Food Distribution Research Society

Journal of Food Distribution Research
Volume 43, Issue 2

Understanding Markets for Grass-Fed Beef: Taste, Price, and Purchase Preferences

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Abstract

We use results of a consumer taste test conducted in Portland, Oregon, and choice-based conjoint analysis to examine consumer attitudes about grass-fed beef compared to conventional grain-fed: taste preferences, willingness to pay, and willingness to buy frozen meat in bulk. We consider the effect of demographic, attitudinal, and shopping location characteristics of consumers. A baseline, uninformed consumer will pay $0.90-$0.94/pound more for grass-fed ground beef; knowledge about production and nutritional factors increases the premium. A majority of participants would buy in bulk if they knew a producer or a friend referred them; 72% will buy frozen beef.

Keywords: grass-fed beef, consumer preference, conjoint analysis, willingness to pay, freezer beef

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Introduction

Increased consumer interest in grass-fed, naturally raised, locally produced meats is based on perceptions and evidence about "healthier" fats, reduced environmental impacts, and increased animal welfare associated with meats not raised in confinement systems on grain-based diets (Daley et al. 2010; National Trust 2012; Schmidt 2010; Umberger et al. 2009; Varnold et al. 2011); this interest is also part of the broader local food movement (Martinez et al. 2010). Livestock producers who would like to produce and sell grass-fed meats must carefully weigh the risks of shifting their production and marketing systems, given the significant and often costly supply chain challenges of getting this type of meat to market. Knowing, in general, that consumer demand for grass-fed is "up" is not enough: producers require geographically relevant information not only about consumer demand and price elasticity, but also how and where consumers will buy the product (such as by the cut or by the carcass, direct or at a store, at mainstream or natural food retailers).

Achieving the consumer-oriented convenience of conventional meats, sold fresh, by the cut, in vacuum packaging, year-round, is neither easy nor cost-effective for many small producers. Producers report that inventory management logistics and the need for a diversified customer base to sell the entire animal at a price point that will compensate for extra costs are two critical barriers to entry into this market niche (Fanatico and Rinehart 2006; Gwin 2009; Gwin, Evans, and Brewer 2011). Selling animals by the whole, half, or quarter, direct to consumers, in one delivery of frozen cuts, is one way small producers can avoid these two problems (Thiboumery and Lorentz 2009). Some restaurants have chosen to buy whole carcasses direct from farmers and ranchers; consumer interest in such "bulk" sales appears at least anecdotally to be rising (Jackson 2009). Yet it is unclear how many people, even those who buy local, grass-fed meat by the cut, are willing to purchase this way.

In this paper, we focus on a few key questions. What are consumer taste preferences and willingness to pay (WTP) for local grass-fed beef versus conventional grain-fed beef? Do those differ for consumers who shop primarily at natural food stores versus mainstream food stores? Are consumers willing to buy beef in bulk, and what demographic, attitudinal, or shopping location characteristics make them more or less willing? Our answers to these questions come from results of a consumer taste test we conducted in Portland, Oregon.

Our study provides several new insights into the market for grass-fed beef. First, we examine consumer interest in buying grass-fed beef in bulk, a valuable and potentially necessary strategy for direct sales by producers. Second, we expand understanding of WTP for grass-fed beef relative to conventional beef by exploring the effect of consumers' prior knowledge and uncovering the underlying consumer attitudes that result in WTP a premium for grass-fed beef. Finally, we expand understanding of the impact of taste preference on WTP by incorporating consumer ratings of the beef they tasted directly into the choice model.

Background

Understanding consumer WTP is very important to niche markets that rely on premium prices to compensate for higher production costs. It was once suggested the per pound cost of producing forage fed beef may be as much as 25% higher than producing conventional beef (Mayer 1999). Grass-fed production can be more expensive, especially in parts of the country with less year-round quality forage (Mathews and Johnson 2010). For example, an enterprise budget prepared for a California grass-fed enterprise notes that pasture can be the limiting factor for grass-fed systems, and that producers may need to increase grazing acreage, feed harvested forage, or decrease herd size, all of which add to costs; producers also assume additional risk when they retain ownership of cattle until finish weight (Larson, Thompson, Klonsky, and Livingston 2004). Yet even in circumstances and regions in which grass-fed beef is less expensive to produce than conventional beef, post-farmgate supply chain costs are still likely to be high, as for any smaller-scale, niche product (Gwin and Thiboumery 2012; Hardesty and Leff 2009; King et al. 2010). Producers must find a customer base that will pay a high enough price for the product to cover their costs and some profit margin. Identifying the price premium consumers will pay, as well as the types of consumers who will pay it and who will use a direct sales channel, is therefore essential to producers.

Other WTP research around natural and/or grass-fed beef has found varied responses. Studies that evaluated sensory properties in blind tests have generally found fewer US consumers prefer grass-fed to conventional beef – for example, Feuz and Umberger (2001) found that only 23% of consumers sampled in Chicago and San Francisco preferred grass-fed to corn-fed steaks. One reason is historic: U.S. consumers have long been habituated to the taste and eating experience of grain-finished beef. Another reason, research-specific, may be that studies have generally focused on muscle cuts (e.g. steaks) or ground beef made from a single muscle cut, often resulting in lower fat content for the grass-fed beef among other sensory differences (Cox et al. 2006; Feuz et al. 2004; Sitz et al. 2005; Xue et al. 2010). However, Cox et al. (2006) found that during a home-use test, the percentage of consumers preferring grass-fed beef increased and the significantly different preference for grain-fed was eliminated. The authors suggest that this is because home cooking eliminated some sensory differences. It is also important to keep in mind that even 23% of the national consumer base far exceeds the demand that can be satisfied by current domestic grass-fed supply. To satisfy annual market demand for 23% of the population would require about 6 million head of cattle/year. Yet the grass-fed sector currently harvests between 150,000 and 170,000 head of cattle per year (Williams 2010).

