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# The Effects of Management and Sex on Carcasses of Yearling Cattle

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# The Effects of Management and Sex on Carcasses of Yearling Cattle

M. T. FOSTER AND J. C. MILLER

**Abstract.**—Studies were made of carcasses from yearling steers and heifers. Physical and chemical analyses were made along with cooking and palatability tests.

More liberal grain rations produced generally proportionate increases in slaughter and carcass grades, dressing percentage, fat content, cooking losses and palatability; with proportionate decreases in lean, bone, moisture content, and shrinkage from chilling.

Although steers dressed slightly higher than comparable heifers, steer carcasses contained less fat with more lean and bone, and roasts from these carcasses lost more in cooking than roasts from heifer carcasses.

Sex had no influence on the palatability of the roasts.

The hind quarter made up a greater portion of the heifer carcasses while the reverse was true for the steer carcasses.

Apparently, fat yearling heifers marketed at an early age produce beef equally as desirable as beef from comparable steers.

Feeding and sex are factors of importance in production, marketing and consumption of beef. Advantageous disposal of heifers becomes a more acute problem as production costs increase. There is a tendency for the buyers' price discrimination against female cattle to begin when these cattle weigh approximately 700 pounds, and to increase with the age and weight of the cattle. Exact information concerning the basis for discrimination is not generally available. Data are herein presented showing the effects upon yearling steer and heifer carcasses produced by varying the amounts of grain in the ration.

## REVIEW OF LITERATURE

**Effects of Feeding on Carcasses of Yearling Cattle.**—Two years' tests at the Illinois Station<sup>1</sup> show that the grade and quality of the beef produced by calves improved as the feeding period advanced to 140 days for heifers, and 200 days for steers. There seemed to be nothing gained by longer feeding periods, so far as finish and quality of meat were concerned. There were no significant differences in palatability or total cooking losses due to finish.

The Iowa Station<sup>2</sup> reports cooking losses of 13.8 per cent in roasts from fat yearling steers and 11.5 per cent from thin carcasses. Gramlich and Loeffel<sup>3</sup> reported that carcasses produced by heifer calves improved in grade, and the percentage of internal fat more than doubled during a 224-day feeding period. The percentage of forequarter, rib, plate and flank increased while the

chuck, round and shank decreased as the feeding period progressed. The mechanically separable fat increased from 19.9 to 31.8 per cent, the lean decreased from 57 to 53 per cent and the bone decreased from 21 to 14 per cent. There was no significant difference in cooking losses due to finish, for the loss by evaporation decreased as the drippings increased.

**Effects of Sex on Carcasses of Yearling Cattle.**—As early as 1893 Wilson and Curtiss<sup>4</sup> found that slaughter tests did not reveal material differences in the character, composition and quality of meat from steers and heifers.

Robertson and MacQueen<sup>5</sup> in 1918 concluded that "The heifer is discriminated against on the market, first, because of her larger percentage of fat to lean meat when in prime condition, and second because the American public does not appreciate the finer quality of the meat."

Extensive tests at the Illinois Station<sup>1</sup> demonstrated that heifer calves will produce choice carcasses in 60 days less time than steer calves. Heifers fed 140 days produced carcasses containing 18 per cent more fat than corresponding steer carcasses, while there was very little difference in fat content after 200 days feeding. There was no difference attributable to sex, in the percentages of round, rump, loin, ribs, chuck; or firmness of fat, color of lean, or palatability of cooked beef. The eye of beef was larger in the steer ribs. The total cooking losses were slightly greater in the cuts from heifer carcasses after 200 days feeding.

Gramlich and Thalman<sup>6</sup> report that the dressing percentage, and the percentage of the more valuable cuts varied little in yearling steers and heifers, although the steer carcasses consistently cut heavier rounds and lighter loins than the heifers.

Results of slaughter and cooking tests<sup>7</sup> conducted in the United States Department of Agriculture meat laboratories on 56 representative steers and 54 representative heifers showed the dressing percentage of the heifers equally as high as the steers although weighing an average of 76 pounds less than the steers at the end of the feeding period. At common final weights, heifers tended to yield a slightly higher percentage of carcass than steers. Heifers reached a given degree of finish at a distinctly lighter weight than steers, and in all cases the amount of kidney and crotch fat was greater in the heifers. There was no difference in palatability due to sex. From these results the conclusion is drawn that "Up to the point where the heifer becomes excessively fat, price discrimination against her is not justified."

## EXPERIMENTAL WORK

**Objects.**—The objects of this investigation were to study:

1. The effects of various methods of feeding on the quality, conformation and finish of the carcasses, and the palatability of the meat produced by yearling steers and heifers.

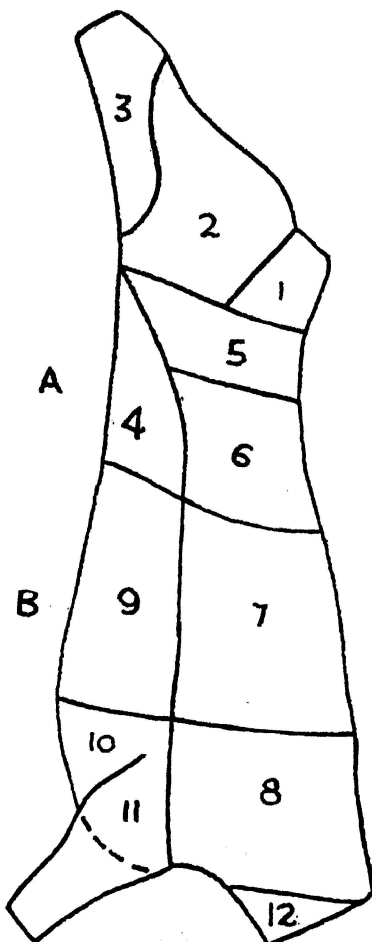
2. The influence of sex on the quality, conformation and finish of the carcass, and the palatability of the meat produced by yearling cattle.

**Plan and Procedure.**—High grade yearling steers and heifers, 14 to 20 months of age when slaughtered and carrying different degrees of finish, were used.

