食物安全焦點
Food Safety Focus

食物安全中心 Centre for Food Safety

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食物安全中心
風險評估組
科學主任馬嘉明女士報告

Reported by Ms. Janny MA, Scientific Officer, Risk Assessment Section, Centre for Food Safety

可能使用了苯甲酸作為防腐劑的汽水
Soft drinks that may have used benzoic acid as preservative

傳媒近日報道，巴西有消費者組織就當地出售的汽水中的苯含量進行研究，發現24個樣本中有7個含有苯這種致癌物質。本文將會詳細論述汽水中的苯。

Recently, the media reported that a consumer organisation in Brazil has conducted a study assessing the level of benzene, which is a cancer-causing agent, in soft drinks available in the Brazilian market. Out of 24 samples, 7 were found to contain benzene. This article provides more information on benzene in soft drinks.

苯是什麼？

苯是一種極度易燃的無色液體，具有獨特的芳香氣味，屬於原油的天然成分。

苯可透過汽車排放廢氣和吸煙等人類活動存在於環境中。苯亦可透過商業活動產生，再製成其他化學物、染料、清潔劑及一些塑膠製品。此外，火山和森林大火亦會天然釋放出小量苯。

苯無處不在，故此可能會污染我們的食物和水源。此外，食物內的苯也可能來自其他來源。

What is Benzene?

Benzene is a colourless and highly flammable liquid with a characteristic aromatic odour. It is a natural part of crude oil.

Benzene is present in the environment through human activities such as vehicle emissions and cigarette smoking. In addition, benzene is produced commercially to make other chemicals, dyes, detergents and some plastics. It may also, to a lesser extent, be released naturally from volcanoes and forest fires.

Since benzene is present ubiquitously, it may contaminate our food and water supplies. The presence of benzene in food can also be attributed to other potential sources.

為什麼部分汽水會含有苯？

九十年代初，科學家發現，汽水如同時含有(1)苯甲酸或其鹽類及(2)抗壞血酸(維他命C)，可產生苯，尤其是在有光和高溫的環境下。

苯甲酸及其鹽類[國際編碼系統編號210至213]是可在食物(包括汽水)中添加的防腐劑，以防止細菌、酵母菌和霉菌生長。在本港，根據《食物內防腐劑規例》，苯甲酸及其鹽類可在汽水等指明食物中用作防腐劑。此外，這些物質亦會天然存在於一些食物中，例如越橘、梅子、布冧及大部分醬果。

抗壞血酸[國際編碼系統編號300]可用作抗氧化劑，同時會天然存在於多種水果及蔬菜中。

Why is Benzene Found in Some Soft Drinks?

In the early 1990s, it was found that benzene could be formed in soft drinks containing both (1) benzoic acid or its salts and (2) ascorbic acid (vitamin C), especially in the presence of light and elevated temperatures.

Benzoic acid and its salts [INS 210-213] are preservatives which can be added to foods including soft drinks to prevent the growth of bacteria, yeasts and moulds. In Hong Kong, under the Preservatives in Food Regulation, benzoic acid and its salts are allowed to be used in specific foods such as soft drinks as preservative. They are also naturally present in some foods e.g. cranberries, prunes, plums and most berries.

Ascorbic acid [INS 300] can be used as an antioxidant. It is also naturally present in a variety of fruits and vegetables.

不過，必須注意的是，汽水同時含有苯甲酸或其鹽類及抗壞血酸，並非必然會產生苯。多種因素，例如酸鹼值、是否暴露於高溫和紫外光下、是否含有某些礦物質和甜味劑等，亦可能會影響苯的產生。

However, it is important to note that the presence of benzoic acid or its salts and ascorbic acid in soft drinks does not necessarily result in the formation of benzene. Many factors e.g. pH, exposure to high temperature and UV light, presence of certain minerals and sweeteners etc. may affect the benzene formation.

焦點個案
Incident in Focus

苯對健康的影響

在短時間內攝入大量苯主要會影響人的中樞神經系統。苯可引致人類的染色體改變。長期攝入苯可引致造血器官的癌症。根據有關工人從工作環境攝入苯的數據及動物研究的證據，國際癌症研究機構認為苯屬於令人類患癌(即第1組)的物質。世界衛生組織(世衛)並沒有就苯訂出可容忍攝入量。

