

2

Understanding the Microworld

Chapter Overview

This chapter introduces students to pathogens and their impact on foodborne illnesses.

Learning Objectives

- 2-1** Identify the conditions that affect the growth of foodborne bacteria (FAT TOM)
- 2-2** Describe the characteristics of major foodborne pathogens, their sources, resulting illnesses, and symptoms
- 2-3** Describe ways to prevent viral, bacterial, parasitic, and fungal contamination
- 2-4** Characterize naturally occurring toxins and ways to prevent illnesses caused by them

Opening Case Study

1. What could have been done to prevent the illnesses?

Answer: The illnesses could have been prevented if the cook had reported his illness to management. If the cook had done so, they would have been required to exclude him from the operation. This most certainly would have prevented the issue. Another action that may have prevented it was correct handwashing. The cook failed to wash his hands several times after using the restroom. This was a critical mistake since feces on the fingers can result in contaminated food.

2. What should the catering company's owners and management team do to ensure that an issue like this does not occur in the future?

Answer: To prevent an issue like this in the future, owners and management should:

- Remind food handlers of the importance of reporting illness to managers.
- Exclude food handlers from the operation who have diarrhea or have been diagnosed with an illness from *Shigella* spp.
- Remind food handlers of the importance of handwashing. If necessary, retrain them on how, when, and where to wash hands.

Chapter Breakdown

Pages 22 to 24**2.1 Pathogens**

Resources

PowerPoint Slides 3 to 6

Reinforce and Review:

- Most pathogens get into food and onto food-contact surfaces because of the way that people handle them. Simple mistakes can contaminate food and lead to a foodborne illness. The FDA has identified six pathogens that are highly contagious and can cause severe illness. These are known as the “Big Six.”

Key Terms

- **Microorganisms:** Small, living organisms that can be seen only through a microscope. There are four types of microorganisms that can contaminate food and cause foodborne illness: bacteria, viruses, parasites, and fungi.
- **Pathogens:** Illness-causing microorganisms.
- **Toxins:** Poisons produced by pathogens, plants, or animals. Some toxins occur in animals as a result of their diet.
- **Fecal-oral route:** The transfer of pathogens from a person’s feces to his or her hands, and then from that person’s unwashed or improperly washed hands to food that is eaten by someone else. A food-borne illness may result.
- **Jaundice:** A yellowing of the skin and eyes, which can be a symptom of a foodborne illness.
- **Onset time:** Time it takes for the symptoms of a foodborne illness to appear after exposure to the pathogen, toxin, or parasite that caused the illness. This time varies depending on the type of food-borne illness and other factors.

Knowledge Check Answers

1. Most pathogens get into food and onto food-contact surfaces because of the way that people handle them, including:
 - Contaminating through fecal–oral route
 - Spreading from person to person
 - Through sneezing or vomiting onto food or food-contact surfaces
 - Touching dirty food-contact surfaces and equipment and then touching food
 - Allowing ready-to-eat food to touch surfaces that have come in contact with raw meat, seafood, and poultry
 - Storing food or cleaning products incorrectly
 - Failing to spot signs of pests in the operation, because pests are a major source of disease
2. Food handlers who do not wash their hands after using the restroom may contaminate food and surfaces with feces from their fingers. Once the food that the food handler touched is eaten, a food-borne illness may result. This is called the fecal–oral route of contamination.

Chapter Breakdown

Pages 25 to 38**2.2 Bacteria**

Resources

PowerPoint Slides 7 to 20

Reinforce and Review:

- Bacteria need certain conditions to grow. Those conditions include food, acidity, temperature, time, oxygen, and moisture (FAT TOM). Certain FAT TOM conditions favor greater bacterial growth in food. They are also often involved in foodborne-illness outbreaks.
- Bacteria can usually be controlled by keeping food out of the temperature danger zone (41°F–135°F [5°C–57°C]). Some bacteria can change into spores to preserve themselves when lacking nutrients. Others can produce toxins in food that can make people sick.

