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Sulphur Dioxide in Meat

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風險傳達組

科學主任陳家茵女士報告

Reported by Ms. Michelle Chan, Scientific Officer,
Risk Communication Section,
Centre for Food Safety

背景

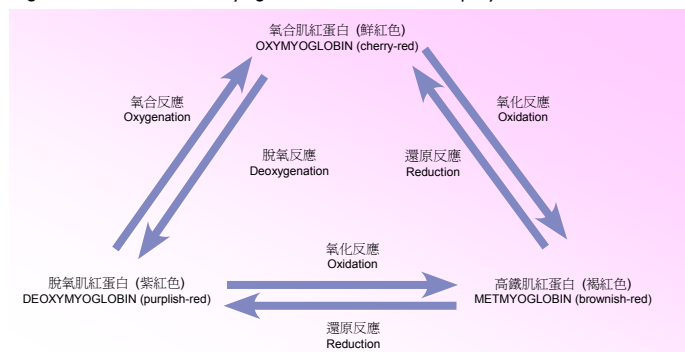
食物安全中心(中心)近日進行了專項食品調查,評估新鮮和冷藏肉類中使用違禁的二氧化硫的情況。調查從街市攤檔和新鮮糧食店合共抽取321個肉類樣本,包括190個豬肉樣本、118個牛肉樣本和13個羊肉樣本,以測試是否含有二氧化硫,結果發現15個樣本(即4.7%)(包括3個豬肉樣本、11個牛肉樣本和1個羊肉樣本)含二氧化硫,含量由百萬分之23至百萬分之3 300。

為什麼在肉類中添加二氧化硫?

新鮮肉類的顏色取決於名為“肌紅蛋白”的帶氧肌肉色素。這種物質主要集中在肉類的表面,可分為脫氧肌紅蛋白、氧合肌紅蛋白和高鐵肌紅蛋白三種形態,而不同形態會呈現不同的顏色(見圖一)。

圖一 新鮮肉類中不同形態的肌紅蛋白所呈現的不同顏色

Fig.1. Various states of myoglobin in fresh meat display different colours



脫氧肌紅蛋白呈紫紅色,是剛切開肉類的原本顏色。如切開的新鮮肉類暴露於空氣中20至30分鐘,脫氧肌紅蛋白便會與氧氣結合,形成呈鮮紅色的氧合肌紅蛋白。街市攤檔和新鮮糧食店所售賣的新鮮肉類通常是這種顏色。不過,當肉類擺放的時間愈久,氧合肌紅蛋白會氧化為高铁肌紅蛋白,肉類呈現褐色的部分會增加。

肉類顏色是消費者用以衡量肉類品質的重要觀感指標。已切開的褐紅色肉類會被視為不新鮮,不宜食用。為讓展示的肉類顏色誘人,有個別商戶在肉類中非法添加二氧化硫,以抑制氧化過程,令肉類即使長時間暴露於空氣中,也可保持消費者喜愛的紫紅色或鮮紅色的新鮮顏色。

Background

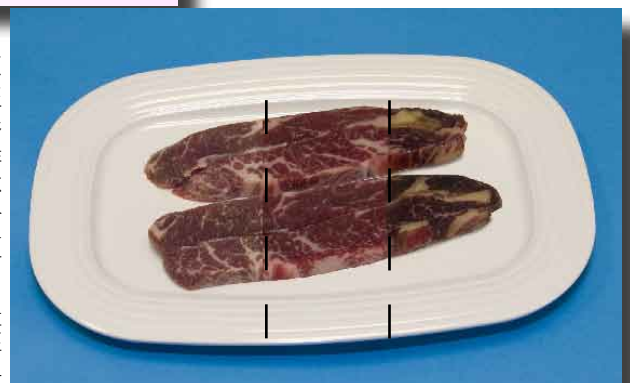
The Centre for Food Safety (CFS) conducted a targeted food surveillance project to assess the use of sulphur dioxide in fresh and frozen meat which is prohibited under current regulations. A total of 321 samples of meat (including 190 pork, 118 beef and 13 mutton samples) from various market stalls and fresh provision shops were collected for testing of the presence of sulphur dioxide. The results revealed that 15 samples (4.7%) (including three pork, 11 beef, and one mutton samples) contained sulphur dioxide at levels between 23 ppm and 3 300 ppm.

