取代食物中
工業生產反式脂肪
的指引

Guidance to Replace
Industrially-produced Trans Fats
in Food

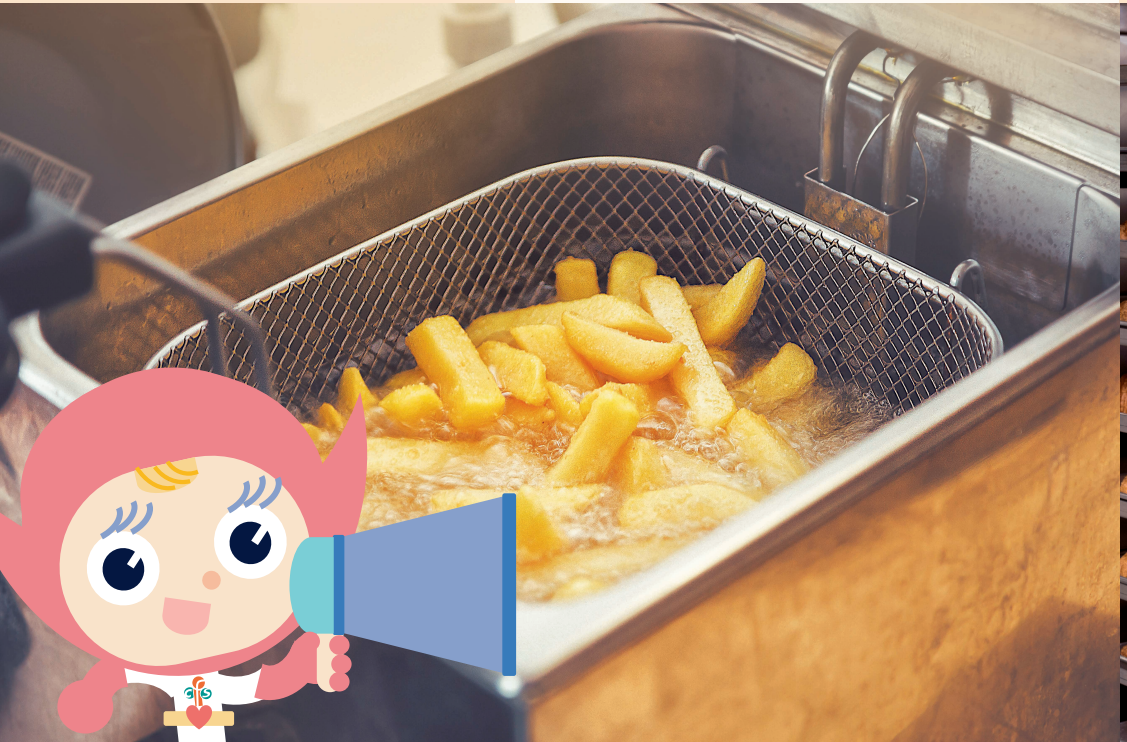
食物環境衞生署
Food and Environmental Hygiene Department

食物安全中心
Centre for Food Safety

安樂食飯
SAFE KITCHEN

有越來越多證據顯示，攝取反式脂肪會增加罹患心血管疾病的風險。本指引旨在鼓勵和協助業界減少食物中的反式脂肪及取代工業生產的反式脂肪，為市民提供較健康的食物。

There is growing evidence indicating that trans fats intake is linked to an increased risk of cardiovascular disease. This set of guidance aims at encouraging and assisting trade to provide healthier food with respect to reducing trans fats and replacing industrially-produced trans fats (IP-TFAs) in food.



引言

所有動物和植物源性的脂肪均含有脂肪酸。脂肪酸可分為飽和脂肪酸及不飽和脂肪酸兩類，後者包括單元不飽和脂肪酸和多元不飽和脂肪酸。反式脂肪屬不飽和脂肪，但因當中有一個或多個碳雙鍵是反式排列，故其特性與飽和脂肪相若，同樣會使低密度脂蛋白（「壞」膽固醇）增加，高密度脂蛋白（「好」膽固醇）減少，罹患心血管疾病的風險會因而提高。

牛和羊的奶及脂肪含有小量天然反式脂肪，而精煉食用油脂也可能含有小量非天然反式脂肪，但我們從膳食攝取的反式脂肪，主要來自以部分氫化油中的工業生產反式脂肪。部分氫化油是透過氫化的工業過程，利用並控制氫氣壓力、溫度、催化劑等相關元素，把食用油脂（一般為植物油）轉變成為不同硬度的部分氫化油脂產品。油經氫化的程度越高，便越接近固體狀。理論上，完全氫化的油不應含有反式脂肪，因為所有雙鍵均已飽和，但這種油會變硬。

