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K. M. Killinger

*University of Nebraska-Lincoln*

W. J. Umberger

*University of Nebraska-Lincoln*

Chris R. Calkins

*University of Nebraska-Lincoln, ccalkins1@unl.edu*

Kent M. Eskridge

*University of Nebraska-Lincoln, keskridge1@unl.edu*

D. Feuz

*University of Nebraska-Lincoln*

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# Consumer Acceptance and Value of Strip Steaks Differing in Marbling and Country-of-Origin

K.M. Killinger  
C.R. Calkins  
W.J. Umberger  
D.M. Feuz  
K.M. Eskridge<sup>1</sup>

Consumers found high marbled beef and domestic beef more acceptable in palatability than low marbled beef and Argentine beef and generally were willing to pay more for more acceptable products.

## Summary

*Consumers (72.6%) visually preferred low marbled steaks. However, high marbled steaks were rated more juicy, tender and desirable in flavor and overall acceptability than low marbled steaks. Based on auction bids, consumers in Chicago (but not San Francisco) were willing to pay more for high marbled steaks than low marbled steaks. Domestic steaks were rated higher in all sensory attributes than Argentine steaks. Consumers in both locations were willing to pay more for domestic steaks than Argentine steaks. Although most consumers visually prefer low marbled steaks, most consumers find high marbled steaks to be more acceptable in sensory characteristics.*

## Introduction

Current research involving the sensory characteristics of beef has focused on consumer acceptance of beef tenderness and the value consumers place on tenderness. However, an improvement in beef tenderness alone may not be sufficient to increase overall consumer acceptance of beef. In this study, factors affecting beef flavor were studied to discover the importance of beef flavor on consumer acceptance and

the value consumers place on flavor.

Marbling has been used in the meat industry as a visual indicator of beef palatability; therefore, strip loins differing in marbling level, but similar in tenderness, were used to investigate the effect of marbling on consumer acceptance. In addition, Argentine beef has been said to have a unique flavor (due to grass feeding and longer aging periods), so Argentine and domestic strip loins, of similar marbling level and tenderness, were used to determine consumer acceptance of beef from Argentina and the United States. Finally, experimental auction procedures were used to determine the value consumers placed on beef that differed in marbling level and country-of-origin.

## Procedure

### *Selection of Strip Loins*

Strip loins of two quality grades (Select and Upper 2/3 Choice) and of two countries (United States and Argentina) were purchased and shipped to the University of Nebraska-Loeffel Meat Laboratory. Each strip loin was assigned a random, three-digit code. The strip loins were aged for nine days at 32°F, and subsequently frozen. The strip loins were later cut into steaks, and the steaks were labeled in ascending order from anterior to posterior.

Steak 1 (the most anterior steak) was used for an objective tenderness determination, and steak 2 was held in reserve. Thawed steaks were cooked on a table-top broiler to an internal temperature of 160°F. The steaks were allowed to cool prior to coring with an automated coring device. Cores (1/2 inch diameter) were then sheared to determine Warner-Braztler shear force using an Instron Universal Testing Machine. For the marbling comparison, high marbled (upper 2/3 Choice) and low marbled (Select) strip loins with similar ( $P>0.05$ ) Warner-Braztler shear

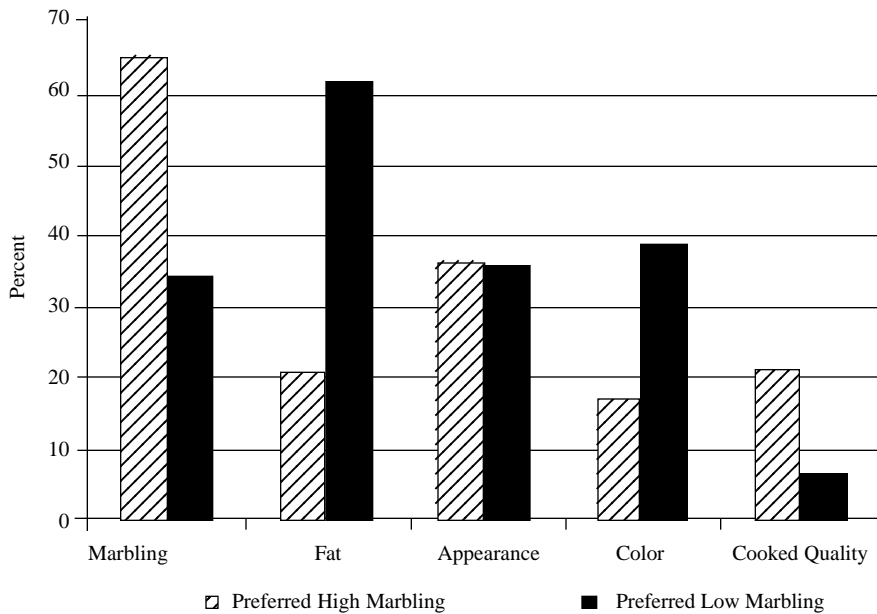
force values were paired for sensory evaluation, while steaks for the country-of-origin comparison were paired based on similar ( $P>0.05$ ) Warner-Braztler shear force values and similar ( $P>0.05$ ) marbling scores. In the country-of-origin comparison, all pairs were within the Select quality grade. Aging of Argentine beef was not under experimental control, and the exact aging period was unknown. However, information provided by the Argentine supplier indicates that the beef was aged for at least 30 days which assures that the Argentine beef was aged for a longer period than the domestic beef (nine days). Therefore, time of aging may contribute to the unique flavor of the Argentine beef used in this study. Efforts to minimize variation due to tenderness within each pair for the marbling comparison and to minimize variation due to both tenderness and marbling within each pair for the country-of-origin comparison add to the uniqueness of the study.

