1971

Can Beef Quality Be Evaluated?

W. J. Costello
South Dakota State University

R. J. Berns

South Dakota State University
Brookings, South Dakota
Department of Animal Science
Agricultural Experiment Station

A.S. Series 71-24

Can Beef Quality Be Evaluated?

W. J. Costello and R. J. Berns

Introduction

Beef quality is important to the consumer. She wants to serve tender, juicy, tasty beef to her family each time she serves it. If she can consistently serve quality beef, she will serve beef frequently. If she finds that she cannot consistently serve quality beef cuts, she will serve something else. For that reason, beef quality becomes important to every one along the production line between the brood cow and the consumer.

Beef quality includes tenderness, flavor and general eating pleasure or satisfaction. Can quality be identified? How are the live animal and beef carcass "quality traits" related to ultimate eating quality? Data from a total of 630 Hereford steers produced on 18 different South Dakota ranches as a part of the beef breeding project were used in an attempt to provide answers to these questions.

Procedures

The steers were fed a high energy ration at Brookings after being weaned at approximately 205 days of age. When the average weight of a ranch group reached 1,000 pounds, the group was marketed. Wholesale cuts or carcasses were returned from the packing plant to the South Dakota State University Meat Laboratory for sampling and data collection.

Table 1 lists the variables evaluated and the means or average values for each. Live conformation, condition, maturity and cutability factors were scored by a committee of animal science staff members. Live market grade was determined by a packer buyer. A U.S.D.A. grader evaluated carcass conformation, maturity, marbling, percent kidney fat for cutability, lean color, lean firmness and grade. A panel of Animal Science Department staff evaluated samples from experiments 3 and 4 for tenderness, flavor and juiciness. All other data resulted from various weights and measures of the animal, carcass or tissues involved.

The cattle in experiment 2 (246 head) and experiment 3 (60 head) are parts of experiment 1 (578 head) but are listed separately because additional information was available on those portions of the larger group. Cattle in experiment 4 (52 head) were slaughtered as each animal reached one of four predetermined weights rather than as ranch groups.

A general description of the cattle would be they were approximately 16-month-old Hereford steers, averaging 1,000 pounds live weight, quality grading high good and yield grading a little above 3 after a 240- to 270-day feeding period. The group averaged about 0.55 inch of fat over a 10.5 square inch rib eye.

Results

The analysis of the data included the calculation of simple correlation

---

Prepared for the Fifteenth Annual Cattle Feeders Day, October 1, 1971.

coefficients which are indications of the degree of relationship between two traits (table 2). A perfect relationship would exist if a change of one unit in one trait was always associated with a constant change in the other trait. The coefficient would be 1.00. Coefficients near zero indicate that one trait may differ without corresponding changes in the other trait.

The highest correlation coefficient in the carcass grade column in table 2 was 0.86 with marbling score. Since marbling was one of the major factors used by the grader in establishing carcass quality grades, a high correlation would be expected. Although none of the correlation coefficients were as high as 0.86 in the live market grade column, there were five coefficients of 0.50 or larger and only five coefficients below 0.25. Five coefficients above 0.50 appeared in the carcass cutability column with 10 below 0.25. Therefore, a few of the traits studied had at least moderate relationships with live market grade and carcass cutability. By observing the traits with the higher correlations some estimate of live grade and carcass cutability may be possible. In contrast, only 8 correlation coefficients in the marbling score column were above 0.25. One of these, 0.86 with carcass grade, was expected as noted earlier and the others were no higher than 0.40. Even lower coefficients were observed in the shear tenderness relationships with other traits. Only two traits had correlation coefficients slightly greater than 0.25 in the shear tenderness column. Few, if any, of the traits observed would have been good indicators of either marbling or shear tenderness variations as they occurred in the group of 578 steers.

