Location and cutting style influence on beef bottom round (biceps femoris) steak tenderness and display color attributes

Meat Science and Technology Center
College of Agricultural & Environmental Sciences
UNIVERSITY OF GEORGIA

#115

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Introduction

- The biceps femoris has been previously identified as a possible value-added cut
- Varying fiber orientation within the muscle negatively impacts tenderness using traditional cutting methods
  - Proximal to distal cutting results in cutting parallel to muscle fiber orientation
- Previous work has shown when fabrication is reoriented to the fiber orientation tenderness is improved

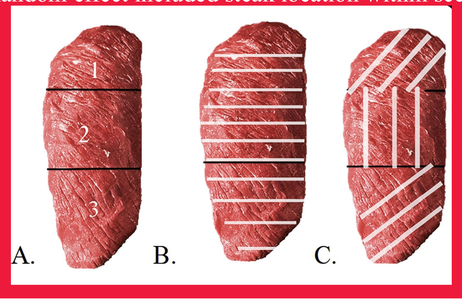
Objective

- To evaluate an economical change in cutting methods of the beef bottom round to understand which locations are best suited to increase steak yields and maximize tenderness and color shelf life

Figure 1. Cutting techniques for optimizing tenderness of the biceps femoris
A– Black lines mark approximate location were the biceps femoris will be separated into thirds based on predominant fiber direction; 1 = Dorsal, 2 = Medial, 3 = Distal. B-White lines mark the traditional fabrication marks to cut into steaks. C- White lines mark the innovative steak fabrication method

Methodology

- Sixty paired IMPS 171B beef bottom rounds were selected at 3 d postmortem- 15 USDA Prime carcasses (**PR**) and 15 USDA Low Choice carcasses (**LC**)
- At 14 d postmortem, bottom rounds were fabricated by removing the ischiatic head and separated into 3 sections
  - **S1**- Dorsal, **S2**- Medial, **S3**- Distal (Figure 1A)
  - Right side (**RS**) were fabricated perpendicular to the muscles' long axis (Figure 1B)
  - Left side (**LS**) were fabricated perpendicular to each sections predominant muscle fiber orientation (Figure 1C)
- Steaks for WBSF ~ medium rare (63°C) degree of doneness
- Retail display steaks were placed in Hussman open top coffin cases for 5 d simulated display (2 ± 2°C) under continuous light (lux ≅ 1781)
  - CIE L^*, a^*, and b^* and spectral measurements recorded daily
  - Hue angle, chroma, ΔE, and proportions of oxy-, met-, and deoxymyoglobin were calculated
- Data were analyzed using a split-split-plot
  - Carcass: whole plot, Respective side: sub-plot, section within muscle: sub-sub-plot
  - Fixed effects included quality grade (**QG**), fabrication, section location and day
  - Random effect included steak location within section



Results

Water Losses

- Steaks fabricated traditionally lost more moisture thawing than steaks alternatively fabricated ($P < 0.01$; Figure 2)
- There was a fabrication × QG interaction for percent cook loss ($P = 0.05$; Figure 3) where RS-LC steaks exhibited greater cook loss than LS-LC ($P = 0.03$)

WBSF

- There was a fabrication × section interaction ($P = 0.05$) for WBSF where RS-S2 steaks were less tender ($P \leq 0.01$) than all other steaks. Overall, steaks fabricated traditionally and from S2 were less tender ($P < 0.01$). Steaks from S1 and S3 exhibited similar WBSF ($P = 0.50$; Figure 4)

Instrumental Color

Fabrication effects:

- For chroma on d1,2, and 3 where RS steaks were more saturated ($P < 0.05$; Table 1) than LS
- For ΔE, there was an effect on d1, 2, 3, and 4 as LS steaks had greater ($P < 0.05$) change compared to RS

Section effects;

- Effects for a^* were different on d1, 2, and 5 ($P < 0.04$; Table 2). On d1 and 2, S3 steaks were less red ($P < 0.05$) than S1, and on d5 S2 was redder than S3 ($P < 0.05$). On d1 and 2, RS steaks were lighter ($P < 0.05$) compared to LS steaks. Steaks from RS had greater ($P < 0.05$) a^* on d1, 2, 3, and 4 compared to LS
- For ΔE on d5, there was an effect as S3 had greater ($P < 0.05$) change compared to S2
- There was a chroma effect on d1 and 2, where S1 steaks were greater ($P < 0.05$) than S3. On d5, S2 steaks were greater ($P > 0.05$) than S3

QG effects:

- Prime steaks had greater L^* ($P \leq 0.03$; all days) and a^* ($P \leq 0.01$; d1, 2, 3, 4, 5) than LC. On all days, S2 steaks were lighter ($P < 0.05$) compared to S1 and S3, which were similar ($P > 0.05$; Table 3) on d0,1, and 3; however, on d2, 4, and 5, S3 steaks were lighter ($P < 0.05$) than S1
- For hue, LS steaks were greater ($P < 0.05$) on all days compared to RS. On d0 and 1, S1 steaks had a lower hue value ($P < 0.05$) compared to S2 and S3. On d2, S2 was greater ($P < 0.05$) than S1, but was similar ($P > 0.05$) to S3
- There was an effect on d1, 2, 3, 4, and 5 as PR steaks were greater ($P < 0.05$) than LC.
- For ΔE, there was an effect for all days as LC steaks had greater ($P < 0.05$) change than PR

