

Barriers and Motivators to Thermometer Use among Food Workers and Consumers

Betty Yaohua Feng

Purdue University

Christine Bruhn

University of California, Davis

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History of temperature control



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History of temperature



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It is difficult to tell by color

- Cooking may not follow recommendations
 - 25 % of burgers don't reach 160°F
 - 40% undercook their chicken



Phang and Bruhn, 2011, Food Prot; Bruhn, 2014, Food Prot Trends

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Do Not Always Practice What They Know

- 57% knew chicken should be cooked to internal temperature 165°F
- However, 5% used a food thermometer
- 58% knew hot food should be held at 140°F,
- However, 0 used a food thermometer to check temperature

Anderson, et al., 2004, Acad. Nutr. Diet.; Soares, et al., 2012, Food Control

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Outbreak

- *Salmonella* Newport associated with ground beef
- 333 people became ill as for December 12, 2018



Photo Credit: FoodSafetyNews.com

CDC, 2018

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Thermometer-Use Among Consumers

Self-reported Survey Item	2006 (%)	2010(%)	2016(%)
Owned a refrigerator thermometer	61	63	51
Refrigerator temperature in a range of 33 – 41°F	66	74	40
Owned a cooking thermometer	67	66	67
Used for chicken parts (Always)	15	17	19
Used for egg dishes (Always)	3	3	6
Used for hamburgers (Always)	8	9	10



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Literature Review Methods

- Population: Consumers (including elderly, pregnant women, school students etc.) and professional food workers.
- Date: after January 1998
- Language: English
- Type of paper: peer-reviewed primary research articles.

Knowledge - Food Workers

- 42% to 96% knew the correct temperature to hold hot food.
- 40% could identify the recommended internal temperature to cook poultry and ground beef (multiple-choice)

Knowledge - Consumers

- 33% to 53% knew the correct temperature to determine the doneness of meat
- Younger age group(<34 yrs) have a lower level of knowledge and reported use of thermometers
- <1% knew the endpoint internal temperature to cook meat

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Discrepancies between Knowledge and Behavior

- 24%-69% agreed that using a food thermometer is the best way to tell when meat has been cooked thoroughly.
- Only 0%-5% of consumers used a thermometer when they cooked meat.

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Barriers to Thermometer Use

- “Not necessary” : The belief that a thermometer is not necessary
- “Difficult to select and use”: The difficulty of selecting and using a thermometer

Barrier Category One: Not Necessary

- Preferred alternative techniques
 - Color is the most frequently reported alternative
 - Other alternatives: by touch, taste, recipe cooking time, texture

Barrier Category One: Not Necessary

- Mainstream media and food professionals seldom serve as role models and often negate the need for food thermometers
 - 8% of the recipes containing raw meat included an endpoint temperature¹
 - 28% of those temperature provided were incorrect¹
 - 25% of the cooking shows used a cooking thermometer²

1. Levine, K., A. Chaifetz, and B. Chapman. 2017. Evaluating food safety risk messages in popular cookbooks. *Br Food J.* 119:1116-1129.

2. Maughan, C., E. Chambers, and S. Godwin. 2017. Food safety behaviors observed in celebrity chefs across a variety of programs. *J Publ Health.* 39:105-112.

Barrier Category One: Not Necessary

- Limited awareness of potential health issue associated with current practices
 - Consumers are confident in their current cooking skills since they have “cooked for years without once getting food poisoning”
 - When preparing dishes that require long cooking time, consumers feel it is unlikely to serve undercooked meat

Barrier Category One: Not Necessary

- Limited knowledge and awareness related to thermometer usage for specific food groups
 - Consumers are more likely to use a food thermometer when cooking
 - **large pieces** of meat or poultry rather than small cuts
 - **roasts** rather than ground meat,
 - whole **chicken** rather than beef

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Barrier Category Two: Difficult to Select and Use

- Which type of food thermometer is best?

Kitchen Thermometers

Since thermocouple thermometers respond so rapidly, the temperature can be quickly checked in a number of locations to ensure that the food is safely cooked. This is especially useful for cooking large foods, such as roasts or turkeys, when checking the temperature in more than one place is advised. The thin probe of the thermocouple also enables it to accurately read the temperature of thin foods such as hamburger patties, pork chops, and chicken breasts.

