

Assessment of Current Guidelines for Culinary Preparation Methods of Fish and Shellfish

Jeri Elizabeth Kostal

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Susan E. Duncan, Chair  
Joseph E. Marcy  
Michael L. Jahncke  
Rick D. Rudd

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## ABSTRACT

Consumers regularly decide to consume fish and shellfish raw or undercooked, which can cause foodborne illness due to product contamination or unsafe handling by the consumer. In order to be considered safe for consumption, intact fish and shellfish should be prepared to an internal temperature of 63°C, according to the 2009 FDA Food Code, with *Salmonella* spp. as the target organism. Focus groups (5 groups, 32 participants) were conducted to determine consumer beliefs and concerns regarding fish and shellfish safety and preparation. Transcripts of focus groups were coded for themes, which were then grouped into categories. Nine categories emerged including: experience, trust, confidence, quality of product, motivation, concerns, cooking procedures, cooking instructions, and knowledge. Emerging themes were used to help develop educational materials to increase consumer ability to properly prepare fish and shellfish. In a separate experiment, participants (n=6) cooked salmon (baked, broiled), tilapia (baked, broiled), and shrimp (broiled, boiled) according to cookbook-based directions. Internal temperatures of products were recorded, with 33.3% of products cooked to a temperature less than 63°C. A group training session was held, during which participants received additional visual and non-oral texture evaluation guidelines to determine when products were prepared to 63°C and informed of safe food handling practices. After training, participants prepared the same products, demonstrating improved food safety behaviors and were more successful at cooking products to temperatures  $\geq 63^\circ\text{C}$  (94.4% of products). Improved cooking instruction and educational materials may reduce the risk of foodborne illness from undercooked fish and shellfish.

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## **Chapter 1**

### **Introduction**

Fish and shellfish are considered a healthy addition to consumers' diets. Both are low in calories when prepared using healthy preparation methods like baking, broiling, microwaving, poaching, steaming, and stir-frying. Both are also high-quality protein sources. Fish and shellfish also have a low content of total fat and saturated fat; the fat that is present in fish and shellfish is mostly unsaturated fat, including omega-3 fatty acids. Omega-3 fatty acids provide many health benefits including helping reduce the risk of heart disease, and increasing healthy brain and sight development in infants. Fish and shellfish are also low in cholesterol and sodium and are a good source of vitamins and minerals. Two fatty fish meals per week are encouraged in order to increase the dietary intake and achieve the associated health benefits of omega-3 fatty acids in the Western diet (USDA 2011).

Although the U.S. is ranked third behind China and Japan in total seafood consumption, the per capita consumption of fish is below the amount recommended for significantly influencing health benefits (NMFS 2011). In 2010, 15.8 pounds of fish and shellfish were consumed per capita in the United States (U.S.), a 0.2 pound decrease from 16.0 pounds in 2008-2009. Of the 15.8 pounds of fish and shellfish, 11.6 pounds per capita were fresh and frozen products, with 6.3 pounds of fresh and frozen finfish and 5.3 pounds of fresh and frozen shellfish per capita. There were 3.9 pounds per capita of canned fishery products consumed and 0.3 pounds per capita of cured fish consumed in 2010. Finfish include such species as salmon and tilapia; shellfish include crustaceans such as crabs and shrimp, and mollusks such as clams and oysters (NMFS 2011).

Most domestic fish and shellfish processing is in coastal areas and 86% of the seafood consumed in the U.S. is imported (NMFS 2011); the Pacific states (Alaska, Washington, Oregon, California, and Hawaii) have the most fish and shellfish processing and wholesale plants (907 plants), followed by the Mid-Atlantic states (New York, New Jersey, Pennsylvania, Delaware, District of Columbia, Maryland, and Virginia) with 620 plants, New England states (Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut) with 517 plants, South Atlantic states (North Carolina, South Carolina, Georgia, and Florida) with 455 plants, and lastly the Gulf states (Alabama, Mississippi, Louisiana, and Texas) with 391 plants (NMFS 2011). The most widely consumed fish and shellfish products per capita are shrimp (4.2 pounds), canned tuna (2.6 pounds), salmon (1.952 pounds), Pollock (1.312 pounds) and tilapia (1.287 pounds) (NFI 2011). Since most commercial fish and shellfish processing is coastal, a large segment of the U.S. consumer population is not familiar with handling fish and shellfish.

Consumer familiarity with consuming and preparing fish and shellfish may be limited as well, to personal experience with family units or exposure through media and retail/food service. Consumers and retail food establishments prepare fish and shellfish by many different methods based on the species, ease of preparation, and preference. Fish has a delicate texture and flavor and the eating quality deteriorates if overcooked, but it must be properly cooked for health safety reasons, primarily pathogen inactivation. Most preparation instructions related to fish and shellfish involve visual and textural cues to determine when the product has been cooked to the appropriate temperature of 63°C (145°F). This end point temperature is to be reached to insure pathogens present in the flesh of the fish or shellfish are inactivated. Using thermometers to measure the final endpoint temperature may not seem practical with many fish and shellfish products and preparation techniques (NACMCF 2008). The challenge of translating preparation

instructions into preparing a safe, fully-cooked product of good eating quality can be intimidating to someone who is not familiar with handling the product.

Intentionally or unintentionally consuming raw or undercooked fish and shellfish may lead to a foodborne illness (NACMCF 2008). The Centers for Disease Control and Prevention estimates that there are 48 million illnesses caused by foodborne agents each year (Gould and others 2011). Known pathogens cause 9.4 million illnesses each year. In 2008, the latest year for which that data was completed, there were 1,034 reports of foodborne illness outbreaks. About 23,152 illnesses were caused by these outbreaks, along with 1,276 hospitalizations and 22 deaths. The most common pathogen was norovirus, followed by *Salmonella*. Poultry (15%), beef (14%), and finfish (14%) caused the most outbreaks where food commodities were the vehicle of the outbreaks, which is a trend that has continued for the past 10 years (Gould and others 2011).

In 2010, 70.9 pounds of poultry, 56.7 pounds of beef, and 15.8 pounds of fish and shellfish were consumed per capita in the United States (United States Department of Agriculture (USDA) 2012), suggesting that incidence of outbreaks per pound of product consumed is much higher for fish and shellfish than for poultry or beef. If fish and shellfish were eaten as frequently as poultry and beef, the number of outbreaks could be much higher. The finfish outbreaks were caused by bacterial, including *Salmonella* and *Clostridium botulinum*, chemical, and toxin related illnesses. Ciguatoxin in finfish was one of the pathogen-commodity pairs that caused the most outbreaks (Gould and others 2011). There is a need to make certain consumers have a better understanding of how to properly prepare fish and shellfish to reduce the risk of food-borne illnesses, especially as there is encouragement to increase consumption of omega-three rich fish and shellfish for health benefits.

Increasing consumer knowledge and awareness of appropriate food preparation practices for fish and shellfish may help address causes of food-borne illnesses associated with fish and shellfish. Practicing sanitary and hygienic habits, ensuring that the temperature of the seafood is properly controlled, appropriate endpoint cooking temperatures are reached, and reducing contamination of the seafood prior to and after cooking are examples of such practices.

Consumers also need to be informed that they should not depend on preparation methods that do not employ heat application (ex. ceviche) or apply uncontrolled heat (ex. microwaving) to assure that the seafood product is microbiologically safe for consumption. Seafood that is raw or undercooked, not adequately handled or stored, or seafood that has been prepared by methods that do not employ heat application or employ uncontrolled heat application should not be consumed by elderly, immunocompromised, young children, or pregnant women. Programs related to education and outreach targeted toward consumers and retail food service workers should stress the risks of foodborne illness, sanitation importance, control of temperature, proper handling, cross-contamination prevention, and correct cooking times and endpoint temperatures (NACMCF 2008).

## **Goal**

The goal of this research is to develop guidance messages and instructional materials for consumers, retail food workers, and industry workers to increase their ability to properly prepare cooked fish and shellfish to the minimum internal endpoint temperature. The messages and materials should increase consumer awareness and influence behaviors to decrease the risk of undercooked or overcooked products, yielding a safe, high quality end product.

## Objectives

- 1) Determine consumer beliefs and concerns regarding fish and shellfish safety.
  - a) Develop ideas as to what barriers are present that prevent consumers from feeling confident of personal preparation of fish and shellfish in their own home, based on focus group data.
  - b) Determine what obstacles could exist that prevents consumers from obtaining information regarding fish and shellfish and what information vehicles are most widely utilized by consumers, based on focus group data.
- 2) Evaluate effectiveness of common visual cookbook descriptions for preparation of salmon, tilapia, and shrimp to the recommended minimum endpoint internal temperature of 63°C for a microbiologically safe product.
  - a) Develop a training session, including a video, brochure, pictures, and verbal guidelines, for communicating the indicators of undercooked salmon, tilapia, and shrimp and increase awareness of food safety protocols in cooking fish and shellfish.
  - b) Assess the effectiveness of training by comparing endpoint internal temperature measurements before training to measurements after training and determine if a higher percentage of temperature measurements achieve the 63°C recommendation.
  - c) Analyze video footage of consumers who prepare fish and shellfish in a laboratory setting, before and after training, to conclude what behaviors they are presenting that could be a barrier to preparing a salmon, tilapia, or shrimp meal that is microbiologically safe.

## References

Gould, L.H., Nisler, A.L., Herman, K.M., Cole, D.J., Williams, I.T., Mahon, B.E., Griffin, P.M., Hall, A.J. 2011. Surveillance for Foodborne Disease Outbreaks – United States, 2008. September 9, 2011. Morbidity and Mortality Weekly Report 60(35): 1197-1202.

National Advisory Committee on Microbiological Criteria for Foods (NACMCF). 2008. Response to the Questions Posed by the Food and Drug Administration and the National Marine Fisheries Service Regarding Determination of Cooking Parameters for Safe Seafood for Consumers. NACMCF, Washington, DC. J Food Prot 71(6):1287-1308.

National Fisheries Institute. 2011. Top 10 Consumed Seafoods. Internet. Accessed October, 22, 2012. <<http://www.aboutseafood.com/about/about-seafood/top-10-consumed-seafoods>>

National Marine Fisheries Service, Office of Science and Technology. 2011. [Internet]. Fisheries of the United States 2010. Silver Spring, MD. [Accessed 2012 October 22]. Available from: <[http://www.st.nmfs.noaa.gov/st1/fus/fus10/FUS\\_2010.pdf](http://www.st.nmfs.noaa.gov/st1/fus/fus10/FUS_2010.pdf)>

United States Department of Agriculture (USDA). 2012. Table 39 – Per Capita Consumption of Major Food Commodities. Internet. Accessed October 22, 2012. <[http://www.ers.usda.gov/datafiles/Agricultural\\_Outlook\\_Statistical\\_Indicators/Updated\\_Tables/AoTable39.xls](http://www.ers.usda.gov/datafiles/Agricultural_Outlook_Statistical_Indicators/Updated_Tables/AoTable39.xls)>

United States Department of Agriculture (USDA). 2011. Seafood Health Facts: Making Smart Choices. National Institute of Food and Agriculture, U.S. Department of Agriculture. Internet. Accessed October 22, 2012. <[seafoodhealthfacts.org](http://seafoodhealthfacts.org)>

## Chapter 2

### Literature Review

Fish and shellfish are commonly consumed by the general public at home or at restaurants. Fish and shellfish have been associated with foodborne illnesses, with about equivalent level of incidence as poultry and beef (Gould and others 2011), yet are consumed much less frequently (USDA 2012). This relationship suggests that these products may not be appropriately prepared to prevent foodborne illness. The consumption of raw fish and shellfish, such as fresh oysters, sushi, and ceviche, may be the primary reason that foodborne illness incidence is high. The recommended internal endpoint temperature for cooked intact fish and shellfish products is 63°C (145°F), as stated by the FDA Food Code (2009), which targets *Salmonella* destruction. Cooking fish and shellfish to temperatures excessively above the recommended temperature may decrease sensory acceptability of the end product but cooking to temperatures below the recommended temperature may cause foodborne illness. The temperature range that provides safety and maintains product eating quality is about a 10 to 15 degree window (63 to 78°C); products cooked to temperatures much higher than 75°C may cause a decrease in eating quality (Felice 2011). However, the internal temperature at which sensory acceptability and eating quality significantly decreases for fish and shellfish has not been established. Fish and shellfish have a delicate texture and finding the correct amount of cooking (heat and time combination) to ensure a high quality product that is safe to consume can be difficult. The following literature discusses fish and shellfish microbiology, common culinary guidelines for preparing fish and shellfish, consumer knowledge and perception of fish and shellfish, information that is currently available for consumers concerning fish and shellfish,

focus group methods and research, consumer concerns regarding seafood, consumer behavior studies, and consumer behavior modification studies.

### **Microbiology of Fish and Shellfish**

Most fish and shellfish are captured in masses with nets, which does not allow for individual inspection of each animal. Therefore, the quality of each fish or shellfish is not inspected, as is done with other high-protein meat sources, like cows, pigs, and poultry. As long as the fish remains intact and is kept chilled, the flesh of the fish will not be sensitive to microbial contamination. However, once the flesh of the fish or shellfish has been punctured, then it can become contaminated with bacteria and other microbial organisms. Commercial processing of fish and shellfish is less automated than the processing of animal and poultry carcasses; therefore, fish and shellfish are handled by workers more extensively when they are preparing the fish into fillets and other products for consumers to purchase. This increases the chances of contamination by workers who may not be practicing proper hygiene. As the fish or shellfish product is comminuted into smaller pieces, the chance of contamination increases. Fish and shellfish that are caught closer to shore may be more likely to be contaminated, since the water in these areas tends to be polluted with wastes that can contain pathogenic organisms (Satin 1999). Proper handling, preparation, serving, and storage of fish and shellfish decrease the chances of microbiological contamination (NACMCF 2008).

The bacterial pathogens occurring in fish and shellfish that most commonly cause infections are *Vibrio* species, *Salmonella*, *Shigella* species, *Clostridium botulinum*, *Staphylococcus aureus*, *Clostridium perfringens*, and *Bacillus cereus*. Other hazards that can occur in fish and shellfish include viruses, like norovirus and Hepatitis A virus, and parasites,

like helminthes and protozoa. Most of these are widespread in the environment; however, humans are the main reservoir for *Shigella*, *Staphylococcus aureus*, norovirus, and Hepatitis A virus (Iwamoto and others 2010). Other toxic substances that are associated with fish and shellfish are ciguatera poisoning, tetrodotoxin poisoning, scombroid poisoning, and shellfish poisoning (Satin 1999).

Of the 188 fish- and shellfish-associated outbreaks of foodborne infections from 1973 to 2006, bacterial agents caused the majority (143 [76.1%]), viral agents caused 40 (21.3%), and parasites caused 5 (2.6%). Mollusks (examples are oysters, clams, and mussels) were the source of most of the 188 outbreaks (85 [45.2%]), fish (examples are salmon and tuna) contributed 73 (38.8%) of the outbreaks, and crustaceans (examples are shrimp, crab, and lobster) caused 30 (16.0%). Oysters and clams were the source of mollusk outbreaks; salmon was the most common source for finfish outbreaks; and crab and shrimp were the most common sources for crustacean outbreaks. Other finfish that caused foodborne infection outbreaks were tuna, seal meat, whale, and whitefish. Most of the outbreaks were caused by *Vibrio* species, with *Vibrio parahaemolyticus* being the major contributor to outbreaks and causing 1,931 illnesses. Oysters caused 72.5% of the *V. parahaemolyticus* illnesses. *Clostridium botulinum* caused the second most seafood-associated outbreaks that were caused by a bacterial pathogen, followed by *Salmonella* and *Shigella*. The most common viral agent was norovirus, which accounted for about one-third (31.8%) of the mollusk-associated outbreaks and was mainly associated with raw oysters. Parasites caused a very limited number of outbreaks associated with seafood during the study period (Iwamoto and others 2010).

## **Cooking of Fish and Shellfish**

Proper handling, cooking, serving, and storage of seafood will help increase the microbiological safety of cooked seafood (NACMCF 2008). Proper preparation is needed to kill any microorganisms present naturally or introduced during handling (Brown 2007). The 2009 *FDA Food Code* recommends that fish be cooked to 63°C (145°F) or above for 15 seconds, with *Salmonella* being used as the target microorganism (FDA 2009). However, this time and temperature suggested is not based on pathogen inactivation data from specific research studies, since there is limited data concerning inactivation of *Salmonella* in fish and shellfish (NACMCF 2008).

Cooking time and temperature are important aspects to take into consideration when preparing fish and shellfish. Fish tissue is very fragile and can cause the consumer to undercook the product to ensure that sensory characteristics are not decreased, but the safety of the finished product should be prioritized over the quality of the sensory characteristics (NACMCF 2008). The tissue of fish has less collagen, lower content of the amino acid hydroxyproline, and shorter muscle fibers than meat or poultry. These characteristics cause the fish to be more tender and the flesh to flake easily when cooked (Brown 2007). Fish or shellfish should not be overcooked since it will become very flaky, dry, lose flavor, and become tough (NACMCF 2008). There are food safety risks associated with undercooking and eating quality risks when overcooked. Understanding raw handling and raw product quality is important.

Fresh fish or shellfish should be cooked within one to two days of catching or buying it, and should be frozen if it is not going to be cooked in that time span. Rombauer and others (2006) recommend keeping the fish or shellfish in the refrigerator on ice until it is ready to prepare. Before cooking, the fish should be rinsed with water and patted dry (Rombauer and

others 2006). Many cookbooks offer guidance and suggestions for proper cooking of fish and shellfish, including a variety of physical measurements of assessment that may not correlate well with actual endpoint temperatures above the targeted minimum internal temperature. One recommendation from Brown (2007) for cooking fish is the “10-minute rule.” When following this rule as a guide to prepare fish, the thickest section of the fillet is measured, and for every inch of thickness, 10 minutes at 350-400°F are needed to properly prepare the fish (Brown 2007). However, the “10-minute rule” may not guarantee cooking to the correct temperature, since fish fillets have varying thickness, which may affect under or overcooking outcomes. A more quantitative approach to determine if a fish has been cooked to the desired temperature is to use a thermometer placed in the thickest part of the fillet. According to Rombauer and others (2006), well-done fish is cooked when it has reached 63°C (145°F) as an internal temperature, and 49-57°C (120-135°F) represent thorough doneness for the majority of people. However, from a food safety standpoint, 49-57°C (120-135°F) is less than the minimum safe internal endpoint temperature and can increase the risk of a foodborne illness. Other methods used to determine when the fish is cooked are changes in physical characteristics, such as the flesh becoming firmer, the fillet beginning to flake, and the flesh becoming opaque throughout the fillet. A wooden toothpick can also be used, and when inserted it should meet little resistance and be clean when removed. When the flesh of the fish is pressed with a finger, it should return to the same shape as it was before pressing (Rombauer and others 2006). Shrimp will turn to a dark pink or red color when cooked (Brown 2007). Once again, these physical and visual measurements may not correspond to an internal endpoint temperature above the recommended minimum temperature of 63°C (145°F).

Rombauer and others (2006) state that baking is a very good method of preparation, since it helps maintain the mild taste of the fish. Broiling is also recommended as a preparation method because it browns the surface of the fish, adding additional flavor. Shrimp also do well with broiling, but can be boiled too (Rombauer and others 2006). Other methods of preparation common for fish and shellfish include pan-frying, poaching, or steaming tilapia, barbecuing, frying, steaming, or poaching salmon, baking, frying, or oven-finishing shrimp, as shown in Table 2-1 (Brown 2007).

Felice (2011) reported the corresponding internal temperature for certain preparation methods at varying cook times. Salmon, baked for 10, 15, and 20 minutes, reached average internal temperatures of 44°C, 59°C, and 70°C, respectively. Baked tilapia (10, 15, and 20 minutes) had average internal temperatures of 52°C, 63°C, and 71°C, respectively. Boiled shrimp (one, two, and three minutes cooking time) had internal average temperature readings of 43°C, 62°C, and 69°C, respectively. These culinary preparation methods represent common cooking methods and time/temperature ranges that may be used for preparing these products; they resulted in internal temperatures that were below, near, and above the recommended minimum safe endpoint temperature of 63°C (Felice 2011).

Felice (2011) determined consumer acceptability of salmon (baked, poached), tilapia (baked, pan-fried), and boiled shrimp prepared to 64°C ± 1 (145°F) and 74°C ± 1 (165°F). Based on overall acceptability on a 9-point hedonic scale, no significant difference was found between the mean hedonic ratings for the products prepared to the two endpoint internal temperatures. All products, except poached salmon, prepared to 74°C ± 1 (165°F) demonstrated an increase in average acceptability ratings compared to lower endpoint internal temperature. However, consumer acceptability of fish and shellfish products cooked to internal temperatures

greater than 74°C (165°F) has not been determined; therefore, the internal temperature at which consumer acceptability begins to decrease is unknown. For the remainder of this document, fish and shellfish products prepared to temperatures less than 63°C will be considered undercooked since they have not reached the recommended minimum internal temperature; products with internal temperatures of 63-74°C (145-165°F) will be considered in the “acceptable eating quality range” based on results from Felice (2011) where products prepared to 64°C ± 1 (145°F) and 74°C ± 1 (165°F) had high sensory acceptability; products with internal temperatures greater than 74°C (165°F) will be considered products with “unknown eating quality” because previous research has not determined the sensory acceptability and eating quality of products prepared to temperatures greater than 74°C (165°F).

**Table 2-1: Common Preparation Methods for Salmon, Tilapia, and Shrimp**

<b>Fish/Shellfish</b>	<b>Common Preparation Methods</b>
<b>Atlantic Salmon</b>	Baked, broiled, barbecued, fried, steamed, poached
<b>Tilapia</b>	Baked, broiled, pan-fried, poached, steamed
<b>Shrimp</b>	Broiled, boiled, baked, fried, oven-finished

Modified from Brown (2007)

### **Consumer Knowledge about Food Safety Practices and Perception of Fish and Shellfish**

Consumer decisions concerning foods is motivated by many different factors, including taste, opportunity, and cost. Guidance, information provided with purchases, product labels, and suggestions from health professionals also can influence choices regarding foods for consumers. In order to construct a plan to convey the health benefits and hazards of fish and shellfish consumption to consumers, there needs to be a better understanding of influences on consumers for food choices (Nesheim and Yaktine 2007).

Rod Smith, the senior vice president of the American Meat Institute, states that there is a knowledge gap involving the correct preparation temperatures and the use of thermometers with meat products (Smith 2011). The American Meat Institute conducted a poll concerning food safety knowledge, from which they found that the majority of American adults do not use thermometers to measure the temperature of the food that they are preparing, whether it be a meal containing meat or poultry or a packaged meal (Smith 2011). Most thermometers found at a grocery store or cooking supply store include temperatures to cook beef, pork, and chicken, but do not include the temperature for seafood. This is one example of a gap in the knowledge available for consumers concerning the proper preparation of fish and shellfish. In addition, many consumers have less experience and confidence in cooking fish and shellfish, which increases the risks of failure in cooking such products (below safe internal temperatures or overcooking).

In a survey sponsored by the American Dietetic Association (ADA) and the ConAgra Foundation, 76% of household food preparers (n=2,551) did not use a thermometer when they were preparing meats and poultry to determine the doneness of these products. Eight out of ten participants did not realize that utilizing a thermometer when preparing meats would help ensure that the end product would taste better since it would be cooked to the proper temperature and not over- or undercooked. Almost half of the participants responded that they did not wash their hands consistently when preparing meals on the grill. One in four of the participants stated that they would place cooked meats, including poultry and fish, on the plate that originally held the raw product. Forty percent of the male participants stated that they would use the same plate for cooked meats that held the raw meat, but that they would shake the plate off first (ADA and ConAgra Foundation 2000).

In a survey concerning practices regarding food safety in the home and consumer knowledge of these practices, 89% of participants (n=1,000) stated that they always/usually placed cooked meats on a different plate than the raw meat was placed and 20% of participants always/usually utilized a thermometer for meat, pork, and poultry to determine doneness, while 23% of participants will regularly use a thermometer for these products (ADA 2011). The majority of participants (95%) stated that they regularly use soap and water to wash their hands when preparing meals and 63% of participants stated they regularly cook products to the recommended temperatures (ADA 2011)

Frewer and others (1994) found that participants believed they could control risks concerning food poisoning in home and believed they were at low risk and had much knowledge about the topic. Ninety percent of participants of a questionnaire believed foods that were self-prepared had a low risk to cause the participant to become ill after consumption. Sixty-six percent of the participants also believed they controlled the safety of the food that they were preparing while 58% believed that the same amount of control was expressed by 'other people' (Redmond and Griffith 2004a). Participants also believed that the location they would be least likely to acquire a foodborne illness was the home, followed by at a home of a parent or friend. Food was prepared at home by 80% of the participants in this study once or twice a day (Redmond and Griffith 2004b).

Brunso (2009) concluded that consumers in European countries who regularly consume fish (at least twice a week) felt more confident handling fish and did not experience problems preparing fish dishes compared to consumers who ate fish once a week to once a month. Consumers who ate fish less often did not feel as confident handling or preparing fish and had more problems in handling and preparing (Brunso 2009).

Hicks and others (2008) also suggested that regular seafood consumption may be associated with knowledge and confidence in handling seafood. An internet survey (July 27-August 7, 2006; U.S., n=1,062) in which consumer awareness of and opinion of seafood and the consumption of seafood was evaluated, identified that seafood consumption is positively impacted by income, education, and age. Those respondents who consumed seafood frequently also prepared the seafood at home more often than going to a restaurant, which could indicate that these people have a better knowledge and comfort level when handling, cooking, and keeping seafood (Hicks and others 2008). When participants of the survey were asked as to why, if they had decreased seafood consumption, the main reason stated was a change in taste preferences. When asked what the biggest safety issues affiliated with seafood were, only 30% knew that the correct answer was pathogens and allergens. Also, 81% of the respondents did not know about warnings involving consumption of seafood caught locally. Respondents (47%) stated that they trusted advice concerning seafood from the government, but only 26% agreed that the government could guarantee product safety. The consumers surveyed believed that the most important factors determining purchase habits of seafood were quality, handling practices, cooking, and storage; however, respondents also did not feel confident about their knowledge regarding these factors, with only 29-39% believing that they were knowledgeable. Hicks and others (2008) believe that outreach education is needed to increase consumer knowledge so that consumers who do not eat seafood frequently will be able to have more confidence to buy and cook seafood at home. Media and internet sources for information about seafood typically employed by the respondents were the media and the internet. The sources not commonly used by the respondents were health professionals, family and friends, and information from stores or that comes with purchased products (Hicks and others 2008).

Felice conducted an internet survey (2011; Seafood (including Fish) Consumer Survey) concerning seafood safety attitudes and habits of seafood and fish consumption. Felice (2011) found that only 16% of participants (n=107) identified (wrote in) the correct temperature for fish and shellfish (63°C/145°F). Most participants (74%) used visual indicators to determine when fish and shellfish were done and 67% of participants stated that they ate raw or undercooked fish and shellfish knowingly. Health concerns that were associated with consuming raw fish and shellfish included different microorganisms, illness, and mercury contamination. Nearly half (48%) of survey respondents worried about undercooking fish and shellfish when preparing products at home (Felice 2011).

### **Information Available to Consumers**

Nesheim and others (2007) divide sources of information available to the consumers into elements that can be controlled by the government agencies and those that are not able to be regulated. Sources that can be regulated include labels and information included with purchased products, such as nutrition and ingredient facts, claims regarding health, country of origin and wild or farm-raised information. Other sources of information include menus from restaurants and fast-food places. Advertising and promotional information may not always be regulated by government. This includes any type of brochures or pamphlets (Nesheim and others 2007). The internet is now commonly being used to research information regarding health. These sources are not always reviewed by experts or government agencies (Hicks and others 2008). The information included on these websites also may not be updated very often (Nesheim and others 2007). Along with the brochures, pamphlets, and internet sources, there are books and games concerning food safety that are targeted toward consumers (Table 2-2). These sources all have

information that could be beneficial to consumers of fish and shellfish; however, none of the sources give visual images that might be instructive for proper fish and shellfish preparation to 63°C.

**Table 2-2: Examples of Resources Pertaining to Food Safety Information Available to Consumers**

Source	Brochure	Website	Book	Other	Relevance
<i>Keep Food Safe: Food Safety Basics</i> (USDA 2007)	✓				Food safety basics, internal temperatures, safe storage temperatures
<i>Seafood Savvy: A Consumer's Guide to Seafood Nutrition, Safety, Handling, and Preparation</i> (Gall 1992)	✓				Seafood nutrition, safety, buying, selection, handling, storage, and preparation
<i>Seafood Is Good for You!</i> (Hicks and Wakefield 2010)	✓				Seafood nutrition and nutrient composition, preparation and handling
<i>A Consumer's Guide to Safe Seafood Handling</i> (Hicks 2010)	✓				Seafood inspection, buying, handling, preparation, and storage guide
<i>Safe and Nutritious Seafood in Virginia</i> (Villabla and others 2008)	✓				Targeted to Virginia consumers, seafood inspection, labeling, hazards, selection, storage, preparation, availability, benefits and nutrition
<i>A Guide to Seafood Sanitation Procedures: Handling Seafood Safely</i> (Nash and Green 2004)	✓				Food safety sanitation practices for employees of a seafood company
www.meatsafety.org (American Meat Institute 2012)		✓			Information regarding proper handling and preparation of meat and poultry
www.fsis.usda.gov (United States Department of Agriculture/Food Safety and Inspection Service 2012)		✓			Videos of preparing meat, poultry, and eggs safely

<b>www.deseagrant.org/ou treach/seafood (University of Delaware College of Earth, Ocean, and Environment and the Delaware Sea Grant College Program 2012)</b>	✓	Seafood research, education, outreach & extension, news & events, publications & products
<b>www.aboutseafood.com (National Fisheries Institute 2012)</b>	✓	Seafood recipes, cooking, health & nutrition, quality
<b>http://seafoodhealthfact s.org/ (National Institute of Food and Agriculture, U.S. Department of Agriculture 2012)</b>	✓	Information and publications about seafood choices, nutrition, safety, benefits & risks
<b>http://seafood.ucdavis.e du/consumer.html#secti on1 (Sea Grant Extension Program Food Science and Technology Department University of California 2012)</b>	✓	Consumer seafood information and publications about purchasing, recipes, health, preparation, quality, storage
<b>http://www.vims.edu/re search/units/centerspart ners/map/seafood/index. php (Virginia Institute of Marine Science 2012)</b>	✓	Seafood education, health, nutrition, safety, species, chef recipes
<b><i>Food Alert! The Ultimate Handbook for Food Safety (Satin 1999)</i></b>	✓	Food-borne diseases, sources of these diseases, consumer protection, food-borne pathogens
<b><i>Kitchen Smarts: Food Safety and Kitchen Equipment (Ruffin 2005)</i></b>	✓	Kitchen safety basics targeted to children
<b><i>Quick Reference to Food Safety &amp; Sanitation (Rue and Williams 2003)</i></b>	✓	Reference book for managers, supervisors, and food workers for food safety and sanitation
<b><i>Internet Guide to Food Safety and Security (Conner 2005)</i></b>	✓	Lists websites for information regarding healthy handling, preparing and storing food

<b><i>Kitchen Safety</i></b> <b>(Learning ZoneXpress</b> <b>1998)</b>	✓	and consuming foods prepared by others Game to teach children kitchen safety basics
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## **Focus Group Research Methods**

One method for gathering information about consumer perception of fish and shellfish preparation and cooking, the habits they use, and the associated food safety concerns is to utilize focus groups. Focus groups are a method to collect qualitative data concerning how the participants feel or think about the topic of interest. The goal is to determine what the target population really thinks and what their true emotions are toward the research topic. The environment must be comfortable and permissive, and the members of the group should have similar characteristics, which are of interest to the researcher. The purpose is for participants to have an effect on each other and to influence the thoughts and ideas of each other. The typical size of focus groups can be five to ten people, but can be anywhere from four to twelve people. Three separate focus groups, at a minimum, are needed so that the researcher will be able to analyze the data from each group and compare and contrast between the groups (Krueger and others 2000).

Focus groups can be used when the researcher wishes to gather richer information about a topic, instead of general knowledge that can be obtained through quantitative methods and other qualitative methods, like surveys. The researcher desires interaction among members of the focus groups during the sessions. The participants' motivation can be examined, and since there is more interaction in the focus group setting, more information about these motivations can be obtained from the participants listening to each other and becoming more aware of their own thoughts or feelings toward the topic. The experiences and attitudes of the participants can be

detected and how these experiences affect the attitudes they express can be examined (Morgan 1993).

A moderator is needed to lead the discussion with questions that are prepared in advance and are somewhat structured. Questions should be general and open-ended. The answers of the participants should not be taken as the complete truth, since they may be saying answers that they assume the moderator wants, may be agreeing with others in the group, or could not be giving their full opinions. The data that is produced is usually closer to public opinion with a smaller selection of participants (Morgan 1993).

The main ways of collecting data from focus group discussions include transcripts, tapes, notes, and memory. Transcripts are typed documents that have the exact conversation and words of the focus group participants and the moderator. When notes are used, a shortened version of the focus group discussion is prepared, with only the important areas of the discussion included. Notes are based on the comments made during the focus groups. Audio and video recordings are typically also used for clarification along with the notes. Memory-based data is used when the results are definite.

There are several methods suggested by Krueger and Casey (2000) to analyze the data. The “Long-Table Approach” involves printing off the transcripts, cutting them apart, organizing the transcripts according to the participant category or demographics, placing the participants’ comments with the corresponding question, and preparing a summary describing the responses to the questions. Important factors to consider are how often comments are made, the detail of responses, emotion behind the comments, and extensiveness of responses. An overall summary of the summaries of the responses to the questions then is prepared. Computers also can be used to analyze the data, using “cut and paste” methods, coding quotes, and using qualitative analysis

software. Krueger and Casey (2000) also mentions a “rapid approach” when there is a short deadline for a decision. There is the “sound approach”, which uses software to tape the focus group and allows the moderator to mark parts of the discussion that he or she wishes to return to during analysis (Krueger and Casey 2000).

### **Consumer Concerns Regarding Seafood**

Focus groups have been used to evaluate consumer (Europe and U.S.) concerns and interests in fish consumption. Primary topics of concern focused on mercury, foodborne illness, price of fish and shellfish, and quality (Athearn and others 2004; Borresen 2008; Brunso and others 2009; Dulsrud and others 2006; Levy and Derby 2000; Pieniak and others 2008; US EPA 2006; Wysocki and others 2009).

Levy and Derby (2000) found that participants were not generally concerned about the risk fish containing mercury, and that new information should be categorized by problems with fish instead of mercury sources; participants believed that mercury present in fish is a pollution problem (Levy and Derby 2000). The FDA and EPA evaluated consumer comments obtained through 16 focus groups, in seven different U.S. locations before they issued a fish advisory concerning the mercury present in fish and shellfish. Based on the focus group comments, FDA and EPA modified the advisory and determined the best title would be “What You Need to Know about Mercury in Fish and Shellfish” (US EPA 2006). Participants were unsure about mercury contamination in wild caught seafood and stated that mercury levels were a reason for their decreased seafood consumption (Wysocki and others 2009).

Perceived concerns with consuming fish were acquiring food poisoning/becoming ill from some type of bacterial or chemical contamination, as a result of consuming fish (Pieniak

and others 2008). Athearn and others (2004) conducted focus groups with pregnant women, an at risk group for food-borne illness, to assess knowledge and acceptance of recent food safety advice, including consumption of raw or undercooked seafood, like sushi. Participants were aware and accepted the recommendation that women who are pregnant should not consume raw or undercooked seafood and were willing to change behaviors about eating raw fish and shellfish. Participants believed that eating raw seafood was risky and should be avoided during pregnancy. Participants indicated that, if they ate sushi prior to becoming pregnant, they were willing to stop eating sushi after becoming pregnant (Athearn and others 2004).

The price of fish and shellfish and the effectiveness on satiety influences consumption. Fish was perceived as an expensive product (Brunso and others 2009; Wysocki and others 2009). Participants did not feel that fish was as filling as meat and they became hungry earlier than when they consumed meat. Participants felt that they would have to consume a greater amount of fish to have the same sensation of fullness, which could also lead to higher costs (Brunso and others 2009).

Perceived quality of fish and shellfish affects consumer behavior. Appearance of the fish or shellfish affects the choice to purchase a fish or shellfish product. Taste and odor also affect purchasing habits (Wysocki and others 2009). When selecting fish for purchase, Spanish consumers were more confident in their ability to determine fish quality compared to Belgian consumers. Both participant groups considered country of origin of the product an important issue to consider when determining the quality of fish. The more experienced the participant was with seafood, fewer barriers were perceived and they were more confident when selecting fish (Brunso and others 2009). Experience with seafood products also determines the consumers'

ability to analyze quality and their interest in having more information available concerning quality (Verbeke and others 2006).

Several studies have been conducted to determine what causes consumers to make their choices when deciding whether or not to consume seafood (Altintzoglou and others 2010; Brunso and others 2009; Pieniak and others 2008; Borresen 2008). Six focus group studies, conducted in two European countries, three in Spain and three in Belgium, investigated motives and barriers that were present in two user groups, light users and heavy users, for consuming fish and shellfish (Brunso and others 2009). Health benefits were an attitudinal motive for the consumption of fish, as also identified by Pieniak and others (2008) and Borresen (2008). The idea that fish and shellfish are healthier protein sources than meat was also discovered. The reason most often stated by the participants for seafood being healthy was polyunsaturated omega-3 fatty acids. Healthfulness of fish was perceived as completely lost if the product is not fresh enough. Another motive for consuming seafood was taste preferences (Brunso and others 2009; Borresen 2008).

Barriers to fish consumption included price, sanitation, smell, and bones within the product. Smell was a barrier, since the participants did not like the smell when they were cooking fish. The fact that some fish has bones was also a barrier for fish consumption (Brunso and others 2009). Altintzoglou and others (2010) reported concerns that increased effort was required for preparation of seafood products. Participants in these studies wanted concise instructions on how to prepare the products and what materials to use (Altintzoglou and others 2010).

Terminology categorizing fish and shellfish products is confusing to the general public. The word “finfish” confused participants while most participants understood the term “seafood”

(Wysocki and others 2009). When “wild caught” was mentioned, participants associated this term with better for them, less chemicals, and products with a better taste. Participants associated “farm-raised” with antibiotic use and environments where everything is controlled while other participants believed these products were pure, clean, and supported by research. Other word associations included “fresh” and “processed”, where “fresh” was what the participants wanted and “processed” had a negative connotation. “Sustainability” was considered a shelf-life issue instead of how the seafood was raised and harvested. Participants expressed the concept that the origin of the seafood matters sometimes (Wysocki and others 2009).

Verbeke and others (2005) determined that there is a gap in knowledge of consumers concerning nutrient content and the health benefits of fish. Age and education had a positive effect on the knowledge of participants concerning health benefits and risks of consuming seafood. This study concluded that more information is needed regarding nutritional content of fish and that communication needs to be more effective to educate the broader public about the benefits and risks of consuming fish (Verbeke and others 2005). Wysocki and others (2009) also determined that there was a need for more advertising and information about health benefits and different types of seafood, along with more education for people who work in retail and at restaurants. Another theme was that consumers needed more education on preparation, cooking and uses for different types of fish and shellfish (Wysocki and others 2009). Norwegian and German participants in focus groups indicated that they would like more information on freshness, fat content of fish, and quality and ethical issues (Dulsrud and others 2006).

## **Perceived Consumers' Knowledge Effect on Actual Behaviors**

Modifying behavior to improve practices does not always follow directly with increase in knowledge. Behavior modification often takes many steps, including an increased awareness of the current behavior. Videotaping provides actual documentation of behaviors presented by participants and can provide additional support to qualitative research studies. Use of video observations can provide information concerning difference between behaviors that participants state they perform and behaviors they actually perform. Using coding software provides a simple and efficient way to analyze these behavioral observations through counting, categorizing, and timing duration of such actions.