汽水中的苯含量

多個海外食物當局進行的研究顯示，汽水中的苯含量普遍低於世衛就飲用水所訂的苯含量準則值，即每公升10微克。

在發現飲料中苯含量高於世衛就飲用水所訂準則或該國自行制定的標準的國家，如英國及美國，業界自願從市面上撤回有關產品及／或重新配製產品以減低苯含量。

美國食物及藥物管理局、英國食物標準局和澳洲及新西蘭食物標準局等不少食物當局認為，從汽水攝入小量苯不會引致公眾健康問題。二零零九年，食品中污染物法典委員會亦指出，汽水中的苯並不是人們攝入苯的主要來源，同時目前已有多份業界指引，尤其是由國際飲料協會理事會擬制的有關《如何降低飲料中產生苯的潛在可能性》指導文件，以限制苯在汽水中產生。

注意要點

- 汽水如同時含有苯甲酸或其鹽類及抗壞血酸(維他命C)，可能會產生苯。
- 從汽水攝入小量苯不會引致公眾健康問題。
- 從食物攝入苯的分量只佔人們每天攝入總量的很小比重。

苯的攝入途徑

一般人每天攝入的苯主要來自吸入周圍空氣這一途徑。從食物攝入的苯分量只佔每天攝入總量的很小比重，估計少於從吸入途徑攝入分量的2%。至於吸煙者，他們每天攝入苯的總量可能有極大部分是來自香煙。(表1)

表1. 從不同來源攝入苯的估計分量(歐洲委員會聯合研究中心，2005)

攝入來源	估計攝入量(微克/天)
食物	0.2-3.1
空氣：透過吸入攝入	220
吸煙(20支香煙)	7900

本港情況

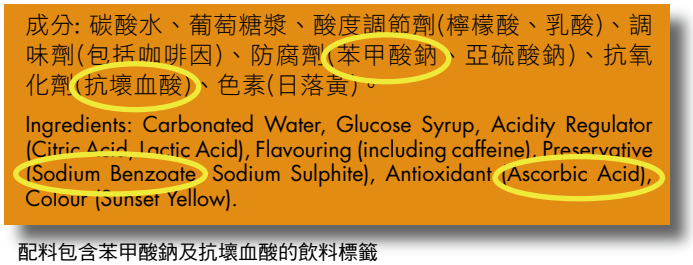
過去三年，食物安全中心抽取了20多個汽水樣本進行苯測試，結果全部合格。

給市民的建議

- 保持均衡飲食，以免因偏吃某幾類食物而攝入過量污染物。

給業界的建議

- 檢討汽水配方、對汽水進行苯測試，並在有需要時重新研配問題產品，以確保汽水中的苯含量盡量降至最低。有關如何降低汽水中產生苯的潛在可能性的詳情，請參考業界指導文件。



配料包含苯甲酸鈉及抗壞血酸的飲料標籤
Food label of drink containing both sodium benzoate and ascorbic acid as ingredients

Health Effects of Benzene

Acute exposure to high concentrations of benzene primarily affects the central nervous system in humans. Benzene can cause chromosomal changes in humans. Long-term exposure to benzene can lead to cancer of the blood-forming organs. Based on available inhalation data in occupationally exposed workers and supported by evidence in animal studies, the International Agency for Research on Cancer considers benzene to be carcinogenic to human (Group 1). The World Health Organization (WHO) has not established any tolerable intake level for benzene.

Benzene Levels in Soft Drinks

Surveys conducted by various overseas food authorities showed that the levels of benzene found in soft drinks were generally less than the WHO guideline value of 10μg/L of benzene established for drinking water.

In countries such as the U.K. and U.S where beverages containing benzene levels above the drinking water guidelines for benzene established by the WHO or benzene standards set by their own country, the trade have voluntarily withdrawn the products from markets and/or reformulated them to reduce the benzene level.

Many food authorities such as the U.S. Food and Drug Administration, U.K. Food Standards Agency and Food Standards Australia New Zealand are of the view that exposure to low levels of benzene from soft drinks does not raise any public health concerns. In 2009, the Codex Committee on Contaminants in Foods also noted that benzene in soft drinks was not a major contributor to overall benzene exposure of the population and there were various trade guidance available, in particular the "Guidance Document to Mitigate the Potential for Benzene Formation in Beverages" developed by the International Council of Beverages Associations, to limit the formation of benzene in soft drinks.

Key Points to Note

- Benzene may be formed in soft drinks containing both benzoic acid or its salts and ascorbic acid (vitamin C).
- Exposure to low levels of benzene from soft drinks does not raise any public health concerns.
- Food only contributes minor amounts to a population's daily benzene exposure.