### *Selection of consumers*

Consumers in two locations (Chicago and San Francisco) were screened over the telephone in order to qualify for the study. To be eligible, consumers had to meet three criteria. They had to be between the ages of 19 and 59, be the primary grocery shopper of the household and be willing to consume beef. In addition to these requirements, efforts were made to balance the selected consumers in regard to age, level of beef consumption, gender, economic category, and ethnicity. In each city, 12 panels were scheduled over a three-day period with a target of 12 consumers per panel.

### *Taste panel procedures*

Prior to the taste panels, selected consumers were mailed a consent form and a survey to discern the consumer's



**Figure 1. Percentage of selection criteria listed by each preference group.**

eating preferences, meat purchasing behaviors and other demographic characteristics. The consumers brought these forms with them and were paid for their participation upon arrival (\$25 in Chicago and \$35 in San Francisco). Consumers were compensated with amounts comparable to other test marketing facilities in the respective cities.

Next, consumers were asked to visually evaluate a pair of steaks in a retail display case. Steaks of different marbling level (upper 2/3 Choice and Select) were purchased at local retail stores in each location. The steaks were packaged similarly and were labeled with four-digit random number codes. Consumers were asked to choose the steak that they would purchase if shopping in a grocery store, list the selection criteria they used to choose the steak and provide the price that they were willing to pay for each steak.

Then, the experimental auction procedures were explained. Consumers were informed that in each auction they would be bidding for a one-pound package (consisting of two frozen steaks) from the same strip loins as the samples in the taste panels. In each auction, there would be three winners, each receiving a one-pound package of steak. The auction method used was a Vickery auction, which is a silent, sealed-bid auction. Two practice auctions were conducted

using the visual evaluation steaks. The consumers then evaluated a warm-up steak sample and a third practice auction was conducted. The practice auctions were simply used to acquaint the consumers with the auction procedures; the products used in these auctions were not purchased by the winning bidders.

#### *Taste panel sample preparation*

Paired strip loins were randomly assigned to taste panels. For the marbling comparison, each taste panel was assigned two matched pairs and for the country-of-origin comparison, one matched pair was assigned. Frozen steaks were shipped to the taste panel facilities. Steaks 3, 4 and 5 from each strip loin were used for taste panel samples. These steaks were thawed at refrigeration temperatures for about 24 hours prior to cooking. The steaks were then cooked to 160°F and cut into small rectangles for sensory evaluation. Steaks 6-11 remained frozen and were used in the auctions.

Consumers used an eight-point hedonic scale to rate taste panel samples for juiciness (1=extremely dry, 8=extremely juicy), tenderness (1=extremely tough, 8=extremely tender), flavor and overall acceptability (1=extremely undesirable, 8=extremely desirable). After evaluating each pair of samples, consumers had the opportunity

to participate in an auction for steaks from the same strip loin as the samples they tasted. This procedure was performed three times (two marbling comparisons and one country-of-origin comparison).

#### *Statistical analysis*

Consumers in experimental auctions tend to bid amounts that do not reflect the market value of the products. Using a Vickery auction, instead of focusing on the absolute bids for the products differing in marbling or country-of-origin, the analysis focuses on the differential between the two bids, which better reflects the value consumers place on the products. Price data were analyzed using the mixed procedure of SAS and visual preference data were analyzed using the chi square procedure in SAS.

### **Results**

In regard to panel demographics, a total of 248 consumers participated in the study (124 in each location). In Chicago, the panels consisted of 102 females and 22 males, while in San Francisco, 96 females and 28 males participated. In both locations, most consumers were between the ages of 30 and 59, and consumed beef 1-4 or more times per week. Their yearly incomes ranged from \$10,000-100,000 or more/year. Most of the consumers were Caucasians.

There was a significant difference in visual preference with 72.6% of consumers preferring the low marbled steak. Selection criteria were categorized into five main categories: marbling, fat, color, appearance and cooked quality (Figure 1). A majority of consumers (61.6%) who preferred low marbling listed fat as a selection criteria, while a majority of consumers (65.4%) who preferred high marbling listed marbling as a selection criteria. It appears that visual preference for steaks differing in marbling is influenced by consumer perception of marbling as a negative factor (high fat content) or a positive factor (increases flavor and juiciness).

