

CONSUMER POULTRY HANDLING BEHAVIORS

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## **ABSTRACT**

Understanding how consumers handle poultry can highlight gaps in consumer knowledge and practice of food safety. Quantitative research provides only a partial image, whereas qualitative data is helpful in gaining a complete picture of a shopper's behaviors. The objective of this study was to determine what poultry product microbes could potentially be transferred during purchasing and home storage; using a shop-along observational technique to observe actual shopping, transporting, and storing behavior of consumers with raw poultry products. In 71% (n=97) of the situations observed there was no visible hand sanitizer or wipes in the meat section of the grocery store. Plastic bags could be found in the meat section 85% (n=97) of the time, which only 25% of shoppers (n=82) used the bag for their poultry products. During transportation, the consumer bagged the poultry separately from other products in 71% of the observations. A majority of shoppers (59%) stored poultry without using a plastic bag or other container. Overall, there needs to be an increase in food safety education on the handling of poultry during purchasing, transporting, and storage.

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## Chapter 1 - LITERATURE REVIEW

### POULTRY CONSUMPTION TRENDS

Poultry meat production in the United States totals over 43 billion pounds annually. When discussing poultry productions most research divides it into four categories: broiler, eggs, turkey, and other chicken. A broiler is defined by the federal code of regulation as a young chicken that is tender meated with soft, pliable, smooth textured skin and flexible breastbone. This accounts for over eighty percent of U.S. poultry meat production (24). The value of broilers produced during 2013 was \$30.7 billion, up 24 percent from 2012, Table 1-1 (43). Broiler production occurs mainly in the south eastern portion of the United States; Figure 1-1. Turkey accounts for the next biggest portion of poultry meat production, the U.S. turkey industry producing over one-quarter billion birds annually, with the live weight of each bird averaging over 25 pounds (24). Turkeys sold in the United States are in clusters across the United States,

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Table 1-1 Poultry Value of Production – United States: 2012 and 2013

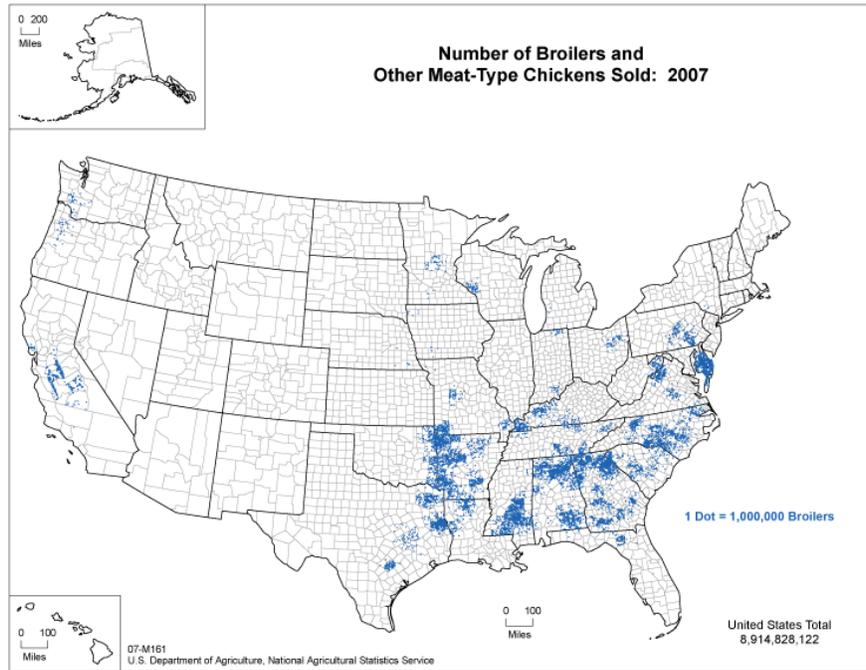
| Year | Broilers <sup>1</sup> | Eggs            | Turkeys         | Chickens <sup>2</sup> | Total           |
|------|-----------------------|-----------------|-----------------|-----------------------|-----------------|
|      | (1,000 dollars)       | (1,000 dollars) | (1,000 dollars) | (1,000 dollars)       | (1,000 dollars) |
| 2012 | 24,827,800            | 7,851,830       | 5,452,135       | 79,086                | 38,210,851      |
| 2013 | 30,679,781            | 8,498,935       | 4,839,072       | 87,861                | 44,105,649      |

<sup>1</sup> Excludes States which produced less than 500,000 broilers.

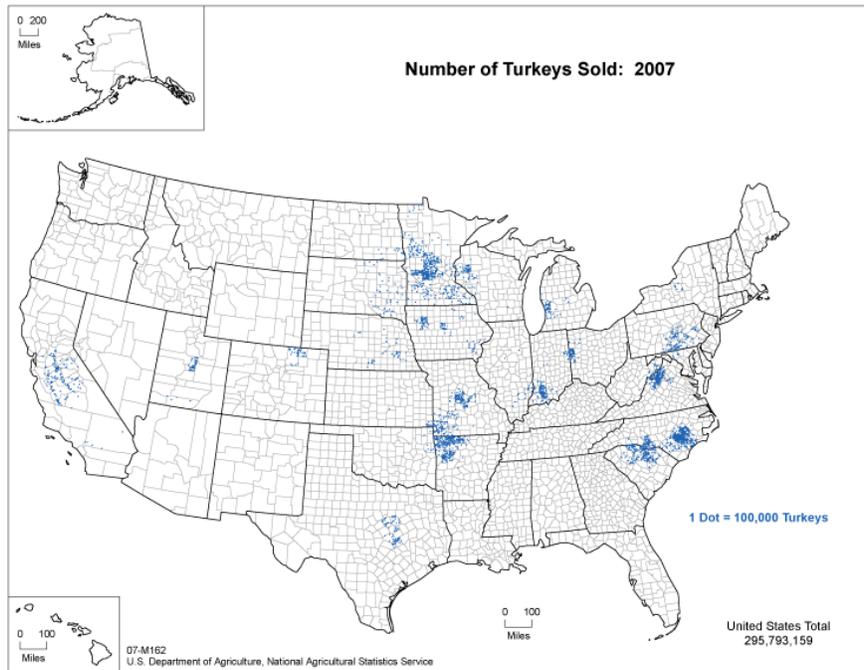
<sup>2</sup> Value of sales

<sup>3</sup> Adapted from USDA Poultry- production and value 2013 Summary (43)

Figure 1-1



**Figure 1-2**



<sup>1</sup> Maps from USDA **2007** Census Ag Atlas Maps (5)

Consumer meat trends were captured by the National Health and Nutrition Examination Survey (NHES), Carrie Daniel et al has compiled this data to help summarize consumer trends, seen in Table 1-2. They found several interesting trends. Compared with women, men consumed more poultry per day (statistically significant ( $P= 0.0005$ )). Peak poultry consumption occurred in adults aged 20–49 years. Black customers consumed the highest amount of poultry (54.4 g/d) compared to Whites ( $P , 0.0005$ ) and Hispanics ( $P , 0.001$ ). Poultry consumption appeared to increase with education level (14).

