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Sensory Evaluation from Asian Consumers of Six Different Beef Shank Cuts

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Abstract

The objective of this study was to evaluate factors affecting Asian consumers' purchasing decisions and eating preferences of six different beef shank cuts. Beef shanks were collected from a Midwestern meat processor, transported to the Kansas State University Meat Laboratory (Manhattan, KS), and fabricated into different shank cuts. Six shank cuts, three from the forequarter [*biceps brachii* (shank A); a combination of *deep digital flexor* and *flexor digitorum superficialis* (shank B); and *extensor carpi radialis* (shank C)], and three from the hindquarter [*flexor digitorum superficialis* (shank D)*; deep digital flexor* (shank E)*,* and a combination of *long digital extensor, medial digital extensor,* and *peroneus tertius* (shank F)] were collected from 12 U.S. Department of Agriculture Low Choice beef carcasses. Shanks from the left side of the carcasses were used for Asian consumer taste panels, while shanks from the right sides were used for visual evaluation. Shanks A, D, and F received high sensory scores, followed by shanks C and E, with shank B receiving the lowest score among all shank cuts ($P < 0.05$). For visual overall liking, shanks A and C received the highest scores, followed by shanks B, E, and F, and shank D received the lowest score ($P < 0.05$). Consumers indicated that there was no difference in flavor and surface color among shank cuts ($P > 0.05$). All shank cuts had similar Warner-Bratzler shear force values except for shank B, which had the highest value ($P < 0.01$). For objective color measurement, shank D had the highest lightness (L*) value ($P < 0.01$), followed by shanks A, B, C, and E ($P > 0.05$), while shank F had the lowest L* value ($P < 0.01$). There were no differences found in redness (a*) and yellowness (b*) among shank cuts.

Introduction

A significant percentage of beef shank meat produced in the U.S. is sold through domestic Asian markets or exported to Asian countries as whole-muscle cuts because stewed beef shank is a popular dish in many Asian cultures. However, to our knowledge, there is little published research available characterizing different beef shank cuts based on Asian consumers' preference and quality traits. Therefore, the objective of this study was to evaluate factors affecting Asian consumers' purchasing decisions as well as their eating preferences of six different beef shank cuts.

Experimental Procedures

The cross-section and whole-muscle cut of six different beef shank cuts, three from the forequarter [*biceps brachii* (shank A); a combination of *deep digital flexor* and *flexor digitorum superficialis* (shank B); and *extensor carpi radialis* (shank C)], and three from the hindquarter [*flexor digitorum superficialis* (shank D); *deep digital flexor* (shank E); and a combination of *long digital extensor*, *medial digital extensor,* and *peroneus tertius* (shank F)] collected from both sides of 12 USDA Low Choice beef carcasses (n = 72) are shown in Figure 1. Shanks from the left side of the carcasses, used for consumer taste panels, were stewed in 208°F water for 90 minutes. Cooking loss and peak temperature of each sample were measured prior to serving. Consumers (n = 91) were fed six samples per person and evaluated samples for connective tissue texture, amount of connective tissue, juiciness, flavor, and overall texture based on Just-About-Right (JAR) line scales. In addition, consumers evaluated sensory overall liking on a continuous line scale and rated each sample as acceptable or unacceptable. Following sensory evaluation, consumers (n = 84) moved to the Kansas State University Color Laboratory to visually evaluate the size and surface color of samples obtained from the right side of the carcasses on Just-About-Right line scales. Consumers also evaluated visual overall liking of each sample on a continuous line scale and rated each sample as acceptable or unacceptable. Warner-Bratzler shear force determination and objective color measurement were conducted after the consumer panels. Following the American Meat Science Association Meat Cookery and Sensory Guidelines to determine Warner-Bratzler shear force (AMSA, 2015), six cores were removed from each sample parallel to the muscle fiber orientation and sheared perpendicular to the muscle fiber using an Instron (Model 5569, Instron Corp., Canton, MA). A MiniScan EZ color measurement spectrophotometer (Model 4500L, Hunter Associates Laboratory Inc., Reston, VA) was used to measure color on each sample cross-section following the CIE L* (lightness), a* (green to red), and b* (blue to yellow) system described in Meat Color Measurement Guidelines (AMSA, 2012). Objective color measurements were obtained by averaging readings taken from three random locations on the sample cross-sections.