Why is Sulphur Dioxide Added to Meat?

The colour of raw meat is determined by the oxygen-carrying muscle pigment known as myoglobin which predominates on the surface of meat. Various states of myoglobin (deoxymyoglobin, oxymyoglobin and metmyoglobin) displaying different colours are shown in Fig. 1.

Deoxymyoglobin is purplish-red and contributes to the interior colour of freshly cut meat. If the raw cut meat is exposed to air for 20 to 30 minutes, the deoxymyoglobin will oxygenate to form cherry-red oxymyoglobin which is the typical colour of fresh meat sold in market stalls and fresh provision shops. However, as display time increases, oxymyoglobin oxidises to metmyoglobin and the portion of meat with brownish discolouration will increase.

Meat colour is an important sensory characteristic by which consumers make judgments of meat quality. Cuts of meat with brownish-red colour will be regarded as not



真空包裝的冷凍牛肉(曾經冷藏)在室溫下除去包裝後的顏色變化。左: 剛從包裝取出。中: 半小時後。右: 27小時後。

Changes in colour of vacuum packed chilled beef (previously frozen) in room temperature after the packaging is removed. Left: Just removed from packaging. Middle: After half an hour. Right: After 27 hours.

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焦點個案
Incident in Focus

二氧化硫是什麼？

二氧化硫是一種防腐劑，經常用於乾果、醃菜和香腸等不同種類的食物中，具有抗菌和防止褐變的功效，並可減慢肉類、水果和蔬菜因氧化造成的變色。

肉類中的二氧化硫對健康有何影響？

二氧化硫是一種毒性低的食物添加劑，可溶於水中。清洗和烹煮可除去食物中大部分的二氧化硫。在一般食用情況下，二氧化硫不會對人體健康造成不良影響。不過，對二氧化硫有過敏反應的人，則可能會出現氣喘、頭痛或噁心等過敏症狀。

有沒有其他方法保持新鮮肉類的顏色？

防腐劑不容許添加於新鮮肉類，但適當的包裝方法及妥善貯存和處理肉類也能保持新鮮肉類的顏色。

包裝

新鮮肉類採用真空包裝能保持脫氧肌紅蛋白所呈現的紫紅色。當拆去包裝後，脫氧肌紅蛋白會迅速重新與氧氣結合，形成呈鮮紅色的氧合肌紅蛋白。

妥善貯存和處理

其實，高鐵肌紅蛋白的形成速度取決於肉類的存放溫度和含菌量等多項因素。把肉類貯存和展示在冷凍環境中，並採用符合衛生標準的方式處理已切開的肉類，均有助保持新鮮的肉類顏色。

本港如何監察肉類中使用二氧化硫的情況？

根據《食物內防腐劑規例》(第132BD章)，二氧化硫、亞硝酸鹽和硝酸鹽等防腐劑均不得用於新鮮或冷藏肉類。中心進行的食物監察計劃，已包括從新鮮糧食店和街市攤檔抽取肉類進行二氧化硫、亞硝酸鹽和硝酸鹽等防腐劑測試。有關肉類中的二氧化硫測試結果的統計數字見圖二。

給業界的建議

1. 遵從法例規定，不應在新鮮肉類中添加二氧化硫。
2. 向可靠來源採購食物。
3. 妥善冷藏新鮮肉類，依從符合衛生標準的方式配製和處理肉類。
4. 如可行的話，採用適當的包裝方法(例如真空包裝)以保持肉類新鮮。

給市民的建議

1. 向可靠的街市攤檔或新鮮糧食店購買肉類。
2. 切勿購買或進食顏色異常鮮紅的肉類。
3. 由於二氧化硫的毒性低，清洗和烹煮可除去食物中大部分的二氧化硫，故在一般食用情況下，不會對人體健康造成不良影響。

更多資料

如需更多有關防腐劑的資料，請瀏覽下列網頁：

- 中心有關肉類中的二氧化硫專項食品調查
- 中心編製有關食物中的防腐劑單張

fresh and undesirable for consumption. In order to display meat with attractive colour, individual traders have been found to add sulphur dioxide to meat illegally to quench the oxidative process. As a consequence, the desirable fresh meat colour (purplish-red or cherry-red) can be retained even though it is exposed to air for an extended period of time.

