

Food contamination

Food borne Hazards

Foods can be contaminated by biological, chemical, or physical hazards; however, biological hazards are most common in Food service and retail. There are many areas within the food production chain, from the farm to the retail establishment, where foods may be contaminated and/or mishandled. It is therefore important for all areas of food production to be carefully monitored and controlled so that the risk of food borne illness is decreased.

Food borne hazards are generally classified as either

- biological,
- chemical, and
- physical

Among these, there are over 200 food borne hazards known to cause food borne illness. Biological hazards are dangers from disease-causing microorganisms and from poisonous toxins that they may produce. Biological hazards are by far the most important food borne hazard in foodservice. Chemical hazards include unwanted substances such as cleaning solutions and pesticides. Chemicals, as well as other non-food substances, should never be placed near food items. Physical hazards are dangers posed by the presence of particles that are not supposed to be a part of the food, such as glass, metal, or bone.

Food-Borne Illnesses

Since foods prepared in foodservice and food retail establishments are the closest link to ingestion by the consumer, monitoring and control of food borne hazards is most critical at the foodservice and food retail end of the food production. Many food borne illnesses occur because of mishandled foods in foodservice and food retail establishments.

Symptoms of food borne illness usually include one or more of the following: diarrhea, vomiting, headache, nausea, and dehydration.

Classification of food borne illnesses

- Infection - Ingestion of a harmful microorganism within a food.
- Intoxication - Ingestion of a harmful toxin produced within a food.
- Toxico-infection - Ingestion of a harmful microorganism within a food that produces a toxin in the human body.

Infection is caused when a living microorganism is ingested as part of a food. After ingestion, the microorganism can then attach to the gastrointestinal tract and begin to grow. This can lead to the common symptoms of food borne illness like diarrhea. In some instances, the microorganisms may be carried in the blood stream from the gastro-intestinal tract to other parts of the body. Food borne viruses and parasites too can cause infection, e.g. bacterial infection by *Salmonella* spp.

Intoxication is caused when a living microorganism grows in or on a food and produces a toxin. The food containing the toxin is then ingested and the toxin itself causes illness. A good example of food intoxication is by bacteria like *Clostridium botulinum* and *Staphylococcus aureus*. Intoxication may also occur due to the consumption of a toxic chemical such as a cleaning chemical.

Toxico-infection is caused when a living microorganism is consumed (like an infection) and then the microorganism produces a toxin in the body, as opposed to in the food that leads to illness. It is different from intoxication. A good example of a food toxico-infection is from *Clostridium perfringens*.

It is important to understand that, under favorable circumstances for contamination, anyone can become ill due to eating contaminated foods. A healthy adult may be without symptoms or may have gastrointestinal symptoms. In most cases, the healthy adult host will recover in a few days. However, the risks and dangers associated with food borne illness are much greater for the elderly, infants, pregnant women, and people who have a weakened immune system. For these groups of people, symptoms and length of food borne illness can be much more severe, even life threatening.

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Biological Contamination

Common biological hazards in a food retail operation

Bacteria

Bacillus cereus
Campylobacter jejuni
Clostridium perfringens
Clostridium botulinum
Escherichia coli
Listeria monocytogenes
Salmonella spp.
Shigella spp.
Staphylococcus aureus
Vibrio spp.

Viruses

Hepatitis A
Norwalk virus group
Rotavirus
Hepatitis A
Norwalk virus group
Rotavirus
Hepatitis A

Parasites

Anisakis spp.
Cryptosporidium parvum
Giardia lamblia
Trichinella spiralis

Bacterial Growth in Foods

Bacteria are the most troublesome and important biological food borne hazard for the foodservice and food retail establishment. Bacteria are living microorganisms that are a single cell. Bacterial cells can exist in two different states: the vegetative state and the spore state. All bacteria live in a vegetative state which can grow and reproduce. Few bacteria are able to change into a special state called the spore state. Spores are produced when the bacterial cell is in an environment where it cannot grow (frozen foods, dried foods). Spores are not able to grow or reproduce. Instead, spores are a means of protection when bacteria are in an environmental that they cannot grow.

The vegetative state and spore state of bacterial cells.