Results and Discussion

Shanks A, C, D, and F received similar scores ($P > 0.05$) close to Just About Right for connective tissue texture (Table 1). Connective tissue texture of shank E was harder than shanks A and D, and shank B was the hardest ($P < 0.01$). For connective tissue amount, shanks A, D, and E received ratings close to Just About Right ($P > 0.05$). Consumers rated shank B with having too much connective tissue and shanks C and F with having too little ($P < 0.01$) connective tissue. Shanks A, D, and F received similar ratings close to Just About Right for juiciness ($P > 0.05$), while shanks C and E were less juicy, and shank B was the least juicy shank ($P < 0.01$). All shanks rated similar for flavor ($P > 0.10$). For overall texture, shanks A, D, and F received similar ratings close to Just About Right ($P > 0.05$), and shanks C and E were tougher ($P < 0.01$). Shank B was the toughest for overall texture ($P < 0.01$). Shanks A, D, and F received the highest sensory overall liking scores, and shank B received the lowest overall liking score ($P < 0.01$). All shank cuts received high sensory acceptability scores (> 85%) except for shank B (62%; $P < 0.01$).

Results from Table 2 indicated that shanks A and C both received scores that were close to Just About Right for shank size. Consumers rated shanks B, E, and F as too big in size, while shank D was too small ($P < 0.01$). Shanks B, C, E, and F had the heaviest raw weight ($P < 0.01$) and were similar in size ($P > 0.05$), followed by shank A, while shank D was the lightest shank ($P < 0.01$). All shanks were rated similar for surface color ($P > 0.10$). For visual overall liking, shank A received the highest score and shank D received the lowest score ($P < 0.05$) although it was similar to shanks B, E, and F ($P > 0.05$). Shanks A and C were most visually acceptable (> 95%), while shanks B, D, E, and F were less acceptable than shanks A and C (> 70%; $P < 0.01$).

Shanks A, C, D, E, and F had similar ($P > 0.01$) Warner-Bratzler shear force values, and shank B had the highest ($P < 0.01$) shear force value (Table 3). For objective color measurement, shank D had the highest L* value ($P < 0.01$), followed by shanks A, B, C, and E ($P > 0.05$), with shank F having the lowest L* value ($P < 0.01$). There were no differences ($P > 0.05$) found in a* and b* among different beef shank cuts. Shanks C and E had a greater percentage in cooking loss compared to shank A, and shanks B, D, and F had the least cooking loss percentage ($P < 0.01$).

Implications

Connective tissue texture and amount directly affected Asian consumers' eating preference for different beef shank cuts, while shank size was the main factor affecting their purchasing decision.

References

AMSA. 2015. Research guidelines for cookery, sensory evaluation, and instrumental tenderness measurements of meat. 2 ed. American Meat Science Association, Champaign, IL.

AMSA. 2012. Meat Color Measurement Guidelines. American Meat Science Association, Champaign, IL.

Table 1. Consumer (n = 91) ratings of palatability traits, overall liking, and acceptability percentage on various beef shank cuts

Beef shank cuts	Connective tissue texture[1]	Connective tissue amount[1]	Juiciness[1]	Flavor[1]	Overall texture[2]	Overall liking[3]	Acceptability (%)[4]
Fore shank							
A	52.10^{a}	47.43^{c}	49.87^{a}	42.23	50.98^{ab}	69.26^{ab}	94.95^{ab}
B	24.46^{c}	66.09^{a}	38.29^{d}	38.68	30.29^{d}	45.55^{d}	62.27^{c}
C	47.87^{ab}	39.31^{d}	43.47^{bcd}	34.57	43.44^{c}	58.91^{c}	88.72^{b}
Hind shank							
D	54.77^{a}	53.31^{b}	48.79^{ab}	39.86	53.03^{a}	73.10^{a}	96.99^{a}
E	44.11^{b}	47.11^{c}	41.18^{cd}	37.72	45.08^{bc}	62.33^{bc}	91.86^{ab}
F	48.45^{ab}	43.83^{cd}	47.34^{abc}	40.86	47.35^{abc}	67.83^{ab}	93.93^{ab}
SEM[5]	2.60	2.35	2.31	2.67	2.35	3.10	3.19
P-value	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	<0.01

