PROJECT SUMMARY
PRODUCT QUALITY

BEEF
RESEARCH

Phase I - Identifying the Influence of Rate of Cooking, Cooking Temperature, and Degree of Doneness on Factors Contributing to Beef Flavor and Tenderness

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Background

Even though beef demand has proven amazingly resilient in the past few years, one of the greatest concerns is the relative price of beef compared to competing proteins. Most believe that the outstanding flavor of beef is what keeps consumers returning to the meat case to make purchases irrespective of price. Since we are expecting consumers to pay more for beef, the outstanding flavor of beef must be maintained and/or improved allowing for beef consumers to be continually satisfied. The importance of beef flavor in the marketplace is underscored by the fact that consumers' flavor preferences are reflected in their beef purchase decisions (Umberger et al., 2002; Sitz et al., 2005), and the fact that the Phase I of the 2011 National Beef Quality Audit identified that four out of five beef industry sectors identified beef flavor as either the first or second most important beef attribute (Igo et al., 2013).

Recent research funded by the beef checkoff has demonstrated that differences in steak thickness, cooking method, cooking temperature, and cooking rate influences the overall eating satisfaction of steaks and influences beef flavor (Shubert, 2015). Perhaps the most intriguing discovery of that research was the improvement in the tenderness and flavor observed in steaks that were cooked more slowly (Shubert, 2015). Ultimately, the findings of this research will contribute to developing the most ideal cooking procedures to maximize the steak eating experience.

Objective

This research is aimed at expanding upon the research idea that rate of cooking and degree of doneness are major contributors to steak tenderness and flavor development.

Methods

Carcasses (N = 90) were selected at commercial beef processing facilities. Strip Loin Steaks were obtained from both sides of each carcass and aged for 21 days. One steak was used to obtain Warner-Bratzler shear force (WBSF) and slice shear force (SSF) measurements. The other steak was rated by a trained sensory panel for juiciness (0 = extremely dry, 10 = extremely juicy), tenderness (0 = extremely tough, 10 = extremely tender), and detectable levels of several flavors (0 = no presence, 10 = very strong presence) including: beef/brothy (basic flavor and aroma of grilled or roasted beef; simulated by the flavor of beef broth), brown/grilled, burnt, buttery (flavor and aroma associated with cooked fat from grain-finished beef; often described as a buttery flavor), bloody/metallic (flavor and aroma associated with blood in beef cooked to a rare degree of doneness; sometimes described as a metallic taste), livery (flavor and aroma associated with cooked beef liver or kidney), and oxidized.

Findings

The results obtained indicate that cooking rate (oven temperature) and final internal temperature (degree of doneness) have significant influences on trained panel sensory, shear force measurements, and percent cook loss. Generally speaking, increasing cooking rate and degree of doneness had detrimental effects on sensory attributes, shear force and cook loss. The sensory results also show that eating characteristics are influenced by more than just degree of doneness, but also by the rate in which steaks reach a given final internal temperature. Steaks cooked at 150°F produced tender steaks; however, the slow cooking rate resulted in decreases in juiciness and the development of brown/grilled flavor notes. Additionally, the extended time required to cook steaks at 150°F would make this an impractical cook method in a foodservice setting. Beginning at 350°F, increasing oven temperature, while keeping degree of doneness constant, generally resulted in a decrease in tenderness, juiciness, and bloody flavor intensity, but an increase in brown/grilled flavor. Since consumer sensory panelists were not used in the current study, it is difficult to determine how tradeoffs in trained sensory ratings would exactly influence consumer acceptability. However, these data can be used as a tool by the foodservice industry to assess the sensory attributes that varying cooking rate and degree of doneness combinations possess in order to adequately select a cooking method that fits their needs to create a combination that has the greatest chance of delivering the consumer a satisfactory eating experience.

Industry Impact

Recent consumer research and the most recently conducted National Beef Quality Audit continue to indicate that beef flavor is a fundamental driver for beef demand. Additionally, recently completed research aimed at steak cookery methods has identified that production practices, specifically days on feed and breed type, considerably influence the flavor attributes of beef. Even further, muscle to muscle differences also influence the flavor of beef. Results of the current study further explain factors influencing beef flavor. These data can be used as a tool by the foodservice industry to assess the sensory attributes that varying cooking rate and degree of doneness combinations possess in order to adequately select a cooking method that fits their needs to create a combination that has the greatest chance of delivering a satisfactory eating experience to the consumer.

Photos

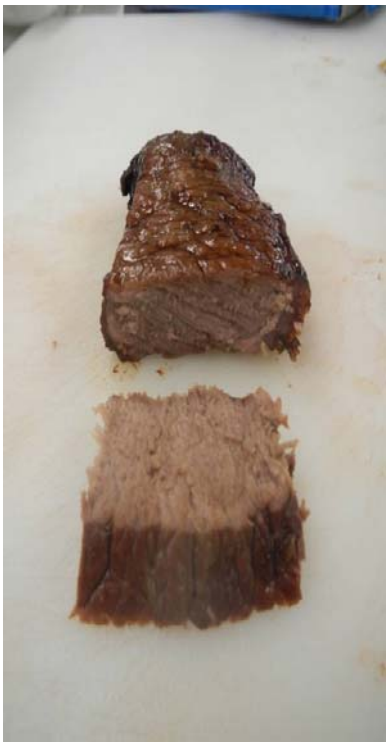

Figure 1. Steak cooked with oven temperature of 350°F and internal temperature of 185°F.

