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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本期內容 IN THIS ISSUE

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焦點個案 *Incident in Focus*

豆漿中的蠟樣芽孢桿菌
Bacillus cereus in Soybean Milk

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

最近，食物安全中心(食安中心)在跟進一宗食物投訴時，從本地一食肆抽取了一個豆漿樣本，其後檢出樣本所含的蠟樣芽孢桿菌數量超過食安中心《食品微生物含量指引》的含量準則，屬不滿意。本地零售店鋪(例如豆製品店及粥店)所製作的豆漿保質期通常較短，需要嚴格的溫度控制才可保障食物安全。在本文中，我們將探討蠟樣芽孢桿菌到底如何在豆漿的生產過程中存活，以及如何預防該菌。

經得起熱處理的蠟樣芽孢桿菌

蠟樣芽孢桿菌是一種可產生孢子的細菌，在環境中無處不在，可以天然存在於土壤、植物、農產品等。因此，用於生產豆漿(見圖1)的大豆可能含有蠟樣芽孢桿菌。

雖然烹煮可有效殺死蠟樣芽孢桿菌的繁殖細胞，但其孢子耐熱，必須經過高溫處理(例如以攝氏121度加熱3分鐘)才能消滅。零售店鋪製作豆漿時的烹煮溫度並不足以殺死這些孢子；相反，烹煮的熱力不但能誘發孢子發芽成為繁殖細胞，還會消滅其他競爭生長的微生

Background

Recently, the Centre for Food Safety (CFS) collected a soybean milk sample from a local food shop when following up on a food complaint. The sample was later found containing a bacterium known as *Bacillus cereus (B. cereus)* in an amount that exceeded the limit in the CFS' Microbiological Guidelines for Food and was consided unsatisfactory. Soybean milk produced by local retail shops, such as soybean product shops and congee shops, usually has a short shelf life and requires stringent temperature control to maintain its safety. In this article, we will look into how the bacterium finds its way to survive in soybean milk production and how to prevent it.

Bacillus cereus Surviving Heat Treatment

B. cereus is a spore-forming bacterium and is ubiquitous in the environment. It is naturally present in soils, plants, agricultural products, etc. Hence, soybeans used in the production of soybean milk (see Figure 1) may contain *B. cereus*.

While cooking is effective to kill vegetative cells of *B. cereus*, its spores are heat-resistant and can only be eliminated by high temperature treatment, e.g. 121°C for 3 minutes. In this regard, the cooking temperature of soybean milk production at retail shops is not

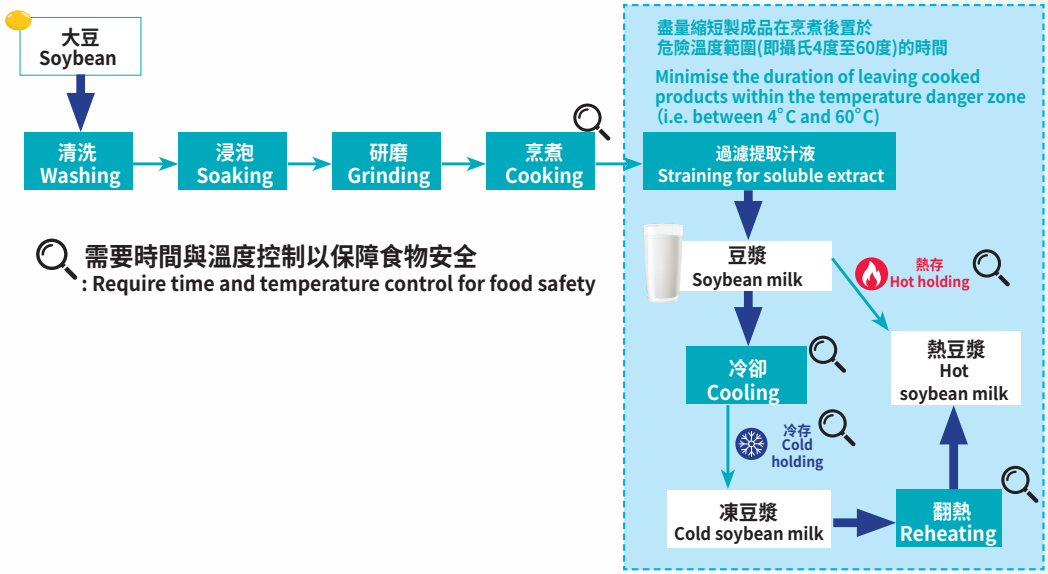

圖1：注意豆漿生產過程中需要時間與溫度控制的工序
Figure 1: Highlights of processes requiring time and temperature control during production of soybean milk

