Purpose

Research Triangle Institute (RTI) is conducting a multiyear evaluation of the 1996 *Pathogen Reduction; Hazard Analysis and Critical Control Point (PR/HACCP) Systems; Final Rule* for the U.S. Department of Agriculture, Food Safety and Inspection Service (USDA, FSIS). As part of this evaluation, RTI is conducting this study to measure the changes in consumer knowledge of safe handling practices, consumers' use of safe handling practices (i.e., behavior), and their confidence in the safety of meat and poultry since the PR/HACCP farm-to-table initiatives were implemented.

These initiatives include the PR/HACCP rule itself plus consumer education campaigns, such as Fight BAC!™ and Thermy™; increased national, state, and local food safety efforts; promotion of farm-to-table strategies by trade associations, industry, and academia; and activities to strengthen education and training of those who handle food. The public's awareness and knowledge of safe food handling practices and their confidence in the safety of meat and poultry products may be influenced by these collective efforts that occurred concurrently with implementation of the PR/HACCP rule.

This report presents our key findings, describes our methodology, and presents the results of the data analysis through the year 2000.

Key Findings

We present our key findings below on changes to date since the PR/HACCP rule. One finding is particularly noteworthy as we review these results and prepare for next steps. Consumers report more confidence and knowledge but in fact are still unknowingly practicing some unsafe behaviors.

Consumer Knowledge and Behavior

- Consumer awareness and knowledge about safe food handling practices have increased. Most consumers report that they are knowledgeable about food safety and use certain safe handling practices such as keeping hands and surfaces clean and taking steps to prevent cross-contamination when cooking. However, when observed consumers do not always follow these practices.
- Although the self-reported use of some safe handling practices has increased, additional improvements are warranted. Many consumers report not following several safe handling practices: properly defrosting meat and poultry; reheating leftovers; and following the "when in doubt, throw it out" rule.
- Although more consumers are eating their hamburgers more thoroughly cooked because of safety concerns, most do not use a food thermometer to check hamburgers and other meat and poultry products for a safe internal temperature.
- Most consumers follow the safe handling practice of regularly checking expiration dates and seals on product packaging when deciding whether to purchase and/or use a product.
- Consumer awareness of *Salmonella* and *E. coli* is high, but consumer awareness of *Campylobacter* and *Listeria* is low.
- Most consumers do not think of any of the known high-risk groups (i.e., young children, seniors, pregnant women, and people with certain illnesses) when

asked which segments of the population are more likely to get foodborne illness).

- The most common sources of food safety information for consumers are product labels/packaging and radio/ television news programs.

Consumer Confidence

- Consumer confidence in the safety of meat and poultry is increasing.
- Most consumers are receptive and willingly accept responsibility for ensuring that the food they eat is safe. They express confidence in their ability to safely handle and prepare meat and poultry. However, some consumers either unknowingly or unwittingly do not always follow safe practices.
- Consumers believe that foodborne illness most likely stems from food handling procedures at food processing plants and restaurants rather than in their homes where they have control. The primary locations are unknown.

Methodology

We are using existing survey, observation, and focus group data and follow-up focus groups in 2002 to measure the changes in consumer knowledge, behavior, and confidence since the PR/HACCP farm-to-table initiatives were implemented. Table 1 identifies the studies we are using in our analysis. Many of the surveys are longitudinal so we can track changes since the 1996 PR/HACCP rule. However, only the FDA/FSIS Food Safety Survey was conducted prior to 1996. Appendix A identifies the sponsor, the data collection approach, the population, and the year(s) of data collection for each study.

In 2002, we will conduct focus groups with the general population and with high-risk populations (e.g., seniors and parents of young children). The purpose of the focus groups is to evaluate changes in consumer knowledge, behavior, and confidence among the general and high-risk populations since the PR/HACCP initiatives. In addition, we will analyze the 2001 survey data from the FDA/FSIS Food Safety Survey and other studies with 2001 data as identified in Table 1.

