CONSUMERS PREFERENCES FOR FAT CONTENT

IN GROUND BEEF

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CHAPTER I

ABSTRACT

Beef is considered less healthy than its two closest competitors: pork and poultry. This has led to research to determine ways to improve healthiness by altering the type and content of fat in beef products. There remains a great deal of uncertainty about the value consumers place on these nutritional improvements, which has slowed the development and marketing of such products.

A survey was developed to determine consumers' preferences for fat content in ground beef and to identify how consumers would most like the healthiness of fat content to be improved. The survey was mailed to a random sample of 2,000 individuals throughout the United States. Survey responses to choice-experiment question were used to define consumers' utility for ground beef as a function of five ground beef attributes: percent lean, omega 6 to omega 3 fatty acid ratio, percent saturated fat, percent conjugated linoleic acid, and product price. Responses to a series of best-worst questions were used to identify which methods consumers most preferred to improve fat content: cattle fed a diet primarily consisting of grass or green leafy hay, supplement with fish meal, supplement with flaxseed oil, use genetic testing to breed only cattle with improved fatty acid content, sort existing cattle and label those with improved fatty acid content or clone cattle with improved fatty acid content. A second series of best-worst questions were used to identify which attributes of ground beef are most important to consumers

when making purchase decisions: expiration date, price, food safety, total amount of fat, package size and fatty acid composition.

Findings and Conclusions: Results reveal that consumers are willing to pay for beef with lower amounts of saturated fat and lower omega 6:3 ratios. Feeding a diet high in grass is the most preferred method to improve the fat content while the least desirable is cloning cattle. Finally, the most important attribute to consumers when purchasing ground beef is food safety while package size is the least important.

Introduction

The American consumer is constantly bombarded with nutritional information about the food they consume. A common theme of advertising in television commercials and radio ads is a call to live a healthier lifestyle, making and purchasing foods that will lead to a longer, happier life. Consumers appear to have received the message. In a recent survey of U.S. consumers, Lusk and Briggeman (2007) found that nutrition was the second-most important food value ranking second only to food safety out of a list of 11 other issues including taste, price, naturalness, convenience, appearance, effect on environment, fairness of production system, tradition, and origin. Because of importance of nutrition to consumers, food manufacturing companies and restaurants alike continue to develop products with health benefits.

The competitiveness of beef in the retail meat market has suffered in past decades. Beef's share of total retail meat consumption has fallen from a recent high of 48% in 1976 to 29.7% in 2006 (LMIC, 2006). Much of the reduction in beef's share of total meat consumption can be attributed to increased popularity of poultry. For example, poultry's share of total meat consumption rose from 26% to 47.3% from 1976 to 2007 (LMIC, 2006). Although beef demand rose from 1999 to 2004, the beef demand index fell 3.6% from 2004 to 2005 and fell another 5.6% from 2005 to 2006 (Mintert, 2007).

Increased concern about the nutritional value of food is one potential factor contributing to the lost market share for beef and to recent demand declines. Several studies have attributed beef demand declines to increased health concerns. For example, Boetel and Liu (2003. p. 345) found "increased food health concerns for fat and cholesterol have resulted in a 6% reduction in the consumption of beef per capita per

quarter since 1987, and an 18% increase in the poultry consumption." Kinnucan et al. (1997) also found that the health information related to cholesterol had a significantly larger effect than relative price elasticities and advertising on beef demand. They found that health information greatly benefited poultry and harmed beef demand while leaving demand for pork and fish unaffected. Further, in a study of Belgium consumers, Verbeke and Ward (2001) found that television publicity had a negative impact on expenditures for beef, but a positive impact on pork expenditures.

To counteract the negative health perception associated with beef, steps are being taken to find ways to improve the fatty acid content by increasing levels of omega 3 fatty acid and conjugated linoleic acid while reducing saturated fat. The goal is to create a "heart healthy" beef product. Scientists and beef industry participants have, at their disposal, several avenues to improve fat content in beef including altering feeding methods to include grass or fish meal, selective breeding to creating breeding lines with healthier fat profiles either through traditional methods or by cloning, or simply by offering premiums and discounts in the current market for fat profiles that are more desirable. Improving the fat content may be one way to improve the competitiveness of beef relative to poultry and pork.

Improving the fat content of beef is not free and producers are in need of information to determine whether the benefits of improving fat content exceed the costs. Indeed, producers have a multitude of opportunities to try to increase beef demand, and thus it is important to determine how the demand for fat and fat content compares to demand for other beef attributes.

This research will determine whether consumers are willing to pay for beef with improved fat content, how they prefer the fat content of beef be improved, and the importance of fat content in beef relative to other beef attributes.

Specific objectives of this research include:

1. Determine consumer willingness-to-pay for a reduction in total fat content of ground beef.
2. Determine consumer willingness-to-pay for a reduction in saturated fat in ground beef.
3. Determine consumer willingness-to-pay for an increase in Conjugated Linoleic Acid in ground beef.
4. Determine consumer willingness-to-pay for a reduction in the Omega 6 to Omega 3 fatty acid ratio in ground beef.
5. Determine consumers' relative preferences for the method of improving the fatty acid composition of ground beef including grass feeding, genetic testing, sorting and labeling, feeding flaxseed oil, feeding fish meal, and cloning.
6. Determine the relative importance consumers place on price, fat content, type of fat, food safety, and package size when purchasing ground beef.

CHAPTER II

LITERATURE REVIEW

Importance of Nutrition and its Implications on Beef Demand

Consumers are increasingly concerned with the healthfulness of the foods they consume. A recent nationwide survey by the United Soybean Board (2006) revealed that 75% of consumers indicated that they have changed their eating habits to reflect increased health concerns. The survey revealed that consumers are interested in being able to choose good fats and omega 3 fatty acids are currently the only type of fat that consumers consistently viewed as healthy. Consumers also indicated that they were concerned about health issues and take such concerns into consideration when making food purchasing decisions.

Kinnucan et al. (1997) addressed the issue of health information and how it affects U. S. meat demand. Their article provides a side by side study of the combined effects of advertising and health information, measured by determining the sum of articles in medical journals with both positive and negative health information, on meat consumption patterns in the United States. The study found that poultry has benefited from cholesterol related health information at the expense of beef. The health information elasticity's for poultry and beef are 1.54 and -0.58 respectively, meaning that a 1% increase in the amount of information related to cholesterol translates into a 1.54%

increase in poultry consumption and a -0.58% decrease in beef consumption. These elasticities illustrate the importance of health information in explaining the increases in poultry consumption and decline in beef consumption over the past three decades, and support the fact that consumers consider the healthfulness of the meat when making purchasing decisions and dietary choices.

Capps & Schmitz (1991) reviewed past literature regarding health and nutrition information and their effect on demand for food products. They stated that previous literature has proved that consumers are willing to compromise on taste for a healthier product and that health related factors influence the decision to purchase leaner meats. They also developed and used a theoretical framework to consider health and nutrition information in the demand for beef, pork, poultry and fish and found that cholesterol information with a half year time lag is a statistically significant determinant in the consumption of these foods. Their studies have many limitations, however, the results proved that the issue of health and nutrition information on food demand is a key issue that agricultural economists should study.

In a study of Belgium consumers Verbeke & Ward (2001) used an almost ideal demand system (AIDS) to investigate how health risks and media coverage affects fresh meat consumption. Their research asked how much change in fresh meat demand could be expected from negative and positive TV press. Their findings showed a 10 fold increase in current advertising expenditure will be needed to offset the negative press associated with consuming beef. The results of their research showed that there is a dramatic impact on beef consumption from negative TV press and to counteract this impact better, more effective ways of advertising beef and fresh meat are needed.

Boetel and Liu (2003) also used an almost ideal demand system (AIDS) with quarterly data from 1976 to 2000 to estimate the effect of generic advertising and non advertising related health information on meat demand. Their results proved that the increased food health concerns for fat and cholesterol have led to a 6% decrease in beef consumption per quarter since 1987 and an 18% increase in poultry consumption. Another significant finding from their research was that beef advertising has a trivial impact on beef consumption, but it decreased pork consumption by 7.55% and decreased poultry consumption by 1.32%. Pork advertising increased poultry consumption by 4%, enough to outweigh the negative effect to poultry from beef advertising. The overall consumption effect from advertising for beef pork and poultry is a 6.5% and 4.3% decline in beef and pork consumption, respectively, with a 4.3% increase in poultry consumption. The authors argue that beef and pork producers should decrease the sum of their advertising expenditures by two thirds to reduce this negative spill over effect.

Scollan et al. (2006) argued that consumers demand food which is safe, healthy, convenient, and of consistent quality. They argued that the relatively high fat content of beef and recent health scares overshadow the many benefits that eating red meat can offer. To address this problem, Scollan et al. (2006) advocate altering the fat content and fatty acid composition of the beef to produce a product more appealing to the consumer. The authors, however, pointed out that altering the fatty acid composition of beef might change the products taste in a way that is unappealing to consumers. Umberger et al. (2002) have shown that the majority of consumers prefer the taste of corn-fed beef to grass-fed beef.