	Vegetative state	Spore state
Presence	Optimal conditions	Stress conditions
Reproduction	Yes	No
Growth	Yes	No
Produce toxin	Yes	No
Resistance to stress	No	Yes
Dangerous if ingested	Yes	No

Bacteria are usually classified by their requirements needed for growth and as a spoilage or pathogenic microorganism. Spoilage bacteria break down foods so that they look, taste, and smell bad. They affect quality. Pathogenic bacteria are disease-causing microorganisms and, if ingested in a food, can make people ill. Both spoilage and pathogenic bacteria are important to those preparing and serving foods. Since pathogens affect food safety, they will be emphasized. Keep in mind, however, that the more effort taken to ensure that foods are safe will generally lead to a better quality food as well. Bacteria have different required temperatures for growth. Psychrophiles (cold-loving) bacteria grow within a temperature range of -15 to 21 °C. These microorganisms are particularly important since they can grow at room temperature and at refrigerated temperatures. Most psychrophilic bacteria are spoilage microorganisms, but some are pathogenic. The next group, mesophiles, grows between 21°C and 43°C with best growth at human body temperature of 37°C (98.6 °F). There are many examples of spoilage and pathogenic mesophiles. Bacteria growing above 43°C are called thermophiles. All thermophiles are spoilage microorganisms.

Growth requirements for bacterial cells.

	Temperature range	Gas reqm
Psychrophile	-15 to 21 °C	-
Mesophile	21°C & 43°C	-
Thermophile	above 43°C	-
Aerobic	-	21% O ₂
Anaerobic	-	No O ₂
Facultative	-	0-21% O ₂
Anaerobe	-	-
Micro-aerophilic	-	3-6% O ₂

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Bacteria also differ in their requirements for oxygen. Aerobic bacteria require an oxygen level normally present in the air (about 21%) for growth. These microorganisms grow only when exposed to air. Anaerobic bacteria, on the other hand, cannot tolerate any oxygen; it is toxic to them. Anaerobic bacteria grow well in vacuum packaged foods or canned foods where oxygen is not available. Facultative anaerobic bacteria can grow with or without oxygen (0-21% oxygen). Most pathogenic food borne microorganisms are facultative anaerobes. Microaerophilic bacteria require a specific amount of oxygen for growth. They must have between 3-6% oxygen to grow and will not grow outside this narrow oxygen range.

Bacterial Growth Cycle

Bacteria reproduce by dividing. During each cycle of growth, each bacterial cell divides into two cells. This is called binary fission. The reproduction of bacteria, or increase in numbers, is referred to as bacterial growth. This means that during each growth generation, each cell gives rise to another cell.

Reproduction of bacterial cells.

Generation time, or time for cell numbers to double, for bacterial cells is typically 20-30 minutes but can be as quick as 15 minutes. Under optimal conditions, this means that a single cell can generate over 1 million cells in just 5 hours! That is why it is vital to stop any opportunities for bacteria to grow. Proper storage and handling of foods helps to prevent bacterial growth.

Bacterial growth.

# of cells	Time
1	0
2	15min
4	30min
16	60min
>1000	3hr
>1 million	5hr

What Do Bacteria Need to Grow?

Bacteria need 6 conditions in order to grow in foods. They need

1. Source of **Food**,
2. **Acidic** environment above pH 4.6,
3. **Temperature** between 5 and 60°C,
4. 4 hours **Time**,
5. **Oxygen** requiring environments, and
6. **Moisture**

Remember the requirements with the acronym **F-A-T-T-O-M**. Since many foods inherently contain microorganisms, we need to be sure to control these six conditions to prevent bacterial growth.

Source of Food:

The presence of a suitable food supply is the most important condition affecting bacteria growth. The food must contain the appropriate nutrients needed for growth. Bacteria generally prefer foods that are high in protein like meats and dairy items.

Acidity:

Disease-causing bacteria grow at a pH of more than 4.6. The term pH is used as a symbol to designate the degree of acidity of a food. The scale for measuring pH is from 0 to 14. A pH of a food that is 7.0 is neither acidic nor basic and is considered "neutral". A pH less than 7.0 indicates that a food is "acidic." A pH range greater than 7.0 refers to a food that is "basic". Most foods are in the acidic range, or less than 7.0 pH.

The pH scale:

Bacteria tend to prefer conditions that are near pH 7.0 but are capable of growing in a pH range of 4.6-7.0. There are many retail foods that fall within this range. Foods that are at a pH less than 4.6 will not support growth of disease-causing bacteria.

