K-STATE Research and Extension

CATTLEMEN'S DAY 2025

KANSAS STATE UNIVERSITY CATTLEMEN'S DAY

The Effects of Aging Time on the Eating Quality of *Gluteus Medius* Steaks

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Abstract

The objective of this study was to determine the palatability characteristics and color traits of *gluteus medius* steaks aged 14, 28, 35, 42, 49, 56, 63, and 70 days. Beef top sirloin butt subprimals were collected and designated to one of the eight aging time periods. Once the subprimals reached their respective aging period, the *gluteus medius* was fabricated into 1-in thick steaks and frozen. The steaks were designated to consumer sensory panels, Warner-Bratzler Shear Force (WBSF), raw color evaluation, or cooked color evaluation. Raw steaks bloomed for 30 minutes before color data were collected. Steaks were cooked to 160°F, sliced at a 45° angle, and bloomed for 3 minutes before internal cooked temperature readings were taken. Samples were cooled for 24 hours before WBSF evaluation. For consumer sensory panels, steaks were cooked to an internal temperature of 160°F before being served. Consumers evaluated samples for overall liking, juiciness liking, tenderness liking, and flavor liking. Results showed that consumers found no difference ($P > 0.05$) among aging treatments for juiciness, tenderness, flavor, or overall liking. Although there were no differences ($P > 0.05$) in the percentage of samples rated acceptable for juiciness, tenderness, flavor, or overall liking, all treatments had, at minimum, 83% of samples rated overall acceptable by the consumers. Additionally, there were no differences ($P > 0.05$) in cooking loss, cooked L^* (lightness), a^* (redness), b^* (yellowness), deoxymyoglobin, oxymyoglobin, metmyoglobin, chroma, or hue angle among all treatments. Steaks that were aged for 14 days had a higher ($P < 0.05$) WBSF value than all other treatments. Steaks aged 63 and 70 days were more tender ($P < 0.05$) than samples aged for 42 days or less. Therefore, these results indicate that extending the aging time of *gluteus medius* steaks has limited impact on the palatability and color characteristics of the steaks.

Introduction

Beef palatability is often conceptualized as a three-legged stool consisting of tenderness, flavor, and juiciness. All of these attributes are important to the overall eating experience for consumers. Studies have shown that flavor significantly influences consumer satisfaction and is often prioritized over tenderness and juiciness when evaluating beef quality (Lucherk et al., 2016, O'Quinn et al., 2018).

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Steaks consisting of the *longissimus dorsi* muscle, such as the ribeye and strip steak, have historically been viewed as higher quality and sold for a premium. However, as the cost of meat products continues to rise, consumers are looking for cheaper alternatives with the same eating experience. Previous work has shown top loin steaks and top sirloin steaks have similar customer ratings across most consumer attributes, including overall likeability (Miller et al., 2018). Other studies have reported similar results for top loin and sirloin steaks (Glascock, 2014, Luckemeyer, 2015, and Laird, 2015). Postmortem aging of beef is a common practice to enhance beef eating quality, specifically as it relates to tenderness. However, few studies have evaluated the effects of aging on the palatability of the *gluteus medius*. Therefore, the objective of this study was to determine the palatability characteristics and color traits of *gluteus medius* steaks aged 14, 28, 35, 42, 49, 56, 63, and 70 days.

