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餸汁中的麻煩友： 產氣莢膜梭狀芽孢桿菌與食物中毒

The Troublemaker in Gravies: *Clostridium perfringens* and Food Poisoning

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,
Centre for Food Safety

背景

今年三月二十日，食物安全中心(中心)公布最新的食物監察計劃結果，當中一個咖哩雞飯樣本驗出產氣莢膜梭狀芽孢桿菌，含量為每克十萬個，較《即食食品微生物含量指引》中所訂的有關標準高出九倍。有關食肆出售的食品致病菌含量超標，對消費者健康構成風險，中心已向其發出警告。本文將會細探產氣莢膜梭狀芽孢桿菌這種致病菌。

產氣莢膜梭狀芽孢桿菌的特點

產氣莢膜梭狀芽孢桿菌廣泛分布於自然環境中，常見於人類和動物的腸道中，故此動物源性的食物和接觸到泥土、塵埃或排泄物的蔬菜多會含有此菌。產氣莢膜梭狀芽孢桿菌常存在於食物中，尤其是餸汁，每克含有少於一萬個這種細菌的食物通常不會令人患病。

產氣莢膜梭狀芽孢桿菌是能產生孢子的細菌，可以在不利的條件下(例如只有少量營養素的情況)產生耐熱的孢子。這種厭氧菌一般在無氧的環境中繁殖，但在低氧的環境中仍能生存一段時間。其最佳繁殖溫度偏高，大約是攝氏43度至45度，不過，此菌不能在攝氏12度以下的環境中繁殖。產氣莢膜梭狀芽孢桿菌在最佳的繁殖條件下每7.1分鐘即可增長一倍，大有可能是繁殖速度最高的食源性細菌。

孢子：孢子被一層厚壁保護着，有耐熱、耐冷和耐化學物特性，可在惡劣環境下生存。在惡劣環境下，孢子不會生長，但在適當的環境下，孢子會發芽和繁殖增長。

產氣莢膜梭狀芽孢桿菌食物中毒

由產氣莢膜梭狀芽孢桿菌引致的食物中毒，通常與未徹底煮熟的食物和已煮熟但放在不當溫度下貯存或長時間冷卻的食物有關。烹煮的熱力會誘發在低氧環境下(例如內腔、肉卷、釀入其他食材的家禽或餸汁內)存活的孢子發芽，繼而在該環境中繁殖。食物放在室溫下長時間冷卻可令此菌迅速繁殖。人們如吃下含有大量產氣莢膜梭狀芽孢桿菌的食物，便會有足夠的細菌數目經過胃

Background

On 20 March 2008, the Centre for Food Safety (CFS) released the latest food surveillance results. A sample of curry chicken with rice was detected with 100 000 per gram of *Clostridium perfringens* which was 10 times the relevant criterion stated in the Microbiological Guidelines for Ready-to-eat Food. The CFS has warned the food premise concerned for selling food product containing unacceptable level of pathogen which could pose risk to consumers' health. In this article, we shall focus on this particular pathogen.



咖哩雞飯

Curry chicken with rice

Features of *Clostridium perfringens*

Clostridium perfringens is widely distributed in the environment and frequently found in intestines of both humans and animals, hence is likely to be present in foods of animal origin and vegetables exposed to soil, dust or faecal material. The organism is not uncommonly found in food, particularly gravies. Food containing less than 10 000 organisms per gram does not usually cause illness.

The organism is a spore-forming bacterium, which is able to form heat resistant spores under unfavourable condition, e.g. limited nutrient availability. Although the bacterium is an anaerobe, which grows in the absence of oxygen, it can tolerate low oxygen level for some time. The organism is characterised by their high optimum growth temperature, around 43°C–45°C, but unable to grow at temperature lower than 12°C. It can double its number as fast as every 7.1 minutes under optimum growth conditions, probably with the fastest growth rate among all foodborne bacteria.

Spore: A spore is a thick-walled structure formed under adverse conditions. It is resistant to heat, cold and chemical and is capable of becoming a vegetative cell (growing cell) under favourable conditions.