Table 1-2 Meat intake (g/day)

| Factor             | Mean |
|--------------------|------|
| <b>Gender</b>      |      |
| Men                | 48.8 |
| Women              | 38.1 |
| <b>Age (years)</b> |      |
| 2–11               | 30.6 |
| 12–19              | 46.2 |
| 20–49              | 51.7 |
| 50–69              | 37.2 |
| 70+                | 29.9 |
| <b>Race</b>        |      |
| White              | 41.4 |
| Black              | 54.2 |
| Hispanic           | 41.3 |
| Other              | 48.8 |
| <b>Education</b>   |      |
| < High School      | 39.7 |
| High School        | 44.8 |
| > High School      | 47   |

<sup>T</sup> Information from Daniel et al (14)

## FOOD SAFETY CONCERN

In the United States, there are an estimated 3,000 foodborne illness cases ending in death each year (11), as well as over 45 million foodborne illnesses contracted (38, 39, 40). Reducing the spread of foodborne illness in the U.S. by even a small percentage could potentially keep millions of people from getting sick each year. Out of the more than 30 pathogens known to cause foodborne illness (39, 40), *Salmonella* and *Campylobacter* spp. are ranked within the top five for the following three categories: overall foodborne illness, hospitalization due to foodborne illness, and foodborne illnesses resulting in death (11). Poultry products such as chicken can have high incidents of *Salmonella* and *Campylobacter* (6, 35, 46) which makes focusing on poultry food safety pertinent to efficiently decreasing foodborne illness.

**Salmonella.** *Salmonella* is the most commonly diagnosed bacterial agent causing foodborne illness (1, 12). An estimated 1.2 million cases occur annually in the United States; of these, approximately 42,000 are laboratory-confirmed cases reported to CDC (1). *Salmonella* serotypes Enteritidis, Typhimurium, and Newport account for about half of culture-confirmed *Salmonella* isolates reported by public health laboratories to the National Salmonella Surveillance System. Typhimurium has been the most common serotype since 1997(1). The amount of *Salmonellist* reported varies across the country, Figure 1-3 and Figure 1-4.

Figure 1-3 Age- standardized rate of Salmonella serotype Enteritidis per 100, 000 population, by county, 2006 to 2011

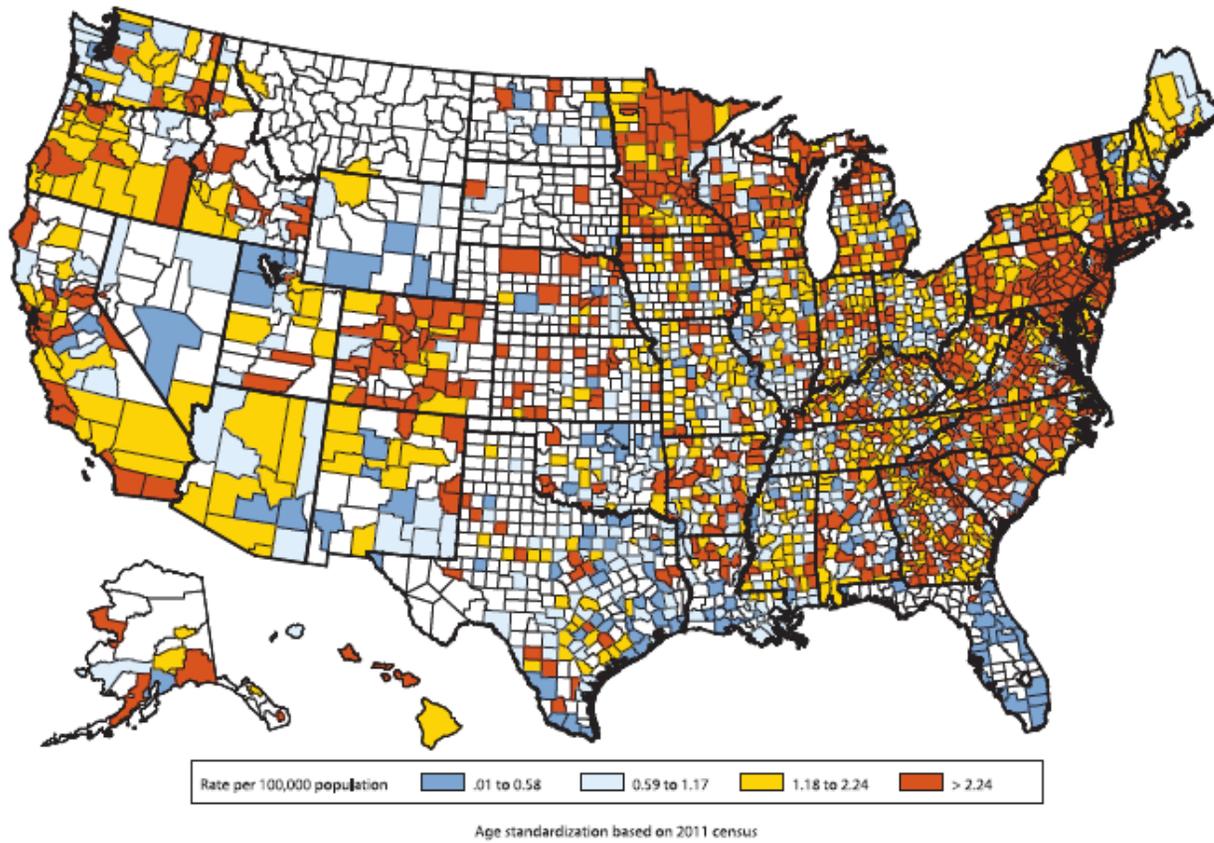
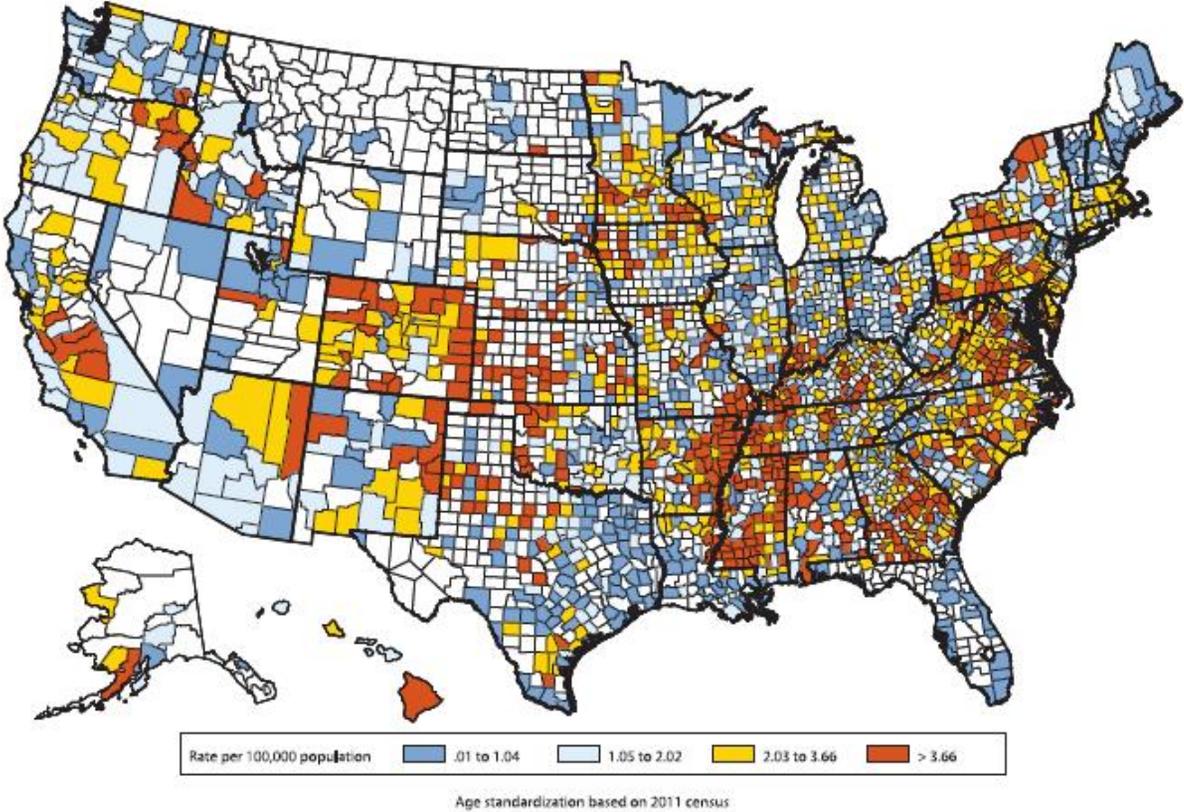