Studies have been conducted to determine consumer behaviors during meal preparation (Anderson and others 2004; Audits International/FDA 1999; Fischer and others 2007; Phang 2010; Scott and Herbold 2010; Worsfold and Griffith 1997). Results showed that consumer behavior when preparing meals increased risk for cross-contamination and foodborne illness. Video observations were used to evaluate consumer behaviors when preparing a meal (Anderson and others 2004). Participants (n=99) were video recorded while cooking a meal containing chicken, ground beef, or seafood (halibut) in their own household. Footage was coded for hand washing, washing of surfaces, cleaning of ingredients, contamination between ingredients, checking temperatures of meal, storage of the final product, and other behaviors based on the Fight BAC! recommendations (Partnership for Food Safety Education (PFSE) 2010). Overall, participants neglected to comply with recommendations of the Fight BAC! handling instructions while preparing the meals. Cross-contamination occurred in almost all of the cooking sessions (Anderson and others 2004). In another observational study in Netherland concerning consumers preparing meals at home, Fischer and others (2007) found that, even though the

participants were aware of food safety issues while preparing meals, it did not always correlate to proper food safety behaviors. Phang (2010) filmed 201 participants while they prepared meals containing burgers and vegetables. Some of the major conclusions from this study were that the majority of participants did not wash their hands long enough or with soap, cleaning utensils with soap and water between different items of food was rare, and that participants performed actions that could cause cross-contamination, like using utensils and cutting boards for both raw meat and vegetables (Phang 2010). Scott and Herbold (2010) observed that lettuce was not rinsed by 40% of participants and tomatoes by 27%. After handling the raw meat, 30% of the participants did not wash their hands even though all participants said that it was valuable practice on the questionnaire (Scott and Herbold 2010).

Consumers do not commonly use thermometers to validate the internal temperature when cooking meat, poultry, or seafood. In the video study by Anderson and others (2004), thermometers were used by only five participants (n=99) to determine meat/poultry/fish doneness. The most common methods for checking the beef, chicken, and fish for doneness were cutting it open or poking the entrée. Forty-three participants did not know the correct endpoint internal temperature for chicken and 44 did not know the correct endpoint internal temperature for ground beef, based on responses to a questionnaire. Chicken was undercooked by 61% of the participants and the ground beef was undercooked by 46% of the participants (Anderson and others 2004). In an observational study performed by Worsfold and Griffith (1997), 15% of cooking occurrences involved cooking a product to below the recommended internal temperature of 74°C. Chicken was not cooked to the proper temperature by 16% of the participants, egg dishes were undercooked 28% of cooking occurrences, and beef dishes were thoroughly cooked by all participants (Worsfold and Griffith 1997).

Phang (2010) observed that 30% of participants (n=201) undercooked burgers and over half of the participants were unaware of the correct final internal temperature for ground beef. Only 12% of the participants knew the correct endpoint temperature. Four percent of the participants utilized thermometers to measure the internal temperature of the burgers and over half did not think they were necessary (Phang 2010). Scott and Herbold (2010) also had participants (n=30) prepare hamburgers and only one participant used a thermometer to measure the temperature of the burger.

In a study by Audits International/FDA (1999), of the 201 instances that fish was prepared in participants' households, 76 (38%) of the final entrees did not reach the recommended 63°C (145°F) endpoint internal temperature. The participants prepared the fish to an average of 66°C (151°F), and to temperatures from 40°C (104°F) to 91°C (196°F) (Audits International/FDA 1999). This range illustrates that many consumers do not prepare fish and shellfish to the safe minimum internal temperature to protect against food-borne illness. In addition, there is a high probability that overcooking may result as well, affecting quality characteristics of and satisfaction with the final product.

Food prepared at home was not considered to have any risk by 20% of the participants. Participants' actions differed from their reported beliefs and they did not know about food safety concerns regarding pathogens in foods (Scott and Herbold 2010). The majority of participants were not educated about foodborne illness and a fifth of the participants believed that food from outside of their home could only get them sick (Phang 2010).

## **Consumer Behavior Modification in Domestic Settings**

Few studies have been performed that evaluate the effectiveness of behavioral modification regarding consumer food safety practices in the domestic setting. Most studies (Angell 2008; Cody and Hogue 2003; Dharod and others 2004; Medeiros and others 2004; Nies and Van Laanen 1995; Takeuchi and others 2005; Unusan 2007) utilized questionnaires concerning food safety knowledge and self-reported behaviors after intervention was implemented. Two studies (Nauta and others 2008; Redmond and Griffith 2006) observed behaviors of participants during meal preparation.

Angell (2008) distributed surveys to participants of “Good Foods for Good Health” programs regarding food safety, including knowledge and self-reported behaviors concerning food safety. Respondents (n=31) showed a significant increase ( $p < 0.0001$ ) in knowledge of food safety and significant increase ( $p < 0.01$ ;  $p < 0.05$ ) in self-reported behaviors after participating in the program (Angell 2008). A phone-based survey was used to determine changes after interventions concerning public food-safety (Cody and Hogue 2003). A pre-survey was performed (n=1,000) in 1999, then a post-survey (1,006) in 2002. Gaps remained in knowledge about food safety that was covered in the “FightBAC!” and “Home Food Safety...It’s in Your Hands” campaigns. Behaviors self-reported by participants indicated more thorough cooking of products, increase in correct hand washing practices after handling raw products, and an increase in thermometer use (Cody and Hogue 2003). Connecticut’s urban Latino population was exposed to the “FightBAC!” campaign after baseline data was gathered (Dharod and others 2004). After exposure, respondents (n=250) showed an increase in knowledge about food safety and an increase in defrosting meat products in the refrigerator and proper hand washing before cooking (Dharod and others 2004). College students (n=103) and consumers (n=158) took part

in a food safety questionnaire before and after undertaking in food safety programs (Medeiros and others 2004). Significant increases occurred in knowledge regarding food safety for both groups, but did not occur in the control group (Medeiros and others 2004). Participants (n=100) were contacted (phone) after attending programs regarding food safety (Nies and Van Laanen 1995). Self-reported behaviors that showed significant improvement included: thawing food in refrigerator; thermometer use; cleaning areas of food preparation; proper hand washing techniques; food refrigeration; and correct use of cutting boards (Nies and Van Laanen 1995). Increasing motivation of thermometer use was studied by Takeuchi and others (2005). Information packets concerning thermometer use were sent to consumers, followed by a survey about the information packets' effect on consumer motivation to use thermometers. Respondents (n=275) indicated increased motivation to use thermometers for small meat cuts after utilizing the packet materials (Takeuchi and others 2005). In a study by Unusan (2007), the effectiveness of online education about food safety was determined, showing that significant improvement regarding food safety behaviors can be implemented using online educational materials.

Nauta and others (2008) utilized a transdisciplinary approach (Fischer and others 2005), which incorporated research from risk communication, microbiology, and risk assessment to develop an intervention for risk information. Participants (n=86) were randomly assigned to three groups (control (n=29); information (n=28); information + cue (n=29)). Participants were given ingredients and to prepare a chicken salad at their homes, of which the raw chicken breast had been inoculated with *Lactobacillus casei* (model organism for *Campylobacter jejuni*). The control group did not receive risk information, while the information group received risk information that elicited a disgusted emotion. The third group also received the risk information and received a behavioral cue with the ingredients that warned them to try to prevent cross-

contamination while handling the raw chicken. After preparation, participants placed left-overs into the refrigerator, which were then collected by researchers. Risk reduction was largest when the cue was added to the information. The transdisciplinary approach is an effective method to evaluate intervention for risks concerning human health (Nauta and others 2008). Redmond and Griffith (2006) conducted a pilot study for food safety interventions in South Wales, UK. Females (n=24) were observed while preparing a meal in a model home kitchen. After a baseline session, intervention concerning food safety was implemented. Immediately after the intervention, participants were observed as they prepared a second meal. A third meal was prepared by participants four to six weeks after the intervention. Participants showed short-term increase in behaviors regarding food safety, but a decrease in these behaviors occurred during the preparation of the third meal (Redmond and Griffith 2006).

## **Conclusions**

Fish and shellfish are commonly consumed in the United States. Currently culinary guidelines for the preparation of these products may not be adequate for consumers to be able to reach the correct internal temperature. Effective educational materials and culinary guidelines need to be developed to inform consumers of these risks and benefits and to help consumers feel more confident regarding fish and shellfish handling and preparation. Training materials to help educate consumers about handling practices that will ensure safe food are also needed.

## References

- Altintzoglou, T., Hansen, K.B., Valsdottir, T., Odland, J.O., Martinsdottir, E., Brunso, K., Luten, J. 2010. Translating Barriers into Potential Improvements: The Case of New Healthy Seafood Product Development. *Journal of Consumer Marketing* 27(3): 224-235.
- American Dietetic Association. 2011. Consumer Knowledge of Home Food Safety Practices Survey. Academy of Nutrition and Dietetics. November 4, 2011. Internet. Accessed September 23, 2012. < [http://homefoodsafety.org/pub/file.cfm?item\\_type=xm\\_file&id=2399](http://homefoodsafety.org/pub/file.cfm?item_type=xm_file&id=2399)>.
- American Dietetic Association and ConAgra Foundation. 2000. Home Food Safety Summer Survey Key Findings. May 12, 2000. Academy of Nutrition and Dietetics. Internet. Accessed September 23, 2012. < <http://homefoodsafety.org/media-releases-may12-2000-key>>.
- American Meat Institute. 2012. Meatsafety.org. Internet. Accessed October 22, 2012. < [www.meatsafety.org](http://www.meatsafety.org)>.
- Anderson, J.B., Shuster, T.A., Hansen, K.E., Levy, A.S., Volk, A. 2004. A Camera's View of Consumer Food-Handling Behaviors. *Journal of the American Dietetic Association* 104(2):186-191.
- Angell, D. 2008. Food Demonstration and Taste Testing Format: Ohio Extension Program Proves Effective. *Journal of Family and Consumer Sciences* 100(1): 38.
- Athearn, P.N., Kendall, P.A., Hillers, V.V., Schroeder, M., Bergmann, V., Chen, G., Medeiros, L.C. 2004. Awareness and Acceptance of Current Food Safety Recommendations During Pregnancy. *Maternal and Child Health Journal* 8(3): 149–162.
- Audits International/Food and Drug Administration (FDA). 1999. 1999 U.S. Food Temperature Evaluation – Design and Summary Pages. 2000. University of Maryland. Internet. Accessed November 13, 2011. < <http://foodrisk.org/exclusives/audits/>>.
- Borresen, T. 2008. *Improving Seafood Products for the Consumer*. Boca Raton, FL: CRC Press LLC. 585p.
- Brown, A. 2007. *Understanding Food: Principles and Preparation*. Belmont, CA: Thomson Higher Education. 654p.
- Brunso, K. 2009. Trends in Consumer Attitudes and Selection. April 2009. Food and Agriculture Organization. Internet. Accessed November 29, 2011. < <http://www.thefishsite.com/articles/652/trends-in-consumer-attitude-and-selection>>.
- Brunso, K., Verbeke, W., Olsen, S.O., Jeppesen, L.F. 2009. Motives, Barriers and Quality Evaluation in Fish Consumption Situations. *British Food Journal* 111(7): 699-716.

- Cody, M.M., Hogue, M.A. 2003. Results of the Home Food Safety – It's in Your Hands 2002 Survey: Comparisons to the 1999 Benchmark Survey and Healthy People Food Safety Behaviors Objective. *Journal of the American Dietetic Association* 103(9): 1115-25.
- Connor, E. 2005. *Internet Guide to Food Safety and Security*. Binghamton, NY: The Haworth Press, Inc. 128p.
- Dharod, J.M., Perez-Escamilla, R., Bermudez-Millan, A., Segura-Perez, S., Damio, G. 2004. Influence of the Fight BAC! Food Safety Campaign on an Urban Latino Population in Connecticut. *Journal of Nutrition Education and Behavior* 36(3): 128-134.
- Dulsrud, A., Norberg, H.M., Lenz, T. 2006. *Too Much or Too Little Information? The Importance of Origin and Traceability for Consumer Trust in Seafood in Norway and Germany. Seafood Research from Fish to Dish*. Wageningen, The Netherlands: Academic Publishers. 213-227.
- Felice, R.J. 2011. *Sensory and Physical Assessment of Microbiologically Safe Culinary Processes for Fish and Shellfish*. Thesis (MS) Virginia Polytechnic Institute and State University. Blacksburg, VA. 155p.
- Fischer, A.R.H., de Jong, A.E.I., de Jonge, R., Frewer, L.J., Nauta, M.J. 2005. Improving Food Safety in the Domestic Environment: The Need for a Transdisciplinary Approach. *Risk Analysis* 25(3): 503-517.
- Fischer, A.R.H., De Jong, A.E.I., Van Asselt, E.D., De Jonge, R., Frewer, L.J., Nauta, M.J. 2007. Food Safety in the Domestic Environment: An Interdisciplinary Investigation of Microbial Hazards During Food Preparation. *Risk Analysis* 27(4): 1065-1082.
- Frewer, L.J., Shepherd, R., Sparks, P. 1994. The Interrelationship Between Perceived Knowledge, Control, and Risk Associated with a Range of Food-Related Hazards Targeted at the Individual, Other People, and Society. *Journal of Food Safety* 14(1): 19-40.
- Gall, K. 1992. *Seafood Savvy: A Consumer's Guide to Seafood Nutrition, Safety, Handling, and Preparation*. Ithaca, NY: Cornell University. 36p.
- Hicks, D. 2010. *A Consumer Guide to Safe Seafood Handling*. September 1, 2010. Delaware Sea Grant College Program. Internet. Accessed October 6, 2011. <<http://www.deseagrant.org/products/mas-bulletin-consumers-guide-safe-seafood-handling>>.
- Hicks, D., Pivarnik, L., McDermott, R. 2008. Consumer Perceptions About Seafood – An Internet Survey. *Journal of Foodservice* 19: 213-226.
- Hicks, D., Wakefield, K. 2010. *Seafood Is Good for You!* September 1, 2010. Delaware Sea Grant College Program. Internet. Accessed October 6, 2011. <<http://www.deseagrant.org/products/seafood-good-you>>.

Iwamoto, M., Ayers, T., Mahon, B. E., & Swerdlow, D. L. 2010. Epidemiology of Seafood-Associated Infections in the United States. *Clinical Microbiology Reviews* 23(2): 399-411.

Krueger, R.A., Casey, M.A. 2000. *Focus Groups: A Practical Guide for Applied Research* (3<sup>rd</sup>). Thousand Oaks, CA: Sage Publications, Inc. 215p.

Learning ZoneXpress. 1998. *Kitchen Safety Board Game*. Owatonna, MN: Learning ZoneXpress.

Levy AS, Derby B. 2000. Report Submitted to Interagency Working Group on Mercury Communications. Findings From Focus Group Testing of Mercury-in-Fish Messages. Internet. Accessed October 12, 2011. <[http://www.fda.gov/OHRMS/DOCKETS/ac/02/briefing/3872\\_Focus%2010.pdf](http://www.fda.gov/OHRMS/DOCKETS/ac/02/briefing/3872_Focus%2010.pdf)>.

Medeiros, L.C., Hillers, V.N., Chen, G., Bergmann, V., Kendall, P., Schroeder, M. 2004. Design and Development of Food Safety Knowledge and Attitude Scales for Consumer Food Safety Education. *Journal of the American Dietetic Association* 104(11): 1671-1677.

Morgan, D.L. 1993. *Successful Focus Groups: Advancing the State of the Art*. Newbury Park, CA: SAGE Publications, Inc. 271p.

Nash, B., Green, D. 2004. *A Guide to Seafood Sanitation Procedures: Handling Seafood Safely*. Raleigh, NC: NC State University. 4p.

National Advisory Committee on Microbiological Criteria for Foods (NACMCF). 2008. Response to the Questions Posed by the Food and Drug Administration and the National Marine Fisheries Service Regarding Determination of Cooking Parameters for Safe Seafood for Consumers. NACMCF, Washington, DC. *J Food Prot* 71(6): 1287-1308.

National Fisheries Institute. 2012. About Seafood. Internet. Accessed October 22, 2012. <[www.aboutseafood.com](http://www.aboutseafood.com)>.

National Institute of Food and Agriculture, U.S. Department of Agriculture. 2012. Seafood Health Facts. Internet. Accessed October 22, 2012. <<http://seafoodhealthfacts.org/>>.

Nauta, M.J., Fischer, A.R.H., Asselt, E.D., Jong, A.E.I., Frewer, L.J., Jonge, R. 2008. Food Safety in the Domestic Environment: The Effect of Consumer Risk Information on Human Disease Risks. *Risk Analysis* 28(1): 179-192.

Nesheim, M.C., Yaktine, A.L. 2007. *Seafood Choices: Balancing Benefits and Risks*. Washington, D.C: The National Academies Press. 722p.

Nies, J.I., Van Laanen, P.G. 1995. Effect of Safe Food Handling Programming on Participants' Food Handling Behaviours. *Family and Consumer Sciences Research Journal* 24(2): 161-179.

Partnership for Food Safety Education (PFSE). 2010. Safe Food Handling – Partnership for Food Safety Education. Internet. Accessed November 1, 2012. <<http://www.fightbac.org/safe-food-handling>>.

Phang, H. 2010. Consumer Handling of Hamburgers. Thesis (MS) University of California Davis. Davis, CA. 77p.

Pieniak, Z., Verbeke, W., Scholderer, J., Brunso, K., Olsen, S.O. 2008. Impact of Consumers' Health Beliefs, Health Involvement and Risk Perception on Fish Consumption: A Study in Five European Countries. *British Food Journal* 110(9): 898-915.

Redmond, E.C., Griffith, C.J. 2004a. Consumer Attitudes and Perceptions Towards Microbial Food Safety in the Domestic Kitchen. *Journal of Food Safety* 24(3): 16-194.

Redmond, E.C., Griffith, C.J. 2004b. Consumer Perceptions of Food Safety Risk, Control and Responsibility. *Appetite* 43(3): 309-313.

Redmond, E.C., Griffith, C.J. 2006. A Pilot Study to Evaluate the Effectiveness of a Social Marketing-Based Consumer Food Safety Initiative using Observation. *British Food Journal* 108(9): 753-770.

Roberts, K.R., Barrett, B.B., Howells, A.D., Shanklin, C.W., Pilling, V.K., Brannon, L.A. 2008. Food Safety Training and Foodservice Employees' Knowledge and Behavior. *Food Protection Trends* 28(4): 252-260.

Rombauer, I.S., Becker, M.R., Becker, E. 2006. *Joy of Cooking*. New York, NY: Scribner. 1132p.

Rue, N.R., Williams, A.G. 2003. *Quick Reference to Food Safety & Sanitation*. Upper Saddle River, NJ: Pearson Education, Inc. 92p.

Ruffin, F.E. 2005. *Kitchen Smarts: Food Safety and Kitchen Equipment*. New York, NY: The Rosen Publishing Group, Inc. 48p.

Satin, M. 1999. *Food Alert! The Ultimate Sourcebook for Food Safety*. New York, NY: Checkmark Books. 306p.

Scott, E., Herbold, N. 2012. An In-Home Video Study and Questionnaire Survey of Food Preparation, Kitchen Sanitation, and Hand Washing Practices. *Journal of Environmental Health* 72(10): 8-13.

Sea Grant Extension Program Food Science and Technology Department University of California. 2012. Seafood Network Information Center. Internet. Accessed October 22, 2012. <<http://seafood.ucdavis.edu/consumer.html#section1>>.

- Smith, R. 2011. Food Safety Knowledge Lacking. September 9, 2011. Feedstuffs FoodLink. Internet. Accessed September 13, 2011. <<http://www.feedstuffsfoodlink.com/ME2/dirmod.asp?sid=&nm=&type=news&mod=News&mi m=9A02E3B96F2A415ABC72CB5F516B4C10&tier=3&nid=D45CBDD0361F49E4B74BB6A77F428213>>.
- Takeuchi, M.T., Hillers, V.N., Edwards, Z.M., Edlefsen, M., McCurdy, S.M. 2005. Now You're Cooking. . .Using a food thermometer!. *Journal of Nutrition Education and Behavior* 37(5): 271-272.
- United States Department of Agriculture (USDA). 2007. Keep Food Safe: Food Safety Basics. July 29, 2011. USDA Food Safety and Inspection Service. Internet. Accessed October 5, 2011. < [http://www.fsis.usda.gov/PDF/Keep\\_Food\\_Safe\\_Food\\_Safety\\_Basics.pdf](http://www.fsis.usda.gov/PDF/Keep_Food_Safe_Food_Safety_Basics.pdf) >.
- United States Department of Agriculture/Food Safety and Inspection Service. 2012. USDA Food Safety and Inspection Service Home. Internet. Accessed October 22, 2012. < <http://www.fsis.usda.gov/>>.
- United States Department of Health and Human Services, Public Health Service, Food and Drug Administration. 2009. Food Code. United States Department of Health and Human Services, College Park, MD. Internet. Accessed October 04, 2011. <<http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/FoodCode/FoodCode2009/>>.
- United States Environmental Protection Agency (US EPA). 2006. Consumption Advice: Joint Federal Advisory for Mercury in Fish. Internet. Accessed October 12, 2011. <<http://water.epa.gov/scitech/swguidance/fishshellfish/outreach/factsheet.cfm>>.
- University of Delaware College of Earth, Ocean, and Environment and the Delaware Sea Grant College Program. 2012. Outreach – Marine Advisory Service – Seafood Technology: SeaGrant. Internet. Accessed October 22, 2012. <<http://www.deseagrant.org/outreach/seafood>>.
- Unusan, N. 2007. Email Delivery of Hygiene Education to University Personnel. *Nutrition and Food Science* 37(1): 37-41.
- Verbeke, W., Sioen, I., Pieniak, Z., Camp, J.V., Henauw, S.D. 2005. Consumer Perception Versus Scientific Evidence about Health Benefits and Safety Risks from Fish Consumption. *Public Health Nutrition* 8(4): 422-429.
- Verbeke, W., Vermeir, I., Brunso, K. 2006. Consumer Evaluation of Fish Quality as Basis for Fish Market Segmentation. *Food Quality and Preference* 18: 651-661.
- Villabla, A., Serrano, E., Sarjahani, A., Schwarz, M., Jahncke, M. 2008. Safe and Nutritious Seafood in Virginia. May 1, 2009. Virginia Cooperative Extension. Internet. Accessed October 6, 2011. <<http://pubs.ext.vt.edu/348/348-961/348-961.html>>.

Virginia Institute of Marine Science. 2012. Virginia Institute of Marine Science – Seafood Education. Internet. Accessed October 22, 2012.  
<<http://www.vims.edu/research/units/centerspartners/map/seafood/index.php>>.

Worsfold, D., Griffith, C. 1997. Food Safety Behavior in the Home. *British Food Journal* 99(3): 97-104.

Wysocki, A.F., House, L., Messina, W.A. Jr. 2009. Seafood Perceptions among People Aged 55 and Above: Summary of Focus Groups Results. Gainesville, FL: University of Florida. 7p.

## Chapter 3

### Identifying Consumer Attitudes and Concerns about Fish and Shellfish Culinary

#### Preparation Techniques and Food Safety

##### Abstract

**Objective:** To determine consumer beliefs and concerns regarding fish/shellfish consumption and preparation. **Design:** Focus group discussions (FGDs) with five groups in three different settings. **Setting:** Academic (Virginia Tech; Blacksburg, VA), Inland Local Community (Dublin, Virginia), Coastal Community (Hampton, Virginia). **Participants:** Fish/shellfish consumers (18-+71). **Phenomena of Interest:** Concerns and beliefs about fish/shellfish consumption and preparation. **Analysis:** FGDs were video and audio recorded, transcribed, and coded preliminarily by hand then by using video-coding software. Preliminary coding was performed by two researchers and inter-coder reliability (n=2) for software coding was validated. **Results:** Total of 32 participants from five FGD. Nine categories were determined: experience, trust, confidence, quality of product, motivation, concerns, cooking procedures, cooking instructions, and knowledge. Experience with fish/shellfish increased confidence in preparation. Trust in product quality and accuracy of information influenced consumer actions. Fish and shellfish have both positive and negative motivators for consumption. Consumers have concerns regarding fish/shellfish products and preparation. Current guidelines need additional instructions to help consumers increase knowledge and confidence. There is confusion and a lack of knowledge regarding fish/shellfish. **Conclusions and Implications:** More educational materials need to be developed to help increase consumers' confidence in preparing fish and shellfish products and increase their knowledge regarding these products.

**Key Words:** fish, shellfish, food safety, focus group discussions, perceptions and practices

## **Introduction**

It is well known that fish and shellfish are a good source of nutrients and important omega-3 fatty acids, like eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Consuming the recommended eight ounces of fish or shellfish a week has been related to a reduced number of cardiac deaths and cases of heart disease. However, the majority of consumers in the United States do not consume the recommended amount of seafood, since three and a half ounces per week is the average intake of fish and shellfish by American consumers. A higher level of intake is recommended (USDA 2010).

Fish and shellfish consumption per capita is much lower than beef and poultry (USDA 2012); however, finfish cause equivalent number of food-borne outbreaks as beef and poultry (Gould and others 2011). Outbreak occurrence per pound of fish and shellfish is much higher than beef and poultry, indicating a need for more education concerning proper preparation of fish and shellfish to reduce the risk of food-borne illness. Increasing consumer knowledge and awareness of proper food safety practices can help decrease the large number of illnesses that occur in domestic kitchens (Medeiros and others 2004).

Focus group discussions are used to gather richer information about a topic of interest, instead of using quantitative methods and other qualitative methods like surveys that provide general knowledge. Experiences and attitudes of participants can be expressed during these discussions, which can provide motivations behind actions performed by participants. Data collected by focus group discussions is typically closer to public opinion with a smaller selection from the general population (Morgan 1993). Focus group discussions have been used in Europe and the U.S. to determine consumer concerns and interest in fish and shellfish consumption (Altintzoglou and others 2010; Athearn and others 2004; Borresen 2008; Brunso and others

2009; Dulsrud and others 2006; Levy and Derby 2000; US EPA 2006; Wysocki and others 2009); however, these focus groups have mainly concerned consumer motivation to purchase and eat fish and shellfish. Studies regarding consumer perception of preparation guidelines for fish and shellfish have not been conducted. Guidance materials need to be effective to help increase ability of consumers with little experience handling and preparing fish and shellfish to ensure consumer confidence and willingness to eat these products.

The information concerning seafood consumption benefits, risks, and proper preparation is not reaching consumers effectively. A method and route of communication needs to be determined. Limited research has been conducted concerning consumers perception of current culinary guidelines for preparing fish and shellfish, which is needed to determine if a lack of preparation descriptions causes consumers to limit fish and shellfish intake or feel incompetent in their preparation.

Focus groups were conducted to identify current consumer beliefs about issues concerning the food safety and cooking methods of fish and shellfish. Recommendations for guidance materials and other food safety aspects for consumers were determined from the focus group discussions.

## **Objectives**

- 1) Determine consumer beliefs and concerns regarding fish and shellfish safety.
  - a) Develop ideas as to what barriers are present that prevent consumers from feeling confident of personal preparation of fish and shellfish in their own home, based on focus group data.

- b) Determine what obstacles could exist that prevents consumers from obtaining information regarding fish and shellfish and what information vehicles are most widely utilized by consumers, based on focus group data.

## **Materials and Methods**

### *Participant Recruitment and Study Design*

Before the experimental protocols were started, an IRB was submitted and approved by the Virginia Tech Institutional Review Board (IRB Number: 11-673) (Appendix A). An online survey (Appendix B-1), which used vt.survey, was distributed through several listserves and email distribution within and beyond the university community to gather general information about fish and shellfish consumption habits, knowledge of fish and shellfish safety, and food safety practices. This survey was modified from a previous survey by Felice (2011). The survey also was utilized to recruit participants for research and sensory studies. There were 27 questions total included in the survey, including three demographic questions, six questions regarding fish and shellfish consumption, eight questions about fish and shellfish safety and food safety practices, and seven questions determining which participants would be interested in being involved in research and sensory studies. The final three questions asked for contact information for those respondents who were interested in participating in research and sensory studies.

A pilot focus group was conducted in order to evaluate the discussion questions and make sure that the wording was easy to understand and concise. The pilot study was also performed to determine the amount of time the discussion questions might take and to decrease the number of questions, if necessary. Subsequently, participants for the research focus group discussions were recruited by an online survey, e-mail, word of mouth, and advertisements. They were chosen by

willingness to participate, availability, and fish and shellfish experience. All participants except for one completed an online demographic survey either before or after the focus group discussion (Appendix C-1). Discussions were led by a facilitator (researcher). Discussion questions (Appendix D) were open-ended questions to encourage communication among the participants. Focus group discussions lasted approximately one hour. Three focus group studies (n = 4, 3, 6) took place in 250 Litton-Reaves Hall on the Virginia Tech campus (Blacksburg, VA), within an academic community. One focus group (n = 12) was conducted at the Seafood Agricultural Research and Extension Center (AREC) in Hampton, Virginia, which was a coastal community. The final focus group (n = 7) was conducted at a church in Dublin, Virginia, which was an inland local community approximately 25 miles from Virginia Tech. A total of 32 participants completed the focus groups. All focus groups were video recorded with a Canon Vixia HF 20 digital camera and audio recorded with an Olympus Digital Voice Recorder WS-400S. A slide presentation, featuring the overarching questions, was used to keep the focus group participants on topic during the discussion; participants were seated in a semicircle in front of the screen used for the presentation. The focus groups were conducted at varying times, depending on what time was most suitable. Focus groups conducted on the Virginia Tech campus were started approximately at 9:30am, while the focus group in Hampton, Virginia started at 1:30pm and the focus group in Dublin, Virginia started at 5:30pm.

At each focus group event, participants were welcomed and signed consent forms (Appendix E & F), the topic of conversation was described, and ground rules were explained. The first discussion questions served as ice breakers and brainstorming activities to get participants thinking about the discussion topic. Subsequent questions were targeted toward gathering data about major themes, with a total of approximately 20 questions. Questions were

in the format of listing questions, activity questions, “think back” questions, and questions that encouraged discussion about emotions and beliefs. Concepts that were addressed by the discussion questions included why consumers choose certain products for preparation at home, concern for safety of meals prepared at home, and beliefs concerning general safety of meats and seafood. Other concepts included reasons for choosing to consume fish and shellfish, how they typically handle, prepare, and determine doneness, if they utilized meat thermometers when cooking meals, and what information sources they employ to gather information about food safety and fish and shellfish preparation. Depending on the amount of discussion concerning certain questions and the time that each question required, some discussion questions were omitted to ensure that the focus groups did not go over an hour long. After the discussion questions had been completed, the participants had an opportunity to add any comments that they felt had been missed or needed clarification. Participants were offered a snack as compensation for their involvement.

After each focus group, the emerging themes were identified, coded, and clustered. Audio recordings from the focus groups were transcribed using Express Scribe Pro v 5.48 © NCH Software (Greenwood Village, CO) and a word processor program. Transcriptions then were analyzed by the primary researcher and a secondary evaluator to determine emerging themes and to code and cluster the themes. Responses from participants were analyzed to determine if responses to discussion questions were relevant to research topics of interest and were coded to describe what the participant was attempting to express. Once codes were developed for relevant participant statements, codes were clustered into categories for which they had similar overarching themes. Themes were common perspectives and word patterns presented by participants in response to discussion questions. Video recordings were then

analyzed with Noldus Information Technology Observer XT software (Wageningen, Netherlands) to code the focus groups for the established themes and determine the frequencies that these themes were described by the participants. The coding scheme was modified as sequential focus groups were conducted and additional themes emerged. These themes then were used to help design guidance materials for consumers to encourage fish and shellfish consumption safety.

Initial coding was performed by the primary investigator. A second coder was briefed on the coding scheme and the meaning of categories and codes. The second coder then reviewed the videos and coded for themes. The results between the primary and secondary coders were examined to determine if there was a discrepancy between the themes determined by the two coders.

### Statistical Analysis

Inter-coder reliability was determined using percent agreement and Cohen's kappa (Freelon 2011). Cohen's kappa values greater than 0.7 are usually considered acceptable to show agreement between coders (Harris and others 2002). Data collected by these focus group studies was almost entirely qualitative data that does not lend itself to statistical interpretation. Frequency data, based on categorization using the Observer XT software, for presented themes were reported (Appendix G).

## **Results**

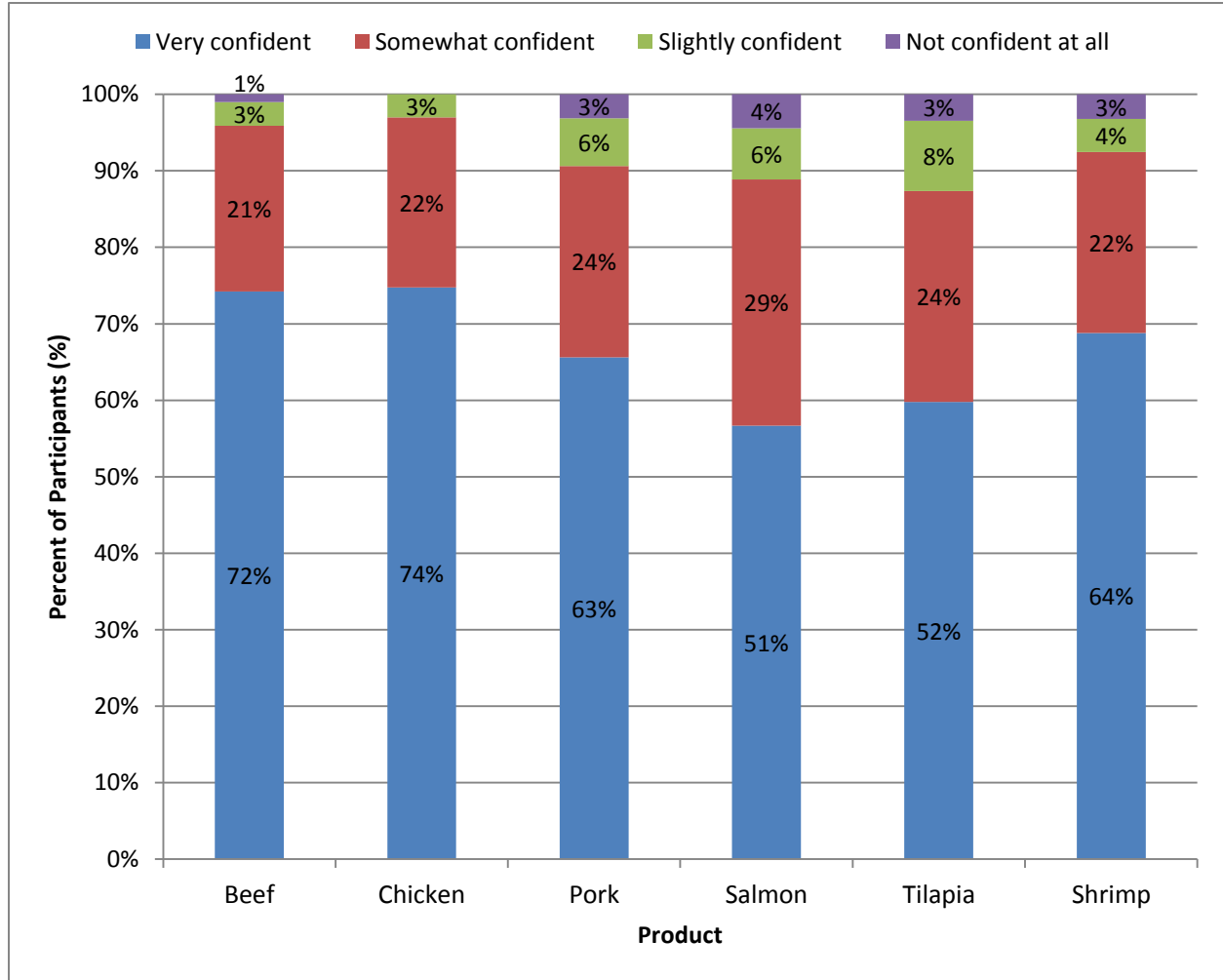
### *Demographic Questionnaire*

There were 160 participants that took the questionnaire, with 46 males (29%) and 113 females (71%). One person did not respond to the question regarding gender and therefore, was excluded from the demographic characteristics. There was a relatively representative population by age group covered, with over half of participants (53%) being college age to young adult (18-40), and slightly less than half (47%) between 41 to over 71. One respondent chose not to answer. The predominant ethnicity represented by this survey was white (82%); other ethnicities, though grossly underrepresented, were diverse, with Hispanic, Latino, or Spanish origin and Asian or Pacific Islander representing the next largest (5%) portion of the tested population.

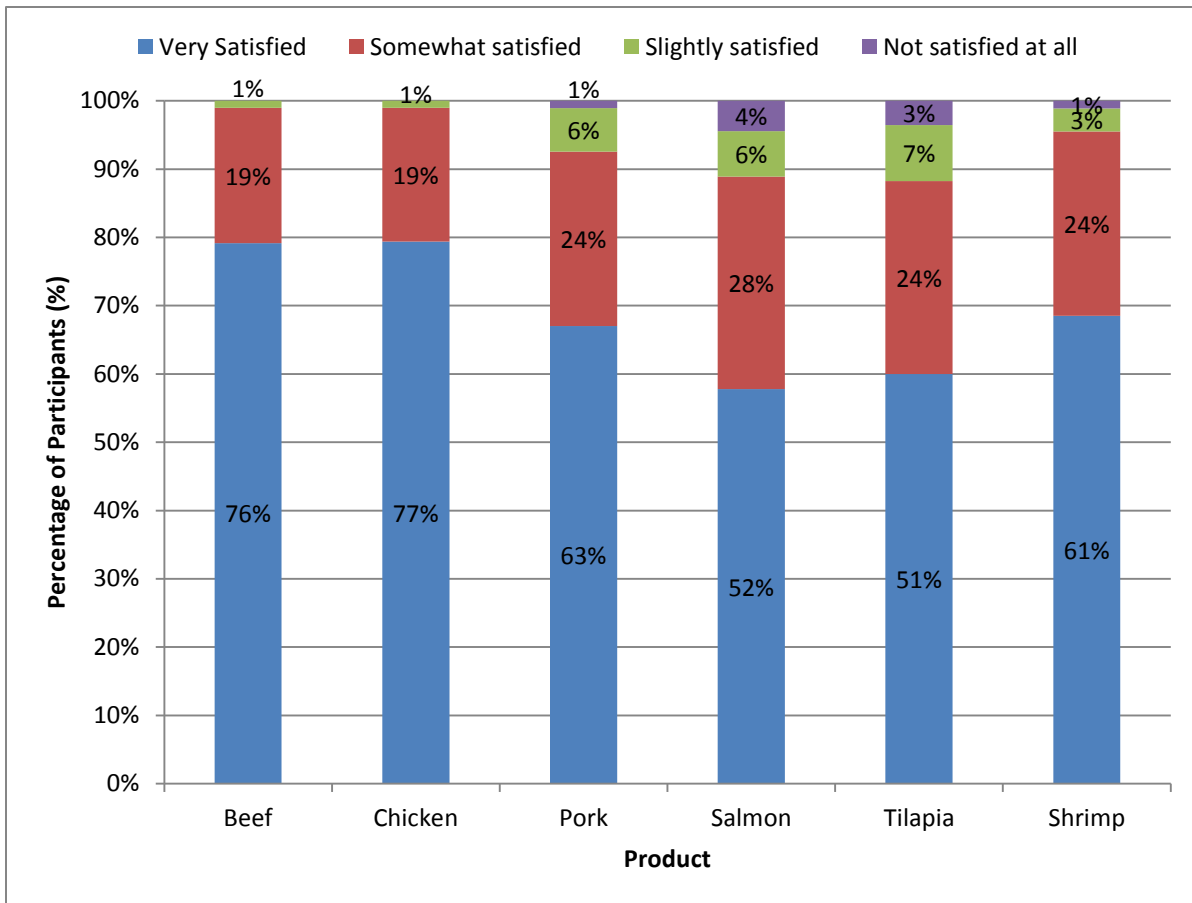
The majority of the participants (88%) consumed fish or shellfish between once a month to several times a week. The most commonly consumed types of fish and shellfish were shrimp (84%), salmon (77%), tuna (76%), tilapia (64%), crab (56%), and scallops (49%). Common preparation methods for fish and shellfish consumed by the participants were grilling (58%), baking (54%), broiling (52%), and pan frying (43%). Preparing fish and shellfish at home by the participant and eating fish and shellfish at a restaurant prepared by a chef/cook were both common (74%) ways for survey participants to consume fish and shellfish. Consuming fish or shellfish prepared by someone else in the participants' household was the next most common response (34%). Most participants (71%) prepared fish and shellfish at home between once a month and several times a month, using common preparation methods like baking (44%), grilling (40%), and pan frying (39%).

