

CONSUMER FOOD SAFETY KNOWLEDGE AND PRACTICES

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ABSTRACT

Consumer knowledge of safe handling guidelines and their reported practices assessed by a mail survey indicated consumers considered themselves informed about food safety, and most reported taking action to minimize risk from potential hazards. However, most responses were related to nutritional changes, and 20% indicated they did not know how to reduce risks from microbiological hazards. Consumers were knowledgeable about appropriate safeguards in selection and cooking specific foods, however mistakes were reported in temperature control and handling leftovers. Consumer Reports, university scientists, health professionals and science magazines were considered the most reliable source of food safety information. Industry advertisement appears to raise consumer concern in some areas. Educational intervention should emphasize the importance of temperature control and sanitation rather than taste to determine safety. Consumers should receive information about protective technologies like heat and irradiation pasteurization.

INTRODUCTION

Food safety requires proper handling from production through consumption. Although standards in the United States are among the highest in the world and

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consumer guidance on proper food handling is available through magazines, newspapers, food labels, and other sources, mistakes still occur. Foodborne disease in the United States reported to the Center for Disease Control (CDC) between 1988 and 1992 totaled 2,423 outbreaks causing 77,373 persons to become ill (Bean *et al.* 1997). Among those outbreaks for which the etiology was determined, bacterial pathogens caused the largest percentage of outbreaks and cases, 79% and 90% respectively, with *Salmonella* Enteritidis accounting for the largest number of deaths.

The CDC, in collaboration with state health departments and federal food regulatory agencies enhanced national surveillance for foodborne disease through FoodNet, a program which details investigations, including case-control studies of sporadic cases of common foodborne infection (Tauxe 1997). Results from five U.S. sentinel sites in 1996, including one in California, indicate *Campylobacter* was the most frequent cause of foodborne infections.

The Economic Research Service estimated the cost of seven foodborne illnesses associated with *Campylobacter jejuni*, *Clostridium perfringens*, *E. coli* O157:H7, *Listeria monocytogenes*, *Salmonella*, *Staphylococcus aureus* and *Toxoplasma gondii* ranged from \$6.6 billion to \$37.1 billion in medical charges and lost productivity (Buzby and Roberts 1997). The cost of *Campylobacter*-associated Guillain-Barre Syndrome was estimated at \$142 million to \$1.3 billion based upon a 55% to 70% causation rate.

Food safety experts have identified the most common food handling problems by consumers: obtaining food from unsafe sources, inadequate cooking or heat processing, improper cooling, intervals of 12 h or more between preparation and eating, poor hygiene or colonized person handling implicated food (Bryan 1988). Mishandling associated with specific pathogens included the same contributing factors (Bean and Griffin 1990).

Consumer perceptions and behaviors related to foodborne illness changed little during the five year period between 1988 and 1993 (Fein *et al.* 1995). Consumers misperceived the nature of foodborne illness and the most likely pathogen source. They believed foodborne disease was a minor illness without fever that occurred within a day of eating a contaminated food. Infections caused by *Salmonella* and *Campylobacter*, the most common foodborne illnesses in the United States (Tauxe 1992), have longer latency and fever-causing properties and are not consistent with the symptoms consumers described.

Most consumers believed their illness was caused by food prepared somewhere other than the home. Williamson (1992) found about one-third of consumers thought food safety problems most likely occurred at food manufacturing facilities, one-third blamed unsafe practices at restaurants, and only 16% thought the home was the most likely place for mishandling. Similarly, Fein *et al.* (1995) found 65% of consumers attributed foodborne illness to food prepared at a restaurant, 17% thought mishandling occurred at the supermarket and 17% at home. In contrast,

food safety experts believe sporadic cases and small outbreaks at home are far more common than those cases constituting recognized outbreaks (Institute of Food Technologist's Expert Panel on Food Safety and Nutrition 1995).

If consumers misperceive the origin and severity of foodborne illness, they are less motivated to change. Motivation to practice safe food handling requires a belief that someone is harmed by not doing so, and that new behavior will prevent illness (Schafer *et al.* 1993). The failure to associate at-home food handling practices with foodborne illness is a serious impediment to convincing people to discontinue potentially hazardous food handling behavior (Fein *et al.* 1995).

