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South Dakota Cattle Feeders Field Day Proceedings
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Animal Science Reports

1973

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Recommended Citation

Smith, Peter B.; Costello, W.J.; Thiex, Peter J.; and Embry, L.B., "Carcass Characteristics of Bulls, Heifers and Steers as Influenced by Ration and Market Weight" (1973). *South Dakota Cattle Feeders Field Day Proceedings and Research Reports, 1973*. Paper 9.
http://openprairie.sdstate.edu/sd_cattlefeed_1973/9

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Brookings, South Dakota

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A.S. Series 73-37

**Carcass Characteristics of Bulls, Heifers and Steers
as Influenced by Ration and Market Weight**

Peter B. Smith, W. J. Costello, Peter J. Thiex
and L. B. Embry

High feed grain prices, a growing worldwide demand for animal protein, and increasing demand for lean, high quality beef make it imperative that beef volume and production efficiency increase. Because of high feed costs it is important to know how concentrate level in the ration and market weight influence production efficiency and carcass composition of different sex groups. The purpose of this study was to evaluate the effects of market weight and ration concentrate level on the quantitative and qualitative carcass traits of yearling bulls, bull calves, heifers and steers.

Procedures

The carcasses used in this study were those obtained from a feedlot performance trial (A.S. Series 73-34). The following table shows the experimental design:

Weight group	Heifers				Steers				Bull calves				Yearling bulls			
	1		2		1		2		1		2		1		2	
Concentrate level, %	50	90	50	90	50	90	50	90	50	90	50	90	50	90	50	90
Number of carcasses	14	14	14	14	6	6	7	7	14	14	13	13	5	7	7	7

The experiment was designed so that weight group 1 cattle would be fed until the heifers reached approximately 950 lb.; steers, 1050 lb.; bull calves, 1100 lb. and the yearling bulls, 1350 lb. Weight group 2 heifers were fed up to 1100 lb.; steers, 1200 lb.; bull calves, 1250 lb. and yearling bulls, 1500 lb. The primary objectives were to study differences in the weight groups and effects of the concentrate level used in arriving at the final weights.

The cattle were slaughtered at a commercial packing company and the following data were obtained after a 72-hour chill: carcass weight, quality grade, conformation, maturity, marbling, firmness score, color score, fat thickness at the 12th rib, rib eye area, percent kidney, pelvic and heart fat, and yield grade. The right sides, or the ribs and rounds from the right sides, were transported to the SDSU meat laboratory for physical separation into semi-boneless retail cuts, fat and

Prepared for the Seventeenth Annual Cattle Feeders Day, November 2, 1973.

bone. Steaks were taken from the rib for proximate analysis, taste panel studies and tenderness determination on the Warner-Bratzler shear machine.

Results

Heifers

Results for the heifer carcasses are shown in table 1. Within weight group 1, the heifers fed the 90% concentrate ration were slaughtered 28 days earlier, possessed a higher dressing percentage, a higher conformation score and a higher percentage of kidney, pelvic and heart fat. This group had lower Warner-Bratzler shear values. However, the taste panel judged steaks from the 50% concentrate group more tender. Chemical analysis indicated higher protein and lower water levels in carcasses from heifers fed the 90% concentrate ration. Concentrate level, however, appeared to have no effect on carcass maturity, color, firmness and rib eye area.

In weight group 2 heifers, there was a greater difference in dressing percent between concentrate levels than was evident in group 1, 1.9% vs. 3.2%, respectively. The 90% concentrate group had higher quality grades and higher percentages of ether extract and water. All other differences between animals fed the 50 and 90% concentrate rations were small. Compared with weight group 1, weight group 2 heifers were fed 63 days longer and had greater carcass weights, dressing percent and carcass grades but less desirable yield grades. Chemical analysis of the 10th rib section detected a lower percent of protein, higher percent of fat and lower percent of water in weight group 2 heifers. Weight group 1 heifers had lower Warner-Bratzler shear values, indicating more tenderness. The taste panel, however, could not detect any differences between weight groups for tenderness, juiciness or flavor.

Steers

Table 2 shows results from the steer carcasses. Within weight group 1, although possessing lighter slaughter and carcass weights, the 90% concentrate group had higher dressing percents, larger rib eye areas, more outside fat cover and higher but less desirable yield grades. Physical separation of the carcasses, however, revealed that the 90% concentrate group had a higher percentage of edible portion, less trimmable fat and a lower percentage of bone. Moreover, steers fed the 90% level of concentrates were more tender.

