

CONSUMER PREFERENCE OF GROUND BEEF  
PATTIES WITH VARYING PERCENTAGES OF  
FINELY TEXTURED BEEF

By

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CONSUMER PREFERENCE OF GROUND BEEF PATTIES WITH VARYING  
PERCENTAGES OF FINELY TEXTURED BEEF

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Title of Study: CONSUMER PREFERENCE OF GROUND BEEF PATTIES WITH  
VARYING PERCENTAGES OF FINELY TEXTURED BEEF

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Abstract: The goal of this study was to evaluate consumer preferences of ground beef patties with varying levels of Finely Textured Beef. Three treatments were utilized during this study 0% FTB, 15% FTB, and max inclusion FTB. All patties were a final makeup of 81% lean and 19% fat with a variance of +/-1%. The sensory panel was split into two phases. The first phase was conducted using bite-sized portions of each sample (n = 689). The second phase utilized a slider-sized patty (n = 675). There were 90 male and 139 female participants with an average age of 27.8 y. For sensory evaluation of bite-sized pieces, consumers found no difference ( $P > 0.05$ ) in juiciness, flavor, or overall like. Panelists detected a difference in tenderness ( $P = 0.02$ ) specifically finding the max inclusion FTB samples to be the most tender. Consumer groups were then split into male and female and further evaluated. Male panelist found no differences in any palatability characteristics ( $P > 0.05$ ). Female panelists found no difference between treatments for flavor ( $P > 0.05$ ). However, females detected differences ( $P < 0.05$ ) in tenderness, juiciness, and overall like. They found max inclusion FTB to be the most tender and juicy. Finally, females rated max inclusion FTB higher for overall like than 15% FTB ( $P = 0.01$ ), but found no difference between max inclusion and 0% FTB or 0% FTB and 15% FTB. Furthermore, consumer groups were split into student and non-student adults and analyzed. Non-student adults found no differences ( $P > 0.05$ ) between treatments. Student panelists found a treatment difference ( $P < 0.05$ ) in tenderness and juiciness. Students found max inclusion FTB to be more tender than 0% FTB ( $P = 0.02$ ), and no difference between max inclusion and 15% or 0% and 15%. Students also rated, 0% FTB to be the least juicy. In the second phase of the panel, evaluating sliders resulted in no treatment differences ( $P > 0.05$ ) in any of the palatability traits. When split into male and female or students and non-student adults there were still no differences detected ( $P > 0.05$ ) between treatments.

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## CHAPTER I

### INTRODUCTION

Ground beef is versatile, easy to prepare, and relatively inexpensive; which is why it is one of the most popular meat products and is a multi-billion dollar commodity in the United States (Glover, 1968). According to the National Cattlemen’s Beef Association, ground beef products comprised nearly half of the US beef consumption in 2012. Furthermore, in 2014, US citizens consumed a total of 11.5 billion killograms of beef. With the shortage of cattle around the country, beef companies have found a processing technique that utilizes more of the product. This product is commonly known as Lean Finely Textured Beef (LFTB) or Finely Textured Beef (FTB). The production of LFTB/FTB retrieves enough lean protein from beef carcass trimmings to allow 1.5 million fewer cattle be slaughtered per year (Rabobank, 2012). Additionally, Beef Products, Inc., (2012) reported that nearly 97 million bushels of corn, 375 billion gallons of water, and 600 thousand acres of farmland could be saved on an annual basis through the production of LFTB. Even with the positive economical impact, consumers became skeptical of the product in 2012 when it gained media attention.

Consumer perception of LFTB/FTB changed drastically in 2012 when media began referring to the product as “pink slime.” Until that point consumers typically were not aware of the inclusion of LFTB or FTB in their ground beef mixture. This is in part



due to USDA ruling that the inclusion of LFTB/FTB was voluntary rather than mandatory on product labels (Green, 2012).

However, after LFTB/FTB spent time as the media headliner, 89% of surveyed consumers indicated they would not purchase it in the next six months (McKendree et al., 2014). The negative consumer perception led to a major decline of LFTB/FTB inclusion in ground beef. In March 2012, Safeway, SuperValu and Food Lion pulled all products with LFTB/FTB (Zirnstein, 2012). Ultimately, as a result of this negative media, manufacturing plants were shut down and production declined. This had a major impact on the beef industry, as a whole. Consumer resistance to the inclusion of LFTB/FTB was at an all time high in 2012, since that time it has begun to slowly reappear. The inclusion of LFTB up to 20% leads to many positive quality characteristics to both fresh and cooked ground beef patties (Moon et al., 2012). Decreased lipid oxidation along with improved fresh color results from addition of LFTB/FTB, ultimately leading to a product with a greater shelf life and more appealing color (Moon et al., 2012). However, limited research has been published in regards to consumer preference of palatability characteristic (tenderness, juiciness, and flavor) of ground beef with various levels of FTB inclusion.

The objective of this study was to evaluate consumer preferences of ground beef patties with varying levels of FTB.

## CHAPTER II

### REVIEW OF LITERATURE

#### **Ground Beef**

According to the Code of Federal Regulations 319.15 ground beef, also called chopped beef, is chopped fresh and/or frozen beef with or without seasoning, having no more than 30% fat, and with no added water, phosphates, binders, or extenders.

Ground beef is versatile, easy to prepare, and relatively inexpensive; which is why it is one of the most popular meat products and is a multi-billion dollar commodity in the United States (Glover, 1968). Ground beef is utilized extensively in fast food restaurants, school lunch programs, military programs and households (Troutt et al., 1992). Ground beef products comprise nearly half of the United States total beef consumption (National Cattlemen's Beef Association, 2012). It is estimated that 40% to 45% of total beef consumed is in the form of ground beef, and when prepared as a meal at home, ground beef is utilized 60% of the time (Green, 2012).

According to some analysts, ground beef consumption has increased over the past several years, possibly as much as 50%. This is due to it being a relatively inexpensive protein choice, which consumers turn to during recession and high unemployment (Green, 2012).

Ground beef has received a negative reputation, at times, by consumers and diet/

health specialist, because it has a typical fat level of 20-30%. Thus, many companies have worked to develop lean ground beef product while maintaining palatability has become a demand by consumers (Troutt et al., 1992).

### **Lean Finely Textured Beef**

According to National Public Radio, “a much-maligned beef product that was once frequently added to hamburger is making a comeback.” In 2012, lean finely textured beef (LFTB) was cut back by beef processors after it caught a nasty nickname from media, “pink slime.” Now with higher beef prices, demand for the product has increased (NPR, personal communications, 2014). Lean finely textured products have added to further processed meats prior to LFTB receiving the nickname of pink-slime.

Lean finely textured tissue (LFTT), previously called fat-reduced tissue or partially defatted chopped tissue, is derived from beef and pork high-fat trimmings by a unique separation process. Lean finely textured tissue is considered by the USDA to be the same as beef and pork for labeling purposes and can be utilized as a high lean meat source. The composition of LFTT is high in protein (17-21%) and low in fat (8-12%). The product is also lower in cost as compared to other lean meat ingredients (He & Sebranek, 1996).

