# History of Consumer Food Safety Education Focus on Beef: Impact on Risk of Foodborne Illness

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## SUMMARY

In the past, food safety topics of public concern appeared to be limited to chemical contamination, pesticide residues, and the occasional case of stomach flu that made the victim miserable for a few hours. In recent years, the public has come to recognize that microbiological safety can have serious, long-term consequences. This paper traces the history of consumer food safety educational programs over the past three decades by examining food safety references and the content of educational material

Over this period, advice to the consumer has evolved from general guidelines to specific targeted messages. Changes in consumer knowledge and behavior, as indicated by surveys and actual observation, indicate that programs have had a positive but limited effect. These findings suggest that additional measures are required by the food production/processing and retail/food service industries to reduce the incidence of life-threatening foodborne illness. While this article focuses on ground beef, the findings apply to many food categories, including fresh produce.

## EDUCATIONAL PROGRAMS

Food safety education is delivered by the federal government through the US Food and Drug Administration (FDA) and the US Department of Agriculture (USDA). States are involved in development and delivery of educational programs through Cooperative Extension at land grant institutions. Food industry organizations engage in general or product-specific information on safe handling, often combined with guidelines on selection and preparation for flavorful dishes. Since the late 1990s, a partnership of educators and government, food industry, and non-government organizations has played a major role in defining and delivering food safety information.

## FOOD SAFETY OVER THE DECADES

Awareness of pathogens and food safety messages has evolved over the past three decades. Textbooks used in college and university food science classes designed for home economists and dietitians provide only a cursorily overview of food safety. Classic textbooks published in the 1950s and 1960s address the chemical, physical and nutritional changes that take place in food during food preparation but do not address food safety*(13, 20, 25)*. Botulism, staphylococcal food poisoning, salmonellosis and *Clostridium perfringens* are briefly mentioned by Bennion in 1980 *(12)*. A more extensive discussion of food safety is included in *Foundations of Food Preparation*, which was published in 1987 *(19)*. Major pathogens such as *Clostridium botulinum* and *Salmonella* are mentioned, but pathogenic *E. coli* is not identified. The authors state that the most important factors to prevent foodborne illness are the application of heat, adequate refrigeration, safe thawing, length of storage, storage conditions, and proper sanitation. Details are provided on appropriate refrigerator temperature and storage time; however, end cooking temperatures are indicated only for stuffed turkey.

Information from the FDA food safety material in the early 1980s is more extensive than that in college-level textbooks, but food safety guidelines lack specific details that would result in safe handling. For example, “Who, Why, When and Where of Food Poisons (And What to Do about Them)” published in the *FDA Consumer* reports that *Salmonella* could be found in raw meat *(10)*. To prevent foodborne illness, readers are advised to handle food in a sanitary manner, cook foods thoroughly, and promptly and properly refrigerate foods. Similarly, the discussion of staphylococcal food poisoning indicates that a toxin is formed when food, including meat, is held at room temperature for too long. Advice for preventing this condition, the same general precautions associated with *Salmonella* control, is repeated here. People are advised to handle food in a sanitary manner with prompt and proper refrigeration. Because details of handling are not specified, consumer adoption of effective food handling practices is unlikely.

Food safety material developed by USDA ten years later is more specific. The publication, *Is*

*Someone You Know at Risk for Foodborne Illness?* identifies people at increased risk as seniors, pregnant women, children, and people with a weakened immune system *(43)*. Written in a proactive way, readers are encouraged to "take control" to reduce the risk for foodborne disease. The reasons why people with specific health conditions are more vulnerable to foodborne illness is explained in a clear and understandable manner. Specific handling guidelines are provided for shopping, cold storage, safe thawing, proper food preparation, serving, and handling leftovers. The recommended temperature for the home refrigerator is specified at 40°F or colder, and readers are advised to cook ground meat to 160°F.

Other publications by USDA provide specific recommendations consistent with current knowledge of foodborne illness. *Food News for Consumers*, for example, recommends that foods should be marinated in the refrigerator, foods should be cooked completely rather than partially cooked, held and reheated, and meat should be cooked to 160°F *(31)*. Similarly, *A Quick Consumer Guide to Safe Food Handling* includes specific information as to temperature control and safe storage time *(45)*.

USDA's Meat and Poultry Hotline, established in 1985, provides answers to consumer questions through a toll free telephone call, fact sheets, articles in educational publications such as *Food News*, and fact sheets available through the internet *(47)*. Hotline representatives also respond to media calls, reaching an even larger audience. Reports of the hotline activities are posted periodically *(46)*.

