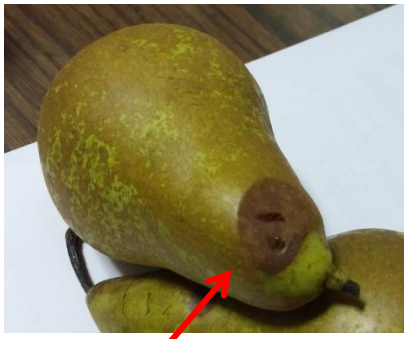
What is food spoilage?

- Food spoilage means undesirable changes that have taken place in a food which have made it unfit to eat

- Deterioration of food caused by natural decay or contamination with micro-organisms

How to tell when food is spoiled?

- **Appearance: look at the food carefully** 
  - Check if there is any abnormal colour change, e.g.
    - spoiled beef darkened in colour;
    - bruised spot on rotten pear
  - Check if there is abnormal curds, e.g.
    - curdling of spoiled milk



Bruised spot on pear

How to tell when food is spoiled?

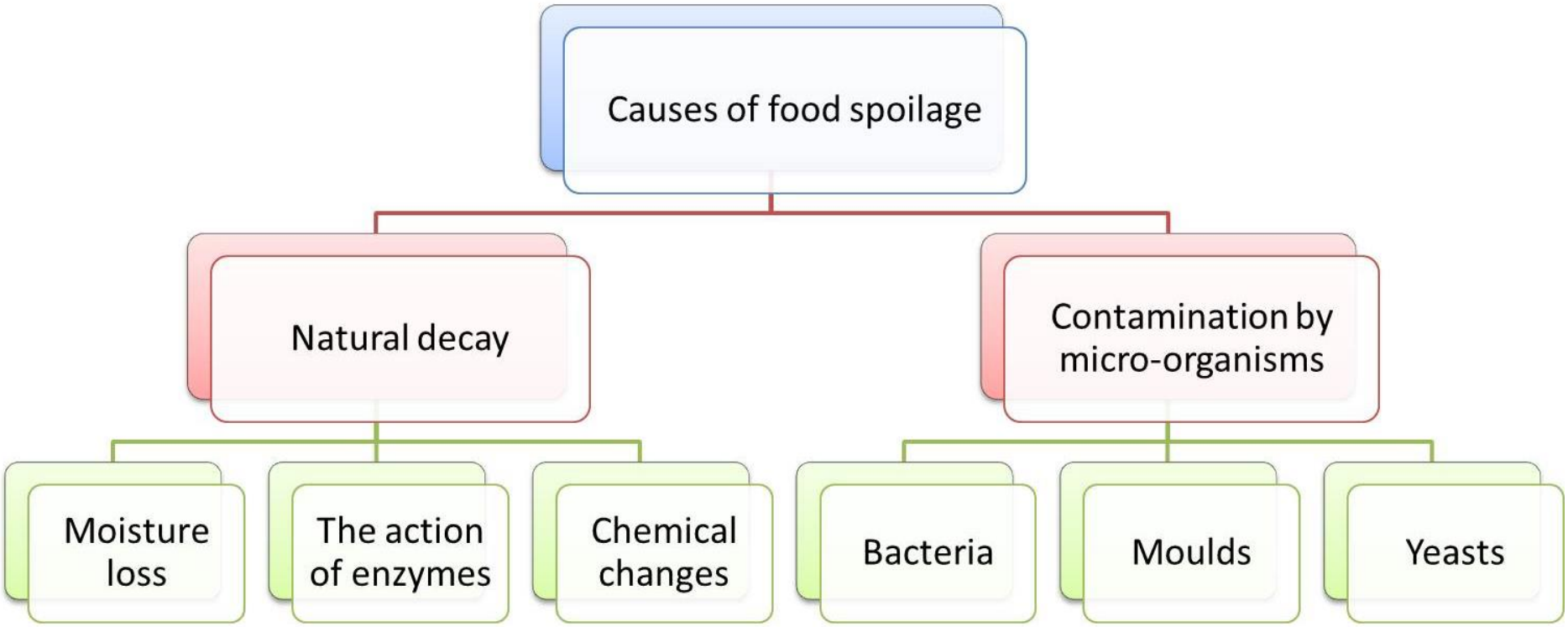
- Check if there are green, white or blue spots on food surface, e.g.
  - mouldy bread usually has green spots on its surface
- Check canned foods for signs of swelling or damage

Green moulds on a mouldy bread

How to tell when food is spoiled?

