

Sustainable Food Safety 201



PEAK SHIFT

CHAPTER 2

Understanding the Microworld

Learn the behavior.
Understand the control.

FDA Food Code 2026, 1-201.10 and Annex 3

BASIS: FDA FOOD CODE / GUIDANCE



How to Study This Chapter

01 Understand

Learn the organism, its behavior, and the control.

02 Compare

Separate growth, survival, contamination, and toxin formation.

03 Explain

Use a restaurant example to put the idea into your own words.

04 Practice separately

Use the study guide and interactive quiz after the lesson.

The lesson teaches. The separate quiz checks understanding.

Organisms, Pathogens, and Toxins

Microorganism

A microscopic organism. Not every microorganism causes disease.

Pathogen

A disease-causing agent, such as a harmful bacterium or virus.

Toxin

A harmful substance, not an organism. Some are produced by microorganisms.

Killing an organism does not necessarily remove a toxin it produced.

How Contamination Reaches Food

01 Source

A person, raw food, water, a surface, or a pest carries contamination.

02 Transfer

Hands, utensils, drips, or contact move it to another food.

03 Exposure

The guest consumes the contaminated food.

A later transfer can defeat an earlier successful cooking step.

2-301.14; 3-301.11; 3-302.11; 4-602.11

BASIS: FDA FOOD CODE + GUIDANCE

Symptoms Are Clues, Not a Diagnosis

Common illness symptoms

Diarrhea, vomiting, nausea, cramps, and fever can have many causes.

A memorable sign

Jaundice means yellowing of the skin or whites of the eyes.

Manager action

Receive reports and apply employee-health rules; do not diagnose the cause.

Similar symptoms can come from different pathogens.

2-201.11 through 2-201.13; CDC symptoms

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Bacteria and Viruses Behave Differently

Bacteria

Many can multiply in food when its conditions support growth.

Viruses

Need living host cells to reproduce. They do not multiply in food.

Cold food can still carry a virus.

3-701.11(C)-(D); Annex 3; Bad Bug Book: bacteria and viruses

BASIS: FDA FOOD CODE + GUIDANCE

FATTOM: Six Growth Conditions

Food

Available nutrients.

Acidity

The food's pH.

Time

Time under growth-supporting conditions.

Temperature

The environment affecting growth.

Oxygen

Whether the organism needs or tolerates oxygen.

Moisture

Water available for microbial growth.

Time and temperature are the conditions restaurants usually control most directly.

Food and Acidity

Food

Protein-rich foods can support growth. Cooked rice, beans, and other plant foods can too.

Acidity

pH 7 is neutral. Lower pH means more acidic; many pathogens favor less-acidic foods.

The ingredient name or a sour taste does not establish TCS status.

Time and Temperature

Cold holding

Ordinary TCS cold-holding limit: 41 F or below.

Hot holding

Ordinary TCS hot-holding limit: 135 F or above.

Growth risk

Time between these limits can allow growth; the rate depends on the organism.

41 F = 5 C. 135 F = 57 C. Cold control slows growth; it does not sterilize food.

Oxygen and Available Water

Oxygen

Some bacteria require oxygen; others can grow without it. A vacuum seal is not a kill step.

Water activity

Available water, written aw, is measured from 0 to 1. Higher values mean more available water.

Removing air does not remove nutrients, water, spores, or unsafe temperature history.

Four Bacterial Growth Stages

01 Lag

Cells adjust to their environment; little increase may be apparent.

02 Log / exponential

The population increases rapidly under favorable conditions.

03 Stationary

New cells and dying cells roughly balance.

04 Death / decline

Viable cells decrease; food is not thereby proven safe.

These describe a growth curve, not permission to hold food without control.

Cells, Spores, and Toxins

Vegetative cell

An active bacterial form; correct cooking destroys many vegetative pathogens.

Spore

A resistant survival form made by certain bacteria; it may survive cooking.

Toxin

A harmful substance. Some preformed toxins withstand ordinary reheating.

Spores survive; cells may grow later; some toxins can remain.

Bad Bug Book: B. cereus, C. perfringens, C. botulinum, S. aureus

BASIS: PUBLIC-HEALTH GUIDANCE

Cooling: A Worked Example

The batch

Ordinary two-stage cooling; no approved alternative. Rice starts at 135 F; eight hours later, 54 F.

