Consumer Sensory Evaluation of the Impact of Bone-In Versus Boneless Cuts on Beef Palatability

K.J. Farmer, E.S. Beyer, S.G. Davis, K.M. Harr, M.D. Chao, J.L. Vipham, M.D. Zumbaugh, and T.G. O'Quinn

Abstract

Palatability traits of ribeye, strip loin, and tenderloin steaks were evaluated in a bone-in versus boneless scenario. Eating quality of these cuts was also evaluated in a high quality (upper 2/3 U. S. Department of Agriculture Choice) and a lower quality (USDA Select) product to evaluate the interactions of marbling level and bone state. Subprimal cuts were collected from both sides of 12 beef carcasses per quality grade and aged for 28 days. Product was fabricated into 1-in thick steaks and randomly designated for consumer sensory analysis. Bone state had no impact ($P > 0.05$) on consumer tenderness and flavor ratings for any of the three cuts. However bone-in strip loin samples were rated juicier and higher ($P < 0.05$) overall than boneless strip loin steaks by consumers. Tenderloin steaks were juicier, more tender, more flavorful, and rated higher overall ($P < 0.05$) than ribeye steaks and boneless strip loin steaks by consumers. Furthermore, there were no differences ($P > 0.05$) between strip loins and ribeyes for flavor liking by consumers and no difference ($P > 0.05$) in overall liking rating between ribeyes and boneless strip loin steaks. Overall, bone status had a minimal impact on beef palatability traits, providing evidence that eating quality is not greatly impacted by bone status for any of the cuts evaluated.

Introduction

Millennials have coined the term "foodie" to describe those who have a passion for eating and learning about the overall eating experience (Ulver, 2019). As a result, these consumers prefer the aesthetic and visual stimulation that bone-in beef cuts offer in comparison to boneless alternatives (Bass, 2018). Moreover, bone-in cuts are believed to have a more flavorful eating experience for consumers (Chicago Steak Company, 2016; Lopez, 2018; Goldwyn, 2021).

Previous research evaluating bone-in versus boneless cuts is limited and has produced mixed results related to eating quality. Therefore, the objective of the current study was to evaluate palatability traits of beef cuts (ribeye, strip loin, tenderloin) in a bone-in versus boneless scenario and compare the palatability characteristics of these cuts in a high quality (upper 2/3 USDA Choice) and a lower quality (USDA Select) product to evaluate the interactions of marbling level and bone state.

Experimental Procedures

Left and right sides of 12 beef carcasses representing USDA Choice (upper 2/3) and USDA Select quality grades were selected by trained Kansas State University personnel at a commercial packing plant in the Midwest. Paired (n = 12 pairs; 24 total/cut/grade) beef short loins, bone-in ribeye rolls, and boneless ribeye rolls were vacuum packaged and transported to the Kansas State University Meat Laboratory. Short loins were fabricated into either a boneless strip loin with a corresponding bone-in tenderloin or a bone-in strip loin with a paired boneless tenderloin at 3 days postmortem. Product was then vacuum-packaged and aged for 28 days at 32–39°F. Frozen subprimal cuts were then fabricated into 1-in thick steaks using a band saw. Steaks were cooked to a peak temperature of 160°F (medium) on clamshell style griddles and temperatures were monitored using a probe thermometer. Samples were cut into 1-in thick × 0.4-in × 0.4-in cuboids, and 2 pieces were served to untrained panelists. Consumer sensory panelists (n = 144) were recruited from Manhattan, KS, and the surrounding area and monetarily compensated for their participation in the study. Panels were conducted in a lecture-style classroom at Kansas State University. Testing followed procedures previously described McKillip et al. (2017), Nyquist et al. (2018), and Davis et al. (2021). Consumers evaluated samples for juiciness, tenderness, flavor liking, beef-like flavor intensity, and overall liking on 100-point continuous line scales anchored on both ends with descriptive terms. Additionally, panelists were asked to classify each sample as acceptable or unacceptable for each of the sensory traits previously listed and to assess the quality of the sample by identifying if the sample was unsatisfactory, everyday quality, better than everyday quality, or premium quality. Consumer sensory panelists recorded their responses using a digital survey (Qualtrics Software, Provo, UT) on an electronic tablet (Lenovo TB-8505F).