Another USDA consumer publication, *Preventing Foodborne Illness*, provides detailed food handling information *(44)*. Sections are devoted to safe shopping, storage, preparation, serving, and handling of leftovers. *Escherichia coli* O157:H7 is mentioned, and consumers are advised to cook ground beef to 160°F. *Listeria* is discussed and pregnant women are identified as being at increased risk for this pathogen. Those at high risk are advised to reheat processed meats.

In 1991, the FDA also provided more comprehensive and specific consumer food safety guidelines. *Preventing Foodborne Illness* provides foodborne illness prevention tips, including sections on cleaning and cooking, safe storage with recommended storage times, symptoms and sources of bacteria and sources for additional information *(3)*. The minimum recommended cooking temperatures for beef is 140°F. A higher temperature for ground beef is not advised. Although this document was reprinted and revised in 1997, a recommended end point cooking temperature for ground beef was not added.

College textbooks published in the 1990s reflect a more comprehensive coverage of foodborne illness. *Food Safety,* by Julie Jones, includes a discussion of significantly more microbial pathogens than books from the previous decade, including *Salmonella*, *Campylobacter jejuni*, *Toxoplasma gondii*, *Staphylococcus aureus*, *C. perfringens*, *Shigella*, *Escherichia coli*, *Trichinella spiralis*, *Bacillus cereus, Vibrio*, *Listeria monocytogenes*, *Yersinia enterocolitica,* and others. Raw meat and meat products are identified as a source of *Salmonella*, *C. perfringens*, and *L. monocytogenes*. Jones notes that *E. coli* is a common resident of the intestinal tract of warm-blooded animals. She notes that for many years it had been considered harmless; however, particular strains of *E. coli* were the cause of enteric disease in the 1980s, with soft cheeses and ground beef identified as the food sources. Sanitary handling to avoid cross-contamination, thorough cooking, and keeping foods out of the danger zone are specified as ways to reduce the probability of illness.

Consumers indicate that they obtain safe handling information from cookbooks and magazines *(35)*. A review of classic cookbooks, such as *Better Homes and Gardens* or *Joy of Cooking*, indicates that virtually all limit food handling information to culinary issues such as the temperature for roasts cooked to rare, medium, or well done. Even books published in the1990s and later, specializing in ground beef or grilling, address preference for degree of doneness rather than food safety considerations. There are exceptions. The 1997 edition of *Joy of Cooking* lists the recommended end point temperature of 160°F for meat loaf (page 722) but incorrectly advises consumers to cook ground beef to 155°F (page 646) *(38)*. Further, readers are advised that risk is lessened by buying top-grade beef and grinding it themselves. This is a potentially risky practice, since the opportunity for cross contamination in the kitchen is high. Some cookbooks provide current, accurate information. The *Complete Meat Cookbook*, for example, recommends 160°F or 155°F for 15 seconds as the end point cooking temperature for ground beef *(1)*.

## LANDMARK FOOD SAFETY EVENT

A landmark event in food safety occurred in 1993. Consumption of undercooked hamburger contaminated with *E. coli* O157:H7 resulted in 501 illnesses, 151 hospitalizations, and 3 deaths *(11)*. This outbreak received extensive publicity because the source of illness was a popular food and many victims were children. In 1994, USDA declared *E. coli* O157:H7 an adulterant in raw beef, and a program began to test for the pathogen in raw ground beef from federally inspected establishments and retail stores *(15)*. In 1994, the public was advised to cook ground beef until it is brown and juices run clear; however, in 1997, FSIS revised this recommendation. Cooked ground beef color was demonstrated to be an inaccurate predictor of end point temperature. Consumers were advised to use a meat thermometer and cook to 160°F rather than rely on color.

Since 1994, USDA has required safe food-handling labels on retail packages or raw and partially cooked meat and poultry products. The label advises consumers to refrigerate the product, avoid cross contamination, cook thoroughly, keep hot food hot, and handle leftovers properly. Interview and survey data indicate that 51% or more of consumers contacted recalled seeing the label. Of these, 79% or more remember reading the label, and 37% of these said they changed the way

they handle raw meat as a result of reading the label *(34, 39, 48)*. These studies found that people were more likely to remember the message to avoid cross contamination than any other.

