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

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蠔豉中的重金屬
Heavy Metals in Dried Oysters

食物安全中心 風險評估組 科學主任邱頌韻女士報告

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

蠔：新鮮（左）；生曬後（右）。
Oysters: fresh (left); after sun drying (right).

背景

二零零七年十二月，有本地傳媒就蠔和蠔豉中的重金屬進行調查，結果發現兩個來自流浮山的蠔樣本鎘含量為百萬分之二點六八和四點一九，四個蠔豉樣本的鎘含量為百萬分之二點三七至四點四，以及兩個蠔豉樣本的鉻含量為百萬分之一點零三和一點一五。根據《食物攙雜(金屬雜質含量)規例》(第132V章)，蠔的鎘和鉻的最高准許濃度分別為百萬分之二和一，於是引起蠔豉樣本中的鎘和鉻含量有否超逾法定上限的疑問。

國際間如何解讀乾製食物中重金屬的最高准許濃度？

重金屬和許多環境污染物在大自然中無處不在。雖然食物中這些物質的總分量經過加工過程後未必會改變，但其濃度或會增減。有見及此，食品法典委員會在《食物中的污染物和毒素通用標準》中提出以下建議：“不過，一般來說，最高上限最好為初級農產品而制定，加上適當的系數後可將最高上限應用於加工食物、衍生食物和以多種配料製成的食物上”，用以考慮加工過程的影響。這種方法已獲澳洲和歐洲聯盟成員國等多個國家所採用，從風險評估和風險管理的角度而言，既合理又符合科學原則。

換言之，在解讀化驗結果時，不論測試結果如何，均須應用適當的系數，以便取得食物中的污染物在加工前的“原本”含量，從而與有關法定上限作比較。

我們如何得出適當的系數以便與法定上限作比較？

經乾製、脫水或濃縮過程製成的已加工食物中某種重金屬的“原本”含量，可按以下公式計算出來：

Background

In December 2007, a local media conducted a survey on heavy metals in oysters and dried oysters. It was found that the cadmium levels of two oyster samples from Lau Fau Shan were 2.68 ppm and 4.19 ppm while the cadmium levels of four dried oyster samples ranged from 2.37 to 4.4 ppm. The chromium levels of the two dried oyster samples were 1.03 and 1.15 ppm. According to the Food Adulteration (Metallic Contamination) Regulations, Cap. 132V, the maximum permitted concentrations for cadmium and chromium in oysters are 2 ppm and 1 ppm respectively. Questions have been raised whether the levels of cadmium and chromium in the dried oyster samples exceeded the legal limits.

What are the International Practices in Interpreting Maximum Permitted Concentrations for Heavy Metals in Dried Food?

Heavy metals and a number of environmental contaminants are ubiquitous in the nature. While their total amounts in food may not change upon processing, their levels may be either concentrated or diluted. In light of this fact, the Codex Alimentarius Commission (Codex) has recommended in its General Standard for Contaminants and Toxins in Foods that “in general however, maximum levels should preferably be set for primary agricultural products and may be applied to processed, derived and multi-ingredient foods by using appropriate factors” to take into account the effect of processing. This approach has been adopted by countries including Australia and member countries in the European Union, and is considered reasonable and scientifically sound from both risk assessment and risk management perspectives.

In other words, when interpreting the laboratory result, an appropriate factor has to be applied to the test result wherever indicated so as to obtain the “original” level of the contaminant present in food before processing that the relevant legal limits are set against.

How Can We Derive the Appropriate Factors for Comparison with the Legal Limits?

The “original” level of a heavy metal for a processed food which has been dried, dehydrated or concentrated prior to drying, dehydration or concentration can be determined using the following formula:

已加工食物 污染物 “原本” 含量
“Original” level of contaminant in a processed food before processing

=

已加工食物樣本中 污染物含量的化驗結果
Laboratory result of the level of the contaminant in a processed food sample

X

“轉換系數”
“Conversion factor”

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Incident in Focus

"轉換系數"可透過下列數據得出：

(a) 食物樣本在乾製、脫水或濃縮過程之前和之後的水分含量化驗結果；以及／或

(b) 有關食物加工前與加工後的水分含量公認數據(例如食物成分數據庫)。

部分乾製食物的轉換系數示例如下：

The "conversion factor" can be derived from:

(a) laboratory test result of water content of a food sample before and after drying, dehydration or concentration; and / or

(b) generally accepted data (e.g. food composition database) regarding the water content of the processed food and its unprocessed counterparts.

