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Relationship of Selected Beef Carcass Traits with Meat Palatability

John D. Crouse
U.S. Meat Animal Research Center

RELATIONSHIP OF SELECTED BEEF CARCASS TRAITS WITH MEAT PALATABILITY

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Summary

Relationships among selected carcass traits and cooked meat palatability were studied on 240 carcasses obtained from steers of different biological types produced under a wide range of feeding regimens. Breed type of steer or feeding regimen had little or no effect on correlations among taste panel (TP) scores for tenderness, juiciness, flavor, and general acceptability. Treatments also had little effect on correlations of conformation, lean color, lean texture, and final maturity with TP observations. Late maturing breeds of steers and steers fed on low energy regimens were rated more youthful than early maturing breeds of steers and steers fed on high energy regimens. Marbling, percentage of longissimus muscle (LM) fat, quality grade, and adjusted fat thickness independently accounted for 2 to 3% of the variation in TP tenderness and 6 to 8% of the variation in TP acceptability.

[1]John D. Crouse is a meat scientist at MARC.

Introduction

The USDA has recently implemented three major changes in standards for quality grading carcass beef (USDA, 1976). First, conformation was eliminated in determining final quality grades (QG). Second, marbling requirements for the Good grade were narrowed to include only carcasses with a slight amount of marbling. Third, minimum marbling requirements for an A maturity carcass in

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Table 1.—Simple correlations among selected carcass traits and palatability traits

Trait no.	Trait	Trait number 1	2	3	4	5	6	7	8	9
1	Final maturity	---	0.25	0.26	0.22	0.02	−0.07	0.08	0.04	0.04
2	Marbling	---	---	.96	.66	.22	.24	.32	.33	.15
3	Quality grade	---	---	---	.66	.22	.24	.33	.34	.14
4	Fat thickness	---	---	---	---	.27	.29	.38	.38	.12
5	Taste panel tenderness	---	---	---	---	---	.32	.55	.78	− .63
6	Taste panel juiciness	---	---	---	---	---	---	.64	.66	.05
7	Taste panel flavor	---	---	---	---	---	---	---	.84	.23
8	Taste panel acceptability	---	---	---	---	---	---	---	---	.39
9	Warner-Bratzler shear	---	---	---	---	---	---	---	---	---

the Prime, Choice, Good, and Standard grade no longer increases with increasing maturity. These changes were the result of research that has shown that maturity, within youthful carcasses, and conformation have little relationship to palatability.

Low positive correlations between marbling score or LM lipid content with TP acceptability scores have been reported for steaks from youthful carcasses. Results from a number of studies have indicated significant relationships between maturity and TP palatability characteristics when evaluated over a range of youthful to mature carcasses. Berry *et al.* (1974) observed significant correlations between TP palatability scores and maturity when evaluated over the full range of maturity groups. However, these correlations were observed to be low and nonsignificant when evaluated within the A maturity group.

Because more than 97% of the "fed" beef is within A maturity, the effect of maturity within A maturity on palatability of steak and roast meat is of most interest. In most previous studies, carcasses from animals with relatively similar growth rates and fattening characteristics typical of domestic beef breeds finished on medium to high energy density diets have been sampled to determine the efficiency of carcass criteria in estimating palatability. In the present study, relationships of carcass quality indicating criteria with palatability and how these relationships were affected by breed groups and nutritional environment were examined. Observations were made on carcasses obtained from steers that varied greatly in growth and fattening characteristics and produced under a wide range of feeding regimens.

Experimental Design

The experimental design ensured variation in carcass traits such as maturity (within the A maturity classification) and carcass composition with relatively low covariance among these traits. This variation allowed an evaluation of independent as well as multiple effects of maturity, marbling, and other traits on palatability. Carcasses from 120 large, late maturing (Chianina, Charolais, Brown Swiss, and Limousin crosses) and 120 small, early maturing (Hereford, Angus, and Red Poll crosses) steers were evaluated. At approximately 250 days of age, steers were assigned to one of five feeding regimens ranging from pasture feeding to an 80% concentrate diet. Serial slaughter techniques were used. Steers were killed at about 90 and 105% of the approximate mature weights for females of these biological types (small: 1,050 lb; large: 1,200 lb). An additional slaughter group was slaughtered at the beginning of the higher concentrate feeding periods in regimens A, B, and D.