Providing consumers with information on production practices and/or nutritional properties affects WTP. Earlier studies in which consumers were informed about beef production method, specifically, what the cattle were fed, did not find a higher WTP for grass-fed. Yet in more recently conducted studies, providing production information increased WTP for grass-fed beef relative to grain-fed beef (Lusk and Parker 2009; McCluskey et al. 2005; Thilmany, Umberger, and Ziehl 2006; Umberger, Boxall, and Lacy 2009; Xue et al. 2010). McCluskey et al. (2005) found that consumers would choose beef with higher Omega-3 levels given information about its healthful properties. Umberger, Boxall, and Lacy (2009) also found that providing health infor-

mation increased WTP. Conner and Oppenheim (2008) found that providing environmental and welfare information did not change WTP for pasture-raised meats, but as they noted, their study participants had pre-existing knowledge of and interest in environmental values and pasture-raised products.

Allowing consumers to taste samples also influences WTP. When included in consumer studies the sensory rating is generally the most important contributor to WTP. In several series of experiments auctioning two wines (Combris et al. 2009), WTP results were quite different for a blind tasting versus seeing origin-labeled products without tasting, but WTP from a tasting *and* origin labels closely followed WTP from the blind tasting: consideration of origin was of little importance relative to sensory evaluation. However, origin is primarily a signal of sensory quality and consumers valuation of grass-fed beef could be quite different even with equal liking as animal welfare or health properties might result in higher WTP. Marin and Durham (2007) found that sensory liking overrode quality perception perceived in natural corked versus screw-cap wines. The experimental auctions conducted by Umberger, Boxall, and Lacy (2009) to evaluate grass-fed beef premiums or discounts also included a tasting opportunity. They found that total bids and premiums, when positive, were lower when the participants tasted grass-fed steaks before bidding. Yet it is clear that at least a sub-population of consumers prefers the taste of grass-fed beef (Cox et al. 2006), which creates an opportunity to develop a niche market for that taste preference in addition to the value consumers place on production practices and possible health benefits. This is important information in evaluating a niche market for grass-fed beef.

Our study further explores the sensory ratings of consumers and also looks more carefully at the potential for a niche market for grass-fed beef by simulating product choice under a variety of conditions to differentiate market segments. Finally, our analysis accounts for a participant's prior knowledge of grass-fed beef: our WTP findings, higher than found in other, earlier studies, likely reflects an overall increase in consumer knowledge about grass-fed beef production and nutritional qualities. Consumers in earlier studies may truly have had no prior knowledge. We attempt to clarify the impact of prior and additional information.

Methods

A sensory consumer test was conducted at the Food Innovation Center in Portland, OR. Participants were selected using an on-line screener, which they found by word of mouth or through a Craig's List advertisement. Only consumers who eat ground beef in the form of burgers were selected. Through screening questions, a sample was recruited that was about equally split between people that shop in mainstream food stores and those that shop primarily at natural food stores and/or food cooperatives. This stratification of the sample was employed to ensure that sufficient variation was obtained in the characteristics of the consumers to evaluate how those characteristics might influence WTP for grass-fed beef. This information and related consumer characteristics are used in the econometric model to analyze WTP for grass-fed and conventional ground beef.

As is standard in consumer tests, the sensory evaluation took place first to avoid biasing the taste impression due to consumers guessing test intention and product source. On the test day, ground

beef patties were prepared by weighing out approximately 3 oz. of raw product, which was then formed into a patty and refrigerated until just prior to cooking. Each patty was salted evenly across the top with 0.2g of salt. Ground beef samples were baked on parchment paper on a sheet tray of 10 samples per tray, in a 450° F oven to an internal temperature of approximately 160° F. The samples were served to the consumer one to two minutes after portioning.

Participants were given two coded beef samples simultaneously on a tray. The first instruction was to cut the samples and give a color rating of each on a nine point scale; they were then asked to write down their taste preference (with a no preference option) and then to rate various quality characteristics (color, juiciness, tenderness) and their liking of each sample on a nine point scale ("dislike extremely" to "like extremely"). They recorded their liking rating according to its code before proceeding with the rest of the questions. This step allowed for the blind tasting aspect and normal sequence of the sensory test to be preserved while enabling the participants to refer to their liking rating later in the survey.

After the sensory questions were completed participants were asked several questions about their beef purchasing experience to gauge their willingness to buy beef directly from producers. They then answered six choice questions about which of the two samples they would choose to buy at various price combinations (with an option not to buy either). Before answering these choice questions they were told that one of the samples they tasted was grass-fed and the other conventionally produced. They were provided with the sample codes so that they could match each sample with their overall liking of that sample from the sensory evaluation. The participants were also split into two groups to receive either a low or a high information explanation of grass-fed and conventional production practices. The first briefly explained the forage diet of grass-fed beef[2] and the second added information about production practices and nutritional characteristics.[3] Only then did participants answer the six questions in which prices varied between the offerings. When those were completed, participants were presented with a paper ballot[4] with Likert scale questions to assess attitudes on the environment, health, animal welfare, food, and nutrition.

This procedure allowed us to analyze participants' propensity to choose grass-fed or conventional beef given (a) differences in both price and information about beef production methods, and (b) participants' individual characteristics, including their liking for the samples

[2] Actual text: "The sample labeled Grass-fed came from an animal whose diet was only grass and forage. These animals cannot be fed grain or grain byproducts. The sample labeled Conventional means the beef was purchased at a retail supermarket from conventional sources."

[3] Actual text: "The sample labeled Grass-fed came from an animal whose diet was only grass and forage. These 'animals cannot be fed grain or grain byproducts and must have continuous access to pasture during the growing season.' Grass-fed beef has also been found to have higher levels of Omega-3 fatty acids which have been shown to reduce the risk of certain cancers and brain disorders. These cattle were also raised without antibiotics or hormones. The sample labeled Conventional means the beef was purchased at a retail supermarket from conventional sources. In the United States beef cattle are typically finished with a grain diet in a feedlot. Ground beef can come from a variety of sources and may come from dairy as well as beef cattle."

[4] The paper ballot was used to save time on these questions.

they tasted. Consumer variable statistics and demographic information for our sample presented in Table 1.

