

Food Safety Notes

Scotten W. Jones

Introduction

ServSafe certification is required for the Person in Charge (PIC) of preparing and serving food to the public. This is a set of notes I put together after going through the ServSafe certification process to help me remember the key concepts. Although ServSafe is designed for commercial food operations, the principles outlined here are just as applicable to a home kitchen.

The notes begin with basic background information common to the entire discussion followed by common food borne contaminants; this is then followed by subjects in the order in which they would occur when preparing and serving food. Specifically; cleaning and sanitizing, procuring and receiving foods, storing foods, preparing foods, and serving foods. Finally a discussion of special concerns for people with allergies or in the high risk group is presented followed by pest control and kitchen design.

To insure you have the latest version of these notes or to download a printable version this file is located at <http://www.georgetownfun.org/Miscellaneous/foodsafety.html>

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1. Basic Food Safety

In this section some of the basic principles of food safety will be covered that underlie the subjects covered in the rest of this guide.

3 main food hazards

The three main hazards to foods are:

- Poor personal hygiene – food workers need to be clean and healthy. Dirty workers can contaminate foods and certain illnesses can be transmitted from a sick individual through the food they prepare or serve to the consumer.
- Cross contamination – a contaminant from one source that gets onto something else, for example juices from raw meat dripping onto a cooked food that is Ready to Eat.
- Time and temperature abuse – food that spends too long in the Temperature Danger Zone (TDZ) can grow bacteria. Any food with a cumulative time of 4 hours in the TDZ must be discarded; you can't make it safe to eat!
- Ready to Eat (RTE) – a food that is in a form that can be safely consumed without additional preparation.
- Temperature Danger Zone (TDZ) – the temperature range that supports rapid bacteria growth. Specifically bacteria grows very slowly below 41°F and cannot divide above 135°F, 41°F to 135°F is therefore the TDZ.

Cross contamination

Cross contamination is a continuing hazard throughout the food production chain, cross contamination from one food to another food, cleaning chemicals, pesticides, allergens, particles from utensils are all potential cross contaminants.

Color coding

Color coding is not required under the current standards but is an emerging best practice to prevent cross contamination during food preparation. Cutting boards, knives and utensils are the most common sources of cross contamination. Cutting boards, knives and utensils can all be color coded and each color is dedicated to a specific use to minimize the chance of cross contamination. There is no universal standard for colors; the following table presents a suggested coding.

Table 1. Recommended Color Coding

Color	Usage
Red	Raw red meat
Yellow	Raw poultry
Green	Fresh fruits and vegetables
Blue	Raw fish and seafood
White	Bread and dairy products
Brown	Cooked meat

General hygiene

Anyone working with food needs to maintain the highest standard of personal cleanliness at all times. Prior to working around food, workers should thoroughly wash their hands.

There is no eating drinking or smoking allowed anywhere food is prepared or served. Human saliva is full of bacteria and is spread around by any of the aforementioned activities. Anyone who wants to eat, drink or smoke must leave the food preparation or service area and wash their hands before returning.

Food workers must also wash their hands after going to the bathroom before returning to work.

Food workers also need to wash their hands after touching themselves, raw foods or working with any chemicals.

Proper hand washing:

- Warm water (100°F)
- Rub hands together with soap and water for 10 to 15 seconds. Make sure to get the fronts and backs and under the finger nails.
- Don't touch the faucet or door handles.
- Dry hands on disposable papers towels or by an air dryer.
- Hand sinks should be dedicated sinks used only for hand washing.
- Wastebasket at the hand washing station.
- Hand sanitizer may be used after hand washing as an option but cannot be substituted for hand washing.

Currently the most common source of food borne illness is the Norovirus and some strains are not killed by hand sanitizer. Only thorough hand washing is effective. Note, the food code requires 10 to 15 seconds, some reports claim 30 second is required to completely remove Norovirus.

There must be a hand washing station within 10 feet of any food preparation area.

Hazardous foods

The standard terminology for food that is hazardous without being properly prepared was previously known as Potentially Hazardous Foods (PHF) but has now been changed to Time and Temperature control for Safety (TCS) foods.

