

# FACTFILE: GCE NUTRITION & FOOD SCIENCE

## MICROBIAL CONTAMINATION



### Microbial contamination

#### Learning outcome

- Describe the possible risks to public health of each of the following bacteria:
  - salmonella;
  - campylobacter;
  - listeria; and
  - escherichia coli (E Coli).



### Salmonella

#### Salmonella

Salmonella bacteria cause food poisoning. Symptoms include diarrhoea, stomach cramps and sometimes vomiting and fever. Most people recover without treatment, but if a person becomes seriously ill he/she may need hospital care because the dehydration (fluid loss) caused by the illness can be life-threatening.

Anyone can get salmonella, but young children, the elderly and people who have immune systems that are not working properly, including people with cancer, AIDS or alcoholism, have a greater risk of becoming severely ill.

#### Sources

Salmonella bacteria may be found in the gut of many animals, including wild animals, farm animals and pets. Poultry, such as hens, chickens and turkeys, are especially likely to carry salmonella. So, salmonella can contaminate meat, including poultry, eggs, milk and other dairy products that we may eat. Adequate cooking of meat, including poultry, usually kills salmonella bacteria.

Humans can become infected if they eat undercooked meat that is contaminated with salmonella. Eating raw or undercooked eggs, or consuming milk or other dairy products contaminated with salmonella can also pass on salmonella infection to humans. Sometimes other foods such as fruit and vegetables can become contaminated with salmonella through contact with manure used to help them grow. Shellfish may also become contaminated if they are in contact with infected sewage in the water.



Dogs, cats and rodents can sometimes become infected with salmonella and tortoises and terrapins are also common salmonella carriers. Contact with infected animals or their stools (faeces) can also allow transmission of infection to humans. The bacteria can pass from the hands into the mouth and then the gut where they can then multiply and cause symptoms.

Once a person has salmonella the infection may be spread to close contacts if strict hygiene measures are not followed to prevent the spread of infection to others.

### Risk to health

- **Dehydration:** This is the most common complication. It occurs if the water and salts that are lost in the stools (faeces) or vomit, are not replaced by drinking adequate fluids.
- **Spread of infection to other parts of the body** such as the bloodstream, the bones, the joints, the meninges that surround the brain and spinal cord, and the gallbladder. However, this is rare.
- **Persistent diarrhoea syndromes** may rarely develop.
- **Irritable bowel syndrome** is sometimes triggered by salmonella infection.

### Prevention

#### 1. Raw and uncooked food

- Raw fruits and vegetables should be washed before being eaten
- Water that is thought to be unsafe should not be drunk, including drinks containing ice cubes that may have been made from unsafe water. This includes untreated water from rivers, lakes and streams
- Milk should be pasteurised or boiled and raw eggs should be avoided.

#### 2. Cooking

- Make sure that food, especially meat, is cooked thoroughly as this will kill bacteria. Food should be cooked right through and be piping hot in the middle.
- If reheating food, it needs to be cooked thoroughly and should be piping hot.
- Food should not be reheated more than once.

#### 3. Chilling

- Food that needs to be chilled should be refrigerated. If food is left out of the fridge bacteria may multiply to levels that can cause food poisoning.
- Refrigerators need to be kept between 0-5°C and the door should not be left open unnecessarily.
- Leftover food should be cooled quickly and then refrigerated. Taking food out of the cooking pot and putting it into a shallow container can speed the cooling process up.

#### 4. Cross-contamination

This is when bacteria pass from foods (commonly raw foods) to other foods. It can occur if foods touch directly, if one food drips on to another, if hands, utensils or equipment, such as knives or chopping boards, touch one food and then another.

#### Rules for avoiding cross-contamination:

- wash hands after touching raw foods
- separate raw and cooked or ‘ready-to-eat’ foods
- keep raw meat in a sealable container at the bottom of the fridge
- don’t use the same surface or chopping board for preparing raw and ready-to-eat foods
- make sure that knives and utensils are cleaned after preparing raw food

Reptiles and amphibians, including terrapins and tortoises, can commonly carry salmonella bacteria, so they should not be kept in a house where children under the age of 1 year live, or where someone with a weakened immune system lives.





