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## 焦點個案 Incident in Focus

## 豬肉中的瘦肉精

## Leanness-enhancing Agents in Pork

食物安全中心

獸醫公共衛生組

陸素梅獸醫師報告

Reported by Dr. Geraldine LUK, Veterinary Officer,

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### Background

In mid-July 2007, two shipments of pork from the United States were rejected by the Taiwanese health authority, as the pork was found to contain a non-permitted leanness-enhancing feed additive, ractopamine, which is a beta-adrenergic agonist ( $\beta$ -agonist) that can promote growth and muscle leanness in certain food animal species.

Increasing consumer demands for high quality lean meat in recent years and the aim for maximising productivity have driven the pig farming industry to constantly improve their existing farming practices, which may include the addition of growth-promoting agents such as hormones, antibiotics and  $\beta$ -agonists in the animal feeds.

### Why are Veterinary Drugs Useful in Food Animal Production?

The development of human pharmaceutical medicines has been accompanied by a similar expansion in the development and the range of pharmaceutical products available to the veterinary profession for the treatment and control of animal diseases, such as bacterial infections, parasitic and fungal diseases. Their use is essential for the health and welfare of food-producing animals. Intensive animal farming has led to a substantial increase in the use of veterinary drugs and growth promoters over the past decades.

As with human medicines, veterinary drugs have to undergo extensive evaluations for efficacy and safety to ensure that they are both effective and safe to use. A range of veterinary drugs is allowed to be used under prescribed conditions in rearing food animals.

### What are $\beta$ -agonists?

$\beta$ -agonists are a group of synthetic compounds that share some similarity in their chemical structures. According to the slight differences in their structures, they are classified into five different sub-groups. Clenbuterol, ractopamine and salbutamol are some of the examples of  $\beta$ -agonists.

When  $\beta$ -agonists are used over a prolonged period, up to three to four months, they can promote growth and increase muscle leanness by inducing a redistribution of fat to muscle tissue in certain food animal species such as pigs and cattle.

### What are the Health Concerns Regarding $\beta$ -agonist Residues in Food?

Inappropriate usage of  $\beta$ -agonists may leave residues in edible tissues that are of health concern for consumers. For instance, acute poisoning can occur in humans as a result of consumption of meat or offal which contains high levels of clenbuterol. As clenbuterol is heat stable in edible tissues,

### 背景

二零零七年七月中，兩批美國豬肉因含有可增加瘦肉的非准許飼料添加劑萊克多巴胺而遭台灣衛生當局退回。萊克多巴胺是 $\beta$ -腎上腺素興奮劑(乙類促效劑)，可令某些食用動物品種加速生長，增加瘦肉，因此俗稱為瘦肉精。

近年，消費者對優質瘦肉的需求日增，養豬業為提高產量，不斷改良現行的飼養方法，當中可能包括在動物飼料中添加促生劑，例如激素、抗生素和乙類促效劑。

### 獸藥在食用動物生產過程中有何用處？

獸藥的發展情況與人類藥物大致相若，可用作治療和控制動物疾病，例如細菌感染、由寄生生物或真菌引致的疾病。獸藥的使用對食用動物的健康及福利十分重要。過去數十年，密集式飼養法導致獸藥和促生劑的使用劇增。

正如人類藥物，獸藥在功效和安全性方面亦須經過全面評估，以確保可供有效、安全使用。現時，有多種獸藥獲准在指明的情況下使用於飼養中的食用動物。

### 乙類促效劑是什麼？

乙類促效劑是一組化學結構相近的合成物，可按其結構上的細微分別再分為五個不同細類，其中例子有鹽酸克崙特羅、萊克多巴胺和沙丁胺醇。

如長期使用乙類促效劑達三至四個月，可令豬、牛等食用動物體內的脂肪轉變為肌肉組織，從而促進生長和增加瘦肉比例。

### 食物中的乙類促效劑殘留對健康有何影響？

不當使用乙類促效劑可令其殘留在食用組織中，對消費者的健康造成影響。舉例來說，人們吃下含大量鹽酸克崙特羅的肉類或內臟後，可出現急性中毒。由於此藥在食用組織中非常耐熱，一般家居烹調方法(例如以沸水烹煮、烤焗、煎炒和以微波爐烹煮)均不能消除這些殘餘。鹽酸克崙特羅中毒症狀包括心跳加速、暈眩、頭痛、神經過敏、顫抖和血壓改變，而患有心臟病或血壓失調的人較易受影響。

在一九九八年至二零零二年期間，本港曾發生多宗鹽酸克崙特羅中毒個案，當中大部分與進食受污染的肉



本地豬肉店鋪  
Local pork stall

焦點個案  
Incident in Focus

臟(尤其是豬肺和豬肝)有關。不過,近年已鮮見這類急性中毒個案。

萊克多巴胺與鹽酸克崙特羅有何分別?