Bacteria can grow easily in any food that has three characteristics:

1. High in protein or carbohydrate.
 2. Moist – water activity (a_w) \geq 0.85
 3. Neutral or slightly acidic – pH between 4.6 and 7.5.
- Water Activity (a_w) – a measure of the water content of food. In food a_w is the partial vapor pressure of water in the food compared to the partial pressure of pure water at the same temperature. Bacteria typically requires $a_w > 0.91$ to grow and fungi $a_w > 0.7$ to grow.
 - pH – a measure of the acidity or alkalinity of a substance. A pH less than 7 is increasingly acidic as you approach 0. A pH above 7 is increasingly alkaline as you approach 14.

Cut fruit and melon, cut tomatoes, meats, poultry, fish, garlic in oil, cooked rice and sprouts are example of TCS. Dry goods not properly stored can grow molds, mildews and yeasts.

Pots, pans, containers and utensils

Any pots, pans, containers, plates, utensils, tools or anything else that comes in contact with food must be NSF commercial/food grade.

Cutting boards can be hard woods if no cracks, synthetic or glass. Color code not required but heading that way.

Sick Workers

Sick workers can contaminate foods with disease causing agents that can then cause illness in the people consuming the food.

Anyone with the following illnesses cannot work in a food operation, they need to stay home until they are free of the illness. These illnesses should also be reported to the board of health:

- E. Coli
- Hepatitis A
- Norovirus – currently the most common cause of food borne illness
- Salmonella
- Shigella

Anyone with the following symptoms cannot work around food:

- Diarrhea
- Fever
- Jaundice
- Sore throat with fever
- Vomiting

2. Bacteria, fungi, parasites and viruses

Bacteria, fungi, parasites, toxins and viruses are all hazards that can make food unsafe to eat.

Bacteria

Bacteria are tiny single cell organisms that can grow rapidly in foods under the right conditions.

The conditions for bacterial growth are given by the acronym FATTOM:

- F – food – high in protein or carbohydrate.
- A – acidity – neutral to slightly acidic (pH 4.6-7.5).
- T – temperature – warm temperatures – TDZ (41°F to 135°F).
- T – time – it takes time for bacteria to grow. The maximum allowed time in the TDZ is 4 hours.
- O – oxygen – some bacteria need oxygen to grow although some do not need oxygen or even grow faster without it.
- M – moisture – moist foods with a water activity >0.85.

There are beneficial and hazardous bacteria; hazardous bacteria can make food unsafe to eat sickening or even killing a person who consumes the food. Some bacteria produce toxins that contaminate the food. Although cooking may kill the bacteria, toxins are not destroyed by cooking and can still make people who consume the food sick.

- Aerobic bacteria – bacteria that need oxygen to grow.
- Anaerobic bacteria – bacteria that don't need oxygen to grow, may even need the absence of oxygen to grow.
- Infection – bacteria that cause illness.
- Intoxication – bacteria produces a toxin and the toxin causes illness.
- Toxin - a poisonous substance, especially a protein that is produced by living cells or organisms and is capable of causing disease when introduced into the body.

Table 2. Lists bacteria that can cause illness through infection with common sources.

Bacteria	Source
E.coli	Meats, fecal matter, cook to 155°F. Most E.coli is on the outside of the animal which is why ground meat is worse (15% have E.coli).
Listeria	Dairy, cold cuts, meats, soft cheeses, hard to kill, wash rinse, sanitize, twice.
Salmonella	Chicken, eggs, poultry, cook to >165°F.
Shigella	Unwashed vegetables, wash thoroughly and scrub, dedicated produce sink, contagious. Cut tomatoes now classified as a TCS food.
Vibrio	Seafood, raw oysters, cook thoroughly and reputable suppliers.

Cooking food to the proper internal temperatures kills bacteria to safe levels.

Table 3. Lists bacteria that can cause illness through intoxication.

Table 3. Food borne bacteria that can cause intoxication.

Bacteria	Source
Bacillus cereus	Cooked rice – this bacteria grows in cooked rice and produces toxins, serve cooked rice within 4 hours.
Clostridium botulinum (botulism)	This bacteria grows without oxygen - swollen cans, vacuum packages (swollen packages), garlic in oil (the oil cuts off oxygen and the bacteria grows). Lives in the soil and comes to life when you take oxygen away. Most spices sold in the US are irradiated to prevent botulism.
Staphylococcus	Skin, cuts, sores, poor personal hygiene. No touching RTE foods, use gloves, tongs, deli paper.