Currently, LFTB is produced from meat trimmings, which are first heated to 42°C. They are then sent to a centrifuge where fat is separated from lean (Riëtte et al., 1997). It is difficult and economically infeasible to remove the lean from fatty trim by hand (Moon et al., 2012). In the case of Beef Products Incorporated (BPI), the lean beef is then treated with a small amount of ammonia gas, which combines with the moisture in the meat and creates ammonium hydroxide (Moon et al., 2012). The LFTB is frozen as

either chips or a sheet, and then mixed with ground beef (Riëtte et al., 1997). Lean finely textured beef allows around 4.5 kg more of lean beef to be recovered from each carcass. It is a way of turning meat and fat excluded from other cuts into a diverse and profitable product (Moon et al., 2012). The United States Department of Agriculture (USDA) declared in 2012 that the addition of LFTB on a label was voluntary (Green, 2012).

According to Riëtte et al. (1997), LFTB has a pH of 6.2 and when added to ground beef patties, results in a higher L\* value. Additionally, ground beef with LFTB inclusion has greater a\* value (indicating a redder patty) and a decreased b\* (yellowness) value. The increase in lightness and redness with a decrease in yellowness could be accredited to the greater pH (Moon et al., 2012). Furthermore, after cooking there was no difference in internal cooked color. Inclusion of LFTB did not affect the L\*, a\* or b\* value (Moon et al., 2012).

Ultimately, the inclusion of LFTB up to 20% can lead to many positive quality characteristics to both fresh and cooked ground beef patties. Decreased lipid oxidation along with improved fresh color, resulting in a product with potential of greater shelf life and more appealing color to consumers (Moon et al., 2012).

### **Economical Impact of Lean Finely Textured Beef**

The production of FTB/LFTB retrieves enough lean protein from carcass trimmings to allow the beef industry to slaughter 1.5 million fewer cattle per year, which translates into a more efficient use of resources from the beef industry (Rabobank, 2012). Furthermore, according to BPI (2012), on an annual basis the 97 million bushels of corn, 375 billion gallons of water, and 600 thousand acres of farmland can be saved with the

production of LFTB. This translates into a reduction in ground beef prices and has a positive impact on the environment (BPI, 2012).

### **Consumer Perception and Buying Habits**

According to Gerald Zirnstein, former USDA scientist, in March 2012, 70% of ground beef sold in US supermarkets contained LFTB. Following Zirnstein announcing this, LFTB went viral on social media. It was noted to be an unnecessary and unsavory additive to ground beef products. After these reports were heavily published on social media, Safeway, SuperValu and Food Lion pulled all products with LFTB on March 21, 2012 (Avila, 2012). Many other stores followed suit. Walmart was one of the few stores that made the decision to offer products with and without LFTB. Ultimately, as a result of this negative media attention, manufacturing plants were shut down and production of LFTB declined. The major producer of LFTB, BPI, shut three of its four plants and laid off many employees. Also, Cargill cut the production of Finely Textured Beef (FTB), similar to LFTB, because its customers were asking for a product that did not contain FTB. Various other, smaller processing facilities also reduced or completely shut down finely textured beef production (Yadavalli & Jones, 2014).

Media had various effects on consumer buying habits. Immediately after the information went out consumers, demand for chicken and turkey was negatively impacted, while USDA Prime beef demand went up. However, one period later those effects reversed and demand for USDA Choice beef and pork also decreased. Consumers responded quickly to the scare of LFTB and made changes to their meat and beef consumption habits, but this behavior did not last long. There was not a significant

statistical impact on the decline of ground beef consumption, which consists of LFTB (Yadavalli & Jones, 2014).

In 2012, a study from Taylor et al. concluded on average, 80% of people in the US have consumed ground beef in their home within the past two-weeks. Also, ground beef was eaten an average of 1.7 times per week. Of adult respondents reporting to consume ground beef, 9-23% reported eating undercooked (pink) ground beef. In 2006 and 2007, a survey with 8,543 randomly selected consumers showed 75.3% of them consumed some type of ground beef in the last 7 days; 61.8% of those consumed ground beef inside their home and 45.8% consumed it outside their home (Taylor et al., 2012). Of those who consumed ground beef inside their home, 18.0% reported consuming pink (undercooked) ground beef (Taylor et al., 2012). Ground beef consumption patterns differed according to several demographic factors, such as age, gender, race, education, income and residential setting; for example, people with higher education and income reported to consuming less ground beef overall (Taylor et al., 2012). Also, consumers are concerned with the levels of saturated fats and Omega 6:3 ratio in their ground beef. They would prefer an improvement in the type of fat composition of ground beef, by searching for animals that have genetic predisposition to produce lower levels of saturated fat and Omega 6:3 ratios (Lusk & Parker, 2009).

### **Pathogens Associated with Ground Beef**

Food safety concerns in the US have increased with concerns of meat products being contaminated with pathogens such as *Escheria coli (E.coli)*, and *Salmonella*, as well as *Bovine Spongiform Encephalopathy (BSE)*; (Yadavalli & Jones, 2014). Bacterial contamination of beef can occur during slaughter and processing. If pathogens are

present on the hide, in the gastrointestinal tract or in the feces, and then transferred to the carcass during slaughter (Smith et al., 2013). Consumers find food safety to be of more concern than price or fat content. (Lusk and Parker, 2009).

Consumption of raw or undercooked products from beef have a risk factor of *E.coli* O157:H7, *Salmonella* and other pathogens. Improperly or inadequately cooked raw meat products are associated with these foodborne illness and outbreaks (Wiegand et al., 2009). In the US, among the 235 outbreaks in 2007 which were attributed to a single food commodity, contaminated beef accounted for 16% of illness (Wiegand et al., 2009). These illnesses and outbreaks are commonly linked to the consumption of ground beef, specifically ground beef that is undercooked (Taylor et al., 2012). There are various approaches to reducing these pathogens, but the most effective way of eliminating them in food is to cook it to the appropriate “lethal” temperature (Wiegand et al., 2009).

*E. coli* O157:H7 initially captured national attention in 1992 when it was isolated from stool samples of consumers with a foodborne illness that was linked to contaminated hamburgers (Liao et al., 2014). In June and July of 2012, it once again captured attention when nine patients with *hemolytic uremic syndrome* (HUS) and *E. coli* O157:H7 infections were recorded (Liao et al., 2014).

In the US in 2011, 63,153 cases of illness were linked to *E. coli* O157:H7 and an additional 112,752 cases from non-O157:H7 STEC (Scallan et al., 2011). In June of 2012, the USDA implemented a mandatory routine verification testing of the six, major non-O157:H7 STEC in raw beef manufacturing trim (Scallan et al., 2011). This routine procedure was already in place for *E. coli* O157:H7 (Scallan et al., 2011). Most non-O157: H7 STEC are found in the gastrointestinal tract of cattle and other ruminants. The

Center for Disease Control and Prevention estimated the top six non-O157:H7 STECs (O26, O45, O103, O111, O121 and O145) accounted for over 70% of infections outbreaks in the US from 1983-2002 (Brooks et al., 2005). Additionally, in 2011, the USDA, Food Safety and Inspection Service (FSIS) declared those STEC strains to be adulterants in raw non-intact beef products and in intact beef, which would be further processed to non-intact raw beef products (Liao et al., 2014).