與鹽酸克崙特羅相較,萊克多巴胺在血液中的半衰期短很多。一般而言,此藥在肝臟中較快喪失活性,較快被排除,同時累積在體內的機會較小。多種動物服用萊克多巴胺後,都會較快把藥物吸收和排出體外,而組織中的殘留量非常低,因此,此藥引起的食物安全問題較少。

在本港及大部分其他國家,鹽酸克崙特羅都不得用於食用動物上。至於萊克多巴胺,某些國家和地區如中國內地、台灣、歐洲聯盟成員國不准許此藥用於食用動物上,但美國、加拿大和澳洲等國家卻准許按建議濃度添加在動物飼料中,促進動物生長。

有沒有其他方法改善豬肉質量?

品種選育可選出良種,以改良豬肉質量。雖然當中過程較漫長,但改良成果長遠恆久,而且可以不斷累積及持續發展,因此符合成本效益。

餵飼模式和營養均衡的飼料對肉質亦有相當大的影響。優良的餵飼方法是十分重要的,既可在豬隻不同發育階段提供所需營養,亦能確保有關豬種凸顯其潛在優點。

一般而言,飼養方法如能盡量減低豬隻的壓力,通常可令肉質更佳。這些方法包括避免過分擠迫,以及避免在豬隻斷奶後及運送、入欄和屠宰期間與不同組別的豬隻混雜在一起。

本港如何監察食物中的乙類促效劑殘留?

《公眾衛生(動物及禽鳥)(化學物殘餘)規例》(第139N章)就給牲口餵飼獸藥包括鹽酸克崙特羅、沙丁胺醇及其他農用化學物的事宜作出規管,而《食物內有害物質規例》(第132AF章)則禁止出售受這些化學物污染的肉類或內臟。有關法例於二零零一年十二月三十一日起生效。

本港屠房對所有進口豬隻實施強制宰前檢驗。倘樣本呈陽性反應,整批豬隻便會被人道毀滅。每年,平均有超過60,000個尿液樣本進行化驗。有關統計數字見圖一。此外,本港又對豬肉和豬內臟實行全面的食物監察計劃,定期從新鮮糧食店和街市攤檔抽取豬肉和豬內臟樣本進行指定的化學物殘留測試。

給業界及消費者的建議

業界應向可靠的供應商採購豬隻、豬肉和豬內臟,而消費者則應光顧可靠的持牌肉店購買豬肉或豬內臟。

ordinary home cooking methods such as boiling, roasting, frying and microwaving cannot eliminate its residues. The symptoms of clenbuterol poisoning are rapid heart beats, dizziness, headache, nervousness, tremor and blood pressure changes. People with heart disease and blood pressure disorder are more likely to be affected.

There were a number of clenbuterol poisoning cases in Hong Kong between 1998 and 2002, most were related to the consumption of tainted offal, in particular the lungs and livers from pigs. Acute cases of clenbuterol poisoning, however, are rarely seen in recent years.

What are the Differences between Ractopamine and Clenbuterol?

As compared with clenbuterol, ractopamine has a much shorter half-life in blood. In addition, it is more readily inactivated in the liver, eliminated faster and has lower potential for bioaccumulation in general. When administered orally to a number of animal species, ractopamine is more rapidly absorbed and rapidly excreted with very low level of tissue residues. The food safety concern for ractopamine is rather low.

Clenbuterol is not permitted for use in food-producing animals in Hong Kong and in most other countries. Whilst ractopamine is not permitted for use in food-producing animals in Mainland China, Taiwan, the European Union countries and some others, it is approved to be added to animal feeds to promote growth at the recommended concentrations in some countries such as the United States, Canada, Australia, etc.

Are Alternative Methods Available to Improve Quality of Pork?

Genetic selection for improved meat quality can be achieved by selective breeding. Although the process is relatively slow, the improvements are permanent, cumulative and sustainable, and therefore cost-effective.