This study was undertaken to determine the prevalence of specific potentially hazardous food handling practices so they could be targeted by educational programming.

MATERIALS AND METHODS

Materials

A mail survey was conducted in 1993 to assess consumer perception of food risks, knowledge and behavior related to specific food handling practices, changed behavior related to perception of safety, and reliability of information sources. Demographic data and descriptive characteristics of the subjects were also obtained.

The questionnaire was pilot tested (n=20) for clarity. The coded questionnaires, personally signed letter on University letterhead indicating participation was voluntary and confidential and a postage paid return envelope were mailed to a sample of California households based upon zip codes. Names and addresses for the sample were purchased from a mail list company (A.B. Zeller Mailing Lists, 224 5th Avenue, New York).

A multiple mailing procedure was used to enhance return rates (Dillman 1978). One week following the initial mailing, all participants were sent a thank you/please return the questionnaire postcard. A second letter, questionnaire, and return envelope were mailed to nonrespondents two weeks following the initial mailing. A second reminder postcard was sent to all nonrespondents three weeks after the initial contact. Of one thousand questionnaires mailed, 605 were returned and analyzed, resulting in a return rate of 60%. Data was analyzed using SAS, and descriptive statistics were generated.

RESULTS AND DISCUSSION

The respondents represented a disproportionately high percentage of Caucasian, 79%; college graduates, 48%; and persons over 60 years of age, 28%. It is

common for mail surveys to obtain a higher response rate from older persons and those with more formal education and higher income. Therefore responses to the food knowledge and food handling questions should be recognized as from persons with more formal education.

TABLE 1.
DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

Age Group n=598		Marital Status n=592	
19 and younger	0%	Never married	14%
20-29 years	11%	Married	67%
30-39 years	21%	Separated/divorced	12%
40-49 years	24%	Widowed	8%
50-59 years	16%		
60 or older	28%		
Formal Education n=597		Ethnicity n=593	
Some high school	4%	Caucasian	79%
High school graduate	12%	Latino	5%
Some college	36%	Asian-American	8%
College graduate	48%	African-American	3%
		Other	5%
Gross Family Income n=553			
Less than \$9,999/yr	3%		
\$10,000-19,999/yr	8%		
\$20,000-29,999/yr	10%		
\$30,000-39,999/yr	14%		
\$40,000-49,999/yr	17%		
\$50,000-59,999/yr	11%		
\$60,000-69,999/yr	9%		
\$70,000 or more/yr	28%		

Attitudes Toward Food Safety

Most California consumers were completely, 17%, or somewhat, 69%, confident in the safety of food purchased at the supermarket (Table 2). This is consistent with attitudes toward safety found in national samples (Opinion Research 1993).

More California consumers were confident in the safety of fruits, vegetables and dairy products than with any other food category. Over 90% were very or somewhat confident in the safety of fruits and vegetables and 89% confident in dairy products. Poultry and beef were viewed similarly with about 70% very or somewhat confident in safety. Fewest people were very or somewhat confident in the safety of drinking water, however this item was viewed with confidence by about half of the consumers surveyed.

More California consumers expressed major concern for bacterial contamination than any other food safety issue described (Table 3). Relative ranking of potential hazards is consistent with the response from consumers in the nationwide Food Marketing Institute survey, however this sample expressed less concern than those surveyed nationally (Opinion Research 1993; ABT Associates 1997). Concern about pesticide residues was ranked as a major concern by 44% of respondents. Mercury in food and lead leaching from dinnerware were considered a major concern by only 33% of consumers. Food irradiated to reduce spoilage was also considered a major concern by 33% of respondents.

Consumer Response to Perceived Risk

Most people indicated they have taken some action to minimize personal or family risk for potential hazards in foods (Table 4). The most frequent response, noted by 73% of respondents, pertained to nutritional risks. Consumers said they had reduced the fat content of their diet. About 60% believed they had reduced pesticide residues in food or controlled bacteria contamination. About 20% indicated they do not know how to reduce risk from microbiological hazards, pesticide residues or lead in ceramic ware.