Results

We summarize the results of the data analysis below. We discuss the changes to date that the PR/HACCP farm-to-table initiatives have had on consumer knowledge and use of safe handling practices (i.e., behavior) and on consumer confidence in the safety of meat and poultry.

Consumer Knowledge and Behavior

Consumer awareness and knowledge about safe food handling practices have increased. For example, more consumers correctly identified meat and poultry as high-risk foods for foodborne illness in 1998 than in 1993. Perception of chicken as a high-risk food increased from 31 percent in 1993 to 45 percent in 1998. Similarly, perception of meat as a high-risk food increased from 24 percent in 1993 to 49 percent in 1998. Sixty-two percent of consumers correctly responded in 1998 that they could make food safe if it has *Salmonella* in it by cooking the food compared to 39 percent in 1993. The percentage of consumers who correctly think that microbes are a serious (or very serious) food safety problem increased from 36 percent in 1993 to 55 percent in 1998 (FDA/FSIS Food Safety Survey, 1993, 1998).

Table 1. Data Sources for Measuring Changes in Consumer Knowledge, Behavior, and Confidence Since the 1996 PR/HACCP Rule[a]

Sponsor	Study	Year(s) of Data Collection
Audits International	Home Food Safety Study	1997, 1999, 2000, 2001
CDC, FoodNet	Population Survey	1996/97, 1998/99, 2000/01
FDA	Utah State University Study	1999, 2001
FDA/FSIS	Food Safety Survey	1993, 1998, 2001
FSIS	Focus Group Study on Food Safety Messages and Delivery Mechanisms	2000
FSIS	Focus Group Study on Listeriosis Food Safety Messages and Delivery Mechanisms for Pregnant Women	2001
FSIS	Focus Groups on Changes in Consumer Knowledge, Behavior, and Confidence	2002
Penn State University	Food Safety Survey	1998, 1999, 2001
University of Maryland/FDA	Food Safety Survey	2001

[a]For the 2001 Food and Drug Administration/Food Safety and Inspection Service (FDA/FSIS) Food Safety Survey and the 2000/01 Centers for Disease Control and Prevention (CDC) Population Survey, we initiated "piggyback" data collection activities to add questions on consumer behavior and confidence to these ongoing surveys.

Most consumers report that they are knowledgeable about food safety, but when observed consumers do not always follow safe handling practices. Nearly 40 percent of consumers say that they know a great deal about food safety, and another 44 percent report that they have some knowledge of food safety (Penn State Food Safety Survey, 1998). However, in studies where consumers are observed during food preparation—the Audits International Home Food Safety Study and a study conducted by the Utah State University—actual practices often differ from reported practices. These studies find that consumers do not always follow safe handling practices such as handwashing and measures to prevent cross-contamination, despite reporting knowledge and use of these practices.

Findings from the Audits International Home Food Safety Study, a direct observation study, suggest that consumers improved their safe handling practices between 1997 and 1999, but additional improvements were not observed in 2000. In the Audits International Home Food Safety Study, household food preparers are observed preparing a meal at home.[1] In 1997, only 4 percent of households had acceptable performance (no critical violations[2] and no more than four major violations). In both

[1]Audits International uses a critical control point evaluation approach to evaluate in-home meal preparation that is similar to the U.S. Food Code.

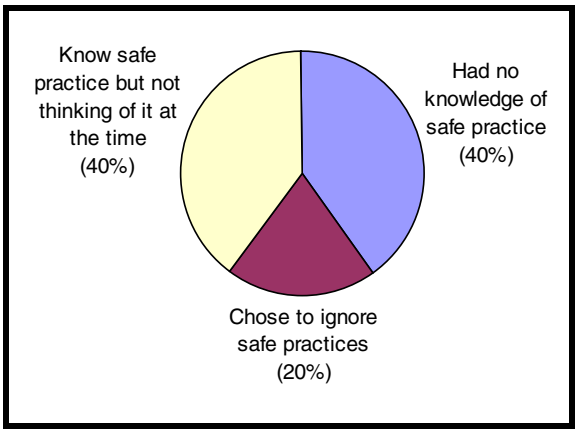
[2]A critical violation is a practice that, by itself, can lead to illness or injury (e.g., not cooking foods to the safe internal temperature or maintaining hot foods at temperatures that permit bacteria growth).

