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廚房內的穀氨酸

Glutamate in Your Kitchens

食物安全中心風險評估組
科學主任黃詩雯女士報告

Reported by Ms. Sosanna WONG, Scientific Officer,
Risk Assessment Section, Centre for Food Safety

1908年，日本教授池田菊苗從海帶湯分離出穀氨酸，並斷定穀氨酸為湯帶來鮮味。他又注意到那湯的味道與甜味、酸味、苦味和鹹味截然不同，並將該種味道命名為鮮味，即第五種味道。自此，穀氨酸一般以穀氨酸一鈉(俗稱味精)的型態進行商業生產，廚師和在家煮食的人常會用以增加菜式的味道。

In 1908, Kikunae Ikeda, a Japanese professor, extracted glutamate from a seaweed broth and determined that glutamate provided a savoury taste to the broth. He also noticed that the taste of the broth was distinct from sweet, sour, bitter, and salty and named it umami, the fifth taste. Since then, glutamate, generally in the form of monosodium glutamate (MSG), has been commercially produced and can be found in kitchens where chefs and home cooks often use to enhance flavour of their dishes.

味精和穀氨酸是什麼？

味精是沒有氣味的穀氨酸白色結晶鈉鹽，而穀氨酸是大自然中含量最高的氨基酸之一，各種生物包括人類都會產生穀氨酸。目前，多種穀氨酸鹽(例如鉀、鈣、鎂和鈉，統稱為「穀氨酸」)都用作食物增味劑。多種食物如調味料也可能含有天然或人工穀氨酸。味精的商業生產過程使用發酵技術，把多種來源的糖分轉化為穀氨酸(圖1)。

What are MSG and Glutamates?

MSG is a white crystallised, odourless sodium salt of glutamic acid, one of the most abundant amino acids found in nature and produced by living organisms including humans. To date, various salts (e.g. potassium, calcium, magnesium and sodium) of glutamic acid (collectively known as "glutamates") have been added to food as flavor enhancers. Various foods such as seasonings and condiments may also contain glutamates from natural or artificial sources. The commercial production of MSG uses fermentation technology to convert sugar sources to glutamates (Figure 1).

由於穀氨酸在食物中無處不在，成年人從食物攝取大量天然或人工穀氨酸：

(1) 天然來源：(i)「結合」穀氨酸結合成蛋白質，幾乎存在於所有食物如奶類、肉類、家禽、魚類、蔬菜和菇類；(ii)「游離」穀氨酸(即不與蛋白質結合)存在於蕃茄、菇類、酵母萃取物、發酵魚露和發酵/水解蛋白質食物(如豉油)，給予這些食物美味；及

Owing to its ubiquitous presence in foods, the dietary exposure to glutamates in adults is extensive through natural or man-made sources:

(1) Natural sources: (i) "bound" glutamates that occur as proteins in almost all food such as milk, meat, poultry, fish, vegetables and mushrooms; and (ii) "free" glutamates (i.e. not bound to proteins) present in tomatoes, mushrooms, yeast extracts, fermented fish sauce and fermented/hydrolysed protein products (such as soy sauce), accounting for these foods; and

