

DETERMINING INFLUENTIAL FACTORS IN CONSUMERS FOOD PURCHASING
DECISIONS

by

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A thesis submitted to the Graduate Council of
Texas State University in partial fulfillment
of the requirements for the degree of
Master of Science
with a Major in Integrated Agricultural Sciences
August 2021

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DEDICATION

For my wonderful mother and father who have given me the opportunity to further my education and for the support they have given me throughout this process. For my grandfather who instilled the passion of agriculture in me. And finally, to all young girls, especially my little sister, that they might reach for the stars and beyond because anything is possible. This is for them.

ACKNOWLEDGEMENTS

First and foremost, I want to thank my research supervisor Dr. Pratheesh Omana Sudhakaran, for being a mentor through the ups and downs of this process. For teaching me to be a better researcher and challenging me to think above and beyond. For pushing me and encouraging me through this journey. Thank you for all the support and guidance.

I would also like to thank my committee members, Dr. Madan Dey and Dr. Doug Morrish, I appreciate the time that they have taken to dedicate toward this thesis, especially since both serve in important roles within the Department of Agricultural Sciences. It has been an honor to know both Dr. Dey and Dr. Morrish and to be able to learn from the both of them and gain valuable skills.

To my team of undergraduate researchers, Shane Doyle, Brittney Heibel, Anja Senn, and Jacob Pena who helped in this process. They each learned and developed their research skills and gave helpful input on this project. Each individual researcher aided in various ways, and each was instrumental in the completion of this project.

To my work colleagues who supported me during the last half of this process. Their words of encouragement and support have meant everything to me.

To the amazing friends that I made along the way, their support and words of encouragement are something I will always remember.

To all my family members that consistently checked in on me and sent words of encouragement.

To my cousin, Manuel Elizondo, for being a role model for me for as long as I can remember. From checking in with me to being involved in important stages in my education. I will forever be thankful.

To my little sister, you always know how to make me smile and I love you so much. I hope that I have made you proud to call me your big sister.

Lastly and most importantly, I want to thank my wonderful mother and father, who have given me the opportunity to further my education and have supported me throughout this entire process. The words of encouragement throughout the years have not gone unnoticed. I love you both with all my heart and words cannot even begin to express how thankful I am for you two.

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LIST OF ABBREVIATIONS

| Abbreviation | Description |
|--------------|---|
| FSMA | The Food Safety Modernization Act |
| USDA | United States Department of Agriculture |
| FDA | The Food and Drug Administration |
| CV | Contingent valuation method |
| WTP | Willingness- to-pay |

1. INTRODUCTION

Food safety has become one of critical issues being discussed all around the world. Currently 1 in 10 people in the world will fall ill after eating contaminated food resulting in the deaths of 420,000 people every year (WHO, 2014). This problem will become an even bigger issue in the future because of different changes within the food system, with one of the most impactful being climate change. The effects of weather, especially temperature and humidity changes are expected to alter the survival and transmission of bacterial, viral and pathogenic contamination of water and food. In terms of foodborne pathogens this means that the rate of survival and the rates at which the pathogen could then multiply, will be altered due to climate change. In cases such as *Salmonella spp.*, a foodborne disease that is heat dependent has been responsible for an estimated 50,000 deaths and that number would continue to increase as temperatures keep rising due to climate change (WHO, 2018). Another impact of changes in weather patterns that lead to increases in natural disasters such as floods, pose a food safety risk as well in the cooking and storing of food and poor sanitation, leading to increases in foodborne diseases. At the current rate climate change is expected to result in the death of 250,000 between the year 2030 and 2050, with food safety deaths contributing to this number as well (WHO, 2014). The interest in food safety should be of importance in future research to determine the probable impact of climate changes, and their impact on human and animal health. In dealing with food safety issues, a variety of disciplines will need to be invested in research to deal with the complexities surrounding food safety (Miraglia et al., 2009). The ways in which food is produced is changing and those changes can sometimes be from consumers

who demand food safety and see it as an important value in buying food products (Smith et al., 2010; Lusk and Briggeman, 2009).

Consumers are exposed to an influx number of positive and negative information regarding food safety, this makes it critical to understand the perceptions and preferences of these consumers. These influences come from media sources, recall information, and development of policies to safeguard the food supply. Issues of declining consumer trust in the food system stems from concern about new policies, technologies, and perception of current agricultural practices and how it impacts the quality and safety of the food supply (Smith et al., 2010; Rivera et al., 2018). The consumer is the driving force within the food system, they demand and are challenging the food system to place more emphasis on their needs and to meet their demands on healthy, safe, and environmental sound food products (Gleaton and Anderson, 2003). While agriculture has increased production potential as well as food safety standards, the growth of this system also poses the issue of a single source of contamination rapidly being distributed through the food supply chain (Lusk and McClusky, 2018). The introduction of legislation as well as the implementation of the Food Safety Modernization Act (FSMA) is a government response to changing the way producers conduct themselves within the food safety system and their response. The focus of FSMA although geared towards producers, consumers should be aware of the policy because of the potential impacts that unsafe foods can have on consumer health and the economy. The consumer knowledge of food safety policies is critical for consumers to understand how policy makers are working to protect them and working to move from reaction to prevention of food safety issues (FDA). Although food continues to become

incrementally safer, there are still challenges to making food safer and more scientific understanding is needed to make decisions that will benefit society (Smith et al., 2010).

Although food safety has been presented as a global problem, in order to understand food safety and the impact that it has on consumers, this study will use Texas as area of the study. There are a multitude of reason for selecting Texas as the study area. Geographically, Texas is the biggest state in United States and recently we saw rapidly increasing trend growth in population of due to migration to metropolitan areas in Texas. Texas is home to four major cities that include Houston, San Antonio, Dallas, and Austin. These areas have had population changes ranging from 2% to about 3% from 2016-2017. In 2018, it was expected that 43.70% of the population growth that occurred within Texas was due to migration to major cities (Valencia, 2019). This has led to the determination of Texas ranking as the second most diverse state in America. This diversity was determined based on a study of the socioeconomic, cultural, economic, household, religious, and political factors (McCann, 2020). Considering a change in the demographics of the population, it is necessary that we need to understand the consumers perceptions to better serve them. A study of consumer perception is long overdue in Texas, and this will act as a preliminary study. The study area of Texas is practical in making conclusions and working within a specific budgetary constraint.

2. OBJECTIVE

Food safety perceptions and knowledge of consumers is a topic that has been thoroughly studied. However, further study of how consumers' knowledge affects their food purchasing behavior is essential. The goal of the proposed project is to understand consumer preferences in terms of food safety issues and food safety regulations. To achieve this goal, the study identified the following objectives:

1. Analyze consumer perception of existing food safety issues and control measures in the market.
2. Determine the change in consumers' willingness to pay for products as information about food safety changes.

Hypothesis 1: Consumers who are more knowledgeable about food safety issues and food safety regulations would give more importance to such information in their purchasing decisions.

Hypothesis 2: Consumers who prefer safer foods will be willing to pay more for safety-related information.

3. LITURATURE REVIEW

3.1 Economic Issues of Food Safety

The attempts to stay safe and healthy are important because of the negative experiences that are caused by contracting a foodborne illness. Food safety is defined as “potential hazards associated with food that can cause ill health in humans” (Henson, 2003). The topic of food safety has emerged as an important topic with scientists, economists, policy makers and many others. Within food safety there are various types of bacteria, viruses, parasites and chemicals that can negatively impact the health of those that consume foods with any of these pathogens. Food safety has gained recognition in the world as it continues to grow, and more and more food is being consumed away from home. These problems also differ between developed and developing countries, but it remains a global problem as trade has made the food supply chain significantly longer and leaves more room for food to potentially be contaminated (WHO, 2019). These pathogens cause over \$15.5 billion in economic burden. This doesn’t include illnesses that aren’t reported as foodborne related incidents; this loss can be in lost sick days as well as bills for doctors’ visits or any type of hospitalization, resulting in \$1.8 billion dollars, productivity loss in the amount of \$856 million and lastly death related costs of \$12.8 billion (Hoffmann, 2015). This economic cost can also be passed on to the producers because of unwillingness to buy the product again or a negative image that is portrayed by the media (Garcia-Fuentes, 2014). As more research is done on food safety and the pathogens associated with foodborne illnesses, there is likely to be a change in the number of incidences due to changes in processing practices, technology, food sourcing and demographics. Although there are currently known and controlled pathogens there is the

potential for the emergence of new pathogens as well as reemergence of already controlled pathogens that can change over time as they become antibiotic resistant (WHO, 2019). In attempts to decrease economic loss, there have been major governmental and industry strides, that include the development of government policy, FSMA, and industry technology, blockchain. The provisions of FSMA include on farm regulations of US produce production, traceability, written preventative control plans, new import safety, enhanced State and local government partnerships, and to improve the food safety management capacity of foreign suppliers (Hoffman, 2015). In addition to government regulations new industry technology has begun to emerge such as blockchain, which aims to deliver immediate information in the food chain that can be used by major markets to ensure safety of food products. It can track down produce back to the location of the incident and make sure those items are pulled immediately without having to throw everything away in the process. The overall goal is food safety, waste reduction, food freshness and sustainability (IBM Food Trust).

3.2 Non-compliance in the Food Supply Chain

Food safety issues can be broken into two areas, which are non-compliance in the food supply chain area and the other is the misinformation in food handling practices at home. In the agricultural supply chain, non-compliance refers to any business that does not follow proper protocols or in other words do not comply and this puts downstream buyers in the supply chain at a food safety risk, this includes the consumer (Hirschauer, 2004). This is the part of the supply chain that consumers do not have direct access or a direct look into the processes and regulations associated with the production of safe food products. Antle (2001), determined that there are two ways that food safety issues within

food supply chains are communicated. They are called *symmetric imperfect*, in which suppliers and buyers may ignore actual levels of contamination that might exist and *asymmetric information*, which is private information that only a select people know and usually consists of their personal ability and effort that they could put into mitigating food safety hazards that may arise, but this is kept from counterparts. The recognition of these two flows of information is important in understanding the role of buyers and consumers in the market. Those buyers and consumers expect high levels of food safety but access to that information can have a cost associated with it. As mentioned earlier, since consumers can't determine the safety of those products by direct observation, they hold producers to a high standard of food quality and safety.

3.3 Consumer Food Safety Handling at Home

Often the food safety threat doesn't have to be at the market level but can be a threat at home. Those perceived risks that consumers have of food safety in the marketplace are different than those risks that consumers might not acknowledge as their food leaves the markets and into their homes (Sanlier, 2010). The food safety threat and the threat of foodborne illness could be present when consumers aren't aware of how their handling practices can affect them or how other establishments such as restaurants are handling the food they serve. If the safety isn't being handled within the supply chain, then it has the potential to move on to the consumers when they purchase food in the market or go out to eat at restaurants. They perceive risks such as health, finance, time, and taste and these are dependent on events in the environment, information, and regulations. Once encountered, the consumers will change their habits based on these events to keep themselves safe and healthy (Yeung and Yee, 2005). These safety risks are also passed

on to the consumers when they prepare food in the home. The food handling safety between males and females and their education levels determined how knowledgeable they were when preparing safe meals. The food handling behaviors of consumers can vary based on age, sexual orientation, and education level. In a study that took different points in the home and tested them for common foodborne illness strains such as *Staphylococcus*, *Escherichia coli* (*E.Coli*), *Listeria*, and *Campylobacter*, it was found that points within the home tested positive for all but *Campylobacter* (Azevedo et al. 2014). These behaviors are then transferred to younger children in the household as they grow up and prepare their own meals or prepare meals for others. When looking at students age 16-19, or those students most likely to work in the food service or prepare meals for themselves, it was found that ethnicity can also be a significant factor in the preparation of foods at home or the knowledge of young high school students (Burke and Dworkin, 2015). Ethnicity being a factor is due to the different types of foods that are consumed in the household, the age that children began cooking their own meals, and the cycle of doing things the way they were taught to do them.

3.4 Food Safety in the Marketplace

Consumer perceptions are important in deciding and buying in the marketplace. The most important qualities are appearance, health, and safety. They want to buy the healthiest and safest options, but many are unaware of the potential food safety problems that exist. The previous thought was that foodborne illnesses could only be passed through unsafe food handling practices and not from potential problems during planting and harvest (Van Loo, 2010). In the market, consumers make the choice and hold all the

buying power. Many of these consumers are attempting to make quality food choices that positively impact their health, environment, and awareness of food security issues.

In the market consumers gravitate towards specific statements made by brands such as “antibiotic free” and “no GMO”. These statements offer a sense of security to the people buying those products and the belief that these are safe products and better versus conventional products (Ellison, 2017). These statements have varying degrees of effectiveness based on age and education of the buyer and in cases ethnicity. In a study of a predominantly minority Chicago charter school it was found that there were gaps in the food safety knowledge that these students had. These gaps were important to note because these students were involved in the food industry and as well as preparing meals for their families. This could lead to various implications in the future and open them up to foodborne illnesses or because of lack of knowledge cause an outbreak that could have been prevented (Burke and Dworkin, 2015).

3.5 Food Safety at Farmers Markets

Farmers markets have increased in popularity due to access to fresh and local foods but are the regulations up to par with the perceptions of consumers. Consumers are ready and willing to purchase foods in these markets based on the perceived benefits of quality and health (Beskik and Nagurney, 2017). Although these benefits are seen differently by different generations, there are many factors that influence the buying habits of these consumers such as their age, gender, income, and education level. Given multiple factors the most significant of those was the differences in generations and their perceptions toward farmers markets. Those perceptions varied between millennials and generation X, in which millennials had a higher belief in food safety conditions at farmers’ markets.

Millennials would be more likely to frequent a farmer's market due to the perceptions and the assumption that there is little risk associated with shopping at farmers markets (Yu et al., 2017). While understanding the type of person that would frequent the market, there was a lack of relationship between the safety perception and the purchases that those consumers make. This is only one side in understanding the prevalence of potential food-borne illness or pathogens that might exist at farmers markets.

To understand the priority of consumers at farmers markets a survey was conducted that targeted different visitors and asked a range of questions on the foods they were buying and perceptions of risk and hygiene. They were also asked a series of agreement or disagreement questions that followed the same line of questioning. The outcome was that sellers believed their products were safe, so consumers placed all their trust in the seller without hesitation. There was a major problem with the identification of high-risk foods and them being placed into low-risk categories. The problem with high-risk foods is the high possibility of catching a foodborne illness (Worsfold et al., 2004).

Consumers are made aware of potentially foodborne illnesses in the supermarket setting but not as much in farmers markets. This is important to address because more and more consumers are switching away from mainstream supermarkets to farmers markets for access to freshness, traceability, taste, quality, and organic (Worsfold et al., 2004). In another study on farmers markets more emphasis was then placed on other products such as meats and again a major focus on food safety perceptions. In most cases, consumers had positive perceptions toward safety at farmers' markets.

Aside from production of local or organic foods for consumers another major focus should be on the food safety issues that arise out of farmers markets where these types of foods are sold. If a major food safety issue were to break out in one of these markets it might impact the economic viability of producers who are able to provide local and organic foods to consumers.

3.6 Impact of Food Safety Modernization Act on Food Safety and Consumers

While various research in the past has been done on food safety, the importance of food safety and the health of the consumer is still a priority and will always be a priority. It is especially important today with the implementation of The Food Safety Modernization Act (FSMA). This was signed into law by President Obama and gives the Food and Drug Administration the authority to protect consumer health and focus on food safety (FDA). The primary goal of FSMA is to prevent foodborne illnesses that cause economic problems that result in wages lost through foodborne illnesses that averages \$694 million to \$1.4 billion for lost productivity due to illness and death (Crutchfield, 1995). Some of the preventative controls that the FDA has put in place include mandatory preventive controls for food facilities, mandatory produce safety standards, and authority to prevent intentional contamination. FSMA has been referred to as revolutionary policy that will change the way food safety is approached. Until FSMA, one of the latest policies on food safety was in 1997 when President Clinton had the Department of Health and Human Services (HHS), the U.S. Department of Agriculture (USDA), and the Environmental Protection Agency (EPA) to identify possible improvements to food safety. Produce was discovered to be the area of most food safety concern, so voluntary guidance was provided on Good Agricultural Practices (GAPs) and Good Manufacturing Practices

(GMPs). Since these were voluntary call for change and reform was asked for since more and more people were being exposed to foodborne illnesses and major recalls were issued (Collart, 2016). A response was needed, and that response was going to need to address the major concerns that still existed.

Previous food safety laws have proved archaic to the modern processes and changing landscape of current food safety issues. The Food Safety Modernization Act is an update to current U.S. food safety policy with focus on (1) the global nature of the food system; (2) the increased importance of both fresh/raw and highly processed products in diets; (3) the increased importance of away-from-home consumption; and (4) the tremendous technological changes that have taken place in food production, handling, transporting, processing, and retailing (Knutson and Ribera, 2011). The main goal is to focus food safety policy on preventing foodborne illnesses rather than just reacting to the foodborne illness event.

Although FSMA expects the foodborne illnesses to be reduced and at the same time reduce costs for costs of outbreaks and costs associated with recalls. While this is important and significant to the discussion of FSMA there are consumer implications that FSMA is not addressing, and it can cause economic problems with unregulated farms that fall into that category. While the positives are more consumer confidence this confidence probably won't transfer to smaller farms which before FSMA were praised for their "no GMO" and "organic" designation (Ellison, 2017). This leads to less consumer confidence in these farms due to a food safety oversight and preference to produce that is regulated under FSMA (Knutson and Ribera, 2011). This leads to a reduction in the willingness to pay for certain products based on their safety, but prior to FSMA consumers were more

willing to purchase from farmers markets and smaller farmers because of certain factors such as fresh and free of antibiotics or non-GMO. The implementation of FSMA changes that and reduces the confidence the consumers found in farmers markets and these

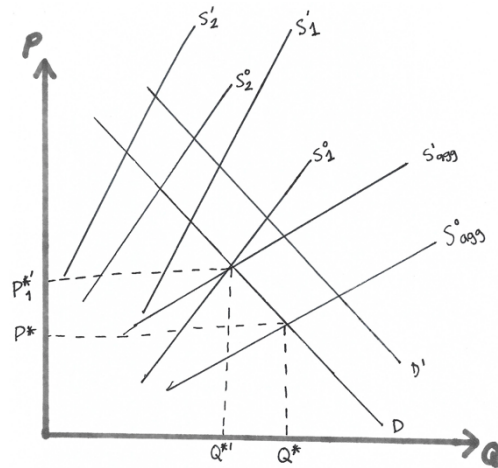


Figure 1: Supply curve and demand curve shifts due to improved product safety adopted from Bovay & Sumner, 2018

consumers also believed that nobody should be exempt from the rules that guide FSMA. The implementation will also increase the marginal cost of production for those farms who need to comply with FSMA regulation of produce. This then leads to an increase in market price because the implementation will be passed on down to the consumers. This is then counteracted with the changes in demand for consumers for a product that is safer and reduces the risk of food-borne illness. Before FSMA, there would be a negative demand response by consumers due to the perceived risk for consuming a product. It is suspected through simulation that FSMA will cause a supply curve shift due to improved product safety and positive demand shift (Figure 1). Although the costs are steep the proposed demand shifts will allow smaller farms to regain their lost revenue faster (Bovay & Sumner, 2018).

With the years to come more research will aid in understanding the impact that these rules have on food safety as well as consumer adaptation to FSMA (Ellison et al., 2016). This is only one aspect of food safety and as time continues, rules and regulations will need to change and adapt with the time. There are still problems that our food system faces but with FSMA the road to a secure system might be in sight and new technology might change the way businesses in the food sector operate.

3.7 Potential Problem for Food Safety: Threat of Agroterrorism

The threat of agroterrorism is important when discussing the implications of food safety regulations especially when it comes to the Food Safety Modernization Act (FSMA). Since the September 11th terrorist attacks the United States realized that there were potential gaps in the food safety and security of the food supply and agricultural economy. Food and agriculture are essential to the infrastructure of society and providing products that sustain life (Turvey et al., 2007). Any attack on the complex agricultural system can have a negative impact on the United States economy at various levels (Kohnen, 2000). Since farm to market isn't always as simple as it seems, there are various stages before the food gets to the consumer's plate. At each of these stages there is a potential threat to the food supply that can cause serious health issues and economic issues as well. Agroterrorism isn't new; it was used during World War I, when German agents infected United States horses and cattle, and since 1912 there have been 12 documented cases of pathogenic agents being used to infect or contaminate livestock (Knowles, 2011). There are four categories of groups that pose a threat, the first being transnational groups that aim to threaten the economy of the United States. The second group is economic opportunists that will try to manipulate the market and are aware of

what various types of threats would do to the economy. The third group being domestic terrorists which see attacks as any threat that could harm the US government, or these could be disgruntled employees or individuals that aim to threaten others to fulfill their own motives. The last and final group are animal activists that pose a threat because of their views on animals as food (Olson, 2012). From each of these groups the biggest problem that can cause a threat to livestock is food and mouth disease (FMD). The focus on prevention falls in line with filling the gaps that exist in the food supply chain and ensuring the consumers are protected from domestic and international threats to the food system. This has become a problem that might need to be addressed more into the future and the steps taken with FSMA ensure that gaps that could exist are located and remediated.

3.8 Potential Problem for Food Safety: Climate Change

Climate change is projected to be a major disruptor for the U.S. economy. Climate change is a major topic that has negative impacts for various sectors and economic issues that occur within those different sectors. Climate change is anticipated to cause warmer temperatures, rising sea levels, extreme weather, and also human health issues. As previously stated, different disciplines will have to come together to understand the complexities that surround potential food safety issues associated with climate change. These issues are just assumed at the moment because although there has been extensive research on climate change and food safety separately, the research associated with linking food safety and climate change are still being researched and recognized as a potential human health issue. This is an important focus since the agricultural sector is the most vulnerable to climate change. Common commodity crops such as corn,

soybeans, wheat, rice, cotton, and oats would suffer if temperatures rise above the threshold that these plants can withstand. As temperatures rise, sea levels rise, drought and water availability, and extreme weather patterns will put a strain on farmers which will cause them to find alternatives or make improvements to their current production methods which is then passed down to the consumer as price increases in the foods that they consume.

Although there are many ways that climate change can impact food safety, six issues have been identified by researchers already. These include the modification of bacterial, viral, and pathogenic contamination, fungal growth and mycotoxins, algal blooms, zoonoses, inland floods, extreme weather events. Currently, according to the CDC there are 250 foodborne diseases that have been recognized by researchers, with the most common being Norovirus, *Salmonella*, *Clostridium perfringens*, *Campylobacter*, *Staphylococcus aureus* (Stap), *Clostridium botulinum*, *Listeria*, *Escherichia coli*, and *Vibrio*. These foodborne diseases range from bacterial, viral, and pathogenic contamination of food sources that can make people sick and, in some cases, require hospitalization. The survival of these different sources of contamination in certain cases is dependent on temperature and handling practices within the supply chain. It is not known if the rising temperatures will cause these pathogens to mutate or change their current behavior (Tirado et al., 2010). If this were to occur, it would be time and money that would have to be spent in understanding the major effects that this could have on foodborne pathogens and the consumers who could be impacted by it. Temperature rising associated with climate change is also assumed to be responsible for fungal growth and formation of mycotoxins moving into the future. Mycotoxins can cause serious illness as

well as death in both human and animals. These fungal growths occur most often in areas where the combination of temperature and humidity cause Mycotoxins to occur, with an estimated 25% of the world's yearly crop production containing the contamination of Mycotoxins. The contamination of mycotoxins can occur in the field or post-harvest given favorable conditions. Mycotoxin intoxication can occur in different geographical regions throughout the world. Along with the potential for mycotoxin toxins there are also aflatoxin, which impact maize and wheat crops as temperature rises. This rise in temperature leads to a 6% reduction in yield of wheat crops (Zhao et al., 2017). These temperature rises are also responsible for toxic fusarium to form on crops when they are under heat stress. The last potential toxin to develop is phycotoxins, which occur when there are large algae blooms that are produced. This is due to run-off of fertilizer into oceans and impacting water-filtering organisms such as mussels and clams (Paeral and Huisman, 2009). If weather changes continue to occur there is also the potential for the rise in zoonotic diseases, these are diseases in which animals can pass them on to humans. The temperature change that is anticipated would contribute to these outbreaks of zoonotic diseases. In aquaculture, ocean warming will allow diseased animals to continue to thrive and increase the residue that is noticed in fish and seafood products that consumers eat (Naicker, 2011). With the outbreak of zoonotic disease as a concern this leads rise to a new concern with the type of veterinary drugs that will be needed to treat new outbreaks. This could impact both human and animal health due to vulnerability to antibiotic resistance and the ability to fight off diseases. The last two potential impacts of climate change include both the use of pesticides and the runoff of environmental contaminants such as fertilizer. While pesticide residue in food has been an issue in the

past it will continue to be a problem as crops have to shift to different areas and become exposed to potential new pest threats. The use of environmental contaminants can impact major water sources and increase the amount of pesticides and heavy metals from soil to these water sources. This then becomes a problem with fish and seafood items that are consumed by humans which may contain higher levels of mercury to be present. With temperatures rising 1-degree Celsius, mercury increases of 3-5% can occur (Martinich and Crimmins, 2019). Given the limited research on linking climate change and food safety it seems as if it is a serious threat that should be given more attention.

3.9 Food Advancing Technology

Consumers want to make informed decisions on what they are consuming and how it will affect their families and the environment, blockchain might be the solution. There are products that enter the food supply chain that may be misbranded, mislabeled or contaminated which could cause social and economic repercussions (Kshetri, 2019). Under FSMA a priority area has become the traceability of food products. This traceability of food products improves the consumer confidence in the food that they eat and what they are willing to pay for it (Ellison et al., 2016). Within the United States, the development of a blockchain system that ensure a safer food system is IBM Food Trust. This development would enable unprecedented visibility during each step of the food supply chain. Blockchain technology stores digitized records and promotes trust and transparency to ensure a safer food system. IBM has developed Food Trust in a response to issues within the food supply chain. Those issues are the slow identification of causes of a food safety incident, gaps in supply chain monitoring where the supply chain becomes vulnerable, and the outdated traceability practices that don't match up with

modern technology. The main goals with the implementation of blockchain are transparency, traceability, and food confidence (IBM Food Trust). IBM Food Trust aims to provide a more transparent communication system that protects consumers, saves vendors money, and keeps food safety issues out of the media. The use of blockchain has gained recognition and use by other companies such as U.S. retailer Walmart, U.S. based Bumble Bee Foods, launch of blockchain platform to trace seafood in collaboration with SAP, a German technology company, Golden State Foods, to track their beef supply chain, and French retailer Carrefour, to track poultry in Spain (Kshetri, 2019). In 2017, there were 456 recalls globally due to contamination and had an estimated cost averaging \$10 million that impacted various businesses (Food Safety Magazine, 2017;2018). The safety and assurances that IBM Food Trust provides can only be done if companies as well as people are willing to get on board and learn where their food is coming from. In 2018, after 18 months of testing IBM Food Trust, it was then put into action by commercial retailers. After this implementation global retailer Carrefour, with locations in France, Spain, Brazil and more, has led to their use of IBM Food Trust with the hope to expand worldwide by 2022. In addition to Carrefour other companies that have joined IBM Food Trust include Topco Associates, LLC, Wakefern, BeefChain, Dennick Fruit Source, and Scoular and Smithfield (IBM News Room). The use of blockchain in food safety management creates transparency in showing the supply chain and the path that food takes from farm to table. Food product traceability has become a priority under FSMA, because tracking of food could ensure that foodborne illness risk is reduced and the potential loss of profit due to a recall is also reduced. The traceability of products also improves consumers' confidence in the food that they eat and their willingness to pay for

those foods (Ellison et al., 2016). With the implementation of IBM Food Trust, producers, manufacturers, distributors, retailers and many more aid in the overall business operations and tackle challenges that relate to food safety and issues within the food industry.

4. METHODOLOGY

This study takes a qualitative research approach to understand the consumer and their perceptions of current existing food safety issues and control measures in the market while also determining if there is a change in consumers' willingness to pay for products as information about food safety changes. This was done in two parts, using focus groups to gather baseline data and the development of four different consumer surveys with a focus on different products such as seafood, cheese, meat, and produce.

4.1 IRB Approval for Consumer Study

This research has been approved by the Texas State Institutional Review Board (IRB) which can be seen in Appendix A. The IRB “protects the rights and welfare of research subjects conducted or supported by Texas State University. The IRB shall review, approve the initiation or, conduct periodic review, and monitor research involving human subjects”.

The Institutional Review Board (IRB) is an administrative body established to protect the rights and welfare of human research subjects recruited to participate in research activities conducted under the auspices of the institution with which it is affiliated.

The IRB is charged with the responsibility of reviewing, prior to its initiation all research involving human participants. IRB is concerned with protecting the welfare, rights, and privacy of human subjects. The IRB has the authority to approve, disapprove, monitor, and require modifications in all research activities that fall within its jurisdiction as specified by both the federal regulations and institutional policy.

4.2 Focus groups

In order to answer the presented questions, a qualitative approach was used to gather data to determine the current food safety issues and control measures in the market as perceived by consumers as well as their willingness to pay for safe food products. To achieve this goal the use of focus groups and consumer surveys was used. Focus groups were held in three different cities in Texas. Those cities included Houston, San Marcos and Dallas. These three cities were proposed based on their access to some of the larger populations within Texas. Each focus group recruited participants through word-of-mouth, social media postings, poster flyers, referrals, and craigslist. Interested participants were then directed to fill out a questionnaire that asked basic demographic questions to ensure that a diverse set of participants was selected. The goal was to recruit about 12-15 participants for each focus group location, once going through the questionnaire, 11 participants were selected for each focus group. The questions fell within four different categories such as shopping habits and preferences, consumer knowledge on food safety, terms in food safety, and picture analysis. The same type of questioning was used across the three different focus groups. The responses from participants during the focus groups were recorded and then analyzed with the help of undergraduate research students. The analysis of the data from the focus group helped to create a baseline knowledge of consumers regarding food safety knowledge, purchasing factors, and shopping habits. This data was helpful in the development of the consumer survey that combines these factors along with analyzing the price that a person would be willing to pay as well as the inclusion of a price premium for safer food products.

4.3 Survey Development

The data compiled from the focus group discussions gave a baseline of information about consumers purchases and their knowledge on food safety. Using this data, a consumer survey was developed to reach a larger population outside of the three focus group areas. The sample population for the survey was selected using stratified random sampling, in which key indicators such as city, gender, income level, age, and ethnic and race were considered. The four different surveys were developed to gather information on cheese, produce, seafood, and meat products. The survey utilized the contingent valuation method to solicit the consumers' willingness to pay for food safety. The surveys were broken down into four different sections, contingent valuation method questioning, general purchasing preferences and food safety knowledge, and demographics. The elicitation of data focuses on the use of the contingent valuation method to analyze the price that a person would be willing to pay based on the different scenarios in relation to a certain food product as mentioned above. Survey questions were varied and included Likert scales, and multiple-choice responses.

4.3.1 Survey Structure

Using Zainudin and Begum (2016) as a starting point in developing survey questions, they offer a suggestion on what a contingent valuation survey contains. They state that the following sections are typically included: a) an introductory section that sets up the survey and prepares the participant to make decisions; b) description that is detailed and offers a representation of the good(s) to be evaluated by participants; c) give the setting in which the good(s) will be provided; d) the way that the good(s) will be paid for; e) the survey elicitation method in which participants preference will be analyzed in respect to

the good(s); f) follow-up questions to understand the participants and the way that they answered questions the way they did; g) questions on participants characteristics including attitudes and demographics. In order to build on the main component of CV, the first section will gather information about the consumers preferences, these questions will serve as an indication as to what consumers are looking for in the market and these questions will differ based on produce, seafood, meat, and cheese purchases. The next section would be consumer knowledge on food safety based again on the type of product that the specific survey is focusing on. These questions would focus on statements regarding regulations, safety labelling, and government and industry intervention in food safety. These two sections will allow us to partially fulfill one of our main objectives to ultimately determine if their knowledge plays a role in them giving more importance to food safety information when they make purchases.

In the CV scenario, dichotomous choice is one approach that is used in CV and uses a particular set of questioning to infer a person's WTP based on a given initial price/payment question and then asking a follow up payment question. The structure of the questioning will first ask a baseline question to determine if they would pay a set price for a particular product. Then based on their response to the first question, a new set of prices will be given based on if the participant responded with "yes/no". For produce, a person will be given a price that will be determined based on the market value of the product to be used. This is the initial amount that a person would be willing to pay, this would then be followed up with a new set of prices that are based off the person answering yes or no to the question. If yes, is indicated then two more monetary values that increase by \$.50 will be given for the person to then select "yes or no" at the two

given price points. This structure would then continue to be used in questioning with the difference being in the scenario that impacts the product that has been selected. The other price points to be discovered would be based on organic products, a negative source of information being introduced, and a positive source of information being introduced. This data would then be used to analyze if there is a willingness to pay a premium price for safer food products.

4.3.2 Contingent Valuation Method

The contingent valuation method (CV) “seeks to measure individuals’ value for the environmental goods directly, by asking them to state their preferences for the environment” (FAO, 2000). The contingent valuation is a method of estimating the value that a person places on a good. This also means what utility that they derive from a particular good. This approach is widely used to elicit a person’s willingness to pay (WTP) to obtain a specified good that has been outlined. This is done in place of real-life observation of behaviors in the marketplace. CV is meant to mimic the behaviors in the regular marketplace by creating a hypothetical market in which no transfer of real money is made (McFadden, 1994). For this survey, the contingent valuation method was used to create a hypothetical market in which consumers were given different scenarios and asked to answer questions on four different products such as, catfish, packaged cheese, ground beef, and romaine lettuce and indicate their willingness to pay.

4.3.3 Survey Participant Selection

Once all four surveys were completed, they were entered into Qualtrics, a web-based survey tool used to conduct survey research and other data collection activities. The Qualtrics team worked with the distribution of the survey using stratified random sampling

with key indicators such as city, gender, income level, age, and race as a consideration. In addition to those indicators this survey was only open to Texas based residents since this is a consumer survey with the goal of understanding consumers perceptions in food safety in Texas. Qualtrics then sent the survey out to participants within their personal database that met the following requirements and allowed them four weeks to complete the survey and then after those four weeks it would be closed. Once the survey had closed Qualtrics provided us with the data of the completed surveys that would then be organized for qualitative data analysis. Of the surveys distributed for cheese products, 278 completed surveys were returned out of 282 surveys that were started resulting in a response rate of 98.6%. For meat products, 270 surveys were completed out of 359 that were started with a resulting response rate of 75.2%. For produce products, 279 surveys were completed out of 514 that were started resulting in a response rate of 54.3%. And finally for seafood products, 265 surveys were completed out of the 552 that were started with a response rate of 48%. Overall, each survey had over 200 participants that completed the surveys that were started by those participants that received an email to participate in the research survey.

4.4 Qualitative Data Analysis

The data was analyzed using descriptive statistics, each individual consumer survey was also be broken down into four individual sections, demographics, consumer purchases and preferences, consumer food safety knowledge and attitudes, and consumers' willingness to pay. Each survey will follow the same pattern and the descriptive statistics will provide a summary of the data collected during the survey process. The use of charts and tables will be used to describe what the data collected from the surveys is showing.

With over 250 respondents for each survey distributed, the descriptive statistics will help to simplify the large amounts of data into a manageable form that will tell a story of consumers preference and knowledge on food safety, as well as how their willingness to pay might differ based on changing food safety information.

4.5 One-Way ANOVA and Tukey Test

A one-way ANOVA was used to check the means of all four groups of products with 7 different price points for comparison to determine whether the mean differences between these four products are statistically significant. Since the results of the ANOVA test cannot tell us which groups are statistically different from each other a post hoc test was conducted after the ANOVA. After receiving the results of the ANOVA, a post hoc test was used. Tukey's test was used to compare all possible group pairings to compare the group means. Each product had a display of seven different comparisons in the study, with difference between group means, and the adjusted p-value for each comparison. The adjusted p-value identifies those comparisons within the group that are significantly different. When comparing the adjusted p-values to the difference between groups means it is statistically significant.

4.6 Simple Linear Regression

A simple linear regression was done to try and model the relationship between price and various variables such as food safety knowledge, gender, income, and others. The regressions proved to be statistically insignificant, so while this is a preliminary process a more sophisticated model is needed to determine how much consumers are willing to pay for food safety using a multinomial logistic regression.

5. RESULTS

The results from all three focus groups and four different commodity surveys are presented in the following chapter. The following results look at the participants food purchasing preferences as well as their knowledge of food safety standards and regulations that currently exist. Each section will present the data collected starting with the focus groups and moving into seafood products, cheese products, meat products, and produce products with a series of tables and figures that present the data that was collected for each commodity.

5.1 Focus Group Demographics

The focus groups took place in different cities within Texas, since Texas is demographically different in certain areas, the basic demographics of the participants was recorded as shown in Table 1, to have a record of the focus group areas and to be able to reference if needed during the analysis of the focus groups.