Conclusion

- Changes in fabrication based on muscle fiber orientation showed improvements in tenderness
- Dorsal and distal sections are more tender and maintain a brighter, more stable red color over this display time
- Further works needs to be done to characterize fiber type differences within the muscle and use trained sensory to further investigate tenderness differences between sections

Acknowledgements

Funding is provided in part by the Georgia Commodity Commission for Beef

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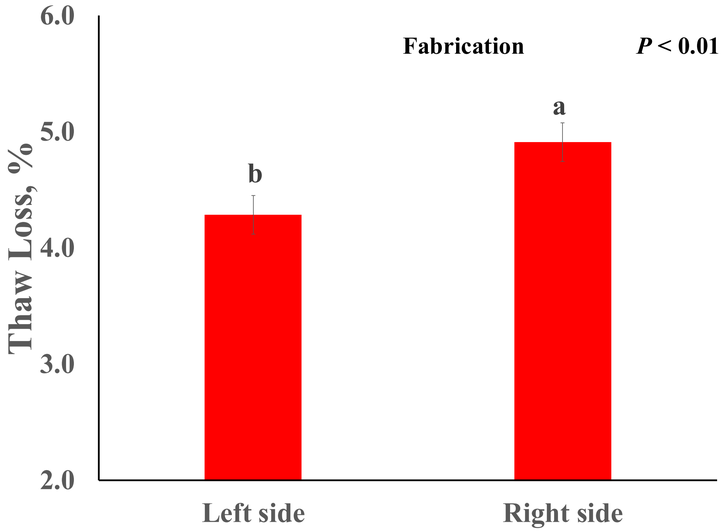

Figure 2. Main effects of fabrication method on the percent thaw loss of biceps femoris steaks

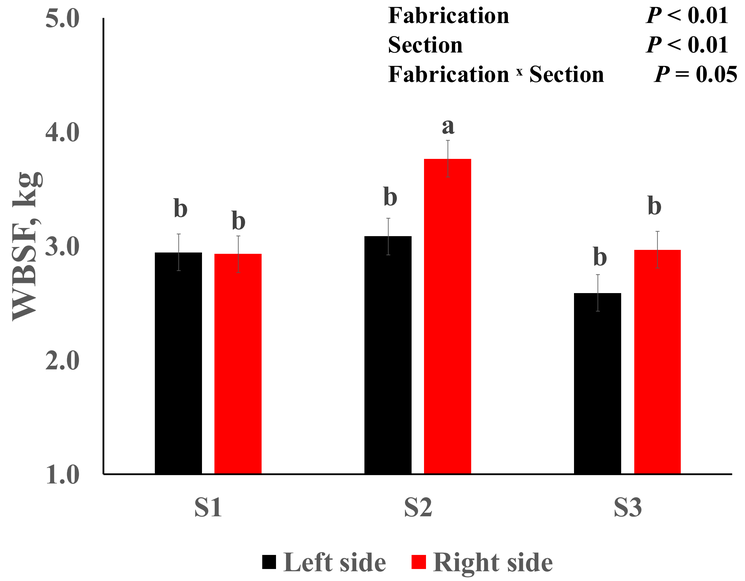

Figure 4. Effects of fabrication method and section location on the Warner-Bratzler shear force of biceps femoris steaks

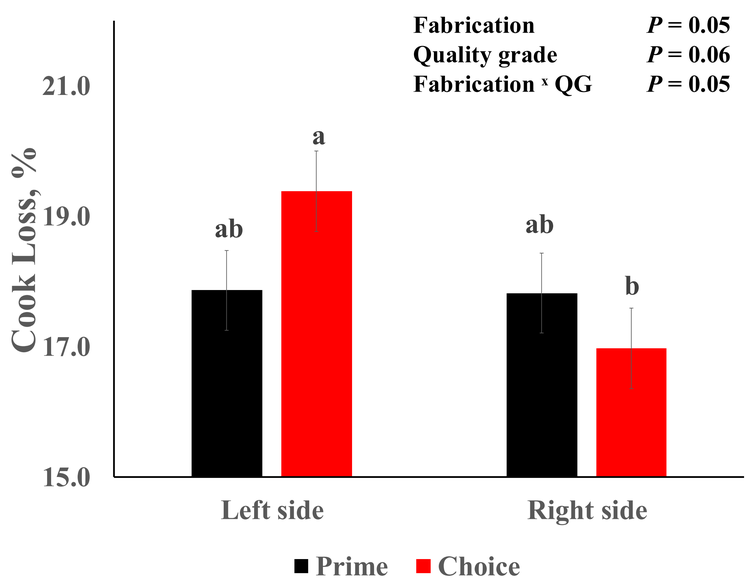

Figure 3. Effects of fabrication method and quality grade on the percent cook loss of biceps femoris steaks