部分氫化油能延長食品的保質期，改善口感，而且通常成本較使用天然動物及植物脂肪低。另一方面，在製造部分氫化油的過程中，工業生產的反式脂肪會在油中大量形成，通常佔脂肪酸總含量的25%至45%。部分氫化油常用於生產各式不同質感的食品，例如人造牛油（俗稱「孖芝蓮」或「孖油」）、植物起酥油、酥皮、批皮、餅乾、蛋糕，以及多種烘焙食品。

Introduction

All animal and plant sources of fats contain fatty acids, which can be saturated or unsaturated, and the latter include both monounsaturated and polyunsaturated forms. Trans fats are classified as unsaturated fats, but with one or more carbon-carbon double bonds in trans configuration, resulting in their properties more like saturated fats. Besides the effect of increasing low-density lipoprotein ('bad') cholesterol by saturated fats, trans fats also reduce the high-density lipoprotein ('good') cholesterol, thus with increased risk to cardiovascular disease.

The milk and fat of cow and sheep may contain a small amount of naturally present trans fats, whereas a small amount of unnatural trans fats may be present in refined edible fats and oils. However, the main dietary sources of intake of trans fats is from IP-TFAs in partially hydrogenated oils (PHOs). PHOs are edible fats and oils which have undergone the industrial process of hydrogenation. By controlling various elements such as hydrogen pressure, temperature, catalysts, etc. in the hydrogenation process, edible fats and oils (vegetable oils in general) are modified into partially hydrogenated fat products of different hardness. The higher the degree of hydrogenation of the oil, the closer it is to a solid state. In principle, fully hydrogenated oil should contain no trans fats since all the double bonds will be saturated, but this fat will become hard.

PHOs can increase shelf life of products, change the texture of the food, and are usually lower in cost as compared with the use of natural animal and vegetable fats. On the other hand, the process of producing PHOs can result in a large amount of IP-TFAs in the oil at a level ranging from 25% to 45% of the total fatty acids generally. PHOs are commonly used for manufacturing food products of different forms and textures such as margarines and vegetable shortenings, pastries, pies, biscuits, cakes and various kinds of baked food.

REPLACE
TRANS FAT

國際間減少反式脂肪的情況

世界衛生組織（世衛）在2018年提出《REPLACE》行動方案（《行動方案》），目標是到2023年在全球食品供應中消除工業生產的反式脂肪。在2020年9月，世衛發表報告，指出全球有40個地區已通過或實施世衛建議的政策措施，就食物中的反式脂肪設定某形式規限。此外，全球12間大型跨國食品企業已承諾於2023年或以前消除其所有食品中的工業生產反式脂肪。現時世界各地的主要油脂供應商都已廣泛應用成熟技術生產不含部分氫化油的油脂製品，以符合市場需求。

世衛一直持續呼籲各國遵照《行動方案》的建議，制定和實施最佳做法政策，從食品供應中消除工業生產的反式脂肪，例如禁止生產或在任何食品中使用部分氫化油。目前已實施禁止部分氫化油的地區有美國、加拿大和新加坡等。

International situation on reducing trans fats

In 2018, the World Health Organization (WHO) has put forward the *REPLACE* action package aiming to eliminate IP-TFAs from the global food supply by 2023. In September 2020, WHO reported that globally more than 40 places have passed or implemented WHO's recommended policies with some forms of trans fats regulation. Moreover, the 12 large multinational food companies have committed to eliminate IP-TFAs from all their products around the world in the year 2023 or before. Nowadays, major fat and oil suppliers worldwide have used mature technologies widely to produce PHO-free fat and oil products to satisfy market needs.

WHO keeps on calling countries to follow the recommendations in the *REPLACE* action package by adopting and implementing the best-practice policy options for eliminating IP-TFAs from the food supply. For instance, one of these options is to prohibit the production or the use of PHOs in any food. As of today, some places such as the United States, Canada, Singapore, etc. have already implemented this option.