1999 and 2000, about 25 percent of households had acceptable performance. The study authors attribute the improvements between 1997 and 1999 to heightened awareness about food safety from increased media attention for certain foods (e.g., hamburgers, raspberries, eggs, and chicken). The authors suggest that further improvements were not observed in 2000 because media attention for these products has decreased. In 2000, the top four critical violations were neglected handwashing, improper food preparation techniques, cross-contamination, and improper handling of leftovers. These findings are consistent with the Utah State University study (Anderson et al., 2000), which videotaped study participants preparing meals.

Figure 1 illustrates reasons individuals participating in the 2000 Audits International Home Food Safety Survey gave for not following safe practices when cooking at home. About 40 percent of participants said that they had no knowledge of the safe practice, and another 40 percent said that they were not thinking of the practice at the time (i.e., they knew the safe practice but forgot to use the safe practice). The remaining 20 percent said that they were aware of the safe practice but did not believe it and therefore consciously chose to ignore it.

Most consumers report that they wash their hands and properly clean cutting boards; however, findings from observation studies suggest that consumers do not always follow these practices. As shown in Table 2, in 1998 more than three-fourths of consumers reported that they properly clean cutting boards after cutting raw meat or poultry and usually wash their hands with soap after handling raw meat or poultry. Consumers' reported use of these practices has increased since 1993. About 68 percent of consumers reported that they always wash their hands before cooking (FDA/FSIS Food Safety Survey, 1998). However, findings from observation studies show a gap between reported behavior and actual behavior. For example, 68 percent of consumers reported that they always wash their hands before cooking (FDA/FSIS Food Safety Survey, 1998); however, in the Utah State University observation study (Anderson et al., 2000), only 45 percent of study participants always washed their hands before cooking. Nearly all participants in the Utah State University Study (Anderson et al., 2000) cross-contaminated ready-to-eat foods with raw meat during meal preparation.

Figure 1. Consumers' Reasons for Not Following Safe Food Handling Practices



Source: Audits International Home Food Safety Study, 2000.

Many consumers do not properly defrost meat and poultry and do not properly handle leftovers. As shown in Table 2, many consumers reported unsafe practices in 1993 for defrosting meat and poultry and for handling leftovers. Only 46 percent of consumers reported defrosting meat and

Table 2. Changes in Consumers' Use of Specific Safe Handling Practices Since the 1996 PR/HACCP Rule

Practice	1993	1998
Properly clean cutting boards after cutting raw meat or poultry before using them to prepare other foods to be eaten raw for the same meal (i.e., wash board with soap, wash board with bleach and soap, or use a different board)[b]	68	79
Usually wash hands with soap after handling raw meat or poultry before continuing to cook[b]	66	76
Wash hands with soap all of the time before preparing food[a]	NA	68
Do not defrost meat or poultry by letting it stand at room temperature for any time[b]	46	NA
Own a food thermometer[a]	NA	46
Always or often use a thermometer when cooking roasts or large pieces of meat[b]	NA	22
Safely reheat leftovers containing meat or poultry (heat until bubbling or use a thermometer)[b]	20	NA
Always or often use a thermometer when cooking chicken parts such as breasts or legs[b]	NA	6
Always or often use a thermometer when cooking hamburgers[b]	NA	3

NA = not available.

[a]Results are for main meal cooks; n = 1,457 (1993) and n = 1,816 (1998).

