食物安全焦點
Food Safety Focus

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食物環境衞生署 Food and Environmental Hygiene Department

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食物中的硝酸鹽
Nitrate in Food

食物安全中心 風險評估組 科學主任邱頌韻女士報告

Reported by Miss Joan YAU, Scientific Officer, Risk Assessment Section, Centre for Food Safety

今年七月六日，本港傳媒報道，一名九個月大的男嬰在進食莧菜粥後皮膚轉為藍色。他證實患上“藍嬰綜合症”，即嬰孩患上正鐵血紅蛋白血症。正鐵血紅蛋白血症是一種罕見的情況，會令血液中的血紅蛋白因氧化而未能把氧氣帶到各身體組織。有關的粥後來證實含有大量的硝酸鹽，在嬰孩體內可以轉化作亞硝酸鹽，可引致正鐵血紅蛋白血症。

On 6 July 2008, the local media reported an incident that the skin of a nine-month-old baby boy turned blue after consumption of congee containing Chinese spinach. He was confirmed to suffer from Blue Baby Syndrome – the form of methaemoglobinaemia in the infancy. Methaemglobinaemia is a rare condition under which haemoglobin in the blood has been oxidised to methaemglobin and is unable to carry oxygen to the body tissues. It is later confirmed that the congee had high content of nitrate which could well be converted to nitrite in the infant causing the methaemoglobinaemia.

硝酸鹽是什麼和食物內為何會有硝酸鹽？

硝酸鹽存在於環境四周、空氣、食物（特別是蔬菜和水果）及水，並可於生物體內製造。硝酸鹽可作食物添加劑之用，主要用於乳酪製品和醃製肉類（例如臘腸、火腿）的防腐劑。

硝酸鹽含量較高的蔬菜例子：(由左上角起順時針方向)菠菜、甜菜根、白蘿蔔及莧菜

Examples of vegetables that have been reported containing higher levels of nitrate: (clockwise from top left) spinach, beetroot, white radish and amaranth

不同種類的蔬菜，其硝酸鹽含量均有很大的差別，而種植環境（季節、光線強度、溫度、種植方法、肥料使用等）、貯存（時間、溫度等，因為將硝酸鹽轉化為毒性較高代謝物亞硝酸鹽的酵素作用及細菌活動在低溫貯存時會減低）及加工程序（清洗、去皮、焯、烹煮等）亦會影響硝酸鹽含量的多寡。據資料顯示，硝酸鹽的含量介乎最低每公斤1毫克（例如豌豆）至最高每公斤超過4 000毫克（例如芝麻菜）不等，而有些蔬菜（例如葉菜）的硝酸鹽含量則處於高水平。

人類主要通過進食蔬菜攝入硝酸鹽，而較少從水或其他食物（醃製肉類）攝入硝酸鹽。

What is Nitrate and Why is it Present in Food?

Nitrate occurs in the environment, in air, food (particularly in vegetables and fruits) and water, and is produced inside living organisms. It can also be used as a food additive, mainly as preservative in cheese products and cured meat (e.g. preserved sausage and ham).

The level of nitrates in vegetables varies greatly among species and can also be affected by growing conditions (seasons, light, temperature, growth method, fertilizer use etc.), storage (time and temperature etc., as enzymatic reaction and bacterial activity that lead to conversion of nitrate to nitrite, which is a more toxic metabolite, are inactivated under cold storage) as well as processing (washing, peeling, blanching, boiling etc.). Levels reported ranged from a low of 1 mg/kg (e.g. peas) to a high of over 4 000 mg/kg (e.g. rucola). Higher levels of nitrate have been consistently reported in certain vegetables such as leafy vegetables.

Human exposure to nitrate is mainly through the consumption of vegetables, and to a lesser extent water and other foods (such as cured meat).