Many people believe that MSG in Chinese food gives them a headache but it is often toxins in cooked rice that has been held too long in the TDZ.

Can goods should be undented with no rust and no signs of the can bulging.

Freezing does not kill bacteria, it just slows growth.

Some bacteria spoil food and can be used to determine age, for example beef darkens due to bacteria growth.

Acidic foods slow bacteria growth, for example adding vinegar to rice slows bacillus growth. Pickles have a pH <4.6 inhibiting bacteria growth. Dehydrating foods also slows bacteria growth.

Fungi

Fungi are tiny organisms that live by decomposing and absorbing the organic material they grow on. Fungi growth is a sign of food spoilage.

Examples of fungi include, mold, yeast, mildews. Fungi can produce toxins just like bacteria and just like bacteria toxin, fungi toxin once formed are not destroyed by cooking.

Fungi grow in most foods. Wash, rinse and sanitize foods. For cheeses cut off the outer 2”.

Parasites

Parasites are organisms that live in or on a host and get their food from or at the expense of the host. Live parasites can infect a person who eats contaminated food sickening or even killing them.

Table 4. Lists parasite and where the parasites are commonly found.

Cook or freeze foods thoroughly. In the US sushi must be frozen to -20°F for 2 weeks to insure any parasites are killed.

Toxins

Toxins include poisons produced by organisms and also inorganic toxins from the environment. Toxins are not destroyed by cooking and it is essential to avoid receiving foods that contain toxins.

Table 4. Parasites and where they are commonly found.

Parasite	Source
Anisakiasis (anisakis)	Seafood
Giardia	Fecal matter, contaminated water supplies. All water used to prepare or clean food must be potable water.
Trichinosis	Pork

Table 5. Lists toxins commonly found in seafood.

Table 5. Common toxins found in seafood's.

Toxin	Source
Ciguatera	Tropical fish such as barracuda, grouper and snapper. The fish take in algae that contain the toxins.
Mercury	Mercury is concentrated in the bodies of long lived fish that are high on the food chain such as king mackerel, marlin, shark and tuna.
Scombroid	Oily fish such as mackerel, mahi mahi and tuna. Toxin is produced when the fish spends too much time in the TDZ.
Shellfish	Clams, mussels and oysters. This toxin is found in shellfish harvested in contaminated waters.

The key to avoiding toxins in seafood is using reputable suppliers who source their fish from unpolluted waters free of algae blooms.

Metal toxins can also contaminate foods. Avoid copper, galvanized metal (contains zinc), lead, pewter (contains lead). Acidic foods are a particular risk for contact with metals because they easily absorb the metal. The one exception on these metals is copper that is allowed solely for whipping eggs.

Certain types of mushrooms contain toxins and can be fatal if ingested. Only purchase mushrooms from reputable suppliers.

Shellfish always contain some level of toxins although it is much worse if they have been harvested from an area with red tide or other pollution.

Viruses

Viruses are tiny infectious agents (much smaller than bacteria) that reproduce inside cells or other organisms. Viruses can survive on non-food surface for significant period of time. Food contaminated with viruses can sicken or even kill the person who consumes the food.

Table 6. Lists viruses that commonly cause food borne illness.

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Virus	Source
Hepatitis A	Contaminated produce or seafood, dirty hands of an infected individual, fecal matter, polluted water.
Norovirus	Dirty hands of an infected individual, fecal matter. Most common source of food borne illness, very hard to kill.

Viruses are easily spread through poor hygiene. Proper hand washing is the single biggest defense against virus based food borne illnesses. Viruses are highly contagious, it is critical that infected individuals do not work around food. Food also needs to be sourced from reputable suppliers.

Food poisoning

Food poisoning (food borne illness) is a generic term for illness brought about from eating food and any of the bacteria, fungi, parasites, toxins or viruses listed in this section can cause “food poisoning”.

Generally food poisoning takes 6 to 12 hours to occur after eating contaminated food unless the food contains a high level of toxins in which case food poisoning may occur much more quickly.

3. Cleaning and Sanitizing

Cleaning and sanitizing insures that plates, pans, utensils, food contact surfaces and anything else food comes in contact with is clean and free of dangerous levels of microorganisms.

