食物安全焦點
Food Safety Focus

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新興食品——植物肉/素肉及培養肉
Plant-based Meat and Cultured Meat – New Food Fads

食物安全中心風險評估組
科學主任周淑敏女士報告

Reported by Ms. Shuk-man CHOW, Scientific Officer,
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近日媒體上有關「人造肉」的報道越來越多。我們所吃的傳統肉類可以是均衡健康飲食的一部分，而所謂「人造肉」則擬用作傳統肉類的替代品，並作為另一蛋白質來源。鑑於現時社會上對「人造肉」並未有統一的定義，使用這個字眼可能會使消費者感到混淆。在本文中，我們會探討一下這些肉類替代品是什麼。

"Artificial meat" is recently a topic with increasing media coverage. While conventional meat that we eat can be part of a balanced and healthy diet, the so called "artificial meat" is intended to be consumed as a substitute for conventional meat and an alternative source of protein. As there is no agreed definition for "artificial meat", the term may cause confusion to consumers. In this article, we explore what these meat alternatives are.

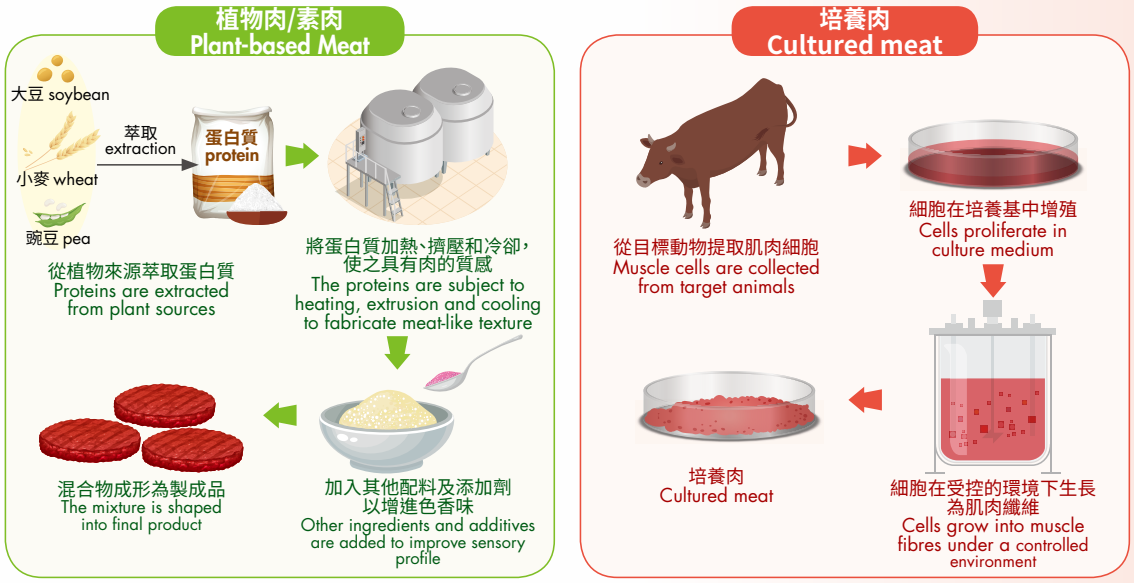

圖1：植物肉/素肉及培養肉的生產過程
Figure1. Production process of plant-based meat and cultured meat.

植物性肉類替代品

雖然有些人未必知曉，但植物性肉類替代品並非什麼新事物。傳統中式素菜中的齋雞(由腐皮製成)及齋滷味(由麵筋製成)，便是植物性肉類替代品的好例子，向來都是本地飲食的一部分。植物肉/素肉基本上是由植物蛋白質製成的仿肉。生產的首個步驟是從大豆、小麥或豌豆等植物來源萃取蛋白質，然後將蛋白質萃取物加熱、擠壓和冷卻，使之具有肉的質感，最後加入其他配料及添加劑(例如調味劑及染色料)，以仿製肉的風味、味道及外觀。

Plant-based meat alternatives

Though it might not sound familiar to some, plant-based meat alternatives are not anything new. Rooted in the Chinese cuisine, vegetarian chicken (made from bean curd sheet) and vegetarian *lo mei* (made from wheat gluten) are examples of plant-based meat alternatives that have long been part of the local diet. Basically, plant-based meat are meat analogues made from plant protein. They are produced by initially extracting proteins from plant sources such as soya bean, wheat or pea. The protein extracts are then subject to heating, extrusion and cooling to fabricate meat-like texture, eventually