They were graded as feeders at the beginning, as slaughter cattle at the end, and as carcasses after being slaughtered and

**BEEF CHART.—WHOLESALE CUTS,  
CHICAGO STYLE**

A. Hindquarter.....	48.0%*
1. Rump.....	5.0
2. Round.....	15.0
3. Hind Shank.....	4.0
4. Flank.....	3.5
5. Loin End.....	7.0
6. Short Loin.....	10.5
Kidney Knob.....	3.0
B. Forequarter.....	52.0
7. Rib.....	9.5
8. Chuck (trimmed).....	17.0
9. Plate.....	8.5
10. Brisket.....	6.5
11. Fore Shank.....	5.5
12. Neck.....	5.0



\*These percentage values are for 600-pound choice grade carcasses. They represent the average of several tests.

chilled. The cattle were fasted 24 hours, having access to water, then weighed and slaughtered. This live weight was used to calculate dressing percentage. Accurate slaughter house records were kept, including offal and carcass weights. Physical analyses were made of the right half of each carcass after 48 hours chilling at 28° to 40° F. After dividing the fore and hind quarters between the 12th and 13th ribs at a line crowding the 12th rib its full length they were divided into wholesale cuts by the Chicago method of cutting<sup>8</sup>. Retail cuts were then made and these separated into lean, visible fat, and bone, the weights and percentages of each being recorded. Chemical analyses were made of the 9th, 10th, and 11th rib cut from the right half of each carcass. Cooking tests were made from the same cuts of the left half of each carcass. Photographs were made of each animal before slaughter, of the right half of each carcass and of the wholesale rib cut.\*

The grading was done by an official committee of three, representing the Bureaus of Animal Industry and Agricultural Economics of the United States Department of Agriculture, and the Animal Husbandry Department of the University of Missouri. The chemical analyses and the cooking tests were made by the Departments of Agricultural Chemistry and Home Economics of the University of Missouri. The roasts were scored for palatability by a committee of six, selected from members of the Departments of Home Economics, Agricultural Chemistry, and Animal Husbandry of the University of Missouri.

The grading, weighing, slaughtering, cutting, chemical analyses, and cooking were done in accordance with the standardized methods outlined in The National Cooperative Project<sup>9</sup> for "A Study of the Factors Which Influence the Quality and Palatability of Meat."

**Animals and Carcasses.**—The cattle used were fed in a series of three feeding trials conducted in 1926-27, 1927-28, and 1928-29 to study the production of beef from fat yearlings. They were high grade Hereford steer and heifer calves secured from the Matador Land and Cattle Company, Matador, Texas; of uniform age, breeding, weight, and condition, and graded as "Low Choice"<sup>10</sup> feeders, at about 8 months of age, when the experiment started.

The treatment and sex of the cattle, the total number of animals fed in each lot, the average grade at time of slaughter and

\*In two cases pictures of the wholesale rib cuts were not available and pictures of retail cuts were substituted.

carcass grade for entire lot; and the number of carcasses studied and their grades are indicated below.

Treatment and Sex of Cattle	Average Grade			Carcasses Studied		
	No.	Average Grade		No.	Average Grade	
		Slaughter	Carcass		Slaughter	Carcass
Full fed grain and roughage 196 days						
Steers.....	16	81.36	78.57	2	82.75	81.58
Heifers.....	8	81.33	81.23	1	84.71	81.42
Fed half grain ration and roughage 196 days						
Steers.....	16	-----	-----	2	70.53	66.00
Heifers.....	8	-----	-----	1	71.31	67.24
Fed roughage only 196 days						
Steers.....	16	-----	-----	2	63.98	59.78
Fed half grain ration and roughage 168 days, then full fed grain on pasture 168 days						
Steers.....	16	81.88	81.25	2	83.15	80.76*
Heifers.....	8	83.24	84.27	1	84.46	81.21
Fed roughage only 168 days, grazed 56 days, then full fed 112 days						
Steers.....	16	73.84	69.89	2	73.84	69.04**

\*2 years only.

\*\*1 year only.

Numerical values for grades (1) Fancy or Prime 90.01-100, (2) Choice 80.01-90.00, (3) Good 70.01-80.00, (4) Medium 60.01-70.00, (5) Common 50.01-60.00.

The grain ration consisted of shelled corn 8 parts and cottonseed meal 1 part. The roughages were corn silage and legume hay in dry lot and bluegrass as pasture in summer.

One animal from each lot except the last was slaughtered in 1927. The remaining steers were slaughtered in 1928 and 1929. The animals slaughtered at the end of 196 days of dry lot feeding were approximately 14 months of age, while those slaughtered after 168 days feeding on pasture were approximately 20 months old. In each of the five groups of steers, average data for two or more steers were used.

The animals which had received a full grain ration with roughage for 196 days were in desirable market condition and weighed approximately 750 pounds. Although the heifer appeared slightly fatter than the steers, all graded as "Low Choice" slaughter cattle. The animals which received a half grain ration with roughage had made considerable growth but were not fat enough to sell for slaughter to best advantage. As slaughter cattle, they graded "Low Good." The steers which had been on a roughage ration only, were very undesirable as slaughter cattle, grading "Medium." In reality, they were in excellent condition for grazing or feeding purposes.

The animals which were carried through the winter period (168 days) on a half grain ration, then full fed 168 days on pasture were very desirable slaughter cattle, weighing over 900 pounds and carrying enough finish to grade "Low Choice" and "Choice" for the steers and heifers respectively. The steers which had received a ration of roughage through the winter, grazed 56 days, then full fed on pasture for 112 days, graded "Low Good" as slaughter cattle.

The grades of the carcasses from all animals corresponded closely to the grades of the animals on foot. The carcasses from the animals fed a full grain ration showed excellent conformation, quality and finish. The rounds, loins and ribs were well developed and plump. The chucks and plates were thick and heavily fleshed. The heifer carcass was more highly finished than the steer carcasses; however, all graded "Low Choice."

The carcasses from the cattle fed half a grain ration carried much less fat, both externally and internally, than the carcasses from the cattle which received a full grain ration. They were more angular in conformation, and lacked fullness and plumpness throughout. However, they were popular carcasses in that there is a ready outlet for that grade and weight of beef on the market. The carcasses were graded "Medium" and "High Medium," which is slightly lower than the cattle graded on foot as slaughter cattle.

The carcasses from the steers fed roughage only were very undesirable for slaughter, lacking in finish to the extent that they were of inferior quality.