Exposure to Benzene

The principal route of daily exposure to benzene in the general population is through the inhalation of ambient air. Food only contributes minor amounts to a population's daily benzene exposure, with the intake estimated to be less than 2% of that from inhalation. For smokers, it is likely that cigarettes contribute significantly to their total daily exposure of benzene. (Table 1)

Table 1. Estimated exposure to benzene through various sources (European Commission Joint Research Centre, 2005)

Source of exposure	Estimated exposure (μg/day)
Food products	0.2-3.1
Air: Inhalation exposure	220
Cigarette smoking (20 cigarettes)	7900

Local Situation

In the past three years, the Centre for Food Safety has taken some 20 samples of soft drinks for testing of benzene. All results were satisfactory.

Advice to Public

- Maintain a balanced diet to avoid excessive exposure to contaminants from a small range of food items.

Advice to Trade

- Ensure benzene levels in soft drinks as low as reasonably achievable by reviewing soft drinks formulations, testing them for benzene and reformulating any affected products where necessary. For details on ways to reduce the potential for benzene formation in soft drinks, please make reference to the industry guidance documents.

食物安全平台
Food Safety Platform

基因改造食物：致敏性與安全評估
Genetically Modified Food – Allergenicity and Safety Assessment

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,
Risk Assessment Section,
Centre for Food Safety

繼上月基因改造食物概論之後，今期將會探討衍生自基因工程的農作物的潛在致敏性與安全評估。

基因改造農作物的致敏性

致敏性指某物質成為致敏原並引發過敏免疫反應的能力。差不多所有食物致敏原都是蛋白質。這些致敏的蛋白質通常較小、耐熱、耐酸，並能抵受胃部的酶解過程。雖然作為主要糧食的農作物均含有數以萬計的不同蛋白質，但當中只有很少會引致過敏。不過，利用基因工程改變農作物的基因構造，可能會改變其致敏性。

轉基因如來自已知會引起過敏的來源，致敏蛋白質便可能會引進到新研發的基因改造農作物內。眾所周知的例子是科研人員在實驗階段中發現一種基因改造大豆被植入巴西果仁(一種已知會引致過敏的食物)內蛋氨酸含量豐富的蛋白質的基因後，會導致對這種果仁敏感的病人產生過敏反應。結果，他們停止對這種基因改造大豆作進一步研發，而有關大豆亦從沒有在市場上出售。為防止致敏原引進到基因改造農作物內，有關當局並不鼓勵轉移通常會引致過敏的食物基因。

由於基因工程中會出現意外影響，轉移通常不會引致過敏的食物基因亦可引致過敏反應。“意外影響”指在既定改變以外的影響，而這些影響可能在基因序列隨機植入植物基因組內的過程中發生。被植入基因可能會改變內源基因的表達，令特定蛋白質出現過量或不足的表達。如寄主植物含有已知的致敏蛋白質，加入新的基因會增強致敏原的表達，植物可能會更容易引起過敏(圖1A)。此外，植入基因序列亦可產生令個別易受影響人士過敏的其他新的蛋白質(圖1B)。

After introducing the basics on genetically modified (GM) food last month, we are going to discuss, in this issue, the potential allergenicity and safety assessment of crops derived from genetic engineering.

