

The Prevention of **FOOD POISONING**



Jill Trickett

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by

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Stanley Thornes (Publishers) Ltd

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Preface

My aim in writing this book is quite simply to provide an introduction to the subject of food poisoning. The fact that the number of outbreaks of food poisoning is increasing each year despite apparently higher living standards and high standards of personal hygiene suggests that many staff employed in the catering industry, and many housewives, have no knowledge of the causes and prevention of food poisoning.

The book seeks to offer an interesting and logical approach to the basic principles of bacterial growth with special emphasis on pathogenic bacteria, their sources, means of access to the kitchen, ways of controlling their growth in foods and hence the prevention of food poisoning. No previous knowledge of the subject is required but for anyone already acquainted with the basic ideas, the provision of sub-headings and cross references should make it possible to refer to any particular subject area.

The need for such a book was brought home to me while preparing a course of lectures on food hygiene for students taking the Royal Institute of Public Health and Hygiene's certificate examination in Food Hygiene and the Handling of Food. It seemed to me that there was not a suitable book for students at this level, the majority of textbooks being too advanced for the requirements of the course. In addition I hope it will be useful for students taking 'A' level G.C.E. Home Economics papers, and for those taking City & Guilds of London Institute Catering Courses. Above all, I hope that the general reader will find much to interest him.

J. Trickett

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Chapter 1

Introduction to Bacteria

Bacteria, also known as germs or micro-organisms, are so small that they can only be seen through a microscope. A bacterium has a very simple structure consisting of one cell only whereas the human body (or that of any animal or insect) is made up of countless numbers of different cells.

Approximately one million bacteria clumped together would cover a pin-head. There are many different types of bacteria and they vary in shape but the bacteria which are spread by food are usually spherical (*cocci*), rod-shaped (*bacilli*) or comma shaped (*vibrios*).

COCCUS

A spherical or near spherical cell



BACILLUS

A rod shaped cell – longer than it is broad



VIBRIO

Curved rods – shaped as 'commas'



Bacteria are present almost everywhere: in the air, on our skin and hair, in our noses and mouths, in our intestinal tracts, in our food, on kitchen equipment, in garden soil and in water. Some are mobile and can swim around in liquids but most cannot move by themselves. These are only transferred by direct contact.

GROWTH AND MULTIPLICATION

If bacteria are supplied with food, water and a warm temperature, they will grow and multiply. As bacteria consist of only one cell, they multiply very simply by growing to a maximum size by absorbing simple substances from their environment and then splitting into two new identical cells. In optimum conditions (the very best conditions) for growth (see Chapter 2, page 5) bacteria will divide into two approximately every twenty minutes. One bacterium will therefore produce two bacteria after twenty minutes. These two bacteria will then both grow and divide into two after a further twenty minutes making a total of four bacteria after forty minutes. After sixty minutes there will be eight bacteria and so after five or six hours there will be thousands of bacteria.

Study the following table to see how quickly the number of bacteria in food can increase. Can you fill in the spaces?

TABLE 1

	20 mins.	40 mins.	60 mins.
	2	4	8
1 hour	16		64
2 hours	128	256	
3 hours	1024	2048	4096
4 hours		16 384	
5 hours	65 536		262 144

After six hours in optimum conditions it is possible for one bacterium to become 262 144 bacteria. If a sufficient amount of the right sort of food is present, most bacteria will continue to grow and multiply but there will always be some bacteria which die instead of dividing into two.

PATHOGENS

Only a few of the thousands of different types of bacteria are responsible for causing illness. Those which do are known as pathogens. Some pathogens (harmful bacteria) can make food poisonous by growing and multiplying in it but they must normally be present in large numbers in order to cause illness. Small numbers of most types of pathogenic bacteria can be swallowed with food without causing any ill effects. However, food can contain large numbers of food poisoning bacteria and yet look and smell perfectly wholesome.

COMMENSALS

Bacteria which do not cause disease in the part of the body where they normally live are called commensals. The majority of commensals are completely harmless bacteria but some can cause disease if they spread to areas of the body where they are not normally present. (See *Staphylococcus* page 30)

SPOILAGE BACTERIA

Certain bacteria are capable of spoiling food without making the food poisonous. A slimy surface on meat is due to growth of bacteria which do not cause food poisoning. The change in odour and appearance of pasteurised milk on keeping is due to substances produced by growing bacteria but these are not usually the harmful types.