A few papers have measured consumers' preferences for fat content in beef and several studies have investigated the effect of total fat content in ground beef using hedonic analysis. For example, Brester et al. (1993) found that a 1% increase in the leanness of ground beef was associated with a price premium of $0.02/lb. More recently, Parcell and Schroeder (2007) found that a 1% increase in leanness was associated with a $0.039/lb premium in ground beef. Unnevehr and Bard (1993) found, studying table cut beef, that consumers significantly discounted external and seam fat, but did not place a consistent value on intramuscular fat content.

To our knowledge, only two previous studies have explicitly investigated consumer preferences for type of fat in beef. Lusk, Fields, and Prevatt (forthcoming) conducted non-hypothetical purchasing experiments with consumers in grocery stores to determine the value they placed on "pasture-raised" beef. They found that explicitly informing consumers about the link between pasture-raised beef and improved levels of Omega 3 fatty acids increased willingness-to-pay for pasture-raised steaks by about a dollar; however, such information did not have a significant effect on willingness-to-pay for pasture-raised ground beef.

McCluskey et al. (2005) administered an in-person survey in several grocery stores in Spokane, WA and utilized a choice-based conjoint questionnaire to determine relative preferences for beef price, fat and calories, and level of omega 3 fatty acids. They found that respondents were willing to pay a premium for beef steaks with lower fat content and higher levels of omega 3 fatty acids. Their results revealed a willingness-to-pay of $2.82 to move from "high" to "low" fat and calories and a willingness-to-pay of $1.71 to move from "low" to "high" omega 3 fatty acid content in beef steaks. Because

of the similarity of this study with the present analysis, several comments are in order. First, almost half the data collected by McCluskey et al. (2005) were from a "specialty" natural food store. Clearly, consumers in such an outlet are not likely to be representative of the general population and are likely to be more willing to pay for healthier products. Second, the survey method employed by McCluskey et al. (2005) simply used the words "high" and "low" when referring to total fat and fatty acid content, making precise predictions about the effects of improving fat content unavailable. Finally, McCluskey et al. (2005) only investigated consumer preferences for one method of improve the fatty acid content of the beef, feeding grass, and there are many alternative methods for improving fat content.

Research Regarding Heart Healthy Beef

Several studies have investigated methods of modifying cattle production systems to improve the fat content in beef. Knight et al. (2004) and Knight and Dickey (2005) studied the heritability of fatty acid composition finding it is indeed heritable, and can be improved by identifying and selecting for natural genetic differences that exist between animals. The authors found that traditional breeding selection programs can be used to improve the fatty acid composition of beef and suggested that DNA markers can be used in selecting breeding stock to create a healthier product.

Gillis, Duckett and Sackman (2004) examined ways to produce healthier beef by creating a product with higher levels of unsaturated fatty acids including omega 3 fatty acids and lower levels of saturated fatty acids. They investigated the effects of supplemental corn oil or rumen protected conjugated linoleic acid (CLA) salt on fatty

acid composition. They found that short term lipid supplementation in feedlot cattle can increase the CLA concentrations, however, these increases are only marginally effective and the authors point out that additional research is needed to determine the long run effects.

Mandel et al. (1997) investigated the effect of feeding fish meal on fatty acid composition of beef steaks. They found that feeding cattle 10% fish meal for 168 days improved the level of omega 3 fatty acids in beef steak. They also found that higher levels of fish meal generated higher omega 3 fatty acid levels. Feeding 10% fish meal was found to provide 85 mg of omega 3 fatty acids in 114 grams of beef. In contrast, 110g of chicken breast only provided between 45-70mg of omega 3 fatty acids. Thus, eating beef fed fish meal provides more omega 3 fatty acids then chicken breast. These differences are important when one recognizes that the recommended daily requirement for adults is 1000mg per day of omega 3 fatty acids.

French et al. (2000) examined the fatty acid composition of grass fed steers. They found that increasing the amount of grass intake (relative to concentrated feed) decreased intramuscular saturated fatty acids. They also found that a higher-grass diet also increased the omega 3 fatty acid concentration and decreased the omega 6 to omega 3 ratio, the latter of which is key to human health.

Maddock et al. (2006) examined the effects of feeding flax (also known as linseed), which is an oilseed, on fatty acid composition. They found that feeding flax decreased the omega 6 to omega 3 ratio and increased the amount of omega 3 fatty acid in beef. The results revealed that feeding flax also increased the number of carcasses grading USDA choice. They found that feeding flax improved the performance and

efficiency of the cattle (e.g., average daily gain) and improved the intramuscular fatty acid composition of the beef, suggesting feeding flax may have advantages over feeding grass.

Scollan et al. (2006) explored both genetic and nutritional approaches to change the fatty acid composition of beef. They found that feeding a diet rich in fresh grass and silage resulted in higher concentrations of omega 3 acids compared to a diet with concentrates. They also found that feeding supplementary fatty acids to the cattle also altered the fatty acid composition. Feeding linseed oil had the biggest positive effect on the fatty acid composition. Feeding sunflower seed oil and fish oil also improved the fatty acid composition in cattle, but to a lesser extent than linseed oil. Elsewhere, Scollan (2006) argued that one of the best ways to manipulate the fatty acid composition of the beef is by changing the foods that the animal is fed. He argued that feeding grass is among the most useful approaches to change the fatty acid composition while maintaining meat flavor and tenderness.

CHAPTER III

CONCEPTUAL FRAMEWORK

Since the work of Lancaster (1966) and Rosen (1974), there has been a recognition that consumers derive utility not necessarily from a good itself, but from the attributes embodied in the good. In Lancaster's (1966) model, a consumers' utility function was defined over attributes and consumers choose goods comprised of different attributes to maximize utility subject to a budget constraint. Rosen (1974) argued that differences in market prices for goods reflect differences in the characteristics or attributes resulting from consumer demand for competing attributes.

In the present context, this recognition implies that an item as simple as beef has a number of different attributes from which consumers derive utility, one of these attributes is nutrition. Beatty, (2007) argued that consumers' utility for food is defined over foods and the nutrients they provide. This utility is maximized subject to the consumer's budget constraints, characteristics of the food, and the foods nutrition values. Using this approach, Beatty (2007) estimated the value of 28 different nutrients. This suggests that consumers' utility for beef is likely to be a function of the nutritional content of the product including the amount and type of fat.

McFadden (1974, 1980) applied these concepts to consumer's choices between competing options or alternatives. A systematic portion of the utility function was assumed to depend on the attributes of the choice option alternative. In addition to this

systematic portion, the utility function is assumed to contain a stochastic error term representing the fact that the analyst cannot observe people's preferences with certainty. Rather, the observable, measurable output of the consumers' decision making process is a choice or purchase decisions. It is assumed that the consumer chooses the choice option that generates the highest utility given available choice options and constraints. More formally, a random utility function may be defined by a deterministic (V_{ij}) and a stochastic (ε_{ij}) component:

(1) $$U_{ij} = V_{ij} + \varepsilon_{ij}$$

where U_{ij} is the i^{th} consumer's utility of choosing option j, V_{ij} is the systematic portion of the utility function determined by ground beef attributes in alternative j, and ε_{ij} is a stochastic element. The probability that a consumer chooses alternative j from a choice set with J possible choice options is

(2) $$\text{Prob}\{V_{ij} + \varepsilon_{ij} \geq V_{ik} + \varepsilon_{ik} \quad \forall\, k \neq j\}$$

If the random errors in equation (1) are independently and identically distributed across the j alternatives and N individuals with a Type I Extreme Value distribution, McFadden (1974), showed that the probability of alternative j being chosen is

(3) $$\text{Prob}\{\text{option } j \text{ is chosen}\} = \frac{e^{V_{ij}}}{\sum_{k=1}^{J} e^{V_{ik}}}$$

In this research, the consumers' utility function for alternative j is assumed to be a function of total amount of fat, type of fat, and price as shown below.

(4) $$V_j = \alpha_j + B_1(\%\text{ fat})_j + B_2(\text{Saturated fat }\%)_j + B_3(\text{Omega 6 to Omega 3 ratio})_j + B_4(\text{Conjugated Linoleic Acid }\%)_j + B_5(\text{Price})_j$$

Based on previous literature, the research hypotheses are that individuals' utility will:

a) decrease as amount of total fat is increased (i.e., $B_1 < 0$),

b) decrease as saturated fat % increases (i.e., $B_2 < 0$),

c) decrease as the level of Omega 6 to Omega 3 increases (i.e., $B_3 < 0$),

d) increase as CLA% increases (i.e., $B_4 > 0$), and

e) decrease as price increases (i.e., $B_5 < 0$).

In addition to identifying consumers' preferences for fat type and content in ground beef, the objectives of this study included determining which methods consumers most preferred in improving the fat content in ground beef and which attributes, including fat content, were most important when consumers purchased ground beef. A typical approach taken in marketing and psychology literature to measure the level of importance or relative preference is simply to ask people to rate several items on a scale of, 1 to 5 where 1 equals "not at all important" and 5 equals "very important." A difficulty with such methods is that they do not force people to make trade-offs and it is common for people to rate all items as "very important." Further, with such ratings, different people are likely to use the scale differently, with a "5" for one person possibly representing a "4" for another. Finally, the results have no natural interpretations. That is, a score of "3" has no meaning outside the survey context.