Figure 2. Steak cooked with oven temperature of 650°F and internal temperature of 185°F.

Graphs/Tables

Table 1. Least squares means comparing consumer panel responses.

Oven Temp	Int Temp	Panel Responses								
		Initial Tenderness	Sustained Tenderness	Overall Tenderness	Juiciness	Beef/ Brothy	Brown/ Grilled	Buttery	Burnt	Bloody
150	135	71.08^{ab}	69.03^{ab}	71.08^{ab}	59.76^{b}	46.74^{c}	39.00^{d}	23.60^{ab}	7.39^{cd}	22.23^{b}
150	145	72.32^{a}	71.05^{a}	72.32^{a}	49.62^{de}	51.90^{bc}	47.48^{b}	22.64^{ab}	9.79^{c}	18.52^{c}
350	135	73.32^{a}	71.67^{a}	73.32^{a}	65.06^{a}	44.79^{c}	36.03^{d}	25.56^{a}	5.64^{d}	27.85^{a}
350	145	68.80^{bc}	67.32^{bc}	68.80^{bc}	59.50^{b}	49.49^{c}	43.25^{c}	24.54^{ab}	8.56^{cd}	20.02^{bc}
350	155	63.39^{de}	61.26^{def}	63.39^{de}	55.03^{c}	49.18^{c}	39.74^{cd}	22.16^{b}	5.37^{d}	17.66^{c}
350	165	60.13^{f}	58.03^{fg}	60.13^{f}	46.91^{ef}	50.18^{c}	45.14^{bc}	18.62^{c}	10.36^{bc}	10.77^{de}
350	175	59.73^{f}	57.73^{g}	59.73^{f}	42.81^{g}	53.32^{a}	48.59^{ab}	18.53^{c}	11.00^{bc}	9.29^{de}
350	185	54.30^{h}	52.31^{i}	54.30^{h}	41.44^{hi}	52.70^{abc}	48.56^{ab}	21.09^{bc}	10.50^{bc}	6.54^{e}
475	135	68.94^{b}	67.17^{bc}	68.94^{b}	61.34^{b}	49.18^{c}	41.24^{cd}	25.07^{ab}	7.50^{cd}	19.54^{bc}
475	145	66.03^{cd}	64.63^{cd}	66.03^{cd}	55.22^{c}	49.77^{c}	45.49^{bc}	24.33^{ab}	7.08^{cd}	17.20^{c}
475	155	61.27^{e}	59.08^{efg}	61.27^{e}	52.20^{cd}	48.70^{c}	47.74^{b}	23.19^{ab}	10.00^{bc}	11.28^{d}
475	165	61.26^{e}	59.80^{efg}	61.26^{e}	46.48^{ef}	51.75^{c}	48.77^{ab}	21.84^{b}	8.39^{cd}	10.31^{de}
475	175	58.06^{fg}	56.54^{gh}	58.06^{fg}	46.42^{ef}	49.60^{c}	51.88^{ab}	22.20^{b}	12.16^{bc}	8.22^{de}
475	185	54.40^{h}	52.75^{i}	54.40^{h}	42.29^{gh}	50.72^{c}	49.90^{ab}	19.60^{bc}	16.23^{ab}	6.12^{e}
650	135	65.91^{cd}	64.36^{cd}	65.91^{cd}	59.74^{b}	47.77^{c}	45.25^{bc}	23.65^{ab}	7.87^{cd}	20.06^{bc}
650	145	63.55^{de}	62.31^{de}	63.55^{de}	53.63^{c}	51.52^{c}	48.65^{ab}	25.34^{a}	11.60^{bc}	11.49^{d}
650	155	60.00^{f}	56.90^{gh}	60.00^{f}	46.26^{ef}	48.90^{c}	52.55^{a}	21.40^{bc}	15.88^{ab}	9.62^{de}
650	165	55.57^{gh}	53.44^{hi}	55.57^{gh}	44.07^{f}	53.10^{ab}	47.00^{bc}	19.67^{bc}	13.65^{b}	7.25^{e}
650	175	53.62^{h}	51.32^{i}	53.62^{h}	38.78^{i}	50.00^{c}	49.20^{ab}	16.83^{c}	17.02^{ab}	5.72^{e}
650	185	55.84^{gh}	54.25^{hi}	55.84^{gh}	35.40^{i}	48.67^{c}	50.03^{ab}	15.54^{d}	19.60^{a}	5.46^{e}
P - value		0.0083	0.0013	0.0020	0.0049	0.0411	0.0011	0.0355	0.0178	0.0101
Standard error		1.8168	2.0052	1.9744	2.7231	3.2197	3.4532	2.8927	1.9370	2.5055

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