Figure 1-4 Age- standardized rate of Salmonella serotype Typhimurium per 100, 000 population, by county, 2006 to 2011



**Campylobacter.** *Campylobacter* is the most commonly isolated gastrointestinal bacterial pathogen in the United States (3, 17, 36). An estimated 1.3 million people are affected each year. In addition to being the most commonly isolated GI pathogen Campy is of interest because infection can lead to Guillain-Barré syndrome, a paralysis that lasts several weeks and usually requires intensive medical care (36). Approximately 1 in 1000 diagnosed Campy infections lead to this disease. *Campylobacter* is capable of surviving in a wide range of environments, such as rivers, estuarine, and coastal waters, and it is routinely found in cattle, sheep, swine, and avian species (28). *Campylobacter* infections are sporadic, that is, they involve individual cases not wide spread out breaks(28) .

**Farm to Table.** There is widespread agreement among sectors including regulators, educators, consumers, health authorities, research scientists, and the food industry that there should be proactive efforts to reduce, eliminate or control pathogens at all stages of the food chain(42, 45). This farm to table approach focuses on holding every step of the meat handling process accountable to food safety standards. This starts at the pre harvest in which several steps can be taken including: reduction of additional contamination, appropriate manure treatment and disposal procedures, and upholding water and food crop cleanliness (42). Feed additives such as: antibiotics, prebiotics, probiotics and symbiotic used for the control of *Salmonella* are also currently being evaluated (45). In response to the need for cleanliness to be started at the production level, the USDA/FSIS implemented a new inspection regulation which requires meat and poultry plants to: (i) establish sanitation standard operating procedures; (ii) operate under the HACCP system; and, (iii) meet microbiological performance criteria and standards for *E. coli* biotype I and *Salmonella*, as a verification of HACCP (18). The meat animal processing industry in the United States has employed extensive pathogen reduction interventions for carcass decontamination in their efforts to meet trade specifications for the raw materials (e.g., raw fresh meat). These interventions produce, comply with regulatory requirements, and provide safer

products to consumers (15, 16, 41) . Control of pathogens at the retail, food service, and consumer level involves activities that prevent introduction of additional contamination, recontamination or cross-contamination, and inactivation or inhibition of existing contamination (42) . Instances of *Salmonella* and *C. jejuni* at different process stages in poultry can be seen in Table 1-3 and

Table 1-5 (8) .

**Food Safety Intervention.** Types of antimicrobial interventions used to control pathogens in further processed meat or other food products are of physical, physicochemical or biological nature (19) . Physical hurdles include low and high temperature, irradiation, high pressure, steam, and -ultrasound; these hurdles have been used to meet decontamination requirements and it has specifically been evaluated in poultry safety (7, 42) . Physicochemical interventions include acidity or low pH, reduced water activity or drying, modification of the oxidation/reduction potential through packaging, and application of antimicrobial additives. Interventions of a biological nature include microbial competitors (lactic acid bacteria) or their antimicrobial products (42, 46) .

**Table 1-3 Prevalence of Salmonella on poultry products**

| Product           | Stage of process   | Type of samples | Number of samples | Percentage positive | References |
|-------------------|--------------------|-----------------|-------------------|---------------------|------------|
| Turkey carcasses  | After picking      | Swab            | 46                | 63                  | 32         |
|                   | After washing      |                 | 33                | 18                  |            |
|                   | After washing      |                 | 50                | 10                  |            |
|                   | After chilling     |                 | 58                | 17                  |            |
|                   | At packaging       |                 | 150               | 114                 | 33         |
| Turkey products   | After chilling     | Swab            | 40                | 25                  |            |
|                   | During cutup       |                 | 270               | 27                  |            |
|                   | Further processed  |                 | 73                | 21                  | 213        |
| Chicken           | Enter chill tank   | Swab            | 171               | 21                  |            |
|                   | Exit chill tank    |                 | 69                | 35                  | 63         |
| Chicken, cut up   | Retail             | Rinse           | 2330              | 19                  | 131        |
| Chicken necks     | Processed          |                 | 2330              | 12                  |            |
|                   | Kitchens           |                 | 757               | 17                  |            |
| Chicken livers    | Processed          |                 | 240               | 51                  | 137        |
| chicken           | Processing/retail  | Neck skin rinse | 120               | 46                  | 51         |
| Chicken           | Processing/ retail | Neck skin rinse | 41                | 7                   | 214        |
| Poultry Chicken   | Supermarkets       | 25g             | 330               | 39                  | 129        |
|                   | Before scalding    | Rinse           | 330               | 18                  |            |
|                   | After inspection   | Ceca cutting    | 330               | 22                  |            |
|                   | After chilling     | Rinse           | 331               | 94                  | 169        |
| Chicken carcasses | Unloading          |                 | 25                | 44                  |            |
|                   | After chilling     |                 | 108               | 22                  | 77         |
| Chicken           | Enter final wash   | Rinse           | 108               | 6                   | 37         |
|                   | Enter chill tank   |                 | 215               | 12                  |            |
|                   | Exit chill tank    |                 | 24                | 42                  | 123        |
|                   | Fully processed    | Skin blended    | 48                | 19                  |            |
| Turkey            | Fully processed    | Breast/thigh    | 45                | 49                  | 167        |
| Chicken           | While processed    | Neck skin       | 862               | 4                   | 78         |
|                   | Retail             | Swab            | 168               | 2                   |            |
| Turkey            | Retail             | Swab            | 69                | 3                   | 83         |
| Fresh chickens    | Supermarkets       | Swab            | 670               | 60                  | 113        |