To side-step some of these problems and investigate people's relative preferences for different methods to improve fat content, we turned to the use of "best-worst" or "maximum-difference" scaling originally introduced by Finn and Louviere (1992). Marley and Louviere (2005) have further identified the theoretical properties of probabilistic, best-worst choice models and this method is rapidly gaining popularity in

business-marketing research (e.g., Sawtooth Software, 2005) and has been recently been applied to health care issues (Flynn et al., 2007). Best-worst scaling, as developed by Finn and Louviere (1992), involves asking the respondent to simultaneously choose their "most" and "least" preferred options out of a set of several competing options. Obviously, by asking people to indicate the "best" and "worst", much more information is obtained than asking the respondent to choose only the "best" or "most important" or "most preferred."

There are several ways of analyzing data from a series of best-worst responses. However, regardless of the approach, consumers can be conceptualized as choosing the two items that maximize the difference between two items on an underlying scale of importance. If a choice set has J items, then there are $J(J-1)$ possible best-worst combinations a person could choose. The particular pair of items chosen by the consumer as best and worst, then, represents a choice out of all $J(J-1)$ possible pairs that maximizes the difference in importance.

Formally, let λ_j represent the location of item j on the underlying scale of preference/importance and let the true or latent unobserved level of importance for individual i be given by $I_{ij} = \lambda_j + \varepsilon_{ij}$, where ε_{ij} is a random error term. The probability that the consumer chooses, say, item j and item k, as the best and worst, respectively out of a choice sets with J items, is the probability that the difference in I_{ij} and I_{ik} is greater than all other $J(J-1)-1$ possible differences in the choice set. If the ε_{ij} are distributed iid Type I Extreme Value, then this probability takes the familiar multinomial-logit form:

$$\text{(5)} \qquad \text{Prob}(j \text{ is chosen best and } k \text{ chosen worst}) = \frac{e^{\lambda_j - \lambda_k}}{\sum_{l=1}^{J}\sum_{m=1}^{J} e^{\lambda_l - \lambda_m} - J}$$

A simpler approach than estimating the parameters of the logit model in equation (5) is, for each respondent, to simply subtract the number of times each issue was picked as "worst" from the number of times picked as "best" across a series of repeated best-worst questions. This approach generates individual-level measures of importance for each issue and for each consumer. Finn and Louviere (1992) showed that differences in the importance of competing issues resulting from this simple calculation are linearly related to the true differences on the underlying scale of importance or preference assuming people choose consistently.

CHAPTER IV

METHODS AND PROCEDURES

A mail survey was developed to accomplish the stated objectives. The survey was mailed to a random sample of 2,000 households throughout the United States in April of 2007. In designing the mail survey, the advice offered by Dillman (2000) was closely followed. In particular, the survey instrument was designed to address the research objectives in a way that respondents could easily and accurately respond to the survey questions. As suggested by Dillman (2000), survey questions were written in bold font on gray background and response categories were in white. The survey was printed and stapled in booklet form with an attractive cover page. The questionnaire was mailed out with a personalized cover letter including each individual's name and address. The cover letter explained the purpose of the survey and asked participants for their help in the research project. A pre-paid return envelope was included in the mailing and respondents were encouraged to contact the survey administrators if they had any questions or comments about the survey. One week after the survey was mailed out, a reminder/thank you post card was sent to all respondents. A copy of one of the survey versions, the cover letter, and the post-card reminder are included in the Appendix.

The final survey consists of 36 questions. The survey began with four general questions regarding the respondents past purchases of ground beef. Following the first

four questions, information about different types of fat and associated health effects was presented. The exact information given to respondents is as follows.

> On the next page, you will be asked several repeated questions about your preferences for beef products with different amounts and types of fat. Although some types of fat in beef may have adverse health consequences, some types of fat may have health benefits. The following information is provided to assist you in answering these questions
>
> - People who consume diets high in saturated fat tend to have higher levels of "bad" cholesterol, which increases the risk of heart disease
>   - in a typical package of ground beef, saturated fats normally comprise about 40% of the total fat content
> - In contrast to saturated fats, medical studies indicate that the ingested ratio of omega-6 to omega-3 polyunsaturated fatty acids is important in maintaining cardiovascular health and preventing heart disease
>   - most health experts suggest diets should have an omega-6 to omega-3 fatty acid ratio of about 1:1 to 2:1; however, most Americans consume these fatty acids in a ratio of about 16:1
>   - a typical package of ground beef has an omega-6 to omega-3 ratio of about 5:1
> - Medial studies suggest consumption of conjugated linoleic acid – CLA, a polyunsaturated fat, may lower body weight, reduce cancer risk, and improve cardiovascular health
>   - in a typical package of ground beef, CLA normally comprises about 0.5% of the total fat content

Immediately following this information (on the opposite page of the survey booklet) were nine choice questions, where the respondent was asked to choose which option of ground beef they would purchase (or neither), where each ground beef option varied according to the amount of fat and the price of the product. Each ground beef option was described by the five attributes shown in Table IV-1.

Table IV-1. Attributes and Attribute Levels in the Choice-Based Conjoint Questions

Attribute	Definition	Levels
Price	Price in dollars for a package of ground beef.	$1.99 $3.99
Fat %	Percent total fat in the ground beef.	10% 20%
Saturated Fat %	Percent of saturated fat measured as a percent of total fat content (note: health experts suggest consuming products low in saturated fat.)	30% 50%
Omega 6:3 ratio	Omega 6 to Omega 3 fatty acid ratio (note: health experts suggest a smaller ratio is better)	6:1 2:1
CLA %	Conjugated linoleic acid, a polyunsaturated fat, measured as a percent of total fat content (note: health experts suggest consuming higher levels of CLA to have health benefits)	0.3% 0.7%

As shown in Table IV-1, each attribute was varied at two levels. Thus, there are $2^5 = 32$ different ground beef options that could be described. In each choice option, people chose between two ground beef options and a third "neither" option. Thus, the full factorial design consisted of $2^5 \times 2^5 = 1024$ possible choices. From this full factorial, 18 choice tasks were selected such that all main and two-way interaction effects were uniquely identified. The 18 choice tasks were selected by choosing choice options out of the full factorial design to minimize a D-efficiency criteria. Lusk and Norwood (2005) have shown that such an approach yields reliable willingness-to-pay estimates. The resulting design had a D-efficiency score of 94.2 (out of 100) indicating that each attribute exhibits only a very low correlation with each other attribute within and across choice options. It was felt that it would be too burdensome to present all 18 choice

questions to each individual, and as such, the 18 questions were blocked into two sets of 9, and two survey versions were created – each with nine choice questions. An example choice question is shown in figure IV-1.

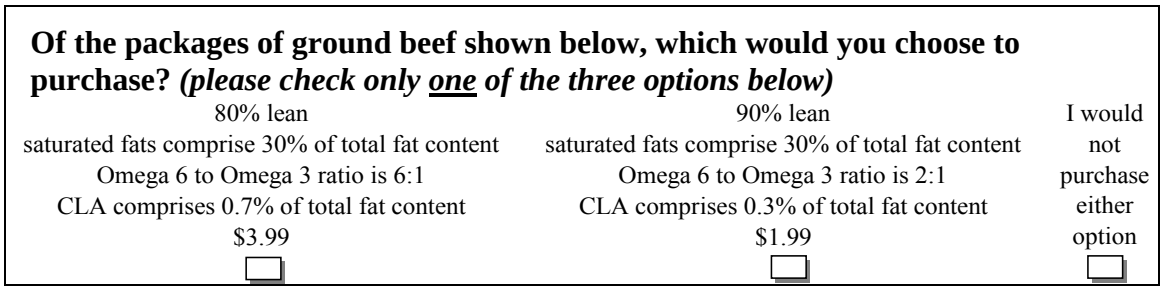

Figure IV-1. Example choice question presented to survey respondents.

As can be seen in figure 1, rather than indicating the percent fat, choice options were presented as the percent lean to be consistent with the way most ground beef is marketed in grocery stores. However, when estimating the model and defining the variables in the survey, fat content is defined as the percent fat (note: 80% lean = 20% fat; 90% lean = 10% fat). As described in the conceptual section, the choices can be used to estimate the coefficients of a random utility model. The functional form for the initial model is

(6) $$V_j = \alpha_j + B_1(\%\text{ fat})_j + B_2(\text{Saturated fat }\%)_j + B_3(\text{Omega 6 to Omega 3 ratio})_j + B_4(\text{Conjugated Linoleic Acid }\%)_j + B_5(\text{Price})_j$$

The probability that option *j* is chosen out of the three options available is given by equation (3), which represents the multinomial logit model. The model parameters are estimated by maximizing the following log-likelihood function:

(7) $$LogL = \sum_{i=1}^{N}\sum_{j=1}^{J} y_{ij} Log\left(e^{V_j} \Big/ \sum_{k=1}^{J} e^{V_k} \right)$$

When y_{ij} = 1 if person 1 chooses option j and 0 otherwise, N = number of people, J = number of options in this model J=3.