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部後仍在體內存活，繼而再在腸道內產生孢子和毒素。因此，大量配製的食物(尤其是已煮熟的肉類和家禽)，以及在烹煮後放在室溫下長時間冷卻的食物，均屬高風險食物。

根據由美國食物及藥物管理局發出的資料，產氣莢膜梭狀芽孢桿菌數目須超過一億才會令人致病；換言之，人們須吃下約一公斤有關咖哩雞飯樣本(每克含有十萬個細胞)才會患病。不過，可令人致病的細菌數目亦視乎細菌菌株和個人的健康或其他狀況而定，更少的細菌數目亦可能令人致病。

產氣莢膜梭狀芽孢桿菌食物中毒：

- 症狀為劇烈腹痛和急性腹瀉
- 病發期通常為10至12小時
- 患者通常可於24至48小時內康復
- 部分人可能會持續出現輕微症狀
- 絕少引致致命疾病，但身體欠佳的人或長者會較易出現嚴重及持續症狀。

在二零零五年至二零零七年，衛生防護中心在本港分別接獲26宗、49宗和17宗產氣莢膜梭狀芽孢桿菌食物中毒呈報個案，受影響人數為280人、263人和72人，當中涉及的食物有牛肉、豬肉和雞肉。另一方面，根據以往食物監察計劃數據顯示，產氣莢膜梭狀芽孢桿菌含量超標的食物主要是混合食品、飯類和麪類、粥和點心。

給業界的建議

- 徹底煮熟食物，然後盡快供餐。如非即時食用，應把已煮熟的食物保持在攝氏60度或以上。
- 預先煮熟食物如需冷凍貯存，應在兩小時內把食物由攝氏60度冷卻至攝氏20度，然後放進冷凍櫃內，以便在其後四小時內把食物由攝氏20度冷卻至攝氏4度。
- 縮短已煮熟食物的冷卻時間，例如將食物分成較小份；放在較淺的容器內；以及／或把有食物的容器“冰鎮”(放在有冰塊的水中)。
- 徹底翻熱已煮熟的食物至中心溫度達攝氏75度或以上，又或把已煮熟食物再次煮滾。

給消費者的建議

- 避免將已煮熟食物放在室溫下超過兩小時。
- 棄掉吃剩的食物，又或把吃剩的食物妥善貯存在雪櫃內，而溫度應保持在攝氏4度或以下。
- 徹底翻熱吃剩的食物至中心溫度達攝氏75度或以上，又或把吃剩的食物再次煮滾。

注意要點：

1. 產氣莢膜梭狀芽孢桿菌是能產生孢子的細菌，在無氧的環境中繁殖。
2. 餸汁如長時間放在室溫下，有利產氣莢膜梭狀芽孢桿菌繁殖。
3. 預先煮熟或吃剩的食物在食用前應妥善貯存和翻熱。

Occurrence of Infection

Food poisoning caused by *Clostridium perfringens* is usually associated with inadequately cooked foods and cooked foods that are cooled for prolonged period or stored under sub-optimal temperature. Heat of cooking can activate the germination of spores which survive in anaerobic conditions like inside internal cavities, rolls of meat, stuffed poultry, or gravies. The organism can then multiply in the area where oxygen level is low; cooling of food at ambient temperature for a long period allows rapid multiplication of the bacterium. Intake of the food containing large number of the organisms allows sufficient amount to survive the passage through stomach, which subsequently form spores accompanied with toxin in the intestine. Hence, foods prepared in bulk, especially cooked meat and poultry dishes, and stored at ambient temperatures with a long cooling period after cooking are at high risk.

Infective dose (number of organisms required to make individuals ill) of *Clostridium perfringens* has been suggested by U.S. Food and Drug Administration to be more than 100 million cells, which means taking around 1 kilogram of the sample of rice with curry chicken (100 000 cells per gram) could cause illness. However, infective dose also depends on the strains of organism and the individual's health and other conditions. Lower dosage may also cause illness.

***Clostridium perfringens* food poisoning:**

- Symptoms: Intense abdominal pain and acute diarrhoea
- Usual onset time is 10–12 hours
- Recovery is usually within 24–48 hours
- Less severe symptoms may persist in some individuals
- Fatal diseases are rare, but prolonged and severe symptoms are more likely to appear in debilitated or elderly persons.

In Hong Kong, from 2005 to 2007, there were 26, 49 and 17 food poisoning outbreaks reported to the Centre for Health Protection which were associated with *Clostridium perfringens*, affecting 280, 263 and 72 persons respectively. Such food poisoning outbreaks were associated with beef, pork and chicken. On the other hand, unsatisfactory levels of *Clostridium perfringens* were mainly found in mixed dishes, rice and noodle dishes, congee and dim sum as revealed in past food surveillance data.