- Cleaning – the removal of proteins, soil and grease.
- Sanitizing – killing microorganisms.

Pots and pans are typically washed in a triple bay sink. When using a triple bay sink the procedure is:

- Scrape and spray off items to remove heavy contaminants.
- Wash in the first sink bay in soapy warm water (hot water from a facet must be >110°F).
- Rinse in the second sink bay in cool clean water.
- Sanitize in the third sink bay. See Table 6. For approved sanitizers and concentrations. Sink sanitization can be accomplished without chemicals if the water is >171°F.
- Air dry.

Table 7 lists the concentrations for approved sanitizing agents and concentrations.

Table 7. Concentration for sanitizing agents.

Sanitizing agent	Concentration
Chlorine	50 -200 ppm
Iodine	12.5 – 25 ppm
Quaternary ammonium (QUATS) ¹	200 – 400ppm

In order for sanitization to be effective four factors are required:

1. The surface or object to be sanitized must be clean and free of food or other physical contaminants.
2. A contact time of 30 seconds.
3. A temperature of 50°F to 120°F.
4. The concentrations listed in table 6. must be maintained. Test strips should be used to test the solution concentration periodically. The test strip is inserted into the bath of 10 seconds and then pulled out to be read.

Plates, glasses and eating utensils are typically cleaned in a dishwasher. Dishwashers must achieve 180°F in the final rinse or use chemicals for sanitization.

Food contact surface cleaning:

1. Must be cleaned and sanitized after each use.
2. When switching between raw and RTE foods.
3. After 4 hours of continuous use.

Food contact surface cleaning:

1. Cleaned before sanitizing.
2. Sanitized with 100:1 bleach to water solution.
3. Wipe down and allow to air dry.

¹ Quaternary ammonium is not the same as ammonia.

Sponges are not allowed in commercial kitchens for surface cleaning. Wipes must be used and they must be stored in a bucket containing sanitizer in between use.

Cleaning chemicals must be stored separately from any food storage or preparation areas.

A dedicated mop sink must be used for filling and emptying buckets used for cleaning.

Mops should be hung up so they can dry between uses.

You must have MSDSs for all chemical posted in public view. MSDSs are needed for:

- Bleaches
- Degreaser
- De limer
- Detergent
- Oils

- MSDS – Material Safety Datasheet – lists the hazards of chemicals with safe handling and first aid instructions. Provided by the chemical supplier, you must maintain current MSDSs for all chemicals and have them publically posted.

Vents and grease traps must be cleaned every 6 months.

Maintain a master cleaning schedule with tasks, who is responsible, when it must be done and checks to insure it is done.

Equipment surfaces in the facility must be:

- Hard, durable surfaces.
- Non-toxic
- Non-absorbent
- Easily cleanable

4. Procuring and Receiving Foods

How you source and receive foods is a critical parts of the food production chain to insure a quality product free of food borne illnesses.

Procuring foods

All foods should be sourced from licensed reputable suppliers to avoid purchasing foods contaminated with toxins, viruses and other contaminants. For example, produce grown in some foreign countries is fertilized with human fecal matter.

Receiving foods

Food needs to be received at the proper temperatures, see Table 8.

Table 8. Receiving temperature for foods

Food	Maximum Temperature
Frozen foods	32°F
Red meat, chicken, fish, dairy, cut fruit	41°F
Live crustaceans	45°F

Fish should have firm texture and no smell. Fish only smells once it is exposed to the air. Look at the eyes, sunken eyes indicate old fish, gills should be pink.

Dairy product must be pasteurized and check dates. Sell by date is when bacteria are at an unsafe level. UHT is ultrahigh temperature pasteurized dairy and does not need to be refrigerated until opened.

Crustaceans must be alive; they have an enzyme that creates a toxin when they die. Oysters and clams must be tagged, you must keep the tag for 90 days and they must be kept segregated with tags. There is a different tag if they are kept in a tank.

Eggs should have no odor, clean and intact shells without cracks. Older eggs will spread more on the grill when you go to cook them.

Produce has no temperature requirements but check for wilting and rotting.

Check frozen foods for ice crystals, water stains or solid mass with product on top, these are signs of refreezing.