TABLE 2.
CONSUMER CONFIDENCE IN FOOD SAFETY

Food		Completely Confident	Somewhat Confident	Not Very Confident	Not at All Confident	Don't Know
Supermarket Food	n=592	17%	69%	11%	3%	0%
Bottled water	n=593	39%	45%	9%	3%	4%
Fruits & vegetables	n=602	34%	58%	7%	1%	0%
Dairy Products	n=599	33%	56%	8%	2%	1%
Eggs	n=597	28%	55%	14%	2%	1%
Tap Water	n=595	18%	35%	30%	15%	2%
Red Meat	n=599	17%	54%	23%	5%	1%
Poultry	n=598	15%	54%	14%	2%	1%
Fish & Seafood	n=601	8%	53%	31%	6%	1%

TABLE 3.
CALIFORNIA CONSUMER CONCERN ABOUT POTENTIAL HAZARDS IN FOOD

Condition		Major Concern	Minor Concern	No Concern	Not Certain	This Is Not Familiar
Bacterial contamination	n=602	50%	40%	7%	2%	1%
Pesticide residues	n=604	44%	45%	7%	2%	2%
Mercury or aluminum	n=603	35%	39%	13%	6%	7%
Lead in dish or dinnerware	n=602	34%	36%	22%	5%	3%
Food irradiated to reduce spoilage	n=604	32%	30%	22%	8%	8%

TABLE 4.
PERCENTAGE OF CONSUMERS WHO HAVE TAKEN ACTION TO MINIMIZE PERSONAL
OR FAMILY RISK FROM POTENTIAL HAZARDS IN FOOD

Potential Hazard		Have	Have Not	Not Sure What to Do
Fat content of food	n=585	73%	19%	8%
Pesticide Residues	n=587	61%	22%	17%
Bacteria contamination	n=589	58%	20%	22%
Lead in ceramic ware	n=582	44%	36%	20%

Consumers were asked if they had purchased or consumed more, the same amount, or less of specific items (Table 5). If they had purchased or consumed less, they were asked to indicate the reasons why. From 12% to 72% of consumers indicated they purchased less of the commodities listed with nutritional and food safety concerns the primary factors driving reduced selection.

- (1) More consumers, 72%, responded they had purchased less red meat in the last two years than any other item specified. The primary reason was concern about fat content, identified by 78% of those who indicated they purchased less, followed by concern about safe handling and bacteria level, selected by 34%.
- (2) More than half of the respondents, 56%, indicated they had increased purchase of bottled water, use of in-home filter or reverse osmosis systems. The driving reasons for this choice was poor taste of tap water, 71%; high mineral content, 50%; and concern about high bacterial level of tap water, 45%.
- (3) Forty-three percent of respondents indicated they purchased fewer eggs, with concern about cholesterol content cited as the reason by 80% of those who purchased less. Concern about bacteria level was identified by only 15% of the sample.
- (4) Forty-one percent indicated they purchased less fish or seafood in the last two years with concern about bacteria level cited by 54% and contaminated waters by 50%.
- (5) Fewer still purchased less poultry, 19%, with microbiological safety the driving factor for 69% of the respondents. Forty-three percent of those who purchased less poultry did so due to concern about hormone residues and 39% due to concern about antibiotic levels.
- (6) Fewer consumers, 12%, indicated they purchased less fruits and vegetables than any other commodity indicated. Price was the driving factor among 68% of consumers who purchased less, while pesticide residues were noted by 37% of consumers, and microbiological concerns by 22%.