- Taste and odour  
  - Think about the normal taste and smell of the food, throw it out if it smells really bad or unusual, e.g.
    - spoiled milk smells sour
    - rotten eggs have a very distinct and unpleasant smell
- Feel 
  - Check if the texture of the food has changed, e.g.
    - slimy texture on meat

How does food spoil?



Natural decay: moisture loss

- When food is exposed in air for a long time, water comes out through the leaves and skin of fruits and vegetables

- Moisture loss affects both the appearance and texture of foods, e.g.
  - the fruit shrinks in size;
  - the skin becomes wrinkled

Natural decay: moisture loss

- The leaves of a choy sum becomes limp and wilted

Natural decay: action of enzymes

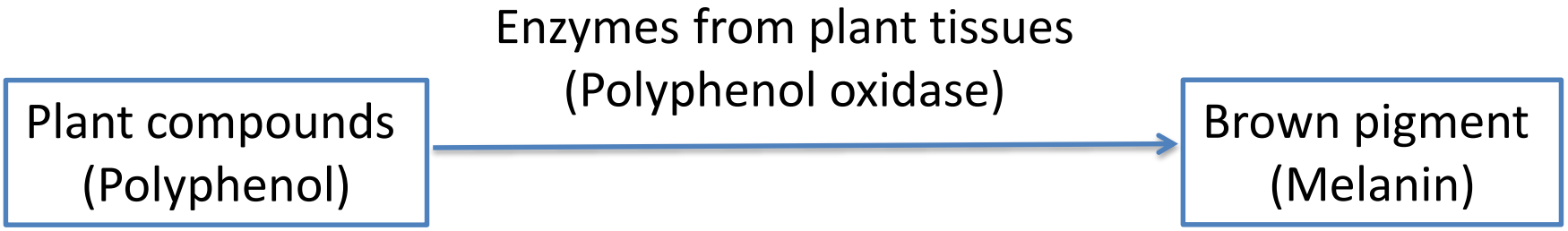
- When fruits or vegetables are peeled or cut, the plant tissue releases some **enzymes** which in the presence of **oxygen** from the air, chemically react with plant compounds to give **brown pigments**.
- This reaction is known as enzymatic browning.

What is “enzyme”?

- Enzymes are proteins that speed up chemical reactions
- Enzymes are inactive until the food is harvested or the animal is slaughtered
- They are sensitive to heat; they remain inactive at very low temperature e.g. in freezer

Natural decay: action of enzymes

- Enzymatic browning:

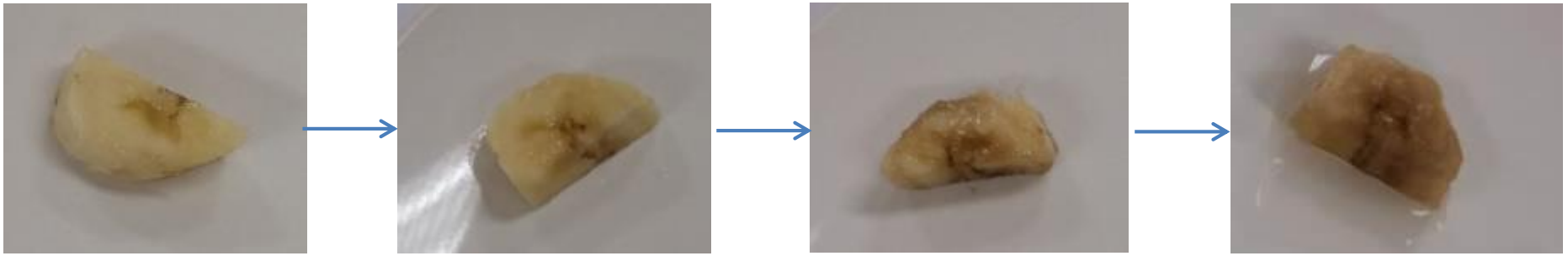


- The reaction makes the food unappealing and limits the shelf life of many fruits and vegetables.

What is shelf life?