Liao et al. (2014) concluded that in 1,129 samples of ground beef purchased from retail display cases in supermarket from 24 US states, only 9 (0.8%) were considered potentially STEC positive in accordance with the FSIS definition. Meaning these 9 samples contained both virulence genes and one or more genes associated with the O antigen in one of the six major non-O157:H7 STEC. This indicated contamination by non-O157:H7 STEC adulterants in the commercial ground beef samples were extremely low in the states the samples were taken from.

When ground beef fat content increased from 7 to 30% and patties were frozen, then thawed or refrigerated before cooking on a gas grill, there was a greater inactivation of *E. coli* O157:H7. Additionally, thermal processing steps used to eliminate *E. coli* O157:H7 can also be utilized to eliminate non-O157 STEC, only a few strains may possess a higher thermal tolerance and need a different type of processing (Vasan et al., 2014). Furthermore, irradiation treatment has been found to eliminate *E. coli* O157:H7, consequently the USDA has created regulations on irradiation of beef products to eliminate these pathogens (Vogt and Dippold, 2005).

The USDA has also issued guidelines, which must be met for certain meat and poultry products for *Salmonella*. These guidelines outline a minimum time and



temperature combination that must be met to achieve a 6.5-log reduction of *Salmonella* in beef products (Vasan et al., 2014). *Salmonella* causes an estimated one million cases of food born illness, which results in nearly 400 deaths a year (Scallan et al., 2011). Vipham et al. (2012) concluded in a ground beef sample group of 2,199 (purchased from 38 cities across the US) *Salmonella* was detected in 0.55%.

Another pathogen of major concern is *Campylobacter*. It adds an estimated 0.8 million illness and 75 deaths annually (Scallan et al., 2011). Vipham et al. (2012) also concluded, in a ground beef sample group of 953 (purchased from 20 cities across the US), 7.35% of beef samples were detected with *Campylobacter*.

When these pathogens find their way into the food chain, major loss occurs. The detection of ground beef positive for *E. coli* O157:H7 caused a nation-wide recall on July 19, 2002. The recall totaled 8.4 million kilograms of fresh and frozen ground beef and beef trimmings (Vogt and Dippold, 2005). This was the second largest recall at the time (Vogt and Dippold, 2005). Major recalls continue to occur; in 2015, one recall totaled 75,749.93 kilograms of ground beef from a Nebraska beef plant (USDA, 2015).

Testing for pathogens should be a routine process, as should continuous research to better understand patterns and behavior of these pathogens. This will allow for science-based decisions on food safety regulations to be created controlling these pathogens (Vipham et al., 2012).

Some LFTB is treated with ammonia gas, which then binds with the moisture present in the beef to produce ammonium hydroxide. This elevates the pH of the beef and results in a reduction of pathogens, such as *E. coli* O157:H7 (BPI, 2015). Additionally,

organic acids, such as lactic, acetic and citric acids can be utilized as antimicrobials. They are effective at pH 4.0-6.0 (Corzier-Dodson et al., 2005).

### **Sensory**

Consumer purchasing and eating decisions can be influenced by appearance, aroma, flavor, and texture (Chambers and Bowers, 1993). Consumers typically discriminate against ground beef with high fat content for various reasons including: shrinkage, splattering during cooking, causing obesity, and greasy taste (Glover, 1964). Ultimately, many consumers will pay for low fat beef, but if it is lacking in taste or texture, they will not continue to purchase the product (National Research Council 1988; Mederios et al., 1987).

Based on consumer preference in palatability, 20% fat ground beef is preferred over 16%, 25% and 30%; based on the differences in flavor, tenderness and juiciness (Glover, 1964). Myers et al. (2012) found that consumer panelists also preferred the flavor of 80% lean patties and tend to give them higher rating and overall acceptability in comparison to 90% lean patties. Additionally, trained sensory panelists found 80% lean patties to be juicier, softer, greasier, and to contain more off-flavor than 90% lean patties.

Troutt et al. (1992) concluded that ground beef patties with fat levels of 5-30% had a difference in palatability. The patties with lower fat levels (5-10%) had less juiciness, moisture release, beef flavor, and oily coating of the mouth as compared to patties with higher fat levels, 20-30% fat. Another study conducted by Berry (1992) concluded that ground beef patties with less than 8% fat began to have reductions in tenderness, juiciness and flavor. This is likely to create problems in consumer acceptance. Furthermore, a study conducted by Cross et al. (1980) showed that patties with 16% fat

were significantly tougher than patties containing 24-28% fat. With the inclusion of LFTB a taste panel concluded that the only difference was an increase in rancidity (Riëtte et al., 1997). Ultimately, maintaining acceptable palatability is the most important consideration in any effort to reduce fat in meat products (Berry, 1992).

### **Conclusion**

Various studies have been conducted to evaluate all factors impacting ground beef. It is known that ground beef is one of the most highly consumed beef products, especially in the US. It is also known that cattle numbers are lower than normal and, as a result of this, supply of beef is at an all time low. Advancements in the meat industry, such as including LFTB in ground beef products provides the opportunity to utilize more of the limited supply we have. The process of creating this product also includes additional steps, which help to eliminate pathogens. A decrease in pathogens and foodborne illness would positively impact the beef industry as a whole. After negative press was released on Lean Finely Textured Beef consumers quickly turned against the product. Therefore, the overall objective of this research was to gain a better understanding of consumer perception and willingness to buy ground beef patties with varying levels of FTB.

## CHAPTER III

### CONSUMER PREFERENCE OF GROUND BEEF PATTIES WITH VARYING PERCENTAGES OF FINELY TEXTURED BEEF

#### ABSTRACT

In 2015, US citizens consumed 11.3 billion kg of beef. Processing techniques have been created to increase efficiency and value of fat trimmings from beef carcasses. This product is commonly known as Finely Textured Beef (FTB). The overall goal of this study was to evaluate consumer preferences of ground beef patties with varying levels of FTB. Three different treatments were utilized during this study: 0% FTB, 15% FTB, and max inclusion FTB. All patties were a final makeup of 81% lean and 19% fat with a variance of +/-1%. The sensory panel was split into two phases. The first phase was conducted using bite-sized portions of each sample (n = 689). The second phase utilized an entire slider-sized patty (n = 675). There were 90 male and 139 female participants with an average age of 27.8 y. For sensory evaluation of bite-sized pieces, consumers found no difference ( $P > 0.05$ ) in juiciness, flavor, or overall like. Panelists detected a difference in tenderness ( $P = 0.02$ ) specifically finding the max inclusion FTB samples to be the most tender. Consumer groups were then split into male and female and further evaluated. Male panelist found no differences in any palatability characteristics ( $P > 0.05$ ). Female panelists found no difference between treatments for flavor ( $P > 0.05$ ).

