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焦點個案 Incident in Focus

可樂類飲料中的4-甲基咪唑 4-Methylimidazole (4-MEI) in Cola Drinks

食物安全中心
風險評估組
科學主任郭麗儀女士報告

Reported by Ms. Joey KWOK, Scientific Officer,
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二零一四年一月，美國一份消費者雜誌刊登調查結果，指出美國市面上售賣的可樂類飲料依然普遍含有4-甲基咪唑。報道令可樂類飲料含化學污染物4-甲基咪唑的問題再次備受關注。

食物中的4-甲基咪唑

焦糖色素(又稱醬色)分醬色I、醬色II、醬色III及醬色IV四類，其中醬色III和醬色IV由鈹類化合物與碳水化合物在不同溫度和壓力下合成，過程中可能會產生污染物4-甲基咪唑。

焦糖色素可使食品呈獨特的棕褐色，廣泛應用於可樂類飲料、啤酒和豉油等食品中。在預先包裝食物的標籤上，焦糖色素的國際編碼系統編號為150，四類焦糖色素的編號分別為150a、150b、150c及150d。

市民在進食含醬色III和醬色IV的食物和飲料時可能會攝入少量4-甲基咪唑。另外，一些食物在烤烘時也會衍生4-甲基咪唑。

對公眾健康的影響

由於4-甲基咪唑可能致癌，令人關注進食含這種物質的食物是否安全。國際癌症研究機構基於動物實驗結果，評估4-甲基咪唑的致癌性，把4-甲基咪唑列為“或可能令人類致癌”(第2B組)的物質。

聯合國糧農組織/世衛聯合食物添加劑專家委員會(專家委員會)，以至近期的歐洲食品安全局均曾對焦糖色素的安全性作出評估，兩者皆認為以人們進食含醬色III和醬色IV的食物而攝入的4-甲基咪唑量，不會造成健康問題。

二零一二年三月，當可樂類飲料含4-甲基咪唑一事曝光時，在可樂類飲料中檢測出的4-甲基咪唑最高水平是每12安士(約360毫升)含153微克4-甲基咪唑。根據我們所作的風險評估，要達到令啮齒類動物致癌的劑量，一名體重60公斤的消費者每天須飲

The issue of 4-methylimidazole (4-MEI), a chemical contaminant, present in cola drinks was once again brought in the limelight in January 2014 when a United States consumer magazine published survey results pointing out that 4-MEI was still widely present in cola drinks available in the US market.

4-MEI and its Occurrence in Foods

Caramel colours are divided into four classes, namely Caramel I, II, III and IV. 4-MEI is a contaminant formed during the manufacturing of Caramel III and IV which involves the interaction of ammonium compounds with carbohydrates under varying conditions of temperature and pressure.

Caramel colours can be used in different foods such as cola drinks, beers, soy sauces, etc. to give the distinctive brown colour. On labels of prepackaged food, caramel colours may be identified with the International Numbering System number "150", whereas the four subclasses may be more specifically identified as "150a", "150b", "150c" and "150d", respectively.

The public may be exposed to low levels of 4-MEI through the consumption of foods and beverages containing Caramel III and IV. In addition, 4-MEI can also be formed in some foods as a by-product during roasting.

Public Health Significance

The safety of 4-MEI in food has raised concern because of its cancer-causing potential. The International Agency for Research on Cancer has evaluated the carcinogenicity of 4-MEI and considered that there was sufficient evidence in experimental animals for the carcinogenicity of 4-MEI and concluded that 4-MEI is "possibly carcinogenic to humans" (i.e. Group 2B).

In the evaluation on caramel colours conducted by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) and more recently again by the European Food Safety Authority, it was considered that the exposure level to 4-MEI that could result from the consumption of foods containing

Caramel III and IV did not give rise to concern.