The estimated coefficients can be used to determine willingness to pay (WTP) for each attribute. Willingness to pay for a one unit increase in the attributes is calculated by dividing the parameter of each attribute by the price parameter (times negative one). Conversely, WTP for a one unit decrease in the attributes (i.e., a one percent reduction in total fat) is calculated by dividing the parameter of each attribute by the price parameter. For example, WTP of a 1% decrease in total fat is

$$WTP_{(\%Fat)} = \beta_1 / \beta_5$$

To calculate WTP for a change in the level of an attribute is simply the WTP for a one unit change multiplied by the number of units changed. For example, the two levels of fat in the survey are 10% fat and 20% fat, and WTP to go from a package of ground beef with 20% total fat to a package of ground beef with 10% total fat is

$$WTP_{(10\% \text{ decrease in Fat})} = (\beta_1 / \beta_5) * 10$$

In addition to calculating WTP, it is also useful to determine the relative importance of each of the attributes. Importance scores for each of the attributes are determined by multiplying the absolute value of the coefficient for each attribute by the change in the attribute level used in the survey. This calculation indicates the extent to which utility changes as the attribute is moved from the highest to lowest level. After this is done for each attribute (price, fat, saturated fat, omega 6 to omega 3 ratio, and CLA), the values are summed together and attribute's utility difference is divided by the sum. For example, the importance score for price = β_5*(3.99-1.99)/$\sum$(all attribute utility differences).

In addition to the base-line model in equation (6), additional models specifications were considered. The first alternative specification considers interactions between demographic variables and the attributes, allowing the marginal utilities of each attribute to be demographic-specific, as shown below:

(7) $V_j = \alpha_j + B_1(\text{Fat})j + B_2(\text{Saturated Fat})j + B_3(\text{Omega 6:3 ratio})j + B_4(\text{CLA})j + B_5(\text{Price})j + B_6(\text{Fat*Child})j + B_7(\text{Saturated Fat*Child})j + B_8(\text{Omega 6:3 ratio*Child})j + B_9(\text{CLA*Child})j + B_{10}(\text{Price*Child})j + B_{11}(\text{Fat*Education})j + B_{12}(\text{Saturated fat*Education})j + B_{13}(\text{Omega 6:3 ratio*Education})j + B_{14}(\text{CLA*Education})j + B_{15}(\text{Price*Education})j + B_{17}(\text{Fat*Income})j + B_{18}(\text{Saturated Fat*Income})j + B_{19}(\text{Omega 6:3 ratio*Income})j + B_{20}(\text{CLA*Income})j + B_{21}(\text{Price*Income})j + B_{22}(\text{Fat*Purchase})j + B_{23}(\text{Saturated Fat*Purchase})j + B_{24}(\text{Omega 6:3ratio*Purchase})j + B_{25}(\text{CLA*Purchase})j + B_{26}(\text{Price*Purchase})j$

A second alternative specification considers interactions between total fat content and the other non-price attributes:

(8) $V_j = \alpha_a + B_1(\%\text{ fat}) + B_2(\text{Saturated fat }\%) + B_3(\text{Omega6:3 ratio}) + B_4(\text{Conjugated Linoleic Acid}) + B_5(\text{Price}) + B_6(\%\text{ fat* Saturated Fat}) + B_7(\%\text{ fat * Omega 6:3 ratio}) + B_8(\%\text{ fat * CLA}).$

In equation (8), the marginal utility of saturated fat, for example, now depends on the amount of total fat. Thus, to determine WTP, total WTP for a package of ground beef with 10% total fat and 30% saturated fat was estimated holding CLA and omega 6:3 ratio constant at the values of 6:1 and 0.7%, respectively. Noting that the utility of the "none"

or "neither" option has been normalized to zero, total WTP for a package of ground beef with 10% total fat and 30% saturated fat is:

$$\text{Total WTP} = -[\alpha_j + B_1(10)j + B_2(30) + B_3(6) + B_4(0.7) + B_6(10*30) + B_7(10*6) + B_8(10*0.7)] / B_{5\text{price}}$$

After this value was determined, WTP for a package of ground beef was estimated again holding everything constant at the values used above except changing percent saturated fat to 50%. Subtracting the two numbers then gives willingness to pay to change from 50% saturated fat to 30% saturated fat when total fat is held constant at 10%. This same procedure was done changing select variables to determine WTP to change from 20% to 10% fat and WTP to change from an Omega 6:3 ratio of 6:1 to a ratio of 2:1.

After completing the nine choice questions, respondents were asked to answer eight additional questions to determine preferences for the method used to improve the fat content of the beef. In particular, respondents were asked to pick the most preferable and least preferable method of improving the fatty acid content out of the competing methods given to them. Figure IV-2 illustrates an example of one of the best-worst questions.

What is the most preferable and least preferable option to improve the fatty acid content of beef *(check one option as the most preferable and one option as the least preferable)*

Most Preferable		Least Preferable
☐	cattle fed a diet primarily consisting of grass or green-leafy hay	☐
☐	supplement cattle diets with fish meal	☐
☐	supplement cattle diets with flaxseed oil	☐
☐	use genetic testing to breed only those cattle with improved fatty acid content	☐
☐	sort existing cattle and label those with improved fatty acid content	☐
☐	clone cattle with improved fatty acid content	☐

Figure IV-2. Example best-worst question related to methods for improving fatty acid content in beef

Figure IV-2 shows the case when respondents were asked to choose the best and worse from all six methods studied. To present competing choice options to respondents, a main-effects fractional factorial designed was utilized. In particular, a 2^6 full factorial design was constructed that indicated whether each of the six attributes was present or absent in the design (i.e., the two levels are present or absent), and nine choice sets were selected from this full factorial such that the presence or absence of each issue was independent of the presence or absence of each of the other issues. Because two survey versions were employed to accommodate the 18 choice experiment questions, one half of the survey respondents received the original nine best-worst choice sets and the other half received the fold-over of the design (note: the fold-over design is created by replacing all "present" with "absent" and vice versa). This design ensures that each of the six issues appears an equal number of times (four to be precise) across all eight choice sets. This means that the maximum number of times an issue can be picked as "best" or "most preferred" by an individual is 4 (e.g., the best possible score for an issue is +4), whereas

the maximum number of times and issue can be picked as "worst" or "least preferred" by an individual is also 4 (e.g., the worst possible score for an issue is -4). Recalling that the "preference score" for each issue is calculated by subtracting the number of times each method or attribute was select as the least important from the number of times each was selected as the most important, it should be clear that the best-worst scores are constrained to fall between +4 and -4.

Following these questions, eight additional best-worst questions were asked regarding the importance the respondents place on several attributes when making a decision to purchase beef. These attributes were expiration date, food safety, price, fatty acid composition, total amount of fat and package size. Because there were six attributes, we simply used the same experimental design described above. The respondent was asked to answer these in the same manner as the preference questions regarding improving the fat content in ground beef, they were to pick which attributes are most and least important to them when purchasing beef. These attributes were arranged in different combinations to show which attributes consumers view as most important when making purchasing decisions. An example best-worst question involving all six issues is shown in figure IV-3. The final section of the survey included seven demographic questions.

When you purchase beef steaks, which of the following attributes is the most important and which is the least important? (check only one attribute as the most important and one attribute as the least important)

Most Important		Least Important
☐	expiration date	☐
☐	price	☐
☐	food safety	☐
☐	total amount of fat	☐
☐	package size	☐
☐	fatty acid composition	☐

Figure IV-3. Example best-worst question related to relative importance of beef attributes.

CHAPTER V

RESULTS

Overall there were 241 surveys returned. After accounting for undeliverable addresses, this implies a 12.7% response rate. Table V-1 reports summary statistics of the demographics of the survey respondents. Fifty eight percent of respondents were males and 42 percent were females. The mean age of the respondents was about 56 years old and the average household income was about $69,000/ year which is very close to the mean estimated income from the U. S. census in 2006 of $65,527/year. Over half of the respondents, 54.1%, received at least a bachelors degree and the majority of the respondents or 75.9% purchase ground beef from the grocery store at least once a month. These demographic results are similar to those of the U.S population according to the 2000 U.S. census the population consisted of 49.1% male and 50.9% female. Also from the census data, 36% of the population have children under the age of 18 living in the household, this is a larger percentage of children living in the household then the survey respondent with 21.2%, however, the survey asked if the respondent had children under the age of 12 in the household. The mean age of the U. S. population in 2000 of 35.3 years is lower than that of the survey respondents.