However, females detected differences ( $P < 0.05$ ) in tenderness, juiciness, and overall like. They found max inclusion FTB to be the most tender and juicy. Finally, females rated max inclusion FTB higher for overall like than 15% FTB ( $P = 0.01$ ), but found no difference between max inclusion and 0% FTB or 0% FTB and 15% FTB. Furthermore, consumer groups were split into student and non-student adults and analyzed. Non-student adults found no differences ( $P > 0.05$ ) between treatments. Student panelists found a treatment difference ( $P < 0.05$ ) in tenderness and juiciness. Students found max inclusion FTB to be more tender than 0% FTB ( $P = 0.02$ ), and no difference between max inclusion and 15% or 0% and 15%. Students also rated 0% FTB to be the least juicy. In the second phase of the panel, evaluating sliders resulted in no treatment differences ( $P > 0.05$ ) in any of the palatability traits. When split into male and female or students and non-student adults there were still no differences detected ( $P > 0.05$ ) between treatments. This is positive for our industry as consumers only detected minor differences in ground beef patties with the inclusion of FTB and when differences were detected they preferred max inclusion FTB.

## INTRODUCTION

Ground beef is versatile, easy to prepare, and relatively inexpensive; which is why it is one of the most popular meat products and is a multi-billion dollar commodity in the United States (Glover, 1968). According to the National Cattlemen's Beef Association, ground beef products comprised nearly half of the US beef consumption in 2012. Furthermore, in 2014, US citizens consumed a total of 11.5 billion kilograms of beef. With the shortage of cattle around the country, beef companies have found a processing technique that utilizes more of the product. This product is commonly known as Lean

Finely Textured Beef (LFTB) or Finely Textured Beef (FTB). The production of LFTB/FTB retrieves enough lean protein from beef carcass trimmings to allow 1.5 million fewer cattle be slaughtered per year (Rabobank, 2012). Additionally, Beef Products, Inc., (2012) reported that nearly 97 million bushels of corn, 375 billion gallons of water, and 600 thousand acres of farmland could be saved on an annual basis through the production of LFTB. Even with the positive economical impact, consumers became skeptical of the product in 2012 when it gained media attention.

Consumer perception of LFTB/FTB changed drastically in 2012 when media began referring to the product as “pink slime.” Until that point consumers typically were not aware of the inclusion of LFTB or FTB in their ground beef mixture. This is in part due to USDA ruling that the inclusion of LFTB/FTB was voluntary rather than mandatory on product labels (Green, 2012).

However, after LFTB/FTB spent time as the media headliner, 89% of surveyed consumers indicated they would not purchase it in the next six months (McKendree et al., 2014). The negative consumer perception lead to a major decline of LFTB/FTB inclusion in ground beef. In March 2012, Safeway, SuperValu and Food Lion pulled all products with LFTB/FTB (Avila, 2012). Ultimately, as a result of this negative media, manufacturing plants were shut down and production declined. This had a major impact on the beef industry, as a whole. Consumer resistance to the inclusion of LFTB/FTB was at an all time high in 2012, since that time it has begun to slowly reappear. The inclusion of lean finely textured beef up to 20% leads to many positive quality characteristics to both fresh and cooked ground beef patties (Moon et al., 2012). Decreased lipid oxidation along with improved fresh color result from addition of LFTB/FTB, ultimately leading to

a product with a greater shelf life and more appealing color (Moon et al., 2012). However, limited research has been published in regards to consumer preference of palatability characteristic (tenderness, juiciness, and flavor) of ground beef with various levels of FTB inclusion.

The objective of this study was to evaluate consumer preferences of ground beef patties with varying levels of FTB.

## **METHODOLOGY**

### ***Product Delivery and Handling***

A commercial beef producer prepared three different ground beef patty treatments for this study: 0% FTB (control), 15% FTB, and max inclusion FTB (max inclusion has FTB at a percentage higher than 15% but can not be revealed per company request). Finely textured beef for this project was formulated by taking beef trimmings and heating them to 42°C, and the lean was then removed using a centrifuge force. A pH enhancement was then added to the product for pathogen control. The product was then mixed with ground beef to create patties with a final makeup of 81% lean and 19% fat with a variance of +/-1%. The patties were packaged in sleeves, frozen at -20°C, and shipped to the Robert M. Kerr Food and Agricultural Products Center (FAPC) at Oklahoma State University (OSU). Upon arrival, patties were frozen at -20°C. Each treatment was labeled by lot number and then assigned a shape and color for sensory analysis. This eliminated any preconceived perceptions by consumers.

### ***Product Preparation and Cooking***

Patties were thawed for approximately 24 h at 4°C. The patties were then cooked for 9 min on an XLT Impingement Oven (model 3240-TS, BOFI Inc., Wichita, KS) at

204°C to an internal temperature of 74°C. Treatments were cooked in groups of 15 patties to eliminate preparation difference. After cooking, patties were placed by treatment group in a warmer. The patties were then split into two groups. One group was assigned shapes and the other was assigned colors for the two different portions of the taste panel.

### ***Consumer Sensory Evaluation***

The consumer taste panel was conducted at FAPC. Taste panels were conducted over four evening session and one afternoon session. Consumers were asked to partake in two phases of the sensory evaluation and to rank the patties on a 9-point hedonic scale. Each consumer filled out a demographics form that included the following information: gender, age, pre-tax annual household income level, and college student classification. Additionally, consumers were asked to answer the following question about their ground beef purchasing habits: how often do you eat hamburger, how often do you eat ground beef in the form of any food, how often do you or your household purchase ground beef.

### ***Consumer Sensory Evaluation Phase I***

The initial portion of the consumer sensory evaluation was conducted using bite-sized portions of each sample. For this portion of the sensory panel the products were labeled with a circle (0% FTB), square (15% FTB), and triangle (max inclusion FTB). Fifty-eight patties of each treatment were served to 229 consumers (n = 689). Each patty was evenly cut into four sections, and placed in the appropriately labeled sample cup. The sample cups were placed back in the warmer to maintain temperature throughout the sensory evaluation. Panelists were provided deionized water and unsalted top crackers to cleanse their palette between samples. Panelists were asked to evaluate tenderness (1 = like extremely, 9 = dislike extremely), flavor (1= like extremely, 9 = dislike extremely),



juiciness (1 = like extremely, 9 = dislike extremely), and satisfaction with overall eating quality (1 = like extremely, 9 = dislike extremely).

### ***Consumer Sensory Evaluation Phase II***

The second portion of the sensory evaluation was conducted using an entire slider-sized ground beef patty. For this portion of the sensory panel, the products were labeled with the colors of blue (0% FTB), white (15% FTB), and red (max inclusion FTB). Two hundred and twenty-five patties from each treatment were served to 225 consumers (n = 675). Each patty was placed in a serving tray with the appropriate colored toothpick and placed over a buffet style warmer to maintain temperature throughout the sensory evaluation. Panelists were provided deionized water and unsalted top crackers to cleanse their palette between samples. Panelists were given the option to add toppings to their sliders. Topping options were: bun, BBQ sauce, cheddar cheese, ketchup, lettuce, mayonnaise, mustard, pickles, and white onions. Panelists were required to make every slider with the exact same toppings. Panelists were asked to evaluate their first bite (1 = like extremely, 9 = dislike extremely) and their overall like after they finished eating (1 = like extremely, 9 = dislike extremely).

Additionally, at the completion of the panel consumers were asked the following question. The three ground beef products may be different or they may be identical. If you believe they are different, can you speculate on how they are different?