The carcasses from the animals which were wintered 168 days on half grain ration, then full fed on pasture 168 days were very desirable beef. They were larger and more mature than the others, possessing sufficient finish to grade "Low Choice."

Carcasses from the steers which were fed roughage through the winter, grazed for 56 days, then full fed on pasture 112 days, were not well finished. These carcasses graded "High Medium" and "Low Good." Carcasses of these grades and quality are desired by many retailers.

#### DISCUSSION OF DATA

The data have been arranged in four parts: first, steers that were fed different amounts of grain in dry lot for 196 days; the second, heifers handled in a similar manner; the third, steer and heifer groups fattened on pasture (following a 168 day dry lot wintering period); and the fourth part is a comparison of all steer and heifer groups handled similarly.



Steers.—Three Groups Fed 196 Days in Dry Lot.—A direct relationship between gain, dressing percentage, and amount of grain fed seemed to exist (Table 1).

TABLE 1.—WEIGHTS, DRESSING PERCENTAGES AND GRADING RECORDS OF STEERS AND HEIFERS HANDLED BY DIFFERENT METHODS

	Full Grain Ration 196 Days		Half Grain Ration 196 Days		Roughage Ration 196 Days	Half Grain Ration 168 Days; Full Fed on Pasture 168 Days		Roughage 168 Days; Grazed 56 Days; Full Fed on Pasture 112 Days
	Steers	Heifer	Steers	Heifer	Steers	Steers	Heifer	Steers
Initial weight.....	347.30	350.00	351.50	383.00	316.80	366.00	362.00	371.00
Final weight.....	772.00	733.00	570.00	675.00	469.00	978.00	942.00	843.80
Total gain.....	424.70	383.00	218.50	292.00	152.00	612.00	580.00	472.80
Average daily gain.....	2.16	1.95	1.11	1.49	.77	1.82	1.72	1.41
Slaughter weight.....	749.50	725.00	568.00	630.00	440.00	941.00	920.00	846.00
Carcass weight warm.....	445.25	429.00	322.70	354.50	235.70	570.80	568.00	477.50
Carcass weight chilled.....	435.50	420.00	314.25	345.00	226.50	561.00	558.00	465.50
Shrink.....	9.75	9.00	8.45	9.50	9.25	9.80	10.00	12.00
Per cent shrink.....	2.18	2.09	2.61	2.68	3.90	1.71	1.76	2.51
Dressing Per cent.....	58.10	57.93	55.32	54.76	51.47	59.62	60.65	55.02
Feeder grade.....	82.05	78.73	82.17	82.90	82.25	79.50	81.05	80.90
Slaughter grade.....	Choice	Good+	Choice	Choice-	Choice-	Good+	Good+	Good+
	82.75	84.71	70.53	71.31	63.98	83.15	84.46	73.84
	Choice-	Choice	Good-	Good-	Medium	Choice-	Choice	Good
Carcass grade.....	81.58	81.42	66.00	67.24	59.78	80.76	81.21	69.04
	Choice-	Choice-	Medium	Medium+	Common+	Choice-	Choice-	Medium+

The slaughter grades of live steers and the carcasses varied directly as the amount of grain fed. The percentage carcass shrinkage from 48 hours chilling decreased as fatness increased. Higher finished carcasses tended to show a higher percentage of hindquarter (Table 2).

TABLE 2.—WEIGHTS AND PERCENTAGES OF FORE AND HIND QUARTER FROM STEERS AND HEIFERS HANDLED BY DIFFERENT METHODS

	Pounds		Per Cent	
	Steers	Heifers	Steers	Heifers
Full Grain Ration 196 Days				
Forequarter.....	110.2	100.5	50.6	48.3
Hindquarter.....	107.5	107.5	49.4	51.7
Total Side.....	217.7	208.0	100.0	100.0
Half Grain Ration 196 Days				
Forequarter.....	78.4	84.0	51.0	49.1
Hindquarter.....	75.6	87.0	49.0	50.9
Total Side.....	154.0	171.0	100.0	100.0
Roughage Ration 196 Days				
Forequarter.....	57.5	-----	51.3	-----
Hindquarter.....	54.5	-----	48.7	-----
Total Side.....	112.0	-----	100.0	-----
Half Grain Ration 168 Days—Full Fed on Pasture 168 Days				
Forequarter.....	142.5	134.5	51.5	49.1
Hindquarter.....	134.1	139.5	48.5	50.9
Total Side.....	276.6	274.0	100.0	100.0
Roughage 168 Days—Grazed 56 Days—Full Fed on Pasture 112 days				
Forequarter.....	119.8	-----	51.8	-----
Hindquarter.....	111.7	-----	48.2	-----
Total Side.....	231.5	-----	100.0	-----

TABLE 3.—THE WHOLESALE CUTS FROM STEERS AND HEIFERS HANDLED BY DIFFERENT METHODS

*Expressed in Pounds*

	Full Grain Ration 196 Days		Half Grain Ration 196 Days		Roughage Ration 196 Days	Half Grain Ration 168 Days; Full Fed on Pasture 168 Days		Roughage 168 Days; Grazed 56 Days; Full Fed on Pasture 112 Days
	Steers	Heifer	Steers	Heifer	Steers	Steers	Heifer	Steers
Round (R & S on).....	51.6	48.0	42.6	44.0	31.9	65.4	64.0	56.6
Round (R & S off).....	31.5	29.2	25.1	26.8	20.0	39.8	38.3	35.6
Rump.....	11.0	10.8	9.5	9.5	5.7	13.8	16.0	11.3
Shank.....	9.1	8.0	8.1	7.7	6.2	11.8	9.7	9.8
Loin.....	39.8	37.0	25.5	30.0	19.0	47.0	46.0	37.8
Loin end.....	21.6	19.6	14.3	17.0	10.5	25.3	24.5	22.0
Short loin.....	18.2	17.4	11.2	13.0	8.5	21.7	21.5	15.8
Flank.....	8.8	11.9	4.2	8.6	2.6	13.0	19.5	10.0
Rib.....	19.8	19.1	13.3	14.2	10.2	27.5	33.0	22.1
Chuck.....	47.3	41.5	35.5	35.5	24.0	58.5	47.5	52.1
Neck.....	4.5	4.5	4.5	4.5	5.1	8.2	11.5	6.0
Plate.....	28.6	27.1	17.0	21.3	10.7	35.7	30.0	28.0
Navel.....	15.3	16.4	9.4	11.9	5.8	22.2	20.5	16.7
Brisket.....	13.3	10.7	7.6	9.4	4.9	13.5	9.5	11.3
Fore shank.....	10.1	9.0	8.7	8.6	6.9	12.2	12.0	11.6
Kidney knob.....	6.3	8.5	2.2	4.1	1.5	8.2	10.0	6.9
Loss.....	1.0	1.4	0.6	0.2	1.1	—	0.5	—
Total side.....	217.8	208.0	154.0	171.0	112.0	276.6	274.0	231.5