Table 1. Demographics of all three focus group participants (n=11)

| Characteristic | | San Marcos Participants n=11 | Houston Participants n=11 | Dallas Participants n=11 |
|----------------|---------------------------------|------------------------------------|---------------------------------|--------------------------------|
| Gender | Female | 72.7% | 63.6% | 63.6% |
| | Male | 27.3% | 36.4% | 36.4% |
| Race | Hispanic / Latino | 63.6% | 18.2% | 18.2% |
| | Caucasian | 27.3% | 36.4% | 27.3% |
| | African American | 9.1% | 36.4% | 45.5% |
| | Asian | | 9.1% | 9.1% |
| Education | High School / Trade Certificate | 45.5% | 9.1% | 36.4% |
| | Associate Degree | 9.1% | 27.3% | 27.3% |
| | Bachelor's Degree | 45.5% | 36.4% | 27.3% |
| | Master's Degree | 0.0% | 27.3% | 9.1% |

5.2 Focus Groups Results

During the three focus groups there were a series of question asked to the respondents that are listed in **Appendix A**, there were four different question cluster groups. Those questions cluster groups included, shopping habits and preferences, consumer knowledge on food safety, terms in food safety, and picture analysis. Participant's responses were analyzed with the help of undergraduate research students and the themes between those three focus groups are discussed in brief in the results. The team of undergraduate research students compiled notes and listed to audio recordings from all three focus group

locations to provide a complete and comprehensive picture of the views and opinions of participants. Additional summaries of each individual focus group can be found in

Appendix C.

The following results are broken down into the four questions clusters of shopping habits and preferences, consumer knowledge on food safety, terms in food safety, and picture analysis. Within these four groups, major themes were identified, and a brief summary of all focus group respondents is included.

Question Cluster #1: Shopping habits and preferences

Seafood, Produce, Cheese and Meat Preferences – The main take away from the focus group is that price is an important factor when consumers are selecting their food items.

Other important qualities include appearance, color, cleanliness, and freshness.

Especially when buying proteins such as meat and seafood products, the color and freshness were important qualities. This also led to the conclusion that different types of markets might be sought out to obtain the freshest items. For example, those that live closer to coastal areas would prefer a local seafood option and also consumers might seek out farmers markets to ensure they have the freshest produce available. When it came to cheese products consumers were more specific and agreed that a specific brand came to mind when thinking of cheese products and that more expensive cheese was associated as being better. Consumption of these products happens weekly with the exception of seafood products that consumers consume seasonally around what is available in the market.

Product Labeling – There was a debate among the participants in the focus groups on the benefit and purchase of organic food. The one common point was that organic food was expensive food. There were those that felt that organic had no purpose and that there was not a point to it, while the other half felt that it was a safer, healthier, and cleaner choice with no pesticides. In addition to organic labeling, they were asked about any other labels that they have seen before, they listed all natural, gluten free, and GMO. An important note is that although they have seen GMO labeling before, they are able to identify it as genetically modified, but don't really know what it means. The majority responded that it means "created in a lab and not natural" and associated it to corn being a GMO.

Question Cluster #2: Consumer knowledge on food safety

Food Safety Consideration – Participants believed that food safety was important in protecting people from illness or death. Food safety issues were seen as the need to avoid cross contamination, being backed by the FDA, and following proper procedures when preparing food for consumption. They believed that everyone could be at risk for a foodborne illness equally and race, gender or other demographic qualities had no impact on that. They also acknowledged that they believed that certain market types or specific stores were better or worse in terms of controlling food safety issues, but many were unsure of any mandatory guideline or general rules pertaining to food safety.

Food Recalls – Media played a role as the participants main source of information on food safety recalls with some confirming on government websites. Although they are receiving the information many feel that there is not enough information being presented to them unless it is a large-scale recall and that information comes what they feel like is

“too little too late”, that someone has to get sick or die before they ever hear about it in the news.

Major Food Recalls in the News – Many of the participants believe that these major food recalls are increasing due to producers cutting corners and higher demands leading to fewer resources for producers, as well as putting less care for faster output. Participants were presented with two recalls, romaine lettuce and tomatoes. When it came to romaine lettuce, they stopped purchasing it and switched to a different kind of leafy green such as kale or spinach. As far as the tomato purchases, they would stop purchasing tomatoes until the recall ended or would find tomatoes coming from a different area or company. Following those incidences, they indicated that they would not purchase these products until 2-3 months after the incident. It is important to note that for these participants, origin of the product was only considered if there was a food recall, if not they did not pay any attention to the origin of the product.

Recall Reduction and Consumer Information- Participants believed that if guidelines and rules are being followed then it should reduce the number of recalls that occur, but they believe that these incidences could also be reduced by buying more food locally or shopping at farmers markets, as well as implementing more checks at every level of the supply chain and making major companies pay for quality control. They also gave suggestions on how consumers could be better informed, such as unanimous, non-conflicting information or a type of system like “Amber Alert” that would notify everyone in a timely manner with appropriate information.

Question Cluster #3: Terms in Food Safety

Food Safety – As for food safety, all three groups knew what it meant and mentioned that it means to keep food in a safe place, at a certain temperature, and preventing cross contamination.

Food Security – Many of the participants in the focus group were confused on this term and how it differentiates from food safety.

Foodborne illness – Participants reported they know what a foodborne illness is, but they had varying definitions of what it meant. They indicated that it is an illness that can be caused by improper storage and preparation of foods, E.coli, salmonella, and Blue Bell Listeria came up as a major illness that has occurred.

HACCP – None of the participants in the three focus groups had heard about this term.

FSMA – Majority of the participants in the three focus groups had not heard about this term, there were a select few in a couple of the focus groups that indicated that they had heard it mentioned before.

Blockchain – Many of the participants had not heard of this term as it relates to food safety.

GAP – There was some confusion with the term and confusing it with an accounting term, but overall participants had not heard about this term.

Question Cluster #4: Picture analysis

The following pictures shown in Table 2 and Table 3 were shown to participants in the focus groups during this section of questioning. The participants were asked various questions such as “Can you identify this label?” or “When you look at these pictures, what do you see or notice?”.

Table 2. Pictures of labels shown to focus group participants

| Pictures of Labels | |
|--|---|
|  |  <small>www.shutterstock.com · 635783000</small> |
|  |  |
|  | |

Table 3. Pictures of food item pictures shown to focus group participants



It appears that each focus group had different opinions and ideas of what certain labels mean or they may not know what the labels mean. Around packaging and displaying, it appears that each focus group is very particular about what they do and do not like and that these factors will influence if the participants of the groups will buy the product. It appears that members from across all groups had strong opinions about how they perceive a label or a picture. It was interesting to note that much of what was discussed was how the meats were presented and looked and only one person ever mentioned nutritional value and other

qualities like the salmon picture with person wearing glove. It appears that the majority of the participants in the three groups will buy fish or meat if it looks good, is packaged well or displayed nicely without any doubts about cross-contamination. As for labels, very few if any were familiar with some of the labels, so we might conclude that the labels might go ignored if they do not know what it means or may continue to hold on to false beliefs about what the labels mean. Overall, it may appear that more education needs to be done over labels or have an explanation on the labels themselves of what they are. More education may be needed on what to look for when examining a product and what questions to ask yourself or look for when it comes to food safety and then reflect on tough decisions like safety over price for example.

5.3 Consumer Survey Results: Seafood Products

After the focus groups were held in the three major cities, four separate consumer surveys were developed and then distributed online. The data that was collected during those four surveys was analyzed and the results are shown below. The survey presented consumers with four different sections, socio-demographics, purchasing preferences, food safety knowledge, and willingness to pay using CV. The surveys are listed in order starting with seafood and following with cheese, meat, and produce products.

5.3.1 Consumer Survey Socio-Demographics

Socio-Demographics of Seafood Participant Sample (n=265)

Descriptive statistics were used to examine the following socio-demographic characteristics: gender, age, education, race, and income can be seen in Table 4. The sample was almost equal between males and females, but females were still more prevalent at 50.2% and males at 48.7%. The two age groups, 35-50 and 50 and above were both equal at 35.1%, and for ages 18-35, 29.8%. Those with a bachelor's degree accounted for 30.6% of the respondents, had a high school degree or less (24.9%). Those with doctoral degrees were the smallest percent at 6%. The two most reported races for this survey group were Hispanic/Latino and White, with 45.3% and 42.3%, respectively. The income reported by respondents was similar across all three groups, with \$50,000-\$100,000 (35.1%), \$50,000 or less (34%), and \$100,000 and above (30.9%).

Table 4. Socio-Demographic profile of sample: Seafood consumers (n=265)

| Characteristic | Number of Respondents | Percent of Respondents |
|--------------------------------------|-----------------------|------------------------|
| Gender | | |
| Female | 133 | 50.2% |
| Male | 129 | 48.7% |
| Other | 1 | 0.4% |
| Prefer not to disclose | 2 | 0.8% |
| Age | | |
| 18-35 | 79 | 29.8% |
| 35-50 | 93 | 35.1% |
| 50 and above | 93 | 35.1% |
| Education | | |
| High school graduate | 66 | 24.9% |
| Associate Degree / Trade Certificate | 42 | 15.8% |
| Bachelor's Degree | 81 | 30.6% |
| Master's Degree | 60 | 22.6% |
| Doctoral Degree | 16 | 6.0% |
| Race | | |
| White | 112 | 42.3% |
| African American | 17 | 6.4% |
| American Indian or Alaska Native | 7 | 2.7% |
| Asian | 3 | 1.1% |
| Native Hawaiian or Pacific Islander | 3 | 1.1% |
| Hispanic / Latino | 120 | 45.3% |
| Other | 3 | 1.1% |
| Income | | |
| \$50,000 or less | 90 | 34.0% |
| \$50,000 - \$100,000 | 93 | 35.1% |
| \$100,000 and above | 82 | 30.9% |

Secondary Socio-Demographic Questions

In addition to the primary demographic questions, other factors such as primary shopper in the household, born in the state of Texas, food handling training, foodborne illness sufferer, and purchasing frequency were asked and are listed in Table 5 to determine the overall scope of the respondents and potentially how this could impact the data results.

For this survey group, the majority of respondents were the primary shopper in their household and purchase grocery products at least once a week. They were also mainly born and raised in Texas, and don't belong to environmental groups. They have not suffered from a foodborne illness and there is a split between those that have food handling training and those that do not.

Table 5. Additional socio-demographic information from seafood consumer survey

| Characteristic | Number of Respondents | Percent of Respondents |
|---|-----------------------|------------------------|
| Primary Shopper | | |
| Yes | 249 | 94.0% |
| No | 16 | 6.0% |
| Originally from Texas | | |
| Yes | 207 | 78.1% |
| No | 58 | 21.9% |
| Formal/Informal Food Handling Training | | |
| Yes | 131 | 49.4% |
| No | 134 | 50.6% |
| Environmental Organization | | |
| Yes | 88 | 33.2% |
| No | 177 | 66.8% |
| Suffered from Foodborne Illness | | |
| Yes | 105 | 39.6% |
| No | 160 | 60.4% |
| Seafood Purchasing Frequency | | |
| Once a week | 111 | 41.9% |
| Every two weeks | 82 | 30.9% |
| Once a month | 72 | 27.2% |

5.3.2 Consumer Purchasing Preferences

Seafood Product Type and Qualities

The survey presented different types of seafood products that might be purchased by the consumer in the market. The product types are listed and percentages of the respondents that consume or do not consume the products that are listed in Table 6. The top five most consumed products in order from greatest to least consumption was, Shrimp (80.4%),

Salmon (75.8%), Tuna (71.7%), Tilapia (66.4%), with Catfish (58.9%) and Crab (58.9%) being tied for fifth place. While the top three least consumed products are Red Snapper (58.5%), Clams, Mussels, and Oysters (57.7%), and Crawfish (55.5%). Respondents were then asked to select the qualities that they look for when purchasing these seafood items and were able to select multiple qualities which can be seen in Table 7. For all twelve seafood products listed the most important quality for each respondent was their income. Their income was an important quality in whether or not they would purchase the particular item.

Table 6. Consumer seafood purchases

| Product Type | Yes | No |
|------------------------------|-------|-------|
| Salmon | 75.8% | 24.2% |
| Catfish | 58.9% | 41.1% |
| Shrimp | 80.4% | 19.6% |
| Tilapia | 66.4% | 33.6% |
| Cod | 33.6% | 50.2% |
| Scallops | 44.9% | 55.1% |
| Crab | 58.9% | 41.1% |
| Lobster | 52.1% | 47.9% |
| Tuna | 71.7% | 28.3% |
| Red Snapper | 41.5% | 58.5% |
| Clams/Mussels/Oysters | 42.3% | 57.7% |
| Crawfish | 44.5% | 55.5% |

Table 7. Consumer preferred seafood purchasing qualities

| | Appearance | Availability of Recipes | Country of Origin | Income | Nutritional Content | Product Style | Seasonality | Farmed or Wild caught |
|---|------------|----------------------------|-------------------------|--------|------------------------|------------------|-------------|-----------------------------|
| Salmon | 15.3% | 8.4% | 11.2% | 18.3% | 16.2% | 8.9% | 9.9% | 11.8% |
| Catfish | 14.4% | 8.7% | 13.1% | 17.6% | 16.6% | 8.5% | 10.8% | 10.3% |
| Shrimp | 16.8% | 8.8% | 13.2% | 18.6% | 13.8% | 9.8% | 9.9% | 9.1% |
| Tilapia | 14.5% | 9.1% | 14.3% | 19.3% | 13.8% | 9.9% | 10.5% | 8.5% |
| Cod | 15.2% | 9.2% | 13.2% | 20.0% | 14.3% | 9.2% | 10.7% | 8.3% |
| Scallops | 15.6% | 9.3% | 13.3% | 17.8% | 15.0% | 9.6% | 10.6% | 8.8% |
| Crab | 14.9% | 7.7% | 13.7% | 20.3% | 14.6% | 9.4% | 9.4% | 9.9% |
| Lobster | 14.6% | 8.6% | 12.7% | 19.9% | 15.8% | 8.1% | 10.9% | 9.5% |
| Tuna | 13.7% | 8.3% | 14.3% | 19.2% | 14.7% | 10.9% | 10.0% | 8.9% |
| Red Snapper | 15.4% | 8.9% | 12.6% | 21.0% | 14.1% | 8.9% | 10.5% | 8.5% |
| Clams, Mussels, and Oyster | 14.8% | 8.7% | 14.2% | 20.2% | 13.8% | 8.9% | 9.8% | 9.6% |
| Crawfish | 14.2% | 8.3% | 14.0% | 20.3% | 14.2% | 9.5% | 11.7% | 7.8% |

Seafood Purchasing Preferences

The respondents of the survey were asked two separate questions on their purchasing preferences as it relates to seafood products. The goal of the two questions was to understand if fresh and frozen and seafood items from the Gulf of Mexico played a role in their purchasing decisions. For the preference of fresh or frozen listed in Table 8, many of the respondents indicated that they prefer seafood that is fresh (74.3%) so this give us evidence to suggest that there is a major preference in fresh over frozen seafood. Also, the respondents indicated that they prefer seafood that was caught in the Gulf of Mexico (78.1%) as seen in Figure 2 and that it would play a role in their purchasing, this also might be more relevant considering that this was a Texas based study and the possibility that a certain percent of the respondents are from coastal areas where fresh caught seafood from the Gulf of Mexico is readily available to them.

Table 8. Consumer seafood preferences

| Preference | Percent of Respondents |
|------------|------------------------|
| Fresh | 74.3% |
| Frozen | 25.7% |

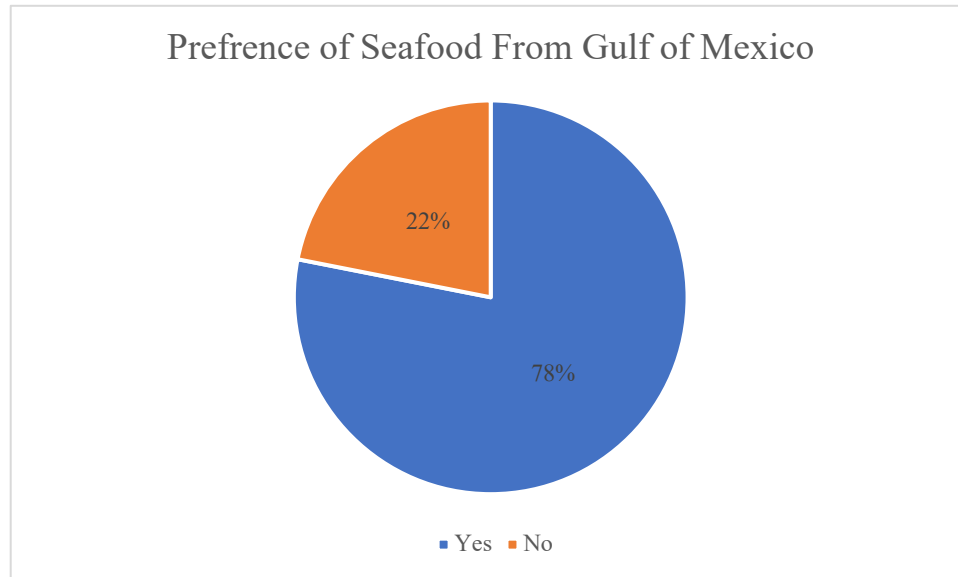


Figure 2. Consumer preference of seafood caught in the Gulf of Mexico

Preferred Market Type

Respondents were asked to select the market types that they typically visit when purchasing food items listed in Table 9. The majority of the respondents shop at supermarkets (49.9%) which for this survey included stores such as HEB, Wal-Mart, Krogers, etc. The other markets that respondents frequented were wholesale markets (23.6%), such as Sams, Costco, etc., farmers markets (13.8%), and specialty markets (12.8%), such as Sprouts, Whole Foods, etc.

Table 9. Consumer preferred market type

| Market Type | Percent of Respondents |
|------------------|------------------------|
| Supermarket | 49.9% |
| Wholesale Market | 23.6% |
| Farmers Market | 13.8% |
| Specialty Market | 12.8% |

Preferred Product Labeling

Respondents were given six different labels that might be found on seafood products in the marketplace shown in Figure 3. Then they were asked to give their level of importance in looking for that label in their seafood purchasing decisions. Some important information to highlight is that three of these labels “non-gmo” (44.2%), “Sustainable” (43%), and “Antibiotic Free” (41.1%), were listed as “extremely important” in their purchasing of seafood products. Overall, when looking at the figure, many respondents found all six labels to be of importance in their seafood purchasing decisions, since there were small percentages of respondents that indicated that these labels were “slightly important” or “not at all important”.

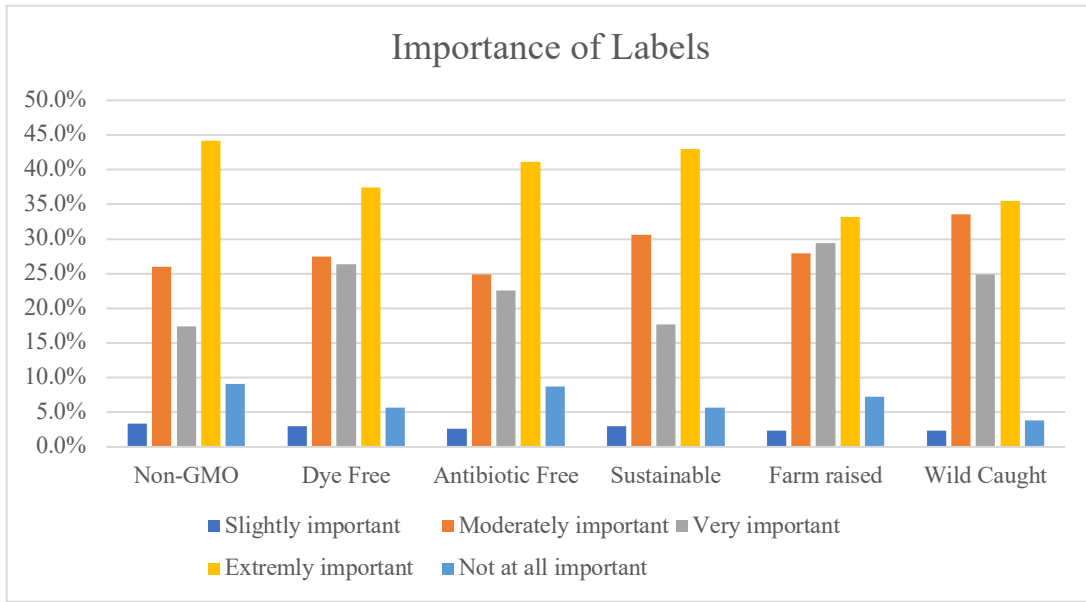


Figure 3. Importance of labels in consumer seafood purchases

5.3.3 Consumer Knowledge on Food Safety

Seafood Food Safety Concerns

The survey respondents were given two different questions on food safety concerns when purchasing produce products. The first was to determine if there were any concerns when purchasing produce, which 49.9% of respondents did have as seen in Figure 4. If the respondents indicated that they did have concerns they were asked what type of concern they had. More than half of those respondents as shown in Table 10 indicated that foodborne pathogens (50.8%) were their main type of concern.

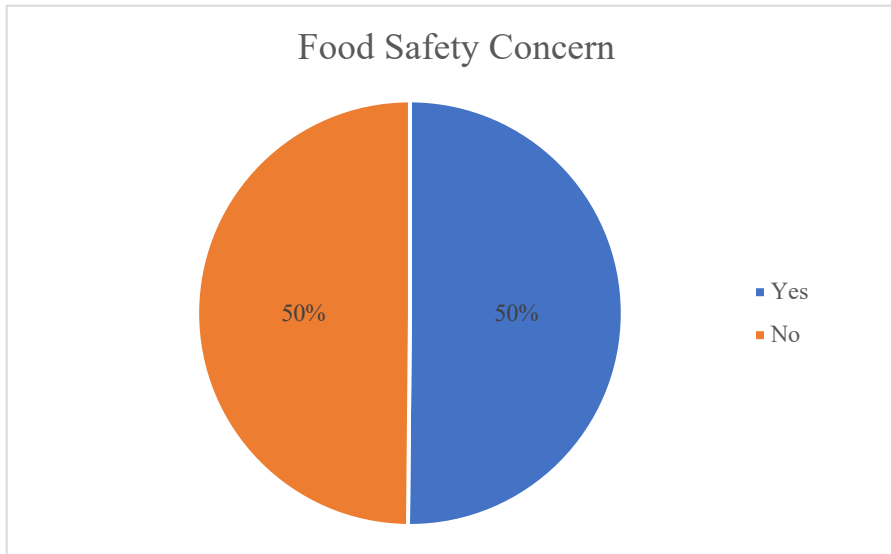


Figure 4. Consumer food safety concerns

Table 10. Consumer type of seafood safety concern

| Type of Concern | Percent of Respondents |
|-----------------------|------------------------|
| Foodborne Pathogens | 50.8% |
| Contaminated Products | 44.6% |
| Other | 4.6% |

Food Safety Standards

The respondents were presented with a Likert scale that gave them a set of four statements that they could agree or disagree on when it comes to food safety standards.

The statements were as follows:

Farm Standards – Do you believe that small farms and large farms should be held to the same standards?

Protection of Consumers – Do you believe that enough is being done to protect consumers from foodborne illnesses?

Store Standards – Do you believe that farmers markets and supermarkets are held to the same standards in selling cheese products?

Recall Confidence – Do you have more confidence in stores that engage in voluntary recalls of cheese products when a safety issue is encountered?

When looking at Figure 5, there are clear divisions in those respondents that either agreed or disagreed with the following statements that were presented to them. This means that as far as farm standards, there were those that agreed that small farms and large farms should be held to the same standards but there were more that disagreed and are saying that these farms shouldn't be held to the same standards.

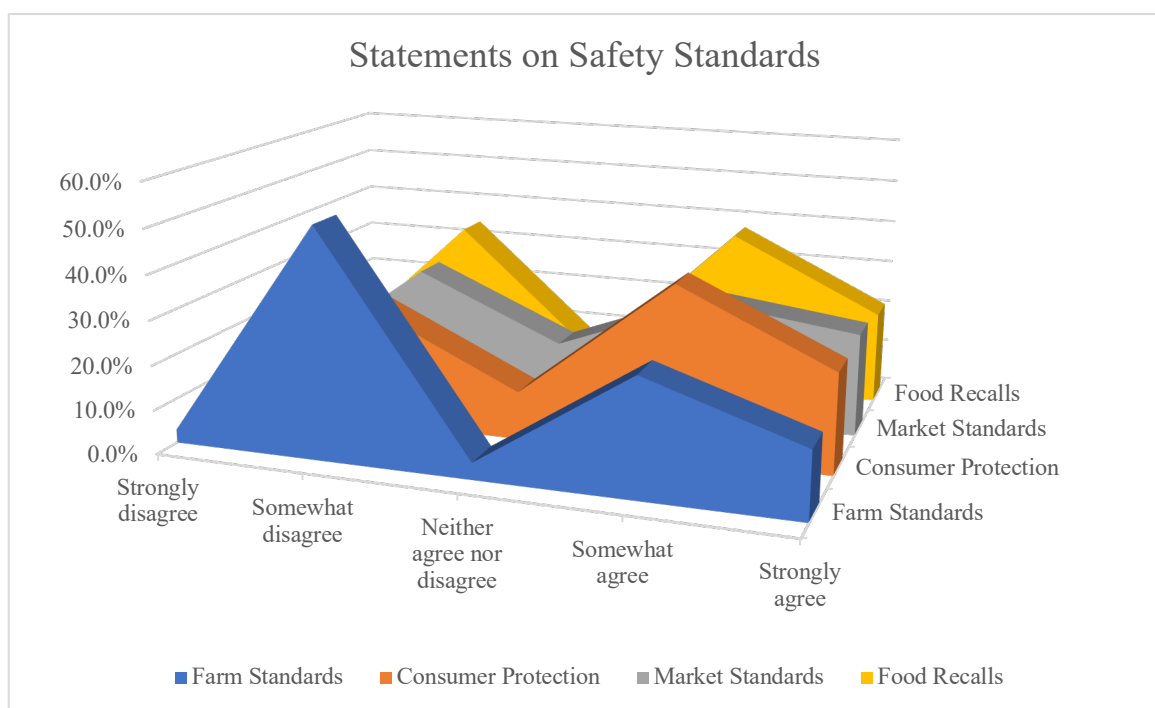


Figure 5. Consumer feelings on food safety standards

Food Safety Regulations

The respondents were also presented with another Likert scale with a set of nine statement on food safety regulations and for them to agree or disagree with the statements

based on their own beliefs around food safety. The statements that were asked to respondents can be seen in Figure 6.

When looking at Figure 6, it is easy to see where respondents fall on these food safety regulation statements, for example, on statements that asked about food safety issues at home and many of the respondents agreed that there are food safety hazards occurring within the home. There was also disagreement as it pertained to FDA accurately catching threats to the food system, and that there should be regulation of small farms and farmers markets.

Perceptions on Current Food Safety Standards

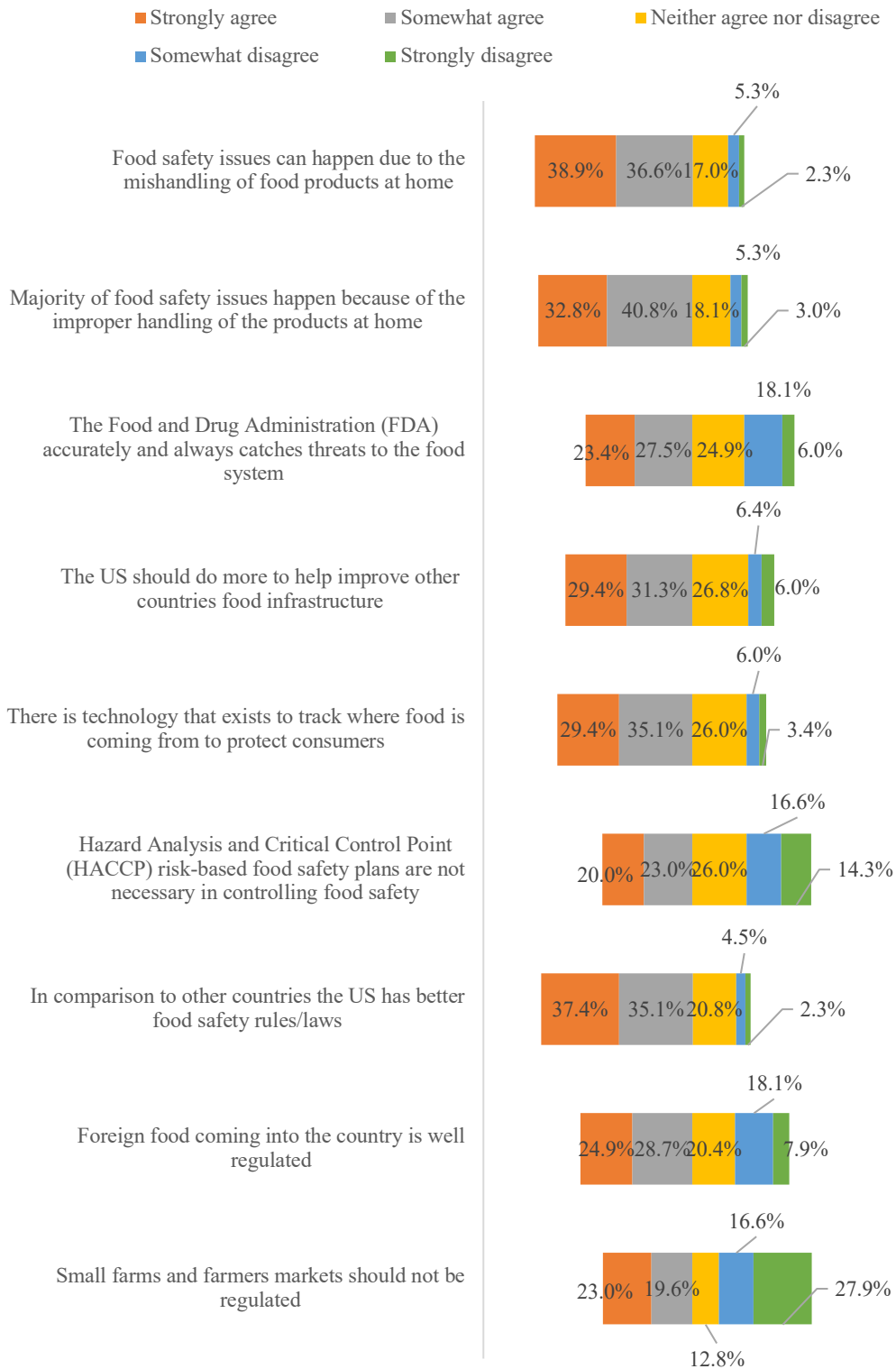


Figure 6. Consumer perception on current food safety standards

Food Safety Responsibility Issues

Respondents were asked to select who they believed should be responsible for food safety issues when they occur. Majority of the respondents shown in Figure 7 believed that Farmers / Producers (44%) should be responsible for food safety issues. While the three other groups, Consumers (18%), Government (19%), and Large Corporations/Industry (19%) were all close to being tied. This might mean that although it mainly falls on the Farmers/Producer that looking into the three other groups more in depth could give some insight to why the respondents answered the way they did.

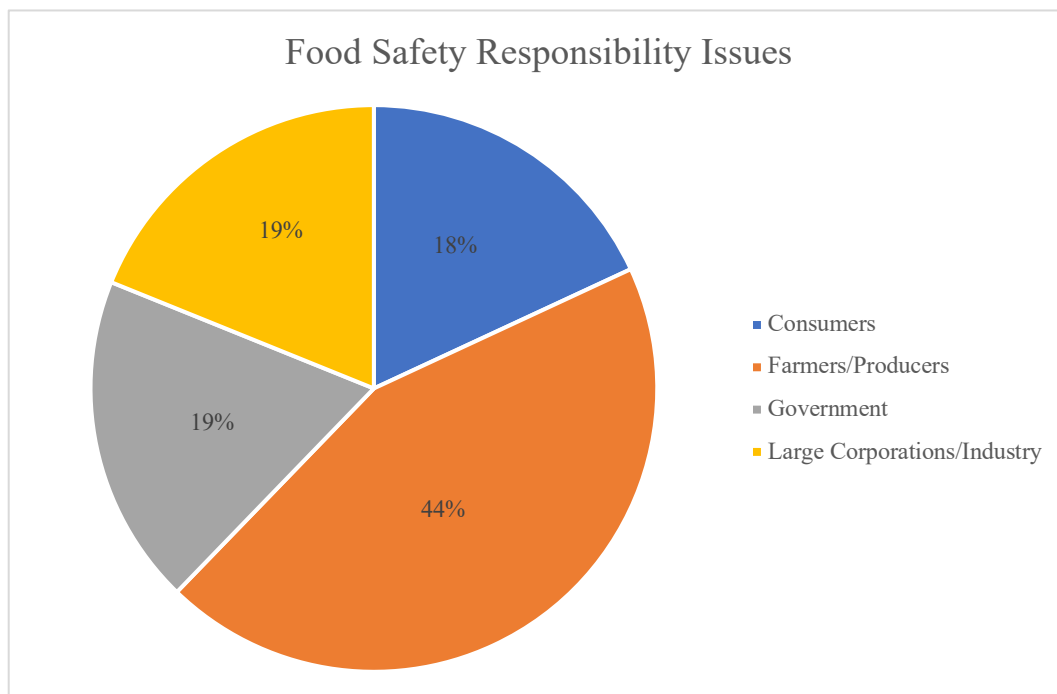





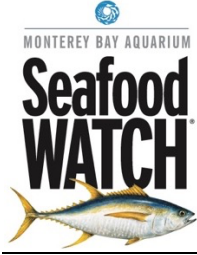


Figure 7. Consumer perceptions on responsibility in food safety issues

Recognition of Labels

The respondents were asked to look at different labels and select the labels that they have seen before. The most recognized label shown in Table 11 was the be food safe logo with 25.0% and the least recognized was FSMA with 5.5%.

Table 11. Consumer recognition of labels in the market

| Picture Shown | Percent of Respondents |
|---|------------------------|
|  | 25.0% |
|  | 10.9% |
|  | 5.5% |
|  | 23.4% |
|  | 20.3% |
|  | 14.8% |

Supply Chain and Regulatory Entity Knowledge

Respondents were given a Likert scale with four statement on the parts of the supply chain, handling through the supply chain, and the role of the FDA and FSIS in food safety. This question was an inquiry of the current knowledge that respondents already have when making their purchasing decisions. The four questions are as follows:

Parts of Supply Chain – Do you know the different parts of the food supply chain?

Supply Chain Safety – Do you feel that cheese is handled safely throughout the food supply chain?

FDA Role – Do you know what role the Food and Drug Administration (FDA) plays in food safety?

FSIS Role – Do you know what role the Food Safety and Inspection Service (FSIS) plays in food safety?

Shown in Figure 8, there is a large percentage of respondents who have somewhat of an idea of the role of FDA and FSIS and their roles as it pertains to food safety and the way that seafood products are handled throughout the supply chain.

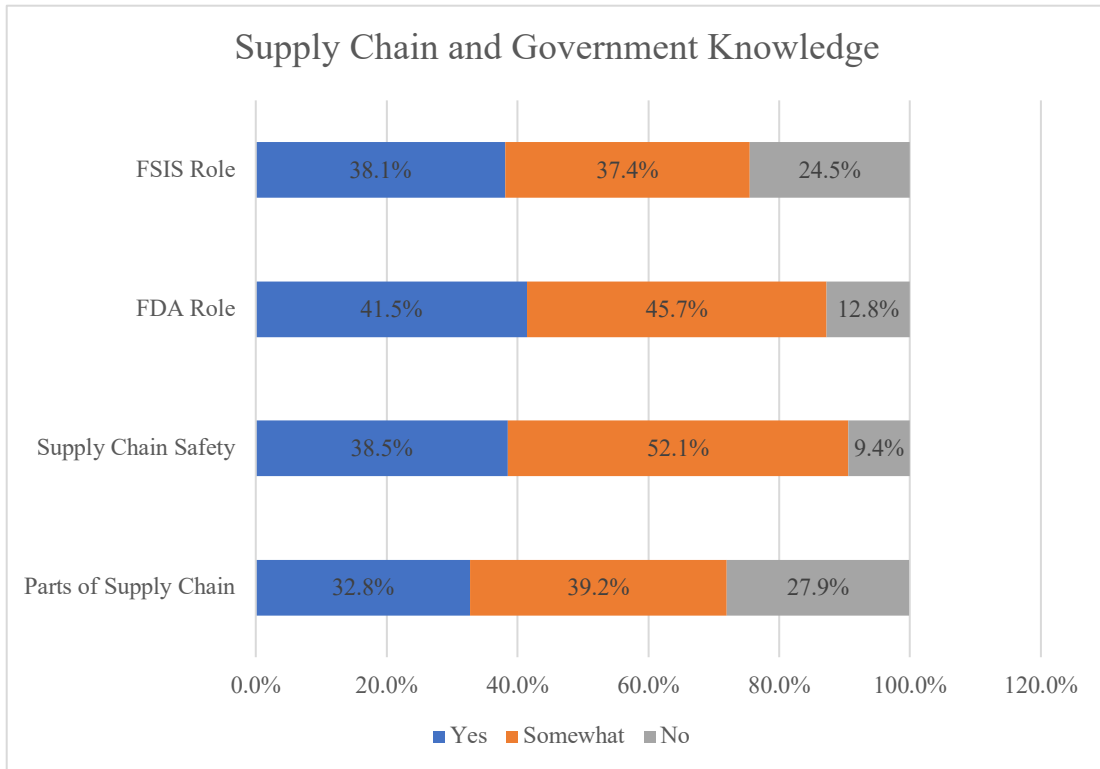


Figure 8. Consumer knowledge on supply chain and government role in food safety

Food Recalls

Two separate questions were asked of respondents on food recalls in the event of a food safety issue. The first to understand if consumers are getting the necessary information that they need to make informed purchasing decisions, and second where that flow of information comes from. Over half of the respondents (61.5%), show in Figure 9 indicated that they are receiving recall information as it comes out but there are still 38.5% of the respondents who are not. Of the respondents who are receiving recall information in Table 12, most of the information is coming from media outlets (34.8%).