Temperature:

Temperature is probably the most critical factor affecting growth of bacteria in foods. Most disease causing bacteria grow within a temperature range of 5 and 60°C. This is commonly referred to as the "Temperature Danger Zone".

Careful monitoring of temperature is the best way for a food retail manager to prevent

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bacteria from growing on foods. There is an old saying “Keep cold foods cold and hot foods hot.” This means that all cold foods should be stored at less than 5°C and all hot foods held at more than 60°C (after proper cooking).

Time:

Because bacteria grow in such a fast manner, it doesn't take long before many cells are produced. A rule of thumb in the food industry is that bacteria need about 4 hours to grow to high enough numbers to cause illness. This includes total time that a food is between 5 and 60°C. Remember, a single bacterial cell can produce over 1 million cells in just 5 hours under ideal conditions.

Oxygen:

As discussed earlier, different bacteria require different amounts of oxygen to grow. Some require a lot of oxygen (aerobic), others cannot tolerate oxygen (anaerobic), some only grow within a narrow oxygen range (microaerophilic), while others can grow with or without oxygen (facultative anaerobes).

Moisture:

Just like most other forms of life, moisture is an important factor affecting bacterial growth. That's why humans have been preserving foods for thousands of years by drying them. Scientists have determined that it isn't how much moisture is in a food that most affects bacterial growth. Growth is influenced most by the amount of “available water” which is designated with the symbol A_w .

A_w is water that is not bound to the food and is available for bacterial growth. A_w is measured on a scale from 0-1.0. Disease causing bacteria can only grow in foods with A_w greater than 0.85. There are many preservation processes that can be done to reduce the A_w of foods including sun drying and freeze drying. The addition of salt or sugar can also be used as a means to reduce available water; however, very high amounts need to be used making this method impractical.

Potentially Hazardous Foods

Foods that are high in protein contain a pH greater than 4.6, and have A_w greater than 0.85 are called potentially hazardous foods. If these foods are stored between 5 and 60°C for enough time, they can permit the growth and/or toxin

production of disease-causing food borne bacteria. Potentially hazardous foods pose the highest risk of food borne illness. There are many examples of potentially hazardous foods prepared in food retail establishments. For example, meat, chicken, milk, eggs, seafood etc. Therefore, it is critical to control the handling and storage of potentially hazardous foods to prevent bacterial growth.

Bacterial, Viral, and Parasitic Food borne Hazards

Biological hazards are the greatest concern to the foodservice and food retail operator. They have been classified here as spore-forming bacteria, non-spore-forming bacteria, viruses, and parasites. In the following sections, each type of bacterial hazard is described, the common foods and route of transmission are identified, and ways to prevent the hazards are discussed.

Spore-Forming Food borne Bacteria

The following group of bacteria can produce a spore structure. Recall that a spore structure allows a cell to withstand environmental stress such as cooking, freezing, high salt foods, dried foods, and very acidic foods. Generally, bacterial spores are not harmful if ingested. However, if conditions of the food are changed that permit the spore to turn into a vegetative cell, the vegetative cell can grow in the food and cause illness if eaten.

Spore-forming bacteria are generally found in ingredients that are grown near the soil like vegetables and spices. They can be particularly troublesome in food retail-type environments because they can survive on foods as a spore. When conditions are improved, such as the addition of dried spices to a beef stew mixture, spores can become vegetative cells.

For example, imagine that a restaurant was preparing a 10-lit vessel of gravy for the next day's lunch. All the ingredients (beans, meat, spices, tomato base) of the gravy are mixed together and cooked to a rapid boil. A rapid boil will destroy all vegetative cells, but spores may survive. The gravy is then kept in the 10-lit vessel and allowed to cool overnight in a refrigerator. It takes the gravy 8 hours to cool

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from 60°C to below 5°C. If given enough time at the right temperature during the cooling process, spore-forming bacteria that survived the cooking process may change into vegetative cells and grow.

To keep spore-forming bacteria from changing to the dangerous vegetative state, it is critical that hot foods be maintained at 60°C or above and cold foods be maintained at less than 5°C. Cooking, reheating, and cooling of foods should also be done as quickly as possible. Important spore-forming pathogens in the food retail industry include *Bacillus cereus*, *Clostridium perfringens*, and *Clostridium botulinum*.