**Table 1-4 Prevalence of Salmonella on poultry products cont'd**

| Product                     | Stage of process                 | Type of samples | Number of samples | Percent positive | References |
|-----------------------------|----------------------------------|-----------------|-------------------|------------------|------------|
| Chicken                     | Chill tank                       | Neck rinse      | 230               | 69               |            |
| Turkey                      | Chill tank                       | Rinse           | 48                | 100              | 92         |
| Chicken                     | Pre chill                        | Rinse           | 103               | 58               |            |
| Chicken                     | Post chill                       | Rinse           | 142               | 61               | 20         |
| Chicken carcasses and parts | Retail                           | Rinse           | 81                | 54               | 57         |
| Chicken                     | Retail                           | Rinse           | 286               | 24               | 233        |
| Chicken                     | Processing plants and meat shops | 25, 10, 1 g     | 300               | 57               | 127        |
| Chicken                     |                                  | swab            | 57                | 11               | 97         |
| Chicken                     | After chilling                   | Rinse           | 14                | 21               |            |
|                             | At packaging                     |                 | 214               | 45               | 166        |
| Chicken                     | Hospital kitchen                 | Rinse           | 249               | 47               | 172        |
| Chickens, chilled frozen    | Retail                           | 4 parts         | 347               | 64               |            |
|                             | (3 surveys)                      |                 | 160               | 58               | 93         |
| Chicken carcasses           | Preevisceration                  | Rinse           | 160               | 48               |            |
|                             | pre-chill                        |                 | 158               | 72               |            |
|                             | Cut up                           |                 | 154               | 77               |            |
| Chicken carcasses           | After chilling                   | Rinse           |                   |                  | 236        |
|                             | Plant A                          |                 | 112               | 26               |            |
|                             | Plant B                          |                 | 112               | 32               |            |
|                             | Plant C                          |                 | 112               | 77               |            |
|                             | Plant D                          |                 | 112               | 38               |            |
|                             | Plant E                          |                 | 112               | 30               |            |

**Table 1-5 Prevalence of C jejuni on poultry products**

| Product                | Stage of process  | Type of samples | Number of samples | Percent positive | References |
|------------------------|-------------------|-----------------|-------------------|------------------|------------|
| Chicken parted         | Frozen 3 weeks    | 165             | 2                 | 202              |            |
| Chicken parted         | Before packaging  | Swab            | 50                | 72               | 193        |
|                        | At packaging      | 50              | 48                |                  |            |
|                        | After delivery    | 25              | 48                |                  |            |
|                        | Water chilled     | 10              | 80                |                  |            |
| Turkey                 | Air chilled       |                 | 6                 | 83               |            |
|                        | Water chilled     | 5               | 100               |                  |            |
|                        | Air chilled       |                 |                   |                  |            |
| Chicken                | Frozen            |                 | 23                | 100              | 65         |
| Chicken                | Retail            | Rinse           | 100               | 58               | 156        |
| Turkey                 | Eviscerated       | Swab            | 33                | 94               | 126        |
|                        | Water chilled     | Swab            | 83                | 34               |            |
|                        | Ceca, just killed | Cutting         | 600               | 100              |            |
|                        | Viscera           | Swab            | 24                | 33               |            |
| Chicken chilled livers | Retail            | 20 g            |                   |                  | 80         |
|                        |                   |                 | 52                | 67               |            |
|                        | frozen livers     | 44              | 4                 |                  |            |
|                        |                   |                 | 143               | 12               |            |
|                        |                   |                 | 16                | 0                |            |
| Frozen chickens        | Retail            | Rinse           | 82                | 22               | 145        |
| Chicken livers         | Processing        | 25 g            | 60                | 85               | 42         |
| Chicken gizzards       |                   |                 | 64                | 89               |            |
| Chicken wings          | Supermarket       | 94              | 83                | 103              |            |
| Chicken, carcasses     | Before freezing   | Rinse           | 120               | 49               | 153        |
|                        |                   |                 | 40                | 73               |            |
|                        |                   |                 | 220               | 50               |            |
|                        |                   |                 | 20                | 65               |            |
| Turkey wings           | Supermarket       | Rinse           | 184               | 64               | 165        |
| Chicken, carcasses     | Before chilling   | Rinse neck      | 60                | 77               | 237        |

|        |                                  |               |    |    |  |
|--------|----------------------------------|---------------|----|----|--|
| livers | After chilling<br>Giblet chiller | Skin<br>Rinse | 36 | 69 |  |
|--------|----------------------------------|---------------|----|----|--|

**Table 1-6 Prevalence of *C jejuni* on poultry products cont'd**

| Product                       | Stage of process | Type of samples | Number of samples | Percent positive | References |
|-------------------------------|------------------|-----------------|-------------------|------------------|------------|
| hearts                        |                  |                 | 60                | 57               |            |
| Turkey, neck skin             | Before chilling  | Rinse           | 60                | 23               | 241        |
|                               | After chilling   | 60              | 0                 |                  |            |
| wings                         |                  |                 | 36                | 0                |            |
| hearts                        |                  |                 | 60                | 0                |            |
| livers                        |                  |                 | 18                | 0                |            |
| Chicken, chilled              | Supermarket      | Rinse           | 22                | 68               | 74         |
| Chicken, frozen               |                  |                 | 37                | 16               |            |
| Turkey wings, chilled         |                  |                 | 184               | 64               |            |
| frozen                        |                  |                 | 81                | 56               |            |
| Chicken livers                | Processing       |                 |                   | 209              |            |
| chilled frozen                |                  | 25 g slice      | 40                | 30               |            |
| Mechanically deboned, chilled |                  | 40              | 14                |                  |            |
| frozen                        |                  |                 | 40                | 13               |            |
| Chicken, carcasses            |                  |                 | 40                | 0                |            |
| livers                        | Before freezing  | Swab            | 120               | 49               | 151        |
| gizzards                      |                  |                 | 40                | 73               |            |
| hearts                        |                  |                 | 20                | 50               |            |
| Chicken                       |                  |                 | 20                | 65               |            |
| Chicken                       | Abattoir market  | 10g             | 70                | 59               | 180        |
|                               | restaurants      |                 |                   |                  |            |
|                               | Retail markets   | Rinse           | 360               | 30               | 210        |
| Chicken                       | Before cooling   | Swab            | 40                | 83               | 99         |

|                      |               |    |    |
|----------------------|---------------|----|----|
| Chicken<br>carcasses | After cooling | 40 | 78 |
|----------------------|---------------|----|----|

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## CONSUMER TRENDS IN POULTRY HANDLING

**In the Grocery Store.** It has been observed that poultry cross-contamination can occur from two major pathways; directly from raw meat to products that will not receive further heat treatment, or indirectly via work surfaces, hands, or other objects (13, 21, 26, 33, 34) . One form of indirect conduct is the poultry juice or fluid on the outside of the package. Harrison et al. (2001) emphasized that cross-contamination from external poultry packaging needs further research to investigate its role in foodborne illnesses (23) . Research done in the United Kingdom determined that both *Salmonella* and *Campylobacter* were present on the external packaging of raw meats (9) . This fact makes it a key factor to determine if consumer are using measures to protect themselves from the cross contamination that could occur in the cart. A national consumer reported survey found that while grocery shopping the majority of consumers kept poultry separate from other foods. In the same study over 65% of consumers reported placing raw poultry in a separate plastic bag before putting it in their shopping cart or making an effort to keep it from touching other foods in their cart (30) . A study completed in the United Kingdom reported only 10% of the samples collected in stores offered plastic bags for storing the meat (9) . Current studies focus on consumer poultry handing when preparing the meat in the kitchen, using laboratory and interviews (2, 4, 10, 25, 27, 44) .

**In the Kitchen .** Hand washing is a major form of indirect contamination that has been evaluated. Inadequate hand washing is a larger contributor to cross contamination than other forms of cross contamination such as utensil contamination (44) .One observational study found that a majority of participants (60 percent) washed their hands before beginning food preparation, but only 16 percent rubbed their hands together for the recommended 20 seconds (10) . During food preparation, an alarming percent of consumers do not wash their hands with soap and water after touching raw poultry and then touching ready-to-eat produce (4, 10) . However, the majority of consumers reported washing their hands after handling raw poultry

product in a national study using consumer reported answers (30) . Most studies have shown that consumers do not follow proper food safety procedures when it comes to hand hygiene.