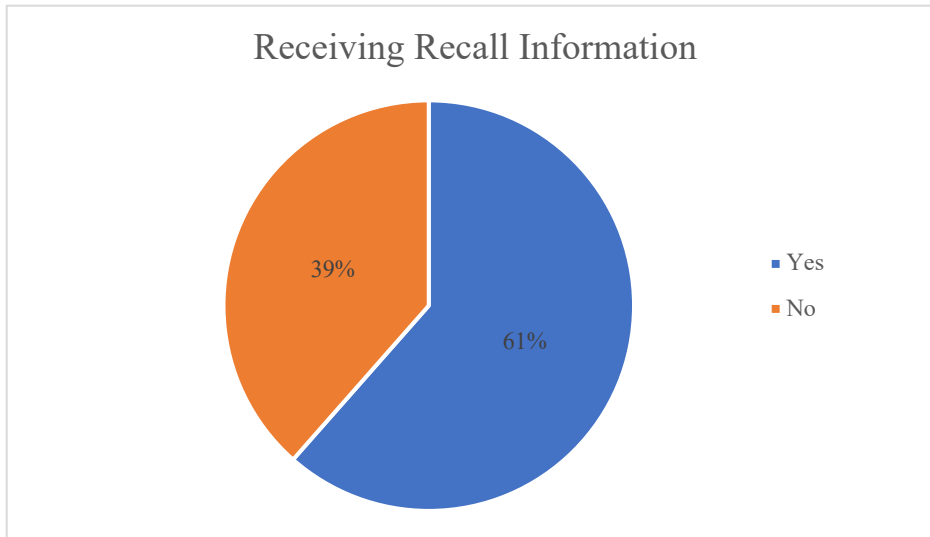


Figure 9. Consumer acknowledgement of receiving recall information

Table 12. Survey participants source of recall information

| Source of Information | Percent of Respondents |
|-----------------------|------------------------|
| Media | 34.8% |
| Government Website | 26.4% |
| Grocery Store Posting | 22.0% |
| Word of Mouth | 7.0% |
| Social Media | 7.3% |
| Celebrities | 2.2% |
| Unsure/Don't Know | 0.4% |

Government and Industry Intervention

Respondents were given a Likert scale in which they were given four statements and asked to indicate their knowledge on current food safety regulation in the United States.

The statements were as follows:

HACCP Knowledge – How knowledgeable about HACCP are you?

Blockchain Knowledge – How knowledgeable about blockchain technology are you?

Government Intervention – How knowledgeable are you on government intervention on food safety?

Industry Intervention – How knowledgeable are you on industry intervention on food safety?

While there were many respondents that were not knowledgeable as seen in Figure 10 about all four of the interventions, there were those that were very knowledgeable on blockchain, and government and industry interventions. Also, most were extremely knowledgeable which was to be expected since HACCP has been around for some time.

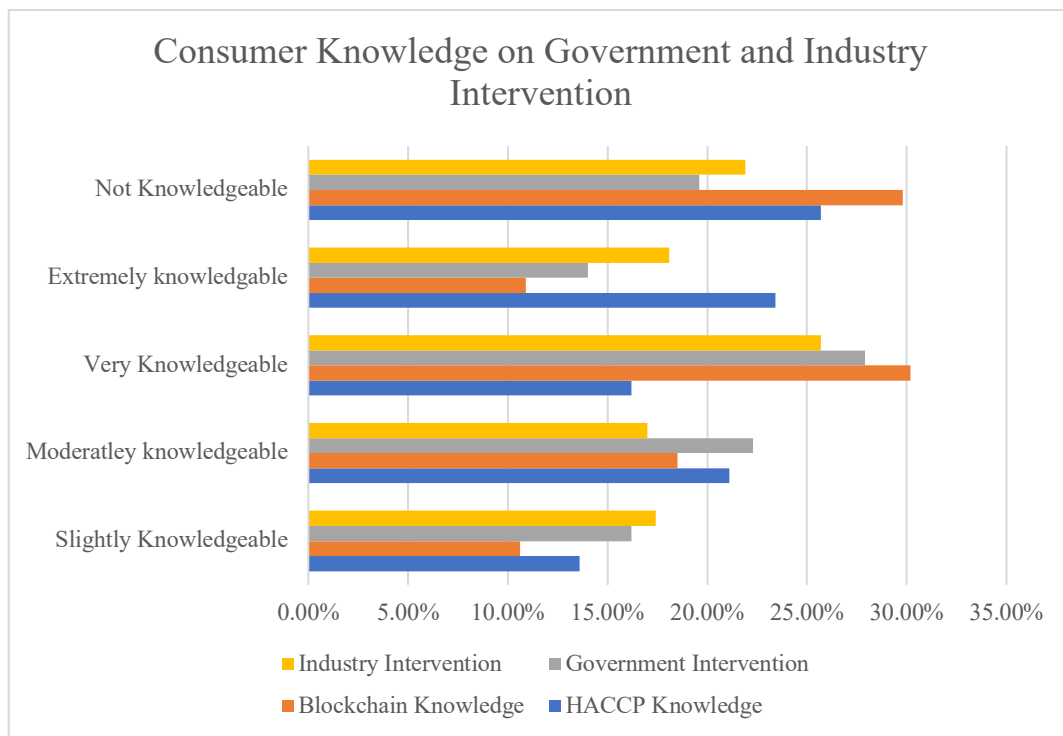


Figure 10. Consumer knowledge on government and industry intervention in food safety

5.3.4 Consumer Willingness to Pay

In this section of the survey, respondents were given a series of scenarios for purchasing fresh farm raised catfish. These questions range from baseline information, a series of negative treatments, as well as positive treatments. The first goal was to obtain a baseline of price that the respondents would spend on the fresh farm raised catfish presented before imposing a treatment. The overall objective and mindset of this section is as follows:

Objective: “The following questions will have different scenarios about a specific seafood product that you might be purchasing in the marketplace. Please answer these questions as if you were the shopper based on the decisions that you would make while shopping.”

There were two questions for baseline price, the first was the respondent’s willingness to pay for fresh farm raised catfish and the second was the respondent’s willingness to pay for frozen farm raised catfish. Figure 11 shows both of the products and how much respondents were willing to pay for these catfish products. The willingness to pay for fresh farm raised catfish was \$6.00, and the willingness to pay for frozen farm raised catfish was \$5.50.

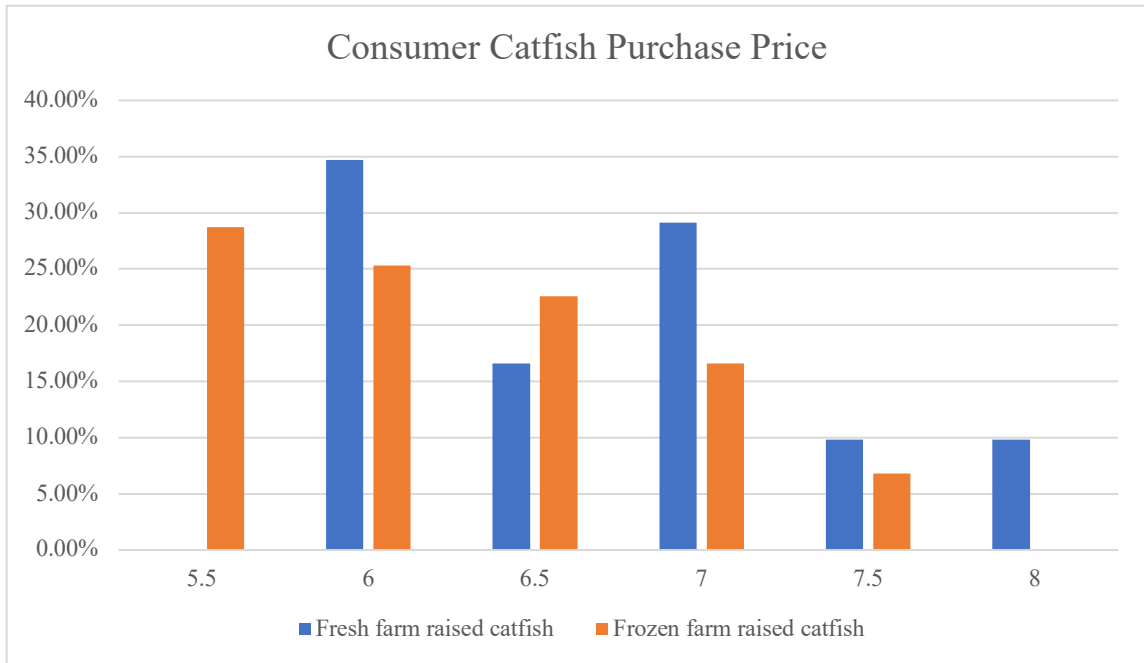


Figure 11. Consumer purchase price for catfish products

After gathering the baseline data, the first negative treatment scenario was imposed:

Scenario: “Assume a news media outlet this is reporting on ABC Seafood company that is recalling more than 30 tons of catfish because the products were produced, packed, and distributed without federal inspection. The recall involves 60-pound cardboard boxes containing “Fresh Farm Raised Catfish USA” from ABC Seafood company. There have been no adverse reactions to consuming these products that has been confirmed. Answer the following questions based on this assumption.”

The respondents were asked to give their willingness to pay for the fresh farm raised catfish after the recall has occurred and been covered in the media in Figure 12. The highest willingness to pay was \$6.00 after the recall has been covered in the media. There is no change in their baseline WTP. The second highest WTP was \$7.00, which would be a \$1.00 increase from the original baseline. As a follow up to the negative scenario, a

follow up question was presented to the respondents shown in Figure 12. They were asked if they would purchase catfish from ABC Seafood company. 66% agreed that yes, they would be purchasing from ABC Seafood Company.

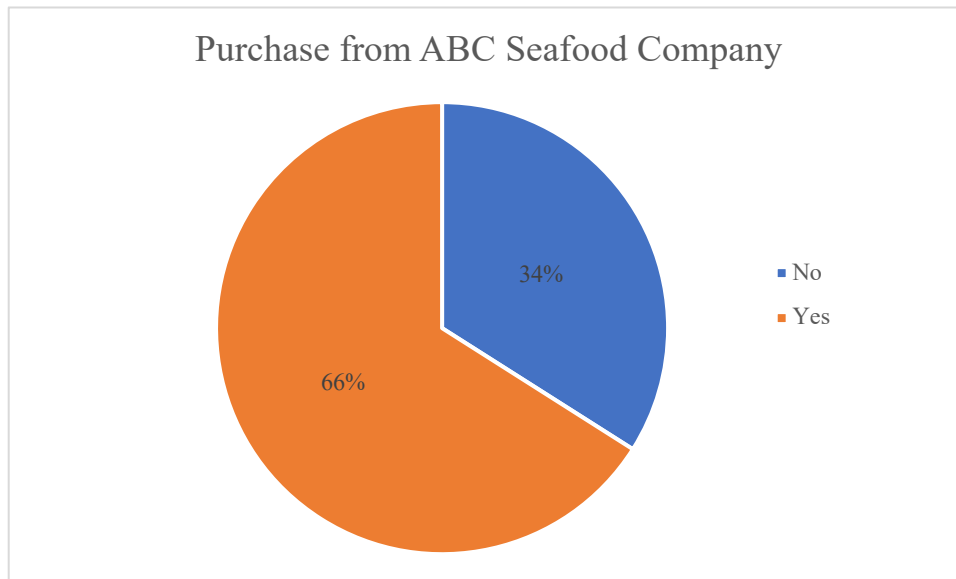


Figure 12. Consumer willingness to purchase from catfish recall company

The second negative treatment scenario was then imposed:

Scenario: “Assume USDA FSIS has announced the recall of fresh farm raised catfish items from ABC Seafood Company because the products were produced, packed, and distributed without the benefit of inspection. The recall involves 60-lb brown cardboard boxes containing “Fresh Farm Raised Catfish USA”. Answer the following questions based on this assumption.”

After the USDA FSIS identifies the products there is still no change in the respondents WTP of \$6.00, but when looking at Figure 14, there was an increase in the number of respondents that would only pay \$6.00.

The respondents are finally given the positive scenario:

Scenario: “Assume it has been three months since the recall was issued by USDA FSIS.

Answer the following questions based on this assumption.”

Respondents indicated that after three months their WTP is still at \$6.00, which was their initial baseline price. Three months after their response rate falls back to the levels of when the first recall came out in the media. Respondents were again presented with a follow up question shown in Figure 13, about their purchases three months after the recall. While 60.8% of the respondents said that they would purchase fresh farm raised catfish after those three months, there were still 39.2% of the respondents who said that they would not.

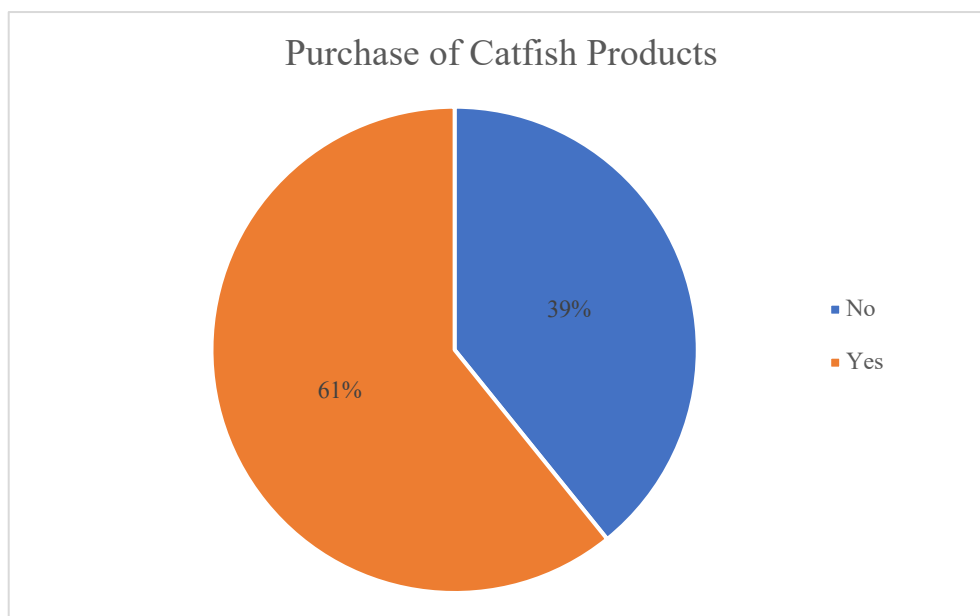


Figure 13. Consumers' willingness to purchase catfish products after a recall

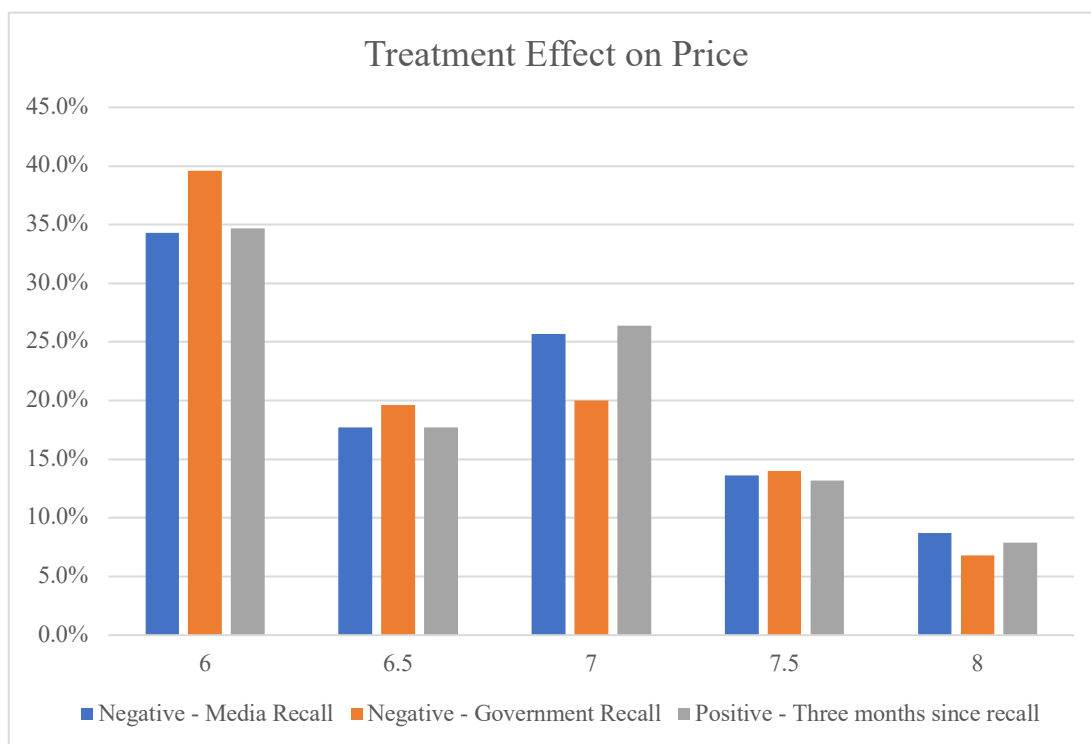


Figure 14. Catfish treatment effects on consumers' willingness to pay

The final two scenarios that the respondents were given, were positive treatments of current HACCP management practices that already exist to reduce the amount of food safety issues as well as blockchain technology that improves communication along the supply chain with data backed information. The two scenarios are examples of government intervention in food safety and industry intervention and seeing if one has a higher WTP than the other. The two scenarios are as follows:

Scenario: "Hazard Analysis and Critical Control Points, is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product. Answer the following questions keeping this statement in mind."

Scenario: “Blockchain technology is an industry development that works across the supply chain, including growers, processors, shippers, retailers, regulators, and consumers. This allows for the immediate access to food supply chain data from farm to store and consumer. With capabilities for safer food, longer shelf lives, reduced waste, faster traceability, and better access to shared information. Answer the following questions keeping this statement in mind.”

The majority of the respondents as shown in Figure 15 gave a WTP of \$6.50 for both HACCP (37%) and blockchain (30.6%), but when looking at Figure 15, the next WTP by respondents was \$7.00 for both HACCP (23%) and blockchain (27.2%). There might be evidence to suggest that there are a select number of respondents who would be willing to pay a \$0.50 increase for HACCP and blockchain that would help to reduce food safety incidences.

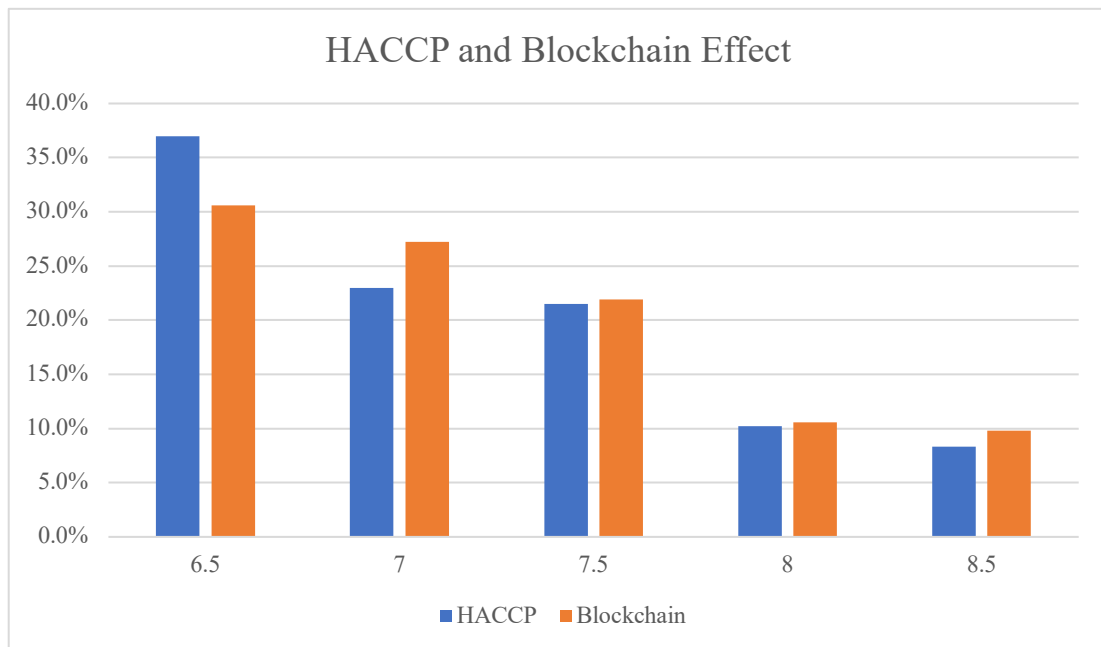


Figure 15. Consumers' willingness to pay for HACCP and Blockchain

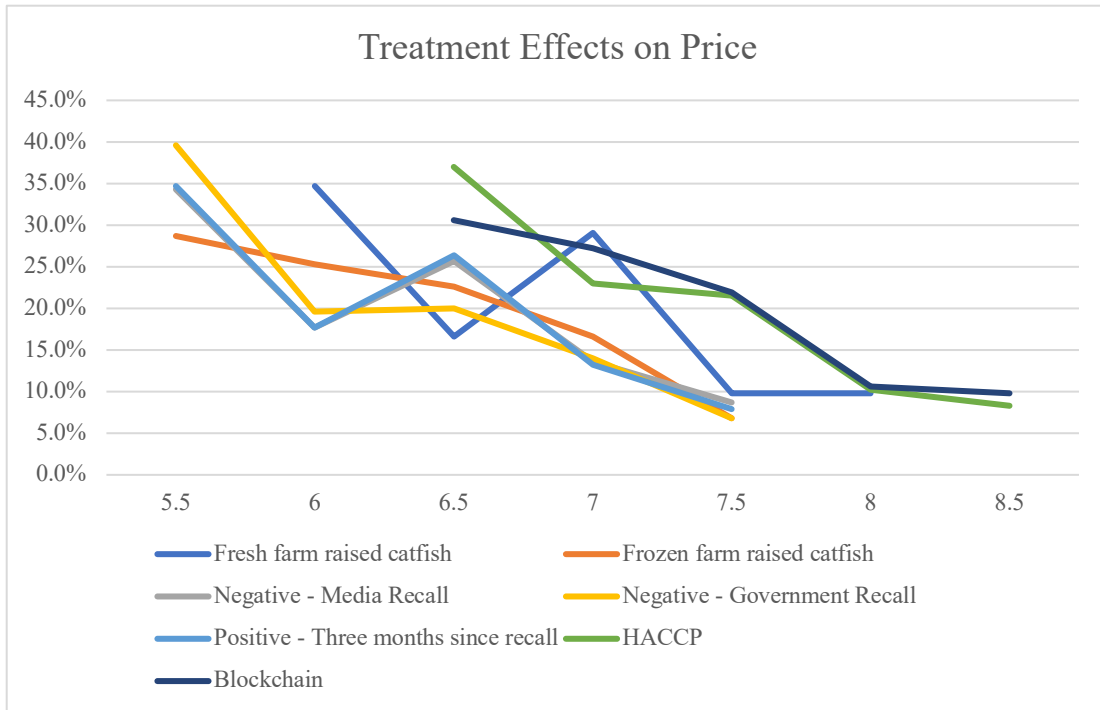


Figure 16. Treatment effect on willingness to pay for catfish

Analysis on Seafood Price

In the Tukey test, the difference in mean prices between seven different points of price were analyzed and differences in those mean prices are listed in Table 13. The results show that the participants had more confidence in blockchain three months after the recall and would pay \$.50 more for blockchain safety. The same goes for HACCP and more confidence in these positive treatments and paying more for it three months after a food recall. Consumers have a higher confidence in the two positive treatments of HACCP and blockchain and would be willing to pay more than their initial base price for catfish. As far as recalls, consumers did not have confidence in government recalls or media recalls, and they still will pay more at their base price and for blockchain and HACCP intervention.

Table 13. Tukey test difference in mean prices for seafood

| | Difference in Mean Prices |
|---|---------------------------|
| Treatments | Seafood |
| Base Price X Three Months after Recall | 0.0075 |
| Blockchain X Three Months after Recall | 0.5000*** |
| Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce X Three Months after Recall | -0.4717*** |
| Government Recall X Three Months after Recall | -0.0660 |
| HACCP X Three Months after Recall | 0.4396*** |
| Media Recall X Three Months after Recall | 0.0132 |
| Blockchain X Base Price | 0.4925*** |
| Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce X Base Price | -0.4792*** |
| Government Recall X Base Price | -0.0736 |
| HACCP X Base Price | 0.4321*** |
| Media Recall X Base Price | 0.0057 |
| Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce X Blockchain | -0.9717*** |
| Government Recall X Blockchain | -0.5660*** |
| HACCP X Blockchain | -0.0604 |
| Media Recall X Blockchain | -0.4868*** |
| Government Recall X Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce | 0.4057*** |
| HACCP X Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce | 0.9113*** |
| Media Recall X Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce | 0.4849*** |
| HACCP X Government Recall | 0.5057*** |
| Media Recall X Government Recall | 0.0792 |
| Media Recall X HACCP | -0.4264*** |

Note: *** indicates a significant difference in mean for seafood

5.4 Consumer Survey Results: Cheese Products

5.4.1 Consumer Survey Socio-Demographics

Socio-Demographics of Cheese Survey Participants ($n=276$)

Descriptive statistics were used to examine the following socio-demographic characteristics: gender, age, education, race, and income shown in Table 14. Half of the respondents were female (50.4%) and a little under half were male (49.3%). All three age categories were similar in the number of respondents, with 35-50 (33.8%), 50 and above (33.5%), and 18-35 (32.7%). The most identified group were those with bachelor's degrees (34.2%), and both high school graduate or less (21.6%) and associate degree or trade certificate (21.2%) were the two that were the second most identified. The majority of the respondents fell within two categories, Hispanic/Latino (40.6%) and White (40.3%). Those respondents that made \$50,000 or less (34.2%) had the most respondents but was similar to those that indicated that they made \$50,000-\$100,000 and \$100,000 and above.

Table 14. Socio-Demographic Profile of Sample: Cheese Consumers (n=278)

| Characteristic | Number of Respondents | Percent of Respondents |
|--------------------------------------|-----------------------|------------------------|
| Gender | | |
| Female | 140 | 50.4% |
| Male | 137 | 49.3% |
| Other | 1 | 0.4% |
| Prefer not to disclose | 0 | 0.0% |
| Age | | |
| 18-35 | 91 | 32.7% |
| 35-50 | 94 | 33.8% |
| 50 and above | 93 | 33.5% |
| Education | | |
| High school graduate | 60 | 21.6% |
| Associate Degree / Trade Certificate | 59 | 21.2% |
| Bachelor's Degree | 95 | 34.2% |
| Master's Degree | 55 | 19.8% |
| Doctoral Degree | 9 | 3.2% |
| Race | | |
| White | 112 | 40.3% |
| African American | 35 | 12.6% |
| American Indian or Alaska Native | 4 | 1.4% |
| Asian | 11 | 4.0% |
| Native Hawaiian or Pacific Islander | 1 | 0.4% |
| Hispanic / Latino | 113 | 40.6% |
| Other | 2 | 0.7% |
| Income | | |
| \$50,000 or less | 95 | 34.2% |
| \$50,000 - \$100,000 | 94 | 33.8% |
| \$100,000 and above | 89 | 32.0% |

Secondary Demographics

In addition to the primary demographic questions, other factors such as primary shopper in the household, born in the state of Texas, food handling training, foodborne illness sufferer, and purchasing frequency to determine the overall scope of the respondent and potentially how this could impact the data results shown in Table 15. For this survey group, the majority of respondents were the primary shopper in their household and purchase grocery products at least once a week. They were also mainly born and raised in Texas, and do not belong to environmental groups. They haven't suffered from a foodborne illness and there is a split between those that have food handling training and those that do not.

Table 15. Additional socio-demographic information from cheese consumer survey

| Characteristic | Number of Respondents | Percent of Respondents |
|---|-----------------------|------------------------|
| Primary Shopper | | |
| Yes | 255 | 91.7% |
| No | 72 | 8.3% |
| Originally from Texas | | |
| Yes | 206 | 74.1% |
| No | 155 | 25.9% |
| Formal/Informal Food Handling Training | | |
| Yes | 123 | 44.2% |
| No | 155 | 55.8% |
| Environmental Organization | | |
| Yes | 78 | 28.1% |
| No | 200 | 71.9% |
| Suffered from Foodborne Illness | | |
| Yes | 102 | 36.7% |
| No | 176 | 63.3% |
| Cheese Purchasing Frequency | | |
| Once a week | 128 | 46.0% |
| Every two weeks | 100 | 36.0% |
| Once a month | 50 | 18.0% |

5.4.2 Consumer Purchasing Preferences

Cheese Product Type and Qualities

For cheese products there were three different product types that the survey respondents were asked to consider, which was packaged cheese, deli cheese, and specialty cheese shown in Table 16. For reference, packaged cheese was any cheese that could be found in the cheese section of a store, deli cheese was any cheese that was found behind a counter,

and specialty cheeses were those such as brie, manchego, gouda, and others that are typically sold by the block. Packaged cheese (92.4%) was the most purchased type of cheese with only 7.6% of respondents indicating that they did not buy packaged cheese. After packaged cheese the purchasing of deli cheese and specialty cheese were the second and third most purchased.

Table 16. Consumer cheese purchases

| Which of the following do you buy? | Yes | No |
|------------------------------------|-------|-------|
| Packaged Cheese | 92.4% | 7.6% |
| Deli Cheese | 68.0% | 32.0% |
| Specialty Cheese | 64.4% | 35.6% |

Table 17. Consumer cheese quality preferences

| | Packaged Cheese | Deli Cheese | Specialty Cheese |
|---------------------|-----------------|-------------|------------------|
| Appearance | 18.5% | 16.9% | 18.7% |
| Country of Origin | 10.8% | 10.7% | 12.5% |
| Income | 19.2% | 19.1% | 18.4% |
| Nutritional Content | 17.0% | 18.6% | 15.5% |
| Product Type | 20.3% | 19.2% | 19.5% |
| Safety | 14.2% | 15.6% | 15.3% |

Cheese Purchasing Preferences

The respondents of the survey were asked two separate questions on their purchasing preferences as it relates to cheese products. The goal of the two questions was to understand if organic cheese or name brand cheese over generic played a role in their purchasing decisions. For the purchase of organic cheese Figure 17 shows many of the

respondents indicated that no they did not buy organic cheese (51.1%) but there were still quite a few respondents that indicated yes (48.9%) organic plays a role in their purchasing decision. Also, as shown in Figure 18 more than half of the respondents indicated that name brand (55.4%) played a role in their purchasing decision over a generic name brand.

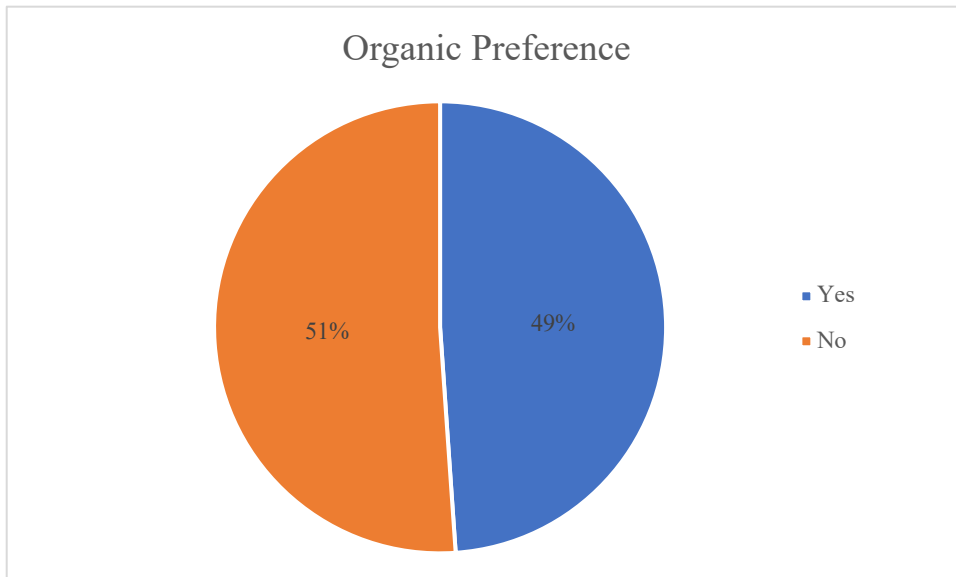


Figure 17. Consumer organic purchasing preference

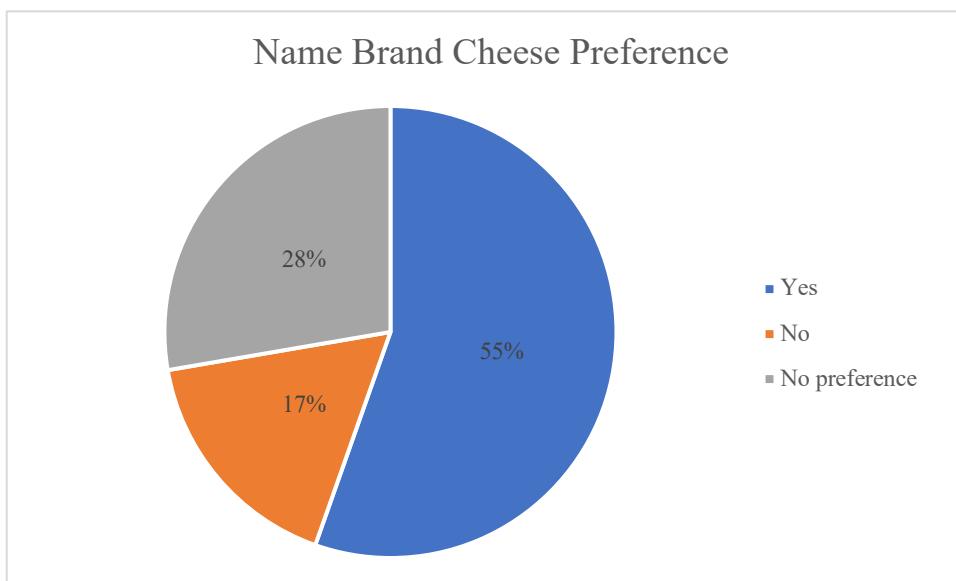


Figure 18. Consumer name brand cheese purchasing preference

Preferred Market Type

Respondents were asked to select the market types that they typically visit when purchasing food items as shown in Table 18. The majority of the respondents shop at supermarkets (69.1%) which for this survey included stores such as HEB, Wal-Mart, Krogers, etc. The other markets that respondents frequented were wholesale markets (18%), such as Sams, Costco, etc., farmers markets (7.6%), and specialty markets (5.4%), such as Sprouts, Whole Foods, etc..

Table 18. Consumer preferred market type

| Market Type | Percent of Respondents |
|------------------|------------------------|
| Supermarket | 69.1% |
| Wholesale market | 18.0% |
| Farmer's market | 7.6% |
| Specialty market | 5.4% |

Preferred Product Labelling

Respondents were given six different labels that might be found on cheese products in the marketplace. Then they were asked to give their level of importance in looking for that label in their cheese purchasing decisions as shown in Figure 19. Some important information to highlight is with the label of “certified organic” with 28.8% of respondents believing that this wasn’t important at all in their purchasing with “non-gmo” at 26.6% of respondents indicating that this was not important at all either. This is contrasted by the three extremely important labels being nutritional content (29.9%), ingredients list (28.4%), and no artificial colors (28.1%).