More participants were concerned with consuming fish and shellfish prepared outside of their home (39%) compared to consuming fish and shellfish prepared at their own homes (26%). Some responses associated with concerns for preparing fish and shellfish at home were foodborne illness, proper cooking, freshness, safety, smell, and cost. Some concerns listed by participants regarding consuming fish and shellfish outside of their home included properly prepared and handled, foodborne illness, quality, safety, and source.

The majority of participants were very confident when preparing beef and chicken dishes, but this confidence decreased when preparing pork and shrimp dishes, and decreased even more when preparing salmon and tilapia dishes (Figure 3-1). This same trend was seen in the satisfaction associated with the completed dishes (Figure 3-2).



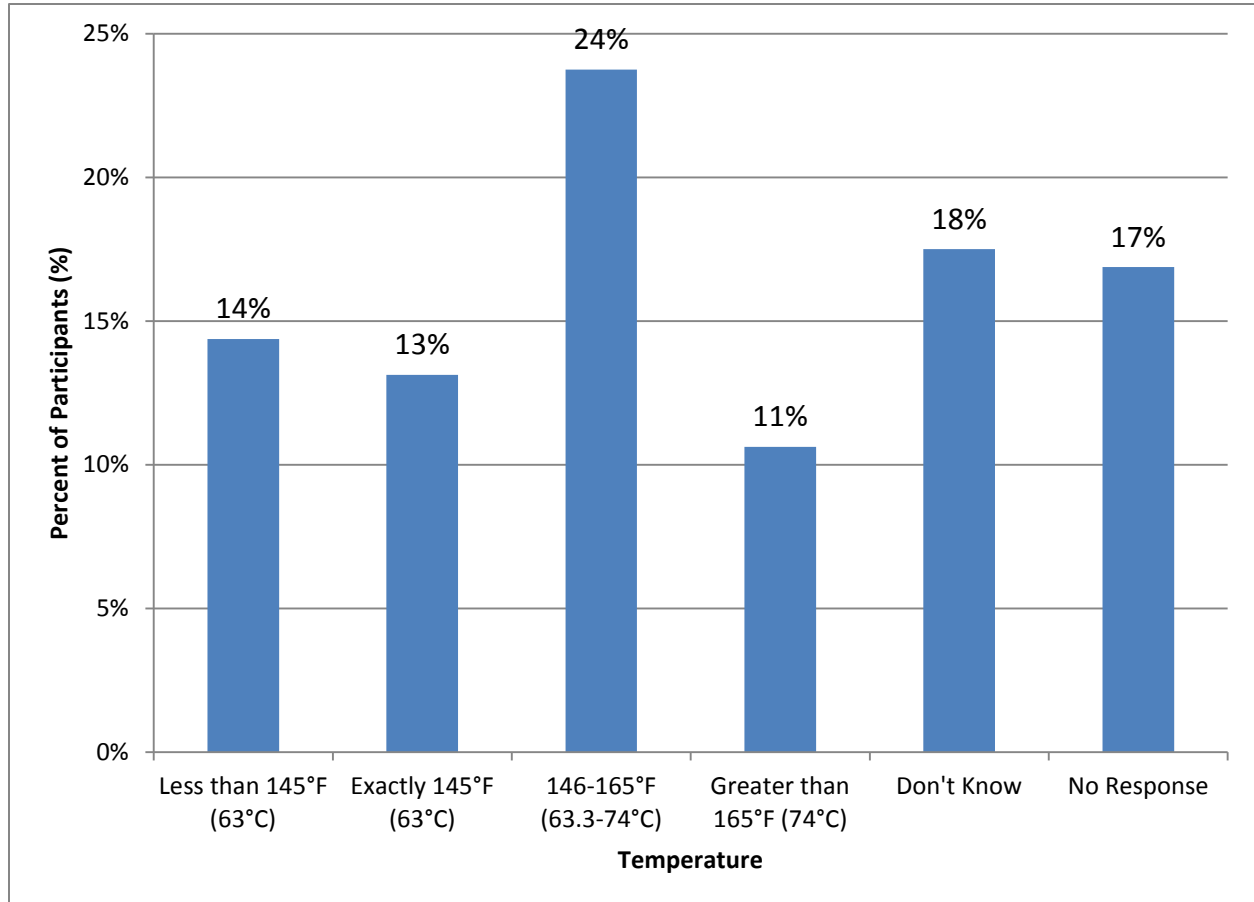
**Figure 3-1: Confidence in Preparing Meals Containing Certain Meat and Fish/Shellfish Products.** Participants (n = 160) were asked to describe their confidence in preparing meals containing listed products. They could select only one choice for each product.



**Figure 3-2: Satisfaction with End Result of Meals Containing Certain Meat and Fish/Shellfish Products.** Participants (n = 160) were asked to describe their satisfaction with the end result of meals containing listed products. They could select only one choice for each product.

The majority (72%) of participants were concerned at some level (slightly to very strongly agree) about the safety of foods they consume, suggesting that food safety concerns the majority of the general public. Only 13% of participants knew the exact internal endpoint temperature for cooking fish and shellfish in order for it to be considered safe for consumption, based on responses to an open-ended question (Figure 3-3). Twenty-four percent of participants listed a temperature that would be safe for consumption and within quality cooking temperatures

reasonable for fish and shellfish (63.3-74°C [146-165°F]). However, 11% listed a temperature greater than 74°C (165°F), which is safe but is of unknown eating quality and may increase the



**Figure 3-3: Temperature Participants Believed Fish/Shellfish Should be Cooked to For Safe Consumption.** Participants (n=160) were asked to write in what temperature fish and shellfish should be cooked to for it to be considered safe for consumption.

potential for eating quality deterioration, like overcooking and dryness. Eighteen percent stated that they did not know the correct temperature, with 14% listing a temperature below the recommended minimum internal endpoint temperature of 63°C (145°F). This could cause participants to undercook fish and shellfish and increase the possibility of acquiring a foodborne illness.

Most participants (46%) indicated that they did not measure the internal temperature of meat or fish/shellfish products that they prepared (Table 3-1). If they did use an instrument to measure the internal temperature of meat or fish/shellfish, most (39%) indicated that they used a meat thermometer as the measurement tool. The full results from this survey are located in Appendix B-2.

**Table 3-1: Recruitment Survey Data Concerning Tools Used to Measure Internal Temperature of Meat/Fish/Shellfish (n=160)**

Use of Instrument to Measure Internal Temperature of Meat/Fish/Shellfish	Percent of Responses (%)
<b>No</b>	46%
<b>Rarely</b>	19%
<b>Sometimes</b>	19%
<b>Often</b>	9%
<b>Always</b>	5%
<b>What Type of Instrument Used to Measure Internal Temperature</b>	
<b>I never use an instrument to measure internal temperature.</b>	36%
<b>I use an instrument but I don't know what type it is.</b>	3%
<b>Thermometer</b>	4%
<b>Meat Thermometer</b>	39%
<b>Temperature Probe</b>	13%

### Focus Groups

#### Demographics of Focus Group Participants

There were a total of 32 participants in the five focus group studies; however, one participant left before filling out the demographic survey (Appendix C-1) and did not respond to attempts made by e-mail. Of the 31 participants that completed the survey, there were 9 males (29%) and 22 females (71%), which is very similar to the gender ratio for the online recruitment survey. The majority of participants (71%) were between the ages of 41-60, 16% of participants

were between 18-30, and two participants (7%) were between the ages of 61-70 and over 71.

The focus group participants were also mainly white (90%); therefore, other ethnicities were not well represented in focus group discussions.

The majority of participants (90%) consumed seafood at least once per month, indicating familiarity with and regular consumption of seafood. The three main types of seafood consumed by the focus group participants were shrimp (94%), salmon (84%), and tuna (81%). Tilapia was also consumed by 61% of the focus group participants. The majority of the participants (77%) prepared fish and shellfish themselves at home. Participants (68%) also ate seafood that had been prepared by a chef or cook at a restaurant. Participants of the focus groups also consumed seafood that had been prepared at home by someone other than themselves (45%), purchased ready-to-eat from a super market or food store (19%), and ready-to-eat from a convenience store, fast food restaurant, or similar type store (13%).

About a third of participants (32%) prepared seafood at home once a week, followed by several times a month (26%), several times a year (16%), once a month (13%), daily to several times a week (7%), and never (3%). There was one “no response” to this question. Participants usually prepared seafood for themselves and their family, including children (42%) and for themselves and a significant other (39%). Participants also prepared fish and shellfish for just themselves (19%) and for themselves and their family, including older family members (16%). One person (3%) selected “not applicable” since he/she did not cook seafood for him/herself. One person also did not respond.

Participants had occupations in a school setting (28%), administration/business (26%), retired/stay at home (19%), or in the seafood industry (13%). Other occupations included a librarian, camp director, artist, and a licensed veterinary technician. The majority of participants

(58%) grew up inland/not near the coast, which were most of the participants that attended the focus groups in the academic setting and local inland community. Nine participants (29%) stated a location that was near the coast or some other body of water, and most of these participants attended the focus group in the coastal community. Three participants (10%) stated that they moved around a lot. One participant did not give a response. Full results from the demographic questionnaire for focus group studies can be found in Appendix C-2.

### Focus Group Dynamics

The first three focus group studies were conducted in a classroom setting on the Virginia Tech campus as an academic community. The door to the classroom was closed prior to starting the focus group discussion to ensure privacy and to help reduce noise distraction. The first focus group had four participants, which included one undergraduate Food Science and Technology student, one graduate Food Science and Technology student, one Virginia Tech faculty member, and one participant that was not associated with Virginia Tech. Therefore, there was a range of ages and occupations included in this focus group. All participants in this group were female. The two participants that were associated with the Food Science and Technology department had a greater knowledge about risks and concerns regarding food consumption, as demonstrated by their contributions to the discussion. The participants seemed like they were not close acquaintances with each other. All participants contributed to the conversation; however, two participants were more willing to express their views. The participants seemed to be at ease during the discussion and did not interrupt each other during the discussion. Since this was the first focus group of the research studies, not including the pilot focus group, the moderator was

not as efficient and her skills increased as each focus group was conducted. Some wording was also modified in the discussion guide due to participant confusion.

The second focus group had three participants, including an undergraduate Food Science and Technology student, a Food Science and Technology staff member, and a Virginia Tech faculty member. As with the first focus group, all participants in this study were female. Two of the participants seemed to know each other well and one participant tended to be a dominant personality throughout the session. One participant did not seem to have as much to contribute, possibly due to the lack of experience with fish and shellfish. There was not equal contribution from all participants to the focus group discussion and, even though it was a smaller group, it was more difficult to keep the participants on topic. There was a less serious atmosphere during this focus group and participants tended to joke and laugh with each other and stray off topic. However, even though it was a smaller focus group and the participants did not stay on topic, similar themes were still presented during the study.

The third focus group had six participants, including a graduate student from a department other than Food Science and Technology, two staff members of Food Science and Technology, an undergraduate student in Food Science and Technology, a previous staff member of Food Science and Technology, and a staff member of Virginia Tech. The participants that were associated with Food Science and Technology were well acquainted with each other and seemed to have good relationships. A dominant personality was not present during this focus group, but there were participants that did not contribute as much or that contributed more to the discussion. All of the participants seemed comfortable expressing their views and the overall group was relatively easy to keep on topic. Most participants were engaged and interested in the conversation that was developing around them. This focus group was slightly shorter (about 45

minutes total) than the other focus groups, even though there were more participants and all of the discussion questions were asked. This could be attributed to the improved skills of the moderator to keep participants on topic and knowing when to move on to the next discussion question.

The fourth focus group was conducted in Hampton, Virginia at the Virginia Seafood AREC as a coastal community setting. There were twelve participants that attended this research study. The demographics of this study were different than the previous focus groups, since there were six participants that worked either at the Seafood AREC or directly with the seafood industry. The other participants were also very familiar with fish and shellfish since they owned fishing boats and fished for a living. The participants that worked at the Seafood AREC or in the seafood industry were familiar with one another. There was also a married couple that participated in the focus group. There were several dominant personalities in this focus group and some participants did not contribute as much to the conversation. This focus group was longer than the other focus group studies and not all of the discussion questions were asked. Since the group was much larger than previous studies, the participants were not as easy to keep on topic. The findings from this focus group were slightly biased because the participants were very knowledgeable about fish and shellfish in general and had a stake in the seafood industry.

The fifth and final focus group was conducted in Dublin, Virginia at a local church and served as an inland local community setting. Seven participants attended this focus group; two were members of the church and most knew each other through church or community activities. Six of the participants were female and there was one male. As with the other groups, there were some participants that contributed more to the conversation than others. There was also a married couple that attended this focus group. Six of the participants in this group were from the

surrounding area and were not associated with Virginia Tech. The seventh participant was visiting from out of town. The participants stayed on topic and all discussion questions were covered. The atmosphere was relaxed and the participants seemed genuinely interested in the topics of discussion.

### Focus Group Activities

To begin each focus group, participants were asked to state their name, occupation, and give an example of the last time they prepared fish or shellfish and who they prepared it for. This was done as an ice-breaker activity to help everyone get to know each other a little and to let the researcher get a feeling for how experienced the participants were with preparing fish and shellfish and who they would typically prepare these products for. Asking the participants specifically about fish and shellfish preparation was done to ensure that the participants knew that they should focus on fish and shellfish during the conversation. After the ice-breaker introduction, the participants were asked to brainstorm about several questions and list their answers on the notepads that were provided by the researcher. The brainstorming activity included four questions, “What meat products, including seafood, do you typically prepare at home?”, “What issues are you aware of concerning these products?”, “How frequently do you consume these at home?”, and “How frequently do you consume these outside of the home?”

Time was taken between each question to make sure that all participants had adequate time to write their responses to these questions. The types of meat, including seafood, which the participants listed, are presented in Table 3-2. Chicken, beef, pork, shrimp, and salmon were the products that were listed most by the participants. The overarching concerns that were listed by the participants were over/undercooking and doneness, followed by bacteria, pathogens, and

viruses (contamination) (Table 3-3). The participants prepare chicken more often at home compared to the other products, followed by beef and pork. The overall trend for the participants was that they prepare these products at home more often than they consume these products at a restaurant. Fish and shellfish preparation at home was associated with special occasions by the participants. After the brainstorming activity, the participants were asked to place their lists aside and the discussion questions began. The main topics of the discussion questions were preparation confidence level, motivation, use of cooking instructions for fish and shellfish, the cooking and preparation of fish and shellfish, and common knowledge, confusion or myths regarding fish and shellfish. The participants were given a chance at the end to bring up additional points if they desired.

**Table 3-2: Meat Products Prepared at Home by Participants (n = 32) Listed during Focus Group Studies (n = 5)**

<b>Types (Meat):</b>	<b>Number<sup>1</sup>:</b>	<b>Types (Meat):</b>	<b>Number:</b>
<b>Chicken</b>	29	<b>Deer</b>	4
<b>Beef</b>	28	<b>Flounder</b>	4
<b>Pork</b>	26	<b>Clams</b>	3
<b>Shrimp</b>	25	<b>Cod</b>	3
<b>Salmon</b>	17	<b>Mussels</b>	3
<b>Steak</b>	9	<b>Haddock</b>	2
<b>Tuna</b>	9	<b>Rabbit</b>	2
<b>Turkey</b>	9	<b>Trout</b>	2
<b>Tilapia</b>	8	<b>Buffalo</b>	1
<b>(Blue) Crab</b>	7	<b>Crawfish</b>	1
<b>Bacon</b>	6	<b>Eel</b>	1
<b>Catfish</b>	6	<b>Goose</b>	1
<b>Fish</b>	6	<b>Haddock</b>	1
<b>Ham</b>	6	<b>Halibut</b>	1
<b>Scallops</b>	6	<b>Lobster</b>	1
<b>Lamb</b>	5	<b>Monkfish</b>	1
<b>Oysters</b>	5	<b>Quail</b>	1
<b>Sausage</b>	5	<b>Wahoo</b>	1

<sup>1</sup>Number = total number of times that meat product was listed by all participants across all five focus group studies

**Table 3-3: Participant (n = 32) Concerns Regarding Meat Products Prepared at Home Listed During Focus Group Studies (n = 5)**

<b>Concern:</b>	<b>Number of Times Mentioned:</b>
<b>Over/Undercooked/Doneness</b>	16
<b>Bacteria/Pathogens/Viruses</b>	12
<b>Freshness</b>	6
<b>Cross contamination</b>	4
<b>Mercury (fish/shellfish)</b>	4
<b>Proper Storage</b>	4
<b>Flavor</b>	3
<b>Gone bad/Rotting</b>	2
<b>Preparation of Fish</b>	2
<b>Purchasing Cuts</b>	2
<b>Use of Thermometer/Cooked to Proper Temperature</b>	2
<b>Wash Meats Before Cooking</b>	2
<b>Additives</b>	1
<b>Bones</b>	1
<b>Directions</b>	1
<b>Growth Hormones</b>	1
<b>High Fat Content</b>	1
<b>Origin of Country</b>	1
<b>Price</b>	1
<b>Safety of Oysters</b>	1
<b>Sustainability</b>	1
<b>Tenderness</b>	1
<b>Wash Hands during handling</b>	1

### Focus Group Themes

Nine main categories emerged from the five focus group discussions. Each category had several codes that were described by the participants. The nine categories included experience, trust, confidence, quality of product, motivation, concerns, cooking procedures, cooking instructions, and knowledge (Appendix H). There were certain themes that were not presented in all focus groups, and those are described later in this chapter. The three focus groups conducted on the Virginia Tech campus were in an academic setting, with participants that were mainly well-educated and held or were pursuing bachelor's or higher degrees. Of the twelve participants in the focus groups in the academic setting, nine were associated with the Food

Science and Technology department, which could have caused them to be more concerned about food safety in general. The focus group held in Hampton, Virginia was in a coastal community and participants were very familiar with fish and shellfish. The focus group conducted in Dublin, Virginia contained participants from the local community with a range of education (high school to master's degrees) but no direct educational experience in food safety. These three different settings were chosen in order to compare different localities and different educational statuses. Frequency data was also reported using Noldus Information Technology Observer XT software (Appendix G).

## **Experience**

### ***Learning from Observing Behaviors***

Participants in these focus groups learned how to prepare fish and shellfish from watching people they knew prepare these products. Some of the participants grew up near a body of water and their parents would regularly cook fish and shellfish for meals. These participants would stay in the kitchen with their parents and watch them prepare meals or help prepare the meals and this was the method they used to become more experienced with cooking fish and shellfish and knowing how to determine that the product was cooked properly. They would also learn how to handle fish and shellfish and how to prepare the product. "I would learn alongside her (mother), and we would always cook together, so we would catch it and scale it and gut it and everything and then learn how to debone it and cook it." Other participants learned from cooking with their family when they were young and then passed it on to their children in the same manner. "He (son) just stayed in the kitchen and watched us (him and his wife) and just like we did with our mom, he (son) just took off to it." When these participants had the chance to observe someone else preparing seafood products, it helped increased their

experience with fish and shellfish because they were able to see firsthand how these products should be treated.

### ***Learning from Trial and Error***

Some participants did not have the experience of growing up and cooking fish and shellfish with their family or did not get the chance to observe how others prepared fish and shellfish. In these cases, participants were forced to learn how to prepare these types of products by experimenting and learning from trial and error. They would try out new recipes, experiment, and learn along the way what methods they liked and which ones they did not.

“I didn’t grow up eating that much fish with my family, so cooking is one of my hobbies I guess, so because of that, I thought well okay, I need to learn how to cook some seafood so that was a mixture of researching online and instructional cookbooks and trial and error. A lot of trial and error.”

Participants also learn from trial and error how much they should cook fish and shellfish. Most participants learned that they do not like overcooked seafood and try to make sure that they do not overcook it when they are preparing it for themselves and their families, for example, “...shrimp, of course you don’t want to overcook it. I’ve had some experiences where I did overcook it, especially on the grill.”

### ***Confidence Building through Experience***

Participants also expressed the fact that, as they experiment and cook fish and shellfish a greater number of times, their confidence in the end product increases. As they become more confident in their preparation, they become more willing to experiment and play with their food.

“Well, personally, I’m very confident in preparing fish and shellfish, just because of the nature of my work. I have a familiarity with it since I was young. So, I like to try

different cooking methods and preparation methods for fish. A lot of times they don't work out like I want them to but then it's fun to try different (recipes), whenever I do cook seafood I try to extend the recipe, try to vary it somehow."

However, the other side of the spectrum was also expressed during the focus group studies. Someone that has not had as much experience, maybe since their family didn't eat it or they didn't grow up near a body of water, does not have as much confidence in their ability to prepare fish and shellfish properly. For example, as stated by one participant, "We're probably just about the opposite. 'Cause I grew up a farm boy in Kansas, so I can slap a steak on the grill and not worry about it, but I my confidence with seafood is a little bit less than that. We try to do some every once in a while but it's not always as successful."

## **Trust**

### ***Quality of Purchase, Origin, and Restaurant Preparation***

The participants in the focus group studies felt that it was sometimes difficult for them to be able to trust the quality of the product that they were purchasing, either from a store, restaurant, or other location. They were aware of the fact that the store itself could have taken a frozen product, thawed it, and then could possibly sell it as a fresh product, as explained by one participant, "...I'm not really sure about the monk fish from [retail grocer] whether it's fresh or frozen and defrosted or not. It's thawed when I buy it or fresh when I buy it. I guess I don't know." This idea of the store or market having previously frozen the fish or shellfish and then defrosting it was expressed by multiple participants; however, during the focus group in Hampton, Virginia, when this concern was expressed another participant tried to alleviate the concern,

“Today, the regulation from the food safety and FDA, it’s supposed to be advertised on counters, previously frozen or fresh, raw caught or farm raised. And you got a question about that, ask them and they might not tell you but it’s supposed to be marked on fish counters in front of every item.”

However, only in the focus group in Hampton, Virginia, which included participants that were closely associated with the seafood industry, was this concept of FDA and food safety regulation introduced.

Participants also expressed an issue with trusting the quality of a product depending on the origin of that product. If they know that the product was caught or raised in the United States, they are more likely to trust the quality of that product than if it was caught or raised in another country. One participant stated, “So frozen fish, I always read the package, even fresh food I always see where it was caught. Like Indonesian shrimp, I’ve always experienced like they don’t taste as good as the U.S. shrimp.” Another participant only buys seafood that is caught in the United States.

When the participants were discussing their experiences eating fish and shellfish at a restaurant, several opinions were expressed. Some participants did not trust that restaurants were always capable of preparing the fish and shellfish properly or to their standards, for example, “I wouldn’t order it unless I knew that restaurant had a good idea of how to cook it and wouldn’t overcook it.” Participants also did not trust the quality of the products that restaurants use to prepare fish and shellfish dishes, as one participant stated, “...and it was either so salty or so seasoned that for a brief minute, I wondered ‘why did they put all this stuff on there so you can’t even taste the fish?’ So that’s like, is it, has it gone bad and they tried to cover it up?” They were particular about where they would order fish and shellfish because they were concerned

they would become sick from consuming the meal, for example "...One place I got sick off fried calamari, and then they opened up a sushi place and I'm not going there."

### ***Accuracy of Information and Tools***

The participants also expressed issues with trusting the accuracy of information and cooking tools. Information that may be said from the people at the store or super market may not be completely accurate and one participant states his/her concern about this,

"Can you trust the people who are selling it you know, even at [retail grocer], I don't think that guy really knows, not in a mean way but the trust of I'm not going to ask you because I don't feel like I'm going to trust what you say. Maybe you haven't been given the right information, you don't know how this food was handled prior to getting to you and that's just a big concern."

Trusting the accuracy of the information from people who work at a restaurant was also mentioned by one participant, "...I test restaurant staff when I go in there. I'll say where is that seafood from or what type...and you wouldn't believe the answers you that you get. Claiming fresh caught crab when it's imitation crab, the whole consumer confidence gets eroded at a lot of these restaurants."

Participants also stated that they did not use cooking tools, like thermometers, because they did not trust the accuracy of these tools, as stated by one participant in the following example,

"Thermometers themselves are really not that reliable. ...if you read the description on like the fancy thermometers, it makes you realize all the ways in which thermometers can go wrong. Like how sensitive they are, exactly where the sensor is, how fast they respond to changes, how much they respond to stuff that's outside of the area you want to

sense. Then there's plus or minus uncertainty and stuff like that, so after that kind of experience for a while, ("pshh" sound) thermometers."

Other participants had the same experiences using thermometers and decided that they were more trouble than they were worth.

## **Confidence**

### ***Preparation Method Determines Consumers' Confidence in Ability to Prepare Product***

Participants' confidence in their ability to properly prepare a fish or shellfish product that would taste good and be cooked thoroughly depends on the preparation method that they are using to prepare that product. Once a preparation method has been used multiple times by the participant, his/her confidence in the end result increases. If the participant is not as familiar with a certain preparation method, then they have to use other visual and textural cues to determine when that product is ready for consumption. "I'm always nervous about if it is done all the way. ...whenever I bake fish I always worry if it's done in the middle." Later in the discussion, the same participant stated, "I'm always happy because I can fry fish pretty well, you can tell by the color. Then if you pan-sear it or grill it; it's just baking it, I'm always peeking to see if it's done." The participants seemed to have certain ways they liked to prepare their fish and shellfish and usually stick to those methods; therefore, when they try a new preparation method, their confidence decreases.

### ***Confidence is Influenced by View of Specialization***

Participants' confidence in a store, restaurant, or venue is affected by whether or not they see it as a specialized market. Many participants will only buy fish and shellfish from a certain store because they see that store as specialized, for example, "[Retail grocer] is a great source for seafood. They have really good seafood and most of it is U.S. caught." Restaurants that are near

the coast or a body of water are also seen as a specialized venue and participants' were more confident in spending money at these types of restaurants because they believed that it would be worth the money.

“I tend to not eat seafood at a lot of places unless I know that you're some place on the coast and they know what they're doing or some place that specializes in seafood. You kinda figure they know what they're doing, but otherwise not too confident to order fish or seafood dishes. Just depends on where I am as to whether I'm willing to try it or not.”

Fish markets or venues that specialize in fish and shellfish also increase the participants' confidence in buying fish and shellfish. If the venue is local and near the coast or body of water, then the participant has confidence that the product is fresh, as explained by the following quote, “Everywhere in Delaware, I know that the seafood counters get restocked daily with fresh seafood, so I trust them that it's going to be healthier than from somewhere else.” This idea of buying locally caught fish and shellfish from local vendors was communicated from multiple participants as a way to increase their confidence in the product. Another example that was presented in the focus groups that took place on the Virginia Tech campus and in Dublin, Virginia was a “seafood truck” that they had confidence in because the participants believed it would travel to the coast each week and bring back fresh seafood to the area.

## **Quality of Product**

### ***Perceived Quality Determines Preparation Method***

The perceived quality of the product that the participant is working with determines how they would prepare that product. If the product is seen as high quality, then the participant is more willing to either undercook or not cook that product at all. For example, one participant states, “...preparation wise, depending on how fresh the fish seems depends on how much I cook

it. So, if the tuna, with the tuna it really should be raw in the middle, which I know is not safe preparation, but if the tuna looks really fresh I feel better doing that then, and not cooking it as much.” Also, if the participant perceived the product to be of “sushi grade” then they would be more willing to consume the product in a raw state. However, if the participant does not perceive the quality as high, then they will use the product in a way that does not require a high quality product. For example, a participant explains how she uses frozen fish and shellfish, “I don’t find the quality (of frozen fish and shellfish) as high typically, but in some cases I’m willing to sacrifice the quality a little bit by putting it in a dish that maybe it’s not as critical that it be the star of the show.”

### ***Quality of Farm-Raised vs. Fresh Caught (Wild)***

Participants expressed a negative connotation towards farm-raised fish and shellfish and believed that fresh caught or wild fish and shellfish taste better and have a better texture, is healthier, less contaminated, has less color additives and is better for the environment overall. One participant was unsure of the differences between farm-raised and fresh caught but explained, “...I just know there are changes and I know there is less taste in the seafood that I’ve been buying that’s farm raised...” Another participant describes his/her take on levels of contamination between the two, “...I’ve done a little bit of research and I’ve actually read that a lot of our farm-raised seafood and fish and things actually have higher levels of mercury than the sea-caught fish.” Most of the participants perceive the quality of fresh caught fish and shellfish as much higher than farm-raised products, but they enjoy the convenience and availability of the farm-raised fish and shellfish.

### ***Perceived Quality of Self-Caught Fish and Shellfish***

When the participants caught the fish or shellfish themselves, they believed that product was of higher quality than they could purchase. It was perceived as a fresher product since they knew exactly when it was caught and it was perceived as a better tasting product. For example, one participant explains catching crabs, "...if I catch my own crabs, granted they could be contaminated, but I feel like if I caught them fresh I trust the quality." Another participant describes fish that was caught by relatives and by his/herself,

"I have a brother and a dad and an uncle who have fished for as long as I can remember and so I enjoy native trout and that's probably the most fish that I eat. I'm not really a big fan of seafood, although I do like tuna fish and salmon and things like that. But I had a chance several years ago to go deep-sea fishing and I actually got to catch a tuna. I was very determined I was going to learn how to cook it, and it turned out well."

When the person is able to catch their own fish or shellfish, it gives them more ownership of that product and they know where that product came from and when they caught it. They believe that this product will be better because it is freshly caught and prepared.

### **Motivation**

#### ***Positive Motivators***

The positive motivators that the participants discussed for consuming fish and shellfish included health benefits, taste and texture, quick and easy preparation, and special occasions. Specific health benefits that were mentioned during the focus group studies were omega-3 fatty acids, lower in calories than other meats, less fat than other protein sources, good for your heart, skin, and brain. Participants also stated that they enjoy the taste and texture of fish and shellfish and one participant stated, "I get tired of chicken and pork and beef and hamburger so I go find

some fish.” Another motivation for preparing fish and shellfish that was stated during the focus group conversations is that the participants believe, as stated in the following example, “...fish is usually quicker a lot of times. It’s a lot faster.” The participants discussed the fact that fish and shellfish dishes do not have to be complicated and have a lot of ingredients to produce a meal of high sensory acceptability. The participants also consider fish and shellfish to be a specialty item, something that they would purchase for a special occasion, as stated by the following participant, “...special occasions, depends on what the occasion is and I go to the store with a recipe in mind so I’m getting everything I need to make that particular thing.” This idea of fish and shellfish being a specialty item was expressed across focus group participants. When someone wishes to celebrate or has an important event, fish and shellfish products are included. These products are not thought of as an everyday item like other meat products.

### *Negative Motivators*

The negative motivators for the participants concerning purchasing fish and shellfish include affordability, lack of availability, and appearance of the fish and shellfish. The participants usually only buy seafood products when they go on sale and one participant stated, “I would say that the price usually prevents me from buying (fish and shellfish).” The participants also find that it can difficult to find the types of fish and shellfish that they would like if they are looking for a specific type of seafood, for example, “It seems like it’s hard to find the right type of fish that I want; it’s all farm-raised Atlantic salmon if I want salmon at [retail grocer]. You can’t find Chinook salmon or king or anything like that.” The location that the participants live in also has an effect on the lack of availability, as described by the following quote, “...it’s kind of hard living in this area [Blacksburg, Virginia] when there’s not good fresh seafood.” When trying to decide on which fish or shellfish product to buy, the appearance of the

available products can deter the participants from purchasing that product, even if it is the type that they specifically came to the store to purchase or if it is on sale.

“Sometimes when the manager’s specials at [retail grocer] look very tempting, but the fish always looks questionable, once it’s gotten to that cheaper state. So I don’t buy it, I just wish it was fresher. But when you see color changes and the fish is still full price and it just doesn’t look appetizing. I’m not sure what causes that just like the graying of red meat. I don’t know if that’s safe.”

The participants use visual and textural cues to determine if they are going to purchase a fish or shellfish product. If the product looks questionable, then they will not purchase it.

## **Concerns**

### ***Concerns Regarding Fish and Shellfish Products***

The concerns that the participants expressed regarding fish and shellfish products included negative health impacts from consuming fish and shellfish, environmental impact, and level of contamination. Participants were concerned that consuming undercooked or raw fish and shellfish could cause them to become sick, as expressed in the following quote, “I get nervous sometimes when I eat (seafood), because I really care about how it gets cooked. And so if I have a feeling that it’s not cooked, then I get really uncomfortable.” Another participant describes a lack in concern for negative health impacts, “I really have no problems, I’ve never been sick from food, I guess it would change if I had some kind of, if I had gotten sick off of it (food) at some point and time, though, but I’ve never had any issues.” This concept that there was a lack of concern about a certain product because the participant had never “gotten sick” from consuming the product was demonstrated multiple times during the focus group studies.

Participants also described the environmental impact on the quality of fish and shellfish that they consume and how it worries them about eating fish and shellfish and preparing it for their families. For example, “I have been getting more and more scared buying a lot of seafood for my kids just because what’s going on environmentally, it’s not just staying in Japan and the tides are carrying everything everywhere and so it worries me a little bit. So I don’t feed my children as much seafood as I grew up on...”

The level of contamination was specifically associated with levels of mercury in fish and shellfish and contamination of oysters. One participant described his/her concern for mercury contamination in fish and shellfish,

“You (another participant) mentioned mercury contamination; you would think any of the top level predator fish, oceanological fish, would have a higher chance of having heavy metal contamination and I don’t even know if you can get around it. Sharks, some types of tuna, swordfish. I think, don’t they pretty much all have some trace amounts at this point. And that just gets built up.”

Another participant expresses his/her concern for consuming oysters, “I used to eat raw oysters...I used to love them...but I’ve essentially gone away from that...I just don’t feel comfortable. I just can’t decide; that’s not a risk I’m willing to take for myself and my family.”

Participants discussed very specific concerns regarding fish and shellfish consumption; however, as you can see from some of the above quotes, the participants were not really sure if the information they had was completely correct. Participants seemed to be getting mixed messages regarding what health issues were actually related to consuming certain fish and shellfish products.

### ***Cooking Fish and Shellfish Products Correctly***

The participants also expressed concern about whether or not the fish or shellfish was cooked thoroughly or if it was going to be overcooked. One participant stated,

“I’m a little nervous about baking fish...I like baking catfish with a mustard and crumb crust, and that browns but I’m always worried that underneath it’s gonna be raw so I usually prefer to stoup it or have it in something... Typically, occasionally when I was baking it I would have to throw it back into the oven because I would cut it open and have to throw it back in the oven...”

Another participant also stated, “...it’s really easy to overcook seafood.” Most participants were concerned about overcooking fish and shellfish and believed that it was easy to do and resulted in a less satisfactory product. The participants expressed the fact that cooking the product thoroughly but not overcooking the product was a very difficult balance to achieve when it comes to fish and shellfish.

### **Cooking Procedures**

#### ***Determining Doneness by Qualitative Methods***

When the participants prepare fish and shellfish dishes, they use qualitative methods to determine when the product is cooked to their liking, like visual and textural cues. One participant describes the cues she/he uses to determine doneness, “...maybe color, that’s part of the opacity thing, when it pales to white, like shrimp turns red and salmon goes from kind of that red to kind of a lighter pink type of color. I mean, a lot of that has to do with the texture and transparency.” Other visual cues that were mentioned include the opening of certain shellfish and other color changes that occur when fish and shellfish are cooked. Participants also mentioned tasting the products to determine whether or not they were cooked thoroughly, for

example one participant said, “I do a lot of sampling... Usually not hungry by the time the meal is ready. I eat too much.” Other participants agreed when this statement was said during the focus group studies.

### ***Thermometer Use for Determining Doneness of Products***

The overall themes for using thermometers across the focus groups was that the participants would either not use thermometers at all or they would use them to determine when bigger meat products were cooked properly. For example, one participant explains,

“I do use a thermometer when I cook my beef and my pork and my turkey. I use it with those. One is the safety but two is that I find that I have a better product; it’s not overcooked, it’s not undercooked. And so, I will use a thermometer on occasion depending on what I’m cooking, when I’m cooking, and my degree of comfort with it.”

Other participants stated that they usually will not use a thermometer and will determine when meat, poultry, or any protein product is done by visual and textural cues. One participant stated, “No, I don’t think I’ve ever put a thermometer into a piece of meat.” Participants also discussed the fact that most fish and shellfish products are either too thin or small to insert a thermometer into and that the texture of fish and shellfish makes it difficult to use a thermometer, for example, “And fish, I feel like most of the fish you cook is thin and small and you don’t cook a big hunk of fish ever.” Therefore, participants either do not use thermometers at all while they are cooking any meat product, or they will only use it to determine when larger pieces of meat have been cooked properly in order to ensure that product will be safe to consume and still have high sensory acceptability.

## **Cooking Instructions**

### ***Information Desired in Instructions for Fish and Shellfish***

Information that participants desired to be included in instructions for fish and shellfish preparation included visual cues, better explanation of jargon used in instructions, more food safety information, temperature measurements, and more instructions in general regarding proper preparation of fish and shellfish. One participant mentioned videos as a good method to help consumers understand proper preparation better,

“If I could read it and look at the pictures and then see a video of something that’s very close to the same thing, sometimes it even gives you two different perspectives on how to do the same thing and they comment more on the video than they would on the text, that’s what I’ve found helps me a lot.”

This idea of videos or more visuals for fish and shellfish preparation was expressed throughout the focus group studies. As internet becomes the main source of information for most consumers, videos describing proper preparation emerged as a theme for a way to help consumers become more confident in their preparation techniques. Participants also find that the jargon used in instructions tends to be confusing and needs further explanation. Many participants find the term “flaky” confusing and do not necessarily understand what this term means or how “flaky” the end product should look, for example, “...but the flaking is kind of vague to me, because is it when it just begins to flake or after it’s lost some moisture, I think it depends on the fish too.” Another term that may be misunderstood in instructions was opaque, as a participant describes in the follow quote,

“Well, along the same lines where I see the instructions that say that it’s opaque. Well, I happen to know what that means but how many people do? So, bearing in mind

experience of various cooks, because obviously a twenty year old might not have the same experience of understanding. I think you've heard all of us talk about experience and how that helps us be more effective. And so, understanding your audience that is going to buy it I think, using terminology that is helpful to the general public would be helpful to all of us."

As expressed by the previous quote, terminology in instructions can be confusing and needs to be further explained as to help anyone who wishes to prepare a fish and shellfish dish and feel more confident in their preparation. Participants also expressed the desire for more food safety information about fish and shellfish, as one participant describes, "Because obviously it's okay to eat some seafood raw...there's a lot of different types of fish...so what are the risks involved? I mean, is it all about handling? And if it is about handling, then how can you get more information about handling...?" Participants were also interested in more information regarding how to tell if a fish or shellfish product was good quality, how it should smell and look, how to store it, how long they could keep these products before cooking, and what exactly is present in fish and shellfish that could cause you to become sick. Temperature measurements were also something that participants stated that they would like to see included in instructions, for example, "A lot of the steak and pork will have temperature instructions. I haven't seen that much...on seafood. So...it would help to know what temperature to know better how long to cook it." However, even if the correct endpoint temperature was included in instructions, participants may choose to not bother, "...I usually avoid recipes that tell me temperatures, I know that's terrible, because here we are talking about how it would be helpful, but I guess it just sounds too time consuming and I don't have a probe, and so I do a lot of things on the fly, and I don't have time to." Overall, participants wanted more instructions for fish and shellfish

preparation for themselves and their families. One participant describes that the lack of instructions is why she does not allow her children to cook seafood on their own, “I wouldn’t mind having better instructions. I think that’s one reason I don’t let my children go off cooking and I just stand there with seafood because I don’t know how to tell them what they are looking for. So I think that would definitely be more helpful for our family...” There was a general consensus from the focus group participants that more instructions for preparing fish and shellfish would help them feel more confident in their preparation.