### ***Statistical Analysis***

Least squares means and SE were generated using the MIXED procedure of SAS (SAS 4.3; SAS Inst., Cary, NC). The model included treatment as the fixed effect. The

panelist was used as the random effect. For all analyses, when a significant F-test was identified ( $P < 0.05$ ), least squares means were separated using a pairwise t-test (PDIFF option). Additionally, groups (male v. female and students v. non-student adults) were analyzed to determine if specific demographic groups found differences using the same method previously identified.

## **RESULTS AND DISCUSSION**

### ***Consumer Demographics***

Consumer panelists were sorted into two main groups: college students, and non-student adults. The average age of panelists was 27.8 y. There were 90 male participants and 139 female participants, three participants did not record their gender. A total of eight panels were conducted, four for college students and four for adults. Student panelists were compensated \$10.00 cash, and adult panelists were compensated with a \$10.00 Walmart gift card. Overall demographics of panelists are presented in Table 1.

### ***Consumer Sensory Evaluation Phase I***

Consumer sensory findings for bite-sized pieces are detailed in Table 2. Results for the initial portion of the sensory panel showed a difference ( $P = 0.02$ ) in tenderness between 0% FTB, 15% FTB, and max inclusion FTB. Consumers found max inclusion FTB pieces to be the most tender and could tell no difference ( $P = 0.88$ ) in 0% FTB and 15% FTB. No differences ( $P > 0.05$ ) were found in juiciness, flavor, or overall like between 0% FTB, 15% FTB, and max inclusion FTB pieces.

Consumers were grouped into male and female subcategories and data were analyzed. Male vs. female consumer findings are detailed in Table 3. Male panelists detected no differences ( $P > 0.05$ ) for tenderness, juiciness, flavor, or overall like

between 0% FTB, 15% FTB, and max inclusion FTB of bite-sized pieces. Female panelists found a difference ( $P < 0.05$ ) in tenderness, juiciness and overall like between the three treatment groups. Females found max inclusion FTB bite-sized pieces to be the most tender and found no difference between the other two treatments ( $P = 0.50$ ). Females also found max inclusion FTB to be the most juicy and rated 0% FTB and 15% FTB similarly ( $P = 0.80$ ). Finally, females rated max inclusion FTB pieces higher for overall like than 15% FTB ( $P = 0.01$ ), but found no difference between max inclusion and 0% FTB or 0% FTB and 15% FTB. Females ranked flavor similar ( $P > 0.05$ ) between the three treatments.

Consumers were also grouped into student and non-student adult classes, and data were analyzed. Student vs. non-student adult panelist findings are detailed in Table 4. Non-student adult panelists found no differences ( $P > 0.05$ ) for tenderness, juiciness, flavor, or overall like between 0% FTB, 15% FTB, and max inclusion FTB. Students rated max inclusion FTB pieces to be more tender than 0% FTB ( $P = 0.02$ ), but found no difference between max inclusion and 15% FTB or 0% FTB and 15% FTB. Furthermore, students predicted 0% FTB to be the least juicy, but no difference between 15% FTB and max inclusion ( $P = 0.91$ ). Students rated all treatments similar ( $P > 0.05$ ) for flavor or overall like.

Based on the final makeup of each treatment (81% lean and 19% fat with a variance of +/-1%) these results agree with Glover (1964) and Berry (1992), showing that consumers prefer 20% fat ground beef for overall palatability (Glover, 1964). Consumers also found patties with lower fat levels (5-10%) had less juiciness and beef flavor (Berry,

1992). Finally, they found ground beef with 20% fat compared to 16%, 25%, and 30%; to have a difference in flavor, tenderness, and juiciness (Glover, 1964).

### ***Consumer Sensory Evaluation Phase II***

Results for evaluating sliders showed no difference ( $P > 0.05$ ) for first bite and overall like after eating. Consumer panel sensory findings by treatment are detailed in Table 5. Males and females also found no differences ( $P > 0.05$ ) for first bite or overall like after eating sliders (Table 6). Finally, consumer groups were split into student and non-student adult groups, and data were analyzed for first bite and overall like after eating sliders (Table 7). Neither group detected any differences ( $P > 0.05$ ). These results were to be expected because panelists were able to use unlimited number of toppings as long as they dressed each slider the same.

### ***Frequencies in Toppings and Final Question***

Panelists recorded the toppings they used on their sliders. The most commonly used toppings were buns and ketchup. The least commonly used toppings were BBQ sauce and white onions. These findings are similar to 2016 ABC News, America's top 10 burger toppings which showed ketchup as first and BBQ sauce as tenth. Overall frequencies of toppings used are listed in Table 8.

Finally, consumers were asked if they thought the three sliders were identical or if they could detect differences. Surprisingly, 13.36% thought they were identical while 84.48% found differences. This is interesting, considering the majority detected no differences rating the sliders individually. Additional studies should be conducted and ask this question first and then ask the consumers to individually rate the sliders to determine if results are consistent.

## **IMPLICATIONS**

Consumption of beef continues to increase in the United States. With a decrease in beef production, it is critical to utilize as much of the product as possible. Innovative processing techniques, such as those utilized in making FTB are an excellent step in that direction. Consumers showed no preference for flavor, juiciness, and satisfaction of overall eating quality between the three treatment groups. They showed a preference between tenderness of the three treatment groups but numerically differences were minor. This is positive for our industry, as consumers cannot detect a difference in ground beef patties with the inclusion of FTB. Therefore, companies can increase yields while keeping their products palatable.

**Table 1.** Demographic characteristics from consumer panelists (n = 232)

Characteristic	Response	Percentage of Consumer
Gender	Male	39.1%
	Female	60.4%
Occupation	Student	60.4%
	Adult	38.7%
Income	Less than \$10,000	10.0%
	\$10,000-\$19,999	13.0%
	\$20,000-\$29,999	7.0%
	\$30,000-\$39,999	4.8%
	\$40,000-\$49,999	8.2%
	\$50,000-\$59,999	4.8%
	\$60,000-\$69,999	6.1%
	\$70,000-\$79,999	7.8%
	\$80,000-\$89,999	10.0%
	\$90,000-\$99,999	4.8%
\$100,000 or more	21.7%	
Frequency of Ground Beef Consumption	Frequently	84.3%
	Rarely	15.2%
	Never	—
Frequency of Hamburgers Consumption	Frequently	76.1%
	Rarely	22.6%
	Never	1.3%
Frequency of Ground Beef Purchases	At least once a week	36.5%
	At least once every two weeks	28.3%
	At least once a month	14.8%
	At least once every two months	4.3%
	Less than once every two months	8.3%
Never	7.0%	

**Table 2.** Effects of treatment<sup>1</sup> on consumer taste panel attributes for Finely Textured Beef (FTB) bite-sizes pieces (n = 689)

Attribute	0%	15%	Max inclusion	<i>P</i> -value
Tenderness <sup>2</sup>	3.35 <sup>a</sup>	3.33 <sup>a</sup>	3.00 <sup>b</sup>	0.02
Juiciness <sup>2</sup>	3.85	3.67	3.47	0.05
Flavor <sup>2</sup>	3.56	3.76	3.53	0.22
Overall like <sup>2</sup>	3.52	3.58	3.31	0.14