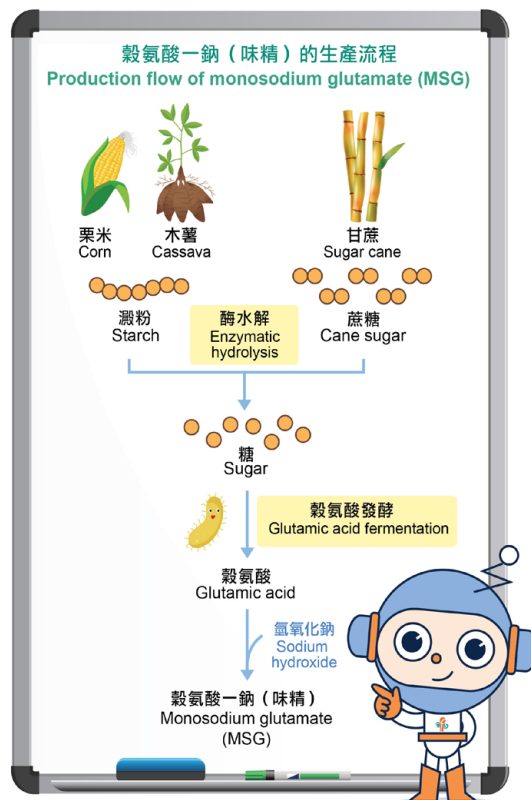


圖1：從多種來源的糖分發酵生產味精

Figure 1: MSG is produced by the fermentation of sugar sources

(2) 人工來源：「游離」穀氨酸以穀氨酸鹽的型態(如味精)添加到食物中。

游離穀氨酸可依附在舌頭的受體產生鮮味，結合穀氨酸則不可依附在受體產生鮮味。天然穀氨酸與人工生產的穀氨酸並無化學上的區別，這些穀氨酸在我們身體內的代謝過程是一樣的。

美國食品及藥物管理局指出，美國一般成年人平均每天從食物中的蛋白質攝取約13克穀氨酸，而添加味精每天的攝取量估計約為0.55克。其他研究結果顯示，在歐洲人口中，味精的平均攝取量佔穀氨酸總攝取量百分之六至十二之間。總括而言，來自食物添加劑的游離穀氨酸僅佔各種來源穀氨酸總攝取量的一小部分。

味精的安全性

聯合國糧食及農業組織 / 世界衛生組織食物添加劑聯合專家委員會把穀氨酸及各種穀氨酸鹽的每日可攝取量列為「不詳列」類別，意即使用作食物添加劑不會影響人體健康。美國食品及藥物管理局表示，在食物中添加味精「普遍認為是安全的」。根據食品法典委員會所述，若按照優良製造規範的原則，味精一般可用於食物，即添加於食物內的味精分量，以發揮該添加劑的預期作用所需的最低分量為限。

自1960年代末，有聲稱指味精對進食含味精食物的人士引起多種不良反應。然而，多項國際科學評估的結論是，目前的證據不足以支持食用味精和頭痛、頸後麻木或刺痛和面色潮紅等症狀之間存在任何因果聯繫。

味精跟餐桌鹽同樣含有鈉。儘管鈉是維持血漿量、酸鹼平衡、神經脈衝傳遞和正常細胞功能必不可少的營養素，過量攝取鈉或會引致血壓上升等非傳染病。一般來說，減少使用餐桌鹽和含鈉的食物添加劑有助減少鹽的食用量。

如何得知食物是否含有味精？

根據本港規例，預先包裝食物如添加了味精，便須在標籤的配料表上標示其名稱(即穀氨酸一鈉)或國際編碼(即621)及作用類別(即增味劑)。成分標示的規定對其他添加穀氨酸(即編碼為620 - 625的添加劑)同樣適用。

給食物業的建議

- 如在食物中使用味精，便應按照優良製造規範，使用達到增味效果所需的最低分量。
- 按照規定在標籤上妥為標示味精等食物添加劑。

給市民的建議

- 考慮用香草和香料(如辣椒、薑等)及穀氨酸含量豐富的配料(如蕃茄、菇類等)來提升食物的味道，以減少鈉的攝取量。
- 閱讀食物標籤，以作出知情的選擇。
- 如希望避免食用味精，可向餐廳員工查詢食物是否有使用味精。

(2) Man-made sources: "free" glutamates added to the diet as salts of glutamic acid such as MSG.

Free glutamates can bind to specific receptors on the tongue and induce the umami flavor, whereas bound glutamates cannot bind to the receptors to induce the umami flavour. Natural glutamates and those artificially produced are chemically indistinguishable and both sources of glutamate are metabolised in the same way in our bodies.

According to the U.S. Food and Drug Administration (FDA), an average adult in the U.S. consumes approximately 13 grams of glutamate each day from the protein in foods, while the intake of added MSG is estimated at around 0.55 gram per day. Other studies show that among the European population, the average MSG consumption represents between 6 and 12% of total glutamate intake. In summary, the intake of free glutamate from food additives only contributes to a small proportion of the total intake of glutamates from all sources.

Safety of MSG

The Joint FAO/WHO Expert Committee on Food Additives allocated an acceptable daily intake "not specified" to glutamic acid and its salts, meaning that their use as food additives does not represent a health concern. The FDA of the U.S. considers the addition of MSG to foods to be "generally recognised as safe". According to the Codex Alimentarius Commission, MSG can be used in foods in general when used in accordance with the principle of Good Manufacturing Practice (GMP), that is, the quantity of MSG added to food shall be limited to the lowest possible level necessary to accomplish the desired effect.