Table V-1. Summary Statistics of Demographic Variables (N = 241)

Variable	Definition	Mean
Gender	1 if Female ; 0 if Male	0.423
Age	Age in years	55.65
Children	1 if children under the age of 12 in household; 0 otherwise	0.212
Bachelors Degree	1 if obtained a bachelors degree; 0 otherwise	0.541
Graduate Degree	1 if obtained a graduate degree; 0 otherwise	0.266
Income 1	1 if annual household income before taxes is less than $20,000; 0 otherwise	0.073
Income 2	1 if annual household income before taxes is $20,000 to $39,999; 0 otherwise	0.179
Income 3	1 if annual household income before taxes is $40,000 to $59,999; 0 otherwise	0.150
Income 4	1 if annual household income before taxes is $60,000 to $79,999; 0 otherwise	0.203
Income 5	1 if annual household income before taxes is $80,000 to $99,999; 0 otherwise	0.101
Income 6	1 if annual household income before taxes is greater than $100,000; 0 otherwise	0.295
Income	1 if annual household income before taxes is less than $20,000 2 if annual household income before taxes is $20,000 to $39,999 3 if annual household income before taxes is $40,000 to $59,999 4 if annual household income before taxes is $60,000 to $79,999 5 if annual household income before taxes is $80,000 to $99,999 6 if annual household income before taxes is greater than $100,000	3.96
Purchase	1 if purchase ground beef from the grocery store at least once a month; 0 otherwise	0.759

The results from the first four general questions in the survey revealed that only one respondent is less concerned today than five years ago about the healthiness of

ground beef. 40.83% of the respondents have the same level of concern today as 5 years ago and 56.67% are more concerned today than 5 years ago about the healthiness of ground beef.

The second questions asked the respondent show often they purchase ground beef from a grocery store over half of the respondents or 52.28% said that they purchase ground beef at least every 2 weeks, 23.65% more said that they purchase ground beef at least once a month, 14.11% of the respondents replied that they purchase ground beef only a few times a year, 1.24% or 3 respondent purchase ground beef about once a year and only 8.71% said that they never purchase ground beef however some of these respondents replied that the reason they never or very rarely purchase ground beef is because they raise their own beef.

When asked what type of ground beef they typically purchase 7.69% said that they purchase ground beef that is 75% lean or less, 15.84% typically purchase ground beef that is 80%lean, 28.96% purchase 85% lean ground beef. 90 of the respondents or 40.72% say that they purchase ground beef that is 90% lean or more and 6.79% were unsure of the type of ground beef that they normally purchase.

When answering the fourth and final general questions, 36.20% of the respondents strongly agreed with the statement "Eating boneless skinless chicken breast is healthier than eating ground beef" 38.46% moderately agree with the statement, 19.91% replied that they neither agree or disagree, 4.52% moderately disagree and only 0.9% or 2 respondents strongly disagreed with the previous statement.

Of the 241 returned surveys, only 220 were usable in estimating the multinomial logit model based on the responses to the choice-based questions (i.e., some respondents

did not answer all choice questions or answered incorrectly and were removed from the data set prior to estimation). The results of the base-line model are presented in Table V-2.

Table V-2. Multinomial Logit Model Estimates from Choice-Based Decisions - Linear Model

Variable	Estimate
Intercept	5.272**[a] (0.256)[b]
Fat	-0.041** (0.007)
Saturated Fat	-0.053** (0.004)
Omega 6:3 ratio	-0.176** (0.017)
CLA	0.142 (0.1706)
Price	-0.366** (0.040)
Number of Respondents	220
Number of Choices	1980
Log Likelihood	-1817
Likelihood Ratio	716.47
McFadden's LRI	0.165

[a] One (*) and two (**) asterisks represent 0.05 and 0.01 levels of statistical significance, respectively.

[b] Numbers in parentheses are standard errors.

Results reveal that all of the variables used except for CLA are significant at the 0.01 level of statistical significance or lower, this may be because consumers have only recently been advised to consume higher levels of CLA and some may still be hesitant of its health benefits. The estimated utility model can be written as

$$V_j = 5.272 - 0.041(\%\ \text{fat})j - 0.053(\text{Saturated fat }\%)j - 0.176(\text{Omega 6:3 ratio})j + 0.142(\text{CLA})j - 0.366(\text{Price})j$$

The estimates presented in Table V-2 correspond with the hypothesized relationships. In particular, the result reveal that utility derived from ground beef is decreasing in the amount of total fat, saturated fat, omega 6:3 ratio, and price, and is increasing in amount of CLA.

Using the results found from the multinomial logit model WTP was estimated. As shown in Table V-3, consumers are willing to pay $0.479 for a 1 unit decrease in the omega 6 to omega 3 ratio, or $1.916 to purchase a package of ground beef with an omega 6: 3 ratio of 2:1 compared to a package with an omega 6:3 ratio of 6:1. Consumers are also willing to pay $0.113 for a 1% decrease in the amount of total fat in the beef or $1.125 for a 10% decrease in total fat. The remaining willingness to pay estimates are shown in Table V-3.

Table V-3. Consumer's Willingness To Pay; Linear Logit Model Estimates

Willingness to pay for . . .	Value
1% decrease in total fat	$0.113
Decrease in total fat from 20% to 10%	$1.125
1% decrease in saturated fat	$0.145
Decrease in saturated fat from 50% to 30%	$2.904
1 unit decrease in omega 6 to 3 ratio	$0.479
Decrease in omega 6 to 3 ratio from 6:1 to 2:1	$1.916
1% increase in CLA percent	$0.387
Increase in CLA percent from 0.3% to 0.7%	$0.155

The importance scores of each of the variables in the linear model were estimated and are shown in Figure V-1. The attribute that was found to be the most important to consumers is saturated fat with an importance score of 35.86%. This result is not surprising as consumers are more aware of saturated fat and are constantly informed to lower the amount of saturated fat in their diet. The price of the ground beef is second-most important with the Omega 6:3 ratio following closely behind it with an importance score of 23.66 which is only about 1% lower then the importance score for price. The attribute with the lowest importance score is also the one that consumers are probably the least informed and have the least knowledge about, CLA.

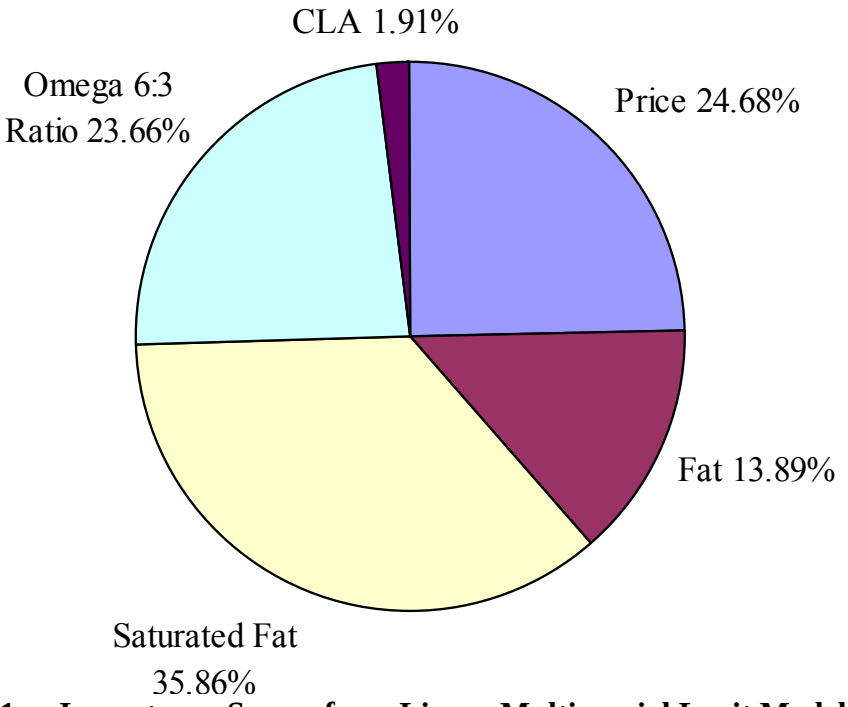

Figure V-1. Importance Scores from Linear Multinomial Logit Model

Table V-4 reports estimates of the logit model accounting for demographic interactions. The demographic variables used in this model are a dummy variable for children, 1 if the respondent has children under the age of 12 in the household and zero otherwise, a dummy variable for education, 1 if the respondent obtained a

bachelor's degree and 0 otherwise, a dummy variable for purchase behavior, 1 if the respondent purchases ground beef from a grocery store at least once a month and zero otherwise and finally income. Because some respondents did not complete the demographic questions, the sample size used in estimating the model reported in Table V-4 is 205.

Table V-4. Multinomial Logit Model including interactions with demographics

Variable	Estimates
Intercept	5.449** (.272)
Fat	-0.081** (0.021)
Saturated Fat	-0.045** (0.010)
Omega 6:3 ratio	-0.306** (0.052)
CLA	-0.407 (0.532)
Price	-0.229* (0.110)
Fat * Child	0.045** (0.017)
Saturated Fat * Child	-0.009 (0.008)
Omega 6:3 * Child	0.009 (0.042)
CLA * Child	0.422 (0.424)
Price * Child	0.063 (0.086)
Fat * Education	0.013 (0.016)
Saturated Fat * Education	-0.016* (0.007)

Table V-4. Multinomial Logit Model including interactions with demographics

Omega 6:3 * Education	-0.085* (0.040)
CLA* Education	0.327 (0.412)
Price* Education	0.096 (0.083)
Fat* Income	-0.007 (0.005)
Saturated Fat * Income	0.0002 (0.002)
Omega 6:3 *Income	0.026* (0.012)
CLA* Income	0.023 (0.124)
Price * Income	0.004 (0.025)
Fat *Purchase	0.100** (0.014)
Saturated Fat* Purchase	-0.001 (0.006)
Omega 6:3 * Purchase	0.104** (0.035)
CLA * Purchase	0.261 (0.359)
Price * Purchase	-0.382** (0.074)
Number of Respondents	205
Number of Choices	1845
Log Likelihood	-1616
Likelihood Ratio	822.8
McFadden's LRI	0.203

[a] One (*) and two (**) asterisks represent 0.05 and 0.01 levels of statistical significance, respectively.