Table 1. Model Variable and Demographic Information

Consumer characteristics variable	**Description**	**Population (Std. Dev.) → Mean after Adjustment for Mainstream Shopper**
LIK6	Liking (9 point scale) – 6 (like slightly)	6.07 (1.94) → 0.07
PRICE	Prices for beef, $2.50,$3.50,$4.50;$0 do not buy	2.33 (1.78)
MOR	More information (0=less information, 1=more)	0.509
NAT	Regular natural food store or food co-op shopper	0.554
KNB	Prior Knowledge of Grass Fed (0=Not at all 16.9%, 1=Somewhat 67.0%, 2=Very well informed 16.1%)	0.991 (0.575)
ORU	Organic buying loyalty (% of produce purchases) (adjusted to make ORU=0 for non-natural store shopper)	47 (27) → 18.9
AGU – age	Distribution of Age Range Selected by Individual	41.4 (14) → -2.96
	18-24 25-29 30-34 35-39 40-45 45-49 8.9% 15.2% 16.1% 8.0% 10.7% 10.7% 50-54 55-59 60-64 65-69 70+ 8.9% 8.9% 7.1% 3.6% 1.8%	
INU - income in $10,000 units	Distribution of Income Range Selected by Individual <$19,999 $20-$29,999 $30-39,999 $40-49,999 16.1% 10.7% 15.2% 13.4% $50-59,999 $60-79,999 $80-99,999 $100,000+ 10.7% 16.1% 8.0% 9.8%	5.26 (3.3) → -0.047
Factors (adjusted → to make factor value=0 for non-natural store shopper)		
SEU	Seasonal and Local Buyer	0 (1) → 0.430
ENU	Environment	0 (1) → 0.095
FDU	Nutrition Ingredient Concerns	0 (1) → 0.222
FRU	Farm Preservation	0 (1) → -0.067
DMU	Domestic Animal Welfare	0 (1) → 0.344
Non-Model Demographic Sample Distribution		
Gender	Female	0.500
Race or Ethnicity	White	0.917
	Black	0.009
	Asian	0.037
	Hispanic	0.018
	No answer	0.018
Education	High school	0.045
	Current student	0.098
	Two-year degree	0.205
	Bachelor's degree	0.411
	Advanced degree	0.241
Children	Presence of children in household = 1, No = 0	0.464

* Variables are adjusted to equal 0 for the baseline consumer who is a mainstream (not natural food store or food cooperative) shopper, age 41.3, income $53,100.

Results and Discussion

Taste Preferences

There was not a statistically significant preference for either the conventional or grass-fed ground beef. However, unlike similar studies, there was a slight, insignificant preference for grass-fed: 54% preferred the grass-fed ground beef, 44% preferred the conventional ground beef, and 2% had no preference. The two types of ground beef were rated similarly for overall liking.

Whether participants primarily shopped at natural food stores or mainstream food stores did not have a statistically significant effect on their taste preferences, though mainstream shoppers were found to have directionally higher overall liking for the grass-fed beef and rated it higher than conventional beef in terms of sensory attributes. This is interesting, because it suggests that natural food store shoppers aren't necessarily a target market for grass-fed producers.

Willingness to Pay

Factors influencing consumer preference for grass-fed or conventional ground beef are evaluated as a choice-based conjoint analysis (CBCA), following Lancaster's theory of value and random utility theory (Cohen 1997; Lancaster 1966; Louviere and Woodworth 1983; McFadden 1974). According to Lancaster's theory, a product's utility is an additive utility based upon the utility of the products' attributes. To measure that utility, a random utility model is typically used which assumes that the utility U_{ij} of an individual i for a product j is composed of systematic and random components. The systematic component v_{ij} is observable and a function of the product attributes and individual characteristics. The random component ε_{ij} is unobservable influences. The utility of good j for consumer i can be expressed as:

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

Since only the systematic component of the model above is observable, it can be specified as a function of product attributes and individual characteristics:

$$(2)\quad v_{ij} = \alpha_j + \beta\, p_j + \gamma_j z_i + u_{ij}$$

where α_j is the marginal utility obtained due to the attributes of choice j, β is the change in marginal utility due to price p_j, and γ_j is the change in marginal utility of an attribute due to individual characteristics.

We built two models to evaluate WTP for grass-fed beef and to examine the consumer characteristics that contribute to WTP a premium for grass-fed beef. The base model examines whether providing information about grass-fed beef production methods and potential health benefits increases WTP a premium for the grass-fed product. It also allows us to test whether self-assessed prior knowledge of grass-fed beef production (not at all, somewhat, or well-informed), regular food shopping location (natural store or mainstream), as well as price and

liking could provide a simple way to examine grass-fed WTP. We developed a second, expanded model to look more closely at consumer attitudes that could lead to a preference for grass-fed beef.

In both WTP models, the attributes of the choices are production method (grass-fed or conventional) and price. Variables which vary among individuals are considered consumer characteristics. In the choice set for each participant, only relative price changed for each set of questions. The participants vary in characteristics provided by the screener, sensory liking, and information they provided (answers to questions) that could affect how they value grass-fed and conventional beef.

Prior to analysis, the grass-fed versus conventional attribute variable was effects coded, with the grass-fed variable coded as 1 for the grass-fed choice, 0 for the conventional choice and -1 for the do not buy choice. A do not buy variable is coded 1 for the do not buy choice and 0 for the other two choices. This arrangement allows the parameter estimates to be viewed against the conventionally produced choice as a baseline. The parameter on the 'Do not buy' variable can best be interpreted in this arrangement as representing the utility (or disutility) of not buying: it captures the utility of the conventional product to the baseline mainstream consumer, but it could also capture a desire to give an answer and thus cannot be considered as purely the conventional product value.[5] There are other equally correct approaches to coding the do not buy choice and product attributes that will produce the same predictions and log-likelihood values. Our primary reason for using this combination is to emphasize the difference between conventional and grass-fed. Price is entered in dollars per pound as shown to the participants, and at 0 for the do not buy choice.

The interactive consumer characteristic variables are created by multiplying the consumer characteristic variables by the effects coded grass-fed variable and additional effects are coded with a conventional variable (1 if conventional, 0 if grass-fed, and -1 on the do not buy choice). The effects coded variable for conventional product is used to create the interactive variables for conventional product for ease of interpretation.