Within weight group 2, the 90% concentrate level resulted in steers that averaged 45 lb. heavier with 70 less days on feed. As contrasted with weight group 1, the 50% concentrate level resulted in slightly higher dressing percents, higher percentages of edible portion and bone and lower percentages of trimmable fat. Moreover, the 50% concentrate level resulted in less marbling, lower quality grades, less desirable yield grades and smaller rib eye areas.

Weight group 1 steers had a higher level of protein and less fat but more water in the 10th rib steak as determined by chemical analysis than the heavy weight steers. In addition, weight group 1 steers averaged 4.9% more edible portion and 6.2% less trimmable fat.

Bull Calves

Results for the bull calves are presented in table 3. Within weight group 1, although the bulls on the 50% concentrate level weighed 7 lb. more after being fed 68 days longer, those fed the higher level of concentrates had higher dressing percentages and heavier, higher grading carcasses containing larger rib eyes. Moreover, the lean color score was much higher for the 90% concentrate ration, although this advantage was considerably less in weight group 1. The 50% concentrate level in both weight groups produced carcasses with less fat thickness, a lower chemical determination of intramuscular fat, a higher percentage of edible portion and less fat trim. The Warner-Bratzler shear and taste panel rated the steaks from bulls fed the higher level of concentrates more tender in both weight groups. Weight group 1, however, appeared to be the most tender.

The 90% concentrate level in weight group 2 produced heavier, higher grading carcasses. Moreover, the lean in the 90% concentrate group was much firmer and brighter colored, moderately firm vs. soft and cherry red vs. dark red, respectively. The 50% concentrate group, however, possessed less fat thickness, more desirable yield grades, a higher percentage of edible portion and bone and less fat trim.

Weight group 1 bulls had less marbling and fat but much firmer, brighter colored lean and a higher percentage of edible portion.

Yearling Bulls

Data from the yearling bulls are presented in table 4. The yearling bulls in weight group 1 fed the 50% concentrate ration were fed 41 days longer and weighed 36 lb. more at slaughter. The bulls on the 50% level of concentrates had more external finish, larger rib eyes and less protein and fat in the 10th rib sample as determined by chemical analysis. It appeared that energy level in the ration had no appreciable effect on conformation, maturity, firmness, color score, percent kidney fat and Warner-Bratzler shear value in weight group 1.

In weight group 2, the bulls on the 50% concentrate ration had lower dressing percents and carcass weights, more youthful maturity scores, and smaller rib eye areas. Level of concentrate did not appear to affect conformation, color, firmness, fat thickness, kidney fat or taste panel evaluation.

Comparing weight groups, group 1 had a lower dressing percent and the difference was largest at the 90% concentrate level. Bulls in weight group 1 fed the lower level of concentrates had more youthful carcasses, less fat thickness and more favorable taste panel evaluation. The group 1 bulls appeared more tender by the shear test with the 90% weight group 1 bulls the most tender.

Summary

Carcass characteristics from yearling bulls, bull calves, heifers and steers fed either a 50 or 90% concentrate ration to two slaughter weight groups were studied. In all sex groups, the final slaughter weight affected carcass composition more than concentrate level.

The cattle in weight group 2 had higher dressing percents, higher quality grades, more marbling, larger rib eye areas, more outside fat cover, lower percentages of protein and water, higher percentages of fat as determined by chemical analysis and yielded lower percentages of edible portion. The Warner-Bratzler shear test indicated that the cattle in weight group 1 were more tender than weight group 2 regardless of sex group.

Although comparisons between sex groups may not be valid because of non-random assortment of the males, it appears that the bulls had heavier carcasses, were trimmer, had more desirable yield grades and a higher percentage of edible portion. The heifers had higher quality grades, smaller rib eye areas, and more outside fat cover than the steers and bulls, respectively. Tenderness as determined by both the Warner-Bratzler shear and taste panel was more desirable in the steers and heifers than in the bulls.

