

Consumer Preferences for Eating Quality of USDA Prime Beef Differentiated into Tiers

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Abstract

USDA Prime carcass numbers have risen steadily since the early 2000s, but the grade remains undifferentiated in value-based marketing programs. As Prime availability grows, opportunities exist to capture added value by differentiating this grade, similar to USDA Choice. Therefore, the objective of this study was to evaluate consumer palatability preferences of strip loin steaks from upper 2/3 Prime (Super Prime), Low Prime, Top Choice, and Low Choice across three degrees of doneness (DOD): Rare, Medium, and Well-done. Beef strip loins ($n = 15/\text{grade}$) were collected from a commercial packing facility and fabricated into 1-in. steaks, aged for 28 days, and assigned to a DOD. Consumer panelists ($n = 192$) rated samples for juiciness, tenderness, flavor, and overall liking using 100-point line scales and indicated acceptability for each trait. There were no ($P > 0.05$) interactions between quality grade and DOD for any consumer-evaluated traits. Super Prime steaks were rated higher ($P < 0.05$) for all sensory traits evaluated by consumers compared to all other grades. Low Prime, Top Choice, and Low Choice did not differ ($P > 0.05$) for juiciness, flavor, or overall liking, although Low Prime was more tender ($P < 0.05$) than Low Choice. A higher percentage ($P < 0.05$) of Super Prime samples were rated as acceptable for juiciness, flavor, and overall liking than all other quality grades. Rare steaks were juicier and more tender ($P < 0.05$) than Medium and Well-done steaks, while Medium and Well-done samples were similar ($P > 0.05$) for those traits. These results indicate that consumers preferred the eating quality of upper 2/3 Prime steaks over the other grades evaluated and support the opportunity for a premium program within the Prime grade, offering the beef industry an opportunity to capture added value from this highest grade within beef.

Introduction

Over the past 25 years, the U.S. beef industry has experienced a steady improvement in carcass quality, most notably in the increased percentage of carcasses grading USDA Prime. During this time, the percentage of carcasses grading USDA Prime has increased by more than 7%, and the percentage of carcasses grading USDA Choice has risen by more than 17% (USDA-AMS, 2024). As a result, the percentage of carcasses grading USDA Select has decreased by more than 25% (USDA-AMS, 2024). Despite this shift, most differentiated value-based marketing programs continue to emphasize Choice carcasses, with Prime often treated as a single, undifferentiated category. As Prime

availability grows, there is an opportunity to better characterize and capture added value from variations within the Prime grade. However, minimal research has been done to evaluate consumers' perceptions of upper 2/3 Prime steaks when compared to other quality grades. Therefore, the objective of this study was to evaluate consumer palatability preferences in strip loin steaks of upper 2/3 Prime when compared to Low Prime, upper 2/3 Choice, and Low Choice.

Experimental Procedures

An equal number ($n = 15$) of beef strip loins representing four marbling categories were collected from a commercial packing facility. The marbling categories represented were: Super Prime (moderately abundant and abundant); Low Prime (slightly abundant); Top Choice (modest and moderate), and Low Choice (small). Subprimals were fabricated into 1-in.-thick steaks and vacuum packaged. Additionally, steaks were designated to one of three degrees of doneness (DOD): Rare (140°F), Medium (160°F), and Well-done (170°F). Upon reaching the designated aging period of 28 days, steaks were frozen at -4°F until subsequent analyses.