<sup>a,b</sup> LS means within a row without common superscript differ ( $P < 0.05$ )

<sup>1</sup> Treatments include: 1) 0% FTB – 81% fine grind beef, 0% FTB, 2) 15% FTB – 81% fine grind beef, 15% FTB, 3) max inclusion – 81% fine grind beef, max inclusion

<sup>2</sup> 1 = like extremely; 2 = like very much; 3 = like moderately; 4 = like slightly; 5 = neither like nor dislike; 6 = dislike slightly; 7 = dislike moderately; 8 = dislike very much; 9 = dislike extremely

**Table 3.** Effects of gender<sup>1</sup> on consumer taste panel attributes for Finely Textured Beef (FTB) bite-sized pieces

Attribute	0% <sup>2</sup>	15% <sup>2</sup>	Max inclusion <sup>2</sup>	P-value
Male (n = 268)				
Tenderness <sup>3</sup>	3.46	3.22	3.19	0.43
Juiciness <sup>3</sup>	3.87	3.48	3.79	0.21
Flavor <sup>3</sup>	3.51	3.61	3.65	0.81
Overall like <sup>3</sup>	3.64	3.38	3.44	0.43
Female (n = 417)				
Tenderness <sup>3</sup>	3.28 <sup>a</sup>	3.40 <sup>a</sup>	2.90 <sup>b</sup>	0.02
Juiciness <sup>3</sup>	3.84 <sup>a</sup>	3.79 <sup>a</sup>	3.28 <sup>b</sup>	0.01
Flavor <sup>3</sup>	3.61	3.85	3.46	0.12
Overall like <sup>3</sup>	3.45 <sup>ab</sup>	3.70 <sup>b</sup>	3.23 <sup>a</sup>	0.04

<sup>a,b</sup> LS means within a row without common superscript differ ( $P < 0.05$ )

<sup>1</sup> Gender includes: Male and Female

<sup>2</sup> Treatments include: 1) 0% FTB – 81% fine grind beef, 0% FTB, 2) 15% FTB – 81% fine grind beef, 15% FTB, 3) max inclusion – 81% fine grind beef, max inclusion

<sup>3</sup> 1 = like extremely; 2 = like very much; 3 = like moderately; 4 = like slightly; 5 = neither like nor dislike; 6 = dislike slightly; 7 = dislike moderately; 8 = dislike very much; 9 = dislike extremely



**Table 4.** Effects of group<sup>1</sup> on consumer taste panel attributes for Finely Textured Beef (FTB) bite-sized pieces

Attribute	0% <sup>2</sup>	15% <sup>2</sup>	Max inclusion <sup>2</sup>	P-value
Student (n = 416)				
Tenderness <sup>3</sup>	3.46 <sup>b</sup>	3.31 <sup>ab</sup>	3.03 <sup>a</sup>	0.06
Juiciness <sup>3</sup>	3.97 <sup>b</sup>	3.48 <sup>a</sup>	3.46 <sup>a</sup>	0.01
Flavor <sup>3</sup>	3.64	3.82	3.57	0.38
Overall like <sup>3</sup>	3.61	3.53	3.34	0.27
Non-student Adult (n = 273)				
Tenderness <sup>3</sup>	3.16	3.34	2.95	0.25
Juiciness <sup>3</sup>	3.67	3.95	3.47	0.15
Flavor <sup>3</sup>	3.43	3.68	3.46	0.54
Overall like <sup>3</sup>	3.37	3.65	3.27	0.22

<sup>a,b</sup> LS means within a row without common superscript differ ( $P < 0.05$ )

<sup>1</sup> Groups include: student and non-student adult

<sup>2</sup>Treatments include: 1) 0% FTB – 81% fine grind beef, 0% FTB, 2) 15% FTB – 81% fine grind beef, 15% FTB, 3) max inclusion – 81% fine grind beef, max inclusion

<sup>3</sup> 1 = like extremely; 2 = like very much; 3 = like moderately; 4 = like slightly; 5 = neither like nor dislike; 6 = dislike slightly; 7 = dislike moderately; 8 = dislike very much; 9 = dislike extremely

**Table 5.** Effects of treatment<sup>1</sup> on consumer taste panel attributes for Finely Textured Beef (FTB) sliders (n = 675)

Attribute	0%	15%	Max inclusion	<i>P</i> -value
First bite <sup>2</sup>	3.16	2.99	3.03	0.42
Overall like <sup>2</sup>	3.13	3.13	3.25	0.64

<sup>1</sup> Treatments include: 1) 0% FTB – 81% fine grind beef, 0% FTB, 2) 15% FTB – 81% fine grind beef, 15% FTB, 3) max inclusion – 81% fine grind beef, max inclusion

<sup>2</sup> 1 = like extremely; 2 = like very much; 3 = like moderately; 4 = like slightly; 5 = neither like nor dislike; 6 = dislike slightly; 7 = dislike moderately; 8 = dislike very much; 9 = dislike extremely

**Table 6.** Effects of gender<sup>1</sup> on consumer taste panel attributes for Finely Textured Beef (FTB) sliders

Attribute	0% <sup>2</sup>	15% <sup>2</sup>	Max inclusion <sup>2</sup>	<i>P</i> -value
Male (n = 262)				
First bite <sup>3</sup>	3.04	2.80	2.89	0.44
Overall like <sup>3</sup>	3.11	3.08	3.08	0.98
Female (n = 406)				
First bite <sup>3</sup>	3.18	3.15	3.11	0.91
Overall like <sup>3</sup>	3.12	3.17	3.40	0.29

<sup>1</sup> Gender includes: Male and Female

<sup>2</sup>Treatments include: 1) 0% FTB – 81% fine grind beef, 0% FTB, 2) 15% FTB – 81% fine grind beef, 15% FTB, 3) max inclusion – 81% fine grind beef, max inclusion

<sup>3</sup> 1 = like extremely; 2 = like very much; 3 = like moderately; 4 = like slightly; 5 = neither like nor dislike; 6 = dislike slightly; 7 = dislike moderately; 8 = dislike very much; 9 = dislike extremely

**Table 7.** Effects of group<sup>1</sup> on consumer taste panel attributes for Finely Textured Beef (FTB) sliders

Attribute	0% <sup>2</sup>	15% <sup>2</sup>	Max inclusion <sup>2</sup>	<i>P</i> -value
Student (n = 411)				
First bite <sup>3</sup>	3.20	2.89	3.05	0.17
Overall like <sup>3</sup>	3.28	3.11	3.26	0.59
Non-student Adult (n = 260)				
First bite <sup>3</sup>	3.10	3.27	3.02	0.49
Overall like <sup>3</sup>	2.96	3.25	3.32	0.26

<sup>1</sup> Groups include: student and non-student adult

<sup>2</sup>Treatments include: 1) 0% FTB – 81% fine grind beef, 0% FTB, 2) 15% FTB – 81% fine grind beef, 15% FTB, 3) max inclusion – 81% fine grind beef, max inclusion