The rule

Reach 70 F within 2 hours, then 41 F or below within 6 hours total.

The decision

Discard this failed batch; correct the cooling process before repeating it.

The six-hour total starts at 135 F. It is not two hours plus six more.

The Big Six: Know the Names

Two viruses

Norovirus; hepatitis A virus.

Four bacteria

Shigella species; Shiga toxin-producing E. coli; Salmonella Typhi; nontyphoidal Salmonella.

Why they matter

These diagnoses trigger specific employee reporting and work-status rules.

Report the diagnosis even when symptoms are absent. The required work status depends on the rule.

2-201.11(A)(2); 2-201.12; Annex 3

BASIS: FDA FOOD CODE + GUIDANCE

Norovirus

Transmission

Tiny amounts of feces or vomit can contaminate hands, food, water, and surfaces.

Recognition

Vomiting, watery diarrhea, nausea, and stomach pain are common.

Prevention

Employee health, soap-and-water handwashing, ready-to-eat protection, and effective cleanup.

Hand sanitizer is not a substitute for washing with soap and water.

2-201; 2-301; 2-502.11; CDC norovirus

BASIS: FDA FOOD CODE + GUIDANCE

Hepatitis A

Transmission

Fecal-oral spread through infected people, contaminated food or water.

Recognition

Fatigue, nausea, abdominal pain; dark urine and jaundice may appear later.

Prevention

Reporting, required work-status controls, hands, ready-to-eat protection, and safe sources.

People may spread infection before the memorable signs appear.

2-201; Annex 3; CDC hepatitis A

BASIS: FDA FOOD CODE + GUIDANCE

Two Viruses, One Key Distinction

Norovirus

Vomiting and watery diarrhea are common recognition clues.

Hepatitis A

Liver involvement; dark urine and jaundice are memorable clues.

Neither virus multiplies in food. Neither is removed by a cold-holding reading.

STEC: Spell Out the Risk

Full name	Shiga toxin-producing Escherichia coli.
Source clues	Ruminant animals; raw or undercooked ground beef; contaminated produce or water.
Illness clues	Severe cramps and diarrhea that can become bloody; possible kidney injury.

Control the source, required cooking, and transfer to ready-to-eat food.

2-201; 3-201.11; 3-401.11; Bad Bug Book: pathogenic E. coli

BASIS: FDA FOOD CODE + GUIDANCE

Nontyphoidal Salmonella

Sources

Animals and people; poultry, eggs, produce, and other contaminated foods.

Illness

Salmonellosis commonly causes diarrhea, fever, and abdominal cramps.

Controls

Safe sources, required cooking, separation, hygiene, and employee-health rules.

An egg or poultry association is useful, but it is not an exclusive food list.

2-201; 3-401.11; Bad Bug Book: Salmonella species

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Salmonella Typhi Is Different

Salmonella Typhi

Human source; causes typhoid fever.
Prolonged high fever is an important clue.

Nontyphoidal Salmonella

Animal and human sources; commonly
causes diarrhea, fever, and cramps.

Similar names do not mean the same source or employee-health rule.

Shigella Species

Source

Primarily infected people; fecal contamination can reach food and water.

Recognition

Diarrhea that may be bloody, cramps, and sometimes fever.

Prevention

Employee health, handwashing, ready-to-eat protection, safe water, and pest control.

A prepared salad can carry contamination even when it stays cold.

2-201; 3-701.11(C)-(D); Annex 3; Bad Bug Book: Shigella

BASIS: FDA FOOD CODE + GUIDANCE

Recognize the Pattern; Apply the Rule

The report

An employee reports diarrhea before a shift assembling ready-to-eat meals.

What is known

A reportable symptom and a food-handling assignment.

What to do

Without an established noninfectious cause, exclude and apply the employee-health procedure.

You do not need a guessed pathogen name before protecting food.

Parasites and Fish

Behavior

Parasites depend on hosts; some are carried in animals, fish, produce, or water.

Example

Anisakis is a parasite associated with raw or undercooked marine fish or squid.