Since the late 1960s, MSG has been claimed to be the cause of a range of adverse reactions in people who have eaten foods containing the additive. However, international scientific assessments have concluded that available evidence does not establish a causal relationship between the consumption of MSG and the development of symptoms such as headache, numbness or tingling in the back of the neck and flushing.

Like table salt, MSG also contains sodium. While sodium is an essential nutrient necessary for the maintenance of plasma volume, acid-base balance and normal cell function, excessive sodium intake is linked to non-communicable diseases, including elevated blood pressure. In general, salt consumption can be reduced by using less table salt and sodium-containing food additives.

How can I Tell if MSG is Present in My Food?

Under the local labelling regulation, if MSG is added to prepackaged food, the requirement is to list out its specific name (i.e. monosodium glutamate) or identification number under the International Numbering System (INS) (i.e. 621) together with its functional class (i.e. flavour enhancer) in the ingredient list on the food label. Ingredient labelling also applies to other added glutamates (i.e. additives designated 620 - 625).

Advice to Food Businesses

- Use in accordance with GMP to limit the quantity of MSG to the lowest level for flavour enhancement should it be added to food.
- Observe the labelling requirement of food additives including MSG.

Advice to the Public

- To reduce sodium intake, consider using herbs and spices (e.g. chili, ginger) and glutamate-rich ingredients (e.g. tomato, mushroom) to enhance the flavour of food.
- Read the food label to make informed choices.
- Ask the staff of restaurants if MSG is used in food if you want to avoid it.

白果中毒

Ginkgo Seed Poisoning

食物安全中心風險評估組
科學主任林漢基博士報告

Reported by Dr John LUM, Scientific Officer,
Risk Assessment Section, Centre for Food Safety

二零二三年六月，衛生防護中心公布一宗懷疑白果中毒個案，涉及的57歲男子在熬湯進食親戚給予的約50顆白果(又稱銀杏)後，出現暈眩、噁心、嘔吐、疲倦、頭痛及心跳加速等症狀。本文將對白果中毒作一簡介。

In June 2023, the Centre for Health Protection announced a suspected case of ginkgo seed poisoning. The case involved a 57-year-old man who developed dizziness, nausea, vomiting, malaise, headache and rapid heartbeats after consuming about 50 ginkgo seeds, given from a relative, in a soup. This article will give a brief introduction on ginkgo seed poisoning.

銀杏樹與白果中毒

銀杏樹是世上最古老樹種之一，在許多國家是受歡迎的觀賞樹種。若一次過進食過量白果，存在於白果內的天然毒素有可能引致食物中毒。中國內地、韓國和日本等常以白果入饌(圖2)的地方，均曾發生白果中毒的個案。

Ginkgo biloba and Ginkgo Seed Poisoning

Ginkgo biloba is one of the world's oldest living tree species and has become popular as an ornamental tree in many countries. Eating excessive amounts of ginkgo seeds in one go can cause food poisoning due to the natural toxins present in the seeds. Ginkgo seed poisoning has been reported in mainland China, Korea and Japan, where the seeds are commonly used in different dishes (Figure 2).

白果中的毒素

白果含有白果毒素(4'-甲氧基吡哆醇)、甲氧基吡哆醇、葡萄糖苷及氰甙等多種天然毒素。在這些毒素中，4'-甲氧基吡哆醇被認為是引致白果中毒的主要毒素。

4'-甲氧基吡哆醇存在於白果的食物貯存組織中，其化學結構與維他命B6相似，因此能干擾其生物合成、新陳代謝及機能，包括由谷氨酸形成氨基丁酸——一個需要維他命B6的生物化學過程。氨基丁酸及谷氨酸均在神經細胞之間起着信息傳遞的作用。一般相信，在氨基丁酸減少與谷氨酸增加的雙重作用下，會引致白果中毒的患癲癇發作。

Toxins in Ginkgo Seeds

Ginkgo seeds contain a number of natural toxins, such as ginkgotoxin (4'-methoxypyridoxine (MPN)), MPN glucoside and cyanogenic glycosides. Among these toxins, MPN is believed to be the major implicated toxin in ginkgo seed poisoning cases.

