E. coli O157:H7 Outbreak Associated with Bagged Fresh Spinach in the US

**Summary of Incident**

On 14 September 2006, the US Food and Drug Administration (FDA) advised consumers not to consume bagged fresh spinach in response to an outbreak of E. coli O157:H7 that caused one death and multiple hospitalisations in multiple states. Upon learning the incident, the Centre for Food Safety (CFS) immediately advised local consumers not to consume the type of product from the US. The CFS also contacted the US Consulate General and requested that the export of bagged fresh spinach products from the US to Hong Kong be temporarily suspended. Local retailers and importers were also asked to stop import and sale of bagged spinach products from the US.

**What is E. coli O157:H7?**

E. coli O157:H7 is a strain of Escherichia coli that is most commonly found in cattle, but also found in the intestines of humans and mammals like deer. This pathogenic E. coli strain can produce potent toxins called Shiga toxin 1 and 2. Affected people may develop gastrointestinal symptoms that include severe watery diarrhoea, bloody diarrhoea, fever, abdominal cramps or vomiting. The incubation period ranges from 1-10 days (median 3-4 days). About 8% of the patients may develop haemolytic uraemic syndrome (HUS), which is characterised by acute kidney failure. Children under five years old have a higher risk of developing complications such as HUS. Some 1-5% of cases of E. coli O157:H7 infection may die.

Although recurring outbreaks of E. coli O157:H7 as a result of food contamination occur overseas, such infections are uncommon in Hong Kong and local cases appeared sporadically. From 1998 to 2005, the Centre for Health Protection of the Department of Health recorded six sporadic human infections of E. coli O157:H7, including one imported case. One of them presented as HUS. As of September 2006, no case of E. coli O157:H7 infection was reported in 2006.
The CFS took samples of ready-to-eat (RTE) food for *E. coli* O157:H7 examination. From 2004 to June 2006, 585 samples were taken and all results were satisfactory. (Table 1).

Table 1: Ready-to-eat food samples taken for *E. coli* O157:H7 examination

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of RTE food samples taken</th>
<th>No. of unsatisfactory samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>216</td>
<td>0</td>
</tr>
<tr>
<td>2005</td>
<td>244</td>
<td>0</td>
</tr>
<tr>
<td>2006 (Jan to Jun)</td>
<td>125</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Centre for Food Safety, Hong Kong

Common Source of Infection

Food and water can be contaminated with *E. coli* O157:H7 due to contact with cattle faeces. Contamination of agricultural products can occur in the field and meat products in the abattoir. Undercooked and raw foods, such as minced beef, hamburgers, unpasteurized dairy products, vegetables and alfalfa sprouts etc. are of particular concern. Consumption of undercooked or raw food may pose a higher risk of illness as only a small number of the bacteria are needed to cause illness. On the other hand, cooking is effective in killing the bacteria and preventing illness. Furthermore, good personal hygiene and proper food handling techniques will minimise the chance of transmitting this bacteria via the faecal-oral route.

Advice to the Trade

Members of the trade should ensure that they obtain vegetables for raw consumption from reliable sources and that the vegetables are fit for human consumption. Fresh vegetables for raw consumption should be thoroughly washed under clean running tap water.

Advice to the Public

When washing vegetables, the outer leaves from vegetables such as lettuce and cabbage should be discarded prior to washing. They should then be immersed in water for an hour and washed thoroughly with clean running water to remove surface contamination.

People at a higher risk (i.e. young children, elderly people, pregnant women and persons with weakened immune systems) should avoid eating food containing raw vegetables (e.g. salad, coleslaw, pickled vegetables etc.). Vegetables should be thoroughly washed and cooked before consumption in order to reduce the likelihood of disease. It should be noted that thorough washing alone may not be able to remove all the microbiological contamination. Thorough cooking is an effective way to ensure food safety.

Further Information

For readers who are interested in learning more about the incident, please visit the following web pages for further information.