In 1997, President Clinton announced the National Food Safety Initiative *(15, 33)*. This measure established the Partnership for Food Safety Education, a not-for-profit organization of government agencies, food industry, nutrition/food safety professional societies, and consumer groups. The Partnership's mission is to educate consumers to protect themselves from bacteria (FightBAC®) and reduce risk of foodborne illness by following 4 simple practices:

CLEAN: *Wash hands and surfaces often*

SEPARATE: *Don't cross-contaminate!*

COOK: *Cook to proper temperature*

CHILL: *Refrigerate promptly*

The partnership provides a coordinated and consistent set of food safety messages based upon consumer-tested information and graphics. Messages are developed through public opinion research and expert scientific and technical review. Information is distributed through mass media, public service announcements, the Internet, point-of-purchase, and school and community initiatives. Material is available to use nationwide by public health, nutrition, food science, education, and special constituency groups.

USDA, FDA, and others in the Partnership sponsor a "Partner's Toolkit" that contains flyers, posters, and a CD with additional educational material. "Consumer Education Planning Guides" mailed to food safety educators include media material such as a press release and public service announcements as well as fact sheets, FightBAC brochures, and food-safety related games and activities.

Although these tools are available, they are not used as widely as they could be. Food safety educators indicate that their available time is a limitation *(16)*. Over 30% of educators responding to a USDA survey report that they spend less than 25% of their time on food safety education, with the rest of the time devoted to various other food, nutrition, and health topics. Only 15% of educators spend 50 to 75% of their time on food safety education. Restricted funding is also a limitation. Twenty percent of educators have annual budgets for food safety education of less than $5,000. The availability of additional resources in terms of both finances and staff could result in more extensive delivery of the FightBAC message.

Use of a thermometer to verify adequate cooking is a key component of the Partnership message to cook to proper temperature. The Research Triangle Institute evaluated the effectiveness of the Thermy™ educational material used nationally to promote use of a food thermometer *(37)*. McCurdy and colleagues also explored consumer attitudes toward food thermometers *(26)*. Both groups found that participants already believed they prepared meat safely. People relied on color and were not aware of the importance of using a food thermometer. Some were not familiar with food thermometers and did not know how to read or interpret the results. Consumers suggested developing messages that emphasized that using a thermometer is the only way to be sure the food has reached a sufficiently high temperature to destroy foodborne bacteria, using a thermometer will help protect children or elderly persons, and using a thermometer improves food quality because the food will not be over-cooked. Consumers report that they are reluctant to use thermometers to cook small or thin meat items because they lack the time, forget, are too lazy, or lack confidence in accurately positioning the thermometer in thin cuts of meat *(26)*.

As a result of these findings, comprehensive guide to using a thermometer when cooking thin portions of meat was developed by Washington State University Extension and the University of Idaho *(41)*. *Now You're Cooking … Using a Food Thermometer!* uses color illustrations to demonstrate that brown meat may not have reached 160°F. Further, the brochure describes different types of thermometers, demonstrates how to use a thermometer to determine end point temperature in burgers, and describes with text and illustrations how to most effectively cook a burger to the recommended end point temperature.

USDA, in partnership with others, developed educational material targeted to specific audiences. *Listeriosis and Pregnancy — What is Your Risk?* produced by the Association of Women's Health, Obstetric and Neonatal Nurses, the International Food Information Council Foundation, USDA, and US Department of Health and Human Services in 2001 utilizes the four FightBAC messages in conjunction with text and photos to explain *Listeria* risk and protection practices. *Protecting Your Baby and Yourself from Listeriosis,* written by USDA in 2004, includes additional pictures and repeats the same basic messages. *To Your Health! Food Safety for Seniors*, published in 2000, targets older Americans with larger print, simple pictures, and updated end-point cook temperatures.

A team of food safety educators from Washington State University, Ohio State University, and Colorado State University developed food safety materials for highest risk consumers. Available for free download are materials for persons living with HIV/AIDS, cancer, bone marrow transplants, and others *(21, 28–30)*. These materials, developed in consultation with the target audience, included specific information on shopping, storing, cooking, and handling leftovers. Tips for using a thermometer are included, as well as updated information on safe end point temperatures of various foods.

## EFFECT OF EDUCATIONAL PROGRAMS ON BEHAVIOR

While food safety messages are tested with the consumers, changing consumer practices is challenging. Survey results on consumer attitudes and practices indicate increased awareness in several areas:

### Hand washing

People appear to be more aware that hand washing is an important component of food safety.