Bacillus cereus

Bacillus cereus is facultative anaerobic, spore-forming bacterium that has been associated with two very different types of illnesses. Depending on the toxin that is produced from the bacteria onto the food, illness can either be associated with diarrhea or vomiting. The diarrheal illness is due to a toxico-infection and the vomiting illness is due to intoxication.

Common foods: A wide variety of foods, including meats, milk, vegetables, and fish have been associated with the diarrheal-type disease. The vomiting-type illness is usually associated with starchy foods such as rice, potatoes, and pasta products.

Transmission in foods: Illness due to *Bacillus cereus* is most often attributed to foods that are improperly stored (cooled, hot-held) to permit the conversion of spores to vegetative cells. Vegetative cells then produce the toxin or grow to high enough numbers in the food to cause illness.

Prevention: Foods must be cooked and cooled rapidly.

Clostridium perfringens

Clostridium perfringens is an anaerobic, spore-forming bacterium that is one of the most commonly reported causes of food borne illness, especially for foods that have been temperature abused. *Clostridium perfringens* causes illness due to toxico-infection where the ingested cells produce a toxin in the human intestinal tract.

Common foods: The microorganism is widely

distributed in foods, especially spices. It is often implicated in meat dishes and dishes containing gravy. Gravy can create an anaerobic environment which allows the microorganism to grow.

Transmission in foods: Illness due to *Clostridium perfringens* is most often attributed to foods that are temperature abused. Foods that are improperly cooled (food in the temperature danger zone for greater than 4hrs.) and then not reheated properly create an ideal condition for the growth of *Clostridium perfringens*.

Prevention: Foods must be cooked and cooled rapidly.

Clostridium botulinum

Clostridium botulinum is an anaerobic, spore-forming bacterium that causes food borne intoxication due to improperly heat processed foods (especially home-canning). The microorganism produces a neurotoxin which is one of the most toxic biological substances known to humans.

Common foods: Foods with a pH greater than 4.6, that are not properly heat processed and then packaged anaerobically (can or vacuum pouch), and held at above 5°C. A good example would be improperly home-canned foods.

Transmission in foods: Illness due to *Clostridium botulinum* is almost always attributed to ingestion of foods that were not heat processed correctly and packaged anaerobically.

Prevention: Discard damaged cans. Do not can or vacuum package foods in a food retail establishment.

Nonspore-Forming Food borne Bacteria

The following group of bacteria is not capable of producing a spore structure; they are always in the vegetative state. Compared to spore-forming bacteria that are in the spore state, vegetative cells are easily destroyed by proper cooking. There are numerous examples of nonspore-forming food borne bacteria that are important in the food retail industry.

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Campylobacter jejuni

Campylobacter jejuni is considered by many food scientists as the number one agent that causes food borne illness. The microorganism, which causes infection, is unique compared to most other food borne pathogens because it has a very strict gaseous requirement for growth. It is classified as a microaerophile because it can tolerate only 3-6% oxygen for growth. The infective dose for *Campylobacter jejuni* in foods is low.

Common foods: This microorganism is commonly found in raw milk and in raw chicken. Some scientists estimate that *Campylobacter jejuni* may be present in nearly 100% of retail chickens.

Transmission in foods: *Campylobacter jejuni* is often transferred from raw meats to other foods by cross-contamination. This is typically done by transfer from a food contact surface (such as a cutting board) or from food worker's hands.

Prevention: Cook raw meats properly. Do not use raw (unpasteurized) milk. Thoroughly clean food contact surfaces (cutting boards) and hands after handling raw foods.

Escherichia coli

The *Escherichia coli* (or *E. coli*) group of bacteria includes four strains of food borne pathogens; enterotoxigenic *E. coli*, enteropathogenic *E. coli*, enterohemorrhagic *E. coli*, and enteroinvasive *E. coli*. The most important of the group is a particular type of enterohemorrhagic *E. coli* called *E. coli* 0157:H7. This is a facultative anaerobic bacterium that can be found in the intestines of warm blooded animals. Illness can be due to an infection and a toxico-infection. Illness due to *E. coli* 0157:H7 is particularly serious in infants because it can cause kidney failure and bloody diarrhea.

Common foods: This microorganism has been isolated from raw milk and raw ground beef.

Transmission in foods: *E. coli* is usually transferred to foods like beef by contact with the intestines of animals. Transmission can also occur if employees are carriers and do not wash their hands properly after going to the bathroom.