<sup>3</sup> 1 = like extremely; 2 = like very much; 3 = like moderately; 4 = like slightly; 5 = neither like nor dislike; 6 = dislike slightly; 7 = dislike moderately; 8 = dislike very much; 9 = dislike extremely

**Table 8.** Frequency of topping used on sliders (n = 232)

Topping	Response	Percentage
BBQ Sauce	Applied	6.89%
	Did not apply	90.51%
	No Response	2.58%
Buns	Applied	65.51%
	Did not apply	31.89%
	No Response	2.58%
Cheddar Cheese	Applied	55.60%
	Did not apply	41.81%
	No Response	2.58%
Ketchup	Applied	56.03%
	Did not apply	41.37%
	No Response	2.58%
Lettuce	Applied	39.65%
	Did not apply	57.75%
	No Response	2.58%
Mayonnaise	Applied	22.41%
	Did not apply	75.00%
	No Response	2.58%
Mustard	Applied	40.08%
	Did not apply	57.32%
	No Response	2.58%
Pickle	Applied	47.84%
	Did not apply	49.56%
	No Response	2.58%
White Onion	Applied	21.55%
	Did not apply	75.86%
	No Response	2.58%

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# APPENDICES

## IRB Approval Form

### Oklahoma State University Institutional Review Board

Date: Thursday, September 04, 2014  
IRB Application No AG1441  
Proposal Title: Preferences for Ground Beef

Reviewed and Processed as: Exempt

**Status Recommended by Reviewer(s): Approved Protocol Expires: 9/3/2017**

Principal Investigator(s):

F. Bailey Norwood	Jayson Lusk	Deborah VanOverbeke
426 Ag Hall	411 Ag Hall	104D An. Sci.
Stillwater, OK 74078	Stillwater, OK 74078	Stillwater, OK 74078

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The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Cordell North (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,



Hugh Crethar, Chair  
Institutional Review Board

## Experiment Questionnaire

There were three versions of this questionnaire. All three contained identical questions, but had different orders of questions in Sections A, B, C, and D.

### **PARTICIPANT INFORMATION**

#### **OKLAHOMA STATE UNIVERSITY**

**Project Title:** Preferences for ground beef

**Investigator(s):**

Jayson Lusk, Department of Agricultural Economics.

Bailey Norwood, Department of Agricultural Economics.

Deb VanOverbeke, Department of Animal Science.

**Purpose:** The objective of the research is to study people's preferences for ground beef. You must be 18 or older to participate.

**What to Expect:** To participate in this study you must be willing to taste ground beef and hamburgers and provide feedback on your eating experience. First you will be asked to taste three pieces of ground beef and report your preference. Then you will be given three sliders (small hamburgers) and asked to make three nearly-identical hamburgers, including whatever toppings and condiments you wish. You will then report your preference for the burgers. All food has been prepared by a meat scientist and so will be as safe as a normal meal.

When you are done eating you will be given \$10 for your participation.

**Risks:** There are no risks associated with this project which are expected to be greater than those ordinarily encountered in daily life. At no point do we ask your contact information, so your identity cannot be matched with your responses.

**Benefits:** A chance to help researchers understand your preferences for ground beef.

**Compensation:** A free meal and \$10 in cash.

**Your Rights and Confidentiality:** Your participation in this research is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this project at any time. If you feel you may have an allergy to any of the foods, please let the researchers know promptly, and you may cease participating with no penalty.

**Confidentiality:** You will be given an identification number and at no time will you be asked for your contact information. Thus, it would be impossible for anyone to match your responses to your identity.

**Contact:** You may contact any of the researchers at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study:

Bailey Norwood. 426 Ag Hall. Department of Agricultural Economics. Oklahoma State University. 405-334-0010. [bailey.norwood@okstate.edu](mailto:bailey.norwood@okstate.edu). fbaileynorwood.com.





If you have questions about your rights as a research volunteer, you may contact the IRB Office at 219 Cordell North, Stillwater, OK 74078, 405-744-3377 or [irb@okstate.edu](mailto:irb@okstate.edu)

**CONSENT DOCUMENTATION:**

I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and of the benefits of my participation. I also understand the following statements:

I affirm that I am 18 years of age or older.

*Preface the signature lines with the following statement (expand if appropriate):*  
I have read and fully understand this consent form. I sign it freely and voluntarily. A copy of this form will be given to me. I hereby give permission for my participation in this study.

	
Signature of Participant	Date
I certify that I have personally explained this document before requesting that the participant sign it.	
	
Signature of Researcher	Date

## Instructions for subjects

- Please sit anywhere you like. This session will proceed as follows.
- **Part A:** First we will bring you each three pieces of ground beef. After taking each bite, please cleanse your palate by eating a cracker and taking a sip of water. You will taste each piece and answer a few questions about your eating experience.
- **Part B:** Then you will be given three sliders (small hamburgers) and will be asked to build identical hamburgers using whatever toppings you wish. You may also take whatever side dishes and drinks you wish. You will take one bite from each slider and report your eating experience. Between each bite, please cleanse your palate by eating a cracker and taking a sip of water. As you eat, please do not talk amongst each other about the burgers or the beef. After taking one bite of each burger and reporting your experience, you are free to continue eating and socializing, and you may talk about anything except the beef and burgers.
- **Part C:** After you have finished eating you will indicate once again your eating experience.
- **Part D:** You will indicate which ground beef products you would purchase at various prices.
- **Part E:** You will comment on whether you believe the burgers are identical or different from each other.
- **Part F:** You will answer a few questions about yourself.

**(A) Meats labeled square, triangle, and circle**

Please indicate the extent to which you like or dislike the tenderness, flavor, juiciness, and overall satisfaction of the beef labeled <i>square</i> .										
<b>SQUARE</b>	<b>Tenderness</b>	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
	<b>Flavor</b>	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
	<b>Juiciness</b>	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
	<b>Satisfaction with overall eating quality</b>	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely

(Remember to cleanse your palate by eating a cracker and taking a sip of water.)

Please indicate the extent to which you like or dislike the tenderness, flavor, juiciness, and overall satisfaction of the beef labeled <i>triangle</i> .										
<b>TRIANGLE</b>	<b>Tenderness</b>	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
	<b>Flavor</b>	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
	<b>Juiciness</b>	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
	<b>Satisfaction with overall eating quality</b>	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely



(Remember to cleanse your palate by eating a cracker and taking a sip of water.)

Please indicate the extent to which you like or dislike the tenderness, flavor, juiciness, and overall satisfaction of the beef labeled <i>circle</i> .										
<b>CIRCLE</b>	<b>Tenderness</b>	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
	<b>Flavor</b>	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
	<b>Juiciness</b>	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
	<b>Satisfaction with overall eating quality</b>	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely

When you have finished Part A you may then build three identical sliders (small hamburgers) and take whatever side-dishes and drinks you like.

***(B) Burgers labeled red, white, and blue (first bites)***

Using the sliders labeled red, white, and blue, make identical burgers using the same toppings and in the same amount. Take one bite from each slider and then indicate below the extent to which you like the overall eating experience.