TABLE 5.
CONSUMER FOOD SAFETY BEHAVIOR AND DRIVING FACTORS*

Have purchased less red meat in the last two years because:		n=583	72%
78%	Concerned about fat content		
34%	Concerned about safe handling and bacteria level		
28%	Price is too high		
26%	Concerned about hormone residues		
22%	Concerned about antibiotic levels		
Buy bottled water, use in-home filter, or reverse osmosis system, for drinking water because:		n=588	56%
71%	Tap water has poor taste		
50%	Tap water has high mineral content		
45%	Tap water may have a high bacterial level		
Have purchased fewer eggs and egg products in the last two years because:		n=585	43%
80%	Concerned about cholesterol content		
30%	Concerned about fat content		
15%	Concerned about safe handling and bacteria level		
5%	Price is too high		
Have purchased less fish or seafood in the last two years because:		n=581	41%
54%	Concerned about safe handling and bacteria level		
50%	Concerned about contaminated		
49%	Price is too high		
6%	Concerned about fat content		
Have purchased less poultry in the last two years because:		n=577	19%
64%	Concerned about safe handling and bacteria level		
43%	Concerned about hormone residues		
39%	Concerned about antibiotic levels		
36%	Concerned about fat content		
12%	Price is too high		
Have purchased less fresh fruits and vegetables in the last two years because:		n=582	12%
68%	Price is too high		
49%	Quality is poor		
37%	Concerned about pesticide residue		
22%	Concerned about safe handling and bacteria level		

* Yes only percents. Multiple yes answers accepted. Percents may be greater than 100%.

Personal Assessment of Knowledge and Health Status

Most consumers considered themselves very, 15%, or somewhat, 65%, informed about food safety (Table 6). Most respondents considered their personal, 64%, and family, 63%, health was very good to excellent. Never-the-less about 40% or more had experienced diarrhea or upset stomach personally or within their family in the last six months (Table 7). This suggests that respondents or family members have experienced foodborne illness and is an interesting contrast to their reported level of knowledge. Daniels (1998) verified that consumers who considered themselves knowledgeable make food handling errors. An average of 2.8 critical food handling violation occurred per household and at least one violations was observed in 96% of households (Daniels 1998).

TABLE 6.
CONSUMER ASSESSMENT OF FOOD SAFETY KNOWLEDGE AND HEALTH STATUS

How informed about food safety n=588		Personal description of health n=590	
15%	Very	31%	Excellent
65%	Somewhat	33%	Very good
19%	Not very	21%	Good
1%	Not at all	12%	Average
0%	Don't know	3%	Poor
Personal assessment of family health in the past 6 months n=573			
28%	excellent		
35%	very good		
24%	good		
12%	average		
1%	poor		

Consumer Handling Practices

Consumers were aware of some safe food handling practices, but lacked knowledge of others.

TABLE 7.
HOUSEHOLDS EXPERIENCING PHYSICAL SYMPTOMS ASSOCIATED WITH
FOODBORNE ILLNESS

Symptom		Respondent Has Experienced		Experienced by Family Member
Upset stomach	n=558	46%	n=463	53%
Diarrhea	n=548	39%	n=447	44%
Flu	n=519	29%	n=428	41%
Nausea	n=520	23%	n=425	33%
Fever	n=512	22%	n=426	36%
Vomiting	n=503	11%	n=419	21%

Temperature Control. Most consumers, 68%, indicated they made certain that frozen foods were frozen solid before purchase (Table 8). Most safely defrost frozen food in the refrigerator, 67%, or in the microwave, 44% (Table 9). Almost half, 46%, however, defrost food on the counter top and 10% defrost in warm water. Most consumers were aware that ground beef and pork should be thoroughly cooked (Table 10). Most, 67%, indicate they never leave cooked meat on the counter at room temperature for over 4 h (Table 8). Over 80% recognized to some degree that leftovers should not be kept at room temperature for several hours. (Table 10) Almost 50% incorrectly thought cooked food should be cooled to room temperature before refrigeration or freezing (Table 10). About two-thirds correctly refrigerate leftovers in small containers, however half indicate practices which are potentially unsafe, such as refrigerating in a large container or in the large container used to prepare the food (Table 9).

These findings are comparable to Williamson (1992) in which a nationwide sample of consumers let roasted chicken sit on the counter until it cooled completely before refrigerating; only 32% of consumers used small shallow containers to refrigerate leftovers; and 14% and 18% indicating uncertainty or no concern about the safety of cooked poultry or meat left unrefrigerated for over 4 h. Among Canadian consumers, 39% inappropriately thought defrosting turkey at room temperature was safe (Ag Canada 1990), and 48% of Illinois consumers believed it was safe to cool food completely at room temperature prior to refrigeration (Brewer *et al.* 1994).

