Consumer Preference for Domestic versus International Beef Steaks

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Introduction

The world is becoming more of a global market place and trade agreements between nations continue to reduce barriers to trade. Increasing trade affects all sectors of the United States' economy including the beef industry. International trade has both positive and negative impacts on the U.S. consumer and the domestic beef industry. One of the benefits of trade is that consumers are presented with a greater variety of products to choose from in the market place. Consumers also benefit from imports when domestic beef production is low and more beef is imported to increase supply and maintain a consistent retail price. Imports of beef during 1999 totaled almost eleven percent of the U.S.'s total beef production (Livestock Market Information Center, 2000). Australia, New Zealand, Canada and Argentina are the four largest exporters of beef to the U.S.

The management practices of cattle industries in countries such as Australia, New Zealand and Argentina differ substantially from the U.S. beef industry. In the U.S., most cattle are placed in a feedlot for 100 to 200 days prior to slaughter and fed a high-energy diet. This feeding program increases the intramuscular fat or marbling in the meat and gives U.S. beef a distinct corn-fed flavor. In contrast, most cattle in countries such as Australia and Argentina are not fed high-energy diets for an extended period. Rather, the cattle are more typically grass-fed and take a longer period of time to produce a finished product. This grass-fed beef also has a distinct flavor.

Most of the beef imported into the U.S. is not labeled as imported beef; it is simply marketed as generic beef and is not distinguishable from domestic beef in the retail meat case. Country-of-origin labeling of imported beef has become an increasingly important topic to the

beef industry as they try to increase domestic demand for beef and improve the quality and consistency of the beef sold in the meat case. The different management and feeding practices used to produce beef in countries such as Australia, New Zealand and Argentina may affect the quality and consistency of the beef that is imported and sold as generic beef in the U.S.. In particular, the flavor of imported beef from these countries may be very unique to domestic consumers who do not typically eat grass-fed beef. Recent research by Neely et al. (1998) and Morgan et al. (1998) has shown that flavor is a key component in consumers' overall satisfaction for fresh beef products. Can consumers determine a difference in the flavor of grass-fed versus corn-fed beef when tenderness is held constant, and are there U.S. consumers who prefer the flavor of grass-fed beef to corn-fed beef? How much will U.S. consumers pay for their preferred beef flavor?

Objectives

The overall objective of this paper is to identify if consumers can perceive flavor differences in beef steaks produced under different feeding practices and to determine if consumers are willing to pay a premium for their preferred flavor. The specific objectives of this paper are: 1) to analyze consumer preferences for flavor in beef steaks by comparing Argentine grass-fed beef versus U.S. corn-fed beef when tenderness is held constant; 2) to establish the price premium that consumers are willing-to-pay for their flavor preference; 3) to identify demographic variables that affect consumers' willingness-to-pay for beef flavor.

Before addressing the main objectives, the methodology and experimental design are briefly discussed and the demographic data and meat purchasing behavior of the sample participants are quantified.

Methodology

Three basic methods are used to elicit consumer's economic value or willingness-to-pay for preferences: personal interviews, written surveys, and experimental auctions. In this study, an experimental auction market procedure was used to elicit consumer willingness-to-pay for steaks with varying flavor. Experimental auction methods are cited as having the "potential to provide more reliable measures of willingness-to-pay than a hypothetical survey method (Lusk et. al., 1999)." Fox et. al. (1995) stated four main advantages to using experimental valuation methods where winning participants are required to purchase the product: 1) auction bidding is designed to reveal true preferences, 2) the use of real money, real food, and repeated participation ensures reliability of the data, 3) the use of the requirement-to-eat factor reinforces the non-hypothetical aspect of the research and 4) the data is less biased by non-responses.

A commonly used experimental auction design is the Vickery sealed-bid, second-price auction where each participant submits a written bid on a particular product (Friedman and Sunder, 1994). The highest bidder is determined to be the "winner" of the auction and must purchase the product at the second highest bid. Second-price auctions have been used to determine the price premium consumers were willing-to-pay for vacuum packaged steaks versus overwrapped steaks (Menkhaus et al., 1992), to determine the value of genetically modified pork (Buhr et al., 1993), to elicit consumer willingness-to-pay for food safety (Hayes et al., 1995) and to place a value on consumer preferences for various quality attributes of fresh pork chops (Melton et al., 1996).