焦點個案
Incident in Focus

最近，越來越多海外食肆及食品雜貨店售賣植物肉/素肉產品，包括雞塊、漢堡肉餅及熟肉片。現今市面上的植物性肉類替代品推陳出新，無論在味道及外觀上都更像真肉，例如透過添加紅菜頭汁來模擬血水，或加入椰子油來模仿肉類脂肪，使之在燒烤時嘶嘶作響。儘管有人認為不含肉類成分的替代品是更健康的選擇，但為了保持產品的質感及風味，這些植物肉/素肉產品一般會添加不同的含鈉調味料及添加劑，以致這些產品往往含有較高分量的鈉。

培養肉

除植物肉/素肉外，培養肉也是另一種新興的傳統肉類替代品。培養肉又稱為實驗室培養肉、試管肉等，是在實驗室由動物細胞培養出來的肉。生產培養肉首先要從目標動物提取肌肉細胞，讓這些細胞在培養基中增殖，然後在受控的環境下生長為肌肉纖維。不能由肌肉細胞合成的營養素，例如鐵質及維他命B12，會加以補充在培養基中，以生產營養價值與傳統肉類相若的培養肉產品。

目前，培養肉產品尚未推出市場作商業銷售，這是因為現有的生產技術既耗時，又需要大量人手及高昂成本，以致無法在合乎經濟原則下大規模生產培養肉。另外，由於以細胞培養的肉只能長成小塊(體積小於一立方厘米)，培養肉只適合用於製造漢堡肉餅或香腸等加工肉類或碎肉產品。培養肉在味道、顏色、外觀及質感上亦與傳統肉類有所不同。為了降低成本、擴大生產規模，以及仿製不同肉類的複雜質感，有需要進一步改良培養肉的生產方法，才可推出市場發售。

注意事項

1. 植物肉/素肉產品是由植物蛋白質製成的仿肉，向來都是本地飲食的一部分。
2. 培養肉是在實驗室由動物細胞培養出來的肉，尚未推出市場作商業銷售。
3. 使用「人造肉」這個字眼去形容肉類替代品，可能會使消費者感到混淆。

給業界的建議

- 確保所售產品適宜供人食用。
- 確保食物標籤上的資料屬實及無誤導成分。
- 在食物標籤上作出正確的描述及提供足夠資料，以便消費者作出知情選擇。

給市民的建議

- 購買食品前參閱包裝上的食物標籤，以清楚了解所含成分。
- 查看營養標籤上所示的鈉及脂肪含量，並選擇含有較少鈉及脂肪的植物肉/素肉產品。

added with other ingredients and additives (e.g. flavouring and colourants) to mimic the flavour, taste and appearance of meat.

Recently, plant-based meat products, in forms of chicken nugget, burger patty and deli slices, are made increasingly available in restaurants and grocery stores overseas. Newer plant-based meat alternatives on the market today are meant to taste and look more like meat. This is achieved for example by adding beet juice to imitate blood or coconut oil to simulate meat fat and help it sizzle on the grill. Though some believe that meat free alternatives are healthier options, plant-based meat products are often added with different sodium-containing condiments and additives to maintain their texture and flavour which contribute to the relatively high levels of sodium in these products.

Cultured meat

In addition to plant-based meat, cultured meat is another on-the-horizon alternative to conventional meat. Cultured meat, also referred to as lab-grown meat and *in vitro* meat, etc, is meat grown in laboratories from animal cells. To produce cultured meat, muscle cells are first collected from target animals and allowed to proliferate in a culture medium. These cells are then grown into muscle fibres under a controlled environment. Nutrients that are not synthesised by muscle cells such as iron and vitamin B12 are supplemented in the culture medium in order to produce cultured meat products with a nutritional value comparable to that of conventional meat.

At present, cultured meat products are not yet commercially available. This is because the current production technology is time-consuming, highly labour-intensive and costly that makes large-scale production of cultured meat not economically viable. In addition, cultured meat is only suitable for making processed or comminuted meat products such as burger patty or sausage as meat only grows into small pieces (less than a cubic centimetre in volume) through cell culture. Cultured meat is also different from conventional meat in taste, colour, appearance and texture. Further modifications are needed to refine the production methods in order to lower cost, improve scalability and replicate the complex textures of different meats before marketing.

