

# Holding and Serving Food



*In the spring of 2006, there were three large outbreaks in Lansing, Michigan in which food workers were known or suspected to have been the cause of approximately 800 norovirus infections.*

## Public Health Reasons

The methods used for holding foods before service are typically much different in a child-care facility than they are in a restaurant setting. Most child-care facilities do not use steam tables or cold-holding units to keep foods hot or cold. In a child-care facility, cold foods are often prepared and then refrigerated. They are then removed from the refrigerator and served immediately to the children. Hot foods are often pre-plated directly from containers of hot food that are on a stovetop or in the oven. Many prepared foods must be kept hot or cold after preparation to minimize the growth of pathogenic bacteria. Those that must be kept hot or cold are classified as potentially hazardous. If the food is classified as potentially hazardous, it must be held at the proper temperature: 41°F (5°C) or colder OR 135°F (57°C) or hotter.

The interaction between two intrinsic factors of food is frequently used to determine if a food is potentially hazardous. These two factors are water activity ( $A_w$ ) and pH. Water activity is the degree to which water is available for biochemical reactions. The optimum water activity for the growth of microorganisms is between 0.97 and 0.99. The pH is a measure of the acidity or basicity of an aqueous solution. The interaction between water activity and pH determines if a food is potentially hazardous. For more information about determining if a food is potentially hazardous or not, refer to the 2009 FDA Food Code, Chapter 1. Foods that are not potentially hazardous do not need to be kept at 41°F (5°C) or colder OR at 135°F (57°C) or hotter.

Fruits, except for figs and melons, are not potentially hazardous because of their low pH. Figs and melons only become potentially hazardous after they are cut or in the case of figs, when they are heated. Potentially hazardous fruits must be kept at 41°F (5°C) or colder for safety. If figs are cooked and not served immediately, they must be held at 135°F (57°C) or hotter. Vegetables are typically not viewed as potentially hazardous until they are heated and then hot-held. Two exceptions to this are coleslaw and cut tomatoes. Both have been implicated in many cases of foodborne illness, so they must be kept at 41°F (5°C) or colder. Vegetables that are cooked and hot-held must be held at 135°F (57°C) or above. Baked potatoes, sweet potatoes, cooked rice, cooked pinto beans, other cooked beans, and texturized soy protein are also classified as potentially hazardous. These foods must be cooked to and held at 135°F (57°C) or hotter. If using raw bean sprouts, keep them at 41°F (5°C) or colder.

### Examples of Potentially Hazardous Foods

These items must be kept at 41°F (5°C) or colder OR at 135°F (57°C) or hotter:

- macaroni and cheese
- cooked vegetables, such as corn and broccoli
- oven fried chicken
- hot dogs
- coleslaw
- melon slices

### Examples of Non-Potentially Hazardous Foods

No temperature control is required for these items:

- waffles
- rolls
- Jell-O®
- apple and orange slices
- bread

Potentially hazardous foods that are to be kept cold must be stored in a refrigerator that keeps food at a temperature of 41°F (5°C) or colder. This temperature is based on the growth curve for *Listeria monocytogenes*, a type of psychotropic (cold-tolerant) bacteria that is able to grow at some refrigeration temperatures (See “Handling Deli Foods” fact sheet). In order to keep foods at 41°F (5°C) or colder, it is recommended to keep the refrigerator set at 39°F (3.8°C). If the refrigerator is not below 39°F (3.8°C), the food may be in the “temperature danger zone” allowing the growth of psychotropic and psychophilic bacteria. A study of 37 child-care facilities in North Carolina and South Carolina found that in 53.1% of the centers and 62.5% of homes, the air temperature inside the refrigerator was not adequate to keep foods at 41°F (5°C).

Although it is uncommon, if a child-care facility does use steam tables, hot and potentially hazardous foods must be kept above 135°F (57°C). This is based on the upper limit at which *Clostridium perfringens* and *Bacillus cereus* can survive. The spores of these two bacteria are highly resistant to heat. Food cooked according to the provisions outlined in the 2009 FDA Food Code should be free of vegetative bacterial cells, so the food is safe to eat. However, the required endpoint cooking temperatures are not sufficient to kill spores of *C. perfringens* or *B. cereus*. In fact, they may actually serve as a heat shock that activates the spores. When spores are activated, vegetative cells can form and grow. To prevent this from occurring, potentially hazardous foods must be held at 135°F (57°C) or hotter after cooking. The FDA Food Code states that foods must be reheated to an internal temperature of 165°F (74°C) if the food is to be hot-held. If food is reheated and immediately served, it does not have to be reheated to 165°F (74°C).