## Campylobacter

### Campylobacter

Campylobacter bacteria can cause food poisoning. Symptoms include diarrhoea, vomiting, stomach pains and cramps, fever, and generally feeling unwell. According to the Food Standards



Agency (FSA), 'Campylobacter is considered to be responsible for more than 280,000 cases of food poisoning each year. More than 72,000 of these were confirmed to be campylobacter poisoning by laboratory reports'.

Anyone can get campylobacter, but young children under 5 years of age, those over 60 and people who work with farm animals or in the meat industry and travellers to developing countries are at greater risk.

### Sources

The FSA also state 'about four in five cases of campylobacter poisoning in the UK come from contaminated poultry'. Campylobacter is also found in red meat, unpasteurised milk and untreated water. Although it does not normally grow in food, it spreads easily and has a low infective dose so only a few bacteria in a piece of undercooked chicken, or bacteria transferred from raw chicken onto other ready-to-eat foods, can cause illness.

It is impossible to tell from its appearance whether food is contaminated with campylobacter. It will look, smell and taste normal so correct handling and cooking are very important.

Symptoms of campylobacter include:

- diarrhoea
- vomiting
- stomach pains and cramps
- fever
- generally feeling unwell

Symptoms usually develop within two to five days, but can take as long as 10 days.

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### Risk to health

Complications are uncommon in the UK. They are more likely in the very young, in pregnant women, or in the elderly. They are also more likely to occur in a person with an ongoing (chronic) condition such as diabetes or if the immune system is compromised in some way, for example, if taking long-term steroid medication or having chemotherapy treatment for cancer. Possible complications include the following:

- **Lack of fluid (dehydration) and salt (electrolyte) imbalance in the body** – This is the most common complication. It occurs if the water and salts that are lost in the stools (faeces), or vomit, are not replaced by drinking adequate fluids.
- **Reactive complications** – Rarely, other parts of the body can 'react' to an infection that occurs in the gut (intestines). This can cause symptoms such as joint inflammation (arthritis), skin inflammation and eye inflammation (either conjunctivitis or uveitis). Joint inflammation can last some months after campylobacter infection.
- **Spread of infection to other parts of the body** such as the bloodstream, the liver and the pancreas gland can occur, however this is rare.
- **Miscarriage** – Campylobacter infection can occasionally cause miscarriage if a woman is pregnant.
- **Irritable bowel syndrome** is sometimes triggered by campylobacter infection.
- **Lactose intolerance** can sometimes occur for a while after gastroenteritis. It is known as 'secondary' or 'acquired' lactose intolerance.
- **Reduced effectiveness of some medicines** – During any episode of food poisoning, certain medicines that are being taken for other conditions or reasons may not be as effective.

## Prevention

The FSA has identified the 4 Cs strategy of hygiene measures to help prevent food poisoning, including food poisoning caused by campylobacter:

### 1. Cleanliness

- Keep work surfaces and utensils clean.
- Wash and dry hands regularly but especially after going to the toilet, before preparing food, after handling raw food and before touching 'ready-to-eat' food.
- People who have diarrhoea or vomiting should not prepare food for others
- Cover sores or cuts on hands with a waterproof plaster before touching food.
- Change dishcloths and tea towels regularly.

To avoid campylobacter infection, the hands should be washed after touching pets or animals, after visiting farms and after gardening.

### 2. Cooking

- Make sure food, especially meat, is cooked thoroughly as this will kill bacteria. Food should be cooked right through and be piping hot in the middle.
- If reheating food, it needs to be cooked right through and be piping hot in the middle.
- Food should not be reheated more than once.

Make sure only to drink pasteurised or boiled milk and avoid drinking water thought to be unsafe (including avoiding drinks containing ice cubes that may have been made from unsafe water).