Base Model

The base model (Table 2) restricts consumer differences (z_i) to how much they liked the respective beef product (LK6), whether they received high or low information (MOR), whether they considered themselves knowledgeable about grass-fed beef (KNU), and whether they were a natural store shopper (NAT).

In the models, explanatory variables are transformed to make the baseline consumer a "mainstream" consumer with respect to the Portland area: a consumer that declared no prior knowledge, got the low information treatment, and typically shops at a conventional supermarket. We also transformed the liking score by subtracting 6 (a rating of "like slightly") from the

[5] Note that because of the effects coding the full base 'utility' of the 'Do not buy' choice is the sum of its own parameter and the negative of the parameter for grass fed beef.

score which results in a value of 0 for the baseline consumer. Thus the baseline parameter values and inferred premiums are based on that individual with a liking level of "like slightly."

Table 2. Base Model

Variable	Parameter Estimate	Std. Error	Premium = Parameter / Price Par.	Variable Description
GRS	0.995 ***	0.329	0.94 ***	Grass-fed versus conventional
NONE	-2.444 ***	0.690		Not buy choice
PRICE	-1.061 ***	0.107		Price
Interactive Variables-Consumer Characteristics				
CNV*LK6	0.783 ***	0.101	0.74 ***	Liking (Like slightly=0) on Conventional
CNV*MOR	-0.054	0.189	-0.05	More production information on conventional
CNV*KNH	-0.445 **	0.185	-0.42 **	Knowledge of grass-fed on Conventional
CNV*NAT	0.315	0.196	0.30	Natural Store shopper on Conventional
GRS*LK6	0.511 ***	0.064	0.48 ***	Liking (Like slightly=0) on grass-fed
GRS*MOR	0.588 ***	0.157	0.55 ***	More information on grass-fed
GRS*KNH	0.620 ***	0.146	0.58 ***	Knowledge of grass-fed
GRS*NAT	0.169	0.160	0.16	Natural Store shopper on grass-fed

Log-Likelihood Constants only =-510.7
Log-Likelihood Model =-346.2
***Significant difference in impact between grass and conventional at 1% level, ** at 5% level, * at 10% level.

A significant positive (negative) parameter estimate for a variable means that the variable increases (decreases) the probability that the baseline mainstream consumer will choose that product. We estimate how much *more or less* a consumer will pay for the chosen product by dividing the characteristic parameter by the parameter estimate for PRICE. Because our effects coding makes the conventional product the baseline, the first value in the fourth column of Table 2, α_j/β from equation (2), is how much more the unknowledgeable, less informed, mainstream store shopping consumer is WTP for the grass-fed product than for the conventional product given equal liking. Premiums listed for interactive variables tell us how the grass-fed or conventional beef WTP value varies with those consumer characteristics.

Prior knowledge clearly matters. The consumer with some prior knowledge about grass-fed beef would pay \$0.55 per pound in addition to the \$0.94 cent premium for grass-fed and \$0.42 per pound less for the conventionally produced beef. If the knowledge variable is excluded from the model, a larger significant parameter for the natural store shopper would result, indicating that they are willing to pay significantly more for the grass-fed beef. Thus it appears that it is primarily the *knowledge* that the natural store shopper has that makes him/her willing to pay more. The consumer who received more detailed information about the two production practices would pay \$0.59 per pound more for the grass-fed and no more for conventional beef. As noted earlier, other studies have usually found information about production practices and health to increase WTP for grass-fed beef. As in other studies, we varied the information given to consumers and noted a WTP premium associated with more information.

Expanded Model

We developed a second, expanded model (Table 3) to look more closely at attitudes that could lead to a preference for grass-fed beef. This model allows us to examine which consumer characteristics change the utility of grass-fed versus conventional beef and thus identify which consumers are more likely to pay a premium for grass-fed.

Table 3. Expanded Model

Variable	Parameter Estimate		Std. Error	Premium = Parameter / Price Par.		Variable Description
GRS	1.073	***	0.358	0.90	***	Grass-fed versus conventional
NONE	-3.074	***	0.745			Not buy choice
PRICE	-1.199	***	0.119			Price
Interactive Variables-Consumer Characteristics						
CNV*LK6	0.716	***	0.105	0.60	***	Liking (Like slightly=0) on conventional
CNV*MOR	0.006		0.210	0.01		More information on conventional
CNV*KNH	-0.382	*	0.211	-0.32	*	Knowledge of grass-fed on conventional
CNV*AGU	0.034	***	0.009	0.03	***	Age in years on conventional
CNV*INU	-0.111	***	0.036	-0.09	***	Income on conventional
CNV*ORU	0.000		0.005	0.00		Organic purchasing level (%) on conventional
CNV*SEU	-0.016		0.107	-0.01		Seasonal/Local on conventional
CNV*FDU	-0.039		0.116	-0.03		Environmental buyer on conventional
CNV*FDU	-0.140		0.110	-0.12		Nutrition/Ingredient concern on conventional
CNV*FRU	-0.145		0.106	-0.12		Farm Preservation Concern on conventional
CNV*DMU	0.031		0.093	0.03		Animal Welfare concern on conventional
CNV*GBFU	0.013		0.008	0.01		Frequency of buying gr. beef on conventional
GRS*LK6	0.663	***	0.075	0.55	***	Liking (Like slightly=0) on grass-fed
GRS*MOR	0.515	***	0.178	0.43	***	More information on grass-fed
GRS*KNH	0.456	***	0.176	0.38	**	Knowledge of grass-fed on grass-fed
GRS*AGU	-0.007		0.008	-0.01		Age in years grass-fed
GRS*INU	0.080	***	0.030	0.07	***	Income ($10,000) on grass-fed
GRS*ORU	0.007	*	0.004	0.01	*	Organic purchasing level (%) on grass-fed
GRS*SEU	0.222	**	0.092	0.19	**	Seasonal/Local on grass-fed
GRS*ENU	0.124		0.088	0.10		Environmental buyer on grass-fed
GRS*FDU	-0.086		0.090	-0.07		Nutrition/Ingredient concern on grass-fed
GRS*FRU	-0.080		0.090	-0.07		Farm Preservation Concern on grass-fed
GRS*DMU	0.298	***	0.082	0.25	***	Animal Welfare concern on grass-fed
GRS*GBFU	0.002		0.006	0.00		Frequency of buying ground beef on grass-fed

Log-Likelihood Constants only =-510.7
Log-Likelihood Model =-312.0
***Significant difference in impact between grass and conventional at 1% level, ** at 5% level, * at 10% level.