Based on the second-price Vickery auction methodology, an experimental valuation process using a fourth-price Vickery auction was developed to elicit consumers' true willingness-to-pay for their preferred steaks. In the case of this research, the fourth highest bid

determined the market price with the top three bidders required to purchase steaks at the fourth highest (market) price.

Procedures

Consumers from Chicago, Illinois and San Francisco, California[2] were selected and screened on a broad range of questions regarding demographics and meat eating practices. Individuals meeting the trial specifications were invited to participate in a research experiment where they would sample various New York Strip steaks. They were told that they would receive $25 (Chicago) or $35 (San Francisco) for their participation and that they would have the option to purchase steaks similar in quality to those they had sampled. Twenty-four taste panels consisting of twelve consumers each were scheduled for a total of 144 participants in Chicago and 144 participants in San Francisco.

Once at the research facility, consumers were first paid the amount specified over the phone and were then asked to complete surveys describing their meat purchasing behavior, eating preferences, knowledge of beef and demographic characteristics. The Vickery auction process was then explained to the consumers. Participants were encouraged to bid exactly what they believed the product to be worth to them. They were informed that if they submitted a successful bid, they were obligated to purchase the steak that they bid on at the auction market price. Three practice (non-purchase) auctions were performed in order to familiarize the consumers with the auction process. Consumers were then brought into taste panel booths where they were given a warm-up sample of steak to taste and evaluate.

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[2] The Chicago market is typically characterized as a Choice beef market while the San Francisco market is characterized as a Select or no-roll beef market. Both the domestic product and the Argentine product had sufficient marbling for the USDA Select grade.

Prior to the tasting and rating the U.S. corn-fed beef and the Argentine grass-fed beef steaks, consumer panelists had tasted, rated, and bid on two pairs of high marbled versus low marbled steaks (USDA upper two-thirds Choice versus USDA Select). Each pair of U.S. corn-fed beef and Argentine grass-fed beef steaks had similar Warner-Bratzler shear force values, therefore, tenderness was held constant within the paired comparisons[3]. The steaks were all cooked to the same degree of doneness (70°C, a medium degree of doneness).

After consumers tasted each steak sample, they rated the sample on sensory traits (juiciness, tenderness, flavor and overall acceptability). Consumers were given a set of "bid sheets" where they wrote down their bid price for each steak after they had completed sensory evaluations on both steak samples in a pair. Each bid was for one pound of frozen, packaged New York Strip steaks from the same loin as the steak that they had tasted. After all of the bids were turned in for the pair, the fourth highest bid for each steak was announced as the market price and the top three bidders all purchased steaks at the market price.

Participant Demographics

In total, 248 consumers actually participated in the study, 124 in Chicago and 124 in San Francisco. Demographic summary statistics are provided in Table 1. Approximately 81% of the consumers participating in the study were female with slightly more male consumers participating in San Francisco. The dominant ethnic background of the consumers was White/Caucasian and the average age of the consumers was 45 years. On average, most participants had some college experience with mean annual household income levels around $60,000 to $69,000, were married and lived in households with three to four family members.

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[3] Warner-Bratzler shear force measures the amount of force required to penetrate a cut of meat and allows a numerical value to be assigned indicating its tenderness level. It is the most accurate measurement of the variation in steak tenderness (Shackelford et. al., 1996).

Table 2 provides the results from the purchasing behavior and consumption preferences survey questions. Fifty-eight percent of the respondents prepare and eat meat three to six times a week with Chicago consumers eating meat more times per week than San Francisco participants. Beef (63%) and chicken (26%) are the meat products that participants most prefer to consume. When consuming meat at home, participants most commonly consumed beef (65%) with chicken being the second most consumed meat (32%). The majority of the participants preferred to consume steak (76%) or roast beef (16%). Most consumers preferred to grill or to broil their steak to a medium degree of doneness, however, Chicago consumers preferred their steak more well done than San Francisco consumers.

When surveyed about their satisfaction with the flavor, tenderness and juiciness of the beef products that they consumed, 93% of the consumers were satisfied. On average, quality was marked most commonly as being the "driver" of shopping decisions, however, both price and quality appeared to be important to Chicago consumers. Forty-eight percent of the participants indicated that they typically bought USDA Choice grade steaks, 15% usually purchased USDA Select steaks and 33% did not know what quality grade they purchased. Forty-six percent of the consumers indicated that they had stopped purchasing a beef product because they were unsatisfied with the products flavor, tenderness or juiciness.