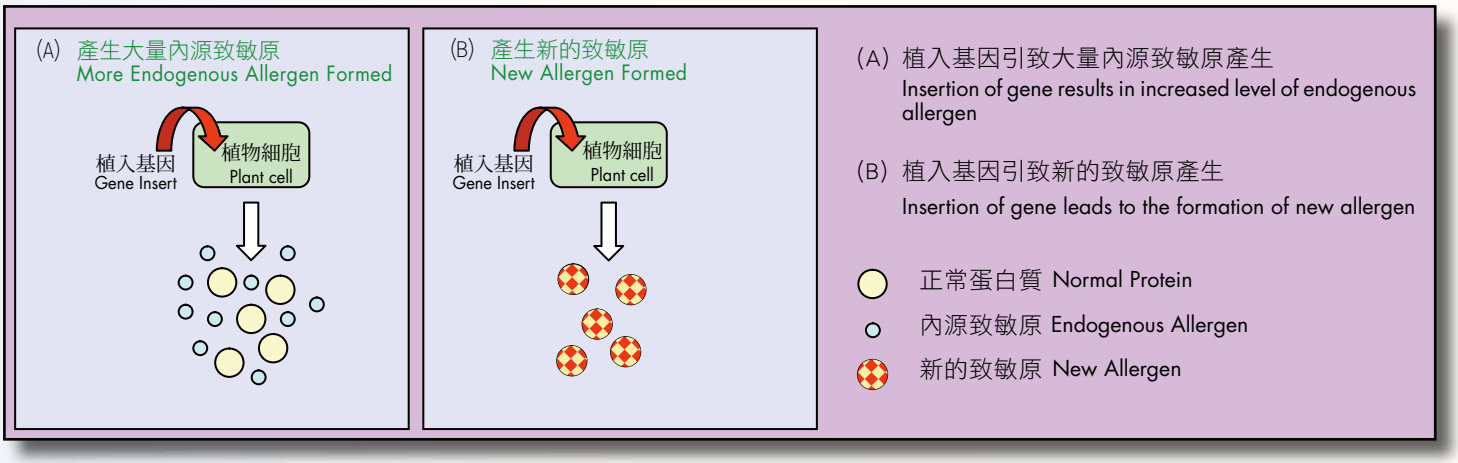
Allergenicity of GM Crops

Allergenicity is the capacity to be an allergen that elicits a hypersensitive immune reaction. Almost all food allergens are proteins and the allergy-causing proteins tend to be relatively small, and resistant to heat, acid, and stomach enzyme degradation. While the crops used as staple foods contain tens of thousands of different proteins, relatively few are allergenic. However, the use of genetic engineering to modify the genetic make-up of crop plants might alter their allergenic potential.

Allergenic proteins may be introduced into newly developed GM crops if the transgene is from a source known to be allergenic. A well-known example is an experimental GM soyabean engineered to contain a Brazil nut (a known allergenic food) methionine-rich protein was found to cause allergic reaction in patients sensitive to this nut. As a result, the GM soyabean was withdrawn from further development and has never been marketed. As a measure to prevent the introduction of allergen to GM crops, the transfer of genes from commonly allergenic foods is discouraged.

Due to the occurrence of unintended effects during the process of genetic engineering, transfer of genes from foods that are not commonly known to cause allergies can have the potential to cause allergic reaction. “Unintended effects” are the effects which go beyond that of the original modification and may arise through the random insertion of DNA sequence into the plant genome. The gene insert may cause modification in the expression of endogenous genes leading to either over-expression or under-expression of specific proteins. If the host plant contains known allergenic proteins, adding a new gene into it could increase the expression of the allergens and the plant may become more allergenic (Figure 1A). It is also possible that the insertion of the DNA sequence creates additional new proteins that are allergenic to susceptible individuals (Figure 1B).

圖1：可能出現的意外致敏影響
Figure 1: Possible unintended allergenic effects



基因改造食物的安全評估

除了致敏性外，基因改造亦可改變轉基因植物的毒性和化學成分。鑑於基因改造可造成預期和非預期的改變，食品法典委員會已就衍生自基因改造生物的食物制定具體的安全評估指引。

根據評估制度，有關當局會評估對健康造成影響的因素，例如基因產品可能出現的毒性及致敏性；新的基因改造農作物的主要成分、不同代謝物的水平和營養方面的影響；並與傳統食物作出比較。如在比較後發現兩者並無顯著分別，新研製的基因改造農作物可視為與傳統食物同樣安全，否則有關當局會再進行評估和動物實驗，以評估有關分別造成的食物安全影響。

Safety Assessment of GM Food

Besides allergenicity, genetic modification might also alter the toxicity and chemical composition of a transgenic plant. Taking into account both intended and unintended changes that may occur due to genetic modification, the Codex Alimentarius Commission (Codex) has set out specific guidelines for safety assessment of food derived from GM organisms.

Under the assessment scheme, factors of health concerns such as the possible toxicity and allergenicity of the gene product, composition of key components, levels of various metabolites and the nutritional impact of the new GM crop will be evaluated and compared to the conventional counterpart. If no major difference is identified from the comparison, the newly constructed GM crop may be considered as safe as its conventional counterpart, or else, the impact on food safety attributable to the differences identified will be evaluated by additional assessment and animal studies.

許多國際機關認為，上述比較分析是進行基因改造食物安全評估的最適當方法。生產基因改造食物國家的有關當局已採用這種比較模式，並據此設立有系統的銷售前安全評估制度，評估衍生自基因工程的食物的安全性。任何新研發的基因改造食物必須經過有關評估，才獲准推出市場銷售。如評估發現有潛在危害，有關的農作物絕不會推出供人食用。目前在國際市場上銷售的基因改造食物均經過安全評估，可供人安全食用。

This comparative analysis is regarded by many international authorities as the most appropriate strategy for safety assessment of GM food. National authorities of GM food producing countries have adopted the comparative approach and based on which to establish structured pre-market safety assessment scheme to evaluate the safety of food derived from genetic engineering. Any newly developed GM food should have undergone such assessment before approval for market sale. In case where potential hazard is identified from the assessment, the crop under evaluation should never be released for human consumption. GM food available in the international market has undergone safety assessment evaluation and is safe for human consumption.