*Expressed in Per Cent*

Round (R & S on).....	23.7	23.1	27.8	25.7	28.5	23.6	23.4	24.4
Round (R & S off).....	14.5	14.0	16.3	15.7	17.9	14.4	14.0	15.4
Rump.....	5.1	5.2	6.2	5.5	5.1	5.0	5.8	4.9
Shank.....	4.2	3.8	5.3	4.5	5.5	4.3	3.5	4.2
Loin.....	18.4	17.8	16.6	17.5	17.0	17.0	16.8	16.3
Loin end.....	10.0	9.4	9.3	9.9	9.4	9.1	8.9	9.5
Short loin.....	8.4	8.3	8.0	7.6	7.6	7.8	7.8	6.8
Flank.....	4.4	5.7	2.7	5.0	2.3	4.7	7.1	4.3
Rib.....	9.1	9.2	8.6	8.3	9.1	9.9	12.0	9.5
Chuck.....	21.8	20.0	23.2	20.8	21.5	21.3	17.3	22.5
Neck.....	2.1	2.2	2.9	2.6	4.6	3.0	4.2	2.6
Plate.....	13.1	13.0	11.0	12.5	9.6	12.9	11.0	12.1
Navel.....	7.1	7.9	6.1	7.0	5.2	8.0	7.5	7.2
Brisket.....	6.1	5.2	4.9	5.5	4.5	4.9	3.5	4.9
Fore shank.....	4.7	4.3	5.7	5.0	6.1	4.4	4.4	5.0
Kidney Knob.....	2.9	4.1	1.4	2.4	1.3	3.0	3.7	3.0
Loss.....	0.0	0.5	0.1	0.1	0.0	0.2	0.2	0.3
Total side.....	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 4.—THE PERCENTAGE OF LEAN IN THE WHOLESALE CUTS FROM STEERS AND HEIFERS HANDLED BY DIFFERENT METHODS

	Full Grain Ration 196 Days		Half Grain Ration 196 Days		Roughage Ration 196 Days	Half Grain Ration 168 Days; Full Fed on Pasture 168 Days		Roughage 168 Days; Grazed 56 Days; Full Fed on Pasture 112 Days
	Steers	Heifer	Steers	Heifer	Steers	Steers	Heifer	Steers
Round (R & S on).....	62.5	64.2	69.3	66.5	68.7	63.8	63.6	66.3
Round (R & S off).....	76.4	81.4	85.7	83.8	85.5	78.9	78.6	81.2
Rump.....	54.0	51.4	62.1	55.8	59.6	53.6	52.5	54.0
Shank.....	24.4	18.8	27.2	18.4	21.0	24.6	22.7	25.5
Loin.....	55.6	54.8	68.9	63.2	67.9	56.8	57.2	61.6
Loin end.....	55.6	52.8	69.0	64.3	69.5	59.7	59.3	65.5
Short loin.....	55.8	57.0	68.8	61.8	65.9	53.5	54.7	56.3
Flank.....	42.0	30.3	63.4	42.5	72.0	33.8	29.9	46.0
Rib.....	48.0	49.5	62.9	57.3	61.8	55.1	55.8	57.5
Chuck.....	61.1	60.4	70.2	65.8	68.8	62.9	60.0	68.1
Neck.....	64.4	65.9	71.1	70.2	59.6	65.4	71.4	66.7
Plate.....	45.8	45.6	61.5	52.4	58.9	47.1	48.8	55.0
Navel.....	46.4	45.4	64.9	54.4	62.1	47.3	48.8	52.7
Brisket.....	45.1	45.8	57.3	50.0	55.1	46.7	49.5	57.5
Fore shank.....	51.0	50.0	55.2	51.7	43.5	50.4	56.7	59.5
Kidney knob.....	—	—	—	—	—	—	—	—
Total side.....	54.0	52.7	65.8	60.0	63.9	55.4	54.2	60.4