Results

Figure 1 shows the results of the sensory evaluations from the domestic versus imported pair of steaks. Consumers strongly preferred the domestic product on all sensory traits (flavor desirability, juiciness, tenderness, and overall acceptability) over the imported product. Of particular interest is the magnitude of the flavor desirability ratings. A mean difference of one full panel rating is seldom observed in beef sensory panel research. It is clear from these results

that consumers in both Chicago and San Francisco felt strongly about flavor and, as a result, about overall satisfaction.

After completing the sensory evaluations, participants bid on the steaks. A few participants only wanted to participate in the research trial for the cash and chose not to bid on any steaks. Participants who bid zero on all auctions were eliminated from the data set leaving 226 usable participants. The results from the auction on the domestic versus imported pair of steaks showed that on average, consumers bid more for the domestic steak sample (Table 3). The differences in sensory ratings translated into significant bid differentials of $.82 and $.55 per pound in Chicago and San Francisco, respectively.

The results discussed above are simply average taste panel rankings and bid prices. One objective of this research was to investigate if consumers exist who prefer and are willing-to-pay more for the domestic corn-fed beef versus the grass-fed beef (and vice versa). Based on overall acceptability rankings and bid differentials between pairs of steaks, consumers were identified who preferred and were willing to pay more for a particular flavor. After tasting and evaluating both of the steaks in the domestic versus Argentine steak pair, 141 consumers were willing-to-pay an average of $1.61 more per pound for the domestic sample, 51 consumers were willing-to-pay an average of $1.36 more per pound for the Argentine sample and 34 consumers were indifferent between the domestic and Argentine steak (Figure 3).

It is clear that there are consumers who prefer the domestic corn-fed beef to the grass-fed beef and vice-a-versa. Each group is willing-to-pay a premium for their preference and those with a stronger preference generally had a larger bid differential. Can we identify consumers by their demographic traits and predict which flavor they will prefer, determine how strong their

flavor preference is, and their willingness-to-pay?   The following equation was estimated using

OLS regression procedures:

Equation 1.   INTDIFF = f(*loc, gen, eth, age, edu, size, inc, eatmeat, beefeat, pref, cook,*
done, satisfy, drive, grade, buy)

where INTDIFF = D - I

INTDIFF is the bid difference between the domestic steak sample (D) and the Argentine

steak sample (I). INTDIFF is positive/negative for consumers who were willing-to-pay more for

the domestic/Argentine steak sample or zero for consumers who were indifferent. *Loc* is either

Chicago or San Francisco, *gen* is male or female, *eth* is ethnic background, *age* is the

participant's age category, *edu* is the participant's education level, *size* is family size category,

inc is the participant's household income category, *eatmeat* is the number of times per week that

meat is eaten in the home, *beefeat* is equal to one if beef is consumed most often and is equal to

zero otherwise, *pref* is the preferred type of beef to consume, *cook* is the preferred steak cooking

method, *done* is the preferred degree of doneness for steaks, *satisfy* is the consumer's satisfaction

with the flavor, tenderness and juiciness of beef products consumed, *drive* is the factor driving

shopping decisions, *grade* is the USDA grade of beef typically purchased, and *buy* is where beef

is typically bought.

The results from the regression analysis are shown in Table 4. The model was not very

robust. The R^2 value for Equation 1 was .13. Other functional forms, regression procedures, and

demographic variables were considered with similar or poorer results. Beef consumption

(*beefeat*), age, ethnic background and income were all significant independent variables in the

INTDIFF model. The coefficients on the *inc* and *beefeat* variables were positive, indicating beef

consuming and higher income participants tended to bid a higher price for the domestic steak.

The ethnic background and the age variables both had negative coefficients indicating that non-Caucasian and older consumers tend to bid less for the domestic, corn-fed steak.

Summary and Implications

These results indicate that: 1) consumers can differentiate between the flavor of domestic, corn-fed USDA Select steaks and Argentine, grass-fed steaks (qualifying for USDA Select quality grade) when tenderness is held constant within the pair of steaks, and 2) consumers are willing-to-pay a significant premium for the steak that they prefer. Sixty-two percent of the participants preferred the domestic, corn-fed flavor to the Argentine, grass-fed flavor and were willing-to-pay an average of $1.61 per pound more for the domestic steak. However, 23% of the participants preferred the Argentine steak and were willing-to-pay and average of $1.36 per pound more for their preference.

