

CHARACTERIZATION AND CONSUMER  
PERCEPTIONS OF BEEF AT RETAIL:  
OKLAHOMA MARKET SURVEY

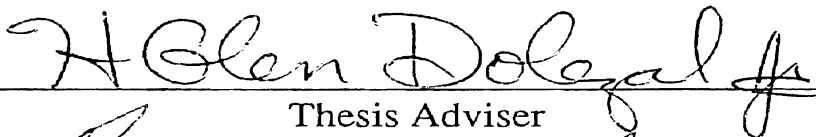
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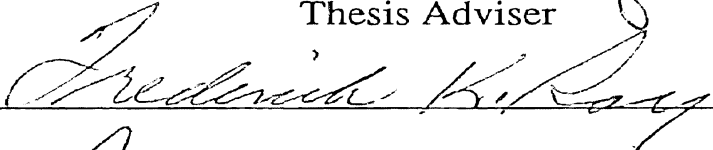
Submitted to the Faculty of the  
Graduate College of the  
Oklahoma State University  
in partial fulfillment of  
the requirements for  
the Degree of  
MASTER OF SCIENCE  
December, 1993

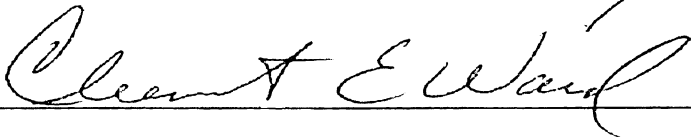
OKLAHOMA STATE UNIVERSITY


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## ACKNOWLEDGMENTS

I wish to express my sincere appreciation to Dr. H. Glen Dolezal and Dr. Frederick K. Ray for their encouragement, patience, support and friendship throughout my thesis. Additional thanks to Dr. Clement E. Ward for serving on my graduate committee. Their suggestions and support were very helpful throughout the study.

To the Oklahoma Beef Industry Council for their desire to improve the beef industry and their support of the educational process, I extend my sincere gratitude. To the wholesale market managers, store owners, retail chains, market managers and workers, thank you for helping me learn about your industry. I am truly impressed with your desire to improve your business.

To Jason K. Apple, my coach, for encouraging me to pursue a degree at Oklahoma State and supporting me while I was coaching. To the Animal Science Department at Oklahoma State University, especially Dr. Bob Totusek, for allowing me to learn and grow. To Betty Rothermel for her constant support and guidance.

My parents, Lamar and Mary Nick, encouraged and supported me all the way and helped me smile when I thought it was impossible. My love and respect goes to you for always knowing when I needed you. To my husband, David, thanks for believing in me and us. To Christina who always understood where I was coming from, even if you did not know where I had been. To Chuck thank you for providing sanity. I am truly indebted to you.

To my fellow graduate students, especially Marc, Jeff, Kim, Brandon, Craig, Tom G., Todd, Troy, Twig, Susan, Jeff, Kyle and Doug, thanks for the laughter and the fun. Anne, without your constant support I would not have made it, thank you. To the undergraduates and work studies, thank you for making my stay at Oklahoma State an educational experience.

To Justin, Lisa, Chris C., Matt, Rhodena, Charles, and Chris P. thank you for teaching me to believe, keeping things in perspective, and your friendship. You have my respect and love. And most importantly, to God for providing the talents and skills necessary to pursue my dreams.

To all of these people thank you for inspiring me to dream and succeed!

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## CHAPTER I

### INTRODUCTION

The last decade has brought about a revolution in the red meat and livestock industry. Grasping the thought that red meat no longer was considered a "center of the plate" food staple caused producers from all segments of the livestock industry to take note. Alternative protein sources were increasing their market share at the expense of red meat. Admittedly, the red meat industry was overwhelmed and confused by the competition. It was almost like watching a horror film and hoping that you would not have bad dreams for the next week.

Well, the red meat industry quickly became a character in the horror film and found itself as easy prey. While alternative protein sources (poultry, fish and legumes) were gaining the respect of the medical and dietetic communities, red meat was criticized for excess fat, high cholesterol and excessive calories. Uncertain of how to refute the negative comments, the red meat industry continued to flounder. Beef consumption reached an all time low in the late 1980's, falling from greater than 50% of U.S. meat consumption in 1975 to approximately 40% in 1989 (USDA, 1990). Finally in the mid 1980's the beef industry had had enough. Utilizing moneys collected from the Beef Check-Off, research was funded to determine how beef was presented at retail, how consumers perceived beef and most importantly how to improve the image of beef in the eyes of the general and professional public.

This commitment to the future of the beef industry has taught a giant industry new and innovative means of marketing and communicating. Producers have become more assertive and willing to fund research that benefits the industry as a whole. Perhaps one of the most challenging components of this revolution was learning how to communicate with consumers. It was evident the consumer had the final say, but convincing cattlemen that Mr. X from downtown Big City was dictating their production practices has taken a lot of swaying. One of the first lines of communication that needed repair was with the medical and dietetic communities. After all, they had been the ones that first put up the red flag. Early in the 1980's dietitians recognized that some protein sources (especially beef) were excessively fat and consequently, recommended to limit consumption of high fat food sources. Reports linking red meat consumption to increased risks of cancer, hypertension, and heart disease also had a negative effect on red meat consumption. The first step to improved consumer relations was realizing that these were real concerns and that it was necessary for the beef industry to lean up.

Understanding consumers and their needs has been monitored closely by the National Live Stock & Meat Board. This provides the industry a sense of current trends and demands for the ever-changing consumer (Demand Strategies, 1991, 1992).

Recognizing that change is inevitable, the beef industry is coming closer to structuring itself such that it can adapt and compete rather than watching its competitors excel. The beef industry has a proud history and continues to add to the rich heritage as they learn to meet the demands of their consumers.

## CHAPTER II

### REVIEW OF LITERATURE

#### Tenderness

A host of factors can contribute to consumer acceptance of a product. Price, availability, palatability, eye appeal of the product, the religious background of the client, and popularity are a few. Perhaps there is no single factor that is more important to the acceptance of food than palatability. The palatability of red meat has greatly influenced its popularity and has been the source for many research projects. An increased demand for lean meats has prompted even more research concerning the palatability traits of red meats. These characteristics include taste, juiciness, and tenderness, of which the most closely monitored of these traits is tenderness.

Tenderness of red meat has been attributed to a variety of different factors. Origin of the meat (breed influence), cooking procedures, presence of connective tissue, muscle type, quality grade, and aging are a few of the traits often associated with meat tenderness. Because of all of the traits that may independently or collectively influence it, tenderness is the most variable of the palatability characteristics. In order for red meat to compete with alternative

protein sources and to meet consumer demands for a consistent product, it is very important that the industry attempt to control the variation.

### Factors that Affect Tenderness

Marbling, identified for amount and distribution in muscle tissue, has been reported to have a direct linear relationship with tenderness (McBee and Wiles, 1967; Jennings et al., 1978; Tatum et al., 1980; Dolezal et al., 1982), whereas others have reported very low or nonexistent associations (Carpenter et al., 1972; Parrish et al., 1973; Parrish 1974; Dikeman and Crouse, 1975; Davis et al., 1979; Smith et al., 1984) with tenderness and other palatability traits. Marbling may influence tenderness based on the following theories presented by Smith and Carpenter, 1974.

The bite theory suggests that within a given bite-size sample, the increased amount of marbling decreases the mass per unit volume. Furthermore, because the lipid replaces muscle tissue, a more dense structure, shear force is likely to decrease and result in greater perceived tenderness. Another theory describes the deposition of intramuscular fat inside the cell walls of the perimysium or endomysium as a strain on the walls and thus thins the cell wall. In a weakened, stretched state it is theorized that perceived tenderness will increase. One theory closely associates tenderness with juiciness. Intramuscular fats serve as a lubricant for the muscle fibers and fibrils, thus making the product juicier and easier to chew. The insurance theory focuses on the presence of higher degrees of marbling. Cuts that have a higher degree of intramuscular fat can be cooked to a higher end-point temperature at a higher

cooking temperature and do not show extreme adverse effects on the palatability of the final product (Designing Foods, 1988).

External fat thickness has been shown to have a low to moderate relationship to tenderness. It has been proven that a moderate amount of external fat is needed to prevent cold shortening. Research by Dutson et al. (1975), Bowling et al. (1977, 1978), Meyer et al. (1977), Tatum (1978), Lochner et al. (1980), Marsh and Lochner (1981), and Tatum et al. (1982) has shown that 6 to 10 mm of s.c. fat thickness is sufficient to retard the postmortem chilling process in order to assure that beef from young cattle will be tender. Cold shortening can be described as exposure of excised prerigor muscles to low temperatures -- 0 to 10°C (Locker and Hagyard, 1963). There was no effect on tenderness when muscles shortened 20% or less; however, a notable difference was recorded when muscles shortened 35 to 40% of their original length (Locker and Hagyard, 1963). The effect of muscle length on tenderness appears to be associated with the degree of overlap of myofibril thick and thin filaments in the 0 to 40% shortening region (Marsh and Carse, 1974) and to contraction nodes and localized stretching plus breaking of sarcomeres in the 60% shortened muscles (Marsh et al., 1974). Research conducted by Herring et al. (1965b), Smith et al. (1976) and Lochner et al. (1980) casts doubts regarding the importance of cold shortening on tenderness. Rapid chilling rates were found to actually decrease the rate of the tenderization process that begins very early in the postmortem state. Holding temperature of muscle until rigor is complete can affect tenderness and has been shown to be the most effective at temperatures that range from 15 to 34°C (Locker and Daines, 1975).

Electrical stimulation, a current postmortem technology that is being used to improve meat quality, enhances tenderness and allows for more rapid chilling of the carcass. An electrical current is applied, causing the muscles to undergo

violent contractions and thus increasing the glycolytic rate more than 100-fold (Bendall et al., 1976; Chrystall and Devine, 1978). Additionally, stimulated muscles show more structural changes (Savell et al., 1978; George et al., 1980; Will et al., 1980).

Cooking procedures can also affect the tenderness of muscle structures. Two structures in meat that contribute to its tenderness are muscle fibers and connective tissue. The effects of cooking on meat structure can be described as producing a softening of the connective tissue by conversion of the collagen to gelatin, accompanied by a toughening of the muscle fibers due to heat coagulation of myofibrillar proteins (Cross et al., 1988). Tenderness of meat reaches its maximum at 60 to 64°C. This is thought to be because collagen shrinkage occurs at 60°C. It has been found that internal temperature may have a greater effect on palatability than marbling or aging (Cross et al., 1988). As the internal temperature of meat increases, meat becomes less tender, harder and dryer.

## Consumers

During the past quarter of a century consumers have been changing. The United States witnessed more women in the work force, more graying Americans, an increasing minority population, and greater concern for nutrition and health by all Americans (Demand Strategies, 1991). Considering these drastic changes, it is easy to understand that today's consumer is more complex than ever and that it is even more important to provide an open line of communication. The red meat industry must be willing to provide an unbiased,



honest source of information to dietitians and the general population. If communication is not limited by the uncertainty of change, the beef industry will be able to meet the demands of the changing consumer with little effort.

### How Consumers Change

The current household structure has evolved from the traditional middle-class, single-income family into more single-parent families, more working mothers and single-person households. This change has shifted the primary concern for meal preparation to convenience and ease of preparation (Demand Strategies, 1991).

Changing technologies have made the focus on convenience much more dramatic. Microwave manufacturers and fast food establishments have flourished because of the shift in the demand for convenience. But this shift in demand did not occur without a price tag. Consumers became more price conscious and are more likely to monitor the use of more expensive food items (Demand Strategies, 1991).

It is estimated by the year 2010 one-third of our population will be 50 years or older. Compare that number to the 24 percent in 1965 and it is easy to determine that the American population is aging at an incredible rate. It is also recognized that older consumers have different needs than do younger consumers (Demand Strategies, 1991).

Consumers are more aware of health and nutrition than ever before. They are also very excited and want to know the truth about nutrition and

available nourishment. Nutritional value of red meat is one particular area of concern (Demand Strategies, 1991).

The intense competition from other protein sources, as well as salads and pastas, have provided a great incentive for the meat industry to focus on the demands and functions of consumer groups. Despite the competition, red meat continues to be featured regularly as a "center of the plate" item in approximately one-half of American households (Demand Strategies, 1991).

### Factors Driving Demand and the Consumer

The following factors effect how consumers choose main-dish alternatives: variety, convenience, health and price (Demand Strategies 1991).

Variety. Whether it is the result of changing lifestyles or the fact that America is maturing, consumers are searching for variety in their diets and in their way of life. Never was this so evident, as in the 1992 presidential election. Consumers wanted a change and some candidates were offering just that, a big change.

Convenience. With changing lifestyles and the demand for variety, consumers are also expecting convenience. The Rand Corporation and Louis Harris and Associates (1989) found that the amount of leisure time has declined from 25 hours per week in 1973 to 15 hours in 1988. The crunch on free time may be explained in a variety of ways. The steady growth of single-member and single-parent families, the increased number of working mothers (30 percent in 1960 compared to 57 percent in 1988) and the fact that consumers are working longer hours (Demand Strategies, 1991).

Along with convenience, comes the concern of consumption trends. It is estimated that 80 percent of all U. S. households have a microwave (Demand Strategies, 1991). The dominant reasons cited for use were: cooking speed, ease of preparation, and clean up. It has been reported that food service sales have grown from 35 to 46 percent of total food sales in the past 25 years (Demand Strategies, 1991). The number of fast food outlets has grown almost 50% since 1984. One aspect that is gaining rapid popularity, is the take-out industry (Demand Strategies, 1991).

Health. Today's consumer is more educated than consumers 25 years ago, but more importantly, they are more likely to search for the truth regarding issues they feel strongly about. The new-found interest that consumers exhibit regarding their general health may be likened to a "fitness revolution". Consumers are exercising more, counting calories and searching for a miracle food that will erase all of the bad things that they have done to their bodies.

A survey in 1990 indicated that consumers were most concerned with salt, saturated fat, sugar and cholesterol content of foods. Cholesterol and fat content have had the most impact on meat consumption, as nearly 30 percent of consumers indicate they have reduced meat use because of health reasons (Demand Strategies, 1991).

Consumers do recognize the efforts of the industry to provide a more appealing product. The War on Fat (NCA, 1990), especially regarding fat trim levels of fresh meats, the fat content of fresh ground meats and low-fat fresh and processed meats, has intrigued consumers. They are not rapid in their return to meat, however, they are incorporating it in their meals more often.

Price. Red meat always faces stiff price competition when compared to alternative protein sources, especially chicken. While prices remained relatively constant in beef and poultry during the 1980's, there remains \$1.73 difference in

price per pound (poultry \$0.93 versus \$2.66 for beef) (Demand Strategies, 1991).

### Consumer Groups

There are several distinct categories of consumers, all of which possess different demands and needs. These markets segments, as identified by the Meat Board in 1991 at the Demand Strategy meeting, are: New Traditionalists, Traditional Males, Convenience Oriented, Affluent Health Conscious and Constrained Health Conscious.

