

Pocket Dictionary of
Food Safety

Jeffrey T. Solate



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*To my wonderful wife, Dorothy,
whose matchless support allowed
time for me to prepare this book.*

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Introduction

The study of food safety and the science of food safety are a relatively new field, with many connections to several biological and medical sciences, including epidemiology, infectious diseases, community medicine, and public health. This first edition of the *Pocket Dictionary of Food Safety* is a collection of terms and definitions prepared initially to assist the students of the Canadian Food Safety Institute as a companion or reference resource when reading lesson notes and completing course assignments.

Some of the terms explained in the dictionary cover related areas such as food microbiology, food chemistry, food quality assurance, foodborne incidents, food regulations, standards, etc. This dictionary can also be used as a reference material by food processors, food production personnel, professionals, consultants, instructors, and food-science and food-technology students. This book also attempts to classify and organize food safety terms from

various sources in an alphabetical listing. The reader will find it a perfect companion to other technical and industry materials.

Users of the *Pocket Dictionary of Food Safety* are invited to send the author new food-safety-related definitions that could be added to the second edition. To order additional copies of this book, please email jeff@canadianfoodsafetyinstitute.ca.

The Author

Jeffrey Solate, director and CEO of the Canadian Food Safety Institute (CFSI), has spent 20 years working in food, natural health products, medical devices, pharmaceuticals, cosmetic regulatory compliance services, and human resources management. He has 10 years' experience in addressing, presenting, and analyzing food safety and food quality issues in Canada, the United States, and international regions.

In 1997, Mr. Solate was elected regional councilor, Food, Drug and Cosmetic Division, of the American Society for Quality for all Canadian regions. Also, until recently, he served as the regional councilor chair, Food, Drug and Cosmetics for Canada, the United States, and international regions. He was the first to receive the ASQ food, drug and cosmetic regional councilor award, in 2000 and in 2001, for both Canada and the United States.

Currently, Mr. Solate is proprietor of the Canadian Food Safety Institute, JTS

& Associates, which serves clients in the food, drug, natural health products, human resources, medical devices, cosmetics, and healthcare industries.

Mr. Solate has given presentations in British Columbia and Puerto Rico on hazard analysis and critical control point (HACCP) in the food and pharmaceutical industries. In British Columbia, he has lectured on HACCP in the Canadian food industry and on pharmaceutical compliance certification programs; in Toronto, he has given several presentations to Food, Drug and Cosmetic Division members.

He has also presented at conferences in Seattle and Boston on HACCP in the food and pharmaceutical industries and has given a presentation on food and pharmaceutical quality assurance issues in Mexico. Previously, he was a member of the Canadian Standards Association (CSA Technical Committee) and served as consultant on regulatory compliance issues (food, drug, and cosmetic).

Mr. Solate was site auditor and consultant, ISO 9000:1994 Quality Management Systems, from 1995 to 2003. He was former lead auditor instructor, Sheridan College, and a professor at Ryerson University. He was a member of the Canadian Standards

Association (CSA) from 1965 to 1981 and served as a regulatory submission consultant in food, pharmaceuticals, and medical devices market research from 1981 to 1993.

Mr. Solate holds a bachelor's degree in business administration and honors degrees in health administration from York University. He pursued graduate studies at the University of Toronto and received a general diploma in health sciences and pharmacology (Cr) from Niagara College.

A

Acanthamoeba **(foodborne protozoa)**

Signs & symptoms

Vision impairment, red eyes, light sensitivity, severe eye pain, eyelid swelling, sinus and skin disease

Duration of illness

7–120 days

Associated foods

Vegetables

Laboratory testing

Parasitology

Treatment

Vision eye care and antifungals

A**Acceptable level**

The presence of a food safety hazard—biological, chemical, or physical—at which levels are low enough not to cause an illness or injury.

Accuracy

The ability of a measuring device to provide a true estimate of a value (measurement) on an average of multiple readings, irrespective of precision.

Acid

A substance with a pH of less than 7.0.

Active managerial control

The purposeful incorporation of specific actions or procedures by management in the operation of its business to attain control over the five foodborne illness risk factors identified by the CDC.

Adenoviruses (foodborne virus)

Signs & symptoms

Fever, nausea, vomiting, and often watery diarrhea

Duration of illness

2–14 days

Associated foods

Contaminated raw food and fast food

Laboratory testing

Blood work; culture of respiratory secretions by nasal swab; stool culture; chest X-ray

Treatment

Increased fluid intake; bronchodilator medications; oxygen through a mask; mechanical ventilation

Adulterated

Food that contains a poisonous or deleterious substance that causes it to be hazardous or unfit for human consumption.

A

Aerobe

A microorganism that is able to grow in the presence of oxygen at levels found in air (i.e., approximately 21%).

Aerobic

Able to reproduce and live only in the presence of free oxygen.

Aeromonas* (foodborne Gram-negative bacteria)**Signs & symptoms***

Diarrhea, abdominal cramps, occasional vomiting, mild fever; occasionally, pop eye

Duration of illness

1–7 days

Associated foods

Freshwater fish

Treatment

Ensuring that adequate fluids are taken

Aerotolerant

An organism that is an anaerobe but is able to grow in the presence of small quantities of oxygen.

Agar

A gel composed of carbohydrate and derived from seaweed that is used to solidify liquid, nutrient media and thus enables bacteria, yeasts, and molds to form colonies on or in a solid matrix. (See also *slope [slant]*.)

Algae

Unicellular and multicellular eukaryotic microorganisms that possess chlorophyll and produce oxygen during photosynthesis.

Alkali

A substance with a pH of more than 7.0.

A

Alternaria (foodborne fungus)

Signs & symptoms

Skin rash, breathing shortness, swollen and itchy eyes

Duration of illness

1–7 days

Associated foods

Vegetables, fruits, and wheat

Laboratory testing

Fluoroimmunoassay

Treatment

Antihistamines, decongestants, nasal spray, and immunotherapy

Anaerobe

An organism that is only able to grow in an environment from which oxygen is absent.

Anaerobic

Able to reproduce and live in the absence of free oxygen.

***Anisakis* (foodborne helminth)**

Signs & symptoms

Abdominal pain, nausea, tingling or tickling sensation in the throat, coughs, vomiting

Duration of illness

1–21 days

Associated foods

Raw or undercooked seafood

Laboratory testing

Morphological examination of the nematode and laparotomy

Treatment

Albendazole

Antibody

An immunoglobulin formed in direct response to the introduction of an antigen into humans or animals. Antibodies combine with their specific antigens. The combination of antigen and antibody causes

A

physical (often visible) clumping of the combined antigen–antibody complexes.

Antigen

Any agent capable of causing an immune response (the production of an antibody) in humans and animals. Antigens are usually large molecules such as proteins or lipopolysaccharides, including some toxins as well as bacterial cell walls.

Approved source

The regulatory authority deemed an acceptable supplier based on a determination of conformity with laws, statutes, regulations, principles, practices, and generally recognized standards of operation that protect public health and safety.

Arcobacter* (foodborne Gram-negative bacteria)**Signs & symptoms***

Diarrhea, abdominal pain, abdominal cramps, nausea, blood infection

Duration of illness

2–5 days

Associated foods

Raw poultry, meat, and milk

Laboratory testing

Stool test

Treatment

Antibiotics

Aseptic

For microbiological test purposes, this refers to the prevention of contamination; aseptic techniques are work practices and precautionary measures that prevent extraneous contamination of cultures and media and infection of workers.

Aspergillus (foodborne fungus)

Signs & symptoms

Amphoric breath sounds, sputum purulent, chest pain, cough, fever

A

Duration of illness

1–7 days

Associated foods

Vegetables, birds, and contaminated water

Laboratory testing

Sputum test; blood test; X-ray and computerized tomography (CT scan)

Treatment

Amphotericin B, caspofungin, flucytosine, itraconazole, and voriconazole

Astroviruses (foodborne virus)

Signs & symptoms

Diarrhea, nausea, vomiting, fever, malaise, abdominal pain

Duration of illness

3–4 days

Associated foods

Raw products, contaminated water

Laboratory testing

Stool test, electron microscopy, enzyme-immunoassay, immunofluorescence

Treatment

Symptomatic care; maintenance of hydration

Autoclave

An item of laboratory equipment whose principle of operation is similar to that of a pressure cooker. It comprises a pressure vessel in which the air is displaced by steam, enabling the contents of the chamber to be raised to a temperature greater than the boiling point of water, as required for the thermal inactivation of bacterial spores. An autoclave is used to sterilize laboratory media and equipment or to decontaminate waste materials by means of defined time-temperature autoclave processes.

A

**Avian influenza virus
(foodborne virus)**

Signs & symptoms

Cough, sore throat, fever, difficulty breathing, diarrhea, runny nose, headache, malaise, muscle aches

Duration of illness

7 days up to 21 days

Associated foods

Meat

Laboratory testing

Chest X-ray; nasopharyngeal culture; blood differential; auscultation

Treatment

Oseltamavir, zanamivir, and breathing machine

B

***Bacillus* (foodborne Gram-positive bacteria)**

(a) *Bacillus*: a rod-shaped bacterium; (b) *Bacillus*: a bacterial genus comprising aerobic, Gram-positive rods that produce heat-resistant spores.