### ***Perceived Accuracy of Cooking Instructions and Source of Instructions***

Participants have certain sources that they feel are more reliable and dependable when it comes to having accurate information regarding cooking instructions. They have certain cookbooks, magazines, and websites that they rely on and visit frequently when they are looking for information about proper preparation techniques and reliable recipes that they know will turn out well. Some examples of cookbooks that were stated by the participants were “Southern Living Cookbook”, “Joy of Cooking”, and cookbooks that have been passed down through generations. These sources have been thoroughly tested and are seen as very dependable sources of information regarding recipes. Participants see these as well-known cooking guides and can go to these sources when they are in a quandary and not sure what to do with a certain product or how it is supposed to look when it is properly prepared. Sources that are seen as “seafood specialists” also increased the participants’ perception of dependability. Participants also stated that they were using online sources more often nowadays, since it is a quick and easy source, for example, “...But also I’ll go online and just do a little research, and I didn’t use to do that, but I’m doing more of that, it’s so quick and easy. So I’ve definitely found that to be helpful.” Another source that participants used to help them better understand fish and shellfish

preparation was television shows, as one participant describes, “I have my favorite celebrity chefs and I go to their websites or I watch their shows or I read their books, or any combination.” Once again, these television shows make it possible for the participant to actually visualize what they are looking for when they are preparing meals, which helps increase their confidence in preparation.

### ***Bridging Personal Experience with Cooking***

As the participants experiment more with different recipes and techniques, they begin to bridge their experience with the meals that they are preparing and add their own personal touches to the meals. Most of the participants discussed the fact that they would usually go by what the cooking instructions said the first time they tried a recipe and then they would modify the recipe as they became more confident in their preparation. One participant stated,

“I usually always follow the instructions the first time, because I like to write on my recipes what I would change or whatever was liked by my family, then I’ll start altering it, but usually the first time around I’ll usually do what the recipe says just to give it a chance. So after that, I’m like less grease, more spice.”

Participants also stated that after they had cooked certain products a number of times, they were better able to determine when these products were cooked to their liking, how long it usually took, and what the products looked like when they were properly cooked. Participants used “personal judgment” when using cooking instructions and would adjust the recipes to better suit their tastes, which comes from experience with cooking these products.

## **Knowledge**

### ***Lack in Knowledge***

Participants stated that they had a lack of knowledge about proper preparation of fish and shellfish and a lack of knowledge in the food chain. They were unsure of information that they had heard and did not know whether that information was correct. One participant stated in regards to her/his knowledge in fish and shellfish,

“I don’t know how to recognize if it’s good or not, I don’t know what it’s supposed to look like so I shy away from buying it all together...But I need to learn a lot...I hate to cook something that I’m afraid I’m not going to like, because that’s the money and time to do it...But I would like to learn more, so I will try more.”

One participant also explained that she/he had a lack in knowledge concerning the origin of fish and shellfish and stated,

“I want to know where the fish came from exactly and how it was treated all the way up until it actually reached me and any lack of confidence about the source or that process would really, really make me doubt the quality of the fish or shellfish...Even if I knew all that information, I might not still be able to judge the safety because I don’t have enough knowledge. Like I don’t know enough about where they are in the ecosystem or I don’t know enough about that particular body of water and how safe it is, so it’s really complicated. If somebody could figure out a way to dumb down all that information that would be good for me.”

Participants’ lack of knowledge regarding fish and shellfish causes them to shy away from preparing and consuming these products. If information was more widely available and clear, consumers may be more willing to try these products.

### *Variations and Accuracy of Knowledge Concerning Fish and Shellfish*

The participants expressed varying degrees of knowledge regarding fish and shellfish. Some participants showed that they had a wide range of knowledge about the risks associated with consuming fish and shellfish while others were very unsure about these topics, for example, "...So here's my question...in general I worry about raw food. I mean, there's a reason we cook it. But I actually don't know of specific diseases or bad things you can get, like specifically...I just know that if it's raw, you could get sick, but I don't know why or what from." The participants that were more knowledgeable about these types of topics were the ones that had some type of food science background or experience with the seafood industry. Participants that lacked this background had less knowledge concerning health risks associated with food consumption. Participants were also unsure about the accuracy of the knowledge that they had concerning fish and shellfish and did not always trust the sources of information that they looked to for advice, for example,

"...sometimes I get a little leery with government and stuff, I'm not always convinced.

Although it doesn't mean it's bad but if I just had a source that I felt very confident in that they were taking into consideration not just political pressures but also health for our community, that would be fantastic so I could just ask questions that I wanted. Because when you go to the internet, I don't know who to trust and sometimes it makes it hard."

The fact that there was such a broad range of knowledge and accuracy of that knowledge indicates that there is not a source that is reaching these participants that is making them feel more confident or more knowledgeable about fish and shellfish overall. Participants did show an understanding of cross-contamination and proper handling, for example, how to handle raw protein products that would eventually be cooked compared to raw fruits and vegetables.

### Unique Themes

Unique themes were presented throughout the focus group studies, themes that were only presented in one or two of the focus groups but not all of the focus groups. During two of the focus groups held at Virginia Tech, the participants had a discussion concerning which parts of certain fish and shellfish were safe to consume. One participant stated,

“I would think that shellfish would be more dangerous than any other type of meat...a lot of times they're filter feeders so they're gonna be getting whatever is on the bottom, which is the worst. And they're going to pick up a lot of junk that's in the water supply on the bottom, like oysters, that would be my assumption.”

This was a unique concept because of the fact that most participants stated that they worried more about chicken and other meat products than fish and shellfish. Some participants also stated that they would only buy certain fish and shellfish products during a certain season or at a certain time of year. Another concept that was presented by one participant was that it depended on whether the fish or shellfish was salt water or fresh water determined the doneness he/she cooked the product. Some participants also stated that determining doneness of certain fish and shellfish products was more difficult than chicken or other meat products because of the abnormal shape of some fish and shellfish.

Since the participants in the focus group conducted in Hampton, Virginia were well associated with fish and shellfish and the seafood industry in general, some themes emerged that did not in the other focus groups. The idea that the general public does not understand how to prepare fish and shellfish and that they are afraid and paranoid to prepare these products was mentioned by several participants. These participants understood that the general public does not have enough knowledge about certain preparation techniques or certain products to be able to

make confident choices and that they need instructions and guidance to be able to be successful. One participant stated, "...there are so many different kinds of seafood and you have to have knowledge of each one, it is a problem. People are afraid of it. We look at it as a convenience food but you do have to have different cooking methods." Another concept that was brought up was the idea of sustainability and that most people lack knowledge about this topic to make correct decisions regarding purchasing sustainable fish and shellfish. Information about sustainability of certain fish and shellfish is simply not reaching most people. Educating employees at grocery stores or restaurants to help them have more knowledge to better inform the consumers also emerged as a theme to increase consumer confidence. A couple participants mentioned that having actual educational demonstrations where participants could prepare these products themselves would increase consumer confidence and increase consumer consumption of these products. Visual aids were mentioned during the other focus groups, but the idea of having actual interactive demonstrations was only mentioned during this focus group. The participants in this group also did not consider frozen, processed fish and shellfish as good quality, since these participants were accustomed with being able to get their fish and shellfish very fresh and were able to determine quality easily. Participants in the other focus groups felt more confident buying frozen fish and shellfish because they did not know how long the "fresh" fish and shellfish had been sitting at the counter in the grocery store.

During the focus group in Dublin, Virginia, the participants stated that a lot of the recipes that they had tried concerning fish and shellfish they had learned from word of mouth or had eaten that dish at someone else's house. They would also use recommendations from people that they knew who had bought fish or shellfish from a certain location and this would increase their confidence in purchasing fish and shellfish from that location. Another theme that was

mentioned in this focus group was the concept of the instructions that come with fish and shellfish products and the format of those directions. When the directions are on the packaging of the product and are in a format that is easy to understand, then these prove to be very helpful for the consumer.

Inter-coder Reliability

Inter-coder reliability was used to determine coder agreement between focus groups. This was performed to ensure validity and reliability of research results and to ensure that the data was interpreted correctly. As seen in Table 3-4, the Cohen’s Kappa values were all greater than 0.7, which indicated that there was a strong agreement between the two codes for all focus group themes (Harris and others 2002). In the cases where agreement was not one hundred percent, one coder may have not coded a section of audio the same way the previous coder had or coders may not have agreed on what code should be applied to certain statements by the participants. In qualitative research, one hundred percent agreement is not expected since coders will have different opinions on how statements should be interpreted (Harris and others 2002).

**Table 3-4: Percent Agreement and Cohen's Kappa Values for Inter-coder (n = 2) Reliability of Focus Groups (n = 5)**

<b>Observation</b>	<b>Percent Agreement (%)</b>	<b>Cohen's Kappa</b>
<b>Academic Community I</b>	99.1	0.99
<b>Academic Community II</b>	97.2	0.96
<b>Academic Community III</b>	100	1.00
<b>Coastal Community</b>	100	1.00
<b>Local Community</b>	98.1	0.98
<b>Mean</b>	98.9	0.99
<b>Range</b>	97.2-100	0.96-1
<b>Median</b>	99.1	0.99

## **Discussion**

Participant confidence in preparation of fish and shellfish depended on their experience with the product and participants gained experience through either learning from observing behaviors of others or from personal trial and error with the product. Increased consumer experience increasing confidence with fish and shellfish products was also found by Brunso and others (2009) and Verbeke and others (2006) in regards to consumer ability to determine quality of products. Review of literature did not indicate that consumers learned seafood preparation by observing behaviors or by personal trial and error, as was discovered in the focus group discussions in this study.

Participants were leery about trusting the quality of fish and shellfish they purchased at stores and their trust in quality of product was affected by the country of origin; similar themes have been discussed in other studies (Brunso and others 2009; Verbeke and others 2006; Wysocki and others 2009). These studies, along with the focus groups conducted for this research, indicated that if the consumer knew that the information was reliable and knew the country of origin for the fish and shellfish, then their trust in product quality increased. Participants also discussed the concept that restaurants may not properly prepare seafood products and that the quality of the product may not always be high; review of literature did not find consumer concerns regarding restaurant preparation of fish and shellfish.

Preparation method determined how confident participants were in their ability to prepare fish and shellfish. Wysocki and others (2009) found that a lack of experience with fish and shellfish species decreased consumer willingness to purchase, prepare, and consume that product. Consumers would purchase seafood from specialty stores and stores that had a large amount of notoriety for the quality of their products (Wysocki and others 2009); this same

concept was discussed by participants, whom were more confident when they believed that the store, restaurant, or venue was “specialized” in fish and shellfish.

The quality of the product also determined participant preparation of the product. If the participant believed the product was of high quality, then they were more willing to undercook the product. Participants believed that fresh caught or wild fish and shellfish were of higher quality compared to farm-raised fish. Wysocki and others (2009) found varying attitudes toward “wild caught” and farm-raised fish and shellfish, with some participants believing that “wild caught” seafood was healthier and of higher quality and others believing that farm-raised seafood was more pure. When participants of the focus groups conducted for this research were able to catch their own fish and shellfish, they believed that the quality of the product was higher than of that which they would purchase at a store or restaurant.

Positive motivators for participants to consume fish and shellfish included: health benefits, taste and texture, quick and easy preparation, and special occasions. Health benefits and taste were also found as motivators in other studies (Borresen 2008; Brunso and others 2009; Pieniak and others 2008; Wysocki and others 2009). Altintzoglou and others (2010) reported that there was increased effort to prepare fish and shellfish, which contrasted with what was found during our focus group discussions. Participants believed that fish was expensive, there was a lack of availability, and appearance was sometimes a negative motivator for purchasing seafood. Price and appearance were discussed as negative motivators by consumers in other studies (Borresen 2008; Brunso and others 2009; Wysocki and others 2009).

Concerns regarding fish and shellfish products discussed by participants included: negative health impacts, environmental impact, and level of contamination. Participants listed other concerns about consuming meat, poultry, and seafood (Table 3-3). Foodborne illness from

bacteria, pathogens, or viruses was discussed as a concern by participants and was also found as a concern of consumers in other studies (Athearn and others 2004; Pieniak and others 2008). Concerns that were previously found in other studies included mercury (Pieniak and others 2008; US EPA 2006; Wysocki and others 2009), which was listed as a concern by participants and stated by others. Sanitation, smell, and bones within the product were concerns of consumers in previous research (Brunso and others 2009), which were also discussed by focus group participants. Another concern of participants was whether or not they were cooking their fish and shellfish correctly and was stated in previous research (Altintzoglou and others 2010).

Participants stated that they rarely use thermometers to determine doneness of meat, poultry, and seafood. This behavior has been observed and reported in previous literature (ADA 2011; ADA and ConAgra Foundation 2000; Anderson and others 2004; Audits International/FDA 1999; Phang 2010; Scott and Herbold 2010; Smith 2011). Participants would occasionally use thermometers to measure the internal temperature of “bigger cuts of meat”.

Instructions for fish and shellfish need more information concerning visual cues, jargon, food safety, correct temperatures, and preparation guidelines. The concept that more information regarding fish and shellfish is needed has been echoed in previous studies (Altintzoglou and others 2010; Dulsrud and others 2006; Verbeke and others 2005; Wysocki and others 2009). Altintzoglou and others (2010) and Wysocki and others (2009) reported that consumers desired more guidance on how to properly prepare different types of fish and shellfish products. Participants used cooking instructions that they found from sources they felt were reliable and seen as “seafood specialists”. They would also bridge personal experience with cooking procedures in order to obtain an end product that they believed would be more enjoyable.

Cooking instructions from reliable sources and bridging personal experience with cooking was not found in the review of literature.

From focus group discussions, a lack in knowledge about proper fish and shellfish preparation was discovered, along with varying and accuracy of knowledge concerning fish and shellfish. Consumer knowledge about fish and shellfish preparation was limited (Wysocki and others 2009). Verbeke and others (2005) also determined that there was a knowledge gap for consumers regarding health benefits and risks of consuming seafood.

## **Conclusions**

Educational materials need to be targeted toward helping increase consumers' confidence in preparing fish and shellfish products and increasing their knowledge about these products. Many consumers do not have enough experience with fish and shellfish to feel confident in preparing these products; therefore, their willingness to purchase and attempt cooking seafood in their own homes is limited. If educational materials were more detailed, explained the benefits and risks of consumption, and included more visual imagery, consumers may be more likely to experiment with more fish and shellfish products. Educational materials also need to be communicated in an effective manner to ensure that they are reaching the targeted consumer population, who are generally not as familiar with preparation of fish and shellfish.

## References

Altintzoglou, T., Hansen, K.B., Valsdottir, T., Odland, J.O., Martinsdottir, E., Brunso, K., Lutén, J. 2010. Translating Barriers into Potential Improvements: The Case of New Healthy Seafood Product Development. *Journal of Consumer Marketing* 27(3): 224-235.

American Dietetic Association. 2011. Consumer Knowledge of Home Food Safety Practices Survey. Academy of Nutrition and Dietetics. November 4, 2011. Internet. Accessed September 23, 2012. < [http://homefoodsafety.org/pub/file.cfm?item\\_type=xm\\_file&id=2399](http://homefoodsafety.org/pub/file.cfm?item_type=xm_file&id=2399)>.

American Dietetic Association and ConAgra Foundation. 2000. Home Food Safety Summer Survey Key Findings. May 12, 2000. Academy of Nutrition and Dietetics. Internet. Accessed September 23, 2012. < <http://homefoodsafety.org/media-releases-may12-2000-key>>.

Anderson, J.B., Shuster, T.A., Hansen, K.E., Levy, A.S., Volk, A. 2004. A Camera's View of Consumer Food-Handling Behaviors. *Journal of the American Dietetic Association* 104(2):186-191.

Athearn, P.N., Kendall, P.A., Hillers, V.V., Schroeder, M., Bergmann, V., Chen, G., Medeiros, L.C. 2004. Awareness and Acceptance of Current Food Safety Recommendations During Pregnancy. *Maternal and Child Health Journal* 8(3): 149–162.

Audits International/Food and Drug Administration (FDA). 1999. 1999 U.S. Food Temperature Evaluation – Design and Summary Pages. 2000. University of Maryland. Internet. Accessed November 13, 2011. < <http://foodrisk.org/exclusives/audits/>>.

Borresen, T. 2008. *Improving Seafood Products for the Consumer*. Boca Raton, FL: CRC Press LLC. 585p.

Brunso, K., Verbeke, W., Olsen, S.O., Jeppesen, L.F. 2009. Motives, Barriers and Quality Evaluation in Fish Consumption Situations. *British Food Journal* 111(7): 699-716.

Dulsrud, A., Norberg, H.M., Lenz, T. 2006. Too Much or Too Little Information? The Importance of Origin and Traceability for Consumer Trust in Seafood in Norway and Germany. *Seafood Research from Fish to Dish*. Wageningen, The Netherlands: Academic Publishers. 213-227.

Freelon, D. 2011. ReCal2: Reliability for 2 Coders. 2011. American University School of Communication. Internet. Accessed September 10, 2012. < <http://dfreelon.org/utills/recalfront/recal2/>>

Harris, J., Pryor, J., Adams, S. 2002. *The Challenge of Intercoder Agreement in Qualitative Inquiry*. Austin, TX: University of Texas at Austin. 27p.

Levy AS, Derby B. 2000. Report Submitted to Interagency Working Group on Mercury Communications. Findings From Focus Group Testing of Mercury-in-Fish Messages. Internet.

Accessed October 12, 2011.

<[http://www.fda.gov/OHRMS/DOCKETS/ac/02/briefing/3872\\_Focus%2010.pdf](http://www.fda.gov/OHRMS/DOCKETS/ac/02/briefing/3872_Focus%2010.pdf)>.

Medeiros, L.C., Hillers, V.N., Chen, G., Bergmann, V., Kendall, P., Schroeder, M. 2004. Design and Development of Food Safety Knowledge and Attitude Scales for Consumer Food Safety Education. *Journal of the American Dietetic Association* 104(11): 1671-1677.

Morgan, D.L. 1993. *Successful Focus Groups: Advancing the State of the Art*. Newbury Park, CA: SAGE Publications, Inc. 271p.

Phang, H. 2010. *Consumer Handling of Hamburgers*. Thesis (MS) University of California Davis. Davis, CA. 77p.

Pieniak, Z., Verbeke, W., Scholderer, J., Brunso, K., Olsen, S.O. 2008. Impact of Consumers' Health Beliefs, Health Involvement and Risk Perception on Fish Consumption: A Study in Five European Countries. *British Food Journal* 110(9): 898-915.

Scott, E., Herbold, N. 2012. An In-Home Video Study and Questionnaire Survey of Food Preparation, Kitchen Sanitation, and Hand Washing Practices. *Journal of Environmental Health* 72(10): 8-13.

Smith, R. 2011. *Food Safety Knowledge Lacking*. September 9, 2011. Feedstuffs FoodLink. Internet. Accessed September 13, 2011.  
<<http://www.feedstuffsfoodlink.com/ME2/dirmod.asp?sid=&nm=&type=news&mod=News&mi m=9A02E3B96F2A415ABC72CB5F516B4C10&tier=3&nid=D45CBDD0361F49E4B74BB6A77F428213>>.

U.S. Department of Agriculture and U.S. Department of Health and Human Services. 2010. *Dietary Guidelines for Americans, 2010*. 7th Edition, Washington, DC: U.S. Government Printing Office, December 2010.

United States Environmental Protection Agency (US EPA). 2006. *Consumption Advice: Joint Federal Advisory for Mercury in Fish*. Internet. Accessed October 12, 2011.  
<<http://water.epa.gov/scitech/swguidance/fishshellfish/outreach/factsheet.cfm>>.

Verbeke, W., Sioen, I., Pieniak, Z., Camp, J.V., Henauw, S.D. 2005. Consumer Perception Versus Scientific Evidence about Health Benefits and Safety Risks from Fish Consumption. *Public Health Nutrition* 8(4): 422-429.

Verbeke, W., Vermeir, I., Brunso, K. 2006. Consumer Evaluation of Fish Quality as Basis for Fish Market Segmentation. *Food Quality and Preference* 18: 651-661.

Wysocki, A.F., House, L., Messina, W.A. Jr. 2009. *Seafood Perceptions among People Aged 55 and Above: Summary of Focus Groups Results*. Gainesville, FL: University of Florida. 7p.

## Chapter 4

### Translating Guidance into Skills for Cooking Fish and Shellfish to Safe ( $\geq 63^{\circ}\text{C}$ ) Internal Endpoint Temperatures

#### Abstract

**Objective:** To determine if additional verbal/visual cues improved cooking guidance and assisted consumers in developing analytical skills to properly evaluate appropriate endpoint temperature of fish/shellfish for microbial safety/product eating quality. **Design:** Participants completed series of pre-training cooking sessions during which they prepared fish and shellfish using different preparation methods. A group training session was conducted, followed by series of post-training cooking sessions. **Setting:** Laboratory kitchen (Virginia Tech Campus; Blacksburg, VA). **Participants:** University affiliates ( $n=6$ ); ages 18-70; one male, five females. **Intervention:** A group training session was conducted in conference room setting, during which participants were given additional verbal/visual cues and shown electronic video publication describing health benefits/risks of consuming fish/shellfish and proper handling/preparation of fish/shellfish. **Main Outcomes Measures:** Dependent variable, final internal endpoint temperature of product, measured with data logger. Independent variables (product, preparation method, before/after training session). Additional dependent variable, count data of behaviors presented by participants, measured by video observations. Independent variables were similar to previously stated, excluding preparation method. **Analysis:** 3-way ANOVA to determine difference in mean internal temperatures before and after training; paired t-test to determine difference in mean internal temperatures of individual products. Chi-square test to determine proportion of participants able to prepare products to correct internal temperature ( $63^{\circ}\text{C}$ ). Poisson Regression to determine behavioral change before and after training.  $\alpha = 0.10$ . **Results:**

Participants (n=6) cooked products to significantly different temperatures ( $p = 0.015$ ) and greater proportion of products (n=72) met correct internal temperature ( $\geq 63^{\circ}\text{C}$ ) ( $p < 0.0001$ ) after the training. Behaviors significantly changed (unwanted  $p=0.009$ ; wanted  $p < 0.001$ ; checking=0.026) after training. **Conclusions and Implications:** More details about visual/textural product changes concerning temperature are needed. Behavior modification is possible and educational materials potentially decrease risk of food-borne illness associated with cooking fish/shellfish.

**Key Words:** fish, shellfish, culinary, food safety, training

## **Introduction**

A search of popular cookbooks and cookbooks specifically geared toward fish and shellfish preparation resulted in guidelines and descriptions of visual characteristics to determine when fish and shellfish products were cooked thoroughly. Guidelines included cooking the product until it “flakes easily”, is “firm”, and “changes to opaque in color”. Shrimp indicators included will turn “opaque” and will be “pink” in color when cooked (Brown 2007; Rombauer and others 2006). Multiple cooking methods for fish and shellfish were suggested by these cookbooks; however, few gave specific descriptions for the different methods suggested. Timed cooking measurements were commonly provided according to the thickness of the product. General terms to determine doneness (“firmness”, “opaque”, “flakiness”) were applied to many varieties of fish, even when the recipes called for a specific type. Some cookbooks mentioned measuring the internal temperature of fish and shellfish to indicate doneness, with an internal temperature of 49-57°C (120-135°F) representing thorough doneness for the majority of people and 49°C (120°F) being appropriate for fish that consumers prefer undercooked (Rombauer and others 2006). These temperatures do not reflect the internal temperature recommended to consumers, industry, and professionals in food service by the FDA Food Code (2009), which states that 63°C for 15 seconds is the minimum internal temperature intact fish and shellfish need to be cooked to for a microbiologically safe product (2009). Objective measurements or indicators for consumers to easily determine adequate cooking of fish and shellfish are currently lacking (NACMCF 2008).

Consuming undercooked fish and shellfish can cause foodborne illness. From 1998 to 2004, seafood consumption caused 11.2 and 5.2% of outbreaks and illnesses (NACMCF 2008). When asked the internal temperature to cook fish and shellfish, only 16% of participants (n=107)

were able to correctly identify 63°C (145°F) (Felice 2011). In the recruitment survey discussed in Chapter 3 of this document, only 13% of participants (n=160) correctly identified the temperature, with 14% stating a temperature less than recommended, 18% stating they did not know the correct temperature, and 17% who did not give a response. Proper practices of handling, serving, and storing of fish and shellfish, along with cooking to the correct temperature, are needed to decrease consumers' chances of foodborne illness. Hand washing techniques and cross-contamination are other important concerns regarding safe preparation of fish and shellfish, since the temperature recommended by the FDA Food Code (2009) expects low initial contamination levels (NACMCF 2008).

Consumers believe that they have enough knowledge to handle causes of food poisoning effectively and can control the hazard. In order for educational materials to be effective, the information must be targeted toward the individual and at-risk populations (Miles and others 1999). If the consumer does not recognize their responsibility to prepare food safely, then educational materials to change behaviors presented by consumers that increases their risk for food poisoning could be ignored and unsuccessful (Redmond and Griffith 2004b). Food safety educational materials and messages that are effective have to be relevant to the consumer, reliable, distributed quickly and at the correct time, and duplicated. The information should be easy to understand and to access and should use media consumers commonly utilize (Jacob and others 2010). Assessments by surveys and focus groups are qualitative and do not provide direct evidence of consumer behaviors whereas video provides direct quantitative observation of behavior practices and can allow for evaluation of behavior modification based on educational guidance and educational materials.

The purpose of this study was to determine if additional verbal and visual cues improved cooking guidance materials and assisted the consumers in developing analytical skills to properly evaluate appropriate endpoint temperature of fish and shellfish for microbial safety and product eating quality.

## **Objectives**

- 1) Evaluate common visual cookbook descriptions to prepare fish (salmon, tilapia) and shellfish (shrimp) to the recommended minimum endpoint internal temperature of 63°C for a microbiologically safe product.
  - a) Develop a training session, including a video, brochure, pictures, and verbal guidelines, for communicating the indicators of undercooked salmon, tilapia, and shrimp and increase awareness of food safety protocols in cooking fish and.
  - b) Assess effectiveness of training by comparing endpoint internal temperature measurements before training to measurements after training to determine improved success rate.
  - c) Compare consumer behaviors in fish and shellfish preparation, before and after training, that affect microbiological safety of final product.

## **Materials and Methods**

### *Fish and Shellfish Products*

Farm-raised tilapia (The Fishin' Company – China) and Atlantic salmon (Good Food S.A – Santiago, Chile) were purchased as frozen fillets with skin and bones removed and individually vacuum packed. Extra jumbo shrimp (Berkley & Jensen – Vietnam) was purchased uncooked

and individually frozen with the heads removed and de-veined but the shells intact. Two different shipments of product were received to correspond with the initial (pre-training) and the final (post-training) cooking sessions. Fish and shellfish were stored at -34°C (-30°F) until needed, thawed and kept at 4°C until used by the participants. Miscellaneous supplies needed for preparation and cooking (cooking spray, etc.) were bought from a local supermarket (Appendix I). Laboratory kitchens (Lab 403B, Department of Human Nutrition, Foods and Exercise, Virginia Tech) were used for product preparation and cooking.

Fish and shellfish raw products were removed from the freezer the night prior, approximately 18-20 hours prior to use, then thawed in the refrigerator (4°C) in preparation for each cooking session. One hour prior to the session, salmon and tilapia fillets were washed with cool water and patted with paper towels to remove moisture from the thawing process. Shells were removed from shrimp, which were also patted with paper towels. The thickest and thinnest sections of salmon and tilapia fillets and the length, thickest and thinnest sections of the shrimp were measured with calipers and recorded (nearest mm). Weight prior to cooking was recorded. Raw products were then stored in the refrigerator until the participant arrived and was prepared to cook them.

### *Culinary Preparation Methods*

Salmon and tilapia were prepared by baking and broiling methods and shrimp were prepared by boiling and broiling. Salmon and tilapia are not commonly prepared by boiling and shrimp is not commonly prepared by baking; therefore, certain methods were applied to selected products. Participants were given instructions for each of the culinary preparation methods for the first set of cooking sessions (Table 4-1).

**Table 4-1: Culinary Preparation Methods Instructions for Preparation of Salmon, Tilapia and Shrimp**

<b>Preparation Method</b>	<b>Fish or Shellfish Product</b>	<b>Preparation Method Instructions</b>
<b>Baked</b>	Atlantic Salmon Tilapia	Rinse and dry the fish Place in shallow glass baking dish sprayed with cooking spray Bake in oven at 375°F on middle rack
<b>Broiled</b>	Atlantic Salmon Tilapia Shrimp	Electric stove set to broil Place in glass baking dish sprayed with cooking spray Place in oven 5 inches or less below heat source (second rack) Leave oven door open 3-4 inches Coat tilapia with butter
<b>Boiled</b>	Shrimp	Water temperature should be about 180°F (82°C) with bubbles gently rising but not fully breaking the surface of the water Add shrimp and boil until desired doneness

(Modified from Brown 2007)

*Participant Recruitment and Study Design*

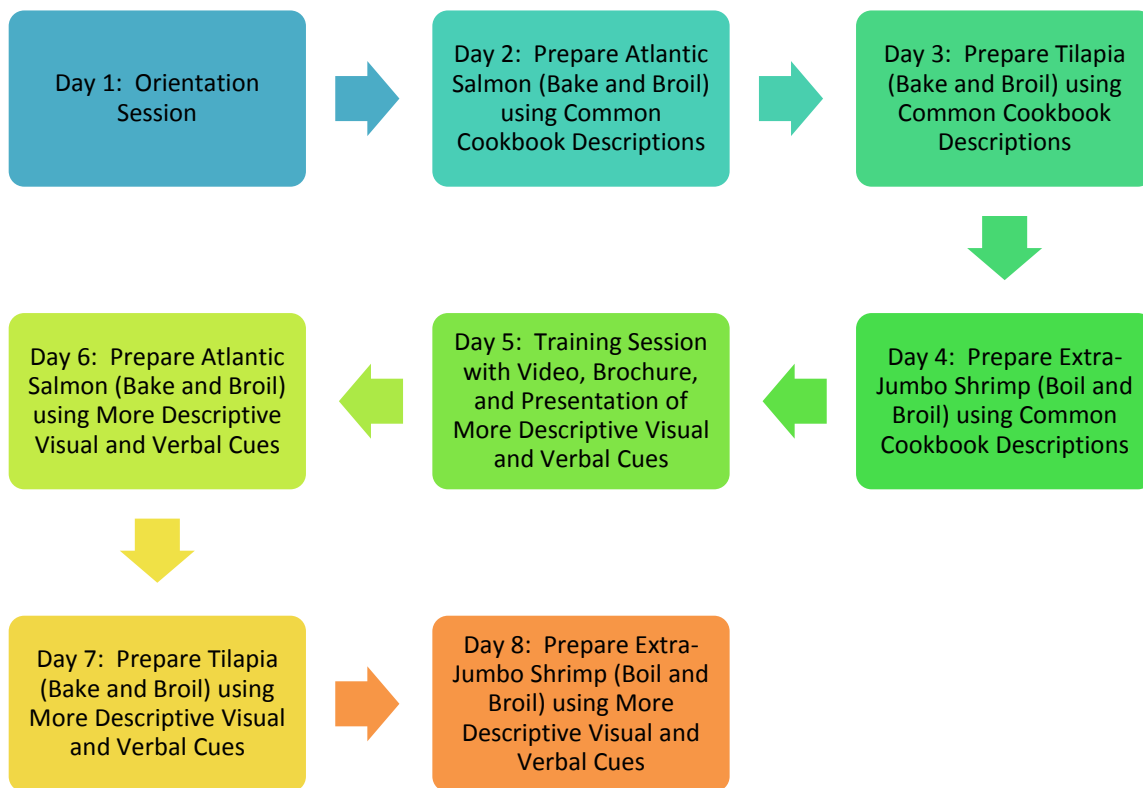
Before the experimental protocols were started, an IRB was submitted and approved by the Virginia Tech Institutional Review Board (IRB Number: 11-673) (Appendix A).

Participants were recruited for the study by the online survey (Appendix B-1) and were chosen based on availability, interest in participating, and experience with fish and shellfish. From the survey responses, six participants (one male and five females) were selected to participate.

Participants ranged in age from 18 to 70, with at least one in each age category (two between 41-50) (Appendix B-2). All were associated with Virginia Polytechnic Institute and State University, including professors, faculty, staff, and students. All selected participants routinely (weekly to several times per month) prepare fish and shellfish at home. Seven participants completed the initial (pre-training) preparation evaluation, but one was unable to complete the

training session and the subsequent cooking sessions; therefore, data for this participant was excluded from data analysis.

Each participant individual completed a total of three initial (pre-training) cooking sessions (salmon, tilapia, shrimp), a group training session, then three final (post-training) cooking sessions. The testing environment was a preparation kitchen laboratory with five test kitchens. All participants used the same laboratory kitchen and cooking equipment supplied in that kitchen. In a preliminary session each participant familiarized him or herself with the kitchen, available cooking materials (Appendix I), and methods of the experiment as well as reviewed and provided informed consent (Appendix F & J). After the preliminary session, participants were asked if there was anything else they would like to have available during their cooking sessions (Figure 4-1).



**Figure 4-1: Flow Diagram Illustrating the Steps for Translating Cooking Guidance into Skills Cooking Fish and Shellfish to Safe ( $\geq 63^{\circ}\text{C}$ ) Internal Endpoint Temperatures**

Cooking sessions were on a one-on-one basis, to avoid bias and influence from other participants and limited to the two preparation methods for one fish or shellfish product each day (Table 4-1) (Figure 4-1). Each cooking session took approximately an hour and the participant received a snack as compensation for his/her participation. During the first set of three cooking sessions, participants were only provided with current cookbook descriptions (Brown 2007; Appendix K) as guidance for preparation of and determining the cooking endpoint for each fish or shellfish (Table 4-1). Participants were observed and video recorded with a digital video camera (Canon Vixia HF 20) throughout their activities in the kitchen. The video camera was

placed approximately eight feet from the participant's left, as they stood looking at the designated oven range. When the participant believed that they had cooked the first product to the appropriate doneness using the first cooking method, the participant was permitted to begin the next preparation method. While the participant was preparing the second product for cooking, the first product was removed from his or her sight and the internal product temperature was measured in the designated area of the fish or shellfish (Felice 2011) with a data logger (Eco, Series 5000 Model 5100 Logger Lab, VPI & SU Inventory No. 117139) and a probe attachment (Thermocouple K, Omega Engineering, INC., HH64 Thermometer). After the participant believed that he/she had cooked the second product to the appropriate doneness, the participant was directed to fill out a questionnaire to determine what cues they used and additional information about food safety and quality characteristics related to the cues (Appendix L). While the participant was focused on that activity, the second product was removed from the participant's sight and internal temperature was taken in the designated area of the fish or shellfish using the data logger and probe attachment. Final endpoint internal temperatures were measured within two minutes of the product being removed from the heat source. The recorded temperatures were not reported to the participant and all effort was made to make certain the participant was not aware of this activity. The sample was weighed and a picture of the finished product was taken. The amount of cooking time for each product was also recorded.

Approximately three months after all participants completed the first set of three cooking sessions, there was a group training session with all participants, which lasted approximately an hour. During the training session, additional verbal and visual cues were described that were identified previously by Felice (2011) (Appendix M-1-M-3 & N). A brochure was presented for each product (salmon, tilapia, and shrimp) that included the health benefits and risks of

consuming fish and shellfish and signs to look for to determine doneness of fish and shellfish products (Appendix O). An electronic publication in the form of a 15-minute instructional video also was shown, which involved fish and shellfish safety concerns and issues with common culinary preparation techniques. In the initial five minutes of the video a fish and shellfish expert (Dr. David Kuhn Food Science and Technology Department, Virginia Tech) was interviewed. He discussed the differences in types of fish and shellfish, food safety issues related to fish and shellfish, why the consumer should cook their fish and shellfish to the recommended final internal endpoint temperature, and proper storage, handling, and preparation of fish and shellfish. In the later half, the video also showed how to properly handle and cook fish and shellfish products, including thermometer placement and visual signs that can be used to determine doneness. The goal for the training session was to verify if additional information regarding cooking and observation skills involving fish and shellfish would help participants of the study reach the recommended product internal endpoint temperature more consistently and decrease the occurrence of barriers to safely preparing a fish or shellfish dish. The primary intention for the electronic video publication was for publication by Virginia Cooperative Extension (VCE) and broad access through VCE and use by the general public. This study was used to determine if the electronic publication provided valuable information for improving cooking and food safety behaviors.

After the training session, cooking sessions were repeated in the same manner as for the initial cooking sessions (Figure 4-1); however, participants were provided with the handouts describing the additional verbal and visual cues (Felice 2011) discussed in the training session (Appendix M-1-M-3 & N), as well as the brochures for each product (Appendix O). The electronic publication and the other materials also were made available on an iPad. Participants

were again observed and video recorded to determine if participants were engaging in activities during preparation of the fish and shellfish that might compromise the safety of the end products. Participants filled out a questionnaire (Appendix P) that covered the following topics: beneficial aspects of the training session, cues useful in determining doneness of products, change in confidence compared to first set of cooking sessions, thermometer use, and cross-contamination. Participants were asked to determine if pictures of salmon, tilapia, and shrimp had been cooked to the correct internal temperature. Participants completed a knowledge quiz when they completed their last cooking session (Appendix Q).

Notes and video recordings were used to determine if the participant did not follow any commonly recommended food safety procedures and if any chances of cross-contamination occurred during the cooking sessions. Recordings were studied to conclude if there are any common barriers among the participants to safely preparing an end product. Observations during the second set of cooking sessions were compared to the observations of the first set of cooking sessions to detect if there was a change in actions of the participants, such as more conscientious actions and the effect of those actions on the safety on the final product. The videos from all cooking sessions were loaded into Noldus Information Technology Observer XT software (Wageningen, Netherlands). A preliminary viewing of videos was completed to determine codes for behaviors presented by participants. These codes were then loaded into the software manually and each time a participant presented a behavior of interest, that time segment of the video was coded. Frequency data for each behavior was reported from each cooking session. Duration of time also could have been reported. Videos analyzed by the primary coder and then by a secondary coder to ensure coding reliability. The coding scheme was briefly explained to the secondary coder prior to first coding session. Wanted (desired) and unwanted (undesired)

behaviors were coded (Table 4-2). The “wanted (desired) behaviors” were behaviors that would be considered as reducing the chance for cross contamination or ensuring that the product is cooked to the proper endpoint temperature. The “unwanted (undesired) behaviors” were behaviors that could increase the chance for cross contamination during the cooking session and possibly cause a foodborne illness. The “checking product” behaviors were the behaviors that the participants showed when they were actively trying to determine whether the product was cooked properly and ready to consume. The coding analyses, which were frequency data reported regarding participant behavior from each cooking session for each participant, were compared from both coders to determine agreement between the coders.

