FLAVOR CHARACTERISTICS OF SELECTED BEEF MUSCLES COOKED TO VARYING DEGREES OF DONENESS

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Background

Recent innovations in U.S. beef fabrication have created opportunities to upgrade the value of selected beef muscles. These muscles were typically undervalued because they were often considered suitable only for ground beef or roasts - not steaks. One result from muscle profiling, which characterized many of the muscles in the chuck and round, was identification of muscles with considerable potential for value enhancement. This value might be gained by making individual muscles available for steaks or value-added products.

Objectives

The value cuts, those muscles with potential to be upgraded through innovative fabrication and/or value-added strategies, have different textural and sensory characteristics than muscles traditionally used for steaks. The extent to which a muscle is cooked is likely to have an impact on the flavor and tenderness characteristics. Thus, the objective of this research was to determine the effect of degree of doneness on sensory traits of selected beef muscles, in comparison with muscles more commonly used for steaks.

Methods

For this study, 120 cuts of meat were used. This consisted of six muscles (infraspinatus, tensor fasciae latae, vastus lateralis, teres major, triceps brachii, and gluteus medius) and two temperature endpoints (66 C and 77 C - which equate approximately to medium rare and medium well). Steaks were cooked on a commercial gas grill in groups of 6 for serving to a trained taste panel consisting of 11 students and employees of the University of Nebraska. Panels were conducted mid-morning and panelists were asked to avoid soft drinks and coffee immediately prior to the sampling session.

Panelists used 8-point rating scales with 8= extremely juicy, extremely tender, extremely strong flavor, extremely strong off-flavor intensity, and extremely desirable flavor preference and 1=extremely dry, extremely tough, extremely weak flavor, extremely weak off-flavor intensity, and extremely undesirable flavor preference. Prior to evaluation of samples by the panel, a number of sessions were held to define flavor terms and gain experience with the products to be tested. Training occurred for juiciness, tenderness, flavor intensity, off-flavor intensity, and off-flavor notes. No training occurred for flavor preference because this is a subjective, individual decision. For each sample, panelists were asked to identify the off-flavor notes, choosing from a list that included the following descriptors: charred, liver-like, metallic, musty/oxidized, acidic and sour.

The experiment was designed as an incomplete block, where each panel session was considered the block. Each session consisted of six samples - three muscle types, with both degrees of doneness represented in a session. After cooking, 1 cm x ½ cm samples were prepared for the panelists. The exception was the teres major, where all external surfaces were removed prior to sampling.

Means of significant (P < .05) main effects and interactions (muscle type by degree of doneness) were separated using the least significant difference method.

Results and discussion

As anticipated, panelists rated steaks cooked to a lower degree of doneness as juicier, more tender, more intense flavor, and higher in flavor preference. It was anticipated that steaks cooked to a greater degree of doneness might have more browned flavor notes that might be more intense in flavor. However, samples contained only two edges that were browned, except for the teres major where the browned surface was removed to allow for consistent sampling, and the results indicate a more intense flavor at a lower degree of doneness.

The muscle differences are of greater interest. Infraspinatus steaks were rated highest for juiciness, tenderness, flavor intensity, and flavor preference and lower for intensity of off flavor than all other steaks. The tensor fasciae latae was similar (but not equal) in tenderness, juiciness and flavor intensity and was statistically similar in off-flavor intensity. There appears to be considerable similarity between these two steaks. The tensor fasciae latae is commonly used for steaks in the U.S. and steaks from the infraspinatus are apparently equal or superior in palatability.

The teres major did not differ from the infraspinatus in tenderness but was dramatically different in off-flavor intensity. The teres major also received the lowest overall flavor preference scores. Perhaps this muscle requires some sauces or gravies to accent the positive tenderness characteristics.

The triceps brachii and vastus lateralis were most like the gluteus medius, although the later was slightly, but significantly, higher in tenderness. Otherwise, these three muscles possessed similar flavor characteristics. The gluteus medius is used as an intermediate-priced steak in the U.S. and it seems the triceps brachii and vastus lateralis might be used as reasonable substitutes.

