食物安全焦點
Food Safety Focus

食物安全中心
Centre for Food Safety

食物環境衞生署
Food and Environmental Hygiene Department

二零二五年一月•第二百二十二期
January 2025•222nd Issue
ISSN 2224-6908

本期內容 IN THIS ISSUE

食物上的霉菌－潛在的健康風險？
Moulds on Food – Potential Health Risks?

食物安全中心風險評估組
科學主任林漢基博士報告

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霉菌在自然環境中普遍存在可見，可令食物變質。麵包只要放在家中數天，表面便有可能出現灰濛濛的霉斑，在香港温暖潮濕的氣候下尤甚。我們將在本文剖析霉菌及其對健康可能造成的風險。

食物上的霉菌的潛在健康風險 — 霉菌毒素

儘管食物上的霉菌外表令人不快，但因進食發霉食物而引致急性中毒的事故並不常見。然而，某些霉菌（例如煙曲菌）可感染人類，尤其是免疫力較弱的病人。此外，某些霉菌可產生對人類有害的有毒物質，稱爲霉菌毒素。人類可通過進食受污染的食物或進食產自以受污染飼料餵飼的動物的食物（例如奶類），直接或間接攝入霉菌毒素。

食物中的霉菌毒素

各種不同霉菌所產生的霉菌毒素，已知的就有數百種之多。這些霉菌毒素中最為人熟識的是黃曲霉毒素、棒曲霉素及脫氧雪腐鐮刀菌烯醇，將在下文繼續加以討論。

In nature, moulds can be found everywhere and are known to cause food spoilage. When bread is left at home for several days, grey patches of moulds will be readily visible on the surface, especially under the warm and humid climate of in Hong Kong. We will examine mould and its potential health risks in further detail in this article.

Potential Health Risks of Moulds on Food - Mycotoxins

Although moulds on food have an unpleasant appearance, acute toxicity resulting from the consumption of mouldy food is not common. Yet, certain moulds (e.g., *Aspergillus fumigatus*) can cause infections in humans, especially in patients with weakened immunity. Moreover, certain moulds can naturally produce toxic substances, known as mycotoxins, which can be harmful to humans. People can be exposed to mycotoxins directly from the consumption of contaminated foods, or indirectly from consumption of food products (e.g., milk) produced from animals fed with contaminated feed.

Mycotoxins in Food

A wide variety of mould species have been identified to produce several hundred different mycotoxins. The most well-known of these mycotoxins are aflatoxins, patulin and deoxynivalenol, which will be further discussed in the following paragraphs.