(Continued on next page)

In regard to price, there was a significant interaction between visual preference and marbling level. Consumers who preferred the high marbled steak were willing to pay \$0.75/lb more ( $P < 0.01$ ) for the high marbled steak (Table 1). Consumers who preferred the low marbled steak were willing to pay \$1.12/lb more ( $P < 0.01$ ) for the low marbled steak. Consumers placed a higher value on the steak (high or low marbled) that they preferred, based on visual assessment. It appears that consumers who are concerned about fat content place a higher value on low marbled steaks than consumers who want to purchase a steak with high eating quality place on high marbled steaks.

In the taste panel evaluations, consumers rated high marbled steaks more ( $P < 0.01$ ) desirable in flavor as well as more ( $P < 0.01$ ) juicy and more ( $P < 0.05$ ) tender (Table 2). Although pairs were matched based on Warner-Bratzler shear force values, consumers perceived differences in tenderness. It is not surprising that objective and subjective evaluations of tenderness are different. Finally, consumers rated high marbled steaks as being more ( $P < 0.01$ ) desirable overall. Consumers in Chicago were willing to pay \$0.23 more ( $P < 0.05$ ) for high marbled steaks than low marbled steaks (Table 3), while consumers in San Francisco were only willing to pay \$0.09 more ( $P > 0.05$ ) for high marbled steaks than low marbled steaks. Consumers in both locations rated high marbled steaks higher in all sensory attributes; however, only consumers in Chicago were willing to pay significantly more for the high marbled steaks, based upon palatability characteristics. There are likely a variety of reasons that consumers in Chicago and San Francisco valued high and low marbled beef differently. Even so, marbling is clearly an important factor that affects beef palatability. Consumers need to be aware of the importance of marbling, and that they are likely to find high marbled steaks more acceptable than low marbled steaks.

Consumers found the domestic steaks to be more ( $P < 0.01$ ) desirable in flavor and rated domestic steaks higher ( $P < 0.01$ ) in juiciness, tenderness and overall acceptability (Table 4). Consum-

**Table 1. The value consumers place on steaks differing in marbling level based on visual evaluation (\$/lb).**

	Price for high marbled steak	Price for low marbled steak	Differential	P-Value
Preferred high marbling	\$3.77	\$3.02	\$0.75	<0.01
Preferred low marbling	\$2.98	\$4.10	\$1.12	<0.01

**Table 2. Taste panel ratings for high and low marbled steaks.**

Attribute <sup>a</sup>	High marbled steaks	Low marbled steaks	P-value
Flavor rating	5.60	5.30	<0.01
Juiciness rating	4.94	4.47	<0.01
Tenderness rating	5.45	5.26	<0.05
Overall acceptability rating	5.37	5.06	<0.01

<sup>a</sup> Samples rated using an 8-point hedonic scale (8=extremely desirable, juicy, tender, desirable; 1=extremely undesirable, dry, tough, undesirable).

**Table 3. The value consumers place on high and low marbled steaks based on experimental auction bids (\$/lb).**

	High marbled steak bid	Low marbled steak bid	Differential	P-value
Chicago	\$2.38	\$2.16	\$0.23	<0.05
San Francisco	\$2.70	\$2.61	\$0.09	>0.05

**Table 4. Taste panel ratings for Argentine and domestic steaks.**

Attribute <sup>a</sup>	Domestic steaks	Argentine steaks	P-value
Flavor rating	5.82	4.60	<0.01
Juiciness rating	4.94	4.47	<0.01
Tenderness rating	5.79	5.14	<0.01
Overall acceptability rating	5.64	4.57	<0.01

<sup>a</sup>Samples rated using an 8-point hedonic scale (8=extremely desirable, juicy, tender, desirable; 1=extremely undesirable, dry, tough, undesirable).

**Table 5. The value consumers place on domestic and Argentine steaks based on experimental auction bids (\$/lb).**

	Domestic steak bid	Argentine steak bid	Differential	P-Value
Chicago	\$2.63	\$1.74	\$0.89	<0.01
San Francisco	\$2.59	\$2.10	\$0.48	<0.01

ers in Chicago were willing to pay \$0.89 more ( $P < 0.01$ ) for domestic steaks than Argentine steaks, and consumers in San Francisco were willing to pay \$0.48 more ( $P < 0.01$ ) for domestic steaks than Argentine steaks (Table 5). The Argentine beef used in this study was imported from a supplier that used grass-fed cattle and a long aging period. Grass-fed beef tends to have a different flavor profile than grain-fed beef, which is more typical of commercial beef in the United States. Length of aging also will affect the flavor of beef, and the Argentine beef was aged longer than most beef in the United States. With both of these factors contributing to the flavor of the

Argentine beef, it is not surprising that consumers found a substantial difference in flavor between the two products. While the flavor of Argentine beef may be unique, the consumers in this study found domestic beef to be more acceptable and placed a higher value on domestic beef.

<sup>1</sup>K.M. Killinger and W.J. Umberger, graduate students, C.R. Calkins, professor Animal Science, Lincoln, K.M. Eskridge, professor, Biometry, Lincoln, D.M. Feuz, assistant professor, Agriculture Economics, Panhandle Research and Extension Center, Scottsbluff. This project was funded by beef producers through their \$1/head checkoff and produced for the Cattlemen's Beef Board and State Beef Councils.