  - How long a food product can be kept safely without loss of high quality

Natural decay: action of enzymes



5 mins

10 mins

20 mins

1 hour

Enzymatic browning in banana

Natural decay: action of enzymes

How to keep sliced bananas from turning brown?

- Sliced bananas are especially vulnerable to browning

- When fruits are cut, the enzymes in the fruit speed up the reaction between oxygen and the plant compounds to produce brown colour.

Natural decay: action of enzymes

- **Method 1:** Stop the enzyme
- Enzymes are proteins and they are destroyed by acids and salt, e.g.
  - brush or dip the banana slices in fruit juice which is acidic e.g. lemon juice, orange juice etc.
  - soak the slices in salt water

What are acids?

- Acids are chemicals that are found in some food which give sour or sharp taste, e.g.
  - vinegar, lemon juice

Natural decay: action of enzymes

- **Method 2:** Limit the access of oxygen
- Oxygen is required for browning reaction
  - Immerse the cuts in cold water
  - Cover the fruits immediately after peeling with a plastic wrap

Natural decay: chemical changes

- Chemical changes begin automatically after fruits and vegetables are harvested, or animals are killed (slaughtered)

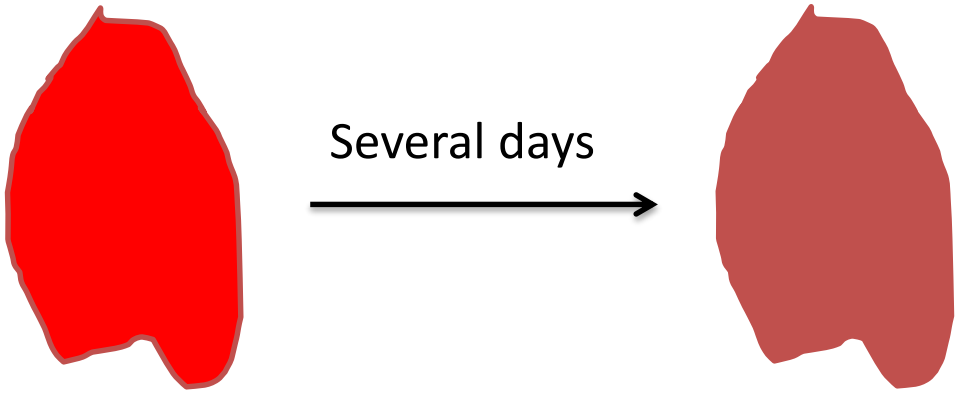
- Oxygen in air, sunlight and high temperature can cause certain foods to undergo undesirable chemical changes

- Chemical changes affect the colour and flavour of foods
  - Fats and pigments in food are mainly affected, e.g.
    - unpleasant smell and taste of cooking oil after use at high temperature

Natural decay: chemical changes

Why does fresh red meat turn brown after a couple of days?

- The red pigment in meat undergoes chemical changes and turns brown when it is exposed to oxygen
- The meat may not be unsafe, it just looks less appealing



Color changes of meat after exposure to air

What is food poisoning?

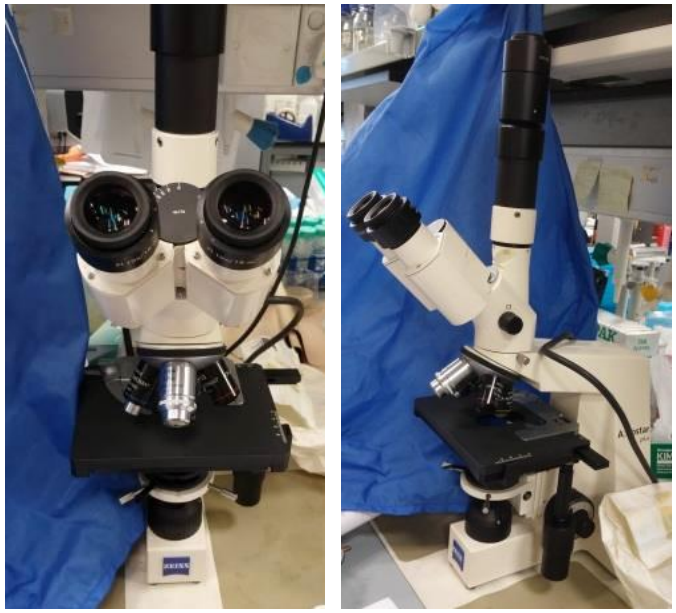
- Eating foods contaminated with micro-organisms may cause food poisoning
- Pregnant women, elderly people, babies and those with a low resistance to infection, are more susceptible to food poisoning or more likely to develop severer disease or complications
- Diarrhoea, vomiting, nausea, headache and fever are common symptoms of food poisoning

What are micro-organisms?