Thermocouples are not designed to remain in the food while it's cooking. They should be used near the end of the estimated cooking time to check for final cooking temperatures. To prevent overcooking, check the temperature before the food is expected to finish cooking.

Thermocouples can be calibrated for accuracy.

Thermistors:

Thermistor-style food thermometers use a resistor (a ceramic semiconductor bonded in the tip with temperature-sensitive epoxy) to measure temperature. The thickness of the probe is approximately 1/8 of an inch and takes roughly 10 seconds to register the temperature on the digital display. Since the semiconductor is in the tip, thermistors can measure temperature in thin foods, as well as thick foods. Because the center of a food is usually cooler than the outer surface, place the tip in the center of the thickest part of the food.

Thermistors are not designed to remain in the food while it's cooking. They should be used near the end of the estimated cooking time to check for final cooking temperatures. To prevent overcooking, check the temperature before the food is expected to finish cooking.

Not all thermistors can be calibrated. Check the manufacturer's instructions.

Oven Cord Thermometers:

This food thermometer allows the cook to check the temperature of food in the oven without opening the oven door. A base unit with a digital screen is attached to a thermistor-type food thermometer probe by a long metal cord. The probe is inserted into the food, and the cord extends from the oven to the base unit. The base can be placed on the counter or attached to the stovetop or oven door by a magnet. The thermometer is programmed for the desired temperature and beeps when it is reached. While designed for use in ovens, these thermometers can also be used to check foods cooking on the stove. Oven cord thermometers cannot be calibrated.

Thermometer Fork Combination:

This utensil combines a cooking fork with a food thermometer. A temperature-sensing device is embedded in one of the tines of the fork. There are several different brands and styles of thermometer forks on the market; some using thermocouples and some using thermistors. The food temperature is indicated on a digital display or by indicator lights on the handle within 2 to 10 seconds (depending on the type). These lights will tell if the food has reached rare, medium, well done, etc. Particularly useful for grilling, the thermometer fork will accurately measure the internal temperature of even the thinnest foods. The thermometer fork should be used to check the temperature of a food towards the end of the estimated cooking time. Thermometer forks are not designed to remain in a food while in the oven or on the grill. Thermometer forks cannot be calibrated.



Dial Food Thermometers

Bimetallic-coil Thermometers:

These thermometers contain a coil in the probe made of two different metals that are bonded together. The two metals have different rates of expansion. The coil, which is connected to the temperature indicator, expands when heated. This food thermometer senses temperature from its tip and up the stem for 2 to 2 1/2 inches. The resulting temperature is an average of the temperatures along the sensing area. These food thermometers have a dial display and are available as "oven-safe" and "instant-read."

"Oven-safe" Bimetallic-coil Thermometers:

This food thermometer is designed to remain in the food while it is cooking in the oven, and is generally used for large items such as a roast or turkey. This food thermometer is convenient because it constantly shows the temperature of the food while it is cooking. However, if not left in the food while cooking, they can take as long as 1 to 2 minutes to register the correct temperature.

The bimetal food thermometer can accurately measure the temperature of relatively thick foods (such as beef roasts) or deep foods (foods in a stockpot). Because the temperature-sensing coil on the stem is between 2 to 2 1/2 inches long and the



Barrier Category Two: Difficult to Select and Use

- Availability of food thermometers
 - If they have a thermometer, they may use it for items when they can not easily tell cooking is adequate
 - After being given a food thermometer and **show how to use it**, 81% of consumers said they were likely to use it when determining when the whole chicken is adequately cooked¹

1. Bruhn, C. M. 2014. Chicken preparation in the home: An observational study. *Food Prot Trends*. 34:318-330.

Barrier Category Two: Difficult to Select and Use

- Lack of skills related to use of food thermometers
 - Observation: consumers know where to insert the thermometer, however, some attempt to take the temperature of the cooked chicken while the case was still on the thermometer^{1,2}
 - One participant stated that “If given a thermometer I would use it, but only if someone teaches me how”³

1. Bruhn, C. M. 2014. Chicken preparation in the home: An observational study. *Food Prot Trends*. 34:318-330.
2. DeDonder, S., C. J. Jacob, B. V. Surgeoner, B. Chapman, R. Phebus, and D. A. Powell. 2009. Self-reported and observed behavior of primary meal preparers and adolescents during preparation of frozen, uncooked, breaded chicken products. *Br Food J*. 111:915-929.
3. Bermudez-Millan, A., R. Perez-Escamilla, G. Damio, D. Gonzalez, and S. Segura-Pérez. 2004. Food safety knowledge, attitudes and behaviors among Puerto Rican caretakers living in Hartford, Connecticut. *J Food Prot*. 67:512-516.