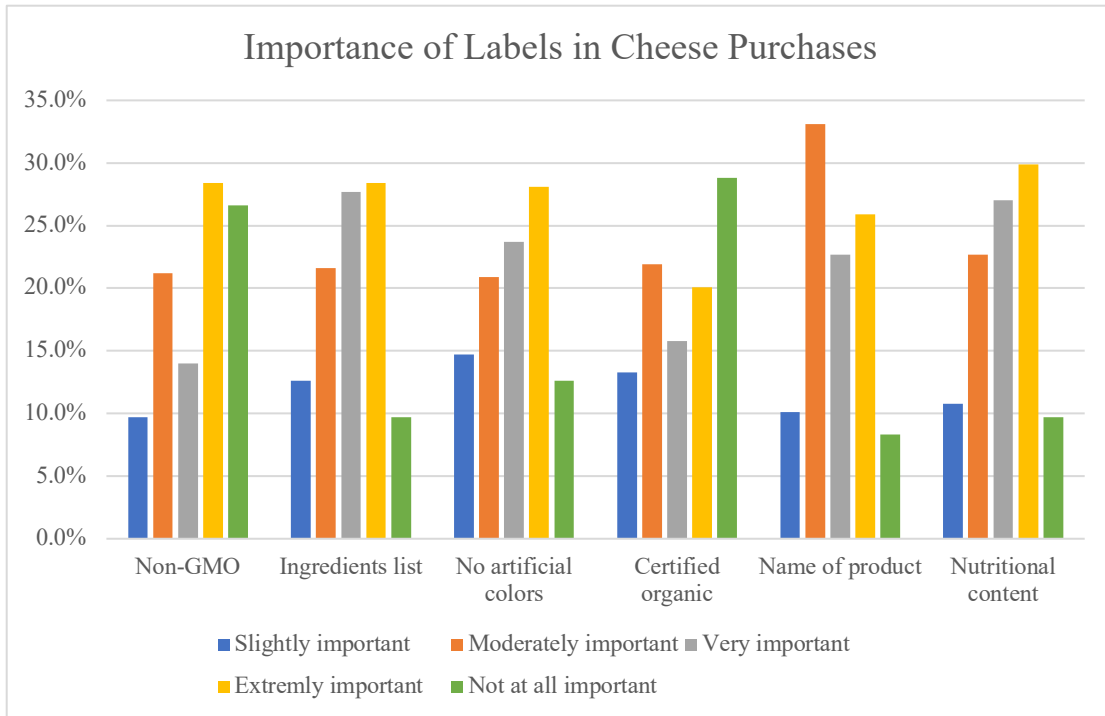


Figure 19. Importance of labels in consumer cheese purchases

5.4.3 Consumer Knowledge on Food Safety

Cheese Food Safety Concerns

The survey respondents were given two different questions on food safety concerns when purchasing cheese products. The first was to determine if there were any concerns when purchasing cheese shown in Figure 20, which 56.1% of respondents did have. If the respondents indicated that they did have concerns they were asked what type of concern they had. A little less than half of those respondents indicated in Table 19 that contaminated products (46.0%) were their main type of concern.

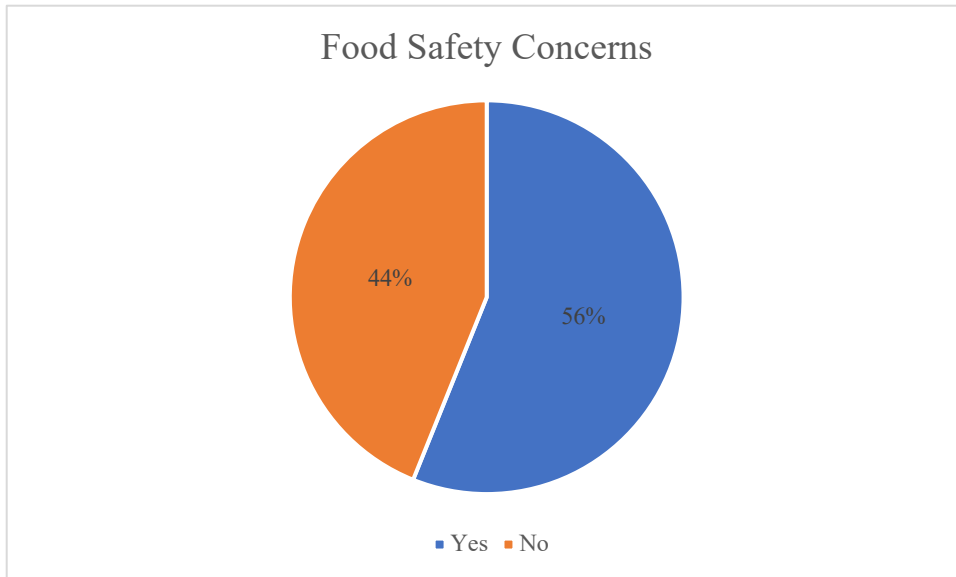


Figure 20. Consumer food safety concerns

Table 19. Consumer type of cheese safety concern

| Type of Concern | Number of Respondents | Percent of Respondents |
|-----------------------|-----------------------|------------------------|
| Foodborne Pathogens | 94 | 33.8% |
| Contaminated Products | 128 | 46.0% |
| Other | 56 | 20.1% |

Food Safety Standards

The respondents were presented with a Likert scale that gave them a set of statements that they could agree or disagree on when it comes to food safety standards. The statements were as follows:

Farm Standards – Do you believe that small farms and large farms should be held to the same standards?

Protection of Consumers – Do you believe that enough is being done to protect consumers from foodborne illnesses?

Store Standards – Do you believe that farmers markets and supermarkets are held to the same standards in selling cheese products?

Recall Confidence – Do you have more confidence in stores that engage in voluntary recalls of cheese products when a safety issue is encountered?

A majority of the respondents as shown in Figure 21 on all four statements fell within “somewhat agree” and “strongly agree”.

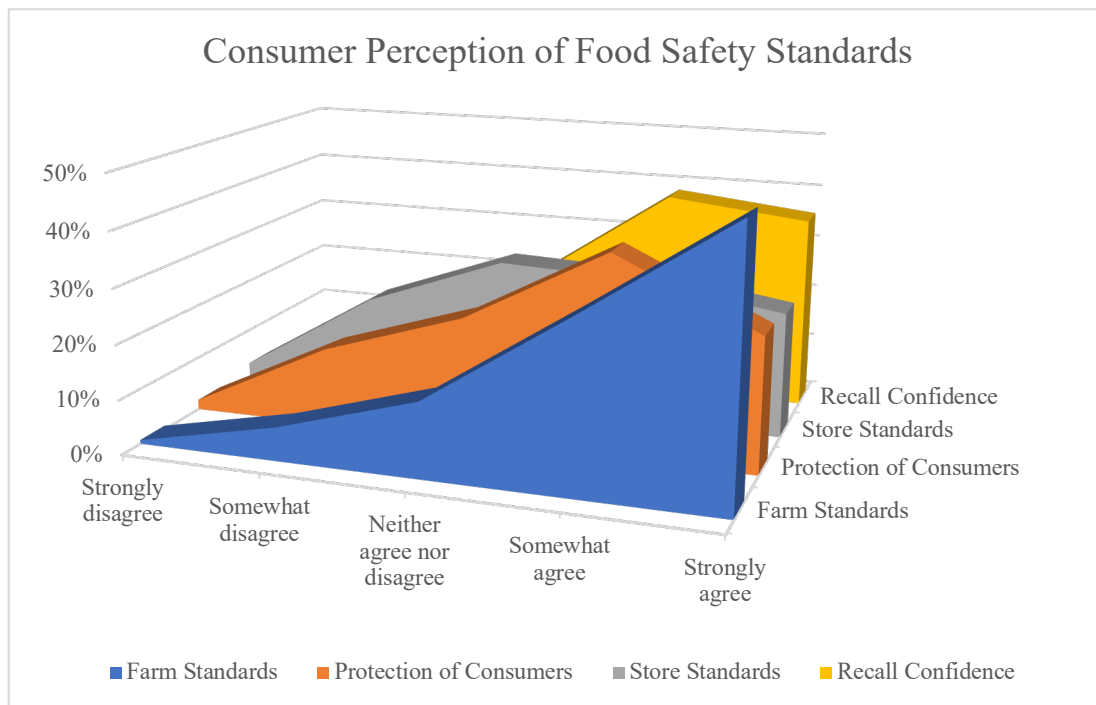


Figure 21. Consumer perception on current standards in food safety

Food Safety Regulations

The respondents were also presented with another Likert scale with a set of statement on food safety regulations and for them to agree or disagree with the statements based on their own beliefs around food safety. The nine statements asked to participants can be seen in Figure 22.

When looking at Figure 22, it is clear that respondents agree that there are food safety issues occurring within the home. There are also clear disagreements with statements such as HACCP based food safety plans are not necessary, this means that they do believe that these plans are necessary for safety.

Perceptions on Current Food Safety Standards

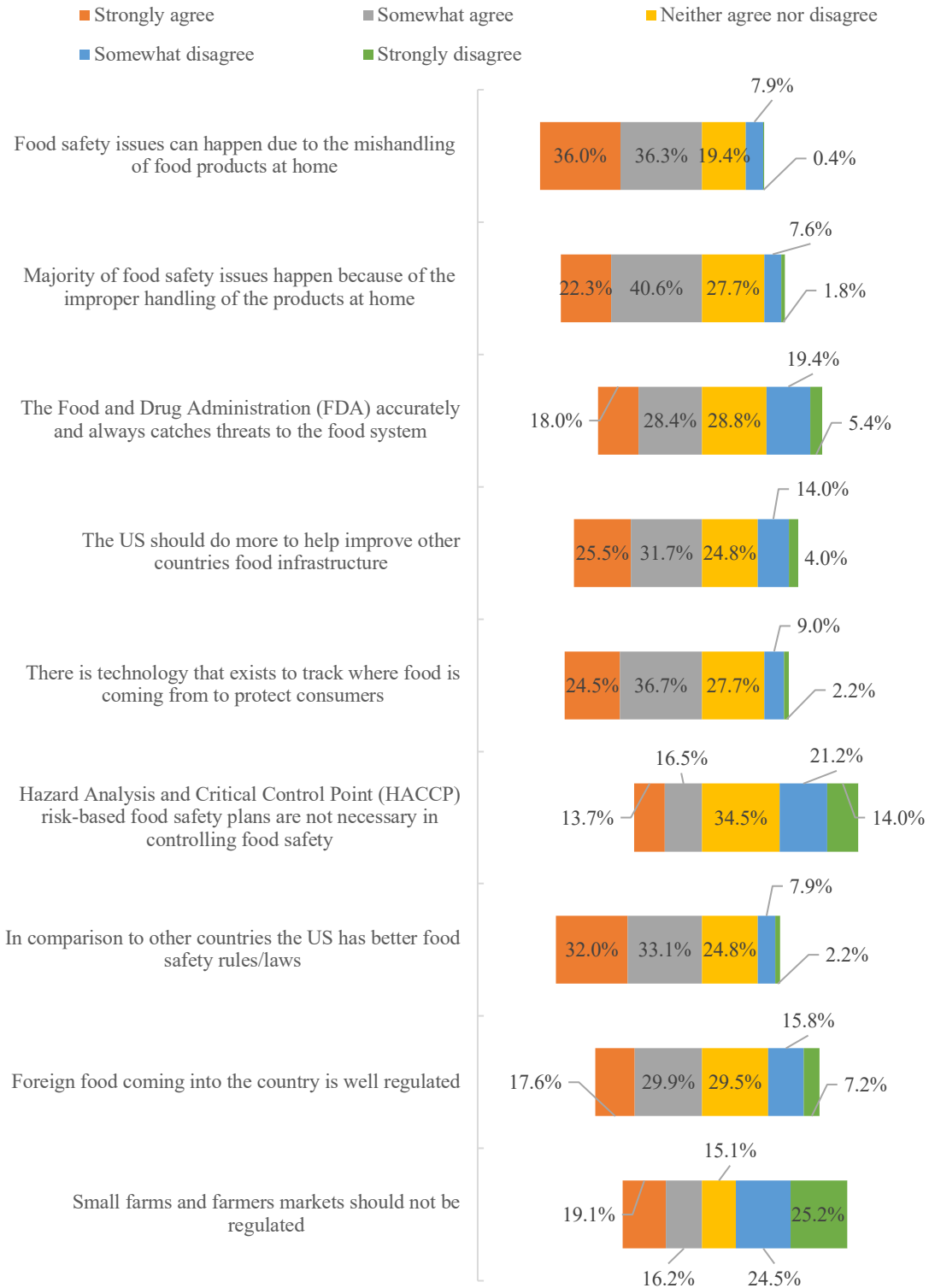


Figure 22. Consumer perceptions on current food safety standards

Food Safety Responsibility Issues

Respondents were asked to select who they believed should be responsible for food safety issues when they occur. In Figure 23 most of the respondents believed that Farmers / Producers (41%) should be responsible for food safety issues. The smallest percent at 12.6% is the thought that consumers should be responsible for food safety issues.

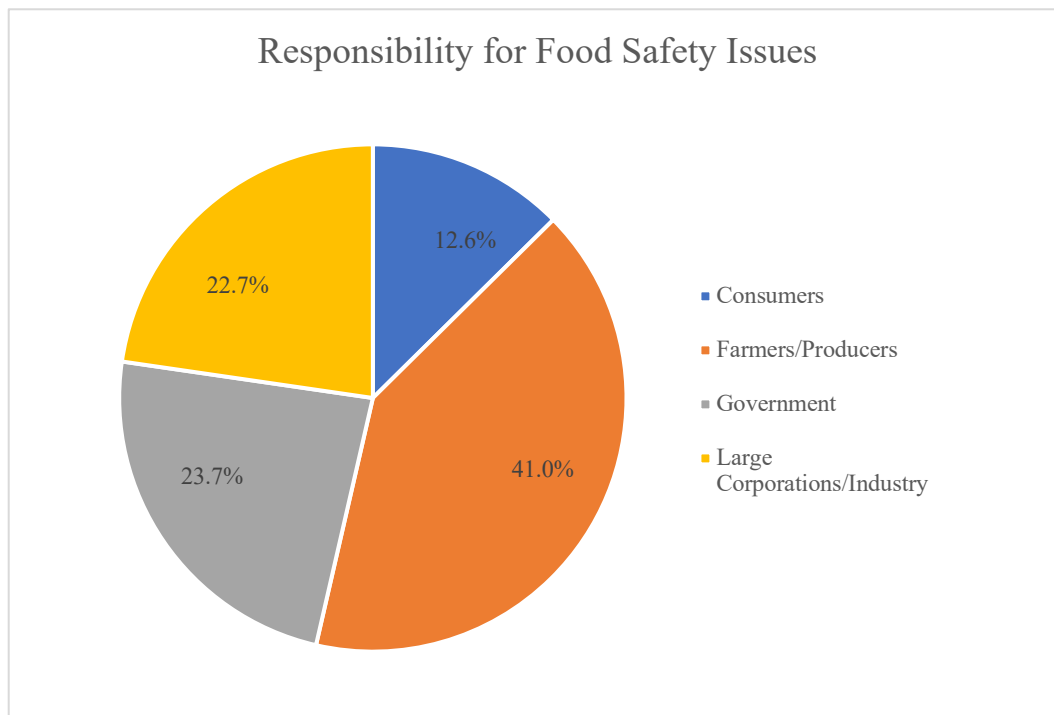








Figure 23. Consumer perception on responsibility in food safety issues

Recognition of Labels

The respondents were asked to look at different labels and select the labels that they have seen before. The most recognized label shown in Table 20 was the USDA logo with 27.7% and the least recognized was FSMA with 5.7%.

Table 20. Consumer recognition of potential food labels

| Picture Shown | Percent of Respondents |
|---|------------------------|
|  | 9.8% |
|  | 6.4% |
|  | 5.7% |
|  | 26.9% |
|  | 27.7% |
|  | 23.5% |

Supply Chain and Regulatory Entity Knowledge

Respondents were given a series of questions on the parts of the supply chain, handling through the supply chain, and the role of the FDA and FSIS in food safety. This question was an inquiry of the current knowledge that respondents already have when making their purchasing decisions. The four questions are as follows:

Parts of Supply Chain – Do you know the different parts of the food supply chain?

Supply Chain Safety – Do you feel that cheese is handled safely throughout the food supply chain?

FDA Role – Do you know what role the Food and Drug Administration (FDA) plays in food safety?

FSIS Role – Do you know what role the Food Safety and Inspection Service (FSIS) plays in food safety?

Overall, the respondents know about the supply chain and regulatory entities such as FDA and FSIS and the role that they play as shown in Figure 24. Even though there are plenty of respondents that selected “somewhat”, it might mean that better communication of supply chain and agencies involved in food safety would benefit those respondents.

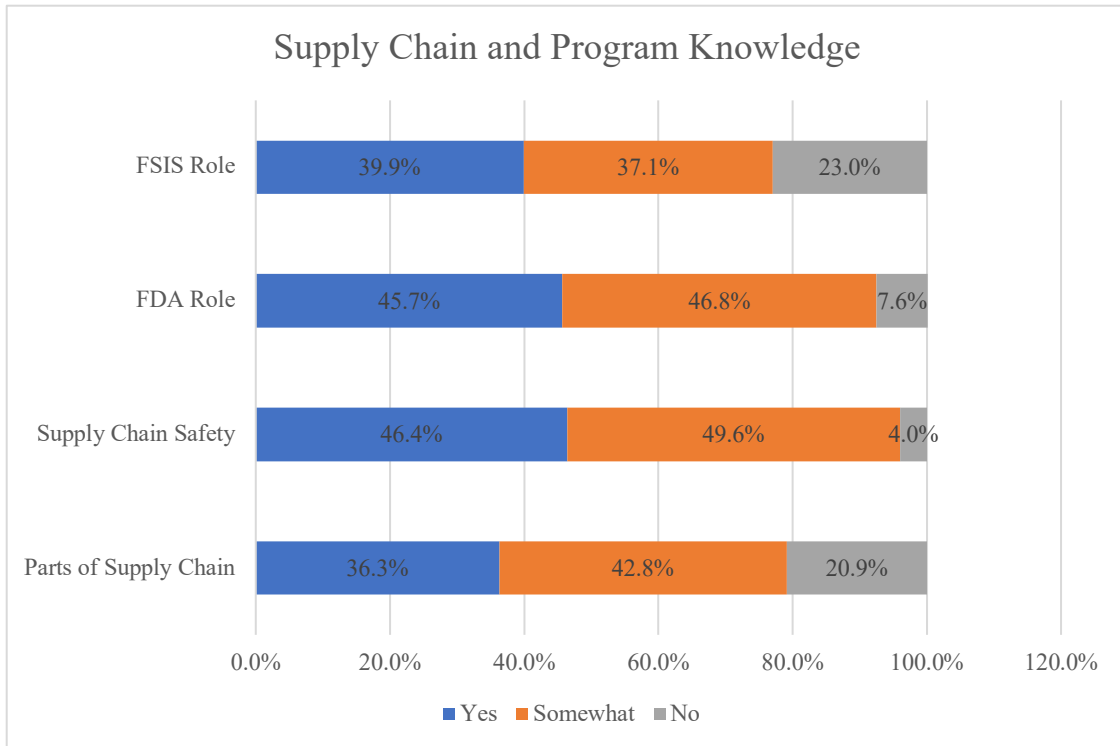


Figure 24. Consumer knowledge on supply chain and government role in food safety

Food Recalls

Two separate questions were asked of respondents on food recalls in the event of a food safety issue also shown in Figure 25. The first to understand if consumers are getting the necessary information that they need to make informed purchasing decisions, and second where that flow of information comes from. Over half of the respondents (68.7%) indicated that they are receiving recall information as it comes out but there are still 31.3% of the respondents who are not. Of the respondents who are receiving recall information shown in Table 21, most of the information is coming from media outlets (25.2%).

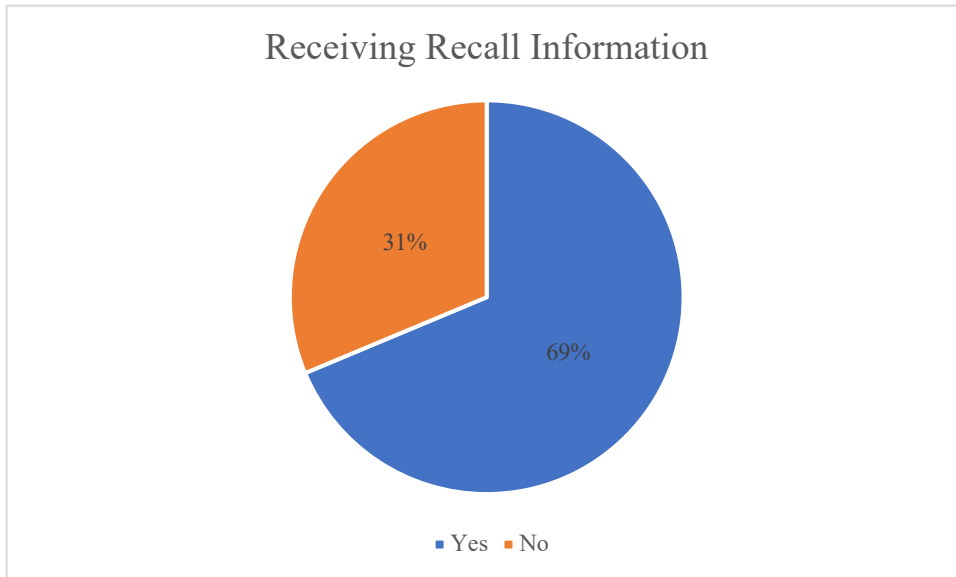


Figure 25. Consumer acknowledgement of receiving recall information

Table 21. Consumer source of recall information

| Source of Information | Percent of Respondents |
|-----------------------|------------------------|
| Media | 25.2% |
| Government Website | 16.5% |
| Grocery Store Posting | 11.5% |
| Word of Mouth | 2.9% |
| Social Media | 9.7% |
| Celebrities | 1.8% |
| Unsure / Don't Know | 1.1% |
| No Response | 31.3% |

Government and Industry Intervention

Respondents were given a Likert scale in which they were asked to indicate their knowledge on current food safety regulation in the United States. The statements were as follows:

HACCP Knowledge – How knowledgeable about HACCP are you?

Blockchain Knowledge – How knowledgeable about blockchain technology are you?

Government Intervention – How knowledgeable are you on government intervention on food safety?

Industry Intervention – How knowledgeable are you on industry intervention on food safety?

As Figure 26, shows when it comes to knowledge of blockchain technology there are many respondents who are not knowledgeable (36.3%). Overall, most of the respondents had slight to moderate knowledge on both HACCP and Blockchain and government and industry interventions in food safety.

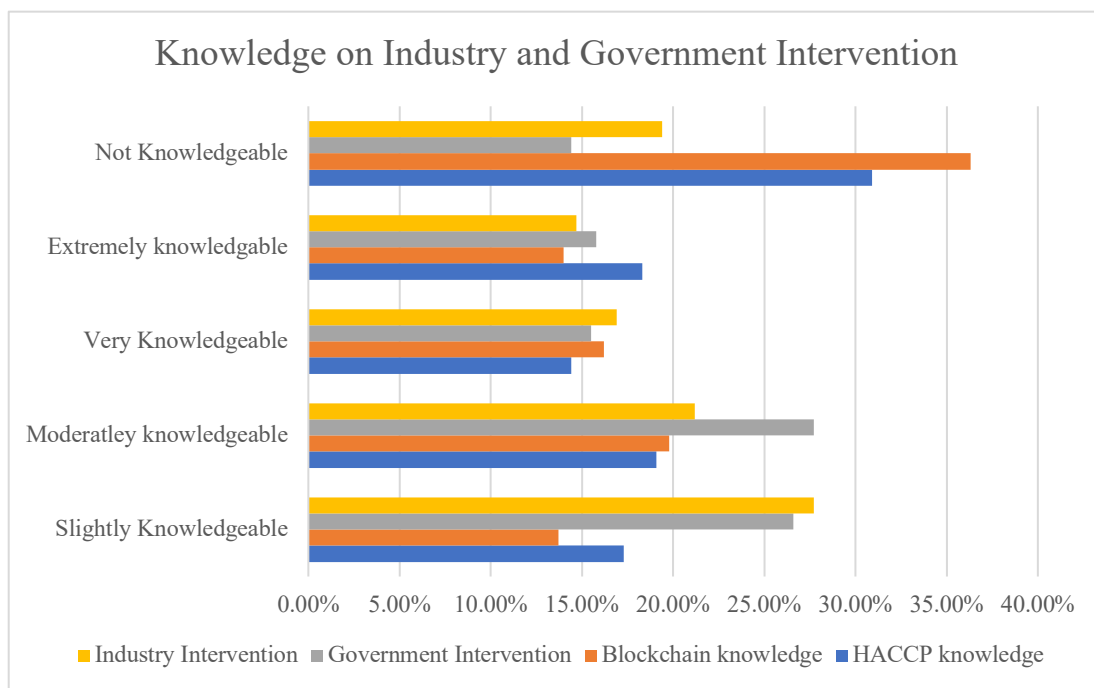


Figure 26. Consumer knowledge on industry and government intervention in food safety

5.4.4 Consumer Willingness to Pay

Price / WTP for Cheese Purchase

In this section of the survey, respondents were given a series of scenarios for purchasing packed cheese. These questions range from baseline information, a series of negative treatments, as well as positive treatments. The first goal was to obtain a baseline of price that the respondents would spend on the cheese products presented before imposing a treatment. The overall objective and mindset of this section is as follows:

Objective: “The following questions will have different scenarios about a specific cheese product that you might be purchasing in the marketplace. Please answer these questions as if you were the shopper based on the decisions that you would make while shopping.”

There were two questions for baseline price, the first was the respondent’s willingness to pay for a package of cheese and the second was the respondent’s willingness to pay for a specialty cheese. Figure 27 shows both of the products and how much respondents were willing to pay for these cheese products. The willingness to pay for a package of cheese was \$3.00, and the willingness to pay for specialty cheese was \$4.00.



Figure 27. Consumer purchase price for cheese products

After gathering the baseline data, the first negative treatment scenario was imposed:

Scenario: “Assume a media article has written an article over the recall of cheese from ABC Company. This is a mandatory recall of some cheese products from this company because it has been contaminated with a toxin that produces E.Coli bacteria. Answer the following questions based on this assumption.”

The respondents were asked to give their willingness to pay for the packaged cheese after the recall has occurred and been covered in the media. The highest willingness to pay was \$2.00 after the recall has been covered in the media. This is a \$1.00 decrease from their initial WTP. As a follow up to the negative scenario, a follow up question was presented to the respondents. They were asked if they would purchase another type of cheese or a different brand of cheese. 84.5% agreed that yes, they would be purchasing a different type and from a different brand.

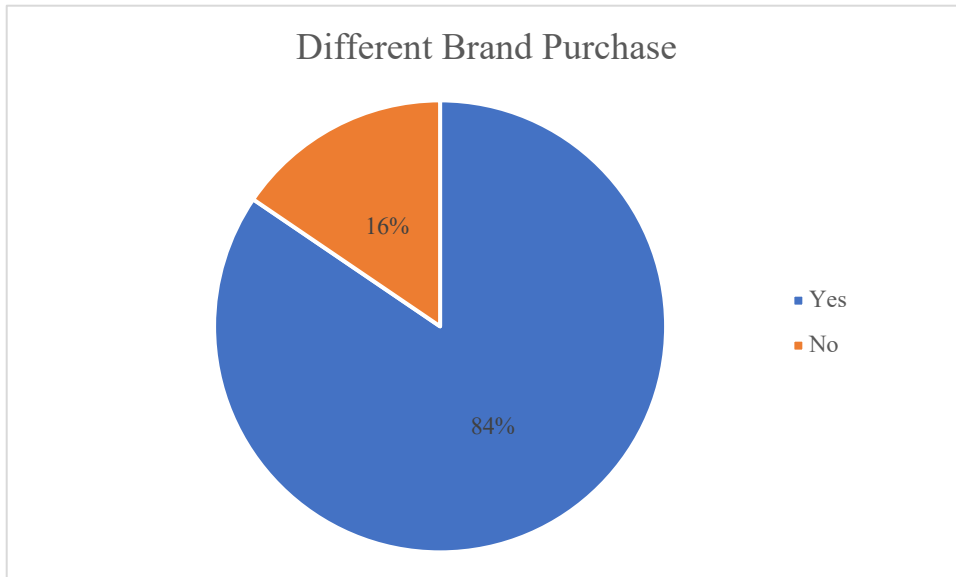


Figure 28. Consumer purchase of different cheese brand after food recall

The second negative treatment scenario was then imposed:

Scenario: “Assume that USDA Food Safety and Inspection Services has identified the E. coli bacteria and is issuing a mandatory recall of all packaged sliced cheese from ABC Company. Answer the following questions based on this assumption.”

After the USDA FSIS identifies the bacteria there is about a 1% increase in respondents selecting \$2.00 as their WTP from the previous scenario which can be seen in Figure 30.

This shows that respondents are willing to pay the lowest amount possible during times of a food scare such as the recall presented. The respondents are finally given the positive scenario:

Scenario: “Assume that it has been three months since the recall of the cheese product incident and no other information or recalls have been reported. Answer the following questions based on this assumption.”

Respondents indicated that after three months their WTP is back to the baseline of \$3.00 (23.7%), what they initially reported as their WTP for a package of cheese, seen in Figure

30. But it is important to note that 23.4% of those respondents still indicated that their WTP was still \$2.00 for a package of cheese. This might mean that although it has been three months since the incident that there is still some concern to consuming packaged cheese therefore their willingness to pay for it hasn't changed. Respondents were again presented with a follow up question about their purchases three months after the recall shown in Figure 29. While 74.5% of the respondents said that they would purchase cheese after those three months, there were still 25.5% of the respondents who said that they would not.

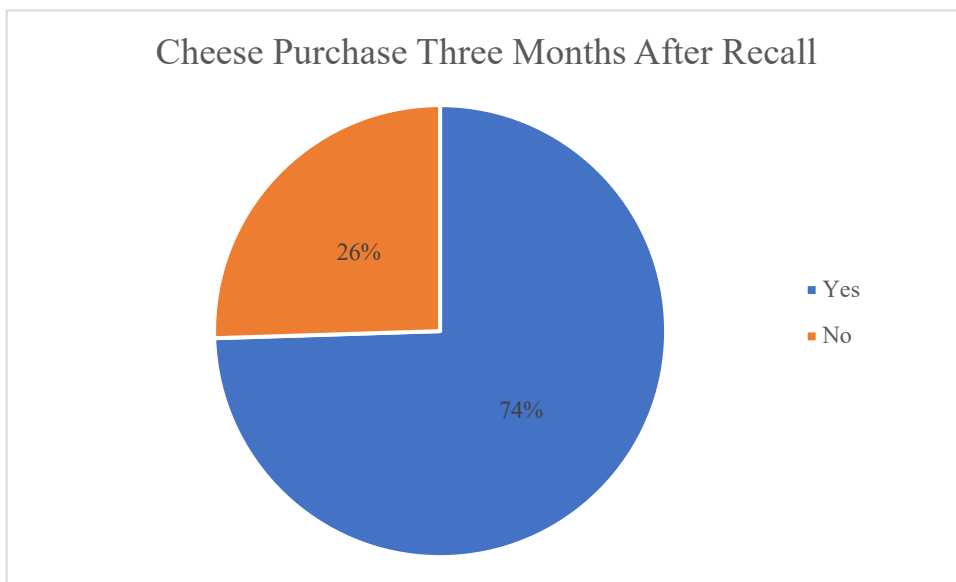


Figure 29. Consumer cheese purchases three months after a recall

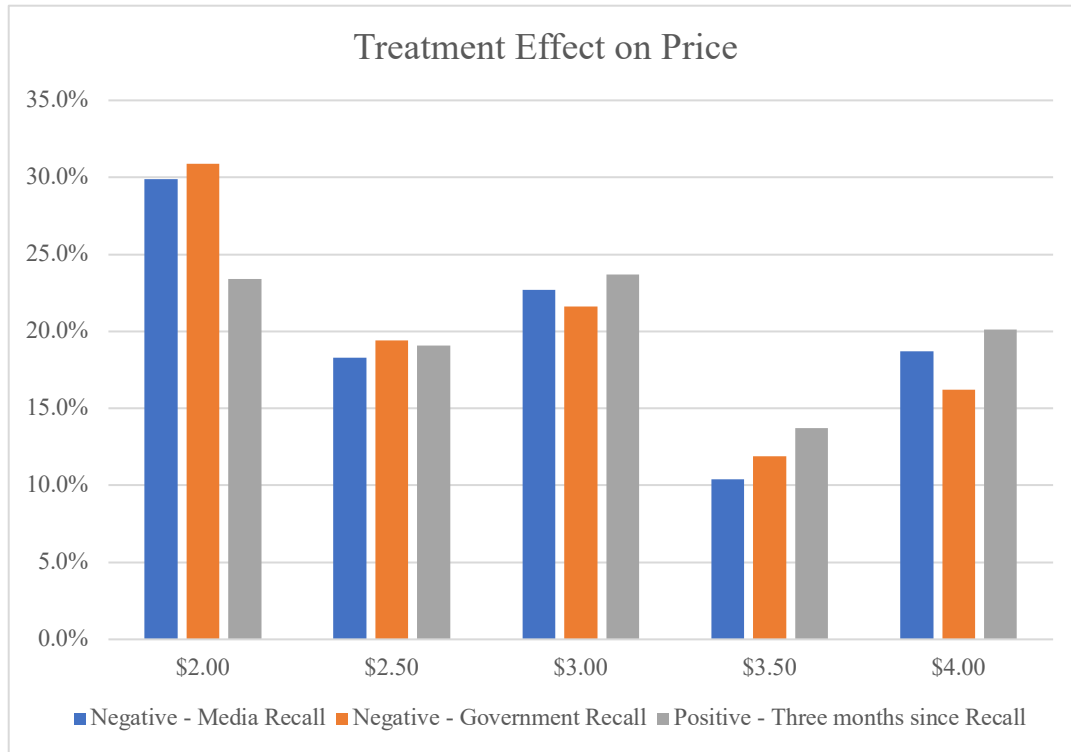


Figure 30. Treatment effect on consumer cheese willingness to pay

The final two scenarios that the respondents were given, were positive treatments of current HACCP management practices that already exist to reduce the amount of food safety issues as well as blockchain technology that improves communication along the supply chain with data backed information. The two scenarios are examples of government intervention in food safety and industry intervention and seeing if one has a higher WTP than the other. The two scenarios are as follows:

Scenario: “Hazard Analysis and Critical Control Points, is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product. Answer the following questions keeping this statement in mind.”

Scenario: “Blockchain technology is an industry development that works across the supply chain, including growers, processors, shippers, retailers, regulators, and consumers. This allows for the immediate access to food supply chain data from farm to store and consumer. With capabilities for safer food, longer shelf lives, reduced waste, faster traceability, and better access to shared information. Answer the following questions keeping this statement in mind.”

The majority of the respondents still gave a WTP of \$3.00 for both HACCP (28.8%) and blockchain (26.6%), but when looking at Figure 31, the next WTP by respondents was \$3.50 for both HACCP (24.5%) and blockchain (25.5%). There might be evidence to suggest that there are a select number of respondents who would be willing to pay a \$0.50 increase for HACCP and blockchain that would help to reduce food safety incidences.

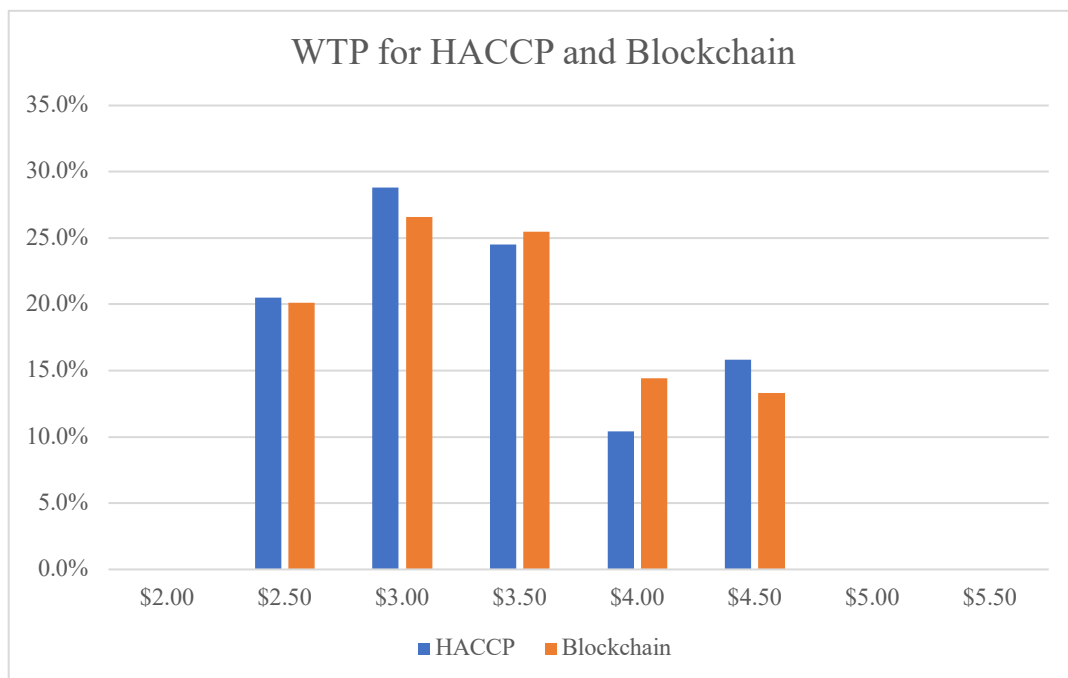


Figure 31. Consumer willingness to pay for HACCP and Blockchain

Figure 32 shows all seven price scenarios and the WTP of the respondents. This graphically shows the changes that occur throughout instances of food safety incidents and the WTP of the cheese product that was being used.