USEFUL BACTERIA

Many bacteria perform useful functions and are essential for certain processes, for example:

1. The manufacture of cheese and yoghourt.
2. The production of some antibiotics and some vitamins.
3. The production of manure from decaying vegetable matter.

SUMMARY

1. Bacteria are very small, approximately 1 000 000 would cover a pin-head.
2. There are thousands of different types of bacteria but only a few of them can cause food poisoning.
3. In optimum conditions for growth, bacteria will divide into two approximately ever 20 minutes.

Chapter 2

The Growth Requirements of Food Poisoning Bacteria

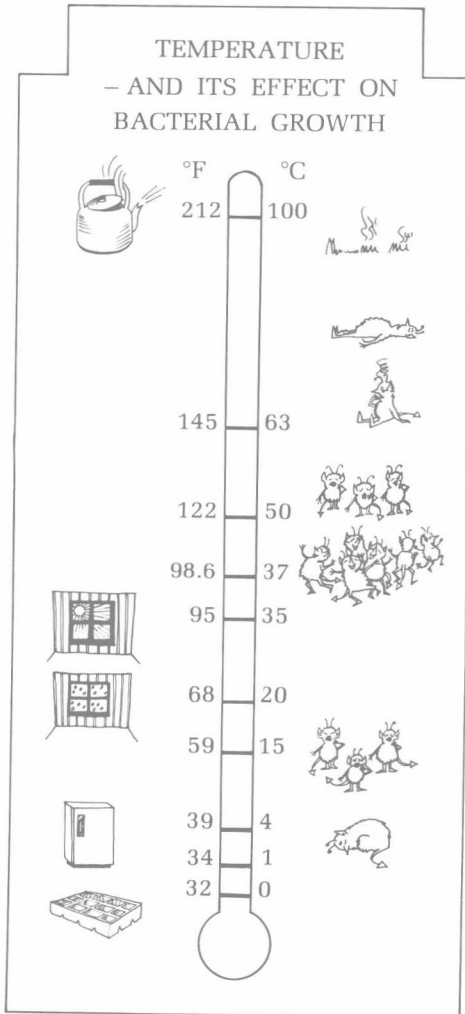
In order to grow and multiply, bacteria have four requirements: warmth, food, moisture, time.

WARMTH

The bacteria which cause food poisoning prefer to live at the temperature of the human body 37°C (98.6°F) and it is at this temperature that they will grow and multiply at the fastest rate. As the temperature increases from 37°C (98.6°F) to 50°C (122°F) the rate of growth slows down and at temperatures above 50°C (122°F) very few bacteria can grow at all. If the temperature is increased still further to 63°C (145°F) or above, bacteria will be killed. The length of time and the temperature required to kill them will depend on the type of bacteria and the food involved. They are normally killed in 1–2 minutes in boiling water.

If the temperature of the food is decreased from 37°C (98.6°F) to 15°C (59°F) the bacteria will continue to multiply but the rate of multiplication will slow down as the temperature decreases. However bacteria are not killed by low temperatures and even in frozen food they remain dormant. This means that they are alive but have stopped growing and multiplying. Pathogenic bacteria will not grow at the temperature of the domestic refrigerator, $1\text{--}4^{\circ}\text{C}$ ($34\text{--}39^{\circ}\text{F}$) but some spoilage bacteria are able to grow and multiply slowly. When the foods are removed from the refrigerator and warmed up, the bacteria will start to multiply once again. Even deep-freezing does not kill all bacteria. In deep frozen food both pathogenic and spoilage bacteria can remain dormant but when the food is thawed and warmed up they will start to grow and multiply again.

In the summer, the temperature in a badly ventilated kitchen can reach 30–40 °C (86–104 °F) which is the temperature range when bacteria can multiply very rapidly and for this reason foods should not be allowed to stand for any length of time in a kitchen. Any preparation should be done as quickly as possible and then the food should be stored in a cool larder or refrigerator until it is ready to be served.



FOOD

Like all living things bacteria need food. They will live and multiply in many foodstuffs particularly those which are high in protein and moisture. The foods which we eat that most frequently support bacterial growth are:

1. Meats, poultry and meat products (meat pies and pasties, sausages).
2. Stocks, gravies, stews and sauces.
3. Milk, cream and egg products (custards, trifles).

The following foods do not normally support the growth of food-poisoning bacteria:

1. Acid foods (pickles, citrus fruits).
2. Foods with a high concentration of salt (salted meats, anchovies, olives).
3. Foods with a high concentration of sugar (jams, syrups).
4. Fatty foods (butter, cooking oils, fatty fish).
5. Dry foods (biscuits, flour).