Consumers ($n = 192$) evaluated samples for juiciness, tenderness, flavor, and overall liking on a 100-point continuous line scale. Anchors were designated on both ends as well as at the midway point with descriptive terms for each, with 0 being extremely dry, tough, and dislike extremely, and 100 being extremely juicy, tender, and like extremely. Consumers were then asked an additional question to determine if the sample was acceptable or unacceptable for each of the sensory traits evaluated. Responses were recorded using a digital survey on an electronic tablet. Steaks designated for consumer panels were thawed at $34\text{--}39^{\circ}\text{F}$ for 24 hours before testing. Steaks were then cooked to their respective assigned DOD on an electric flat top grill utilizing a weighted (4.56 lb) steak press. Temperatures were monitored using a Type K thermocouple. Rare steaks were flipped at 80°F and pulled at 127°F for a peak temperature of 140°F . For a Medium DOD, steaks were flipped at 86°F and pulled from the grill at 154°F for a peak temperature of 160°F . Well-done steaks were flipped at 90°F and pulled at 165°F for a peak temperature of 170°F . Consumers were served two $0.5 \times 0.5 \times 1.0$ in. cubes per sample. All final peak temperatures were collected. Data were analyzed using a split-plot design in SAS, with quality grade as the whole plot factor and DOD as the subplot factor. Alpha was set at 0.05.

Results and Discussion

Table 1 shows consumer sensory ratings. There were no ($P > 0.05$) interactions between quality grade and DOD for any consumer-evaluated traits. When evaluating the main effect of quality grade, Super Prime steaks were juicier, more tender, and rated higher for flavor and overall liking ($P < 0.05$) than all other grades (Table 1). Super Prime samples were rated 19% higher than Low Prime samples for juiciness, 15% higher for tenderness, 13% higher for flavor liking, and 14% higher for overall liking. No differences ($P > 0.05$) were observed among Low Prime, Top Choice, and Low Choice for juiciness, flavor, and overall liking (Table 1). Tenderness ratings were similar ($P > 0.05$) between Low Prime and Top Choice and between Top Choice and Low Choice. However, Low Prime steaks rated higher ($P < 0.05$) compared to Low Choice steaks for tenderness (Table 1).

Table 2 shows the percentage of samples identified as acceptable for each palatability trait. A higher percentage of Super Prime steaks were rated as acceptable ($P < 0.05$)

for juiciness, tenderness, flavor, and overall liking than all lower grades (Table 2). Super Prime had more than 93% of all samples rated acceptable for all traits evaluated by consumers. No differences ($P > 0.05$) were found in the percentage of samples rated acceptable for tenderness between Low Prime and Top Choice steaks and Top Choice and Low Choice steaks (Table 2). However, a higher percentage ($P < 0.05$) of consumers rated Low Prime steaks as acceptable for tenderness than Low Choice steaks (Table 2).

When evaluating the main effect of DOD, Rare steaks were juicier, more tender, and rated higher overall ($P < 0.05$) than Medium and Well-done steaks (Table 1). However, Medium and Well-done steaks rated similarly ($P > 0.05$) for juiciness, tenderness, and overall liking. No differences ($P > 0.05$) were found between Rare and Medium steaks, and Medium and Well-done steaks for flavor liking. However, Rare steaks were rated higher ($P < 0.05$) than Well-done steaks for flavor liking (Table 1). Additionally, a higher percentage ($P < 0.05$) of Rare steaks were rated as acceptable for juiciness than Medium steaks, and a higher ($P < 0.05$) percentage of Medium steaks were rated as acceptable for juiciness than Well-done steaks (Table 2). A higher percentage ($P < 0.05$) of Rare steaks were rated as acceptable for tenderness than Medium and Well-done steaks. However, there was no difference ($P > 0.05$) in the percentage of Medium and Well-done steaks that were rated acceptable for tenderness (Table 2). For overall acceptability, no differences ($P > 0.05$) were found in the percentage of samples rated acceptable between Rare and Well-done steaks or between Well-done and Medium. However, a higher percentage ($P < 0.05$) of Well-done steaks were rated as acceptable than Medium for overall acceptability (Table 2). The DOD had no effect ($P > 0.05$) on the percentage of samples rated acceptable for flavor liking.

Implications

These results indicate that consumers preferred the eating quality of upper 2/3 Prime steaks over the other grades evaluated and support the need for a premium program within the Prime grade, offering the beef industry a valuable opportunity to capture added value from this highest grade within beef.