硝酸鹽含量較高的蔬菜例子

Examples of vegetables that have been reported containing higher levels of nitrate

食物 Food	每千克含量(毫克) Reported Level (mg/kg) 歐洲 [a] Europe [a]	每千克含量(毫克) Reported Level (mg/kg) 中國北京 [b,c] Beijing, China [b,c]
菠菜 Spinach	64 ~ 3 048	1 388 ~ 5 214
甜菜根 Beetroot	110 ~ 3 670	-
白蘿蔔 White radish	135 ~ 3 488	1 105 ~ 3 721
莧菜 Amaranth	439 ~ 3 483	-

焦點個案
Incident in Focus

硝酸鹽可能會對健康造成哪些影響？

硝酸鹽本身可說是沒有毒性的，但其代謝物（例如亞硝酸鹽）卻因為對健康有害，例如可導致正鐵血紅蛋白血症和癌症，所以備受關注。

硝酸鹽在人體內可轉化成亞硝酸鹽，引致正鐵血紅蛋白血症，而患者的皮膚會呈青紫色。一些人口組別（例如不足四至六個月的初生嬰兒）及患有葡萄糖六磷酸去氫酵素缺乏症的人較易出現上述症狀。不過，食物中的硝酸鹽含量對一般成人來說是可以安全食用的。聯合國糧食及農業組織／世界衛生組織聯合食物添加劑專家委員會（下稱“專家委員會”）在二零零二年表示對人類攝入大量硝酸鹽可能引致正鐵血紅蛋白血症的研究證據仍待確定。

世界衛生組織轄下的國際癌症研究機構曾評估攝入硝酸鹽和亞硝酸鹽的致癌性，認為從食物中攝入的硝酸鹽或亞硝酸鹽如產生內生性硝化作用，即轉化為亞硝基化合物（如亞硝胺），可令實驗動物患癌，但表示只有有限或不充分的證據證明食物內的硝酸鹽或亞硝酸鹽可令人類和動物患癌。此外，歐洲食物安全局根據所得的證據進行評估，結論是從膳食或食水攝入硝酸鹽不會增加人類患癌的風險。

專家委員會曾評估硝酸鹽的安全性，並把安全參考值（即每日可攝入量）定為每公斤體重0至5毫克（以硝酸鈉計算），或每公斤體重0至3.7毫克（以硝酸鹽離子計算）。

怎樣才是高效益低風險的吃菜之道？

蔬菜提供膳食纖維、維他命和礦物質，對人體營養十分重要，並公認有助預防癌症和其他慢性疾病。在二零零八年，歐洲食物安全局衡量從蔬菜攝入硝酸鹽的風險和好處，結論是“整體來說，由於從蔬菜攝入硝酸鹽相信不會對健康帶來可見的風險，因此公認進食蔬菜帶來的好處應大大高於從蔬菜攝入硝酸鹽的風險。”市民應保持均衡飲食，進食多種蔬果（即交替進食葉菜類蔬菜、果菜類蔬菜、根莖類蔬菜、花莖/葉球甘藍類蔬菜等），避免偏吃少種類食物。

六個月或以下的嬰兒最容易受正鐵血紅蛋白血症影響，故應避免進食硝酸鹽含量偏高的蔬菜（例如菠菜、甜菜）及使用了硝酸鹽作為食物添加劑的加工食物（例如乳酪、醃製肉類）。

給公眾的建議

1. 保持均衡飲食，切勿偏食。
2. 為減少從進食蔬菜攝入硝酸鹽對健康所帶來的風險，市民可：
   - 把蔬菜存放在雪櫃內；
   - 烹煮前，先把蔬菜清洗、剝皮、去梗或焯水（視乎情況而定）；以及
   - 蔬菜在切開或磨碎後，應盡早烹煮。

給業界的建議

1. 耕種者應遵從優良務農規範（例如正確使用肥料），以期盡量減低蔬菜中的硝酸鹽濃度。
2. 向可靠來源採購食品。
3. 遵從有關使用和標示食物添加劑的法定規定。

硝酸鹽含量較低的蔬菜例子
Examples of vegetables that have been reported containing lower levels of nitrate

食物 Food	每千克含量(毫克) Reported Level (mg/kg) 歐洲 [a] Europe [a]	每千克含量(毫克) Reported Level (mg/kg) 中國北京 [b,c] Beijing, China [b,c]
豌豆 Peas	1 ~ 100	-
番茄 Tomato	1 ~ 144	12 ~ 72
椰菜花 Cauliflower	7 ~ 390	164 ~ 854
青瓜/黃瓜 Cucumber	22 ~ 409	56 ~ 570
茄子 Eggplant	29 ~ 572	169 ~ 643
西蘭花 Broccoli	16 ~ 758	-

a 歐洲食物安全局 EFSA
b 《中國食品衛生雜誌》(2006)所載北京市春季蔬菜硝酸鹽含量測定及居民暴露量評估[18(6)：514–516]
Based on the article by FENG J. et. al. Assessment of nitrate exposure in Beijing residents via consumption of vegetables. Chinese Journal of Food Hygiene (2006) 18(6): 514-516. [Article in Chinese]
c 有關數字調整至整數。 The figures have been rounded to the nearest whole number.

