

Effect of Feed on Beef Quality

only minor differences in tenderness, juiciness, flavor, found in beef from corn-fed, barley-fed, stilbestrol-treated steers

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The claim that West Coast grain-fed beef is inferior in quality to eastern corn-fed beef is not supported by experimental evidence.

When the Pacific Coast marketed—almost exclusively—grass-fed beef that carried more age than the corn-fed beef produced in the Middle West, the beef from the midlands was justifiably considered more desirable in over-all quality. However, in recent years the west has been producing ever-increasing amounts of grain-fed beef in feedlots, and California has ranked among the leading states.

Accumulated experience seems to indicate that stilbestrol—subcutaneously implanted—increases daily gains and feed efficiency of steers on a feedlot fattening ration, and the prospect that stilbestrol will be more commonly used suggests the need for determining its effect upon eating quality of the beef. Studies are also needed to determine at what stage of finish—quantity, quality, and distribution of fat—beef approaches its maximum eating quality.

A number of investigators have reported on the effect of carcass fatness of beef on the organoleptic properties of tenderness, juiciness, and flavor. There seem to be no significant differences in palatability of beef from steer carcasses ranging in fatness from about 26% to 31% and little difference in palatability between beef rib samples containing 30% fat and those with about 38% fat.

In one reported study—based on 728

animals of varying ages, weights, breeding, feeding—in which the fat content of the edible portion of the 9-10-11 rib cuts ranged from 7.5% to 57.5%, it was found that fatness significantly enhanced the desirability of lean beef flavor.

The results of another study—comparing beef fed on pasture alone with beef given grain supplements and with beef kept on dry lot—indicated that beef produced by feeding concentrates in addition to pasture, or in dry lot, was definitely superior to beef produced by fattening on pasture alone. The principal differences in palatability were in the factors of aroma, flavor of fat, flavor of lean, quality of juice, and juiciness.

In an investigation primarily concerned with the influence of an animal's age on the quality and palatability of beef, it was observed that in nearly every case fattened animals scored higher than unfinished ones.

The influence of fatness of beef on juiciness has been estimated by mechanical—press fluid—and organoleptic—panel scores—means, but most investigators found no correlation, or at least no important correlation, between the measurements. Findings in some studies did indicate that with an increase in per cent fat in press fluid due to more intramuscular fat, the per cent of press fluid decreases. At the same time, judges' scores for quantity and quality of juice tended to increase. One explanation for this seeming anomaly was that the fat added flavor and stimulated the flow of

saliva, and the impression of juiciness, richness, and smoothness was enhanced.

In attempts to correlate tenderness with degree of fatness, beef from feeders was judged to be less tender than beef from similar cattle after fattening. However, it is possible that changes in muscle fibers and connective tissues, as well as fat content, may have occurred during the fattening period.

In experiments at Davis, an attempt was made to determine how much difference in eating quality was created by 1, finishing steers on corn instead of barley; 2, feeding a higher proportion of concentrate to obtain a higher degree of finish—enough to achieve approximately U.S.D.A. Choice grade; and 3, implanting the animal with stilbestrol at the beginning of the feeding period—a procedure which tends to increase the amount of gain per pound of feed.

There were two trials—the first in May and June of 1954; the second in January and February of 1955—each involving 32 Hereford steers above average in uniformity of breeding, age, and quality. In each trial the animals were divided into four groups: I. Barley-fed, Good grade; II. Barley-fed, Choice grade; III. Stilbestrol-treated, barley-fed, Choice grade; IV. Corn-fed, Choice grade.

The grades in these groups are the approximate grades expected from ration-fed cattle. The actual grades achieved are shown in the table on this page.

The concentrate portion of the ration
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Animal History and Feed-Lot Performance

	Trial 1				Trial 2			
	Avg. days on feed—97				Avg. days on feed—185			
	Group I	Group II	Group III	Group IV	Group I	Group II	Group III	Group IV
No. of steers	8	8	8	8	8	8	8	8
Initial age—mos.	27	27	27	27	20	20	20	20
Initial weight—lbs.	943	937	938	939	831	833	845	844
% concentrate in ration	24	54	50	53	22	59	61	59
Average daily gain—lbs.	1.8	2.4	3.2	2.6	1.8	2.4	2.7	2.2
Avg. daily feed consumption—lbs.	26.1	28.7	30.6	28.6	27.3	25.6	24.8	25.6
Feed per 100 lbs. gain—lbs.	1,450	1,196	956	1,100	1,476	1,054	929	1,138
U.S.D.A. slaughter grade								
Prime—no. of animals	0	0	0	0	0	0	1	0
Choice—no. of animals	1	3	1	2	3	8	7	8
Good—no. of animals	6	5	7	6	4	0	0	0
Commercial—no. of animals	1	0	0	0	1	0	0	0
Avg. fat content of carcasses—%	33.3	35.6	33.0	36.4	34.6	42.6	41.8	40.1

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fed to groups I, II, and III—in both trials—consisted of 65% ground barley, 20% molasses beet pulp, and 15% ground oats. Group IV—in both trials—received No. 2 yellow ground corn as concentrate. Sixty milligrams of stilbestrol—in both trials—were implanted in the ear of each animal in Group III. The hay fed to all groups consisted of 50-50 alfalfa and oat hay.