The results of this study suggest that country-of-origin labeling may need to be considered in order to provide consumers with a consistent beef product that meets their palatability expectations. Currently, imported beef may meet the USDA inspection specifications for a safe and wholesome product, be graded with a USDA quality grade and sold in the retail meat case in the same manner as domestically produced beef. However, beef imported from countries that produce cattle under different management practices will likely produce a uniquely flavored product. If consumers are not aware of the origin of their beef, they may purchase a beef product that produces an unfavorable eating experience. Thus, it is important that consumers are properly informed of the factors affecting the palatability of their steak.

This information should also be of interest to agribusiness firms interested in niche marketing or branding grass-fed beef products. While demographic groups of consumers could

not be identified, the results show that there are consumers who can distinguish a flavor difference between domestic, corn-fed beef and grass-fed beef and are willing-to-pay a significantly higher price for their preferred flavor. As more is learned about consumer preferences for beef and as those preferences are met with the appropriate product, it is likely that demand for beef in the U.S. can be increased.

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Table 1. Definitions of Demographic Variables and Percentage of Panelist in each Category

Definition	Chicago %	San Francisco %	Overall %
Gender of Respondent:			
1= Male	17.09	21.10	19.03
2 = Female	82.91	78.90	80.97
Age of respondent:			
1 = Under 25 years	1.71	3.67	2.65
2 = 25 – 34 years	5.13	7.34	6.19
3 = 35 – 44 years	47.86	29.36	38.94
4 = 45 – 54 years	31.62	36.70	34.07
5 = 55 – 64 years	13.68	22.94	18.14
6 = Over 64 years	0.00	0.00	0.00
Ethnic background:			
1 = White/Caucasian	94.87	74.31	84.96
2 = African American	2.56	6.42	4.42
3 = Hispanic	1.71	9.17	5.31
4 = Asian	0.85	0.92	0.88
5 = Native American	0.00	0.92	0.44
6 = Other	0.00	8.26	3.98
Education level of respondent:			
1 = Elementary school	0.00	0.00	0.00
2 = Some high school	0.85	0.92	0.88
3 = High school graduate	18.80	10.09	14.60
4 = Some college	33.33	47.71	40.27
5 = Completed junior college	11.11	16.51	13.72
6 = Completed 4-year university	24.79	17.43	21.24
7 = Completed graduate school	11.11	7.34	9.29
Household income level:			
1 = Less than $20,000	3.48	3.81	3.64
2 = $20,000 to $29,000	3.48	3.81	3.64
3 = $30,000 to $39,999	11.30	6.67	9.09
4 = $40,000 to $49,999	8.70	16.19	12.27
5 = $50,000 to $59,999	12.17	9.52	10.91
6 = $60,000 to $69,999	16.52	15.24	15.91
7 = $70,000 to $79,999	11.30	10.48	10.91
8 = $80,000 to $89,999	10.43	11.43	10.91
9 = $90,000 to $99,999	6.09	9.52	7.73
10 = Greater than $100,000	16.52	13.33	15.00

Table 1. Definitions of Demographic Variables and Summary Statistics

Definition	Chicago %	San Francisco %	Overall %
Number of family members living in household			
1 = 1	4.27	9.17	6.64
2 = 2	13.68	19.27	16.37
3 = 3	17.09	22.94	19.91
4 = 4	31.62	32.11	38.86
5 = 5	28.21	13.76	21.24
6 = more than 5	5.13	2.75	3.98
Marital Status:			
1 = Single	7.76	16.51	12.00
2 = Divorced	6.90	11.01	8.89
3 = Separated	0.86	0.92	0.89
4 = Married	83.62	67.89	76.00
5 = Widowed	0.86	2.75	1.78
6 = Domestic partnership	0.00	0.92	0.44
Employment:			
1 = Student	0.85	2.75	1.77
2 = Part-time	36.75	24.77	30.97
3 = Full-time	28.21	45.87	36.73
4 = Not employed	34.19	26.61	30.53

Table 2. Definitions of Meat and Beef Purchasing Behavior Variables and Summary Statistics