Advice to Trade

- Cook food thoroughly and serve cooked food as soon as possible, or keep the food at 60°C or above if it is not consumed immediately.
- Pre-cooked food subjected to cold storage should be cooled from 60°C to 20°C within 2 hours; and from 20°C to 4°C inside a chiller within the next 4 hours.
- Reduce the cooling time of cooked food, for example, by dividing into small portions, placing in shallow containers and/or placing in ice bath.
- Reheat cooked food thoroughly till the core temperature reaches at least 75°C or bring it to a boil.

Advice to Consumers

- Avoid storage of food at ambient temperature for more than two hours.
- Discard leftovers or otherwise store them properly in the refrigerator at 4°C or below.
- Reheat leftovers thoroughly, till the core temperature reaches at least 75°C or bring them to a boil before consumption.

Key Points to Note:

1. *Clostridium perfringens* is spore-forming and grows without oxygen.
2. Gravies held at room temperature for prolonged period provide favourable conditions for its growth.
3. Pre-cooked or leftover foods should be stored and reheated properly before consumption.

食物中的殘餘除害劑 (下篇)

Pesticide Residues in Food (Part III)



食物安全中心
風險評估組
科學主任林漢基博士報告

Reported by Dr. John LUM, Scientific Officer,
Risk Assessment Section,
Centre for Food Safety

我們在上一期論述了食物中殘餘除害劑的安全問題，本文是《食物中的殘餘除害劑》系列的最後一篇，將會仔細探討如何制定食物中的殘餘除害劑准許含量。

食物中殘餘除害劑的法定准許含量 — 最高殘餘限量

在食物生產過程中使用除害劑無可避免會令最終產品含有殘餘物，食物安全規管當局通常會就食物中的殘餘除害劑制定標準。這些標準稱為“最高殘餘限量”，是食物中殘餘除害劑的最高法定准許含量。制定最高殘餘限量的主要目的，是確保食物生產過程中使用的除害劑(例如在農作物生長期間使用的除蟲劑和在農作物貯存期間使用的除真菌劑)在食物中的殘留量會盡量降至最少，從而把對公眾健康造成的風險減至最低。此外，制定最高殘餘限量可促進國際貿易，為貿易伙伴提供參考數值。

如何釐定最高殘餘限量？

簡言之，最高殘餘限量是透過評估按照優良務農規範而施用的除害劑在食品中的殘餘物數據所制定。優良務農規範是一套安全施用除害劑(例如與公眾健康和環境安全相關的考慮)的國家認可規定，以便有效和穩妥地防治害蟲。准許施用除害劑的食品類別，建議施用的速率、次數和分量，以及農作物在最後一次施用除害劑後須經過多久才可收割等各項規定，均會詳載於優良務農規範中。

採納優良務農規範的目的，是確保把食物中的殘餘除害劑水平盡量降至最低，而又不影響施用除害劑的預期效用，即防治、殺滅、驅趕或減少有害生物。由於各國的情況不同(例如有害生物的種類和環境狀況)，各國有關個別除害劑的核准優良務農規範未必相同，因此各自或會就其優良務農規範制定出不同的最高殘餘限量。不過，這些最高殘餘限量必須能夠充分保障消費者的健康，才會獲得採納。

雖然制定最高殘餘限量可保障消費者的健康，但人們不應把它直接看成“食物安全上限”。事實上，除害劑的最高殘餘限量通常會訂在一個安全的水平。在這個水平及一般食用情況下，從食物中攝入的除害劑總分量會低於安全參考值(即每日可攝入量和急性參考劑量)(見圖一)。因此，只要從食物中攝入的除害劑總分量低於安全參考值，即使吃下的個別食物含有超出最高殘餘限量的殘餘除害劑，亦未必表示健康會受損。

最高殘餘限量足以保障公眾健康嗎？

在制定最高殘餘限量時，規管當局通常會進行攝入量評估，以評估根據優良務農規範制定的建議最高殘餘限量是否足以保障公眾健康。現時有不同的方法進行攝入量評估，其中一種會以當地食物消費量模式為基礎，並假設食物含有達到最高

In the previous issue, we have discussed the safety of pesticide residues in food. In this last issue of the series on Pesticide Residues in Food, we will have a closer look at the setting of permitted level of pesticide residues in food.