Key Points to Note

1. Plant-based meat products are meat analogues made from plant protein and have long been part of the local diet.
2. Cultured meat is meat grown in laboratories from animal cells. It is not yet commercially available.
3. The use of the term "artificial meat" to describe meat alternatives may cause confusion to consumers.

Advice to the Trade

- Ensure products for sale are fit for human consumption.
- Ensure information on food labels is truthful and not misleading.
- Correctly describe food products and provide adequate information on food labels to allow informed choices.

Advice to the Public

- Read the food label on the packaging before purchase to have a clear understanding of the ingredients of a food product.
- Check for the sodium and fat content on nutrition labels and choose plant-based meat products with less sodium and fat.

食物安全平台
Food Safety Platform

當務之急——不再使用工業生產的反式脂肪

High Time to Keep Industrially-Produced Trans Fats (IP-TFAs) at Bay

食物安全中心風險評估組科學主任林伏波博士及
風險傳達組科學主任陳蓉蓉女士報告

Reported by Dr. Violette LIN, Scientific Officer, Risk Assessment Section, and Ms. Melva CHEN, Scientific Officer, Risk Communication Section, Centre for Food Safety

反式脂肪增加血液中的「壞」膽固醇，亦同時使「好」膽固醇減少，是心臟健康的雙料殺手，每年導致全球50多萬人死於心臟病。世界衛生組織(世衛)呼籲各國政府及食品工業採取一致行動，以期不再使用工業生產的反式脂肪。

Trans fats (TFAs), a double jeopardy to heart health by increasing "bad" cholesterol and decreasing "good" cholesterol in blood, attribute to more than a half million deaths from heart disease every year around the world. Calling for concerted actions from governments and food industry, the World Health Organization (WHO) aims to eliminate industrially-produced trans fats (IP-TFAs).

為何世衛針對工業生產的反式脂肪？

我們的日常飲食並不需要反式脂肪。世衛建議，反式脂肪的攝入量應少於所需能量的1%，不論來源為工業生產的產品(例如用於油炸/烘焙食品、人造牛油及起酥油的部分氫化油)，或是反芻動物(即牛羊等動物的肉及奶製品)。以一個每日所需能量為2000千卡的人為例，反式脂肪的每日攝入量上限是2.2克。

雖然來自反芻動物的反式脂肪與工業生產的反式脂肪對健康的不良影響似乎相若，但世衛的目標是取代工業生產的反式脂肪，原因是工業生產的反式脂肪可加以避免和完全取代，而來自反芻動物的反式脂肪卻是天然存在的。一般來說，工業生產的反式脂肪是膳食反式脂肪的主要來源。

圖2：減少食品中工業生產的反式脂肪的基本步驟
Figure 2. Basic steps to reduce industrially-produced trans fats in food products.

有何良方在全球食品供應中停用工業生產的反式脂肪？

世衛指出，要停用工業生產的反式脂肪，最有效的方法是立法或制定規管措施，嚴格禁止或限制在任何食品中使用工業生產的反式脂肪。許多地方正以自願或強制方式停用工業生產的反式脂肪(參閱世衛的各國反式脂肪評分表)。一些國家的經驗顯示，自願措施可減少反式脂肪，而另一些國家則發現，強制停用更為有效。

世衛提出兩種良好作業方式：(i)限制所有食品中工業生產的反式脂肪佔總脂肪的比例，不得超過2克/100克；以及(ii)把部分氫化油重新歸類為有害物質，從而禁止使用。世衛表明，這兩種方式各有長短。政府機關可考慮當地情況，例如現行規管做法、化驗所的處理能力，以及當地食品工業的性質，來決定採用哪種方式。

停用工業生產的反式脂肪會否局限食品選擇？

部分氫化油是工業生產的反式脂肪的來源，在20世紀初首次引入食品供應中，以取代成本較高的牛油、豬油及高價值的植物脂肪，例如可可脂。

隨着世衛呼籲採取行動，食品工業內的一些持份者，例如國際食品飲料聯盟，已承諾消除工業生產的反式脂肪。據世衛報告指，已有許多改用較健康的替代品來取代反式脂肪，而無造成業務虧損的成功個案。更重要的是，改良食品配方不會改變食品的味道或消費者的滿意程度。本地業者可採取一些基本步驟，來減少產品中工業生產的反式脂肪(見圖2)。

Why Does the WHO Target IP-TFAs?