[b] Numbers in parentheses are standard errors.

The results show that when including demographic characteristics the model has less statistically significant estimates and the estimates for the interaction effects are less

consistent with each other. The results do reveal that utility is still decreased as hypothesized when fat, saturated fat, omega 6:3 ratio and price increase however it also decreased when CLA increased which is not as hypothesized however the estimate for CLA is not statistically significant. When looking at the interaction between the attributes and the demographic for purchase behavior it is interesting to note that the estimate for Price*Purchase is negative and relative to other estimates has a larger estimate value then most meaning that if the respondent purchases ground beef at least once a month their utility is decreased more by an increase in price than someone who does not regularly purchase ground beef. When conducting a chi-square test the hypothesis that the interaction effects are zero is rejected with 20 degrees of freedom and 95% confidence level suggesting that the extra parameters are significantly different than zero and useful in determining the consumers level of utility.

In addition to considering demographic interactions a third model considers interactions between total fat and the remaining non-price attributes as shown in Table V-5.

The estimated model can be written as:

$V_j = 8.378 - 0.233(\%\ \text{fat})j - 0.106(\text{Saturated fat }\%)j - 0.387\,(\text{Omega 6:3 ratio})j - 0.397(\text{CLA})j - 0.381(\text{Price})j + 0.003(\%\ \text{fat* Saturated Fat})j + 0.014\,(\%\ \text{fat * Omega 6:3 ratio})j + 0.038(\%\ \text{fat * CLA})j$

Table V-5. Multinomial Logit model with interactions between attributes

Variable	Estimate
Intercept	8.378**[a] (0.786)[b]
Fat	-0.233** (0.046)
Saturated Fat	-0.106** (0.013)
Omega 6:3 Ratio	-0.387** (0.056)
CLA	-0.397 (0.793)
Price	-0.381** (0.040)
Fat * Saturated Fat	0.003** (0.001)
Fat * Omega 6:3	0.014** (0.004)
Fat * CLA	0.038 (0.054)
Number of Respondents	220
Number of Choices	1980
Log Likelihood	-1804
Likelihood Ratio	742.7
McFadden's LRI	0.171

[a] One (*) and two (**) asterisks represent 0.05 and 0.01 levels of statistical significance, respectively.

[b] Numbers in parentheses are standard errors.

The results show that, as in the model with no interactions, consumers utility decreases with increases in fat, saturated fat, omega 6:3 ratio and price and all of these variables are significant at the 0.01 level of statistical significance. Consumers utility

also decreases with an increase in CLA which is contrary to hypothesized and to the initial model. To better interpret these results willingness to pay was calculated using the above model. Because of the interaction effects between attributes the willingness to pay for total fat depends on saturated fat and vice versa.

The willingness to pay results can be seen in the following tables.

Table V-6. Willingness to Pay; Non Linear Model [a]

	Total Fat		WTP to change from 20% total fat to 10%
Saturated Fat	10%	20%	
30%	$8.76	$6.63	$2.13
50%	$4.91	$4.51	$0.40
WTP to change from 50% Saturated Fat to 30%	$3.85	$2.13	

[a] CLA and Omega 6:3 ratio held constant at 0.7% and 2 respectively

Table V-6 shows consumers are willing to pay $2.13 to purchase a package of ground beef that has only 10% fat, or that is 90% lean, instead of one with 20% total fat, 80% lean, when saturated fat is 30%. Consumers are also WTP $3.85 to change from a package that has 10% fat with 50% of the fat being saturated to one with only 30% saturated fat, or $2.13 to make the same change in a package of ground beef that has 20% fat or that is 80%lean. These results imply a strong interaction effect between saturated fat and total fat content they show that reductions in saturated fat are more highly valued when the total fat content is lower suggesting the two attributes are complements, consumers prefer to have low saturated fat and low total fat together.

Table V-7 calculates WTP for beef that has 0.7% CLA and 30% saturated fat. Consumers are willing to pay $2.13 to change from 20% total fat to 10% total fat in a package of ground beef that has an omega 6:3 ratio of 2:1, the consumer is only willing to

pay $0.71 to make the same change in percent total fat when the omega 6:3 ratio is 6:1, suggesting that consumers value the type of fat that is in the ground beef not just the amount of fat. The consumer is willing to pay $2.64 to change from a ratio of 6:1 to one of 2:1 in a package of ground beef having 10% total fat and $1.22 in a package of ground beef that is 20% fat.

Table V-7. Willingness to Pay; Non Linear Model[b]

	Total Fat		WTP to change from 20% total fat to 10%
Omega 6 to 3 ratio	10%	20%	
2:1	$8.76	$6.63	$2.13
6:1	$6.12	$5.41	$0.71
WTP to change from an Omega 6 to 3 ratio of 6:1 to 2:1	$2.64	$1.22	

[b] CLA and Saturated Fat held constant at 0.7% and 30%, respectively.

When looking at all of the WTP results the consumer is willing to pay more for changes in the type of fat compared to changes in the amount of fat suggesting that consumers are conscientious of the type of fat in ground beef and that they believe the type of fat to be just as important if not more important than the amount of fat. Consumers do make a difference between good fats and bad fats and will pay for products with higher amounts of "good" fats or lower amounts of "bad" fats.

The final portion of the survey asked the respondent to select their most and least preferred methods for improving the fat content in ground beef and the most and least important attributes they consider when purchasing ground beef. The results for the most and least preferred method of improving the fat content are presented in table V-8. Results reveal that the most preferred method of improving fat content in the ground beef is to feed the cattle a diet primarily consisting of grass, with grass having an importance

score of 1.992. The least preferred method with an importance score of -2.913 is to clone cattle.

The range of importance scores could span from +4 to -4, with an importance score of zero meaning that the method was chosen to be most preferred as often as it was chosen to be the least preferred. Thus, a negative importance score means the method was chosen to be the least preferred method more than it was chosen to be the most preferable method for altering the fat content.

Table V-8. Importance Scores for methods of improving fat content in Ground Beef

Method	Definition	Mean	95% Confidence Interval	
			Lower	Upper
Grass	Feed Cattle a Diet primarily consisting of grass or green leafy hay.	1.992 (2.096)[a]	1.727	2.257
Genetic testing	Use genetic testing to breed only those cattle with improved fatty acid content.	0.436 (1.700)	0.222	0.650
Sort & Label	Sort existing cattle and label those with improved fatty acid content.	0.290 (1.360)	0.118	0.462
Flaxseed oil	Supplement cattle diets with flaxseed oil.	0.237 (1.559)	0.041	0.433
Fish meal	Supplement cattle diets with fish meal.	-0.104 (1.713)	-0.320	0.112
Clone	Clone cattle with improved fatty acid content.	-2.913 (2.184)	-3.189	-2.637

[a] Numbers in parentheses are standard deviations. Number of respondents = 241

The most and least important attributes to consumers when purchasing ground beef are shown in Table V-9. Results indicate the most important factor when purchasing ground beef is food safety. This is not surprising considering the health scares that are

continually a problem with many items purchased in the grocery store. The next most important attribute was found to be the expiration date of the beef which can probably be related to food safety. The attribute that was of least important was package size, however the fatty acid composition was found to be the next least important, or was ranked 5th in importance. This may be due to the fact that the fatty acid composition is not found on the label of the beef and is not something that consumers can make purchase decisions about. Although fat type was not very important, total amount of fat in the package of ground beef was the 3rd most important attribute that consumers consider when purchasing ground beef following closely behind the importance score for expiration date. If information about fatty acid content of the ground beef was displayed as total fat content is and consumers could purchase a package of beef with different fatty acid composition than consumers would be more aware of it, resulting in a higher importance score.

Table V-9. Importance Scores for attributes of Ground Beef

		95% Confidence Interval	
Attribute	Mean	Lower	Upper
Food Safety	1.822 (1.857)[a]	1.587	2.057
Expiration Date	0.589 (1.887)	0.350	0.828
Total Fat	0.577 (1.820)	0.348	0.806
Price	-0.232 (2.034)	-0.489	0.025
Fatty Acid Composition	-0.564 (1.800)	-0.791	-0.337
Package Size	-1.805 (2.093)	-2.070	-1.540

[a] Numbers in parentheses are standard deviations. Number of respondents = 241

CHAPTER VI

IMPLICATIONS AND CONCLUSIONS

The results found from this research suggest it may be profitable to market and sell beef products that are healthier for the consumer and that the consumer would be willing to pay extra for these healthier products. One important thing that should make marketing and selling these healthier products easier would be to include information on the label explaining the fatty acid content of the beef. If the information of the fatty acid content of ground beef was displayed on the label as the total fat content is consumers would be more aware of it leading to a higher importance score for fatty acid content of beef. Some important pieces of information that should be included are the omega 6 to omega 3 ratio of the ground beef, the amount of saturated fat and the amount of CLA present in the package of ground beef. This research looked at ground beef specifically however consumers want healthier beef products whether in ground beef, or packages of steaks or any other beef product and if farmers and ranchers produced and labeled healthier products consumers should purchase them. The results presented in this research prove that there is market potential for "heart healthy beef."