What are the Possible Health Implications due to Nitrate?

Nitrate itself is relatively non-toxic, but its metabolites such as nitrite have raised concern because of implications for adverse health effects such as methaemoglobinaemia and cancers.

Nitrate in the body can be converted to nitrite, which can cause methaemoglobinaemia and the person develops cyanosis as a result. Population subgroups such as young infants (i.e. less than 4-6 months of age) and people with glucose-6-phosphate dehydrogenase (G6PD) deficiency are more susceptible to the above condition. However, the content of nitrate in food is generally safe for adult consumption. The Joint Food and Agriculture Organization (FAO) / World Health Organization (WHO) Expert Committee on Food Additives (JECFA) in 2002 considered the evidence on the potential of a high nitrate intake to cause methaemoglobinaemia from human studies equivocal.

The International Agency for Research on Cancer (IARC) of WHO has evaluated the carcinogenicity of ingested nitrate and nitrite and considered that ingested nitrate or nitrite under conditions that result in endogenous nitrosation (i.e. conversion into nitroso compounds such as nitrosamines) can cause cancer in experimental animals, but nitrate and nitrite themselves in food have limited or inadequate evidence to cause cancers in humans and animals. In addition, the European Food Safety Authority (EFSA) concluded from the available evidence that nitrate intake from diet or drinking water is not associated with increased cancer risk in humans.

JECFA has evaluated the safety of nitrate and allocated a safety reference value (i.e. acceptable daily intake) of 0-5 mg per kg body weight (bw), expressed as sodium nitrate, or 0-3.7 mg/kg bw, expressed as nitrate ion.

How to Eat Vegetables with Maximum Benefits and Minimum Risks?

Vegetables are important to human nutrition as a source of dietary fibre, vitamins and minerals and their beneficial effects in protecting against cancers and other chronic diseases are well recognized. EFSA compared the risks and benefits of exposure to nitrate from vegetables in 2008 and concluded that "overall, the estimated exposures to nitrate from vegetables are unlikely to result in appreciable health risks, therefore the recognised beneficial effects of consumption of vegetables prevail". The public are advised to maintain a balanced diet and eat a variety of fruits and vegetables (i.e. leafy vegetables, fruiting vegetables, root vegetables, flowering/head brassicas etc. on different days) in order to avoid excessive exposure to chemicals from a small range of food.

Babies below 6 months of age are most vulnerable to methaemoglobinaemia and should avoid vegetables of high nitrate content (e.g. spinach, beets) and processed food with nitrates added as food additives (e.g. cheese, cured meats).

Advice to the Public

1. Maintain a balanced diet. Avoid overindulgence of food items.
2. To reduce the health risk of nitrate due to consumption of vegetables, members of the public can –
   - keep the vegetables under refrigeration;
   - wash, peel, remove the stem, blanch the vegetables before cooking, when appropriate; and
   - cook vegetables soon after cutting or mashing.

Advice to the Trade

1. Farmers are advised to observe good agricultural practice (GAP) (e.g. proper use of fertilizer) with an aim to minimize nitrate concentrations in vegetables.
2. Obtain food products from reliable sources.
3. Follow the regulatory requirements regarding the use and labelling of food additives.

食物安全平台
Food Safety Platform

食物中的生物危害：致病細菌（下篇）
Biological Hazard in Food – Pathogenic Bacteria (Part II)

食物安全中心
風險評估組
科學主任莊梓傑博士報告

Reported by Dr. Ken Chong, Scientific Officer,
Risk Assessment Section,
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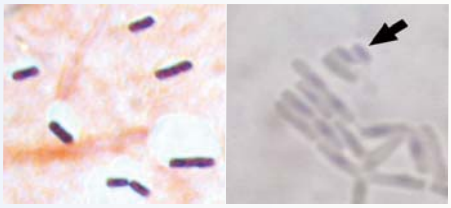
我們在上一期介紹了食物中的腐敗細菌和致病細菌，又概述了致病細菌產生毒素的不同方式，今期將會繼續探討致病細菌。