*(Remember to cleanse your palate by eating a cracker and taking a sip of water between each bite.)*

Red	Like Extremely <input type="radio"/>	Like Very Much <input type="radio"/>	Like Moderately <input type="radio"/>	Like Slightly <input type="radio"/>	Neither Like nor Dislike <input type="radio"/>	Dislike Slightly <input type="radio"/>	Dislike Moderately <input type="radio"/>	Dislike Very Much <input type="radio"/>	Dislike Extremely <input type="radio"/>
White	Like Extremely <input type="radio"/>	Like Very Much <input type="radio"/>	Like Moderately <input type="radio"/>	Like Slightly <input type="radio"/>	Neither Like nor Dislike <input type="radio"/>	Dislike Slightly <input type="radio"/>	Dislike Moderately <input type="radio"/>	Dislike Very Much <input type="radio"/>	Dislike Extremely <input type="radio"/>
Blue	Like Extremely <input type="radio"/>	Like Very Much <input type="radio"/>	Like Moderately <input type="radio"/>	Like Slightly <input type="radio"/>	Neither Like nor Dislike <input type="radio"/>	Dislike Slightly <input type="radio"/>	Dislike Moderately <input type="radio"/>	Dislike Very Much <input type="radio"/>	Dislike Extremely <input type="radio"/>

After you have finished your meal please complete all remaining questions.

***(C) Burgers labeled red, white, and blue (after you are finished)***

Now that you have finished eating, please indicate below the extent to which you like the overall eating experience.									
Red	Like Extremely <input type="radio"/>	Like Very Much <input type="radio"/>	Like Moderately <input type="radio"/>	Like Slightly <input type="radio"/>	Neither Like nor Dislike <input type="radio"/>	Dislike Slightly <input type="radio"/>	Dislike Moderately <input type="radio"/>	Dislike Very Much <input type="radio"/>	Dislike Extremely <input type="radio"/>
White	Like Extremely <input type="radio"/>	Like Very Much <input type="radio"/>	Like Moderately <input type="radio"/>	Like Slightly <input type="radio"/>	Neither Like nor Dislike <input type="radio"/>	Dislike Slightly <input type="radio"/>	Dislike Moderately <input type="radio"/>	Dislike Very Much <input type="radio"/>	Dislike Extremely <input type="radio"/>
Blue	Like Extremely <input type="radio"/>	Like Very Much <input type="radio"/>	Like Moderately <input type="radio"/>	Like Slightly <input type="radio"/>	Neither Like nor Dislike <input type="radio"/>	Dislike Slightly <input type="radio"/>	Dislike Moderately <input type="radio"/>	Dislike Very Much <input type="radio"/>	Dislike Extremely <input type="radio"/>

**(D) Food purchasing decisions**

Imagine you are in the grocery store buying a package of ground beef. There are three ground beef options exactly the same as the options you tried today: red, white, and blue. For each of the following four questions that follow, please indicate which option you would be most likely to buy.

**Which of the following would you purchase?**

<i>Choice #1</i>	Red \$4.25/lb	White \$4.25/lb	Blue \$4.25/lb	If these were the only options, I would buy something else.
I would choose...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<i>Choice #2</i>	Red \$3.50/lb	White \$3.50/lb	Blue \$4.25/lb	If these were the only options, I would buy something else.
I would choose...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<i>Choice #3</i>	Red \$3.50/lb	White \$4.25/lb	Blue \$3.50/lb	If these were the only options, I would buy something else.
I would choose...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<i>Choice #4</i>	Red \$4.25/lb	White \$3.50/lb	Blue \$3.50/lb	If these were the only options, I would buy something else.
I would choose...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**(E) What were these three products?**

The three ground beef products may be different or they may be identical. If you believe they are different, can you speculate on how they are different?

\_\_\_\_\_ I think the red, white, and blue products are identical

\_\_\_\_\_ I think at least two of the products are different (*Please speculate in the box below how you think they are different. Are they cooked differently? Made from different types of meat? Any thoughts you have are welcome.*)

**(F) A few more questions**

(F.1) Please check all toppings and condiments you placed on your burgers. *Please check all that apply.*

 ketchup pickles mustard cheddar cheese BBQ sauce mayonnaise lettuce bun tomatoes white onions

(F.2) What is your gender? *Please check one.*

 male female other

(F.3) What is your age? \_\_\_\_\_ years

(F.4) How often do you eat hamburgers? *Please check one.*

 Frequently Rarely Never

(F.5) How often do you eat ground beef in the form of any food (for example, hamburgers, tacos)? *Please check one.*

 Frequently Rarely Never

(F.6) How often do you or your household purchase ground beef? *Please check one.*

- At least once a week
- At least once every two weeks
- At least once a month
- At least once every two months
- Less than once every two months
- Never

(F.7) What is your pre-tax, annual household income level? *Please check one.*

- |  |  |
|--|--|
| <input type="checkbox"/> less than \$10,000  | <input type="checkbox"/> \$60,00 to \$69,999 |
| <input type="checkbox"/> \$10,00 to \$19,999 | <input type="checkbox"/> \$70,00 to \$79,999 |
| <input type="checkbox"/> \$20,00 to \$29,999 | <input type="checkbox"/> \$80,00 to \$89,999 |
| <input type="checkbox"/> \$30,00 to \$39,999 | <input type="checkbox"/> \$90,00 to \$99,999 |
| <input type="checkbox"/> \$40,00 to \$49,999 | <input type="checkbox"/> \$100,00 or more    |
| <input type="checkbox"/> \$50,00 to \$59,999 |  |

*IF YOU ARE A COLLEGE STUDENT, PLEASE ANSWER THE FOLLOWING QUESTION.*

(F.8) Which class best describes your status as a college student? *Check one.*

**Only for  
respondents  
who are**

- Freshman       Sophomore       Junior

Section E

college students

Senior

Graduate student

Other

IF YOU ARE NOT A COLLEGE STUDENT, PLEASE ANSWER THE NEXT TWO QUESTIONS.

(F.9) Are you the primary shopper for your household? *Please check one.*

Yes

No

I share equally in the food purchasing decisions

**Only for respondents who are not college students**

(F.10) What is your relationship with OSU? *Please check one.*

Faculty

Staff

Other employment by OSU

I am not employed by OSU

(F.11) Overall, what did you think of your experience today? *Please check all that apply.*

I liked the food

I liked the atmosphere

The taste test was fun

The directions were clear and easy to follow



VITA

Morgan Marie Neilson

Candidate for the Degree of

Master of Science

Thesis: CONSUMER PREFERENCE OF GROUND BEEF PATTIES WITH  
VARYING PERCENTAGES OF FINELY TEXTURED BEEF

Major Field: Animal Science

Biographical:

Education: Completed the requirements for the Master of Science in Animal Science at Oklahoma State University, Stillwater, Oklahoma in May, 2016; completed the requirements for the Bachelor of Science in Animal Science and Agricultural Communications at Oklahoma State University, Stillwater, Oklahoma in 2014; graduated from Meeker High School, Meeker, Colorado in 2010.

Experience: American Meat Science Association Communications Intern, 2014; U.S. House of Representatives Intern, 2013; Cargill Feed & Nutrition Sales Intern, 2012.

Professional Memberships: American Meat Science Association, American Sheep Industry