Prevention: Cook hamburger patties until well

done or until all the juices run clear. Do not use raw milk products. Make sure that employees practice good personal hygiene.

Listeria monocytogenes

Listeria monocytogenes is a facultative anaerobic bacterium that causes food borne infection. It is important to food retail operations because it can survive under many conditions such as high salt foods. Unlike many other food borne pathogens, it can grow at refrigerated temperatures below 41 F. Listeriosis, the illness caused by *Listeria monocytogenes*, usually causes gastro-intestinal symptoms for the healthy adult. However, disease complications can be life threatening (septicemia, meningitis, encephalitis) for people with weakened immune systems.

Common foods: This microorganism has been isolated from many foods and is most common in raw meats, raw poultry, dairy products (cheeses, ice cream, raw milk), raw vegetables, and seafood.

Transmission in foods: Transmission to foods can occur by cross-contamination. Also, foods that are not cooked properly can contain live cells.

Prevention: Cook foods thoroughly. Practice good personal hygiene.

Salmonella spp.

Salmonella is a facultative anaerobic bacterium that frequently causes a food borne infection. Like *E. coli*, the source for *Salmonella* is the intestinal tracts of warm blooded animals.

Common foods: This microorganism exists in many foods, especially raw meat and poultry products, eggs, milk, dairy products, pork, milk chocolate, and cream-filled desserts.

Transmission in foods: Transmission to foods is very common by cross contamination from raw foods (especially poultry), from food contact surfaces (cutting boards), or from food handlers.

Prevention: Cook foods thoroughly. Practice good personal hygiene, and clean and sanitize food contact surfaces after use with raw foods.

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Shigella spp.

Shigella is a facultative anaerobic bacterium that causes about 10% of food borne illnesses in the U.S. The microorganism is frequently found in the intestines of humans and warm blooded animals. The microorganisms can cause an infection or toxico-infection. A common illness caused by Shigella is bacillary dysentery.

Common foods: This microorganism is common in ready-to-eat salads (i.e. potato, chicken), milk and dairy products, poultry, and raw vegetables.

Transmission in foods: Water that is contaminated by fecal material and unsanitary handling by food workers are common transmission routes.

Prevention: Practice good personal hygiene and wash foods with potable water supply (suitable for drinking).

Staphylococcus aureus

Staphylococcus aureus is a facultative anaerobic bacterium that produces a very heat-stable toxin as it grows on foods. It is therefore an example of intoxication. The microorganism is normally present on human skin, hands, and nasal passages, and can be transferred to foods easily. It also survives in high salt conditions.

Common foods: This microorganism is common to cooked ready-to-eat foods, salads, meats and poultry products, custards, and high salt foods (like ham), and milk and dairy products.

Transmission in foods: Since humans are the primary source, cross-contamination from the worker's hands is the most common way the microorganism is introduced into foods. Foods requiring large amounts of food preparation and handling are especially susceptible.

Prevention: Practice good personal hygiene. Keep ready-to-eat foods out of the temperature danger zone.

Vibrio spp.

There are three species within the Vibrio group of bacteria that cause been implicated in food borne infections. They include Vibrio cholera, Vibrio parahaemolyticus, and Vibrio vulnificus. All are important since they are very resistant to salt and are common in seafood.

Common foods: Vibrio spp. are commonly found in raw, under-processed, improperly handled, contaminated fish and shellfish. These bacteria are generally found more in the summer months and from warmer waters.

Transmission in foods: Since the microorganism exists in many raw seafood, transmission to other foods by cross contamination is a concern. Most illnesses are caused due to eating raw or undercooked seafood, especially oysters.

Prevention: Cook seafood properly. Avoid consumption of raw seafood. Practice good personal hygiene.

Food borne Viruses

Food borne viruses differ from food borne bacteria. They are the smallest and simplest form of life known. Viruses require a living host (animal, plant, or human) to grow and reproduce. Unlike bacteria, they do not reproduce or grow in foods. They are usually transferred from one food to another, from a food handler to a food, or from a water supply to a food. There are three viruses that are important in food retail preparation; Hepatitis A, Norwalk virus, and rotavirus.

Hepatitis A

Hepatitis A is a food borne virus that is associated with many food borne infections. It is a particularly important hazard to retail food establishments because it has an incubation period of 10-45 days. This means that a food worker can harbor the microorganism for up to 6 weeks and not show symptoms of illness. However, during this time, the food worker can contaminate foods and other workers in the food retail establishment.