MPN is found in the food storage tissues of ginkgo seeds. It is chemically similar to vitamin B6 and interferes with its biosynthesis, metabolism and function, including the formation of gamma-aminobutyric acid (GABA) from glutamate, a process that requires vitamin B6. Both GABA and glutamate play a role in transmitting nerve signals from one nerve cell to another. The dual effects of a decrease in GABA and an increase in glutamate are thought to cause seizures in the victims of ginkgo seed poisoning.



圖2: 白果在多地菜式均有食用

Figure 2: Ginkgo seeds are consumed in different cuisines

白果中毒的病徵

白果中毒最令人關注的是急性毒性，中毒者通常會在進食後1至12小時出現噁心、嘔吐、腹瀉、腹痛、思維混亂及抽搐等症狀。

兒童特別容易出現白果中毒。在進食大量白果的嚴重個案中，病人可能會失去知覺，甚至死亡。現時並無白果中毒的解毒劑，治療主要集中在減輕各種症狀，因應每個中毒個案所出現的症狀而定。

Clinical Presentation of Ginkgo Seed Poisoning

Acute toxicity is the main concern of ginkgo seed poisoning. Nausea, vomiting, diarrhoea, abdominal pain, confusion and convulsions are common symptoms in ginkgo seed poisoning which usually begin 1 to 12 hours after ingestion.

Children are especially susceptible to ginkgo seed poisoning. In severe cases where large amounts of ginkgo seeds have been eaten, loss of consciousness and deaths may occur. There is no antidote for ginkgo seed poisoning. Treatment mainly centres on alleviating various symptoms, depending on the manifestation of each poisoning case.



圖3: 白果含有的神經性白果毒素(4'-甲氧基吡哆醇)與維他命B6結構接近，能干擾其生物合成、新陳代謝及機能

Figure 3: The neurotoxic ginkgotoxin (4'-methoxypyridoxine) found in *Ginkgo biloba* seeds is structurally similar to vitamin B6 and interferes with its biosynthesis, metabolism and function

烹煮能消除白果的毒素嗎？

烹煮不能完全消除白果內的毒素，因為4'-甲氧基吡哆醇相對耐熱。然而，烹煮可除去氰甙等其他不耐熱毒素的毒性，從而降低白果的毒性。值得注意的是，未成熟及未經烹煮的白果毒性較強，故不應食用。

Can Cooking Destroy Ginkgo Seeds Toxins?

Cooking cannot completely destroy toxins in ginkgo seeds because MPN is relatively heat-stable. Nevertheless, cooking may reduce the toxicity by inactivating some other heat-labile toxins in the seed such as cyanogenic glycosides. It is worth noting that unripe and uncooked ginkgo seeds are reported to be more toxic, and should not be consumed.

白果進食量有上限嗎？

食物安全規管機構，包括聯合國糧食及農業組織/世界衛生組織食物添加劑聯合專家委員會等並未就白果毒素進行評估，也未訂定用作風險評估的健康參考值。此外，食品法典委員會並未訂定相關食物安全標準。然而，有報告指出一次過進食僅10顆經烹煮的白果也可能令人急性中毒。因此，消費者(尤其是兒童)每天應只限吃數顆經烹煮的白果。

Any Limits on Ginkgo Seeds Consumption?

Ginkgotoxin has not been evaluated by food safety authorities including the Joint FAO/WHO Expert Committee on Food Additives (JECFA), and health-based guidance value has not been established for risk assessment. There is no relevant food safety standard established by Codex. Nevertheless, it has been reported that the ingestion of as few as 10 cooked ginkgo seeds at one time may cause acute poisoning in humans. As such, consumers should limit the intake to a few cooked ginkgo seeds per day, especially for children.

注意事項

- 白果含有多種天然毒素。
- 烹煮可減低但不能消除白果的毒性。

Key Points to Note

- Various natural toxins are present in ginkgo seeds.
- Cooking can reduce but not eliminate the toxicity of ginkgo seeds.
- Ingestion of as few as 10 cooked ginkgo seeds at one time may cause acute poisoning.