New Traditionalists. It is projected that this segment will remain the largest and represent 31 percent of all households in 2020. This household typically represents a family with children. Food selections are primarily driven by the desire for variety, while health and budget constraints are secondary. Meat consumption of this group is slightly below normal and they consume very few meals away from the home (Demand Strategies, 1991).

Traditional Males. The smallest group represents single, blue collar males, with below-average education. This segment does not focus on health concerns and are more likely to eat out. Traditional Males consider meat to be healthy and cite the main reason for consuming red meat as taste (Demand Strategies, 1991).

Convenience Oriented. This segment represents households that have two working parents and a higher than average income. This segment will remain relatively the same size. Convenience Oriented consumers are responsible for the increase in fast food establishments, the increase in take out meals and the

demand for easy-to-prepare meals. Even though this group acknowledges the dangers of high fat and cholesterol, they are very unlikely to change their eating habits for health reasons. Additionally, these consumers consider meat to be the best-tasting main dish (Demand Strategies, 1991).

Affluent Health Conscious. This is the fastest growing segment and is projected to include 23 percent of all households by 2020. These households have an above average income and education level and health is the primary concern in meal selection. Because of the perceived health risk associated with meat, this group has the lowest frequency of meat consumption. An active lifestyle is also a characteristic of the Affluent Health Conscious group (Demand Strategies, 1991).

Constrained Health Conscious. This is the second group that is projected to maintain its size. Consumers in this group enjoy the taste of meat, however, because of dietary and budget concerns, they must monitor their consumption. This group is the least likely to eat away from home (Demand Strategies, 1991).

### Current Trends

The only thing that is certain in the meat and livestock industry is change. Providing an appealing product to today's consumer has become one of the most challenging tasks that faces the industry. However, information collected by the Meat Board and other special interest groups offers some guidance for meeting these demands.

Consumer focus has changed drastically from what it was in the 1980's. Consumers are now more concerned with product performance, product

familiarity and satisfaction (Demand Strategies 1992). Food attitudes, however, remain essentially the same. Over half of the American population agrees that it is important to limit fat intake and avoid cholesterol. Accordingly, many have reduced their consumption of red meat because of health associated risks. While consumers strive to maintain a healthy weight and lifestyle, they are unwilling to make a commitment to exercise and proper eating habits. This attitude has contributed to the craving for quick-fix exercise programs and convenience-oriented food items.

Food purchase patterns reflect the state of the economy. As food prices continue to rise and the economy weakens, consumers are spending less of their disposable income on food purchases. In 1980, 56 percent of retail food was bought at a conventional supermarket contrasted with only 27% projected for 1993. This has occurred because of the increase in superstores, wholesale clubs, and warehouse stores (Demand Strategies, 1992). Carry-out meals are expected to be the new trend in food purchase patterns and are expected to match the number of meals consumed at retail. Consumers are entertaining more at home, spending more time with their families and baking from scratch (Yankelovich, 1991).

While poultry is generally perceived as being more healthy than red meat, beef remains the preferred choice when consumers eat out. Moreover, greater than 70 percent of households continue to consume fresh beef, processed meat, poultry and/or pork; however, the distribution of consumption has changed over the past decade. Beef consumption has remained relatively stable, while the pork industry has sacrificed most of its market share to poultry (Demand Strategies 1992). The average price spent per pound on U.S. Choice beef in 1982 was \$2.38, compared to \$2.81 in 1990, whereas whole broilers were \$0.72

per pound in 1982 versus \$0.90 per pound in 1990 (U.S. Department of Labor 1990).

Roughly 3/4th of the American population considers beef to be convenient, versatile, tasty, easy and quick to prepare (Consumer Climate, 1991). However, one in two people consider beef to be too high in cholesterol, too fat and too expensive (Consumer Climate, 1991). Beef consumption is the highest among the following groups: men, individuals 21 to 44 years of age, non-college graduates, middle-income consumers and Midwest residents (National Eating Trends, 1991). Conversely, consumption is the lowest among these groups: women, individuals 45 to 64, college graduates, upper-income families and residents of the Western United States (National Eating Trends, 1991).

## Current Research

### National Beef Tenderness Survey

The primary focus of the National Beef Tenderness Survey (Morgan et al., 1991) was to assess the magnitude of the tenderness problem as it related to consumers' perception of taste. Previous studies by Savell et al., 1989; revealed that tenderness or meat texture was the single most important factor affecting taste.

Steaks surveyed by Morgan et al. (1991) were cooked in the following manner: top loin and top sirloin steaks were broiled to an endpoint temperature

of 65°C; top round, eye of round, chuck tenders and chuck arms were braised to and endpoint of 85°C (AMSA, 1978). The mean shear force for all cuts analyzed in the National Beef Tenderness Survey (Morgan et al., 1991) was 3.65 kg, while the mean shear force values for chuck, rib, loin, and round cuts were 3.72, 3.36, 3.17, and 4.31 kg, respectively. Top sirloin steaks were tougher and received the lowest sensory ratings compared with other loin cuts. All roasts tended to be more tender than steaks from the same subprimal. U.S. Choice chuck retail cuts, compared to Select and no-roll chuck cuts, had approximately 10% fewer cuts with shear force value in excess of 4.0 kg.

Average post fabrication time was 17 d (ranging 10 to 30 d). Smith, et al. (1978) reported that aging of U.S. Choice beef carcasses for a minimum of 11d will optimize tenderness, flavor and overall palatability of the majority of the muscles in steaks and(or) roasts from the chuck, rib, loin, and round when such cuts are ultimately broiled or roasted.

Roasts from the chuck tended to have lower shear force values compared with their chuck steak counterparts (Morgan et al., 1991). A possible explanation for this difference in tenderness is the longer cooking time required for thicker roasts; thus increasing the opportunity for solubilization of collagen during thermal processing (Locker, 1977). Increased marketing of thinly cut steaks, shorter cooking times with more intensive heat could increase meat toughness and decrease consumer satisfaction. Top sirloin steaks were the toughest ( $P < .05$ ) of the loin cuts surveyed (Morgan et al., 1991). These data concur with results reported by Savell et al. (1977, 1980) and Wheeler et al. (1990) indicating that top sirloin steaks were less tender than top loin steaks. Round roasts tended to be more tender and have less detectable connective tissue than steaks from the round, a similar trend as noted in the chuck. Differences could be attributed to differences in cooking (braising vs. roasting) and shorter



cooking times, along with increased amounts of connective tissue detected in thinly cut steaks (Morgan et al., 1991).

### Influence of Quality Grade on Cooked Beef Tenderness

Researchers have reported that tenderness, juiciness, and flavor increase with increasing degrees of marbling in a direct linear relationship (McBee and Wiles, 1967; Jennings et al., 1978; Tatum et al., 1980; Dolezal et al., 1982), whereas others have reported very low or nonexistent associations (Carpenter et al., 1972; Parrish et al., 1973; Parrish, 1974; Dikeman and Crouse, 1975; Davis et al., 1979; Smith et al., 1984). It must be remembered that these comparisons are not necessarily "cause and effect relationships" because of the large sources of variation by cattle type and source, different handling systems in the various fabrication facilities, and various post fabrication times for subprimals. The only notable difference in shear force values interaction for quality grade x cut type was in the chuck (Morgan et al., 1991). However, previous data reported by Smith et al. (1984) indicates that marbling is of very limited value in explaining differences in sensory panel ratings of round steaks compared to loin and rib steaks.

### Relationship between Warner Bratzler Values and Tenderness Ratings

Shackelford et al. (1991) reported that Warner Bratzler shear force (WBS) values of top loin steaks should not exceed 3.9 kg for a 68% confidence level (CL) and 4.6 kg for 50% CL to assure overall tenderness ratings of "slightly tender" or greater from a trained sensory panel. A single WBS threshold cannot be applied to all types of retail cuts or consumer markets (retail vs. food service). Loin and chuck cuts surveyed by Morgan et al. (1991) were compared to the 68% CL for tenderness. Over 50% of the top sirloin steaks received sensory tenderness scores below "moderately tender," compared to 25% of the rib steaks. Fewer than 60% of the cuts from the chuck met the 68% CL. The 50% CL was applied to steaks from the round because of lower consumer expectations and increased toughness. High percentages of retail cuts from the chuck and round would receive overall tenderness rating scores of less than "slightly tender." Ideally, the red meat industry should strive for 100% of all retail cuts receiving an overall tenderness rating of at least "slightly tender" within a 95% CL (Morgan et al., 1991).

### National Beef Market Basket Survey

In 1991, Savell et al. surveyed beef retail cases in 12 cities across the United States for fat thickness, cut representation, package weights and counts, and case space allocation. Data collected revealed over 42% of beef retail cuts had no external fat, overall fat thickness for all retail cuts in the beef case was

.31 cm, and approximately 75 % of all cuts surveyed were boneless (Savell et al., 1991). Beef steaks and roasts had 27.4% less separable fat than values from USDA Handbook 8-13. Ground beef surveyed, regular, lean, and extra lean, had approximately 10% less fat than values reported in USDA Handbook 8-13. It is important to establish the actual fat content of beef retail cuts because of the use of beef composition data in nutritional analysis and subsequent dietary recommendations. The National Nutrient Data Bank, maintained by USDA Human Nutrition Information Service which is responsible for publishing the USDA Handbook 8-13, currently is based on 1.27 cm external fat remaining on retail cuts.

The data that were collected (one visit to each city) indicates that some retail chains merchandised cuts with less external fat than others; however, even the chains with the most external fat offered some retail cuts with little or no external fat present. External fat only composed approximately 3 % of the total weight of retail cuts. Approximately 37% of the ground beef sold was regular, 40% lean and over 22% extra lean. Considerable variation exists in the amount of each type of ground beef in stores within cities and across cities. No baseline information was available, however the proportion of lean and extra lean ground beef may be higher than perceived previously. Extractable fat content of ground beef was: regular 23.6%, lean 19.22%, and extra lean 15.42%.

Results from Morgan et al., 1991 and Savell et al. 1991 revealed that the beef industry has made remarkable progress in its effort to reduce excess fat. Especially, as indicated by the 27.4% less separable fat on beef retail cuts surveyed by Savell et al. 1991 than compared with USDA Handbook 8-13.

## CHAPTER III

### PHYSICAL CHARACTERISTICS AND COOKING PROPERTIES OF RETAIL BEEF

#### ABSTRACT

Retail outlets ( $n = 33$ ) were selected in Oklahoma ( $n = 24$ ), Kansas ( $n = 5$ ), and Texas ( $n = 4$ ) to assess the tenderness and physical characteristics of six beef retail steaks and to determine the retail availability of U.S. Choice and Select/no-roll beef. Eye of round (ER;  $n = 100$ ), top round (TR;  $n = 96$ ), top sirloin butt (TSB;  $n = 110$ ), boneless top loin (TL;  $n = 117$ ), chuck "mock" tender (MT;  $n = 55$ ), and chuck arm (CA;  $n = 86$ ) steaks were purchased in three replications. All steaks were measured for external fat and steak thickness, vacuum packaged, and stored ( $-20^{\circ}\text{C}$ ) prior to broiling to a medium degree of doneness ( $70^{\circ}\text{C}$ ) for Warner-Bratzler shear force (WBS) determination. Quality grades for the steaks purchased were 33.7% U.S. Choice vs 66.3% no-roll. Mean external fat maximum thickness was less than 6 mm for all steaks (ER = 3.3, TR = 3.5, TSB = 5.9, TL = 5.5, MT = 1.0, CA = 4.6 mm). Mean steak thickness was similar ( $P > .05$ ) for retail cuts from the loin and chuck (TSB = 2.3, TL = 2.6, MT = 2.5, CA = 2.5 cm), but thinnest ( $P < .05$ ) for steaks from the round (ER = 1.8, TR = 1.5 cm). Peak WBS values were

lowest ( $P < .05$ ) for TL (3.6 kg), intermediate for CA, MT, and TSB (4.0, 4.1, and 4.3 kg, respectively) and highest for ER (4.6 kg) and TR (4.5 kg) steaks. Similar trends were noted for percentages of very tender (WBS  $< 3.9$  kg) vs tough (WBS  $> 4.5$  kg) steaks (TL = 67.1 vs 15.6, CA = 45.0 vs 20.5, MT = 32.8 vs 22.9, TSB = 35.8 vs 35.1, TR = 31.0 vs 46.4, and ER = 14.2 vs 48.2% for very tender vs tough, respectively). No ( $P > .05$ ) differences were noted in WBS between Choice and no-roll categories; however, the replication x retail cut interaction was significant for WBS. Mean WBS values were most variable for TR, TSB, and MT steaks over the three sampling periods. As advertised ground beef fat levels decreased (RGB  $>$  LGB  $>$  XGB  $>$  DGB), actual lipid content decreased and percentage moisture increased. Results of this study indicate that research is needed to improve both consistency and level of tenderness in beef retail cuts, especially TSB, ER, and TR steaks.

(Key Words): Beef, Tenderness, Market Surveys

## Introduction

In the beef industry's commitment to their future, they determined that it was necessary to assess the current status of beef. One of the key factors dealt with external fat and how it affected the industry as a whole. Several research projects and strategic planning committees originated from this issue. In the mid 1980's research was funded by the National Live Stock & Meat Board to determine how beef was sold at retail and how consumers perceived beef. The National Consumer Retail Beef Study (1987) revealed that fat trim levels

averaged 6 mm and suggested marketing retail beef products with 3 mm or less fat trim. By the beginning of the 1990's, all retail beef had less than 6 mm fat trim, with most stores merchandising beef with approximately 3 mm fat trim. Retailers, however are faced with a dilemma. They receive product in the door that averages 2.5 cm fat trim. Consequently, the retailer incurs the loss of product weight that is actually sold and frequently pays for the excess fat trim to be picked up by a rendering service. This began the beef industry's War on Fat in 1990 by the National Cattleman's Association (NCA). Additional proposals were presented to cattlemen at the 1993 NCA Convention that would change the current yield grade system. One version of the proposal places a premium on leaner beef and heavily discounts fatter cattle.

Conscious efforts by every segment of the beef industry are necessary to meet the demands of consumers. Most importantly, the beef industry must be willing to identify a means of reducing waste by eliminating inefficiencies in their production practices at all levels. By continuing to be diligent in research and reporting findings in a timely manner, the beef industry will be praised for its open communication with the public.

## Materials and Methods

### Steaks

*Store Selection.* Retail outlets ( $n = 33$ ) were selected in Oklahoma ( $n = 24$ ), Kansas ( $n = 5$ ), and Texas ( $n = 4$ ) based on volume of red meat sold

(information obtained from wholesalers). Oklahoma was divided into four regions, east and west by Interstate 35 and north and south by Interstate 40. When selecting cities from these regions, an attempt was made to match cities with similar economic and demographic characteristics. Each retail outlet and corporate office was contacted by Oklahoma State University (OSU) personnel to request permission to conduct research in their facilities.

Regional cities, Kansas City and Dallas, were selected to provide sampling in cities that were included in the National Beef Tenderness Survey (Morgan et al., 1991) and National Beef Market Basket Study (Savell et al., 1991) and to gain retail information for major metropolitan areas that border Oklahoma.