One study found that the most common indirect transfer agents leading to cross-contamination were hands (51%), counters (18%), and utensils (16%) (4) . A national study reported that after using a cutting board or other surface to prepare raw poultry at home, 94.4% of consumers reported following practices to prevent cross-contamination by either washing the cutting board or other surface with soap or bleach disinfectant or using a different cutting board for preparing the next food product (30) . In a study conducted in Asia a total of 31% of participating Korean, 24% of Indian, and 30% of Thai consumers used the same cutting board for different foods, such as meats and vegetables and did not take measures to decontaminate the cutting board between uses (29) . Similar inadequate preparation was seen in an Italy study as well with 78.7% of consumers affirmed using the same cutting board for raw and cooked foods (32) . One-third of the participants did not keep raw chicken separated from ready-to-eat food (10) . Overall education of consumers in proper poultry handling in the kitchen is seen across several countries.

**The Refrigerator.** Another contributing factor to food safety is poultry storage. Previous research reports once home only about 17% of consumers correctly stored raw on the bottom shelf of their refrigerators in a sealed container or plastic bag (30) . A study conducted in Asia found that consumers stored raw meat on the top or middle shelf of the refrigerator creating the potential for poultry juice to drip onto other items on lower shelves (16% of Indian, 17% of Korean, and 21% of surveyed Thai consumers). A study that evaluated the refrigerator conditions of consumers reported that 11% of all respondents had a thermometer in their refrigerator prior to research; after all respondents were give thermometers 28% of the respondents reported their refrigerator temperatures were above the recommended temperature of 40\_F (31) . A study in Italy collected information on various refrigerator habits in the home a found the following; avoiding frequent opening of the refrigerator occurred 64.1% of the time, a not placing the

refrigerator near heat sources occurred in 36.4% of respondents, as well as 22.3% reported that their refrigerator was over full (32) .Consumers could benefit from education on how to keep refrigerated foods at a safe temperature (31, 32) .

**Thermometer.** A vast majority of participants do not use a thermometer to determine if chicken is cooked to a safe temperature (4, 10) . One third of the participants undercooked their chicken (44) . Only 12 to 26% of consumers in a national survey reported using a thermometer to measure the internal temperature of cuts of poultry smaller than the whole bird; about 35% of consumers reported reheating leftovers until steaming hot or using a food thermometer to check the internal temperature (30) . Survey data indicated that 30 subjects owned a food thermometer, and six of those owning a food thermometer reported using it often or always in cooking. Of those subjects who reported owning a food thermometer, 48% (n=14) reported being very confident in using a food thermometer correctly (4) .

## **OBSERVATIONAL RESEARCH**

Consumer behavior questionnaires provide only a partial image of how consumers handle poultry while shopping. For behavioral data, self-reported information may be biased and show incorrect information because there can be a substantial difference between what people say they do and what they actually do(20) .Context is necessary to understand consumer food handling habits (22) . In a comprehensive review of consumer food safety habits it was seen that the use of interviews was found to be the most common method for obtaining information on consumer food safety habits, accounting for 48% of studies, followed by self-completion questionnaires that accounted for 27% of studies (37) . Furthermore a mix off all data is needed to fully grasp consumer habits. For example, young adults in this study were observed performing only 25% of recommended hand-washing practices, despite reporting that they perform half of these practices and correctly answering nearly three-quarters of the knowledge questions related to hand washing (2). In addition, almost every young adult observed self-rated their food safety skill as at least fair, however as a whole, they only performed 50 percent of the recommended safe food handling practices. Thus, this sample shows that relying on self-reported behavior fails to truly reflect actual food handling behaviors (10) .

## **OBJECTIVE**

To date observational data of how poultry is handled in the grocery store has not been adequately evaluated. This study determined how poultry microbes could potentially be transferred during purchasing and home storage using a shop-along observational technique to observe the actual shopping, transporting, and storing behaviors of consumers with raw poultry products. This allowed the researcher to view the shopper's poultry habits first hand.



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## Chapter 2 - Consumer Poultry Handling Behavior

## **ABSTRACT**

Considerable work on consumer's food safety habits has highlighted issues associated with home food preparation. However consumer handling of foods such as poultry during shopping and storage has not been noted. The objective of this study was to determine consumer behaviors during purchasing and initial storage of raw poultry to determine potential cross-contamination issues. A shop-along observational study to determine actual shopping, transportation, and storage behavior of consumers who purchase raw poultry products. No visible hand sanitizer or wipes were observed in 71% of grocery store meat sections of the grocery store. Plastic bags could be found in the meat section 85% of the time, but only 25% of shoppers used the bag for their raw poultry purchases. During checkout the poultry was bagged separately from other products 71% of the time. A majority of shoppers stored raw poultry in the original package without an additional container or an overwrap. Overall, there needs to be an increase in food safety education on the handling of poultry during purchasing, transportation, and storage.

## INTRODUCTION

The United States Department of Agriculture (USDA) predicts more than 40 billion pounds of poultry meat will be produced in the United States in 2014 (16) . Poultry products such as chicken can have high incidents of *Salmonella* and *Campylobacter*(3, 19) , which makes focusing on poultry food safety pertinent to efficiently decreasing foodborne illness. Many studies have been conducted on food safety in the home (1, 2, 5, 11, 14, 25) , however observational studies focused on actual shopping behavior have not yet been found. Typical shopping behavior studies occur in a laboratory setting (12) . Gaining a better understanding of how consumers handle poultry in the grocery store, during transport, and initial storage could highlight gaps in consumer's knowledge and practice related to food safety.

In the United States there are over 45 million foodborne illnesses contracted a year(21, 22, 23) , with an estimated 3,000 foodborne illness cases ending in death (6) . Reducing the spread of foodborne illness in the U.S. by a small percentage could potentially keep millions of people from getting sick each year. Out of the more than 30 pathogens known to cause foodborne illness (22, 23) *Salmonella* and *Campylobacter* spp. are ranked among the top five for the following three categories; overall foodborne illness, hospitalization due to foodborne illness, and foodborne illnesses resulting in death(6) . Knowing how these two pathogens can spread through unsafe handling can help improve practices that reduce their potential for contamination and, consequently, lower these illnesses every year.

Cross-contamination has been identified as an important factor in food borne illness dissemination and has been noted specifically for *Campylobacter* (8, 13) . It has been observed that poultry cross-contamination can occur from two major pathways; directly from raw meat to products that will not receive further heat treatment, or indirectly via work surfaces, hands, or other objects (7, 8, 13, 15, 17) . One form of indirect conduct is the poultry fluid or leakage on the outside of the package. Harrison et al. (2001) emphasized that cross-contamination from

external poultry packaging needs further research to investigate its role in foodborne illnesses (10) . Research done in the United Kingdom indicated that both *Salmonella* and *Campylobacter* were present on the external packaging of raw meats. This same study also reported only 10% of the samples collected in stores offered plastic bags for bagging the meat (4) . Studies such as these indicate that poultry packaging could be contaminating other products, but little is known about which products or other surfaces might be contaminated. Improvement, through education or other methods, for safe poultry handling is needed in order to decrease the spread of foodborne pathogens found on poultry.