Signs & symptoms

Diarrhea, vomiting, abdominal pain

Duration of illness

12–24 hours

Associated foods

Vegetables, herbs, spices, dairy products, and meat

Laboratory testing

Gram stain (micromorphology), capsule (microscopic observation)

B***Treatment***

β -lactam antibiotics, such as penicillin, and others that are active against Gram-positive bacteria

Bacteria

Single-cell microorganisms, usually classified as the simplest of plants.

Bacteriocins

Protein antibiotics produced by a variety of strains of bacteria. They are inhibitory or lethal to other bacteria (often related species).

Bacteriophage

Any virus whose host is a bacterium.

***Bacteroides* (foodborne Gram-negative bacteria)**

Signs & symptoms

Chalk-colored stool, dark urine, fever, chills, loss of appetite, nausea, vomiting, abdomen pain, weight loss, weakness

Associated foods

Meat

Laboratory testing

Blood culture and indirect immunofluorescence

Treatment

Antimicrobials such as clindamycin, metronidazole, chloramphenicol, cefoxitin, and penicillin

Biological hazard

Danger to food from disease—causing microorganisms known as pathogens, poisonous plants, mushrooms, and fish that carry harmful toxins.

B**Bioterrorism**

Intentionally infecting people to cause illness and death by the spread of highly contagious diseases such as smallpox, anthrax, botulism, plague, and viral hemorrhagic fevers.

Biotyping

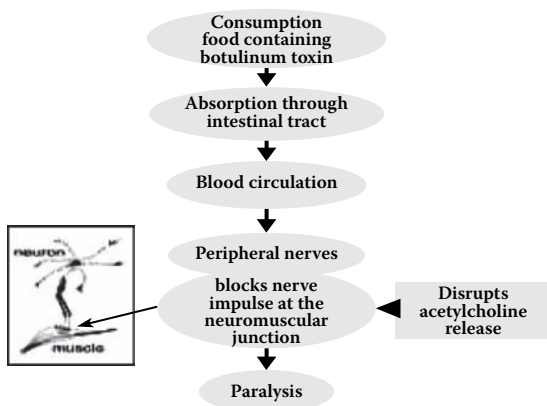
The conventional method for distinguishing between bacterial types using their metabolic and/or physiological characteristics.

Boiling-point

The temperature at which a liquid changes to a gas. The boiling point of water is 212°F (100°C) at sea level.

Botulism

Sequence of events in foodborne botulism



Source: Bibek, R., and Bhunia, A., *Fundamental Food Microbiology*, Taylor & Francis, CRC, 2005. With permission.

***Brucella* (foodborne Gram-negative bacteria)**

Signs & symptoms

Flu, fever, sweats, headache, back pain, physical weakness

B

Duration of illness

Weeks to months

Associated foods

Milk

Laboratory testing

Blood test

Treatment

Antibiotics such as doxycycline and rifampin

Buffer

A substance or substances that allow the pH value of a solution to be maintained at a nearly constant value, very often a weak acid in the presence of one of its salts (e.g., citric acid and sodium citrate). Also used is disodium hydrogen phosphate, and sodium dehydrogenating phosphate or certain proteins are also used. When extra acid is added, the buffer reacts with the hydrogen ions of the acid, thus maintaining the pH value so that it does not decrease. In other words, there is a buffer against acidification.

Burkholderia (foodborne Gram-negative bacteria)

Signs & symptoms

Fever, malaise, headache, myalgia, pulmonary infection

Duration of illness

1–14 days

Associated foods

Meat

Laboratory testing

ELISA test and polysaccharide-based microarray

Treatment

Antibiotic such as ceftazidime, chloramphenicol, doxycycline, and cotrimoxazole

C

Calibrate (calibration)

In relation to laboratory equipment, calibration is the process of establishing the accuracy of a laboratory measuring device (e.g., a thermometer, a temperature probe, a balance) by comparing with a reference device of known accuracy that is usually traceable to a national standard. Any inaccuracies found are taken into account on subsequent use of the laboratory device.

Camp test (Christie, Atkins, Munch-Petersen test)

A synergistic, hemolytic reaction, which is a characteristic enhancement of the conventional hemolysis reaction that occurs on sheep blood agar when, for example, *Listeria monocytogenes* is grown in close proximity to a specific, weakly beta hemolytic strain of *Staphylococcus aureus*, but not when

C

Listeria monocytogenes is grown in close proximity to *Rhodococcus equi*.

Campylobacter (foodborne Gram-negative bacteria)

Signs & symptoms

Cramping, abdominal pain, fever, nausea, vomiting, watery diarrhea (sometimes bloody)

Duration of illness

2–5 days

Associated foods

Raw poultry, fresh produce, unpasteurized milk

Laboratory testing

Stool culture

Treatment

Antibiotics such as erythromycin, fluoroquinolone, ciprofloxacin, and azithromycin

***Candida* (foodborne fungus)**

Signs & symptoms

Fever, malaise, nausea

Duration of illness

4–6 months

Associated foods

Junk food

Laboratory testing

Candida immune complexes test; combination of IgA, IgG, and IgM tests

Treatment

Antifungal medication such as nystatin and diflucan; controlled diet and probiotics

***Clonorchis* (foodborne helminth)**

Signs & symptoms

Abdominal pain, nausea, diarrhea

Duration of illness

2–30 days

C

Associated foods

Undercooked fish and meat

Laboratory testing

Stool test

Treatment

Riclabendazole, praziquantel, bithionol, albendazole, and mebendazole

Clostridium (foodborne Gram-positive bacteria)

Signs & symptoms

Fever, mild diarrhea, mild abdominal cramps and tenderness

Duration of illness

6 hours–10 days

Associated foods

Canned corn, peppers, green beans, soups, beets, asparagus, mushrooms, ripe olives, spinach, tuna fish, chicken, chicken livers, liver pate, luncheon meats, ham, sausage, stuffed eggplant, lobster, smoked and salted fish

Laboratory testing

Cytotoxicity assay; toxin ELISA; other stool tests; computed tomography

Treatment

Correction of dehydration and electrolyte (mineral) deficiencies; discontinuing the antibiotic that caused the colitis, and using antibiotics to eradicate the *C. difficile* bacterium

Cocco-bacillus

A bacterium whose cells are intermediate in shape between those of a rod and a coccus.

Coccus

A bacterium whose cells are approximately spherical.

Code of Federal Regulations (CFR)

The application of codes to the general and permanent rules established by federal

C

agencies and departments and published in the Federal Register.

Colony-forming unit (cfu)

The unit of quantification for microbiological enumeration (counting) tests. When microorganisms, especially bacteria and yeasts, are inoculated into or onto agar, they may be deposited either as separate cells or as small clumps of cells, both of which give rise to individual discrete colonies. The term colony-forming unit (cfu) is used because it is not possible to distinguish between colonies derived from single cells and colonies derived from small clumps.

Commercial sterility

A condition in which a food product may contain viable microorganisms yet is microbiologically stable (i.e., no microbial growth occurs under the conditions found within the product and/or the product storage conditions). This term usually applies to some canned products that are microbiologically

stable when stored at ambient temperature in temperate climates but may become unstable when stored in tropical conditions.

Conductivity (or resistivity) units

Measurement units used for monitoring water quality. Water containing chemical contaminants has a higher conductivity than water that has been purified. Units of conductivity are microsiemens per centimeter ($\mu\text{S}/\text{cm}$) and units of resistivity are megohms per centimeter. These measurements are temperature dependent and are usually expressed as microsiemens per centimeter at 25°C or megohms per centimeter at 25°C . Tap water may have a conductivity of 80–800 $\mu\text{S}/\text{cm}$ at 25°C , depending on the nature of the water source. Reverse osmosis (RO) water typically has a conductivity of 2–40 $\mu\text{S}/\text{cm}$ at 25°C , again depending on the nature of the tap water used.

Contamination

The presence in food of potentially harmful substances, including microorganisms

C

(bacteria, viruses, parasites), chemicals (pesticides, toxic metals), and physical objects (hair, dirt, glass).

Control measure

Any action or activity that can be used to prevent, eliminate, or reduce an identified biological, chemical, or physical hazard. Control measures determined to be essential for food safety are applied at critical control points in the flow of food.

Control point (CP)

Any step in the flow of food when control can be applied to prevent, reduce, or eliminate a biological, chemical, or physical hazard. Loss of control at this point will not result in unsafe or high-risk levels of food.