The consumer attitudinal score variables for this model were developed using the Likert scale questions asked at the end of the consumer test. Those questions were reduced to representative scores using principal components analysis (PCA). The benefit of using PCA to assess attitudes is that multiple questions are used to measure an individual's level of concern or interest about an issue rather than relying on a single question, which might measure an individual's attitude less accurately due to the wording or context. PCA essentially distills multiple variables into a smaller number of related components. For this analysis the majority of the questions have been used and developed in previous studies. Durham (2007) used PCA to incorporate health concerns and environmental attitudes into analysis of what motivates organic purchases. That study drew upon Roberts (1996), who segmented consumers for their environmental orientations, and Kraft and Goodell (1993) who did the same for health conscious consumers. McCluskey, Durham, and Horn (2009) extended the question set to assess food interest and nutritional attitudes as well as concerns about animal welfare and farm preservation. For this study, some additional Likert questions were added to enhance assessment of domestic animal welfare concerns and food interest. See the appendix for the questions used and details on the methodology. The factor scores produced by the PCA and utilized in the analysis are defined as *Seasonal and Local Buyer* (SEU), *Environmentalism* (ENU), *Nutrition Ingredient Concerns* (FDU), *Farm Preservation* (FRU), and *Animal Welfare* (DMU) based on the questions contributing most strongly to the score.

As in the base model these variables are adjusted to a mainstream shopper baseline. This transformation is accomplished by taking the average attitudinal score for shoppers that did not select natural food supermarkets or food coops when reporting where they shopped (i.e., mainstream supermarket shoppers) and subtracting that average from the original attitudinal score. In the third column of Table 1, the first number reported is our study population's average for the variable followed by its standard deviation in parentheses. If those are followed by an arrow (→), the next number is the average once the transformation has taken place. For most of the attitudinal scores the mainstream supermarket shopper was below the sample population mean which was 0 since these are standardized variables. The other variables added to the model, age, income, and organic buying percentage are also transformed. Age is transformed by subtracting the mean age, income by subtraction of mean income (in $10,000 units), and organic percentage by its mean value for mainstream shoppers. The variables entered into the model are the effects coded grass-fed variable and price for each choice, a do not buy variable, and interactive variables created by multiplying the effects coded grass and conventional variables by the individual characteristics. As before the variables for liking of the respective products (LK6), more information received (MOR), and prior knowledge (KNU) are included, but not Natural Store Shopper; added to these are interactive with age, organic purchasing level, the five attitudinal scores (SEU, ENU, FDU, FRU, DMU), and frequency of ground beef consumption (GBFU).

In this model, the impact of knowledge drops off and is replaced by the actual attitudes associated with knowledge that might impact the grass-fed choice. Having more information is still important for grass-fed selection. We would note that attitudes about some topics are quite similar for mainstream and natural shoppers (for example, farm preservation), while these two groups vary more dramatically on others (for example, farm animal welfare). The two attitude scores

that are influential include support for seasonal/local food and small businesses, and concern for farm animal welfare. Demographic variables that are influential include consumer age, which increased selection of conventional beef, and income, which increased preference for grass-fed and decreased preference for conventional, indicating wealth effects and/or that grass-fed is considered a premium product. More loyal organic produce consumption does not significantly impact the choice of either. As expected, liking remained a key and essentially equivalent influence on WTP for both types of beef.

Interestingly, the grass-fed to conventional WTP differential resulting from greater knowledge declines somewhat in this model. This indicates that the knowledge variable was encompassing the information from additional variables, which supports the idea that the attitudinal concern underlies the knowledge impact. We drop the natural store shopper variable from the expanded model because it was not significant once the prior knowledge variable was added to this model or the previous model.

Results indicated that participants were willing to pay a premium for grass-fed ground beef versus conventional, grain-fed beef. Mainstream food shoppers were willing to pay a premium of $0.94/pound. Natural food store shoppers could only be identified as willing to pay more for grass-fed beef in models which did not include the grass-fed knowledge or other more detailed consumer attitude variables, and even then the natural store shopper variable did not explain much of the premium. The natural store shopper variable by itself will be associated with many consumer characteristics, possibly including age and income as well as individual attitudes and beliefs. The consumer attributes more strongly associated with natural store shoppers than with mainstream store shoppers are those that were associated with higher willingness to pay for grass-fed beef. Other studies of WTP have noted that store type became less significant when attitudinal information was included in the model (McCluskey, Durham, and Horn 2009). Conner and Oppenheim (2008) found lower mean WTP for pasture raised livestock at grocery stores versus food co-operatives, associated with lower scores on health, animal welfare, and environmental concerns.

Figure 1 graphically depicts the relative impacts of consumer characteristics on WTP for the two types of beef sampled. Liking had the largest impact on WTP, yet the size of that impact did not differ significantly based on whether a sample was grain-fed or grass-fed.

WTP calculations can sometimes be questioned when consumers are not actually buying. However, research has shown that while the baseline total WTP may be biased upwards, the marginal difference between related goods is not (Lusk and Schroeder 2004). The possibility of bias in the baseline WTP is the reason for coding the variables in order to look at differences between conventional and grass-fed and what shifts the value of each rather than look at the overall price of either. The premiums and variation in value due to consumer heterogeneity are our focus.

While the relative premiums are of great interest, it may be more informative to look at how the basic model predicts how consumers will choose among grass-fed and conventional beef based on price and across the knowledge and information variables. These results are shown in Figures 2 and 3.