What is Sulphur Dioxide?

Sulphur dioxide is a commonly used preservative in a variety of foods including dried fruits, pickled vegetables and sausages. In addition to its anti-microbial and anti-browning functions, sulphur dioxide can delay discolouration in meat, fruits and vegetable caused by oxidation.

What are the Health Concerns Regarding Sulphur Dioxide in Meat?

Sulphur dioxide is a food additive of low toxicity. It is also water soluble and most of it tends to be removed through washing and cooking. Upon normal consumption, it should pose no adverse health effects on humans. However, for susceptible individuals who are hypersensitive to sulphur dioxide, allergic symptoms including shortness of breath, headache and nausea may be experienced.

Are Alternative Methods Available to Keep the Colour of Fresh Meat?

Preservatives are not allowed to be added to fresh meat. However, retention of colour of fresh meat can be accomplished by suitable packaging methods as well as proper storage and handling of meat.

Packaging

Vacuum packaging of fresh meat can retain the purplish-red colour of deoxymyoglobin which can be reoxygenated quickly to bright red oxymyoglobin once the package is removed.

Proper storage and handling

In fact, the rate of metmyoglobin formation depends on multiple factors including display temperature and bacterial load. Storage and display of meat under refrigeration and hygienic preparation of meat cuts both help to retain desirable meat colour.

How is the Use of Sulphur Dioxide in Meat Monitored in Hong Kong?

Under Preservatives in Food Regulations, Chapter 132BD, preservatives including sulphur dioxide, nitrite and nitrate are not permitted in fresh or frozen meat. As part of the food surveillance programme, meat taken from fresh provision shops and market stalls is tested for preservatives such as sulphur dioxide, nitrite and nitrate. Relevant statistics showing test results of sulphur dioxide in meat are summarised in Fig. 2.

Advice to the Trade

1. Comply with the legal requirements and should not add sulphur dioxide to fresh meat.
2. Source food from reliable sources.
3. Store fresh meat properly under refrigeration. Prepare and handle meat following hygienic practices.
4. If applicable, employ suitable packaging methods (e.g. vacuum packaging) to keep the freshness of meat.

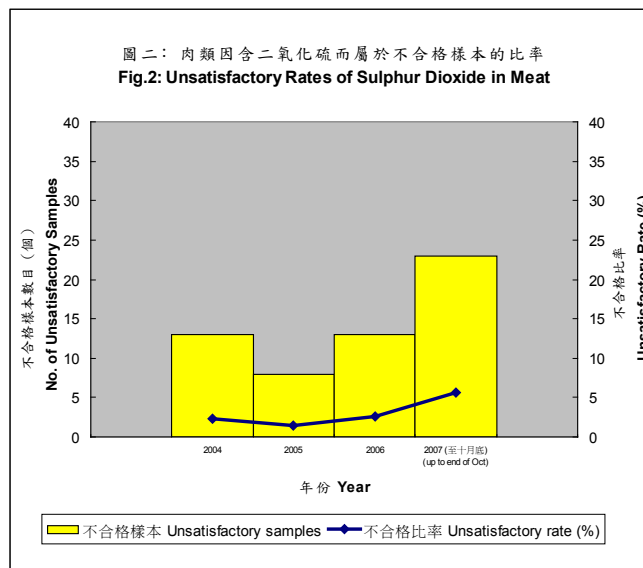
Advice to the Public

1. Purchase meat from reliable market stalls or fresh provision shops.
2. Do not buy or consume meat which is unnaturally red.
3. Since sulphur dioxide is of low toxicity and most of it will be removed through washing and cooking, adverse health effect is unlikely upon normal consumption.