*Store Visitation.* Data were collected from each retail outlet on three different store visits conducted over three seasons (avoiding holidays). The dates of the replications were as follows: Rep 1 = October 1990 to January 1991, Rep 2 = April to June 1991, and Rep 3 = August to September 1991.

During each store visit, all fresh beef retail items (full and self serve) were inventoried and retail case allotment for all meat items was recorded. Retail cut characteristics of external fat trim, cut thickness, quality grade and bone-in vs. boneless cuts were evaluated by OSU personnel and were averaged among similar cuts in the case.

Retail steaks, from the top round (TR) or *semimembranosus* and *adductor*, eye of round (ER) or *semitendinosus*, top sirloin butt (TSB) or *gluteus medius*, top loin (TL) or *longissimus dorsi*, chuck arm (CA) or *triceps brachii* and mock tender (MT) or *supraspinatus*, were randomly selected and purchased (when available) such that they were representative of the quality grades

available at each retail outlet for each store visit. Product was transported to the OSU Meat Laboratory using steel belted coolers with cold packs and ice. At OSU, physical characteristics of external fat thickness and cut thickness (measurements taken in three locations and averaged for final measurement), adjusted external fat thickness (fat measured in three locations, averaged and then adjusted for the entire parameter of the cut), and cut weight were recorded. Additionally, the following retail package information was noted: price per pound, package price, package weight and number of steaks per package. Steaks were assigned an identification number, crust frozen at  $-23^{\circ}\text{C}$  for 15 to 20 minutes, vacuum packaged in a Multivac<sup>®</sup> M855 Vacuum Packager and frozen ( $-30^{\circ}\text{C}$ ) until all steaks were collected for each replication.

*Cooking Procedure.* Steaks were grouped by muscle type and cooked in random order for each replication (Table 1). Steaks were thawed ( $2 \pm 1^{\circ}\text{C}$ ) for 24 hr and subsequently broiled on Farberware<sup>®</sup> Open-Hearth broilers to an internal temperature of  $70^{\circ}\text{C}$  (medium degree of doneness). Constantan coated copper thermocouples were placed in the geometric center of steaks to monitor internal temperature with an Omega 5000 DATALOGGER<sup>®</sup>. Steaks were turned upon reading  $35^{\circ}\text{C}$  and then removed upon attaining the final internal temperature. Data were collected to assess cooking time (minutes/100 g serving) and shrinkage (% weight loss). After steaks cooled to room temperature ( $22^{\circ}\text{C}$ ), an average of six cores, 1.3 cm in diameter were removed parallel to the muscle fibers and individually sheared one time to determine Warner Bratzler peak shear force using an Instron<sup>®</sup> Model 4502. The cooked steak (including cores used for shear data) was stored in Whirl Pak<sup>®</sup> bags at  $-30^{\circ}\text{C}$  for subsequent chemical analysis. Note: The recommended cooking procedures (AMSA, 1978)



were not used in an attempt to mock consumer preparation of steaks in their homes.

Table 1. Cooking order of retail steaks

Cooking Order	Replication		
	1	2	3
1	Eye of Round	Top Butt	Top Round
2	Mock Tender	Chuck Arm	Top Loin
3	Top Round	Top Loin	Mock Tender
4	Top Loin	Top Round	Top Butt
5	Top Butt	Mock Tender	Eye of Round
6	Chuck Arm	Eye of Round	Chuck Arm

*Proximate Analysis.* Proximate analysis of all retail steaks purchased was performed in duplicate according to procedures outlined by AOAC (1988). Each cooked steak was individually frozen in liquid nitrogen and powdered in a Waring® commercial blender. Three grams of the powdered sample were placed on ashless filter paper, dried at 100°C for 24 h, desiccated for 1 h and re-weighed to determine moisture. Following moisture determination, each sample was placed in a soxhlet for 24 h for ether extraction of lipid followed by drying at 100°C for 12 h. Each sample was then desiccated and re-weighed to calculate lipid content. Using the Kjeldal method, protein content was determined from a separate .5 g powdered sample placed in a digestion tube with two Kjeltabs® (3.5g Potassium Sulfate + .0035 g Selenium) and digested for 2 h at 420°C. Samples were removed, extended with 70 to 80 ml of deionized water and analyzed for protein using a KJELTEC® 1030 Auto Analyzer. The previous procedures were repeated for each replication.

*Statistical Analysis.* All statistical analyses were conducted using the General Linear Models procedures of SAS (1990). The main effects of cut type, quality grade, replication and their interactions were initially analyzed. There were no significant three-way interactions and therefore, this term was pooled with the error for additional data runs. Least squares means were utilized to account for the unequal number of steaks among subclasses.

### Ground Beef

*Product selection and transportation.* Ground beef samples, regular (RGB), lean (LGB), extra lean (XGB), and diet lean (DGB), were randomly selected such that they were representative of the retail case of each store visited and were purchased when available. Ground beef subsamples were transported to OSU in the same manner as their steak counterparts.

*Sample preparation.* Two 113.5g patties were formed with a Tupperware<sup>®</sup> hand press from each ground beef sample purchased. Retail package information of price per pound, package weight and package price was recorded. Patties were assigned an identification number, crust frozen at -23°C for 15 to 20 min, vacuum packaged in a Multivac<sup>®</sup> M855 Vacuum Packager and frozen at -30°C until all replications were collected.

A raw patty from each purchase was evaluated for chemical composition, while the remaining patty was grouped and cooked according to advertised lipid levels. Patties were thawed ( $2 \pm 1^{\circ}\text{C}$ ) for six hr and subsequently broiled in an Impingement Oven Series 1000<sup>®</sup>, using the cooking schedule described in Table 2.

Table 2. Ground beef cooking schedule

Schedule	Ground Beef Type			
	Regular	Lean	Extra Lean	Diet Lean
Oven temperature ( $^{\circ}\text{C}$ )	218	218	218	218
Cook time (min:sec)	6:30	6:40	6:30	6:30

After a two hr cooling period to room temperature ( $25^{\circ}\text{C}$ ), cooking shrinkage (percent weight loss) was recorded and patties were stored in Whirl Pak<sup>®</sup> bags at  $-30^{\circ}\text{C}$  for subsequent chemical analysis.

*Proximate analysis.* Proximate analysis of all retail ground beef samples purchased was performed in duplicate according to procedures outlined by AOAC (1988). Ground beef patties (cooked and raw) were individually frozen in liquid nitrogen, powdered in a Waring Blendor<sup>®</sup> and analyzed in duplicate for percent moisture (oven drying), lipid (ether extract), and protein (Kjeldal). The same procedures were used for steaks and ground beef subsamples.

*Statistical analysis.* The main effects of advertised composition (RGB, LGB, XGB, and DGB), replication and their interactions were analyzed using the General Linear Models procedures of SAS (1990). Least squares means were partitioned for these effects when a significant ( $P < .05$ ) F value was obtained.

## Results and Discussion

### Steaks

*General Information.* Eighty-six percent of the retail cuts surveyed were boneless. This shows greater than a 10% increase in boneless cuts available at retail level when compared to the National Beef Market Basket Survey (Savell et al., 1991). Additionally, 88 steak types, 51 roasts, 51 special cuts, and 29 forms of ground beef were noted in the retail case inventories. This diverse selection of retail beef provides the consumer with variety; however, it may also have a negative effect. Consumers may not be able to identify a particular cut by reading the label or by visual appraisal (this is due to inconsistent identification of retail cuts, especially in different retail outlets); thus leading to consumer frustration and confusion.

*Physical Characteristics.* Subsample steaks were purchased and evaluated for physical characteristics and chemical composition. Approximately two-thirds

of the steaks purchased were no-roll; one-third were U.S. Choice (Table 3). Steaks from the loin (TSB and TL) were the fattest ( $P < .05$ ) externally, followed by CA and steaks from the round; however, all retail steaks averaged less than 6 mm of external fat trim (Table 4). As expected, MT steaks were the trimmest ( $P < .05$ ) among all steaks surveyed because the *supraspinatus* is surrounded by other muscles and intermuscular fat, whereas the other cuts were covered by s.c. fat. Relative to steak thickness (Table 4), cuts from the round were the thinnest ( $P < .05$ ) while the steaks from the loin and chuck did not vary ( $P > .05$ ) in thickness. Steak thickness differed ( $P < .05$ ) between U.S. Choice and no-roll categories; however, there were no differences ( $P > .05$ ) among quality levels for fat thickness or adjusted fat thickness (Table 5). The steak thickness x quality grade interaction reflected that U.S. Choice CA steaks were thicker ( $P < .05$ ) than their no-roll counterparts; however, there were no ( $P > .05$ ) differences among round, loin and MT steaks between quality grades.

*Cooking Properties.* Cook time (min/100 g) was affected by cut size (thickness and weight) and surface area. As surface area decreased, cooking time and shrink loss increased as indicated by the longest cooking time and greatest shrink loss for MT ( $P < .05$ ) when compared to other cuts surveyed (Table 6).

*Tenderness.* Peak Warner Bratzler shear force values (WBS) values were highest for cuts from the round, intermediate for the TSB, CA, and MT and lowest for TL steaks (Table 6). These data were consistent with values reported by Morgan et al. (1991). Research results by Savell et al. (1977, 1980) and

Wheeler et al. (1990) also concur with these data, in that steaks from the top butt are less tender than steaks from the top loin.

Similar trends were noted when steaks were categorized to estimate percentage very tender ( $\text{WBS} < 3.9 \text{ kg}$ ) and tough ( $\text{WBS} > 4.5 \text{ kg}$ ), according to methods described by Shackelford et al. (1991). Tenderness categories presented in Table 6 and Figure 1 indicate that TL steaks were the most tender and that approximately 75% of CA and MT steaks could be categorized as tender; however, it should be noted that approximately one of every two round steaks (TR or ER) would have the possibility of being perceived as tough. Similar results were noted by Morgan et al. (1991) and Smith et al. (1984) for round steaks. Additionally, this variation could be explained by the anatomical location of the cut and its function. Based on this information, it would be expected that steaks from the round would be less tender than steaks from the rib or loin. Considering this information and the percentage tough steaks from the round, mechanical tenderization of all steaks from the round should be encouraged.

The steak type x quality grade interaction was not different ( $P > .05$ ) for WBS values (Table 7). Additionally, WBS was unaffected ( $P > .05$ ) for quality grade x replication. Furthermore, quality grade did not substantially influence percentages of tender or very tender steaks, cook time, or percentage shrink. For the replication x steak type interaction (Figure 2), no differences ( $P > .05$ ) were noted among CA steaks; however, shear values varied the most for steaks from the loin. In addition, round steaks and the MT showed a tendency to have similar shear values for two replications and then one replication in which the WBS was tougher ( $P < .05$ ). The fact that replication had a greater effect on tenderness than did quality grade in the present study along with data reported by Morgan et al. (1991) that beef retail steaks varied in the degree of tenderness

between muscles as well as within muscles further compounds the issue of tenderness. Because there is no interaction ( $P > .05$ ) between quality grade and tenderness (Table 5), it becomes questionable that quality grading is serving its purpose. Quality grading was designed to categorize a non-homogenous population of beef into more homogenous groups of carcasses or cuts that would provide more consistent palatability traits.

One theory introduced by Bill Helming (1992) suggests eliminating the beef quality grading system as we know it today and implementing a yield and quality grade system similar to the pork industry. Several factors may prevent this plan from being effective. Most importantly the gene pool of beef cattle 20 times more diverse than the genetics that are used to produce the pork that is sold in the United States. Additionally, swine production is more environmentally controlled than beef cattle production and the generation interval for swine is much shorter than beef cattle and changes can be achieved more rapidly.

Recognizing that many factors contribute to tenderness provides an opportunity for researchers to search for means to control the variety of factors. Understanding the components of tenderness definitely is not an easy task; however it is a very important one, as tenderness contributes to the overall palatability of beef.

*Steak composition.* Top loin steaks contained more ( $P < .05$ ) lipid than steaks from the chuck, sirloin, or round; whereas steaks from the TR had the lowest lipid concentration (Table 8). This can be explained by the amount of intramuscular fat (marbling) contained in cuts from the loin, especially when compared to the round retail steaks. Steaks from the round possessed a higher

portion ( $P < .05$ ) of protein than cuts from the loin or chuck. Lipid concentration did vary ( $P < .05$ ) between U.S. Choice (6.51%) and no-roll (4.82%) steaks (data not in tabular form).

### Ground Beef

*Raw composition.* Ground beef samples were purchased and evaluated for raw and cooked composition according to their advertised fat level (Table 9). Currently the USDA identifies RGB as ground beef with  $< 30\%$  fat, LGB as  $< 25\%$  fat and XGB as  $< 22.5\%$  fat (deHoll, 1989). There were directionally consistent and statistical differences ( $P < .05$ ) for advertised ground beef fat levels for percent lipid and moisture content (Table 10). As advertised ground beef fat levels decreased (RGB  $>$  LGB  $>$  XGB  $>$  DGB) actual lipid content decreased and percentage moisture increased (Table 11). These values were consistent with advertised label composition for a majority (97.0%) of stores surveyed. There were a few instances where the actual lipid concentration was not consistent with the advertised fat level. Ground beef composition was consistent with values reported by Savell et al. (1991).

*Cooked composition.* Cooking properties of ground beef are found in Table 12. Shrink loss for ground beef patties was not different ( $P > .05$ ) for RGB, LGB or DGB; however, XGB patties did have less shrink loss. Lipid and moisture composition tended to follow a pattern similar to the raw patties. When patties were grouped by replication (Table 13), ground beef samples taken



during the second test period contained less ( $P < .05$ ) lipid than replication three, but did not differ ( $P > .05$ ) from replication one.

### Implications

Currently the retail industry is presenting products that are meeting consumer demands, especially when concerning fat trim levels and fat content of ground beef. However, the whole red meat industry must focus on waste fat, tenderness and how improve the industry's image. Product consistency is especially volatile when considering tenderness. Continued efforts to improve tenderness is a must!

Table 3. Number of retail steaks purchased stratified by steak type and quality grade

Steak type	Quality grade		Total
	Choice	No-Roll	
Eye of round	31	69	100
Top round	31	65	96
Top butt	39	71	110
Top loin	41	76	117
Mock tender	21	34	55
Chuck arm	27	59	86
Total	190 (33.7%)	374 (66.3%)	564

Table 4. Least squares means for physical characteristics of retail steaks stratified by steak type

Trait	Eye of Round	Top Round	Top Butt	Top Loin	Mock Tender	Chuck Arm
Fat, mm	3.3 <sup>d</sup> (.26)	3.5 <sup>d</sup> (.25)	5.9 <sup>b</sup> (.23)	5.5 <sup>b</sup> (.22)	1.0 <sup>e</sup> (.33)	4.6 <sup>c</sup> (.28)
Adj. fat, mm <sup>a</sup>	1.3 <sup>d</sup> (.13)	1.2 <sup>d</sup> (.13)	2.9 <sup>b</sup> (.12)	2.7 <sup>b</sup> (.12)	0.2 <sup>e</sup> (.17)	2.0 <sup>c</sup> (.15)
Cut thickness, cm	1.8 <sup>d</sup> (.07)	1.5 <sup>e</sup> (.07)	2.3 <sup>c</sup> (.07)	2.6 <sup>b</sup> (.06)	2.5 <sup>bc</sup> (.09)	2.5 <sup>bc</sup> (.08)

<sup>a</sup> Fat measured in three different locations, averaged and then adjusted for the entire parameter of the cut.