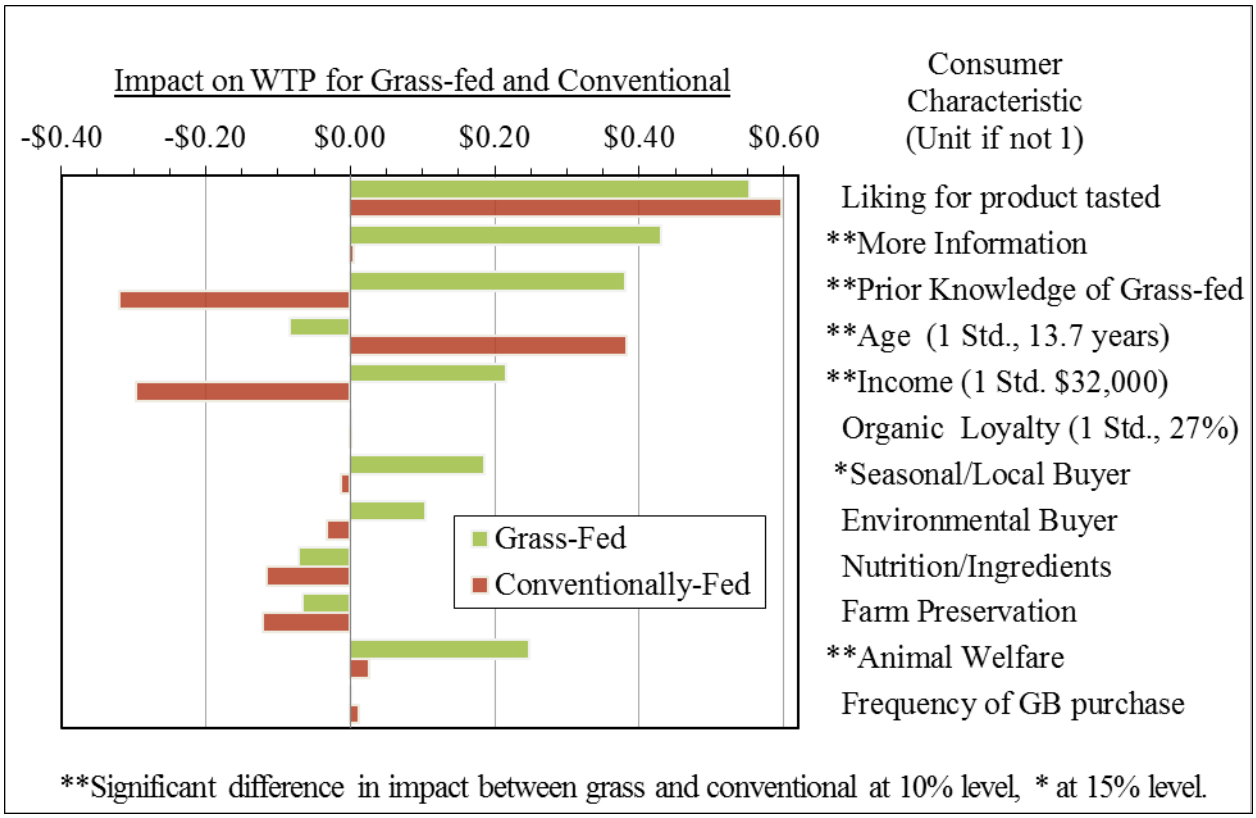

Figure 1: Impact of consumer characteristics on WTP

Figure 2 compares three of the possible price combinations used in the WTP choice set: conventional at $1 less than grass-fed at $3.50 per pound, both samples at $3.50 per pound, and grass-fed at $4.50 per pound with conventional at $2.50 per pound. When grass-fed is priced at $4.50 per pound and conventional at $2.50 per pound, a $2 per pound price difference, the model predicts that 48% would choose grass-fed, 37% would choose conventional, and 15% would not buy. This sizeable preference for grass-fed at a significantly higher price is likely influenced by the fact that our consumer sample had a high proportion of natural food shoppers, and half of them received additional information on grass-fed before making their choices.

Figure 3 shows the impact of information and prior knowledge. Consumers having some prior knowledge of grass-fed has a larger effect than if they are given more information in increasing the probability they will pay a premium for grass-fed beef. In the left hand pie chart we see that a smaller proportion would select the grass-fed at a $2 per pound price difference than in our unadjusted sample in the right hand pie chart in Figure 2, because for the pie chart on the left hand side of figure 3 the consumer depicted is our baseline mainstream shopper with no prior knowledge, who did not receive additional information, at the same price difference.

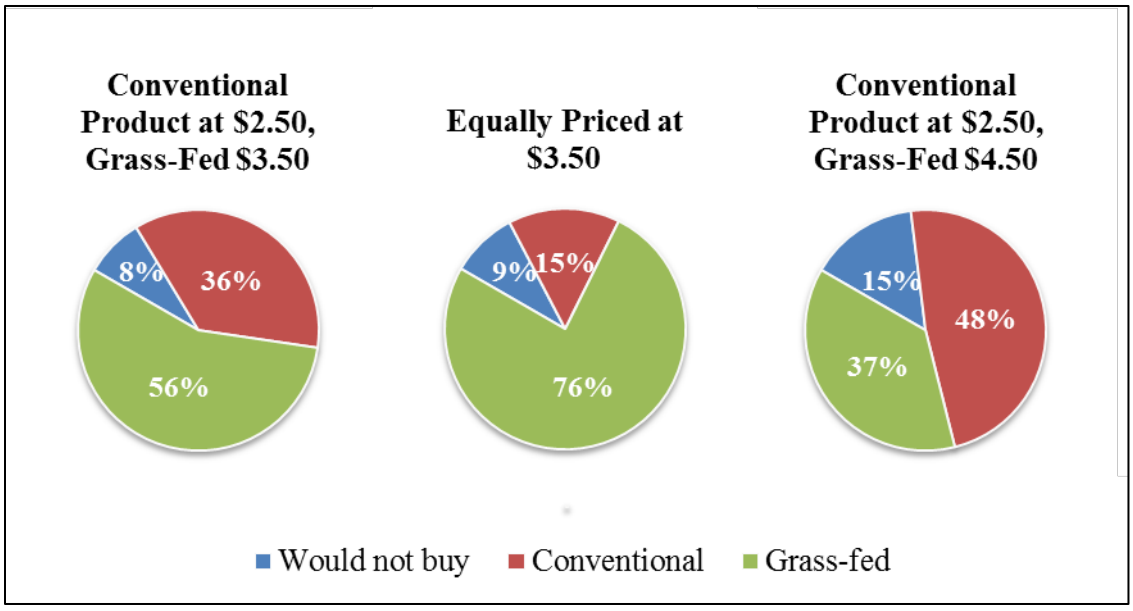

Figure 2: Impact of price: percent of consumers choosing grass-fed, conventional, or neither, at given prices