Between Group II—barley-fed, Choice grade—and Group IV—corn-fed, Choice grade—there was no difference in rate of gain, slaughter grade, or fat content. Group III—stilbestrol-treated, barley-fed, Choice grade—made significantly greater gains than the other three groups. In the first trial, Group III had a significantly lower fat content than Groups II or IV, but in the second trial—in which the feeding period was doubled—this difference was not observed.

At weekly intervals, two animals from each group were selected on the basis of comparable finish, and slaughtered at a local packing house. After being graded by a U.S.D.A. inspector, the carcasses were allowed to age for 11 days before any subsequent analyses were made.

Following estimation of the fat content from specific gravity measurements of the seven rib section, this section was divided into two three-rib roasts—6th, 7th, 8th ribs; and 9th, 10th, 11th ribs. The 12th rib was retained for further studies on composition.

For the organoleptic tests, a scoring method was selected in which samples from each of the four groups were evaluated simultaneously. The comparison between corn- and barley-fed beef was made only on Choice grade meat; the influence of degree of finish—Good vs. Choice—involved only barley-fed animals; and the stilbestrol comparison was made on animals which had all been fed to Choice grade on barley.

Both prime rib roasts and top round steaks were used for these studies, so that—in each case—a relatively lean, less tender cut, as well as a particularly

tender part of the animal, was judged. The weight of the rib roasts ranged between seven and 11 pounds; the top round cuts, between three and four pounds.

Eight animals—two from each group—were slaughtered each week. On four successive days, four sets of round steaks were judged in the mornings, and four rib roasts in the afternoons. Thus the experiment required four weeks, with a total of 32 judging sessions—16 for the round steaks and 16 for the rib roasts.

Roasting was selected as the method of cooking affording the best control and reproducibility. Both types of cuts were roasted, uncovered, in aluminum pans at 300F until the internal temperature—as measured by a meat thermometer—registered 150F. For the rounds this required about one hour and for the ribs about four hours.

The meat was sliced approximately 1/4" to 3/8" thick. The pieces, cut to about four square inches in area—with the fat trimmed off as much as possible—were closely matched for location in the muscle, as well as for size, shape, and general appearance; and were kept warm in their own juice on a steam bath for a half-hour interim before being served. One piece from each of the four groups, plus a randomly chosen duplicate of one sample—which permitted a check on the reproducibility and consistency of the judges' scores—was served each judge at each session. The five pieces were served on a warm plate in random order opposite code numbers.

The judges were required to score each sample on a seven-point scale for tenderness, juiciness, and flavor—that is, a score of seven indicated a very desirable sample with respect to one of these three qualities; five indicated a desirable sample; and two, acceptable. The judges also ranked the samples from one to five, according to their general preference.

The 14-member panel of judges was trained and selected from an initial group of 23 persons by observing their scoring of similar cuts of beef—ranging from U.S.D.A. Choice to Utility grades—purchased in local markets. Both consistency

of scoring and range of scores employed were considered in choosing the final panel.

The average scores and ranks for the two replications of the experiment, as shown in the table below, indicate that—in the rib roasts—there were few significant differences among the four groups in the quality factors judged. In the rounds, however, the Good grade meat frequently scored lower than one or more of the three groups of Choice animals. This was particularly noticeable in the flavor scores for both years, in the juiciness scores for the second replication—1955—and in the average ranks in the 1954 series. Even in these instances the differences were not large. Average scores and ranks among the three groups of Choice animals were quite uniform.

Thus it appears that the organoleptic quality of barley-fed beef is equal in every respect to that of corn-fed and that no real difference exists between the quality of meat from stilbestrol-implanted cattle and that of untreated animals fed a similar ration. It also appears that the degree of finish—as reflected in the fatness of the beef—is not as important a factor as might be supposed in determining the flavor, tenderness, or juiciness of the meat.

If differences in breed and environment of cattle, differences in aging procedure, and differences in method of cooking were superimposed on the experimental variable of degree of finish—as would normally be the case in practical situations—it is unlikely that any differences between eastern or western grain-fed beef would be noticed in flavor, tenderness, or juiciness.

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Average Panel Scores and Ranks

Group	RIBS								ROUNDS							
	Tender-ness		Juiciness		Flavor		Ranks		Tender-ness		Juiciness		Flavor		Ranks	
	'54	'55	'54	'55	'54	'55	'54	'55	'54	'55	'54	'55	'54	'55	'54	'55
I	5.50	5.50	5.19	4.76	5.38	5.03	3.19	2.86	3.83	3.99	4.30	3.83	4.27	3.95	3.39	3.42
II	5.59	5.37	5.27	4.89	5.35	5.09	2.92	2.82	4.14	4.43	4.50	4.31	4.59	4.55	2.90	2.61
III	5.64	4.94	5.28	4.67	5.51	4.89	2.93	3.18	4.14	4.04	4.48	4.13	4.50	4.40	3.03	2.98
IV	5.34	5.10	5.37	4.74	5.45	4.97	2.95	3.13	4.33	4.04	4.63	4.11	4.58	4.38	2.69	3.01
F values . .	.92	2.48	.36	.21	.34	1.25	.87	.96	1.61	1.74	.41	2.14	1.84	7.61**	3.54*	3.30*
L.S.D.																
(95%)*	.28	.34	.27	.27	.23	.15	.29	.38	.35	.31	.42	.28	.24	.20	.34	.47

* Significance between 95% and 99% (F-value greater than 2.95).

** Significance greater than 99% (F-value greater than 4.97).