It should be noted that one of the low correlation coefficients in the carcass grade, marbling score, carcass cutability and live market grade columns was with shear tenderness. Shear tenderness is the amount of force, in pounds, required to cut through a one inch core of cooked steak. It is measured by a Warner-Bratzler shear machine and is a recognized mechanical measure of meat tenderness. The low correlation coefficients with shear tenderness indicate that none of the traits above were closely related to tenderness differences in this group of animals.

In experiments 3 and 4 simple correlation coefficients between taste panel evaluations of tenderness, flavor and juiciness and other live and carcass traits are all low except when related to the other taste panel traits (table 3). Shear tenderness and taste panel tenderness are not closely correlated, 0.27 and 0.34, in experiments 3 and 4. Marbling score related to taste panel responses at similar levels, but in experiment 3 as marbling increased panel evaluations increased, whereas in experiment 4 increased marbling was related to less desirable panel responses.

Statistical methods are available to combine values for many traits and to determine the ability of the combined information to predict another known value. The procedure also tells which of the traits have the greatest predicting ability. Use of the few traits will then provide almost as much prediction capacity as would be achieved if all traits were used. For example, applying this technique to the data from the group of 246 steers resulted in predictions which could account for 86.9% of the variation in carcass cutability when all 27 traits were used. However, the technique also revealed that 82.4% of the variation could be accounted for by using only 4 traits; fat thickness, carcass weight, loin eye area and carcass maturity. Carcass cutability can be predicted quite accurately because a large proportion of the variation, more than 80%, was accounted for by a few variables in all four experiments. Fat thickness, carcass weight and loin eye area were selected by the computer as important factors in predicting cutability in all four experiments. Carcass quality grade could also be predicted from a few other traits quite accurately, accounting for 80% or more of the variation in quality grade.

However, using as many as 27 traits to predict shear tenderness in experiment 2 accounted for only 25.6% of the variation. The five traits making major contributions to shear tenderness prediction accounted for 14.7% of the variation.

Predictions of taste panel traits from other traits in experiments 3 and 4 were about as ineffective as shear tenderness predictions. Wide variations in the amount of variation accounted for and in the traits selected for use in the predictions indicated that no one trait or group of traits observed in this study was able to predict palatability.

Summary

Data from 630 Hereford steers indicate that live and carcass traits are related to carcass cutability.

Live and carcass traits did not show high relationships with and were not able to predict shear tenderness or flavor, juiciness or tenderness as evaluated by a taste panel.

Although carcass quality grade was predicted accurately by live and carcass traits, it did not reflect true quality differences in this group of cattle. Carcass quality grade was not highly related to shear tenderness or panel traits.

Table 1. Means for all Variables Studied

Variable	Experiment No. 1	2	3	4	Units of Measure
No. of steers	578	246	60	52	
Initial age	220	229	229	222	Days
Days on feed	252	251	274	242	Days
Rate of gain	2.32	2.32	2.22	2.21	Pounds per day
Live weight	991.4	989.0	1012.9	933.1	Pounds
Conformation score	11.9	11.6	11.8	10.9	Average = 10
Condition score	9.8	9.9	10.4	9.0	Average = 7
Estimated live maturity	--	4.24	4.36	4.18	Average = 4
Live market grade	19.3	19.2	19.2	18.5	Low Choice = 19
Carcass weight	607.9	608.3	613.8	560.0	Pounds
Dressing percent	60.75	60.68	60.83	59.88	Percent
Carcass conformation	19.5	19.7	19.6	20.1	Choice = 20
Carcass maturity	22.6	22.5	21.8	21.8	A+ = 22, A = 23
Marbling score	4.9	5.2	4.8	4.4	Small = 5
Carcass grade	18.3	18.6	17.8	17.8	High Good = 18
Fat thickness	0.51	0.56	0.59	0.59	Inches
Loin eye area	10.67	10.66	10.22	10.43	Square inches
Carcass cutability	49.45	49.52	48.40	50.22	USDA est. percent
Lean color	4.6	4.8	4.4	5.2	Light cherry red = 5
Lean firmness	4.8	4.9	5.1	5.4	Moderately firm = 5
Shear tenderness	16.0	15.0	15.4	16.1	Pounds
Taste panel tenderness	--	--	3.60	3.37	1 = extremely desirable
Taste panel flavor	--	--	3.32	3.06	1 = extremely desirable
Taste panel juiciness	--	--	3.60	3.55	1 = extremely desirable
Percent moisture	72.63	72.51	72.48	73.05	Percent
Percent fat	3.86	4.19	4.35	4.16	Percent
Percent protein	21.72	21.48	21.92	21.72	Percent
Muscle fiber diameter	--	56.23	58.37	55.89	Microns
Muscle fiber waviness	--	2.7	2.4	2.8	Score
Muscle fiber length	--	2.3	2.0	2.0	Score
Live percent cutability	49.28	49.49	--	--	