When the issue of 4-MEI present in cola drinks was brought to public attention in March 2012, the highest level of 4-MEI found in cola drinks was 153 micrograms per can of 12 fl. oz. (about 360 mL). Based on our risk assessment, a 60-kg individual would have to consume over 300 cans



可樂類飲料普遍使用焦糖色素以呈現獨特的棕褐色
Caramel colours are commonly used in cola drinks to give the distinctive brown colour

焦點個案
Incident in Focus

用300罐以上含有該濃度的可樂。這次調查檢出每樽汽水(12安士)最高含352.5微克4-甲基咪唑，消費者每天仍須飲用130樽以上含有該濃度的汽水，才會達到令啮齒類動物致癌的劑量。美國食物及藥物管理局認為，因使用焦糖色素而含有4-甲基咪唑的食物並無即時或短期危險，並不建議消費者因為擔心4-甲基咪唑而改變飲食習慣。

法定規管

雖然目前並無國際公認的4-甲基咪唑健康參考值，亦無食物中的最高准許含量，但專家委員會在其化學品質量規格中對醬色III和醬色IV裡的4-甲基咪唑訂定了限量標準，作為優良製造規範的指標。在美國，焦糖色素可作為染色料在食物中安全地使用。在本港，焦糖色素是准許染色料。

雖然國際規管機構普遍認為使用焦糖色素的食物含有4-甲基咪唑並無安全問題，美國加州取態不同，規定企業如所生產或銷售的產品會令人每天攝入超過29微克的4-甲基咪唑，便須加上警告字句。標有警告字句並不代表有關產品違反了任何食物安全標準，只是方便加州市民作出知情的選擇。

注意要點

- 4-甲基咪唑是醬色III及醬色IV(編號150c和150d)製作過程中產生的污染物。
- 市民在進食以醬色III和醬色IV生產的食物和飲料時可能會攝入少量4-甲基咪唑。
- 根據現有資料，因進食含醬色III及醬色IV的食物而攝入的4-甲基咪唑量沒有安全問題。

給業界的建議

1. 焦糖色素生產商應在技術許可的情況下，通過良好的過程控制，把4-甲基咪唑的含量減到最少。
2. 食物生產商在使用食物色素時，分量應只限於在食物中發揮預期增色用途所需的最低分量。
3. 確保所有出售的食品均符合本港規例，包括食物添加劑及標籤規定等。

給市民的建議

1. 保持均衡飲食，以免因偏食幾類食品而過量攝入食物添加劑和污染物。
2. 關注這問題的消費者可以查看預先包裝食物上的標籤是否標示含有焦糖色素或特別列明醬色III和醬色IV或其編號(150、150c和150d)，便可知所選擇。

of that cola drink daily to reach the doses causing cancer in rodents. Referring to the highest level of 4-MEI found in the recent survey (352.5 micrograms of 4-MEI per bottle of 12 fl. oz.), an individual would still have to consume over 130 bottles of the soft drink daily to reach the doses causing cancer in rodents. The US Food and Drug Administration considers that there is no immediate or short-term danger presented by 4-MEI in foods from the use of caramel colours, and does not recommend consumers change their diets because of concerns about 4-MEI.

Regulatory Control

At present, there is no internationally recognised health-based guidance value for 4-MEI nor its maximum permitted levels in foods. Nevertheless, JECFA has specified the maximum levels of 4-MEI in Caramel III and IV in the chemical specifications of caramel colours to indicate good manufacturing practice. In the US, caramel colours may be safely used for colouring foods generally. In Hong Kong, caramel is a permitted colouring matter.

Whilst international authorities have opined that 4-MEI in foods from the use of caramel colours does not give rise to concern, the US State of California has adopted a different approach, and requires businesses to provide a warning if they manufacture or sell products in California that cause exposures to 4-MEI of more than 29 micrograms/day. Such warning does not necessarily mean a product is in violation of any food safety standards. Rather, it serves to enable Californians to make informed decisions.