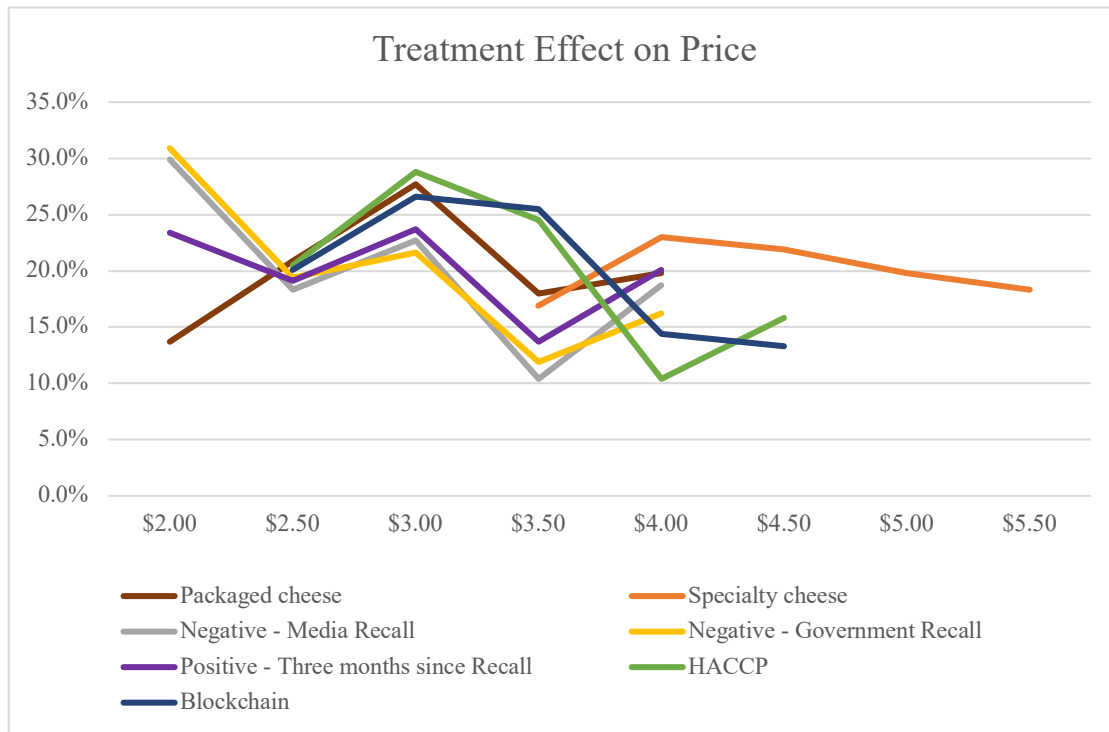


Figure 32. Combination of treatment effect on willingness to pay

Analysis of Cheese Price

The results of the Tukey test, shown in table 16 show that three months after a cheese recall, consumers are ready and confident to return to their initial base price for cheese. When it comes to the positive treatments of HACCP and blockchain, consumers don't have confidence in these two treatments and would instead pay their baseline price without the consideration of the two. Even if HACCP and blockchain changed their confidence there is a .2320 difference between those more confident in HACCP than in blockchain. When consumers were presented with a media recall this did not impact them or their confidence to continue purchasing cheese at their base price that they indicated.

Table 22. Tukey test difference in mean prices for cheese

| | Difference in Mean Prices |
|---|---------------------------|
| Treatments | Cheese |
| Base Price X Three Months after Recall | 0.4299*** |
| Blockchain X Three Months after Recall | -0.1259 |
| Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce X Three Months after Recall | 0.4209*** |
| Government Recall X Three Months after Recall | -0.0917 |
| HACCP X Three Months after Recall | 0.1061 |
| Media Recall X Three Months after Recall | 1.5576*** |
| Blockchain X Base Price | -0.5558*** |
| Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce X Base Price | -0.0090 |
| Government Recall X Base Price | -0.5216*** |
| HACCP X Base Price | -0.3237*** |
| Media Recall X Base Price | 1.1277*** |
| Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce X Blockchain | 0.5468*** |
| Government Recall X Blockchain | 0.0342 |
| HACCP X Blockchain | 0.2320*** |
| Media Recall X Blockchain | 1.6835*** |
| Government Recall X Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce | -0.5126*** |
| HACCP X Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce | -0.3147*** |
| Media Recall X Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce | 1.1367*** |
| HACCP X Government Recall | 0.1978*** |
| Media Recall X Government Recall | 1.6493*** |
| Media Recall X HACCP | 1.4514*** |

Note: *** indicates a significance in the mean price difference for cheese

5.5 Consumer Survey Results: Meat Products

5.5.1 Consumer Survey Socio-Demographics

Socio-Demographics of Participant Sample ($n=270$)

Descriptive statistics were used to examine the following socio-demographic characteristics: gender, age, education, race, and income as seen in Table 23. Half of the respondents were female (50.4%) and a little under half were male (49.3%). All three age categories were similar in the number of respondents, with 35-50 (33.8%), 50 and above (33.5%), and 18-35 (32.7%). The most identified group were those with bachelor's degrees (34.2%), and both high school graduate or less (21.6%) and associate degree or trade certificate (21.2%) were the two that were the second most identified. The majority of the respondents fell within two categories, Hispanic/Latino (40.6%) and White (40.3%). Those respondents that made \$50,000 or less (34.2%) had the most respondents but was similar to those that indicated that they made \$50,000-\$100,000 and \$100,000 and above.

Table 23. Socio-Demographic profile of sample: Meat Consumers (n=270)

| Characteristic | Number of Respondents | Percent of Respondents |
|--------------------------------------|------------------------------|-------------------------------|
| Gender | | |
| Female | 143 | 53.0% |
| Prefer not to disclose | 127 | 0.0% |
| Male | 0 | 47.0% |
| Other | 0 | 0.0% |
| Age Group | | |
| 18-35 | 81 | 30.0% |
| 35-50 | 93 | 34.4% |
| 50 and above | 96 | 35.6% |
| Education | | |
| Associate Degree / Trade Certificate | 61 | 22.6% |
| Bachelor's Degree | 62 | 23.0% |
| Doctoral degree | 10 | 3.7% |
| High school graduate or less | 68 | 25.2% |
| Master's Degree | 69 | 25.6% |
| Race/Ethnicity | | |
| Black or African American | 35 | 13.0% |
| American Indian or Alaska Native | 3 | 1.1% |
| Asian | 6 | 2.2% |
| Hispanic/Latino | 113 | 41.9% |
| Native Hawaiian or Pacific Islander | 0 | 0.0% |
| Other | 1 | 0.4% |
| White | 112 | 41.5% |
| Income | | |
| \$100,000 and above | 79 | 29.3% |
| \$50,000 - \$100,000 | 95 | 35.2% |
| \$50,000 or less | 96 | 35.6% |

Secondary Demographic Questions

In addition to the primary demographic questions, other factors such as primary shopper in the household, born in the state of Texas, food handling training, foodborne illness sufferer, and purchasing frequency to determine the overall scope of the respondents and potentially how this could impact the data results can be seen in Table 24. For this survey group, the majority of respondents were the primary shopper in their household and purchase grocery products at least once a week or more. They were also mainly born and raised in Texas, and do not belong to environmental groups. They have not suffered from a foodborne illness and there is a split between those that have food handling training and those that do not.

Table 24. Additional socio-demographic information from meat consumer survey

| Characteristic | Number of Respondents | Percent of Respondents |
|---|------------------------------|-------------------------------|
| Primary Shopper | | |
| No | 22 | 8.1% |
| Yes | 248 | 91.9% |
| Originally from Texas | | |
| No | 48 | 17.8% |
| Yes | 222 | 82.2% |
| Formal/Informal Food Handling Training | | |
| No | 135 | 50.0% |
| Yes | 135 | 50.0% |
| Environmental Organization | | |
| No | 186 | 68.9% |
| Yes | 84 | 31.1% |
| Suffered from foodborne illness | | |
| No | 174 | 62.1% |
| Yes | 96 | 35.6% |
| Meat Purchasing Frequency | | |
| Every two weeks | 73 | 27.0% |
| Once a month | 17 | 6.3% |
| Once a week or more | 180 | 66.7% |

5.5.2 Consumer Purchasing Preferences

Meat Product Type and Qualities

For meat products there were six different product types that the survey respondents were asked to consider. The top three types of products that they purchased as seen in Table 25, were Beef (94.1%), Chicken (93%), and Meat Products (88.1%), which includes any type of sausage or combination of meat that didn't specifically fall within one of the given product types. The least consumed meat type was Lamb & Goat with 61.1% of respondents indicating that they didn't buy these types of meats. Overall, the most important quality that was factored into their purchasing as seen in Table 26 was their income and ultimately the price that they would pay for the product. Other qualities that respondents were asked to consider included, appearance, color, country of origin, income, nutritional content, safety of food, and type of product. A list of the products and their rank of important qualities is listed below:

Beef – Income, Safety of Food, Appearance, Type of Product, Color, Nutritional Content, and Country of Origin

Chicken – Income, Safety of Food, Appearance, Nutritional Content, Type of Product, Color, Country of Origin

Lamb & Goat – Income, Type of Product, Safety of Food, Country of Origin, Appearance, Color

Pork – Income, Safety of Food, Appearance, Type of Product, Nutritional Content, Color, Country of Origin

Turkey – Income, Type of Product, Appearance, Safety of Food, Nutritional Content, Color, Country of Origin

Meat Products – Income, Appearance, Safety of Food, Type of Product, Nutritional Content, Color, Country of Origin

Table 25. Consumer meat purchasing preferences

| | Appearance | Color | Country of Origin | Income | Nutritional Content | Safety of Food | Type of Product |
|---------------------|------------|-------|-------------------|--------|---------------------|----------------|-----------------|
| Beef | 14.0% | 11.8% | 7.5% | 18.8% | 11.0% | 14.1% | 12.1% |
| Chicken | 18.5% | 13.6% | 9.9% | 21.3% | 17.2% | 19.5% | 15.2% |
| Lamb & Goat | 10.7% | 8.3% | 11.8% | 19.2% | 14.4% | 16.8% | 18.8% |
| Pork | 16.2% | 11.8% | 10.9% | 19.2% | 12.2% | 16.3% | 13.4% |
| Turkey | 15.6% | 11.1% | 11.0% | 18.3% | 13.1% | 15.1% | 15.7% |
| Other Meat Products | 15.6% | 11.5% | 10.2% | 20.1% | 12.1% | 15.3% | 15.3% |

Table 26. Consumer meat quality preferences

| | Yes | No |
|------------------------|-------|-------|
| Beef | 94.1% | 5.9% |
| Chicken | 93.0% | 7.0% |
| Lamb & Goat | 38.9% | 61.1% |
| Pork | 73.0% | 27.0% |
| Turkey | 73.7% | 26.3% |
| Meat Products | 88.1% | 11.9% |

Meat Purchasing Preferences

The respondents of the survey were asked three separate questions on their purchasing preferences as it relates to meat products. The goal of the three questions was to understand if consumers relied on other sources of meat such as wild game, and if organic or local played a role in their purchasing decisions. For the consumption of wild game seen in Table 27 a little under half the respondents indicated that yes (43.3%) they

did consume wild game, which in Texas could possibly be used as an alternative to purchasing meat products in stores. Also, more than half of respondents indicated that purchasing local (61.5%) was a consideration in their meat purchases and although half of respondents indicated no (51.1%) to organic playing an important role in their purchasing there were still 48.9% that looked for organic meat when purchasing.

Table 27. Consumer meat purchasing factors

| | Yes | No |
|-----------|-------|-------|
| Wild Game | 43.3% | 56.7% |
| Organic | 48.9% | 51.1% |
| Local | 61.5% | 38.5% |

Preferred Market Type

Respondents were asked to select the market types that they typically visit when purchasing food items. The majority of the respondents shop at supermarkets (63.2%) shown in Table 28, which for this survey included stores such as HEB, Wal-Mart, Krogers, etc. The other markets that respondents frequented were wholesale markets (20%), such as Sams, Costco, etc., specialty markets (9.1%), such as Sprouts, Whole Foods, etc., and farmers markets (7.7%).

Table 28. Consumer preferred market type

| Market Type | Percent of Respondents |
|------------------|------------------------|
| Supermarket | 63.2% |
| Wholesale Market | 20.0% |
| Farmers Market | 7.7% |
| Specialty Market | 9.1% |

Preferred Product Labelling

Respondents were given six different labels that might be found on meat products in the marketplace. Then they were asked to give their level of importance in looking for that label in their meat purchasing decisions and those results are shown in Figure 33. Some important information to highlight is with the label of “antibiotic free” with 39.5% of respondents believing that this was very important in their purchasing decision. Also, “non-gmo” (30.4%) and “no artificial colors” (30.4%) were both considered extremely important by the respondents in their meat purchases. An important note for all the labels, while there weren’t many labels that respondents found as not at all important, “certified organic” (18.1%) still had the highest number of respondents that didn’t find this label important.

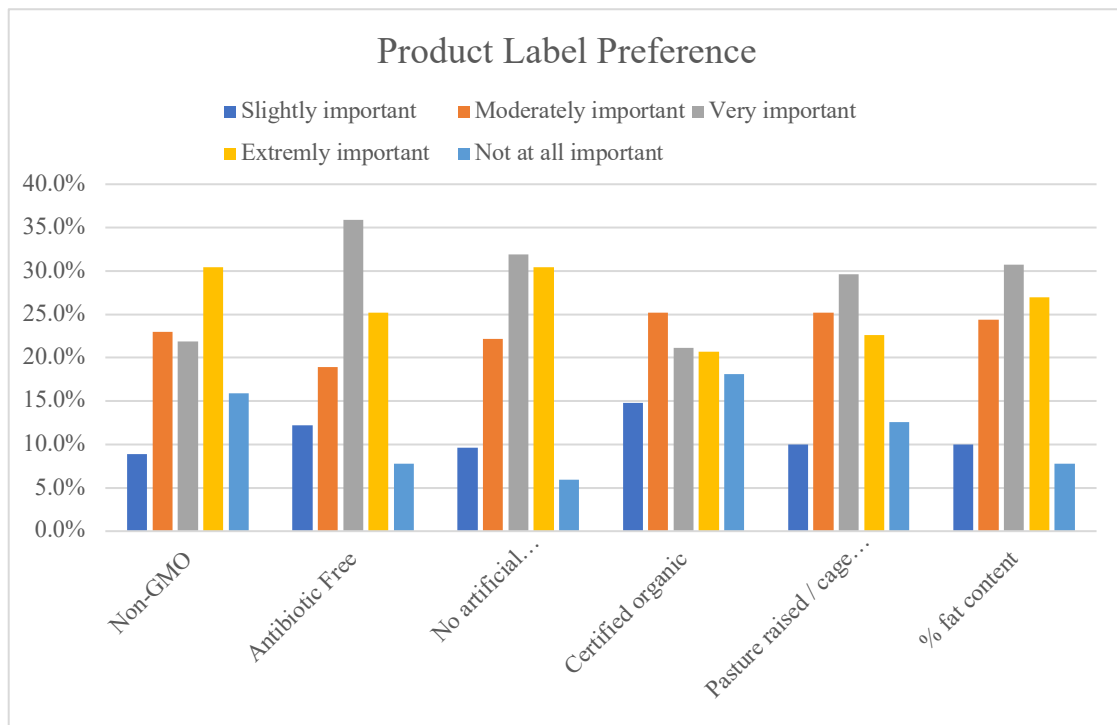


Figure 33. Consumer product label preference

5.5.3 Consumer Knowledge on Food Safety

Meat Food Safety Concerns

The survey respondents were given two different questions on food safety concerns when purchasing meat products. The first was to determine if there were any concerns when purchasing meat, which 68.9% of respondents did have as shown in Figure 34. If the respondents indicated that they did have concerns they were asked what type of concern they had. More than half of those respondents indicated in Table 29, that contaminated products (53.5%) were their main type of concern.



Figure 34. Consumer meat food safety concerns

Table 29. Consumer type of meat food safety concern

| Type of Concern | Percent of Respondents |
|-----------------------|------------------------|
| Foodborne Pathogens | 43.2% |
| Contaminated Products | 53.5% |
| Other | 3.2% |

Food Safety Standards

The respondents were presented with a Likert scale that gave them a set of four statements that they could agree or disagree on when it comes to food safety standards.

The statements were as follows:

Farm Standards – Do you believe that small farms and large farms should be held to the same standards?

Protection of Consumers – Do you believe that enough is being done to protect consumers from foodborne illnesses?

Store Standards – Do you believe that farmers markets and supermarkets are held to the same standards in selling cheese products?

Recall Confidence – Do you have more confidence in stores that engage in voluntary recalls of cheese products when a safety issue is encountered?

A majority of the respondents on all four statements fell within “neither agree nor disagree” and “strongly agree” as seen in Figure 35. This might suggest that the respondents agreed with the statements or didn’t know enough to agree or disagree with the statements presented to them.

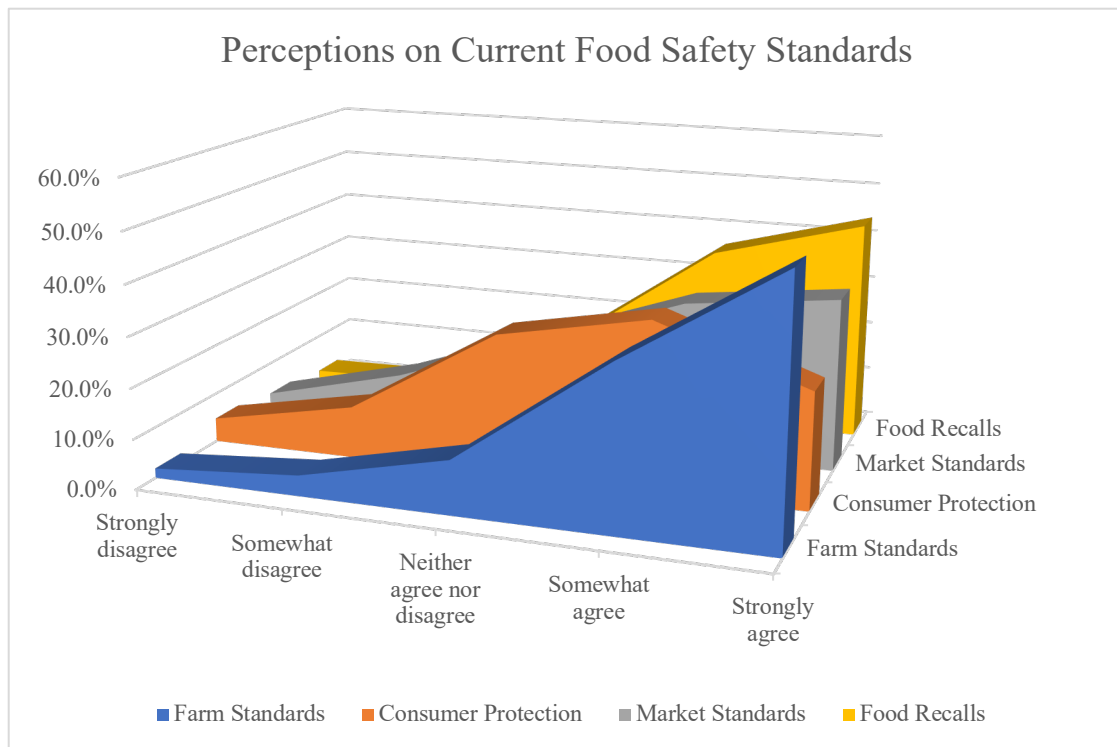


Figure 35. Consumer perception on current food safety standards

Food Safety Regulations

The respondents were also presented with another Likert scale with a set of statement on food safety regulations and for them to agree or disagree with the statements based on their own beliefs around food safety. The nine statements that were asked to participants can be seen in Figure 36.

Figure 36 shows the respondents agreement or disagreement on the following statements.

The major takeaways that can be seen are that respondents believe that HACCP plans help to control food safety issues, they agree that food safety issues can occur in the home, and that the US should help to improve the food infrastructure of other countries.

Perceptions on Current Food Safety Regulations

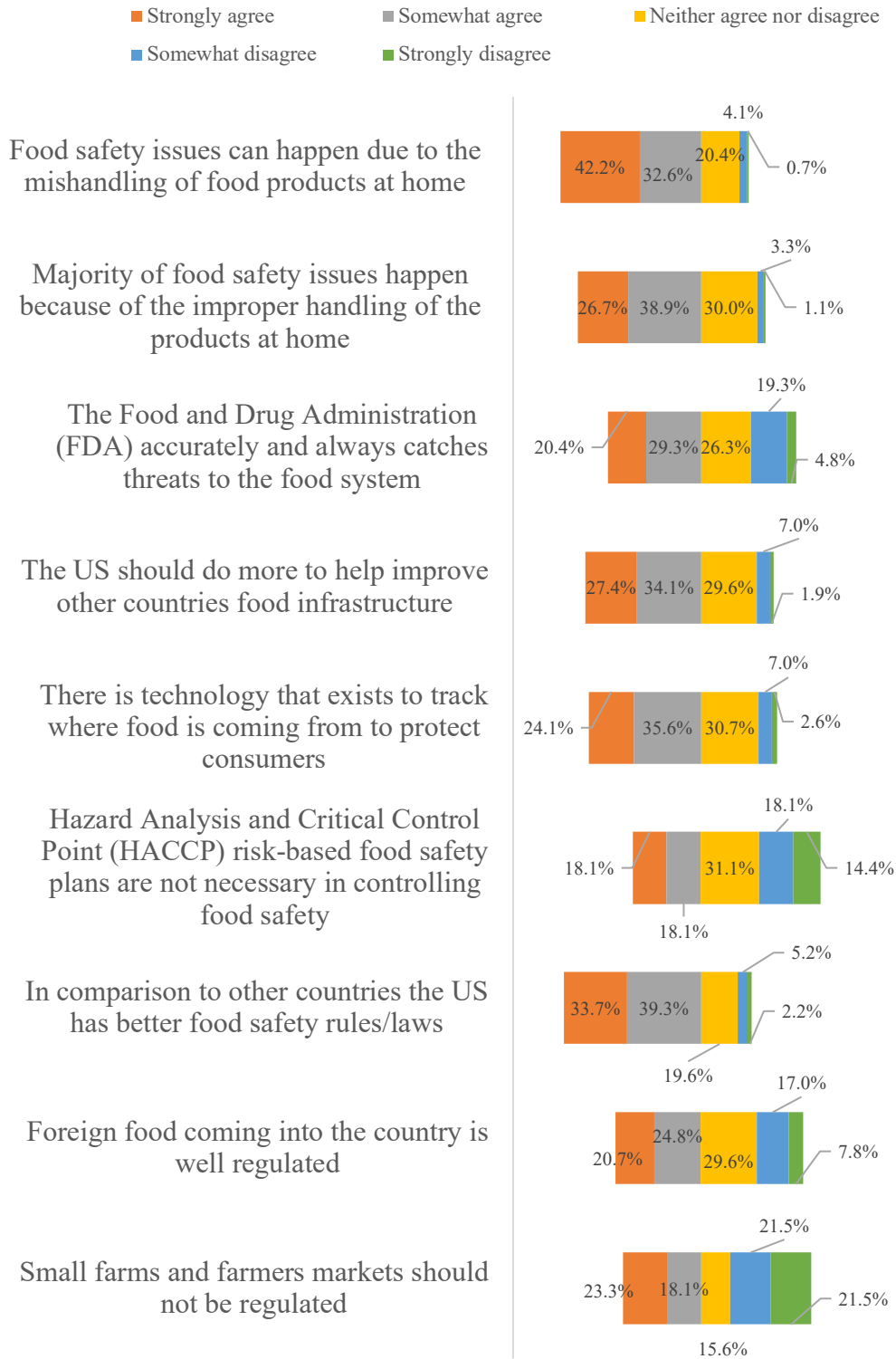


Figure 36. Consumer perception on standards in food safety

Food Safety Responsibility Issues

Respondents were asked to select who they believed should be responsible for food safety issues when they occur, which can be seen in Figure 37. Most of the respondents believed that Farmers / Producers (41%) should be responsible for food safety issues, with Large Corporations/Industry (29%) coming close as second. The smallest percent at 20% is the thought that consumers should be responsible for food safety issues. Although they clearly identified that farmers and producers should be responsible, the data indicates that there might be shared responsibility among the four groups.

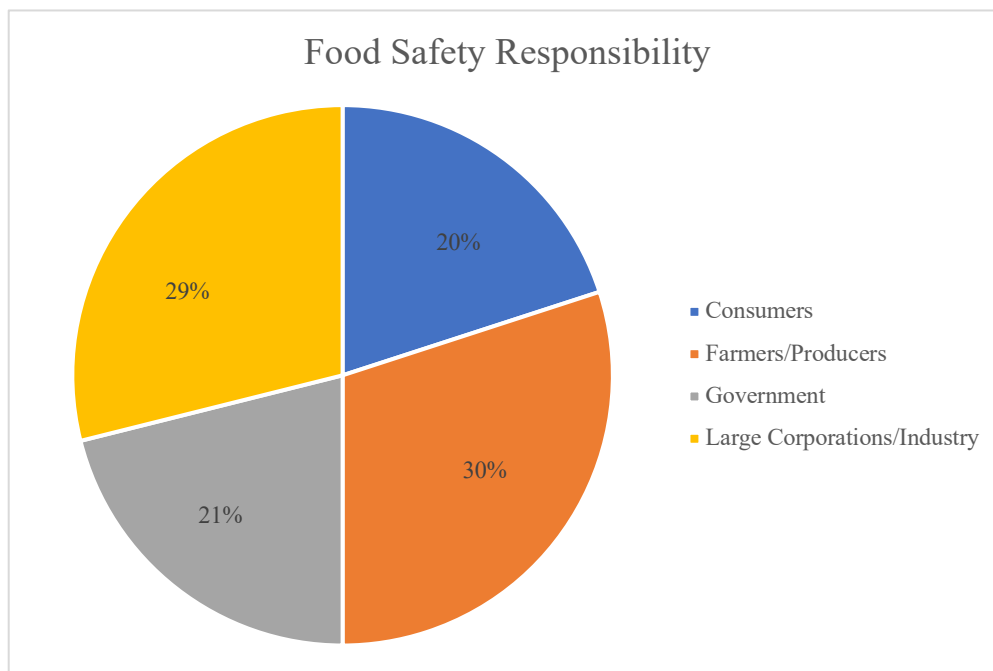







Figure 37. Consumer perception on responsibility in food safety issues

Recognition of Labels

The respondents were asked to look at different labels and select the labels that they have seen before. The pictures shown to respondents can be seen in Table 30. The most recognized label was the USDA logo with 30.5% and the least recognized was HACCP with 7.1%.

Table 30. Consumer recognition of potential labels in the market

| Picture Shown | Percent of Respondents |
|---|------------------------|
|  | 10.2% |
|  | 7.1% |
|  | 26.2% |
|  | 30.5% |
|  | 25.9% |

Supply Chain and Regulatory Entity Knowledge

Respondents were given a series of four statements on the parts of the supply chain, handling through the supply chain, and the role of the FDA and FSIS in food safety. This question was an inquiry of the current knowledge that respondents already have when making their purchasing decisions. The four questions are as follows:

Parts of Supply Chain – Do you know the different parts of the food supply chain?

Supply Chain Safety – Do you feel that cheese is handled safely throughout the food supply chain?

FDA Role – Do you know what role the Food and Drug Administration (FDA) plays in food safety?

FSIS Role – Do you know what role the Food Safety and Inspection Service (FSIS) plays in food safety?

Overall, Figure 38 shows that while there are respondents who were able to answer yes or no for these statements, there were mainly a majority of responses of somewhat, meaning that people aren't able to give a definite yes to knowing about the supply chain and role of FDA and FSIS.

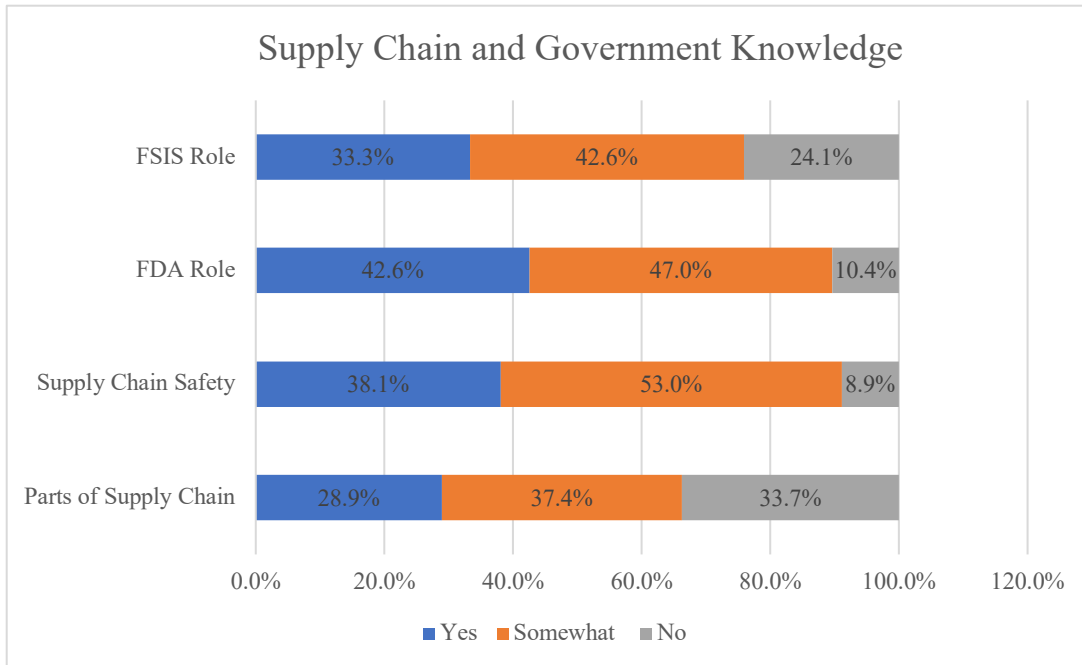


Figure 38. Consumer knowledge on supply chain and government role in food safety

Government and Industry Intervention

Respondents were given a Likert scale in which they were asked to indicate their knowledge on current food safety regulation in the United States. The statements were as follows:

HACCP Knowledge – How knowledgeable about HACCP are you?

Blockchain Knowledge – How knowledgeable about blockchain technology are you?

Government Intervention – How knowledgeable are you on government intervention on food safety?

Industry Intervention – How knowledgeable are you on industry intervention on food safety?

When it comes to knowledge of blockchain technology Figure 39 shows there are many respondents who are not knowledgeable (38.5%). Overall, most of the respondents had

slight to moderate knowledge on both HACCP and Blockchain and government and industry interventions in food safety.

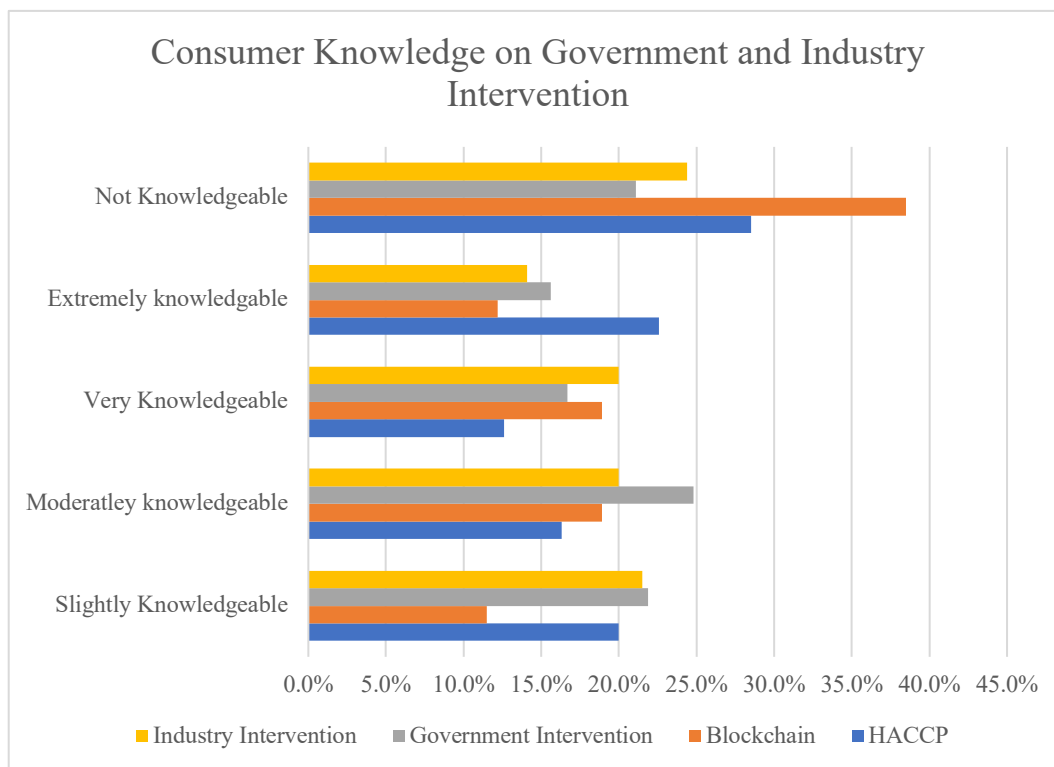


Figure 39. Consumer knowledge on government and industry intervention in food safety

Food Recalls

Two separate questions were asked of respondents on food recalls in the event of a food safety issue. The first question was to understand if consumers are getting the necessary information that they need to make informed purchasing decisions, and second where that flow of information comes from. Over half of the respondents (63.3%) in Figure 40 indicated that they are receiving recall information as it comes out but there are still 36.7% of the respondents who are not. Of the respondents who are receiving recall information, most of the information is coming from media outlets (38%) as shown in Table 31.

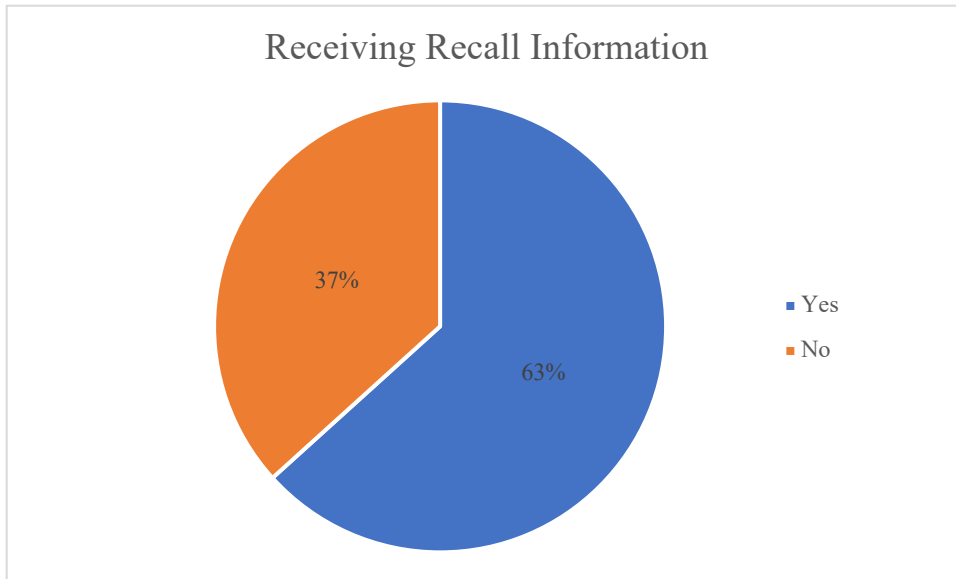


Figure 40. Consumer acknowledgement of receiving recall information

Table 31. Consumer source of recall information

| Source of Information | Percent of Respondents |
|-----------------------|------------------------|
| Media | 38.0% |
| Government Website | 24.6% |
| Grocery Store posting | 14.6% |
| Word of mouth | 5.3% |
| social media | 15.8% |
| Celebrities | 0.6% |
| Unsure/ Don't Know | 1.2% |

5.5.4 Consumer Willingness to Pay

Price / WTP for Meat Purchases

In this section of the survey, respondents were given a series of scenarios for purchasing ground beef. These questions range from baseline information, a series of negative treatments, as well as positive treatments. The first goal was to obtain a baseline of price that the respondents would spend on the ground beef presented before imposing a treatment. The overall objective and mindset of this section is as follows:

Objective: “The following questions will have different scenarios about a ground beef product that you might be purchasing in the marketplace. Please answer these questions as if you were the shopper based on the decisions that you would make while shopping.”

There were two questions for baseline price, the first was the respondent’s willingness to pay for a one pound of ground beef and the second was the respondent’s willingness to pay for one pound of organic ground beef. Figure 41 shows both of the products and how much respondents were willing to pay for these cheese products. The willingness to pay for one pound of ground beef was \$4.00, and the willingness to pay for one pound of organic ground beef was \$6.00.