Definition	Chicago %	San Francisco %	Overall %
Number of times per week meat products are prepared and eaten in home.			
1 = 1-2 times	5.13	5.50	5.31
2 = 3-4 times	22.22	40.37	30.97
3 = 5-6 times	25.64	28.44	26.69
4 = 7-8 times	19.66	14.68	17.26
5 = 9-10 times	10.26	3.67	7.08
6 = more than 10	17.09	7.34	12.39
Preferred meat product for consumption:			
1 = Beef,	61.61	65.09	63.30
2 = Pork	7.14	0.00	3.67
3 = Chicken	25.00	28.30	26.61
4 = Lamb,	0.89	2.83	1.83
5 = Fish,	5.36	1.89	3.67
6 = Duck	0.00	1.88	0.92
Meat product consumed most often at home:			
1 = Beef	65.52	64.76	65.16
2 = Pork	0.00	0.95	0.45
3 = Chicken	32.76	30.48	31.67
4 = Lamb	0.00	0.00	0.00
5 = Fish	1.72	3.81	2.71
6 = Other	0.00	0.00	0.00
Preferred type of beef to consume:			
1 = Steak	73.50	79.44	76.34
2 = Ground Beef	7.69	5.61	6.70
3 = Roast	17.95	13.08	15.63
4 = Other	0.85	1.86	1.34
Preparation method for cooking beef steaks:			
1 = Broiling	23.68	27.36	25.45
2 = Grilling	65.79	56.60	61.36
3 = Pan Broiling	3.51	3.77	3.64
4 = Pan Frying	1.75	4.72	3.18
5 = Roasting	2.63	3.77	3.18
6 = Stir-Frying	0.88	1.89	1.36
7 = Braising	0.00	0.00	0.00
8 = Cooking in Liquid	1.75	1.89	1.82

Table 2. Definitions of Meat and Beef Purchasing Behavior Variables and Summary Statistics

Definition	Chicago %	San Francisco %	Overall %
Preferred degree of doneness for steaks:			
1 = Very Rare	1.71	1.85	1.78
2 = Rare	0.00	4.63	2.22
3 = Medium rare	21.37	44.44	32.44
4 = Medium	29.91	25.00	27.56
5 = Medium well	29.06	11.11	20.44
6 = Well done	15.38	6.48	11.11
7 = Very well done	2.56	6.48	4.44
Satisfaction with the flavor, tenderness, juiciness of the beef products consumed:			
1 = Extremely satisfied	5.98	6.42	6.19
2 = Very satisfied	28.21	45.87	36.73
3 = Satisfied	58.12	42.20	50.44
4 = Unsatisfied	7.69	4.59	6.19
5 = Very unsatisfied	0.00	0.92	0.44
6 = Extremely unsatisfied	0.00	0.00	0.00
Grade of beef steaks typically purchased:			
1= USDA Choice	46.96	48.62	47.77
2= USDA Select	13.91	15.60	14.73
3 = Don't know	33.91	33.03	33.48
4 = USDA Prime	0.87	1.83	1.34
5 = Other (Branded Product)	4.35	0.92	2.68
Factor "driving" shopping decisions:			
1 = Price	31.25	15.00	23.58
2 = Quality	46.43	64.00	54.72
3= Budget	10.71	8.00	9.43
4 = Health	11.61	13.00	12.26
Where beef is typically bought:			
1 = Grocery store	86.96	75.76	81.78
2 = Butcher shop	9.57	15.15	12.15
3 = Other	3.48	9.09	6.07
Stopped purchasing beef due to dissatisfaction with product's tenderness, flavor, or juiciness:			
1 = Yes	50.86	39.81	45.54
2 = No	49.14	60.19	54.46

Table 3. Average Auction Bids ($/pound) for Domestic and Imported Beef Steaks (Standard Deviation in Parenthesis).

Treatment:	Chicago Mean (Std. Dev.)	San Francisco Mean (Std. Dev.)	Overall Mean (Std. Dev.)
Domestic	$2.68 (1.38)	$2.66 (1.61)	$2.67 (1.49)
Imported (Argentine)	$1.84 (1.59)	$2.11 [a] (1.67)	$1.97 (1.63)
Difference (Domestic vs. Argentine)	$0.82 [b]	$0.55 [b]	$0.70 [b]

N=226

[a] = Average bid is significantly different ($\alpha = .05$) between locations.

[b] = Average bid is significantly different ($\alpha = .05$) between treatment.

Table 4. Regression Coefficients for Domestic versus Argentine model (INTDIFF model).