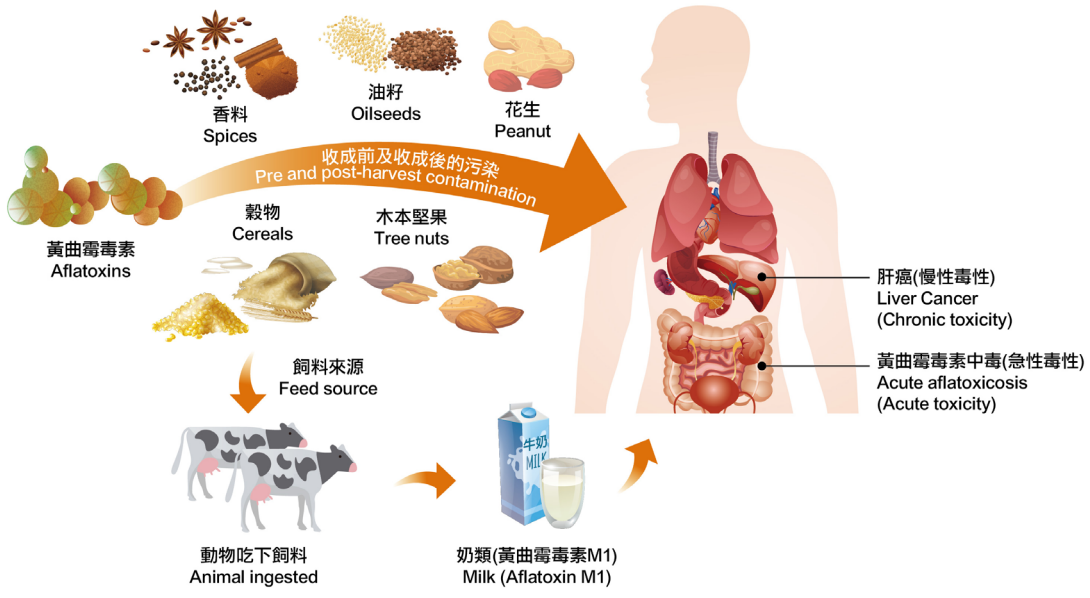

圖1: 人類攝入霉菌毒素的各種來源
Figure 1: Various sources of human exposure to mycotoxins

黃曲霉毒素

黃曲霉毒素是毒性最強的霉菌毒素之一，最常見於穀物、油籽、香料及木本堅果。攝入大量黃曲霉毒素可引致急性中毒（即黃曲霉毒素中毒），令肝臟受損並有可能致命。長期進食受黃曲霉毒素污染的食物可引致肝癌，其中受乙型肝炎病毒感染的人士如同時攝入黃曲霉毒素，其患上肝癌的風險比非乙型肝炎病毒感染者要高許多。

棒曲霉素

棒曲霉素最常見於腐爛的蘋果及蘋果製品，包括蘋果汁。人類攝入過量棒曲霉素可引致噁心、胃腸道不適及嘔吐。

脫氧雪腐鐮刀菌烯醇

脫氧雪腐鐮刀菌烯醇又稱嘔吐毒素，穀物(尤其是小麥及玉米)最容易受污染。脫氧雪腐鐮刀菌烯醇最令人關注的健康問題，是攝入後可能於短時間內引發急性疾病，症狀包括噁心、嘔吐、腹瀉、腹痛及發燒等。

香港對食物中霉菌毒素的規管

在本港，《食物內有害物質規例》（第132AF章）訂明食物中霉菌毒素的法定限量。此規例已於2021年修訂，進一步更新和加强對霉菌毒素的規管。例如，考慮到黃曲霉毒素對本港市民的食物安全風險甚大，黃曲霉毒素在一些較容易受污染的個別堅果、花生和乾果的最高含量已由每公斤15-20微克收緊至每公斤10-15微克。此外，由於脫氧雪腐鐮刀菌烯醇在穀類食物中較爲常見，加上其毒性對嬰幼兒的影響較大，故擬供 36 個月以下嬰幼兒食用而含有穀類的食物的脫氧雪腐鐮刀菌烯醇最高含量，已訂定為每公斤200微克。就棒曲霉素而言，蘋果汁及加有蘋果汁的其他飲品的棒曲霉素最高含量已訂定為每公斤50微克。

如何減低霉菌毒素帶來的風險？

霉菌毒素大多耐熱，不能通過烘焗、烘焙及煎炸等各種家居烹煮方法消除。由於烹煮無法完全消除霉菌毒素，因此預防霉菌毒素的產生是減少攝入霉菌毒素的關鍵。霉菌一般不會在妥為製乾和貯存的食物內滋生，因此妥善貯存是防止霉菌滋生並產生霉菌毒素的有效方法。食品法典委員會已發出預防和減少多種食品中霉菌毒素的不同操作規範。食物安全中心亦也已編製相關的業界指引，以預防及減少黃曲霉毒素污染。

注意事項

- 產生霉菌毒素的霉菌可在包括穀物、油籽、香料及木本堅果等不同食物中滋生。
- 大部分霉菌毒素是耐熱的，因此不能通過烘焗、烘焙及煎炸等各種家居烹煮方法消除。
- 霉菌一般不會在妥為製乾和貯存的食物內滋生，因此妥善貯存是防止霉菌滋生並產生霉菌毒素的有效方法。