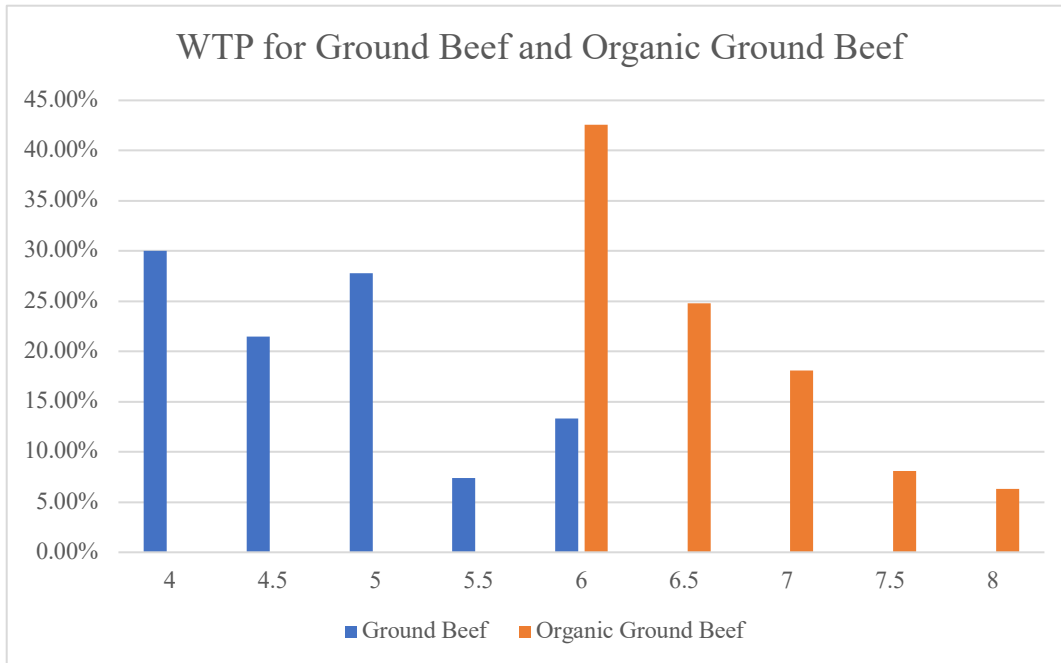


Figure 41. Consumer purchase price for beef products

After gathering the baseline data, the first negative treatment scenario was imposed:

Scenario: “Assume a media outlet has written an article on the mandatory recall of raw ground beef products from XYZ Company that have tested positive for Salmonella.

Answer the following questions based on this assumption.”

The respondents were asked to give their willingness to pay for one pound of ground beef after the recall has occurred and been covered in the media. The highest willingness to pay was \$4.00 after the recall has been covered in the media. This means that there was no change from their initial WTP. As a follow up to the negative scenario, a follow up question was presented to the respondents. They were asked if they would purchase ground beef from a different company. 83% agreed that yes, they would be purchasing a different company following the recall as shown in Figure 42.

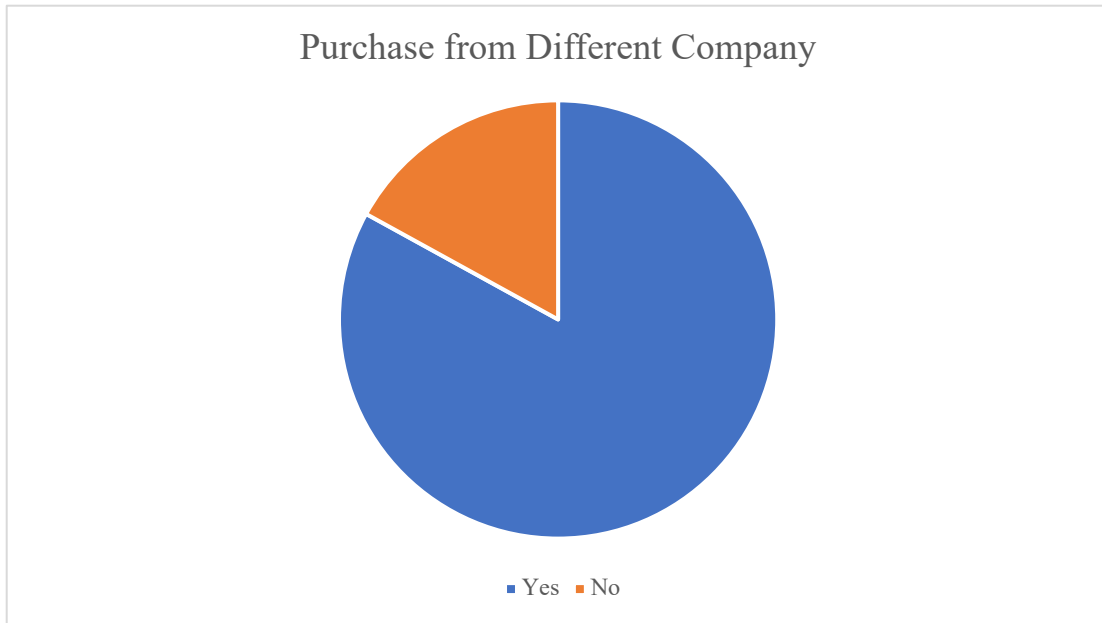


Figure 42. Consumer decision to purchase from a different company

The second negative treatment scenario was then imposed:

Scenario: “Assume USDA FSIS has announced the following raw ground beef items are subject to recall: Vacuum sealed packages containing “Ground Beef”. Answer the following questions based on this assumption.”

After the USDA FSIS identifies the bacteria there is still no change in the respondents WTP of \$4.00. The respondents are finally given the positive scenario:

Scenario: “Assume it has been three months since the recall was issued by USDA FSIS. Answer the following questions based on this assumption.”

Respondents indicated that after three months their WTP is still at \$4.00, which was their initial baseline price as seen in Figure 44. Respondents were again presented with a follow up question about their purchases three months after the recall. While 68.9% of the respondents said that they would purchase ground beef after those three months, there

were still 31.1% of the respondents who said that they would not which can be seen in Figure 43.

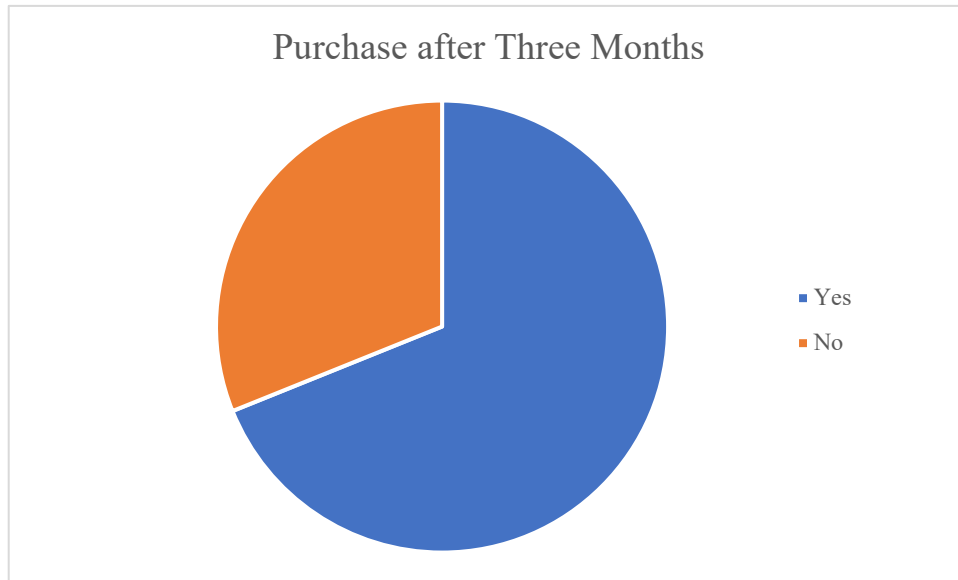


Figure 43. Consumer meat purchase three months after recall

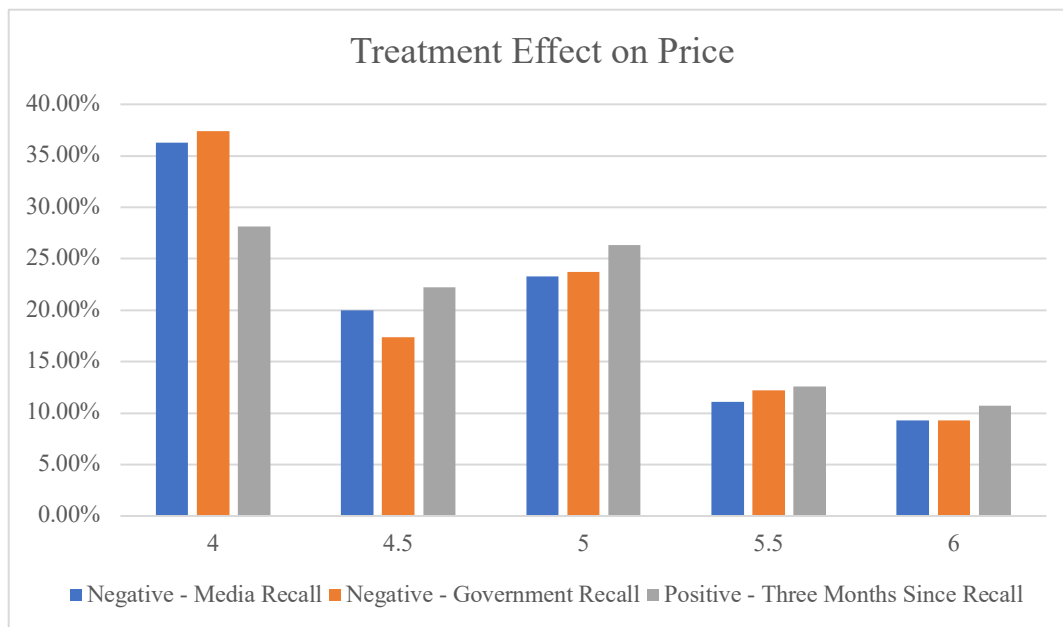


Figure 44. Treatment effect on consumers meat price

The final two scenarios that the respondents were given, were positive treatments of current HACCP management practices that already exist to reduce the amount of food safety issues as well as blockchain technology that improves communication along the

supply chain with data backed information. The two scenarios are examples of government intervention in food safety and industry intervention and seeing if one has a higher WTP than the other. The two scenarios are as follows:

Scenario: “Hazard Analysis and Critical Control Points, is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product. Answer the following questions keeping this statement in mind.”

Scenario: “Blockchain technology is an industry development that works across the supply chain, including growers, processors, shippers, retailers, regulators, and consumers. This allows for the immediate access to food supply chain data from farm to store and consumer. With capabilities for safer food, longer shelf lives, reduced waste, faster traceability, and better access to shared information. Answer the following questions keeping this statement in mind.”

The majority of the respondents gave a WTP of \$4.50 for both HACCP (31.1%) and blockchain (30.4%), but when looking at Figure 45, the next WTP by respondents was \$5.00 for both HACCP (28.9%) and blockchain (23.7%). There might be evidence to suggest that there are a select number of respondents who would be willing to pay a \$0.50 increase for HACCP and blockchain that would help to reduce food safety incidences.

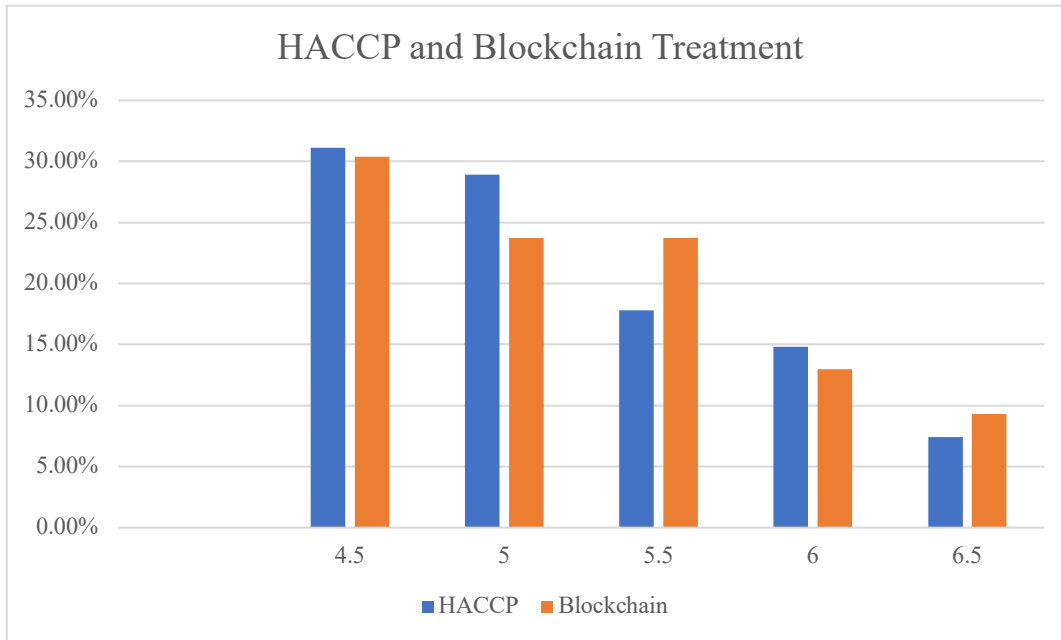


Figure 45. Consumer WTP for HACCP and Blockchain treatment

Figure 46 shows all seven price scenarios and the WTP of the respondents. This graphically shows the changes that occur throughout instances of food safety incidents and the WTP of the cheese product that was being used.

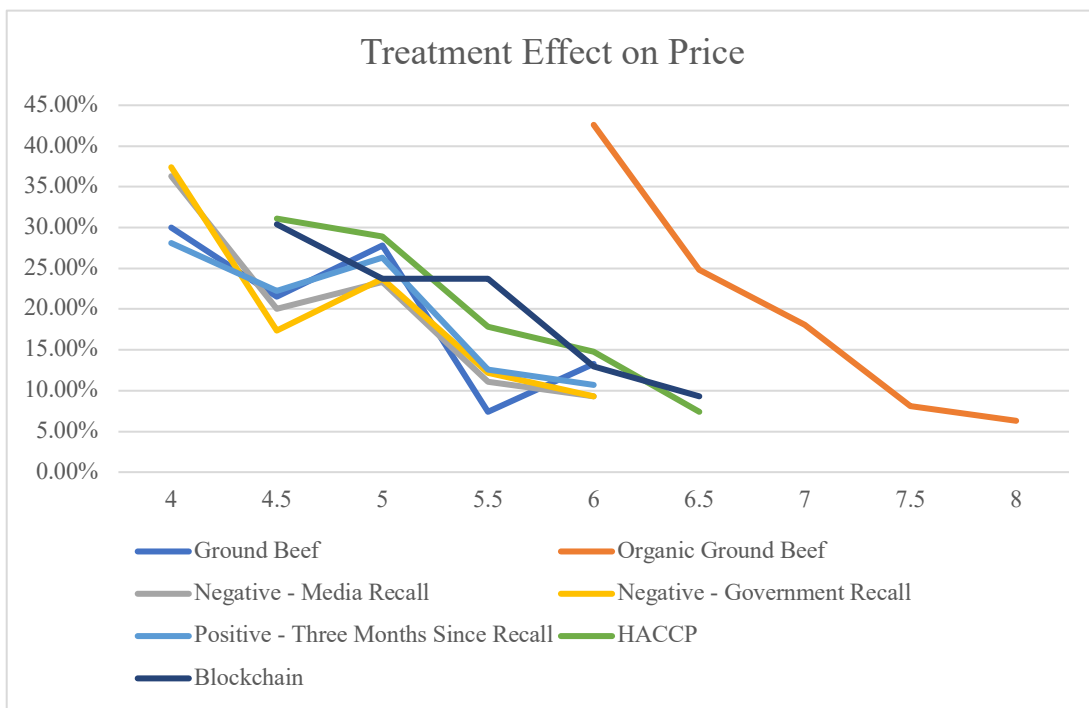


Figure 46. Treatment effect on ground beef WTP

Analysis of Meat Price

In the Tukey test, the difference in mean prices between seven different points of price were analyzed and differences in those mean prices are listed in Table 32. When it comes to consumers the results show that three months after a meat recall consumers have confidence in returning back to their initial base price for ground beef. Also, after the three months consumers will pay at government and media recall prices. In terms of the positive treatments of HACCP and blockchain these had no effect on the confidence of the consumer and didn't impact the price that they were willing to pay for ground beef. But between the two consumers had more confidence in paying extra for blockchain over HACCP.

Table 32. Tukey test difference in mean prices for meat

| | Difference in Mean Prices |
|---|---------------------------|
| Treatments | Meat |
| Base Price X Three Months after Recall | 0.4574*** |
| Blockchain X Three Months after Recall | -0.0815 |
| Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce X Three Months after Recall | -0.0111 |
| Government Recall X Three Months after Recall | 0.4130*** |
| HACCP X Three Months after Recall | -0.0926 |
| Media Recall X Three Months after Recall | 1.7759*** |
| Blockchain X Base Price | -0.5389*** |
| Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce X Base Price | -0.4685*** |
| Government Recall X Base Price | -0.0444 |
| HACCP X Base Price | -0.5500*** |
| Media Recall X Base Price | 1.3185*** |
| Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce X Blockchain | 0.0704 |
| Government Recall X Blockchain | 0.4944*** |
| HACCP X Blockchain | -0.0111 |
| Media Recall X Blockchain | 1.8574*** |
| Government Recall X Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce | 0.4241*** |
| HACCP X Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce | -0.0815 |
| Media Recall X Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce | 1.7870*** |
| HACCP X Government Recall | -0.5056*** |
| Media Recall X Government Recall | 1.3630*** |
| Media Recall X HACCP | 1.8685*** |

Note: *** indicates significance in difference in mean prices for meat

5.6 Consumer Survey Results: Produce Products

5.6.1 Consumer Survey Socio-Demographics

Socio-Demographics

Descriptive statistics were used to examine the following socio-demographic characteristics: gender, age, education, race, and income shown in Table 33. More than half of the respondents identified as Male (54.5%), and a little less than half, Female (44.8%). The age group 35-50 had the largest percentage of respondents at 38.7%. With 18-35 and 50 and above following behind. Those with a master's degree accounted for 29% of the respondents, with high school graduate or less along with bachelor's degree following behind. The smallest percent of respondents held a doctoral degree (6.5%). The two most reported races for this survey group were White and Hispanic/Latino, with 48.7% and 32.6%, respectively. The highest income percentage reported by respondents was \$50,000 - \$100,000 (38.4%).

Table 33. Socio-Demographic profile of sample: Produce Consumers (n=279)

| Characteristic | Number of Respondents | Percent of Respondents |
|-------------------------------------|------------------------------|-------------------------------|
| Gender | | |
| Female | 125 | 44.8% |
| Prefer not to disclose | 1 | 0.4% |
| Male | 152 | 54.5% |
| Other | 1 | 0.4% |
| Age Group | | |
| 18-35 | 100 | 35.8% |
| 35-50 | 108 | 38.7% |
| 50 and above | 71 | 25.4% |
| Education | | |
| Associate / Trade Certificate | 55 | 19.7% |
| Bachelor's Degree | 59 | 21.1% |
| Doctoral degree | 18 | 6.5% |
| High school graduate or less | 66 | 23.7% |
| Master's Degree | 81 | 29.0% |
| Race/Ethnicity | | |
| African American | 34 | 12.2% |
| American Indian or Alaska Native | 7 | 2.5% |
| Asian | 5 | 1.8% |
| Hispanic / Latino | 91 | 32.6% |
| Native Hawaiian or Pacific Islander | 1 | 0.4% |
| Other | 5 | 1.8% |
| White | 136 | 48.7% |
| Income | | |
| \$100,000 and above | 78 | 28.0% |
| \$50,000 - \$100,000 | 107 | 38.4% |
| \$50,000 or less | 94 | 33.7% |

Secondary Demographic Questions

In addition to the primary demographic questions, other factors such as primary shopper in the household, born in the state of Texas, food handling training, foodborne illness sufferer, and purchasing frequency to determine the overall scope of the respondents and potentially how this could impact the data results is shown in Table 34. For this survey group, the majority of respondents were the primary shopper in their household and purchase grocery products at least once a week or more. They were also mainly born and raised in Texas, and more than half do not belong to environmental groups, but 45.9% do. More than half have suffered from a foodborne illness as well as more than half having some type of formal or informal food handling training.

Table 34. Additional socio-demographic information from produce consumer survey

| Characteristic | Number of Respondents | Percent of Respondents |
|---|------------------------------|-------------------------------|
| Primary Shopper | | |
| No | 25 | 9.0% |
| Yes | 254 | 91.0% |
| Originally from Texas | | |
| No | 37 | 13.3% |
| Yes | 242 | 86.7% |
| Formal/Informal Food Handling Training | | |
| No | 81 | 29.0% |
| Yes | 198 | 71.0% |
| Environmental Organization | | |
| No | 151 | 54.1% |
| Yes | 128 | 45.9% |
| Suffered from foodborne illness | | |
| No | 136 | 48.7% |
| Yes | 143 | 51.3% |
| Produce Purchasing Frequency | | |
| Every two weeks | 82 | 29.4% |
| Once a month | 21 | 7.5% |
| Once a week or more | 176 | 63.1% |

5.6.2 Consumer Purchasing Preferences

Produce Product Type and Qualities

For meat products there were 22 different product types that the survey respondents were asked to consider. The top three types of products that they purchased as shown in Table 35 were Apples (89.2%), Grapes (82.4%), and Bananas (82.1%). The least consumed produce type was Specialty and Tropical Fruits with 49.5% of respondents indicating that they did not buy these types of produce. Overall, the most important quality that was

factored into their purchasing was their income and ultimately the price that they would pay for the product. Other qualities that respondents were asked to consider included, appearance, color, country of origin, income, nutritional content, safety of food, and type of product. A list of the products and their rank of important qualities is listed in Table 36 below:

Table 35. Consumer produce purchases

| | Yes | No |
|---|------------|-----------|
| Apples | 89.2% | 10.8% |
| Bananas | 82.1% | 17.9% |
| Berries and Cherries | 68.8% | 31.2% |
| Citrus | 64.9% | 35.1% |
| Grapes | 82.4% | 17.6% |
| Melons | 70.3% | 29.7% |
| Pears | 59.9% | 40.1% |
| Specialty and Tropical | 50.5% | 49.5% |
| Artichokes and Asparagus | 55.2% | 44.8% |
| Avocados | 70.3% | 29.7% |
| Beans and Peas | 71.7% | 28.3% |
| Broccoli, Cauliflower, and Cabbage | 74.9% | 25.1% |
| Celery and Cucumbers | 70.3% | 29.7% |
| Corn | 72.0% | 28.0% |
| Herbs | 59.5% | 40.5% |
| Leafy Greens | 68.1% | 31.9% |
| Mushrooms | 66.7% | 33.3% |
| Onions and Garlic | 79.6% | 20.4% |
| Peppers | 72.0% | 28.0% |

| | | |
|-----------------------------|-------|-------|
| Potatoes and Carrots | 78.1% | 21.9% |
| Squash Varieties | 63.4% | 36.6% |
| Tomatoes | 78.9% | 21.1% |

Table 36. Consumer produce quality preferences

| | Appearance | Cleanliness | Country of Origin | Income | Nutritional Content | Safety of Food | Seasonality |
|--|------------|-------------|-------------------|--------|---------------------|----------------|-------------|
| Apples | 17.7% | 13.1% | 8.3% | 23.4% | 14.2% | 13.2% | 10.0% |
| Bananas | 17.1% | 13.4% | 8.9% | 17.6% | 20.2% | 13.4% | 9.4% |
| Berries and Cherries | 17.4% | 13.5% | 10.0% | 18.9% | 13.8% | 15.2% | 11.2% |
| Citrus | 17.0% | 13.5% | 11.1% | 18.4% | 15.9% | 12.9% | 11.1% |
| Grapes | 19.9% | 12.4% | 9.0% | 18.9% | 15.3% | 12.9% | 11.5% |
| Melons | 17.4% | 12.1% | 11.1% | 18.9% | 13.2% | 13.6% | 13.6% |
| Pears | 16.5% | 15.1% | 9.5% | 19.0% | 14.4% | 13.1% | 12.4% |
| Specialty and Tropical | 15.5% | 13.7% | 10.2% | 18.7% | 14.5% | 14.5% | 12.8% |
| Artichokes and Asparagus | 17.3% | 13.2% | 10.5% | 18.4% | 14.9% | 13.4% | 12.4% |
| Avocados | 17.8% | 12.0% | 11.8% | 18.6% | 15.3% | 13.4% | 11.2% |
| Beans and Peas | 14.9% | 12.9% | 11.1% | 18.8% | 16.3% | 14.2% | 11.8% |
| Broccoli, Cauliflower and Cabbage | 17.7% | 13.2% | 9.5% | 18.6% | 15.6% | 14.1% | 11.3% |
| Celery and Cucumbers | 18.1% | 13.3% | 11.6% | 19.7% | 13.8% | 13.8% | 9.8% |
| Corn | 18.3% | 13.1% | 9.9% | 19.4% | 15.7% | 13.3% | 10.2% |

| | | | | | | | |
|-----------------------------|-------|-------|-------|-------|-------|-------|-------|
| Herbs | 17.6% | 12.2% | 11.4% | 18.6% | 13.6% | 15.1% | 11.5% |
| Leafy Greens | 17.7% | 13.6% | 10.7% | 17.4% | 16.4% | 14.5% | 9.6% |
| Mushrooms | 19.0% | 14.4% | 10.4% | 17.7% | 13.7% | 14.1% | 10.6% |
| Onions and Garlic | 18.4% | 13.5% | 10.3% | 16.8% | 16.5% | 13.2% | 11.4% |
| Peppers | 17.0% | 14.3% | 10.7% | 18.2% | 14.4% | 14.4% | 11.0% |
| Potatoes and Carrots | 18.5% | 13.8% | 11.0% | 17.0% | 16.1% | 14.6% | 9.0% |
| Squash Varieties | 17.6% | 13.4% | 10.7% | 19.4% | 14.7% | 13.4% | 10.8% |
| Tomatoes | 17.3% | 13.4% | 11.6% | 18.6% | 16.5% | 11.9% | 10.7% |

Produce Purchasing Preference

The respondents of the survey were asked two separate questions on their purchasing preferences as it relates to produce products. The goal of the two questions was to understand if organic or local produce played a role in their purchasing. For the purchase of organic produce many of the respondents indicated that they would prefer organic produce (69.2%) as shown in Table 37, with a few respondents that indicated no (30.8%) organic plays no role in their purchasing decision. Also, a majority of the respondents indicated that local produce products (71.3%) played a role in their purchasing decision over non-local.

Table 37. Consumer organic and local produce preferences

| | Yes | No |
|---------|--------|--------|
| Organic | 69.20% | 30.80% |
| Local | 71.30% | 28.70% |

Preferred Market Type

Respondents were asked to select the market types that they typically visit when purchasing food items which can be seen in Table 38. The majority of the respondents shop at supermarkets (65.6%) which for this survey included stores such as HEB, Wal-Mart, Krogers, etc. The other markets that respondents frequented were wholesale markets (19.4%), such as Sams, Costco, etc., farmers markets (10.4%) and, specialty markets (4.7%), such as Sprouts, Whole Foods, etc.

Table 38. Consumer preferred market type

| Market Type | Percent of Respondents |
|------------------|------------------------|
| Supermarket | 65.60% |
| Wholesale Market | 19.40% |
| Farmers Market | 10.40% |
| Specialty Market | 4.70% |

Preferred Product Labeling

Respondents were given seven different labels that might be found on produce products in the marketplace. Then they were asked to give their level of importance in looking for that label in their produce purchasing decisions, those labels can be seen in Figure 47. Some important information to highlight is with the label of “non-gmo” with 41.9% of respondents believing that this was extremely important in their purchasing decision. Another important factor was, “pesticide free” (36.2%) and was also considered extremely important by the respondents. An important note for all the labels, many of the respondents considered most of the labels to be important except for a few most noticeably “Gluten free” (21.2%) and “certified organic” (16.8%).

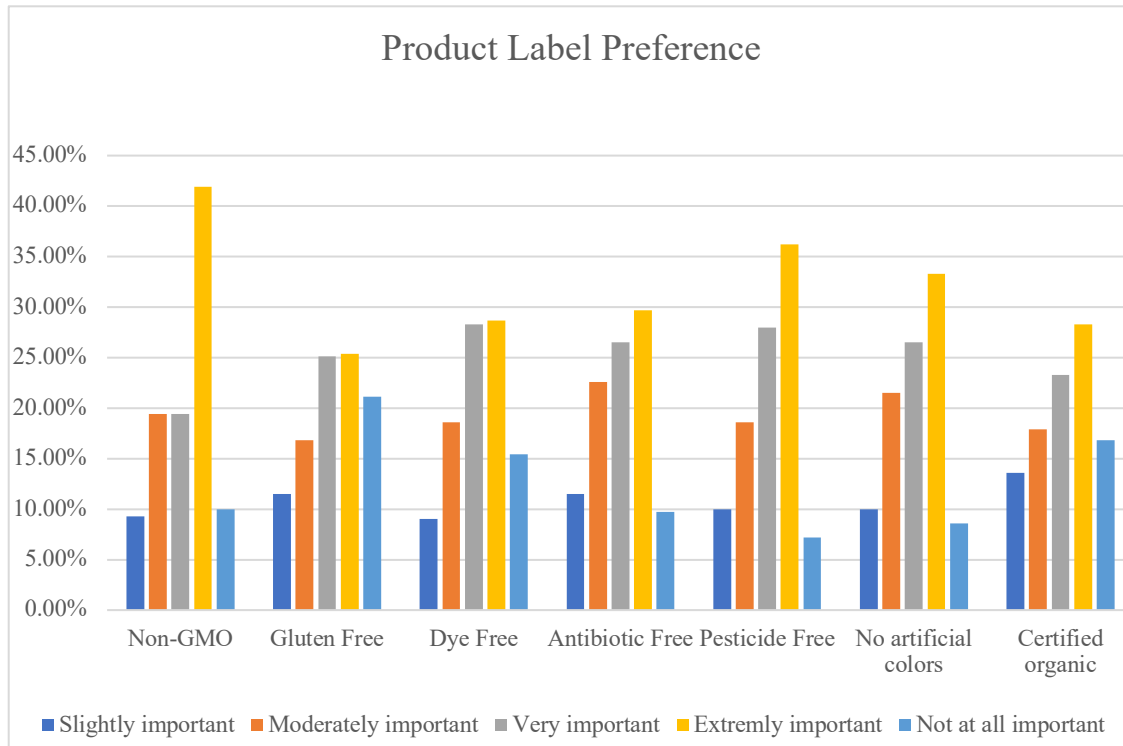


Figure 47. Consumer product label preferences

5.6.3 Consumer Knowledge on Food Safety

Produce Food Safety Concerns

The survey respondents were given two different questions on food safety concerns when purchasing produce products. The first was to determine if there were any concerns when purchasing produce, which 71.3% of respondents indicated in Figure 48, that they did have concerns. If the respondents indicated that they did have concerns they were asked what type of concern they had as seen in Table 39. More than half of those respondents indicated that foodborne pathogens (59.8%) were their main type of concern.

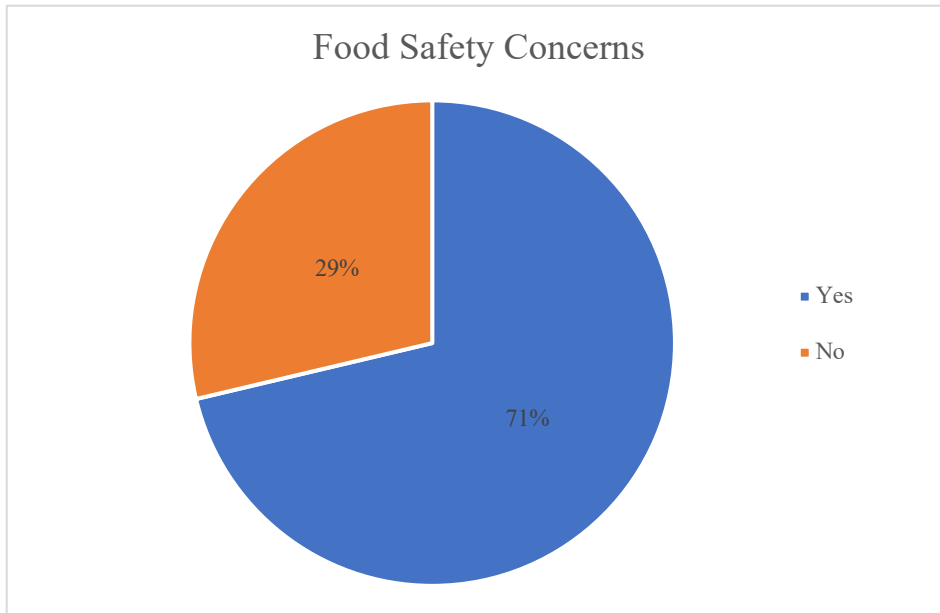


Figure 48. Consumer acknowledgement of food safety concerns

Table 39. Consumer specific food safety concerns

| Source of Information | Percent of Respondents |
|-----------------------|------------------------|
| Foodborne Pathogens | 59.8% |
| Contaminated Products | 25.1% |
| Other | 15.1% |

Food Safety Standards

The respondents were presented with a Likert scale that gave them a set of statements that they could agree or disagree on when it comes to food safety standards. The statements were as follows:

Farm Standards – Do you believe that small farms and large farms should be held to the same standards?

Protection of Consumers – Do you believe that enough is being done to protect consumers from foodborne illnesses?

Market Standards – Do you believe that farmers markets and supermarkets are held to the same standards in selling cheese products?

Recall Confidence – Do you have more confidence in stores that engage in voluntary recalls of cheese products when a safety issue is encountered?

A majority of the respondents on all four statements fell within “neither agree nor disagree” and “strongly agree” which can be seen in Figure 49. Of all the statements, the statement on protection of consumers was the one that respondents fell on the other end and tended to have a higher disagreement and were unsure if enough was being done for consumers to protect them.

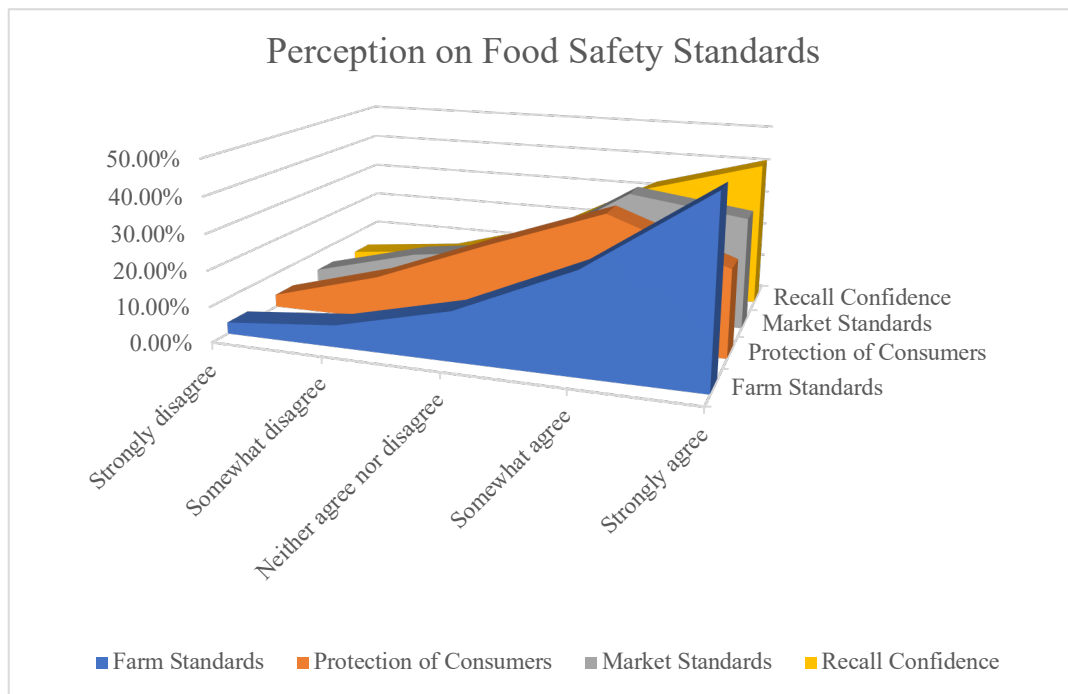


Figure 49. Consumer perception on standards in food safety

Food Safety Regulations

The respondents were also presented with another Likert scale with a set of statement on food safety regulations and for them to agree or disagree with the statements based on their own beliefs around food safety. The statements were as follows:

The participants agreement or disagreement with the statements can be seen in Figure 50.

The major takeaways that can be seen are that respondents believe that food safety issues can occur in the home, and that the US should help to improve the food infrastructure of other countries. There weren't many respondents that fell toward the side of disagreement, except for disagreeing with the statement on HACCP based plans, which they believe should be necessary in controlling food safety. While many people believe that small farms and farmers markets should not be regulated there were those that disagreed and believe that small farms and farmers markets need to be regulated.

