EFFECTS OF COOKING BEEF MUSCLES FROM FROZEN OR THAWED STATES ON COOKING TRAITS AND PALATABILITY

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Summary

We used an electric belt grill to cook steaks from two muscles; outside round (*biceps femoris*), and loin strip (*longissimus lumborum*) from both frozen and thawed states. The color values L* and a*, Warner-Bratzler shear force (WBSF), juiciness, flavor, connective tissue amount, and overall tenderness did not differ (P>0.05) between steaks cooked from frozen and thawed states. Thawed steaks cooked faster and had less cooking loss. The *biceps femoris* had higher WBSF than *longissimus* and was rated less tender by trained panelists. Color values L*, a*, or b* did not differ (P>0.05) among the muscles. The *biceps femoris* needed more time to cook and had greater cooking loss than *longissimus*.

(Key Words: Cooking, Belt Grill, Frozen or Thawed Steaks.)

Introduction

Freezing preserves meat quality for a number of months with insignificant changes in product size, shape, texture, color, and flavor. However, freezer burn, discoloration, dehydration, rancidity, drip loss, and bleaching might occur, depending upon freezing conditions, storage time, packaging, and thawing procedures. When meat is thawed at room temperature, the risk of growth of spoilage and pathogenic microorganisms increases. Therefore, cooking meat directly from the frozen state might offer advantages of less drip loss and reduced risk of microbial growth.

Previous research suggests that cooking yield and palatability were not affected by the physical state of meat at the start of cooking, but meat cooked from the frozen state required more cooking time. On the contrary, some researchers have reported greater cooked yield, improved tenderness, and higher juiciness ratings for beef cooked from the frozen state. To rationalize these differences, the objectives of our study were to evaluate the effects of cooking two beef muscles from either the frozen or thawed state on cooking traits and palatability.

Experimental Procedures

Sub-primals from a commercial processing plant were aged 19 days postmortem at 34°F, then frozen. We sawed one-inch thick steaks from 20 outside rounds (NAMP 171B), and 20 loin strips (NAMP 170) from USDA Choice carcasses. Steaks were numbered from 1 to 12 for each outside round or loin strip to identify anatomical location. Steak #10 was cooked from the thawed state, while steak #11 was cooked directly from the frozen state on an electric belt grill (TBG-60 Magigrill, MagiKitch'n, Inc., Quakertown, PA) at 200°F. All steaks were cooked to 158°F internally. Cooking loss and cooking time were recorded for each steak. We measured the color values L*, a*, and b* (Illuminant A) on each steak 3 hr after cooking.

After cooked steaks were refrigerated overnight (39°F), we removed six cores (0.5 inch in diameter) parallel to muscle fiber orientation and sheared each core once using an Instron Universal Testing Machine. A 110-lb load cell and 10 inches/min cross-head speed were used. We cooked steaks in a similar manner for sensory evaluation. Trained panelists (n=6) evaluated palatability attributes on an 8-point scale for myofibrillar tenderness, juiciness, flavor, overall tenderness, and connective tissue amount (1=extremely tough, dry, bland, extremely tough, and abundant; 8=extremely tender, juicy, intense, tender, and none). We analyzed the data in two ways. Paired t-tests were used to distinguish effects of cooking from frozen vs. thawed state on cooked color, cooking time, cooking loss, Warner-Bratzler shear force, and sensory properties. To analyze muscle effects, we used one-way analysis of variance for a completely randomized design.

Results and Discussion

No differences ($P>0.05$) in L* (lightness), a* (redness), WBSF, juiciness, flavor, connective tissue amount, or overall tenderness were found between steaks cooked from the frozen or thawed states (Tables 1 and 2). However, frozen steaks required more cooking time ($P<0.01$), had higher cooking loss ($P<0.01$), lower b* values (less yellow) ($P<0.05$), and lower myofibrillar tenderness scores (less tender) ($P<0.05$) than thawed steaks (Tables 1 and 2). The biceps femoris required more time to cook ($P<0.05$), had more connective tissue ($P<0.01$), less intense flavor score ($P<0.05$), higher WBSF ($P<0.05$), and lower tenderness scores ($P<0.01$) than the longissimus (Tables 1 and 2). Cooking from the frozen state offers some advantages because thawing is much faster, drip loss does not occur, and the risk of microbial growth associated with slow thawing should be reduced. However, higher cooking losses and a greater energy requirement for cooking might outweigh these advantages.

Table 1. Warner-Bratzler Shear Force, Cooking Time, Cooking Loss, and Cooked Color Values for *Biceps femoris* and *Longissimus lumborum* Steaks Cooked from Frozen or Thawed State

Source of Variation	WBSF (lb)	Cooking Time (min)	Cooking Loss (%)	L*	a*	b*
Muscle						
Biceps femoris	10.58	11.37	31.04	58.16	19.54	20.58
Longissimus lumborum	9.28	10.78	28.94	56.77	19.49	20.25
P-value	0.025	0.013	0.07	0.15	0.97	0.65
State						
Frozen	10.12	13.13	32.96	57.87	18.97	19.67
Thawed	9.75	9.02	27.03	57.05	20.06	21.15
P-value	0.52	<0.0001	<0.0001	0.40	0.40	0.049

Table 2. Sensory Panel Values[a] for *Biceps femoris* and *Longissimus lumborum* Steaks Cooked from Frozen or Thawed State

Source of Variation	Myofibrillar Tenderness	Connective Tissue Amount	Juiciness	Flavor Intensity	Overall Tenderness
Muscle					
Biceps femoris	4.63	3.90	5.35	5.59	4.00
Longissimus lumborum	5.58	6.81	5.23	5.81	5.84
P-value	<0.0001	<0.0001	0.64	0.012	<0.0001
State					
Frozen	4.93	5.31	5.24	5.73	4.80
Thawed	5.28	5.40	5.34	5.68	5.04
P-value	0.024	0.65	0.68	0.42	0.10

[a]Eight point scale for myofibrillar tenderness, juiciness, flavor intensity, connective tissue amount and overall tenderness where: 1=extremely tough, dry, bland, abundant and tough and 8=extremely tender, juicy, intense, non and tender.