Feeding regime and diet with balanced level of nutrients have been shown to have significant effects on the meat quality. A good feeding program is essential to provide the right nutrition to pigs in different stages of development. This will also ensure the genetic merit of the pigs are fully expressed.

Generally speaking, farming practices that minimise stress in pigs typically maximise pork quality. These practices include avoid overcrowding of animals, avoid mixing of animals from different groups after weaning, during transportation and in lairage and slaughtering.

How are  $\beta$ -agonist Residues in Food Monitored in Hong Kong?

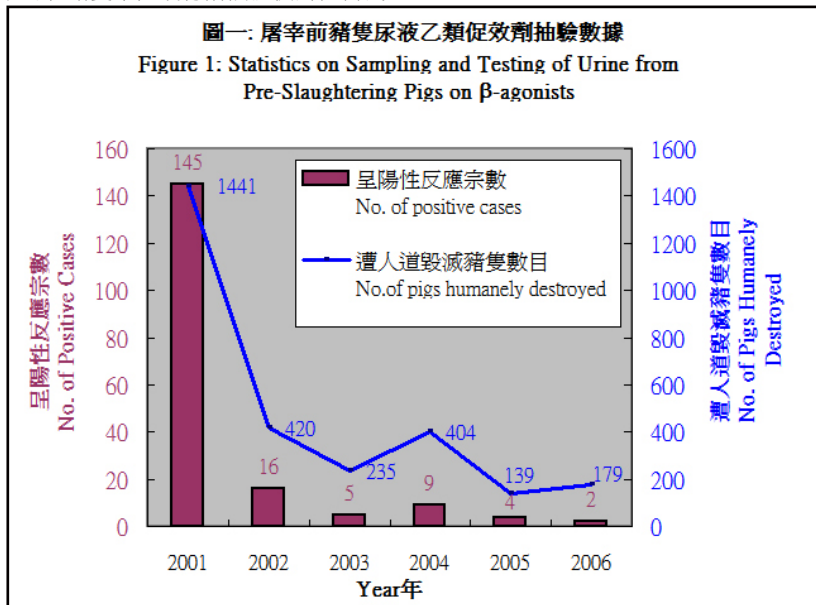
The Public Health (Animals and Birds) (Chemical Residues) Regulation, Cap 139N governs the feeding of veterinary drugs including clenbuterol, salbutamol and other agricultural chemicals to livestock, whilst the Harmful Substances in Food Regulations, Cap 132AF forbid the sale of tainted meat

or offal thereof. The relevant legislations have become effective since 31 December 2001.

In the local slaughterhouses, mandatory pre-slaughtering testing of all pig consignments is in place. Those consignments of pigs found to have positive results are humanely destroyed. An average of over 60,000 urine samples are tested every year. The relevant statistics are shown in Figure 1. There is also a comprehensive food surveillance programme for pork and pig's offal. Samples of pork and pig's offal are taken regularly from fresh provision shops and market stalls for testing of specified chemical residues.

Advice to the Trade and Consumers

The trade should obtain their supply of pigs, pork and pig's offal from reliable sources whilst the consumers should purchase pork or pig's offal from licensed and reliable meat shops.



風險傳達  
工作一覽  
Summary of  
Risk Communication Work

風險傳達工作一覽 (二零零七年八月) Summary of Risk Communication Work (August 2007)	數目 Number
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# 淺談食物中的金屬污染物

## Overview of Metallic Contaminants in Food

食物安全中心  
風險傳達組科學主任  
游天頌先生報告

Reported by Arthur YAU, Scientific Officer,  
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### 引言

地殼中自然蘊藏多種金屬和金屬化合物。人類活動、地質活動和其他大自然力量可把金屬帶往地面，因而增加人們攝入金屬污染物的機會。早於史前時期，在環境中金屬水平偏高的地區，人們已透過食物和水攝入這些物質。及至近代，人們則是透過食物和水攝入由工業及其他人類活動所產生的各種環境污染物，包括金屬。本欄將會由今期起一連五期探討食物中的金屬污染物。