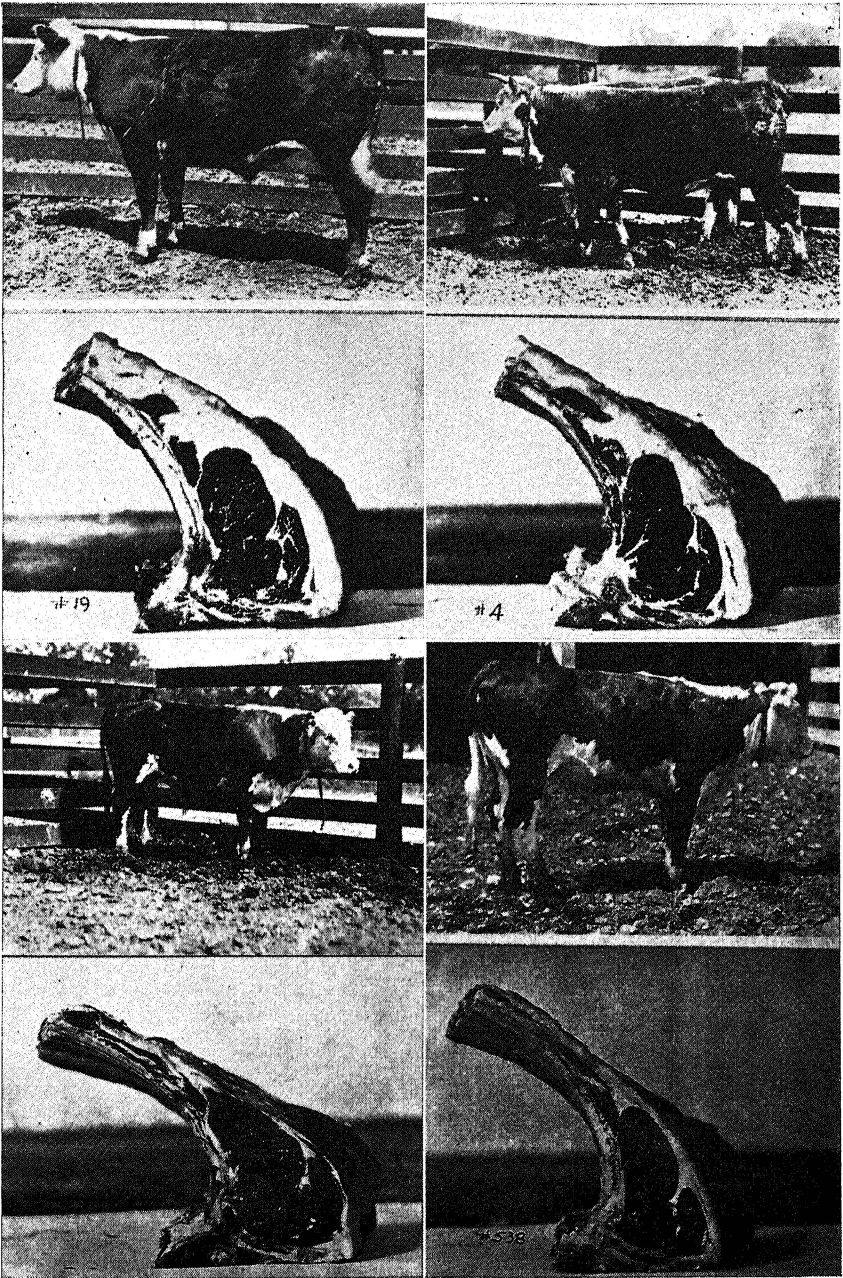


Plate I.—Upper left: Steer fed a full grain ration and roughage 196 days. Upper right: Heifer full fed 196 days. Lower left: Steer fed half a grain ration and roughage 196 days. Lower right: Heifer fed half a grain ration and roughage.

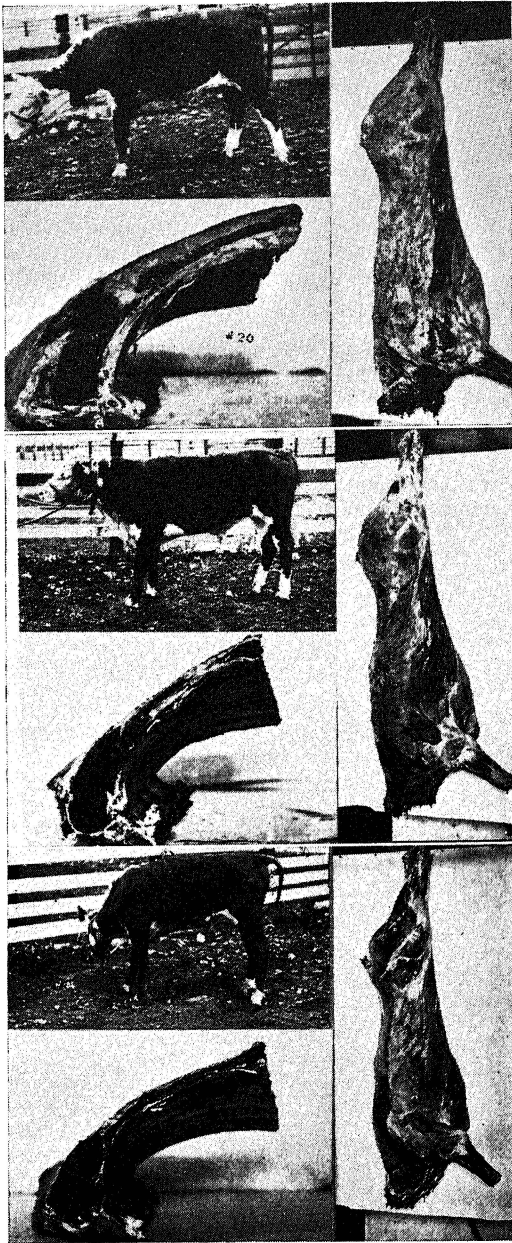


Plate II.—Upper: Steer fed a full grain ration and roughage 196 days. Middle: Steer fed a half grain ration and roughage 196 days. Lower: Steer on roughage ration only, for 196 days.

During the fattening process, the greatest percentage of fat was deposited in the flank, plate, rib, loin and rump in the order named (Table 5). Practically every wholesale cut from the carcasses produced by feeding a full grain ration contains more than twice the amount of fat in corresponding cuts produced by feeding a half grain ration. As the percentage of fat increased, the percentage of lean and bone decreased. A surprisingly small difference appeared between the percentage of lean, fat and bone in the carcasses produced by feeding a half grain ration and by feeding roughage only, even though the former were nearly 100 pounds heavier.

TABLE 5.—THE PERCENTAGE OF FAT IN THE WHOLESALE CUTS FROM STEERS AND HEIFERS HANDLED BY DIFFERENT METHODS

	Full Grain Ration 196 Days		Half Grain Ration 196 Days		Roughage Ration 196 Days	Half Grain Ration 168 Days; Full Fed on Pasture 168 Days		Roughage 168 Days; Grazed 56 Days; Full Fed on Pasture 112 Days
	Steers	Heifer	Steers	Heifer		Steers	Heifer	
Round (R & S on)	20.0	18.2	9.6	14.7	8.5	19.4	21.6	14.5
Round (R & S off)	18.5	15.1	8.4	11.8	8.0	16.3	17.8	12.1
Rump	27.2	30.8	13.7	25.3	12.3	29.0	32.3	26.5
Shank	16.7	12.5	8.6	11.8	8.1	18.6	19.6	10.2
Loin	32.5	32.8	17.3	22.5	14.7	30.2	31.8	25.9
Loin end	32.4	34.4	17.6	22.2	17.1	27.4	29.3	23.6
Short loin	32.6	31.3	17.0	22.9	11.8	33.6	35.0	29.1
Flank	58.0	69.7	36.6	56.3	28.0	65.4	69.5	53.0
Rib	35.4	34.3	13.6	22.4	10.8	28.3	32.0	21.7
Chuck	22.8	24.0	9.3	16.8	10.8	21.3	25.3	15.0
Neck	20.0	15.9	6.7	14.9	11.5	16.0	15.2	16.7
Plate	41.3	41.9	18.3	23.2	17.8	40.1	39.5	28.6
Navel	41.2	41.7	16.0	28.9	15.5	40.1	40.4	31.7
Brisket	41.4	42.1	21.3	34.0	20.4	40.0	37.6	23.9
Fore shank	13.7	17.4	5.7	12.6	7.2	13.2	14.2	12.1
Kidney knob	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total side	30.5	32.8	14.2	23.3	12.9	29.3	32.7	23.0