Key Points to Note

- 4-MEI is a contaminant formed during the manufacturing of Caramel III and IV (150c, 150d).
- Public members may be exposed to low levels of 4-MEI through the consumption of foods prepared with Caramel III and IV.
- Based on the available information, exposure to 4-MEI resulting from the consumption of foods containing Caramel III and IV does not give rise to concern.

Advice to the Trade

1. Manufacturers of caramel colours should maintain the levels of 4-MEI as low as technically possible through appropriate process control.
2. Food manufacturers should use food colours with the lowest possible level required for the intended colouring function.
3. Ensure that all food products for sale comply with local regulations, including food additive and labelling requirements.

Advice to the Public

1. Maintain a balanced diet so as to avoid excessive exposure to food additives and contaminants from a small range of food items.
2. For concerned individuals, they can read food labels on prepackaged food and look for caramel colours or more specifically Caramel III and IV, or their identification numbers (150, 150c, 150d) to make informed choices.

風險傳達 工作一覽 Summary of Risk Communication Work

風險傳達工作一覽 (二零一四年一月) Summary of Risk Communication Work (January 2014)	數目 Number
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家居烹調方法與食物安全

Home-cooking Methods and Food Safety

食物安全中心
風險評估組
科學主任陳蓉蓉女士報告
Reported by Ms. Melva CHEN, Scientific Officer,
Risk Assessment Section,
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烹調是將不同食材混合、配搭並加熱而成菜餚的操作過程。烹調除了有助消滅病原體，減少生物性危害外，還可增加食物的色香味，改變食物的質感，使食物更容易消化。不過，食物在烹調過程中也有可能形成對我們健康有害的物質。由本期開始，我們將一連四期介紹烹調方法與食物安全，本文將率先談談一些常見的家居烹調方法引起的危害及有關的對策。

烹調引起的危害

煎炸和烘焗食物時的高溫會令食物起化學變化，從而在過程中產生**丙烯酰胺**、某些**多環芳香族碳氫化合物(PAHs)**及**雜環胺(HCAs)**等會令或可能令人類患癌的污染物。此外，高溫會促進食物中油脂的氧化過程，釋放不利於健康的物質，例如對心臟和血管的傷害較膽固醇有過之而無不及的**膽固醇氧化物(COPs)**。至於水煮和蒸煮這些烹調方法，溫度一般不會超過攝氏100度，很少形成**丙烯酰胺**、**PAHs**和**HCAs**。但肉類始終不宜長時間(三小時以上)反覆烹煮，因為這樣也有可能釋放**COPs**。由此可見，控制煮食溫度和時間是十分重要的。

Cooking is the practice or skill of preparing food by combining, mixing, and heating ingredients. It helps kill pathogens and improve biological safety, adds flavours to the food, modifies the texture as well as makes them easier to be digested. However, cooking may also generate undesirable substances that are harmful to our health. This article is the first of a series of four on cooking methods and food safety, and will talk about the hazards generated by some common home-cooking methods and ways to reduce the risk.

Hazards Generated by Cooking

The high temperature of frying and baking can cause chemical changes in food and subsequently generate process contaminants such as **acrylamide**, certain **polycyclic aromatic hydrocarbons (PAHs)** and heterocyclic amines (HCAs), which have been found to be carcinogenic or potentially carcinogenic to humans. In addition, high temperatures will promote oxidation of fats in food and form undesirable substances such as cholesterol oxidation products (COPs) which can be more injurious to heart and blood vessels than cholesterol. The temperatures of boiling and steaming usually do not exceed 100°C and formation of acrylamide, PAHs and HCAs are unlikely. Even so, repeated and prolonged boiling (e.g. longer than three hours) of meat is not recommended because it may also cause the formation of COPs. Therefore, the control of both the temperature and time during cooking is important.