除了毒素這種武器外，有些致病細菌會有保護層，令其可熬過烹煮過程。細菌可透過具有生長和繁殖能力的繁殖體形式生存。此外，有一小部分還可以孢子的形式存在，雖然這種形式的細菌無法生長或繁殖，但卻能讓其在不利生長的環境下存活。

即食食物中能夠產生孢子的致病細菌

蠟樣芽孢桿菌和產氣莢膜梭狀芽孢桿菌都是可透過孢子形式或繁殖體形式存在的致病細菌，其孢子有一層厚壁保護着，能夠抵受熱力，故這兩種致病細菌都能抵受烹煮過程所產生的熱力。烹煮的熱力不但能誘發孢子發芽，成為繁殖細胞，還會殺死其他不耐熱的細菌，減少環境中與繁殖細胞競爭生長的其他細菌。食物如在烹煮後長時間不當地存放在中等溫度的情況下（例如室溫），便可讓繁殖細胞大量生長，因此，我們要避免長時間把已煮熟的食物冷卻，應立即把已冷卻的食物存放在攝氏4度或以下的雪櫃內。



芽孢桿菌的繁殖細胞(左)和孢子(右，箭咀下)(照片來源：香港大學微生物學系黃世賢醫生)
Vegetative cells (left) and spores (right, under the arrow) of *Bacillus* spp. (Photo: Dr. Samson S.Y. Wong, Department of Microbiology, University of Hong Kong)

有些人可能會認為，翻熱過程既然能夠殺死繁殖細胞，只要在進食前徹底翻熱食物，長時間把食物冷卻和貯存在室溫下的問題就不大。這種說法有部分正確，但卻存在漏洞。讀者可能還記得，我們在上一期曾說過蠟樣芽孢桿菌可產生耐熱的毒素，而這些毒素是不能透過烹煮過程去消滅。

即食食物中不能產生孢子的致病細菌：本港食物中毒事故的主因

雖然產生孢子的致病細菌難以消滅，但二零零六年本港食物中毒事故中最主要致病媒介卻是副溶血性弧菌、沙門氏菌和金黃葡萄球菌，而這些都是屬於不能產生孢子的致病細菌。讀者不禁會問原因何在呢?

就引致食源性疾病而言，可能有其他因素比致病細菌能夠產生孢子的能力更為重要。副溶血性弧菌天然存在於海水中，常與生或未經徹底煮熟的海鮮和受污染的已煮熟食物有關。進食來自不合衞生來源的海鮮可能是副溶血性弧菌感染個案經常發生的原因之一。沙門氏菌可於肉類、家禽和沾染了受污染的水的新鮮農作物中發現。沒有徹底煮熟食物和在貯存或配製期間與其他食物交叉感染均可引致沙門氏菌感染。人類是金黃葡萄球菌的常見宿主。食物會透過直接接觸或間接經皮屑或呼吸道飛沫等途徑受污染，尤其是在個人衞生不佳的情況下。此外，把食物貯存在不當溫度亦會令上述細菌大量繁殖。由此可見，大部分問題都是由不當或不合衞生的食物處理程序所引致的。

致病細菌 Pathogenic bacteria	生長溫度範圍* Growth Temperature Range*
李斯特菌 *Listeria monocytogenes*	0 – 45°C (37°C)
沙門氏菌 *Salmonella* spp.	6.5 – 47°C (35 – 37°C)
金黃葡萄球菌 *Staphylococcus aureus*	7 – 45°C (37°C)
蠟樣芽孢桿菌(繁殖體形式) *Bacillus cereus* (vegetative form)	10 – 49°C (30 – 37°C)
產氣莢膜梭狀芽孢桿菌(繁殖體形式) *Clostridium perfringens* (vegetative form)	10 – 52°C (43 – 47°C)
副溶血性弧菌 *Vibrio parahaemolyticus*	12.8 – 40°C (37°C)

* 括號內為最佳生長溫度 Optimal growth temperatures are shown in brackets

資料來源：美國食物及藥物管理局編製的《惡菌書》(Bad Bug Book)及新西蘭食物安全局編製的微生物病菌資料單(Microbial Pathogen & Data Sheets)。
Source: Bad Bug Book from the US FDA and Microbial Pathogen & Data Sheets from the New Zealand Food Safety Authority

In the last issue, we presented spoilage and pathogenic bacteria in food as well as various ways of toxin production by pathogenic bacteria. We would continue to discuss pathogenic bacteria in this issue.