Legally Permitted Level of Pesticide Residues in Food – the Maximum Residue Limits (MRLs)

The use of pesticides in food production inevitably leaves residues in the final products and the food safety regulatory authorities usually set standards for pesticide residues in food. These standards, known as the “Maximum Residue Limits (MRLs)”, are the maximum legally permitted levels of pesticide residues in food. The primary purpose of setting MRLs is to ensure that the use of pesticides during food production (e.g. use of insecticides during crops growing and fungicides during crops storage) leaves residues in food as low as reasonably achievable, and thereby minimising the risk to public health. The establishment of MRLs also facilitates international trade by providing references to trading partners.

How are MRLs Established?

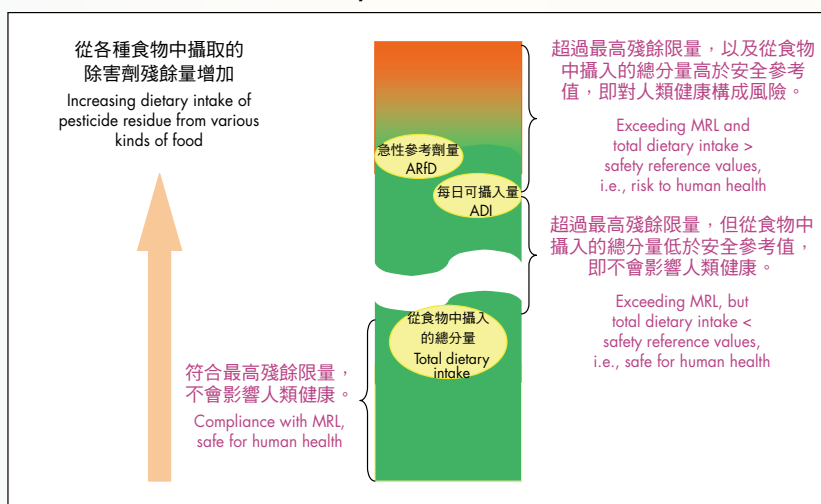
In brief, MRLs are established by evaluating pesticide residue data in food commodities when the pesticide is used according to good agricultural practice (GAP). GAP is a set of nationally authorised conditions to use the pesticide safely (e.g. in relation to public health and environmental safety concerns) for effective and reliable pest control. Various conditions, such as the type of commodities authorised for using the pesticide, the recommended application rates, frequencies, and amount as well as the duration between the last application of the pesticide and harvest, are prescribed in the GAP.

The adoption of GAP aims at ensuring that levels of pesticide residues in food are as low as practicable, while not compromising the intended functions of the pesticides (i.e. for preventing, destroying, repelling or mitigating pests). As the conditions in different countries (e.g. types of pests and the environmental conditions) are different, the approved GAP for individual pesticide may not necessarily be the same in different countries. As such, different MRLs may be established by different

countries according to their GAP. Nevertheless, all these MRLs would only be adopted if they provide sufficient protection to the consumers' health.

Although the establishment of MRLs can protect consumers' health, it should not be viewed directly as the “food safety limits”. In fact, MRLs of pesticides are usually established at safe levels such that the total dietary intakes are lower than the safety reference values (i.e. ADI and ARfD) under normal consumption (Figure 1). Therefore, consumption of food containing pesticide residues higher than MRLs does not automatically imply that consumers' health is at risk, provided that the total dietary intake is lower than the safety reference values.

圖一：最高殘餘限量與安全參考值的關係
Figure 1: Relationship between Maximum Residue Limit (MRL) and Safety Reference Values



Is the Establishment of MRLs Adequate to Protect Public Health?

During the establishment of MRLs, exposure assessment is usually conducted to assess whether the proposed MRLs based on GAP are adequate to protect public health. There are different methods to conduct the exposure assessment, and one of them is based on the local food consumption patterns and the assumption that food contains pesticide residues at MRLs. The exposure assessment will also consider the possibility that residue of the same pesticide may be present in different

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殘餘限量的殘餘除害劑。此外，攝入量評估亦會考慮同一種除害劑可能會存在於獲准施用的不同食品，如番茄、蘋果和其他蔬菜等。規管當局然後會將從食物中攝入某一除害劑的總分量與安全參考值(即每日可攝入量和急性參考劑量)作出比較，以評估對健康可能帶來的風險。有一點十分重要

重要的是，符合最高殘餘限量的食物可供人安全食用。

總括而言，正確施用除害劑可提高食物的質量和產量，但無可避免會令食物含有一些殘餘物。農民如按照優良務農規範施用除害劑，食物中的除害劑殘餘量便會低，進食這些食物亦不會影響健康。

food commodities (e.g. tomato, apple and other vegetables) upon authorised use. The resulting overall dietary intake of a particular pesticide will then be compared with the safety reference values (i.e. ADI and ARfD) to assess the possible health risks, if any. It is essential that foods complying with the MRLs are safe for human consumption.