- US FDA "Spinach and E. coli Outbreak"
- FEHD Risk in Brief - Microbiological Food Safety of Raw Vegetables Intended for Human Consumption
- FEHD Microbiological Risk Assessment - Salads

Risk Communication Work

<table>
<thead>
<tr>
<th>Incident</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidents/Food Safety Cases</td>
<td>38</td>
</tr>
<tr>
<td>Public Enquiries</td>
<td>113</td>
</tr>
<tr>
<td>Food Complaints</td>
<td>374</td>
</tr>
<tr>
<td>Educational Seminars/Lectures/Talks/Counselling</td>
<td>88</td>
</tr>
<tr>
<td>New Messages put on the CFS Website</td>
<td>9</td>
</tr>
</tbody>
</table>
Overview of Biological Hazards

Food Safety Focus

Reported by Mr. Johnny CHU, Scientific Officer, Risk Assessment Section, Centre for Food Safety

Hazards

In the first issue of the newsletter, we have mentioned that a “hazard” can be classified as a substance or agent present in food with the potential to cause an adverse health effect to the consumer. Food hazards can be divided into three main categories: biological, chemical and physical. In this issue, we are going to give you some more information on biological hazards.

Biological Hazards

Biological hazards are biological agents that have the capacity to cause harmful effects in humans. Common biological hazards include bacteria, viruses and parasites.

Pathogenic Bacteria

Bacteria are living single-celled organisms and are generally considered to be the most important causative agents of foodborne illnesses. Bacteria grow fast in foods that are warm, moist, protein-rich and low in acid. Milk, shell eggs, poultry, fish, meat and shellfish are common food items that support the growth of bacteria. Most bacteria are not harmful to us while some can make people ill by living and multiplying inside human bodies (e.g. Salmonella, Listeria monocytogenes). Others (e.g. Staphylococcus aureus, Bacillus cereus) produce toxins in foods and people fall ill because of the toxins when they eat the foods. However, the mere presence of the organism in food may not cause the disease. The amount of organism present is important. The table below shows the top 3 pathogenic bacteria causing food poisoning in 2005 in Hong Kong:

<table>
<thead>
<tr>
<th>Pathogenic bacteria</th>
<th>Foods involved</th>
<th>Number of bacteria required to cause disease in healthy adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibrio parahaemolyticus</td>
<td>Raw or under-cooked seafood</td>
<td>Greater than 10^6 organisms per gram of food</td>
</tr>
<tr>
<td>Salmonella</td>
<td>Raw or undercooked egg and egg products</td>
<td>Usually 10^2 to 10^3 organisms but sometimes as few as 15 to 20 organisms</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>Ready-to-eat foods that have been contaminated and then kept at ambient temperature for a prolonged period of time</td>
<td>Greater than 10^6 organisms per gram of food are required to produce enough toxin</td>
</tr>
</tbody>
</table>

| Source: Bad Bug Book from the US FDA and Microbial Pathogen Data Sheets from the New Zealand Food Safety Authority |

Pathogenic Bacteria

Pathogenic bacteria are defined as bacteria that are capable of causing infection in humans. Some common pathogenic bacteria include Salmonella, Shigella, Campylobacter, and Listeria monocytogenes. These bacteria can cause a variety of illnesses, ranging from mild gastrointestinal symptoms to severe infections that can be life-threatening.

The table above provides information on the number of bacteria required to cause disease in healthy adults. As shown, Vibrio parahaemolyticus requires a much higher number of organisms (greater than 10^6) compared to Salmonella (10^2 to 10^3) and Staphylococcus aureus (greater than 10^6). This highlights the importance of proper food handling and cooking to prevent the growth and multiplication of these bacteria.

In summary, biological hazards are a significant concern in food safety and require careful monitoring and regulation to ensure consumer safety. By understanding the characteristics and requirements of pathogenic bacteria, we can develop effective control strategies to minimize the risk of foodborne illnesses.