Apart from the weapon – toxins, some pathogenic bacteria have a shield to help them survive the cooking process. Bacteria can live in a vegetative state in which they can grow and reproduce. Few of them can also exist in spore form which is unable to grow or reproduce but can help the bacteria to survive in an environment that is unfavourable for growth.

Spore-Forming Pathogenic Bacteria in Ready-to-Eat Food

Bacillus cereus and *Clostridium perfringens* are examples of pathogenic bacteria that can exist in both spore and vegetative forms. The thick-walled structure of the spore is resistant to heat and it can help the pathogenic bacteria survive the heat of cooking. The heat of cooking not only activates the germination of spores to become vegetative cells, but can also kill other bacteria that are not heat-resistant resulting in an environment short of competitors for the vegetative cells to grow. Foods, which are improperly left at a moderate temperature (e.g. room temperature) for a long time after cooking, allow the growth of large amount of vegetative cells. Therefore, we should avoid prolonged cooling of cooked food and immediately store cooled food at 4°C or below.

Some people may think that prolonged cooling and storage at room temperature is not a problem if the food products are reheated thoroughly before consumption, since reheating kills the vegetative cells. This is partially true, but there is a catch. You may recall from the last issue that *Bacillus cereus* can also produce heat-resistant toxin which cannot be destroyed by cooking process.

Non-Spore-Forming Pathogenic Bacteria in Ready-to-eat Food – Common Cause of Food Poisoning in Hong Kong

Although spore-forming pathogenic bacteria are difficult to wipe out, locally the most common food poisoning causative agents in 2006 were found to be *Vibrio parahaemolyticus*, *Salmonella* species, and *Staphylococcus aureus*, all of them are not spore-forming pathogenic bacteria. You may wonder why it is so.

Some other factors may be more important than the spore-forming ability of the pathogenic bacteria in causing foodborne diseases. *Vibrio parahaemolyticus* can be found naturally in marine water, and commonly associated with raw or undercooked seafood products and cross-contaminated cooked food. Consumption of raw seafood from unhygienic sources may be one of the reasons to account for its high prevalence. *Salmonella* species can be found on meats and poultry as well as fresh produce tainted with contaminated water. Inadequate cooking and cross-contamination during storage or food preparation may result in salmonella infection. Humans are the common reservoir for *Staphylococcus aureus*. Contamination of food, especially in case of poor personal hygiene, can occur by direct contact, indirectly by skin fragments, or through respiratory tract droplets. In addition, storage of foods at improper temperature can help all these bacteria to grow to large number. You can see that most of the problems are due to improper or unhygienic handling of foods.

食物事故點滴
Food Incident Highlight

貯存和烹煮的溫度

不論細菌能否產生孢子，避免把有潛在危險的食物貯存在危險溫度範圍(攝氏4至60度)可防止致病細菌生長。我們從前頁的表中可見大部分致病細菌都可在危險溫度範圍內生長。

雖然李斯特菌可在攝氏0度生存並繁殖，但此菌可透過正常烹煮殺死。我們必須避免即食食物在烹煮後受到污染，以及避免長時間貯存可能含有李斯特菌的未經烹煮的食物。

我們可利用不同的溫度和處理時間殺死不同的細菌。一般而言，把食物烹煮至中心溫度達攝氏75度，並保持至少30秒便能殺死大部分致病細菌（但以孢子形式生存的致病細菌除外）。

雖然引發食源性疾病的致病細菌的特性各有不同，但食物中毒的主要原因是人們不當或不合衞生的處理食物程序。大家只要多點留意有關處理食物的正確方法，就能輕易減低由細菌引致的食物中毒風險。

Temperature for Storage and Cooking

No matter whether the bacteria can form spore or not, storage of potentially hazardous food outside the danger zone (4 to 60°C) can prevent the growth of the pathogenic bacteria. You can find from the table in the previous page that most pathogenic bacteria can grow at danger zone temperature.

Although *Listeria monocytogenes* can survive and multiply at 0°C, it can be destroyed by normal cooking. It is important to avoid post-cooking contamination of ready-to-eat food and prolonged storage of raw foods that may contain this bacterium.

Bacteria are destroyed under different temperature/time combination. In general, cooking food to an internal temperature of 75°C for at least 30 seconds can kill most of the pathogenic bacteria (but not the spore form).