八種常見家居烹調方法比較
Comparison of 8 common home-cooking methods

方法 Methods	溫度* Temperature	時間 Time	主要關注的污染物 Major contaminants of concerns	能否保留蔬菜中的水溶性維他命 Retain water soluble vitamins in vegetables
炒 Stir-frying	(~160-240°C)	短 Short	- 蔬菜中的 丙烯酰胺 - Acrylamide in vegetables	√
焗 Baking	(~150-230°C)	長 Long	- 高脂肉類中的 PAHs 和 COPs - PAHs and COPs in high-fat meats	X
炸 Deep-frying	(~160-200°C)	短 Short	- 蔬菜中的 丙烯酰胺 ，尤指馬鈴薯製品 - Acrylamide in vegetables especially potato products - 翻用食油中的 PAHs - PAHs concentrated in re-used cooking oils - 肉類和動物油脂中的 COPs - COPs in meats and animal fats	X
煎 Pan-frying	(~150-200°C)	短 Short	- 肉類中的 HCAs - HCAs in meats	X
煮 Boiling	(~100 °C)	中等 Medium	- 水焯和浸熟不大可能產生污染物 - Unlikely to form contaminants with blanching and poaching - 含動物油脂的火鍋湯底重覆翻滾可能會產生 COPs - Repeated boiling of hot-pot soup containing animal fats may form COPs	X
蒸 Steaming	(~100°C)	中等 Medium	- 不大可能產生污染物 - Unlikely to form contaminants	√
炆 Stew	(~80-100°C)	長 Long	- 高脂肉類經長時間加熱可能會產生 COPs - COPs may be produced during prolonged and repeated heating of high-fat meats	X
隔水燉 Cooking food or soup in a covered container over simmering water	(~60-100°C)	長 Long	- 產生的 COPs 分量微不足道，原因是隔水燉的食材多為瘦肉、水果和中草藥 - Unlikely to form significant amounts of COPs as this method is usually for cooking lean meats, fruits and Chinese herbs	X

*指一般家居烹調溫度。煎炸和焗的最高烹調溫度受多種因素影響，例如食油種類和煮食爐／焗爐火力等。

*Refers to usual home-cooking temperatures. The maximum cooking temperatures of frying and baking can be affected by various factors such as types of cooking oils and power of the stoves/ovens.

減低風險的家居烹調貼士

只要調整烹調時間、溫度及／或其他處理食物的方式，便可減少烹調過程中形成的污染物，吃得自然更健康。

縮短煎炸時間

- 炒菜前先把菜在沸水裡焯一分鐘；肉類和馬鈴薯在煎炸前先以水煮或蒸至半熟。
- 馬鈴薯和其他澱粉類食物煎炸至淺金黃色即可，不宜炸至深褐色。
- 用食物溫度計檢查肉類溫度，一煮熟便立即盛起。

調低溫度

- 切勿全程用猛火煎炸或烘焗食物。
- 避免把食油加熱至冒煙。

其他處理方式

- 烹調前把肉類和家禽的肥膏切去，有助減少PAHs和COPs。
- 把馬鈴薯切得厚一些，因為厚切馬鈴薯表面面積對體積的比例較薄切馬鈴薯低，有助減少丙烯酰胺的形成。
- 薯片在油炸前先沾上粉漿（如粟米粉漿或麵粉漿），可以減低丙烯酰胺的產生。
- 經常更換食油以保持品質。

Home-cooking Tips to Reduce Risks

By modifying cooking times, temperatures and/or other types of handling, the amount of process contaminants formed can be reduced and the foods can be enjoyed in a healthier way.

Shortening frying time

- Blanch (immerse in boiling water for one minute) vegetables and partially boil or steam meats and potatoes before frying.
- For potatoes and other starchy products, go for a light golden colour rather than a darker brown colour.
- Use a food thermometer to gauge the meat temperature so the meat can be removed from heat as soon as it is ready.

Lowering the temperature

- Do not use high heat during the whole frying or baking process.
- Avoid heating oil until it smokes.