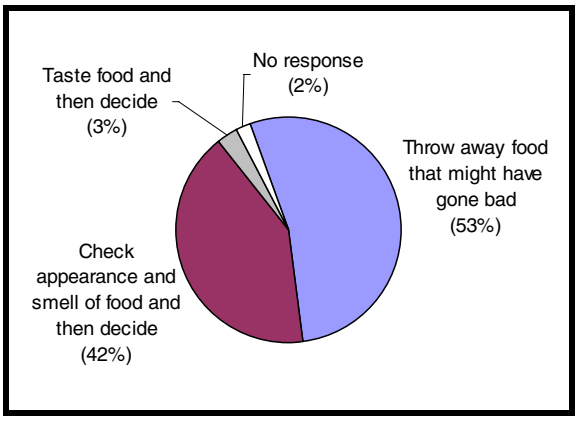
[b]Results are for main meal meat/poultry cooks; n = 1,415 (1993) and n = 1,766 (1998).

Source: FDA/FSIS Food Safety Survey, 1993 and 1998.

poultry safely and only 20 percent reported safely reheating leftovers (FDA/FSIS Food Safety Survey, 1993).

Nearly half of consumers do not follow the recommended rule "when in doubt, throw it out." As shown in Figure 2, 53 percent of consumers throw food out that they believe might have gone bad, 42 percent check the appearance and smell of the food and then decide, and 3 percent taste the food and then decide (Penn State Food Safety Survey, 1999). The correct practice is to throw away food that might have gone bad.

Figure 2. Nearly Half of Consumers Do Not Follow the Rule, "When in Doubt, Throw it Out"



Source: Penn State Food Safety Survey, 1999.

Nearly a third of consumers have their refrigerators at too high a temperature. The Utah State University study (Anderson et al., 2000) found that 29 percent of study participants have their refrigerator air temperature higher than 40°F, with 7 percent higher than 45°F. Refrigerators at too high a temperature prevent the food from reaching a safe cold storage temperature.

Most consumers use expiration dates and check seals of product packaging. About 85 percent of consumers report that they regularly check expiration dates and regularly check food packages to be sure the seal is not broken (Penn State Food Safety Survey, 1999). Checking expiration dates for perishable foods is a safe handling practice that is particularly important to help prevent listeriosis, since *Listeria* grows at refrigerator temperatures. Checking for unbroken seals helps ensure the product was not contaminated during shipping and handling.

Use of some safe handling practices differs among certain subpopulation groups. We conducted analyses using the 1993 and 1998 FDA/FSIS Food Safety Survey data to compare the safe handling practices of consumers in certain subpopulations—seniors (60+), individuals without a high school education, and households with young children (<5 years)—with that of the general population.[3] We summarize our findings below.

- Seniors are more likely to wash their hands before cooking, properly clean cutting boards, safely reheat leftovers, and own a food thermometer. Seniors' use of the other safe handling practices identified in Table 2 is similar to that of the general population.
- Consumers without a high school education are less likely to own a food thermometer and use a thermometer to check the doneness of large cuts of meats. Their use of the other safe handling practices identified in Table 2 is similar to that of the general population.
- Main meal cooks in households with young children are less likely to properly clean cutting boards, properly defrost meat/poultry, safely reheat leftovers, and own a food thermometer. The prevalence of the other safe handling practices identified in Table 2 is similar to that of the general population. This survey finding contradicts findings from focus groups with parents in which parents say that they are more cautious about food preparation since having children (Cates and Carter-Young, 2000, 2001).

Although more consumers are eating their hamburgers more thoroughly cooked because of safety concerns, most do not use a food thermometer to check hamburgers and other meat and poultry products for a safe internal temperature. The percentage of consumers who cook their hamburgers brown all the way through with no pink in the middle increased from 74 percent in 1993 to 83 percent in 1998 (FDA/FSIS Food Safety Survey, 1993 and 1998). About 73 percent of consumers reported that when eating at restaurants they order their hamburgers medium or well done with no pink on the inside (CDC Population Survey, 1998/99).

These findings are consistent with a survey conducted by the Market Research Corporation of America (MRCA) in 1996.

[3]We used a Chi square test to test for differences in prevalence rates of safe practices for the general population and the subpopulations of interest. We used SUDAAN, RTI's software for the statistical analysis of correlated data, to conduct the analysis.