$^{a-d}$Least squares means without a common superscript differ ($P < 0.05$).
[1]Sensory evaluation scores: 0 = too hard/too little, too dry, too bland; 50 = just about right (ideal score); 100 = too soft/too much, too wet/too intense.
[2]Combination of myofibrillar and connective tissue texture. Sensory evaluation scores: 0 = too tough; 50 = just about right (ideal score); 100 = too tender.
[3]Sensory evaluation scores: 0 = dislike extremely; 50 = neither like nor dislike; 100 = like extremely.
[4]Acceptability (%) = percentage of people accept the muscle ÷ total number of observations.
[5]Standard error of the least squares mean.

Table 2. Consumer (n = 84) visual evaluation rating of size, color, overall liking, and acceptability percentage for various beef shank cuts

Beef shank cuts	Raw weight (g)	Size[1]	Color[1]	Overall liking[2]	Acceptability (%)[3]
Fore shank					
A	724.31^{b}	52.51^{c}	54.17	63.79^{ab}	95.37^{a}
B	881.18^{a}	67.50^{a}	59.26	58.68^{bc}	84.82^{b}
C	881.48^{a}	59.89^{b}	55.80	67.45^{a}	96.53^{a}
Hind shank					
D	435.17^{c}	32.11^{d}	55.69	52.99^{c}	74.11^{b}
E	936.06^{a}	68.49^{a}	53.32	59.05^{bc}	84.82^{b}
F	864.77^{a}	67.41^{a}	50.99	59.16^{bc}	84.82^{b}
SEM[4]	35.43	2.00	2.51	3.06	3.58
P-value	<0.01	<0.01	0.21	0.02	<0.01

$^{a-d}$Least squares means without a common superscript differ ($P < 0.05$).
[1]Visual evaluation scores: 0 = too small/too light; 50 = just about right (ideal score); 100 = too large/too dark.
[2]Visual evaluation scores: 0 = dislike extremely; 50 = neither like nor dislike; 100 = like extremely.
[3]Acceptability (%) = percentage of people accept the muscle ÷ total number of observations.
[4]Standard error of the least squares mean.

Table 3. Warner-Bratzler shear force values, L*, a*, and b* in color measurement, and cooking loss percentage for various beef shank cuts

Beef shank cuts	Warner-Bratzler shear force, kg	L*[1]	a*[2]	b*[3]	Cooking loss (%)[4]
Fore shank					
A	3.30[b]	45.50[b]	24.41	16.06	30.95[b]
B	8.85[a]	45.86[b]	24.53	16.48	28.96[c]
C	3.31[b]	45.59[b]	25.26	16.22	33.05[a]
Hind shank					
D	3.90[b]	47.72[a]	25.64	17.28	29.06[c]
E	3.65[b]	45.84[b]	24.07	16.30	33.63[a]
F	3.89[b]	43.44[c]	23.78	15.85	27.92[c]
SEM[5]	0.28	0.65	0.83	0.56	0.82
P-value	<0.01	<0.01	0.54	0.47	<0.01

[a-c]Least squares means without a common superscript differ ($P < 0.05$).
[1]L* = lightness (0 = black and 100 = white).
[2]a* = redness (-60 = green and 60 = red).
[3]b* = blueness (-60 = blue and 60 = yellow).
[4]Cooking loss (5): [(raw weight – cooked weight) ÷ raw weight] × 100.
[5]Standard error of the least squares mean.