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Table 1. Effects of fabrication technique on instrumental color of biceps femoris steaks during a 5-day retail display

	Day of Display												
	0		1		2		3		4		5		
Parameter	Left[1]	Right[2]	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	SEM
*L**	44.00	44.62	42.18^{b}	43.33^{a}	41.23^{b}	43.11^{a}	40.94	41.60	41.94	42.48	40.94	41.40	0.33
*a**	33.05	33.20	28.68^{b}	29.62^{a}	24.05^{b}	25.64^{a}	22.28^{a}	20.68^{b}	17.64^{b}	19.00^{a}	15.17	15.92	0.35
Chroma	42.03	42.06	37.11^{b}	37.90^{a}	31.83^{b}	33.17^{a}	28.34^{b}	29.63^{a}	25.15	26.04	23.50	23.71	0.39
Hue angle	38.13^{a}	37.89^{b}	39.37^{a}	38.61^{b}	41.02^{a}	39.41^{b}	43.38^{a}	41.38^{b}	45.72^{a}	43.42^{b}	50.08^{a}	48.22^{b}	0.49
ΔE	0	0	5.84^{a}	4.59^{b}	10.99^{a}	9.21^{b}	14.61^{a}	13.09^{b}	17.73^{a}	16.57^{b}	20.07	19.63	0.41

[a-c]Least squares means within a main effect column without a similar subscript differ ($P < 0.05$).

[1]Left sides were fabricated perpendicular to each sections predominant muscle fiber orientation.

[2]Right sides were fabricated perpendicular to the muscle's long-axis simulating traditional fabrication.

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Table 2. Effects of section location on instrumental color of biceps femoris steaks during a 5-day retail display

	Day of Display																		
	0			1			2			3			4			5			
Parameter	S1[1]	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	SEM
*L**	43.10^{b}	45.63^{a}	44.21^{b}	41.44^{b}	44.48^{a}	42.35^{b}	40.58^{c}	44.00^{a}	41.92^{b}	39.64^{b}	43.28^{a}	40.89^{b}	40.44^{c}	44.41^{a}	41.77^{b}	39.56^{c}	42.95^{a}	41.00^{b}	0.40
*a**	33.39	33.00	33.03	29.85^{a}	28.87^{b}	28.73^{b}	25.57^{a}	24.65^{ab}	24.31^{b}	22.03	21.58	20.83	18.64	18.66	17.66	15.74^{ab}	16.20^{a}	14.69^{b}	0.43
Chroma	4.20	41.97	41.96	38.16^{a}	37.34^{ab}	37.01^{b}	33.21^{a}	32.46^{ab}	31.83^{b}	29.53	29.27	28.16	25.79	26.17	24.83	23.79^{ab}	24.33^{a}	22.70^{b}	0.47
Hue angle	37.70^{b}	38.24^{a}	38.09^{a}	38.50^{b}	39.35^{a}	39.11^{a}	39.71^{b}	40.66^{a}	40.28^{ab}	41.96	42.72	42.46	44.03	44.81	44.87	48.94	48.60	49.90	0.60
ΔE	0	0	0	4.77	5.28	5.60	9.59	10.04	10.68	13.56	13.41	14.59	17.12	16.47	17.85	19.88^{ab}	18.96^{b}	20.71^{a}	0.48

$^{a\text{-}c}$Least squares means within the same day without a common subscript differ ($P < 0.05$).

[1]Dorsal (S1), Medial (S2), Distal (S3).

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Table 3. Effects of quality grade on instrumental color of biceps femoris steaks during a 5-day retail display

	Day of Display												
	0		1		2		3		4		5		SEM
Parameter	PR[1]	LC[2]	PR	LC	PR	LC	PR	LC	PR	LC	PR	LC	
*L**	44.98[a]	43.64[b]	43.59[a]	41.93[b]	42.93[a]	41.40[b]	42.04[a]	40.50[b]	43.03[a]	41.39[b]	41.68[a]	40.67[b]	0.33
*a**	33.17	33.09	29.57[a]	28.73[b]	25.47[a]	24.22[b]	22.22[a]	20.74[b]	19.00[a]	17.63[b]	16.16[a]	14.93[b]	0.35
Chroma	42.13	41.96	38.06[a]	36.95[b]	33.28[a]	31.73[b]	29.84[a]	28.14[b]	26.36[a]	24.84[b]	24.33[a]	22.88[b]	0.39
Hue angle	38.07	37.95	39.03	38.94	40.13	40.30	42.10	42.66	44.20	44.94	48.81	49.48	0.49
ΔE	0	0	4.80[b]	5.64[a]	9.43[b]	10.77[a]	13.08[b]	14.62[a]	16.44[b]	17.86[a]	19.23[b]	20.46[a]	0.41

[a-c] Least squares means within the same day without a common subscript differ ($P < 0.05$).

[1] Bottom rounds sourced from USDA Prime carcasses.

[2] Bottom rounds sourced from USDA Low Choice carcasses.