**Table 4-2: Behaviors Coded Presented by Participants (n = 6) during Pre- and Post-Training<sup>1</sup> Cooking Sessions for Fish (Salmon, Tilapia) and Shellfish (Shrimp)**

<b>Wanted<sup>2</sup> Practices</b>	<b>Unwanted<sup>2</sup> Practices</b>	<b>Checking<sup>2</sup> Product</b>
Hand Washing	Touching hair/body/face	Glancing at product
Washing Utensils	Using Dirty Utensils	Touching product with finger
Washing Product	Using Dirty Plate	Touching product with Utensil
Washing Dishes	Washing Hands without Soap	Flaking Product
Patting Product Dry	Touching Objects after touching raw seafood	Cutting Product Open
Cleaning Surfaces	Eating off dirty plate	Using Thermometer
Glancing/Noticing Thermometer	Licking Fingers	Looking at time/clock
Looking at information packet <sup>3</sup>		Putting Product in
Looking at iPad <sup>3</sup>		Taking Product Out
Setting a timer <sup>3</sup>		Tasting Product
		Flipping product over <sup>3</sup>

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication. <sup>2</sup>Wanted = behaviors that could reduce chance for cross contamination/ensuring that product is cooked to proper endpoint temperature, unwanted = behaviors that could increase chance for cross contamination/possibly cause foodborne illness, checking = behaviors when actively trying to determine when product was cooked properly. <sup>3</sup>Behaviors of participants coded for during second cooking sessions only.

The final internal temperature of the product, final product weight, and total time required to cook product was recorded when the participant identified that the product was adequately cooked. A picture was taken of the final product. Products that were prepared to internal temperatures less than 63°C (145°F) were considered undercooked because they did not meet the FDA 2009 Food Code recommended minimum internal temperature for safe consumption; products with temperatures 63-74°C (145-165°F) were considered in the acceptable eating quality range based on results from studies performed by Felice (2011) where products prepared to 64°C ± 1 (145°F) and 74°C ± 1 (165°F) had high sensory acceptability; products prepared to temperatures greater than 74°C (165°F) were considered products with unknown eating quality because previous research has not determined the sensory acceptability and eating quality of fish and shellfish products prepared to temperatures greater than 74°C (165°F).

### Statistical Analysis

A 3-way analysis of variance (ANOVA) was used to determine if there was an overall difference in the means of the final internal endpoint temperature (dependent variable) of the products with the main effects of training (before/after), product, and preparation method. Participants were included in the error term. Not all products received all preparation methods; therefore, full model interactions could not be computed. Instead, paired t-tests were performed on each product (salmon, tilapia, shrimp) to analyze the effect of training (before/after) and preparation method. A second 3-way ANOVA statistical model was used to determine if there were effects in internal product (fish) temperature based on training (before/after), product (salmon, tilapia) and preparation method (baked, broiled). Because this was a complete block

model design, it was possible to evaluate interactions of training\*product, training\*preparation method, and training\*product\*preparation method. Shrimp was excluded from this model because the preparation methods were different. Finally, the final internal temperature for each product was evaluated by a 2-way ANOVA, with training (before/after), preparation method, and the interaction of training\*preparation as the main effects. Student's t-tests and Tukey HSDs were performed to determine significance between the main effect interactions. An Effect Likelihood Ratio Test and an odds ratio were used to determine if the odds of the participants cooking the products to a temperature at or above 63°C (145°F) were greater after the training session compared to before the training session. Data was transformed to ordinal data, with 0 indicating that the internal temperature measurement was less than 63°C (145°F) and 1 indicating that the internal temperature measurement was 63°C (145°F) or above. The odds ratio is an indicator of how much impact the variables affect the probability of success. An additional Effect Likelihood Ratio Test was used to determine if there were greater odds of participants cooking products to temperatures of unknown eating quality (cooking to temperatures greater than 74°C/165°F) the fish and shellfish after the training session compared to before the training. This temperature (74°C/165°F) was selected based on Felice (2011). SAS JMP desktop statistical discovery software (Cary, NC) was used to perform these tests. The significance level was preset at  $\alpha=0.10$  because there are only six participants for these research studies; therefore, the sample size and power of this experiment is relatively small. Microsoft Excel was used for averages, standard deviations, and percentages. In order to determine if the training had an effect on the behaviors presented during the cooking sessions, a generalized linear model using a Poisson regression in a log linear model was performed on each category of behaviors (good, bad, and checking) using SAS JMP software. Inter-coder reliability was determined using

percent agreement and Cohen's kappa (Freelon 2011). Cohen's kappa values greater than 0.7 are usually considered acceptable to show agreement between coders (Harris and others 2002).

## **Results**

### Quantitative Data

Average final internal temperatures before the training session were below the recommended internal endpoint temperature of 63°C for salmon overall, broiled salmon, shrimp overall, and boiled shrimp (Table 4-3). All average internal temperatures after the training session were greater than 63°C. While the standard deviation for all products except for shrimp overall and broiled shrimp decreased after the six participants completed the training session (Table 4-3), there were still some isolated circumstances of products not reaching the targeted final temperature of 63°C or greater. The average overall final internal temperature (all products) before the training session ( $66.7 \pm 13.4^\circ\text{C}$ ) increased to  $72.8 \pm 9.91^\circ\text{C}$  after the training session (Table 4-4,  $p=0.014$ ; power = 0.703). The effects of the product and preparation method were also significant. The interaction of training\*product was not significant. Results from paired t-tests are included in Table 4-3; means within a row by method with different superscripts are significantly different ( $p<0.10$ ). The overall mean internal temperatures for the following products and preparation methods were significantly greater after training: salmon overall ( $p=0.033$ ; power = 0.461), broiled salmon ( $p=0.039$ ; power = 0.430), shrimp overall ( $p=0.015$ ; power = 0.622), and broiled shrimp ( $p=0.051$ ; power = 0.368).

**Table 4-3: Means ( $\pm$ SD) for Final Internal Temperature Measurements of Fish (Salmon, Tilapia) and Shellfish (Shrimp) for Cooking Sessions with Participants (n = 6), Before and After Training<sup>1</sup>**

Product	Overall <sup>2</sup>		Baked <sup>3</sup>		Broiled <sup>3</sup>		Boiled <sup>3</sup>	
	Before	After	Before	After	Before	After	Before	After
	$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$
<b>Salmon</b>	61.5 <sup>a</sup> $\pm$ 10.4 <sup>4</sup>	69.4 <sup>b</sup> $\pm$ 6.14	63.2 <sup>a</sup> $\pm$ 8.63	66.2 <sup>a</sup> $\pm$ 3.65	59.8 <sup>a</sup> $\pm$ 12.4	72.7 <sup>b</sup> $\pm$ 6.62	NA	NA
<b>Tilapia</b>	76.6 <sup>a</sup> $\pm$ 12.0	77.6 <sup>a</sup> $\pm$ 7.88	76.0 <sup>a</sup> $\pm$ 9.41 <sup>5</sup>	71.3 <sup>a</sup> $\pm$ 3.81	77.2 <sup>a</sup> $\pm$ 15.1 <sup>5</sup>	84.0 <sup>a</sup> $\pm$ 5.04 <sup>5</sup>	NA	NA
<b>Shrimp</b>	62.1 <sup>a</sup> $\pm$ 12.6 <sup>4</sup>	71.4 <sup>b</sup> $\pm$ 13.1	NA	NA	66.2 <sup>a</sup> $\pm$ 4.56	77.3 <sup>b</sup> $\pm$ 9.80 <sup>5</sup>	58.0 <sup>a</sup> $\pm$ 16.9 <sup>4</sup>	65.6 <sup>a</sup> $\pm$ 14.2

NA = Not Applicable (product not prepared by preparation method).

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication. <sup>2</sup>Number of observations for overall products (salmon, tilapia, shrimp) = 12. <sup>3</sup>Number of observations for each preparation method (baked, broiled, boiled) = 6.

<sup>4</sup>Average temperatures below the FDA Food Code (2009) recommended endpoint temperature of 63°C. <sup>5</sup>Highlighted average temperatures are over the temperature Felice (2011) found to have sensory acceptability (74°C), above the range for acceptable eating quality (63-74°C), and has unknown eating quality. Paired t-tests: Means within a row with different superscripts are significantly different (p<0.10)

**Table 4-4: Results of the 3-Way ANOVA Testing with Final Internal Temperature as a Dependent Variable, and Training<sup>1</sup> (Before/After), Product (Fish<sup>2</sup> [Salmon, Tilapia], Shellfish<sup>3</sup> [Shrimp]), and Preparation Method (Baked, Broiled, Boiled) as Independent Variables**

Source of Effect	df	F Ratio	p-value <sup>4</sup>
Training (Before/After)	1	6.30	0.014*
Product	2	7.74	0.001*
Preparation Method	2	3.80	0.026*
Product*Order	2	1.14	0.328
Total Error	64/72		

\* Indicates significance

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication. <sup>2</sup>Fish (Salmon, Tilapia) prepared by baked (n=6), broiled (n=6) preparation methods. <sup>3</sup>Shellfish (Shrimp) prepared by broiled (n=6), boiled (n=6) preparation methods.

<sup>4</sup>Predefined  $\alpha$ -value = 0.10.

The second 3-way ANOVA demonstrated that the overall mean internal temperatures for salmon and tilapia were significantly different ( $p < 0.0001$ ), along with temperatures before and after training ( $p = 0.091$ ), and the temperatures of the two methods of preparation (baking, broiling) ( $p = 0.054$ ). The influence of training on baking was to decrease the mean internal temperature of tilapia and increase the mean temperature of salmon, as well as decrease the standard deviation of the final product temperature. Training increased the mean internal temperature of broiled salmon and tilapia; however, the overall mean internal temperature for tilapia was already above the recommended endpoint temperature before training. Effect tests results are included in Appendix R.

The 2-way ANOVAs performed on the final internal temperature for each product illustrated that different preparation methodologies affected the final internal temperature for each product differently. Overall, the mean internal temperatures were significantly different based on training for both broiled salmon ( $p = 0.015$ ) and broiled shrimp ( $p = 0.093$ ). Mean internal temperatures for baked salmon, baked tilapia, broiled tilapia, and boiled shrimp were not

significantly different based on training. Effect tests result tables are included in Appendix R for all 2-way ANOVAs.

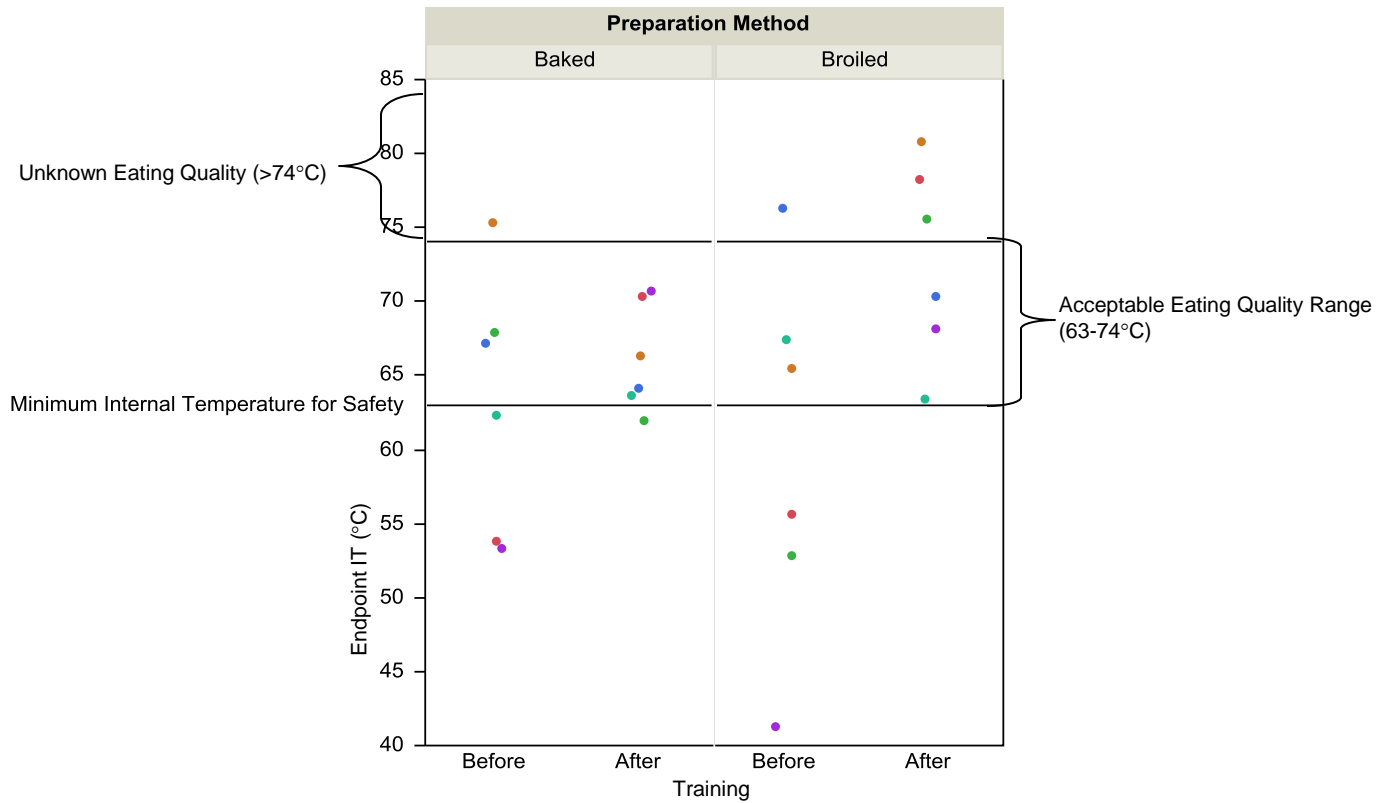
The participants were treated as a random independent variable because they were chosen based on willingness to take part in the study and experience with cooking fish and shellfish. To better understand how the training affected panelist performance in cooking each product, a 2-way ANOVA was completed with training (before/after) by panelist. Preparation method was not accounted for in this model. The mean internal temperature was not significantly different among participants for salmon and shrimp ( $p>0.10$ ). However, there were differences among panelist performance for cooking to the final endpoint temperature for tilapia. Overall, five participants improved their ability to cook salmon, tilapia, and shrimp to 63°C or higher after the training session (Table 4-5). One participant (#6) did not improve, but also had properly prepared fish and shellfish to greater than 63°C before training. Three participants increased their occurrences of cooking to temperatures with unknown product eating quality (>74°C) salmon, tilapia, and shrimp after the training session, one participant decreased his/her occurrences of cooking to temperatures with unknown product eating quality (>74°C), and two participants had equal occurrences of cooking to temperatures with unknown product eating quality (>74°C) before and after training. Five participants increased their ability to prepare products in the acceptable range where the product is considered safe to consume and still maintain a high quality product (63-74°C), and one participant remained constant in this range.

**Table 4-5: Count of Occurrences of Undercooking (<63°C), Acceptable Eating Quality Range (63-74°C), and Unknown Eating Quality (>74°C) Products (Salmon, Tilapia, Shrimp) by Participant Before and After Training<sup>1</sup>**

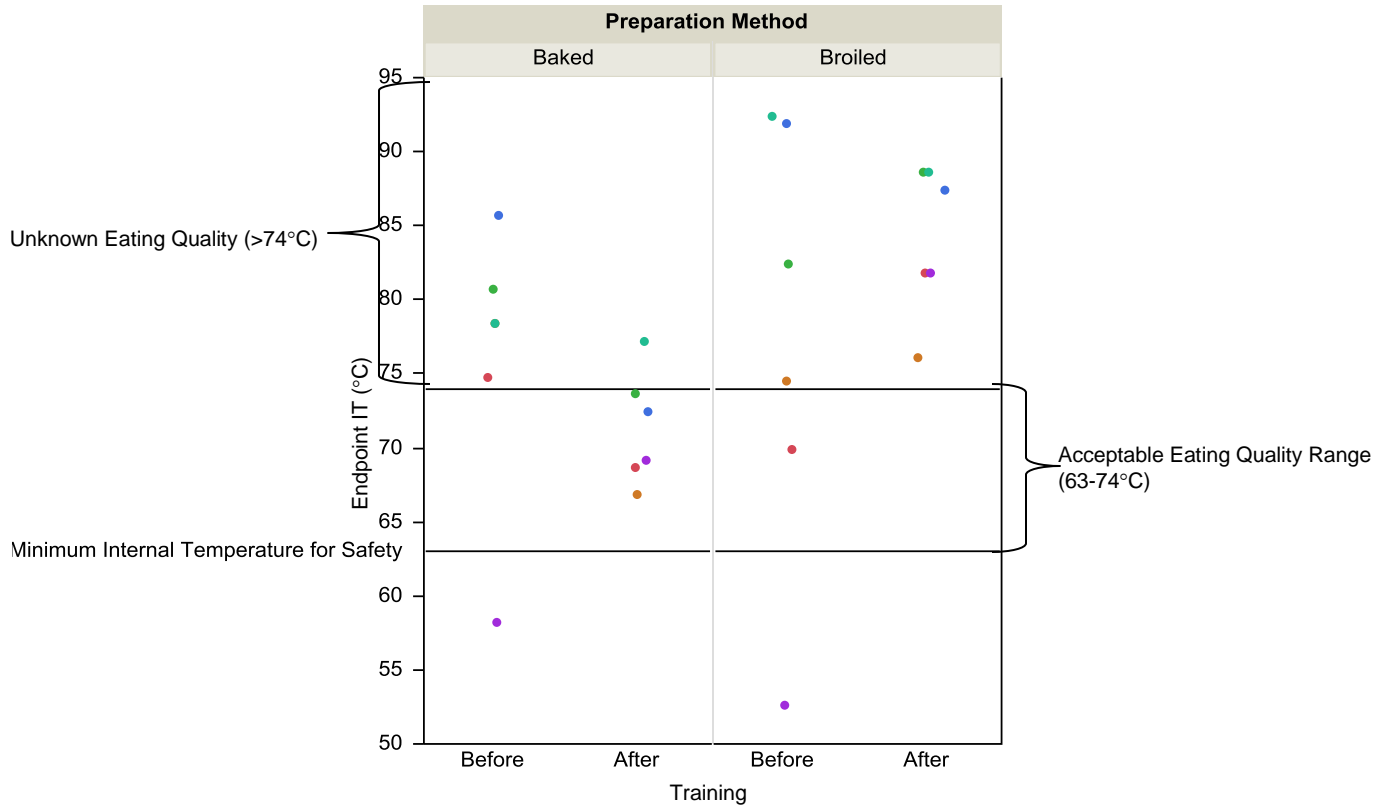
Participant <sup>2</sup>	<63°C		63-74°C		>74°C	
	Before	After	Before	After	Before	After
<b>1</b>	1	0	2	5	3	1
<b>2</b>	2	0	2	3	2	3
<b>4</b>	3	1	1	2	2	3
<b>5</b>	4	0	1	3	1	3
<b>6</b>	0	0	3	3	3	3
<b>7</b>	2	1	2	3	2	2
<b>Overall Total</b>	12	2	11	19	13	15

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication. <sup>2</sup>Participant #3 completed the pre-training session but not the post-training session, and was dropped from the analysis.

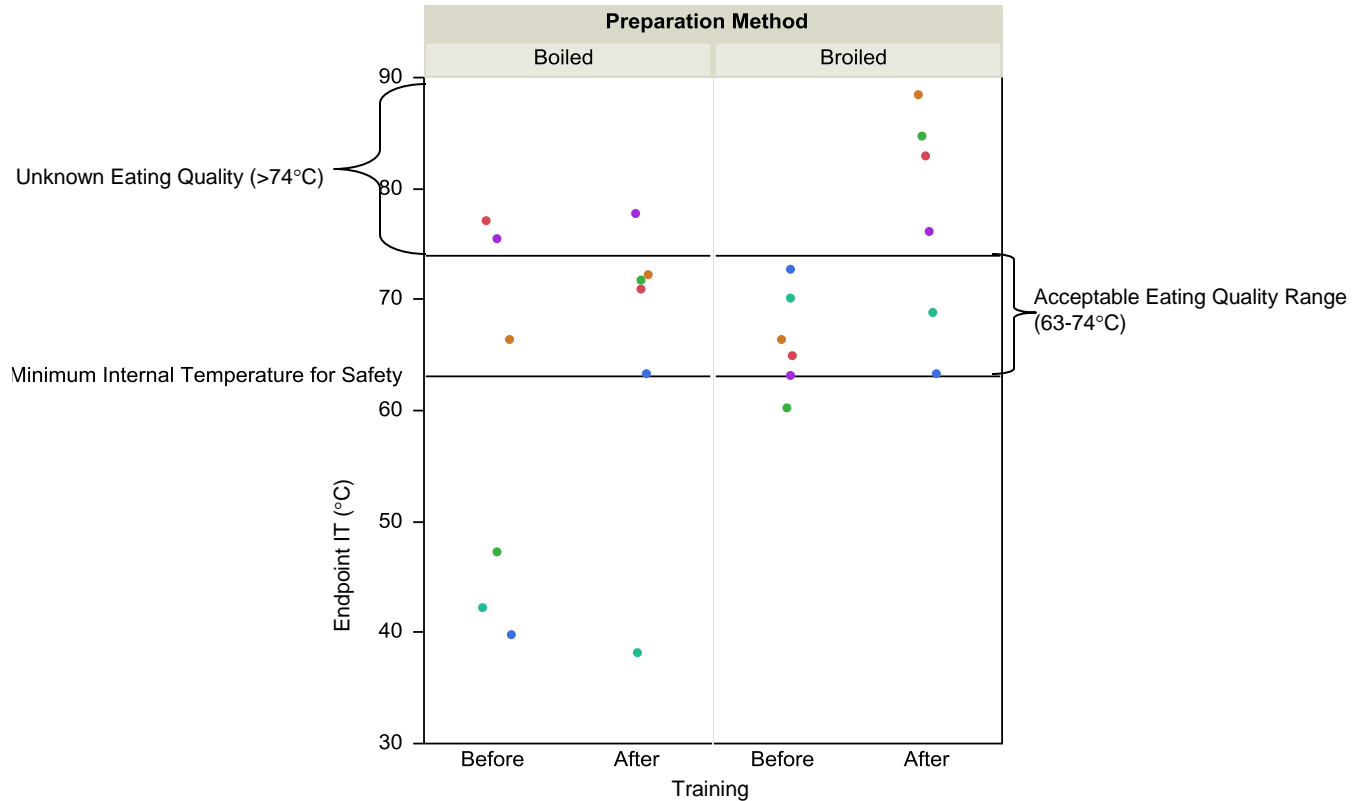
Although the mean internal temperature was significantly different after training for only broiled salmon ( $p=0.015$ ) and broiled shrimp ( $p=0.093$ ), participant ability improved to correctly prepare salmon (baked, broiled), tilapia (baked, broiled), and shrimp (broiled, boiled) to 63°C or greater. The following figures (Figures 4-2 – 4-4) demonstrate that, although not significant for each product and preparation method, fewer products were undercooked and the spread of the internal temperatures decreased.



**Figure 4-2: Graph of Internal Temperature Measurements of Salmon (Baked, Broiled) by Participant<sup>1</sup> (n=6) Before/After Training Session<sup>2</sup>.** <sup>1</sup>Each different colored dot indicates a different participant. <sup>2</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication.



**Figure 4-3: Graph of Internal Temperature Measurements of Tilapia (Baked, Broiled) by Participant<sup>1</sup> (n=6) Before/After Training Session<sup>2</sup>.** <sup>1</sup>Each different colored dot indicates a different participant. <sup>2</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication.



**Figure 4-4: Graph of Internal Temperature Measurements of Shrimp (Boiled, Broiled) by Participant<sup>1</sup> (n=6) Before/After Training Session<sup>2</sup>.** <sup>1</sup>Each different colored dot indicates a different participant. <sup>2</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication.

The percent of undercooked products (<63°C) decreased for all three products (Table 4-6). Due to training, only one occurrence of undercooking for both salmon and shrimp and no occurrences of undercooking of tilapia after the participants took place in the training session. The percent of samples with unknown eating quality increased for salmon and shrimp and decreased for tilapia after the training session. An Effect Likelihood Ratio Test (Table 4-7), based on the chi-square test, and an odds ratio were performed to determine the odds of the participants meeting the correct internal temperature (63°C) during the cooking sessions after training compared to before training. Product and preparation method were also taken into account during the analysis. Participants were more likely to cook the products to an internal

temperature greater than 63°C after the training compared to before the training ( $X^2(1, N=72) = 10.6; p=0.001$ ). The odds ratio for the training (before/after) was 10.4, which indicated that the odds of the participants meeting the correct internal temperature increased by a factor of 10.4 compared to before and after. The relation between the proportion of participants reaching the correct temperature and product was also significant, but the training was the variable of interest in this study. An additional Effect Likelihood Ratio Test and odds ratio were performed on the final internal temperature data to determine if the proportion of participants cooking products to internal temperatures with unknown eating quality ( $>74^\circ\text{C}$ ) was greater after the training compared to before the training. The relationship between whether or not the participant cooked the product to a temperature greater than  $74^\circ\text{C}$  and whether it was before or after the training session was not significant,  $X^2(1, N=72) = 0.437, p=0.509 (\alpha = 0.10)$ . The odds ratio was 1.50, which indicated that the odds of the participants cooking products to internal temperatures greater than  $74^\circ\text{C}$  increased by a factor of 1.50 compared to before and after.

**Table 4-6: Undercooked Products (Fish [Salmon, Tilapia], Shellfish [Shrimp]) and Products Cooked with Unknown Eating Quality by Participants (n = 6) during Cooking Sessions, Before and After Training Session<sup>1</sup>**

Product	Undercooked (%) (<63°C)		Unknown Eating Quality (%) (>74°C)	
	Before <sup>2</sup>	After <sup>2</sup>	Before <sup>2</sup>	After <sup>2</sup>
Salmon	50.0	8.33	16.7	25.0
Tilapia	16.7	0	75.0	58.3
Shrimp	33.3	8.33	16.7	41.7

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication. <sup>2</sup>n=12 for each product (Salmon, Tilapia, Shrimp).

**Table 4-7: Results of the Effect Likelihood Ratio Tests for the Proportion of Participants able to Successfully Meet the Correct Internal Temperature ( $\geq 63^{\circ}\text{C}$ ) as a Dependent Variable, and Training<sup>1</sup> (Before/After), Product (Fish<sup>2</sup> [Salmon, Tilapia], Shellfish<sup>3</sup> [Shrimp]), and Preparation Method (Baked, Broiled, Boiled) as Independent Variables**

Source of Effect	Chi-square Value	p-value ( $\alpha = 0.10$ )
Training (Before/After)	10.6	0.001*
Product	4.66	0.097*
Preparation Method	2.96	0.227

( $X^2$  (1,  $N=72$ ),  $p < 0.0001$ , preset  $\alpha = 0.10$ )

\* Indicates significance

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication. <sup>2</sup>Fish (Salmon, Tilapia) prepared by baked ( $n=6$ ), broiled ( $n=6$ ) preparation methods. <sup>3</sup>Shellfish (Shrimp) prepared by broiled ( $n=6$ ), boiled ( $n=6$ ) preparation methods.

The physical measurements, including weight and thickness, of the raw fish and shellfish for the first and second cooking sessions are included in Appendix S. The cook loss (%) of the products from the first and second cooking sessions is included in Appendix T; however, the participants were provided with seasonings and additional ingredients, which they were allowed to add to their products prior to cooking. The raw weights of the products were measured before the additional ingredients were added by the participants which affected the calculated cook loss (%).

#### Qualitative Data:

After the participants attended the training session, the trend in the behaviors (Table 4-2) changed significantly, based on the evaluation of notes and video recordings. A Poisson regression in log linear model was used to determine significance for each behavior group. The number of behaviors performed by participants was the dependent variable, with training (before/after), product, and participant as the independent variables (Table 4-8). Participants were included as an independent variable because participants demonstrated behaviors very differently; for example, one participant only checked their product 13 occurrences during a

cooking session while another participant checked their product 74 occurrences. This could be caused by differing familiarity with the product the participant was preparing during that session. The number of unwanted behaviors, those behaviors that could increase the chance for cross-contamination and foodborne illness, significantly decreased after the training session ( $X^2$  (1,  $N=36$ ) = 6.83;  $p=0.009$ ;  $\alpha = 0.10$ ). The number of wanted behaviors, those behaviors that would decrease the chance for cross-contamination and foodborne illness or behaviors that would help the participant successfully prepare the product to the correct internal temperature, significantly increased after the training session ( $X^2$  (1,  $N=36$ ) = 11.28;  $p<0.001$ ;  $\alpha = 0.10$ ). The number of checking product behaviors, those behaviors presented when the participant was actively trying to determine if the product was properly cooked, significantly increased after the training session ( $X^2$  (1,  $N=36$ ) = 4.95;  $p=0.026$ ;  $\alpha = 0.10$ ). Although the participant and product had a significant effect on the count of behaviors, the training was the independent variable that was of interest.

**Table 4-8: Results of the Poisson Regression Tests for the Count of Behaviors as a Dependent Variable, and Training<sup>1</sup> (Before/After), Participant (n=6), and Product (Fish [Salmon, Tilapia], Shellfish [Shrimp]) as Independent Variables**

( $\alpha=0.10$ )	Unwanted Behaviors <sup>2</sup>	Wanted Behaviors <sup>2</sup>	Checking Product <sup>2</sup>
Source of Effect	p-value	p-value	p-value
Training(Before/After)	0.064*	<0.001*	0.026*
Product	<0.000*	<0.000*	<0.000*
Participant	<0.000*	<0.000*	<0.000*

\*Indicates significance

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication. <sup>2</sup>Wanted = behaviors that could reduce chance for cross contamination/ensuring that product is cooked to proper endpoint temperature, unwanted = behaviors that could increase chance for cross contamination/possibly cause foodborne illness, checking = behaviors when actively trying to determine when product was cooked properly.

Other important observations made from the analysis of the videos from the cooking sessions include thermometer use and flaking procedures. Before the training session, only one

participant utilized the thermometer to measure the internal temperature of the product. This participant (#6) was an employee in the Virginia Tech Food Science and Technology Department. After the training session, all six participants attempted to utilize the thermometer to measure the internal temperature of the products. One participant had difficulties using the thermometer and was not successful in measuring the internal temperature. Another observation was that before the training session, participants did not use the correct procedure to “flake” the salmon and tilapia products and were unsure of how to actually “flake” a fillet. After the training session, all of the participants demonstrated the correct “flaking” procedure and understood where on the fillet they should “flake” and how they should go about the process.

There was a strong agreement between the two coders for all behavioral observations, based on the high Cohen’s kappa values (Table 4-9) with all values greater than 0.7 (Harris and others 2002) and most greater than 0.89. In qualitative research, one hundred percent agreement is not expected since coders will have different coding abilities and attention to behavioral detail (Harris and others 2002).

**Table 4-9: Percent Agreement and Cohen's Kappa Values for Inter-coder (n=2) Reliability of Behavioral Observations (Unwanted<sup>1</sup>, Wanted<sup>1</sup>, Checking Product<sup>1</sup>) of Participants (n=6) Before/After Training<sup>2</sup>**

Participant	Before Training		After Training	
	Percent Agreement (%)	Cohen's Kappa	Percent Agreement (%)	Cohen's Kappa
<b>1</b>	80.9	0.75	97.5	0.96
<b>2</b>	92.6	0.89	97.6	0.96
<b>4</b>	97.2	0.96	97.6	0.96
<b>5</b>	96.3	0.95	98.4	0.98
<b>6</b>	98.5	0.98	94.8	0.92
<b>7</b>	98.5	0.98	96.1	0.94
<b>Mean</b>	94.0	0.92	97.0	0.95
<b>Range</b>	80.9-98.5	0.75-0.98	94.8-98.4	0.92-0.98
<b>Median</b>	96.8	0.96	97.6	0.96

<sup>1</sup>Wanted = behaviors that could reduce chance for cross contamination/ensuring that product is cooked to proper endpoint temperature, unwanted = behaviors that could increase chance for cross contamination/possibly cause foodborne illness, checking = behaviors when actively trying to determine when product was cooked properly. <sup>2</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication.

Participants indicated on the post-cooking pre-training questionnaire (Appendix L) that they would like more details to instructions. They suggested that photographs, final temperature measurements, and cooking time at a specific temperature should be included in instructions. Jargon in instructions was a hindrance. There was varying knowledge and concern expressed by participants in regards to foodborne illness, with participants expressing a lack of knowledge or concern about foodborne illness, with the participant being more concerned about product quality than safety. Participants also expressed knowledge of the relationship between quality and consumption risk and knowledge of pathogens being present in fish and shellfish. The main motivating factors for consuming fish and shellfish, as expressed by participants on the post-cooking pre-training questionnaire, were taste and seasoning. A participant's low confidence level in his/her preparation did not always lead to low satisfaction with the end product and if the

participant had a high confidence level in his/her preparation then it led to a higher comfort level with cooking of the product.

The participants' perception of visual cues, as expressed on the post-cooking pre-training questionnaire, related to a cooked product included a loss of translucence, more opaque color, drier, flaking easily, firmness, and a color change. When asked about the cues associated with an undercooked product, participants associated these products with not enough color change, transparent, soft, moist, and no flaking. Participants associated overcooked products with a tough, very dry, dark color, and white product. Participants did not express any negative concerns about the quality of an undercooked product. When asked about the quality of a product that had been overcooked, all participants expressed thoughts that had a negative connotation toward the product.

Other thoughts that were expressed during the post-cooking questionnaires before the training session included the visual cue of browning of tilapia fillets that was not seen with salmon and shrimp. Participants also expressed the idea that there are different levels of understanding when it comes to cooking fish and shellfish and that some people need step-by-step instructions, while others will simply skim over instructions. Some participants also wished to see examples of exactly what they should be looking for in a properly cooked product, since they did not have the knowledge base to make up their own mind. Overall, participants wanted quantitative measurements (time and temperature) but they indicated that they would not focus on these and would look more at the color and texture of the fish and shellfish.

Participants identified several training aspects that were valuable for their post-training cooking session, based on questionnaire (Appendix P); responses included time measurements, additional visual cues and pictures of the progression of cooking, textural cues and descriptions

including flakiness, firmness, and springiness comparisons, and the inclusion of internal temperature. Characteristics that participants used to determine doneness of each of the three products (salmon, tilapia, and shrimp) including various visual and textural cues; temperature evaluation with a thermometer was used much more frequently (Table 4-10). The summary sheet of visual and non-oral evaluation guidelines was specifically identified as valuable by participants (Appendix N). Participants' comments indicate visual and non-oral cues to determine doneness were product specific. For example, one participant stated "Checking to see the appropriate amounts of white protein coagulate on the fish (salmon) helped me to determine if I should check the internal temperature", whereas another participant stated, "Hard to tell when done (tilapia) by visual and by flaking."

**Table 4-10: Characteristics from Post-Cooking Questionnaire Participants (n=6) Stated They Used to Determine Doneness of Fish (Salmon, Tilapia) and Shellfish (Shrimp) during the Post-Training<sup>1</sup> Cooking Sessions**

<b>Characteristics Used to Determine Doneness</b>			
<b>Product</b>	<b>Visual Cues</b>	<b>Textural Cues</b>	<b>Other</b>
<b>Salmon</b>	Sequence of doneness, white film, round edges, golden brown color, internal color, dry surface	How to flake, firmness (finger and fork), segments separating easily	Temperature (use of thermometer)
<b>Tilapia</b>	Color, brown edges, opaque and white, crispy and golden edges, curling edges, surface dryness	Comparing to flaked tuna, flaking segments, firmness (poking)	Temperature, timing
<b>Shrimp</b>	Color change, bright orange, shape change (curl), segment definition	Firmness (comparison to samples), springiness	Temperature

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication.

Most participants expressed more or much more confidence in the preparation of each product (Table 4-11) after the training session. The reasons the participants stated for their change in confidence in their preparation of salmon included additional guidelines, like the

pictures of white film (coagulated protein), edges, lateral separation, and the lines between the muscle segments; information on temperature measurements; explanation of the flaking procedure; and more information about color change.

Increased confidence in ability to prepare tilapia were associated with temperature measurement, knowing what changes occur and what to look for, washing of the fish, a better understanding of firmness and flakiness, and an increase in how careful they were while cooking the product. Participants stated that knowing the temperature and how to measure, what to look for in physical changes of the product (color, opaqueness, a q-shape for the curl) and textural changes (springiness) increased their preparation confidence of shrimp.

**Table 4-11: Participant (n=6) Self-Expressed<sup>2</sup> Change in Confidence during the Post-Training<sup>1</sup> Cooking Sessions for Fish (Salmon, Tilapia) and Shellfish (Shrimp) Preparation**

Product	Change in Confidence (Number of Participants)		
	Much More Confident	More Confident	No Change in Confidence
Salmon*	3	2	0
Tilapia	2	3	1
Shrimp	4	1	1

\*One participant failed to answer this question

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication. <sup>2</sup>Expressed on questionnaire taken after post-training cooking sessions.

During post-training salmon cooking sessions, all participants tried to utilize the available thermometer to measure the internal temperature of the salmon fillet. Participants stated that the thermometer was beneficial to determine whether the salmon fillet was properly cooked; they either used it as a primary method to determine doneness or a secondary method to confirm when they already knew what “done” salmon looks and “acts like”. Issues that the participants stated concerning the use of the thermometer included that the oven temperature was too hot to hold the thermometer close to the broiler; that they had to continue cooking the salmon after utilizing the thermometer; and that the thinness of the salmon fillet made it difficult to know how far to insert

the probe of the thermometer. Two participants stated that they did not have any issues. The participants were asked to record the readings of the thermometer and most of these reading corresponded with the temperature measurements from the data logger. However, one participant recorded a reading that was above the measurement from the data logger; the recorded temperature from the data logger caused this product to be considered undercooked. The participant may not have placed the thermometer in the thickest section of the salmon fillet to measure the internal temperature.

All six participants also utilized the thermometer evaluate the temperature of tilapia fillets, and expressed the same benefits and difficulties as for the salmon fillets; however, most of the readings recorded by the participants were lower than the measurements from the data logger. This could possibly be caused by carry-over cooking of the tilapia fillets.

Five participants measured the internal temperature of the shrimp with the thermometer. In addition to the benefits and difficulties expressed previously for salmon and tilapia fillets, participants identified that that the thermometer was slow to use and hard to get into the shrimp because of the small size of shrimp. The readings reported by the participants were also lower than the measurements with the data logger; once again, this could be caused by carry-over cooking.

Cross-contamination information from the training sessions increased participant awareness of behaviors in some but not all participants (Table 4-12). Several participants reported that they were already knowledgeable about cross-contamination risks prior to training. Behaviors that participants stated they performed that would reduce the chance for cross-contamination included washing hands, minimizing contact, washing the product, and keeping the raw and cooked products separate. Behaviors that the participants stated they performed that

would increase the chance for cross-contamination included not washing their hands, touching objects after touching raw product without washing their hands in-between, using dirty paper towels, and not washing the product.

Several participants stated that they learned new knowledge including washing products and not to use utensils that came in contact with the raw product regarding handling of tilapia and shrimp and that they noticed a behavioral change including washing products and being more careful during the preparation. All participants believed they had reduced the chance for cross-contamination because they did not put the cooked product back on the plate that held the raw product, washed their hands frequently, washed thermometer and utensils, sanitized sink and faucet, and washed the product and used clean paper towels. One participant stated that he/she may have increased the chance for cross-contamination because he/she used a hand that touched the raw product to turn on the faucet; however, he/she sanitized the faucet afterwards, demonstrating an increased awareness of appropriate preventive actions.

**Table 4-12: Participant (n=6) Responses to Questions Concerning Cross-Contamination Issues and Their Behaviors Preparing Fish (Salmon, Tilapia) and Shellfish (Shrimp) During Post-Training<sup>1</sup> Cooking Sessions**

Product	Cross-Contamination Issues (# of Participants)							
	Felt More Informed		Change in Behavior		Reduced Chance		Increased Chance	
	Yes	No	Yes	No	Yes	No	Yes	No
Salmon*	1	4	2	3	4	1	3	2
Tilapia	4	2	4	2	6	0	0	6
Shrimp	3	3	3	3	6	0	1	5

\*One participant failed to answer this question.

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication.

In the post-training questionnaire, participants used their observational skills to determine if illustrated products were cooked to the correct internal temperature. Questions had two pictures of the targeted product; participants were asked to select one, both, or neither of the

pictures. Three participants were able to select the correct picture for salmon, while the other three participants selected that both salmon fillets had been properly cooked. Only one participant was able to select the correct answer for the two pictures of tilapia fillets; both fillets had been properly cooked and three participants selected the first picture and two participants selected the second picture. This suggests that visual cues alone are not sufficient for evaluating appropriate temperature endpoints for fish products. Physical methods (flaking, compression) and temperature evaluation are needed.