焦點個案
Incident in Focus

物，提供有利繁殖細胞生長的環境。因此，豆漿在烹煮後如長時間置於環境溫度下，繁殖細胞便會大量增生。

繁殖細胞可產生耐熱的致吐毒素。豆漿受污染後即使翻熱，仍可導致食物中毒，患者在飲用不久後便會出現嘔吐的徵狀。

預防在於時間與溫度控制

雖然蠟樣芽孢桿菌十分頑強，但無礙生產可供安全飲用的豆漿。為了預防微生物危害，部分生產工序需要時間與溫度控制(見圖1)。首先，研磨所得的大豆原漿必須徹底煮熟，以殺死蠟樣芽孢桿菌的繁殖細胞及其他細菌。熱處理還可使大豆中可影響消化的酶失效。

在烹煮後，應盡量縮短製成品置於危險溫度範圍(即攝氏4度至60度)的時間，以防止蠟樣芽孢桿菌存活的孢子所形成的繁殖細胞生長。煮熟的大豆原漿經濾布過濾提取汁液後，即成豆漿。新鮮製成的豆漿可貯存於攝氏60度以上，以供熱飲。如供冷飲，豆漿必須盡快冷卻，即在2小時內降溫至攝氏20度，並在其後4小時或更短的時間內降溫至攝氏4度，然後貯存於攝氏4度或以下。有些食品服務業會為消費者翻熱冷存的豆漿以供飲用。翻熱時，豆漿的溫度必須至少達攝氏75度。

最後同樣重要的是，為了減少微生物污染，生產環境及設備必須保持衞生，特別是在烹煮後使用的設備，例如濾布、容器及飲料機，每次使用後都必須清洗乾淨，以盡可能減少蠟樣芽孢桿菌滋生的機會，從而防止下一批煮熟的豆漿受到污染。

注意事項

1. 大豆可受蠟樣芽孢桿菌天然污染。一般烹煮可殺死蠟樣芽孢桿菌的繁殖細胞，但無法消除其孢子及毒素。
2. 豆漿在烹煮後如置於環境溫度下過久，蠟樣芽孢桿菌存活的孢子所形成的繁殖細胞可產生毒素。
3. 應盡量縮短豆漿在烹煮後擺放於攝氏4度至60度的時間，因為這個溫度範圍有利蠟樣芽孢桿菌的繁殖細胞生長和產生毒素。

給業界的建議

- 豆漿保質期較短，應避免過量生產。
- 加快冷卻過程，例如把豆漿分成較小份，或把瓶裝豆漿置於冷水或冰水中冷卻。
- 盡量縮短豆漿的貯存時間，最好在生產後一天內清理存貨。

給市民的建議

- 零售店鋪所製作的豆漿應盡快飲用。
- 豆漿如非即時飲用，應冷存於攝氏4度或以下。

sufficient to kill the spores. Instead, the heat of cooking can not only induce the spores to germinate and become vegetative cells, but also create a favourable environment for the cells to grow by eliminating other microorganisms competing for growth. As a result, if the soybean milk is left under ambient condition for a prolonged period of time after cooking, vegetative cells can proliferate into a large number.

The vegetative cells can then produce a heat-resistant emetic (i.e. causes vomiting) toxin. Even if contaminated soybean milk is reheated subsequently, it can still cause food poisoning that is characterised by causing the victim to vomit shortly after consumption.

Prevention by Time and Temperature Control

Despite the tenacious nature of *B. cereus*, soybean milk can still be safely produced. To prevent the microbiological hazard, certain production processes require time and temperature control (see Figure 1). First, the soybean slurry from grinding process has to be cooked thoroughly to kill *B. cereus* vegetative cells and other bacteria. The heat treatment can also denature soybean enzymes that affect digestion of consumers.

After cooking, it is important to minimise the duration of leaving cooked products within the temperature danger zone, i.e. between 4°C and 60°C, in order to prevent the growth of vegetative cells of *B. cereus* formed from surviving spores. Cooked soybean slurry is strained through cheese cloth for soluble extract, i.e. soybean milk. After straining, freshly made soybean milk can be held at above 60°C for hot serving. As for cold soybean milk, it has to be cooled as quickly as possible, i.e. cooling to 20°C within two hours, and then to 4°C within the next four hours or less. Cooled soybean milk can then be stored at or below 4°C for cold serving. At certain food service businesses, soybean milk in cold holding may be reheated for serving. In that case, it has to be reheated with temperature reaching at least 75°C.