Examples of conversion factors for selected dried groceries are illustrated below:

食品 Food Item	加工前的水分含量 Water Content in Unprocessed State 克／每 100 克可食用分量 g/100g edible portion (%)	加工後的水分含量 Water Content in Processed State 克／每 100 克可食用分量 g/100g edible portion (%)	轉換系數* Conversion Factor*
鮑魚 Abalone	68.6[b] – 77.5[a]	18.3[a]	0.28 – 0.38
淡菜 Mussel	79.9[a]	15.6[a]	0.24
墨魚 Cuttlefish	79.2[a] – 84.9[b]	24.8[a]	0.20 – 0.28
蠔 Oyster	82.0[a] – 87.1[a]	13.1[b]	0.15 – 0.21
扇貝 Scallop	84.2[a]	27.4[a]	0.22
海參 Sea cucumber	77.1[a,b]	18.9[a]	0.28
蝦 Shrimp	73.6[a] – 80.6[a]	13.8[b] – 25.0[b]	0.23 – 0.35
魷魚 Squid	80.4[a] – 82.2[b]	21.8[a]	0.23 – 0.25
香菇 Shitake mushroom	91.6[b] – 91.7[a]	12.3[a] – 13.2[b]	0.09 – 0.10
黑木耳 Black wood ear	89.8[b]	11.4[b] – 15.5[a]	0.12

* "轉換系數" "Conversion factor" = (100% – "加工前的水分含量"(%) / 100% - "Water Content in Unprocessed State" (%)) ÷ (100% – "加工後的水分含量"(%) / 100% - "Water Content in Processed State" (%))

資料來源 Sources：
a. 中國食物成分表2002 (China Food Composition 2002)
b. ASEAN Food Composition Table

我們必須留意，食物樣本在脫水過程之前和之後的水分含量會因品種、季節、地理環境和加工要求等多項因素而有所不同，因此，直接化驗食物樣本在加工之前和之後的水分含量可較準確估計"轉換系數"。如"轉換系數"來自公認的數據，業界應確保有關數據來源是準確和可靠的。

食物安全中心(中心)在評估食品中的重金屬含量有否超逾法定上限時，已遵從食品法典委員會的上述建議。在加入"轉換系數"後，該四個蠔豉樣本中據稱的鎘和鉻含量均在本港法定上限之內。

上述方法可確保在本港供應的食物安全嗎？

人們往往會把法例所訂的法定上限與各項相關的安全參考值(例如由聯合國糧食及農業組織／世界衞生組織聯合食物添加劑專家委員會制定的暫定每周可容忍攝入量)混為一談。為了監管和維持食物的標準，法例訂明不同食物中的化學物准許含量。吃下的食品如含有超逾法定標準的化學物，並不一定表示消費者的健康會受損。中心在評估食物樣本的整體安全和所驗出的金屬可對健康造成的影響時，會考慮有關食物的污染物含量及平均食用量。

給業界的建議

業界應確保所出售或進口的食物適宜供人食用，並符合法定標準。

It is important to note that water content of a food sample before and after dehydration may vary with a number of factors including species, seasons, geographical locations, processing requirements, etc. Therefore, direct laboratory analysis of the water content of food sample before and after processing would provide a better estimate of the "conversion factor". If the "conversion factor" is derived from generally accepted data, the trade should ensure that the data sources are accurate and reputable.

The Centre for Food Safety (CFS) has followed the above Codex's recommendation in assessing whether the level of heavy metal in a food item has exceeded the legal limit. By applying the "conversion factors", the reported cadmium and chromium levels in the four dried oyster samples are therefore within the legal limits in Hong Kong.

Can the Above Approach Ensure Safe Food Supply in Hong Kong?