Controlled atmosphere packaging (CAP) foods

Using CAP, a package of food is modified so that, until the package is opened, its composition is different from air, and

continuous control of that atmosphere is maintained, such as by using oxygen scavengers (chemicals placed directly into the packaging wall that absorbs oxygen that permeates into the package over time) or a combination of total replacement of oxygen, no respiring foods (i.e., meat and seafood), and impermeable packaging material. The food product is packaged in a laminate or film, following which the atmosphere inside the pack is controlled. Distilled water usually has a conductivity of around $4\ \mu\text{S}/\text{cm}$ at 25°C . The quality of highly purified water with a conductivity $< 1\ \mu\text{S}/\text{cm}$ at 25°C is usually measured in terms of resistivity. A higher resistivity indicates higher quality; $1\ \mu\text{S}/\text{cm}$ is equivalent to $1\ \text{megohm}/\text{cm}$ and there is a reciprocal relationship between the two units (i.e., conductivity = $1/\text{resistivity}$).

Cook chill (CC) processing

Cook chill packaging, in which cooked food is hot-filled into impermeable bags that have the air expelled and are then sealed or crimped closed. The bagged food is rapidly chilled and refrigerated at

C

temperatures that inhibit the growth of pathogens.

Corrective action

An activity that is taken by a person whenever a critical limit is not met or a deviation occurs.

CP

See *control point*.

Criterion

A requirement on which a judgment or decision can be based.

Critical control point (CCP)

An operational step, point, or procedure in a food preparation process at which control can be applied and is essential to prevent or eliminate a biological, chemical, and physical hazard or reduce it to acceptable

levels. A loss of control at this point results in unsafe and high-risk levels in food.

Critical limit (CL)

A criterion of one or more prescribed parameters that must be met to ensure that a CCP effectively controls a hazard.

Cross-contamination

The transfer of harmful substances or disease-causing microorganisms from one surface to another by hands, food-contact surfaces, sponges, cloth towels, equipment, storage, and utensils.

***Cryptosporidium* (foodborne protozoa)**

Signs & symptoms

Watery diarrhea, nausea, vomiting, mild fever, weight loss, stomach cramps, pain

Duration of illness

1–2 weeks

C

Associated foods

Water, uncooked food, raw vegetables and fruits

Laboratory testing

Stool culture and blood test

Treatment

Symptomatic treatment; bed rest, fluids, and nitazoxanide medicine

Cyclospora (foodborne protozoa)

Signs & symptoms

Fever, headache, fatigue, malaise, anorexia, watery diarrhea, nausea, abdominal cramps, vomiting

Duration of illness

1–6 weeks

Associated foods

Food or water contaminated with feces from infected humans or animals

Laboratory testing

Stool culture and blood test

Treatment

Antibiotics combination of trimethoprim-sulfamethoxazole (Bactrim, Septra, or Cotrim) and maintenance of hydration

Cyst (of protozoa)

A specialized cell produced either in response to adverse environmental conditions or as a normal part of the life cycle of protozoa.

D

Danger zone

The temperature range between 41°F (5°C) and 135°F (57°C), which favors the growth of pathogenic microorganisms.

Date marking

The practice of indicating the date or day by which all food should be consumed, sold, or discarded.

***Debaryomyces* (foodborne fungus)**

Signs & symptoms

Cough, fever, dyspnea

Associated foods

Dairy products and fish

Laboratory testing

Blood test

D

Treatment

Antibiotics

Decline/death phase

The phase of bacterial growth, following the stationary phase, in which the rate of death within the colony exceeds the rate of reproduction and the number of living cells begins to decrease.

De-ionization

A means of purifying water by the removal of ions from a solution.

Deleterious substance

A substance that is harmful or injurious.

Deviation

The failure to meet a required critical limit for a critical control point.

Diphyllobothrium **(foodborne helminth)**

Signs & symptoms

Asymptomatic, abdominal discomfort, anemia, worm eggs in stool, diarrhea, vomiting, weight loss

Duration of illness

4–6 weeks

Associated foods

Raw or undercooked seafood

Laboratory testing

Stool test

Treatment

Niclosamide and praziquantel

Distillation

The process of converting a liquid into a vapor (e.g., by boiling water to create steam) and then condensing the vapor (steam) and collecting the condensed liquid/distillate (i.e., distilled water). This process purifies

D

water by separating it from the substances dissolved in it.

D-value

The time required (usually expressed in minutes) at a given temperature to reduce the number of viable cells or spores of a given microorganism to 10% of the initial population (i.e., to reduce by 90%)—for example, the time required to reduce the numbers of a microorganism from 10^5 cfu/mL to 10^4 cfu/mL. Usually expressed, for example, as $D_{60} = 2$ minutes where 60 is the temperature in Celsius.

E

Electrolyte

A substance or solution that contains free positively and negatively charged ions and is therefore able to conduct an electric current.

Encephalitozoon and enterocytozoon (foodborne protozoa)

Signs & symptoms

Diarrhea, bronchitis, pneumonia, sinusitis

Duration of illness

1–2 weeks

Associated foods

Food or water contaminated with feces from infected humans or animals

Laboratory testing

Immunofluorescence antibody test

E

Treatment

Albendazole and fumagillin

Entamoeba (foodborne protozoa)

Signs & symptoms

Diarrhea and amebiasis

Duration of illness

3–6 weeks

Associated foods

Food or water contaminated with the feces from infected humans or animals

Laboratory testing

Stool test

Treatment

Luminal amoebicides such as paromomycin, diloxanide fuloate

Enterobacter (foodborne Gram-negative bacteria)

Signs & symptoms

Urine infection, sepsis, meningitis, necrotizing enterocolitis

Duration of illness

1–10 days

Associated foods

Water, vegetables, dairy

Laboratory testing

Urine test; stool test

Treatment

Antibiotics

***Enterococcus (foodborne
Gram-positive bacteria)***

Signs & symptoms

Urinary tract infections, bacteremia, bacterial endocarditis, diverticulitis, meningitis

Duration of illness

24–48 hours

Associated foods

Meat such as sausage, and dairy products

Laboratory testing

Bile–esculin test

E

Treatment

Ampicillin and vancomycin

Enzyme

A proteinaceous catalyst, produced by living organisms, that acts on one or more specific substrates.

Equilibrium relative humidity (ERH)

The vapor pressure of water in the atmosphere, expressed as a percentage. Air that is completely saturated with pure water has an ERH of 100%; air that is completely dry has an ERH of 0% (see *water activity*).

***Escherichia* (foodborne Gram-negative bacteria)**

A bacterium associated with cattle and beef that causes human illness when undercooked, contaminated ground beef is eaten. Infection can also occur after drinking raw milk or by contact with sewage-contaminated water. Food service employees

with *E. coli* must report this infection to the proper health authorities.

Signs & symptoms

Bloody diarrhea, abdominal cramps, and little fever

Duration of illness

5–10 days

Associated foods

Ground beef, unpasteurized milk and juice, sprouts, lettuce, and salami

Laboratory testing

Stool test

Treatment

Most persons recover without antibiotics

Eukaryote

A self-replicating organism that possesses, within itself, a clearly defined nucleus containing its genetic material separated from its cytoplasm by a nuclear membrane. (See also *prokaryote*.)

E**Exclude**

To prevent a person from working as a food employee or entering a food establishment except for those areas open to the general public.

Exposure assessment

The qualitative and/or quantitative evaluation of the likely intake of biological, chemical, and physical agents via food as well as exposures from other sources if relevant (Codex Alimentarius Commission 1999).

F

F

The equivalent, in minutes at some given reference temperature, of the total heat supplied, with respect to its capacity to destroy spores or vegetative cells of a particular organism.

F₀

The severity of a heat process with respect to a reference temperature of 121.1°C.

F₀ = 3 minutes

A heat process of 121.1°C for 3 minutes or a process at a different temperature of equivalent lethality determined according to the z-value for a specified microorganism. A process of F₀ = 3 minutes is used in canning to achieve a >12 log cycle reduction in the numbers of mesophilic *Clostridium*

F

botulinum spores. This is considered to provide an adequate margin of safety.

Facultative

“Optional lifestyle” associated with a mode of life not normally adopted (e.g., facultative anaerobe = usually grows aerobically but can grow anaerobically).

Family

A taxonomic group of organisms consisting of related genera. Families are grouped into orders.

Fasciola* (foodborne helminth)**Signs & symptoms***

Fever, nausea, vomiting, appetite loss, indigestion

Duration of illness

5–6 weeks

Associated foods

Fish

Laboratory testing

Stool test

Treatment

Chloroquine, bithionol, and emetine

Fast foods

Quick, reasonably priced, and readily available alternatives to home cooking. While convenient and inexpensive for a busy lifestyle, fast foods are typically high in calories, fat, saturated fat, sugar, and salt. Fast food chains and restaurants have responded to the public's increasing awareness about nutrition and have attempted to help people concerned about health. For example, they now make ingredient and nutrition information available on their menus. Despite these changes, however, in order to maintain a healthy diet, it is necessary to choose fast foods carefully.

Fat

Organic compounds that are made up of carbon, hydrogen, and oxygen. They are a

F

source of energy in foods. Fats belong to a group of substances called lipids, and they come in liquid or solid form. All fats are combinations of saturated and unsaturated fatty acids.