Last but not least, the production environment and equipment have to be kept hygienic to reduce microbiological contamination. In particular, the equipment used after cooking processes, such as cheese cloth, container and dispenser, has to be cleaned after each use to minimise the building up of *B. cereus* which may contaminate cooked soybean milk of the next batch.

Key Points to Note

1. Soybeans can be naturally contaminated with *B. cereus*. Normal cooking can kill vegetative cells of *B. cereus*, but not the spores and toxin of it.
2. If cooked soybean milk is left at ambient temperature for too long, vegetative cells of *B. cereus* formed from surviving spores can produce toxin.
3. It is important to minimise the duration of leaving soybean milk at a temperature range between 4°C and 60°C after cooking which favours the growth of *B. cereus* vegetative cells and toxin production.

Advice to the Trade

- Avoid over-production as soybean milk has a short shelf life.
- Speed up the cooling process by, for example, dividing soybean milk into small portions or using water bath or ice bath to cool bottled soybean milk.
- Minimise the storage time of soybean milk, preferably clearing the stock within one day after production.

Advice to the Public

- Consume soybean milk produced at retail shops as soon as possible.
- Refrigerate the soybean milk at 4°C or below if it is not to be consumed immediately.

食物安全平台
Food Safety Platform

經巴士德消毒的蛋 – 食用生蛋的較安全之選

Pasteurised Eggs – a Safer Cousin of Raw Table Eggs

食物安全中心風險傳達組
科學主任陳蓉蓉女士報告

Reported by Ms. Melva CHEN, Scientific Officer,
Risk Communication Section, Centre for Food Safety

蛋是烹製方便、價錢合理且營養豐富的食物，但要盡得吃蛋的益處，便先要了解一下如何安全處理和烹製蛋類。內部看來正常的蛋，也可能含有稱為沙門氏菌的細菌，若不徹底煮熟，可使人患病。如果烹製的含蛋菜式無需加熱處理，使用經巴士德消毒的蛋是較安全的選擇。

小心生或未煮熟的蛋類菜式

新鮮蛋類即使蛋殼清潔、沒有裂紋，亦可能含有可導致沙門氏菌病的沙門氏菌，病徵包括噁心、發燒、腹痛、腹瀉及嘔吐，但長者、嬰兒及免疫力弱人士可能出現更嚴重的後果，甚至死亡。近年來，證實與沙門氏菌有關的食物中毒個案數目大增。根據衞生防護中心的資料，二零一六年涉及沙門氏菌的個案有48宗，而在二零二零年一月至八月期間卻已經有104宗，當中佔101宗(影響240人)的涉事食品都是蛋，主因之一可能是生或未煮熟的蛋類菜式日益流行，而烹製時未有使用經巴士德消毒的蛋。

圖2：生或未煮熟的蛋類菜式例子
Figure 2: Examples of raw or undercooked egg dishes

有些食物明顯是以未煮熟的蛋製作的，從食物中未凝固的蛋黃便可看出來，例如早餐的太陽蛋及班尼迪蛋、拉麵中的溫泉蛋，以及用作火鍋蘸醬的生蛋。有些食品可能含有生或未煮熟的蛋，則較少為人所知，例如自製蛋黃醬、意大利芝士蛋糕、慕司及布甸，通常都是以生蛋製成。至於滑蛋叉燒飯中的炒滑蛋，往往不會煮至全熟，以令口感軟滑。有些含蛋的甜品也沒有徹底煮熟，以保持鬆軟的質感，例如梳乎厘班戟、高力豆沙及蛋白批。最近大熱的巴斯克焦香芝士蛋糕，便是一種沒有完全烘烤以保持中心黏軟的蛋糕。

蛋製品及有殼蛋進行巴士德消毒

由十九世紀法國科學家路易巴士德發明並以其名字命名的巴士德消毒法，是一種把食物加熱至特定溫度並保持一段時間以消滅病原體和延長保質期的熱處理方法。蛋類進行巴士德消毒的優點在於一方面能消滅沙門氏菌等危險微生物，另一方面既不會把蛋煮熟，又不會影響其色澤、味道、營養價值或用途。市面上早已有售經巴士德消毒的蛋製品，例如全蛋、蛋黃及蛋白漿/粉，一些本地食肆常用來製作生或略熟的菜式。有趣的是，雖然有殼蛋進行巴士德消毒的科技早在八十年代後期已經發展，但商業化生產的規模在過去十年才開始增長。有殼蛋可採用熱水浸泡的方式進行巴士德消毒，溫度與時間一般嚴格控制在攝氏55度至60度及60分鐘以上，以消滅差不多全部(即99.999%)的沙門氏菌，但又不會把蛋煮熟。蛋類經巴士德消毒後，蛋殼外會加上食用蠟，以保持新鮮及防止污染。業界最近亦在研究其他更具成本效益的有殼蛋巴士德消毒技術，例如高濕熱風及微波的使用。本地市面上有售經巴士德消毒的有殼蛋，可供食物業及家庭使用。

Easy to prepare and reasonably priced, eggs are a parcel of nutrition waiting to be released, although it takes a bit of knowledge on how to handle and prepare them safely to get all the benefits of eating eggs. The inside of eggs that appear normal can contain bacteria called *Salmonella*, which can make people sick if the eggs are not cooked thoroughly. What if the egg-containing delicacies require no heat treatment? Pasteurised eggs can be a safe alternative.