Further Information

Further information about preservatives can be obtained from the following web pages:

- [The CFS Targeted Food Surveillance on Preservatives in Sulphur Dioxide in Meat](#)
- [The CFS Pamphlet on Preservatives in Food](#)



砷與食物安全

Arsenic and Food Safety

食物安全中心
風險傳達組
科學主任游天頌先生報告

Reported by Mr. Arthur YAU, Scientific Officer,
Risk Communication Section,
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本文是《食物中的金屬污染物》系列之四，將會集中探討砷這種類金屬，詳述其不同形態、我們攝取砷的途徑和減少攝入砷的方法。

砷是什麼？

砷是大自然中常見的一種元素，可分為有機砷、三價無機砷和五價無機砷三種形態。在大自然裏，砷多以無機砷化合物的形式，存在於火成岩和沉積岩中。這些砷化合物最終會進入土壤、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，而有機砷的毒性則低很多。

砷化合物用於製造電晶體、雷射產品、半導體、玻璃和顏料等工業用途。由人類活動產生的絕大部分砷化合物屬於三氧化二砷。這種無機砷化合物又稱為砒霜，是中國古典文學中常常提及的一種毒物。至於其他形態的砷化合物，則主要用於製造各種特製合金。

砷如何進入食物內？人們如何攝取到砷？

一般而言，人們通過飲食攝取砷。在水源砷含量自然偏高的地方，飲用水也是人們從飲食中攝取砷的主要來源。不過，本港並無此問題。在二零零六年十月至二零零七年九月，本港飲用水中的砷含量最高值少於每公升0.001毫克，遠低於世界衛生組織在二零零四年就飲用水中的砷含量所訂下的暫定準則值，即每公升0.01毫克。此外，一般人很少會透過空氣或皮膚攝取到砷。

由於大多數砷化合物可溶於水中，故這種金屬較常見於海產，尤其是貝類。根據文獻記載，魚類體內的砷含量由每公斤1毫克至10毫克不等，而底棲攝食動物和貝類則可高達每公斤100毫克。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。另一方面，魚類體內的砷多屬毒性較低的有機砷。根據中心在二零零二年所進行的中學生從食物攝取到重金屬的情況的風險評估研究，攝入量一般和攝入量高的中學生每周從食物攝取的無機砷，按每公斤體重計算分別是2.52微克和6.77微克。即使我們保守地假設從所有食物中檢測出的砷總含量有10%屬於無機砷，有關數字均低於安全水平，即每周按每公斤體重計算可攝取15微克砷。



貝類是本港市民攝取砷的主要食物來源
Shellfish is a major source of dietary arsenic exposure in Hong Kong

據，市民從海產攝取的砷總含量有0.2%至6.0%屬於無機砷。由此可見，從食物中攝取此一水平的砷不會令健康受損。

砷對健康有何影響？

雖然不少中國人可能聞“砒霜”色變，但其毒性須視乎吃下的劑量而定。由食物引致的急性砷中毒罕見，急性砷中毒徵狀包括嚴重嘔吐和腹瀉、肌肉痙攣、面部水腫和心臟衰竭。有報告顯示，吃下2克至21克的砷可引致死亡，但亦有其他報告指吃下1克至16克的砷不會有致命後果。至於從飲用水中長期攝取無機砷，可導致外周血管疾病。雖然人們攝取砷與罹患其他疾病的關係不太明顯，但有證據顯示攝取砷可造成心血管疾病和高血壓。

國際癌症研究機構認為，飲用水中的砷可令人患膀胱癌、肺癌和皮膚癌。此外，由於從事採礦和冶銅的人在工作環境中攝入無機砷(主要透過吸入方式)以致患肺癌、腸胃癌和腎癌的個案增加，故該機構又認為，整體而言，砷和砷化合物會令人患病。

The following article, being the fourth in this series on “Metallic Contaminants in Food”, will focus on arsenic – its various forms, how we are exposed and what can be done to minimise our exposure to arsenic.

What is Arsenic?