Although bacteria thrive on foods enjoyed by humans, they can also use a crumb lodged in a crack on a table for food or a smear of blood on a chopping board which has not been washed thoroughly.

SOME OF THE FOODS WHICH WILL SUPPORT BACTERIAL GROWTH



MOISTURE

Like all living things bacteria require moisture for growth. Most foods contain sufficient water for bacterial growth but dehydrated products such as milk powder, dried soup powder and dried egg powder will not allow the growth of bacteria. In dried products bacteria survive but remain dormant until the powders are reconstituted. If a pint of milk is made up from milk powder, as soon as the water is added, it must be stored in a refrigerator to prevent any bacteria present from multiplying.

TIME

As we have already seen, if bacteria are provided with food, water and a temperature near 37 °C (98.6 °F), they will divide into two every twenty minutes. A few bacteria cannot cause illness but if contaminated food (food containing bacteria) is kept for a sufficiently long time in the right conditions the number of bacteria will increase making the food poisonous. If food is eaten shortly after it is cooked or prepared, the risk of food poisoning is considerably reduced.

AEROBES AND ANAEROBES

Bacteria differ from one another in their requirements for air. Most of them require the presence of air to grow and multiply and these are called aerobes. (See *Salmonella* Chapter 6 page 25, *Staphylococcus* Chapter 7 page 30, *Bacillus cereus* Chapter 10 page 41.) Some do not require the presence of air to grow and multiply and these are called anaerobes. (See *Clostridium welchii* Chapter 8 page 34 and *Clostridium botulinum* Chapter 9 page 39.)

SPORES

When bacteria are growing and multiplying we say they are in the vegetative state. In this state they are usually easily destroyed by heat or chemicals. Some but not all bacteria can exist in another form – the spore form. A spore is a rounded body which forms inside the bacterial cell when conditions become

unfavourable for growth or multiplication. The rest of the cell then gradually disintegrates leaving only the spore. This spore can resist very high temperatures and high concentrations of chemicals that would kill bacteria in the vegetative state. They can survive up to five hours in boiling water and so they are not destroyed by normal cooking methods. Spores are also formed when there is insufficient moisture present. They can survive for years without food or water but when conditions again become favourable and the four requirements for growth are present, the spores return to the vegetative state and continue to grow and multiply. (See *Clostridium welchii* Chapter 8 page 34, *Clostridium botulinum* Chapter 9 page 39 and *Bacillus cereus* Chapter 10 page 41.)

SUMMARY

1. The four requirements for bacterial growth are warmth, food, moisture and time.
2. The bacteria which cause food-poisoning grow best at 37 °C (98.6 °F).
3. Bacteria are not killed by the cold but those which cause food-poisoning stop multiplying in a refrigerator.
4. Bacteria in the vegetative state are killed after two minutes in boiling water.
5. Some bacteria form spores which are only destroyed after several hours in boiling water.
6. Bacteria grow best in foods which are high in moisture and are not too acid, not too sugary and not too salty.
7. Bacteria cannot grow and multiply without moisture but they can remain dormant in dried foods.
8. The temperature and humidity of the kitchen provide excellent conditions for the growth and multiplication of bacteria.

Chapter 3

What is Food Poisoning?

Food poisoning is an illness brought about by eating harmful food. The symptoms are usually vomiting, diarrhoea and abdominal pains. Vomiting and diarrhoea are the body's method of disposing of harmful substances from the digestive tract thus preventing them from getting into the blood stream. In a few types of food poisoning the poisons enter the blood stream, causing illness in the body generally, with a wide variety of symptoms.

INCUBATION PERIOD

This is the time that passes between the entry of the poisonous food into the body and the occurrence of the first symptoms. In the case of bacterial food poisoning, the length of the incubation period helps to decide which type of bacteria has caused the food poisoning. Some types of bacteria cause food poisoning with a relatively long incubation period (up to 2 days) and other types of bacteria cause food poisoning with a relatively short incubation period (2 hours). The length of the incubation period also depends on the number of bacteria present as well as the type of bacteria causing the food poisoning. If the food is very heavily contaminated with a certain type of bacteria, the incubation period will be shorter than if the food is contaminated with only half the number of the same type of bacteria.

DURATION

The duration of the illness is the time between the appearance of the first symptoms of food poisoning and the clearing up of the last ones. When all the symptoms of food poisoning have gone, it does