Holding potentially hazardous foods without temperature control allows the product to warm or cool as it equilibrates with the environment and may allow foods to be in the “temperature danger zone” (41°F-135°F; 5°C-57°C). For both cooling and warming conditions, bacterial growth depends on the amount of time a food spends in the optimum growth temperature range during equilibration with its surroundings. As a result, the FDA Food Code has a provision that allows time as a public health control under certain circumstances. (*NOTE: Not all states allow this practice so the facility must first check the appropriate regulations.*) The provision states that hot foods that are potentially hazardous can be stored without temperature control for up to four hours, after which they must be discarded or eaten. *C. perfringens* or *B. cereus* will produce toxins if their optimal temperature range is met for longer than four hours. Food that has been refrigerated can be held for up to six hours without temperature control if the food is at 41°F (5°C) when initially removed from the refrigerator *and* does not exceed 70°F (21°C). If food is held at 41°F (5°C) during refrigeration before being transferred to an ambient temperature of 70°F (21°C) for six hours, the growth rate of *L. monocytogenes* remains slow enough to ensure that the critical limit of 1 log growth is not reached. If a facility uses time as a public health control then the operation must have in place a system for noting when the food has been removed from temperature control, and the local regulatory authority must approve this system. If this notation system is not in place, time as a public health control *cannot* be used.

Provisions within the FDA Food Code also prohibit food handlers from touching ready-to-eat foods (cooked or uncooked) with their bare hands. Instead utensils, such as spatulas, tongs, or single-use gloves, must be used during preparation and serving. Pathogenic microorganisms are less bound to skin than the resident microflora so they are easily transferred from hands to food or food-contact surfaces by direct contact. Single-use gloves are used to prevent bare hand contact with exposed ready-to-eat foods. However, contamination on the gloves is just the same as on hands and failure to change gloves when they are soiled could also lead to contamination of foods and surfaces.

## Practices

### Hot-Holding Guidelines

- If there is a time gap between preparing hot foods and serving, hold potentially hazardous foods at 135°F (57°C) or hotter. This can be done by using double boilers, keeping foods on a lit burner on the stovetop, or in an oven set at a low temperature.
- Stir or turn the food regularly during hot-holding to more evenly distribute heat throughout the food.
- Cover the food to retain heat and reduce potential contaminants from getting into the food.

### Cold-Holding Guidelines

- If preparing chilled potentially hazardous foods, such as cut fruits or vegetables, keep them at a temperature of 41°F (5°C) or colder until served.
- In order to keep foods at 41°F (5°C) or colder, it is recommended to keep the refrigerator set at 39°F (3.8°C).

### Food Held Without Temperature Control

If this practice is allowed, the process *must* be approved by the local regulatory authority.

- Hot ready-to-eat (RTE) foods can be kept without temperature control for up to four hours, after which they must be discarded or eaten.
- Refrigerated food can be kept for up to six hours without temperature control if the food is at 41°F (5°C) when initially removed from the refrigerator and as long as the food temperature does not exceed 70°F (21°C) during holding.

*Never mix freshly prepared food with foods being held for service as this practice can result in cross-contamination of foods.*

### Serving Food

- Practice good personal hygiene, such as wearing clean clothes and hair restraints and washing hands frequently and properly (See “Practicing Good Hand Hygiene for Food Workers” fact sheet).
- Serve food as quickly as possible after preparation.
- Use cleaned and sanitized utensils with long handles to serve food.
- Store serving utensils in the food with the handle extended above the container rim or on a clean, sanitized food-contact surface.
- Do not use bare hands to handle food that is cooked or ready-to-eat. Wear single-use gloves or use utensils to handle food.
- The following types of gloves can be used:
  - fitted, disposable, latex gloves (may cause allergic reactions in the user or consumer)
  - fitted, disposable, non-latex gloves (made from polyethylene)
  - non-form-fitted, disposable gloves (made from polyethylene or vinyl)
- Handle plates by the edge or bottom, cups by the handle or bottom, and utensils by the handles.
- For family-style self-service, make sure children do not use their bare hands or dirty utensils to get food out of the shared food containers.
- Throw away single-use items after using them. This includes straws, paper towels, cups, and plates.