The Missouri Station\* has reported that immature animals on a fattening ration increase in both bone and lean tissue, but that the rate of fat storage is much greater than the increase of either lean or bone. Immature animals on a limited ration continue to grow and increase in bone and muscle almost as rapidly as animals being full fed, but the feed consumed is only sufficient for normal growth requirements, resulting in relatively little fat storage. This may explain the similarity in physical composition of the carcasses from the steers fed a half grain ration and those fed roughage only.

The forequarter contains a greater percentage of lean than the hindquarter and the condition of the animal does not materially affect this relationship (Table 7). The percentage of fat is con-

\*Experiment Station Bulletin 54.

sistently higher in the hindquarter, and that of bone higher in the forequarter.

Chemical analysis (Table 8) shows a tendency for the fat to vary directly and the moisture inversely with the amount of grain which has been fed. A comparison of the fat content of the eye muscle from steers receiving a half grain ration and steers receiving a ration of roughage only, substantiates the data secured by the physical analysis (Table 5).

A summary of the cooking tests, reveals no marked difference in palatability of rib roasts secured from carcasses produced by steers fed a full grain ration and those fed a half grain ration. However, the roasts from the carcasses produced by feeding a ration of roughage only were quite inferior. They lacked tenderness, quality and quantity of juice.

**Heifers.—Fed 196 Days in Dry Lot.**—A full grain ration produced more rapid gain, a higher slaughter grade, a higher dressing percentage, and a carcass which graded higher and shrank less from chilling than that produced by the half grain ration (Table 1).

The percentage of hindquarter was higher in the carcass from the heifer which received a full grain ration (Table 2). No significant difference existed in the percentages of wholesale cuts from carcasses of heifers fed a full grain ration and a half grain ration (Table 3).

A full grain ration produced a carcass containing approximately 8 per cent less lean, 10 per cent more fat, and 3 per cent less bone than one produced by a half grain ration (Tables 4, 5 and 6). The

TABLE 6.—THE PERCENTAGE OF BONE IN THE WHOLESALE CUTS FROM STEERS AND HEIFERS HANDLED BY DIFFERENT METHODS

	Full Grain Ration 196 Days		Half Grain Ration 196 Days		Rough- age Ration 196 Days	Half Grain Ration 168 Days; Full Fed on Pas- ture 168 Days		Roughage 168 Days; Grazed 56 Days; Full Fed on Pas- ture 112 Days
	Steers	Heifer	Steers	Heifer	Steers	Steers	Heifer	Steers
Round (R & Son) . . . . .	17.5	17.6	21.1	18.8	22.9	16.8	14.7	19.3
Round (R & S off) . . . . .	5.1	3.4	6.0	4.8	6.5	4.8	3.7	6.7
Rump . . . . .	18.9	17.8	24.2	18.9	28.1	17.4	15.2	19.5
Shank . . . . .	58.9	68.7	64.2	69.8	71.0	56.8	57.7	64.3
Loin . . . . .	11.8	12.3	13.8	14.2	17.5	13.0	10.9	12.4
Loin end . . . . .	12.0	12.8	13.4	13.5	13.3	13.0	11.4	10.9
Short loin . . . . .	11.6	11.7	14.3	15.3	21.2	12.9	10.3	14.6
Flank . . . . .	---	---	---	1.1	0.0	.8	.5	1.0
Rib . . . . .	16.6	16.1	23.5	20.3	27.4	16.7	12.2	20.8
Chuck . . . . .	16.1	15.6	20.5	17.4	20.4	15.8	14.7	16.9
Neck . . . . .	15.6	18.2	22.2	14.9	28.8	18.5	13.4	16.7
Plate . . . . .	12.9	12.5	20.1	16.3	23.4	12.9	11.6	16.4
Navel . . . . .	12.4	12.9	19.1	16.7	22.4	12.6	11.1	15.6
Brisket . . . . .	13.5	12.1	21.3	16.0	24.5	13.3	12.9	18.6
Fore shank . . . . .	35.3	32.6	40.2	35.6	49.3	36.4	29.2	28.4
Total side . . . . .	15.0	14.4	20.0	17.0	22.9	15.0	13.1	16.4