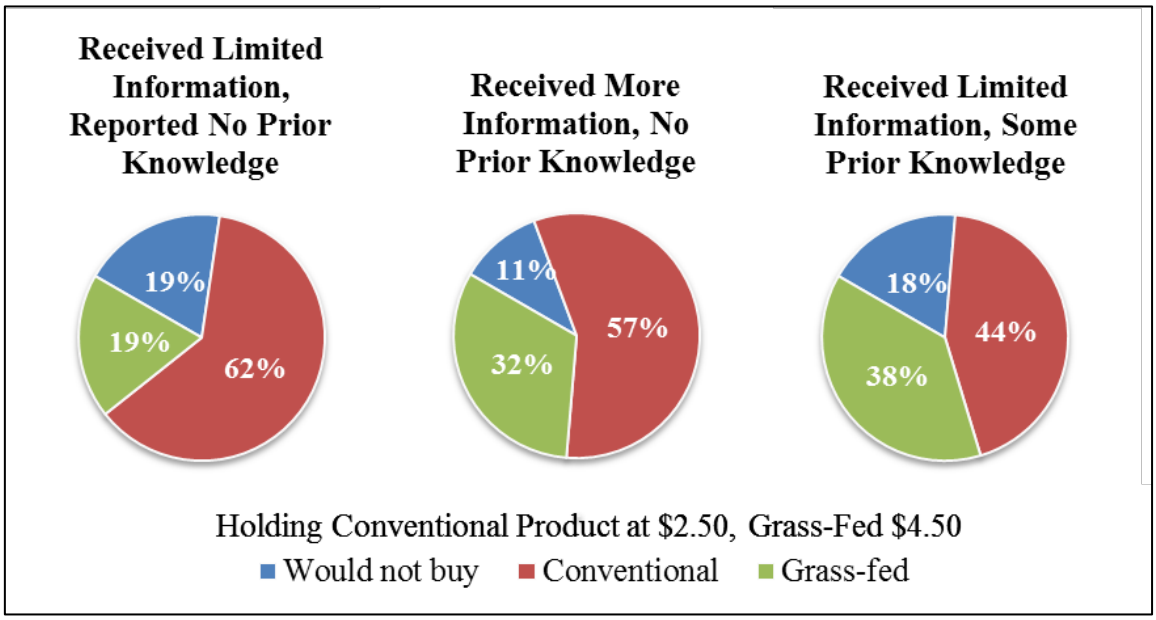

Figure 3: Impact of information and prior knowledge: percent of consumers by product choice

Our WTP results compared with other geographic areas

We expected to find WTP results that matched or exceeded those found from similar taste tests conducted elsewhere in the country, because our study area, Portland, Oregon, is a "leading trend" market in terms of natural, local/regional, and sustainable food, a characterization consistent with what we learned about our study participants. Most were aware of and interested in "sustainable" food production, including grass-fed meats, regardless of typical shopping location: 72% of mainstream food store shoppers said they were at least somewhat informed about the possible benefits of grass-fed beef and cattle production. Mainstream shoppers expressed a very favorable view of grass-fed beef: 86% perceived it as healthy, 60% as more humane than conventional beef, 62% as better for the environment than conventional beef, 50% as flavorful, and 56% as safe. A large majority – 64% of mainstream shoppers and 84% of natural food store shoppers – said that food safety concerns had had an impact on them, and a slight majority of all participants (51%) have switched to natural or organic beef in the last few years due to those concerns.

Given this consumer base, a higher-than-average WTP would not have been surprising. Indeed, compared with earlier studies, our results are much more favorable to grass-fed. Our study estimated WTP a premium of $0.90-94 per pound for grass-fed ground beef, approximately 35-40% higher than WTP for conventional at equal sensory liking. A decade ago, Feuz and Umberger (2001) found quite the opposite: WTP was 26% lower for grass-fed beef compared with grain-fed beef.

Yet when compared with more recent studies, our WTP results are fairly average. We expect this is due to an increase, over the last decade, in general consumer knowledge of grass-fed meat production and exposure to grass-fed meat products. More recent studies have found WTP premiums for grass-fed ranging from approximately -37% (Sitz et al. 2005) to about 180% (Evans, Brown, Collins, D'Souza, Rayburn, and Sperow 2011).[6] WTP results also vary based on whether the test is done with ground beef or muscle cuts (steaks): comparisons using steaks (Cox et al. 2006) found a smaller premium for grass-fed than comparisons using ground beef, as this study did. This is consistent with the fact that most U.S. consumers expect steaks to be marbled, for both flavor and marbling's relationship to tenderness; grass-fed steaks tend to be less marbled than grain-fed steaks. The difference is much less noticeable in ground beef, and our WTP results for grass-fed are much higher than when steaks were used (-9.5% and 3.0%; Cox et al. 2006). That our results were lower than those of other ground beef research (Evans et al. 2011) may in part be due to the other ground beef research being conducted not in a large metropolitan area but in a smaller, university town where participants may be more educated (even more so than in Portland) about alternative food choices in general and grass-fed specifically. It is also important to remember when comparing the size of WTP effects that there has been a great deal of heterogeneity in the WTP and preference literature related to alternative versus conventional meats, with respect to participants' demographic profiles, sample selection methodologies, and how premiums have been calculated.

[6] We calculated the -37% premium from domestic conventional WTP of $3.95 versus WTP of $2.48 for an Australian grass-fed sample (Sitz et al. 2005). We calculated the 180% premium from (Evans et al. 2011) ground beef estimates of $0.44 for grain-fed versus $1.23 for grass-fed.