Table 2. Simple Correlation Coefficients for Selected Traits (Experiment 1 - 578 Head)

Traits	Carcass grade	Shear tenderness	Marbling Score	Carcass cutability	Live market grade
Initial age	0.14	0.28	0.11	0.18	0.26
Days on feed	0.23	-.14	0.09	0.25	0.28
Rate of gain	0.42	0.01	0.33	0.10	0.50
Live weight	0.35	0.06	0.23	0.06	0.61
Conformation score	0.25	-.22	-.08	-.64	-.29
Condition score	-.24	-.26	-.04	-.70	-.34
Live percent cutability	-.05	-.22	-.01	0.06	-.32
Live market grade	0.42	0.13	0.21	0.30	1.00
Carcass weight	0.35	0.09	0.26	0.00	0.59
Dressing percent	0.43	0.22	0.19	0.58	0.61
Carcass conformation	0.51	0.03	0.27	0.45	0.62
Carcass maturity	0.37	-.02	0.14	0.39	0.37
Marbling score	0.86	-.13	1.00	0.04	0.21
Carcass grade	1.00	-.12	0.86	0.27	0.42
Fat thickness	0.25	0.00	0.26	-.41	0.38
Loin eye area	-.33	-.12	-.01	-.44	-.42
Carcass cutability	0.27	0.10	0.04	1.00	0.30
Lean color	0.46	-.05	0.39	0.14	0.21
Lean firmness	0.50	-.19	0.40	0.14	0.08
Shear tenderness	-.12	1.00	-.13	0.10	0.13
Percent moisture	-.16	0.06	-.19	0.11	-.06
Percent fat	0.04	-.21	0.30	-.58	-.36
Percent protein	0.10	0.24	-.13	0.52	0.39

Table 3. Simple Correlations of Taste Panel Traits With Other Traits

	Tenderness	Marbling score	Carcass cutability	Fat thickness	Carcass maturity	Lean firmness	Lean color	Taste panel tenderness	Taste panel flavor	Taste panel juiciness	Live market grade	Chilled carcass weight
Taste Panel Tenderness												
N = 60	0.27	-.26	0.08	-.04	-.04	-.31	-.02	1.00	0.81	0.79	-.01	0.01
N = 52	0.34	0.20	-.41	0.40	0.02	0.38	-.01	1.00	0.77	0.72	0.21	0.42
Taste Panel Flavor												
N = 60	-.01	-.23	0.01	-.01	0.04	-.15	0.00	0.81	1.00	0.87	0.01	-.11
N = 52	0.17	0.13	-.08	0.15	0.07	0.28	0.02	0.77	1.00	0.72	0.05	0.03
Taste Panel Juiciness												
N = 60	-.04	-.16	-.09	0.12	0.12	-.14	0.03	0.79	0.87	1.00	0.08	-.07
N = 52	0.18	0.23	-.46	0.27	-.06	0.28	0.02	0.72	0.72	1.00	0.06	0.14