本港減少反式脂肪的情況

食物環境衞生署食物安全中心（食安中心）一直與業界緊密合作，致力在食品供應中減少反式脂肪的含量。食安中心亦進行了一系列研究，以了解本港食物的反式脂肪含量，並在2008年發出《減少食物中反式脂肪》業界指引，及在2010年起實施的營養資料標籤制度中，規定所有預先包裝食品必須列出反式脂肪含量。

政府當局在2018年公布了《邁向2025：香港非傳染病防控策略及行動計劃》，當中一項主要指標，是探討實施政策，禁止在食品供應中使用部分氫化油，即工業生產反式脂肪的主要來源，以期從源頭保障市民，免除攝入工業生產反式脂肪酸的食物安全風險。

Local situation on reducing trans fats

The Centre for Food Safety (CFS) of the Food and Environmental Hygiene Department has been working closely with the trade to reduce the trans fats content in the food supply. The CFS has conducted a series of studies to track its contents in local food, produced the *Trade Guidelines on Reducing Trans Fats in Food* in 2008, and has implemented the Nutrition Labelling Scheme since 2010, which requires trans fats to be declared on labels of prepackaged food.

In *Towards 2025: Strategy and Action Plan to Prevent and Control Non-communicable Diseases in Hong Kong* announced by the Government in 2018, one of the key tasks is to explore the adoption of policies that eliminate PHOs, the main source of IP-TFA, in the food supply, thereby eliminating the food safety risks associated with the consumption of IP-TFAs and protecting the public at source.

美味牌植物牛油
TasteGood Margarine

Ingredients: Soybean oil, fully hydrogenated soybean oil, water, salt, whey, soy lecithin, vegetable mono and diglycerides, potassium sorbate, citric acid, beta carotene (for colour)
成分：大豆油，完全氫化大豆油，水，鹽，乳清，大豆卵磷脂，植物甘油單酯和甘油二酯，山梨酸鉀，檸檬酸，β-胡蘿蔔素（色素）

完全氫化
Fully hydrogenated ✓

部分氫化
Partially hydrogenated ✗

氫化
hydrogenated ?

要留意配料所含的氫化油是部分氫化油還是完全氫化油，有需要時可以要求供應商提供相關文件（例如產品規格說明、化驗報告）
Take note if the hydrogenated oil in the food ingredient is partially or fully hydrogenated. If needed, request documentations (e.g. product specification, laboratory reports) during procurement

生產和配製食物的建議

為促進消費者的健康，並避免購買含有部分氫化油的配料，業界在生產和配製食物時，要先了解食物中反式脂肪的來源，如有需要便改用較健康的替代品。

首先，業界可列出生產有關食物時會使用的所有配料，留意哪些配料的反式脂肪含量偏高。反式脂肪通常存在於部分氫化油，食物商在採購時應避免使用，並要求供應商提供相關文件（例如產品規格說明、化驗報告），以確定個別食品或食物配料是否含有部分氫化油。

Advice on food production and preparation

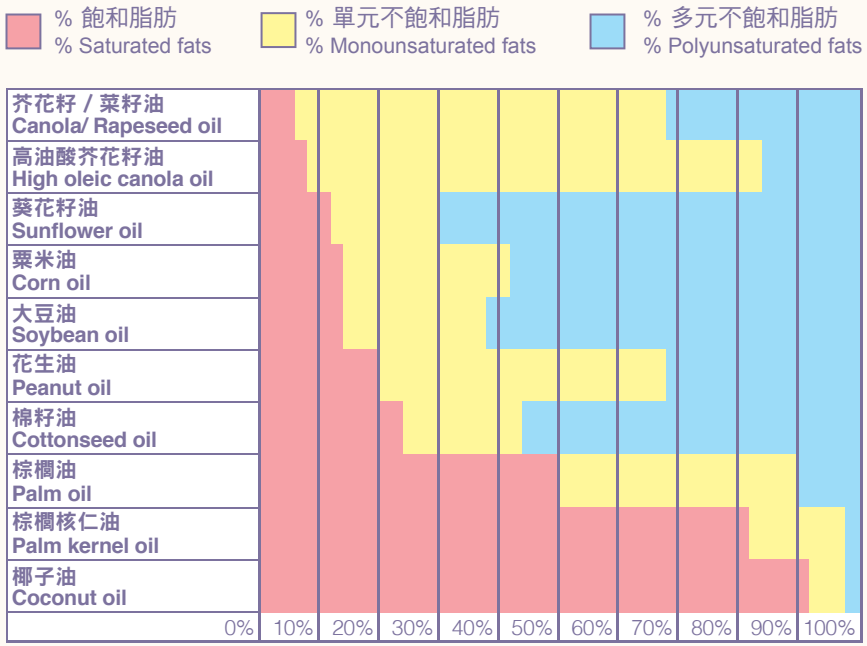
In order to promote consumers' health and to avoid purchasing PHO-containing ingredients, when producing and preparing food, traders may first realise the source of trans fats in food. If necessary, these ingredients shall be replaced with healthier alternatives.