FATTOM

An acronym for food, acidity, time, temperature, oxygen, and moisture—the conditions needed for microorganisms to grow.

FDA

United States Food and Drug
Administration

Fish

A fresh or saltwater finfish, crustaceans, and other forms of aquatic life (including alligator, frog, aquatic turtle, jellyfish, sea cucumber, and sea urchin) and all mollusks, if intended for human consumption.

Food

Raw, cooked, or processed edible substance, ice, beverage, chewing gum, or ingredient used or intended for use or for sale in whole or in part for human consumption.

Food additives

Substances that become part of a food product when added (intentionally or unintentionally) during the processing or production of that food.

Food allergy

Condition caused by a reaction to naturally occurring protein in a food or a food ingredient. Major food allergens and the “Big 8” are the foods that account for 90% or more of all food allergies. The Big 8 are shellfish (crab, lobster, or shrimp), fish (bass, flounder, or cod), peanuts, tree nuts (almonds, pecans, chestnuts, pistachios, Brazil nuts, etc.), milk, eggs, soy and tofu, and wheat.

F**Food contact surface**

Any equipment or utensil that normally comes in contact with food or that may drain, drip, or splash on food or on surfaces normally in contact with food. Examples include cutting boards, knives, sponges, countertops, and colanders.

Food defense

The protection of food products from intentional adulteration or contamination.

Food establishment

An operation at the retail or food-service level that serves or offers food directly to the consumer and that, in some cases, includes a production, storage, or distributing operation that supplies the direct-to-consumer operation.

Food guide pyramid

Guide designed to help people make healthy food choices.

Food jags

When a child will only eat one food item, meal after meal. Some other common childhood eating behaviors that can cause alarm in many parents include fear of new foods and refusal to eat what is served.

Food labeling

Offers a great deal of information on most packaged foods.

Food poisoning

The result of eating organisms or toxins in contaminated food. Most cases of food poisoning are from common bacteria such as *Staphylococcus* or *E. coli*.

Food preparation process

A series of operational steps conducted to produce a food ready to be consumed.

F**Food security**

Best defined by the World Health Organization (WHO) as “the implication that all people at all times have both physical and economic access to enough food for an active, healthy life.” Internationally, food security is defined as a 2-year supply of food for a particular country.

Foodborne illness

A sickness resulting from the consumption of foods or beverages contaminated with disease-causing microorganisms (pathogens), chemicals (pesticides), or other harmful substances (glass).

Foodborne outbreak

The occurrence of two or more cases of illness resulting from the ingestion of a common food.

Fungus

A unicellular or multicellular, eukaryotic microorganism that does not contain chlorophyll and has a rigid cell wall composed of cellulose- or chitin-based polymers. The “body” of a fungus is normally composed of filaments known as hyphae, which accumulate into a larger mass known collectively as mycelium. Fungi generally prefer to grow in or on solid materials. (See also *yeasts*.)

Macrofungi produce visible fruiting bodies, examples of which are mushrooms and toadstools.

Molds (microfungi) are filamentous fungi, most species of which do not produce visible fruiting bodies.

Fusarium (foodborne fungus)

Signs & symptoms

Abdominal pain, diarrhea, vomiting, prostration, fever, chills, myalgias, bone marrow, skin rash, shortness of breath, blocked nose, itchy throat, dark circles under eyes, nose rubbing, and allergic salute

F

Duration of illness

4–28 days

Associated foods

Vegetables, cereal (rice, bean, soybean)

Laboratory testing

Polymerase chain reaction (PCR)

Treatment

Antifungal drug such as amphotericin B alone or in combination with flucytosine or rifampin; antihistamines, decongestants, nasal spray, and immunotherapy

G

Game animal

In general, an animal such as bison, deer, elk, rabbit, raccoon, and squirrel. Game animals are not ratites or livestock.

Genotyping

Methods used to differentiate bacteria and other microorganisms based on the composition of their nucleic acids.

Genus (plural: genera)

A taxonomic group consisting of closely related species. Genera are grouped into families.

G

Giardia (foodborne protozoa)

Signs & symptoms

Diarrhea, gas, or flatulence; greasy stools that tend to float; stomach or abdominal cramps; nausea

Duration of illness

2–6 weeks

Associated foods

Food or water contaminated with feces from infected humans or animals

Laboratory testing

Stool test

Treatment

Antibiotics and fluids

Gram reaction

A classification system for bacteria based upon their cell wall composition. The reaction to the Gram stain is observed by light microscopy and distinguishes *Gram-negative* bacteria from *Gram-positive* bacteria. The cell walls of Gram-positive bacteria are

resistant to decolorization after staining with a specific dye while the cell walls of Gram-negative bacteria can be decolorized easily.

Gray (Gy)

The unit of energy absorbed from ionizing radiation by the matter through which the radiation passes. A radiation dose of 1 Gy involves the absorption of 1 joule (J) of energy by each kilogram of matter through which the radiation passes. Large multiple units are frequently used to express the radiation dose in food irradiation (e.g., 1000 Gy = 1 kGy).

H

HACCP

Acronym for hazard analysis and critical control point.

HACCP plan

A written document that is based on the principles of HACCP and describes the procedures to be followed to ensure the control of a specific process or procedure.

HACCP system

The result of implementing the HACCP principles in an operation that has foundational comprehensive, prerequisite programs in place. A HACCP system includes all prerequisite programs and the HACCP plan, including all seven HACCP principles.

H

HACCP team

A group of people who are responsible for developing and implementing a HACCP plan.

Halophile

An organism that can tolerate and grow optimally in the presence of high levels of salt (sodium chloride) in its environment. The term is no longer widely used for yeasts and molds because most so-called halophiles are tolerant of low water activity in general and should therefore be called xerophiles. However, some bacteria, such as some *Vibrio* spp. and a few molds, are true halophiles and grow only poorly in the absence of salt.

Hazard

A biological, physical, or chemical property that may cause a food to be unsafe for human consumption.

Hazard analysis and critical control point (HACCP)

A prevention-based food safety system that identifies and monitors specific food safety hazards that can adversely affect the safety of food products.

Hazard characterization

The qualitative and/or quantitative evaluation of the nature of the adverse health effects associated with a hazard. For the purpose of microbiological risk assessment, the concerns relate to microorganisms and/or their toxins (Codex Alimentarius Commission 1999).

Hazard identification

The identification of biological, chemical, or physical agents capable of causing adverse health effects that may be present in a particular food or group of foods (Codex Alimentarius Commission 1999).

H

Helicobacter (foodborne Gram-positive bacteria)

Signs & symptoms

Nausea and abdominal pain

Duration of illness

Several days

Associated foods

Dairy products

Laboratory testing

Endoscopy; biopsy of gastric mucosa; blood tests and noninvasive breath tests

Treatment

Antibiotics and acid-blocker/proton pump inhibitor (e.g., clarithromycin, amoxicillin)

Hemolysis

The breakdown or “lysis” of red blood cells (erythrocytes) by bacteria. When blood is incorporated into agar media, the result is an opaque red-colored agar. If bacteria cause hemolysis, then the area around the colony would appear to have a zone of

discoloration (greening) or clearing where the red cells are ruptured. Various types of hemolysis have been described according to the size of the zone of clearing and any coloring within the zone of hemolysis.

Hepatitis A and E viruses (foodborne virus)

Viruses that can be transmitted through direct contact with an infected person or ingestion of contaminated food or water. It is often seen with a jaundice condition. A food-service employee diagnosed with this virus must report it to the proper health authorities.

Signs & symptoms

Fatigue, fever, abdominal pain, nausea, diarrhea, appetite loss, depression, jaundice, sharp pains in the right-upper quadrant of the abdomen, weight loss, itching; feces tend to be light in color due to lack of bilirubin in bile

Duration of illness

2–14 weeks

H

Associated foods

Raw food

Laboratory testing

Microscopically examining a stool sample;
blood tests

Treatment

Rest, well-balanced diet, and maintenance
of hydration

Hermetically sealed container

A container that is designed to keep micro-organisms out in such products as low-acid canned foods.

Heterophyidae (foodborne helminth)

Signs & symptoms

Diarrhea, abdominal pain

Duration of illness

1–15 days

Associated foods

Raw or undercooked seafood

Laboratory testing

Stool test

Treatment

Praziquantel

Highly susceptible population (HSP)

Persons who are more likely than other populations to experience foodborne disease because they are immunocompromised, preschool-age children (infants or toddlers), or older adults.

Hoax

A false claim of damage due to food contamination or an intentional contamination of food and then claiming damage.

H

Humectant

A soluble substance that binds water and makes the water unavailable for microbial use or growth.

Hydrophobic

Repels water. Fatty foods and the waxy surfaces of some microorganisms are hydrophobic and therefore difficult to wet. Detergents are added to diluents used for fatty test samples to aid their dispersion.