Variable	Coefficient	t-statistic
Loc	-0.274	-0.962
Gen	-0.103	-0.316
Eth	-0.225 [b]	-1.818
Age	-0.277 [a]	-2.010
Edu	-0.016	-0.155
Size	-0.107	-0.962
Inc	0.091 [b]	1.694
Eatmeat	0.025	0.254
Beefeat	0.877 [a]	3.168
Pref	0.100	0.623
Cook	0.051	0.520
Done	0.020	0.186
Satisfy	0.065	0.338
Drive	-0.018	-0.122
Grade	0.135	1.252
Buy	0.033	0.217

[a] = coefficient is statistically significant at the 5% level

[b] = coefficient is statistically significant at the 5% level
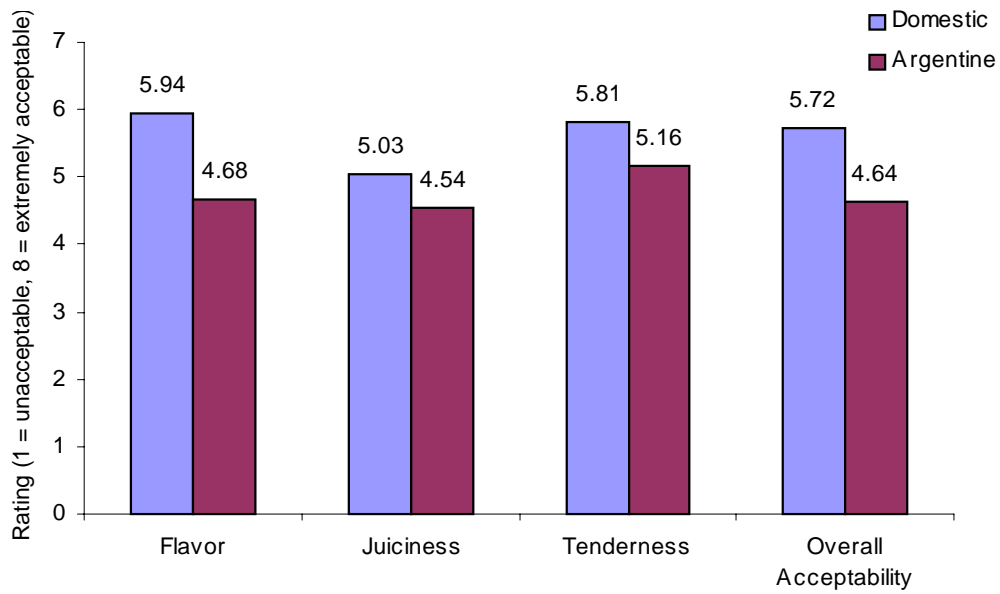
n=188; $R^2 = .13$

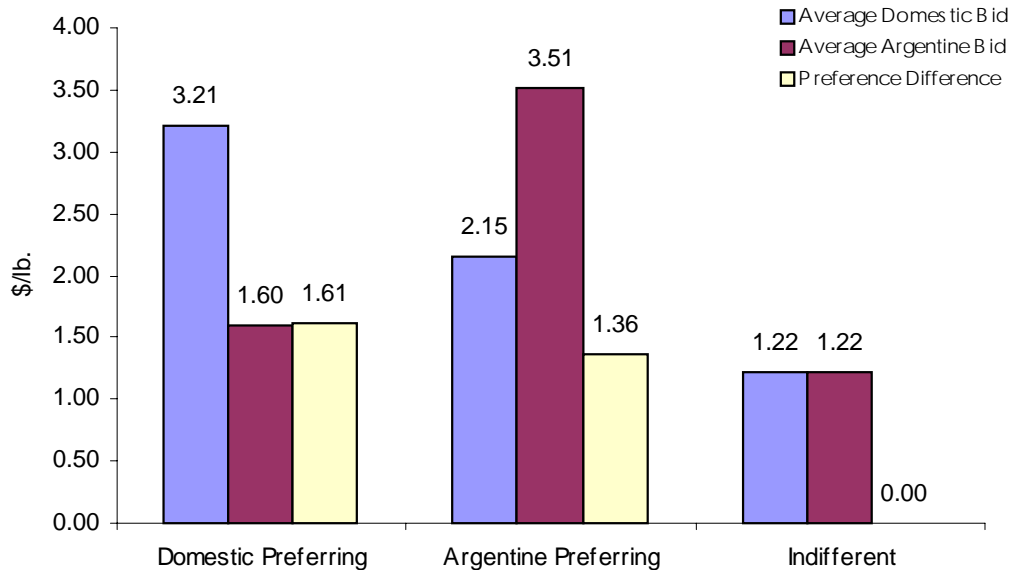**Figure 1.** Taste Panel Ratings for Domestic and Argentine Beef Steaks

Figure 2. Average Bids for Preferred Flavor Preference (Domestic versus Argentine)