<sup>bcd</sup> Means in a row lacking a common superscript letter differ ( $P < .05$ ).

Table 5. Least squares means for physical characteristics, cooking properties and tenderness categories of retail steaks stratified by quality grade

Trait	Grade	
	Choice	No-Roll
Fat, mm	3.9 (.18)	4.0 (.12)
Adj. fat, mm <sup>a</sup>	1.8 (.09)	1.7 (.06)
Cut thickness, cm	2.3 <sup>f</sup> (.05)	2.18 (.03)
Cook time, min/100g	9.21 (.17)	8.88 (.12)
Cook shrink, % <sup>b</sup>	31.55 (.34)	31.30 (.24)
Shear force, kg <sup>c</sup>	4.11 (.06)	4.23 (.05)
Tender, % <sup>d</sup>	69.7	65.9
Very Tender, % <sup>e</sup>	39.2	35.9

<sup>a</sup> Fat measured in three different locations, averaged and then adjusted for the entire parameter of the cut.

<sup>b</sup> ((Raw weight - cook weight)/raw weight)\*100.

<sup>c</sup> An average of six 1.3 cm cores per steak were sheared once to determine Warner Bratzler values.

<sup>d</sup> Tender = shear force < 4.5 kg.

<sup>e</sup> Very tender = shear force < 3.9 kg.

<sup>f</sup>g Means in a row lacking a common superscript letter differ (P < .05).

Table 6. Least squares means for cooking properties, shear force values, and tenderness categories stratified by steak type

Trait	Eye of Round	Top Round	Top Butt	Top Loin	Mock Tender	Chuck Arm
Cook time (min/100 g)	14.2 <sup>f</sup> (.25)	4.2 <sup>i</sup> (.25)	4.3 <sup>i</sup> (.23)	8.4 <sup>g</sup> (.23)	16.0 <sup>e</sup> (.32)	7.2 <sup>h</sup> (.27)
Cook shrink, % <sup>a</sup>	33.5 <sup>e</sup> (.50)	29.5 <sup>gh</sup> (.50)	31.3 <sup>f</sup> (.46)	28.9 <sup>h</sup> (.44)	34.9 <sup>e</sup> (.64)	30.5 <sup>fg</sup> (.53)
Shear force, kg <sup>b</sup>	4.60 <sup>e</sup> (.09)	4.45 <sup>ef</sup> (.09)	4.29 <sup>fg</sup> (.08)	3.58 <sup>i</sup> (.08)	4.12 <sup>gh</sup> (.12)	3.96 <sup>h</sup> (.09)
Tender, % <sup>c</sup>	49.2	53.6	65.2	84.5	74.5	76.8
Very tender, % <sup>d</sup>	15.5	28.6	36.0	66.7	32.7	45.8

<sup>a</sup> ((Raw weight - cook weight)/raw weight)\*100.

<sup>b</sup> An average of six 1.3 cm cores per steak were sheared once to determine Warner Bratzler values.

<sup>c</sup> Tender = shear force < 4.5 kg.

<sup>d</sup> Very tender = shear force < 3.9 kg.

<sup>efghi</sup> Means in a row lacking a common superscript letter differ (P < .05).

Table 7. Least squares means for Warner Bratzler shear by steak type and quality grade<sup>a</sup>

Steak type	Quality grade	
	Choice	No-Roll
Eye of round	4.50 (.15)	4.71 (.11)
Top round	4.42 (.15)	4.52 (.11)
Top butt	4.29 (.14)	4.28 (.10)
Top loin	3.47 (.13)	3.68 (.10)
Mock tender	3.98 (.20)	4.19 (.15)
Chuck arm	3.92 (.17)	4.02 (.11)

<sup>a</sup> No differences ( $P > .05$ ) were noted for quality grade.

Table 8. Least squares means for proximate composition of cooked steaks stratified by steak type

Trait	Eye of Round	Top Round	Top Butt	Top Loin	Mock Tender	Chuck Arm
Lipid, %	5.05 <sup>c</sup> (.30)	3.91 <sup>d</sup> (.29)	5.04 <sup>c</sup> (.26)	7.44 <sup>a</sup> (.26)	5.75 <sup>bc</sup> (.39)	6.35 <sup>b</sup> (.32)
Moisture, %	59.7 <sup>b</sup> (.85)	62.4 <sup>a</sup> (.81)	60.9 <sup>ab</sup> (.74)	59.3 <sup>b</sup> (.72)	61.2 <sup>ab</sup> (1.10)	61.1 <sup>ab</sup> (.89)
Protein, %	34.5 <sup>a</sup> (.35)	33.1 <sup>b</sup> (.33)	31.8 <sup>c</sup> (.30)	31.3 <sup>c</sup> (.30)	32.2 <sup>bc</sup> (.45)	32.1 <sup>c</sup> (.37)

abcd Means in a row lacking a common superscript letter differ (P < .05).

Table 9. Number of ground beef samples purchased stratified by advertised fat level

Advertised fat level	Number purchased
Regular	90
Lean	57
Extra lean	62
Diet lean	31
Total	240



Table 10. Least squares means for raw proximate composition of ground beef stratified by advertised fat level

Trait	Ground beef type			
	Regular	Lean	Extra lean	Diet lean
% Lipid	25.32 <sup>a</sup> (.51)	17.71 <sup>b</sup> (.63)	12.60 <sup>c</sup> (.61)	9.93 <sup>d</sup> (.96)
% Moisture	57.14 <sup>d</sup> (.39)	62.72 <sup>c</sup> (.49)	67.14 <sup>b</sup> (.47)	69.16 <sup>a</sup> (.74)

abcd Means in a row lacking a common superscript letter differ ( $P < .05$ ).

Table 11. Lipid content of raw and cooked ground beef samples stratified by advertised fat level

Type	Mean	Minimum	Maximum	SD
Regular				
Lipid %, raw	25.38	13.40	40.87	4.89
Lipid %, cooked	24.00	15.09	29.83	2.83
Lean				
Lipid %, raw	17.81	7.74	30.14	4.91
Lipid %, cooked	19.79	10.80	26.97	3.76
Extra lean				
Lipid %, raw	12.52	3.08	30.15	4.84
Lipid %, cooked	15.26	5.18	24.87	4.32
Diet lean				
Lipid %, raw	10.07	2.89	17.23	3.55
Lipid %, cooked	13.69	5.31	19.92	4.05

Table 12. Least squares means for cooking properties of ground beef stratified by advertised fat levels

Trait	Ground beef type			
	Regular	Lean	Extra lean	Diet lean
Cook time, min:sec	6:30	6:40	6:30	6:30
Cook shrink, % <sup>a</sup>	31.0 <sup>b</sup> (.35)	30.0 <sup>b</sup> (.44)	28.7 <sup>c</sup> (.42)	30.6 <sup>b</sup> (.67)
Lipid, %	24.07 <sup>b</sup> (.41)	19.74 <sup>c</sup> (.49)	15.27 <sup>d</sup> (.47)	13.51 <sup>e</sup> (.75)
Moisture, %	51.63 <sup>c</sup> (.29)	54.39 <sup>d</sup> (.34)	57.58 <sup>b</sup> (.33)	58.51 <sup>b</sup> (.52)
Protein, %	23.05 <sup>c</sup> (.20)	24.63 <sup>d</sup> (.24)	25.98 <sup>b</sup> (.23)	26.81 <sup>b</sup> (.36)

<sup>a</sup> ((Raw weight - cook weight)/raw weight)\*100.

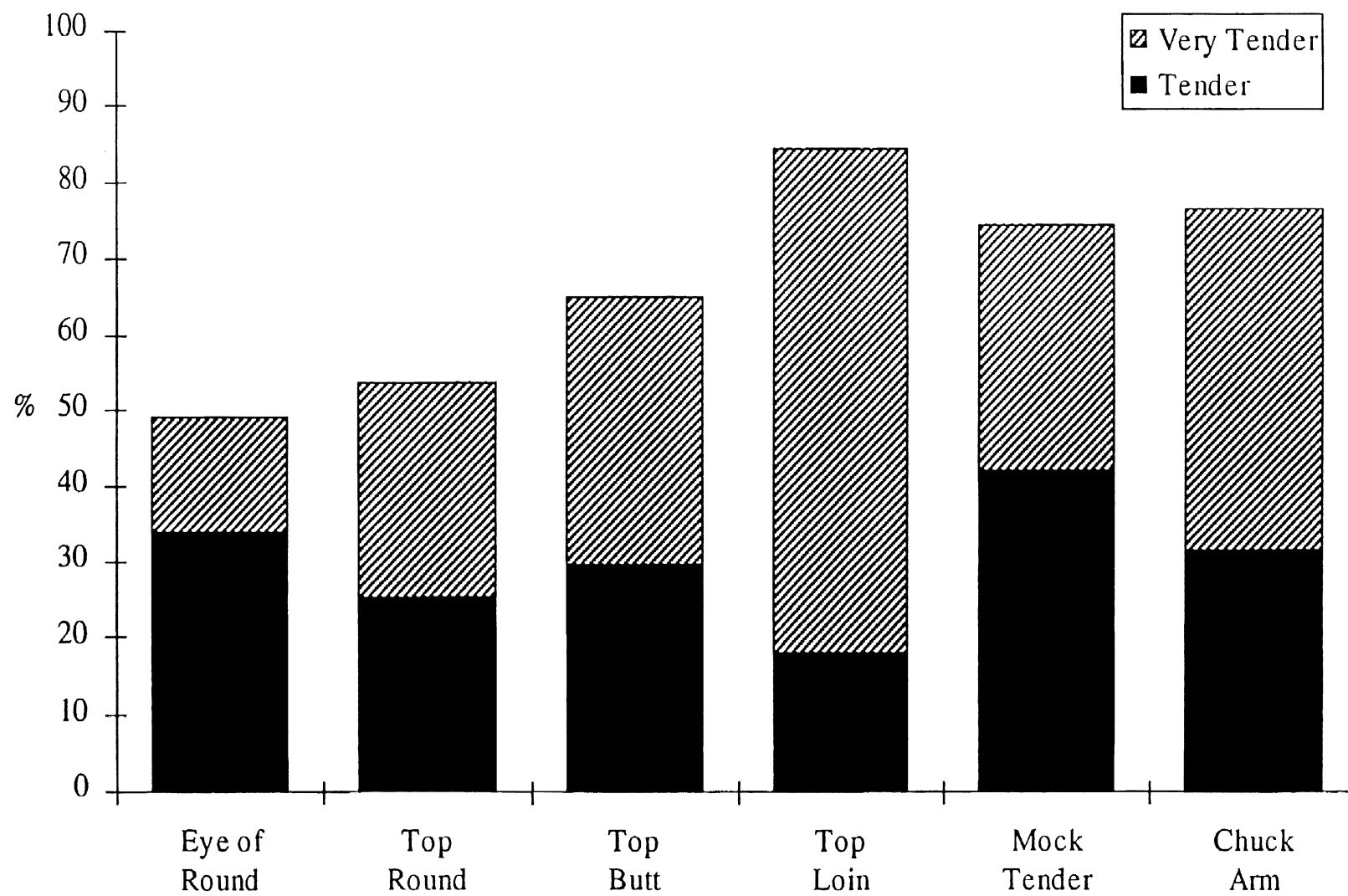
<sup>bcd</sup> Means in a row lacking a common superscript letter differ (P < .05).

Table 13. Least squares means for proximate composition of cooked ground beef stratified by replication

Trait	Replication					
	1		2		3	
Lipid, %	18.23 <sup>ab</sup>	(.54)	17.26 <sup>b</sup>	(.46)	18.96 <sup>a</sup>	(.41)
Moisture, %	55.68 <sup>ab</sup>	(.38)	56.01 <sup>a</sup>	(.32)	54.90 <sup>b</sup>	(.29)
Protein, %	24.80 <sup>b</sup>	(.26)	25.52 <sup>a</sup>	(.23)	25.04 <sup>ab</sup>	(.20)

<sup>ab</sup> Means in a row lacking a common superscript letter differ (P < .05).

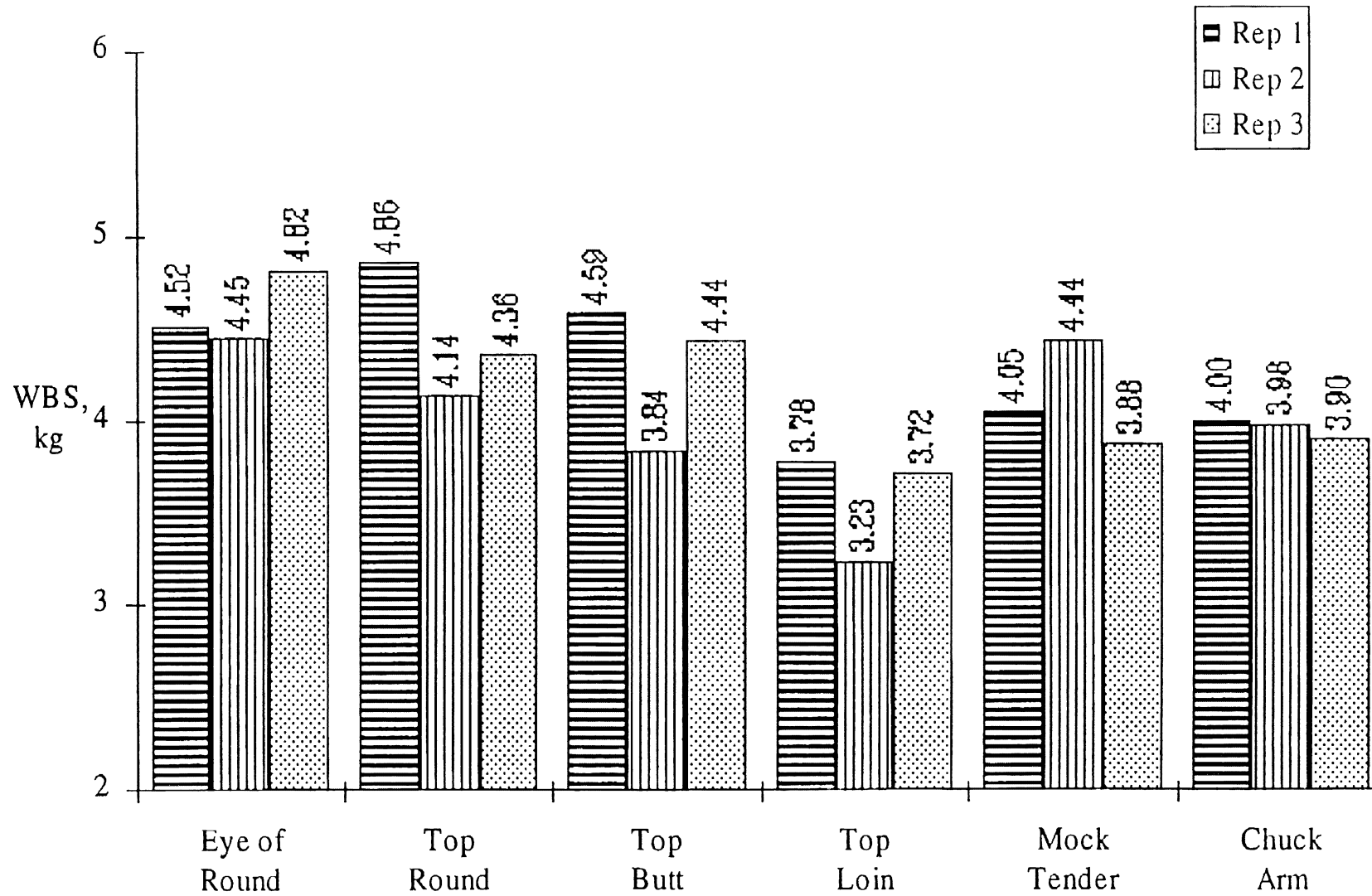
Figure 1. Percentage tender/very tender stratified by steak type