Consumer behavior questionnaires provide only a partial image of how consumers handle poultry while shopping. A number of data collecting instruments have been developed for measuring food environment, the majority of which were developed to track food availability (20) . Context is necessary to understand consumer food handling habits (9) . Observational data is helpful in gaining a complete picture of a shopper's behaviors. However it is pertinent to choose the right method of observational data collection. For example, a study gathering distance traveled to the grocery versus actual proximity to the grocery store showed that more people reported shopping 1 mile away from their home than actually lived 1 mile away from a grocery store (18) . Thus, actual concrete observation may be necessary to determine what people actually do

This study determined current consumers behaviors that could potentially contribute to poultry microbial spread to none poultry items. Observations were during purchasing and home storage of poultry products using a shop-along observational technique, which observes actual shopping, transporting, and storage behaviors of consumers with raw poultry products.

## MATERIALS AND METHODS

**Participants.** One hundred and two consumers who did at least 40% of their households' grocery shopping, regularly purchased raw poultry, and had plans to purchase poultry on their next shopping trip, were recruited from three cities (Manhattan, Kansas; Kansas City area, Kansas/Missouri; Nashville, Tennessee). A time was scheduled for two observers to meet and “shop-along” with each consumer, to observe the consumer on their grocery shopping trip, and to observe them storing their purchased poultry products at home. Usable data was collected from 96 consumers; some participants could not be used because of retailer hostility and not purchasing poultry.

**Observation guide.** An observational guide was developed to create consistency between all three research facilities. The guide was divided into four major segments in order to collect information on: items the customer touched after touching poultry when in the store, any product being purchased that came in direct contact with the poultry, availability of food safety measures in the grocery store or used by staff, and the transport and home storage of the poultry. Other behaviors also were recorded to conceal the actual purpose of the study.

Because of the amount of information collected, to protect the safety of the interviewers and consumers, as well as the unpredictable environment of an observational study, each shop-along required two researchers to gather observations. Thus, the observation guide was divided into a guide for “Researcher A” and a guide for “Researcher B”. Researcher A recorded observations in which categorical responses had been created in preliminary observational shopping trips. Researcher A also recorded the products the poultry touched on the conveyor belt after the cashier scanned the item, as well as any items bagged with the poultry. The at home portion of the study was also formatted into questions with categorical responses and was the responsibility of Researcher A. The observation guide for “Researcher A” is in Figure 2-1.

Researcher B recorded the open ended observations. Thus, there was particular need to be cognizant of the study goals to ensure appropriate items and information were recorded. For example, Researcher B recorded the three items the consumer touched directly after touching poultry. However, any item touched after the shopper used hand sanitizer or wipes was not considered to be at risk of poultry contamination. The items the poultry package touched when placed directly in the cart were also recorded by Researcher B. If the shopper placed the poultry product in a bag before placing it with other items, the items were not considered to have come in contact with the poultry. Researcher B also recorded any products the poultry came in contact with on the conveyor belt before reaching the cashier at checkout. The observation guide for “Researcher B” is in Figure 2-2.

**Figure 2-1** Researcher A Observation Guide

**Meat/ Seafood Section of the Store**

- 1) Are there any bags available to put meat products in?  
 Yes  
 No
- 2) Are there any forms of sanitizing wipes or hand wash?  
 Yes, Sanitizing wipes  
 Yes, Hand sanitizer  
 No
- 3) Did the customer use the bag for their poultry product?  
 Yes  
 No
- 4) Was there any noticeable dripping, leakage, or damage from the packages?  
 Yes  
 No
- 5) If they noticed dripping or leakage did they put the package back on the shelf?  
 Yes  
 No  
 N/A
- 6) Where did they put the poultry in the cart?  
 Child seat area  
 Main basket  
 Underneath main basket  
 Other \_\_\_\_\_
- 7) Did the customer use sanitizing wipes or hand wash?  
 Yes, they used on their hands  
 Yes, they used on other object in cart  
 Yes, they used on poultry product  
 Yes, they used on other area ; Describe: \_\_\_\_\_  
 No
- 8) If yes, where did they get it?  
 Meat Section  
 Front of Store  
 Brought with them  
 Other \_\_\_\_\_  
 N/A

**Check Out**

- 1) Take note of any additional items that poultry comes in contact with during the bagging process.  
\_\_\_\_\_
- 2) Does the cashier wrap the poultry in a plastic bag before it is placed in another bag?  
 Yes  
 No
- 3) Is the poultry placed in a separate bag from other products?  
 Yes, in a bag with just poultry  
 No, it was placed in a bag with products other than raw meat.  
Take note of all items in the bag with the poultry product

## Home Storage

Poultry product \_\_\_\_\_

1) What surfaces did the poultry touch before being stored? (this is outside of the bag)

- Counter
- Kitchen table
- Sink
- Other, describe \_\_\_\_\_
- None

2) How was the poultry stored?

- It was placed directly in the refrigerator
- It was placed directly in the freezer
- Placed (or left ) in a bag and then placed in the freezer
- Placed (or left) in a bag and then placed in the refrigerator
- Taken out of original package and bagged then but in the freezer
- Taken out of the original package and bagged and then but in the refrigerator
- Other; please elaborate

\_\_\_\_\_

3) Was the poultry placed directly on top of anything when stored? Comment on what the poultry was placed on.

\_\_\_\_\_

4) What shelf was the poultry placed on? Please describe any noteworthy observations.

- Lowest shelf, there was no possibility of liquid dripping down on other food
- Middle or higher self, there is possibility of liquid dripping onto other products
- Middle or higher self, no possibility of liquid dripping onto other products
- Other, please elaborate

\_\_\_\_\_

5) If purchased were the eggs stored in the container they were bought in?

- Yes
- No, describe how they were stored
- Not applicable

### Follow up Question

1) Do you have a meat thermometer?

- Yes
- No

2) Is it digital or dial?

- Digital
- Dial
- Other \_\_\_\_\_

3) How often do you calibrate?

**Figure 2-2** Researcher B Observation Guide

**Poultry**

1) List any poultry product the customer touches. Followed by the next three items that they touch. If the product is put in the cart list any items the poultry touched in the cart.

i. Poultry product touched \_\_\_\_\_

List the three products that the customer touched after touching the poultry.

List any products the poultry touched in the cart.

1. \_\_\_\_\_

1. \_\_\_\_\_

5. \_\_\_\_\_

2. \_\_\_\_\_

2. \_\_\_\_\_

6. \_\_\_\_\_

3. \_\_\_\_\_

3. \_\_\_\_\_

7. \_\_\_\_\_

4. \_\_\_\_\_

8. \_\_\_\_\_

ii. Poultry product touched \_\_\_\_\_

List the three products that the customer touched after touching the poultry.

List any products the poultry touched in the cart.

1. \_\_\_\_\_

1. \_\_\_\_\_

5. \_\_\_\_\_

2. \_\_\_\_\_

2. \_\_\_\_\_

6. \_\_\_\_\_

3. \_\_\_\_\_

3. \_\_\_\_\_

7. \_\_\_\_\_

4. \_\_\_\_\_

8. \_\_\_\_\_

**Section 3: Check Out**

4) Take note of any additional items that poultry comes in contact with during the placement on the conveyer belt.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Researcher Training.** Research staff and managers from research facilities at Tennessee State University (Nashville), and the Sensory Analysis Center at Kansas State University (Manhattan and Kansas City area locations) attended a one day training workshop. The researchers were given observation guides developed to aid in uniform data collection and were given various scenarios to help prompt any situational questions that could arise. The training session included an actual shop-along followed by a debriefing session.