Other types of handling

- Trimming visible fats of meats and poultry before cooking may help reduce PAHs and COPs.
- Cutting potato into thick chips/slices which have a lower surface area to volume ratio compared to thinner chips/slices may help reduce acrylamide formation.
- Coating potato chips with batters (e.g. corn starch or wheat flour batters) before frying may help reduce acrylamide formation.
- Replace cooking oil as needed to maintain quality.



烹製家禽及禽蛋的食物安全措施

上月，一批來自廣東省佛山市的活家禽樣本對H7禽流感病毒呈陽性反應。為防止病毒進入社區，從而減低禽流感的風險，當局即時採取應變措施，包括立即暫停進口和售賣活家禽21天，以及銷毀活家禽。

世界衛生組織指出，肉類(包括家禽和野禽)經適當處理和烹煮後可安全食用，原因是正常的煮食溫度(肉類中心溫度最少達攝氏70度)可使流感病毒失去活性。市民應把家禽和禽蛋徹底煮熟，確保肉色不再呈粉紅色，蛋黃已經凝固。

不過，食物處理人員應緊記採取預防措施，提防交叉污染。處理家禽和禽蛋後，要用肥皂徹底洗淨雙手；在配製食物的過程中遵守良好的衛生規範；並保持廚房範圍清潔衛生。

Food Safety Practices in Preparing Poultry and Poultry Eggs

Last month, samples of live poultry imported to Hong Kong from Foshan City of Guangdong Province were tested positive for H7 avian influenza (AI) virus. Contingency measures, including immediate suspension of import and sale of live poultry for at least 21 days and culling of live poultry, were implemented immediately to halt the virus from spreading to the community, thereby greatly reducing the risk of AI.

The World Health Organization considers that it is safe to consume properly prepared and cooked meat, including poultry and game birds, since viruses could be inactivated by normal cooking temperatures (i.e. with centre temperature at or above 70°C). The public is advised to cook poultry and poultry eggs thoroughly making sure that the meat is not pink and egg yolks are not runny.

Nevertheless, food handlers are reminded to take precautionary measures to prevent cross contamination. Food handlers should wash hands thoroughly with soap after handling poultry and poultry eggs, use good hygienic practices in food preparation, and maintain good hygiene in kitchen area.

象拔蚌中的麻痺性貝類毒素和砷

二零一三年十二月，食物安全中心(中心)透過恆常的食物事故監察系統，獲悉中國內地禁止美國若干水域的雙殼貝類進口，原因是在一批美國進口的象拔蚌中檢出麻痺性貝類毒素和砷超出內地標準。中心隨即在本港零售點抽取12個象拔蚌樣本作麻痺性貝類毒素和砷檢測，結果全部合格。

另一方面，上月有本地傳媒從市面上抽取海產樣本作化驗，雖然象拔蚌的砷含量合格，但據報有兩個桂花蚌(海參腸臟)的樣本檢出高含量砷。中心立即抽取樣本進行化驗，結果並無樣本超標，故市民無須憂慮。

中心建議市民保持均衡飲食，以免因偏食幾類食品而過量攝入污染物。

PSP Toxins and Arsenic in Geoduck

In December 2013, the Centre for Food Safety (CFS) detected through its routine Food Incident Surveillance System that Mainland China has banned the import of bivalves shellfish harvested from certain waters of the US because a shipment of geoduck from the US was found to contain paralytic shellfish poisoning (PSP) toxins and arsenic exceeding the Mainland standards. The CFS immediately collected 12 geoduck samples from local retail outlets for testing of PSP toxins and arsenic. All results were satisfactory.

Separately, the local media tested seafood samples taken from the local market last month. While the geoduck samples were satisfactory, it was reported that two osmanthus mussel (sea cucumber intestine) samples were detected with high levels of arsenic. The CFS immediately took follow-up samples for laboratory analysis. No unsatisfactory results were found. There was no cause of concern.

Members of the public are advised to maintain a balanced diet so as to avoid excessive exposure to contaminants from a small range of food items.