在油脂精煉脫臭過程中形成
- 由甘油二酯 (又稱二酸甘油酯) (DAG) 產生
- 在長時間高溫(>240℃)環境下產生

It is formed

- during deodorization (oil refining)
- from diacylglycerols (DAG)
- associated with elevated temp. (>240°C) and time

食物中GE的來源
Source of GE in Food

- 精煉植物油
  - 棕櫚油的縮水甘油酯含量一般較高
- Refined vegetable oils
  - Palm oil generally contains higher level of GE



資料來源：
歐洲食物安全局(2016)
Source:
EFSA (2016)

植物油的縮水甘油(歐盟數據)
Levels of glycidol in vegetable oils in EU

GE為何引起關注？
Concerns on GE?

- 動物研究發現，縮水甘油對動物造成以下影響：
  - 神經系統毒性
  - 腎臟毒性
  - 減低生育能力
  - 具基因毒性
  - 致癌
- 國際癌症研究機構(IARC)把縮水甘油分類為
  - 第2A組物質（即“可能令人類患癌”）
  - 目前並沒有充分證據證明令人類患癌

- Effects of glycidol in animal studies:
  - Neurotoxicity
  - Renal toxicity
  - Anti-fertility effects
  - Genotoxicity
  - Carcinogenicity
- IARC classifies glycidol
  - Group 2A agent (i.e. “probably carcinogenic to humans”)
  - Currently, there is no sufficient evidence that glycidol can cause cancer in humans

食物環境衞生署
Food and Environmental Hygiene Department

食安中心以往的風險評估研究
Previous Risk Assessment Study conducted by the CFS

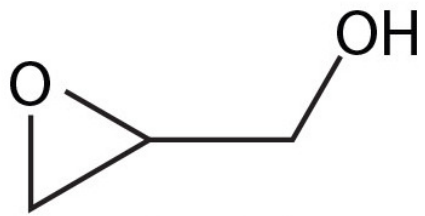
- 中心就本地食用油脂和嬰兒配方奶粉中的GE含量進行研究，結果顯示本地食用油脂和嬰兒配方奶粉中的GE含量全部低於歐洲、新西蘭及澳洲的同類型研究

- The CFS has evaluated the levels of GE in edible fats and oils, as well as infant formula available in local market
- GE level for edible fats and oils samples and infant formula in this study were lower than similar study findings in EU, as well as New Zealand and Australia

食物環境衞生署
Food and Environmental Hygiene Department

建議及標準 - JECFA
Recommendations and Standards - JECFA

- JECFA
  - 縮水甘油具基因毒性，並可誘發癌症
  - 不宜就縮水甘油訂定健康參考值
  - 建議採取適當措施，**把油脂中GE和縮水甘油的含量降低**



Glycidol

- JECFA
  - glycidol is both 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**

食物環境衞生署
Food and Environmental Hygiene Department

建議及標準 - Codex
Recommendations and Standards - Codex

- 食品法典委員會
  - 並未就食物中GE和縮水甘油的含量訂定標準
  - 於2019年推出《減少精煉油和以精煉油製作的食品中氯丙二醇脂肪酸酯及縮水甘油脂肪酸酯的含量的實務守則》，以協助業界減低食品中GE的含量

- Codex
  - not established standards on GE or glycidol in food
  - Issued the “Code of Practice for the Reduction of 3-Monochloropropane-1,2- Diol Esters (3-MCPDEs) and Glycidyl Esters (GEs) in Refined Oils and Food Products Made With Refined Oils” in 2019, to provide producers and manufacturers with guidance to reduce formation of GE in refined oils and food products made with refined oils

食物環境衞生署
Food and Environmental Hygiene Department

本港建議和標準
Local Standards on GE

- 2021年，中心修訂了《食物內有害物質規例》（第132AF章），為擬供嬰兒食用的配方產品的GE含量訂定了最高含量上限
  - 擬供嬰兒食用的配方產品(粉狀): 50 µg/kg
  - 擬供嬰兒食用的配方產品(液態): 6 µg/kg

- In 2021, the CFS amended the Harmful Substances in Food Regulations (Cap. 132 AF) and establish the maximum level for GE in infant formula and follow-up formula
  - Powdered infant formula and follow-up formula: 50 µg/kg
  - Liquid infant formula and follow-up formula: 6 µg/kg

食物環境衞生署
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丙烯酰胺
Acrylamide

丙烯酰胺
Acrylamide

- 丙烯酰胺
  - 用以製造聚丙烯酰胺的工業化學物

- Acrylamide
  - an industrial chemical used in the manufacture of polyacrylamides.

丙烯酰胺
Acrylamide

- 2002年，研究人員首次報告在食物中發現
  - 不經意產生
    - 在食品中的游離氨基酸（天門冬酰胺）及還原糖（葡萄糖和果糖）

天門冬酰胺 + 還原糖 $\xrightarrow{\geq 120℃}$ **丙烯酰胺**

  - 高溫(一般>120ºC)，例如煎炸、燒烤或烘焗
- Discovered in food in 2002
  - formed unintentionally
    - free amino acid (asparagine),reducing sugars (glucose and fructose) in food

asparagine + reducing sugars $\xrightarrow{\geq 120℃}$ **acrylamide**

  - high temperature (>120ºC), e.g. frying, baking, roasting

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丙烯酰胺的來源及產生
Source and Formation in Food