During training, appropriate shop-along observational behavior also was reviewed and emphasized. For example, one behavior discussed was that researchers and consumers were allowed only minimal talking to each other after introductions and consent forms were signed. In addition, the researchers needed to respect the personal space of their shop-along consumers and other shoppers, in order to, help with conducting an unobtrusive study as well as helping keep the retailer's establishment easy for other shoppers to maneuver. Not interfering with the participants shopping, such as not helping carry items or picking up anything that was dropped, also was discussed to maintain as much of a natural experience as possible. Before conducting an unsupervised shop-along observation, researchers at each facility were required to have attended the researcher training session, or complete training that included at least one shop-along under the guidance of the facility manager who was present at the training session.

**Analysis.** The questions that could be answered in a multiple choice format were coded accordingly. The data that involved listing products was coded by a single researcher to allow for consistency. The items potentially contaminated by poultry were separated into 11 categories: beverages, cart, dry goods, eggs, fresh produce, frozen products, fixed features, meat or poultry, non-food products, personal items, and refrigerated products. Percentages were calculated for all questions and categories to understand potential issues that occurred with poultry shopping, handling, and initial storage behaviors.

## RESULTS AND DISCUSSION

**Meat Section.** Ninety-six shoppers were observed while grocery shopping and buying poultry (one shopper went to two stores, thus the following percentages reflect 97 poultry shopping observations). In only 29% of the shopping situations were hand sanitizer or wipes visibly available in the meat section of the store. Only three of the participants used hand sanitizer in the meat sections and two of those participants brought their own hand sanitizer. Hand hygiene is a key component of good practice in the community and can produce significant benefits in terms of reducing the incidence of infection (24) . That the majority of stores observed did not have any hand sanitizer or wipes available in the meat section is a problem that could be corrected. However, it is important to note that of the 30% that did have hand sanitizer or wipes available, only one participant used it. Therefore, it also is important to educate shoppers on the importance of using hand sanitizer in the meat section after touching poultry packages (Table 2-1).

Because shoppers are not practicing good hand hygiene when handling poultry in the grocery store meat section, there are a variety of items that could be contaminated as a result of contact with their hands. The list of items that the shopper's hands came directly in contact with after touching poultry packages can be seen in Table 2-2. An item of major concern is the grocery cart. The cart was touched directly after handling poultry 85 of the time, which could potentially mean the cart is a risk factor for *Salmonella* and *Campylobacter* spp. The bacteria potentially left on the car could affect other shoppers, not just the participant being observed. A shopper who is not purchasing poultry, or is purchasing poultry and is following safety precautions, could still be exposed to poultry contaminates via the cart. This is especially concerning for those that are at higher risk, such as infants or young children and the elderly. With young children, they may be placed in the basket of the cart and come in contact with the

handle. Thus, food-borne illness potentially could be spread because of another person’s lack of proper precaution when handling poultry products. Mitigation by using sanitizing wipes on cart handles at the store entrance should be specifically promoted, in addition to consumers sanitizing hands in the meat section.

The other categories frequently touched after touching poultry were dry goods, refrigerated items, other meat and poultry, and personal items. This can be attributed, in part, to store layout. The majority of stores are set up so that after the meat section the closest area is the refrigerated food section. Additionally the shopper can turn into the center of the store which usually stores dry goods. Of particular concern is the percentage of consumers who touched a personal item, including children, immediately after touching raw poultry. Direct transfer of microbes to children is an especially problematic behavior because children are particularly vulnerable to food borne illness.

Table 2-1 Observation with a sanitizer available in the meat section

| Sanitizer Type       | % of observations available<br>(n=96) |
|----------------------|---------------------------------------|
| Sanitizing wipes     | 26%                                   |
| Hand Sanitizer       | 3%                                    |
| No Sanitizer noticed | 71%                                   |

Table 2-2 Percent of shoppers that touched items types within three touches after touching poultry packages.

| Item touched                                    | Shopper %<br>(n=96) |
|---|---------------------|
| Cart  | 85                  |
| Dry goods                                       | 49                  |
| Meat or poultry                                 | 33                  |
| Refrigerated items                              | 33                  |
| Personal Item (child, purse, etc.)              | 31                  |
| Frozen foods                                    | 16                  |
| Fresh produce                                   | 9                   |
| Beverages                                       | 5                   |
| Non-food products (medicine, cleaning supplies) | 7                   |
| Eggs  | 4                   |
| Fixed feature at Grocery (shelf displays etc.)  | 4                   |

Plastic bags could be found in the meat section during 85% of the shop-along visits. Retailers are taking a step in the right direction by having bags available for meat storage in the meat section. However, of the observations where plastic bags were available only 25% of shoppers used the bag for their poultry products. Using a bag for poultry at this point in the shopping trip could decrease the potential for cross-contamination of other products in the cart, and during checkout, transport, and storage in the consumers' homes. This is a particularly easy behavior change that could result in considerable reduction in cross-contamination.

Contact with other products occurred frequently in the cart, which could result in cross-contamination. The shoppers placed the poultry in the main basket of the grocery cart 84% of

the time. Dry goods, fresh produce, and refrigerated items were the items that came into direct contact with poultry in the cart most often. The list of items that were touched directly by the poultry can be seen in Table 2-3. Produce is a product that is most likely prepared with a minimal amount of heat, yet it was the third most likely product to come in direct contact with poultry in the grocery cart. Thus, education is needed for shoppers to emphasize separating poultry items from fresh produce items in the cart. The frequency of dry goods contact can be attributed to larger number of dry goods purchased while shopping. The prevalence of refrigerated items coming into contact with poultry is problematic because these items frequently provide a moist environment that could promote a moist environment that could promote transfer and growth of microbes. In addition, some of these items, such as milk, are handled repeatedly in the home, which could result in multiple cross-contamination from a single product.

Table 2-3 Percentage of items that were in contact with poultry in the cart

| Items   | % total items touched<br>(n=276) |
|---|----------------------------------|
| Dry goods                                       | 33                               |
| Fresh Produce                                   | 18                               |
| Refrigerated                                    | 18                               |
| Meat or poultry                                 | 11                               |
| Frozen  | 10                               |
| Beverages                                       | 7                                |
| Non-food products (medicine, cleaning supplies) | 2                                |
| Eggs  | 2                                |

**Checkout.** A minimal amount of contact with other products occurred on the conveyor belt.

Although poultry's contact with the conveyer belt was not a focus of this study it should be noted that contamination of the conveyer is a potential concern. In some instances, the clerk did wipe down the conveyer belt with a wipe or spray and paper toweling, but the frequency of that was not studied here. Poultry was bagged separately from other products in 71% of the observations. When poultry was bagged with other products it sometimes was already in a plastic bag from the meat section or wrapped in a plastic bag at check out. Therefore, 82% of the shopping occasions observed would seem to have minimal cross contamination from sharing a bag with poultry products. The bagging process is one area in the grocery shopping experience where either the cashier, bagger, or the customer understands the importance of the food safety measures. When educating shoppers about food safety, the proper way to bag poultry appears to be understood by a majority of people; educational messages probably only need to confirm this behavior.

**Home Storage.** When viewing how shoppers store poultry in their home, it was noticed that 33% of the shoppers placed the poultry directly on the counter before placing it into storage.