Cross Contamination. Most California consumers, 80%, said they never used the same plate for raw and cooked meat (Table 8). About two-thirds of the respondents reported they always cleaned food preparation area with soap and water (Table 8). This compares to a nationwide sample in which 54% said they would wash a cutting board with soap and water between using it to cut raw meat and chop vegetables (Williamson *et al.* 1992). Similarly, among Canadians, 68% recognized that chopping raw vegetables and uncooked chicken with the same

knife and cutting board without cleaning was an unsafe practice (Ag Canada 1990).

Using Unsafe Food. Most people, 80%, reported they examined packages to see if they were opened or damaged (Table 8). About half indicated they do not use luncheon meat, pasta, or sauce after the use-by date on the package, however 13% ignored the date and used a product if it smelled unspoiled (Table 9). Most people, 72% never used raw eggs in salads, desserts, or drinks (Table 8). One third never used taste to determine safety; however 47% sometimes or always tasted to see if leftovers were safe (Table 8). This compares to a Canadian survey in which 47% inaccurately assumed they could tell if a food might cause food poisoning by looking at it or smelling it (Ag Canada 1990).

Other Facts. Over 70% recognized that freezing does not kill all bacteria that cause foodborne illness (Table 10). In 1993 relatively few were familiar with the effects of food irradiation on product safety (Table 10). Only 36% recognized that irradiation of meat or poultry destroys bacteria that causes foodborne illness and 33% knew irradiated foods are considered safe by health and safety organizations.

TABLE 8.
CONSUMER FREQUENT USE OF FOOD HANDLING PRACTICES

Practice		Always	Sometimes	Rarely	Never
Examine food packages to see if they have been opened or damaged	n=597	80%	15%	4%	1%
When purchasing frozen foods, check to be sure they are frozen solid	n=594	68%	19%	10%	3%
After preparing foods, clean food preparation area with soap and water	n=592	63%	26%	8%	3%
Leave cooked meat on the counter at room temperature for over 4 h	n=594	2%	9%	22%	67%
Use same plate for raw and cooked meat, do not wash plate before using it for cooked meat	n=590	2%	8%	10%	80%
Taste leftovers to check if they are still safe	n=581	26%	21%	18%	35%
Use raw eggs in salads, desserts, and drinks, like egg nog.	n=592	1%	9%	18%	72%

TABLE 9.
CONSUMER FOOD HANDLING PRACTICES

When I cook a large portion of food, I refrigerate the leftovers ...		n=601
67%	In several small containers	
15%	In the pot I cook it in	
36%	In a large container	
6%	Never prepare this	
When I need to defrost frozen foods, I take it out of the freezer and put it ...		n=602
67%	In the refrigerator	
44%	In the microwave	
46%	On the countertop	
10%	In a bag in warm water	
2%	Never use frozen food	
If a luncheon meat, pasta, or sauce item is past package date, I ...		n=602
48%	Do not use after the date	
13%	Ignore date, use if smells OK	
2%	Use if 1-2 weeks past date	
34%	Use if 2-3 days past date	
8%	Use if 4-7 days past date	
22%	Do not buy this type of food	

Sources of Credible Information

Consumers considered university scientists and health professionals to be a more reliable source of food safety information than family or friends (Table 11). *Consumer Reports* was considered reliable by the greatest percentage of persons with 42% rating it highly reliable and 50% somewhat reliable. Science magazines were considered highly reliable by more persons than food or news magazines, and these were considered reliable by more persons than the newspaper. Television was considered reliable by fewer people than print media, with talk shows rated highly unreliable by almost 20% of respondents. Material prepared by the USDA or FDA and TV programs like 60 Minutes or 20/20 were considered reliable by about 75% of consumers and highly reliable by about 20% of consumers. Material prepared by the supermarket was considered highly reliable by only 4% of respondents. Previous research has indicated that consumers use television, print media and other people to obtain information on food safety with greatest credibility ascribed to health professionals and least to supermarket brochures (Hoban 1994; Hoban and Kendall 1992; Bruhn *et al.* 1992).