給消費者及業界的建議

- 購買食物時應光顧可靠的店鋪，妥善貯存食物（例如按照生產商的指示，貯存於陰涼乾燥處）。
- 食物如有發霉或損壞迹象，便應棄掉。
- 每次只買少量食物並盡快用完，以防食物發霉。
- 遵循食物安全中心與其他國際機構發出的相關指引。
- 保持均衡和多元化的飲食，以免因偏吃某幾類食物而過量攝入包括霉菌毒素在內的污染物。

Aflatoxins

Aflatoxins are amongst the most toxic mycotoxins, most commonly found in cereals, oilseeds, spices and tree nuts. Ingesting large doses of aflatoxins can result in acute poisoning, i.e., aflatoxicosis, which could be deadly, usually through damage to the liver. Long-term consumption of food contaminated with aflatoxins can cause liver cancer, and the risk of liver cancer in individuals exposed to both aflatoxins and hepatitis B virus (HBV) infection is much higher than that in non-HBV infected individuals.

Patulin

Patulin is most commonly found in rotten apples and apple products, including apple juice. Excessive exposure to patulin has been found to cause nausea, gastrointestinal disturbances and vomiting in humans.

Deoxynivalenol

Deoxynivalenol (DON), also known as vomitoxin, is most commonly found to contaminate cereals, particularly wheat and maize. The primary health concern of DON in humans is its potential to induce acute illness, including nausea, vomiting, diarrhoea, abdominal pain and fever, within a short time after ingestion.

Regulation of Mycotoxins in Food in Hong Kong

In Hong Kong, regulatory limits for mycotoxins in food are stipulated in The Harmful Substances in Food Regulations (Cap. 132AF). The regulatory control of mycotoxins was further updated and strengthened in the amendment exercise of this regulation in 2021. For example, the maximum limits of aflatoxins in certain tree nuts, peanuts and dried fruit which are more susceptible to aflatoxin contamination were tightened up (from 15-20 μg/kg to 10-15 μg/kg) considering the food safety risks posed by aflatoxins to the local population. Moreover, since DON is more common in cereal food, and infants and young children are more vulnerable to the toxic effects of DON, a maximum limit (200 μg/kg) was established for food containing cereal intended to be consumed by infants and young children under the age of 36 months. For patulin, a maximum limit (50 μg/kg) was established for patulin in apple juice and other beverages to which apple juice has been added.

How to Minimise the Risk of Mycotoxins?

Most mycotoxins are heat stable, and therefore cannot be removed by various home cooking methods, including roasting, baking and frying. As mycotoxins cannot be completely destroyed by cooking, prevention is the key to minimising our exposure to mycotoxins. Nevertheless, mould usually does not grow in properly dried and stored foods, so proper storage is an effective measure against mould growth and the production of mycotoxins. The Codex Alimentarius Commission has also issued different codes of practice for the prevention and reduction of mycotoxins in various food commodities. The Centre for Food Safety (CFS) has issued related guidelines to provide guidance for food trade producing and handling peanuts in pursuit of preventing and reducing aflatoxin contamination.

Key Points to Note

- Moulds that produce mycotoxins can grow in a variety of foods, including cereals, oilseeds, spices and tree nuts.
- Most mycotoxins are heat stable, and therefore cannot be removed by various home cooking methods, including roasting, baking and frying.
- Moulds usually do not grow in properly dried and stored foods, so proper storage is an effective measure against mould growth and the production of mycotoxins.

Advice to Consumers and Trade

- Purchase food from reliable sources and store them properly (e.g., follow the manufacturer's instructions to keep them in a cool and dry place).
- Food that looks mouldy or damaged should be discarded.
- Buy small amounts of food and use them as soon as possible to prevent food from turning mouldy.
- Follow the corresponding Guidelines issued by the CFS and international authorities.
- Maintain a balanced and varied diet to avoid excessive exposure to contaminants, including mycotoxins, from a small range of food items.