Tender = shear force < 4.5 kg

Very tender = shear force < 3.9 kg

Figure 2. Shear force values stratified by steak type and replication



## CHAPTER IV

### CONSUMER PERCEPTIONS OF BEEF AT RETAIL: AN OKLAHOMA MARKET SURVEY

#### ABSTRACT

Questionnaires (n = 3723) were distributed at 26 retail outlets in Oklahoma (n = 19), Texas (n = 4), and Kansas (n = 3) to survey consumer perceptions of beef. A total of 778 (20.9%) responses were returned via mail. Categorical information included gender (female = 84.2%; male = 15.8%), 3 age groups (< 36 yr = 23.0%; 36 to 60 yr = 50.7%; 61 yr or > = 26.3%), and 3 income levels (< \$25,000 = 40.9%; \$25,000 to \$49,000 = 42.4%; \$50,000 or > = 16.7%). The remaining questions (n = 25) were designed to assess shopping patterns, factors influencing red meat purchases, meat cookery, and diet/health considerations. A majority of the respondents budget \$40 to \$59 per month for meat; 59.7% ranged from \$20 to \$79 per month. The trend was for older and lower income consumers to spend less than \$60 per month on red meat (71.4 and 59.0%, respectively). Given a list of traits, consumers emphasized meat quality (18.3%), fat trim/leanness (17.1%), food safety (15.2%), price (15.2%), and color (12.8%) as the most important factors influencing their red meat purchasing decisions. Meat packaging (37.1%), convenience (24.8%), and

weekly specials (22.1 %) were identified as their lowest priority factors. Interestingly, fat trim/leanness was more important for females (16.1 % higher) than males, convenience ranked lowest for older (> 60 yr) consumers (11.7 % lower), and nutrition appealed primarily to middle aged (36 to 60 yr) consumers (9.3 % higher). Most (60.2 %) of the consumers reported that meat cookery information was unavailable at the meat counter; 66.0 % said they would use cookery information if it were made available. When asked to define meat quality, consumers identified freshness (85.0 %), meat color (84.5 %), tenderness (63.7 %), U.S. grade (62.9 %), fatness (61.7 %), flavor (50.0 %), food safety (45.1 %), and juiciness (34.3 %) as contributing factors. Most of the consumers polled perceive beef to be healthy relative to protein (97.5 %), minerals/vitamins (85.1 %), and calories (72.5 %). Conversely, many consumers still view beef as unhealthy relative to fat (72.4 %) and cholesterol (64.6 %), especially the older (> 60 yr) and higher income (\$50,000 or >) consumer groups. The results of this survey reinforce the belief that consumer perceptions of meat quality vary considerably. Additional materials with practical information relative to meat quality, cookery and diet/health should be made available at retail.

(Key Words): Beef, Consumer, Survey

## Introduction

Understanding the demands and needs of the consumer is necessary for the beef industry to build a trusting relationship. Research conducted by the



National Live Stock & Meat Board has provided the industry with a source of information that is very valuable.

Data collected by the Meat Board (Demand Strategies 1991, 1992) indicates how consumers are changing, what their current demands are and how beef plays a role in the changing lifestyles of Americans. Several years of research have provided the industry with an opportunity to study what has caused the industry to be where it is today; however, not even a skilled fortune teller can supply adequate details that depict the future of beef.

The future of any industry is solely based on its history. One chapter in the history of the beef industry is relatively new. That chapter describes how an industry changes from being a commodity driven market to being a consumer driven market. One of the responsibilities that comes with being a consumer driven industry is that of communication. The beef industry is in control of its future now more than ever. If the beef industry does not approach diet/health issues, and other consumer related issues with a certain degree of openness, their future will be limited.

## Materials and Methods

A survey was developed to assess consumer attitudes regarding red meat. Questions addressed consumer perceptions of red meat, their definition of quality and factors used to determine quality, shopping habits, moneys spent on red meat per month and other pertinent information concerning beef purchasing trends. Additional questions provided categorical information such as gender, age, and income. A cover letter was attached to the survey to increase

consumer's curiosity about the survey to hopefully increase the number of respondents. The cover letter also included the names Oklahoma State University (OSU) personnel and a telephone number for any questions that the consumer may have regarding the completion of the survey. Surveys were distributed for the first replication by allowing consumers to pick up questionnaires on their own at check out counters or weekly ad stands. Consumers were allowed to complete the questionnaires in the privacy of their own homes and to mail their responses to OSU in pre-paid, pre-addressed envelopes.

In order to increase response rate, the questionnaire was improved so that it was easier for the consumers to complete and a more effective means of distribution, the mall-intercept method, was used for the second disbursement. The mall intercept process incorporates personal contact with the consumer and allows them to ask any questions before completing the survey. A training meeting was held to answer any questions the distribution representatives may have had and to address interviewer bias and how to avoid it when distributing the surveys. The Oklahoma Cattlemen's Association was employed to disperse the surveys during September of 1991.

*Statistical analysis.* Frequency distributions were generated to determine popular responses. Additionally, data were categorized for the following main effects: gender, age, income and appropriate interactions. These data were analyzed using General Linear Models procedures. Least squares means were partitioned when a significant ( $P < .05$ ) F value was obtained. These data were analyzed using SAS (1990).

## Results and Discussion

Questionnaires (n = 3723) were distributed in 26 retail outlets in Oklahoma (n = 19), Texas (n = 4) and Kansas (n = 3) to survey consumer perceptions of beef. Approximately 21 % of the surveys distributed were returned via mail.

Table 1. Survey respondents stratified by categorical data

Category	Number of groups					
	1		2		3	
Gender	Male	(15.8%)	Female	(84.2%)	--	--
Age, yr	< 36	(23.0%)	36 to 60	(50.7%)	> 60	(26.3%)
Income, thousand	< 25	(40.9%)	25 to 50	(42.4%)	> 50	(16.7%)

Additional questions assessed critical shopping patterns and consumer attitudes and perceptions regarding red meat. Consumers generally purchased their groceries weekly (56.7%) or 2 to 3 times per week (34.2%) and shop most frequently from noon to 5:00 p.m. (40.9%). A similar trend was observed when respondents were asked how frequently they purchased beef (49.0%, weekly). Shoppers also indicated that they purchase a majority of their red meat at retail outlets (86.6%). Steaks and roasts represent less than 50% of the red meat purchased; while ground beef purchases were greater than half of red meat procurements. Round (60.5%), ribeye (37.9%), T-bone (34.7%) and chuck (33.9%) steaks were the most frequently purchased steak cuts. Roasts from the

chuck and round (62.6% and 43.8%, respectively) were the most popular. Respondents expressed they prefer (75.4%) to buy lean or extra lean ground beef. Likewise, Savell et al. (1991) noted that greater than 60% of the ground beef sold at retail is either lean or extra lean. Consumers indicated that they favor boneless cuts (56.2%) compared to bone-in cuts (29.0%). Results from this study indicated that greater than 85% of the cuts offered at retail were boneless, this is approximately 10% higher than reported by Savell et al. (1991). Most (54.4%) consumers indicated that they ate away from home at least once or twice per week for the evening meal. Note: Data in this paragraph are not presented in tabular form.

When asked to rank the reason for shopping at a particular store, 44.5% of the consumers identified price as their most important criteria. Price was followed closely by store location (40.9%). The least important reason for selecting a shopping site was a specific section within the store.

Beef and poultry were identified by over one-half of the consumers as items they purchased every time they shopped (Table 2). Those meats purchased only for special occasions were cured meats, seafood, breakfast meat and pork. Consumers indicated they seldom (74%) purchase lamb or specialty meats, which may be a result of the fact that these items are often not available at retail.

When asked to identify how much of their monthly budget was allocated to meat, there was no difference between gender. A majority of respondents allocated \$40 to \$59 per month for meat (Table 3). The trend was for lower income and older consumers to spend less than \$60 per month on meat (59.0% and 71.5%, respectively).

Respondents indicated that color (appearance), quality, food safety, fat trim/leanness, and price were all very important factors when making purchasing decisions (Table 4). Packaging was the least influential trait considered when

purchasing meat. When asked to indicate which of the previous traits was the most important, consumers selected quality and fat trim/leanness (Table 5). Six out of 10 respondents indicated that store advertisements influence their buying habits.

Most consumers (60.2%) indicated that meat cookery information was not available at the meat counter; 66.0% said they would use cookery information if it were made available (data not in tabular form). The most common cooking methods utilized by consumers are listed in Table 6. Steaks were frequently barbecued (grilled), broiled, and fried; roasts were commonly moist baked; and the most popular cookery methods used for ground beef were frying and barbecue (grilling).

Traits used by consumers to determine quality are similar to the factors that influence their red meat purchases (Table 7). Freshness and color of the product were the most frequently used factors to define quality of red meats. Respondents also identified fatness and tenderness as important components of quality.

A majority of consumers regarded beef as healthy in respect to the following: protein, minerals/vitamins and calories; however, cholesterol and fat are perceived as concerns, particularly when beef is considered (Figure 1). This is especially true for older ( $> 60$  yr) and higher income (\$50,000 or  $>$ ) consumer groups. Similar findings were reported by the Meat Board in 1992, where approximately 46% of the respondents in their survey indicated that beef was not too high in cholesterol (Consumer Climate, 1992). Conversely, 54% of the consumers surveyed by the Meat Board in 1992 said that beef did not have too much fat; this is approximately 17% fewer consumers than in the Oklahoma study. When questioned regarding the convenience of beef, greater than 70% of the respondents indicated that they viewed beef as convenient when considering

storage, portion size, cooking and preparation time (Figure 2). Once again, similar responses were recorded by the Meat Board in 1991.

When respondents were asked to rank U.S. quality grades, approximately one-third of the consumers indicated that they were unsure; 49.9% selected Prime as the highest quality grade, 30.2% ranked Choice as the second highest, and 31.0% chose Select as third (data not in tabular form). These results confirm data collected by the Beef Extra Survey (1987) and the American Meat Institute's study for Giant Food Inc., that consumers are confused about grades (Designing Foods, 1988).

### Implications

A vast consumer education program is a necessity, especially if we plan to maintain and hopefully improve our market share. Educational programs should include, but not be limited to: food safety and handling, meat cookery workshops, diet and health and their relationship to meat in a balanced diet, and economical shopping for meat products. Consumers are willing to learn. The beef industry must be willing to educate.

Table 2. Frequency percentage distribution indicating purchasing patterns of meat

Retail meat item	Everytime I shop	Only for special occasions	Only when on sale	I never buy this product
Beef	54.4	17.5	20.4	3.1
Breakfast meat	27.2	31.0	22.8	10.5
Cured meats	6.9	37.3	18.0	23.7
Lamb	0.9	8.5	3.7	73.9
Luncheon meats	38.8	21.1	19.0	12.9
Pork	20.6	31.0	25.8	12.3
Poultry	50.9	15.6	24.0	2.6
Seafood	11.7	34.8	18.8	23.0
Specialty meats	1.0	3.7	0.8	81.9
Veal	1.7	7.8	3.2	74.0

Table 3. Frequency distribution of monthly budget allocated to purchasing meat

Food Dollars	%
\$0-\$19	11.2
\$20-\$39	17.0
\$40-\$59	26.6
\$60-\$79	15.6
\$80-\$99	12.2
\$100 +	14.5



Table 4. Frequency percentage distribution for factors of importance influencing red meat purchases

Factors	Very Impt <sup>a</sup>	Impt	SW <sup>b</sup> Impt	SW <sup>b</sup> Unimpt <sup>c</sup>	Not Impt	Definitely Not Impt
Color of meat (appearance)	67.2	20.7	6.0	1.0	0.5	0.5
Convenience	12.2	29.2	28.1	7.6	8.2	3.1
Cut of meat	37.3	32.4	18.1	3.2	1.7	0.6
Fat trim/Leanness	59.1	24.7	7.6	1.5	0.6	0.4
Food safety-Wholesomeness	63.2	18.6	6.3	1.3	0.8	0.4
Nutrition	43.2	29.8	12.5	2.8	1.8	0.6
Packaging	15.6	24.2	24.3	12.1	9.5	5.5
Price	53.1	28.5	9.5	1.8	0.9	0.6
Quality	66.7	22.9	2.7	0.5	0.0	0.4
Tenderness	48.6	32.0	9.9	1.0	0.6	0.4
Weekly specials	41.3	23.7	17.5	4.0	4.4	2.2

<sup>a</sup> Impt = Important.

<sup>b</sup> SW = Somewhat.

<sup>c</sup> Unimpt = Unimportant.

Table 5. Frequency percentage distribution of factors influencing red meat purchases identified as most and least important

Factors	Importance	
	Most	Least
Color of meat (appearance)	12.1	1.0
Convenience	1.4	21.5
Cut of meat	5.1	4.1
Fat trim/Leanness	15.3	2.1
Food safety-Wholesomeness	13.9	1.3
Nutrition	6.4	2.3
Packaging	0.0	33.3
Price	13.5	1.2
Quality	16.6	0.9
Tenderness	2.4	0.9
Weekly specials	4.1	18.8

Table 6. Frequency distribution of the most common beef cookery methods used by consumers

Cookery Method	Steak %	Roast %	Ground Beef %
Bake (moist)	8.5	72.2	18.4
Barbecue (grill)	62.0	6.6	52.6
Baste	1.2	7.6	0.1
Boil	2.2	8.9	1.8
Broil	47.5	4.8	18.4
Dry roast	1.1	19.3	1.4
Fry (sauté)	26.5	0.9	62.7
Microwave	0.9	1.3	4.0
Simmer	6.5	19.8	13.1
Steam	0.6	4.5	1.0

Table 7. Frequency distribution of factors consumers use to determine beef quality

Quality traits	%
Freshness	85.0
Color	84.5
Tenderness	63.7
U.S. Grade	62.9
Fatness	61.7
Flavor	50.0
Food safety	45.1
Juiciness	34.3

Figure 1. Consumer perception of beef: Is it healthy?