All steers were slaughtered by a commercial packer. Carcasses were evaluated and quality graded by USDA standards after a 24-hr chill at 2°F.

Correlations

Correlations among selected carcass traits are presented in Table 1. Preliminary analyses indicate that breed type of steer and feeding regimen had no effect on magnitude of correlations. The very low correlation between final maturity and TP traits in these A maturity carcasses agrees with previous research and supports recent modifications of maturity in the USDA grade standards.

Carcass traits most highly associated with taste panel traits were measures of fatness. A low positive correlation between marbling and TP traits was also observed; however, the amount of variability in TP tenderness accounted for by marbling (3%) was low. Interestingly, fat thickness (FT) was as highly correlated to TP traits as measures of marbling. This relationship was not appreciably affected by treatment subclass means. The covariance between marbling and FT ($r = 0.58$) would partly account for the relation of FT to TP traits. Partial correlations between FT and TP items holding marbling constant (Table 2) were low but real for TP flavor and acceptability. Partial correlations between marbling and TP items holding FT constant were lower than the former correlations. These observations indicate that FT and marbling would be of similar value in estimating TP panel evaluations of organoleptic traits.

Holding maturity constant had little effect on correlations between marbling and TP traits. However, variation in marbling appears to be slightly less associated with TP traits at a constant time on feed than when time on feed is allowed to vary within subclass treatments.

Simple regressions of TP tenderness and TP acceptability on marbling and fat thickness are shown in Table 2. Regression curves of TP traits on carcass traits were flat. A change of 30° in marbling (scored 0 = devoid to 30 = very abundant) was required to make a one-unit increase in TP tenderness values. Fat thickness was required to increase by 1 in to make a similar change. Marbling, QG, and FT independently accounted for 2 to

Table 2.—Regression equations for taste panel tenderness and acceptability

Dependent variable	R^2	SE	Intercept	Carcass traits and coefficients: Marbling	Fat thickness
TP tenderness	0.03	0.75	4.60	0.033	
	.03	.75	4.75	.039	
TP acceptability	.06	.51	4.68		.036
	.08	.50	4.65		.042

Table 3.—Frequency distribution of taste panel tenderness scores

Marbling score	Number of samples	Taste panel tenderness scores: 3 or greater No.	%	4 or greater No.	%	5 or greater No.	%	6 or greater No.	%
P devoid	17	17	100	13	76	6	35	1	6
Traces	47	46	98	37	79	20	43	4	9
Slight	83	83	100	72	87	41	49	4	5
Small	54	53	98	50	93	27	50	4	7
Modest	26	26	100	26	100	19	73	1	4
Moderate	8	8	100	7	88	5	63	2	25
≤ S abundant	5	5	100	5	100	4	80	0	0
Number/score			28		88		106		16

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3% of the variation in TP tenderness and 6 to 8% of the variation in TP acceptability.

Frequency Distributions

Table 3 gives frequency distribtuions of TP tenderness scores and acceptability scores for each marbling score. The percentage of samples with or above a given level of desirability for each marbling score is shown. At a level of TP satisfaction for tenderness of three or over, the probability of attaining this level of satisfaction would be 100% at the practically devoid level of marbling. However, the probability of attaining a higher level of satisfaction, say 5, would only be 35% at the practically devoid level of marbling. To attain a TP tenderness score of four or greater with an 87% probability, slight amounts of marbling would have been required.

In the present study, the relationship existed between carcass quality, indicating criteria and TP traits were very low. For example, marbling accounted for only 6% of the variation in TP acceptability, and a thirtyfold increase in marbling would be required to yield a one-unit change in TP responses.