獲准用於製造食物的基因改造農作物例子 **Examples of GM crops approved for food use**

基因改造農作物 **GM Crops**	可能應用範圍 **Potential Uses**
大豆 Soyabean	豆類飲品，豆腐，豆油，豆粉和用來製造麵包、餡餅及食用油等 Soy beverages, tofu, soy oil, soy flour, and as ingredients in breads, pastries and edible oil, etc
粟米 Corn	粟米油，粟米粉，糖或糖漿和用來製造零食、烘焙食物、糖果糕點及汽水等 Corn oil, corn flour, sugar or syrup, and as ingredients in snacks, bakery, confectionery and soft drink, etc
番茄 Tomato	番茄醬和番茄汁 Tomato puree, tomato juice
馬鈴薯 Potato	薯片、薯蓉、薯仔湯及澱粉 Potato chips, mashed potato, potato soup, starch
木瓜 Papaya	木瓜湯及甜品 Papaya soup and desserts
南瓜 Squash	南瓜湯及甜品 Squash soup and desserts
稻米 Rice	主要糧食、米粉及麪 Staple food, rice flour and noodle

食物事故點滴 Food Incident Highlight

食物中的蘇丹紅

五月，英國發現由巴基斯坦進口的混合調味料含有蘇丹紅一號這種非准許染料。

蘇丹紅一號是蘇丹紅的其中一種，而蘇丹紅屬於工業用人造化學染料，不得用來製造食物。有些研究指，這些染料可令實驗動物患癌，但現時並無足夠證據確定可令人類患癌。外地曾發現有人在混合調味料及辣椒製品中非法使用蘇丹紅。除了上述食品外，有關家禽飼料中濫用蘇丹紅以增加蛋黃顏色一事，亦曾引起本港市民的關注。

食物安全中心在上月公布有關蛋類及蛋類製品中的蘇丹紅專項食品調查結果，200個樣本全部合格。消費者應向可靠的零售商購買食物。

Sudan Dyes in Food

In May, Sudan I, a non-permitted colour, was found in spice mix imported into the United Kingdom from Pakistan.

Sudan I is one of the Sudan red dyes, which are synthetic chemical dyes for industrial use and are not permitted for food use. Some studies indicate these dyes may cause cancer in experimental animals; however, current evidence is inadequate to conclude they can cause cancer in humans. Illegal use of Sudan dyes are found in spice mix and chilli products overseas. Other than these products, abuse of Sudan dyes in poultry feeds to enhance the colour of egg yolks has also caused local concern.

Last month, the Centre for Food Safety released the results of a targeted food surveillance on Sudan dyes in 200 eggs and egg products. All results were satisfactory. Consumers are advised to purchase food from reliable retailers.

魚翅中的甲基汞

六月，台灣驗出一批由印尼進口的冷凍魚翅含有過量甲基汞。

甲基汞是魚類透過食物鏈天然積存在體內的有機汞，體型較大的捕獵魚類的甲基汞含量通常較高。甲基汞可影響神經系統，尤其是對發育中的胎兒。過去三年，經食物安全中心測試的所有魚翅樣本，其汞含量全部合格，但部分捕獵魚類(例如金目鯛、銀鱈魚、青衣、劍魚、大西洋胸棘鯛(俗稱金獅魚))的汞含量則超出標準。

為取得吃魚的最大效益，市民應適量進食各種魚類，切勿偏吃。孕婦、計劃懷孕的婦女及幼童較易受甲基汞影響，因此避免進食汞含量可能較高的魚類會減低風險。

Methylmercury in Shark Fins

In June, excessive methylmercury was detected in a batch of frozen shark fins imported to Taiwan from Indonesia.

Methylmercury is the organic form of mercury naturally accumulates in fish through the food chain, often at higher levels in large predatory fish. It has the potential to affect the nervous system particularly in the developing foetus. In the past three years, mercury levels in all shark fin samples tested by the Centre for Food Safety were satisfactory, while excessive levels had been found in some predatory fish such as alfonsino, black cod, ling, swordfish and orange roughy.

To get the most benefits from eating fish, the public are advised to consume a variety of fish in moderation and avoid overindulgence. Pregnant women, women planning pregnancy and young children are more sensitive to the adverse effects, thus avoiding consumption of the types of fish which may contain high levels of mercury would reduce the risk.

風險傳達工作一覽 Summary of Risk Communication Work

風險傳達工作一覽（二零零九年六月） Summary of Risk Communication Work (June 2009)	數目 Number
事故/食物安全個案 Incidents / Food Safety Cases	57
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