To start with, traders may first list out all the ingredients used in producing the food and pay attention to those high in trans fats. Trans fats are usually found in PHOs. Traders should avoid using PHOs and request documentations (e.g. product specification, laboratory reports) during procurement to ascertain whether a food product or an ingredient contain PHOs.




食安中心建議食物製造商使用含大量單元不飽和脂肪酸（例如芥花籽油、橄欖油）或多元不飽和脂肪酸含量高（例如大豆油、粟米油）的油類（一些植物油的脂肪酸分布情況見圖）。如使用分量適當，單元不飽和脂肪酸和多元不飽和脂肪酸均對健康有益。如使用人造牛油和植物起酥油，則應選用不含部分氫化油的產品。

The CFS advises food manufacturers to use fats and oils that are high in monounsaturated (e.g. canola oil and olive oil) and polyunsaturated (e.g. soybean oil, and corn oil) fats (see Figure for the fatty acid profile of some vegetable oils), which are beneficial to health if taken in appropriate amount. If margarines and vegetable shortenings are to be used, choose those that are without PHOs.



一些植物油的脂肪酸組成分析(大概比率)*
Approximate fatty acid composition of selected vegetable oils*

現時取代部分氫化油的技術方案

現時在國際和本地市場均已有不含部分氫化油的食用油脂（例如不含部分氫化油的人造牛油和植物起酥油）供作食物配料使用，可配合不同用途和切合消費者的利益。食物商應以含有最少飽和脂肪和最多不飽和脂肪酸的配方，取代食品中的部分氫化油。只有在並無替代品的情況下，才應有限度使用動物脂肪（例如牛油、豬油）、椰子油和棕櫚油等通常有較多飽和脂肪的油類（見表）*。

技術方案	例子
1. **性質穩定的植物油：** 在室溫下呈液體狀	天然穩定度高的油；特性油（高油酸油類）；含抗氧化劑和乳化劑的油
2. **天然硬脂：** 飽和脂肪天然含量高，在室溫下呈固體狀	動物脂肪；熱帶油脂（棕櫚油、椰子油、棕櫚核仁油）
3. **完全氫化硬脂：** 完全氫化的油類，呈蠟質脂肪狀，含100%飽和脂肪	完全氫化的大豆油或其他油類
4. **分餾油脂：** 以慢速冷卻方式，可分離出更多固體狀和液態狀的脂肪分餾物	低溶點棕櫚軟脂（液態）；高溶點棕櫚硬脂（固體狀）
5. **重組脂肪：** 把三酸甘油酯的脂肪酸互相置換(交酯化)	以化學方式或借助酵素重組脂肪酸製成的硬脂
6. **混和不同油脂**	把大豆油和棕櫚油混合，液態油會變得黏稠
7. **方案1至6結合使用**	讓液態油與特定的硬脂或分餾油起交酯作用

Existing technical solutions for PHOs replacement

At present, non-PHO-containing edible fats/oils ingredients (e.g. PHO-free margarines and vegetable shortenings) are already available in the international and local markets to cater for the different applications and address consumers' interest. PHOs in products should be replaced with formulations that contain as little saturated fats and as much unsaturated fatty acid as possible. Animal fats (e.g. butter, lard), coconut oil and palm oil are fats/oils usually containing higher level of saturated fats; they should only be used in a limited number of applications where there is no alternative (see Table)*.

Technical solution	Examples
1. **Stable plant oils:** liquid at room temperature	Naturally stable oils; trait-enhanced oils (high oleic oils); oils with antioxidants and emulsifiers
2. **Natural hardstocks:** naturally high in saturated fats and solid at room temperature	Animal fats; tropical oils and fats (palm, coconut, palm kernel)
3. **Fully hydrogenated hardstocks:** full hydrogenation turns oils into 100% saturated fats waxy fats	Fully hydrogenated soy oil or other oils
4. **Fractionated oils and fats:** use slow cooling to separate more solid and more liquid fat fractions	Low melting (liquid) palm olein; high melting (solid) palm stearin
5. **Rearranged fats:** fatty acids are reshuffled ("interesterified") within the triglycerides	Chemically or enzymatically rearranged hardstocks
6. **Blending of oils and fats**	Mix of soy oil and palm oil, which gives a viscous liquid
7. **Combinations of approaches 1-6**	Liquid oil interesterified with a specific hardstock or fractionated oil