TFAs are not required in our everyday diet. The WHO recommends less than 1% of energy intake from consuming TFAs, regardless of their origin either from industrially-produced (e.g. partially hydrogenated oils (PHOs) used in fried/baked food, margarine and shortening) or from ruminant sources (i.e. in meat and dairy products of cattle, sheep, etc.). This equates to a maximum of 2.2 grams TFAs daily for a person requiring 2000 kilocalories/day.

Although the adverse health effects of ruminant TFAs or IP-TFAs appear to be similar, the WHO targets to replace IP-TFAs. This is because IP-TFAs can be avoided and fully replaced, whereas ruminant TFAs are naturally present. In general, IP-TFAs are the predominant source of dietary TFAs.

What is the Best-practice Policy to Eliminate IP-TFAs in Global Food Supply?

According to the WHO, the most effective way to eliminate IP-TFAs is to implement legislative or regulatory actions to strictly prohibit or limit their use in any food. Eliminating IP-TFAs using a voluntary or mandatory approach is happening in many places (see the WHO's TFA Country Score Card). Experiences in some countries showed that voluntary measures could lead to reductions in TFAs while in some others mandatory elimination was found to be more effective.

The WHO lists two approaches of best-practice policy: (i) limiting IP-TFAs to no more than 2 grams/100 grams of total fat in all foods; and (ii) prohibiting PHOs by reclassifying them as harmful substances. The WHO states that both approaches have advantages and limitations. Government bodies may consider the local situation such as existing regulatory practices, laboratory capacity and the nature of local food industry to decide which approach to adopt.

Will Eliminating IP-TFAs Restrict Food Choices?

PHOs, the source of IP-TFAs, were first introduced into food supply in the early 20th century as an economical replacement for butter, lard and high-valued vegetable fats such as cocoa butter.

Following the WHO's call for action, some stakeholders in the food industry, such as the International Food and Beverage Alliance, have already committed to remove IP-TFAs. The WHO reports that many have successfully replaced TFAs with healthier alternatives without incurring any business loss. More importantly, this reformulation does not lead to a change in taste or consumers' satisfaction. Local traders may adopt some basic steps to reduce IP-TFAs in their products (see Figure 2).

在本地食品供應中停用工業生產的反式脂肪——香港的成績如何？

過去十多年來，食物安全中心(中心)一直與業界緊密合作，減少食品供應中的反式脂肪。二零零七年，就本地食品進行的首項反式脂肪研究發現，一些熱門酥皮及油炸食品所含的反式脂肪分量偏高，結果提高了大眾對反式脂肪的認識。二零零八年，中心發出《業界指引》，以協助業界減少反式脂肪。二零一零年，營養資料標籤制度實施，強制規定預先包裝食品必須標示反式脂肪含量，以便向消費者提供有關資料，並推動業界改良產品配方。

政府與業界的共同努力已取得一些成果：跟進研究顯示，反式脂肪呈下降趨勢，而含有較少或不含反式脂肪的預先包裝產品在本地市場也愈趨普及。然而，最近在二零一九年進行的研究發現，某些非預先包裝食品，尤其是酥皮忌廉湯及雞批等高脂食品，仍然含有較多工業生產的反式脂肪。要進一步減少本地食品中工業生產的反式脂肪以保護心臟健康，或有需要考慮制訂更多措施。

Eliminating IP-TFAs from Local Food Supply – How Does Hong Kong Fare?

Over the last decade, the Centre for Food Safety (CFS) has been working closely with the trade to reduce TFAs in the food supply. In 2007, the first study on TFAs in local food was conducted. The findings identified very high TFA levels in some popular pastries and deep fried foods, arousing awareness of the community on TFAs. In 2008, the CFS produced Trade Guidelines to facilitate the trade to reduce TFAs. In 2010, the Nutrition Labelling Scheme mandated TFAs to be declared for prepackaged foods, which served to provide information to consumers and lead industry to reformulate products.