Arsenic is an element that is commonly found in nature. Arsenic exists in organic, inorganic arsenic (III) and arsenic (V) forms. In nature, arsenic is often present in igneous and sedimentary rock as inorganic arsenic compounds. These arsenic compounds may end up in soil, air, water or become airborne. The inorganic forms are usually considered more toxic to human, whereas the organic forms are of much less concern in toxicity.

Arsenic compounds are used industrially in the production of transistors, lasers, semiconductors, glass and pigments. A large majority of arsenic compounds related to human activities is in the form of inorganic arsenic trioxide. This particular compound is known as *pishuang* in Chinese, which is a poison often mentioned in old Chinese literature. The other forms of arsenic compounds are mainly used for the production of special alloys.

How Does Arsenic End Up in Food? How are People Exposed?

Generally, people are exposed to arsenic through eating. In areas where water is naturally high in arsenic, drinking water is also a significant contributor to the dietary intake. However, this is not of local concern as the maximum level of arsenic in [potable water in Hong Kong](#) is less than 0.001 mg/l between October 2006 and September 2007. This is well below the 2004 World Health Organization's provisional guideline value of 0.01 mg/l arsenic in drinking water. Furthermore, absorption of arsenic through air and skin only plays a minor role in the general population.

As arsenic compounds are mostly soluble in water, arsenic is more likely to be present in seafood, especially shellfish. According to literature, the level of arsenic can range from 1 to 10 mg/kg in fishes and up to 100 mg/kg in bottom feeders and shellfish. 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. On the other hand, arsenic present in fish is more often in the less toxic organic form. According to the CFS [Risk Assessment Study on the Dietary Exposure to Heavy Metals in Secondary School Students](#) in 2002, the dietary exposure of inorganic arsenic is 2.52 and 6.77 µg/kg body weight/week for average eaters and high consumers respectively. These are lower than the safety level of 15 µg/kg body weight/week, even though a conservative assumption that 10% of total arsenic detected is in inorganic form in all food is made. Our own data suggests that the proportion of total arsenic in seafood that is inorganic ranged from 0.2% to 6.0% locally. This level of dietary arsenic exposure is unlikely to cause health problems.

What are the Effects of Arsenic on Health?

Even though *pishuang* may sound frightening to many Chinese, its toxicity is determined by the dose ingested. Acute poisoning due to arsenic present in food is rare. Symptoms of acute arsenic poisoning include severe vomiting and diarrhoea, accompanied by muscular cramps, facial oedema and cardiac dysfunction. It had been reported that an oral dose of 2 to 21g of arsenic was fatal, while others reported non-fatal outcome when 1 to 16g arsenic was ingested. Chronic exposure to inorganic arsenic via drinking water may cause peripheral vascular disease. The relationship of arsenic exposure and other diseases are less clear, but there is evidence for cardiovascular diseases and hypertension.

The International Agency on Research on Cancer (IARC) considered that arsenic in drinking water can cause cancer of the urinary bladder, lung and skin. IARC also consider arsenic and arsenic compounds as a whole are carcinogenic to humans, as occupational exposure to inorganic arsenic, mainly by inhalation, in mining and copper smelting increases the incidents of lung, gastrointestinal and renal cancer.

食物安全平台
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給消費者的建議

1. 向可靠的店鋪購買食物。
2. 保持均衡飲食，避免大量進食貝類。

給業界的建議

向可靠的供應商採購食物，切勿購入受污染地區的貝類和其他海產。

Advice to Consumers

1. Obtain food supplies from reliable sources.
2. Maintain a balanced diet and to avoid overindulgence of shellfish.

Advice to the Trade

Obtain food supplies from reliable sources and not to obtain shellfish and other seafood from contaminated areas.