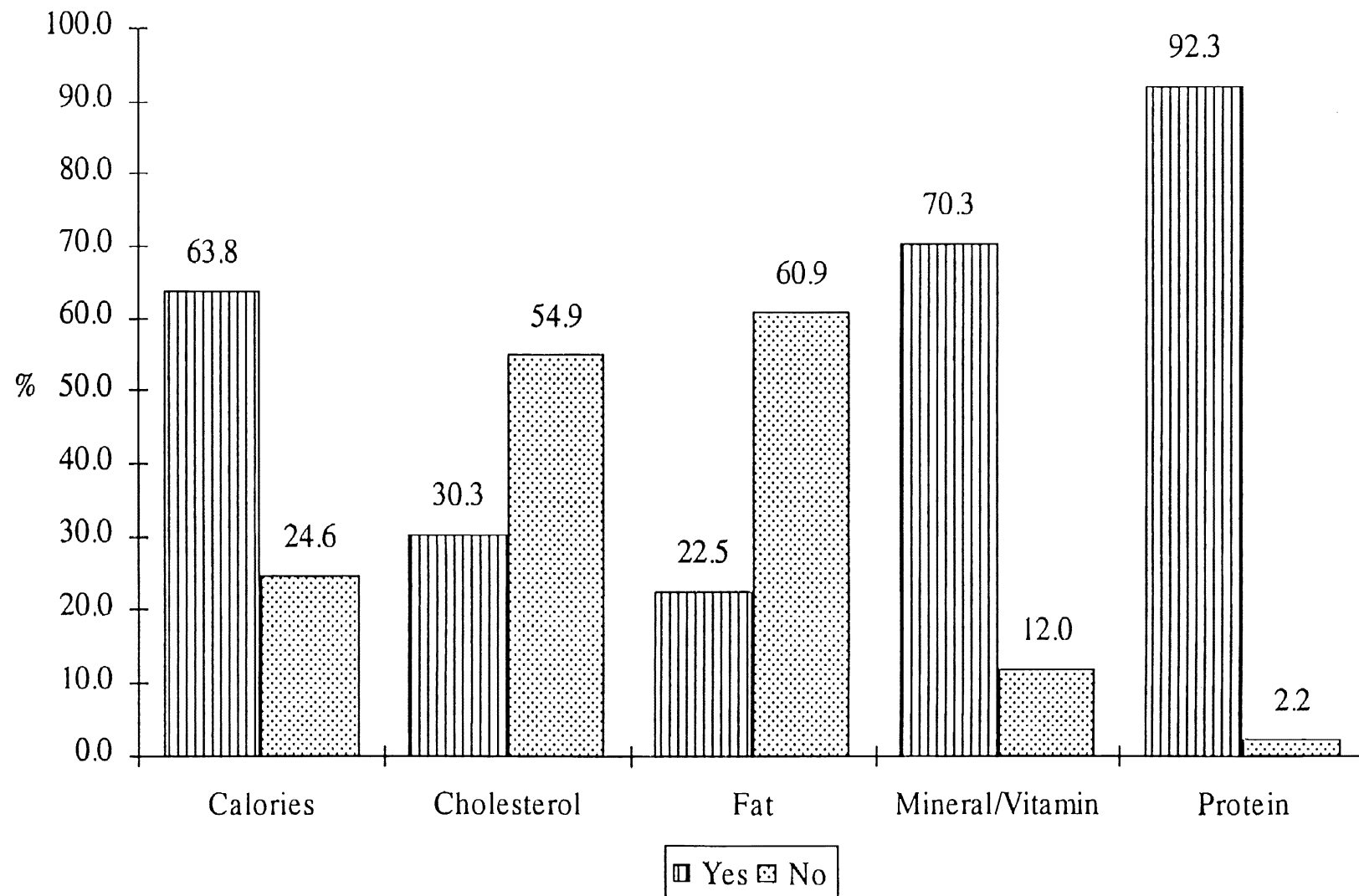
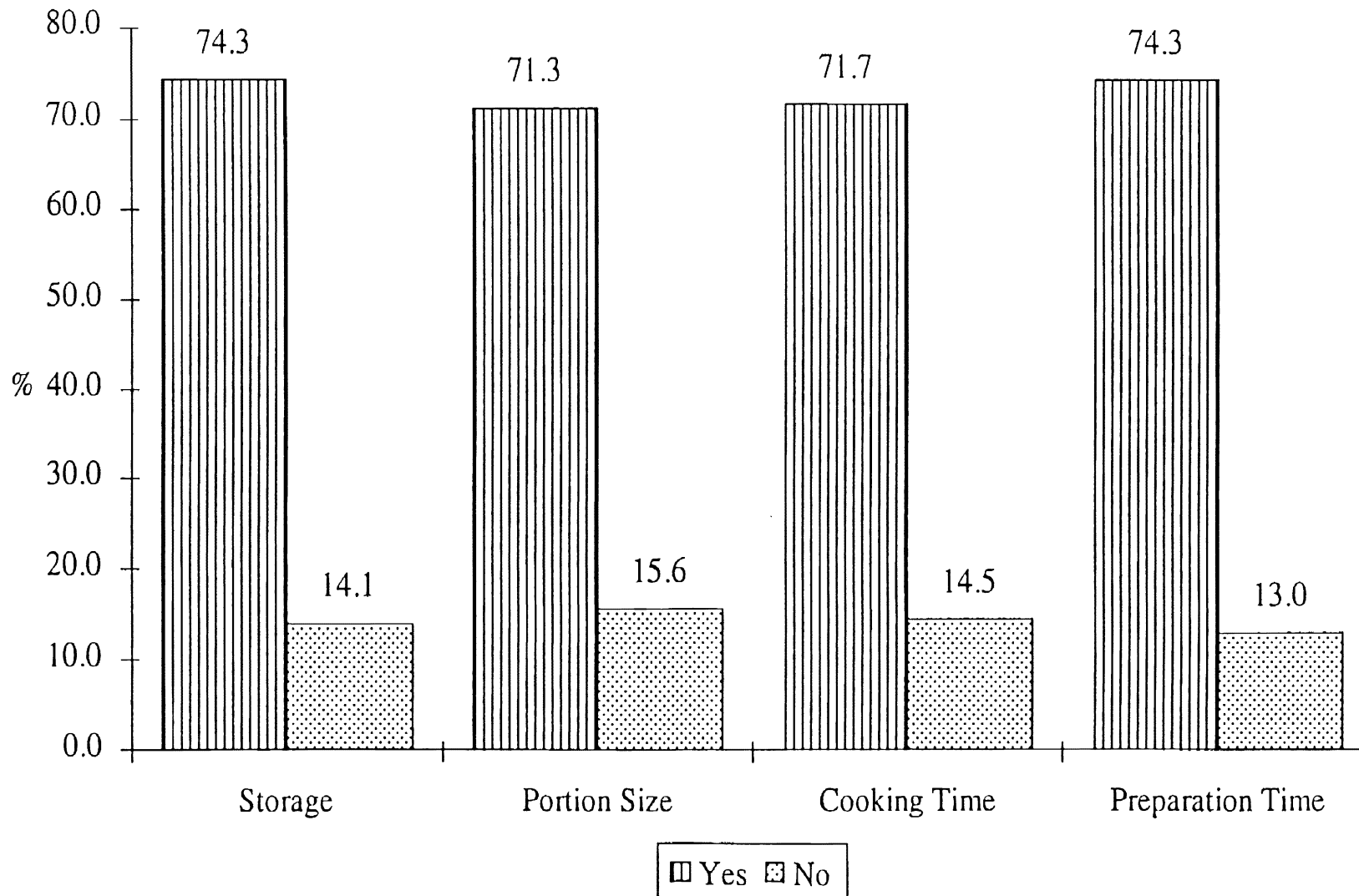


Figure 2. Convenience categories for beef identified by consumers



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## APPENDIXES

## APPENDIX A

### PRICE INFORMATION

Label information was collected from the 564 steaks and 240 ground beef samples that were purchased for evaluation of physical characteristics and chemical composition. Price per pound did differ depending on the quality grade; a was only different for the following cuts: TSB steak and MT steaks and roasts.

Steaks from the Choice grade ranged in price \$1.38 to \$7.99, while No-Roll steaks varied \$1.48 to \$7.49. When comparing the average price per pound of Choice versus No-Roll steaks, a price difference ranged from -\$0.03 to \$0.60 per pound. Choice TL steaks averaged \$6.60 per pound, ranging \$4.98 to \$7.99; No-Roll TL steaks averaged \$6.00 per pound, ranging \$3.98 to \$7.49. A premium price was collected for steaks that were labeled as Heritage Lite. Top loin steaks ranged in price \$6.19 to \$7.19 and averaged \$6.77 per pound.

Ground beef was generally priced according to its advertised fat content. Regular ground beef averaged \$1.67 per pound; LGB, \$1.95 per pound; XGB, \$2.35 per pound; and DGB \$2.67 per pound.

## APPENDIX B

### PRICE PER POUND OF RETAIL STEAKS COLLECTED AT ALL RETAIL OUTLETS STRATIFIED BY QUALITY GRADE AND STEAK TYPE

Quality Grade	Rep 1				Rep 2				Rep 3				Summary			
Cut type	Mean	Min	Max	SD	Mean	Min	Max	SD	Mean	Min	Max	SD	Mean	Min	Max	SD
<b>Choice</b>																
Eye of Round	3.44	2.99	4.08	0.34	3.64	3.18	3.99	0.34	3.36	2.49	4.79	0.77	3.48	2.49	4.79	0.51
Top Round	3.43	2.99	3.99	0.32	3.49	2.99	3.99	0.36	3.14	2.49	3.99	0.49	3.34	2.49	3.99	0.42
Top Butt	4.30	2.58	5.39	0.77	4.21	2.98	4.99	0.85	4.34	2.19	5.39	0.78	4.29	2.19	5.39	0.78
Top Loin	6.76	5.48	7.69	0.74	6.76	5.59	7.99	0.76	6.38	4.98	6.99	0.66	6.60	4.98	7.99	0.72
Mock Tender	3.40	3.19	3.69	0.19	2.80	1.38	3.49	0.81	3.19	2.38	3.79	0.53	3.11	1.38	3.79	0.62
Chuck Arm	2.91	2.28	3.28	0.32	3.00	2.48	3.49	0.33	2.65	1.69	3.99	0.63	2.82	1.69	3.99	0.50
<b>No-Roll</b>																
Eye of Round	3.22	1.79	3.99	0.67	3.44	2.69	3.99	0.42	3.19	1.79	3.99	0.56	3.28	1.79	3.99	0.57
Top Round	3.21	1.79	3.89	0.62	3.48	2.98	3.89	0.32	3.23	1.48	3.89	0.62	3.31	1.48	3.89	0.54
Top Butt	3.87	2.29	4.79	0.68	3.75	2.88	4.79	0.63	3.76	2.09	4.79	0.69	3.80	2.09	4.79	0.66
Top Loin	5.80	3.98	7.49	0.80	5.99	4.49	6.99	0.78	6.21	4.99	6.99	0.68	6.00	3.98	7.49	0.78
Mock Tender	3.14	2.59	3.59	0.30	3.00	2.38	3.49	0.40	2.89	2.38	3.49	0.36	3.02	2.38	3.59	0.36
Chuck Arm	2.78	2.19	3.19	0.28	2.96	2.29	3.49	0.36	2.80	1.99	3.79	0.55	2.85	1.99	3.79	0.40

# APPENDIX C

## DATA COLLECTED FOR ALL 33 STORES (REPLICATION 1)

	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
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### Choice

Boneless Top Sirloin	1 - 2	0.90 - 2.61	1.61	2.58 - 5.39	4.30	0.10 - 0.35	0.20	0.03 - 0.15	0.08	0.60 - 1.25	0.93
Chuck Arm	1 - 3	0.75 - 3.32	1.64	2.28 - 3.28	2.91	0.00 - 0.30	0.16	0.00 - 0.10	0.06	0.40 - 2.30	0.95
Eye of Round	1 - 4	0.60 - 2.03	1.30	2.99 - 4.08	3.44	0.00 - 0.30	0.14	0.00 - 0.10	0.04	0.45 - 1.10	0.71
Mock Tender	1 - 12	1.11 - 3.19	1.70	3.19 - 3.69	3.40	0.00 - 0.15	0.04	0.00 - 0.03	0.01	0.50 - 1.40	0.95
Strip Loin	1 - 2	0.60 - 1.51	0.92	5.48 - 7.69	6.76	0.05 - 0.41	0.24	0.02 - 0.25	0.12	0.60 - 1.40	1.00
Top Round	1	0.76 - 2.03	1.51	2.99 - 3.99	3.43	0.00 - 0.28	0.16	0.01 - 0.12	0.05	0.40 - 0.90	0.62

### Select

Boneless Top Sirloin	1	1.40 - 1.81	1.59	2.68 - 3.99	3.45	0.16 - 0.30	0.25	0.07 - 0.15	0.12	0.80 - 0.95	0.88
Strip Loin	1 - 2	0.78 - 1.34	1.02	2.99 - 5.29	4.02	0.24 - 0.30	0.26	0.12 - 0.15	0.13	1.00 - 1.05	1.02

### No-Roll

Boneless Top Sirloin	1	0.97 - 1.69	1.29	2.29 - 4.79	3.87	0.10 - 0.46	0.25	0.00 - 0.30	0.12	0.50 - 1.10	0.84
Chuck Arm	1 - 3	0.66 - 2.62	1.30	2.19 - 3.19	2.78	0.00 - 0.30	0.20	0.00 - 0.16	0.08	0.50 - 2.10	0.85
Eye of Round	1 - 6	0.60 - 2.35	1.36	1.79 - 3.99	3.22	0.00 - 0.35	0.13	0.00 - 0.18	0.04	0.40 - 1.40	0.70
Mock Tender	2 - 10	0.65 - 2.49	1.14	2.59 - 3.59	3.14	0.00 - 0.15	0.02	0.00 - 0.03	0.00	0.70 - 1.20	0.89
Strip Loin	1 - 2	0.57 - 1.56	1.04	3.98 - 7.49	5.80	0.02 - 0.35	0.23	0.00 - 0.18	0.11	0.70 - 1.30	0.99
Top Round	1 - 2	0.86 - 2.35	1.46	1.79 - 3.89	3.21	0.00 - 0.40	0.18	0.00 - 0.14	0.05	0.40 - 0.75	0.58

### Ground Beef

Diet Lean Ground Beef		1.14 - 1.55	1.31	2.28 - 3.19	2.79
Extra Lean Ground Beef		0.93 - 1.64	1.20	1.78 - 2.99	2.41
Lean Ground Beef		0.82 - 1.69	1.27	1.68 - 2.69	2.04
Regular Ground Beef		0.86 - 2.89	1.34	1.18 - 1.89	1.68