Results and Discussion

There were no ($P > 0.05$) interactions found between quality grade and cut/bone state for any of the traits evaluated by consumers. The means for the main effects of quality grade and cut/bone state are reported in Table 1. When evaluating the main effect of quality grade, all Choice steaks were rated higher ($P < 0.05$) than Select steaks for juiciness, tenderness, flavor, and overall liking. Bone state had no impact ($P > 0.05$) on consumer ratings of juiciness and overall liking for tenderloins and ribeyes, but in the strip loin, bone-in steaks were rated juicier ($P < 0.05$) and higher ($P < 0.05$) for overall liking when compared to boneless steaks. Moreover, bone state had no impact ($P > 0.05$) on consumer ratings of tenderness and flavor ratings for any of the three cuts. Regardless of bone state, tenderloin steaks were juicier, more tender, more flavorful, and rated higher overall ($P < 0.05$) than ribeyes and boneless strip loin steaks. However, bone-in strip loin steaks were similar ($P > 0.05$) in juiciness to bone-in tenderloins. There were no differences ($P > 0.05$) between strip loins and ribeyes for flavor liking. Additionally, boneless ribeye steaks were similar ($P > 0.05$) to bone-in and boneless strip loin samples for tenderness and similar ($P > 0.05$) to boneless strip loins for overall liking ratings.

Consumers were also asked to rate palatability traits as either acceptable or unacceptable as they were evaluating each sample (Table 1). No ($P > 0.05$) interactions were found between quality grade and cut/bone state. Choice steaks had a higher ($P < 0.05$) percentage of consumers that rated juiciness as acceptable when compared to Select steaks. But quality grade did not impact ($P > 0.05$) the percentage of samples rated

acceptable by consumers for tenderness, flavor, and overall acceptability. Furthermore, bone state had no impact ($P > 0.05$) on the percentage of consumers that rated juiciness as acceptable for tenderloins and ribeyes, but in strip loins, bone-in steaks had a higher ($P < 0.05$) percentage of acceptable consumer responses than boneless cuts. The percentage of acceptable samples for tenderness and overall acceptability were not ($P > 0.05$) impacted by bone state in tenderloins and strip loins; however, in ribeyes, the percentage of acceptable consumer ratings was higher ($P < 0.05$) for bone-in cuts for both traits. Tenderloins had a higher ($P < 0.05$) percentage of acceptable ratings for tenderness than strip loins and ribeyes. Likewise, tenderloins also had a higher ($P < 0.05$) percentage of acceptable ratings for juiciness and overall acceptability when compared to boneless strip loins and boneless ribeyes. Strip loin and ribeye steaks had similar ($P > 0.05$) percentages of acceptable juiciness ratings, except for boneless strip loins, which had lower ($P < 0.05$) percentages than either bone-in cut.

Additionally, consumer panelists were asked to identify the quality level at which they perceived each sample (Table 1). Once again, there were no ($P > 0.05$) interactions observed between quality grade and cut/bone state. Likewise, no ($P > 0.05$) quality grade effects were observed for the percentage of steaks rated as unsatisfactory, everyday, and premium quality. However, a greater ($P < 0.05$) percentage of Choice samples were rated as better than everyday quality compared to Select. Moreover, bone state did not ($P > 0.05$) impact quality perception on strip loin and tenderloin samples. Bone state also did not ($P > 0.05$) impact premium, better than everyday, and everyday quality perceptions among ribeyes; but the percentage of consumers rating ribeye samples unsatisfactory was higher ($P < 0.05$) for boneless ribeye steaks. Fewer ($P < 0.05$) samples from tenderloins were perceived as unsatisfactory quality when compared to boneless strip loin and ribeye steaks. Likewise, a greater ($P < 0.05$) percentage of consumer ratings for tenderloin samples were perceived as premium quality than either of the other cuts.