Hygiene

Practices necessary for establishing and maintaining good health.

Why hand washing is so important in food safety



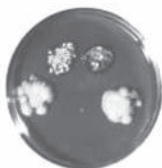
Magnified bacteria population on hand



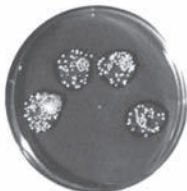
Sanitizer in sneeze hand



Unwashed hand



Rinsed hand



Washed hand



Sanitized hand

I

Ice point

The temperature at which a liquid changes to a solid. The ice point of water is 32°F (0°C).

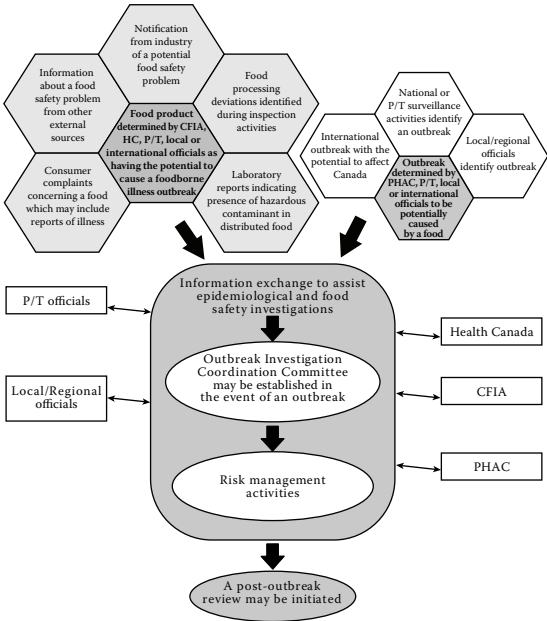
Incubation period

The phase in the course of an infection between the invasion of the host by the pathogen and the appearance of the symptoms of illness.

Infection

Disease caused by invasion of living pathogenic organisms, which multiply within the body, causing illness.

Identification of foodborne hazard



Intoxication

Disease caused by consumption of poisons (toxins), which may be chemical, naturally occurring in food, or produced by pathogenic microorganisms.

Isomers

Chemical compounds that share the same atomic structure but differ from each other in the conformation (shape) of the molecule (e.g., mirror images).

Isospora (foodborne protozoa)

Signs & symptoms

Foul smelling diarrhea, anorexia, fever, weakness, weight loss

Duration of illness

1–4 weeks

Associated foods

Food or water contaminated with feces from infected humans or animals

Laboratory testing

Fluorescent microscopy, stool test

Treatment

Antibiotics, trimethoprim-sufamethoxazole

J

Jaundice

A condition that causes the skin and eyes to yellow.

K

***Klebsiella* (foodborne Gram-negative bacteria)**

Signs & symptoms

High fever, chills, flu and cough productive of a lot of mucus

Duration of illness

Several days

Associated foods

Raw vegetables

Laboratory testing

Urine test

Treatment

Antibiotics such as amoxicillin and ampicillin

L

Lag phase

The period of bacterial growth following transfer to a new environment, when adaptation to new conditions takes place and there is little or no increase in the number of cells in the colony.

***Listeria* (foodborne Gram-positive bacteria)**

Signs & symptoms

Fever, muscle aches, nausea, diarrhea

Duration of illness

7–31 days

Associated foods

Raw food from animal sources, vegetables, ready-to-eat food, unpasteurized milk, cheese from unpasteurized milk; hot dog, luncheon, and deli meats

L

Laboratory testing

Blood test

Treatment

Antibiotics such as ampicillin, vancomycin, ciprofloxacin, linezolid, and azithromycin

Log phase

The period of bacterial growth following the lag phase, when multiplication rate is constant and rapid and the number of cells in the colony increases exponentially.

M

Meat

The flesh of animals used as food, including the dressed flesh of cattle, swine, sheep, or goats and other edible animals, except fish, poultry, and wild-game animals.

Metabolism

The biochemical changes (constructive and destructive) that occur in living organisms. Metabolism results in energy production and growth and involves nutrient uptake into cells and the excretion of waste end-products.

***Metagonimus* (foodborne helminth)**

Signs & symptoms

Diarrhea, abdominal pain

M

Duration of illness

1–14 days

Associated foods

Undercooked or seawater fish

Laboratory testing

Stool test

Treatment

Praziquantel

Microaerobe

An organism that is able to grow optimally in a microaerobic environment.

Microaerobic

An environment or atmosphere in which oxygen is present at a lower partial pressure (percentage) than that in air (usually 5–10% as opposed to 21% in air).

Microbe

A general term for microscopic organisms, particularly pathogens.

Micron

One thousandth of a millimeter; often written as “ μm .”

Microorganism

A form of life that can be seen only with a microscope, including bacteria, viruses, yeast, and single-celled animals.

Modified atmosphere packaged (MAP) foods

Food that is partially processed or lightly cooked before being put into a container and sealed. The MAP process uses special gases that control reduction in the proportion of oxygen, total replacement of oxygen, or an increase in the proportion of other gases such as carbon dioxide or nitrogen.

M

Mold

See *fungus*.

Molluscan shellfish

Any edible species of raw fresh or frozen oysters, clams, mussels, and scallops or edible portions thereof, except when the scallop product consists only of the shucked adductor muscle.

Monitoring

The act of observing and making measurements to help determine whether critical limits are being met and maintained.

Morphology

The appearance (shape, size, form) of a microbial cell or colony—hence, cell morphology, colony morphology.

Mycobacterium (foodborne Gram-positive bacteria)

Signs & symptoms

Cough, fever, night sweats, malaise, lethargy, hemoptysis, adenopathy, pleuritic chest pain, weight loss, hepatomegaly, and splenomegaly

Duration of illness

4–12 weeks

Associated foods

Vegetables, raw products, and contaminated water

Laboratory testing

Tuberculin skin test using the Mantoux procedure; radiographic examination, sometimes including CT scans; bacteriology (direct staining and culture of sputum or other specimens). Molecular amplification (PCR) and gene probes assist in rapid diagnosis

Treatment

Oxygen, IV fluids, erythromycin, clarithromycin, azithromycin, doxycycline, levofloxacin, and albuterol

N

Nanometer

One thousandth of a micron; often written as “nm.”

National Shellfish Sanitation Program (NSSP)

The voluntary system by which regulatory authorities for shellfish-harvesting waters and shellfish processing and transportation and the shellfish industry implement specified controls to ensure that raw and frozen shellfish are safe for human consumption.

Norovirus

A gastrointestinal virus that is commonly called the “Norwalk-like virus,” “small, round-structured virus,” and “winter vomiting disease.” It results in nausea, diarrhea, vomiting, and stomach cramps. Because it

N

is highly contagious, a norovirus must be reported to the proper health authorities.

Signs & symptoms

Nausea, vomiting, diarrhea, stomach cramping, fever, chills, headache, muscle aches, tiredness

Duration of illness

2–6 days

Associated foods

Seafood and raw vegetables

Laboratory testing

Reverse transcriptase polymerase chain reaction (RT-PCR), environmental swabs; immune electron microscopy of fecal specimens; detection of a fourfold increase of specific antibodies in acute- and convalescent-phase blood samples

Treatment

Maintenance of hydration

NSSP

National Shellfish Sanitation Program.

O

Obligate

A required attribute (e.g., obligate aerobe = grows only under aerobic conditions).

Operational step

An activity or stage in the flow of food through a food establishment, such as purchasing, receiving, storing, preparing, cooking, holding, cooling, reheating, and serving.

***Opisthorchis* (foodborne helminth)**

Signs & symptoms

Fever, joint pain, rash, dyspepsia, abdominal pain, constipation, diarrhea

Duration of illness

2 weeks–2 months

O

Associated foods

Raw or undercooked seafood

Laboratory testing

Stool test

Treatment

Praziquantel

Organism

An individual living thing.

Osmophile

An organism that can tolerate high levels of sugars in its environment. The term is no longer widely used because most osmophiles are tolerant of low water activity in general and should therefore be called xerophiles.

Outbreak

An incident in which two or more people experience the same illness after eating the same food.

P

Paragonimus (foodborne helminth)

Signs & symptoms

Dry cough, rust-colored sputum, fever, dyspnea, chest pain

Duration of illness

1 week–3 months

Associated foods

Raw or undercooked seafood

Laboratory testing

Stool test, sputum test, lung biopsy, and X-ray

Treatment

Praziquantel

P**Parasite**

An organism that lives on or in another, usually larger host organism in a way that harms or is of no advantage to the host.

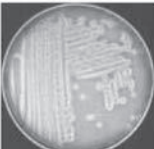
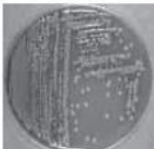
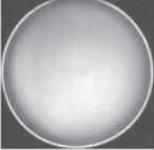
Pasteurization

A heat treatment that kills vegetative pathogens and most spoilage microorganisms in milk and other foods but does not inactivate bacterial spores or some nonpathogenic vegetative organisms; a common pasteurization process for milk is 71.7°C for 15 seconds.

