Project Title: Management Factors Affecting Inherent Beef Flavor: The Role of Post-Weaning Forage, Energy Supplementation (Weight Gain), and Finishing Diets

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Background

Out of all the different palatability characteristics of meat, flavor is a major attribute relating to a pleasurable eating experience. Umberger et al. (2002) found that consumers were willing to pay considerably more for cuts they had identified as having a desirable flavor. The type of postweaning forage for grazing can influence the flavor profile of meat after finishing. Certain forages can create undesirable flavors in cooked product (Larick and Turner, 1987). Distillers grains with solubles (DGS) are now being fed to cattle as a finishing diet more regularly and with that, more flavor changes have been found, including an increased amount of undesirable flavors (Haack et al., 2011). An animal's diet is not the only factor that determines the flavor profile of the meat. As meat ages, the oxidation of lipids (i.e. FA) create unique flavors (Smith et al., 1978). Thus, the objectives of this research were to (1) evaluate production factors (post-weaning forage, energy supplementation during summer grazing, and finishing diets) associated with development of desirable endogenous beef flavor; (2) assess the effects of aging on flavor of different muscles; (3) relate biochemical constituents of muscle to specific flavor notes using the beef lexicon; (4) assess relationships of production factors, biochemical constituents, and the flavor lexicon to consumer flavor desirability; and (5) evaluate the potential of vaccenic acid (and other constituents) as a predictor of flavor.

Methodology

Crossbred steers (n = 64) were backgrounded on either warm or cool-season grass pastures. Within each pasture, half of the cattle were supplemented (0.6 kg WDGS/kg body weight/day) for energy using WDGS. After the grazing period was completed half of each pasture and supplementation treatment was finished on an all-corn diet while the other half were fed corn with wet distillers grains with solubles (WDGS) at a 35% inclusion rate. Cattle were harvested and strip loins and bottom round flats were collected from each side of the carcass. One strip loin and bottom round from each animal was aged for 7 days while the other muscles were aged for 28 d. Steaks from all subprimals were used to measure moisture, fat, protein, pH, heme iron, non-heme iron, cooking loss, mineral content, amino acid content, fatty acid profile, consumer acceptance, and beef lexicon flavor analysis. All data were analyzed as a 2x2x2x2 factorial arrangement split plot design, forage and supplementation were the whole plot and finishing diet and aging period were the split plots, within a randomized complete design using the Mixed procedure in SAS (Version 9.2, SAS Institute Inc., Cary, NC, 2009). The experimental unit was the individual animal. Least square means with the probability of difference (pdiff) option was used for mean separation, with significance determined at $P < 0.05$ levels. The regression procedure with the stepwise option was used to create prediction models for consumer acceptance and lexicon flavor notes.

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Findings

Neither aging period nor vaccenic acid content had an effect on any consumer scores. For almost all sensory attributes (overall like, flavor like, beefy like, and grill like scores), the strip loin had more favorable consumer scores than the bottom round flat (Table 1.).

Through the use of stepwise linear regression, prediction models were created for consumer overall and beef flavor like scores using components of meat. Table 2 shows the variables and coefficients included in each of the models. Heme iron and phosphorous content appear to have a negative influence on consumer scores in both muscles tested. For the strip steak samples, the fatty acid profile had the most influence over consumer scores.

All of the meat attributes that influence consumer scores can be manipulated by the diet. For example, finishing on WDGS increased concentrations of 18:2 and 18:3 fatty acids in the neutral lipids and supplementing for energy increased 20:1 neutral lipid fatty acids but decreased 20:5 phospholipid fatty acids. Backgrounding on warm-season grasses increased the concentration of 20:1 in neutral lipids, while it decreased the amount of 20:4 in phospholipids.

The beef lexicon panel at Texas A&M University in College Station, Texas was used to characterize the flavor profile in both strip and round steaks. As above, the lexicon results were used to construct prediction models for consumer acceptance. For strip steaks, floral, smoked/charred, and warmed over flavor notes all negatively influence the consumer acceptance ratings while green grass and brown flavor notes positively influence preference. For round steaks, buttery flavors positively influenced and sour milk flavors negatively influenced flavor desirability.

All of the flavor notes listed previously can also be influenced by composition of the meat, just like the consumer scores. For instance, most of the components that influence floral, sour milk, musty, green grass, and metal flavors are fatty acids. All of the attributes associated with the prevalence of flavor notes can also be influenced by the diet, similar to the consumer scores.

When the effect of the dietary treatment on consumer scores is evaluated directly, the data show diet having less of an impact. The interaction between supplementation and finishing diet has an effect on consumer scores for both muscles, but grass type only had an effect on consumer scores of the B. femoris.

Cattle's diet, from weaning to finishing, has a substantial effect on the composition of the meat. Background grazing, supplementation, finishing diet, and combinations of all three determine the concentration of minerals, amino acids, fatty acids, and other components of meat. The dietary treatment cattle receive can therefore greatly influence good beef flavor. Specific flavor notes that promote an enjoyable eating experience can be promoted through the diet.

Implications

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Table 1. The effect of muscle type on consumer panel scores.

	L. dorsi	*B. femoris*	SEM	Muscle	Age	Muscle * Age
Overall like	6.20[a]	5.75[b]	0.08	<0.0001	0.36	0.21
Flavor like	6.09[a]	5.74[b]	0.08	0.0003	0.36	0.3
Beefy like	6.19[a]	5.92[b]	0.08	0.01	0.16	0.31
Beefy intensity	5.93	5.78	0.08	0.19	0.09	0.39
Grill like	5.82[a]	5.59[b]	0.07	0.02	0.82	0.19
Grill intensity	5.36	5.15	0.08	0.06	0.32	0.75

[ab]Means with different superscripts within the same row are different $p \leq 0.05$

Table 2. Prediction of coefficients for the influence of meat traits on overall flavor and beefy flavor like scores for both the *L. dorsi* and *B. femoris*

	L. Dorsi		B. Femoris	
Trait	Flavor Like	Beefy Like	Flavor Like	Beefy Like
Intercept	28.91	23.50	4.98	5.78
pH	-2.73	-1.28	-	-
Heme Iron, ppm	-0.29	-0.11	-	-
Methionine	-	-	-	-0.13
Calcium, %	-	38.34	-	-
Phosphorus, %	-26.11	-35.95	-15.19	-
Potassium, %	-	-	-	3.46
Zinc, ppm	-	-	0.04	-
Manganese, ppm	0.21	-	-	-
Copper, ppm	-	-	-0.39	-
Sodium, %	-	-	63.52	-
Neutral Lipids,%				
15:0	1.55	-	-	-
16:1	-	-0.36	0.30	-
18:1v	-	-	-0.82	-
18:2	0.63	-	-	-
20:0	-3.13	-3.71	-	-
18:3	-1.57	-2.37	-	-
20:1	-1.84	-	1.26	-
Others	-	-	-	-0.55
Phospholipids,%				
13:0	-	0.54	-	-
14:1	0.74	-	-	-
16:1	-	-0.30	-	-
18:1t	-0.17	-0.07	-	-
20:0	-	-	1.24	0.80
18:3	-0.46	-0.78	-	-
20:4	-	-	-0.12	-
20:5	0.28	0.28	-	-
24:1	-	-0.47	-	-
Others	-0.29	-	-	-

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