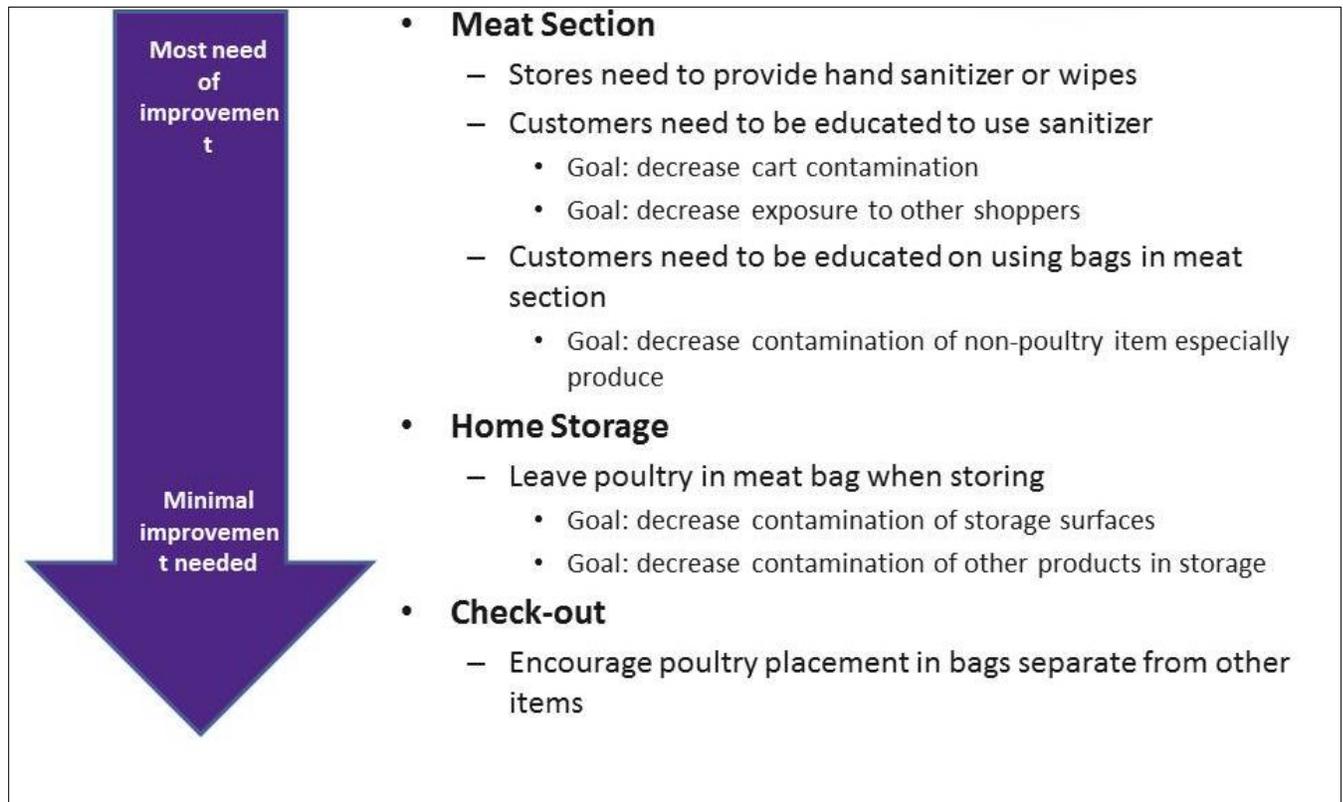
This made the counter a potential risk area for cross-contamination. Another prime area for potential contamination could be placing the poultry directly into the refrigerator or freezer. A majority of shoppers (59%) stored poultry either in the refrigerator or freezer in its original packaging without storing it in either another plastic bag or other container. Consequently, this action could allow cross-contamination with other items the poultry touched in the refrigerator or freezer. This is a concern because participants stored poultry in a way where it was in contact with a non-poultry item 20% of the time.

Education of shoppers is needed on at home storage methods of poultry products. Not only are shoppers not taking necessary precautions with their home storage of poultry products but they may be undoing the precautions that were taken at the store. A majority of shoppers left the store with poultry in its own bag (82%) however they took it out of this protective layer when placing the product in the refrigerator or freezer.

## **CONCLUSION**

Overall, there needs to be an increase in food safety practices when handling poultry during purchasing, transport, and initial storage. The area that would potentially be the most beneficial to improve would be shopper behavior in the meat section of the store, with the goal of stopping poultry cross-contamination during the rest of the shopping trip. Increasing the use of protective bags in the meat section could go a long way in decreasing potential poultry contamination. The bags are available, but are not being used by consumers. Additional availability and use of hand sanitizers or wipes in the meat section would be helpful along with a concomitant push for their use to decrease the spread of potential bacteria or germs. Simply using the wipes available at the front of many stores to wipe down the cart handle at the beginning of the shopping trip would help to prevent cross contamination from prior shoppers. It appears that most checkout clerks are handling and separating poultry appropriately and these

practices need to continue. It also is important to increase the number of consumers who store their raw poultry in a plastic bag (e.g. the one from the meat section) or other container.



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## APPENDIX B- SCREENER AND CONSENT FORMS

### Grocery Store Shop-Along Study Phone Screener/Scheduler

Hello, this is \_\_\_\_\_ from The Sensory Analysis Center. May I please speak to \_\_\_\_\_?

(Hello, this is \_\_\_\_\_ from [facility].) I am calling in regards to grocery store survey you filled out online. We are working on a USDA (U.S. Department of Agriculture) funded research study about grocery habits and at home storage of food. We are looking for participants who are willing to let two researchers observe them grocery shopping and then storing their food products at home.

If you participate in this study, you will receive **\$25** as a token of our appreciation. Are you still interested in participating?

1. How soon is your next shopping trip, within the next week, 2 weeks or longer?
2. Would you be able to tell me what items you would be buying during this trip? I am going to read you a list of items please let me know which ones you plan on buying on this grocery trip.

- Broccoli
- Fresh Bread
- Raw or Frozen Chicken
- Frozen Pizza
- Soup
- Raw or Frozen Turkey
- Pasta
- Tomatoes

If they will not be able to tell you  
what is on the list now I have offered

If chicken or turkey are a yes continue if not terminate.

3. Excellent, we would like you to participate in the next couple of weeks. What day of the week is most convenient for you?

**Informed Consent Statement**

**Sensory Analysis Center**

Kansas State University

Justin Hall 139

Manhattan, KS 66506

1. I, (print) \_\_\_\_\_, agree to participate as a panelist in research for the Sensory Analysis Center at Kansas State University.
2. I understand that the purpose of this research is to participate in an observational study of shopping habits and storage of food.
3. I understand that I will be participating in this research project for the duration of my shopping trip and the at home storage of my food.
4. For this test, I will receive \$25 when I complete the session.
5. I understand that my performance as an individual will be treated as research data and will in no way be associated with me for other than identification purposes, thereby assuring confidentiality of my performance and responses.
6. I understand that I do not have to participate in research, and that if I choose not to participate there will be no penalty.
7. I understand that I may withdraw from this research at any time.
8. If I have any questions concerning this study, I understand that I may contact Dr. Edgar Chambers IV, Justin 143D, Kansas State University, Manhattan, KS at 785-532-0156.
9. If I have questions about my rights as a consumer or about the manner in which this research was conducted, I may contact Rick Scheidt, Chair, Committee on Research Involving Human Subjects, at 203 Fairchild Hall (785-532-3224).

---

**Signature**

**Date**

---

**Address**

**City**

**State**

**Zip**