Implications
The results observed within palatability traits show that regardless of bone state, bone-in and boneless cuts of the same muscle are rated similarly by panelists. This indicates that a similar overall eating experience could be derived from a boneless or bone-in steak from the same cut and quality grade.

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Table 1. Least squares means for consumer sensory panel ratings, percentage of samples rated acceptable, and perceived quality level for strip loin, tenderloin, and ribeye steaks of varying bone states and USDA quality grade[1]

Trait	Strip loin Bone-In	Strip loin Boneless	Tenderloin Bone-In	Tenderloin Boneless	Ribeye Bone-In	Ribeye Boneless	SEM[2]	P-value	Choice	Select	SEM[2]	P-value
Palatability rating[3]												
Juiciness rating	58.5[bc]	51.1[d]	63.7[ab]	66.6[a]	57.2[cd]	52.7[cd]	2.5	< 0.01	66.7[a]	54.0[b]	1.8	< 0.01
Tenderness rating	53.1[bc]	49.7[c]	73.5[a]	78.4[a]	56.5[b]	51.2[bc]	2.6	< 0.01	64.9[a]	55.9[b]	1.9	< 0.01
Flavor rating	59.7[b]	55.6[b]	66.2[a]	64.7[a]	58.3[b]	56.0[b]	2.2	< 0.01	63.0[a]	57.1[b]	1.7	< 0.01
Overall like rating	60.0[b]	53.2[c]	69.0[a]	72.2[a]	58.2[bc]	54.5[c]	2.4	< 0.01	65.2[a]	57.2[b]	1.9	< 0.01
Acceptability rating[4]												
Juiciness acceptability	83.7[ab]	72.1[c]	87.5[a]	89.0[a]	81.7[ab]	76.1[bc]	0.04	< 0.01	87.3[a]	76.3[b]	0.03	< 0.01
Tenderness acceptability	77.3[bc]	74.2[c]	95.0[a]	96.9[a]	83.8[b]	70.1[c]	0.04	< 0.01	89.7	82.8	0.03	0.08
Flavor acceptability	86.1	79.2	87.2	85.6	82.9	79.1	0.03	0.20	85.4	81.7	0.02	0.20
Overall acceptability	84.6[abc]	78.1[cd]	91.2[a]	89.1[ab]	82.2[bc]	73.4[d]	0.04	< 0.01	86.7	80.7	0.03	0.08
Perceived quality level[5]												
Unsatisfactory	13.6[bc]	15.5[ab]	7.2[cd]	6.8[d]	15.0[b]	23.4[a]	0.04	< 0.01	9.9	16.0	0.03	0.07
Everyday	50.9[a]	55.8[a]	37.0[b]	34.2[b]	57.2[a]	47.4[a]	0.04	< 0.01	43.0	51.0	0.03	0.09
Better than everyday	28.2[abc]	20.9[c]	31.6[ab]	33.8[a]	19.4[c]	23.6[bc]	0.04	0.02	31.0[a]	21.3[b]	0.03	0.02
Premium	4.5[b]	2.0[b]	21.4[a]	23.0[a]	6.4[b]	3.8[b]	0.04	< 0.01	9.5	5.3	0.02	0.10

[abcd]Least squares means in the same section of the same row without a common superscript differ ($P < 0.05$).

[1]Quality grade: Choice = USDA Choice (upper 2/3) with marbling scores ranging from modest[00] to moderate[100]. Select = USDA Select with marbling scores ranging from slight[00] to slight[100].

[2]Standard error of the mean (largest) of the least square means in the same section of the same row.

[3]Sensory scores: 0 = extremely dry/tough/extremely bland; 50 = neither dry nor juicy/neither tough nor tender; 100 = extremely juicy/tender/extremely intense.

[4]Percentage of samples rated as acceptable (yes/no) by consumer sensory panelists.

[5]Percentage of samples classified at various quality levels by consumer sensory panelists.