蔬菜清洗機和農產品清潔劑 — 維持食物安全的較佳選擇？

Vegetable Washing Machines and Produce Washes – Are they Better Choices to Keep Food Safe?

食物安全中心風險傳達組
科學主任葉景新先生報告

Reported by Mr. Kenneth YIP, Scientific Officer,
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新鮮蔬果提供多種維持健康所需的維他命和礦物質，是均衡飲食的重要部分。農產品不論是用作配製菜餚或直接食用，都須徹底清洗。本文將簡述清洗農產品的需要、闡述一些蔬菜清洗機的原則和限制，並探討使用農產品清潔劑清洗蔬果是否較可取。

為何農產品在進食前要清洗？

大部分蔬果均在農地種植，農產品有可能在種植期受環境中的O157:H7型大腸桿菌等細菌污染，或受到蚜蟲等昆蟲侵擾。此外，農夫爲確保收成和質量，或會使用包括除害劑在內的化學品，因而或有除害劑殘餘在農產品內。土壤粒子、動物排泄物及雜草等異物也可能在收割時攙雜農產品中。

清洗蔬果有助去除未溶解的物質及水溶性化學品。在去皮前沖洗也可以減少污垢及細菌從刀子轉移到未清洗的水果或蔬菜。雖然清洗無法完全消滅農產品上的微生物，但徹底沖洗新鮮農產品能有效較少農產品表面上的微生物。

利用機器清洗農產品 — 採用的技術

為減少人手工作及加快清潔的程序，採用不同技術的蔬菜清洗機被相繼研發。當中，利用水流進行清洗是其中一種常見的方法之一。相關的機器一般有滾動裝置的產生水波沖擦蔬果的表面，帶走未溶解的異物及水溶性的複合物。

另一種蔬菜清洗機使用的技術是超聲波。通過將頻率高於人類耳朵能聽到的超音聲波傳送到水等液體媒介，便會產生能清潔食物表面的微氣泡。氣泡最終會破裂並產生衝擊力，碰撞農產品的表面。

部分蔬菜清洗機採用水淨化技術，例如羥基自由基等來清潔農產品。由於羥基自由基具有很強的氧化能力，可以透過氧化還原和自由基連鎖式反應分解有機污染物，使消毒變得更容易。

圖2: 以流動清水清洗新鮮蔬果時要注意的事項
Figure 2: Points to note when using running water to wash fresh fruits and vegetables

圖3: 部分蔬菜清洗機
Figure 3: Points to note when using running water to wash fresh fruits and vegetables

使用蔬菜清洗機背後的局限性

雖然不同的農產品清洗機配備專門的潔淨機制，但也可能有各自的局限。機動清洗與人手清洗相似。然而，某些型號將產品存放在密閉環境中，與使用流動清水的情況相比，可能缺乏足夠的清水把不要的物質從容器清除。研究結果顯示，要顯著減少需氧菌總數和腸桿菌科細菌的數量，需要持續 20 秒的高流水量（8公升/分鐘）。殘留在水中的化學品和微生物也可能會在清洗後重新污染農產品。

至於採用超聲波技術的機器，使用不當的頻率可能會損壞農產品的組織並縮短保質期。不穩定的氣泡破裂可能會對農產品產生破壞力，從而導致植物細胞受損和使細胞內物質流出。這些損害可能導致農產品組織軟化和營養流失。

Fresh fruits and vegetables are important parts of a balanced diet. They provide a variety of vitamins and minerals to support health. Washing the produce thoroughly is essential, regardless of whether it will be used for culinary preparation or direct consumption. This article will briefly discuss the need for washing produce, introduce some principles and limitations of vegetable washing machines, and explain whether produce washes are preferable for washing fruits and vegetables.

Why Should Produce be Washed Before Consumption?

Most fruits and vegetables are grown on farmlands. The produce may be contaminated by bacteria such as Escherichia coli O157:H7 or infested by pests like aphids from surroundings during the growing stage. Besides, farmers may apply chemicals, including pesticides to secure crop yield and quality, and these residues may be left in the produce. Foreign substances including soil particles, animal droppings and weeds may also be introduced when the produce is collected.