Beware of Recipes Containing Raw or Undercooked Eggs

Fresh eggs, even those with clean, uncracked shells, may contain *Salmonella* that can cause Salmonellosis. Symptoms include nausea, fever, abdominal pain, diarrhoea and vomiting, but serious consequences, even death, may result in the elderly, infants and those with impaired immune systems. In recent years, the number of confirmed food poisoning outbreaks related to *Salmonella* has been on a surge. According to the Centre for Health Protection, there were 48 outbreaks involving *Salmonella* in 2016, whereas from January to August 2020, there have been already 104 outbreaks, of which eggs account for 101 outbreaks (affecting 240 persons) as the single incriminated food item. One of the underlying reasons is probably the rising popularity of raw or undercooked egg dishes which do not use pasteurised eggs.

Some foods are obviously prepared with undercooked eggs, as evident by the soft, runny egg yolks, including sunny side-up eggs and eggs Benedict for breakfast, *onsen* eggs in ramen noodles, as well as raw eggs used as the dipping sauce for hot pot. Some recipes may contain raw or undercooked eggs that are lesser known to people. Homemade mayonnaise, tiramisu, mousses and puddings, for example, are usually made with raw eggs. Soft scrambled eggs as the topping for BBQ pork rice are often lightly cooked to achieve a silky mouth feel. Some egg-containing desserts are not thoroughly cooked to retain the soft, fluffy texture, such as souffle pancakes, Shanghai-style egg white souffle balls with red bean fillings and meringue pies. The recently on-the-trend Basque burnt cheesecake is one of the kind not baked all the way through to keep its centre gooey.

Pasteurisation of Egg Products and Shell Eggs

Pasteurisation, named after its inventor Louis Pasteur, a 19th century French scientist, is a process of heating foods to a specific temperature for a set period of time to destroy pathogens and extend shelf life. Pasteurisation of eggs has the merit of, on the one hand, destroying dangerous microorganisms such as *Salmonella*, and, on the other hand, neither having the eggs cooked nor affecting their colour, flavour, nutritional value or use. Pasteurised egg products such as liquid or powdered whole eggs, egg yolks and egg whites have long been available on the market and are commonly used in some local food premises for raw or lightly cooked dishes. Interestingly, although the science for pasteurising eggs in their shells was developed in the late 1980s, the production was scaled up commercially only in the last decade. Shell eggs can be pasteurised in a hot water immersion process that strictly controls the temperature and time, usually between 55°C to 60°C for more than 60 minutes, to reduce nearly all (i.e. 99.999%) of the *Salmonella* while not cook up the eggs. After pasteurisation, the eggs are coated with food-grade wax to maintain freshness and prevent contamination. Recently, industries are also exploring other more cost-effective techniques, such as high-moisture hot air and microwave, for pasteurisation of shell eggs. Pasteurised shell eggs are available on the local market for food business and household use.

使用經巴士德消毒的蛋

不論食物業或在家烹調，如製作的菜式需要生或並非全熟的蛋，都應使用經巴士德消毒的有殼蛋或蛋製品。此外，即使所使用的是經巴士德消毒的有殼蛋或蛋製品，處理食物時亦要注意經常保持良好衞生，以避免其他來源的食物交叉污染。由於巴士德消毒不能殺死所有微生物，而經巴士德消毒的蛋在使用時通常不會再進行熱處理，因此經巴士德消毒的蛋須冷存於攝氏4度或以下，或按食物標籤上的指示貯存，以防變壞。

圖3：市面上有售經巴士德消毒的有殼蛋、蛋粉及蛋漿
Figure 3: Pasteurised shell eggs, egg powders and liquid eggs are available on the market

Use of Pasteurised Eggs

Both food business and home cooking should use pasteurised shell eggs or egg products for dishes calling for raw or lightly cooked eggs. Also, food handlers should note that good hygiene practices should always be followed to avoid cross-contamination of foods from other sources even though pasteurised shell eggs or egg products are used. As pasteurisation does not kill all forms of microorganisms and the pasteurised eggs usually will not undergo further heat treatment when used, it is important to refrigerate pasteurised eggs at or below 4°C or follow the storage instructions provided on food labels to prevent spoilage.