Perception on Food Safety Standards

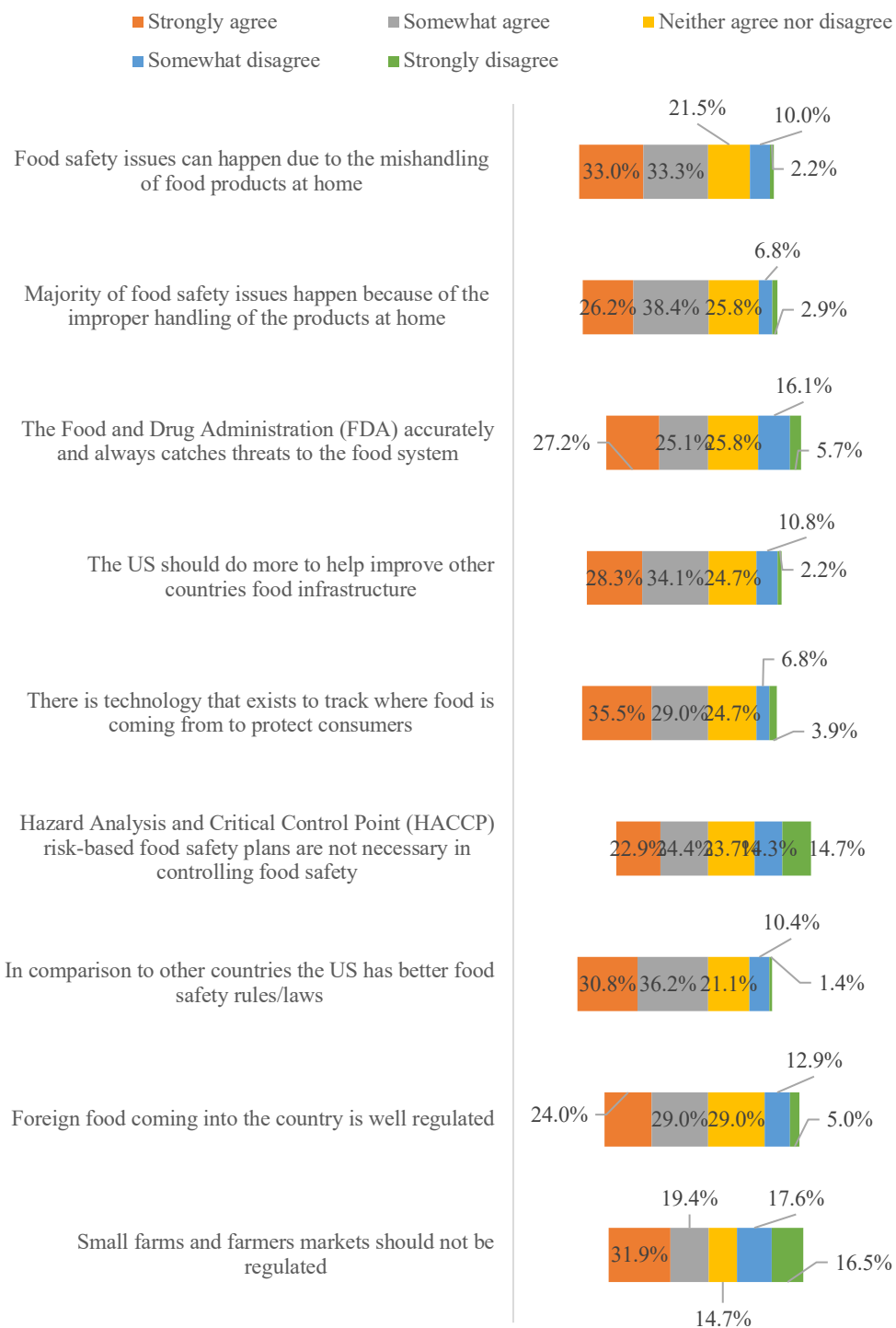


Figure 50. Consumer perception on food safety standards

Food Safety Responsibility Issues

Respondents were asked to select who they believed should be responsible for food safety issues when they occur, which can be seen in Figure 51. Most of the respondents believed that Farmers / Producers (37%) should be responsible for food safety issues, with Consumers (31%) coming in as second. The smallest percent of respondents selected Large Corporations/Industry and Government as the entities responsible for food safety issues.

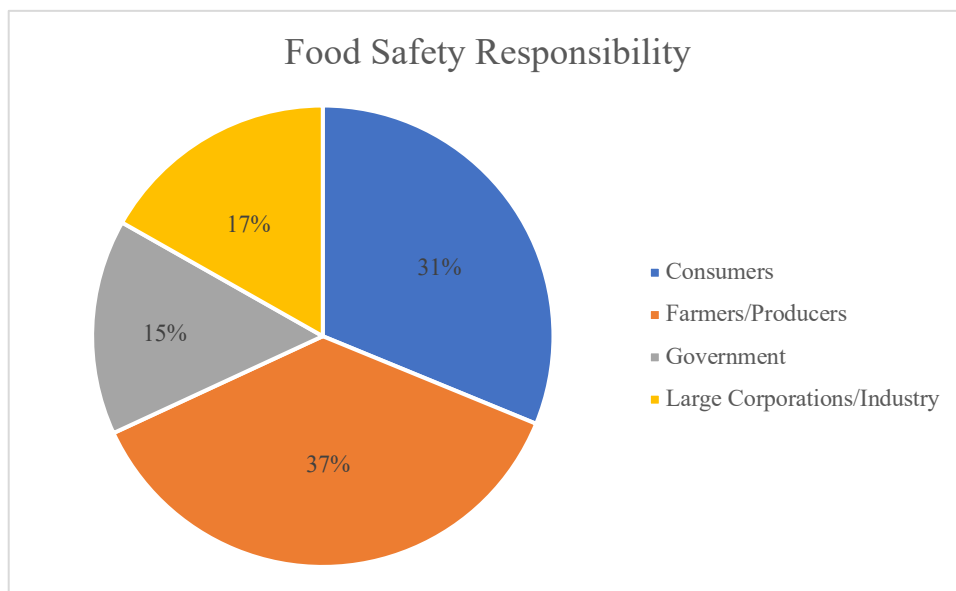








Figure 51. Consumer perception on responsibility in food safety

Recognition of Labels

The respondents were asked to look at different labels and select the labels that they have seen before. The most recognized label as seen in Table 40, was the USDA Organic logo with 24.1% and the least recognized was HACCP with 7.8%.

Table 40. Consumer recognition of potential labels in the market

| Picture Shown | Percent of Respondents |
|---|------------------------|
|  | 13.5% |
|  | 7.8% |
|  | 9.5% |
|  | 24.1% |
|  | 23.5% |
|  | 21.7% |

Supply Chain and Regulatory Entity Knowledge

Respondents were given a series of questions on the parts of the supply chain, handling through the supply chain, and the role of the FDA and FSIS in food safety. This question

was an inquiry of the current knowledge that respondents already have when making their purchasing decisions. The four questions are as follows:

Parts of Supply Chain – Do you know the different parts of the food supply chain?

Supply Chain Safety – Do you feel that cheese is handled safely throughout the food supply chain?

FDA Role – Do you know what role the Food and Drug Administration (FDA) plays in food safety?

FSIS Role – Do you know what role the Food Safety and Inspection Service (FSIS) plays in food safety?

Overall, Figure 52 shows that while there are respondents who answered no to these four statements, over half of the respondents were knowledgeable when asked about the knowing the supply chain and the role of the FDA and FSIS in food safety.

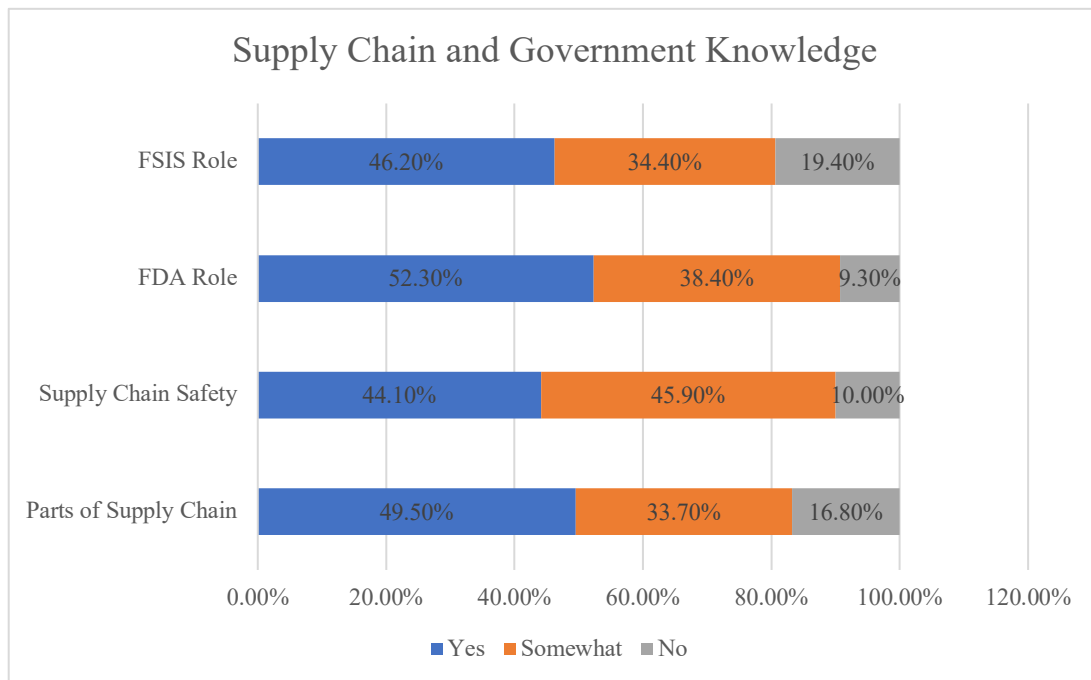


Figure 52. Consumer knowledge on supply chain and government role in food safety

Government and Industry Intervention

Respondents were given a Likert scale in which they were asked to indicate their knowledge on current food safety regulation in the United States. The statements were as follows:

HACCP Knowledge – How knowledgeable about HACCP are you?

Blockchain Knowledge – How knowledgeable about blockchain technology are you?

Government Intervention – How knowledgeable are you on government intervention on food safety?

Industry Intervention – How knowledgeable are you on industry intervention on food safety?

When it comes to knowledge of blockchain technology there are many respondents who are not knowledgeable (25.8%) are shown in Figure 53, but also those that are very knowledgeable (29%). Overall, most of the respondents had slight to moderate knowledge on both HACCP and Blockchain and government and industry interventions in food safety. When it came to HACCP, many respondents were extremely knowledgeable which was to be expected since HACCP has been around for some time.

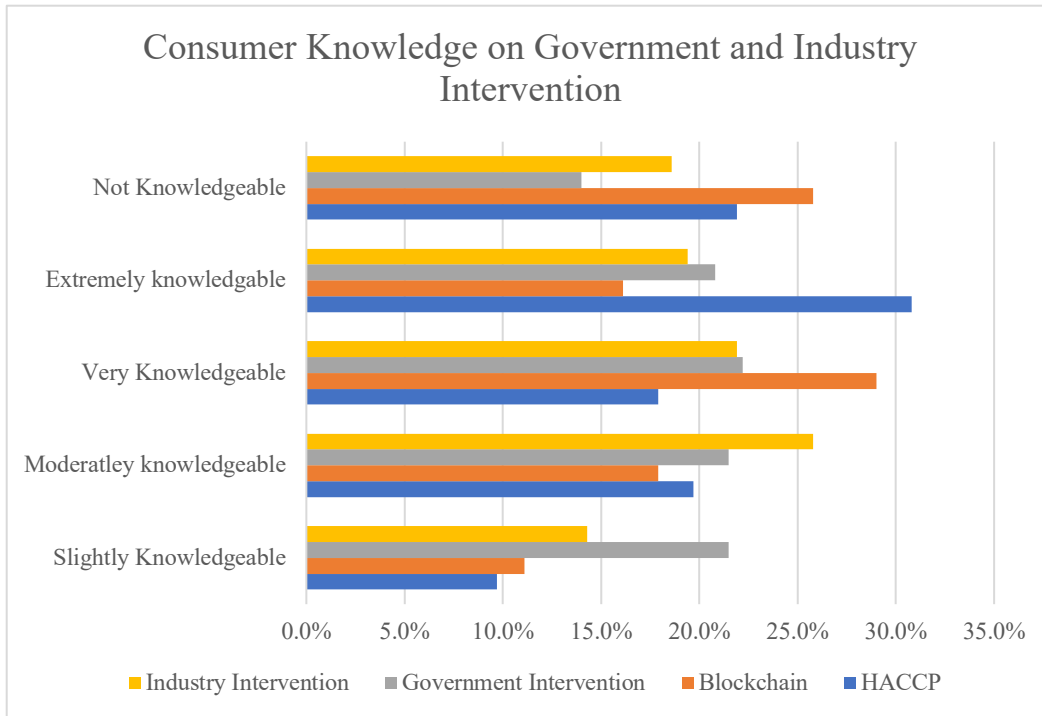


Figure 53. Consumer knowledge on government and industry intervention in food safety

Food Recalls

Two separate questions were asked of respondents on food recalls in the event of a food safety issue. The first question was to understand if consumers are getting the necessary information that they need to make informed purchasing decisions, and second where that flow of information comes from. Over half of the respondents (72%) indicated that they are receiving recall information as it comes out but there are still 28% of the respondents who are not which is shown in Figure 54. Of the respondents who are receiving recall information, shown in Table 41, most of the information is coming from media outlets (22.9%). There were also 28% that did not give a response.

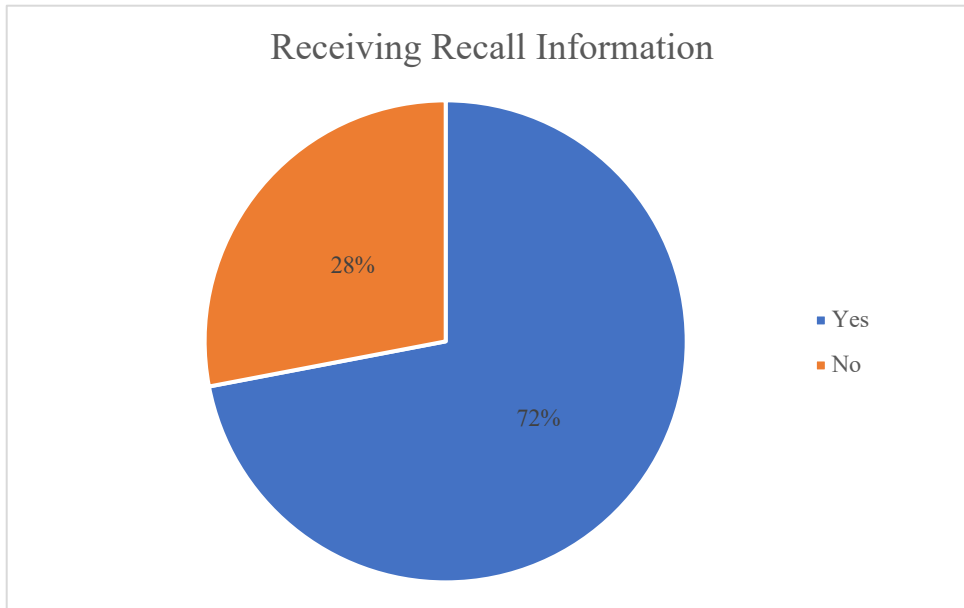


Figure 54. Consumer acknowledgement of receiving recall information

Table 41. Consumer source of recall information

| Source of Information | Percent of Respondents |
|-----------------------|------------------------|
| Media | 22.9% |
| Government website | 16.8% |
| Grocery store posting | 8.6% |
| Social Media | 18.6% |
| Word of mouth | 1.8% |
| Unsure/Don't know | 0.7% |
| Celebrities | 1.4% |
| Other | 1.1% |
| No responses | 28.0% |

5.6.4 Consumer Willingness to Pay

Price / WTP for Produce Purchase

In this section of the survey, respondents were given a series of scenarios for purchasing romaine lettuce. These questions range from baseline information, a series of negative treatments, as well as positive treatments. The first goal was to obtain a baseline of price that the respondents would spend on the romaine lettuce presented before imposing a treatment. The overall objective and mindset of this section is as follows:

Objective: “The following questions will have different scenarios about a specific produce product that you might be purchasing in the marketplace. Please answer these questions as if you were the shopper based on the decisions that you would make while shopping.”

There were two questions for baseline price, the first was the respondent’s willingness to pay for a heart of romaine lettuce and the second was the respondent’s willingness to pay for a heart of organic romaine lettuce. Both of the products are shown in Figure 55 and how much respondents were willing to pay for romaine lettuce. The willingness to pay for a heart of romaine lettuce was \$2.00, and the willingness to pay for a heart of organic romaine lettuce was also \$2.00.

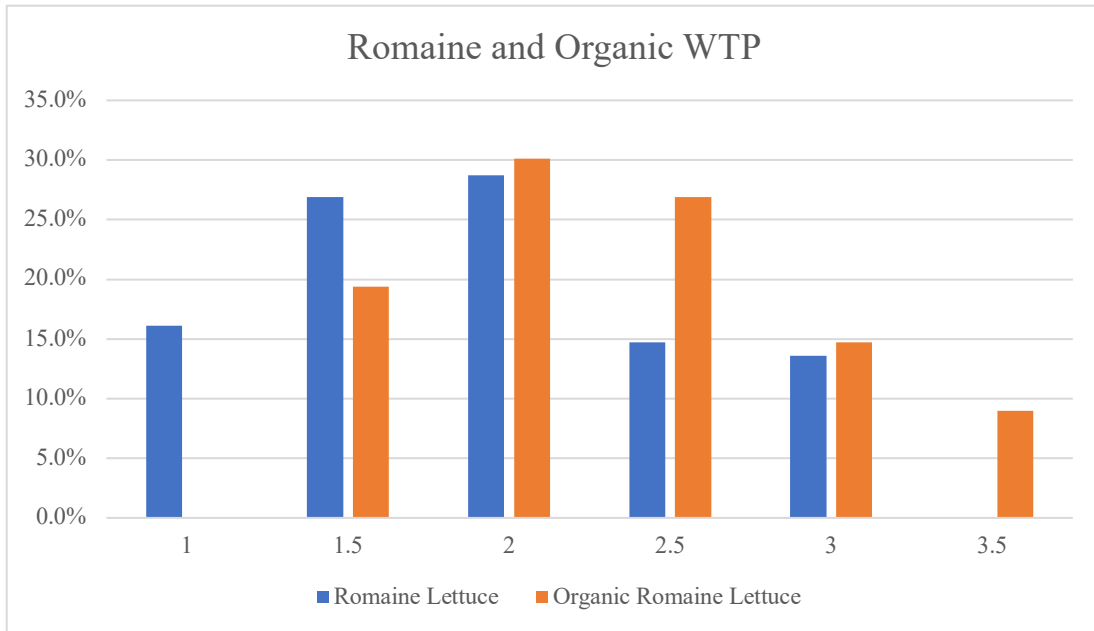


Figure 55. Consumer purchase price for romaine lettuce

After gathering the baseline data, the first negative treatment scenario was imposed:

Scenario: “Assume a media article has been written about an incident in Salinas, California. The article states that illness caused by E. coli has been found in lettuce coming from Salinas, California. They also let readers know that E. coli can cause various symptoms but the most common being severe stomach cramps, diarrhea, and vomiting. Answer the following questions based on this assumption.”

The respondents were asked to give their willingness to pay for a heart of romaine lettuce after the recall has occurred and been covered in the media. The highest willingness to pay was \$1.00 after the recall has been covered in the media, which can be seen in Figure 58. This means that there was a \$1.00 decrease from their initial WTP. There were also a .3% difference in the number of respondents that would still pay their initial WTP of \$2.00. As a follow up to the negative scenario, a follow up question was presented to the respondents. They were asked if they would purchase another type of leafy green, such as

spinach or kale. 84% agreed that yes, they would be purchasing a different leafy green following the recall as seen in Figure 56.

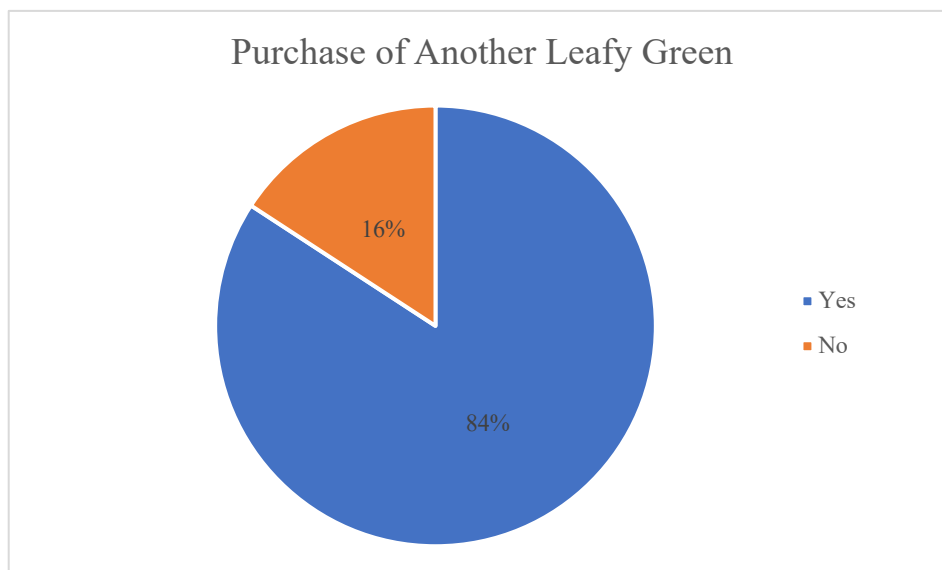


Figure 56. Consumer purchase of another leafy green after a recall

The second negative treatment scenario was then imposed:

Scenario: “Assume a situation where there is a recall of romaine lettuce coming from Salinas, California. FSIS has issued a public health alert for romaine products from the Salinas, California growing regions due to illnesses caused by E. coli O157:H7. FSIS warns against consuming any wraps, sandwiches, prepackaged salad, salad kits, or other products containing romaine lettuce harvested from Salinas, California.”

After the USDA FSIS identifies illness are being caused by E. coli the respondents’ percentage of those willing to pay \$1.00 increases as shown in Table 58, which again is a whole \$1.00 below their baseline.

The respondents are finally given the positive scenario:

Scenario: “Assume that it has now been three months since the E. coli breakout in romaine lettuce from Salinas, California. Answer the following questions based on this assumption.”

Respondents indicated that after three months 28% of the respondent WTP is \$1.50, which is \$0.50 below their initial baseline price. There are still 26.2% of the respondents whose WTP remains at \$1.00, even after the three months. Respondents were again presented with a follow up question about their purchases from Salinas, California three months after the recall. While 65.6% of the respondents said that they would purchase from Salinas, CA after those three months, there were still 34.4% of the respondents who said that they would not, shown in Figure 57.

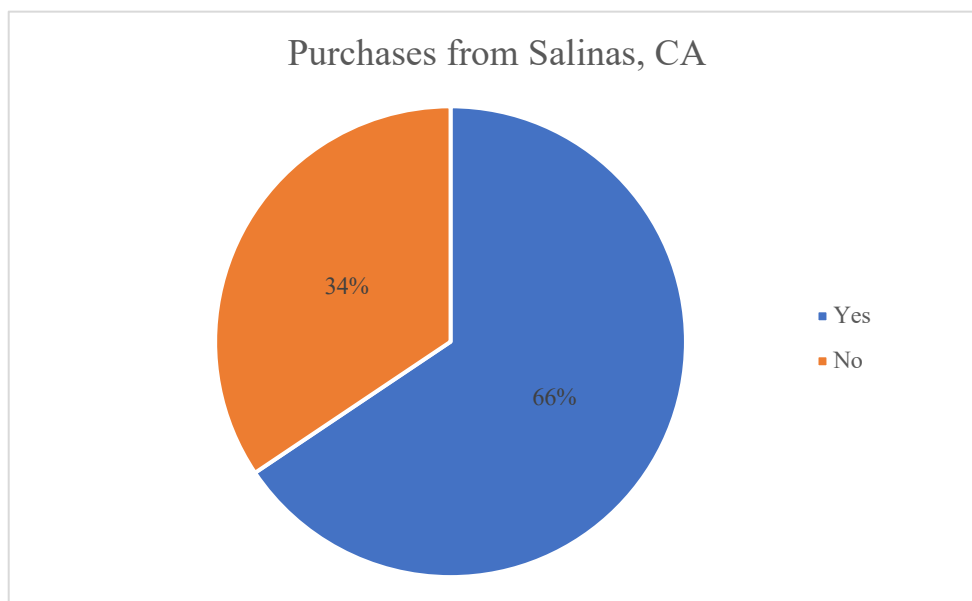


Figure 57. Consumer purchase of romaine lettuce from Salinas, California

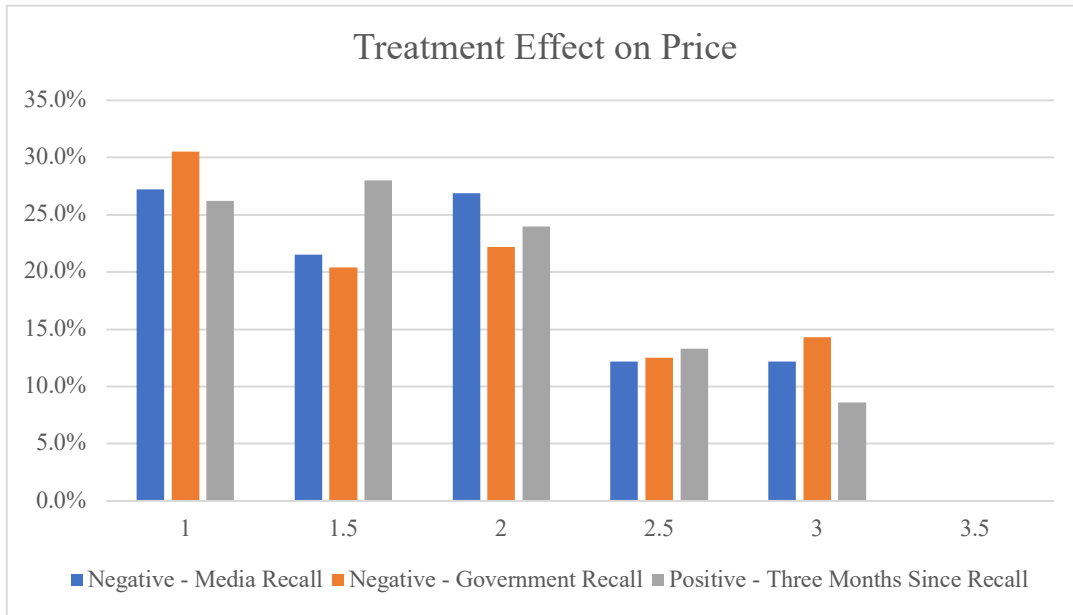


Figure 58. Treatment effect on consumers WTP on ground beef

The final two scenarios that the respondents were given, were positive treatments of current FSMA regulation that has been put into action to prevent the amount of food safety issues as well as blockchain technology that improves communication along the supply chain with data backed information. The two scenarios are examples of government intervention in food safety and industry intervention and seeing if one has a higher WTP than the other. The two scenarios are as follows:

Scenario: “Food Safety Modernization Act (FSMA) is a set of federal government regulations that oversees the global supply chain to prevent contamination. This control is done through various regulations across all types of products, such as the produce safety rule that ensures farms are held to certain standards. Those standards are in place to reduce presence of bacteria in food supply. These practices are preventative and are tracked to ensure better regulation and protect consumers from foodborne illness. Answer the following questions keeping this statement in mind.”

Scenario: “Blockchain technology is an industry development that works across the supply chain, including growers, processors, shippers, retailers, regulators, and consumers. This allows for the immediate access to food supply chain data from farm to store and consumer. With capabilities for safer food, longer shelf lives, reduced waste, faster traceability, and better access to shared information. Answer the following questions keeping this statement in mind.”

The majority of the respondents gave a higher WTP of \$2.50 for FSMA (27.6%), but when looking at Figure 59, the next WTP by respondents was \$1.50 for both FSMA (26.5%) and blockchain (24.7%). There might be evidence to suggest that there are a select number of respondents who would be willing to pay a \$0.50 increase for FSMA rather than blockchain if it would help to reduce food safety incidences.

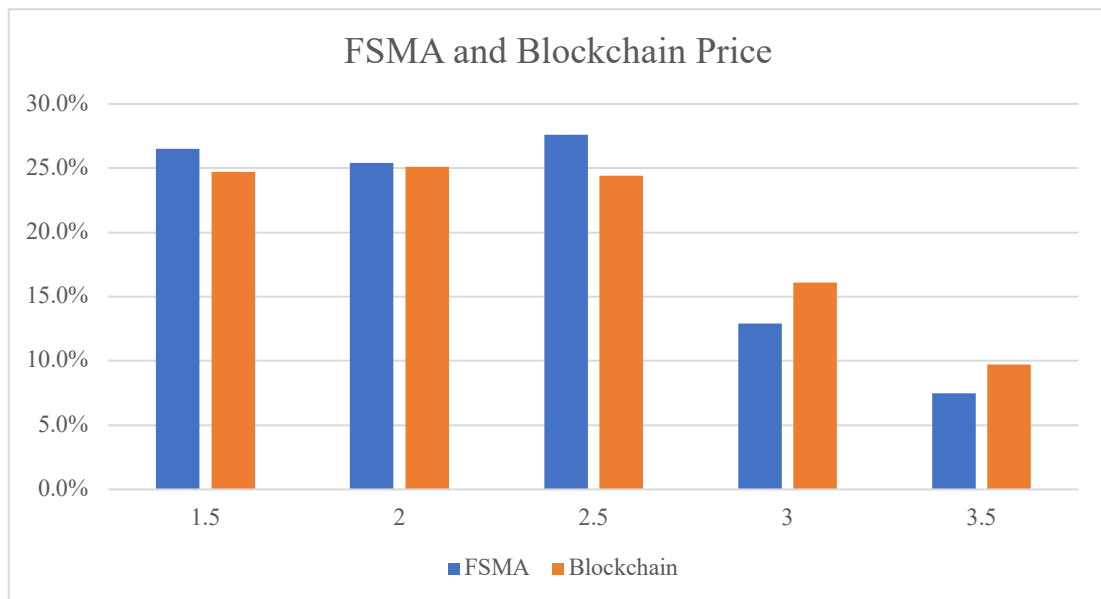


Figure 59. Effect on price from FSMA and blockchain

Figure 60 shows all seven price scenarios and the WTP of the respondents. This graphically shows the changes that occur throughout instances of food safety incidents and the WTP of the romaine lettuce that was being used.

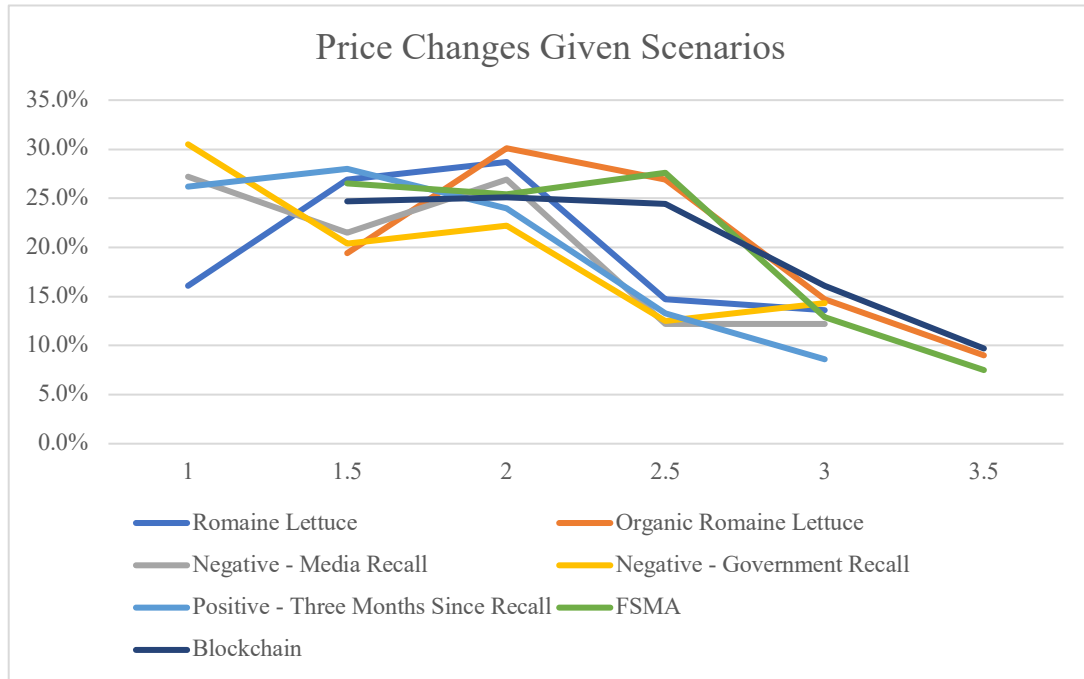


Figure 60. Price change over series of treatment effects

Analysis of Produce Price

In the Tukey test, the difference in mean prices between seven different points of price were analyzed and differences in those mean prices are listed in Table 42. For consumers when it came to romaine lettuce, three months after the recall consumers are confident in returning back to their baseline price or paying \$.50 extra for safe food using blockchain. When it came to FSMA and blockchain, there was no significant difference between the two but blockchain had more confidence over other negative treatments. When it came to negative information such as media and government recall, there was not enough confidence for consumers to change their price that they were willing to pay.

Table 42. Tukey test difference in mean prices for produce

| | Difference in Mean Prices |
|---|---------------------------|
| Treatments | Produce |
| Base Price X Three Months after Recall | 0.1631*** |
| Blockchain X Three Months after Recall | 0.5538*** |
| Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce X Three Months after Recall | 0.4964*** |
| Government Recall X Three Months after Recall | 0.0484 |
| HACCP X Three Months after Recall | 0.0520 |
| Media Recall X Three Months after Recall | 0.5681*** |
| Blockchain X Base Price | 0.3907*** |
| Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce X Base Price | 0.3333*** |
| Government Recall X Base Price | -0.1147 |
| HACCP X Base Price | -0.1111 |
| Media Recall X Base Price | 0.4050*** |
| Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce X Blockchain | -0.0573 |
| Government Recall X Blockchain | -0.5054*** |
| HACCP X Blockchain | -0.5018*** |
| Media Recall X Blockchain | 0.0143 |
| Government Recall X Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce | -0.4480*** |
| HACCP X Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce | -0.4444*** |
| Media Recall X Frozen/Specialty/Organic Ground Beef/Organic Romain Lettuce | 0.0717 |
| HACCP X Government Recall | 0.0036 |
| Media Recall X Government Recall | 0.5197*** |
| Media Recall X HACCP | 0.5161*** |

Note: *** indicates significance in difference of mean prices for produce

5.7 Regression Analysis for Seafood, Cheese, Meat, and Produce

A regression was run to determine if the independent variables of age, gender, ethnicity, education, and food safety knowledge had any effect on the dependent variable of price.

The summary of the regression statistics is shown in Table 43, and when looking at the data, it was not statistically significant. It was determined that more in-depth econometric modeling such as a multinomial logistic regression will need to be analyzed in a future study.

Table 43. Output statistics from regression

| Seafood | | Cheese | | Meat | | Produce | |
|-----------------------|------------|-----------------------|------------|-----------------------|------------|-----------------------|------------|
| Regression Statistics | | Regression Statistics | | Regression Statistics | | Regression Statistics | |
| Multiple R | 0.46833019 | Multiple R | 0.33470606 | Multiple R | 0.41420177 | Multiple R | 0.97483454 |
| R Square | 0.21933317 | R Square | 0.11202814 | R Square | 0.17156311 | R Square | 0.95030239 |
| Adjusted R Square | 0.17890023 | Adjusted R Square | 0.0715481 | Adjusted R Square | 0.13904029 | Adjusted R Square | 0.94806039 |
| Standard Error | 0.59616837 | Standard Error | 0.63131565 | Standard Error | 0.61796719 | Standard Error | 0.14600821 |
| Observations | 265 | Observations | 278 | Observations | 270 | Observations | 279 |

6. DISCUSSION / CONCLUSION

The aim of this research was to analyze consumer perception of existing food safety issues and how that knowledge might give more importance to food safety issues. As well as determine the changes in consumers' willingness to pay for products as food safety related information changes. The four different surveys gathered consumers' preferences and knowledge on food safety as well as imposing negative and positive food safety treatments and impact on willingness to pay. The study shows that there are gaps of knowledge for consumers on food safety regulations and standards as well as more confidence in consumers' willingness to pay for positive food safety information. The findings show that all four surveys for seafood, cheese, meat, and produce products differed in the responses from the respondents but there were some similarities and differences among the products.

The focus groups validated information that was collected in the four consumer surveys. For focus groups, price was the number one factor and shifts in market types might occur based on type of product and where they can find quality and fresh products. In the surveys there were multiple qualities that were listed as the number one quality, but price still ranked within the top three of those qualities selected. This was also seen in the organic debate, while many in the focus groups were split on the qualities of organic foods, this was the same for the surveys and there was also a split between purchasing organic and not purchasing. Two other important points that were discussed in the focus groups and were also noticeable in the surveys were consumers purchasing of food items that they are familiar with and those that they had achieved brand loyalty with especially

since they are unsure of what they should be looking for to ensure they are purchasing a safe food product.