- Micro-organisms are tiny living things which can only be seen under a microscope

- The main micro-organisms are **bacteria**, **moulds** and **yeasts**

- They can be found in air, water, on most of the foods and our hands, etc.



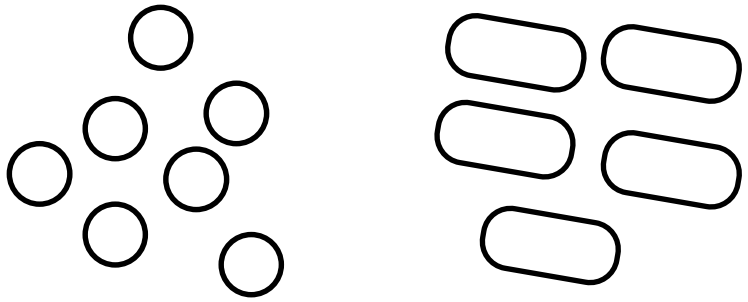
Microscope

What are micro-organisms?

- Micro-organisms growth rapidly in warm and moist conditions with food

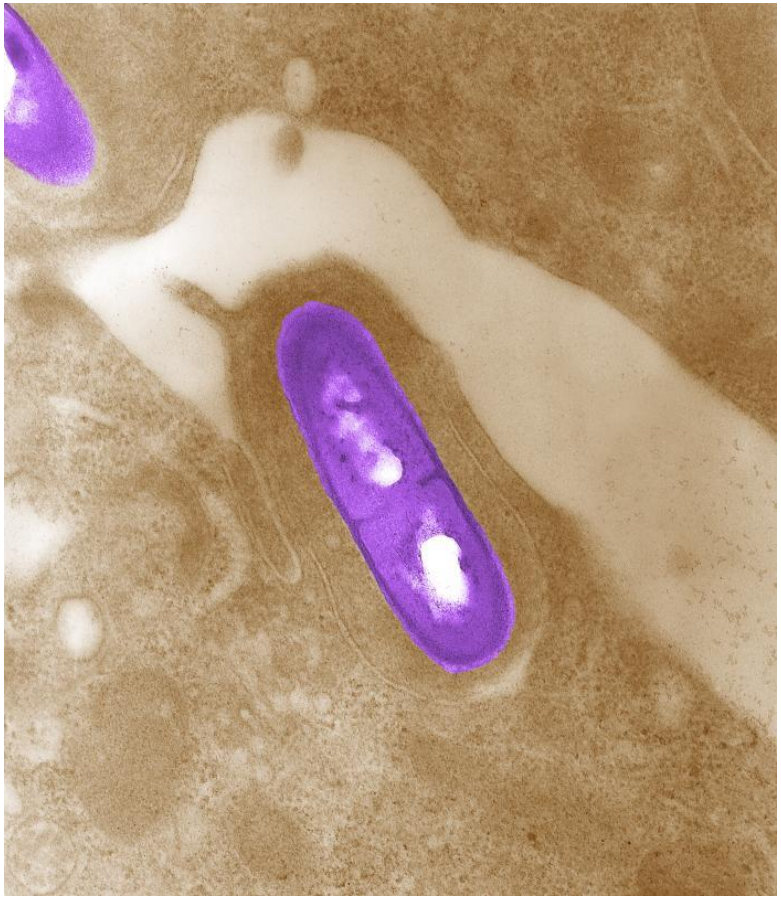
Bacteria

- Bacteria are found in lots of places, including air, water, dusts, plants, animals, people and food.
- Different bacteria have different shapes when we see them under a microscope.
- Most of them are spherical or rod-shaped