- 一次過進食僅10顆經烹煮的白果已能引致急性中毒。

給消費者的建議

- 每天只限吃數顆白果。兒童、長者及健康狀況欠佳人士須加倍留意。
- 食用白果前應先烹煮，以降低白果的毒性，儘管烹煮無法完全去除所有毒素。
- 進食白果後如感到不適，應立即求醫。

給業界的建議

- 向消費者提供食物安全建議，例如提醒顧客每天最多只可吃數顆白果，特別是在大批出售時。

Advice to Consumers

- Limit intake to a few ginkgo seeds per day, especially for children, the elderly and individuals with poor health conditions.
- Cook ginkgo seeds before consumption to reduce toxicity, but cooking cannot completely eliminate all toxins.
- Anyone who feels ill after eating ginkgo seeds should seek medical attention immediately.

Advice to the Trade

- Provide food safety advice to consumers such as reminding customers not to consume more than a few ginkgo seeds per day especially when selling in bulk.

食物業內的機械人 — 確保衛生和食物安全 Robotics in Food Service - Ensuring Hygiene and Food Safety

隨著科技進步，食物業界轉向使用送餐機械人從廚房送遞食物至餐桌的趨勢日漸普及。這些機械人一般有多張餐桌共用，眾多消費者或須從同一個架上拿取食物，此舉可能增加不潔的手交叉污染食物的風險。此外，部分消費者或會把吃過的食物或用過的餐具放回機械人處，也可能引致其他食物受污染。

為保障食物安全，食物業經營者應保持機械人的衛生狀況良好，並採取措施提醒消費者不要把吃過的食物放回送餐機械人處。盛載的食物應蓋好，在送餐的過程中沒有摻進雜質。消費者應按照指示取餐，不要把吃過的食物或用過的餐具放回機械人處。

As technology advances, food businesses are increasingly turning to food service robots to deliver food from the kitchen to dining tables. These robots usually serve a number of dining tables. Consumers may have to collect foods from the same shelf, which could increase the risk of cross-contamination by unhygienic hands. Moreover, some consumers may return finished plates food or used utensils to the robots, which could also lead to contamination of other food carried by the robots.

To ensure food safety, food business operators should maintain a high standard of hygiene for the robots and implement measures to remind consumers not to return finished plates to the food serving robots. Loaded food should be covered properly and kept unadulterated during delivery. Consumers should follow the instructions for collecting their orders and should not return finished plates or used cutlery back to the robots.

安全配製燒味和滷味 Prepare Siu Mei and Lo Mei Safely

燒味和滷味是受歡迎的菜式。這些菜式本來就屬高風險食物，因為一般是預先配製而且烹煮後再經處理，加上煮熟後通常存放在室溫下，沒有再經過熱處理或熱處理不足，未能消滅致病菌。處理食物時若不遵守衛生規範，即食食物可能傳播「超級細菌」 - 抗菌素耐藥性的微生物。

食物處理人員配製燒味和滷味時，應保持良好個人、環境及食物衛生。好好計劃烹製時間表，以免製作過量，以致長時間在室溫下存放。處理食物前要洗手並正確使用手套。展示及處理時應使用掛鉤或鉗，以減少直接以手接觸燒味和滷味。由於斬件後細菌可在保鮮紙內展示的燒味迅速滋長，燒味店應在顧客點選後才把燒味斬件。若在室溫下展示，便應遵從「[2小時/4小時原則](#)」，或在製作後2小時內放進雪櫃。

有關安全製作燒味和滷味的詳情，請瀏覽食安中心網頁。

Siu mei and lo mei are popular dishes. They are intrinsically high-risk as they are usually prepared in advance, with post-cooking handling and are often stored at room temperature with no or insufficient heat treatment to eradicate disease-causing bacteria after they have been cooked. If hygiene practices are not observed, ready-to-eat foods may spread disease-causing bacteria and microbes with [antimicrobial resistance \(AMR\)](#).

Food handlers should maintain good personal, environmental and food hygiene when preparing siu mei and lo mei. Plan production schedules well to prevent over-production and prolonged storage at room temperature. Wash hands before handling food and use gloves properly. Use hooks and pliers during display and handling to minimise bare-hand contact. As bacteria may grow faster on cut siu mei displayed in plastic wrap, siu mei shops should chop up siu mei upon orders. Follow the "[2-hours/4-hours](#)" rule if food is displayed at room temperature, or refrigerate it at 4°C or below within two hours of production.

Visit the CFS website for details on the safe preparation of [siu mei and lo mei](#).



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