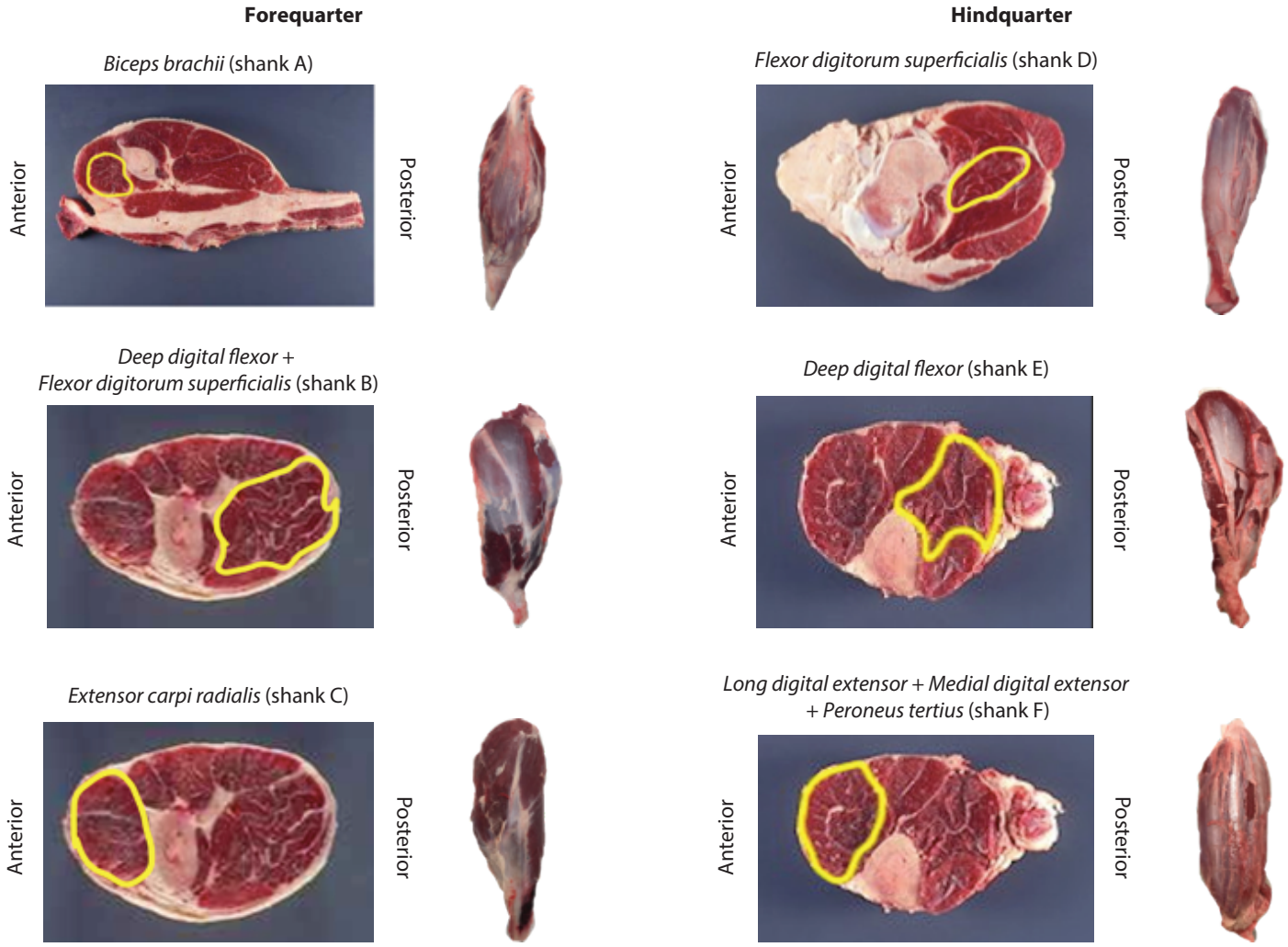

Figure 1. Cross-section of the anatomical location of 6 different beef shank cuts (left; courtesy of Bovine Myology), and the whole-muscle cut (right) corresponding to each shank cut utilized in this study.