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Barrier Category Two: Difficult to Select and Use

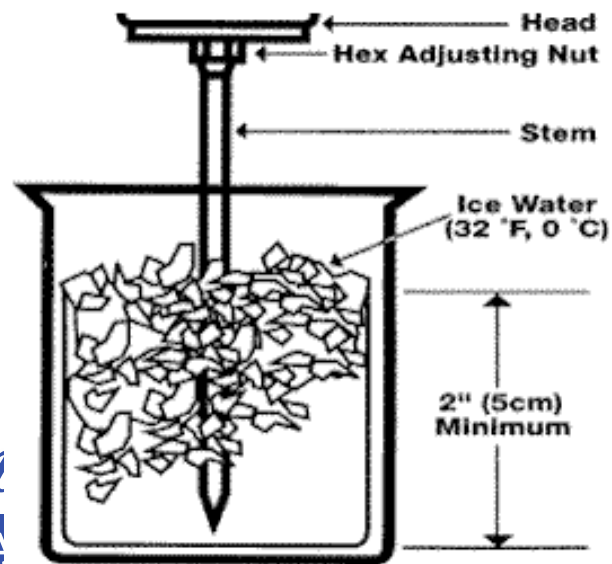
- Limited knowledge related to endpoint temperature
 - **96%** food workers knew where to insert, but **25%** knew the endpoint temperature for the hamburger¹
 - **75%** consumers knew to use thermometer to cook whole chicken, but **53%** knew the recommended endpoint temperature for chicken²

1. Pichler, J., J. Ziegler, U. Aldrian, and F. Allerberger. 2014. Evaluating levels of knowledge on food safety among food handlers from restaurants and various catering businesses in Vienna, Austria 2011/2012. *Food Contr.* 35:33-40.

2. Bruhn, C. M. 2014. Chicken preparation in the home: An observational study. *Food Prot Trends.* 34:318-330.

Barrier Category Two: Difficult to Select and Use

- Failure to calibrate food thermometers
 - Consumers are surprised that thermometers need to be calibrated
 - The difference between the reading on the consumer's home thermometer and the researcher's Fisher Scientific thermometer was often greater than 10°F



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Barrier Category Two: Difficult to Select and Use

- Lack of knowledge food thermometer cleaning and sanitation
 - Only 5% of consumers clean the thermometer after use¹
 - Food thermometers can be the source of cross-contamination if not cleaned and sanitized
 - Observation²:
 - Touching the tip of the thermometer before using
 - Picking up off the floor before using in ready-to-eat food

1. DeDonder, S., C. J. Jacob, B. V. Surgeoner, B. Chapman, R. Phebus, and D. A. Powell. 2009. Self-reported and observed behavior of primary meal preparers and adolescents during preparation of frozen, uncooked, breaded chicken products. *Br Food J.* 111:915-929.

2. Robertson, L. A., R. R. Boyer, B. J. Chapman, J. D. Eifert, and N. K. Franz. 2013. Educational needs assessment and practices of grocery store food handlers through survey and observational data collection. *Food Contr.* 34:707-713.

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Recommendations

1. Include the correct endpoint internal temperature in all recipes.
2. Encourage role models to use a thermometer and reference endpoint internal temperature in their communications

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Recommendations

3. Direct food safety education toward health professionals such as dietitians and nurses.
4. When describing recommended practices, provide background information to support the practice.

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Recommendations

5. Let people practice the behavior.
6. Create and reference easy-to-access videos in thermometer selection and calibration.

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Recommendations

7. Engage under representative populations, especially those not traditionally targeted.

8. Work with microbiologists and engineers to validate and optimize recommended temperature, specially for new low temperature cooking styles.

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Thank You

Questions?

Reference: Y. Feng and C.M. Bruhn. 2019. Motivators and Barriers to Cooking and Refrigerator Thermometer Use Among Consumers and Food Workers: A Review. *J. Food Protection* 18(1):128-150.

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