- 丙烯酰胺水平較高的食物
  - 薯條、薯片、咖啡
  - 糕餅、曲奇、麵包、餡卷和多士
- 水煮的情況下沒有或只有微量形成

- Food with higher acrylamide
  - potato chips, crisps, coffee,
  - pastries, cookies, bread, rolls and toasts
- Little or no formation of acrylamide when food is boiled

食物環境衞生署
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丙烯酰胺的毒性
Toxicity of Acrylamide

- 毒性
  - 對人體會產生神經系統毒性作用
  - 對實驗動物影響生殖和發育
- 基因毒性致癌物
  - 在動物中引致基因毒性和致癌

- Toxicity
  - nervous system is a principal site for toxicity in humans
  - reproductive and developmental problems in animals
- It is a genotoxic carcinogen
  - genotoxic and carcinogenic in animals

食物環境衞生署
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丙烯酰胺的毒性
Toxicity of Acrylamide

- 國際癌症研究機構(IARC)
  - 第2A組物質（即“可能令人類患癌”）
  - 目前並沒有充分證據證明丙烯酰胺會令人類患癌

- IARC
  - Currently, there is no sufficient evidence that acrylamide can cause cancer in humans
  - group 2A (i.e. "probably carcinogenic to humans“)

食物環境衛生署
Food and Environmental Hygiene Department

丙烯酰胺的毒性
Toxicity of Acrylamide

- 流行病學研究
  - 證明人體從職業/膳食攝入丙烯酰胺與癌症發率呈正相關
  - 未能提供一致的證據

- Epidemiological studies
  - association of cancer (in humans) with occupational / dietary exposure to acrylamide
  - no consistent evidence

食物環境衛生署
Food and Environmental Hygiene Department

食安中心以往的風險評估研究
Previous Risk Assessment Study conducted by the CFS

- 食安中心的總膳食研究結果顯示
  - 與其他地方（包括歐洲、美加等地）比較，本港市民從膳食攝入丙烯酰胺的分量較低
  - 不過，丙烯酰胺對市民健康的影響仍是值得關注

- According to the results of the Total Diet Study, the dietary exposure of the local population to acrylamide was found to be low, relative to other countries and regions (including the United States, Canada, Europe etc.)
- However, the estimated dietary exposure of the local population to acrylamide may indicate a human health concern

食物環境衞生署
Food and Environmental Hygiene Department

建議及標準- JECFA
Recommendations and Standards - JECFA

- 專家委員會結論
  - 無法提出建議食用多少含有丙烯酰胺的特定食物是安全的
  - 攝入量應要"可合理達到的盡量低原則"

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

食物環境衞生署
Food and Environmental Hygiene Department

建議及標準- Codex
Recommendations and Standards – Codex

- 食品法典委員會
  - 沒有建立食品中丙烯酰胺的標準
  - 2009年推出《減低食品中丙烯酰胺的操作規範》，為國家當局和製造商提供指引，以防止和減少馬鈴薯產品和穀物產品中丙烯酰胺的形成

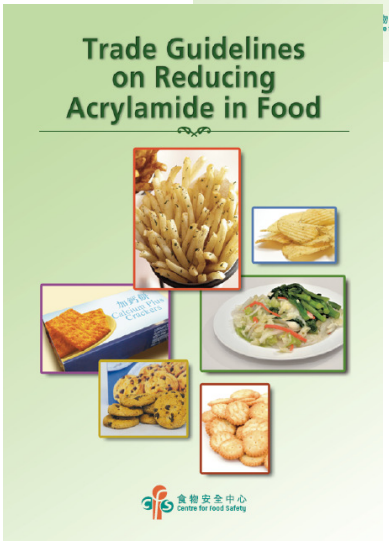
- Codex
  - has not established standards on acrylamide in food
  - issued the “Code of Practice for the Reduction of Acrylamide in Foods” in 2009, to gives guidance to national authorities and manufacturers to prevent and reduce formation of acrylamide in potato products and cereal products

食物環境衞生署
Food and Environmental Hygiene Department

本港建議
Local Recommendation

- 食安中心已制定《減低食品中丙烯酰胺的業界指引》
- 協助業界減少在食物（特別是馬鈴薯和穀類製品及炒菜）中丙烯酰胺的含量

- The CFS has formulated the “Trade Guidelines on Reducing Acrylamide in Food”
- Help industry to reduce the content of acrylamide in food (especially potato and cereal based products as well as cooking vegetables)



食物環境衛生署
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有用連結
Useful Links

- 食物安全中心減低食品中丙烯酰胺的業界指引(2013年更新)
  - https://www.cfs.gov.hk/tc_chi/food_leg/files/Acrylamide_C_New_3.pdf

- CFS Trade Guidelines on Reducing Acrylamide in Food (updated 2013)
  - https://www.cfs.gov.hk/english/food_leg/files/Acrylamide_E_New_3.pdf

食物環境衛生署
Food and Environmental Hygiene Department

有用連結
Useful Links

- 食品法典委員會《減低食品中丙烯酰胺的操作規範》(2009)
  - https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXC%2B67-2009%252FCXP_067e.pdf

- Codex Code of Practice for the Reduction of Acrylamide in Foods (2009)
  - https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXC%2B67-2009%252FCXP_067e.pdf

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- Codex Code of Practice for the Reduction of 3-Monochloropropane-1,2- Diol Esters (3-MCPDEs) and Glycidyl Esters (GEs) in Refined Oils and Food Products Made With Refined Oils (2019)
  - https://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

~ 完 ~

~The End~

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