The most distinguishing feature of our study, in comparison with others, is that we found prior knowledge, in lowering the value of conventional as well as raising the value of grass-fed beef, to be more influential than information provided during the test. Furthermore, few studies have considered whether interest in farm animal welfare is influencing consumer choice. While other studies have more clearly differentiated between production information and nutrition information, they have not examined consumer attitudes regarding production practices. In our model the factor representing concern about farm animal welfare is associated with a higher premium for grass-fed. Somewhat to our surprise, the nutrition and ingredient concern variable was not so associated. This may be explained by a more direct response through the information and knowledge premiums or because ground beef is not generally considered a health food.

Willingness to Buy in Bulk

To understand market potential, grass-fed beef producers and marketers need to have at least an estimate of how many consumers will pay how much of a price premium for their product. Yet information about demand based on purchase format – specifically, how many consumers are willing to buy frozen cuts in bulk (by the whole, half, or quarter carcass) – is almost as critical as price premium information, especially for small-scale operations selling fewer than 100 head per year. The significant cost associated with processing, packaging, distribution, inventory management, and retailer-required margins for small-volume, unconventional meats can drive up the overall cost of production, hence the price for consumers. Selling in bulk, direct to consumers, can lower these costs. But how many consumers are willing (and able) to buy in bulk?

Nearly a quarter of our study participants (24%) responded that they had previously purchased beef, as a whole, half, or quarter carcass, direct from a rancher, at least once, a surprisingly high result, even though the question was about beef in general and not only grass-fed beef. Of the other 76% who had not purchased beef this way, 69% would consider purchasing bulk beef if they knew a producer that sold it or if a friend recommended a source. Price matters, too: 73% would consider purchasing this way if it were less expensive than the beef they are currently buying. Also notable is that 72% of all participants were willing to purchase frozen beef. This creates more options for producers; fresh product is more perishable and must be sold much more quickly, which complicates distribution logistics.

Participants who had not yet purchased bulk beef were asked why (by selecting all that applied from a given set of potential reasons). The most chosen reason, selected by 58% of respondents to that question, was that there is too much meat associated with such a purchase; the second, selected by 55%, was that they lack the freezer space for so much meat. The "too much meat" problem is a serious challenge for producers: 50% of participants said they purchase three pounds of beef or less per month. At that rate, even a quarter of a beef (more than 100 pounds) would be fairly overwhelming.

Whether participants primarily shopped at natural food stores or mainstream food stores did not have a statistically significant effect on whether they had purchased beef in bulk or were willing to do so. Natural food store shoppers were more likely than mainstream shoppers to consider

buying in bulk if they knew the producer. Only a few other factors were significantly related to willingness to buy in bulk: current bulk buyers tended to be older and shop at warehouse stores. Prospective bulk buyers tended to be older and eat more beef than average.

Conclusions

Our study of consumer preferences and WTP for grass-fed beef has four primary findings. First, our WTP results for grass-fed beef are within the bounds of those found elsewhere in the country, when compared only with more current studies. We suggest recent WTP estimates are higher than older studies due to an increase in general consumer knowledge about grass-fed over the years. Second, if participants in this study are representative of the Portland Metro region, there is significant interest in the region in buying beef in bulk, i.e., sacrificing some convenience to purchase grass-fed beef. Third, we confirm other research findings that whether a consumer typically shops at natural food stores or mainstream stores does not matter to WTP or willingness to buy in bulk. Fourth, we find that knowledge about production and nutritional qualities, and also attitudinal variables, are what matter instead. For example, the premium consumers are WTP for grass-fed beef increases when consumers know something about possible health benefits associated with it. When knowledge and attitudinal variables are known and included in the model, the effect of shopping location drops away.

We acknowledge that our results are drawn from a very small sample. Furthermore, our results may not extend far beyond the Portland metro region, except for other, similarly progressive, food-oriented areas. Most participants in our study had previously tried grass-fed beef, suggesting that this product is available and familiar locally and possibly that the participants are adventurous when it comes to food. Finally, our WTP/premium estimates, though relatively large, are not necessarily high enough to assure a profit for grass-fed producers. Producers will need to find consumers that are not only willing to buying grass-fed beef for its taste, production practices, and potential nutritional benefits, but are willing to pay enough of a premium to cover the additional production and supply chain costs for this unconventional product.

Acknowledgements

Research was conducted at the Food Innovation Center, Portland Oregon and partially supported by the USDA-CSREES Multicommodity Research Special Grant. The authors would like to thank Carman Ranch for the contribution of the grass-fed beef used in this study.

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Appendix

The following questions, listed by the score they contributed to most strongly, were included in the principal components analysis.

Domestic Animal Welfare: "It is important to treat farm animals humanely," "I'm concerned about the welfare of domestic farm animals," and "I buy free range chicken eggs."

Environmental: "I have switched products for environmental reasons," "I will not buy a product if the company who sells it is ecologically irresponsible," "I have purchased products because they cause less pollution," "I do not buy household products that harm the environment," "I have convinced members of my family or friends not to buy some products that are harmful to the environment."

Farm Preservation: "I'm concerned about the survival of family farms in the United States," "I am concerned about the loss of family farms in my region," "I would vote for referendums or initiatives to preserve farmland."

Health Concern (dropped from analysis because not significant): "I read more health-related articles than I did 3 years ago," "I worry that there are harmful chemicals in my food," "I'm concerned about my drinking water quality."

Nutrition/Ingredients: "I avoid foods from animals produced with hormones or antibiotics," "I am interested in information about my health," "I avoid foods containing nitrites or preservatives," "My daily diet is nutritionally balanced."

Seasonal Food/Local Business: "I buy 'environmentally friendly' products even if they are more expensive," "I buy from small and local businesses," "I seek out seasonal and local ingredients," "I like to eat out in restaurants that feature local and seasonal foods," "I buy food from local farms and ranches whenever I can."

A few questions contribute to more than one category: "I buy free range chicken eggs" contributes to Seasonal/Local; "I buy food from local farms and ranches whenever I can" contributes to Farm Preservation. The PCA was performed SAS 9.3 using the factor procedure, retaining eigenvalues greater than 1, with varimax rotation and Kaiser normalization. Additional details are available from the authors.