For both types of proteins, consumers indicated that their income and the price of the protein was the most important quality in their purchasing decisions, which was also gathered in the focus groups. They also preferred to shop at a traditional supermarket to purchase these two types of products. When it came to food safety, both consumers for meat and seafood believed that food safety issues can happen due to the mishandling of products at home. They also believed that HACCP based risk-safety plans were necessary to protect them from foodborne illnesses and that the U.S. has better food safety rules/laws than other countries. These consumers are also split on who they believe is responsible for food safety issues when they occur, they also have knowledge of the supply chain and regulatory agencies but there are still many of them that still lack knowledge on these topics, so more education to fill this gap would be necessary.

For cheese and produce products the similarities between the two were those consumers that would rather purchase organic cheese or produce which looking back at focus groups might be due to cleanliness or freshness factors. These consumers also believe that there are potential hazards at home in their handling practices, they were also split on who is to blame for food safety issues when they occur. In terms of food safety knowledge both are knowledgeable on supply chain and regulatory entities, but there are those that are unaware and again there are gaps of knowledge of what consumers know in terms of how their food is being handled.

The major difference between cheese and produce products was the knowledge of blockchain. This was attested to the new developments with blockchain in produce

especially for leafy green that tend to have the most food recalls. Blockchain has been in the media for produce so more and more consumers are learning about it and how it impacts their produce purchases.

The biggest difference between the meat and seafood products was their knowledge on food safety standards such as those standards that small and large farms are held to as well as if they are being protected in the market. For seafood, many of the consumers fell within strongly agreeing or strongly disagreeing and for meat most of the consumers leaned toward strongly agreeing on the four different food safety standards. This means that consumers might lack some knowledge with farm standards as well as what is being done in the market to protect consumers.

Based on the data collected it can be inferred that when given both negative and positive treatments there are changes in demand for products that occurs. When a negative treatment, media recall or government recall was introduced this caused a negative downward shift in demand for the particular product presented to them. A similar effect occurs when a positive treatment, such as three months since a recall or HACCP and Blockchain are introduced to consumers. When this positive treatment is imposed the demand for the product will go back up because the fear of a food safety issues has been removed or minimized.

Looking at the research as a whole, consumers have their own preferred qualities that they look for in the market when buying products. The biggest factors are those of their food safety knowledge and how that impacts their willingness to pay for products given positive or negative food safety information. The results show that there are gaps in knowledge that need to be filled, especially in teaching consumers the basics of what they

should be looking for in the market or from those handling their products. It is also evident that consumers are unsure of where the food safety problems occur, although they agree that practices within the home could be making them prone to food safety issues. With trade making supply chains longer, it is important for consumers to understand each point within that chain to make more informed decisions. This also poses an opportunity for smaller producers and a rise in farmers markets so consumers have more confidence in their food products and reducing that long supply chain where food safety issues could occur.

There were limitations to this study, while this is only a qualitative look at the data and understanding the knowledge and willingness to pay for consumers more econometric modelling needs to take place to determine the specific influencing factors on consumers' willingness to pay for safe food products. This study was also done during COVID-19, which impacted the market prices used in the study and potentially the current perceptions of consumers that might differ from their baseline perceptions.

This study only begins to hit the surface of the work and research that will need to be done by all different disciplines to come together to understand the implications of food safety on consumers' moving forward. More research and collaboration in food safety matters will need to be research and for new developments to be made and what impact that has on the consumers moving into the future.

APPENDIX SECTION

Appendix A: Focus Group Questions

Shopping Habits and preferences

- Frequency of shopping?
 - Time preference for shopping
- Factors considered while purchasing food particularly meat products.
 - Income (price)
 - Nutritional content
 - Safety of food
 - Origin
 - Appearance
 - Type of market
 - Any differences in factors while considering seafood purchase, cheese products or fruits and vegetables

Consumer knowledge on food safety

- Terminology
 - Food Safety
 - Food Security
 - Food-borne illnesses
 - HACCP
 - FSMA
 - GAP
- Source of food safety information
 - Most reliable source
 - Timely information
 - Enough information? Any Suggestions for improvements?
- Why food safety is important in agriculture?
- Are you aware of food recalls by Authorities?
 - Your perception of food recalls
 - Your perception on how to mitigate food safety issues
- Are you aware of food safety practices followed by the facilities handling food products?
 - Perception of food safety practices in these facilities

Secondary Questions (If time permits)

- Do you know how foodborne illnesses affect different populations?
- What kinds of unsafe food handling practices have you witnessed in supermarkets?
- Do you look at labeling to determine quality and safety of food products?
- Do you know what rules farmers markets must follow regarding food safety?

Terms in Food safety

- What is a high risk or low risk food? What kinds of foods fall in these categories?
- What are cottage foods?

- What is the difference between Agriculture, Apiculture, Aquaculture, Horticulture, Silviculture, Viticulture, and Olericulture?
- Are you familiar with Organic labels?
 - Your perception about organic labels
 - What are some of the common labels you know?
- Do you think different advocacy groups have an impact on food safety?

Appendix B: Texas State University IRB approval



In future correspondence please refer to 6137

November 16, 2018

Pratheesh Omana Sudhakaran, Ph.D.
Texas State University
601 University Drive.
San Marcos, TX 78666

Dear Dr. Omana Sudhakaran:

Your IRB application titled "Determining Consumers' Willingness to Pay for Safe Food Products" was reviewed and approved by the Texas State University IRB. It has been determined that risks to subjects are: (1) minimized and reasonable; and that (2) research procedures are consistent with a sound research design and do not expose the subjects to unnecessary risk. Reviewers determined that: (1) benefits to subjects are considered along with the importance of the topic and that outcomes are reasonable; (2) selection of subjects is equitable; and (3) the purposes of the research and the research setting is amenable to subjects' welfare and producing desired outcomes; that indications of coercion or prejudice are absent, and that participation is clearly voluntary.

1. In addition, the IRB found that you need to orient participants as follows: (1) signed informed consent is not required as participation implies consent; (2) Provision is made for collecting, using and storing data in a manner that protects the safety and privacy of the subjects and the confidentiality of the data; (3) Appropriate safeguards are included to protect the rights and welfare of the subjects. (4) Focus Group participants can earn up to \$30.00 and survey participants compensated \$20.00 for their participation.

This project is therefore approved at the Exempt Review Level

2. Please note that the institution is not responsible for any actions regarding this protocol before approval. If you expand the project at a later date to use other instruments, please re-apply. Copies of your request for human subjects review, your application, and this approval, are maintained in the Office of Research Integrity and Compliance.

Report any changes to this approved protocol to this office. All unanticipated events and adverse events are to be reported to the IRB within 3 days.

Sincerely,

Monica Gonzales
IRB Regulatory Manager
Office of Research Integrity and Compliance

OFFICE OF THE ASSOCIATE VICE PRESIDENT FOR RESEARCH

601 University Drive | JCK #489 | San Marcos, Texas 78666-4616

Phone: 512.245.2314 | fax: 512.245.3847 | www.txstate.edu

This letter is an electronic communication from Texas State University-San Marcos, a member of The Texas State University System.



The rising STAR of Texas

September 24, 2020

From

Dr. Pratheesh Omana Sudhakaran
Asst. Professor
Dept. of Agricultural Sciences
Agriculture Building
Texas State University

To

The Graduate School
Texas State University

Subject: IRB Approval and Confirmation of Anisa Elizondo as research team.

Dear Sir/Madam

I am currently conducting an economic research on food safety aspect of consumer behavior. As part of the data collection, I have applied for IRB approval and got approved (IRB approval # 6137) at the Exempt Review Level. Ms. Anisa Elizondo (A04015019) is working with me in this project and the data from this study will be used for her MS thesis work.

Please contact me if you have any questions or concerns on this regard.

Sincerely,

Dr. Pratheesh Omana Sudhakaran

DEPARTMENT OF AGRICULTURAL SCIENCES

601 University Drive | Agriculture Building | San Marcos, Texas 78666

phone: 512.245.2459 | fax: 512.245.3320 | WWW.TXSTATE.EDU

This letter is an electronic communication from Texas State University.

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Appendix C: Notes from focus groups in Houston, Dallas, and San Marcos

Houston Focus Group Notes

- Frequency of consumption
 - Fruits/Veggies
 - Once a week is the consensus
 - Meat
 - 3-4 times a week
 - One, likes meat fresh
 - Seafood
 - 2-3 times
 - Most is seasonal consumption
- What factors do you consider when buying meat?
 - #1 price
 - Appearance and quality
 - One lady commented that Organic is important, a man answered that organic doesn't last as long
 - Smell of the meat
 - Color and proportion of meat to fat
 - H-E-B was the general consensus of where participants purchased meat
- Seafood?
 - Will NOT purchase seafood at Walmart, H-Mart or other seafood market was the general choice
 - Time-sensitive: Fresh is best so buy only when needed, and it needs to be purchased from a counter
 - Origin: since they live close to Gulf Coast, they want to get local
 - One man commented on avoiding farm raised, another agreed that the meat of farmed animals tastes different
- Produce?
 - Cleanliness – (dirty greens was an example)
 - Organic is best for leafy greens
 - One man disliked that fruits are sold underripe
 - Variety
- Is Food Safety a Consideration?
 - Would not return to a store or establishment if they had a food safety or cleanliness issue
- What do you think of when you hear food safety?
 - Allergies and the need to avoid cross contamination
 - Food Safety is backed by the FDA
 - Cleanliness and proper procedure when preparing food
- Does origin matter?
 - A couple of people say it does matter
 - It doesn't seem like people know what origin of produce means
 - Seasonality of products will lead people to farmers market to get in season produce
- Safety consideration of fruits and veggies?

- Cleaning the produce
- What is being recalled, avoid those types of fruits/vegetables
- Consumption factors?
 - Meat
 - Freshness
 - Deli section
 - How long will it last
 - Company names
 - Cheese
 - Real cheese, no processed cheese
 - Deli section for cheese products
 - Packaged cheese products?
 - Date
 - Specific brand, more expensive is better
- Terms in food safety
 - Food Safety
 - Yes, people know what it is
 - Food security
 - Most haven't heard of it
 - 2 ladies mentioned that it refers to people who are unable to get fresh fruit and vegetables
 - Foodborne illness
 - Yes, people know what it is, but with varying definitions: storage and preparation of foods vs. viruses in foods
 - E.coli, salmonella
 - Blue Bell Listeria
 - Discussed storage and handling of food at home
 - HACCP
 - No, haven't heard of it
 - FSMA
 - No, haven't heard of it
 - GAP
 - No, haven't heard of it
- Most reliable source of information for food safety?
 - News sources on tv or internet
 - Confirm on FDA website
 - Food safety courses are required for people who work in restaurants
 - Parents of school aged children receive info through the cafeteria
- Do you receive information in a timely manner?
 - No, they feel as if someone must die or an illness has to occur before they know about it
- Do you receive ample information?
 - Food networks and news sources talk about the information when a recall has occurred or during peak food seasons like holidays, but no consistent flow of information

- Checks occur at the point of purchase, like visually inspecting the food and checking temperatures
 - Most mentioned they are not seeking information unless a recall has occurred
- Are you aware of any recalls?
 - Yes, they happen all the time
 - Romaine lettuce, Blue Bell, tomatoes
- How many remember romaine recall last thanksgiving?
 - All remembered
- How many will stop purchasing romaine?
 - Almost all answered they stopped buying romaine during recall and switched to kale
- How long until you buy lettuce again?
 - Only two ladies mentioned they switched to kale or spinach
 - Everyone else mentioned they buy lettuce now
 - One lady specified that it took her a month or two after the recall to feel comfortable again
- What made you purchase lettuce again?
 - If food is back, you assume they've taken the necessary steps to make it safe for sale again
 - After a recall they are being more careful about what goes out to the public
- Why are we seeing an uptick in food recalls?
 - The government is finding new ways to poison us
 - Producers cutting corners or not caring enough to wash and store food properly
 - Higher demand and fewer resources have pushed the producers to create output faster and less carefully. Production has outgrown quality control.
 - Not enough money to safely check everything
- How to reduce these incidents?
 - Buy local from co-ops or farmers markets
 - Have more food inspectors. Make major companies pay for quality control.
 - Implement more checks at every level
- Would these procedures increase your confidence?
 - Yes
- Are you aware of food handling practices?
 - People think these are mandatory guidelines that companies are required to follow
 - They are not sure if these are carried out at every level
- Could this be a source of contamination?
 - Yes, workers don't wear gloves anymore
- Picture Analysis
 - #1- Be Food Safe
 - No, never seen
 - #2 – HACCP

- No, never seen
 - One had seen, but not sure where. Possibly in a restaurant.
- #3 – FSMA
 - No, never seen
- #4 – USDA Organic
 - Yes, have seen it
 - Food is safe and healthy because they care about what they are putting out there
 - They have extra guidelines and are usually more expensive
- #5 – USDA
 - Yes, have seen it
 - Up to FDA standards
- #6 – Meat Case Picture
 - Fresh, quality
 - Cleaner because counter attendants wear gloves
 -
- #7 – Chicken in Package
 - USDA label
 - Purdue Brand
 - Nutritional label
- #8 – Non-GMO
 - Yes, all familiar
 - Trust this label because they don't like genetically modified foods
 - Some confusion over what a GMO was
- #9 – Fish Case
 - Wearing gloves
 - Looks good and fresh
 - Fresh ice and good color
 - Never seen the label
- #10 – Ethnic Meat Market
 - No, wouldn't buy it
 - Probably Fiesta or La Michoacána Market
 - Appearance is unappealing, meat looks off color
 - Cultural presentation
- #11 – Meat in package
 - Looks good
 - USDA
 - Price
 - Date
 - Try to buy grass-fed beef
 - Some parts of the beef looks brown so one lady wouldn't buy
- Are you familiar with cottage food?
 - Not familiar
- Do you know the difference between agriculture, horticulture, aquaculture, apiculture, silviculture?
 - Heard of agriculture and horticulture

- One man knew of aquaculture

Picture Analysis



When asked if they had seen this label before,

Majority Response: No

Minority Response: Yes, one person had seen it before



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When asked if they had seen this label before,

Majority response: No, every person said no



When participants were asked if they had seen this label before,
Majority response: No, no one had seen the label before



When participants were asked if they had seen this label before,
Majority response: Yes

Key words and opinions used when discussing the label: “safe”, “healthier”, “expensive”

The majority of participants associated this label with “safer” food because it is certified. They associated it with more expensive food items. They said that this label meant that the brand cares more about their product and “what they’re putting out there”.



Majority response: Yes, have seen the label before, design is unfamiliar

Minority: No, have not seen it (maybe 1 or 2 people)

"It means that it is up to FDA standards"



Majority response: Food is safe, clean, fresh, handled properly

Minority response: Food is exposed (1 person)

Key words/phrases used when discussing this image: "whole foods", "fresh, not packaged", clean, gloves used when handling means that its being handled properly, in a clean container, safe container space.



When asked “what do you look at when you see this product?”,

Majority response: brand, expiration, USDA label

Minority response: nutrition label



When asked if they have seen this label,

Majority response: Yes

Minority: No (1 person)

Key words/phrases used when discussing this image: “healthier”, “chemical free”, “pesticide free”, “I know it’s safer to eat”

*only 1 person knew that “non-GMO” does not really matter.



Majority response to this picture: looks good, fresh, clean (3), cold, clean ice, safe due to gloves (2)

Minority response: label indicates farm raised fish (1 person), the label is unknown (1 person)



Majority response: would not buy, is confused by the mixing of fruits/veggies with raw meat, thinks meat looks discolored

Minority response: meat is in a container that seems safe and chilled

Most of the focus group participants seemed wary of this picture and indicated they would likely not consider buying these products.



When asked what they would look at when considering this product,

Majority response: Date/expiration, USA label, price, “grass-fed” label, check for puncture marks

Minority response: smell of the product, whether the meat looks brown

Rockwall Focus Group Notes

- Frequency of consumption
 - Fruits/Veggies
 - 2-3 times a week
 - Dairy
 - twice a week
 - Meat
 - once a week
 - one participant hunts, so buys meat very rarely
 - Seafood
 - Most is seasonal consumption
- What factors do you consider when buying meat?
 - #1 price
 - quality of the meat: appearance and certain stores have better quality overall
- What factors do you consider when buying seafood?
 - Price, seafood is expensive
 - Picky about seafood
 - Thinks about when it will be prepared, they want it fresh
 - Most don't consider it a main protein
- What factors do you consider when buying produce?
 - Price
 - Freshness
 - Farmers market for fruits
 - Price and location due to sales
 - Variety
- Does origin of product matter?
 - A couple of people say it does matter
 - It doesn't seem like people know what origin of produce means
 - Seasonality of products will lead people to farmers market to get in season produce
- Safety consideration of fruits and veggies?
 - Cleaning the produce
 - What is being recalled, avoid those types of fruits/vegetables
- Consumption factors?
 - Meat
 - Freshness
 - Deli section
 - How long will it last
 - Company names
 - Cheese
 - Real cheese, no processed cheese
 - Deli section for cheese products
 - Packaged cheese products?
 - Date

- Specific brand, more expensive is better
- Terms in food safety
 - Food Safety
 - Yes, people know what it is
 - Food security
 - No, haven't heard of it
 - Confusion on what it is
 - Foodborne illness
 - Yes, people know what it is
 - E.coli, salmonella, food poisoning
 - HACCP
 - No, haven't heard of it
 - FSMA
 - No, haven't heard of it
 - GAP
 - No, haven't heard of it
 - Some confusion with the finance/accounting term for GAP
- Most reliable source of information for food safety?
 - Internet, google
 - Radio
 - Social media
 - CNN
- Do you receive information in a timely manner?
 - No, they feel as if someone must die or an illness has to occur before they know about it
- Will you buy a tomato if they are recalled?
 - No, wait for the recall to end
- If authorities give information on tomatoes being from California how will this affect your purchases?
 - Buy local
 - Buy tomatoes from different places of origin
 - Won't buy for a couple months
 - Want to know affected region
- Is this the same for meat products?
 - Meat is more specific with recalls – date, company, lot number
 - More confidence with buying meat that has recall information
- Suggestions to better inform consumers?
 - How information is received, social media, radio
 - Mass communication should be unanimous, no conflicting information
 - “amber alert” style notification
- Why is food safety important?
 - Don't want people to die or get sick
- Perception of food recall?
 - Why are we having these recalls
 - What is going wrong

- How is it prepared, grown, transported, what does the supply chain look like
- Research is helpful to consumer knowledge and awareness
- Do you think we have good food handling procedures?
 - No
 - Most people don't know anything more specific than general rules
 - Food safety is not a priority
- Picture Analysis
 - #1- Be Food Safe
 - No, never seen
 - #2 – HACCP
 - No, never seen
 - #3 – FSMA
 - No, never seen
 - #4 – USDA Organic
 - Yes, have seen it
 - Don't trust it
 - #5 – USDA
 - Yes, have seen it
 - Don't pay attention
 - #6 – Meat Case Picture
 - Fresh, quality
 - No blood
 - Neat appearance
 - Price, separation
 - #7 – Chicken in Package
 - Date
 - Quantity
 - Price
 - #8 – Non-GMO
 - Yes, all familiar
 - Not sure about what GMO is
 - Scare tactics
 - #9 – Fish Case
 - None have seen label
 - Not fresh enough
 - Only want frozen packaged fish
 - #10 – Ethnic Meat Market
 - No, don't like it
 - Cross contamination
 - Looks like its been played with
 - Price is “too cheap”
 - Doesn't look appealing, not uniform
 - Wrong packaging
 - #11 – Meat in package
 - Price

- Date
- Color of meat, fat
- Want red/pink coloring, not brown
- Block chain?
 - Never heard of before
- Organic?
 - Expensive
 - What is the point?
 - No difference in the taste

Picture Analysis



When asked if they had seen this label before,
Majority Response: No one had seen it



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When asked if they had seen this label before,
Majority response: No one had seen it before
One person said it looked familiar



When asked if they had seen this label before,

Majority response: No one was familiar

One person said she might have seen it before



When asked if they had seen this label before,

Majority response: Yes, everyone was familiar

- Two people said they did not trust it.
- One woman was not aware that agriculture included plants and crops along with animals...
- One man said that he trusts this label and believes that the govt. enforces organic regulations.



Majority response: Yes, most people had seen this label

- One person said they “don’t pay any mind to it”



When asked, “When you see this picture, how confident do you feel? What are some things you think of?” Comments:

- Food looks fresh (3 people)
- Not bloody
- Quality looks good (2 people)
- Price was secondary consideration (3 or 4 people)
- Neatness was third



When asked “what do you look at when you look at this package?”

Majority:

- Quantity was first consideration
- Price was second
- Date was third



When asked if they have seen this label,

Majority response: Yes

- One lady associated non-GMO food with hormones in her diet...
- Three people mentioned that “non-GMO” label is just a scare tactic



When asked, “Are you confident in this product by looking at this picture?”

- One person said yes
- One person said no, they are more biased towards packaged fish
- One person said it doesn’t look fresh enough
- None of the participants have seen that label before



When asked, “How do you feel about the food in this picture?”

Majority response:

- They do not like how it looks, doesn’t look fresh
- Looks like it is cross-contaminated
- Looks as if it’s been played with, with the veggie faces
- Not uniform, would prefer neater packaging, “looks like they threw it together”
- The cheap price was concerning to one person



When asked, “What are the things you consider when looking at this package?”

- Price was first consideration
- Date was secondary
- Visual quality of the meat, fat amount was third
- One lady mentioned she preferred red/pink meat as opposed to brown meat

San Marcos Focus Group Notes

- How often grocery shopping?
 - Weekly is the majority
- Factors concerning Seafood purchase?
 - Vary rarely
 - Some once a month
- Why no to consuming seafood?
 - Choice – not a good choice/options around this area
 - Doesn't look good, looks like bad quality
 - Won't buy because they feel like they won't cook it right or overcook it
 - Rather eat seafood at a restaurant instead of making it
- Factors when purchasing produce?
 - Fresh
 - Quality
 - Color
 - If it will be used immediately
- Is origin considered?
 - Is it from California or Mexico
 - Most don't for veggies
 - Unless they see something on the news, then they will look where it is coming from
- Is type of market considered?
 - Prefers HEB or Central market
 - No Walmart produce – consensus
 - Farmers market for in-season fruits and veggies
- Factors when purchasing meat products?
 - Color
 - Package
 - Rotation – is the product being moved quickly
 - Won't buy product with cheap packaging
 - Vacuum sealed so it stays fresher longer
 - Won't buy brown meat
 - Don't look at nutritional factors/origin
- Factors when purchasing cheese products?
 - Kind
 - Brand
 - Fresh
- Terms in Food Safety
 - Food Safety
 - Yes, they know
 - Keep in safe place, certain temperature, no cross contamination
 - Food security

- No, nobody knows
- Food-borne illness
 - Yes, they know
 - Salmonella, is a concern to them
- HACCP
 - No, hasn't heard
- FSMA
 - One person was close to understanding, has seen the label
- GAP
 - No, hasn't heard
- Where do they receive information on food safety?
 - Google
 - News
 - Internet
- What is the most reliable?
 - News
 - Most people agree they are not getting enough information of food safety issues
 - Nobody is going to the links that the news or media outlets provide to them
 - Grocery store issuing a notice or a recall
- Why is food safety important?
 - People don't want to die or get sick
- Food recalls?
 - They hear about it on social media
- Perceptions of food recalls?
 - Scary especially if people have already bought it
 - What if you have that product
 - Will hold off on buying that particular item until the recall is called off or go with a different brand all together
- Suggestions to mitigate food recalls?
 - Follow guidelines
 - Wearing gloves
 - Hope that rules are being followed
 - Government can only do so much, so what/who is making sure it is being done
- Familiarity with high risk and low risk foods?
 - No idea what categorizes them
 - High risk – fresh
 - Low – canned foods
- Agriculture
 - Yes
- Aquaculture

- Yes
 - Horticulture
 - Yes
 - Silviculture
 - No
 - Apiculture
 - No
 - Hydroponics
 - Yes
 - Aquaponics
 - No
- Organic?
 - Expensive, safer, healthier, cleaner
 - No pesticides
 - There are controls in place
 - Some buy occasionally, three said that they for sure buy organic
 - It doesn't last as long as produce that have chemical to preserve it
- What other labels?
 - All natural
 - Low-sodium
 - Gluten free
 - Less fat
 - GMO – don't know what it means
- GMO label?
 - Genetically modified
 - No idea what it means
 - Created in a lab and not natural
 - Most corn is GMO
- Regulations for farmers?
 - Guidelines in place
 - People don't think many are following them
 - People will find cheaper and easier way to do things if they need to
 - When foods aren't regulated or followed correctly then it will lead to recalls
- Think of being in a market? Have you noticed unsafe practices?
 - Date – might have expired a week ago
 - Small markets are sketchy, undercut meat, safety issues, HEB is better
 - Cross contamination is probably more common but assume it also happens at HEB
- Foodborne illness and how it affects populations?
 - Think that people are equally impacted based on race, gender ect.
- Pictures
 - #1 – Be Food Safe

- No, have not seen
- #2 – HACCP
 - No, have not seen
- #3 – FSMA
 - No, have not seen
- #4 – USDA organic
 - Yes, have seen
- #5 – USDA
 - Yes, means governance
- #6 - Meat Case
 - Looks fresh
 - Not wal-mart
 - A sprouts market
 - Looks good
 - High price point
- #7 - Chicken in package
 - Sees the brand
 - No added hormones
 - Likes the cage free
 - Would buy the product
- #8 - GMO label
 - Would buy non-gmo projects
 - Has a website that you can check out, only one noticed
- #9 – Fish case
 - Have not seen sustainability labels
 - Fish looks fresh, clean, gloves on, ice to regulate temperature
- #10 – Ethnic Market Meat Case
 - Distract with faces on the meat
 - Gets goosebumps, bad feeling
 - Chicken is close to red meat
 - Can't tell how old it is
 - Would not buy even with prices so low
- #11 – Meat in package
 - Sell by date
 - Color
 - Price
 - Marbling
- Food scares
- After a week of incident, what do you do?
 - Won't eat tomatoes for at least three months
 - Most will eat them after the recall has lifted
 - Must have trust in the market
 - HEB doesn't tell where the produce is coming from so still won't buy

- Blockchain?
 - Many have never heard of this before

Picture Analysis



When asked, “Have you seen this label before?”

- Every person agreed they had never seen it before



- No one had seen this label before either



- No one had seen this label before



- Everyone had seen this label before



- Everyone had seen this label before
- One person said this means the food is certified by the USDA



When asked, “What do you think about this food?”

- Fresh was the initial majority response
- 3 people said the quality looks good
- 1 person mentioned the price was good



When asked, “What do you look at when you see this product?”

- Packaging quality
- Price
- Brand
- Date
- One person noted he likes that it says cage-free
- All people agreed this was a product they would purchase



- Most people were familiar with this label



- No one had seen the label
- Fish looks fresh, 5 people mentioned
- 1 noted the ice looks clean



- The veggie faces are distracting
- Majority said they would not purchase
- The storage, particularly the sliding door, was cause for concern to one lady. She mentioned that bugs might easily get in.
- Four people were concerned with the cross-contamination, chicken right next to the beef
- Three people agreed that “marinated” meat is not trustworthy because it can “mask” how old the meat is



When asked, “What are the things you look at when you see this package?”

- Sell-by date, first concern
- Price, secondary
- Color, marbling in the meat
- Product of USA
- “Prime” grade of the meat

Appendix D: Sample of seafood survey questions that were asked to consumers

Demographics

Which gender do you most identify with?

- ☐ Male
- ☐ Female
- ☐ Other: _____
- ☐ I don't want to disclose

In which age group are you?

- ☐ 18 – 35
- ☐ 35 – 50
- ☐ 50 and above

What is your level of education?

- ☐ High school graduate or less
- ☐ Associate Degree/Trade Certificate
- ☐ Bachelor's Degree
- ☐ Master's degree
- ☐ Doctoral Degree

What is the appropriate choice to describe you?

- ☐ White
- ☐ Native American
- ☐ African American
- ☐ Hispanic / Latinx
- ☐ Hispanic White
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Native Hawaiian or Pacific Islander

What is your household income?

- ☐ \$50,000 or less
- ☐ \$50,000 - \$100,000
- ☐ \$100,000 and above

Are you the primary shopper in your household?

- ☐ Yes
- ☐ No

Are you originally from Texas?

- ☐ Yes
- ☐ No

If yes, what city/area?

If no, what city/area?

What is your occupation?

Do you have any formal/informal food handling training?

☐ Yes

☐ No

Do you belong to an environmental/animal rights organization? (Greenpeace, PETA, Rainforest Alliance, World Wildlife Fund, ect.)

☐ Yes

☐ No

If yes, which organization?

Have you ever suffered from a food-borne illness?

☐ Yes

☐ No

General Questions

Indicate whether you purchase the product and check which qualities are important when you buy those products.

| Do you purchase this product? | | Product | Seafood Qualities | | | | | | | |
|-------------------------------|----|----------|-------------------|---------------------|------------------------------|------------|-------------|---------------|-------------------------|-----------------------|
| Yes | No | | Income (Price) | Nutritional content | Country of origin / Location | Appearance | Seasonality | Product style | Availability of recipes | Farmed or wild caught |
| | | Salmon | | | | | | | | |
| | | Catfish | | | | | | | | |
| | | Shrimp | | | | | | | | |
| | | Tilapia | | | | | | | | |
| | | Cod | | | | | | | | |
| | | Scallops | | | | | | | | |
| | | Crab | | | | | | | | |

| | | | | | | | | | | |
|--|--|-------------------------------|--|--|--|--|--|--|--|--|
| | | Lobster | | | | | | | | |
| | | Tuna | | | | | | | | |
| | | Red Snapper | | | | | | | | |
| | | Clams, Mussels and Oysters | | | | | | | | |
| | | Crawfish | | | | | | | | |

Do you have any food safety concerns when purchasing seafood products?

☐ Yes

☐ No

Are these potential food safety concerns you have when purchasing seafood?

☐ Foodborne pathogens

☐ Contaminated products

☐ Other

If other, list your own food safety concerns

When buying seafood products which type of market(s) do you usually purchase them?

☐ Supermarket (e.g. HEB, Walmart, Krogers)

☐ Wholesale Market (e.g. Sam's Club, Costco)

☐ Farmers Market

☐ Specialty Market (e.g. Whole Foods, Sprouts)

Do you prefer seafood fresh or frozen?

☐ Fresh

☐ Frozen

Being from Texas, do you prefer seafood that was caught in the Gulf of Mexico?

☐ Yes

☐ No

Which labels do you look for when shopping for seafood products?

| Specification | Very Important | Somewhat Important | Neutral | Not Important | Unsure/Don't Know |
|-----------------|----------------|--------------------|---------|---------------|-------------------|
| Non-GMO feed | | | | | |
| Dye Free | | | | | |
| Antibiotic Free | | | | | |
| Sustainable | | | | | |

| | | | | | |
|-------------|--|--|--|--|--|
| Farm raised | | | | | |
| Wild caught | | | | | |

How do you feel about the following statements?

| Statement | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|--|----------------|-------|---------|----------|-------------------|
| Do you believe that farmed fish and wild caught fish should be held to the same standards? | | | | | |
| Do you believe that enough is being done to protect consumers from foodborne illnesses? | | | | | |
| Do you believe that farmers markets and supermarkets are held to the same standards in selling seafood products? | | | | | |
| Do you have more confidence in stores that engage in voluntary recalls of seafood products when safety issues are encountered? | | | | | |

Who do you think should be responsible for food safety issues?

- ☐ Consumers
☐ Farmers/Producers
☐ Large Corporations/Industry
☐ Government

Do you recognize the following labels?

| Label | Yes | No |
|-------|-----|----|
|-------|-----|----|

| | | |
|---|--|--|
|  | | |
|  | | |
|  | | |
|  | | |
|  | | |
|  | | |

How do you feel about the following statements on topics of food safety?

| Statement | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|--|----------------|-------|---------|----------|-------------------|
| Small farms and farmers markets should not be regulated | | | | | |
| Foreign food coming into the country is well regulated | | | | | |
| In comparison to other countries the US has better food safety rules/laws | | | | | |
| Hazard Analysis and Critical Control Point (HACCP) risk-based food safety plans are not necessary in controlling food safety | | | | | |
| There is technology that exists to track where food is coming from to protect consumers | | | | | |
| The US should do more to help improve other countries food infrastructure | | | | | |
| The Food and Drug Administration (FDA) accurately and always catches threats to the food system | | | | | |

Do you know the different parts of the seafood supply chain?

- ☐ Yes
☐ Somewhat
☐ No

Do you feel that seafood is handled safely throughout the seafood supply chain?

- ☐ Yes
☐ Somewhat
☐ No

Are you getting information about food safety recalls?

___ Yes
___ No

If yes, where do you get the information from?

___ Media
___ Government website (USDA, FDA, CDC)
___ Grocery store posting
___ Word of mouth
___ Social media
___ Celebrities
___ Unsure/Don't Know
___ Other: _____

Do you know what role the Food and Drug Administration (FDA) plays in food safety?

___ Yes
___ Somewhat
___ No

Do you know what role the Food Safety and Inspection Service (FSIS) plays in food safety?

___ Yes
___ Somewhat
___ No

| Question | Very knowledgeable | Somewhat knowledgeable | Neutral | Somewhat unknowledgeable | No knowledge |
|--|--------------------|------------------------|---------|--------------------------|--------------|
| How knowledgeable about HACCP are you? | | | | | |
| How knowledgeable about blockchain technology are you? | | | | | |
| How knowledgeable are you on government intervention on food safety? | | | | | |
| How knowledgeable are you on industry intervention | | | | | |

| | | | | | |
|-----------------|--|--|--|--|--|
| on food safety? | | | | | |
|-----------------|--|--|--|--|--|

Seafood Purchasing

The following questions will have different scenarios about a specific seafood product that you might be purchasing in the marketplace. Please answer these questions as if you were the shopper based on the decisions that you would make while shopping.

Q1:

Consider that you are buying fresh farm raised catfish, please indicate your willingness to pay for one pound from the following price categories.

- ___ \$ 6.00
- ___ \$ 6.50
- ___ \$ 7.00
- ___ \$ 7.50
- ___ \$ 8.00

Q2:

Consider that you are buying frozen farm raised catfish, please indicate your willingness to pay for one pound from the following price categories.

- ___ \$ 5.50
- ___ \$ 6.00
- ___ \$ 6.50
- ___ \$ 7.00
- ___ \$ 7.50

Assume a news media outlet that is reporting on ABC Seafood company that is recalling more than 50 tons of catfish because the products were produced, packed and distributed without federal inspection. The recall involves 60-pound cardboard boxes containing "Fresh Farm Raised Catfish USA" from ABC Seafood company. There have been no adverse reactions to consuming these products that has been confirmed. Answer the following questions based on this assumption.

After being presented with the above information, please indicate your willingness to pay for one pound of fresh farm raised catfish.

- ___ \$ 6.00
- ___ \$ 6.50
- ___ \$ 7.00
- ___ \$ 7.50

___ \$ 8.00

Would you purchase fresh farm raised catfish from ABC Seafood company?

___ Yes

___ No

Assume USDA FSIS has announced the recall of fresh farm raised catfish items from ABC Seafood company because the products were produced, packed, and distributed without the benefit of inspection. The recall involved 60-lb brown cardboard boxes containing "Fresh Farm Raised Catfish USA". Answer the following questions based on this assumption.

After being presented with the above information, indicate your willingness to pay for one pound of fresh farm raised catfish.

___ \$ 6.00

___ \$ 6.50

___ \$ 7.00

___ \$ 7.50

___ \$ 8.00

Assume it has been three months since the recall was issued by USDA FSIS. Answer the following questions based on this assumption.

After being presented with the above information, please indicate your willingness to pay for one pound of fresh farm raised catfish.

___ \$ 6.00

___ \$ 6.50

___ \$ 7.00

___ \$ 7.50

___ \$ 8.00

Are you purchasing catfish products?

___ Yes

___ No

Hazard Analysis Critical Control Point (HACCP) is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product. Answer the following questions keeping this statement in mind.

After reading about HACCP, please indicate your willingness to pay for one pound of fresh farm raised catfish.

___ \$ 6.50

___ \$ 7.00

___ \$ 7.50

___ \$ 8.00

___ \$ 8.50

Blockchain technology is an industry development that works across the supply chain, including growers, processors, shippers, retailers, regulators, and consumers. This allows for the immediate access to food supply chain data from farm to store and consumer. With capabilities for safer food, longer shelf lives, reduced waste, faster traceability, and better access to shared information. Answer the following questions keeping this statement in mind.

Given the above information on the new technology, please indicate your willingness to pay for one pound of fresh farm raised catfish.

___ \$ 6.50

___ \$ 7.00

___ \$ 7.50

___ \$ 8.00

___ \$ 8.50

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