In an annual survey repeated over several years, consumers were asked to volunteer practices they follow to keep food safe. In 1990, no consumers volunteered that they wash their hands *(32)*. In 2005–2007, between 74 and 76% identified washing hands as something they do "every time" *(18)*. Further, a review of select safe-handling practices indicates that more consumers report washing their hands with soap after handling raw meat or poultry, with 66% reporting washing in 1993, 76% in 1998 and 82% in 2001 *(4)*. In 2009, 87% reported washing their hands with soap and water, but this percentage had decreased from 92% in 2008 *(23)*.

Do consumers really wash every time? The American Society for Microbiology has repeatedly shown that actual behavior is frequently different from reported behavior. For example, 92% of Americans say they wash their hands after using a restroom, but when observed, only 88% of women and 66% of men actually wash their hands *(5)*. Video taping consumers in their homes while preparing a meal revealed that 45% of subjects attempted to wash their hands before starting meal preparation, of which 38% used soap *(2)*. This indicates that consumers know that hand washing is important, but people may not always wash as frequently as food safety authorities recommend.

## Cross-contamination

Consumer response to a question on cleaning cutting boards indicates an increasing percentage respond with recommended behavior. In 1996 and 1997, 7% of consumers acknowledged that they do not always wash their hands after handling raw meat or poultry, and 7% also admitted that they do not always wash the cutting board after cutting these raw foods *(39)*. Proper cleaning of cutting boards or other surfaces after cutting raw meat or poultry was reported by 68% of consumers in 1993, 79% in 1998, and 85% in 2001 *(4)*. In contrast, in 2009, only 50% of consumers reported using different or freshly cleaned cutting boards between raw meat and poultry and produce *(23)*. Others found that in 1999 and 2002, 18% of consumers did not wash the plate between using it to hold raw and cooked meat *(14)*.

People may overstate what they perceive as the recommended behavior. Actual observation again reveals that consumers do not always follow recommended practices. When consumers were observed during meal preparation, over 477 cross-contamination events occurred. Most of these, 84%, involved contamination of ready to eat foods with raw meat or poultry *(2)*.

## Thorough cooking of ground beef

A national telephone survey conducted between December 1992 and February 1993 found that 23% of consumers served home prepared hamburgers rare or medium *(24)*. In 1996 and 1997, 10% of consumers interviewed said they had eaten undercooked hamburger in the five days prior to the interview, while 30% said they preferred undercooked hamburger *(39)*. In 1998 and 2001, those who said they had eaten rare or medium burgers decreased to 17 and 18%, respectively *(4)*.

## Use of meat thermometer to determine doneness

More consumers reported owning a meat thermometer in 2001, at 60%, compared to only 46 in 1998 *(4)*. In 1998, 22% of consumers reported using a meat thermometer to determine when roasts or large pieces of meat are done. This percentage increased to 32% in 2001. Use of a thermometer is not an ingrained behavior. In 2009, 71% responded that they cook food to the required temperature. However, only 25% said they used a thermometer to check doneness of meat and poultry items *(23)*. The percentage using a meat thermometer when cooking hamburgers is much lower. Only 3% indicated that they used a thermometer in 1998, and 6% in 2001 *(4)*. Consumers can accidentally undercook ground beef that is used as part of a large meal item. Even though consumers believed their meatloaf was fully cooked, 46% of the meatloaves had not reached the recommended temperature of 160°F *(2)*.

Popular sources of recipes do not encourage use of a thermometer but rather rely on time of cooking and color. Celebrity chef Bobby Flay describes several tasty ways to cook burgers in the Sunday newspaper insert, *Parade* magazine *(17)*. Readers are told to "Grill for 3-4 minutes on each side, until golden brown and cooked medium inside." The September 2009 issue of *Saveur* magazine featuring *The Burger Bible* focuses on flavorful ingredients. Readers are advised to "cook burgers, flipping once, until cooked to desired doneness, about 12 minutes total for medium rare"*(6)*. In the article "Ultimate Burgers," *Sunset Magazine* advises readers to grill burgers 4 to 6 minutes, turning once for rare, and ten minutes for medium to well-done burgers *(42)*. Cooks are advised to "check doneness," but use of a thermometer is not mentioned. Perhaps the most shocking advice comes from the *New York Times (40)*. The writer interviewed several chefs from around the country, gleaning tips from each to share with the reader. None mention use of a thermometer. The paper reports that Seamus Mullen, the chef and an owner of the Boqueria restaurants in the Flatiron district and SoHo, uses a wire cake tester to determine doneness. *"We stick it in the middle through the side," he said. "If it's barely warm to the lips, it's rare. If it's like bath water, it's medium rare. The temperature will never lie. It takes the guesswork out of everything."*

## Knowledge and behavior

Surveys indicate that consumer knowledge of several key messages on safe handling has increased, but knowledge gaps still exist *(4, 36)*. In some cases, people are not familiar with details of the recommendation. They do not know the appropriate end-point temperature for cooked hamburger or the appropriate temperature for the refrigerator. People do not realize the importance of hand washing, and they think that rinsing hands or a cutting board with water constitutes adequate cleaning.