### 3. Chilling

- Food that needs to be chilled should be refrigerated. If food is left out of the fridge bacteria may multiply to levels that can cause food poisoning.
- Refrigerators need to be kept between 0-5°C and the door should not be left open unnecessarily.
- Leftover food should be cooled quickly and then refrigerated. Taking food out of the cooking pot and putting it into a shallow container can speed the cooling process up.

### 4. Cross-contamination

This is when bacteria pass from foods (commonly raw foods) to other foods. It can occur if foods touch directly, if one food drips on to another, if hands, utensils or equipment, such as knives or chopping boards, touch one food and then another.

#### Rules for avoiding cross-contamination:

- wash hands after touching raw foods
- separate raw and cooked or 'ready-to-eat' foods
- keep raw meat in a sealable container at the bottom of the fridge
- don't use the same surface or chopping board for preparing raw and ready-to-eat foods
- make sure that knives and utensils are cleaned after preparing raw food



## Listeria Monocytogenes

Listeria is a rare, but potentially life-threatening bacteria. Although some adults experience only mild infections of the eye and skin, and gastroenteritis, it can lead to severe blood poisoning (septicaemia) or meningitis.

Pregnant women, the elderly and people with weakened immune systems, including those suffering from cancer, AIDS or alcoholism, are more susceptible to listeria. It is particularly dangerous in pregnancy as it can cause a mild 'flu-like' illness which is not serious to the mother but can cause miscarriage, premature delivery, stillbirth or severe illness in a newborn child.

### Sources

Infection usually occurs after eating food contaminated with the listeria bacteria. Foods associated with transmission are most often ready-to-eat refrigerated and processed foods, such as, pre-prepared cooked and chilled meals, salads, soft cheeses (made from raw milk), cold cuts of meat, pâtés, smoked fish and seafoods.

It is impossible to tell from its appearance whether food is contaminated with listeria. It will look, smell and taste normal.

Listeria is also widespread in the environment and can be found in raw foods, for example, raw chicken, soil or manure used as fertiliser, vegetation, water

sewage and in the faeces of many animals, birds and fish, as well as the intestines of many animals. Up to 5% of the population may be carriers of the disease and do not become ill.

Pregnant mothers sometimes transmit the infection to their baby. This can happen in the womb or when giving birth.

### Risk to health

Up to 1 in 20 of the population may be carriers of the disease and do not become ill. Once infected, it can take from 1 to over 90 days for illness to develop. This is called the incubation period. The average incubation period is about 30 days.

Most healthy adults and children who develop listeriosis have only a mild flu-like illness or infection of the gut (gastroenteritis), with diarrhoea and sometimes vomiting. Severe infection with blood poisoning (septicaemia) or infection around the brain (meningitis) may occur, especially in the elderly and those with weakened immune systems.

Infected new born babies may show signs of infection at birth or during the first few days of life. Infection in new born babies can be very severe and can include lung infection (pneumonia) and meningitis. Infected babies may have severe difficulty with breathing and feeding.

Vets and farmers may develop a skin infection on the arms or hands after contact with infected animals.



### Prevention

Listeria is unusual because it not only grows at normal room temperature and up to about 40°C, but can grow at low temperatures, including refrigeration temperatures of below 5°C. It is however killed by cooking food thoroughly in conventional or microwave ovens and by pasteurisation.

- Keep foods for as short a time as possible and follow storage instructions including 'use by' and 'eat by' dates.
- Cook food thoroughly, especially meat, ensuring that it is cooked through to the middle.
- Keep cooked food away from raw food e.g. raw chickens are commonly infected so care should be taken to avoid cross contamination. Chicken should be cooked to a core temperature of 75°C.
- Wash salads, fruit and raw vegetables thoroughly before eating.
- Wash hands, knives, and cutting boards after handling uncooked food.
- Make sure that the refrigerator is working correctly and has a temperature below 5°C. Cook-chill foods should not be stored for more than 5 days at 3°C. Listeria bacteria can grow at low temperatures and will multiply to dangerous levels in chilled and refrigerated foods which are kept for too long or at too high a temperature.
- When heating food in a microwave follow heating and standing times recommended by the manufacturer to diffuse cold spots, as listeria may survive in food that has been cooked or reheated in a microwave because of uneven heating.
- Throw away left-over reheated food. Cooked food which is not eaten immediately should be cooled as rapidly as possible and then stored in the refrigerator.
- Pregnant women, the elderly, and people with weakened immune systems should not help with lambing or touch the afterbirth.
- Those who are particularly at risk, such as pregnant women and those with impaired immune systems, should avoid eating all mould-ripened soft cheeses and pâté. They should ensure that cook-chill meals and ready-to-eat poultry are cooked thoroughly.