TABLE 10.
CONSUMER KNOWLEDGE OF SAFE FOOD HANDLING PRACTICES

Statement		Strongly Agree	Agree	Disagree	Strongly Disagree	Don't know
For greater safety, ground beef patties should be cooked until they are no longer pink	n=594	45% *	44%	7%	1%	3%
Pork cooked rare and medium is completely safe to eat	n=590	2%	6%	43%	44% *	5%
Freezing food kills all bacteria that may cause illness	n=592	1%	8%	50%	24% *	17%
Cooked food should be cooled to room temperature before refrigeration or freezing	n=590	13%	36%	14%	26% *	11%
Leftover foods can be safely kept at room temperature several hours	n=594	2%	12%	44%	39% •	3%
Irradiation of meat or poultry will destroy bacteria that causes food-borne illness	n=583	7% *	29%	18%	2%	44%
Irradiated food is considered safe by the major health and safety organizations	n=583	5% *	28%	14%	3%	50%

* Indicates correct response

Implications to Consumer Education

Consumers look at food risks as a totality, including nutritional, microbiological, and chemical risks. This suggests that an education program should not be limited to microbiology or nutrition, but should address all aspects of product safety.

Some industry actions raise consumer concern. Two poultry processors in California advertised that their chickens have not received supplemental hormones. This practice is not utilized by any poultry processor because it is not cost effective. The advertisement suggested a difference when none exists, raised consumer anxiety about poultry products in general and may have depressed poultry sales. Note that 43% of consumers concerned about poultry safety reduced consumption because of concerns about use of hormones.

TABLE 11.
RELIABILITY OF SOURCES OF FOOD SAFETY INFORMATION

Source		Highly Reliable	Somewhat Reliable	Somewhat Unreliable	Highly Unreliable
People					
University scientist	n=558	35%	55%	9%	1%
Health professional	n=574	29%	60%	10%	1%
Friends or family	n=552	7%	49%	37%	7%
Print media					
Consumer Reports	n=556	42%	50%	7%	1%
Science Magazine	n=546	29%	60%	10%	1%
Food Magazine, i.e. Sunset	n=551	15%	64%	18%	3%
News Magazine, i.e. Time	n=552	15%	60%	22%	3%
Newspaper	n=564	7%	58%	28%	7%
Electronic Media					
TV program, i.e. 60 Minutes, or 20/20	n=554	19%	55%	21%	5%
Radio	n=566	6%	53%	35%	6%
Television news	n=563	6%	53%	33%	8%
TV talk show, i.e. Donahue	n=548	4%	37%	40%	19%
Written Material					
Government (USDA/FDA)	n=574	21%	55%	18%	6%
Health Food Stores	n=550	12%	55%	28%	5%
Supermarket	n=562	4%	55%	31%	9%

Half of the consumers responding to this survey were college graduates. Recognition of food-related risks and safe handling may be much higher among this sample than among consumers in general.

Consumer handling practices suggest areas to focus safe handling information. The importance of cold temperatures to retard growth of microorganisms should be stressed, particularly refrigerating during defrosting, rapid cooling of cooked food, and refrigeration in small rather than large containers. The potential for cross contamination seems to be understood, but an emphasis of cleaning with detergent rather than water should be emphasized. Consumers appear to be unaware that food that looks and tastes good can contain pathogens. Consumers should be advised to base safety decisions on time and temperature control, not product taste.

Consumers need information on protective technologies such as food irradiation. People today may be more aware of the benefits of this technology and the endorsement by health professionals due to the media coverage following FDA's approval of meat irradiation in December 1997.

Consumers use many sources for food safety information. Consumer perception of the reliability of convenient materials, like supermarket brochures, can be enhanced by including statements from reliable sources. Other work has shown that consumers are more likely to believe a message when it is heard from a variety of sources (Bruhn *et al.* 1992). This suggests that messages from multiple sources should be utilized to convey information to the public.

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