Participants demonstrated good knowledge ( $\bar{x} = 8.33$ ) on the post-training knowledge quiz (10 questions, Appendix Q) covering food safety and fish/shellfish preparation. All of the questions were derived from the video that was shown during the training session. Most participants missed the questions concerning risks associated with consuming undercooked fish and shellfish and the pathogens associated with fish and shellfish; however, this was not a true indicator of their overall knowledge concerning food safety and microbiology knowledge because there were only two questions targeted to that information. Participant preference for different formats (paper, electronic) of information was highly weighted toward paper (n=5). Participants were also asked what tool they would like to be able to access the electronic version of information on; two participants stated phone, two stated laptop or desktop, and one stated iPad.

## **Discussion**

The products for this study (salmon, tilapia, shrimp) were chosen because they are commonly consumed by the U.S. population (NFI 2011), which was confirmed by the recruitment survey discussed in Chapter 3. These products are also dramatically different from

each other; salmon is a fatty salt-water fish that is typically bought in thick fillets, tilapia is a lean fresh-water fish typically purchased in long, thin fillets, and shrimp is a small shellfish with a high salt-content that can be bought either whole with heads on or with the heads removed and deveined. By choosing products that were different from each other, it was possible to determine if consumers have more difficulty preparing a certain type of seafood compared to others and the effect of training on participant ability to correct prepare the different products. Salmon posed the greatest difficulty to cook to the proper internal endpoint temperature, which may have been caused by the thickness of the fillet and the high fat content. Tilapia had more occurrences of cooking to temperatures with unknown eating quality, which could be due to the thin fillet and texture of cooked tilapia. Tilapia becomes less firm as it cooks and participants may have not been aware of the texture change. Shrimp is a product that is commonly known to lose eating quality if overcooked and participants may have been more cautious during preparation to ensure they did not overcook, causing the end product to actually be undercooked. Training had the greatest effect on participant ability to broil salmon.

Preparation method also affected overall mean internal temperatures of products. Participants were relatively familiar with baking salmon and tilapia; therefore, overall mean internal temperatures for baked products were greater than the recommended internal temperature before and after training. Participants increased their ability to bake tilapia to a temperature that was both safe for consumption and maintained eating quality and decreased cooking to temperatures associated with unknown eating quality. Participants had a greater difficulty broiling products; broiled salmon was undercooked more commonly before training, broiled tilapia was cooked to unknown eating quality temperatures more commonly before and after training, and broiled shrimp was cooked to unknown eating quality temperatures more after

training. This difficulty of properly broiling products could be caused since broiling is a rapid, high and direct heat method, during which the heat quickly penetrates the product. Consumers need to be informed that broiling is a quick preparation method and they should be more observant when preparing products using this method. Participants also tended to undercook boiled shrimp pre-training, but training increased their ability to boil shrimp to a safe and high quality end product.

Current culinary guidelines are not adequate to ensure that consumers have the ability to prepare fish and shellfish products to the recommended internal endpoint temperature. This was demonstrated by the higher occurrence of undercooking products (50% for salmon; 16.7% for tilapia; 33.3% for shrimp) by participants pre-training in this study. In a study conducted by Felice (2011), descriptions for evaluating doneness of fish and shellfish, as obtained from common cookbooks and textbooks, were used as a metric for determining when Atlantic salmon, tilapia, shrimp, and oysters were cooked. Most products did not reach the recommended internal temperature of 63°C but fulfilled the descriptions listed in the cookbooks and textbooks (Table 4-13). The mean final internal temperatures using the visual doneness characteristics stated by the cookbooks and textbooks for baked Atlantic salmon was 60.5°C, poached Atlantic salmon was 62.5°C, baked tilapia was 59.4°C, broiled tilapia was 61.0°C, and sautéed shrimp was 60.1°C. Broiled Atlantic salmon, pan-fried tilapia, boiled shrimp, broiled shrimp, broiled oysters, and pan-fried oysters all had mean final internal temperatures that reached or were greater than the 63°C recommended endpoint internal temperature based on the guidelines of the cookbooks and textbooks. These studies showed that even if a fish or shellfish product fulfilled the suggested visual and textural descriptions listed in cookbooks and textbooks, the product

could be undercooked or cooked to temperatures associated with unknown eating quality (Felice 2011).

**Table 4-13: Results from Felice (2011): Average Final Internal Temperatures of Fish (Salmon, Tilapia) and Shellfish (Shrimp, Oysters) using Common Cookbook Descriptions to Determine Doneness**

Product	Preparation Method	Average Final IT (°C)
Atlantic Salmon	<b>Baked</b>	<b>60.5<sup>1</sup></b>
	Broiled	67.7
	<b>Poached</b>	<b>62.5</b>
Tilapia	<b>Baked</b>	<b>59.4</b>
	<b>Broiled</b>	<b>61.0</b>
	Pan-Fried	66.4
Shrimp	Boiled	65.4
	Broiled	69.9
	<b>Sautéed</b>	<b>60.1</b>
Oysters	Broiled	77.9
	Pan-Fried	78.0

Modified from Felice (2011). <sup>1</sup>Bolded type indicates an average final IT that was below the recommended internal endpoint temperature of 63°C.

Consumers also have difficulties preparing other meat and poultry products to the correct internal temperature. Chicken was undercooked by 16% of participants (n=108) in an observational study by Worsfold and Griffith (1997), along with 28% of egg dishes being undercooked by participants. Cooking to below the recommended internal temperature of 74°C occurred in 15% of products (Worsfold and Griffith 1997). In an observational study by Phang (2010), 30% of participants (n=201) undercooked hamburgers. Products like beef and chicken have received more publicity concerning correct final internal temperatures than fish and shellfish; however, consumers still undercook these products.

Thermometer use to determine doneness of meat, poultry, and seafood is not a common practice for consumers. During pre-training cooking sessions of fish and shellfish, only one participant out of six (16.7%) utilized a thermometer to measure the internal temperature of the products (this participant was affiliated with Virginia Tech Food Science and Technology

Department; Blacksburg, VA). In other observational studies during which participants prepared meals in a home setting, thermometer use by participants was not common. Only 4% of participants (n=201) utilized a thermometer to determine doneness in hamburgers and over 50% did not think it was necessary (Phang 2010), while only one participant out of 30 used a thermometer to measure the internal temperature of burgers (Scott and Herbold 2010). Previous surveys have reported that 24% of respondents (n=2,551) utilized a thermometer when preparing meats and poultry (ADA and ConAgra Foundation 2000); only 20% of respondents (n=1,000) always/usually use a thermometer to determine doneness of meat, pork, and chicken, while 23% of these respondents regularly utilized a thermometer for these products (ADA 2011). Rare use of thermometers may be attributed to the fact that most common cookbook guidelines emphasize the use of visual cues to determine doneness (Phang 2010).

Even if consumers own or use a thermometer, they may not be able to properly prepare meals because they do not have adequate knowledge concerning correct internal temperatures to cook these products. As previously discussed, 13% of participants (n=160) that took the recruitment survey for these studies were able to correctly write-in the temperature to cook fish and shellfish, which was similar to 16% of participants (n=107) that responded to a survey by Felice (2011). Only 12% of participants (n=201) knew the correct temperature to cook hamburgers (Phang 2010). Consumers may undercook products when preparing them at home if they do not utilize a thermometer and only use visual cues to assess doneness; however, thermometer use will not be effective if consumers do not have enough knowledge regarding correct internal endpoint temperatures. Also, many thermometers do not indicate the internal temperature for cooking seafood but do have temperatures for poultry, pork, and beef.

Additional educational materials that contain details about visual and textural changes in fish and shellfish products related to cooking to correct internal temperatures are beneficial to consumers to increase their ability to prepare a microbiologically safe product with high sensory acceptability. Occurrences of undercooking products decreased significantly during post-training cooking sessions, with only two occurrences of undercooked products (n=36). The handouts regarding additional verbal and visual cues used during the training session (Appendix G1-G3; L) were developed by Felice (2011) after a trained panel (n=7) determined visual qualitative descriptors for cooking fish (salmon, tilapia) and shellfish (shrimp) to 64°C and 74°C. These materials, along with the electronic publication, increased participant knowledge about visual and textural cues to look for to determine doneness. Visual guidelines, including pictures and videos, were mentioned during focus group discussions (Chapter 3) as a way to better describe how to prepare fish and shellfish products and increase confidence and knowledge in preparation. Guidance on thermometer use also increased participant willingness to utilize thermometers and increased their ability to correctly use thermometers. Participants used the available thermometer to confirm products had met the correct internal temperature after determining that the product fulfilled visual and non-oral descriptions. Supplying consumers with educational materials (brochure, video, recipe cards) concerning thermometer use has been shown to increase consumer motivation to utilize thermometers in their homes (Takeuchi and others 2005).

The risk of food-borne illness can also be substantially decreased by providing educational materials concerning proper handling and preparation of fish and shellfish products. Although seafood is consumed less than beef and poultry in the U.S., consumption of seafood causes a similar number of food-borne outbreaks (USDA 2012). Based on post-training,

participants reduced undercooking from 12 occurrences, which could cause the participant to acquire a food-borne illness from consumption, to two occurrences of undercooking.

Educational materials could also reduce healthcare costs and lost work time since consumer illnesses caused by eating improperly handled or prepared seafood would be reduced. While cooking to unknown eating quality temperatures remained a potential quality problem post-training and participants tended to cook products to higher temperatures ( $>74^{\circ}\text{C}$ ) in compensation for undercooking, this risk was not statistically high. Further exploration is needed to determine if educational materials do indeed cause consumers to potentially cook products to temperatures with unknown eating quality and if cooking to temperatures greater than the temperature determined by Felice (2011) ( $>74^{\circ}\text{C}$ ) actually causes a decrease in sensory acceptability.

Consumers are not as confident preparing or as satisfied with meals that contain salmon, tilapia, and shrimp compared to meals containing beef and chicken, as determined by the recruitment survey (Chapter 3). Educational materials helped participants feel more confident in their post-training preparation of fish (salmon, tilapia) and shellfish (shrimp). As discussed in the focus group results from the previous chapter (Chapter 3), an increase in confidence in preparation increases consumer willingness to prepare these products and to attempt preparing other fish and shellfish products utilizing multiple cooking methods.

Providing participants with information concerning reducing cross-contamination significantly decreased occurrences of unwanted (undesired) behaviors, significantly increased wanted (desired) behaviors, and also significantly increased participant attentiveness to the product that they were preparing (checking product). Several behaviors (Table 4-2) were chosen in accordance with Fight BAC! consumer food-safety recommendations

(<http://www.fightbac.org/>), including hand washing, washing surfaces, cleaning areas, rinsing products, placing cooked products on plate that held raw products, and using a thermometer. Participants become more aware of the behaviors they were performing and the effect those behaviors had on the overall safety of the finished product, which can reduce their chances of acquiring a food-borne illness and increase the safety of their end product. Similar results were found from other observational studies concerning increasing consumer food safety related behaviors using information intervention (Nauta and others 2008; Redmond and Griffith 2006). Nauta and others (2008) designed a message about food safety and hygienic practices in the home to distribute to participants that elicited a “disgusted” emotion. Also included was information concerning behaviors that reduce the chance for cross-contamination when handling raw chicken. Redmond and Griffith (2006) developed a promotional strategy to improve food safety practices, including leaflets, posters, magnets, a documentary that was shown on television, and a newspaper article. These materials were placed in the community where the targeted audience lived (Redmond and Griffith 2006). Both studies (Nauta and others 2008; Redmond and Griffith 2006) saw an increase in safe food practices; however, Redmond and Griffith (2006) observed a reduced effect of intervention after four to six weeks had passed since implementation. Long-term effect of educational materials developed for training participants on proper preparation of fish and shellfish could be possible future research.

Multiple studies have been conducted to determine the effectiveness of behavior intervention on self-reported food safety practices (Angell 2008; Cody and Hogue 2003; Dharod and others 2004; Medeiros and others 2004; Nies and Van Laanen 1995; Takeuchi and others 2005; Unusan 2007); however, self-reported behaviors do not always correlate with actual

observed behaviors performed by consumers (Anderson and others 2004; Phang 2010; Scott and Herbold 2010).

Some limitations to this study include the fact that the sample size was relatively small, six participants, and that the participants knew they were being filmed. Since the participants were aware of the camera, they may have changed their typical behaviors that they would perform in a home or more comfortable setting. The kitchen setting in a laboratory test kitchen as opposed to their personal kitchen created a heightened awareness and may have made the participants feel uncomfortable and nervous. This may have modified the behaviors that the participants would normally present. However, in a study by Kettunen and others (2001) concerning nurse-patient interaction showed that there was limited behavioral bias caused by participants knowing they were being video recorded. The participants themselves were also all associated with Virginia Tech; therefore, they may have been more educated than the typical consumer because they work at or are affiliated with a college university. One participant was a Food Science and Technology staff member, with another participant who was previously associated with the Food Science and Technology Department. Therefore, the participants in this study did not represent the general consumer population since two participants were familiar with food safety practices and all were affiliated with the university. Additional research needs to be conducted to determine effectiveness of training materials with a participant group that more closely resembles typical consumers and not affiliates of universities. The training session took place approximately a week prior to the second set of cooking sessions; therefore, the information provided during the training session may have been fresh in the participants' minds and behaviors may have been different if more time had passed between the training session and the second set of cooking sessions. Another limitation to this study was that the order of

preparation was not randomized. All participants completed the series in the same manner; product preparation order was the same for each participant (see Figure 4-1). Participants may have hurried through preparation of the second product in order to finish the session, which may have caused the second product prepared on each day to have greater chances of being undercooked. Participants may have been ready to complete the study and therefore, could have hurried preparation during the last session (shrimp). The study was designed to facilitate ease with preparing products for participant cooking sessions (Figure 4-1); therefore, the primary researcher only had to prepare one type of product (salmon, tilapia, shrimp) per day for participants during the entirety of the research study.

## **Conclusions**

Product and preparation method play an important role in safety and quality of the end products that consumers cook. Thermometers could be improved and modified to have a smaller probe, quicker reaction to temperature measurements, and indicate internal endpoint temperatures for fish and shellfish, which could increase consumer willingness to utilize thermometers for these products. Although there is currently information available concerning fish and shellfish preparation, barriers are still present concerning jargon and visual guidance for fish and shellfish. These barriers could be overcome by educational materials that are more descriptive and informative. More guidance details about visual and textural product changes related to temperature are needed in formats that are readily accessible and easy to use. Behavior modification is possible in steps, including educating consumers, consumers becoming more aware of presented behaviors, and practice of desired behaviors. Use of video evaluation provides documentation of behaviors and analysis of behavior change after training or

interventions. Educational visual demonstration materials potentially can decrease risk of foodborne illness associated with cooking fish and shellfish.

## References

- American Dietetic Association. 2011. Consumer Knowledge of Home Food Safety Practices Survey. Academy of Nutrition and Dietetics. November 4, 2011. Internet. Accessed September 23, 2012. < [http://homefoodsafety.org/pub/file.cfm?item\\_type=xm\\_file&id=2399](http://homefoodsafety.org/pub/file.cfm?item_type=xm_file&id=2399)>.
- American Dietetic Association and ConAgra Foundation. 2000. Home Food Safety Summer Survey Key Findings. May 12, 2000. Academy of Nutrition and Dietetics. Internet. Accessed September 23, 2012. < <http://homefoodsafety.org/media-releases-may12-2000-key>>.
- Anderson, J.B., Shuster, T.A., Hansen, K.E., Levy, A.S., Volk, A. 2004. A Camera's View of Consumer Food-Handling Behaviors. *Journal of the American Dietetic Association* 104(2):186-191.
- Angell, D. 2008. Food Demonstration and Taste Testing Format: Ohio Extension Program Proves Effective. *Journal of Family and Consumer Sciences* 100(1): 38.
- Brown, A. 2007. *Understanding Food: Principles and Preparation*. Belmont, CA: Thomson Higher Education. 654p.
- Cody, M.M., Hogue, M.A. 2003. Results of the Home Food Safety – It's in Your Hands 2002 Survey: Comparisons to the 1999 Benchmark Survey and Healthy People Food Safety Behaviors Objective. *Journal of the American Dietetic Association* 103(9): 1115-25.
- Dharod, J.M., Perez-Escamilla, R., Bermudez-Millan, A., Segura-Perez, S., Damio, G. 2004. Influence of the Fight BAC! Food Safety Campaign on an Urban Latino Population in Connecticut. *Journal of Nutrition Education and Behavior* 36(3): 128-134.
- Felice, R.J. 2011. *Sensory and Physical Assessment of Microbiologically Safe Culinary Processes for Fish and Shellfish*. Thesis (MS) Virginia Polytechnic Institute and State University. Blacksburg, VA. 155p.
- Freelon, D. 2011. ReCal2: Reliability for 2 Coders. 2011. American University School of Communication. Internet. Accessed September 10, 2012. < <http://dfreelon.org/utills/recalfront/recal2/>>
- Frewer, L.J., Shepherd, R., Sparks, P. 1994. The Interrelationship Between Perceived Knowledge, Control, and Risk Associated with a Range of Food-Related Hazards Targeted at the Individual, Other People, and Society. *Journal of Food Safety* 14(1): 19-40.
- Gould, L.H., Nisler, A.L., Herman, K.M., Cole, D.J., Williams, I.T., Mahon, B.E., Griffin, P.M., Hall, A.J. 2011. Surveillance for Foodborne Disease Outbreaks – United States, 2008. September 9, 2011. *Morbidity and Mortality Weekly Report* 60(35): 1197-1202.
- Harris, J., Pryor, J., Adams, S. 2002. *The Challenge of Intercoder Agreement in Qualitative Inquiry*. Austin, TX: University of Texas at Austin. 27p.

- Jacob, C., Mathiasen, L., Powell, D. 2010. Designing Effective Messages for Microbial Food Safety Hazards. *Food Control* 21(1): 1-6.
- Kettunen, T., Poskiparta, M., Liimatainen, L. 2001. Empowering Counseling – A Case Study: Nurse-Patient Encounter in a Hospital. *Health Education Research* 16(2): 227-238.
- Medeiros, L.C., Hillers, V.N., Chen, G., Bergmann, V., Kendall, P., Schroeder, M. 2004. Design and Development of Food Safety Knowledge and Attitude Scales for Consumer Food Safety Education. *Journal of the American Dietetic Association* 104(11): 1671-1677.
- National Advisory Committee on Microbiological Criteria for Foods (NACMCF). 2008. Response to the Questions Posed by the Food and Drug Administration and the National Marine Fisheries Service Regarding Determination of Cooking Parameters for Safe Seafood for Consumers. NACMCF, Washington, DC. *J Food Prot* 71(6):1287-1308.
- Nauta, M.J., Fischer, A.R.H., Asselt, E.D., Jong, A.E.I., Frewer, L.J., Jonge, R. 2008. Food Safety in the Domestic Environment: The Effect of Consumer Risk Information on Human Disease Risks. *Risk Analysis* 28(1): 179-192.
- Nies, J.I., Van Laanen, P.G. 1995. Effect of Safe Food Handling Programming on Participants' Food Handling Behaviours. *Family and Consumer Sciences Research Journal* 24(2): 161-179.
- Phang, H. 2010. Consumer Handling of Hamburgers. Thesis (MS) University of California Davis. Davis, CA. 77p.
- Redmond, E.C., Griffith, C.J. 2004a. Consumer Attitudes and Perceptions Towards Microbial Food Safety in the Domestic Kitchen. *Journal of Food Safety* 24(3): 16-194.
- Redmond, E.C., Griffith, C.J. 2004b. Consumer Perceptions of Food Safety Risk, Control and Responsibility. *Appetite* 43(3): 309-313.
- Redmond, E.C., Griffith, C.J. 2006b. A Pilot Study to Evaluate the Effectiveness of a Social Marketing-Based Consumer Food Safety Initiative using Observation. *British Food Journal* 108(9): 753-770.
- Roberts, K.R., Barrett, B.B., Howells, A.D., Shanklin, C.W., Pilling, V.K., Brannon, L.A. 2008. Food Safety Training and Foodservice Employees' Knowledge and Behavior. *Food Protection Trends* 28(4): 252-260.
- Rombauer, I.S., Becker, M.R., Becker, E. 2006. *Joy of Cooking*. New York, NY: Scribner. 1132p.
- Scott, E., Herbold, N. 2010. An In-Home Video Study and Questionnaire Survey of Food Preparation, Kitchen Sanitation, and Hand Washing Practices. *Journal of Environmental Health* 72(10): 8-13.

Takeuchi, M.T., Hillers, V.N., Edwards, Z.M., Edlefsen, M., McCurdy, S.M. 2005. Now You're Cooking. . .Using a food thermometer!. *Journal of Nutrition Education and Behavior* 37(5): 271-272.

United States Department of Agriculture (USDA). 2012. Table 39 – Per Capita Consumption of Major Food Commodities. Internet. Accessed October 22, 2012.  
<[http://www.ers.usda.gov/datafiles/Agricultural\\_Outlook\\_Statistical\\_Indicators/Updated\\_Tables/AoTable39.xls](http://www.ers.usda.gov/datafiles/Agricultural_Outlook_Statistical_Indicators/Updated_Tables/AoTable39.xls)>

United States Department of Health and Human Services, Public Health Service, Food and Drug Administration. 2009. Food Code. United States Department of Health and Human Services, College Park, MD. Internet. Accessed October 04, 2011.  
<<http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/FoodCode/FoodCode2009/>>.

Unusan, N. 2007. Email Delivery of Hygiene Education to University Personnel. *Nutrition and Food Science* 37(1): 37-41.

Worsfold, D., Griffith, C. 1997. Food Safety Behavior in the Home. *British Food Journal* 99(3): 97-104.

# Appendices

## Appendix A: Institutional Review Board Approval Letter



VirginiaTech

Office of Research Compliance  
Institutional Review Board  
2000 Kraft Drive, Suite 2000 (0497)  
Blacksburg, Virginia 24060  
540/231-4806 Fax 540/231-0959  
e-mail [irb@vt.edu](mailto:irb@vt.edu)  
Website: [www.irb.vt.edu](http://www.irb.vt.edu)

### MEMORANDUM

**DATE:** September 23, 2011

**TO:** Susan E. Duncan, Jeri Kostal, Tiffany Drape, Virginia Fernandez-Plotka

**FROM:** Virginia Tech Institutional Review Board (FWA00000572, expires May 31, 2014)

**PROTOCOL TITLE:** Sensory and Physical Assessment of Microbiologically Safe Culinary Processes for Fish and Seafood

**IRB NUMBER:** 11-673

Effective September 22, 2011, the Virginia Tech IRB Chair, Dr. David M. Moore, approved the new protocol for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at <http://www.irb.vt.edu/pages/responsibilities.htm> (please review before the commencement of your research).

### PROTOCOL INFORMATION:

Approved as: Expedited, under 45 CFR 46.110 category(ies) 6, 7

Protocol Approval Date: 9/22/2011

Protocol Expiration Date: 9/21/2012

Continuing Review Due Date\*: 9/7/2012

\*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

### FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals / work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

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VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

*An equal opportunity, affirmative action institution*

## **Appendix B-1: Recruitment Survey for Consumer Preparation and Focus Group Studies**

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Your participation in this survey infers informed consent in future use of the data for research information related to a research study.

IRB NUMBER: 11-673

**Your Name: (First and Last)**

**Your e-mail address:**

Demographics:

**What is your gender?**

- Female  
 Male

**What is your age?**

- 18-24  
 25-30  
 31-40  
 41-50  
 51-60  
 61-70  
 71+

**Ethnicity:**

- American Indian or Alaskan Native  
 Asian or Pacific Islander  
 Black or African American  
 Hispanic, Latino, or Spanish Origin  
 White, Caucasian  
 other:

Seafood Consumption Habits:

**How often do you consume fish/shellfish?**

- Daily to several times a week

- Once a week
- Several times a month
- Once a month
- Several times a year
- Never

**What type of fish/shellfish do you consume?**

- Salmon
- Tilapia
- Trout
- Catfish
- Tuna
- Flounder
- Crab
- Crawfish
- Lobster
- Shrimp
- Mussels
- Oysters
- Clams
- Scallops

other:

**How is the fish/shellfish you consume usually prepared?**

- Barbecued
- Baked
- Blackened
- Broiled
- Deep Fried
- Grilled
- Microwaved
- Pan Fried
- Poached

- Raw
  - Sautéed
  - Smoked
  - Steamed
- other:

**Who prepares the fish/shellfish you typically consume?**

- Prepared by yourself, at home
  - Prepared by someone other than yourself, in a home environment
  - By a chef/cook at a restaurant
  - Ready-to-eat from a convenience store, fast food, or similar type
  - Ready-to-eat from a super market or food store
- other:

**How often do you prepare fish/shellfish yourself?**

- Daily to several times a week
- Once a week
- Several times a month
- Once a month
- Several times a year
- Never

**If you prepare fish/shellfish yourself, what preparation method/culinary method do you use?**

- Barbecued
- Baked
- Blackened
- Broiled
- Deep Fried
- Grilled
- Microwaved
- Pan Fried
- Poached
- Raw
- Sautéed

Smoked

Steamed

other:

**Do you have any concerns about preparing fish/shellfish products at home? If so, what are they?**

Yes

No

**Concerns:**

**Do you have any concerns about consuming fish/shellfish outside of your home? If so, what are they?**

Yes

No

**Concerns:**

In general, when preparing meals at home containing the following meats and fish/shellfish, how confident are you in your preparation of that meal? In other words, how confident are you that you prepared it to a correct internal endpoint temperature?

**Beef**

Very confident    Somewhat confident    Slightly confident    Not confident at all

**Chicken**

Very confident    Somewhat confident    Slightly confident    Not confident at all

**Pork**

Very confident    Somewhat confident    Slightly confident    Not confident at all

**Salmon**

Very confident    Somewhat confident    Slightly confident    Not confident at all

**Tilapia**

Very confident    Somewhat confident    Slightly confident    Not confident at all

**Shrimp**

Very confident    Somewhat confident    Slightly confident    Not confident at all

In general, when preparing meals at home containing the following meats and fish/shellfish, how satisfied are you with the finished product and your preparation of that product?

**Beef**

Very satisfied    Somewhat satisfied    Slightly satisfied    Not satisfied at all

**Chicken**

Very satisfied    Somewhat satisfied    Slightly satisfied    Not satisfied at all

**Pork**

Very satisfied    Somewhat satisfied    Slightly satisfied    Not satisfied at all

**Salmon**

Very satisfied    Somewhat satisfied    Slightly satisfied    Not satisfied at all

**Tilapia**

Very confident    Somewhat confident    Slightly confident    Not confident at all

**Shrimp**

- Very confident    Somewhat confident    Slightly confident    Not confident at all

**Indicate your agreement with the following statement: I am concerned with the safety of the foods that I consume.**

- Very Strongly Agree    Strongly Agree    Slightly Agree    Neither Agree or Disagree    Slightly Disagree    Strongly Disagree    Very Strongly Disagree

**To what temperature do you think fish/shellfish should be cooked in order for it to be considered safe for consumption? (ex. Chicken: 165 degrees F)**

**Do you typically use an instrument to measure the internal temperature of the meat or fish/shellfish product you are preparing?**

- No  
 Rarely  
 Sometimes  
 Often  
 Always

**If you use an instrument to measure the internal temperature of the meat or fish/shellfish product you are preparing, what type of instrument do you use?**

- I never use an instrument to measure the internal temperature.  
 I use an instrument but I don't know what type it is.  
 Thermometer  
 Meat Thermometer  
 Temperature Probe

other:

**Would you be interested in participating in sensory studies on fish/shellfish or other food products?**

- Yes  
 No

If you have answered no to the previous question, then you are done with the survey. Thank you for your participation!

If yes, please respond to the following questions:

**Do you have allergies to any of the following:**

- No known allergies  
 Eggs  
 Peanuts

- Tree Nuts (Walnuts, etc.)
- Milk
- Fish
- Shellfish
- Fruits
- Wheat
- Vegetable
- Soy Products

other:

**Select the products that you are most willing to evaluate:**

- Fish
- Shellfish
- Milk and dairy products
- Soymilk or soy-based products
- Chicken
- Beef
- Pork
- Fruits
- Vegetables
- Desserts
- Beverages
- Snackfoods

other:

**Please provide contact information so we can contact you for future sensory studies.**

**Would you be interested in participating in a consumer preparation study, during which you would be preparing salmon, tilapia, and shrimp?**

- No, I am not interested
- Maybe, I am interested but would like more information
- Yes, I am interested

**Would you be willing to be videotaped and observed during several cooking sessions?**

- Yes
- No

**Do you have 7-10 hours, in approximately one hour time blocks, that you could participate in these cooking sessions, sometime between November 1 to December 23 or January 4 to January 31?**

- Yes, between November 1 to December 23
- Yes, between January 4 to January 31
- No, I do not have the time to participate

**Would you be interested in participating in a focus group study concerning current trends in the consumer population regarding attitudes about seafood?**

- No, I am not interested
- Maybe, I am interested but would like more information
- Yes, I am interested



Thank you for your participation!

---







## Appendix B-2: Recruitment Survey Answers for Consumer Preparation and Focus Group Studies

Demographics:





### What is your gender?

Female 113 (71%)   
Male 46 (29%)   
*no answer* 1 (1%) |

### What is your age?





18-24 32 (20%)   
25-30 24 (15%)   
31-40 28 (18%)   
41-50 24 (15%)   
51-60 38 (24%)   
61-70 8 (5%)   
71+ 5 (3%) |  
*no answer* 1 (1%) |

### Ethnicity:

American Indian or Alaskan Native 2 (1%) |  
Asian or Pacific Islander 8 (5%)   
Black or African American 3 (2%) |  
Hispanic, Latino, or Spanish Origin 8 (5%)   
White, Caucasian 131 (82%)   
other: 2 (1%) |  
*no answer* 6 (4%) 

Seafood Consumption Habits:

### How often do you consume fish/shellfish?

Daily to several times a week 24 (15%)   
Once a week 31 (19%)   
Several times a month 65 (41%)   
Once a month 20 (13%) 

Several times a year	<b>16</b> (10%)	■
Never	<b>4</b> (3%)	■
<i>no answer</i>	<b>0</b> (0%)	

**What type of fish/shellfish do you consume?**

Salmon	<b>123</b> (77%)	■
Tilapia	<b>103</b> (64%)	■
Trout	<b>46</b> (29%)	■
Catfish	<b>53</b> (33%)	■
Tuna	<b>121</b> (76%)	■
Flounder	<b>51</b> (32%)	■
Crab	<b>89</b> (56%)	■
Crawfish	<b>23</b> (14%)	■
Lobster	<b>45</b> (28%)	■
Shrimp	<b>134</b> (84%)	■
Mussels	<b>37</b> (23%)	■
Oysters	<b>41</b> (26%)	■
Clams	<b>46</b> (29%)	■
Scallops	<b>79</b> (49%)	■
other:	<b>15</b> (9%)	■

**How is the fish/shellfish you consume usually prepared?**

Barbecued	<b>13</b> (8%)	■
Baked	<b>87</b> (54%)	■
Blackened	<b>40</b> (25%)	■
Broiled	<b>84</b> (52%)	■
Deep Fried	<b>64</b> (40%)	■
Grilled	<b>93</b> (58%)	■
Microwaved	<b>9</b> (6%)	■
Pan Fried	<b>69</b> (43%)	■
Poached	<b>8</b> (5%)	■
Raw	<b>40</b> (25%)	■
Sautéed	<b>46</b> (29%)	■
Smoked	<b>32</b> (20%)	■
Steamed	<b>52</b> (33%)	■

other: 11 ( 7%) ■

### Who prepares the fish/shellfish you typically consume?

Prepared by yourself, at home	<u>119</u> (74%)	■
Prepared by someone other than yourself, in a home environment	<u>55</u> (34%)	■
By a chef/cook at a restaurant	<u>118</u> (74%)	■
Ready-to-eat from a convenience store, fast food, or similar type	<u>12</u> ( 8%)	■
Ready-to-eat from a super market or food store	<u>31</u> (19%)	■
other:	<u>1</u> ( 1%)	■

### How often do you prepare fish/shellfish yourself?


Daily to several times a week	<u>14</u> ( 9%)	■
Once a week	<u>20</u> (13%)	■
Several times a month	<u>47</u> (29%)	■
Once a month	<u>32</u> (20%)	■
Several times a year	<u>25</u> (16%)	■
Never	<u>20</u> (13%)	■
<i>no answer</i>	<u>2</u> ( 1%)	■


### If you prepare fish/shellfish yourself, what preparation method/culinary method do you use?

Barbecued	<u>10</u> ( 6%)	■
Baked	<u>71</u> (44%)	■
Blackened	<u>12</u> ( 8%)	■
Broiled	<u>44</u> (28%)	■
Deep Fried	<u>14</u> ( 9%)	■
Grilled	<u>64</u> (40%)	■
Microwaved	<u>8</u> ( 5%)	■
Pan Fried	<u>63</u> (39%)	■
Poached	<u>5</u> ( 3%)	■
Raw	<u>11</u> ( 7%)	■
Sautéed	<u>37</u> (23%)	■
Smoked	<u>6</u> ( 4%)	■
Steamed	<u>34</u> (21%)	■
other:	<u>6</u> ( 4%)	■

**Do you have any concerns about preparing fish/shellfish products at home? If so, what are they?**

Yes 42 (26%) 

No 115 (72%) 


*no answer* 3 (2%) 


**Concerns:**


Parasites, undercooking, overcooking to ensure safety.. but compromises quality
My apartment mates cannot stand the smell of fish
I'm too lazy to cook for myself
don't know how to cook properly
Ensuring fish is cooked completely throughout. Originally from UK I do not trust defrosted fish/shellfish as much as I prefer to buy fresh fish (never frozen), which is more common in UK.
Foodborne illness, husband cooks salmon on grill at home. Use a meat thermometer to check the internal cooked temperature, but still am concerned at times.
Making sure it is cooked properly.
There's always the concern of fish going bad, and the smell.
I'm always concerned that I've either undercooked the fish or overcooked it. It never seems to turn out properly done! I tend to overcook it though, just to prevent any foodborne illnesses.
The smell. Not knowing the source and under what conditions the shell/fish were raised. I've heard nasty stories of products imported from overseas that were treated heavily with antibiotics because of the unsanitary conditions in which they raised.
Fully cook
Overcooking crab legs and they get chewy
Determining if it is cooked and will it taste any good
overcooking
too much oil used or blacken too much
Only that my house smells like fried food or fish for the rest of the night!
Mainly that it costs more than I wish it did.
Mostly about where grocery-store shrimp have come from. I understand that Asian shrimp farms are often very unsanitary, and it may be risky to consume shrimp from those environments. Also a few concerns about mercury levels in tuna.
Knowing with certainty that what you buy is fresh/safe.
If I can get it fresh enough from the vendor
I try to be as clean as possible and that eliminates my concern.
Whether the fish I buy at the grocery is safe, uncontaminated. That's the reason I do not purchase or consume mussels.
Only if I violate the preparation guidelines. Then that concerns me. But I worry more about eating in restaurants. I have seen some borderline situations with proper preparation there.
preparation and length of time between purchasing and cooking
I tend to over-cook fish, so my concern is not that we'll get ill. My concern is that I'll have spent good money for naught!
How much mercury or other heavy metals are in the fish I eat?

that it was cooked thoroughly
Is the fish fresh? Is it cooked enough?
thoroughly cooked
I don't really know how to prepare it properly.
Don't always know when it's done.
When purchasing the product from a supermarket, I am concerned about freshness. I prefer to purchase at the coast, where I know it is fresh and quality is good. I prefer fresh to frozen due to differences in cooking outcomes. I also like to buy US seafood.
Reducing cross contamination Cooking it thoroughly without drying it out
Difficult to cook at home. Easy to overcook, and nervous about under cooking.
There are a lot of env and health concerns, heavy metal consumption, biocides, bottom trawling. I try to eat "wild caught" fish and "farm raised" shrimp. Even though farm raised in Thailand isn't exactly good either.
odor!!! we eat mostly shrimp-- most of the shrimp I would be able to purchase is just not fresh enough (I spent some of my childhood on the South Carolina coast. We caught our own shrimp, so needless to say, NOTHING you could get around here compares.....) No one in my family really likes any other kind of fish or shellfish, at all.
My first concern is that the fish comes from a proper handler. I keep the raw fish separate from any ready to eat products, and keep the area I use to cleaning/preparing the raw fish sanitized. Immediately after dealing with the raw fish I wash my hands, and make sure any utensils (or cutting board) is either in the sink to be cleaned or in the dish washer so that I will not use it for anything else until it is properly cleaned. I use a thermometer when I believe the food to be fully cooked, to confirm that it has reached an appropriate temperature.
overcooking and making it stretchy/hard to eat, undercooking and getting a disease, contaminating my kitchen with raw stuff, too hard to fix at home
Side-comment: I am aware when meat that I cook is not cooked to the correct temperature. I usually cook pork chops/lion to 135-140F, steaks to 120F and tuna/salmon similar to steaks. All other meat (including ground) is thoroughly cooked.
Properly prepared,
since I don't eat seafood, I don't cook it but my husband and daughter do. I have a concern that they will not get it done and somehow they will get sick as a result.
Overcooking
Mostly not overcooking so it is rubbery
Must be thoroughly cooked, worried about mercury levels.
I probably should b/c I do know about food safety concerns, but I live on the edge.