* 資料來源 Source of reference:
Module 2: Promote. How-to guide for determining the best replacement oils and interventions to promote their use. In: REPLACE trans fat: an action package to eliminate industrially produced trans-fatty acids. Geneva: World Health Organization; 2019 (WHO/NMH/NHD/19.12). (Available at URL: https://www.who.int/docs/default-source/replace-transfat/replace-module-2-p.pdf?sfvrsn=e9f83030_4)

對於各種替代方案，食安中心有以下建議：

- 應採用最健康的替代品，即含有最少飽和脂肪和最多多元不飽和脂肪酸的替代品。
- 如脂肪只用作傳熱，或起脫模或潤滑作用（例如煎炸食物），應使用不會快速氧化的液態油（例如高油酸芥花籽油）。
- 如選用的油脂需有飽和脂肪的「稠度」或功能性：
  - 動物脂肪、熱帶油及其分餾物，以及完全氫化油等硬脂的飽和脂肪含量高。例如，棕櫚油可作為烘焙用的起酥油，但其飽和脂肪含量高約50%，**不建議完全以上述硬脂作替代品**。
  - 在某些用途上，把液態油與上述硬脂混和，是取代部分氫化油的方法之一。混和過程會使脂肪分子混合，例如把液態油與1%或2%的完全氫化油混和，便會形成黏稠的液態油，利於在專業廚房使用。
  - 一種常用的方法，是重組脂肪，使脂肪分子中的脂肪酸混合，把整體飽和脂肪含量降低，同時提升脂肪在固態下所呈現的結構功能性。舉例而言，以25%棕櫚硬脂與大豆油交互酯化製成的烘焙用起酥油，其飽和脂肪含量約為30%。
  - 因應產品配方，結合各種技術（分餾法、完全氫化、脂肪重組和混和法）使用。

The CFS has the following recommendations for the various alternatives as follows:

- Use the healthiest replacements -- lowest saturated fats and highest polyunsaturated fat.
- When fat is only needed as a heat transfer medium, release agent or lubricant (e.g., for frying), use liquid oils that do not oxidise quickly, e.g. high oleic canola oil.
- For other products that need 'body' or other functionalities of saturated fats:
  - Hardstocks such as animal fats, tropical oils and its fractions, and fully hydrogenated oils have high saturated fats content. For example, palm oil can be used as a baking shortening but is around 50% saturated fats. Thus, it **is not recommended to use the above hardstocks as full PHOs replacement**.
  - For some applications, blending of liquid oils with the above hardstocks is one way to replace PHOs. Blending is the mixing of fat molecules. For example, liquid oil blended with 1% or 2% of fully hydrogenated oil gives a viscous liquid that is easy to use in professional kitchens.
  - Fat rearrangement is often the method of choice since it mixes the fatty acids within the fat molecule. This gives more solid fat structuring capacities at lower overall saturated fats levels. For example, a baking shortening made by interesterifying 25% of palm stearin with soybean oil will have around 30% saturated fats.
  - Combinations of technologies (fractionating, full hydrogenation, fat rearrangement and blending) are well suited to formulate products.

在香港，不少餐飲業和烘焙業人士已選用不含部分氫化油的油脂來生產食品。例如，以穩定度在中至高水平的植物油（如高油酸芥花籽油）作煎炸油，而揀選烘焙用的軟質人造牛油時，則以軟質油類與飽和脂肪含量高的油類（例如棕櫚油／棕櫚硬脂和一般植物油）混合使用。

食物商在採購時應按本身的需要，向油脂供應商查詢產品配料的成分資料詳情，確保所採購的產品不含部分氫化油，同時亦向消費者提供有關食物中氫化油成分的正確資訊。

In Hong Kong, many catering and baking industries have already chosen these PHO-free products for food production. For instance, when choosing a frying fat, medium- and high-stability vegetable oils (e.g. high oleic canola oil) could be a healthier alternative; when choosing a soft baking margarine, blending of soft oils and highly saturated oils (e.g. palm oil or palm stearin and general vegetable oils).

During procurement, traders should check with the fat and oil suppliers for the ingredient details of the products according to their own needs. They shall ensure that the purchased products do not contain PHOs, and provide correct information on any hydrogenated oil ingredient in the food to consumers.

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