Pathogen

A microorganism (bacteria, parasites, viruses, or fungi) that causes disease in humans.

View of common food pathogens on bacteria colony plate

		
Pseudoeruoapkargen 1	<i>Salmonella typhimurium</i>	<i>Shewanella putrefaciens</i>
		
<i>Shigella sonnei</i>	Staphbetadeltagen 1	<i>Vibrio parahaemolyticus</i>
		
<i>Yersinia enterocolitica</i>	<i>Leuconostoc mesenteroides</i>	<i>Listeria ivanovii</i>

Source: <http://www.microbiologyatlas.kvl.dk/biologi/english/forsidekolonier.asp>

P

Pathogenic

Disease-causing microorganisms.

PCO

Pest control operator (licensed).

***Penicillium* (foodborne fungus)**

Signs & symptoms

Skin rash, shortness of breath, blocked nose, itchy throat, dark circles under eyes, nose rubbing, and allergic salute

Associated foods

Vegetables, fruit, and cheese

Laboratory testing

Urine test, enzyme-linked immunosorbent assay

Treatment

Decongestants, nasal sprays, cromolyn sodium, and immunotherapy

Personal hygiene

Individual cleanliness and habits.

Person in charge

The individual present at a food establishment who is responsible for the operation at the time of inspection.

pH

The measure of the acidity of a product.
Key: pH 0–7 is acidic, pH 7 is neutral, and pH 7–14 is alkaline.

Phage (bacteriophage)

A virus that infects bacteria.

Phage typing

A method used to distinguish between bacteria within the same species on the basis of their susceptibility to a range of bacterial viruses (bacteriophages).

P

Phenotype

The observable characteristics of an organism, which include biotype, serotype, phage type, and bacteriocin type.

Photooxidation

Oxidation of chemicals (e.g., in laboratory media) catalyzed by visible or ultraviolet light.

Plesiomonas* (foodborne Gram-negative bacteria)Signs & symptoms*

Diarrhea, abdominal pain, nausea, vomiting, fever

Duration of illness

2 days–3 weeks

Associated foods

Shellfish, water

Laboratory testing

Stool culture, enteric pathogens abnormal

Treatment

Most antibiotics, such as ciprofloxacin, ofloxacin, and norfloxacin

Polymerase chain reaction (PCR)

A technique used to amplify the number of copies of a preselected region of DNA to a sufficient level for testing.

Polymorphism

Individuals of the same species that appear in two or more morphologically distinct types (morphotypes) exhibit polymorphism.

Positive release

Refers to the process of holding batches of food product in “quarantine” under appropriate storage conditions until the results of specified tests (usually microbiological) are available and signed by an authorized person as satisfactory. At this point, the “quarantine” is lifted and the products made available for dispatch.

P

**Potentially hazardous food/
time/temperature controls for
safety of food (PHF/TCS)**

A food that requires time and temperature controls to limit pathogenic microorganism growth or toxin formation.

Poultry

Any domesticated bird (chicken, turkey, duck, goose, guinea, ratite, squab) or game bird (pheasant, partridge, quail, peacock, pigeon).

Prerequisite programs

Procedures, including standard operating procedures (SOPs), that address basic operational and sanitation conditions in an establishment.

Preventive measure

Physical, chemical, or other factors that can be used to control an identified health hazard.

Procedural step

An individual activity in applying the contents of this book to a food establishment's operations.

Process approach

A method of categorizing food operations into one of three categories:

Simple/no-cook step

Food preparation with no-cook step wherein ready-to-eat food is received, stored, prepared, held, and served.

Same-day service

Food preparation for same-day service wherein food is received, stored, prepared, cooked, held, and served.

Complex food preparation

Complex food preparation wherein food is received, stored, prepared, cooked, cooled, reheated, hot-held, and served.

P

Prokaryote

A self-replicating organism that does not possess any specialized membrane separating its chromosomes from its cytoplasm.

Proteus* (foodborne Gram-negative bacteria)Signs & symptoms*

Odor in urine; kidney stone development

Duration of illness

Days to weeks

Associated foods

Vegetables (soil) and water

Laboratory testing

Urine test

Treatment

Most antibiotics

Protozoa

A diverse group of eukaryotic, mostly unicellular, microorganisms with a defined life

cycle, ranging in size from about 1 μm to just visible to the naked eye.

***Pseudomonas* (foodborne Gram-negative bacteria)**

Signs & symptoms

Fever, tiredness, muscle pains, joint pains, chills

Associated foods

Water, vegetables

Laboratory testing

Blood culture, sputum culture

Treatment

Antibiotics and penicillins

Pulsed field gel electrophoresis (PFGE)

A technique that allows chromosomal restriction fragment patterns to be produced.

Q

Quality assurance

All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.

Quality control

The operational techniques and activities that are used or carried out to fulfill requirements for quality.

Quantitative risk assessment

A risk assessment that provides numerical expressions of risk and indication of the attendant uncertainties (Codex Alimentarius Commission 1999).

R

Ratite

A flightless bird such as an ostrich, an emu, or a rhea.

Ready-to-eat (RTE) food

RTE foods include the following:

- Raw animal foods that have been properly cooked
- Fish intended for raw consumption that has been frozen to destroy parasites
- Raw fruits and vegetables that are washed
- Fruits and vegetables that are cooked for hot holding
- Plant food for which further washing, cooking, or other processing is not required for food safety and from which rinds, peels, husks, or shells, if naturally present, are removed

R

- Substances derived from plants such as spices, seasonings, and sugar; a bakery item such as bread, cakes, pies, fillings, or icing for which further cooking is not required for food safety
- Dry, fermented sausages, such as dry salami or pepperoni
- Salt-cured meat and poultry products, such as prosciutto ham, country-cured ham, and Parma ham
- Dried meat and poultry products, such as jerky or beef sticks, and low-acid foods that have been thermally processed and packaged in hermetically sealed containers

Record

A documentation of monitoring observations and verification activities.

Reduced oxygen packaging (ROP)

Encompasses a large variety of packaging methods where the internal environment of the package contains a controlled oxygen level (typically 21% at sea level), including

**Grouping of Ready-to-Eat Food Commodities
Relative to the Control Potential for *Listeria
monocytogenes***

- A. Foods heat-treated to a listericidal level in the final package.
- B. Heat-treated products that are handled after heat treatment. The products support growth of *L. monocytogenes* during the shelf-life at the stipulated storage temperature.
- C. Lightly preserved products, not heat-treated. The products support growth of *L. monocytogenes* during the shelf-life at the stipulated storage temperature.
- D. Heat-treated products that are handled after heat treatment. The products are stabilized against growth of *L. monocytogenes* during the shelf-life at the stipulated storage temperature.
- E. Lightly preserved products, not heat-treated. The products are stabilized against growth of *L. monocytogenes* during the shelf-life at the stipulated storage temperature.
- F. Raw, ready-to-eat foods.

Source: Stephen J. Forsythe, *The Microbiology of Safe Food*. Dec. 2000, Wiley-Blackwell. With permission.

vacuum packaging (VP), modified atmosphere packaging (MAP), controlled atmosphere packaging (CAP), cook chill (CC) processing, and sous vide (SV). Using ROP methods in food establishments has the advantage of providing extended shelf life to many foods because it inhibits spoilage organisms that are typically aerobic.

R**Reference cultures**

For microorganisms, these are usually obtained from a recognized national collection.

Regulatory authority

A federal, state, local, or tribal enforcement body or authorized representative having jurisdiction over the food establishment.

Repeatability

An assessment of the variation between microbiological test results obtained by a single operator in one laboratory examining replicate test samples from the same test material at the same time using the same methods and equipment.

Reproducibility

An assessment of the variation between test results obtained by different operators in the same or in different laboratories, each examining replicate test samples from the

same test material using the same methods and the same or different equipment.

Restrict

To limit the activities of a food employee so that there is no risk of transmitting a disease that is transmissible through food and so that the food employee does not work with exposed food, clean equipment, utensils, linens, and unwrapped single-service or single-use articles.

Restriction enzyme analysis (REA)

A method for discriminating between isolates of the same species on the basis of patterns obtained from the separation of DNA fragments in agarose gel after digestion with one or more restriction enzymes. Differences in the banding profiles of two isolates are referred to as a restriction fragment length polymorphism (RFLP).

R

Restriction enzymes (restriction endonucleases)

Enzymes that attack DNA. Each enzyme recognizes a particular and different nucleotide sequence and cuts the DNA at a specific site.

Reverse osmosis

A means of purifying water in which water molecules are forced through a semipermeable membrane under pressure from a high-solute concentration to a low-solute concentration—that is, in the opposite direction from conventional (natural) osmosis.