### 在人們膳食中須特別關注的重金屬污染物

由於鉛、砷、鎘和汞(水銀)毒性較強，故須特別留意這四種金屬在食物中的情況，尤其是長期(慢性)攝入問題，因為它們可積累在人體內，損害器官，尤其是胎兒和幼童等易受影響群組。雖然這些金屬可引致急性中毒，但這種情況多數由非飲食途徑引起。這四種金屬各自會與其他元素組成不同的化合物，而這些化合物的特性和吃下後對人體造成的毒性影響各有差異。除了在工作環境中攝入外，有些金屬污染物主要透過食物進入人體，另一些則主要經由空氣或直接皮膚接觸等其他途徑進入人體。由於國際機關已對這些金屬污染物作出評估，並制定了各項安全參考值，因此我們對它們的特性已有不少認識。

### 金屬污染物的攝入來源

在這四種金屬中，鉛可透過多種媒介(包括空氣、泥土、水和食物)進入人體。有研究報告指，吸煙、汽車使用含鉛汽油、鉛製食水管和含鉛的食物罐焊料都是人們攝入鉛的主要來源。在空氣中懸浮的鉛粒子可下降積聚，殘留在蔬菜表面及/或經吸收滲進蔬菜和穀物。此外，鉛亦可積聚在貝類等食用水產體內和陸上動物的內臟。

汞的攝入來源亦不限於食物。除了飲食外，汞還可透過含汞化合物的補牙物料、工作環境和草藥攝入。人們從飲食中攝入的汞大多屬於無機汞。不過，劍魚等一些體型較大的捕獵魚類可在體內大量積累甲基汞這種毒性較強的有機汞。

砷主要透過進食水產(尤其是在海底覓食的貝類和動物)攝入。此外，有小量的砷亦會透過可能含砷的農用化學物(例如肥料)而進入食用植物。

一般人主要透過飲食攝入鎘。受已污染的泥土或水所污染的食用農作物，鎘的含量可較高。食用動物的腎臟、甲殼類動物和軟體動物較常積累了這種金屬，牠們都是人們攝入鎘的其他食物來源。

由於食物中的這些金屬污染物來源甚廣，因此較有效的監管做法是從產生污染的農場或工廠等源頭上規控污染。

### Introduction

Many different types of metals and metal compounds exist naturally in the earth's crust. Human activities, geological activities and other forces of nature may bring metals up to the surface and can increase the chance of human exposure to metallic contaminants. The history of such exposures goes back to pre-historic time, when humans were exposed to heavy metals via food and water in areas where the levels of heavy metals in the environment were naturally high. More recently, humans are exposed to metals as environmental pollutants from industrial or other human activities via food and water, among other things. This article is the introduction of a series of five articles on metallic contaminants in food.

### Metallic Contaminants that are of Particular Concern in Human Diet

Four metals, namely lead, arsenic, cadmium and mercury, are of particular concern in food because of their toxicity, especially for long term (chronic) intake since they may accumulate in the body and cause organ damage particularly to susceptible groups such as fetuses and young children. Although acute poisoning from these metals is possible, it is more likely that it happens through non-food route. Each of these metals also forms numerous compounds with other elements, which vary in properties and levels of toxicity to humans when ingested. Other than through exposure in workplace, some of these metal contaminants enter our body mainly through the food we eat while others mainly enter our body through other means like from the air we breathe or from direct skin contact. We have reasonably good knowledge of the properties of these metallic contaminants as they have been evaluated by international authorities and safety reference values have been established.

### Sources of Exposure to Metallic Contaminants

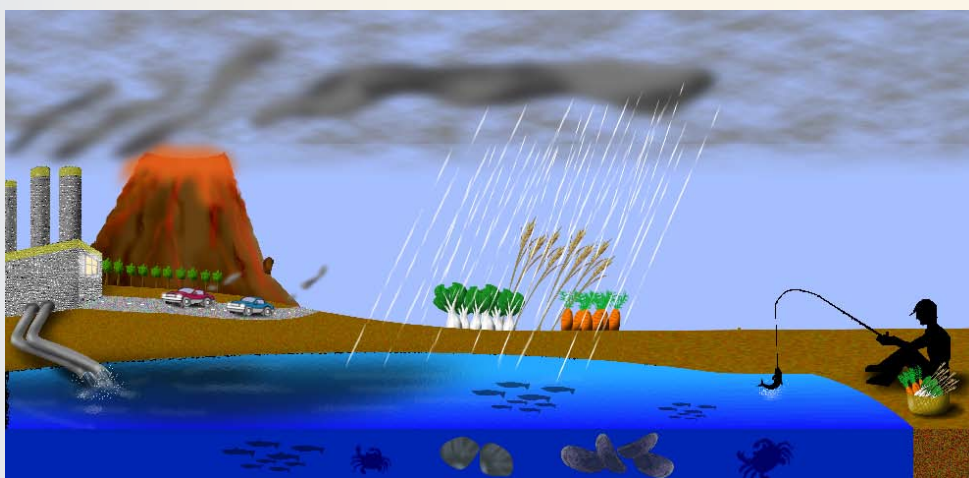
Of these four metals, lead can enter the body via a number of media including air, soil, water and food. Tobacco smoking, use of leaded petrol in vehicles, lead water pipe and leaded food can solder are reported to be major sources of lead exposure. Lead can be left on the surface of vegetables and/or absorbed into vegetables and cereals in areas where lead particles in air are deposited, and it can also bioaccumulate in aquatic food animals like shellfish and in offal of land animals.