The results suggest that consumers are willing to pay for healthier beef products and that the amount of fat and make up of the fat in ground beef is something that they consider when making purchase decisions. However key question that this research does not answer are:

1. Is the amount that consumers are willing to pay enough for farmers and ranchers to justify making changes in their current operating procedures to produce healthier beef products?
2. Is the amount that consumers are willing to pay enough to offset the extra costs to farmers of producing healthier products?

These questions will have to be answered with additional research however this research provides a step towards having heart healthy beef in the market place.

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APPENDIX

<<March XX, 2007>>

<<MERGE individual's address HERE>>

I am writing to ask your help in a study being conducted by Oklahoma State University. This study is part of an effort to learn about people's preferences for fat content in ground beef.

We are contacting a random sample of residents in the United States to ask about their preferences for fat content in beef. Even if rarely eat beef or if you feel that you do not know very much about fat content in beef, we are still interested in your opinions.

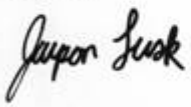
Results from the survey will be used to help ranchers and other cattle and meat producers make better decisions about how to improve the quality of their product. By understanding what people know and want, cattle producers and meat processors can do a better job at creating products that better reflect your preferences.

Your answers are completely confidential and will be released only as summaries in which no individual's answers can be identified. When you return your completed questionnaire, your name will be deleted from the mailing list and never connected to your answers in any way. This survey is voluntary. However, you can help us very much by taking a few minutes to share your thoughts.

If you have any questions or comments about this study, I would be happy to talk with you. My telephone number is 405-744-7465 or you can email me at jayson.lusk@okstate.edu.

Thank you for helping with this important study.

Sincerely,



Jayson L. Lusk, Ph.D.
Professor and Willard Sparaks Endowed Chair of Agribusiness Studies

P.S. Please return your survey in the enclosed postage paid envelope. Many thanks.

<<Date XX, 2007>>

Last week we mailed you a questionnaire seeking your opinions about fat content in ground beef.

If you have already completed and returned the questionnaire to us, pleas accept our sincere thanks. If not, please do so today. We are especially grateful for your help because it is only by asking people like you to share your opinions that we can create better beef products.

Thank you very much for your help with this important study. We really appreciate it.

Jayson Lusk

Jayson L. Lusk, Professor
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(405)744-7465 • Fax (405)744-8210 • www.agecon.okstate.edu

Survey Version 1

Oklahoma State University

Study on

Consumer Preferences for Fat Content in Ground Beef

Consumer Preferences for Fat Content in Ground Beef

1. **Are you more or less concerned about the healthiness of beef as compared to five years ago?**
   - ❑ Less concerned today than 5 years ago
   - ❑ About the same level of concern
   - ❑ More concerned today than 5 years ago

2. **How often do you purchase ground beef from the grocery store?**
   - ❑ About once a week
   - ❑ About every two weeks
   - ❑ About once a month
   - ❑ A few times a year
   - ❑ About once a year
   - ❑ Never ⟶ if you never purchase ground beef, please stop now and return the survey

3. **What type of ground beef do you normally purchase from the grocery store?**
   - ❑ about 75% lean or less
   - ❑ about 80% lean
   - ❑ about 85% lean
   - ❑ about 90% lean or more
   - ❑ I don't know

4. **To what extent do you agree or disagree with the following statement, "Eating boneless skinless chicken breast is healthier than eating ground beef."**
   - ❑ Strongly agree
   - ❑ Moderately agree
   - ❑ Neither agree nor disagree
   - ❑ Moderately disagree
   - ❑ Strongly disagree

➢ **On the next page, you will be asked several repeated questions about your preferences for beef products with different amounts and types of fat. Although some types of fat in beef may have adverse health consequences, some types of fat may have health benefits. The following information is provided to assist you in answering these questions**

- **People who consume diets high in saturated fat tend to have higher levels of "bad" cholesterol, which increases the risk of heart disease**
  - ♦ **in a typical package of ground beef, saturated fats normally comprise about 40% of the total fat content**
- **In contrast to saturated fats, medical studies indicate that the ingested ratio of omega-6 to omega-3 polyunsaturated fatty acids is important in maintaining cardiovascular health and preventing heart disease**
  - ♦ **most health experts suggest diets should have an omega-6 to omega-3 fatty acid ratio of about 1:1 to 2:1; however, most Americans consume these fatty acids in a ratio of about 16:1**
  - ♦ **a typical package of ground beef has an omega-6 to omega-3 ratio of about 5:1**
- **Medial studies suggest consumption of conjugated linoleic acid – CLA, a polyunsaturated fat, may lower body weight, reduce cancer risk, and improve cardiovascular health**
  - ♦ **in a typical package of ground beef, CLA normally comprises about 0.5% of the total fat content**

5. Of the packages of ground beef shown below, which would you choose to purchase? *(please check only one of the three options below)*

80% lean saturated fats comprise 30% of total fat content Omega 6 to Omega 3 ratio is 2:1 CLA comprises 0.7% of total fat content $3.99	80% lean saturated fats comprise 50% of total fat content Omega 6 to Omega 3 ratio is 6:1 CLA comprises 0.7% of total fat content $1.99	I would not purchase either option
☐	☐	☐

6. Of the packages of ground beef shown below, which would you choose to purchase? *(please check only one of the three options below)*

80% lean saturated fats comprise 30% of total fat content Omega 6 to Omega 3 ratio is 2:1 CLA comprises 0.3% of total fat content $1.99	80% lean saturated fats comprise 50% of total fat content Omega 6 to Omega 3 ratio is 6:1 CLA comprises 0.3% of total fat content $3.99	I would not purchase either option
☐	☐	☐

7. Of the packages of ground beef shown below, which would you choose to purchase? *(please check only one of the three options below)*

90% lean saturated fats comprise 30% of total fat content Omega 6 to Omega 3 ratio is 2:1 CLA comprises 0.7% of total fat content $1.99	90% lean saturated fats comprise 30% of total fat content Omega 6 to Omega 3 ratio is 6:1 CLA comprises 0.3% of total fat content $1.99	I would not purchase either option
☐	☐	☐

8. Of the packages of ground beef shown below, which would you choose to purchase? *(please check only one of the three options below)*

90% lean saturated fats comprise 30% of total fat content Omega 6 to Omega 3 ratio is 6:1 CLA comprises 0.3% of total fat content $1.99	90% lean saturated fats comprise 50% of total fat content Omega 6 to Omega 3 ratio is 2:1 CLA comprises 0.3% of total fat content $1.99	I would not purchase either option
☐	☐	☐

9. Of the packages of ground beef shown below, which would you choose to purchase? *(please check only one of the three options below)*

80% lean saturated fats comprise 50% of total fat content Omega 6 to Omega 3 ratio is 2:1 CLA comprises 0.3% of total fat content $3.99	90% lean saturated fats comprise 30% of total fat content Omega 6 to Omega 3 ratio is 6:1 CLA comprises 0.7% of total fat content $1.99	I would not purchase either option
☐	☐	☐

10. Of the packages of ground beef shown below, which would you choose to purchase?

90% lean saturated fats comprise 50% of total fat content Omega 6 to Omega 3 ratio is 6:1 CLA comprises 0.7% of total fat content $1.99	80% lean saturated fats comprise 30% of total fat content Omega 6 to Omega 3 ratio is 2:1 CLA comprises 0.3% of total fat content $1.99	I would not purchase either option
☐	☐	☐

11. Of the packages of ground beef shown below, which would you choose to purchase? ***(please check only one of the three options below)***

90% lean	80% lean	I would not purchase either option
saturated fats comprise 50% of total fat content	saturated fats comprise 30% of total fat content	
Omega 6 to Omega 3 ratio is 2:1	Omega 6 to Omega 3 ratio is 2:1	
CLA comprises 0.3% of total fat content	CLA comprises 0.7% of total fat content	
$3.99	$3.99	
☐	☐	☐

12. Of the packages of ground beef shown below, which would you choose to purchase? ***(please check only one of the three options below)***

90% lean	90% lean	I would not purchase either option
saturated fats comprise 30% of total fat content	saturated fats comprise 50% of total fat content	
Omega 6 to Omega 3 ratio is 6:1	Omega 6 to Omega 3 ratio is 2:1	
CLA comprises 0.7% of total fat content	CLA comprises 0.7% of total fat content	
$3.99	$3.99	
☐	☐	☐

13. Of the packages of ground beef shown below, which would you choose to purchase? ***(please check only one of the three options below)***

80% lean	80% lean	I would not purchase either option
saturated fats comprise 50% of total fat content	saturated fats comprise 50% of total fat content	
Omega 6 to Omega 3 ratio is 6:1	Omega 6 to Omega 3 ratio is 6:1	
CLA comprises 0.7% of total fat content	CLA comprises 0.7% of total fat content	
$1.99	$3.99	
☐	☐	☐