References

USDA-AMS. 2024. Historical Beef Grading Data. <https://www.ams.usda.gov/reports/meat-grading>

Table 1. Least squares means of consumer (n = 64/degree of doneness) panel palatability ratings¹ for strip loin steaks across four marbling categories and three degrees of doneness

Treatment	Juiciness	Tenderness	Flavor liking	Overall liking
Quality grade ²				
Super Prime	74.3 ^a	75.6 ^a	70.6 ^a	73.6 ^a
Low Prime	62.5 ^b	65.6 ^b	62.5 ^b	64.4 ^b
Top Choice	60.0 ^b	60.5 ^{bc}	60.9 ^b	61.8 ^b
Low Choice	59.4 ^b	59.5 ^c	59.9 ^b	60.9 ^b
SEM ⁴	2.0	2.1	1.6	1.8
<i>P</i> -value	< 0.01	< 0.01	< 0.01	< 0.01
Degree of doneness ³				
Rare	69.0 ^a	69.3 ^a	66.9	69.4 ^a
Medium	63.6 ^b	63.3 ^b	60.9	62.8 ^b
Well-done	59.5 ^b	63.3 ^b	62.7	63.3 ^b
SEM ⁴	2.4	1.8	1.9	1.7
<i>P</i> -value	< 0.01	0.02	0.08	< 0.01

^{abc} Least squares means within the same section of the same column without a common superscript differ ($P < 0.05$).

¹ Sensory scores: 0 = extremely dry/tough/dislike extremely, 50 = neither dry nor juicy, neither tough nor tender, neither like nor dislike, 100 = extremely juicy/tender/like extremely.

² Marbling scores: Super Prime - Moderately Abundant, Abundant, and Very Abundant ; Low Prime - Slightly Abundant ; Top Choice - Moderate and Modest ; Low Choice - Small.

³ Degrees of doneness: Rare - 140°F, Medium - 160°F, and Well-done - 170°F.

⁴ Standard error (largest) of the least square means.

Table 2. Least-squares means (n = 64/degree of doneness) of the percentage of samples rated as acceptable¹ for each palatability trait evaluated by consumers for strip loin steaks across four marbling categories and three degrees of doneness

Treatment	Juiciness acceptability	Tenderness acceptability	Flavor acceptability	Overall liking acceptability
Quality grade²				
Super Prime	95.8 ^a	95.2 ^a	93.2 ^a	95.5 ^a
Low Prime	86.6 ^b	90.7 ^{ab}	84.4 ^b	87.5 ^b
Top Choice	84.8 ^b	86.8 ^b	86.1 ^b	85.1 ^b
Low Choice	81.3 ^b	85.3 ^b	84.2 ^b	84.7 ^b
SEM ⁴	3.4	2.8	2.3	2.4
<i>P</i> -value	< 0.01	< 0.01	< 0.01	< 0.01
Degree of doneness³				
Rare	93.9 ^a	93.6 ^a	89.4	92.4 ^a
Medium	87.7 ^b	87.1 ^b	84.7	85.6 ^b
Well-done	80.9 ^c	89.0 ^b	88.2	88.8 ^{ab}
SEM ⁴	2.4	1.9	1.8	1.9
<i>P</i> -value	< 0.01	< 0.01	0.10	< 0.01

^{abc} Least squares means within the same section of the same column without a common superscript differ ($P < 0.05$).

¹ Percentage of samples rated acceptable for the palatability trait by consumer sensory panelists.

² Marbling scores: Super Prime - Moderately Abundant, Abundant, and Very Abundant ; Low Prime - Slightly Abundant ; Top Choice - Moderate and Modest ; Low Choice - Small.

³ Degrees of doneness: Rare - 140°F, Medium - 160°F, and Well-done - 170°F.

⁴ Standard error (largest) of the least square means.