Spherical Rod-shaped

Examples of bacteria with different shapes



Listeria is rod-shaped

Content providers: CDC/ Dr. Balasubr Swaminathan; Peggy Hayes

S.aureus is spherical

Content providers: CDC/ James Archer

Source: http://phil.cdc.gov/phil/details.asp

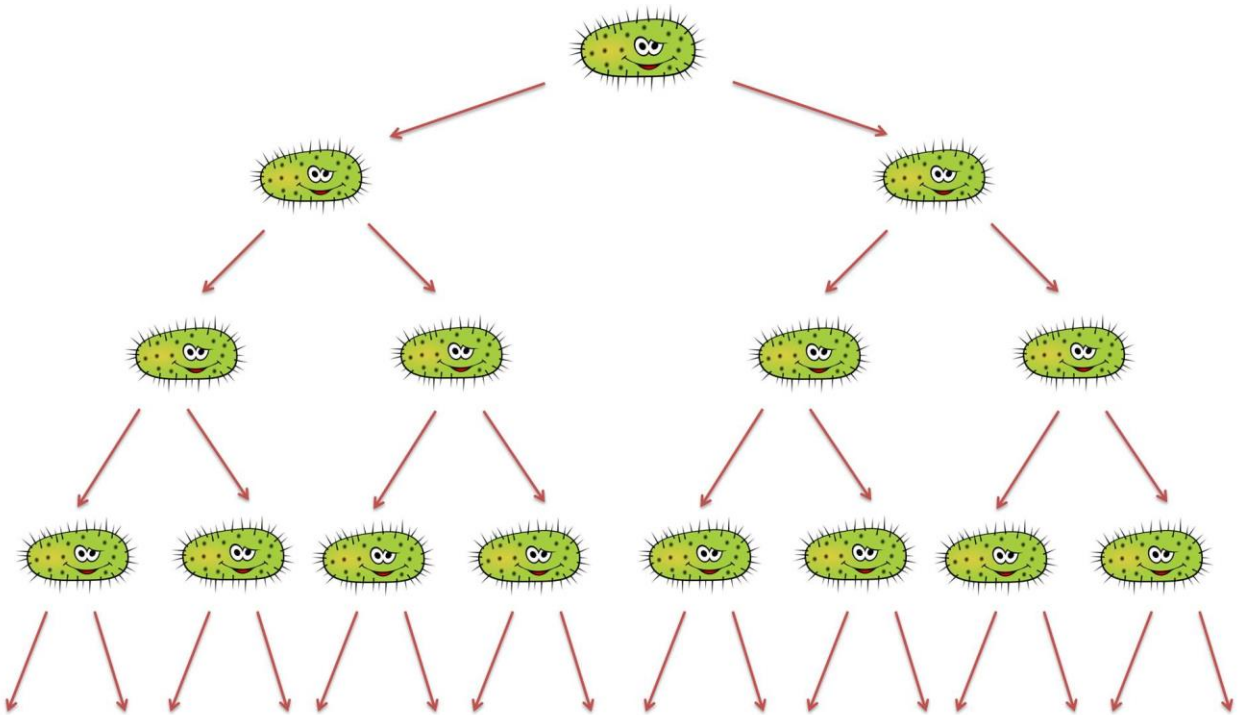
Bacteria

- Food contaminated with bacteria is often undetected because the food usually looks, tastes and smells normal.
- Harmful bacteria which can cause food poisoning is known as pathogenic bacteria.