Washing fruits and vegetables can help remove undissolved physical matter and water-soluble chemicals. Rinsing produce before peeling can also reduce the dirt and bacteria transferred from the knife onto the unwashed fruit or vegetable. Although washing cannot eliminate microbes on the produce, thorough rinsing of fresh produce is effective in reducing microorganisms on their surfaces.

Produce Washing by Machines - Technologies Adopted

To reduce manual work and expedite the cleaning process, vegetable washing machines adopting different technologies have been developed. One of the popular methods is using water currents for washing. The machines usually contain rotation chambers to generate waves of water to rub the surfaces of fruits and vegetables, whereby undissolved foreign substances and water-soluble compounds will be removed.

Another cleaning technique adopted by vegetable washing machines is the use of ultrasonic sound waves. By transferring ultrasonic sound waves with frequencies higher than the human ear can perceive to liquid media like water, it creates microbubbles that clean food surfaces. The bubbles eventually burst and create impact forces to collide with foreign substances on the produce surfaces.

Some vegetable washing machines use water purification technology such as hydroxyl radical water treatment to clean produce. Because hydroxyl radicals have strong oxidizing capabilities, they can break down organic contaminants through REDOX and free radical chain reactions, which makes disinfection easier.

Limitations Behind Automatic Produce Washing

While different produce washing machines are equipped with specialised mechanisms, they may have their respective limitations. Mechanical washing is similar to manual washing. Nevertheless, some models store the produce in a closed system that may lack sufficient fresh water supply for transferring unwanted substances out of the containers, in contrast to manual washing under running water. Study findings revealed that a high water flow rate (8 L/min) for 20 seconds is necessary to facilitate significant reductions of total aerobic count and *Enterobacteriaceae*. The chemicals and microbes that remain in the water may also re-contaminate the produce after washing.

For machines utilising ultrasound technology, using improper frequencies may damage tissues and shorten the shelf lives of the produce. The bursting of unstable bubbles may generate shearing forces on the produce, thus causing damage of plant cells and leakage of cellular contents. These damages could lead to tissue softening and nutrient loss.

用於淨化清洗農產品的水的淨水器可能會有淨化容量不足的問題。這是因為可以進入機器處理的水量有限。對於處理水量較大的容器，可能需要較長的時間才能完成清洗。此外，這些裝置未必能有效去除附在農產品表面的黏性物質。

農產品清潔劑－有利於提升清潔表現嗎？

部分人可能會選擇在流動清水之外，使用配方洗滌劑清洗新鮮蔬果，期望能改善清潔效能。然而，農產品表面通常有不少孔洞，有可能吸收這些農產品清潔劑中的化學品，這些化學品可能難以完全從農產品中去除，並在清洗過程後殘留在水果和蔬菜中。

市民在家中清洗新鮮蔬果時，建議使用清水徹底清洗，並避免使用肥皂、配方洗滌劑或農產品清潔劑。

Water treatment devices for purifying the water used for produce washing may face capacity issues. It is because only limited amounts of water can be passed into the machine for treatment. A longer time may be required for completion of washing in containers with large water volumes. Also, it may not be efficient to remove sticky substances adhered to produce surfaces.

Produce Washes – Good for Enhancing Washing Performance?

Some may opt to wash fresh fruits and vegetables with produce washes like special detergents in addition to running water, in the hope that the cleansing work can be improved. However, produce is usually porous and could absorb the chemicals in the products, which may be difficult to remove completely and remain in the fruits and vegetables as residues after the washing process.

The public is advised to wash fresh fruits and vegetables thoroughly without using soaps, special detergents, or produce washes in the household setting.