Table 1. Carcass Characteristics of Heifers

	Weight group 1			Weight group 2		
	50%	90%	Avg.	50%	90%	Avg.
Number of animals	14	14		14	14	
Live weight, lb.	952	970	961	1109	1102	1105
Dressing percent	62.4	64.3	63.4	62.9	66.1	65.5
Carcass weight, lb.	594	633	613	699	729	714
Days on feed	238	210	224	301	273	287
Quality grade ^a	18.6	19.0	18.8	19.6	21.1	20.6
Conformation ^a	21.0	22.5	21.7	21.3	22.6	22.0
Maturity ^b	22.9	23.0	23.0	23.0	23.1	23.0
Marbling ^c	5.1	5.3	5.2	6.1	7.0	6.5
Firmness score ^d	5.8	5.8	5.8	6.0	5.8	5.9
Color score ^e	4.5	4.9	4.7	5.1	5.1	5.1
Yield grade	4.0	4.5	4.2	5.0	5.1	5.1
Fat thickness, in.	0.69	0.81	0.75	1.04	0.98	1.01
Rib eye area, sq. in.	9.6	9.9	9.7	10.6	10.4	10.5
% kidney fat	3.5	3.9	3.7	3.2	3.9	3.6
Shear force	16.3	15.8	15.9	18.0	16.7	17.3
Panel tenderness ^f	2.7	3.9	3.3	3.2	3.0	3.1
Juiciness ^g	3.5	3.6	3.6	3.3	3.7	3.5
Flavor ^h	3.0	2.8	2.9	2.8	3.1	2.9
Proximate analysis, %						
Protein	21.64	23.06	22.35	21.74	21.57	21.66
Fat	6.12	6.74	6.43	7.11	8.86	7.99
Water	71.43	70.09	70.76	70.36	68.74	69.55

^aGood- = 16; Good+ = 18; Choice- = 19; Prime- = 22.

^bA- = 24; A = 23; A+ = 22; B = 20; C- = 18.

^cDevoid = 1; Small = 5; Moderately abundant = 9.

^dExtremely soft = 1; Slightly soft = 4; Very firm = 7.

^eVery dark red = 1; Cherry red = 4; Light cherry red = 5; Dark pink = 7.

^fExtremely tender = 1; Slightly tender = 4; Extremely tough = 8.

^gExtremely desirable = 1; Extremely undesirable = 8.

^hExtremely juicy = 1; Slightly juicy = 4; Extremely dry = 8.

Table 2. Carcass Characteristics of Steers

	Weight group 1			Weight group 2		
	50%	90%	Avg.	50%	90%	Avg.
Number of animals	6	6		7	7	
Live weight, lb.	1094	1035	1046	1159	1204	1182
Dressing percent	61.2	63.4	62.3	65.0	64.5	64.8
Carcass weight, lb.	669	657	663	753	778	765
Days on feed	245	217	231	350	280	315
Quality grade ^a	18.7	18.2	18.4	18.7	20.3	19.5
Conformation ^a	21.5	21.5	21.5	22.1	21.3	21.2
Maturity ^b	23.0	23.0	23.0	23.0	23.0	23.0
Marbling ^c	4.7	4.8	4.8	5.1	6.4	5.8
Firmness score ^d	6.0	5.7	5.8	6.0	5.9	5.9
Color score ^e	4.8	5.2	5.0	4.7	5.3	5.0
Yield grade	3.8	3.9	3.8	5.0	4.4	4.7
Fat thickness, in.	0.61	0.69	0.65	0.89	0.85	0.87
Rib eye area, sq. in.	10.1	10.8	10.5	10.5	11.3	10.9
% kidney fat	2.2	3.1	2.6	3.8	3.1	3.5
Shear force	15.6	13.4	14.5	17.8	17.8	17.8
Panel tenderness ^f	3.1	2.2	2.7	3.2	3.2	3.2
Juiciness ^g	3.7	3.9	3.8	3.4	3.8	3.6
Flavor ^h	2.9	2.8	2.8	2.9	3.1	3.0
Proximate analysis, %						
Protein	22.06	23.52	22.79	21.61	21.26	21.43
Fat	4.64	4.4	4.25	5.69	7.02	6.36
Water	72.24	72.39	72.31	71.63	70.7	71.16
Physical separation, %						
Edible portion	56.90	58.69	57.81	53.02	52.07	52.86
Trimmable fat	29.35	27.89	28.61	33.91	34.77	34.34
Bone	13.75	13.42	13.58	13.07	12.53	12.8

^aGood- = 16; Good+ = 18; Choice- = 10; Prime- = 22.

^bA- = 24; A = 23; A+ = 22; B = 20; C- = 18.

^cDevoid = 1; Small = 5; Moderately abundant = 9.

^dExtremely soft = 1; Slightly soft = 4; Very firm = 7.

^eVery dark red = 1; Cherry red = 4; Light cherry red = 5; Dark pink = 7.

^fExtremely tender = 1; Slightly tender = 4; Extremely tough = 8.

^gExtremely desirable = 1; Extremely undesirable = 8.

^hExtremely juicy = 1; Slightly juicy = 4; Extremely dry = 8.