**Do you have any concerns about consuming fish/shellfish outside of your home? If so, what are they?**

Yes **63** (39%) 

No **95** (59%) 

no answer **2** (1%) 

**Concerns:**






The chef didn't prepare the food correctly
If they are cleaned and cooked well.
Have experienced two meals when fish was still frozen inside the tuna steak
Proper preparation of shellfish and fish to avoid food poisoning
I don't have any concerns really. But I don't eat oysters during the summer months!
Where the seafood comes from
Foodborne illness. Taste.
If eating at a restaurant, I trust that the restaurant personnel will properly cook the fish. When eating at someone else's house, worry about whether or not they know how to cook to proper temperatures.
For tuna, usually ask for it well done.
I tend to avoid sushi in "sketchy" establishments, but I tend to assume most restaurants handle their fish well.
food poisoning
I am allergic to shrimp, so I worry that if I go out, shrimp may have touched my food at some point and I will get sick. I also worry that the seafood at restaurants is not fresh.
food safety
Spending money on a product that isn't always a safe, quality product.
That the restaurant is clean and serves fresh fish
Eating farm-raised fish in restaurants completely negates my purpose for eating fish as they have been fed corn thus increasing n6 and lowering n3, so I might as well enjoy a nice corn-fed beef steak as opposed to the salmon that was farm-raised. ALSO, for the questions below, I typically undercook my beef and salmon as a personal preference, yes I know my risks, but it's much more tasty.
Is it cooked all the way, how old is it,
Food poisoning. Had it about 2 years ago from eating at a sushi restaurant.
Undercooking, cross-contamination
Freshness
Food Poison
not on fish in general but shellfish, they may contain bacteria not cooked fully.
I'm always concerned if food has been properly handled. So if it smells fishy, I don't eat it.
Careful about source of raw oysters. I purchase only from reliable source.
Will it be sufficiently cooked?
I don't usually think about those issues when dining out.
Most concerns I have are related to overfishing of certain species. I try to be conscious of the effects that my consumption of a particular species has on the survival of that species as a whole. I really enjoy consuming fish, as I do about once a week (living on a teaching assistant salary), and I enjoy preparing it. I also enjoy consuming it in restaurants, although, that is mostly raw (sushi). But I do my research before I buy fish and try to purchase what is "in season" and what is less harmful.
Storage/Preparation standards in restaurants aren't well known/publicized.
I like to know where the fish originally came from. If I am going to buy fresh fish I usually go to a store like Whole Foods where I can ask questions and get detailed answers.
The concern is if the food was properly handled and prepared.
I don't order fish much outside my home. But when I do it is typically sushi or at a nicer restaurant. I

trust my foodhandlers.
I am highly iodine sensitive. I can't eat shrimp. I am worried about contamination in shellfish and therefore don't eat it more than once a year at most.
Usually worried about it being undercooked or finding bones. Not a huge worry, but I do think about it occasionally.
Shellfish, whether it is safe to eat I only order from restaurants with a very good reputation
As I mentioned, yes I do have concerns about restaurant preparation. In one local restaurant I have stopped buying certain meals because the shrimp and shellfish were not cooked properly. I have complained about the problem to the chain and to the local restaurant. I am not sure that they have improved. So I avoid ordering their seafood items.
How much mercury or other heavy metals are in the fish I eat?
that it was stored/handled/cooked properly
How it is prepare and maintaining good practices
fresh, hygienic and pollution
How the fish was handled and whether or not it has bones.
Freshness, cross contamination
sometime i am just concerned about where the fish/shellfish is obtain from but besides that i do not worry much
Country of origin of the seafood.
I don't believe I have had any illness from consumption of seafood at a restaurant, but I know people who have, so this is a concerning thought. I like raw oysters.
Freshness and quality of sushi grade fish- I still eat it but I do pause momentarily.
Concerns with possible cross-contamination, personal hygiene, and thorough cooking by person preparing the seafood.
Same as above, although there is no labeling to tell you where it came from.
Contaminated products that are either farm-raised or come from areas such as the Gulf Coast.
They are very slight. If I hear that a sushi restaurant has bad practices, I won't eat there. (Re: question below about confidence and measuring temperatures: I almost always measure meat temps but fish is usually too small--I don't know how to measure appropriately)
Freshness
fully cooked!!!
I want to have confidence in the restaurant I choose, in that they have chosen the correct seafood suppliers so that the food is of good quality and not spoiled. I have concerns about the seafood being fully cooked, but at restaurants I can only judge by appearance, smell, and texture.
exposure to unsafe chemicals
is it overcooked and disgusting or is it undercooked and potential for disease
Any concerns I have generally stem from when I order sushi. I have to be confident that the sushi is being prepared properly by a person with good hygiene. The fish must be fresh, "sashimi-grade" fish.
Concerns only when consuming raw seafood, like salmon, tuna. I am not very confident about whether or not it has any infections.
heavy metals - only consume fish like tuna and salmon once in awhile
properly prepared
Source of seafood. Properly handled and cooked correctly.
That the restaurant will not get it cooked thoroughly.





Freshness
Proper preparation of product but more so, was it transported and stored properly before arriving at the restaurant?
Must be thoroughly cooked, worried about mercury levels.
Especially with clams and oysters, I am particular about where I eat them, considering we don't live near the shore.
I dont choose seafood if the establishment is not a certain standard after I sit down to eat.

In general, when preparing meals at home containing the following meats and fish/shellfish, how confident are you in your preparation of that meal? In other words, how confident are you that you prepared it to a correct internal endpoint temperature?






### Beef

Very confident	<u>115</u>	(72%)	
Somewhat confident	<u>34</u>	(21%)	
Slightly confident	<u>4</u>	(3%)	
Not confident at all	<u>2</u>	(1%)	
<i>no answer</i>	<u>5</u>	(3%)	






### Chicken

Very confident	<u>118</u>	(74%)	
Somewhat confident	<u>35</u>	(22%)	
Slightly confident	<u>5</u>	(3%)	
Not confident at all	<u>0</u>	(0%)	
<i>no answer</i>	<u>2</u>	(1%)	


### Pork


Very confident	<u>101</u>	(63%)	
Somewhat confident	<u>39</u>	(24%)	
Slightly confident	<u>9</u>	(6%)	
Not confident at all	<u>4</u>	(3%)	
<i>no answer</i>	<u>7</u>	(4%)	


### Salmon


Very confident	<u>82</u>	(51%)	
Somewhat confident	<u>47</u>	(29%)	
Slightly confident	<u>10</u>	(6%)	
Not confident at all	<u>6</u>	(4%)	
<i>no answer</i>	<u>15</u>	(9%)	


### Tilapia

Very confident **84** (52%) 


Somewhat confident **38** (24%) 


Slightly confident **12** (8%) 


Not confident at all **5** (3%) 


*no answer* **21** (13%) 


### Shrimp

Very confident **102** (64%) 

Somewhat confident **35** (22%) 


Slightly confident **7** (4%) 


Not confident at all **4** (3%) 


*no answer* **12** (8%) 

In general, when preparing meals at home containing the following meats and fish/shellfish, how satisfied are you with the finished product and your preparation of that product?


### Beef

Very satisfied **121** (76%) 


Somewhat satisfied **31** (19%) 


Slightly satisfied **1** (1%) 


Not satisfied at all **0** (0%)

*no answer* **7** (4%) 


### Chicken

Very satisfied **123** (77%) 


Somewhat satisfied **31** (19%) 


Slightly satisfied **2** (1%) 


Not satisfied at all **0** (0%)


*no answer* **4** (3%) 


### Pork

Very satisfied **101** (63%) 


Somewhat satisfied **38** (24%) 


Slightly satisfied **9** (6%) 

Not satisfied at all **1** (1%) 

*no answer* **11** (7%) 

### Salmon

Very satisfied **84** (52%) 

Somewhat satisfied **44** (28%) 

Slightly satisfied **9** (6%) ■  
 Not satisfied at all **6** (4%) ■  
*no answer* **17** (11%) ■

**Tilapia**

Very satisfied **81** (51%) ■■■■■  
 Somewhat satisfied **39** (24%) ■■■  
 Slightly satisfied **11** (7%) ■  
 Not satisfied at all **4** (3%) ■  
*no answer* **25** (16%) ■

**Shrimp**

Very satisfied **98** (61%) ■■■■■  
 Somewhat satisfied **39** (24%) ■■■  
 Slightly satisfied **4** (3%) ■  
 Not satisfied at all **2** (1%) ■  
*no answer* **17** (11%) ■

**Indicate your agreement with the following statement: I am concerned with the safety of the foods that I consume.**

Very Strongly Agree **38** (24%) ■■■  
 Strongly Agree **39** (24%) ■■■  
 Slightly Agree **38** (24%) ■■■  
 Neither Agree or Disagree **18** (11%) ■  
 Slightly Disagree **10** (6%) ■  
 Strongly Disagree **9** (6%) ■  
 Very Strongly Disagree **4** (3%) ■  
*no answer* **4** (3%) ■

**To what temperature do you think fish/shellfish should be cooked in order for it to be considered safe for consumption? (ex. Chicken: 165 degrees F)**


**133 responses**


160 degrees F	145	145
145	155	145F
165	Without googling... maybe 130?	i have no idea..
140 degrees F	No idea.	varies
225	Depends on the fish, and the	no clue


	source of the fish	
155	No idea	150
150F?	160	165
165	above 100 centigrade	140 degrees F
don't know	I think it's about 125 degrees, depends on the cut	145
145 to 150 F	125	145 F
120	150 degrees F	165 degrees
150	Don't know	145F
170	140F	140 F
180	350	160
160	145 degrees F	145
135 Degrees	140 degrees F	165
140 degrees F	145-150 degrees F	165
?	above 150 degrees f	?
165	150	150 degrees F
80 C (Pasteurization)	145 F	140 degrees F
160	150	no idea
Some isn't cooked?	180 F	same as chicken
150	150	175F
150	No clue	140
150F	Don't know.	145
if fresh no min temp	145 degrees F	? no idea
150	100	140
140F	140 F and higher	Don't know, go by look
140	165	165F
until it is done----	145	200F
150 degrees F	150	boiling or higher t
170F	above 180F	I don't check temperature
???	200	No clue- till it looks right?
130	160-165	165
145	180	I have no idea - until it is no longer translucent - appears cooked/white and it flakes well
140	130 degrees F	145F
160	155 degrees F preferable, 145 min.	170
130	?	145 degrees F
145F	325 degrees	145
160	? Fish-when it flakes/Shrimp-pink	150
I don't know	140	not entirely sure


145 F	?	No idea
160	200	No idea
Done	No idea	
?	165	


**Do you typically use an instrument to measure the internal temperature of the meat or fish/shellfish product you are preparing?**


No **74** (46%) 

Rarely **30** (19%) 


Sometimes **31** (19%) 


Often **15** (9%) 


Always **8** (5%) 


*no answer* **2** (1%) 


**If you use an instrument to measure the internal temperature of the meat or fish/shellfish product you are preparing, what type of instrument do you use?**


I never use an instrument to measure the internal temperature. **58** (36%) 

I use an instrument but I don't know what type it is. **4** (3%) 


Thermometer **7** (4%) 


Meat Thermometer **62** (39%) 


Temperature Probe **21** (13%) 

other: **1** (1%) 

**Would you be interested in participating in sensory studies on fish/shellfish or other food products?**

Yes **71** (44%) 


No **86** (54%) 


*no answer* **3** (2%) 

If you have answered no to the previous question, then you are done with the survey. Thank you for your participation!

If yes, please respond to the following questions:

**Do you have allergies or intolerances to any of the following:**

No known allergies **66** (41%) 

Eggs **1** (1%) 

Peanuts **0** (0%) 

Tree Nuts (Walnuts, etc.)	<u>1</u>	( 1%)	
Milk	<u>1</u>	( 1%)	
Fish	<u>1</u>	( 1%)	
Shellfish	<u>3</u>	( 2%)	
Fruits	<b>0</b>	( 0%)	
Wheat	<b>0</b>	( 0%)	
Vegetable	<b>0</b>	( 0%)	
Soy Products	<b>0</b>	( 0%)	
other:	<u>7</u>	( 4%)	

**Select the products that you are most willing to evaluate:**

Fish	<u>60</u>	(38%)	■
Shellfish	<u>56</u>	(35%)	■
Milk and dairy products	<u>51</u>	(32%)	■
Soy milk or soy-based products	<u>46</u>	(29%)	■
Chicken	<u>60</u>	(38%)	■
Beef	<u>58</u>	(36%)	■
Pork	<u>51</u>	(32%)	■
Fruits	<u>64</u>	(40%)	■
Vegetables	<u>62</u>	(39%)	■
Desserts	<u>59</u>	(37%)	■
Beverages	<u>59</u>	(37%)	■
Snackfoods	<u>57</u>	(36%)	■
other:	<u>6</u>	( 4%)	■

**Would you be interested in participating in a consumer preparation study, during which you would be preparing salmon, tilapia, and shrimp?**

No, I am not interested	<u>34</u>	(21%)	■
Maybe, I am interested but would like more information	<u>38</u>	(24%)	■
Yes, I am interested	<u>18</u>	(11%)	■
<i>no answer</i>	<b>70</b>	(44%)	■

**Would you be willing to be videotaped and observed during several cooking sessions?**

Yes	<u>40</u>	(25%)	■
No	<u>44</u>	(28%)	■
<i>no answer</i>	<b>76</b>	(48%)	■

**Do you have 7-10 hours, in approximately one hour time blocks, that you could participate in these cooking sessions, sometime between November 1 to December 23 or January 4 to January 31?**

Yes, between November 1 to December 23	<u>16</u> (10%)	■
Yes, between January 4 to January 31	<u>20</u> (13%)	■
No, I do not have the time to participate	<u>49</u> (31%)	■
<i>no answer</i>	<u>75</u> (47%)	■

**Would you be interested in participating in a focus group study concerning current trends in the consumer population regarding attitudes about seafood?**

No, I am not interested	<u>30</u> (19%)	■
Maybe, I am interested but would like more information	<u>36</u> (23%)	■
Yes, I am interested	<u>23</u> (14%)	■
<i>no answer</i>	<u>71</u> (44%)	■

Thank you for your participation!

**Appendix C-1: Demographic Survey for Focus Group Participants**

# Focus Group Participant Demographics Survey

By doing this survey, you are giving consent for the information to be used in a research study; however, the participant's name and e-mail will not be included in the data analysis and the data provided will be anonymous.

IRB NUMBER: 11-673

**Your Name: (First and Last)**

**Your e-mail address:**

Demographics:

**What is your gender?**

- Female
- Male

**What is your age?**

- 18-24
- 25-30
- 31-40
- 41-50
- 51-60
- 61-70
- 71+

**Ethnicity:**

- American Indian or Alaskan Native
- Asian or Pacific Islander
- Black or African American
- Hispanic, Latino, or Spanish Origin

- White, Caucasian
- other:

**What is your occupation?**

**Where were you born and where did you grow up? Please be as specific as possible.**

Seafood Consumption Habits:

**How often do you consume fish/shellfish?**

- Daily to several times a week
- Once a week
- Several times a month
- Once a month
- Several times a year
- Never

**What type of fish/shellfish do you consume?**

- Salmon
- Tilapia
- Trout
- Catfish
- Tuna
- Flounder
- Crab
- Crawfish
- Lobster
- Shrimp
- Mussles

- Oysters
  - Clams
  - Scallops
- other:

**Who prepares the fish/shellfish you typically consume?**

- Prepared by yourself, at home
  - Prepared by someone other than yourself, in a home environment
  - By a chef/cook at a restaurant
  - Ready-to-eat from a convenience store, fast food, or similar type
  - Ready-to-eat from a super market or food store
- other:

**How often do you prepare fish/shellfish yourself?**

- Daily to several times a week
- Once a week
- Several times a month
- Once a month
- Several times a year
- Never

**When you prepare fish and shellfish at home, who do you typically prepare it for? If you do not prepare fish and shellfish at home, please select N/A.**

- Just myself
  - Myself and a significant other
  - Myself and my roommates
  - Myself and my family, including children
  - Myself and my family, including older family members
  - N/A
- other:

Thank you for your participation!

**Appendix C-2: Demographic Questionnaire Results from Focus Group Studies**

	Overall Sample (n=31)		Male: 29% (n=9)		Female: 71% (n=22)		
	#	%	#	%	#	%	
Age	18-24	4	13	1	11	3	14
	25-30	1	3	0	0	1	5
	31-40	0	0	0	0	0	0
	41-50	12	39	2	22	10	45
	51-60	10	32	3	33	7	32
	61-70	2	6	2	22	0	0
	71+	2	6	1	11	1	5
Ethnicity	American Indian or Alaskan Native	1	3	0	0	1	5
	Asian or Pacific Islander	2	6	0	0	2	9
	Black or African American	0	0	0	0	0	0
	Hispanic, Latino, or Spanish Origin	0	0	0	0	0	0
	White, Caucasian	28	90	9	100	19	86
	Other	0	0	0	0	0	0
	NR	0	0	0	0	0	0
How often do you consume fish/shellfish?	Daily to several times a week	6	19	1	11	5	23
	Once a week	7	23	1	11	6	27
	Several times a month	10	32	3	33	7	32
	Once a month	5	16	2	22	3	14
	Several times a year	2	6	1	11	1	5
	Never	0	0	0	0	0	0
	NR	1	3	1	11	0	0
What type of fish/shellfish do you consume?	Salmon	26	84	6	67	20	91
	Tilapia	19	61	3	33	16	73
	Trout	16	52	3	33	13	59
	Catfish	17	55	5	56	12	55
	Tuna	25	81	5	56	20	91
	Flounder	21	68	7	78	14	64
	Crab	19	61	6	67	13	59
	Crawfish	9	29	4	44	5	23
	Lobster	16	52	5	56	11	50

	Shrimp	29	94	8	89	21	95
	Mussels	14	45	3	33	11	50
	Oysters	17	55	4	44	13	59
	Clams	15	48	4	44	11	50
	Scallops	21	68	7	78	14	64
	Other	5	16	0	0	5	23
Who prepares the fish/shellfish you typically consume?	Prepared by yourself, at home	24	77	7	78	17	77
	Prepared by someone other than yourself, in a home environment	14	45	2	22	12	55
	By a chef/cook at a restaurant	21	68	4	44	17	77
	Ready-to-eat from a convenience store, fast food, or similar type	4	13	0	0	4	18
	Ready-to-eat from a super market or food store	6	19	0	0	6	27
	Other	0	0	0	0	0	0
	NR	1	3	1	11	0	0
How often do you prepare fish/shellfish yourself?	Daily to several times a week	2	6	1	11	1	5
	Once a week	10	32	1	11	9	41
	Several times a month	8	26	1	11	7	32
	Once a month	4	13	3	33	1	5
	Several times a year	5	16	1	11	4	18
	Never	1	3	1	11	0	0
When you prepare fish and shellfish at home, who do you typically prepare it for?	Just myself	6	19	1	11	5	23
	Myself and a significant other	12	39	2	22	10	45
	Myself and my roommates	0	0	0	0	0	0
	Myself and my family, including children	13	42	3	33	10	45
	Myself and my	5	16	1	11	4	18
	NR	1	3	1	11	0	0

	family, including older family members						
Occupation	NA	1	3	1	11	0	0
	Other	1	3	1	11	0	0
	Student	5	16	1	11	4	18
	Retired	5	16	3	33	2	9
	Administration	5	16	1	11	4	18
	Stay at Home	1	3	0	0	1	5
	Educator/Teacher	2	6	0	0	2	9
	Seafood Industry	4	13	3	33	1	5
	Research Position	2	6	0	0	2	9
	Business	3	10	1	11	2	9
	Other (Librarian, camp director, artist, licensed vet tech)	4	13	0	0	4	18
Residence	Near Coast/Water	9	29	3	33	6	27
	Inland	18	58	6	67	12	55
	Moved Around A lot	3	10	0	0	3	14
	NR	1	3	0	0	1	5

## Appendix D: Focus Group Discussion Outline and Questions

- Coffee, nametags, consent forms, snacks
- Ground rules: I am here to facilitate and lead the discussion but I am interested in what you have to say and your discussions with each other. Please feel free to ask each other questions and speak to each other but I will be here to bring you back to the research topics of interest if you get off topic and to ask new questions when the conversation begins to lag.
- Introduction: Name, what they do, please briefly state an example of when you recently prepared fish or shellfish and who you prepared it for. Give example first.
- Brainstorming activity: What meat products, including seafood, do you typically prepare at home? What issues are you aware of concerning these meats? Do you typically consume any of these more frequently at home or outside of the home?
  - Notecards – collected after done
- Confidence – “Discuss your experiences preparing meals, like beef, poultry, pork, or any type of fish and shellfish at home or eating at a restaurant”
  - What are your thoughts about preparing beef, poultry, pork, or any type of fish and shellfish?
  - Motivation – What motivates you to make your choices when selecting fish and shellfish products?
  - Prompt for negative/positive emotions regarding confidence and motivation.
  - Does access to cooking instructions influence your choice to prepare one over the other?
  - What would cooking directions look like that would make you feel more confident in preparing fish and shellfish and what form would be most beneficial?
- Think about times when you were preparing meals at home, what type of guidance do you use? Do you typically use cooking directions (any form) when you are cooking meats and why or why not?
  - Flavorings, seasonings, cooking to taste good – “Describe your satisfaction with using cooking directions to prepare meats”
  - What directions do you find beneficial - probe for more detail when participant states their levels – how so, that’s interesting, please explain
    - Probe for how often do you use tools during cooking – “what tools do you find useful in helping you determine if a product is cooked completely?” - thermometers, set cooking times and temperatures? Have some different types of thermometers available to pass around, if someone brings up thermometers.
    - How do you determine when a meat you are preparing is ready for consumption?
    - Where do you find your directions for preparing fish and shellfish products?

- What instructions are available for beef, poultry, and pork that you would want for fish and shellfish? Can you provide examples?
    - Probe – how often do you use directions for cooking
  - Share past experiences about preparing fish and shellfish.
    - What might be beneficial information that you could find in guidance materials?
      - Probe – mention food safety – quality, preparation, tools, storage and handling, cross-contamination
  - Pose cooking terms:
    - Pathogen, bacteria, virus, parasites
      - Picture of certain one
      - Continue onto cross contamination
    - Cross contamination
    - Endpoint Temperatures – how do you assess? Why?
    - Flaking
    - What other textural/visual assessments do you use?
    - What are your opinions of proper handling of fish and shellfish?
    - What difficulties/challenges can you identify that limit your success in making these assessments of endpoints/doneness?
  - What are issues with seafood that you find confusing?
    - What are some examples of common knowledge that you have heard?
    - What are some examples of myths that you have heard?
  - As we are ending this session, I want to give you a chance to bring up any additional thoughts or opportunity to revisit anything that was discussed today.
    - Do you have anything you want to add?

**Appendix E: Focus Group Consent Form**  
**VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY**  
**Informed Consent for Participants**  
**in Research Projects Involving Human Subjects**

**Title of Project:** Consumer Attitudes and Beliefs about Fish and Shellfish and Food Safety

**Investigator(s):** Dr. Susan Duncan, PhD. and Jeri Kostal

**I. Purpose of this Research/Project**

You are invited to participate in a focus group study to identify consumer attitudes and concerns about shellfish and fish culinary preparation techniques and food safety.

**II. Procedures**

The focus group will meet one time, for about one hour. During the focus group, you will be asked to participate in group discussions and activities to help the researchers better understand consumer attitudes and concerns about seafood and fish culinary preparation techniques and food safety. You will be audio and video recorded and it is required for participation in this study.

**III. Risks**

There are no more than minimal risks for participating in this study.

**IV. Benefits**

Your participation in the study will provide better knowledge concerning the current attitudes and concerns of consumers about food safety in regards to seafood and fish. Your participation will also provide important messages for consumer guidance materials and will help determine themes consistent with the consumer population. If you would like a summary of the research results, please contact the researcher at a later time.

**V. Extent of Anonymity and Confidentiality**

The results of my performance as a participant will be kept strictly confidential except to the investigator. Individual participants will be referred to by a code number for data analyses and for any publication of the results. Video recorded images may be valuable for illustration of certain observations but your image will be used only if you provide consent (see separate document "Permission for Use of Video/Photograph Images"). The recordings will be kept in a locked office in 250 Litton-Reaves. The recordings will be transcribed by Jeri Kostal and Tiffany Drape. Jeri Kostal, Tiffany Drape, Susan Duncan, and Virginia Fernandez-Plotka will be the only people with access to the

recordings. The recordings will be erased/destroyed after manuscripts and presentations have been completed.

I will not release any information about the other participants of the focus group to anyone outside of the research team members. I also will not release any information about what was discussed during the focus group study to anyone outside of the focus group participants and research team members.

## **VI. Compensation**

You will be compensated with a snack at the end of the focus group study.

## **VII. Freedom to Withdraw**

If you agree to participate in this study, you are free to withdraw from the study at any time without penalty. There may be reasons under which the investigator may determine you should not participate in this study. If you are under the age of 18, you are asked to refrain from participating. If you are uncomfortable being videotaped or observed while cooking, you are asked to withdraw from the study at this time.

## **VIII. Subject's Responsibilities**

I voluntarily agree to participate in this study. I have the following responsibilities:

1. To attend the scheduled focus group study and perform in my normal behaviors.
2. To participate in the group discussion and activities with the other focus group members.
3. To try to provide the most accurate information possible about the topics discussed during the focus group discussion.

## **IX. Subject's Permission**

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

\_\_\_\_\_ Date \_\_\_\_\_  
Subject Signature

\_\_\_\_\_ Date \_\_\_\_\_  
Subject Printed Name

Should I have any pertinent questions about this research or its conduct, and research subjects' rights, and whom to contact in the event of a research-related injury to the subject, I may contact:

Jeri Kostal  
Graduate Research Assistant, Investigator

(434) 738-8918, [jkost07@vt.edu](mailto:jkost07@vt.edu)

Susan Duncan, Faculty/ Investigator

(540) 231-8675; [duncans@vt.edu](mailto:duncans@vt.edu)

David Moore  
Chair, Virginia Tech Institutional Review  
Board for the Protection of Human Subjects  
Office of Research Compliance  
2000 Kraft Dr., Suite 2000 (0497)  
Blacksburg, VA 24061

(540) 231-4991; [moored@vt.edu](mailto:moored@vt.edu)

## Appendix F: Permission for Use of Video/Photograph Images

### Permission for Use of Video/Photograph Images:

My signature below indicates my permission for Virginia Polytechnic Institute and State University to use video footage recorded and photographs taken during the consumer preparation studies in December 2011 and the focus group studies in March 2012 for use in a thesis manuscript for completion of a Master's degree in Food Science and Technology by Jeri Kostal in which I served as a participant. This video footage may be used for educational or research communications as well as promotional purposes. I waive any rights of compensation or ownership thereto.

There is no time limit on the validity of this release nor is there any geographic specification of where these materials may be distributed. This release applies to video footage and photographic images collected as part of consumer preparation studies and focus group studies listed on this document only.

**Name (please print):** \_\_\_\_\_

**Date:**                    /   /

**Signature:** \_\_\_\_\_

**Address:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Phone:**                (   )   -

**Appendix G: Frequency Data for Codes Expressed by Participants (n = 32) during Focus Group Studies (n = 5)**

Focus Group Categories and Codes	Number of Times Expressed:					
	ACI <sup>3</sup>	ACII	ACIII	CC	LC	Total
<b>Experience<sup>1</sup></b>						
Learning from Observing Behaviors <sup>2</sup>	3	1	2	4	1	11
Learning from Trial and Error	3	1	3	3	4	14
Confidence Building through Experience	4	1	4	6	5	20
<b>Trust</b>						
Quality of Purchase, Origin, and Restaurant Preparation	31	7	16	20	11	85
Accuracy of Information and Tools	14	3	7	6	2	32
<b>Confidence</b>						
Preparation Method Determines Consumers' Confidence in Ability to Prepare Product	5	6	1	0	0	12
Confidence is Influenced by View of Specialization	10	0	18	4	14	46
<b>Quality of Product</b>						
Perceived Quality Determines Preparation Method	2	0	1	0	2	5
Quality of Farm-Raised vs. Fresh Caught (Wild)	5	0	1	4	5	15
Perceived Quality of Self-Caught Fish and Shellfish	4	2	1	1	2	10
<b>Motivation</b>						
Positive Motivators	11	9	5	14	2	41
Negative Motivators	9	2	14	13	9	47
<b>Concerns</b>						
Concerns Regarding Fish and Shellfish Products	23	2	8	11	10	54
Cooking Fish and Shellfish Products Correctly	7	2	6	0	4	19
<b>Cooking Procedures</b>						
Determining Doneness by Qualitative Methods	13	5	4	3	6	31
Thermometer Use for Determining Doneness of Products	4	14	15	12	13	58
<b>Cooking Instructions</b>						
Information Desired in Instructions for Fish and Shellfish	20	15	14	13	18	80
Perceived Accuracy of Cooking Instructions and Source of Information	16	2	14	5	15	52
Bridging personal experience with cooking	2	6	6	2	8	24
<b>Knowledge</b>						
Lack in Knowledge	4	11	11	10	8	44
Variations and Accuracy of Knowledge Concerning Fish and Shellfish	3	4	11	6	1	25
<sup>1</sup> Bolded terms are main categories expressed during focus group studies						
<sup>2</sup> Codes expressed during focus group studies						
<sup>3</sup> AC = Academic Community, CC = Coastal Community, LC = Local Community						

## Appendix H: Original List of Focus Group Themes before Condensing

- Experience
  - Learning by observing behaviors
  - Learning from trial and error
  - Confidence building through experience
- Trust
  - Quality of purchase, origin, restaurant preparation
    - Trust quality of purchase
    - Trusting quality of origin
    - Restaurant preparation methods and quality
  - Accuracy
    - Accuracy of available information
    - Accuracy of cooking tools
- Confidence
  - Cooking method/Preparation Method
  - Influenced by view of specialization (store, restaurant, venue)
- Quality of Product
  - Determines preparation method
  - Farm raised vs. fresh caught (wild)
  - Quality of self-caught product
- Motivation
  - Positive Motivators:
    - Health benefits
    - Taste and texture
    - Quick and easy preparation
    - Special occasions/seafood is a specialty item
  - Negative Motivators:
    - Affordability
    - Lack of availability because of location (negative motivator)
    - Appearance/presumed quality of product
- Concerns
  - Concerned about the product
    - Negative health effects
    - Environmental impact
    - Level of contamination
  - Cooking and Information
    - Cooking instruction reliability
    - Cooked thoroughly/properly
    - Cooking instruction detail
- Cooking Procedures
  - Determining doneness by qualitative methods
    - Visual cues to determine doneness
    - Texture to determine doneness

- Tasting product to determine doneness
  - Thermometer Use:
    - Using thermometer for big pieces of meat
    - Using thermometer to determine doneness
    - Not using thermometers
- Cooking Instructions
  - Wanted information in instructions:
    - Importance of visual cues in guidance materials
    - Jargon in guidance materials is confusing
    - Desire in more food safety information
    - Desire for temperature measurements in instructions but realize they will not use them
    - Desire for temperature measurement
    - Desire for more instructions for fish/shellfish
  - Perceived Accuracy of Cooking Instructions:
    - Reliability of instructions
    - Dependability of source
  - Source of Cooking Instructions:
    - Found from internet
    - Found from cookbooks
    - Found from TV show
  - Bridging personal experience with cooking
- Knowledge
  - Lack in Knowledge
    - Lack of knowledge in food chain
  - Accuracy of knowledge
  - Varying knowledge in health risks

## Appendix I: Equipment Specifications for Research Studies

### HD Camcorder:

Canon Vixia HF20  
Video Product 38NU  
Item NTSC CO1  
No. 032900743043

### Camera:

Canon PowerShot SD1000  
Item PC1228  
No. 5124528014

### Data Logger:

Eco  
Series 5000 Model 5100  
Logger Lab  
VPI & SU Inventory No.  
117139

### Probe:

Thermocouple-K  
Omega Engineering, INC.  
HH64 Thermometer

### Timer:

Acurite Digital Kitchen  
Timer  
Model No. 00534  
Lake Geneva, WI 53147

### Scale:

Denver Instrument  
XP – 1500  
1500x0.05g  
Power:15VDC 100ma  
180239  
X056138  
6542 Fig Street  
Arvada, CO 80004

### Calipers:

Mitutoyo Corp  
Absolute Digimatic  
Code No. 500-170  
Model No. CG-4" c  
Serial No. 0002138  
Made in Japan

### Oven:

KitchenAid  
Schott Ceran  
Whirlpool Corporation usa  
ST Joseph, MI 49085  
Kilowatts 9.9 KW  
Model #: KERI201PBS0  
Serial #: RR1410032

### Pots:

Farberware 8qt  
Aluminum Clad Stainless  
Steel  
Pat. 4,613,070  
Made in U.S.A.

### Baking Dishes:

Pyrex 2QT-2L 8x8x2 in.  
Corning 222-R  
NY USA

Anchor Ovenware  
Baking Dish  
8x11x2 in 2 QT  
USA 8 1031

### Spatulas:

Ecko Spatula  
Square and Round  
Max: 400°F/204°C

### Cooking Spray:

Kroger Canola Oil  
Cooking Spray  
Net wt 6 oz (170g)  
DOT 2P M5749  
1111085680

### Salt:

Kroger Salt

### Pepper:

Kroger Pepper

### Old Bay:

Old Bay Seasoning For  
Seafood, Poultry, Salads,  
Meats  
McCormick & Co, INC  
Hunt Valley, MD 21031-  
1100  
Packed in U.S.A.  
Net wt 6oz (170g)  
7032800523

### Butter:

Kroger Unsalted Butter  
Grade AA  
Distributed by the Kroger  
Co  
Cincinnati, Ohio 45202  
Product of U.S.A.  
Four – 4 oz Sticks  
Net wt 16oz (1LB) 453g  
1111089305

### Lemons

### Limes

**Appendix J: Translating Cooking Guidance to Skills Consent Form**  
**VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY**  
**Informed Consent for Participants**  
**in Research Projects Involving Human Subjects**

**Title of Project:** Cooking Instructions for Properly Cooking Fish and Shellfish

**Investigator(s):** Dr. Susan Duncan, PhD. and Jeri Kostal

**I. Purpose of this Research/Project**

You are invited to participate in a study to determine if current common cookbook information is adequate enough for consumers to be able to safely cook fish and shellfish.

**II. Procedures**

You will have three cooking sessions with common cookbook descriptors as cooking instructions, then a training session, and then three more cooking sessions using additional visual and verbal cues as cooking instructions. Each cooking session and the training session will take no longer than an hour. Written observations and measurements will be taken while you are cooking and you will be video and audio recorded. The audio and video recording is required for participation in this study. A questionnaire will be given at the end of each cooking session.

**III. Risks**

There are no more than minimal risks for participating in this study. If you have a fish and/or shellfish allergies or an aversion to fish or shellfish please inform the investigator.

**IV. Benefits**

Your participation in the study will provide better knowledge concerning the quality of current cookbook descriptors and if additional training and visual and verbal cues would be helpful. If you would like a summary of the research results, please contact the researcher at a later time.

**V. Extent of Anonymity and Confidentiality**

The results of your performance as a participant will be kept strictly confidential except to the investigator. Individual participants will be referred to by a code number for data analyses and for any publication of the results. Video recorded images may be valuable for illustration of certain observations but your image will be used only if you provide consent (see separate document "Permission for Use of Video/Photograph Images"). The recordings will be kept in Dr. Duncan's locked office and Jeri Kostal will transcribe the recordings. Jeri Kostal, Susan Duncan, and Virginia Fernandez-Plotka will be the

only people with access to the recordings. The recordings will be erased/destroyed after manuscripts and presentations have been completed.

## **VI. Compensation**

You will be compensated with a snack at the end of each cooking session and at the end of the training session.

## **VII. Freedom to Withdraw**

If you agree to participate in this study, you are free to withdraw from the study at any time without penalty. There may be reasons under which the investigator may determine you should not participate in this study. If you have allergies or an aversion to fish or shellfish, or are under the age of 18, you are asked to refrain from participating. If you are uncomfortable being videotaped or observed while cooking, you are asked to withdraw from the study at this time.

## **VIII. Subject's Responsibilities**

I voluntarily agree to participate in this study. I have the following responsibilities:

1. To attend all scheduled cooking and training session and perform in my normal behaviors.
2. To prepare the seafood products to the best of my ability with the given information.
3. To interact with the other participants during the training session and provide any additional information that might be helpful to consumers.