Legal limits stipulated in law are often confused with the respective safety reference values such as the Provisional Tolerable Weekly Intake (PTWI) established by the Joint Food and Agriculture Organization (FAO) / World Health Organization (WHO) Expert Committee on Food Additives (JECFA). The law states the amounts of chemicals allowed in different foods for monitoring and maintaining food standards. Consuming food products with chemicals exceeding the legal standards does not automatically imply that the consumer's health is at risk. The CFS will take into account the level of the contaminant in the food and the average quantity of the food consumed when assessing the overall safety of the sample and the associated health effects of the metals detected.

Advice to the Trade

The trade should ensure the foods they sell or import are fit for human consumption and comply with the legal standards.

汞與食物安全
Mercury and Food Safety

食物安全平台
Food Safety Platform

食物安全中心
風險傳達組
科學主任郭麗儀女士報告

Reported by Ms. Joey KWOK, Scientific Officer,
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《食物中的金屬污染物》系列已在本欄連載了四期，本文是此系列的末篇，將會集中探討汞(水銀)，包括人們攝取汞的途徑和減少攝入汞的方法。

汞是什麼？汞來自何處？

汞是金屬元素，地殼中蘊藏了小量這種礦物。純汞是銀白色的，閃閃發亮，在室溫下呈液態，多年來一直用作製造溫度計、電路開關和部分燈泡等產品。汞以三種形態存在，即汞金屬(元素)、無機汞和有機汞。甲基汞是有機汞最常見的形態，其毒性最強。

火山爆發、岩石風化和人類活動(例如燃燒化石燃料，特別是煤；開採金礦和汞礦；電鍍和焚燒垃圾等)，均會令汞進入空氣或水中。

人們如何攝取到汞？

人們可從工作環境中攝取到汞。此外，汞合金補牙物、傳統中藥和化妝品也可能是攝取汞的來源。不過，食物明顯地是一般人攝取汞的最主要來源。

魚類中的汞

在河流、湖泊和海洋裏，細菌可以把汞轉化為甲基汞。這種毒性最強的形態會被水中生物攝入體內，沿着食物鏈由微生物(包括動物及植物)轉送至體型較大的生物內。甲基汞可在魚類體內累積，並與魚類組織中的蛋白質緊密結合，因此劍魚、鯊魚和旗魚等體型較大的捕獵魚類通常會累積較多這種化學物(表一)。魚類是人們攝取汞的主要食物來源，而烹煮不能有效減低魚類中的汞含量。

表一：汞含量較高的魚類
Table 1: Fish that can contain higher levels of mercury

• 劍魚 Swordfish	• 鯊魚 Shark
• 旗魚 Marlin	• 金眼鯛(金目鯛) Alfonsino
• 某些金槍魚(吞拿魚)，例如藍鰭、大眼 Certain types of tuna, e.g. bluefin, bigeye	

汞對健康有何影響？

汞及其化合物對動物並沒有任何已知的生理作用。急性汞中毒通常是因工作以致過量攝取汞，因進食含汞的食物而導致急性中毒的情況罕見。攝入大量的汞可損害神經系統，特別是發育中的腦組織，因此發育中的胎兒、嬰兒及幼童最易受到汞的毒性影響。

糧食及農業組織／世界衞生組織聯合食物添加劑專家委員會為總汞和甲基汞訂定暫定每周可容忍攝入量，按每公斤體重計算，可容忍攝入量分別是每周5微克和1.6微克。根據二零零四年進行的一項本港研究顯示，中學生從食物攝取總汞和甲基汞的分量均低於暫定每周可容忍攝入量，換言之，他們從食物中攝取這兩種化學物而導致健康受損的機會不大。“魚類”是中學生攝取總汞和甲基汞的主要食物來源(佔總汞和甲基汞的攝入量的59%)，其次是“魚類以外的海產”(分別佔總汞和甲基汞的攝入量的14%和18%)。測試結果顯示劍魚的總汞和甲基汞的含量最高。

給消費者的建議

1. 幼童、孕婦和計劃懷孕的婦女等容易受汞影響的羣

The following article, being the fifth and last in this series on “Metallic Contaminants in Food”, will focus on mercury. The various sources from which people are exposed to mercury, as well as the measures that people may take to reduce their exposure to this particular metal will be discussed.