Mercury exposure is also not limited to food. Besides diet, mercury exposure can occur through dental fillings that contain mercury compounds, occupational exposure and herbal medicines. Most dietary exposure is in the inorganic form. However, some large predatory fish like swordfish may bioaccumulate the more toxic organic form, methylmercury, in significant quantity.

Arsenic exposure occurs mainly through consumption of aquatic food, especially shellfish and animals that feed from the bottom of the sea. Trace amounts of arsenic may also enter food plants through the application of agricultural chemicals like fertilisers, which may contain arsenic.

Cadmium exposure occurs mainly through the diet. Food crops that are polluted through contaminated soil or water may contain high concentrations of the metal. Crustaceans, molluscs and kidneys of food animals are other possible dietary sources of cadmium, as they are more likely to accumulate the metal.

As these metallic contaminants of food may come from many different sources, it is more efficient to control contamination from these sources like the farms or factories that produce the pollution.



工業排污、汽車廢氣、火山活動、天然土壤的侵蝕和農用化學品都是金屬污染的源頭，這些污染物繼而可污染食用農作物、魚和貝類。  
Industrial discharge, exhaust from vehicles, volcanic activities, natural erosion from soil and agricultural chemicals are sources of metallic contaminants, which can in turn contaminate food crops, fish and shellfish.

食物安全平台  
Food Safety Platform

### 食物添加劑與金屬污染物的分別

一般市民往往會對食物中的各種化學物感到混淆。食物添加劑和金屬污染物是兩類不同的化學物，當中主要分別撮述如下：

	食物添加劑	金屬污染物
在食物中存在的原因	直接或間接地添加在食物中	自然或因污染而存在於食物中，通常不能完全消除
在食物中的作用	在食物中發揮特定作用	在食物中全無作用或作用不大
安全評估	國際機關通常會對其安全作出評估，然後才批准使用於食物中	國際機關通常會對其安全作出評估，以盡量減低從食物或其他來源過量攝入
容許含量	足夠科技上的需要	在合理可行的情況下愈低愈好

### Differences between Food Additives and Metallic Contaminants

The general public are often confused about different chemicals present in food. Food additives and metallic contaminants are two distinct types of chemicals. The major differences are summarised below.

	Food Additives	Metallic Contaminants
Reason for its presence in food	Added, directly or indirectly, on purpose	Exist naturally or through contamination and often cannot be completely removed
Effect on food	Perform functions in food	No or little functions in food
Safety evaluation	Safety often evaluated by international authorities before being allowed to be used in food	Safety often evaluated by international authorities to minimise excessive exposure from food and other sources
Allowable concentration	Sufficient for the technological purpose	As low as reasonably achievable

### 減低風險措施

金屬污染物存在於各式各樣的食物中，為避免因偏吃某幾類食物而過量攝入，保持均衡飲食才是上上之策。

### Risk Reduction Measures

Since metallic contaminants exist in a wide variety of food, maintaining a balanced diet is the most effective way to avoid excessive exposure to metallic contaminants from a small range of food items.