Table 3. Carcass Characteristics of Bull Calves

	Weight group 1			Weight group 2		
	50%	90%	Avg.	50%	90%	Avg.
Number of animals	14	14		13	13	
Live weight, lb.	1107	1100	1103	1242	1281	1262
Dressing percent	61.0	63.4	62.2	62.3	63.4	62.9
Carcass weight, lb.	676	698	687	781	813	797
Days on feed	295	227	243	357	311	334
Quality grade ^a	17.5	18.3	17.9	18.4	20.1	19.3
Conformation ^a	21.9	22.0	21.9	22.6	22.5	22.6
Maturity ^b	23.0	23.0	23.0	21.9	23.2	22.5
Marbling ^c	4.8	4.9	4.7	5.9	6.3	6.1
Firmness score ^d	6.0	6.0	6.0	3.4	5.7	4.5
Color score ^e	2.7	4.3	3.6	1.8	4.4	3.1
Yield grade	3.2	3.6	3.4	4.0	4.6	4.3
Fat thickness, in.	0.47	0.62	0.55	0.64	0.88	0.76
Rib eye area, sq. in.	11.3	11.5	11.4	11.7	11.9	11.8
% kidney fat	2.6	3.3	2.9	3.2	3.1	3.2
Shear force	18.7	14.4	16.5	19.3	18.8	19.0
Panel tenderness ^f	3.8	3.3	3.6	4.3	3.9	4.0
Juiciness ^g	3.9	3.8	3.9	3.6	3.9	3.6
Flavor ^h	2.9	3.0	3.0	3.4	3.1	3.3
Proximate analysis, %						
Protein	21.82	23.08	22.45	21.89	19.04	20.46
Fat	2.95	5.19	4.07	4.42	6.27	5.35
Water	74.27	71.79	73.03	73.08	71.35	72.2
Physical separation, %						
Edible portion	62.11	60.19	61.30	62.29	57.52	59.9
Trimmable fat	23.24	27.23	25.23	23.42	30.80	26.17
Bone	14.35	12.58	13.47	14.29	12.4	13.4

^aGood- = 16; Good+ = 18; Choice- = 19; Prime- = 22.

^bA- = 24; A = 23; A+ = 22; B = 20; C- = 18.

^cDevoid = 1; Small = 5; Moderately abundant = 9.

^dExtremely soft = 1; Slightly soft = 4; Very firm = 7.

^eVery dark red = 1; Cherry red = 4; Light cherry red = 5; Dark pink = 7.

^fExtremely tender = 1; Slightly tender = 4; Extremely tough = 8.

^gExtremely desirable = 1; Extremely undesirable = 8.

^hExtremely juicy = 1; Slightly juicy = 4; Extremely dry = 8.

Table 4. Carcass Characteristics of Yearling Bulls

	Weight group 1			Weight group 2		
	50%	90%	Avg.	50%	90%	Avg.
Number of animals	5	7		7	7	
Live weight, lb.	1371	1335	1353	1542	1530	1536
Dressing percent	62.8	62.2	62.5	63.0	64.6	64.1
Carcass weight, lb.	862	831	846	980	989	984
Days on feed	145	104	124	217	168	192
Quality grade ^a						
Conformation ^a	21.0	21.0	21.0	21.0	21.0	21.0
Maturity ^b	22.0	22.0	22.0	18.9	22.1	20.4
Marbling ^c	3.2	4.0	3.6	3.1	3.7	3.4
Firmness score ^d	4.6	4.6	4.6	4.6	4.7	4.6
Color score ^e	3.8	4.0	3.9	3.7	3.6	3.6
Yield grade	2.8	2.6	2.7	3.9	3.7	3.8
Fat thickness, in.	0.52	0.44	0.48	0.7	0.71	0.70
Rib eye area, sq. in.	14.5	14.3	14.4	13.7	14.8	14.2
% kidney fat	1.9	2.0	1.9	1.9	2.0	1.9
Shear force	17.4	17.1	17.3	17.8	18.5	18.1
Panel tenderness ^f	4.5	4.7	4.6	5.2	5.1	5.2
Juiciness ^g	3.4	4.0	3.7	3.9	4.0	4.0
Flavor ^h	3.1	3.3	3.2	3.0	3.3	3.2
Proximate analysis, %						
Protein	22.87	24.06	23.59	23.08	23.26	23.17
Fat	1.84	2.9	2.37	2.77	3.15	2.96
Water	74.41	73.42	73.91	73.85	72.99	73.42

^aGood- = 16; Good+ = 18; Choice- = 19; Prime- = 22.

^bA- = 24; A = 23; A+ = 22; B = 20; C- = 18.

^cDevoid = 1; Small = 5; Moderately abundant = 9.

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