What is Mercury? Where does it Come from?

Mercury is a metallic element found at low concentrations in the earth's crust. Pure mercury is shiny, silver-white and liquid at room temperature. Traditionally it has been used to make products like thermometers, electrical switches, and some light bulbs. Mercury exists in three forms, namely metallic (elemental), inorganic and organic. Methylmercury, which is the most prevalent form of organic mercury, is the most hazardous form.

Mercury can be released into the air and water as a result of volcanic eruptions or weathering of rocks, as well as human activities such as combustion of fossil fuels (especially coal), gold and mercury mining, electroplating, waste incineration, etc.

How are People Exposed to Mercury?

People can be exposed to mercury in their occupational environment. In addition, dental amalgam fillings, Traditional Chinese Medicines and cosmetics are also possible sources of exposure to mercury. Diet, however, is by far the most important source of exposure in most general public.

Mercury in fish


劍魚柳 Swordfish fillet

In streams, lakes and oceans, mercury can be transformed by bacteria into methylmercury, the most hazardous form. Methylmercury is readily taken up by living organisms and is passed along the microscopic plants and animals to larger organisms via the food chain. It can accumulate in fish and bind tightly to the protein in fish tissues, thus large predatory fish such as swordfish, shark and marlin would have a greater tendency to accumulate higher amount of the chemical (Table 1). Fish is the major dietary source of mercury exposure in humans. Cooking cannot reduce the concentration of mercury in fish effectively.


金眼鯛的一種：紅金眼鯛 A kind of alfonsino: *Beryx splendens*

What are the Effects of Mercury on Health?

Mercury and its compounds have no known physiological functions in animals. Acute toxicity is often a result of occupational exposure, but that from dietary exposure is rare. Exposure to high level of mercury can cause adverse effect to the nervous system, especially the developing brain. Hence, developing foetuses, infants and young children are more sensitive to such toxic effects.

The Joint FAO/WHO Expert Committee on Food Additives (JECFA) has established Provisional Tolerable Weekly Intakes (PTWIs) of 5 μg/ kg bw/week for total mercury and 1.6 μg/ kg bw/week for methylmercury, respectively. A local study conducted in 2004 revealed that dietary exposures to total mercury and methylmercury among secondary school students were below their respective PTWIs, meaning that their dietary exposures to these chemicals were unlikely to cause harmful effects. The food group "fish" was identified as the main contributor (59% for both total mercury and methylmercury), followed by the food group "seafood other than fish" (14% of total mercury and 18% methylmercury). Swordfish was found to have the highest concentrations of both total mercury and methylmercury.

Advice to Consumers

1. Susceptible groups such as young children, pregnant women and women

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組，在選擇食物時應加倍小心，宜避免進食體型較大的捕獵魚類。

2. 魚類含有豐富的優質蛋白質和奧米加-3脂肪酸，宜適量食用。

3. 保持均衡飲食，避免過量進食汞含量可能偏高的食物，例如魚類和貝類。

給業界的建議

向可靠的供應商採購食物，切勿購入來自受污染地區的魚類和貝類。

planning pregnancy should be careful in their selection of food, in particular, they are advised to avoid eating large predatory fish.

2. Moderate consumption of fish is recommended as fish is a good source of high-quality protein and omega-3 fatty acids.

3. Maintain a balanced diet and avoid overindulgence of food items that may have high mercury contents (e.g. fish and shellfish).

Advice to the Trade

Obtain food supplies from reliable sources, and do not obtain fish and shellfish from contaminated areas.