Experimental Procedures

Beef top sirloin butt subprimals (n = 80) were collected from a commercial packing facility 48 hours postmortem and aged for 14, 28, 35, 42, 49, 56, 63, and 70 days at 35.6-39.2°F in vacuum packaging as whole subprimals. Once the subprimals reached their designated age time, the *gluteus medius* and *biceps femorus* were separated and fabricated into 1-in thick steaks. The steaks were then vacuum packaged and frozen. All steaks were designated for either consumer sensory panels, Warner-Bratzler Shear Force (WBSF), raw color evaluation, or cooked color evaluation. Steaks were thawed for 24 hours at 34-39°F prior to all analyses and assays. Steaks used for WBSF were removed from the package and allowed approximately 30 minutes to bloom. After the 30-minute bloom time, raw L^* (lightness), a^* (redness), b^* (yellowness), and spectra data were collected using a Hunter Lab MiniScan spectrophotometer (Illuminant A, 10° observer, 1-in aperture). The data collected from these readings were used to calculate the percent deoxymyoglobin (DMb), oxymyoglobin (OMb), and metmyoglobin (MMb), chroma, and hue angle according to the AMSA Guidelines for Meat Color Measurement. All steaks were cooked on a flat top griddle to an internal temperature of 160°F. In preparation for WBSF and color evaluation, the steaks were sliced at a 45° angle parallel to the muscle fiber orientation and allowed to bloom for an additional 3 minutes post-cooking before measuring internal cooked color, using the same technique that was used for raw color. Samples were cooled at 33.8-39.2°F for 24 hours before WBSF evaluation. Steaks were weighed prior to cooking and after cooking to calculate the percentage of cook loss. Steaks designated for consumer sensory panels were cooked to an internal temperature of 160°F, sliced into 3 pieces approximately 2-in × 2-in in size, and served to consumers. Consumers (n = 96) evaluated five samples of varying age times for overall liking, juiciness liking, tenderness liking, and flavor liking. These traits were evaluated on a 10-point line scale with 1 being dislike extremely, and 10 being like extremely. Additionally, each sample was evaluated for acceptability of each trait (acceptable/unacceptable).

Results and Discussion

Table 1 shows that consumers found no difference ($P > 0.05$) among aging treatments for juiciness, tenderness, flavor, or overall liking. Although there were no differences ($P > 0.05$) in the percentage of samples rated acceptable for juiciness, tenderness, flavor, or overall liking, all treatments had, at minimum, 83% of samples rated overall acceptable by the consumers as shown in Table 2. Additionally, Table 3 shows there were no differences ($P > 0.05$) in cooking loss, cooked L^*, a^*, b^*, DMb, OMb, MMb,

chroma, or hue angle among all treatments. Steaks that were aged for 14 days had a higher ($P < 0.05$) WBSF value than all other treatments. Steaks aged 63 and 70 days were more tender ($P < 0.05$) than samples aged for 42 days or less. Although there were differences found in raw color, there were few evident trends. Steaks that were aged 14, 49, and 56 days were redder ($P < 0.05$) than those aged for 63 and 70 days. Steaks aged for 14 days were darker ($P < 0.05$) than steaks aged for 49 days or more. Although there were no differences ($P > 0.05$) in raw calculated MMb, there were differences ($P < 0.05$) in DMb, with values being higher in 14, 35, 49, and 56 days than 63 and 70 days. Furthermore, OMb was higher ($P < 0.05$) at 63 days than at 14, 35, 42, and 56 days.

Implications

There was no impact on palatability traits evaluated by consumers through aging *gluteus medius* steaks from 14 to 70 days. However, increased aging time was associated with improved shear force values and steaks lighter in color. Therefore, these results indicate that extending the aging time of *gluteus medius* steaks has limited impact on the palatability and color characteristics of the steaks.

Acknowledgments

This project was funded by the Beef Checkoff.

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Table 1. Least-square means for consumer (n = 96) panel palatability ratings for *gluteus medius* steaks across eight aging treatments

Aging period	Overall liking[1]	Flavor liking[1]	Juiciness liking[1]	Tenderness liking[1]
14	5.9	5.9	5.8	5.7
28	6.0	5.6	5.4	5.6
35	6.3	6.2	5.8	5.8
42	6.7	6.2	6.4	6.4
49	6.2	5.9	5.9	6.3
56	6.7	6.5	6.4	6.7
63	6.5	6.1	5.7	6.4
70	6.2	5.9	5.5	6.4
SEM[2]	0.35	0.41	0.36	0.44
P-value	0.29	0.59	0.30	0.32

[1]Sensory scores: 1 = dislike extremely, 5 = neither like nor dislike, 10 = like extremely.
[2]Standard error of the mean (largest) of the least square means.