Key Terms

- **Bacteria:** Single-celled, living microorganisms that can spoil food and cause foodborne illness.
- **FAT TOM:** Acronym for the conditions needed by foodborne bacteria to grow—food, acidity, temperature, time, oxygen, and moisture.
- **pH:** A measure of acidity on a scale of 0 to 14.0, with 0 being highly acidic, 7.0 being neutral, and 14.0 being highly alkaline.
- **Temperature Danger Zone:** The temperature range between 41°F and 135°F (5°C and 57°C), within which most foodborne microorganisms rapidly grow.
- **Water activity:** Amount of moisture available in food for bacteria to grow. It is measured on a scale from 0.0 to 1.0, with 1.0 having the most moisture available.
- **Spore:** Form that some bacteria can take to protect themselves when nutrients are not available. Spores can revert back to a form capable of growth.

Knowledge Check Answers

1. Bacteria grow rapidly between 41°F and 135°F (5°C and 57°C). This range is known as the temperature danger zone. Within the temperature danger zone, bacteria grow even more rapidly from 70°F to 125°F (21°C to 52°C).
2. There are four bacteria:
 - *Shigella* spp.
 - *Salmonella* Typhi
 - Nontyphoidal *Salmonella* (NTS)
 - Shiga toxin-producing *Escherichia coli* (STEC), also known as *E. coli*

Chapter Breakdown

Pages 38 to 43**2.3 Viruses**

Resources

PowerPoint Slides 21 to 26

Reinforce and Review:

- Viruses are the leading cause of foodborne illness. They cannot grow in food, but they can survive refrigeration and freezer temperatures. Good personal hygiene helps prevent the spread of viruses.

Key Terms

- **Virus:** Smallest of the microbial food contaminants. Viruses rely on a living host to reproduce.

Knowledge Check Answers

1. The best ways to prevent the spread of viruses:
 - Prohibit food handlers who are vomiting or who have diarrhea or jaundice from working.
 - Make sure food handlers wash their hands regularly and correctly.
 - Avoid bare hand contact with ready-to-eat food.
2. Not all viruses are destroyed by normal cooking temperatures. Hepatitis A is one example of this.

CLASSROOM ACTIVITY: Mapping Pathogens

LO: 2-2 Describe the characteristics of major foodborne pathogens, their sources, resulting illnesses, and symptoms

Materials: Blank paper

1. Divide students into six groups and give each group a piece of paper.
2. Assign one "Big Six" pathogen to each group and ask them to create a concept map for their pathogen that includes:
 - Source of the pathogen
 - Food commonly linked with the pathogen
 - Measures that can be taken to prevent the pathogen from causing illness
3. Tell each group that they will have 10 minutes to review their pathogen and create the concept map.
4. Ask each group to present their pathogen to the rest of the class. Optionally, create an online discussion board thread and ask students to upload pictures of their concept maps there.

Instructor note: A concept map is a diagram or graphic that visually represents relationships between ideas.

Chapter Breakdown

Pages 43 to 48**2.4 Parasites**

Resources

PowerPoint Slide 27

Reinforce and Review:

- Parasites cannot grow in food. They require a host to live and reproduce. They can contaminate both food and water—particularly water used to irrigate produce. Purchasing products from approved, reputable suppliers helps prevent foodborne illnesses caused by parasites.

Key Terms

- Parasites:** Organisms that need to live in a host organism to survive. Parasites can be found in water and inside many animals, such as cows, chickens, pigs, and fish.

Knowledge Check Answers

- Parasites cannot grow in food. They require a living host to grow and reproduce.
- The most important way to prevent foodborne illnesses from parasites is to purchase food from approved, reputable suppliers. Cooking food to required minimum internal temperatures is also important. Also, make sure fish that will be served raw or undercooked has been correctly frozen by the manufacturer.

Chapter Breakdown

Pages 48 to 49**2.5 Fungi**

Resources

PowerPoint Slide 28

Reinforce and Review:

- Fungi, such as molds and yeasts, mostly spoil food. However, some molds can produce harmful toxins. Food containing mold should always be discarded unless the mold is a natural part of the product. Yeasts can spoil food quickly. Food spoiled by yeast should also be thrown out.

Key Terms

- **Fungi:** Pathogens that can spoil food and sometimes make people sick. Molds and yeasts are examples.
- **Mold:** Type of fungus that causes food spoilage. Some molds produce toxins that can cause food-borne illness.
- **Yeast:** Type of fungus that can cause food spoilage.