食物事故點滴
Food Incident Highlight

食物中的溴酸鹽

二零零七年十二月初，內地當局在美國和日本進口的某些薯片中驗出可能致癌的物質溴酸鉀。不過，食物安全中心在本港抽取的相同牌子同類食品中並無發現溴酸鹽。

溴酸鹽以往常在麪粉處理過程中用作改善麪粉的特性。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(專家委員會)在一九八八年表示，食物不得含有溴酸鹽，但卻容許在麪粉處理過程中使用小量溴酸鹽，只要在最終產品中並無驗出即可。隨着化驗技術日新月異，其後發現最終產品仍含有溴酸鹽殘餘，於是專家委員會決定溴酸鹽不宜用作麪粉處理劑，因此溴酸鹽不得添加在麪粉中。

食物製造商和進口商應向可靠來源採購食物配料，並確保麪粉或麪粉製品不含溴酸鹽。

硝基呋喃、孔雀石綠與罐頭豬肉製品

二零零七年十二月初，食物安全中心抽取多個罐頭豬肉製品進行獸藥殘餘化驗。在抽取的19個樣本中，有兩個含微量的硝基**呋**喃類代謝物，一個含孔雀石綠。根據驗出的殘餘含量，按一般食用量進食問題食品，對健康產生嚴重影響的機會不大。有關分銷商已回收問題食品。

硝基**呋**喃是一類可用作獸藥的抗菌劑，在食物中的主要關注是有某種硝基**呋**喃可能令實驗動物患癌。

孔雀石綠是人造染料，在魚類中可用作抗真菌劑治病。某些孔雀石綠代謝物可長時間留在組織中。由於孔雀石綠可令實驗動物患癌，故食物不應含有孔雀石綠。

食物製造商和進口商應向可靠來源採購食物配料，並確保食物符合本港規定。

回收行動牽涉的產品相片(由左至右)：上海梅林牌B2午餐肉(低鈉)(340克，批次編號B2 5)；梅林牌紅燒排骨(397克，批次編號T12 10)；以及梅林牌午餐肉(198克，批次編號M1 8)。
Photos of products that are affected by the recall (left to right): batch number B2 5 of the 340g cans of "Shanghai MaLing B2 Pork Luncheon Meat (Less Sodium)"; batch number T12 10 of the 397g cans of "MaLing Stewed Pork Ribs"; and batch number M1 8 of the 198g cans of "MaLing Pork Luncheon Meat".

Bromate in Food

在本港抽驗的薯片沒有驗出溴酸鹽
Bromate was not detected in the locally sampled potato chips

In early December 2007, a Mainland authority detected potassium bromate, a possible carcinogen, in certain potato chips imported from the USA and Japan. However, bromate was not detected in similar products from the same brands sampled by the Centre for Food Safety locally.

Bromate was used in treating flour in the past as they can improve the properties of dough. International authority JECFA in 1988 opined that bromate should not be present in food. However, low level of bromate used in flour treatment was allowed provided that its level was not detectable in the final product. With advancement in analytical techniques, it was later found that residues of bromate could be present in the finished product. Subsequently, JECFA concluded that it was not appropriate to use bromate as flour-treatment agent. Therefore, bromate should not be added into flour.

Food manufacturers and importers should source food ingredients from reliable sources and should ensure that flour or flour products do not contain bromates.

Nitrofuran, Malachite Green and Canned Pork Products

In early December 2007, the Centre for Food Safety sampled a number of canned pork products to examine for veterinary drug residues. Out of 19 samples taken, two were found to contain trace amount of a nitrofuran metabolite and one was found to contain malachite green. Based on the levels detected, usual consumption of the affected products is unlikely to pose significant health risk. The distributors concerned had initiated recalls of the affected products.

Nitrofurans are a group of antimicrobial agents which can be used as veterinary drugs. The main concern of nitrofurans in food is that a type of nitrofurans may cause cancer in experimental animals.

Malachite green (MG) is a synthetic dye that can be used as antifungal agent to treat diseases in fish. Certain metabolites of MG may persist in tissues for a long period of time. As MG is able to cause cancer in experimental animals, food should not contain MG.

Food manufacturers and importers should source food ingredients from reliable sources and should ensure that the food complies with local regulations.

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

風險傳達工作一覽（二零零七年十二月） Summary of Risk Communication Work (December 2007)	數目 Number
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公眾查詢 Public Enquiries	136
業界查詢 Trade Enquiries	183
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