Identifying consumer preferences for specific beef flavor characteristics

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Project Summary

Background
When asked what determines their choice of a main course for dinner, almost 90% of consumers rank taste as most important. Consumers’ overall perceptions of the taste of beef are based largely on the combined assessment of three primary sensory attributes: tenderness, juiciness, and flavor. Although tenderness often is cited as the most important determinant of a beef product’s sensory performance, results of several studies suggest that beef’s unique flavor may be of equal or greater importance to the overall sensory experience.

Previous research has identified several factors along the beef production and processing chain that influence beef flavor characteristics, including cattle breed, whether animals are finished on forages or grain, type of grain included in the finishing diet, duration of the grain-finishing period, USDA quality grade, and method used for postmortem aging of beef cuts. In recent years, innovative marketing strategies involving differentiation of beef products according to production-related differences in flavor have emerged and are gaining momentum. However, scientific information linking consumer preferences with particular beef flavor characteristics, originating from differences in production history, is limited. This study was conducted to identify and characterize specific beef flavors that are associated with differences in cattle production history and method of postmortem aging and to quantify relationships between these specific flavors and preferences of discriminating beef consumers.

Methodology
Beef strip loins, representing 12 different product categories (treatments) currently available to beef consumers in U.S retail and food service markets, were purchased for use in the study. Treatments were chosen specifically to permit identification and characterization of production-related beef flavor differences associated with the effects of USDA grade (Prime, Premium Choice, Low Choice, Select), cattle breed-type (Angus, Holstein, American Wagyu), finishing diet (grass-fed, corn-fed, barley-fed), use of growth technologies (non-implanted, implanted, implanted & fed β agonists), and postmortem aging method (wet-aged, dry-aged). Sensory analysis was conducted at culinary schools in the Eastern, Central, and Western regions of the U.S. Untrained consumer panelists (n = 307) consisted of culinary faculty members, culinary students, and discriminating beef consumers. Panelists rated samples from each treatment for 13 different flavor notes (beefy/brothy, browned/grilled, buttery/beef fat, nutty/roasted nut, earthy/mushroom, bloody/metallic, grassy, livery, fishy, sour, sweet, and bitter) and overall flavor desirability. In addition, samples were analyzed to determine intramuscular (IM) fat content of raw products, fatty acid composition of cooked products, and quantities of 24 different volatiles produced during cooking.

Findings
Of the factors tested, finishing diet (grass-fed vs. grain-fed, Figure 1) and USDA quality grade (Figure 2) had the greatest effects on beef flavor. Only minor differences in flavor were observed in comparisons involving cattle breed-type, type of grain in the finishing diet (corn or barley), use of growth technologies, and postmortem aging method (30-d dry-aged vs. 14-d wet-
Lengthening the wet-aging period from 14 d to 46 d had a negative effect ($P < 0.05$) on beef flavor desirability. Panelists preferred samples with flavors described as beefy/brothy, browned/grilled, buttery/beef fat, nutty/nutty roasted nut, and sweet and disliked flavors identified as bloody/metallic, grassy, gamey, livery, fishy, sour, and bitter. Study participants showed a strong preference for the flavors of products with high percentages of IM fat that contained greater amounts of monounsaturated fatty acids and lesser amounts of saturated and polyunsaturated fatty acids. Products rated as most desirable ($P < 0.05$) in overall flavor were dry-aged, Prime Wagyu and dry-aged, Prime Angus beef, whereas the products rated as least desirable ($P < 0.05$) in overall flavor were organic grass-fed beef and conventionally raised, Low Choice beef that had been wet-aged for 46 d.

Several different volatile compounds were identified that were associated with differences ($P < 0.05$) in desired beef flavor attributes. Of the volatiles identified in this study, diacetyl (2, 3-butanedione) and acetoin (3-hydroxy-2-butanone) were most closely correlated with ratings for overall flavor desirability. Both volatiles were positively correlated ($P < 0.05$) with flavors described as buttery/beef fat, beefy/brothy, browned/grilled, and sweet and negatively correlated ($P < 0.05$) with most of the undesirable flavor notes. These 2 ketones are primary contributors to the flavor and aroma of butter and are widely used in the manufacture of artificial butter flavorings.

**Implications**

Great taste remains a primary reason consumers frequently make beef their food of choice for a pleasurable dining experience. This study identified relationships between production history and specific flavors that are most preferred by discriminating beef consumers. Results of the project should assist in the development of strategies to capitalize on production-related differences in beef flavor.
Figure 1. Flavor profiles of beef produced by grass-fed and grain-fed cattle

Figure 2. Flavor profiles of Premium Choice Angus, Low Choice Angus, Select Angus, and Low Choice Calf-Fed Holstein beef
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