美國爆發與切片洋蔥有關的O157:H7型大腸桿菌感染

E. coli O157:H7 Outbreak in the USA Linked to Slivered Onions

二零二四年九月，美國開始爆發大型O157:H7型大腸桿菌感染事故，合共236人受影響，其中一人死亡，四人出現溶血尿毒症。調查發現，事故很可能是一家連鎖快餐店使用的新鮮切片洋蔥所致。為審慎起見，食物安全中心已加強監測，在多家快餐店抽取含有洋蔥的漢堡包樣本進行檢測。有關樣本並沒有驗出O157型大腸桿菌。

大腸桿菌是一種通常存活於人類和哺乳類動物腸道內的細菌，也可於未經烹煮的蔬菜和未煮熟的肉類中找到。大腸桿菌可經由受糞便污染的食物和水、交叉污染和配製食物過程中與人之間直接接觸傳播。可致病的O157:H7型大腸桿菌可能引致溶血尿毒症，這是一種可致命的腎臟疾病，年幼的人和長者的風險特別高。要防止O157:H7型大腸桿菌污染，應遵從食物安全五要點，保持良好個人及廚房衞生。生的食物與熟食要分開。進食前，徹底沖洗蔬果，肉類則要徹底煮熟。

A large outbreak of *E. coli* O157:H7 started in September 2024 in the United States, where 104 people were infected, 1 died and 4 developed haemolytic uraemic syndrome (HUS). Investigations suggested that contaminated fresh slivered onions used by a fast food chain were the likely cause. Being prudent, the Centre for Food Safety stepped up surveillance and collected samples of burgers with onions from local fast food shops for testing. No *E. coli* O157 was detected.

E. coli is a type of bacteria that normally lives in the intestines of humans and mammals. It can be found in raw vegetables and undercooked meat products. It is transmitted through faecal contamination of foods and water, as well as cross-contamination, or by direct human contact during food preparation. A potent toxin produced by the pathogenic strain *E. coli* O157:H7 can result in HUS, a potentially fatal kidney disease. The young and the elderly are especially vulnerable. To prevent *E. coli* O157:H7 contaminations, practice Five keys to Food Safety and maintain good personal and kitchen hygiene. Keep cooked and raw food separate. Wash fruits and vegetables thoroughly and cook meat thoroughly before consumption.

進食已過食用期限的食物 — 安全嗎？

Consuming Food Past the Expiry Date – Is It Safe?

不少人對各種預先包裝食物上的“此日期或之前食用”和“此日期前最佳”日期存有誤解。

食物標籤上所註明的食用期限分爲兩種：“此日期或之前食用”和“此日期前最佳”。“此日期或之前食用”日期關乎食物安全。極容易腐壞的食物如乳製品及沙律等，不應在“此日期或之前食用”日期過後食用，因爲食物可能已變壞，或會對健康構成風險。另一方面，“此日期前最佳”日期關乎食物品質而非安全。一般而言，食物在此日期過後仍可供安全食用，但味道及質感可能不如之前。但儘管如此，消費者不應進食已變壞的食物。

消費者在購買食物時，應查看食用期限，並要清楚兩者的分別。按照建議的方式貯存食物；包裝有損的食物即使未過標籤上的食用日期，也切勿購買或進食。食用期限只適用於未開封的食品，因爲食物開封後，保質期便可能有改變。

Many people have misconceptions about “use by” and “best before” dates that appear on different types of prepackaged food products.

Expiry dates, which are indicated on food labels, can be categorized into two types: "use by" and "best before." A "use by" date is related to food safety. Highly perishable foods, such as dairy products and salads, should not be consumed after the "use by" date as the food may have deteriorated, posing health risks. On the other hand, a "best before" date is about food quality instead of safety. Normally, the food should be safe to eat after this date, but its flavour and texture might not be as good as before. Nonetheless, consumers should not eat spoiled foods.

Consumers are reminded to check expiry dates when purchasing food and understand the differences between the two. Store food under recommended conditions and do not purchase or consume it if the packaging is damaged, even if it is still within the date marked on the label. Expiry dates apply only to unopened products, as their durability may change once they are opened.

風險傳達工作一覽（二零二四年十二月）

Summary of Risk Communication Work (December 2024)

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