Common foods: Ready-to-eat foods that are washed with a non-potable water supply or foods that are handled excessively can be contaminated with Hepatitis A. Examples include raw vegetables and raw seafood. Due to the long incubation period, it is very difficult to identify the food source of a Hepatitis A infection.

Transmission in foods: The virus is primarily transmitted from person-to-person contact, by cross contamination, and by fecal contamination.

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Prevention: Handle and cook foods properly. Avoid consumption of raw seafood. Practice good personal hygiene.

Norwalk virus group, Rotavirus

The Norwalk virus and rotavirus are other common food borne viruses that are associated with many food borne infections, with some outbreaks involving up to 3000 people.

Common foods: Raw seafood. Raw fruits and vegetables that are washed with a contaminated water supply. Non-heated foods that are handled by people who are shedding the virus.

Transmission in foods: The virus is transmitted from person-to-person contact and by fecal contamination.

Prevention: Handle and cook foods properly. Avoid consumption of raw seafood. Practice good personal hygiene.

Food borne Parasites

Food borne parasites are another important food borne biological hazard. Parasites are small or microscopic creatures that need to live on or inside a host to survive. There are many examples of parasites that can enter the food system and cause food borne illness. Parasitic infection is far less common than bacterial or viral food borne illness.

Anisakis spp.

Anisakis spp. are nematodes (or roundworms) that have been associated with food borne infection.

Common foods: They generally cause food borne disease through consumption of raw or undercooked seafood. The most common foods include seafood such as cod, haddock, fluke, salmon, herring, flounder and monkfish.

Transmission in foods: This parasite is transferred in the water in which the marine animal lives. This parasite may also be transferred to other foods by improper food handling.

Prevention: Handle and cook seafood properly.

Cryptosporidium parvum, Giardia lamblia

Cryptosporidium parvum and Giardia lamblia are single cell microorganisms called protozoa.

They can cause food borne infections. These microorganisms are important because they are common causes of non- bacterial diarrhea in the United States.

Common foods: These parasites are most commonly associated with the consumption of contaminated water. Raw foods that are in contact with contaminated water, especially raw vegetables, can also be contaminated.

Transmission in foods: These parasites are transmitted from a contaminated water supply, person-to- person contact and by fecal contamination.

Prevention: Handle and cook foods properly.

Trichinella spiralis

Trichinella spiralis is a food borne roundworm that can cause parasitic infection.

Common foods: Pork is by far the most common food which carries Trichinella spiralis. It can also be found in bear meat.

Transmission in foods: This parasite is inherently carried by animals. It is generally thought that a possible route to the animal is through consumption from eating infected tissues from other animals and garbage.

Prevention: Cook pork until there are no signs of pink and always cook meats properly.

Chemical Hazards

Chemical hazards are usually classified as either naturally occurring chemicals or added chemicals. Naturally occurring chemicals include toxins that are produced by a biological organism. Added chemicals include chemicals that are intentionally or non-intentionally added to a food.

Naturally occurring common chemical hazards in a food retail operation.

Ciguatoxin

Ciguatoxin is an example of a fish poisoning intoxication from the consumption of tropical fish. The origin of the toxin is from tiny sea creatures called algae. The toxin is heat stable and is not destroyed by cooking. Different

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marine fish ingest algae containing toxin, and the toxin accumulates in the fish over time. Symptoms of ciguatoxin poisoning include common food borne illness symptoms and unique symptoms including weakness and slight paralysis of the mouth, tongue, throat, hands, and feet.

Common foods: Marine finfish most commonly cause ciguatoxin poisoning. Common marine species include barracudas, groupers, jacks, mackerel, snappers, and triggerfish.

Transmission in foods: The toxin is transferred to finfish after ingestion of toxin containing algae.

Prevention: The toxin is not destroyed by cooking; therefore, prevention can be very difficult. Purchasing seafood from a reputable supplier is the best preventative measure.

Mycotoxin

Another group of food borne microorganisms that can cause disease includes fungi. Fungi include both molds and yeasts. They differ from bacteria in that they are larger in size and usually prefer foods that are high in sugar or starches. They can often withstand more extreme conditions (highly acidic foods, lower Aw foods) compared to bacteria.