Bacteria

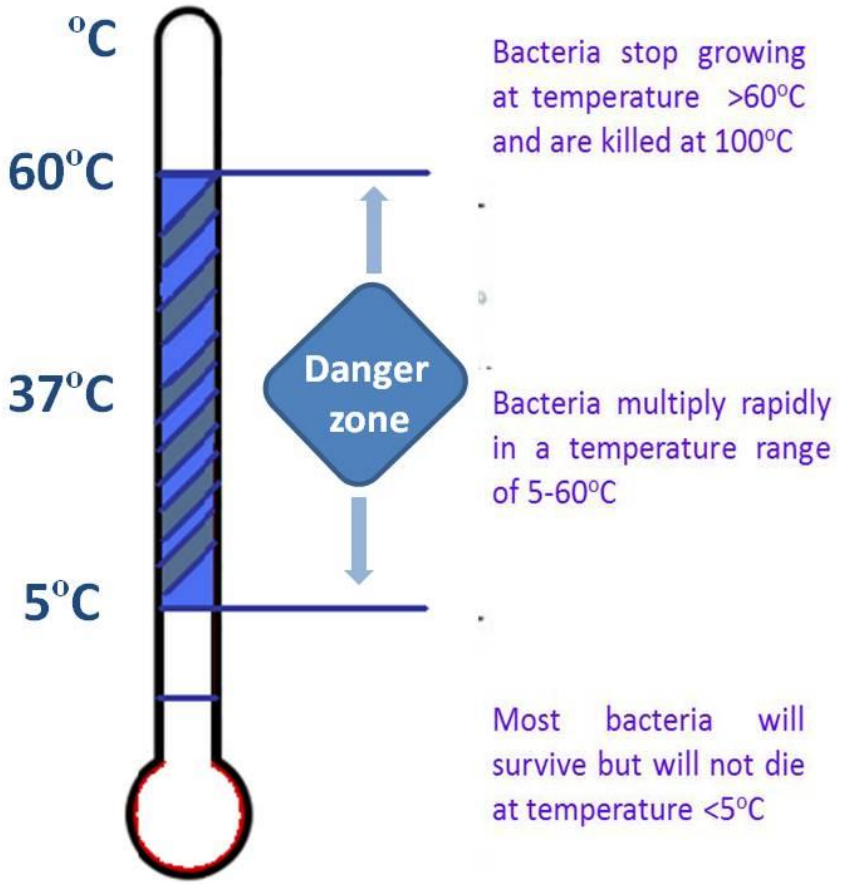
- Bacteria growth rapidly by dividing into two, and into two again in minutes

Time in minute	0	20	40	60	80	100
No. of bacteria	1	2	4	8	16	32



Bacteria

- Bacteria grow at different rates in different temperatures:
  - Most active in a temperature range of 5-60°C, known as the danger zone.
  - The best (optimum) temperature is 37°C, that is, the human body temperature.
  - Most bacteria cannot survive at temperature of 70°C or above.
  - At 4°C or lower, bacteria stop reproducing and become dormant (inactive).



Examples of food spoilage by bacteria: *Listeria*

Reports of deadly disease caused by *Listeria Monocytogenes* doubled in Hong Kong

The Centre for Food Safety reported that the incidence of food poisoning cases caused by *Listeria Monocytogenes* have increased more than twofold in the past two years. Last year, there were 26 reported cases in Hong Kong with a mortality rate of 20%. In the previous three years, the annual average number was 11 cases only.

Listeria Monocytogenes often grow quickly in ready-to-eat food with a shelf life of more than five days that needs to be refrigerated. Soft cheese, smoked salmon, processed meat and salad are examples of food that have high chance to be contaminated with the bacteria.

Source: local newspapers (integrated report), September 2014

Listeria

- *Listeria* is a common food-poisoning bacteria
- *Listeria* can be killed under normal cooking temperature but is able to grow slowly at refrigerated temperature as low as 0°C
- Ready-to-eat foods with long shelf-life under refrigeration such as cheese and meat have been involved in *Listeria* food-poisoning cases
- *Listeria* can cause fever, muscle pain, headache, nausea, vomiting or diarrhoea
- Healthy individuals usually only develop mild symptoms.
- The effects on infants, young children, the elderly and people with weak immune systems can be severe and even lead to death.

Example of food spoilage by bacteria: *Salmonella*

Rice vermicelli in soup with egg detected with *Salmonella*

The Tin Shui Wai branch of a restaurant chain was ordered to stop selling rice vermicelli in soup with egg after a sample of the dish was found to be infected with *salmonella* bacteria. The Centre for Food Safety ordered the restaurant concerned to clean the premises and improve their food preparation hygiene.

Salmonella is found in eggs and food of animal origin. Undercooked eggs and egg products and food prepared with raw eggs are often involved in *salmonella* food-poisoning cases.

Source: local newspapers (integrated report), May 2015

Salmonella

- *Salmonella* is a type of bacteria
- *Salmonella* is found in eggs and food of animal origin
- Undercooked eggs and egg products and food prepared with raw eggs have been involved in salmonella food-poisoning cases
- *Salmonella* can cause vomiting, abdominal pain and diarrhoea.
- The effects on infants, young children, the elderly and people with weak immune systems can be severe and even lead to death.