# APPENDIX D

## DATA COLLECTED FOR ALL 33 STORES (REPLICATION 2)

	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
<b>Choice</b>											
Boneless Top Sirloin	1 - 2	0.87 - 2.00	1.38	2.98 - 4.99	4.21	0.10 - 0.30	0.23	0.05 - 0.18	0.12	0.60 - 1.30	0.95
Chuck Arm	1	0.64 - 2.28	1.05	2.48 - 3.49	3.00	0.15 - 0.25	0.20	0.02 - 0.20	0.11	0.65 - 1.50	0.93
Eye of Round	1 - 6	0.71 - 1.98	1.20	3.18 - 3.99	3.64	0.00 - 0.28	0.12	0.00 - 0.19	0.07	0.50 - 1.20	0.73
Mock Tender	1 - 12	0.60 - 3.21	1.66	1.38 - 3.49	2.80	0.00 - 0.35	0.07	0.00 - 0.07	0.02	0.70 - 1.45	0.99
Strip Loin	1 - 2	0.45 - 1.14	0.80	5.59 - 7.99	6.76	0.10 - 0.32	0.21	0.05 - 0.16	0.10	0.65 - 1.50	0.99
Top Round	1 - 2	0.77 - 1.98	1.26	2.99 - 3.99	3.49	0.00 - 0.25	0.11	0.00 - 0.13	0.05	0.50 - 0.90	0.65

<b>Select</b>											
Boneless Top Sirloin	1	1.42 - 1.61	1.50	3.18 - 3.69	3.52	0.18 - 0.20	0.19	0.06 - 0.18	0.11	0.80 - 1.15	0.95
Chuck Arm	2	1.49	1.49	2.99	2.99	0.15	0.15	0.05	0.05	0.60	0.60
Eye of Round	1 - 2	0.87 - 1.78	1.33	2.89 - 3.89	3.39	0.00 - 0.20	0.10	0.00 - 0.07	0.04	0.50 - 1.00	0.75
Strip Loin	2	0.70 - 1.51	1.11	3.99 - 5.29	4.42	0.05 - 0.28	0.18	0.00 - 0.14	0.08	0.70 - 1.35	1.08
Top Round	1	1.10 - 1.15	1.13	2.19 - 3.29	2.74	0.18 - 0.20	0.19	0.02 - 0.04	0.03	0.50 - 0.60	0.55

<b>No-Roll</b>											
Boneless Top Sirloin	1	0.89 - 2.02	1.39	2.88 - 4.79	3.75	0.10 - 0.36	0.25	0.05 - 0.20	0.12	0.70 - 1.20	0.95
Chuck Arm	1 - 2	0.49 - 2.60	1.25	2.29 - 3.49	2.96	0.00 - 0.30	0.14	0.00 - 0.15	0.05	0.50 - 2.20	0.93
Eye of Round	1 - 6	0.54 - 2.21	1.24	2.69 - 3.99	3.44	0.00 - 0.30	0.15	0.00 - 0.18	0.05	0.30 - 1.00	0.69
Mock Tender	2 - 6	0.55 - 1.60	1.12	2.38 - 3.49	3.00	0.00 - 0.10	0.02	0.00 - 0.05	0.01	0.80 - 1.50	1.04
Strip Loin	1 - 2	0.43 - 1.64	1.02	4.49 - 6.99	5.99	0.05 - 0.45	0.21	0.00 - 0.23	0.11	0.70 - 1.40	0.99
Top Round	1 - 2	0.70 - 2.23	1.26	2.98 - 3.89	3.48	0.00 - 0.35	0.14	0.00 - 0.15	0.04	0.40 - 1.00	0.62

<b>Ground Beef</b>					
Diet Lean Ground Beef	1	0.67 - 1.14	0.95	2.28 - 2.99	2.74
Extra Lean Ground Beef	1	0.50 - 2.09	1.27	1.78 - 2.99	2.36
Lean Ground Beef	1	0.84 - 1.50	1.17	1.59 - 2.19	1.92
Regular Ground Beef	1	0.74 - 2.02	1.25	0.98 - 3.19	1.71

	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
<b>Heritage Lite</b>											
Boneless Top Sirloin	1	1.12 - 1.27	1.19	3.89 - 4.99	4.67	0.07 - 0.20	0.14	0.00 - 0.10	0.06	0.80 - 1.00	0.92
Chuck Arm	1	0.71 - 1.26	1.02	3.39 - 3.69	3.49	0.10 - 0.15	0.12	0.05 - 0.08	0.07	0.80 - 1.50	1.10
Eye of Round	1	1.56	1.56	2.49	2.49	0.20	0.20	0.05	0.05	0.60	0.60
Strip Loin	1	0.63 - 0.84	0.74	6.19 - 7.19	6.57	0.05 - 0.15	0.11	0.02 - 0.08	0.04	0.70 - 1.30	0.93
Top Round	1	1.56	1.56	2.49	2.49	0.17	0.17	0.09	0.09	0.70	0.70



# APPENDIX E

## DATA COLLECTED FOR ALL 33 STORES (REPLICATION 3)

Choice	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
Boneless Top Sirloin	1	0.87 - 2.27	1.43	2.19 - 5.39	4.34	0.00 - 0.35	0.22	0.00 - 0.20	0.11	0.50 - 1.25	0.93
Chuck Arm	1 - 2	0.72 - 4.09	1.73	1.69 - 3.99	2.65	0.00 - 0.40	0.21	0.00 - 0.20	0.11	0.60 - 3.00	1.34
Eye of Round	1 - 4	0.51 - 1.67	1.19	2.49 - 4.79	3.36	0.00 - 0.40	0.10	0.00 - 0.16	0.04	0.45 - 1.00	0.71
Mock Tender	3 - 4	0.72 - 1.93	1.24	2.38 - 3.79	3.19	0.00 - 0.30	0.07	0.00 - 0.10	0.02	0.60 - 1.60	1.00
Strip Loin	1 - 2	0.64 - 1.56	0.92	4.98 - 6.99	6.38	0.00 - 0.35	0.21	0.00 - 0.20	0.11	0.50 - 1.70	1.07
Top Round	1 - 3	0.84 - 2.90	1.45	2.49 - 3.99	3.14	0.00 - 0.28	0.11	0.00 - 0.14	0.04	0.45 - 0.70	0.57

No-Roll	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
Boneless Top Sirloin	1	0.94 - 2.05	1.37	2.09 - 4.79	3.76	0.10 - 0.40	0.25	0.05 - 0.25	0.13	0.50 - 1.10	0.86
Chuck Arm	1 - 3	0.56 - 2.60	1.20	1.99 - 3.79	2.80	0.00 - 0.45	0.18	0.00 - 0.25	0.08	0.50 - 2.00	0.82
Eye of Round	1 - 6	0.47 - 2.26	1.51	1.79 - 3.99	3.19	0.00 - 0.40	0.16	0.00 - 0.18	0.02	0.30 - 1.25	0.73
Mock Tender	1 - 5	0.52 - 2.09	0.99	2.38 - 3.49	2.89	0.00 - 0.05	0.01	0.00 - 0.00	0	0.70 - 1.40	0.94
Strip Loin	1 - 2	0.47 - 1.82	1.04	4.99 - 6.99	6.21	0.05 - 0.35	0.21	0.02 - 0.18	0.10	0.70 - 1.40	1.02
Top Round	1	0.58 - 2.39	1.36	1.48 - 3.89	3.23	0.00 - 0.30	0.14	0.00 - 0.15	0.06	0.40 - 1.00	0.57

Ground Beef	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB
Diet Lean Ground Beef	1	0.72 - 1.80	1.23	1.99 - 3.19	2.60
Extra Lean Ground Beef	1	0.85 - 1.88	1.22	1.78 - 2.99	2.27
Lean Ground Beef	1	0.60 - 1.95	1.27	1.25 - 2.09	1.86
Regular Ground Beef	1	0.71 - 2.80	1.27	0.98 - 1.99	1.61

Heritage Life	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
Boneless Top Sirloin	1	0.86 - 1.21	1.03	3.99 - 4.99	4.66	0.00 - 0.25	0.12	0.00 - 0.03	0.02	0.60 - 1.00	0.83
Chuck Arm	1	0.62 - 0.67	0.65	3.69	3.69	0.20	0.20	0.06 - 0.10	0.08	0.80 - 1.00	0.90
Eye of Round	1 - 2	0.67 - 1.84	1.53	3.49 - 4.19	3.63	0.05 - 0.30	0.14	0.03 - 0.12	0.07	0.5 - 0.7	0.61
Mock Tender	2	0.50	0.50	3.69	3.69	0.05	0.05	0.03	0.03	1.00	1.00
Strip Loin	1	0.56 - 0.81	0.68	7.19	7.19	0.15 - 0.20	0.17	0.08 - 0.08	0.08	0.80 - 1.30	1.10
Top Round	1	1.60 - 1.84	1.75	3.49	3.49	0.00 - 0.20	0.13	0.00 - 0.06	0.04	0.50 - 0.60	0.55

Select	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
Boneless Top Sirloin	1	1.34 - 1.66	1.52	3.08 - 3.39	3.22	0.10 - 0.30	0.20	0.05 - 0.20	0.11	0.75 - 1.00	0.88
Chuck Arm	2	1.07	1.07	2.49	2.49	0.20	0.20	0.04	0.04	0.50	0.50
Eye of Round	2 - 4	0.46 - 0.84	0.65	3.49 - 3.79	3.64	0.00 - 0.20	0.10	0.00 - 0.05	0.03	0.50 - 0.60	0.55
Mock Tender	2	0.66	0.66	2.79	2.79	0.05	0.05	0.00	0.00	1.00	1.00
Strip Loin	1 - 2	0.83 - 1.11	0.93	3.79 - 5.99	4.96	0.20	0.20	0.10 - 0.18	0.13	0.90 - 1.15	1.05
Top Round	1	1.16 - 1.92	1.42	1.79 - 3.29	2.72	0.00 - 0.15	0.07	0.00 - 0.03	0.01	0.50 - 1.00	0.70

# APPENDIX F

## SUMMARY REPORT FOR DATA COLLECTED FOR ALL 33 STORES

	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
<b>Choice</b>											
Boneless Top Sirloin	1 - 2	0.87 - 2.61	1.47	2.19 - 5.39	4.29	0.00 - 0.35	0.22	0.00 - 0.20	0.10	0.50 - 1.30	0.94
Chuck Arm	1 - 3	0.64 - 4.09	1.53	1.69 - 3.99	2.82	0.00 - 0.40	0.19	0.00 - 0.20	0.09	0.40 - 3.00	1.13
Eye of Round	1 - 6	0.51 - 2.03	1.23	2.49 - 4.79	3.48	0.00 - 0.40	0.12	0.00 - 0.19	0.05	0.45 - 1.20	0.72
Mock Tender	1 - 12	0.60 - 3.21	1.53	1.38 - 3.79	3.11	0.00 - 0.35	0.06	0.00 - 0.10	0.02	0.50 - 1.60	0.98
Strip Loin	1 - 2	0.45 - 1.56	0.89	4.98 - 7.99	6.60	0.00 - 0.41	0.22	0.00 - 0.25	0.11	0.50 - 1.70	1.02
Top Round	1 - 3	0.76 - 2.90	1.41	2.49 - 3.99	3.34	0.00 - 0.28	0.13	0.00 - 0.14	0.05	0.40 - 0.90	0.61

<b>No-Roll</b>											
Boneless Top Sirloin	1	0.89 - 2.05	1.35	2.09 - 4.79	3.80	0.10 - 0.46	0.25	0.00 - 0.30	0.12	0.50 - 1.20	0.88
Chuck Arm	1 - 3	0.49 - 2.62	1.25	1.99 - 3.79	2.85	0.00 - 0.45	0.17	0.00 - 0.25	0.07	0.50 - 2.20	0.87
Eye of Round	1 - 6	0.47 - 2.35	1.37	1.79 - 3.99	3.28	0.00 - 0.40	0.15	0.00 - 0.18	0.05	0.30 - 1.40	0.70
Mock Tender	1 - 10	0.52 - 2.49	1.09	2.38 - 3.59	3.02	0.00 - 0.15	0.02	0.00 - 0.05	0	0.70 - 1.50	0.95
Strip Loin	1 - 2	0.43 - 1.82	1.04	3.98 - 7.49	6.00	0.02 - 0.45	0.21	0.00 - 0.23	0.10	0.70 - 1.40	1.00
Top Round	1 - 2	0.58 - 2.39	1.36	1.48 - 3.89	3.31	0.00 - 0.40	0.15	0.00 - 0.15	0.05	0.40 - 1.00	0.59

<b>Ground Beef</b>					
Diet Lean Ground Beef	1	0.67 - 1.80	1.16	1.99 - 3.19	2.67
Extra Lean Ground Beef	1	0.50 - 2.09	1.23	1.78 - 2.99	2.35
Lean Ground Beef	1	0.60 - 1.95	1.24	1.25 - 2.69	1.95
Regular Ground Beef	1	0.71 - 2.89	1.29	0.98 - 3.19	1.67

<b>Heritage Lite</b>											
Boneless Top Sirloin	1	0.86 - 1.27	1.13	3.89 - 4.99	4.67	0.00 - 0.25	0.13	0.00 - 0.10	0.04	0.60 - 1.00	0.89
Chuck Arm	1	0.62 - 1.26	0.84	3.39 - 3.69	3.54	0.10 - 0.20	0.15	0.05 - 0.10	0.07	0.55 - 1.50	0.94
Eye of Round	1 - 2	0.67 - 1.84	1.54	2.49 - 4.19	3.44	0.05 - 0.30	0.15	0.03 - 0.12	0.07	0.50 - 0.70	0.61
Mock Tender	2	0.50	0.50	3.69	3.69	0.05	0.05	0.03	1.03	1.00	1.00
Strip Loin	1	0.56 - 1.04	0.76	6.19 - 7.19	6.77	0.05 - 0.20	0.13	0.02 - 0.08	0.06	0.70 - 1.30	1.02
Top Round	1	1.56 - 1.84	1.71	2.49 - 3.49	3.29	0.00 - 0.20	0.14	0.00 - 0.09	0.05	0.50 - 0.70	0.58

<b>Select</b>											
Boneless Top Sirloin	1	1.34 - 1.81	1.54	2.68 - 3.99	3.40	0.10 - 0.30	0.22	0.05 - 0.20	0.11	0.75 - 1.15	0.91
Chuck Arm	2	1.07 - 1.49	1.28	2.49 - 2.99	2.74	0.15 - 0.20	0.18	0.04 - 0.05	0.05	0.50 - 0.60	0.55
Eye of Round	1 - 4	0.46 - 1.78	0.99	2.89 - 3.89	3.52	0.00 - 0.20	0.10	0.00 - 0.07	0.03	0.50 - 1.00	0.65
Mock Tender	2	0.66	0.66	2.79	2.79	0.05	0.05	0.00	0.00	1.00	1.00
Strip Loin	1 - 2	0.70 - 1.51	1.02	2.99 - 5.99	4.47	0.05 - 0.30	0.21	0.00 - 0.18	0.11	0.70 - 1.35	1.05
Top Round	1	1.10 - 1.92	1.30	1.79 - 3.29	2.73	0.00 - 0.20	0.12	0.00 - 0.04	0.02	0.50 - 1.00	0.64