To sum up, proper use of pesticide could improve quality and quantity of food, but inevitably leaves some residues in food. If pesticide is used according to GAP, the residual level would be small and consumption of these foods is not likely to affect health.

食物事故點滴
Food Incident Highlight

受砷污染的梨汁

今年三月初，加拿大食物檢驗局因兩個牌子的幼兒梨汁可能受砷污染而發出**健康危害警報**，食物安全中心遂發出**新聞公報**及**食物警報**，通知市民。

砷是大自然中常見的元素，可分為有機砷和無機砷兩種形態，存在於土壤、空氣和水中，又或隨風飄散。無機砷通常被認為會對人類造成較大的毒性影響。由人類活動產生的絕大部分砷化合物屬於三氧化二砷(又稱為砒霜)。另一方面，使用含砷的農用化學物會令砷在土壤和植物中累積，但這只會導致微量的砷殘留在食物中。

食物業宜向可靠的供應商採購食物。

Arsenic in Pear Juice

In early March 2008, the Canadian Food Inspection Agency issued a **health hazard alert** for two brands of pear juice for toddlers because they might be contaminated with arsenic. The Centre for Food Safety issued a **press release** and a **food alert** to inform the public on the issue as a result.

Arsenic is a common element in nature. It exists in both organic and inorganic forms and may exist in soil, air, water or become airborne. The inorganic forms are usually considered more toxic to human. A large majority of arsenic compounds related to human activities is in the form of inorganic arsenic trioxide, which is known as *pishuang* in Chinese. On the other hand, the use of arsenic-containing agricultural chemicals can lead to accumulation of arsenic in soil and plants, but this only contributes to trace amount of arsenic in food.

The food trade is advised to obtain food supplies from reliable sources.

花生製品中的黃曲霉毒素



花生糖
Peanut candy

今年三月，台灣衛生署藥物食品檢驗局公布包括花生糖、花生粉和粒狀花生的花生製品檢測結果，發現部分樣本含有過量黃曲霉毒素。

黃曲霉毒素是由黃曲霉菌在適當的溫度和濕度條件下產生的一組有毒化合物，較常見於花生、木本堅果、玉米、無花果乾、穀物和前述食物的製品中。黃曲霉毒素

無色、無味和無臭，能抵受高溫，被列為可令人類患癌的物質，可能會引致肝癌。嚴重急性中毒個案可引致肝臟受損，甚或死亡。

食物業人士應採購優質的原材料和產品，把食物貯存在陰涼、乾燥的環境，並以“先入先出”的原則存取食物。至於市民，則應向可靠的店鋪購買食物，把食物貯放在不受陽光直接照射的陰涼、乾燥地方，在“此日期前最佳”前進食產品，並棄掉發霉或已破損的食物。

Aflatoxins in Peanut Products

In March 2008, the Bureau of Food and Drug Analysis in Taiwan **released** surveillance results on peanut products (including peanut candies, ground peanuts and grains of peanut). Some samples of which were found to contain excessive amounts of aflatoxins.

Aflatoxins are a group of toxic compounds produced by some moulds of the *Aspergillus* species under favourable conditions of temperature and humidity. Aflatoxins are more likely to be found in peanuts, tree nuts, corn, dried figs, cereals and their products. They are colourless, tasteless and odourless, and are stable at high temperatures. Aflatoxins are classified as carcinogens to humans, and are associated with liver cancer. Severe acute cases may lead to liver damage or even death.

Members of the food trade should source ingredients and products of good quality. They should store food in cool and dry environment, and practise stock rotation on a “first-in-first-out” basis. Members of the public should purchase food from reliable shops, keep foods in dry and cool place without direct sunlight, consume products before the “best before” date and discard any food that looks mouldy or damaged.

風險傳達 工作一覽 Summary of Risk Communication Work

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