Of considerable interest was the interaction of degree of doneness and steak type with off-flavor intensity ratings. The only steak that differed between the 66 C and the 77 C degree of doneness was the infraspinatus steak. As final degree of doneness went up, so too did the intensity of off flavor. This suggests the steak might best be served on the medium to rare side.

Off flavor notes demonstrate the generally superior flavor characteristics of steaks from infraspinatus muscles. With tenderness assistance like blade tenderization the triceps brachii may be comparable with the gluteus medius. The vastus lateralis has a distinctly undesirable flavor and is not very tender. Processors may choose to use this muscle as the basis for a breaded product or a heavily spiced item.

Table 1. Main effects of degree of doneness and steak type on sensory ratings

Group	Juiciness	Tenderness	Flavor intensity
All Steaks:			
66EC	5.7[a]	5.6[a]	5.1[a]
77EC	4.2[b]	5.2[b]	4.9[b]
All temperatures:			
Infraspinatus	6.0[c]	6.4[c]	5.5[c]
Teres major	5.2[d]	6.2[c]	4.6[c]
Tensor fasciae latae	5.4[d]	5.5[d]	5.1[c]
Gluteus medius	4.3[e]	5.3[d]	5.0[c]
Triceps brachii	4.4[e]	4.9[e]	5.0[c]
Vastus lateralis	4.2[e]	4.0[f]	4.7[c]

[a,b] Means within a column (for temperature) with different superscripts are significantly (P<0.05) different

[c,de,f] Means within a column (for steak type) with different superscripts are significantly (P<0.05) different

Table 2. The interaction of degree of doneness and steak type on off-flavor intensity and flavor preference ratings

Steak type	Off-flavor intensity		Flavor preference	
	66EC	77EC	66EC	77EC
Infraspinatus	1.9[a]	2.4[b]	5.8[a]	5.1[b,c]
Teres major	3.6[f]	3.4[e,f]	3.7[e]	3.6[e]
Tensor fasciae latae	1.9[a]	2.0[a,b]	5.4[a,b]	5.2[b]
Gluteus medius	3.6[f]	3.2[d,e,f]	4.2[d]	4.1[d]
Triceps brachii	2.7[c]	3.0[c,d,e]	4.8[c]	4.1[d]
Vastus lateralis	3.4[e,f]	2.9[c,d]	4.1[d]	3.8[d,e]

[a,b,c,d,e] Means within a sensory trait with different superscripts are significantly (P<0.05) different

Table 3. Main effects of degree of doneness and steak type on off-flavor notes (percentage of panelists detecting each flavor)

Group	Charred	Liver-like	Metallic	Musty/Oxidized	Acidic	Sour
All steaks:						
66EC	12.1[a]	23.5	28.1[b]	27.6[a]	25.2[b]	4.8[b]
77EC	25.9[b]	24.4	11.8[a]	34.6[b]	15.6[a]	2.6[a]
All temperatures						
Infraspinatus	29.6[f]	13.0[c]	5.2[a]	26.1[c,d]	4.4[c]	0.6[c]
Teres major	0.6[c]	36.6[e]	28.0[f]	7.6[f]	22.6[d]	6.6[e]
Tensor fasciae latae	15.4[d,ef]	8.0[c]	13.2[c,d]	20.5[c]	18.8[d]	3.3[c,d,e]
Gluteus medius	26.9[e,f]	25.3[d]	23.2[e,f]	39.0[e,f]	31.6[e]	3.8[c,d,e]
Triceps brachii	29.4[e,f]	25.2[d]	19.5[d,e]	23.1[c,d]	19.8[d]	2.2[c,d]
Vastus lateralis	12.4[d]	35.6[e]	30.4[f]	30.3[d,e]	25.4[d,e]	5.5[d,e]

[a,b] Means within a column (for temperature) with different superscripts are significantly (P<0.05) different

[c,de,f] Means within a column (for steak type) with different superscripts are significantly (P<0.05) different