食物事故點滴
Food Incident Highlight

種籽類食品中的沙門氏菌

由今年十月中起，英國食物標準局就回收受沙門氏菌污染的種籽類食品(包括芝麻籽和什錦種籽)發出數則食物警報。

回收行動由英國數間健康食品連鎖店和超市集團主動展開。部分問題產品屬於即食食品，可拌進乳酪和沙津中。

種籽類食物可在生長、收割或貯存期間受沙門氏菌污染。充分的加熱程序應足以殺死此菌。不過，這類食物經過加熱程序後仍可在生產環境中再次受沙門氏菌污染。感染沙門氏菌的人可出現發燒和腹痛及腹瀉等腸胃不適，而這些症狀在嬰兒和長者身上會較嚴重。

製造商應確保食物生產過程有足夠措施消滅沙門氏菌，並防止食物透過下列途徑再受污染，例如受污染的生配料、生產廠房內的動物、經包裝物料或人類把沙門氏菌從外面環境帶進廠房。

李斯特菌與青口

食物安全中心(中心)接獲新西蘭當局通知，指某批在新西蘭加工的冷藏青口肉樣本中驗出李斯特菌而需回收。由於有關懷疑受污染的食品已出口至本港，故中心在十一月二十五日發出警報，呼籲零售商停售疑受李斯特菌污染的數批新西蘭冷藏青口肉。



涉及回收行動的冷藏青口樣本
A sample of the frozen mussels that are affected by the recall

雖然李斯特菌病在本港並不常見，而身體健康的人也很少會出現感染症狀，但長者、初生嬰兒、孕婦和免疫力較弱的人卻易受此菌感染。由於李斯特菌自然存在於泥土和水中，許多生的食物都含有此菌。烹煮能殺死李斯特菌。不過，此菌可在受污染的冷藏食物中繁殖，因此市民必須小心處理已煮熟的食物，防止其再受污染。

至於屬於易受影響群組的人士，則應避免進食高風險食物，例如冷凍即食食物和冷藏食物(包括沒有經巴士德消毒法處理的奶製品、軟芝士、冷吃肉類、肝醬、預先製成的沙律及煙燻或生的海產)。

Salmonella in Seed Products



芝麻籽
Sesame seeds

Since mid-October 2007, the Food Standards Agency (FSA) in the United Kingdom (UK) has issued a number of food alerts regarding the recall of seed products (including sesame seeds and seed mixes) due to *Salmonella* contamination. The recall incidents have been initiated by a variety of health food chains as well as supermarket chains in the UK. Some of the products concerned were ready-to-eat which could be added to yoghurts and salads.

Seeds can become contaminated with *Salmonella* during growth, harvest or storage. Adequate heat processing should be able to kill the bacteria. However, after heat treatment, seeds can become re-contaminated by *Salmonella* that are present in the production environment. Individuals who are infected with *Salmonella* may suffer from fever, and gastrointestinal discomfort such as abdominal pain and diarrhoea. The symptoms are more severe in infants and the elderly.

Manufacturers should ensure adequate processing in their food production steps to eliminate the bacteria, and to prevent re-contamination (e.g. by contaminated raw ingredients, by animals in the production plant, by *Salmonella* brought into the production plant via packaging materials or humans from the outside environment).

Listeria monocytogenes and Mussels

The Centre for Food Safety (CFS) appealed to retailers on 25 November to stop selling certain lots of frozen mussel meat from New Zealand (NZ) due to the suspected contamination with *Listeria monocytogenes*. The alert was made after the CFS was informed by the NZ authority of a product recall as the bacterium was detected in samples of frozen mussel meat processed in NZ and the products suspected to be contaminated had been exported to Hong Kong.

Although listeriosis is uncommon in Hong Kong and the symptoms of infection are rare in healthy individuals, the elderly, the newborn, pregnant women and people with weakened immunity are particularly at risk. The bacteria exist naturally in soil and water and consequently exist in many raw foods. Cooking can kill the bacteria. However, they tend to grow in refrigerated food that is contaminated and therefore one must be careful when handling cooked food to prevent re-contamination.

People of the susceptible groups should avoid consuming high risk food such as chilled ready-to-eat foods and refrigerated foods. They include unpasteurised dairy products, soft cheeses, cold cuts, pate, prepared salads, smoked and raw seafood.

風險傳達
工作一覽
Summary of
Risk Communication Work

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