致病細菌

細菌是有生命的單細胞微生物，一般認為是食源性疾病最主要的原因。細菌會在溫暖、溼潤、蛋白質豐富及酸度極低的食物中迅速滋長。牛奶、蛋殼、魚類、家禽及貝類等水產生物皆有利細菌滋長的常見食物。雖然大部分細菌對我們無害，但有些（例如沙門菌及大腸桿菌）會在人體內生存並大量繁殖，引發疾病。這些細菌會在食品中形成致病細菌，導致食物中毒。

致病細菌

食物中的細菌總數通常可以用以表示食物的衛生水平。細菌數本身並不意味食物危險。食物中有細菌但不會对人体造成影響。以下表顯示在2005年引發食物中毒的三大致病細菌:

<table>
<thead>
<tr>
<th>致病細菌</th>
<th>涉及的食物</th>
<th>所需細菌數量</th>
</tr>
</thead>
<tbody>
<tr>
<td>副溶血性弧菌</td>
<td>生菜</td>
<td>大腸細菌數多於10^10個</td>
</tr>
<tr>
<td>沙門氏菌</td>
<td>生肉</td>
<td>大腸細菌數多於10^10個</td>
</tr>
<tr>
<td>金黃葡萄球菌</td>
<td>水果</td>
<td>大腸細菌數多於10^10個</td>
</tr>
</tbody>
</table>

病毒

病毒是結構非常簡單的細小生物，脫離有生命的細胞後便不能繁殖，因此不會在食物中或食物表面上繁殖。病毒會透過食物或飲食的不良衛生習慣而污染食物，或存在於食物中的細胞。
Parasites

Parasites are organisms that live in or on another living organism, which is called the host. Parasites include single-celled organisms and worms. Human beings may be infected with single-celled parasites (e.g. *Giardia lamblia*) through consumption of contaminated water and food such as raw vegetables. Parasitic worms have more complex life cycles. Immature worms need to pass through an animal host (e.g. freshwater fish and snails) before it can infect the final host (e.g. human beings, dogs and cats). Human beings may get infected with parasitic worms through consumption of undercooked meat, freshwater fish and freshwater snails. Examples are tapeworms, *Clonorchis sinensis* and *Angiostrongylus cantonensis* respectively.

Simple Rules to Manage the Risk

Prevention of contamination is the most important control factor to enhance food safety. It is also important to keep foods at refrigerated temperature to prevent bacteria from growing to hazardous levels. Finally, foods should be cooked thoroughly before consumption in order to destroy pathogens that may be present.

Arsenic in Fish

Some concerns were raised recently over arsenic levels detected in fish, including *Cololabis saira* (also commonly known as pacific saury or *sanma*).

Arsenic is a metalloid present naturally in the earth's crust. It exists as a natural contaminant in both organic and inorganic forms in foods, with the inorganic form of particular toxicological concern. However, arsenic in fish is usually present in its less toxic organic form. The primary route of arsenic exposure in humans is mainly through ingestion of foods, especially aquatic foods.

Cancerous arsenic can cause skin lesions, nerve damage, skin cancer and diseases of the blood vessels.

Risk assessment studies conducted by the Food and Environmental Hygiene Department in 2002 found that dietary exposure to arsenic for both average and high consumers of secondary school students fell well below the safety reference value established by international food safety authorities. Therefore, people with a usual dietary habit were unlikely to experience toxicological effects of arsenic.

According to previous local surveillance results, very few fish samples exceeded local regulatory standard for arsenic and there is no cause for undue concern.

Mercury in Seafood

A local university has recently published a study which found that high levels of mercury were detected in newborn infants' blood and considered that the amount of fish consumed by pregnant women was directly proportional to the level of mercury in infants.

Mercury, an element that naturally exists in the environment, is considered a natural contaminant of food. It may cause adverse effects to the nervous system, especially the developing brain. Foetuses, infants and young children are more sensitive to such toxic effects.

Previous risk assessment studies conducted by the Food and Environmental Hygiene Department for secondary school students concluded that major toxicological effects of mercury were not expected via dietary exposure. Fish was identified as the main dietary source of mercury and the large predatory fish, such as swordfish and tuna, had the highest concentrations.

Moderate consumption of fish is recommended as it is an excellent source of high quality protein and low in saturated fat. However, pregnant women, infants and young children should avoid consuming excessive amount of predatory fish. Please visit the CFS website for further information.