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### Introduction

In the beef industry, U.S. Department of Agriculture quality grades and marbling levels have long been associated with beef palatability and eating experience. Marbling score and maturity are the two major components of USDA quality grade. Traditionally, marbling texture has not been considered a factor of marbling score; however, there are often discernments at both the packer and retail level, as more than 75% of branded beef programs supervised by USDA-AMS have a specification of fine or medium textured marbling (USDA, 2015). Additionally, in some cases, fine and medium textured steaks are graded higher than their coarse counterparts, which results in a loss of possible premiums for producers and packers. There is very little research evaluating marbling texture and its effect on palatability and eating experience.

Key words: marbling, consumer, palatability

### Experimental Procedures

Top Choice (Modest<sup>00</sup> – Moderate<sup>100</sup> marbling), Low Choice (Small marbling), and Select strip loins (n = 117; 39/quality grade; Institutional Meat Purchase Specifications #180) were procured from a Midwestern beef processor. Strip loins were selected according to USDA Marbling Texture reference cards (USDA-AMS-LS-SB-02) and required at least 75% of the marbling to meet the standard (fine, medium, or coarse) for the particular group. Thirteen strip loins were selected per each marbling treatment within each quality grade. Strip loins were then transported to the Kansas State University Meat Laboratory where they were fabricated into 1-in. steaks, vacuum packaged and then aged for 21 days prior to freezing at -40°F.

Prior to panel sessions, steaks were thawed at 39°F for 24 hours. Steaks were prepared to a medium degree of doneness (160°F) on clamshell grills (Cuisinart Griddler Deluxe, Cuisinart, East Windsor, NJ). Prior to serving, steaks were cut into 0.4 in cubes, with 3 cubes immediately served to 7 consumer panelists. Untrained consumer panelists (n = 104) evaluated nine samples, one from each treatment, for tenderness, juiciness, flavor liking, and overall liking on a 3.93-in. line scales, which were verbally anchored at end and midpoints. Additionally, consumers rated each steak as either acceptable or unacceptable for each trait. Consumers were also asked to visually appraise each steak

through a digital survey (Qualtrics, Provo, UT) on electronic tablets (HP Steam, HP, Palo Alto, CA). Pictures of each steak were edited to 1 × 2.5 in. dimensions of the center of the steak to remove any external fat, or ribeye area differences and color made uniform across all images. Consumers rated the desirability of the appearance of each steak as well as how likely they were to purchase the steak pictured, with verbal anchors at each end and midpoints of a scale. Data were analyzed as a completely randomized design with a 3 × 3 factorial arrangement, with quality grade, marbling texture, and quality grade × texture interaction serving as fixed effects as well as included panel number as a random effect and steak peak temperature as a covariate.

## Results and Discussion

There were no quality grade × texture interactions ( $P > 0.05$ ) for all of the traits evaluated (Table 1). Marbling texture had no effect on palatability traits ( $P > 0.05$ ). Consumers rated all treatment groups (fine, medium, and coarse) as similar ( $P > 0.05$ ) for tenderness, juiciness, flavor liking, and overall liking. Furthermore, when asked to rate each sample as acceptable or unacceptable for each palatability trait, consumers found a similar ( $P > 0.05$ ) percentage of samples from each texture treatment acceptable (Table 2). Consumers rated Low Choice steaks as similar ( $P > 0.05$ ) to Top Choice steaks for all palatability traits evaluated. Low Choice steaks were rated higher ( $P < 0.05$ ) than Select for tenderness, flavor liking, and overall liking scores; however, they were similar ( $P > 0.05$ ) to Select for juiciness ratings. Moreover, both Top Choice and Low Choice were rated greater ( $P < 0.05$ ) for flavor liking than Select samples. A similar trend was observed when consumers were asked to rate samples as acceptable or unacceptable. No differences ( $P > 0.05$ ) were found among quality grades for the percentage of samples rated acceptable for tenderness, juiciness, and overall liking, with greater than 83% of samples rated acceptable for each trait. However, a lower percentage ( $P < 0.05$ ) of Select samples were rated acceptable for flavor than either Top Choice or Low Choice.