# APPENDIX G

## DATA COLLECTED FOR OKLAHOMA STORES (REPLICATION 1)

Choice	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
Boneless Top Sirloin	1 - 2	0.90 - 2.61	1.68	2.58 - 4.98	3.95	0.12 - 0.35	0.22	0.06 - 0.15	0.09	0.60 - 1.15	0.89
Chuck Arm	1 - 3	0.75 - 3.32	1.64	2.28 - 3.28	2.91	0.00 - 0.30	0.16	0.00 - 0.10	0.06	0.40 - 2.30	0.95
Eye of Round	1 - 4	0.60 - 1.93	1.18	3.18 - 4.08	3.50	0.00 - 0.30	0.11	0.00 - 0.10	0.03	0.45 - 1.10	0.73
Mock Tender	3 - 12	1.11 - 3.19	1.68	3.19 - 3.49	3.34	0.00 - 0.09	0.02	0.00 - 0.01	0.00	0.50 - 1.40	0.94
Strip Loin	1 - 2	0.61 - 1.51	0.89	5.48 - 6.98	6.35	0.15 - 0.41	0.25	0.04 - 0.25	0.13	0.60 - 1.40	1.04
Top Round	1	0.76 - 1.93	1.45	3.08 - 3.69	3.42	0.00 - 0.28	0.15	0.01 - 0.12	0.04	0.40 - 0.90	0.62

No-Roll	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
Boneless Top Sirloin	1	0.97 - 1.69	1.30	2.29 - 4.79	3.82	0.10 - 0.46	0.25	0.00 - 0.30	0.12	0.50 - 1.10	0.83
Chuck Arm	1 - 2	0.73 - 2.03	1.22	2.19 - 3.19	2.72	0.02 - 0.28	0.20	0.00 - 0.16	0.08	0.50 - 1.00	0.72
Eye of Round	1 - 6	0.71 - 2.35	1.38	1.99 - 3.99	3.30	0.00 - 0.35	0.13	0.00 - 0.18	0.04	0.50 - 1.40	0.71
Mock Tender	2 - 4	0.65 - 1.32	0.93	2.88 - 3.49	3.14	0.00 - 0.15	0.02	0.00 - 0.03	0.00	0.70 - 1.00	0.86
Strip Loin	1 - 2	0.57 - 1.56	1.04	3.98 - 6.99	5.71	0.02 - 0.35	0.22	0.00 - 0.18	0.10	0.70 - 1.30	1.02
Top Round	1 - 2	0.86 - 2.35	1.48	2.19 - 3.89	3.30	0.00 - 0.28	0.16	0.00 - 0.14	0.06	0.50 - 0.75	0.59

Ground Beef	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB
Diet Lean Ground Beef	1	1.25 - 1.55	1.40	2.28 - 2.49	2.39
Extra Lean Ground Beef	1	0.93 - 1.64	1.24	1.79 - 2.98	2.39
Lean Ground Beef	1	0.82 - 1.69	1.30	1.88 - 2.69	2.06
Regular Ground Beef	1	0.86 - 1.89	1.29	1.38 - 1.89	1.71

# APPENDIX H

## DATA COLLECTED FOR OKLAHOMA STORES (REPLICATION 2)

	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
<b>Choice</b>											
Boneless Top Sirloin	1 - 2	1.14 - 2.00	1.40	2.98 - 4.98	4.37	0.10 - 0.27	0.20	0.05 - 0.14	0.10	0.80 - 1.10	0.96
Chuck Arm	1	0.64 - 2.28	1.21	2.48 - 2.99	2.84	0.15 - 0.23	0.17	0.02 - 0.18	0.09	0.65 - 1.50	1.00
Eye of Round	1 - 6	0.71 - 1.98	1.23	3.18 - 3.98	3.62	0.00 - 0.28	0.12	0.00 - 0.19	0.07	0.50 - 1.20	0.73
Mock Tender	3 - 12	0.60 - 3.21	1.87	1.99 - 3.49	3.08	0.00 - 0.35	0.09	0.00 - 0.07	0.03	0.80 - 1.45	1.05
Strip Loin	1 - 2	0.58 - 1.07	0.78	5.59 - 6.98	6.47	0.10 - 0.25	0.20	0.05 - 0.15	0.10	0.65 - 1.10	0.94
Top Round	1	0.77 - 1.98	1.38	2.99 - 3.69	3.27	0.00 - 0.25	0.10	0.00 - 0.10	0.05	0.55 - 0.70	0.61

<b>No-Roll</b>											
Boneless Top Sirloin	1	0.89 - 2.02	1.41	2.88 - 4.79	3.75	0.10 - 0.36	0.24	0.05 - 0.20	0.13	0.70 - 1.10	0.96
Chuck Arm	1 - 2	0.49 - 2.60	1.26	2.29 - 3.49	2.98	0.00 - 0.30	0.13	0.00 - 0.12	0.04	0.50 - 2.20	0.90
Eye of Round	1 - 6	0.54 - 1.95	1.17	2.79 - 3.99	3.45	0.00 - 0.30	0.15	0.00 - 0.18	0.05	0.30 - 1.00	0.68
Mock Tender	2 - 5	0.55 - 1.60	1.12	2.38 - 3.49	3.05	0.00 - 0.10	0.02	0.00 - 0.05	0.01	0.90 - 1.10	1.01
Strip Loin	1 - 2	0.43 - 1.59	0.96	4.79 - 6.99	6.13	0.05 - 0.45	0.21	0.00 - 0.23	0.11	0.70 - 1.35	0.98
Top Round	1 - 2	0.70 - 2.23	1.33	2.98 - 3.89	3.47	0.00 - 0.35	0.14	0.00 - 0.14	0.04	0.40 - 1.00	0.62

<b>Ground Beef</b>					
Diet Lean Ground Beef	1	0.75 - 1.14	0.95	2.28 - 2.89	2.63
Extra Lean Ground Beef	1	0.81 - 2.09	1.38	1.79 - 2.98	2.31
Lean Ground Beef	1	0.84 - 1.50	1.21	1.59 - 2.09	1.94
Regular Ground Beef	1	0.74 - 1.84	1.25	1.28 - 1.89	1.69

<b>Heritage Lite</b>											
Boneless Top Sirloin	1	1.12 - 1.27	1.21	3.89 - 4.99	4.62	0.07 - 0.20	0.12	0.00 - 0.10	0.04	0.80 - 1.00	0.90
Chuck Arm	1	0.71 - 1.26	0.99	3.39	3.39	0.10 - 0.15	0.13	0.05 - 0.07	0.06	0.80 - 1.50	1.15
Eye of Round	1	1.56	1.56	2.49	2.49	0.20	0.20	0.05	0.05	0.60	0.60
Strip Loin	1	0.63 - 0.84	0.73	6.19 - 7.19	6.52	0.05 - 0.12	0.09	0.02 - 0.04	0.03	0.70 - 1.30	0.93
Top Round	1	1.56	1.56	2.49	2.49	0.17	0.17	0.09	0.09	0.70	0.70

# APPENDIX I

## DATA COLLECTED FOR OKLAHOMA STORES (REPLICATION 3)

	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
<b>Choice</b>											
Boneless Top Sirloin	1	0.87 - 1.73	1.37	3.78 - 4.98	4.53	0.00 - 0.30	0.19	0.00 - 0.20	0.10	0.50 - 1.10	0.88
Chuck Arm	1	0.77 - 4.09	2.18	1.79 - 2.99	2.59	0.00 - 0.40	0.23	0.00 - 0.20	0.11	0.90 - 3.00	1.71
Eye of Round	1 - 3	0.70 - 1.67	1.37	2.49 - 3.96	3.10	0.05 - 0.40	0.13	0.00 - 0.16	0.05	0.45 - 1.00	0.71
Mock Tender	3 - 4	1.05 - 1.93	1.52	2.38 - 3.16	2.90	0.00 - 0.30	0.10	0.00 - 0.10	0.03	1.00 - 1.60	1.20
Strip Loin	1 - 2	0.66 - 1.56	0.95	4.98 - 6.99	6.08	0.15 - 0.35	0.25	0.08 - 0.15	0.12	0.50 - 1.50	1.01
Top Round	1 - 3	0.92 - 2.90	1.62	2.49 - 3.56	2.90	0.00 - 0.25	0.10	0.00 - 0.10	0.03	0.45 - 0.70	0.56

<b>No-Roll</b>											
Boneless Top Sirloin	1	0.94 - 2.05	1.40	2.09 - 4.79	3.73	0.20 - 0.40	0.27	0.06 - 0.25	0.13	0.50 - 1.10	0.84
Chuck Arm	1 - 3	0.56 - 2.24	1.14	1.99 - 3.79	2.82	0.00 - 0.45	0.20	0.00 - 0.25	0.08	0.50 - 1.60	0.75
Eye of Round	1 - 6	0.47 - 2.12	1.47	1.79 - 3.99	3.20	0.00 - 0.35	0.16	0.00 - 0.18	0.06	0.30 - 1.25	0.68
Mock Tender	1 - 4	0.52 - 2.09	0.98	2.38 - 3.49	2.85	0.00 - 0.05	0.01	0.00 - 0.00	0	0.70 - 1.40	0.94
Strip Loin	1 - 2	0.47 - 1.82	0.98	4.99 - 6.99	6.22	0.05 - 0.35	0.21	0.02 - 0.18	0.10	0.70 - 1.40	1.01
Top Round	1	0.58 - 2.39	1.38	1.48 - 3.89	3.17	0.00 - 0.30	0.13	0.00 - 0.15	0.05	0.40 - 0.70	0.55

<b>Ground Beef</b>					
Diet Lean Ground Beef	1	0.72 - 1.80	1.21	2.28 - 2.99	2.57
Extra Lean Ground Beef	1	0.85 - 1.88	1.29	1.78 - 2.79	2.17
Lean Ground Beef	1	0.60 - 1.95	1.34	1.69 - 1.99	1.88
Regular Ground Beef	1	0.71 - 2.80	1.30	0.98 - 1.89	1.63

<b>Heritage Lite</b>											
Boneless Top Sirloin	1	0.86 - 1.21	1.03	3.99 - 4.99	4.66	0.00 - 0.25	0.12	0.00 - 0.03	0.02	0.60 - 1.00	0.83
Chuck Arm	1	0.62 - 0.67	0.65	3.69	3.69	0.20	0.20	0.06 - 0.10	0.08	0.80 - 1.00	0.90
Eye of Round	1 - 2	0.67 - 1.84	1.47	3.49 - 4.19	3.67	0.05 - 0.30	0.15	0.03 - 0.12	0.06	0.50 - 0.70	0.61
Mock Tender	2	0.50	0.50	3.69	3.69	0.05	0.05	0.03	0.03	1.00	1.00
Strip Loin	1	0.56 - 0.81	0.68	7.19 - 7.19	7.19	0.15 - 0.20	0.17	0.08 - 0.08	0.08	0.80 - 1.30	1.10
Top Round	1	1.60 - 1.84	1.74	3.49	3.49	0.0 - 0.20	0.13	0.00 - 0.06	0.03	0.50 - 0.60	0.53

# APPENDIX J

## SUMMARY REPORT FOR DATA COLLECTED FOR OKLAHOMA STORES

Choice	Num /Pkg	Pkg Wt Range	Average Pkg Wt	Price/LB Range	Average Price/LB	Fat Trim Range	Average Fat Trim	Adj Fat Trim Range	Avg Adj Fat Trim	Cut Thk Range	Average Cut Thk
Boneless Top Sirloin	1 - 2	0.87 - 2.61	1.47	2.58 - 4.98	4.31	0.00 - 0.35	0.20	0.00 - 0.20	0.10	0.50 - 1.15	0.90
Chuck Arm	1 - 3	0.64 - 4.09	1.75	1.79 - 3.28	2.77	0.00 - 0.40	0.19	0.00 - 0.20	0.09	0.40 - 3.00	1.26
Eye of Round	1 - 6	0.60 - 1.98	1.24	2.49 - 4.08	3.43	0.00 - 0.40	0.12	0.00 - 0.19	0.05	0.45 - 1.20	0.72
Mock Tender	3 - 12	0.60 - 3.21	1.68	1.99 - 3.49	3.14	0.00 - 0.35	0.06	0.00 - 0.10	0.02	0.50 - 1.60	1.54
Strip Loin	1 - 2	0.58 - 1.56	0.88	4.98 - 6.99	6.27	0.10 - 0.41	0.24	0.04 - 0.25	0.12	0.50 - 1.50	1.00
Top Round	1 - 3	0.76 - 2.90	1.49	2.49 - 3.69	3.20	0.00 - 0.28	0.12	0.00 - 0.12	0.04	0.40 - 0.90	0.60

No-Roll											
Boneless Top Sirloin	1	0.89 - 2.05	1.37	2.09 - 4.79	3.77	0.10 - 0.46	0.25	0.00 - 0.30	0.13	0.50 - 1.10	0.88
Chuck Arm	1 - 3	0.49 - 2.60	1.21	1.99 - 3.79	2.85	0.00 - 0.45	0.17	0.00 - 0.25	0.07	0.50 - 2.20	0.80
Eye of Round	1 - 6	0.47 - 2.35	1.33	1.79 - 3.99	3.32	0.00 - 0.35	0.15	0.00 - 0.18	0.05	0.30 - 1.40	0.69
Mock Tender	1 - 5	0.52 - 2.09	1.01	2.38 - 3.49	3.00	0.00 - 0.15	0.02	0.00 - 0.05	0.00	0.70 - 1.40	0.94
Strip Loin	1 - 2	0.43 - 1.82	0.99	3.98 - 6.99	6.02	0.02 - 0.45	0.21	0.00 - 0.23	0.10	0.70 - 1.40	1.00
Top Round	1 - 2	0.58 - 2.39	1.39	1.48 - 3.89	3.32	0.00 - 0.35	0.14	0.00 - 0.15	0.05	0.40 - 1.00	0.59

Ground Beef					
Diet Lean Ground Beef	1	0.72 - 1.64	1.12	2.28 - 2.98	2.54
Extra Lean Ground Beef	1	0.81 - 2.09	1.30	1.78 - 2.98	2.30
Lean Ground Beef	1	0.60 - 1.95	1.29	1.59 - 2.69	1.99
Regular Ground Beef	1	0.71 - 2.80	1.28	0.98 - 1.89	1.67

Heritage Lite											
Boneless Top Sirloin	1	0.86 - 1.27	1.12	3.89 - 4.99	4.64	0.00 - 0.25	0.12	0.00 - 0.10	0.03	0.60 - 1.00	0.87
Chuck Arm	1	0.62 - 1.26	0.82	3.39 - 3.69	3.54	0.10 - 0.20	0.16	0.05 - 0.10	0.07	0.80 - 1.50	1.03
Eye of Round	1 - 2	0.67 - 1.84	1.49	2.49 - 4.19	3.43	0.05 - 0.30	0.16	0.03 - 0.12	0.06	0.5 - 0.7	0.61
Mock Tender	2	0.50	0.50	3.69	3.69	0.05	0.05	0.03	0.03	1.00	1.00
Strip Loin	1	0.56 - 0.84	0.70	6.19 - 7.19	6.86	0.05 - 0.20	0.12	0.02 - 0.08	0.05	0.70 - 1.30	1.02
Top Round	1	1.56 - 1.84	1.70	2.49 - 3.49	3.24	0.00 - 0.20	0.14	0.00 - 0.09	0.04	0.50 - 0.70	0.58

# VITA

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