Food borne molds are important because they can produce chemical compounds called mycotoxins. Mycotoxins have been linked to cancer. Yeasts do not cause food borne illness.

There are several molds that produce mycotoxins. An important and common food borne mycotoxin, called aflatoxin, is produced by *Aspergillus* spp. Mycotoxins are commonly found in dry and/or acidic foods. Common foods containing mycotoxins include corn, nuts, and grains. Many mycotoxins are not destroyed by cooking.

Scombrototoxin

Scombrototoxin, also called histamine poisoning, is caused by eating foods high in a chemical compound called histamine. Histamine is

usually produced by bacteria when they decompose foods. Histamine is not destroyed by cooking. Unique symptoms of illness include dizziness, a burning sensation, a facial rash or hives, and a peppery taste in the mouth.

Common foods: The most common foods causing scombrototoxin include tuna and mahi-mahi fish. Swiss cheese has also been implicated.

Transmission in foods: Over time, bacteria that are present in a particular food can break down histidine in food and cause the production of histamine. Temperature abuse also leads to more histamine production.

Prevention: Purchase seafood from a reputable supplier. Store seafood below 41 °F and do not accept seafood that has been previously thawed.

Shellfish toxins

There are numerous examples of shellfish toxins. The most common include Paralytic Shellfish Poisoning (PSP), Diarrhetic Shellfish Poisoning (DSP), Amnesic Shellfish Poisoning (ASP), and Neurotoxic Shellfish Poisoning (NSP). All involve an accumulation of toxins produced in shellfish.

Common foods: Any shellfish may contain any of the toxins. PSP is more common with mussels, clams and scallops. DSP is more common with mussels, oysters, and scallops. ASP is more common with mussels. NSP is common for Gulf Coast marine animals.

Transmission in foods: Inherent to marine shellfish.

Prevention: Purchasing food from a reputable supplier.

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Added chemicals:

Cleaning solutions

Food additives

Pesticides

Heavy metals

There is a long list of chemicals that are added to foods which can pose a health risk. Intentionally added chemicals may include food additives, food preservatives, and pesticides. Pesticides leave residues on fruits and vegetables, and can usually be removed by a vigorous washing procedure or by peeling off the skin. Use of intended food additives is regulated by the FDA to assure that they are safe. Non-intentionally added chemicals may include contamination by chemicals such as cleaning compounds.

Physical Hazards

Physical hazards can enter the food system and cause food borne illness. Animal bones are a good example of a particle that can easily be part of a food such as ground beef. Stones, rocks or wood particles can be associated with raw fruits and vegetables. For physical hazards, it is important to wash all raw fruits and vegetables thoroughly and visually inspect foods that cannot be washed (such as minced meat).

Common physical hazards in a food retail operation:

Bone particles

Glass

Metal

Stone

Wood

Conclusion

There are many food borne hazards that a food retail establishment may encounter. Food retail operations are typically toward the end of the food production chain because foods are prepared and eaten there. It is very important to control activities in these operations and prevent food borne hazards that could lead to food borne illness. Control and prevention of food borne hazards in a food retail establishment starts with understanding the different types of food borne hazards. The next step is to understand how to control food borne

hazards with good personal hygiene, prevention of cross contamination, as well as proper storage, cooking, cooling, and reheating of foods.

Domestic food borne illness prevention

At home, prevention of Food borne illness mainly consists of:

- Separating foods while preparing and storing to prevent cross contamination. (i.e. clean cutting boards, utensils, and hands after handling meat and before handling ready-to-eat foods, etc.)
- washing and drying hands before handling ready-to-eat foods.
- not preparing food when sick or recovering from recent illness
- respecting food storage methods (hot foods hot and cold foods cold) and food preservation methods (especially refrigeration), and checking the expiration date;
- avoiding over-long storage of left-overs;
- washing the hands before preparing a meal, and before eating;
- washing fresh fruits and vegetables with clean water, especially when not cooked (e.g. fruits, salads), scrubbing firm fruits and vegetables with a brush to clean;
- washing dishes after use, rinsing them well in hot water and storing them clean and dry;
- keeping work surfaces and chopping boards clean and dry;
- keeping the kitchen and cooking utensils clean and dry;
- not relying on disinfectants or disinfectant-impregnated cloths and surfaces as a substitute for good hygiene methodology (as above);
- preventing pets walking on food-preparation surfaces.