***Rhodotorula* (foodborne fungus)**

Signs & symptoms

Diarrhea, fever

Duration of illness

1–2 weeks

Associated foods

Dairy and vegetables

Laboratory testing

Urine test, stool test

Treatment

Amphotericin B or its lipid formulations

Ribotyping

A method for characterizing bacterial isolates according to their ribosomal RNA pattern (ribotype) and identifying the isolate by comparing the pattern obtained with a database of patterns.

Risk

A function of the probability of an adverse health effect and the severity of that effect consequential to a hazard in food (Codex Alimentarius Commission 1999).

R**Risk analysis**

An estimate of the likely occurrence of a hazard.

Risk assessment

The scientific evaluation of known or potential adverse health effects by means of hazard identification (what is the hazard?), hazard characterization (what type of adverse effects are caused?), exposure assessment (what is the likelihood of its being consumed and how much will be consumed?), and risk characterization (what is the effect on a given population of exposure to the hazard?).

Risk characterization

The process of determining the qualitative and/or quantitative estimation, including attendant uncertainties, of the probability of occurrence and severity of known or potential adverse health effects in a given population based on hazard identification, hazard characterization, and

exposure assessment (Codex Alimentarius Commission 1999).

Risk communication

An interactive process of exchange of information and opinion on risks.

Risk control plan (RCP)

A concisely written management plan developed by the retail or food-service operator with input from the health inspector that describes a management system for controlling specific out-of-control risk factors.

Risk factor

One of the broad categories of contributing factors to foodborne illness outbreaks, as identified by the CDC, that directly relates to foodborne safety concerns within retail and food-service establishments. The five factors are poor personal hygiene, inadequate cooking temperatures, improper

R

holding temperatures, contaminated equipment, and food from unsafe sources.

Risk management

The process of accepting, minimizing, or reducing assessed risks.

Rotaviruses (foodborne virus)*Signs & symptoms*

Watery diarrhea, low-grade fever

Duration of illness

4–8 days

Associated foods

Raw products and ready-to-eat products

Laboratory testing

Stool test; enzyme immunoassay; electron microscopy; polyacrylamide gel electrophoresis; reverse transcription-polymerase chain reaction (RT-PCR)

Treatment

Maintenance of hydration

S

***Saccharomyces* (foodborne fungus)**

Signs & symptoms

Diarrhea, irritable bowel

Associated foods

Saccharomyces causes food spoilage of sugar-rich foods, such as maple sap, syrup, concentrated juices, and condiments

Laboratory testing

Urine test, stool test

Treatment

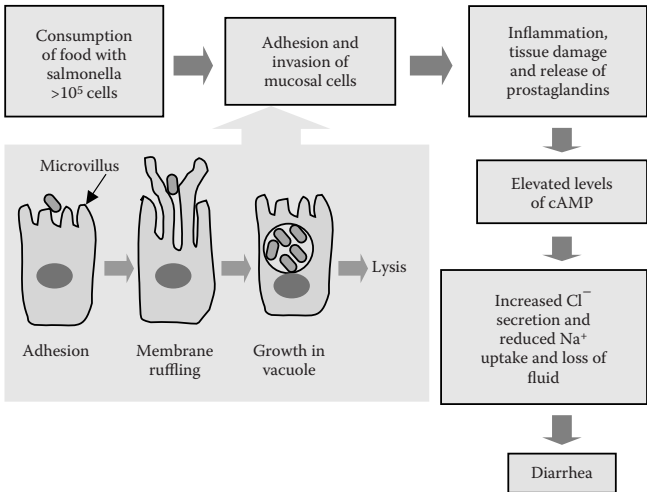
Fluconazole and amphotericin B

Salmonella

A bacteria that can cause diarrhea, fever, and stomach pain in people who have eaten food or had contact with animals with the salmonella bacteria. This could be highly contagious, so food-service employees with

S

**Schematic drawing showing steps
involved in *Salmonella* pathogenesis**



Source: Bibek, R., and Bhunia, A., *Fundamental Food Microbiology*, Taylor & Francis, CRC, 2005. With permission.

this disease should report it to the proper health authorities.

Signs & symptoms

Fever, diarrhea, headache, vomiting, myalgias

Duration of illness

1–3 weeks

Associated foods

Eggs, poultry, raw meat

Laboratory testing

Stool test; blood test

Treatment

Antibiotics such as ciprofloxacin

Sanitary

Free of disease-causing organisms and other harmful substances.

Sanitization

The reduction of the number of pathogenic microorganisms on a surface to levels accepted as safe by regulatory authorities.

Sapoviruses (foodborne virus)

Signs & symptoms

Vomiting, diarrhea, fever, abdominal pain

Duration of illness

2–3 days

S

Associated foods

Seafood and contaminated water

Laboratory testing

Stool culture

Treatment

Maintenance of hydration

Sarcocystis (foodborne protozoa)

Signs & symptoms

Fever, myalgias, bronchospasm, fleeting pruritic rashes, transient lymphadenopathy

Duration of illness

9–39 days

Associated foods

Undercooked meat

Laboratory testing

Blood test, cerebrospinal fluid analysis

Treatment

Antiprotozoal therapy

Selectivity

The ability of a growth medium to restrict the growth of organisms that would otherwise compete with the target organism for nutrients, etc. but that allows the target organism to grow well.

Sensitivity

The ability of a method to detect slight variations in the number of microorganisms within a given matrix (e.g., a food).

Sequelae

A morbid affliction (illness) occurring as the result of a previous disease or infection.

Serotype (serovar)

A variety of microorganism within a species that is serologically distinct from all other members of the species. Most commonly used for distinguishing or comparing different isolates of *Salmonella* and *Escherichia coli*.

S

Serotyping

A method of distinguishing bacteria on the basis of their antigenic properties (i.e., their surface proteins or other components).

Serovar

See *serotype*.

Serratia* (foodborne Gram-negative bacteria)**Signs & symptoms***

Urinary color red, wound infections, pneumonia and red sputum

Associated foods

Raw vegetables (soil); water and milk

Laboratory testing

Rodes on smear and urine test

Treatment

Antibiotic therapy

Severity

The seriousness of the effects of a hazard.

***Shigella* (foodborne Gram-negative bacteria)**

Signs & symptoms

Diarrhea, abdominal pain, chills, malaise, headache, fever

Duration of illness

2–3 days

Associated foods

Raw vegetables; milk and dairy products

Laboratory testing

Stool test, blood test, and sigmoidoscope

Treatment

Bactrim or Cipro

S**Shigellosis**

A bacterial infection causing severe diarrhea that can pass from person to person or from eating contaminated food. Food may become contaminated by infected food handlers who do not properly wash hands after using the restroom. Flies and sewage-contaminated water are other sources. Any food handler with shigellosis must report it to the proper health authorities.

**Sine wave
(simple harmonic motion)**

The amplitude (height) and the frequency (distance of separation of waves) determine the characteristics of a wave. Sine wave describes the type of wave that occurs in the motion of light (in its wave-like form). These characteristics are exploited in phase contrast microscopy.

Slope (slant)

A solid agar medium that has been allowed to set in a diagonally oriented tube (e.g.,

capped test tube, universal bottle, or something similar). There are two components to a slope: the slope, with a large surface in contact with the air, and the butt, which is the deep agar below the slope. Inoculation may involve streaking the slope, to grow and maintain cultures, as well as stabbing to the bottom of the butt with an inoculated wire, to enable growth in reduced oxygen conditions.

Solute

A substance that has been dissolved in a solvent to form a solution; for example, salt (solute) is dissolved in water (solvent) to form brine (solution). Similarly, sugar is dissolved in water to form syrup.

Solution

The result of dissolving a solute in a solvent. (See *solute*.)

S

Solvent

A substance, such as water, in which solutes may be dissolved. (See *solute*.)

SOP

Standard operating procedure.

Sous vide (SV)

Raw or partially cooked food that is packaged in a hermetically sealed, impermeable bag, cooked in the bag, rapidly chilled, and refrigerated at temperatures that inhibit the growth of pathogens.

Species

A taxonomic unit within a genus. A species may contain particular varieties within it, based on serotypes, phage types, etc. All related species are grouped into a genus.

Specificity

The degree to which a method will provide confidence that the target organism will be found; that is, a high specificity provides a high level of confidence in the result and the percentage of false positives will be very low.

Spore

A very tough, dormant form of certain bacterial cells that is very resistant to desiccation, heat, and a variety of chemical and radiation treatments that are otherwise lethal to vegetative cells.

Spore former

A bacterium capable of producing spores under adverse conditions. Spore formers in food include *Clostridium botulinum*, *Bacillus cereus*, and *Clostridium perfringens*.

S

Stab culture

Inoculation of a slope or deep agar by stabbing with an inoculated straight wire or needle to the bottom of the butt of the slope or deep agar. Growth may occur at various depths, depending on the oxygen requirements of the organism.

Standard operating procedure (SOP)

A written method of controlling a practice in accordance with predetermined specifications to obtain a desired outcome.