Moulds

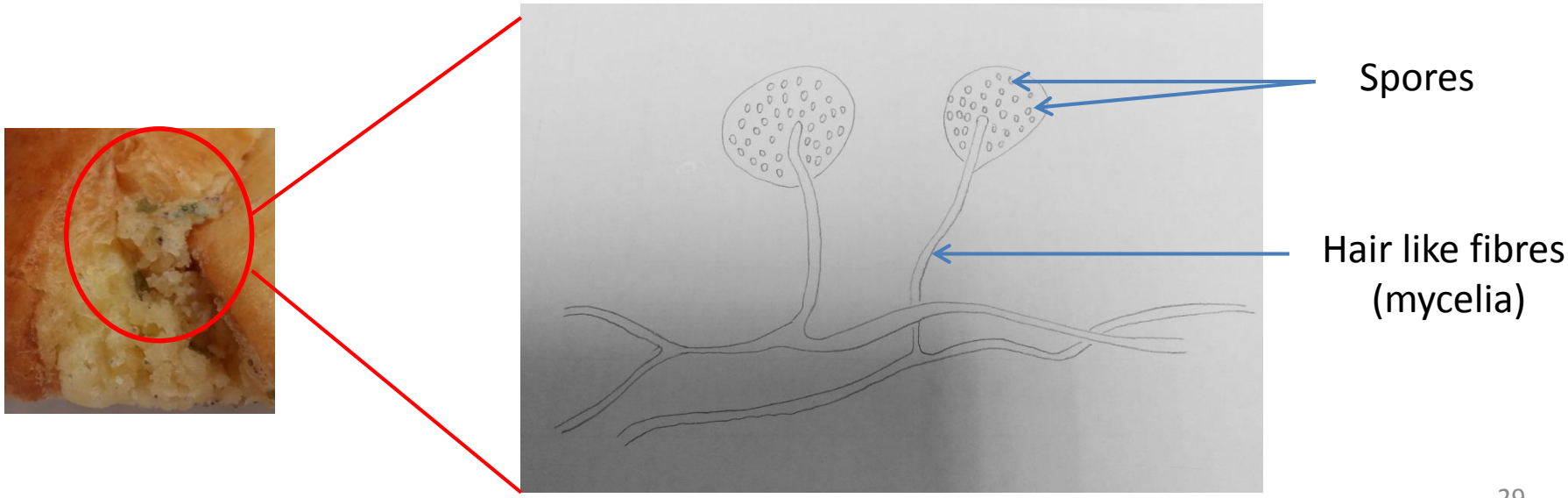
- Moulds are larger then bacteria or yeast
- Moulds are members of the fungi family

What is fungi?

- They are living things, neither a plant nor an animal
- Mushrooms, moulds, and yeasts are members of fungi family
- They grow by absorbing nutrients from their surroundings

Moulds

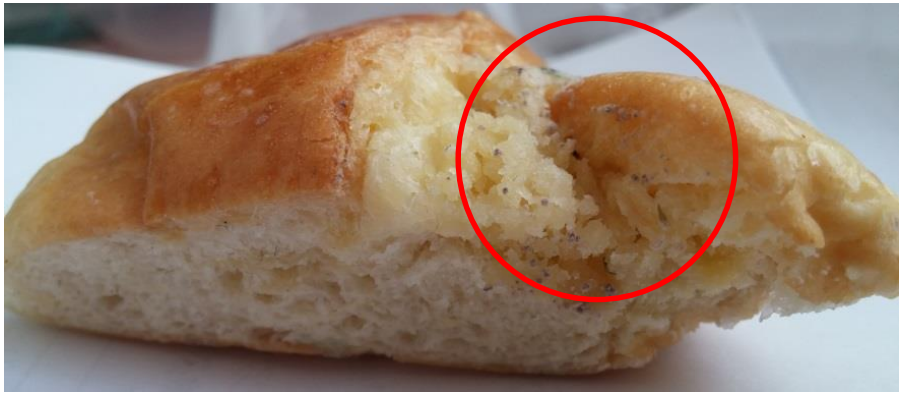
- They are made up of hair like fibres (mycelia) and spores
  - They grow on the surface of food e.g. on cheese and bread
  - Reproduce by producing spores which travel in the air
- Moulds can produce harmful toxins (mycotoxins), which are poisonous substances