食物事故點滴
Food Incident Highlight

消毒凍房環境及食品包裝的指引
Guidance on Disinfecting the Environment and Food Packages of Cold Stores

為進一步減低在凍房感染2019冠狀病毒病的風險，食物安全中心(食安中心)制訂了消毒凍房工作環境及食品包裝的指引，以及相關的預防措施。

凍房的工作環境及雪櫃等設備應加強清潔和定期消毒。貨物外的包裝應在運入倉庫或裝載運送前消毒。食品應妥為保護，以免受消毒劑污染。食品包裝如非密封，應小心抹拭以作消毒。含氯消毒劑(例如1:99的稀釋家用漂白水)、含酒精消毒劑(例如70-80%濃度的乙醇)及季銨鹽化合物均可作消毒之用。

此外，必須採取防範措施和佩戴人防護裝備。

詳情請參閱食安中心網頁。

To further reduce the risk of contracting COVID-19 in cold stores, the Centre for Food Safety (CFS) produced a set of guidance on disinfection for the working environment and food packages of cold stores with relevant preventive measures.

It is advised to step up cleansing and regular disinfection to the working environment and equipment like refrigerators. For disinfection of outer food packages, disinfection should be completed before bringing into the warehouse or loading for delivery. Food should be well-protected to prevent contamination by disinfectants. If the food package is not sealed, it should be disinfected by wiping the surface carefully. Chlorine-based disinfectants (e.g. 1:99 diluted household bleach) , alcohol-based disinfectants (e.g. 70-80% ethanol) and quaternary ammonium compounds (QUATs) can be used for disinfection.

Besides, precautions have to be taken and personal protection equipment should be put on.

For further details, please refer to the CFS website.

《食物內有害物質規例》關於食物內霉菌毒素及其他污染物的修訂建議
Proposed Amendments to the Harmful Substances in Food Regulations in Terms of Mycotoxins and Other Contaminants in Food

為了加強規管食物內的有害物質，食物安全中心(食安中心)建議收緊三種真菌毒素(即黃曲霉毒素、脫氧雪腐鐮刀菌烯醇及棒曲霉素)在食物內的最高含量，並同時訂定五類其他污染物(包括苯並[a]芘、縮水甘油脂肪酸酯、三聚氰胺、氯丙二醇及芥酸)在食用油脂、調味料或擬供嬰兒食用的配方產品中的最高含量。此外，食安中心亦建議參考世界衞生組織行動方案及香港非傳染病防控策略及行動計劃的建議，把可導致心臟病的「部分氫化油」(即工業生產的反式脂肪酸的主要來源)列為食物中的違禁物質。

歡迎市民瀏覽有關的網頁，並在諮詢期內就各項修訂建議提交意見，諮詢期於二零二一年三月十五日結束。

In order to strengthen the regulation of harmful substances in food, the Centre for Food Safety (CFS) has proposed to tighten up the maximum levels (MLs) for three types of fungal toxins, namely aflatoxins, deoxynivalenol and patulin, in food. At the same time, the MLs of five types of other contaminants, including benzo(a)pyrene, glycidyl fatty acid esters, melamine, 3-monochloropropane-1,2-diol and erucic acid, are proposed to be set for edible fats and oils, condiments or formula products intended for infants. Furthermore, partially hydrogenated oils, which are the main source of industrially-produced trans fatty acids that contribute to heart diseases, will be prohibited in food under the proposals, making reference to the recommendations by the World Health Organization's action package and the local Strategy and Action Plan to Prevent and Control Non-communicable Diseases in Hong Kong.

The public is encouraged to visit the dedicated webpage and to offer comments on the proposals during the consultation period which ends on 15 March 2021.

風險傳達工作一覽（二零二零年十二月）
Summary of Risk Communication Work (December 2020)

事故／食物安全個案 Incidents/ Food Safety Cases: 192	公眾查詢 Public Enquiries: 86	業界查詢 Trade Enquiries: 201	食物投訴 Food Complaints: 271	給業界的快速警報 Rapid Alerts to Trade: 9
給消費者的食物警報 Food Alerts to Consumers: 6	懷疑食物中毒個案通報 Suspected Food Poisoning Alerts: 1	教育研討會/ 演講/ 講座/ 輔導 Educational Seminars/ Lectures/Talks/ Counselling: 14	上載到食物安全中心網頁的新訊息 New Messages Put on the CFS Website: 45	