## Escherichia Coil 0157 (E. Coli)

There are various strains of *E. coli* (bacteria). Many strains are usually harmless and live in the gut of healthy people. However, some strains are a cause of common infections, such as urine infections and gut infections (gastroenteritis). A strain called VTEC 0157 is an uncommon cause of infection, but it can be serious. It can lead to a severe gut infection with bloody diarrhoea. Also, the poison (toxin) released by VTEC 0157 can cause other serious diseases such as haemolytic uraemic syndrome (HUS) and thrombotic thrombocytopenic purpura (TTP). The majority of people fully recover from a VTEC 0157 infection. However, in a few people, it can be fatal.

### Sources

VTEC 0157 is found in the gut and stools (faeces) of many animals, including cattle and sheep. Infections occur by eating food that is contaminated with VTEC 0157, including undercooked meat. There have also been some outbreaks of infection linked to handling or petting such animals on farms or in sanctuaries.

VTEC 0157 is an uncommon bacterium to contaminate food but, when it does the consequences can be serious. A number of outbreaks of disease caused by VTEC 0157 have been reported in recent years. Outbreaks have been reported where the contaminated food has been:

- beef and beef products, such as undercooked beef burgers
- milk (usually unpasteurised)
- yoghurt
- cooked meats
- meat pie
- cheese
- dry-cured salami
- raw vegetables
- unpasteurised apple juice

A person infected with VTEC 0157 will pass it out with stools, sometimes for several weeks, even after symptoms have gone. Therefore, some people pass on the bacteria to others if their hygiene is poor. For example, not washing hands after going to the toilet, and then preparing food for others.

Swimming in contaminated water has also resulted in small outbreaks of VTEC 0157. Drinking water that has not been treated to remove bacteria can also be a source of infection.

### Risk to Health

VTEC 0157 can cause a range of symptoms - from none at all to a severe life-threatening illness. It can take anywhere between 1 and 14 days to develop symptoms once infected, but most commonly it takes 3-4 days. Additional risks include:

#### • Infection of the gut (gastroenteritis)

Some people infected with VTEC 0157 have typical symptoms of gastroenteritis. That is, diarrhoea with or without being sick (vomiting), tummy (abdominal) cramps and high temperature (fever). Sometimes there is some blood mixed in with the diarrhoea. This can last a few days and clear within a week or so, just like many other cases of gastroenteritis.

#### • Haemorrhagic colitis

A number of people infected with VTEC 0157 develop a very inflamed large which bleeds a lot. This causes very bloody (haemorrhagic) diarrhoea and abdominal pains, which can be severe. Often there is no fever with haemorrhagic colitis. Symptoms can be bad for several days and then, usually, gradually lessen. Symptoms typically clear completely within two weeks.

#### • Haemolytic uraemic syndrome (HUS)

Between 1 and 2 in 10 people infected with VTEC 0157 develop HUS in addition to gastroenteritis or haemorrhagic colitis. HUS is a condition that is triggered by the poison (toxin) made by VTEC 0157. It causes kidney failure, a type of anaemia called haemolytic anaemia (anaemia caused by damage to the red blood cells), and thrombocytopenia (lowered platelets which can lead to spontaneous bleeding). HUS usually develops about 7 to 10 days after the diarrhoea. It most commonly develops in young children or the elderly. Severe illness can develop and about 1 in 10 children who develop HUS will die of the condition.