Vacuum packed foods (MAP, Sous, Vide, ROP), check expiration date, clear package, no bubbles, must be 41°F or lower.

Canned goods, check for missing labels, large dents on seems, rust, swollen, don't use.

Dry food check expiration dates. Most insects come in with dried foods.

Pre bagged lettuce – triple washed is OK to use without washing.

5. Storing Foods

Proper food storage:

- 6" off the floor.
- First-in first-out. Always use oldest foods first.
- Wrap and label all foods.
- As soon as an original container is opened the food must be taken out and if not used stored in a sealed – labeled container.
- Keep foods and containers clean and dry.
- Foods put in the refrigerator must be used within 7 days.
- Do not load a refrigerator to more than 70% of the space.

In order to reduce the risk of a food contaminating another food during storage in refrigerators, food should be stored from top to bottom in the following order:

1. Pastry – top shelf
2. Fruits and vegetables
3. Ready to eat foods
4. Vegetables and fruits
5. Whole muscle meats
6. Ground meats
7. Poultry and eggs – bottom shelf

This order is chosen so that food that need high cooking temperature are under foods that need lower cooking temperatures to prevent the higher cooking temperature foods from dripping onto the lower cooking temperature foods.

Storage temperatures:

- Dry foods 50°F to 70°F
- Refrigerators <41°F. Measure the temperature in the hottest part.

Food storage area cannot have any overhead sewage lines.

6. Preparing Foods

Bare hands are OK for preparing foods as long as preparation will be followed by a killing step such as cooking the food.

Always wash hands before preparing foods, after touching any raw food and moving on to any other preparation activity.

Food preparation attire:

- Hair restrained
- Clean short nails
- No nail polish or false nails
- No jewelry except for a plain band
- Clean aprons, chef coat or uniform
- Uniform put on at the food establishment

Thawing

There are four safe methods to properly thaw foods:

1. In the refrigerator.
2. Under running 70°F potable water – food defrosts faster in water but you lose food quality.
3. In a microwave if cooked immediately after thawing to 165°F.
4. As part of the cooking process. This is the method to use for high risk populations.

Microwaved foods should be let stand for 2 minutes after cooking to let the internal temperature even out.

- Potable – water that is safe to drink. Typically from a public water supply or well if the well is regularly tested.

Cooking temperatures

Cooking of food reduces live microorganisms to a safe level to consume the food, cooking does not destroy toxins or spores. The required internal temperatures per the 2009 FDA food code are.

Table 9. FDA Required Internal Temperatures.

Temperature	Foods (hold temperatures for 15 seconds except where noted)
165°F	Casseroles Game meats Microwaved TCS foods – hold for 2 minutes Poultry Reheated leftovers Stuffed foods
155°F	Ground fish Ground meats Pooled eggs for holding
145°F	Eggs cooked to order Fish, Meats

Game meats can only be served if commercially raised.

Commercially prepared foods only need to be reheated to 135°F.

Temperatures must be checked with a sanitized and calibrated thermometer.

- Infrared thermometers - used to check surface temperatures.
- Bimetallic thermometers - measure temperatures at the dimple, typically fairly far up the probe. Take ~1 minute to measure temperature. Need to be calibrated regularly.
- Thermocouple – accurate to about 2°F, accurate at the tip and nearly instantaneous. Are expensive.

To calibrate a thermometer, dip in crushed ice and water for 30 seconds, should read 32°F. Bimetallic thermometers will have a nut you can turn to adjust them. You can also dip them in boiling water and look for 212°F for calibration.

Glass thermometers are not allowed except for confectioners use.

You must prominently post a consumer advisory warning – warning consumers of the dangers of consuming raw or undercooked meats, poultry, fish, eggs and seafood.

Once cooked food has the spore form of bacteria and if reheated, must be heated to 165°F for 15 seconds within 2 hours. Never use hot holding equipment to reheat foods.

For larger roasts, hold the thermometer for a longer time to check temperature.

Cooling Food

Hot foods following cooking need to be cooled through the danger zone (41°F to 135°F) quickly to avoid the growth of harmful bacteria.