Almost three-quarters of the respondents who started cooking their hamburgers more thoroughly said that they made the change because of the possibility of getting sick (Ralston et al., 2000).

In 1997, FSIS began recommending that consumers use a food thermometer to check for doneness of hamburgers. This recommendation is based on research by USDA's Agricultural Research Service (ARS) that indicates one out of four hamburgers turns brown before it has reached a safe internal temperature. In 1998, only 3 percent of consumers used a food thermometer when cooking hamburgers (FDA/FSIS Food Safety Survey, 1998).

As shown in Table 2, less than one-half of consumers own a food thermometer. Only 22 percent of consumers report using a thermometer when cooking roasts or other large cuts of meat. Few consumers use a thermometer when cooking small cuts of meat such as chicken parts or hamburgers. In the Utah State University study (Anderson et al., 2000), only 5 percent of study participants used a food thermometer to check for doneness, and most of them did not know how to interpret the reading. As a result, 82 percent of study participants undercooked the chicken entrée, and 46 percent of study participants undercooked the meat loaf.

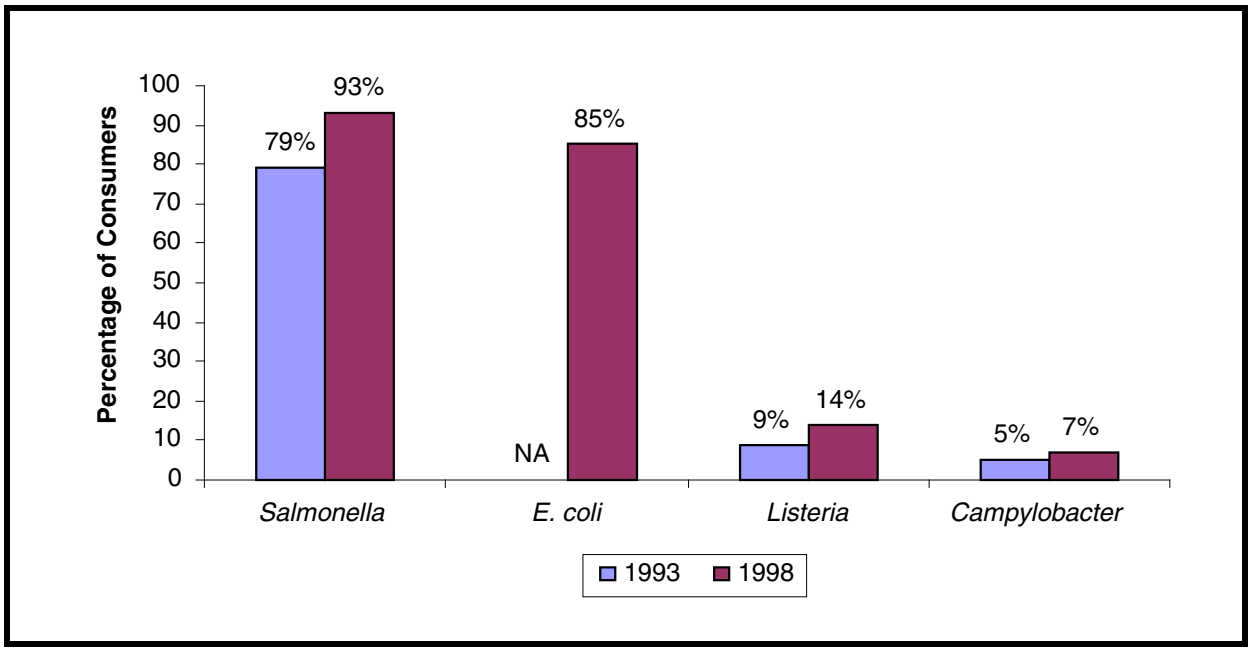
In spring 2000, FSIS rolled out its Thermy™ campaign, a national consumer education program to promote food thermometer use. We will use data from the 2001 FDA/FSIS Food Safety Survey on thermometer usage along with data from focus groups we are currently conducting to evaluate the effectiveness of the Thermy™ educational program and materials.