Different characteristics of pathogenic bacteria may aid in causing foodborne disease, but the primary causes of food poisoning are improper or unhygienic handling of foods by humans. More emphasis on the proper food handling practices can readily reduce risk of bacterial food poisoning.

痲痺性貝類毒素與美洲龍蝦消化腺

近日，美國食物及藥物管理局警告消費者切勿進食美洲龍蝦的消化腺，因為消化腺可能受到污染，含有大量可引致痲痺性貝類中毒的毒素。有關建議只限於龍蝦消化腺，即在龍蝦體腔內作為肝臟和胰臟的綠色軟組織。至於龍蝦肉，則可供安全食用。烹煮不能消除痲痺性貝類毒素。

痲痺性貝類中毒的症狀包括口部、面部或頸部刺痛及／或痲痺；肌肉無力；頭痛及噁心，嚴重病例可引致呼吸衰竭和死亡。這些症狀一般會在攝入毒素後的兩小時內出現。


美洲龍蝦的消化腺(箭咀所指)
Tomalley (under the arrow) of American lobster

食物安全中心已透過快速警報系統通知業界此事。為預防痲痺性貝類中毒，市民應在烹煮前先除去貝類的內臟和生殖器。兒童、長期病患者和長者可能較易出現中毒症狀，應小心進食貝類。如進食貝類後出現症狀，應立即求醫。

沙門氏菌與辣椒

我們在上一期報道，美國因番茄可能受聖保羅沙門氏菌污染而採取回收行動。其後，美國食物及藥物管理局把調查焦點由番茄轉移至產自墨西哥的jalapeño辣椒及serrano辣椒。該局現警告公眾切勿進食任何加入了在墨西哥生長或包裝的生jalapeño辣椒及生serrano辣椒的食物。該局在某墨西哥農場的一個灌溉水樣本和一個辣椒樣本中驗出聖保羅沙門氏菌，即與美國沙門氏菌感染個案屬於相同基因指紋的品種。該局已撤銷針對番茄的警告，因為現時美國市面上的番茄與這次沙門氏菌感染事件無關。

在本港，食物安全中心已聯絡美國和墨西哥有關當局，以便取得更多資料，並已通知業界有關事件。中心現正密切留意有關情況。

Paralytic Shellfish Poisoning Toxins and American Lobster Tomalley

Recently, the United States Food and Drug Administration warned consumers to avoid eating tomalley in American lobster because of potential contamination with high levels of the toxins that cause Paralytic Shellfish Poisoning (PSP). The advisory applies only to tomalley, the soft, green paste-like substance found in the body cavity of the lobster that functions as the liver and pancreas. The lobster meat is, however, safe to eat. Cooking does not eliminate the PSP toxins.

Symptoms of PSP include tingling and/or numbness of the mouth, face or neck; muscle weakness; headache; and nausea. In extreme cases, it may lead to respiratory failure and death. Symptoms usually occur within two hours of exposure to the toxin.

The Centre for Food Safety has brought this issue to the trade's notice through the rapid alert system. To avoid PSP, the viscera and gonads of shellfish should be removed before cooking. Children, patients with chronic illness and the elderly may be more susceptible to poisoning and should be cautious in consuming shellfish. When symptoms occur after consuming shellfish, seek medical advice immediately.

Salmonella and Hot Peppers

Further to the recall of tomatoes because of possible *Salmonella* Saintpaul contamination in the United States (US) reported in the last issue, the US Food and Drugs Administration (FDA) has shifted its focus of investigation from tomatoes to jalapeño and serrano peppers from Mexico. The FDA now warns the public not to eat any food that contain *raw* jalapeño and *raw* serrano peppers that are grown or packed in Mexico. FDA found *Salmonella* Saintpaul in one sample of irrigation water and one sample of peppers in a Mexican farm that have the same genetic fingerprint as the ones found in the US outbreak. It has removed the warning on tomatoes as tomatoes currently available in the US market are not associated with the outbreak.

Locally, the Centre for Food Safety (CFS) has contacted relevant authorities of the US and Mexico for further information and alerted the trade on the issue. The CFS is closely monitoring the situation.


(由左至右) jalapeño辣椒及serrano辣椒(照片來源：美國食物及藥物管理局 Luis A. Solorzano)
(Left to right) jalapeño and serrano peppers (Photos: Luis A. Solorzano, US FDA)

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

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