The 2009 FDA Food Code requires:

1. Cool from 135°F to 70°F within the first 2 hours.
2. Cool from 70°F to 41°F within the next 4 hours.

Although the food cooling method outlined above keeps food in the danger zone for 6 hours versus the 4 hour limit, the rapid initial cooling and then slower final cooling has been found to produce a safe harmful bacteria level. Alternately cool from 135°F to 41°F in 4 hours.

Cooling dos and don'ts:

1. Do reduce portion sizes.
2. Do place food into shallow pans.
3. Do place pans in ice baths to accelerate cooling.
4. Do use cooling paddles or ice wands for liquids or stews.
5. Don't put foods into the refrigerator until the temperature of the food has been reduced to 70°F and reduce portion sizes.

5. Serving Foods

Gloves

No handling of RTE foods with bare hands. Glove, tongs or deli paper is required.

Glove must be changed:

- Any time they are soiled
- After 4 hours of continuous use
- Any time you switch between raw foods and RTE foods

Time and temperature safety

- Food in the TDZ must be served within 4 hours or discarded.
- Hot holding of foods must be $>135^{\circ}\text{F}$ and the food should be stirred regularly.
- Measure holding temperatures every 4 hours.
- Cold food must be held at $<41^{\circ}\text{F}$.

Food service rules:

- Never mix new and old food in the same container.
- One serving utensil per food.
- Keep food covered.
- If the food is on a buffet line, a sneeze guard is required.
- Ice is considered a food.
- Store ice scoops outside the ice machine.
- No stacking of plates – the underside of the plate can contaminate the plate underneath.
- Carry plates from underneath; do not touch the food area.
- TCP and RTE food cannot be stored in the same coolers
- Don't touch the rim of glasses.
- Handle silverware by the handle portion only.
- No raw and RTE food next to each other.
- On a buffet line a new plate is required for every trip to the buffet.

6. Special Concerns

Allergens

Allergens are proteins that cause allergic reactions in susceptible individuals. Allergic reactions can include tightening of the throat, hives, trouble breathing, loss of consciousness and even death.

Allergy causing proteins are not heat or cold sensitive and must be avoided all together.

The eight most common allergens cause 90% of all allergic reactions. They are:

1. Eggs
2. Dairy
3. Wheat
4. Soy
5. Tree nuts
6. Peanuts
7. Fish
8. Shell fish (crustaceans)

Things to consider:

- Talk to the customer, document what they tell you.
- Be honest.
- Read all ingredients and prepare food in dedicated pans.
- Avoid grills, the grill grating is impossible to completely clean.
- Cook foods in pans in the oven.
- Steam tables can aerosol allergens.
- Most commercial sauces are thickened with wheat.
- Tuna fish is packed in milk products.
- French fries are dipped in milk products.
- Soy sauce

Massachusetts has an allergen awareness law.

High risk groups

Elderly, pregnant woman and people with weakened immune systems are all in the high risk group when it comes to food borne illness.

Things to avoid for high risk individuals include:

- Sprouts
- Soft cheeses
- Cold cuts
- Rare meats
- Raw seafood
- Hollandaise sauce unless made with pasteurized eggs
- Salad dressing unless made with pasteurized eggs
- Uncooked eggs

9. Pests

Pest management, prevent pests from entering:

- Check deliveries.
- Doors and windows should seal tightly or have air curtains.
- Seal around all vents.

Garbage should be disposed of quickly and kept in leak proof, easy to clean covered containers.

Signs of cockroaches:

- Oily odor
- Droppings like grains of pepper
- Capsule shaped eggs

Signs of rodents:

- Droppings
- Signs of gnawing
- Nesting materials
- Holes

Optimum flying height for a fly is 5', put fly paper at that height.

Pesticides can only be applied by a licensed Pest Control Officer (PCO).

10. Kitchen Design

- Coving at the bottoms of walls for easy cleaning.
- Hand washing sinks within 10' of all preparation station.
- Separate storage area for chemicals.
- Separate mop sink for filling and emptying buckets.
- Triple sink with grease trap.
- Separate storage area for pesticides if stored on site (they can only be applied by a licensed pest control officer, why store on site)
- Lights must be shatter proof or covered to prevent glass falling into food.
- Light level requirements:
 - 50 ft-candles over preparation areas.
 - 20 ft-candles in storage areas.
 - 10 foot-candles in dining rooms.
- Vacuum break in any waters lines hooked up to equipment.