Awareness of specific pathogens is increasing. Consumers are aware of *Salmonella* (93 percent) and *E. coli* (85 percent) but are unfamiliar with *Listeria* (14 percent) and *Campylobacter* (7 percent) (FDA/FSIS Food Safety Survey, 1998). As shown in Figure 3, awareness of specific pathogens increased between 1993 and 1998, perhaps because of increased media attention. Compared with the general population, seniors (60+) and consumers without a high school education are less likely to be aware of specific pathogens.

Most consumers do not think of any of the known high-risk groups (i.e., young children, seniors, pregnant women, and people with certain illnesses) when asked which segments of the population are more likely to get foodborne illness). Less than 6 percent of consumers said that infants, young children, pregnant women, seniors, and people with certain illnesses are more likely to get foodborne illness (FDA/FSIS Food Safety Survey, 1998). This general lack of awareness hinders high-risk consumers from receiving the most safely prepared food.

The most common sources of food safety information for consumers are product labels/packaging and television/ radio news programs. About 40 percent of consumers get information on food safety from product labels and packaging and about 40 percent also get information on food safety from television and radio news programs. About 25 percent of consumers get information on food safety from newspaper and magazine stories and cookbooks. Few consumers rely on grocery store handouts, schools, government sources such as hotlines or extension offices, and the Internet for food safety

Figure 3. Changes in Consumers' Awareness of Specific Pathogens Since the 1996 PR/HACCP Rule



NA = not available.

Source: FDA/FSIS Food Safety Survey, 1993 and 1998.

information (FDA/FSIS Food Safety Survey, 1998).[4]

Consumer Confidence

Focus group findings suggest that confidence in the safety of meat and poultry is increasing. In focus group discussions with household food preparers from the general and high-risk populations (Cates and Carter-Young, 2000), most participants reported that their confidence in the safety of meat and poultry is increasing or about the same compared to 5 years ago. Participants attributed their increased confidence to increased awareness of safe handling practices, improved labeling (e.g., Safe Handling Instructions label), and prepackaging of meat and poultry. Only 1 of the 67 participants expressed negative feelings about the government's ability to keep food safe. The focus groups that RTI plans to conduct in 2002 will provide additional information on consumer confidence in the safety of meat and poultry.

Most consumers are receptive and willingly accept responsibility for ensuring that the food they eat is safe. They express confidence in their ability to safely handle and prepare meat and poultry. Nearly 85 percent of consumers strongly or somewhat agree that "food safety is up to each of us as individuals" (Penn State Food Safety Survey, 1998). About 68 percent of consumers say that they make a great effort to choose safe foods and handle them so as to keep them safe, and 24 percent say they make some effort (Penn State Food Safety Survey,

[4]Percentages do not equal 100 percent because consumers could respond to more than one category.

1998). However, as previously discussed, consumers do not always follow safe handling practices when observed cooking.

In focus group discussions with household food preparers from the general and high-risk populations (Cates and Carter-Young, 2000, 2001), most participants reported that they are completely or mostly confident that the meat and poultry they prepare at home are safe to eat. Participants attribute their confidence to the precautions they take to handle and prepare meat and poultry safely and confidence in supermarkets. However, discussions about their actual practices revealed that some participants unknowingly or unwittingly follow some unsafe practices when cooking at home.

Consumers are more knowledgeable about the potential risk of meat and poultry, and this increased knowledge may contribute to their confidence level. Nearly half of consumers correctly believe that meat and poultry pose a greater risk of foodborne illness than many other foods (FDA/FSIS Food Safety Survey, 1998). The perception that meat and poultry are high-risk foods increased between 1993 and 1998. In 1993, less than a third of consumers identified meat and/or poultry as high-risk foods. In 1998, this number increased to nearly 50 percent. Focus group findings suggest that consumers attribute the risk of foodborne illness from consuming meat and poultry to possible contamination by pathogens such as *E. coli* and *Salmonella* (Cates and Carter-Young, 2000, 2001).