Moulds

Example of food spoilage by moulds

- Spoiled garlic bread
  - Green moulds growing on surface of garlic bread



Example of food spoilage by moulds: aflatoxins

Pre-packed pistachio contaminated with aflatoxins

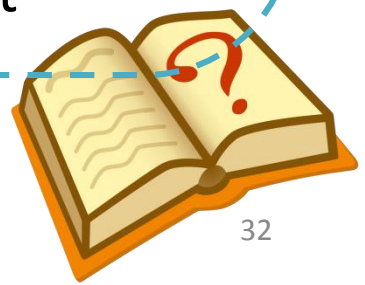
The Centre for Food Safety reported that they were notified by the European Commission that a kind of pre-packed shelled pistachio was detected with aflatoxins. The center confirmed that the product concerned has not entered the local market and they urge retailer to return the affected product to the importer for disposal.

Aflatoxins are a group of toxic compounds produced by some mould species under favourable temperature and humidity. They are more commonly found in peanuts and corn. Aflatoxins can lead to liver cancer, especially for hepatitis B carriers, after long term ingestion. Consumers are advised not to consume food that looks mouldy or damaged to avoid excessive intake of the toxin.

Source: local newspapers (integrated report), September 2014

Aflatoxins

- Aflatoxins are toxins produced by moulds
- They are commonly found in crops e.g. peanuts, maize, cereals etc.
- Aflatoxins can cause liver damage and cancer in human
- Conditions that favour the growth of the aflatoxins-producing moulds:
  - High humidity
  - High temperature
  - Poor handling and storage of crops after harvest

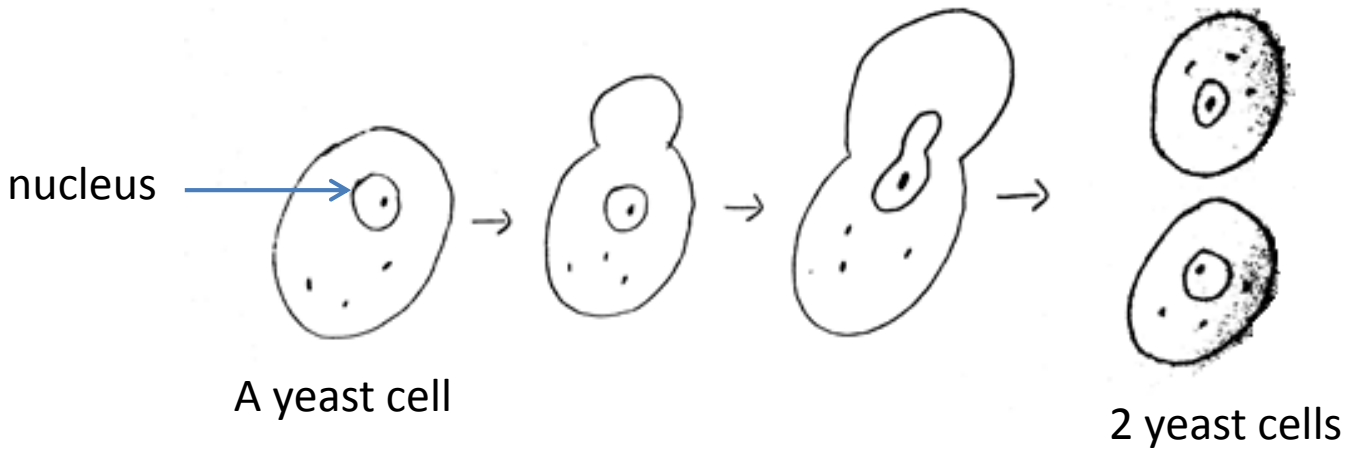


Yeasts

- Yeasts are tiny single-celled fungi.
- Active in warm, moist conditions with food for growth
- Yeasts can grow without oxygen (anaerobic growth)
- Responsible for food spoilage in high sugar foods such as fruit, jam and fruit yoghurts
- Signs of food spoilage by yeasts, e.g.
  - the cork of a juice bottle is popped out
  - bloated cans of food and drinks

Yeasts

- They reproduce by “budding”, they send out a little bud that grows then breaks away to form another yeast cell



Budding of yeast