## **IX. Subject's Permission**

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

\_\_\_\_\_ Date \_\_\_\_\_  
Subject Signature

\_\_\_\_\_ Date \_\_\_\_\_  
Subject Printed Name

Should I have any pertinent questions about this research or its conduct, and research subjects' rights, and whom to contact in the event of a research-related injury to the subject, I may contact:

Jeri Kostal  
Graduate Research Assistant, Investigator

(434) 738-8918, [jkost07@vt.edu](mailto:jkost07@vt.edu)

Susan Duncan, Faculty/ Investigator

(540) 231-8675; [duncans@vt.edu](mailto:duncans@vt.edu)

David Moore  
Chair, Virginia Tech Institutional Review  
Board for the Protection of Human Subjects  
Office of Research Compliance  
2000 Kraft Dr., Suite 2000 (0497)  
Blacksburg, VA 24061

(540) 231-4991; [moored@vt.edu](mailto:moored@vt.edu)

**Appendix K: Common Cookbook Descriptions Provided to Participants during First Cooking Session of Translating Cooking Guidance to Skills**

**Table K-1: Preparation Methods Description**

<b>Fish or shellfish, Preparation Method</b>	<b>Preparation Method Description</b>
<b>Fish (Atlantic Salmon, Tilapia), Baked</b>	Rinse and dry the fish Place in shallow glass baking dish sprayed with cooking spray Bake in oven at 375°F on middle rack
<b>Fish (Atlantic Salmon, Tilapia) and Shrimp, Broiled</b>	Electric stove set to broil Place in glass baking dish sprayed with cooking spray Place in oven 5 inches or less below heat source (second rack) Leave oven door open 3-4 inches Coat tilapia with butter
<b>Shrimp, Boiled</b>	Water temperature should be about 180°F (82°C) with bubbles gently rising but not fully breaking the surface of the water Add shrimp and boil until desired doneness

Modified from Brown (2007)

**Table K-2: Visual Doneness Characteristics from Common Cookbooks**

<b>Product</b>	<b>Preparation Method</b>	<b>Visual Doneness Characteristics</b>
<b>Salmon</b>	Baked	Firm, opaque, and just begins to flake; flakes easily with a fork; it should look rosy, not deeply salmon-colored; still moist and separates easily into segments
	Broiled	
<b>Tilapia</b>	Baked	Firm, opaque in color, flakes easily without falling apart; still moist and separates easily into segments
	Broiled	
<b>Shrimp</b>	Boiled	Will look opaque and pink, flesh becomes pearly opaque
	Broiled	

Modified from Felice (2011)

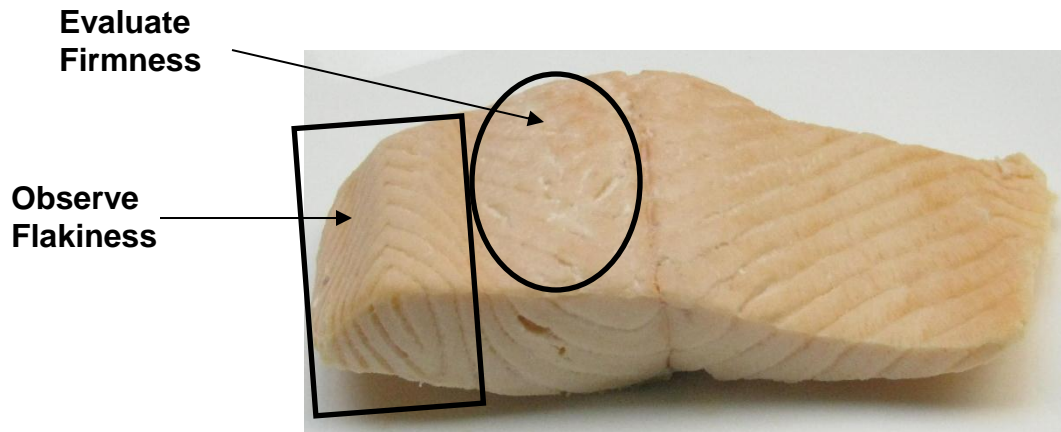


## Appendix M: Descriptions Used for Second Cooking Session During Translating Cooking Guidance to Skills

### Appendix M-1: Non-Oral Texture Evaluation Guidelines (Felice 2011) (page 1 of 3)

#### Salmon

- Firmness – Using the index finger of your dominant hand apply pressure to the thickest section of the salmon fillet so that the pad of your finger indents and resistance from the product is detected
- Flakiness – Using a fork, apply slight pressure with the back tips of the fork's prongs and pull toward you, observe the ease at which the muscle segments separate to individual segments. Observe flakiness along the edge near the thickest portion of the fillet



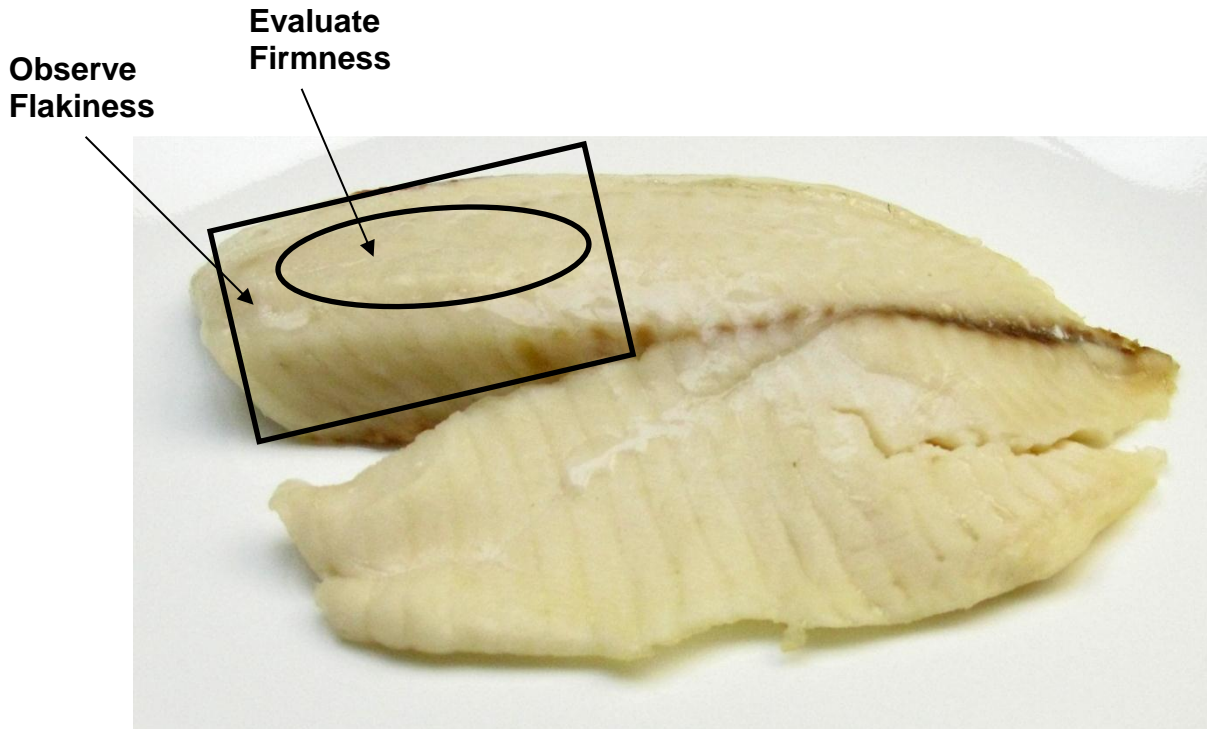
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**When testing for flakiness (in salmon or tilapia) apply pressure with the back tips of the fork's prongs**

**Appendix M-2: Non-Oral Texture Evaluation Guidelines  
(page 2 of 3)**

**Tilapia**

- Firmness – Using the index finger of your dominant hand apply pressure to the thickest section of the tilapia fillet (avoid areas with separation among muscle segments), so that the pad of your finger indents and resistance from the product is detected
- Flakiness - Using a fork, apply slight pressure with the back tips of the fork's prongs and pull toward you, observe the ease at which the muscle segments separate to individual segments. Observe flakiness at the thickest portion of the fillet (see diagram on previous page)

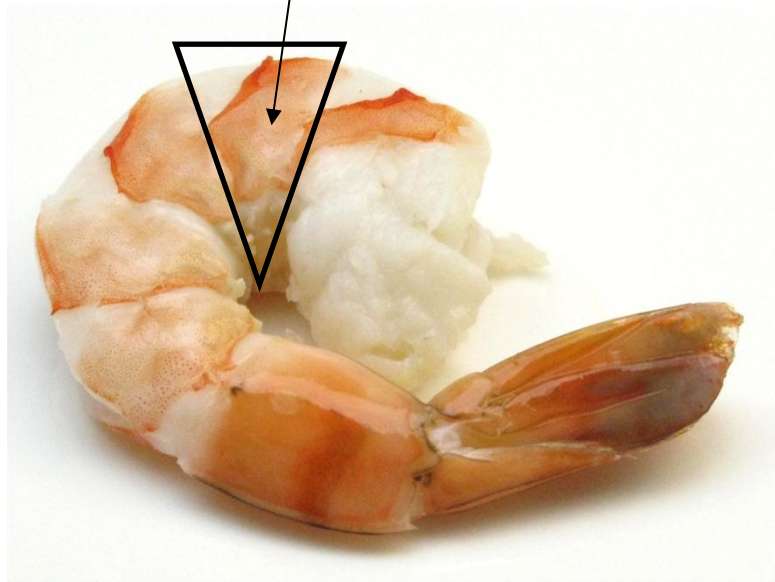


### Appendix M-3: Non-Oral Texture Evaluation Guidelines (page 3 of 3)

#### Shrimp

- Firmness – Using the index finger of your dominant hand apply pressure to the second segment section of the shrimp, so that the pad of your finger indents and resistance from the product is detected
- Springiness:
  - Amount of Recovery - Using the index finger of your dominant hand apply pressure to the second segment section of the shrimp, so that the pad of your finger indents and resistance from the product is detected. Remove pressure from finger and observe the products ability to return (amount) to its' original structure/form
  - Rate of recovery - Using the index finger of your dominant hand apply pressure to the second segment section of the shrimp, so that the pad of your finger indents and resistance from the product is detected. Remove pressure from finger and observe the rate (speed) at which the product returns to its' original structure/form

**Evaluate Firmness  
and Springiness  
(Amount and Rate  
of Recovery)**



## **Appendix N: Summary of Visual and Non-Oral Evaluation Guidelines for Cooking to 63°C for Salmon, Tilapia, and Shrimp**

### **Salmon:**

#### Visual:

- Presence of white film on the top of the fillet, which is coagulated protein
- Fillet will turn from a dark pink color to a lighter pink color throughout the entire thickness
- Lines between the muscle segments are defined and have darkened in color
- The edges of the fillet have rounded and become yellow/golden in color
- Separation occurs down the central line of the fillet

#### Non-Oral:

- Firm like medium cheddar cheese at room temperature
- Flaky, but not as flaky as canned tuna

### **Shrimp:**

#### Visual:

- The grey undertone will be gone and the flesh of the shrimp will be white
- Remaining head flesh will be white and opaque, no longer translucent and grey
- Flesh will be pinkish-orange
- The muscle segments will be visibly distinct from each other
- The overall shape of the shrimp will be moderately to tightly coiled

#### Non-Oral:

- Firm like medium cheddar cheese at room temperature
- Springiness (both amount and rate of recovery) like a cooked hotdog

### **Tilapia:**

#### Visual:

- The flesh will no longer be translucent and will be white and opaque
- There will be separation between the muscle segments and the lines between the muscle segments will be defined and dark in color
- Edge color of the fillet will be yellow
- Edges will begin to round and become crispy and curling

#### Non-Oral:

- Soft like Kraft Velveeta cheese at room temperature
- Flaky like canned tuna

Salmon is a fatty fish that is rich in omega-3 fatty acids, DHA and EPA, which may be valuable for protecting your health. Salmon is also high in protein and low in bad fats, cholesterol, and sodium. Most salmon fillets have a thin belly or tail flesh and a thicker section near where the back fins were located. Raw salmon fillets should be smooth, firm, and should not have an odor. They should also be a dark pink color throughout the entire fillet. The fillets should be kept in the refrigerator until they are ready to be prepared to help control the growth of any bacteria. If you purchase frozen salmon fillets, thaw them in the refrigerator the night before



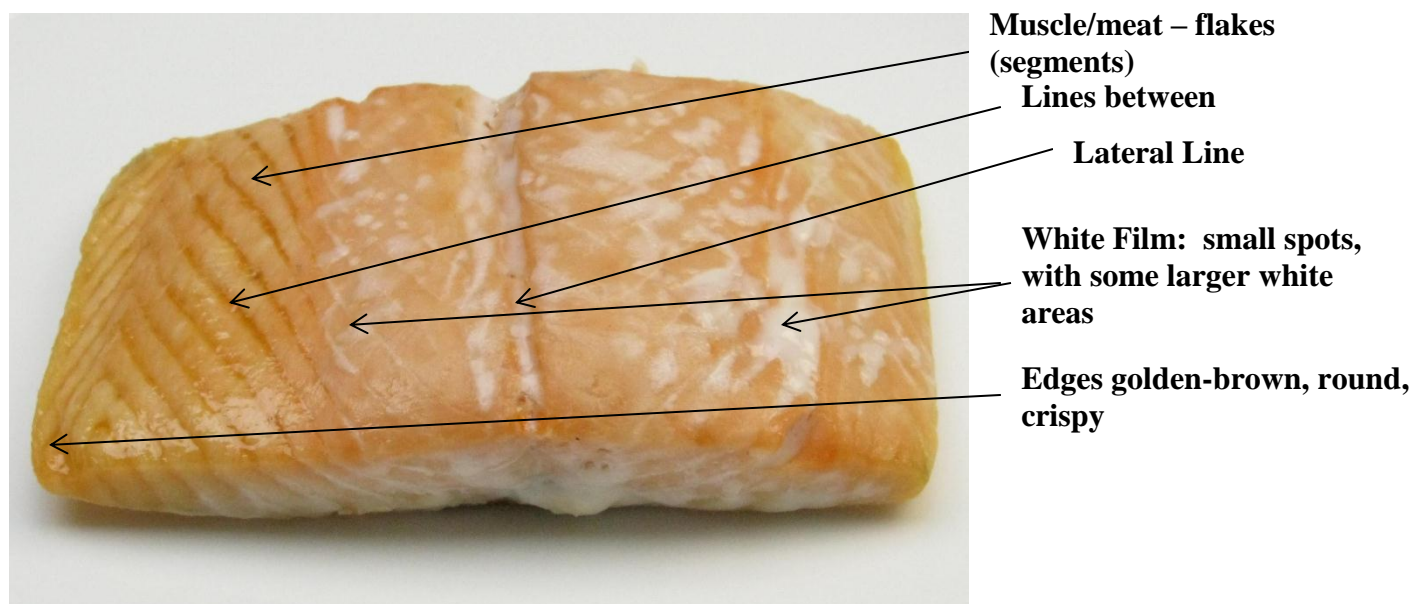
**Figure 5: Raw Salmon Fillet**

you wish to cook them. Washing the fillets prior to preparing them also helps reduce the any contamination that could be present on the surface of the fillets. When baking salmon fillets at 375°F, it takes about 20

minutes for the internal temperature to reach 145°F. Broiling salmon at 500°F takes about 15 minutes for the final internal temperature to be reached. However, the amount of time required can vary on the size and thickness of the salmon fillet, so it is always a good idea to have a meat thermometer available as well.

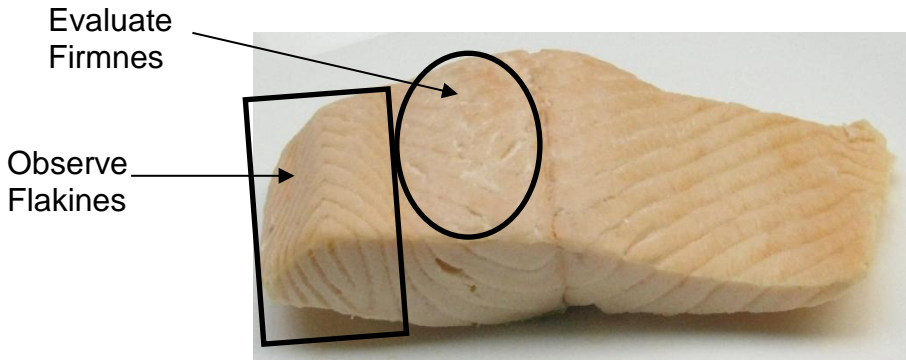
As the salmon fillet cooks, the color of the fillet goes from dark pink to a lighter pink and the texture of the fillet becomes firmer. The lines between the muscle segments also become

darker and more defined and there is an obvious separation between the muscle segments. The lateral line in the middle of the fillet becomes more defined and the flesh on both sides of the lateral line begins to pull away. A white film also begins to form on top of the fillet, which is coagulated protein that is coming out of the flesh of the salmon. When there are small spots of white film and some larger white areas, then the salmon fillet is cooked properly. The edges of the fillet also begin to round and develop a golden-brown, crispy appearance.



**Figure 6: Visual Cues for Doneness**

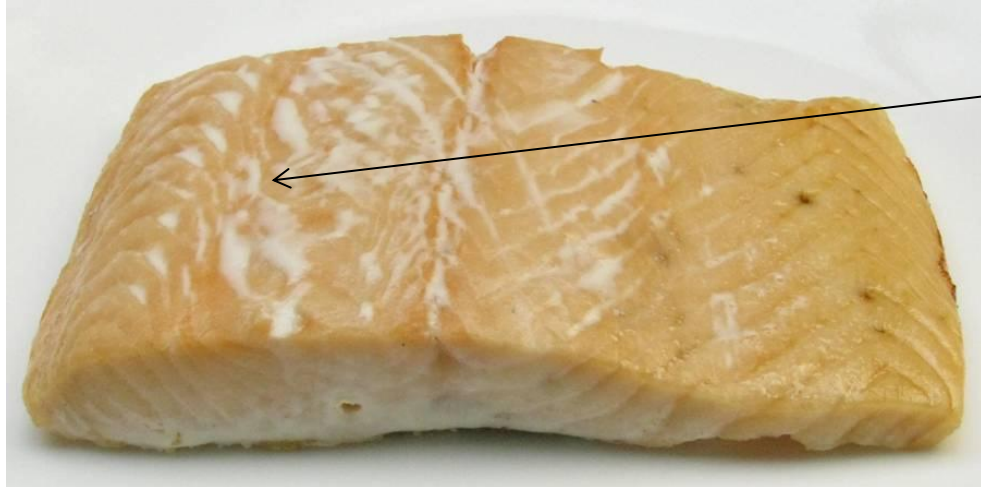
Another method to determine if the salmon fillet has been cooked to the proper internal temperature of 145°F is to flake the fillet with a fork. In order to flake the fillet, take the fork and gently pull back on the segments in the thickest portion of the fillet to determine if the muscle segments separate easily, and if they do not, then the fillet has most likely not cooked long enough. You can also evaluate the firmness of the fillet to determine if it has been cooked to 145°F. Using the index finger of your dominant hand, apply pressure to the thickest section of the salmon fillet so that the pad of your finger indents and you are able to detect the resistance



from the product. The firmness of the fillet should be similar to the firmness of medium cheddar cheese at room temperature.

Figure 7: Diagram of Where to Evaluate Firmness and Flakiness

Measuring the temperature of the salmon fillet is a good way to ensure that the salmon is cooked to a point that is safe for consumption, since the visual cues do not guarantee that the fillet has reached the minimum safe temperature of 145°F. You want to make sure that the internal temperature of the thickest portion of the fillet has reached 145°F or 63°C for at least 15 seconds. Make sure to place the thermometer in the center of the thickest section of the fillet and also make sure that the probe does not come in contact with a fat deposit. Do not place the probe in a large gap between the muscle segments and do not push it all the way through to the pan.



Insert thermometer probe here.

Figure 8: Diagram of Thermometer Placement

# Tilapia

Tilapia is a lean fish with a low fat content and low moisture content compared to other fish. Tilapia is a good source of protein and low in bad fats, cholesterol, and sodium. Tilapia fillets are typically thin, with two uneven sides, one of which is thicker and the other which is thinner. Raw tilapia fillets should be smooth, firm, void of discolorations, and should not have a fishy odor. Keeping the tilapia in the refrigerator prior to cooking ensures that the growth of any



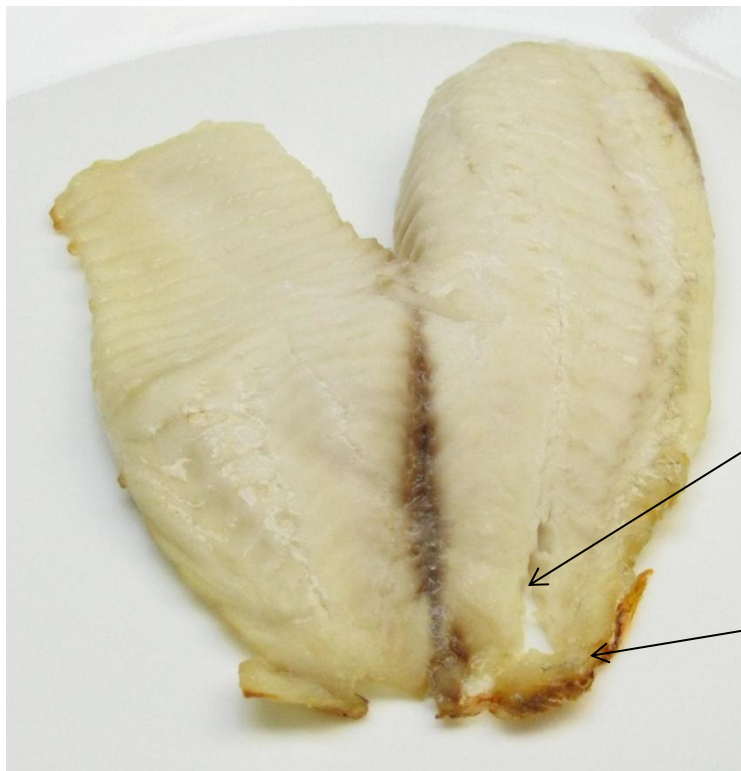
**Figure 9: Raw Tilapia Fillet**

bacteria present on the tilapia is controlled and helps reduce the risk of acquiring a foodborne illness from consuming the finished product. Thaw frozen tilapia fillets in the refrigerator the night before preparing and rinse the fillets with cool, clean water to wash off any contamination that may be present on the surface of the fillets. Tilapia takes about 15 minutes to bake at 375°F for the internal temperature to reach 145°F and takes about 10 minutes to broil at about 500°F for the internal temperature to reach 145°F.

However, remember that the length of time that it takes for the tilapia fillet to reach the correct internal temperature also depends on the thickness of the fillet. Using a thermometer to measure

the internal temperature of the fillet ensures that the fillet will be properly cooked without reducing sensory acceptability.

As the tilapia fillet cooks, the flesh will change from translucent to an opaque whitish color and become softer in texture. The muscle segments become more defined and there is



flaking and separation in the fillet. The edges begin to round and curl. They become golden-brown and crispy (Figure 2).

**Separation, flaking**

**Golden-brown, crispy, and curling**

**Figure 10: Diagram of Visual Doneness Cues**

Another method to determine if the tilapia fillet has been cooked to the proper internal temperature of 145°F is to flake the fillet with a fork. In order to flake the fillet, gently pull back on the muscle segments in the thickest section of the fillet. If the segments do not separate easily, then the fillet is most likely not cooked properly. You can also evaluate the firmness of the fillet by applying pressure to the thickest section of the tilapia fillet with your index finger of your dominant hand. The firmness should be similar to Kraft® Velveeta cheese at room temperature (Figure 3).

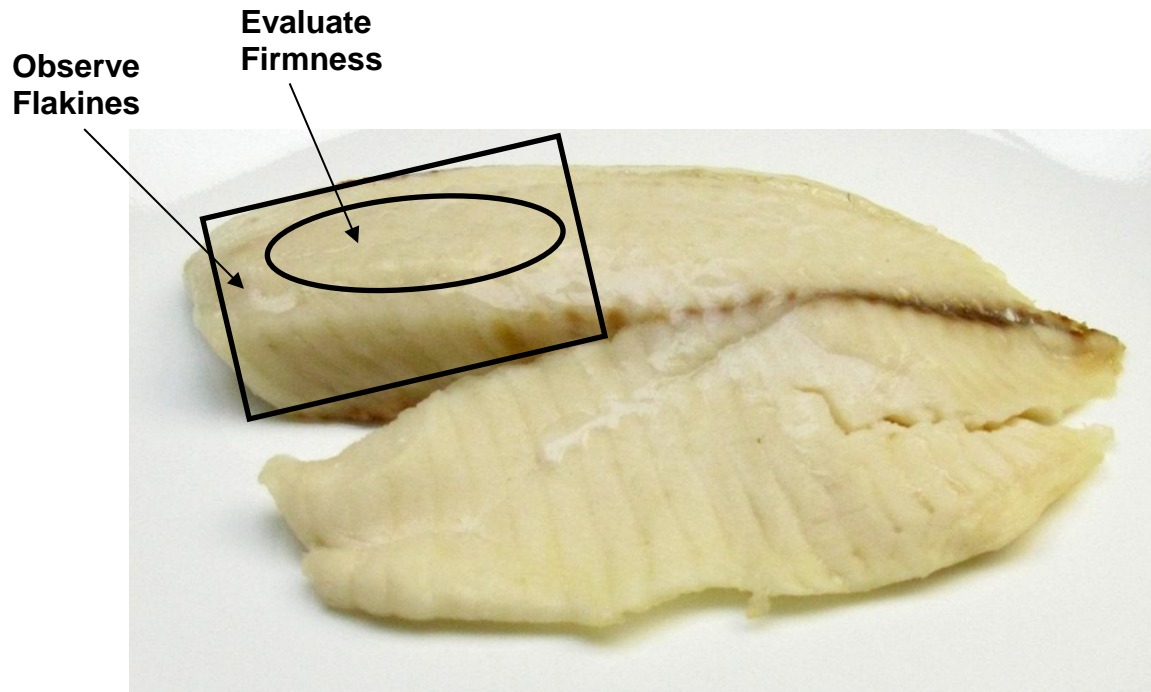


Figure 3: Diagram of Flakiness and Firmness Evaluations

Insert thermometer probe here

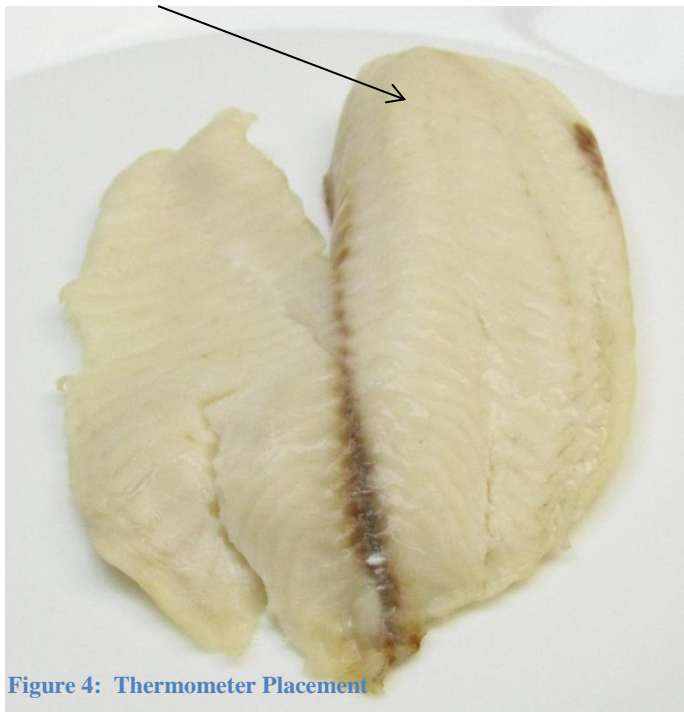


Figure 4: Thermometer Placement

Visual and textural cues do not always ensure that the tilapia fillet has reached the correct minimum internal temperature; therefore, it is always a good idea to have a thermometer available to measure the internal temperature. Place the probe in the center of the thickest section of the fillet and make sure that the thermometer reads 145°F for at least 15 seconds. Since tilapia fillets are thin fillets, make sure that you do not push the

thermometer probe all the way to the pan (Figure 4).

# Shrimp

Shrimp is a crustacean and is relatively low in fat content and high in salt content compared to other fish and shellfish. The flesh of the shrimp should be firm and the shrimp should not have any odor. Shrimp should be kept in the refrigerator until ready to use to reduce the chance of contracting a foodborne illness from consuming the finished product. If the shrimp is kept on ice, make sure that it does not come in direct contact with the melted ice water. Frozen shrimp should be thawed in the refrigerator the night before they are going to be

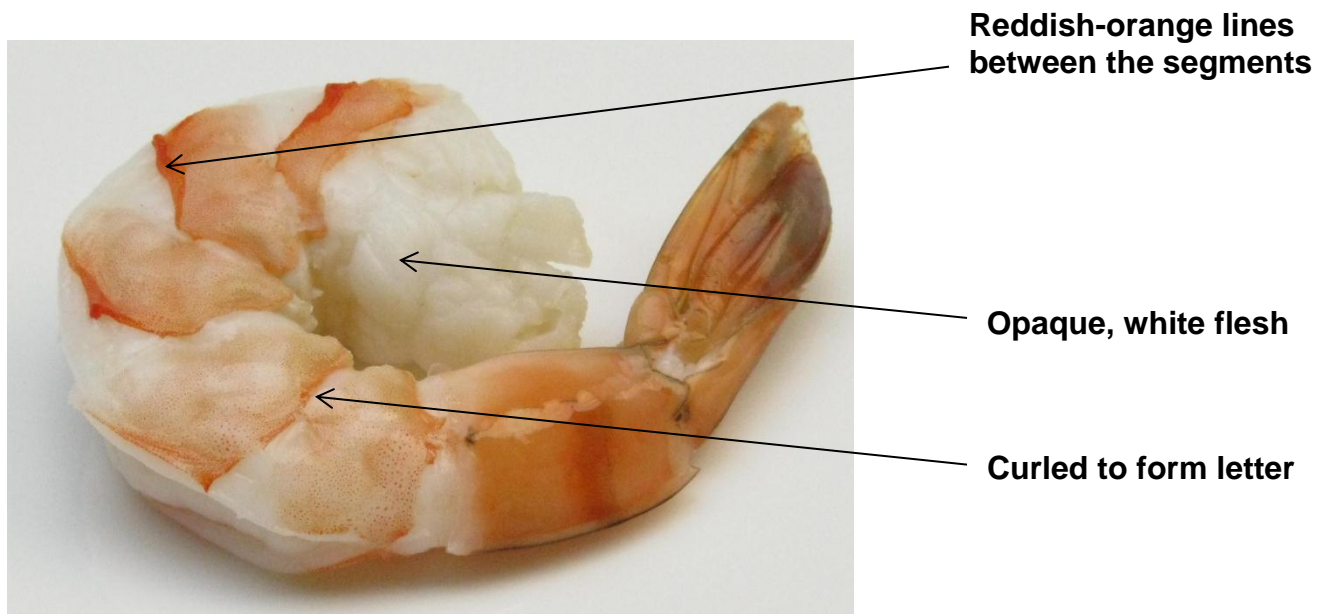


**Figure 11: Picture of Raw Jumbo Shrimp**

prepared. Washing the shrimp before preparing them helps to remove any ice crystals and also helps reduce the level of contamination that may be on the surface

of the shrimp. Boiling shrimp takes about two and a half minutes to reach the recommended minimum internal temperature of 145°F. Broiling shrimp at 500°F takes about eight minutes for the internal temperature to reach 145°F. The size of the shrimp and the temperature will determine how long it takes for the internal temperature to 145°F, so it is always a good idea to have a thermometer available.

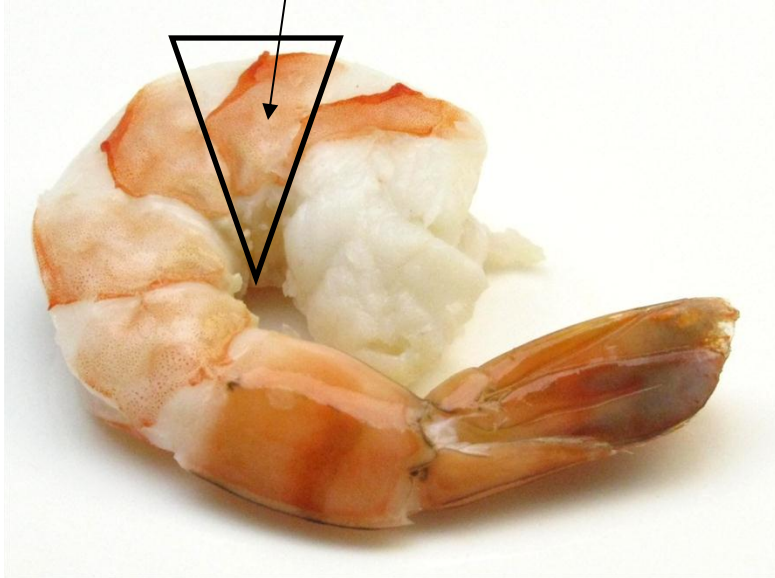
As the shrimp cooks, the flesh will change from translucent and grey to opaque, white and reddish-orange. The shrimp will become firmer in texture and will begin to curl up. The grey undertone of the shrimp will disappear and the lines between the segments will change to a reddish-orange and become more distinct (Figure 2). The shape of the shrimp will change from the shape of the letter J, to the shape of the letter C, and finally to the shape of the letter Q when the shrimp is fully cooked.



**Figure 12: Diagram of Visual Cues for Shrimp**

The firmness and springiness of the shrimp can also be evaluated to determine if the shrimp has been cooked properly. In order to determine the firmness of the shrimp, use the index finger to apply pressure to the second segment section of the shrimp. The firmness of the shrimp should be similar to medium cheddar cheese at room temperature. To determine the springiness of the shrimp, use the index finger to apply pressure to the second segment of the shrimp. As removing index finger, observe the ability of the shrimp to return to its original form to determine the amount of recovery. Also, as removing index finger from the shrimp, observe the rate at which the shrimp returns to its original form to determine the rate of recovery. The amount of recovery and the

**Evaluate Firmness and Springiness (Amount and Rate of Recovery)**



**Figure 3: Diagram of Evaluation of Firmness and Springiness**

shrimp has been properly cooked. It may be difficult to measure the internal temperature of shrimp since they are relatively small but you can place the probe of the thermometer into the thickest portion of the larger shrimp (Figure 4). Make sure that the thermometer reads 145°F for at least 15 seconds.

Insert thermometer probe here.



**Figure 4: Diagram of Thermometer Placement**

rate of recovery help to determine the springiness of the shrimp, which should be similar to a cooked hotdog (Figure 3).

Using a thermometer is always a good idea to ensure that the shrimp has reached the minimum internal temperature of 145°F, since visual and textural cues do not guarantee that the

**Appendix P: Questionnaire for After Second Cooking Session**  
**Consumer Preparation Study Questionnaire: Second Cooking Session**

**Participant #:** \_\_\_\_\_

**Fish/Shellfish Product:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Preparation Method:** \_\_\_\_\_

1. What aspects of the training session did you find valuable? Be as specific as possible.
  
2. Considering all the sources of information you had available, what information was most useful in helping you evaluate the doneness of the salmon/shrimp/tilapia?
  
3. Which characteristics did you use to determine when the salmon/shrimp/tilapia was ready for consumption? Be as descriptive as possible.
  
4. On a scale of 1 to 5, with 1 meaning “no difference in confidence” and 5 meaning “much more confident”, how has your confidence in preparing salmon/shrimp/tilapia changed since the preliminary cooking sessions?
  - a. If you assigned a score of 2 or more, provide a description of what has increased your confidence in preparing salmon/shrimp/tilapia since the preliminary cooking session.
  
5. Did you use the available thermometer to measure the internal temperature of the salmon/shrimp/tilapia? (If no, please skip to Question 6.)
  - a. Was the use of the thermometer valuable in determining the doneness of the salmon/shrimp/tilapia?
  - b. What issues or difficulties were associated with using the thermometer?
  - c. What was the temperature reading of the thermometer, if you remember?
  
6. Do you feel more informed about the issue of cross-contamination after the training session? Explain.
  - a. How have your behaviors changed during fish and shellfish preparation to reduce the risk of cross-contamination (if applicable)?
  - b. Were there any instances during your session today that you feel like you reduced the risk for cross-contamination?
  - c. Were there any instances during your session today that you feel like you increased the risk for cross-contamination?
  
7. Please select the picture which includes the salmon/shrimp/tilapia sample that has been prepared to an appropriate endpoint temperature. Two pictures with both and neither choices.

a.



- b.
- c. Both
- d. Neither

## Appendix Q: Knowledge Quiz for Research Study Participants After Second Cooking Session

1. What risks are associated with consuming undercooked fish and shellfish?
  - a. Bacteria
  - b. Viruses
  - c. Parasites
  - d. All of the above
2. Which pathogen was not listed by Dr. Kuhn as being associated with consuming undercooked fish and shellfish?
  - a. Norovirus
  - b. Vibrio
  - c. Campylobacter
  - d. Tapeworm
3. Which of the following would not be considered cross-contamination?
  - a. Touching utensils after touching raw meats
  - b. Placing the fish and shellfish in the lowest part of the refrigerator
  - c. Cutting vegetables on a cutting board that came in contact with raw meats
  - d. Placing cooked meats onto a plate that held the raw meats, without washing the plate
4. Why does salmon take longer to cook than tilapia, even when cooking it at the same temperature and using the same cooking method?
  - a. Salmon fillets are typically thicker than tilapia fillets
  - b. Tilapia has more fat than salmon
  - c. Salmon is considered a fatty fish
  - d. Tilapia has a higher moisture content than salmon
  - e. Two of the above
  - f. Three of the above
5. Where should you flake salmon and tilapia fillets to determine if they have been cooked properly?
  - a. In the section of the fillet that has become the most brown from cooking
  - b. In the exact middle of the fillet
  - c. Near the thickest portion of the fillet
  - d. It does not matter where you flake the fillet, just as long as it flakes easily
6. What is the white film composed of that forms on top of the salmon fillet as it cooks?
  - a. Fat from the muscle
  - b. Coagulated protein
  - c. Water and nutrients
  - d. Omega-3 fatty acids
7. What changes occur to the color of fish and shellfish when they have cooked thoroughly?
  - a. They become more opaque

- b. They become more translucent
  - c. The middle of the fillet becomes darker in color
  - d. The middle of the fillet becomes lighter in color
8. When shrimp is fully cooked, it becomes the shape of what letter in the alphabet?
- a. C
  - b. J
  - c. Q
  - d. O
9. What is the temperature that fish and shellfish should be cooked to in order to be considered safe for consumption?
- a. 165°F
  - b. 145°F
  - c. 160°F
  - d. 125°F
10. When using a thermometer to measure the internal temperature, where should you place the probe to read the temperature?
- a. In the section of the fillet that has become most brown from the cooking process
  - b. In the exact middle of the fillet
  - c. In the thinnest section of the fillet
  - d. In the middle of the thickest section of the fillet
11. You were provided with informative materials during the training session and during the cooking sessions. Which version of these materials would you be more likely to utilize? The electronic version or the paper version?
- a. Electronic
  - b. Paper
12. If you would prefer the electronic version, which tools would you want to be able to access the informative materials on?
- a. Phone
  - b. Ipad
  - c. Laptop or desktop
  - d. Other:

## Appendix R: Results of ANOVA Tests for Final Internal Temperatures

**Table R-1: Results of the 3-Way ANOVA Testing with Final Internal Temperature as a Dependent Variable, and Training<sup>1</sup> (Before/After), Product (Fish<sup>2</sup> [Salmon, Tilapia]), and Preparation Method (Baked, Broiled) as Independent Variables with Interactions**

Source of Effect	df	F Ratio	p-value <sup>3</sup>
Product	1	20.28	<0.0001*
Preparation Method	1	2.72	0.107
Product*Preparation Method	1	1.11	0.299
Training	1	3.00	0.091*
Product*Training	1	1.78	0.190
Preparation Method*Training	1	4.31	0.045*
Product*Preparation Method*Training	1	0.019	0.892
Total Error	40/48		

\* Indicates significance

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication. <sup>2</sup>Fish (Salmon, Tilapia) prepared by baked (n=6), broiled (n=6) preparation methods. <sup>3</sup>Predefined  $\alpha$ -value = 0.10.

**Table R-2: Results of the 2-Way ANOVA Testing with Final Internal Temperature of Salmon as a Dependent Variable, and Training<sup>1</sup> (Before/After) and Preparation Method<sup>2</sup> (Baked, Broiled) as Independent Variables with Interactions**

Source of Effect	df	F Ratio	p-value <sup>3</sup>
Preparation Method	1	0.200	0.660
Training	1	5.28	0.033*
Preparation Method*Training	1	2.11	0.162
Total Error	20/24		

\* Indicates significance

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication. <sup>2</sup>Salmon prepared by baked (n=6), broiled (n=6) preparation methods. <sup>3</sup>Predefined  $\alpha$ -value = 0.10.

**Table R-3: Results of the 2-Way ANOVA Testing with Final Internal Temperature of Tilapia as a Dependent Variable, and Training<sup>1</sup> (Before/After) and Preparation Method<sup>2</sup> (Baked, Broiled) as Independent Variables with Interactions**

Source of Effect	df	F Ratio	p-value <sup>3</sup>
Preparation Method	1	3.29	0.085*
Training	1	0.072	0.791
Preparation Method*Training	1	2.21	0.153
Total Error	20/24		

\* Indicates significance

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication. <sup>2</sup>Tilapia prepared by baked (n=6), broiled (n=6) preparation methods. <sup>3</sup>Predefined  $\alpha$ -value = 0.10.

**Table R-4: Results of the 2-Way ANOVA Testing with Final Internal Temperature of Shrimp as a Dependent Variable, and Training<sup>1</sup> (Before/After) and Preparation Method<sup>2</sup> (Boiled, Broiled) as Independent Variables with Interactions**

Source of Effect	df	F Ratio	p-value <sup>3</sup>
Preparation Method	1	3.91	0.062*
Training	1	3.46	0.078*
Preparation Method*Training	1	0.121	0.731
Total Error	20/24		

\* Indicates significance

<sup>1</sup>Training included 1 hour of verbal, visual descriptions using brochures and electronic (video) publication. <sup>2</sup>Shrimp prepared by boiled (n=6), broiled (n=6) preparation methods. <sup>3</sup>Predefined  $\alpha$ -value = 0.10.

**Appendix S: Physical Measurements of Raw Fish and Shellfish for Translating Cooking Guidance to Skills Studies**

**Table S-1: Physical Measurements of Raw Fish and Shellfish for First Cooking Sessions**

<b>Product</b>	<b>Raw Weight (g)</b>		
	<b>Mean ± SD</b>	<b>Median</b>	<b>Range</b>
Atlantic Salmon	146.75 ± 3.08	146.45	10.45
Shrimp	15.41 ± 1.32	15.35	4.7
Tilapia	108.61 ± 14.07	107.18	45.2
<b>Product</b>	<b>Thickness (mm)</b>		
	<b>Mean ± SD</b>	<b>Median</b>	<b>Range</b>
Atlantic Salmon	21.60 ± 2.61	22.26	9.22
Shrimp	14.81 ± 0.46	14.94	1.8
Tilapia	16.71 ± 1.30	16.25	4.12

**Table S-2: Physical Measurements of Raw Fish and Shellfish for Second Cooking Sessions**

<b>Product</b>	<b>Raw Weight (g)</b>		
	<b>Mean ± SD</b>	<b>Median</b>	<b>Range</b>
Atlantic Salmon	154.12 ± 8.06	151.97	31.69
Shrimp	15.48 ± 2.48	15.3	9.3
Tilapia	159.69 ± 39.24	150.61	126.35
<b>Product</b>	<b>Thickness (mm)</b>		
	<b>Mean ± SD</b>	<b>Median</b>	<b>Range</b>
Atlantic Salmon	23.60 ± 3.31	23.88	11.14
Shrimp	13.26 ± 0.67	13.28	2.74
Tilapia	16.53 ± 1.33	16.19	4.51

**Appendix T: Cook Loss of Products for the Translating Cooking Guidance to Skills Studies**

**Table T-1: Average Cook Loss (%) of Salmon, Tilapia, and Shrimp by Various Methods during the First Cooking Sessions**

<b>Product</b>	<b>Average Cook Loss (%)<sup>1</sup></b>
<b>Baked Salmon</b>	9.69 ± 2.09
<b>Broiled Salmon</b>	8.81 ± 3.54
<b>Baked Tilapia</b>	13.43 ± 2.44
<b>Broiled Tilapia</b>	13.71 ± 2.93
<b>Broiled Shrimp</b>	10.64 ± 2.07
<b>Boiled Shrimp</b>	7.73 ± 4.63

<sup>1</sup>Participants were allowed to add seasonings to their products prior to cooking and after initial raw weight was recorded; therefore cook loss (%) may not be accurate.

**Table T-2: Average Cook Loss (%) of Salmon, Tilapia, and Shrimp by Various Methods during the Second Cooking Sessions**

<b>Product</b>	<b>Average Cook Loss (%)<sup>1</sup></b>
<b>Baked Salmon</b>	9.49 ± 7.28
<b>Broiled Salmon</b>	18.15 ± 10.12
<b>Baked Tilapia</b>	12.12 ± 2.28
<b>Broiled Tilapia</b>	17.55 ± 4.16
<b>Broiled Shrimp</b>	25.97 ± 6.27
<b>Boiled Shrimp</b>	19.70 ± 6.21

<sup>1</sup>Participants were allowed to add seasonings to their products prior to cooking and after initial raw weight was recorded; therefore cook loss (%) may not be accurate.