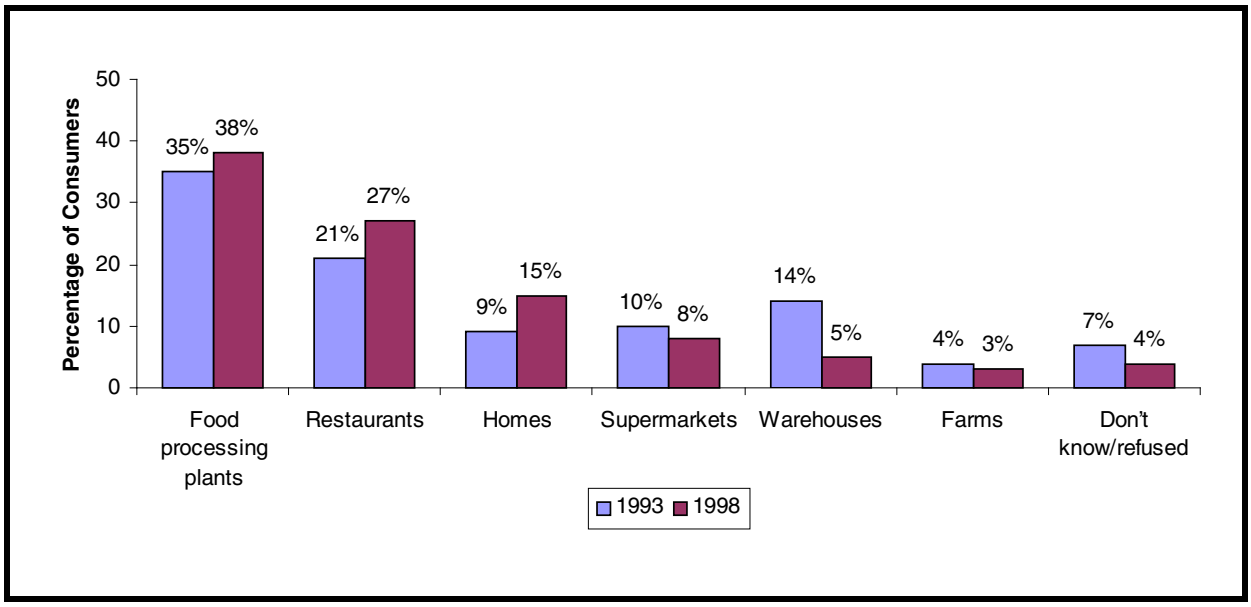
Consumers think foodborne illness most likely stems from food handling procedures at food processing plants and restaurants rather than their homes. As shown in Figure 4, consumers think foodborne illness is most likely to occur due to handling procedures at food processing plants (38 percent of consumers) and restaurants (27 percent of consumers) (FDA/FSIS Food Safety Survey, 1998). Only 15 percent of consumers think most food safety problems occur at home. Few consumers identified farms, warehouses, and supermarkets as sources of food safety problems. The percentage of consumers who believe food processing plants and restaurants are the source of most food safety problems increased between 1993 and 1998. Unfortunately, we do not know where most foodborne illness originates, and consumers believing it is outside the home might reduce their concern for food safety.

Conclusion

This report discusses the changes to date that the PR/HACCP farm-to-table initiatives have had on consumer knowledge and use of safe handling practices and their confidence in the safety of meat and poultry. Most consumers report that they are knowledgeable about food safety and that they keep hands and surfaces clean and follow practices to prevent cross-contamination when cooking; however, when observed consumers do not always follow these practices.

Although consumer awareness of pathogens is increasing, consumers do not always follow safe handling practices to minimize pathogens. For example, most consumers do not use a food thermometer to ensure that foods have been cooked to a safe internal temperature to kill pathogens, and many do not properly defrost meat and poultry and prepare leftovers. Consumers do report, however, that they regularly check product expiration dates on perishable foods, a practice that is particularly important to help prevent listeriosis.