#### • Thrombotic thrombocytopenic purpura (TTP)

Some people (mainly adults) infected with VTEC 0157 develop TTP. This can cause serious problems in the blood, kidneys and brain. Some people can die of this condition.

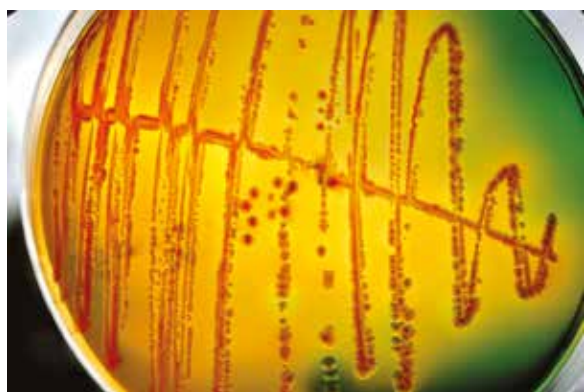
- **Asymptomatic carriage**

This means that some people can 'carry' the VTEC O157 in their gut for a time but without having any symptoms. However, if the bacteria are carried in the gut they will be passed out with the stools (faeces) for a time. Therefore, even if a person has no symptoms, he/she can pass on the bacteria to others if his/her hygiene is not good.

People infected with E. Coli O157 can have one, some, or all of the following symptoms: diarrhoea – about 50% of people also have blood in their stools; stomach cramps and fever.

Some infected people may have mild diarrhoea or no symptoms at all. A very small number of patients may develop 'haemolytic uraemic syndrome' (HUS) which is associated with kidney failure, anaemia, and bleeding. Complications are more common in children under five years of age and the elderly.

On average, it takes three to four days for symptoms to develop after swallowing an infectious dose of E. Coli O157. Symptoms can last up to two weeks, except in cases with complication. Most people get rid of the bacteria after about one week although children may continue to carry it for longer periods.



## Prevention

VTEC O157 is highly infectious. It only takes a few bacteria to cause illness. If a person is infected with VTEC O157, in order to reduce the chance of passing on the infection to others, the following guidance is recommended until symptoms go:

- Wash hands thoroughly after going to the toilet. Ideally, use liquid soap in warm running water, but any soap is better than none. Dry properly after washing. If a child is infected and wears nappies, be especially careful to wash the hands after changing nappies and before preparing, serving, or eating food.
- Don't share towels.
- Don't prepare or serve food for others.
- If clothing or bedding is soiled, first remove any stools (faeces) into the toilet. Then wash in a separate wash at as high a temperature as possible.
- Regularly clean the toilets that are used with disinfectant. With hot water and detergent, wipe the flush handle, toilet seat, bathroom taps, surfaces and door handles at least once a day. Keep a cloth just for cleaning the toilet, or use a disposable one each time.
- The infected person should stay off work, school, nursery, college, etc, until the doctor advises that it is safe to return. Avoid contact with other people as far as possible during this time.

If employment involves working with vulnerable people, such as young children, the unwell or the elderly, or working with food, it is necessary to inform the employer of the VTEC O157 infection. The doctor should also speak to public health authorities so that a decision can be made as to when it is safe to return to work. Further stool samples may have to be provided to confirm that the infection has cleared. The same applies to young children who attend nurseries and schools. Further tests may also be required to determine when it is safe to return to work.

Children under the age of 5 years who have confirmed VTEC O157 should not swim in swimming pools or share paddling pools with other people until they have been tested to show that their infection has cleared.



## Revision Questions

1 Complete the following table for each of the most common food poisoning bacteria.

Type of food poisoning	Source	Means of infection	Foods commonly associated with outbreaks	Risks to health	Prevention

2 Choose two bacteria from the list below. Identify their sources and explain how to prevent them from spreading:

- Salmonella
- Campylobacter
- Listeria Monocytogenes
- Escherichia Coli 0157

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