The conjoint efforts between the Government and the trade appear to reap some fruits: a decreasing trend in TFAs and prepackaged products with low or no TFAs blooming on the local market as revealed by follow up studies. However, the recent 2019 study found certain non-prepackaged foods, especially those high-fat products like cream soup with puff pastry and chicken pies, still contain relatively high levels of IP-TFAs. For further reducing IP-TFAs in local food to protect our heart health, additional measure may need to be considered.

食物事故點滴
Food Incident Highlight

水產檢出含有氯霉素
Chloramphenicol Found in Aquatic Food

近日有傳媒報道，在本地街市的冷藏魚類及蟹樣本中檢出氯霉素。氯霉素是一種可用於治療細菌感染的抗生素，但對人類骨髓具有潛在毒性。

根據《食物內有害物質規例》(第132AF章)，在本港出售供人食用的食物不得含有氯霉素。氯霉素包括在食物安全中心(中心)食物監測計劃的檢測之列。過去12個月，中心抽取了483個水產樣本進行氯霉素檢測，在3個樣本中驗出氯霉素，並已採取跟進行動。

市民應購買來自持牌食肆的水產。業界應向可靠的供應商採購水產。畜牧場及水產養殖場不應使用氯霉素。

Recently, the media reported detection of chloramphenicol in frozen fish and crab samples purchased from local wet markets. Chloramphenicol is an antibiotic and can be used to treat bacterial infections. Nevertheless, it has potential toxicity to bone marrow in human.

According to the Harmful Substances in Food Regulations (Cap 132AF), all food sold in Hong Kong for human consumption is not allowed to contain chloramphenicol. The Food Surveillance programme of the Centre for Food Safety (CFS) includes testing of chloramphenicol. In the past 12 months, the CFS has collected 483 aquatic food samples for testing of chloramphenicol, among which three were tested positive. Follow up action was taken.

The public should purchase aquatic food from licensed food premises. The trade is advised to source aquatic food from reliable suppliers. Chloramphenicol should not be used in animal and aquatic farms.

食物中的柄曲霉素風險評估研究報告
Risk Assessment Study Results on Sterigmatocystin in Food

食物安全中心最近就食物中的柄曲霉素完成了一項研究，抽取了超過300個樣本進行檢測，涵蓋12個食物組別，包括麵粉、早餐麥片、香料、穀類、粉麵、烘焙食品、咖啡豆、澱粉代用品、花生及堅果、芝士、啤酒，以及醃製肉類。大約九成樣本都檢測不到柄曲霉素，而檢出含有柄曲霉素的樣本大部分所含的分量都甚低。風險評估結果顯示，本港市民從上述食品攝入的柄曲霉素分量對健康影響不大。

柄曲霉素是一種霉菌毒素，因食品貯存不當被霉菌污染而產生。動物研究顯示，長期攝入柄曲霉素可令動物患癌，而柄曲霉素也有機會令人患癌。為了減低食物受柄曲霉素污染的風險，應妥善貯存食物，例如存放於陰涼乾燥的地方，以防止霉菌滋生。

The Centre for Food Safety has recently completed a study on sterigmatocystin (STC) in food. Over 300 samples covering 12 food groups, namely flour, breakfast cereal, dried spices, grains, pasta and noodles, bakery and pastry items, coffee beans, starch substitute, peanuts and tree nuts, cheese, beer and cured meat, were collected for testing. About 90% of the samples were not detected with STC. For samples detected with STC, the majority had very low levels. Risk assessment results showed low health concern for the local population due to dietary exposure to STC.

STC is a mycotoxin that can be formed on food commodities contaminated with moulds due to improper storage. Animal studies showed that STC may cause cancer to animals upon chronic exposure and it is possibly carcinogenic to humans. For reducing the risk of STC contamination, food should be stored properly, such as keeping in cool and dry places to prevent fungal infestation.

風險傳達工作一覽（二零一九年九月）
Summary of Risk Communication Work (September 2019)

事故／食物安全個案 Incidents/ Food Safety Cases: 150	公眾查詢 Public Enquiries: 65	業界查詢 Trade Enquiries: 121	食物投訴 Food Complaints: 480
給業界的快速警報 Rapid Alerts to Trade: 6	給消費者的食物警報 Food Alerts to Consumers: 2	教育研討會/ 演講/ 講座/ 輔導 Educational Seminars/ Lectures/ Talks/ Counselling: 53	上載到食物安全中心網頁的新訊息 New Messages Put on the CFS Website: 51