Even if they know the recommendations, people do not always follow them. People say that the recommendations do not apply to them, or that they are too busy

and the recommended practices are inconvenient *(9, 36)*. Taste preference also plays an important role in food choice. Some prefer their burgers cooked to rare *(35)*. McIntosh and coworkers found that awareness of the danger of improperly cooked hamburger, knowledge of foodborne pathogens, and knowledge of food safety practices had no effect on willingness to change burger cooking practices *(27)*.

### Knowledge and behavior of those at highest risk

Athearn et al. *(8)* found that pregnant women interviewed through focus groups expressed moderate concern about food safety and had made some changes since becoming pregnant; however, many were not following seven of 12 recommended practices. Women believed their food was safe and resisted change because of convenience or taste preference. Pregnant women and those at increased risk for *Listeria* infection said that they did not want to reheat luncheon meat.

Focus group discussions revealed that persons with HIV/AIDS had "weakly positive" attitudes toward food safety and that many consumed foods that would be considered risky *(22)*. Initially, people were resistant to and confused about many safety recommendations. Initially, project participants did not want to use a food thermometer and did not want to avoid favorite foods, such as unheated deli meats. Barriers to accepting the food safety recommendations include lack of understanding why the practices are necessary, willingness to take risks, resistance to change, feeling that someone else, such as food processors, should control food-related risks, and belief that risks could be controlled by their own food preparation actions. Even after hearing why extra food safety precautions are appropriate for their health conditions, participants were not willing to adopt all recommendations. The most widely accepted recommendation was that regarding hand washing. Resistance was strongest for the recommendations to avoid unheated lunchmeats and to use a thermometer to determine safe cooking temperature.

## SUMMARY AND IMPLICATIONS

Food safety education is available in more venues today than in previous decades. Messages are directed to the general audience as well as populations at increased risk, such as children, pregnant women, older people, and those whose immunity is compromised. Guidelines are specific, with details on how to wash hands and cooking surfaces, how cool to keep the refrigerator, and the appropriate end temperature for cooked ground beef. Messages are presented nationwide, but consumers do not remember the details of how cold or how hot food should be held. Many do not follow all the recommendations. People think they already handle food safely and are reluctant to change habitual behavior. Many will not sacrifice flavor preference for safe handling. In summary, a substantial number of consumers continue to follow unsafe food handling practices. Education alone is not sufficient to protect against foodborne disease.

According to the International Food Information Council Foundation's fourth annual Food & Health Survey, more than half of Americans think foodborne illness from bacteria, such as *E. coli* and *Salmonella*, is the most important food safety issue today *(23)*. Failure to offer food that is free of pathogens has a profound impact on consumer confidence in the food supply and likelihood to select specific food items in the future. A 2009 nationwide survey found that less than 20% of consumers trust food companies to develop and sell food products that are safe and healthy *(7)*. Consumers indicated that when they heard of recalls, they changed their buying practices, with 63% saying they will not buy the food in question again until the source of contamination has been found and eliminated. Although most consumers in this survey recalled contamination incidents with peanut butter, spinach, tomatoes, and ground beef, recalls and foodborne illnesses traced to these products continues to be in the news.

This author believes that to reduce the likelihood of a foodborne illness outbreak, the meat industry should expand use of advanced food safety technology such as high pressure processing and irradiation. These treatments greatly reduce levels of pathogens that cause illness from accidental cross-contamination or undercooking. Use of these technologies will benefit the meat industry through reduction of meat-related foodborne illnesses and fewer ground beef recalls. Additionally, the public will be protected from pathogens that cause devastating foodborne illness. The food service industry must join the efforts to enhance safety by using products processed for added safety. Similarly, consumers can make safer choices only if supermarkets offer foods processed for added safety. Health educators should continue to advocate safe food handling, coupled with promoting the advantages of safety-enhanced food.

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