Figure 4. Changes in Consumers' Opinions on Sources of Foodborne Illness Since the 1996 PR/HACCP Rule



Source: FDA/FSIS Food Safety Survey, 1993 and 1998.

Consumers express confidence in their ability to safely prepare meat and poultry products, but in reality, consumers do not always follow safe handling practices. We will conduct focus groups and analyze the post-HACCP survey data in 2002 to identify post-HACCP changes in consumer knowledge, behavior, and confidence. A final report on the changes in consumer knowledge, behavior, and confidence since the PR/HACCP rule will be published in September 2002.

References

Anderson, J.B., et al. 2000. "A Camera's View of Consumer Food Handling and Preparation Practices." Final report prepared for the Food and Drug Administration. North Logan, Utah: Spectrum Consulting.

Audits International. 2000. Home Food Safety Study. Northbrook, IL. <http://www.audits.com/>.

Cates, S.C., and H.L. Carter-Young. December 2000. "PR/HACCP Rule Evaluation Report—Focus Group Study on Food Safety Messages and Delivery Mechanisms." Final report prepared for the U.S. Department of Agriculture, Food Safety and Inspection Service.

Cates, S.C., and H.L. Carter-Young. February 2001. "PR/HACCP Rule Evaluation Report—Listeriosis Food Safety Messages and Delivery Mechanisms for Pregnant Women." Final report prepared for the U.S. Department of Agriculture, Food Safety and Inspection Service.

Centers for Disease Control and Prevention, FoodNet. 1996/1997. Population Survey data set. Atlanta, GA.

Centers for Disease Control and Prevention, FoodNet. 1998/1999. Population Survey data set. Atlanta, GA.

Food and Drug Administration and the Food Safety and Inspection Service. 1993. Food Safety Survey data set. Washington, DC.

Food and Drug Administration and the Food Safety and Inspection Service. 1998. Food Safety Survey data set. Washington, DC.

Penn State University. 1998. Tabulations from the Food Safety Survey provided by Dr. Rex Warland, Penn State University. University Park, PA.

Penn State University. 1999. Tabulations from the Food Safety Survey provided by Dr. Rex Warland, Penn State University. University Park, PA.

Ralston, K., et al. 2000. "Awareness of Risks Changing How Hamburgers Are Cooked." *Food Review* 23(2):44-50.

Appendix 1. Description of Data Sources on Changes in Consumer Knowledge, Behavior, and Confidence Since the 1996 PR/HACCP Rule

Sponsor	Study	Data Collection Approach	Population	Year(s) of Data Collection (number of data points)
Audits International	Home Food Safety Study	Direct observation—auditors scored individuals preparing a meal	Targeted sample of households in 70 to 80 metropolitan areas (not random)	1997 (106) 1999 (121) 2000 (115)
CDC, FoodNet	Population Survey	Telephone survey	U.S. individuals in FoodNet sites (5 sites for 1996/97 survey; 7 sites for 1998/99 survey); all ages eligible, limited to adults for RTI analysis	1996/97 (9,003) 1998/99 (12,755)
FDA	Utah State University Study	Direct observation—individuals videotaped and scored preparing meal	Targeted sample of residents of Utah; primary meal preparer; participants reflected the overall Utah demographics	1999 (99)
FDA/FSIS	Food Safety Survey	Telephone survey	U.S. adults; nationally representative sample weighted using Census counts based on proportions of the U.S. population categorized by race/ethnicity, gender, and education	1993 (1,620) 1998 (2,001)
FSIS	Food Safety Messages and Delivery Mechanisms	Focus groups	Household food preparers in four locations with general population, parents with young children, young adults, and seniors	2000 (67)
FSIS	Listeriosis Food Safety Messages and Delivery Mechanisms	Focus groups	Pregnant household food preparers in four locations; high-school educated and college-educated individuals	2001 (63)
Penn State University	Food Safety Survey	Telephone survey	U.S. adults	1998 (1,000) 1999 (1,400)