Knowledge Check Answers

1. Yes, they sometimes can. Fungi are pathogens that only sometimes make people sick. Mold and yeast are examples. Mostly, fungi spoil food.
2. Aflatoxin is created by some molds.

Chapter Breakdown

Pages 49 to 55

2.6 Biological Toxins

Resources

PowerPoint Slide 29

Reinforce and Review:

- Fish toxins can be a natural part of the fish. Other toxins are made by pathogens on the fish. Some also occur when fish eat smaller fish containing the toxin. Shellfish, such as oysters, can likewise become contaminated when they eat marine algae that have a toxin. Purchasing products from approved, reputable suppliers is the most important prevention measure for seafood toxins.
- Foodborne illnesses linked with mushrooms are almost always caused by eating toxic wild mushrooms collected by amateur hunters. Foodborne illnesses can also be caused by other naturally occurring plant toxins. Purchasing products from approved, reputable suppliers helps prevent these types of foodborne illnesses.

Key Terms

No key terms for this section

Knowledge Check Answers

1. Histamine toxin can be prevented through proper holding. When scombroid fish, such as tuna and mahimahi, are time-temperature abused, bacteria on the fish can make the toxin. Holding scombroid fish at correct temperatures can prevent this.
2. No, mushroom toxins are not destroyed by cooking or freezing. Use only mushrooms and mushroom products purchased from approved, reputable suppliers.

End of Chapter

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Discussion Questions

1. What are the six conditions that support the growth of bacteria?

The six conditions are:

- Food: Carbohydrates or proteins
- Acidity: Food that contains little or no acid
- Temperature: Temperatures between 41°F and 135°F (5°C and 57°C)
- Time: The longer food spends at temperatures between 41°F and 135°F (5°C and 57°C), the more opportunity bacteria in the food have to grow to unsafe levels
- Oxygen: Some bacteria grow with oxygen, others grow without it
- Moisture: Food with high levels of available moisture

2. What two FAT TOM conditions are easiest for an operation to control?

Time and temperature. To control time, limit how long TCS food spends in the temperature danger zone. To control temperature, keep TCS food out of the temperature danger zone.

3. How can an outbreak of Norovirus be prevented?

An outbreak of Norovirus can be prevented by practicing good personal hygiene. This is the most important prevention measure and includes the following:

- Excluding staff members who have diarrhea and are vomiting from the operation
- Excluding staff members who have been diagnosed with Norovirus from the operation
- Washing hands
- Avoiding bare hand contact with ready-to-eat food

4. What measures should be taken to prevent a seafood-specific foodborne illness?

Food must be purchased from an approved, reputable supplier. This is the single most important prevention measure.

5. What six pathogens have been dubbed the “Big Six”? Why have they been singled out by the FDA?

The “Big Six” pathogens include the bacteria *Shigella* spp., *Salmonella* Typhi, Nontyphoidal *Salmonella*, and Shiga toxin-producing *E. coli*, and the viruses hepatitis A and Norovirus. These pathogens have been singled out by the FDA because they are highly infectious.

Page 57**Apply Your Knowledge****Rice Makes Children Sick****1. What pathogen caused the illness and why?**

The illness was caused by the bacteria *Bacillus cereus*. It is commonly linked with cooked rice, including fried rice. The outbreak occurred because the pathogen was allowed to grow when the rice was cooled incorrectly and held at the wrong temperature. Once this occurred, the bacteria formed a toxin, which, when eaten, made the children sick. Reheating the food may inactivate the living bacteria, but it does not eliminate any toxin that the bacteria have already created.

Pages 58 to 59**Study Questions**

1. B. jaundice.
2. A. Control time and temperature.
3. A. Food easily contaminated by hands
4. C. Practice good personal hygiene.
5. A. Fish
6. A. Norovirus
7. A. Toxin
8. C. Hepatitis A, Norovirus, *Salmonella* Typhi, Nontyphoidal *Salmonella*, *Shigella* spp., and Shiga toxin-producing *E. coli*
9. B. Time
10. D. Nontyphoidal *Salmonella*