食物事故點滴  
Food Incident Highlight

### 本港青口中的有機污染物

八月下旬，本港傳媒報道，由亞洲多間研究機構合作進行的一項研究指，本港水域的青口樣本含有滴滴涕、氯丹、多氯聯苯和多溴二苯醚等有機污染物，而一個本地樣本測試到的滴滴涕含量據報為研究中的亞洲城市裏最高。

滴滴涕和氯丹是有機氯殺蟲劑，本港已在農務中禁用多年。至於多氯聯苯和多溴二苯醚，則是工業化學品，用途分別包括在電子儀器中用作絕緣液體和冷卻劑，以及在合成樹脂和塑膠中用作阻燃劑。由於這些有機化合物可長時間殘留在環境中，因此會在食物鏈內積聚。食物含這些有機污染物的主要關注是有關物質會否致癌或其對神經系統的不良影響。就報道所指在本地樣本測試得的污染物含量而言，一般進食有關青口不會對健康構成即時風險。

食物安全中心一直關注食物中有機污染物的問題，並透過恆常食物監察計劃監察水產中的有機污染物，包括滴滴涕、氯丹和多氯聯苯。市民應保持均衡飲食，以免因進食少種類食物而過量攝入污染物。

### Organic Contaminants in Local Mussels

In late August 2007, the local media reported, based on a study conducted by several research institutes in Asia, that mussel samples collected from Hong Kong coastal waters contained organic contaminants including dichlorodiphenyltrichloroethane (DDT), chlordane, polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs). The level of DDT detected in one local sample was reported to be the highest in the Asian cities studied.

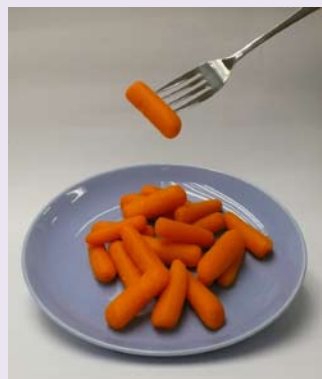


青口  
Mussels

DDT and chlordane are organochlorine insecticides that have been banned for agricultural use in Hong Kong for years. PCBs and PBDEs are industrial chemicals being used as insulating fluids and coolants in electrical equipment, and flame retardants in polymer resins and plastics, respectively. As these organic compounds are persistent in the environment, they tend to concentrate along the food chain. The main concern of their presence in food is their cancer-causing potential or adverse effects on the

nervous system. For the reported levels of contaminants in the local mussel samples, normal consumption is unlikely to pose immediate health risks.

The CFS has been attending to organic contaminants in food and monitoring them (including DDT, chlordane and PCBs) in aquatic products under the food surveillance programme. The public is advised to maintain a balanced diet to avoid excessive exposure to contaminants from a small range of food.



小甘筍  
Baby Carrots

### 小甘筍中的志賀氏桿菌

八月中旬，加拿大及美國發生因小甘筍可能受志賀氏桿菌污染而需要回收的事件。不過，兩國宣布回收行動時，有關產品的售賣期限已過。

志賀氏桿菌可引致志賀氏菌病（又稱為桿菌性痢疾）。此菌可存在於人類和高級靈長類動物（例如猴子及猩猩）體內，少至10至100個細菌已能引致感染。志賀氏菌病可透過進食或飲用受糞便

污染的食物和水，以及經由患者或帶菌者傳播給其他人。以往涉及此病的食品有沙律、生的蔬菜，以及受食物處理人員污染的冷吃熟食。患者可能會出現水狀腹瀉、發燒、腹痛、噁心或嘔吐，糞便或會帶血及黏液。這些病徵在幼童、長者和免疫力較弱的人身上會較嚴重，並可引致死亡。

市民在進食或處理食物前，應妥善洗手。此外，亦應徹底洗淨和煮熟蔬菜才進食，以有效地減低微生物風險。

### Shigella in Baby Carrots

In mid-August 2007, a recall of baby carrots was initiated in Canada and the United States, as the product concerned might be contaminated with the bacteria *Shigella*. The "Sell By" dates of the product, however, had already expired by the time the recall was announced.

*Shigella* can cause a disease known as shigellosis or bacillary dysentery. Humans and the higher primates (e.g. monkeys and chimpanzees) are the hosts for the bacteria which have an infective dose of as low as 10 to 100 organisms. Infection may occur after ingestion of faecal contaminated food or water as well as from person to person. Food items implicated in past disease outbreaks include salads, raw vegetables, and cold cooked food that has been contaminated by food handlers. Individuals who are infected with *Shigella* may suffer from watery diarrhoea, fever, abdominal pain and nausea or vomiting. The stool may contain blood and mucus. The symptoms can be more severe in young children, the elderly and people with weakened immune system, and may even cause deaths.

The public is advised to wash hands properly before eating or handling food. Washing and cooking vegetables thoroughly before consumption can effectively reduce microbiological risk.