# References

- Fraser, A. 2009. Define "Potentially Hazardous Food." <http://www.foodsafetysite.com/educators/competencies/general/microbiology/mic2.html> (accessed 10/9/12).
- Food and Drug Administration. 2003. Quantitative assessment of the relative risk to public health from foodborne *Listeria monocytogenes* among selected categories of ready-to-eat foods. <http://www.fda.gov/Food/ScienceResearch/ResearchAreas/RiskAssessmentSafetyAssessment/ucm183966.htm> (accessed October 3, 2012).
- Food and Drug Administration. 2009. Food Code. (DHHS Publication no. PB2009-112613). Alexandria, VA: U.S. Department of Commerce Technology Administration.
- Hall, H. E. & Angelotti, R. 1965. *Clostridium perfringens* in meat and meat product. *Applied Microbiology* 13:352-354.
- Healthy and Active Preschoolers. 2011. Food safety handling procedures. <http://www.healthypreschoolers.com/part-12-holding> (accessed October 3, 2012).
- Integrated Food Safety Information Delivery System. 2006. Hot and Cold Holding Temperatures Fact Sheet. <http://www.profood.org/images/english/Hot%20and%20Cold%20Holding%20Temperatures%20fact%20sheet.pdf> (accessed October 3, 2012).
- Hugonnet, S. & Pittet, D. 2000. Hand hygiene – beliefs or science? *Clinical Microbiology and Infection* 6:348-354.
- Jumaa, P. A. 2005. Hand hygiene: simple and complex. *International Journal of Infectious Diseases* 9:3-14.
- Juneja, V. K., Snyder, O. P., & Cygnarowicz-Provost, M. 1994. Influence of cooling rate on outgrowth of *Clostridium perfringens* spores in cooked ground beef. *Journal of Food Protection* 57 (12): 1063-1067.
- Juneja, V. K., Whiting, R. C., Marks, H. M., & Snyder, O. P. 1999. Predictive model for growth of *Clostridium perfringens* at temperatures applicable to cooling of cooked meat. *Food Microbiology* 16 (4):335-349.
- Kalinowski, R. M., Tompkin, R. B., Bodnaruk, P. W., & Pruett, W. P. 2003. Impact of cooking, cooling, and subsequent refrigeration on the growth or survival of *Clostridium perfringens* in cooked meat and poultry products. *Journal of Food Protection* 66 (7):1227-1232.
- Marth, E. H. 1998. Extended shelf life refrigerated foods: Microbiological quality and safety. *Food Technology* 52 (12):57-62.
- Palumbo, S. A. 1986. Is refrigeration enough to restrain foodborne pathogens? *Journal of Food Protection* 49:1003-1009.
- Queensland Health. 2008. Serving, self-service and displaying food. *Tool for the Development of a Food Safety Program for Childcare Facilities* 28-29.
- Steele, F. M. & Wright, K. H. 2001. Cooling rate effect on outgrowth of *Clostridium perfringens* in cooked, ready-to-eat turkey breast roasts. *Poultry Science* 80:813-816.
- Wohlgenant, K., Cates, S., Fraser, A., Chapman, B., Jaykus, L. A., & Chen, X. 2013. Sanitation in classrooms and food preparation areas in child care facilities in North Carolina and South Carolina. Manuscript in Preparation.
- Young, M. K., Smith, P., Holloway, J., & Davison, R. P. 2008. An outbreak of *Clostridium perfringens* and the enforcement of food safety standards. *Communicable Disease Intelligence* 32:462-465

## Authors and Acknowledgements

**AUTHORS** Cortney Miller, MS, Angela Fraser, PhD, Sturgis, MFA (editor), Anna Saunders, Xi Chen, MS, Department of Food, Nutrition, and Packaging Sciences, Clemson University, Clemson, SC 29634

**Published:** March 31, 2013      **Revised:** March 6, 2013

This material is based upon work supported by the Cooperative State Research, Education and Extension Service, U.S. Department of Agriculture, under Agreement No. 2008-51110-04335, the National Integrated Food Safety Initiative of the Cooperative State Research, Education, and Extension Competitive Grants Program. Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