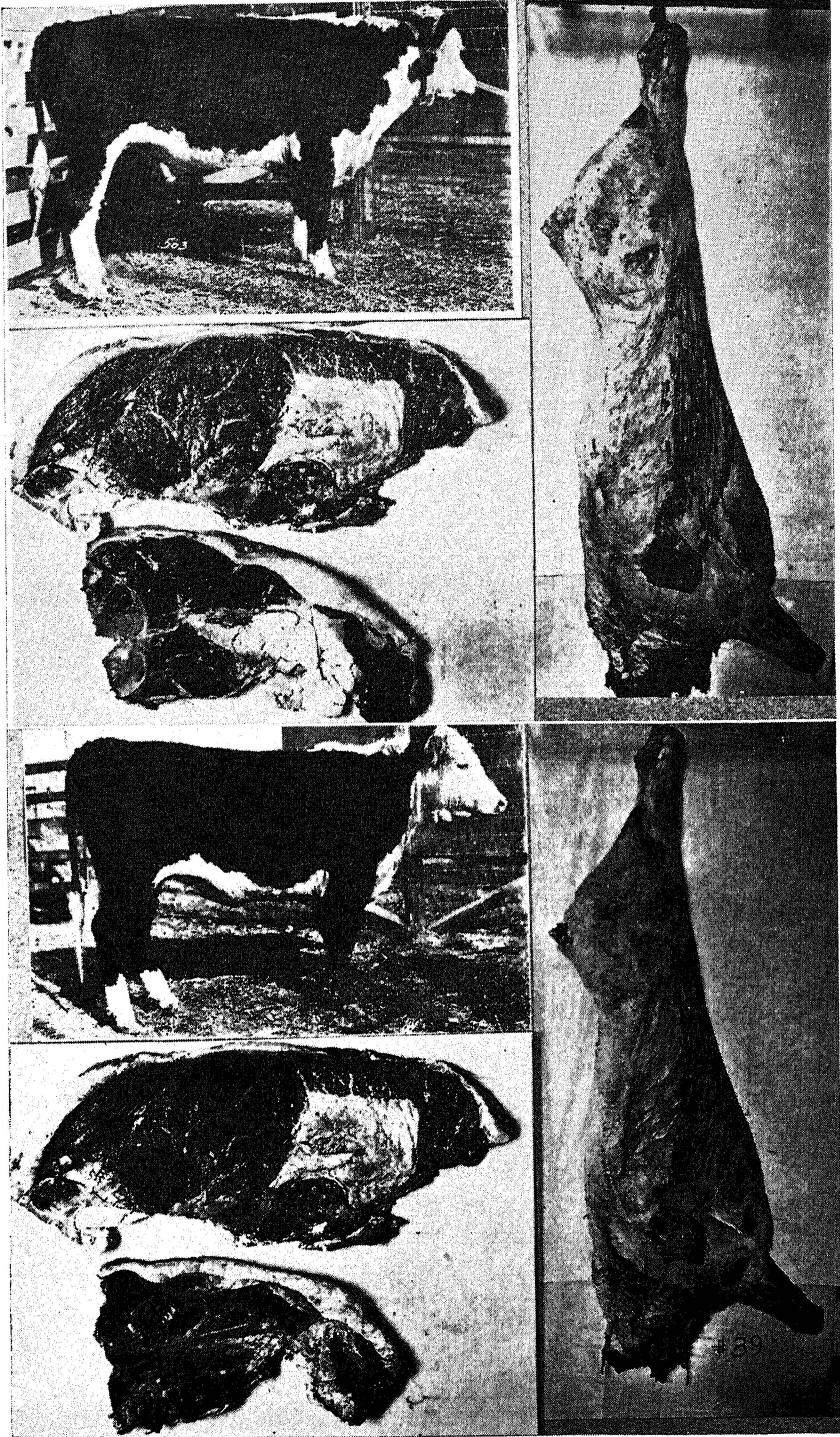


Plate III.—Upper: Steer carried through winter period (168 days) on a half grain ration then full fed on pasture 168 days. Lower: Heifer from same lot.

forequarters contained a higher percentage of lean and bone but less of fat than the corresponding hindquarters (Table 7).

The eye muscle from the heifer fed a full grain ration contained less moisture and a higher percentage of fat (Table 7).

The cooking and palatability test indicated a superiority of the rib roast from the full fed heifer carcass. A higher percentage of loss in cooking occurred in the roast from the heifer fed a full grain ration, no doubt due to a higher percentage of fat drippings.

TABLE 7.—THE PERCENTAGE OF LEAN, FAT AND BONE IN THE FORE AND HIND QUARTERS FROM STEERS AND HEIFERS HANDLED BY DIFFERENT METHODS

	Full Grain Ration 196 Days		Half Grain Ration 196 Days		Rough- age Ration 196 Days	Half Grain Ration 168 Days; Full Fed on Pas- ture 168 Days		Roughage 168 Days; Grazed 56 Days; Full Fed on Pas- ture 112 Days
	Steers	Heifer	Steers	Heifer	Steers	Steers	Heifer	Steers
<i>Percentage of Lean</i>								
Forequarter	54.0	54.5	65.9	60.0	61.2	56.4	56.7	62.2
Hindquarter	54.0	51.0	65.7	60.0	67.2	54.3	51.8	58.5
Total side	54.0	52.7	65.8	60.0	64.1	55.4	54.2	60.4
<i>Percentage of Fat</i>								
Forequarter	28.9	30.2	11.5	20.8	10.8	26.3	28.0	19.2
Hindquarter	32.2	35.2	16.1	25.6	15.0	32.5	37.2	27.0
Total side	30.5	32.8	13.8	23.3	12.9	29.3	32.7	23.0
<i>Percentage of Bone</i>								
Forequarter	17.1	16.8	23.3	19.4	26.3	17.1	14.5	18.6
Hindquarter	12.7	12.1	16.5	14.6	19.4	12.8	10.3	14.1
Total side	15.0	14.4	20.0	17.0	22.9	15.0	12.4	16.4

**Steers and Heifers.**—Fed on Pasture.—Gain, dressing percentage, slaughter, and carcass grades varied directly with the amount of grain fed. The percentage of wholesale cuts differed very little in the two groups of cattle. The carcass sides from the steers fed the small grain ration contained 5.0 per cent more lean, 6.3 per cent less fat, and 1.4 per cent more bone (Table 7). These carcasses contained a higher percentage of moisture, protein and ash; the others contained a higher percentage of fat (Table 8).

Heifers fattened on pasture following a 168-day wintering period are subject to penalties on the market, due to the possibility of pregnancy and because the carcasses carry an excessive amount of kidney and crotch fat. The heifer carcass used in this test showed higher finish than steer carcasses produced by a similar method, yet they were not graded any higher, perhaps due to the fact that they were somewhat wastey. As in previous tests the heifer carcass produced a greater percentage of hindquarter than forequarter.

**Steers and Heifers**—All Groups.—Young cattle of quality and breeding required a relatively long period to produce choice carcasses. The carcass from the heifer full fed 168 days on grass



was evidently too wasteful to be graded "Choice." This heifer was also too heavy to sell on the market for the same price as steers of approximately the same weight and quality. Steers showed slightly higher dressing percentage except in case of the heifers full fed 168 days on pasture. The forequarters of the steers comprised a slightly greater percentage of the carcass than the hindquarters, while the reverse was true of the heifers (Table 2). A high percentage of fat in hindquarters of heifers (Table 7) tends to explain this fact. There was no significant difference in the percentage of wholesale cuts due to sex, except a higher percentage of chuck in the steer carcasses (Table 3). There was a tendency for the percentage of lean to be higher in the steer carcasses than in heifer carcasses, especially in the case of those receiving a half grain ration 196 days (Table 7).