When asked to visually rate steaks on desirability of appearance, consumers rated steaks from each marbling texture treatment as similar ( $P > 0.05$ ). Moreover, steaks from each quality grade were found to be similar in terms of desirability of appearance ( $P > 0.05$ ). Additionally, when asked to rate how likely they were to purchase each steak, consumers rated each marbling texture treatment as similar ( $P > 0.05$ ). Likewise, there were no significant differences ( $P > 0.05$ ) between quality grades when asked to rate how likely they were to purchase the steak. This indicates that when external fat and color are not a factor in a purchasing decision, the amount of marbling or texture of the marbling does not play a role in beef purchases.

## Implications

These results indicate there are no significant palatability differences between marbling texture types when fed to consumers. This implies coarse marbled beef should not be discriminated against for grading or purchasing decisions at the packer and wholesale level. Additionally, this would allow more cattle to be sorted into branded programs, which could increase profits at both the wholesale and retail level. These results indicate consumers do not have a preference for quality grades or marbling textures when external fat, muscling, and color do not play a role in the selection process.

**Table 1. Least squares means for consumer panel ratings<sup>1</sup> of grilled beef strip loin steaks of varying USDA quality grades and marbling texture treatments (n = 104)**

Treatment	Tenderness	Juiciness	Flavor liking	Overall liking
Marbling texture				
Fine	66.6	63.8	65.0	67.7
Medium	63.0	60.9	62.1	64.2
Coarse	63.7	61.9	63.3	64.9
SEM <sup>2</sup>	2.2	2.2	1.8	1.8
P-value	0.29	0.53	0.35	0.22
Quality grade				
Top Choice <sup>3</sup>	64.6 <sup>ab</sup>	63.2	64.3 <sup>a</sup>	66.1 <sup>ab</sup>
Low Choice	67.5 <sup>a</sup>	63.7	66.3 <sup>a</sup>	68.3 <sup>a</sup>
Select	61.2 <sup>b</sup>	59.6	59.8 <sup>b</sup>	62.4 <sup>b</sup>
SEM	2.2	2.2	1.8	1.8
P-value	0.04	0.24	0.01	0.02
Quality grade × texture				
P-value	0.51	0.46	0.78	0.62

<sup>1</sup>Sensory scores: 0 = Extremely tough/dry/dislike flavor, 100 = Extremely juicy/tender/like flavor.

<sup>2</sup>SE (largest) of the least squares means.

<sup>3</sup>USDA marbling score of Modest<sup>00</sup>-Moderate<sup>100</sup>.

<sup>ab</sup>Least squares means in the same main effect (quality grade or marbling texture) without a common superscript differ (P<0.05).

**Table 2. Percentage of beef strip loin steaks of varying USDA quality grade and marbling texture treatments rated acceptable for tenderness, juiciness, flavor, and overall liking (n = 104)**

Treatment	Tenderness acceptability	Juiciness acceptability	Flavor acceptability	Overall acceptability
Marbling texture				
Fine	87.9	86.4	87.5	88.5
Medium	86.0	85.7	85.8	85.0
Coarse	86.6	83.7	85.1	85.2
SEM <sup>1</sup>	2.7	2.6	2.4	2.5
P-value	0.78	0.63	0.68	0.38
Quality grade				
Top Choice <sup>2</sup>	85.8	84.7	87.6 <sup>a</sup>	87.5
Low Choice	89.2	87.6	88.7 <sup>a</sup>	87.8
Select	85.2	83.4	81.4 <sup>b</sup>	83.2
SEM	2.8	2.6	2.8	2.7
P-value	0.29	0.35	0.03	0.20
Quality grade × texture				
P-value	0.59	0.50	0.38	0.40

<sup>1</sup>SE (largest) of the least squares means.

<sup>2</sup>USDA marbling score of Modest<sup>00</sup>-Moderate<sup>100</sup>.

<sup>ab</sup>Least squares means in the same main effect (quality grade or marbling texture) without a common superscript differ (P<0.05).