Control

Safe source and applicable cooking or documented parasite-destruction freezing.

Anisakis is a parasite, not a seafood toxin. Cold holding alone is not parasite destruction.

3-402.11; 3-402.12; Bad Bug Book: Anisakis

BASIS: FDA FOOD CODE + GUIDANCE

Read the Frozen-Fish Package

The label

Vacuum-packaged fish: "Keep frozen until use." It is still fully frozen.

Before refrigerator thawing

Remove the fish from the reduced-oxygen environment.

Why it matters

Reduced oxygen can support hazards that refrigeration alone does not eliminate.

Opening a package later does not rescue an already unsafe time-temperature history.

Yeasts and Molds

Yeasts

Fungi that may spoil acidic or sugary foods; gas, fermentation, or off odors can be clues.

Molds

Fungi that can grow as visible colonies. Some produce harmful mycotoxins.

Not all fungi are harmful. Unintended spoilage is not made safe by scraping or tasting.

3-101.11; 3-701.11; USDA mold guidance

BASIS: FDA FOOD CODE + GUIDANCE

Tuna and Histamine

The delivery

Fresh tuna arrives at 50 F with no verified time-temperature history.

The concern

Temperature abuse can allow histamine formation in susceptible fish.

The decision

Reject this delivery. Cooking or chilling cannot remove histamine already formed.

A freshness date is not proof of safe handling.

3-202.11; FDA fish guidance: scombrototoxin

BASIS: FDA FOOD CODE + GUIDANCE

Ciguatera and Shellfish Toxins

Ciguatera

Certain tropical reef fish can carry toxin from the marine food chain. Tingling or altered hot-cold sensation can be clues.

Shellfish toxins

Shellfish can accumulate toxins from harmful algae. Effects depend on the toxin.

Control species, harvest source, and required records. Normal cooking is not the control.

Natural Toxins Beyond Seafood

Wild mushrooms

Some contain dangerous toxins. Appearance or a cooking promise is not safe identification.

Plants

Certain plants and improperly prepared foods can contain naturally occurring toxins.

Approval and source

Wild-picked mushrooms require establishment approval unless a stated Code exception applies.

"Natural" does not mean harmless. Do not taste unknown foods to identify them.

3-201.11; 3-201.16; Bad Bug Book: natural toxins

BASIS: FDA FOOD CODE + GUIDANCE

A Few Additional Recognition Clues

Slow cooling

Bacillus cereus: rice or starches. Clostridium perfringens: bulk meat or gravy.

Reduced oxygen

Clostridium botulinum: apply the approved process; never taste suspect food.

Refrigerated RTE food

Listeria can grow at refrigeration temperatures; cold control is not the only control.

Hands and wounds

Staphylococcus aureus can produce heat-stable toxin in abused food.

Use these names to understand the control, not to diagnose a batch or memorize an exhaustive list.

Bad Bug Book; 3-501.14; 3-501.17; 3-502.12

BASIS: FDA FOOD CODE + GUIDANCE

Choose the Control That Fits

Worker-contaminated salad

Discard the affected salad. Then prevent further transfer.

Food cooled too slowly

A prior cook does not excuse a failed cooling process.

Histamine in tuna

More cooking does not remove the formed toxin.

Raw fish for service

Use the applicable parasite-destruction process or a stated exemption.

Identify the hazard, the food condition, and the point where control is needed.

3-701.11(C)-(D); chapter synthesis: cited Code and guidance

BASIS: FDA FOOD CODE + GUIDANCE

Chapter 2: What to Remember

FATTOM

Six growth conditions; time and temperature are the most direct daily controls.

The Big Six

Two viruses and four bacteria with specific employee-health rules.

Survival is different

Cells, spores, and toxins do not respond identically to cooking.

Source still matters

Marine toxins, parasites, and wild foods need the correct source and process.

Know the reason for the control, not just the name of the hazard.

1-201.10; 2-201; 3-201; 3-501; Annex 3

BASIS: FDA FOOD CODE + GUIDANCE

Next: Independent Practice

Study guide

Review the definitions, comparisons, and restaurant examples.

Interactive quiz

Answer separately, review every explanation, and revisit the referenced topic.

Next chapter: contamination, allergens, and food defense.