Table 2. Least-squares means (n = 12/aging treatment) for the percentage of consumers who rated each palatability trait as acceptable[1] for *gluteus medius* steaks

Aging period (days)	Overall acceptability[2]	Flavor acceptability[2]	Juiciness acceptability[2]	Tenderness acceptability[2]
14	83.0	87.1	78.8	84.3
28	86.9	76.5	70.7	84.6
35	87.6	88.2	85.9	75.4
42	89.6	91.4	81.8	87.3
49	83.2	82.0	76.2	83.1
56	92.6	88.3	90.3	92.5
63	93.6	89.4	82.7	91.8
70	90.7	85.3	79.2	83.3
SEM[3]	5.3	4.9	4.4	5.5
P-value	0.51	0.41	0.31	0.33

[1]Acceptability asked as a yes/no question with yes being acceptable and no being unacceptable.
[2]Percentage of samples rated acceptable for that particular trait by consumer sensory panelists.
[3]Standard error of the mean (largest) of the least square means.

Table 3. Least-square means for *L (lightness), *a** (redness), and *b** (yellowness) values, percentage of myoglobin content, chroma, hue angle, cooking loss, and Warner-Bratzler Shear Force (WBSF) for raw and cooked *gluteus medius* steaks**

Aging period (days)	Cook loss	WBSF	*L**[1]	*a**[2]	*b**[3]	Metmyo-globin	Oxymyo-globin	Deoxymyo-globin	Chroma	Hue angle
Raw										
14			40.64^{d}	21.53^{a}	19.16^{a}	5.33	39.95^{bcd}	54.76^{a}	28.83^{a}	0.73^{abc}
28			41.30^{cd}	19.97^{ab}	18.06^{ab}	5.61	40.84^{abc}	53.54^{ab}	26.93^{a}	0.74^{abc}
35			42.85^{bcd}	20.21^{a}	17.01^{bcd}	6.03	36.87^{cd}	57.10^{a}	26.43^{ab}	0.70^{c}
42			42.60^{bcd}	19.77^{ab}	17.81^{ab}	5.69	39.94^{bcd}	54.37^{ab}	26.63^{ab}	0.73^{abc}
49			44.57^{ab}	21.23^{a}	17.68^{abc}	5.71	35.17^{d}	59.17^{a}	27.66^{a}	0.70^{c}
56			46.30^{a}	20.78^{a}	18.10^{ab}	5.33	35.79^{cd}	58.91^{a}	27.58^{a}	0.72^{bc}
63			44.81^{ab}	16.11^{c}	15.55^{d}	7.48	46.17^{a}	46.35^{c}	22.48^{c}	0.77^{a}
70			43.36^{bc}	17.01^{bc}	15.69^{cd}	7.16	44.60^{ab}	48.23^{bc}	23.15^{bc}	0.75^{ab}
SEM[4]			0.87	1.12	0.74	0.70	1.97	2.26	1.28	0.02
P- value			<0.01	0.01	0.01	0.22	<0.01	<0.01	0.01	0.02
Cooked										
14	29.21	4.25^{a}	48.30	20.10	32.87	1.69	29.79	64.32	28.91	0.81
28	29.71	3.57^{bc}	50.51	19.50	29.35	0.51	39.19	66.19	28.08	0.82
35	28.32	3.69^{b}	50.03	20.74	28.17	0.02	38.69	68.41	29.86	0.81
42	27.85	3.43^{bc}	50.96	18.37	27.51	0.23	42.72	68.06	27.58	0.86
49	30.12	3.28^{cbd}	50.90	17.92	30.11	0.44	41.61	63.66	27.06	0.85
56	26.00	2.89^{d}	50.38	18.70	26.96	0.43	42.70	68.45	28.68	0.84
63	26.97	3.09^{cd}	51.36	18.11	29.27	0.05	42.88	67.82	26.99	0.86
70	26.97	2.86^{d}	49.21	18.64	29.62	0.11	42.11	66.11	28.60	0.83
SEM[4]	1.70	0.18	0.9	0.99	2.48	0.58	1.84	1.88	1.09	0.02
P- value	0.58	<0.01	0.26	0.4	0.78	0.50	0.51	0.42	0.58	0.60

^{abc}Means within the same section of the same column lacking a common superscript differ ($P < 0.05$).

[1]L*: 0 = black, 100 = white.

[2]a*: -60 = green, 60 = red.

[3]b*: -60 = blue, 60 = yellow.

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