➢ **Beef producers, processors, and grocery stores have several options to improve the fatty acid content of beef. We would now like to ask you several repeated questions about your preference for these options to improve the fatty acid content of beef. When answering the questions, please assume all options are equally effective at improving fatty acid content. Each question below lists two or more options to improve the fatty acid content. For each question, check only one option as the most preferable and also check only one option as the least preferable.**

14. What is the most preferable and least preferable option to improve the fatty acid content of beef ***(check one option as the most preferable and one option as the least preferable)***

Most Preferable		Least Preferable
☐	cattle fed a diet primarily consisting of grass or green-leafy hay	☐
☐	supplement cattle diets with flaxseed oil	☐

15. What is the most preferable and least preferable option to improve the fatty acid content of beef ***(check one option as the most preferable and one option as the least preferable)***

Most Preferable		Least Preferable
☐	supplement cattle diets with fish meal	☐
☐	sort existing cattle and label those with improved fatty acid content	☐

16. **What is the most preferable and least preferable option to improve the fatty acid content of beef** ***(check one option as the most preferable and one option as the least preferable)***

Most Preferable		Least Preferable
☐	use genetic testing to breed only those cattle with improved fatty acid content	☐
☐	clone cattle with improved fatty acid content	☐

17. **What is the most preferable and least preferable option to improve the fatty acid content of beef** ***(check one option as the most preferable and one option as the least preferable)***

Most Preferable		Least Preferable
☐	cattle fed a diet primarily consisting of grass or green-leafy hay	☐
☐	supplement cattle diets with fish meal	☐
☐	clone cattle with improved fatty acid content	☐

18. **What is the most preferable and least preferable option to improve the fatty acid content of beef** ***(check one option as the most preferable and one option as the least preferable)***

Most Preferable		Least Preferable
☐	cattle fed a diet primarily consisting of grass or green-leafy hay	☐
☐	use genetic testing to breed only those cattle with improved fatty acid content	☐
☐	sort existing cattle and label those with improved fatty acid content	☐

19. **What is the most preferable and least preferable option to improve the fatty acid content of beef** ***(check one option as the most preferable and one option as the least preferable)***

Most Preferable		Least Preferable
☐	supplement cattle diets with fish meal	☐
☐	supplement cattle diets with flaxseed oil	☐
☐	use genetic testing to breed only those cattle with improved fatty acid content	☐

20. **What is the most preferable and least preferable option to improve the fatty acid content of beef** ***(check one option as the most preferable and one option as the least preferable)***

Most Preferable		Least Preferable
☐	supplement cattle diets with flaxseed oil	☐
☐	clone cattle with improved fatty acid content	☐
☐	sort existing cattle and label those with improved fatty acid content	☐

21. What is the most preferable and least preferable option to improve the fatty acid content of beef *(check one option as the most preferable and one option as the least preferable)*

Most Preferable		Least Preferable
☐	cattle fed a diet primarily consisting of grass or green-leafy hay	☐
☐	supplement cattle diets with fish meal	☐
☐	supplement cattle diets with flaxseed oil	☐
☐	use genetic testing to breed only those cattle with improved fatty acid content	☐
☐	sort existing cattle and label those with improved fatty acid content	☐
☐	clone cattle with improved fatty acid content	☐

➢ **We would now like to ask you several repeated questions regarding the importance of several attributes when you purchase ground beef. For each question, check only <u>one</u> attribute as the most important and also check only <u>one</u> attribute as the least important.**

22. When you purchase beef steaks, which of the following attributes is the most important and which is the least important? *(check only one attribute as the most important and one attribute as the least important)*

Most Important		Least Important
☐	expiration date	☐
☐	food safety	☐

23. When you purchase beef steaks, which of the following attributes is the most important and which is the least important? *(check only one attribute as the most important and one attribute as the least important)*

Most Important		Least Important
☐	price	☐
☐	fatty acid composition	☐

24. When you purchase beef steaks, which of the following attributes is the most important and which is the least important? *(check only one attribute as the most important and one attribute as the least important)*

Most Important		Least Important
☐	total amount of fat	☐
☐	package size	☐

25. **When you purchase beef steaks, which of the following attributes is the most important and which is the least important?** ***(check only one attribute as the most important and one attribute as the least important)***

Most Important		Least Important
☐	expiration date	☐
☐	price	☐
☐	package size	☐

26. **When you purchase beef steaks, which of the following attributes is the most important and which is the least important?** ***(check only one attribute as the most important and one attribute as the least important)***

Most Important		Least Important
☐	expiration date	☐
☐	total amount of fat	☐
☐	fatty acid composition	☐

27. **When you purchase beef steaks, which of the following attributes is the most important and which is the least important?** ***(check only one attribute as the most important and one attribute as the least important)***

Most Important		Least Important
☐	price	☐
☐	food safety	☐
☐	total amount of fat	☐

28. **When you purchase beef steaks, which of the following attributes is the most important and which is the least important?** ***(check only one attribute as the most important and one attribute as the least important)***

Most Important		Least Important
☐	food safety	☐
☐	package size	☐
☐	fatty acid composition	☐

29. **When you purchase beef steaks, which of the following attributes is the most important and which is the least important?** ***(check only one attribute as the most important and one attribute as the least important)***

Most Important		Least Important
☐	expiration date	☐
☐	price	☐
☐	food safety	☐
☐	total amount of fat	☐
☐	package size	☐
☐	fatty acid composition	☐

➢ **Finally, we would like some background information about you. This is an important part of our analysis. The survey is anonymous and your name is in no way linked to the responses.**

30. **What is your gender?**
- ☐ Male
- ☐ Female

31. **Are there children under the age of 12 living in your household?**
- ☐ Yes
- ☐ No

32. **Have you obtained a Bachelor's degree from a university or college?**
- ☐ Yes
- ☐ No

33. **Have you obtained a graduate degree such as an M.S., M.A., M.B.A., Ph.D. or M.D. or J.D.?**
- ☐ Yes
- ☐ No

34. **What is your approximate annual household income before taxes in 2006?**
- ☐ Less than $20,000
- ☐ $20,000 to $39,999
- ☐ $40,000 to $59,999
- ☐ $60,000 to $79,999
- ☐ $80,000 to $99,999
- ☐ $100,000 or more

35. **What is your present age?** _____ years

36. **In what U.S. state do you live?** _____ state

Thank you for help! Please return your survey in the pre-paid postage envelope!

VITA

Natalie Nichol Wilson

Candidate for the Degree of

Master of Science or Arts

Thesis: CONSUMERS PREFERENCES FOR FAT CONTENT IN GROUND BEEF

Major Field: **Agricultural Economics**

Biographical:

Personal Data: Born in Santa Maria, California, on March 20, 1984, The daughter of Allen and Rosana Wilson.

Education: Graduated from Arroyo Grande High School, Arroyo Grande, California, June 2002; received an Associates of Science degree in Agribusiness from Northeastern Oklahoma A&M, Miami, Oklahoma, May 2004: received a Bachelor of Science degree in Agricultural Business from Oklahoma State University, Stillwater, Oklahoma, May 2006; completed the requirements for the Master of Science degree at Oklahoma State University in December, 2007.

Experience: Graduate Research Assistant, Oklahoma State University Department of Agricultural Economics, August 2006 to December 2007; Financial Assistant, Adams & Associates, May 2005 to September 2005;

Name: Natalie Nichol Wilson Date of Degree: December, 2007

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: CONSUMERS PREFERENCES FOR FAT CONTENT IN GROUND BEEF

Pages in Study: 58 Candidate for the Degree of Master of Science

Major Field: Agricultural Economics

Scope and Method of Study: Beef is considered less healthy than its two closest competitors: pork and poultry. This has led to research to determine ways to improve healthiness by altering the type and content of fat in beef products. There remains a great deal of uncertainty about the value consumers place on these nutritional improvements, which has slowed the development and marketing of such products.

A survey was developed to determine consumers' preferences for fat content in ground beef and to identify how consumers would most like the healthiness of fat content to be improved. The survey was mailed to a random sample of 2,000 individuals throughout the United States. Survey responses to choice-experiment question were used to define consumers' utility for ground beef as a function of four ground beef attributes: percent lean, omega 6 to omega 3 fatty acid ratio, percent saturated fat, percent conjugated linoleic acid, and product price. Responses to a series of best-worst questions were used to identify which methods consumers most preferred to improve fat content: cattle fed a diet primarily consisting of grass or green leafy hay, supplement with fish meal, supplement with flaxseed oil, use genetic testing to breed only cattle with improved fatty acid content, sort existing cattle and label those with improved fatty acid content, clone cattle with improved fatty acid content. A second series of best worst questions were used to identify which attributes of ground beef are most important to consumers when making purchase decisions: expiration date, price, food safety, total amount of fat, package size, and fatty acid composition.

Findings and Conclusions: Results reveal that consumers are willing to pay for beef with lower amounts of saturated fat and lower omega 6:3 ratios. Feeding a diet high in grass is the most preferred method to improve the fat content while the least desirable is cloning cattle. Finally, the most important attribute to consumers when purchasing ground beef is food safety while package size is the least important.

Advisor's Approval Dr. Jayson Lusk