Heifers produced higher finished carcasses than steers fed similar rations. Carcasses from heifers fed a half grain ration contained approximately 10 per cent more fat than the corresponding steer carcass. The percentage of lean in the fore and hind quarters of cattle fed a half grain ration showed little difference due to sex. The forequarters of cattle of both sexes contained a higher percentage of lean after being fed a full grain ration. The percentage of fat was higher in the hindquarters and the percentage of bone consistently greater in the forequarters in all carcasses irrespective of sex or method of feeding.

TABLE 8.—CHEMICAL COMPOSITION EXPRESSED IN PERCENTAGE OF THE EDIBLE PORTION FROM THE 9TH, 10TH AND 11TH RIB CUT OF STEERS AND HEIFERS HANDLED BY DIFFERENT METHODS

	Moisture		Fat		Protein (N x 6.25)		Ash	
	Steers	Heifer	Steers	Heifer	Steers	Heifer	Steers	Heifer
<i>Full grain ration 196 days</i>								
Eye Muscle.....	71.76	71.73	5.05	5.05	22.35	22.05	1.21	1.14
Fat of Rib.....	14.50	16.08	80.86	79.03	5.41	4.28	0.25	0.30
Remaining Edible Portion..	67.71	65.17	14.13	15.38	20.00	18.77	0.97	0.97
<i>Half grain ration 196 days</i>								
Eye Muscle.....	75.63	76.02	1.15	1.29	22.69	21.55	1.10	1.16
Fat of Rib.....	27.31	21.61	62.47	70.14	7.84	7.67	0.54	0.44
Remaining Edible Portion..	70.67	67.91	6.30	7.88	22.40	20.27	1.10	1.06
<i>Roughage Ration 196 days</i>								
Eye Muscle.....	76.55		1.07		21.75		1.17	
Fat of Rib.....	30.05		59.48		8.99		0.61	
Remaining Edible Portion..	70.90		6.30		22.43		1.13	
<i>Half grain ration 168 days</i>								
<i>Full fed on pasture 168 days</i>								
Eye Muscle.....	73.77	71.20	3.37	6.12	20.70	21.20	1.07	0.99
Fat of Rib.....	12.43	9.63	82.22	87.36	4.78	3.11	.22	0.98
Remaining Edible Portion..	67.91	68.99	9.99	10.06	19.46	18.90	1.01	0.94
<i>Roughage 168 days—Graed 56 Days—Full fed on pasture 112 days</i>								
Eye Muscle.....	74.61		2.29		21.86		1.05	
Fat of Rib.....	19.19		72.53		8.20		.40	
Remaining Edible Portion..	69.03		9.98		20.05		1.02	

Little difference occurred in the chemical composition of the rib cuts from steers and heifers fed a full grain ration for 196 days (Table 8). Ribs from steer carcasses produced by feeding a half grain ration contained more moisture, protein and ash but less fat than ribs from corresponding heifer carcasses. The same relationship existed between steer and heifer ribs from carcasses produced by full feeding 168 days on pasture. These data agree with the physical analysis of the wholesale cuts from the heifers full fed 168 days on pasture which showed considerably more hand separable fat than did the steer carcasses (Table 5). No consistent differences in palatability of the beef from fat yearling heifers and steers were observed. In every case, however, the loss from cooking was greatest in the steer ribs.

### SUMMARY

No. cattle and feeding	Age at time of slaughter	Feeder grade	Slaughter grade	Carcass grade	Remarks
2 steers full fed 196 days	14 months	Low Choice	Low Choice	Low Choice	Heifer fatter.
1 heifer full fed 196 days	14 months	High Good	Choice	Low Choice	
2 steers fed $\frac{1}{2}$ grain ration 196 days	14 months	Low Choice	Low Good	Medium	Fairly desirable beef, heifer fatter.
1 heifer fed $\frac{1}{2}$ grain ration 196 days	14 months	Low Choice	Low Good	High Medium	
2 steers fed roughage only 196 days	14 months	Low Choice	Medium	High Common	Very thin.
3 steers fed $\frac{1}{2}$ grain ration 168 days and full fed 168 days on pasture	18 months	High Good	Low Choice	Low Choice	Well finished desirable carcass.
1 heifer fed $\frac{1}{2}$ grain ration 168 days and full fed 168 days on pasture	18 months	Low Choice	Choice	Low Choice	Fat, but wasty and rough.
2 steers fed roughage only 168 days—grazed 56 days—full fed 112 days	18 months	Low Choice	Good	Low Good	Good beef, but not finished.

### Methods of Feeding

1. The amount of fat in the carcasses varied from 32.8 per cent for the full fed heifers to 12.9 per cent for the steers fed only roughage.

2. The percentage of lean, bone and moisture decreased with increased finish.

3. The percentage of carcass shrinkage decreased as the fat content increased.

4. Rib roasts from the full fed cattle carcasses were slightly more palatable than roasts from the cattle fed half a grain ration,

the difference being greater in the heifers. Carcasses from cattle fed roughage only were decidedly less palatable.

5. Cooking losses were generally greater in the beef of higher finish.

### Sex

1. With the exception of the heifers full fed 168 days on pasture, the steers dressed a higher percentage than the heifers similarly handled.

2. In every case heifer carcasses graded equally as well as steer carcasses produced by similar methods of feeding.

3. Heifer carcasses showed somewhat higher percentage of fat and lower percentage of lean and bone than carcasses from steers similarly handled.

4. No difference due to sex was observed in carcass shrinkage after 48 hours chilling.

5. Hindquarters made up a slightly greater percentage of the carcass of the heifer than of the steers.

6. The percentages of round and chuck were greater in the steer carcasses, while the percentage of flank was greater in the heifer carcasses.

7. Chemical analyses of the 9th, 10th, and 11th rib cuts revealed a higher fat content in the ribs from the heifers, while the protein, ash and moisture contents were slightly greater in the ribs from the steers.

8. There was no appreciable difference in palatability of the cooked rib cuts due to sex.

9. From the foregoing data it would seem that yearling heifers marketed before they became too wasty, produced beef equally as desirable as steers fed in a similar manner.

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