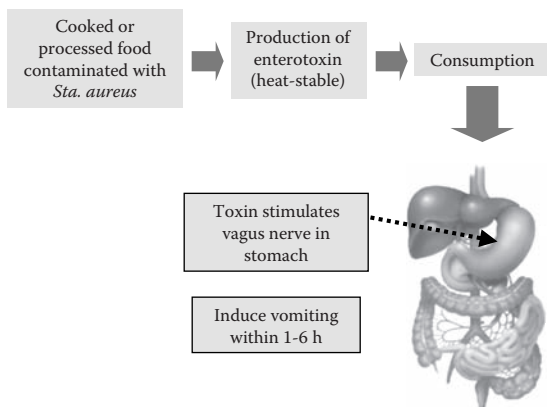
Staphylococcus* (foodborne Gram-positive bacteria)**Signs & symptoms***

Intravascular devices, infections of prosthetic joints, wound infections, osteomyelitis associated with foreign bodies, endocarditis, diarrhea, agitation, headache

Duration of illness

4–10 days

**Pathogenic mechanism of intoxication
with enterotoxin from *Staphylococcus aureus***



Source: Bibek, R., and Bhunia, A., *Fundamental Food Microbiology*, Taylor & Francis, CRC, 2005. With permission.

Associated foods

Custard, cream-filled pastry, meat and fish

Laboratory testing

Urine test

Treatment

Antibiotics such as penicillin, ensuring that adequate fluids are taken

S

Stationary phase

The period of bacterial growth, following the log phase, in which the number of bacterial cells remains more or less constant as cells compete for space and nourishment.

Strain

An isolate or group of isolates that can be distinguished from other isolates of the same genus and species by either phenotypic and or genotypic characteristics.

Streptococcus* (foodborne Gram-positive bacteria)**Signs & symptoms***

Fever, altered mental status, chills, myalgia, nausea, vomiting, diarrhea, oliguria, sore throat

Duration of illness

1–2 weeks

Associated foods

Raw meat and vegetables

Laboratory testing

Bile-esculin test

Treatment

Antibiotics such as penicillin, erythromycin, and clindamycin

Substrate

A substance that is utilized in chemical or biochemical reactions.

Symbols

$<$ = less than

$>$ = greater than

$\geq$ = greater than or equal to

$\leq$ = less than or equal to

$\pm$ = plus or minus

$\sim$ = approximately

T

***Taenia* (foodborne helminth)**

Signs & symptoms

Nausea, weakness, loss of appetite, increased appetite, headache, constipation, dizziness, diarrhea, pruritus ani

Duration of illness

2–3 months

Associated foods

Undercooked beef or pork

Laboratory testing

Cysticercosis antibody, IgG

Treatment

Praziquantel

Taxonomy

The arrangement and classification of living organisms.

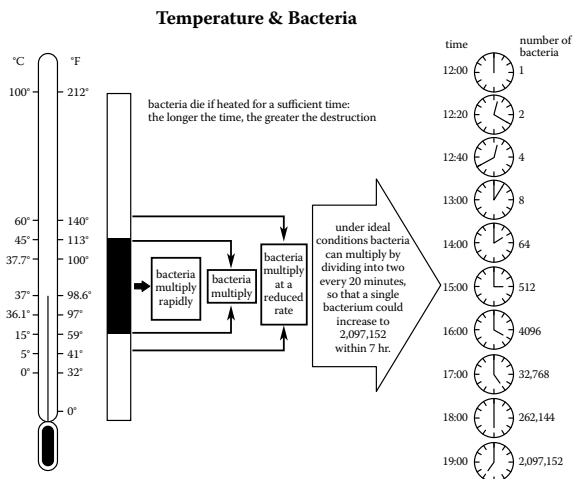
T

TC

Temperature control.

Temperature measuring device

A thermometer, thermocouple, thermostat, or other device for measuring the temperature of food, air, or water.



Thermoduric (thermotolerant) organism

A vegetative organism able to survive heat processes that are usually lethal to vegetative bacteria but that is not as heat resistant as a bacterial spore. In dairy microbiology, the term refers to pasteurization survivors such as the *enterococci*.

Toxigenic microorganisms

Pathogenic bacteria that cause foodborne illness in humans due to the ingestion of poisonous toxins produced in food.

Toxin

A poisonous substance that may be found in food.

***Toxoplasma* (foodborne protozoa)**

Signs & symptoms

Enlarged lymph nodes in the head and neck, headache, mild illness with fever, muscle pain and sore throat

T

Duration of illness

1–2 weeks

Associated foods

Toxoplasma food, raw or undercooked meat (lamb, pork, and beef)

Laboratory testing

Brain biopsy, cranial CT scan, MRI of head, serologic titers for toxoplasmosis, slit lamp exam

Treatment

Antibiotics

Trend analysis

The examination of data collected over a period of time, for a single activity or operation, to determine whether they remain consistent or show any changes (for better or worse). Examples of such data might be laboratory results, process control charts, or complaints records. Analysis might be done by using simple graphs or more complex statistical techniques.

Trichinella (foodborne helminth)

Signs & symptoms

Diarrhea, nausea, abdominal discomfort, muscle aches, itching, fever, chills, joint pain, swollen eyelids, bleeding into the eyes, bleeding under tongue, light sensitivity, fatigue, chills, sweating, thirst, skin irritation

Duration of illness

2 days–8 weeks

Associated foods

Undercooked or raw pork such as pork sausage

Laboratory testing

Enzyme-linked immunosorbent assay, indirect immunofluorescence, and latex agglutination

Treatment

Thiabendazole, corticosteroids, mebendazole, pain medications, bed rest, and fluids.

U

Ultraheat treatment (UHT)

A high-temperature heat treatment (usually 138–142°C for 2–5 seconds) applied to liquid foods, usually followed by aseptic packaging for the production of long-life, ambient-stable, low-acid products.

USDA

U.S. Department of Agriculture.

V

Vacuum packaging (VP)

The process in which air is removed from a package of food and the package is hermetically sealed so that a vacuum remains inside the package.

Validation of HACCP plan

That element of verification focused on collecting and evaluating scientific and technical information to determine whether the HACCP plan, when properly implemented, will effectively control the hazards.

Validation (of microbiological methods)

The confirmation, by detailed examination and the provision of objective evidence, that the particular requirements for a specific intended use are fulfilled (European

V

Standard BS EN ISO/IEC 17025 2000).
In simple terms, “Can it work?” “Does it work in the laboratory under the required conditions?”

Variance

A written waiver issued and authorized by a regulatory agency.

Vegetative cell

A bacterial cell that is capable of actively growing.

Verification

Ensuring that monitoring and other functions of a HACCP plan are being properly implemented.

Vero cytotoxigenic

Organisms that produce a toxin capable of killing vero cells—an established cell line derived from African green monkey

kidney. Vero cytotoxigenic strains of *Escherichia coli* cause a severe form of gastrointestinal disease in humans. The difficulties that have evolved with the nomenclature of enterohemorrhagic *E. coli* were clarified by the International Life Sciences Institute (ILSI) in 2001.

***Vibrio* (foodborne Gram-negative bacteria)**

Signs & symptoms

Infected open wounds, causing septicemia

Duration of illness

6 hours–5 days

Associated foods

Brackish water and saltwater

Laboratory testing

Stool Gram-stain culture

Treatment

Oral rehydration therapy

V**Virus**

The smallest of microorganisms that is dependent on a living host cell to survive and multiply and therefore cannot multiply in or on food.

W

Water activity (a_w)

The amount of water available in the product to allow bacteria to live and grow. Scientifically, it is the quotient of the water vapor pressure of the substance, divided by the vapor pressure of pure water at the same temperature.



Xerophile

An organism that can grow at low water activity (0.85 or below). Water activity is reduced by high levels of a solute such as salt, sugar, or glycerol in the aqueous phase of the food. (See *halophile*, *osmophile*, *water activity*.)

Y

Yeasts

Fungi that have evolved a mostly single-celled lifestyle and reproduce asexually by producing buds or occasionally by fission (in the same way that bacteria divide).

Yeasts grow well in liquid environments, especially nutritionally rich ones, and some can grow anaerobically using a fermentative metabolism. Some yeasts can adopt a filamentous, mold-like form, just as some molds can grow in a yeast-like form. (See *fungus*.)

***Yersinia* (foodborne Gram-negative bacteria)**

Signs & symptoms

Fever, abdominal pain, diarrhea

Duration of illness

1–4 weeks

Y

Associated foods

Dairy, raw pork and meat

Laboratory testing

Examination of sputum; lymph node biopsy and stool test

Treatment

Antibiotics such as aminoglycosides, doxycycline, trimethoprim-sulfamethoxazole, and fluoroquinolones

Z

Zoonotic disease

A disease that is communicable from animals to humans such as BSE (mad cow), avian flu, *Escherichia coli*, salmonella, rabies, and malaria.

Z-value

A term used in heat process calculations that expresses the number of centigrade degrees (C°) increase required to achieve a 10-fold decrease in the D-value of an organism. (See *D-value*; $F_0 = 3$ minutes.)

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