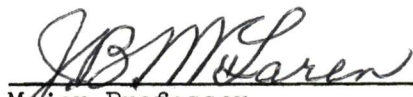


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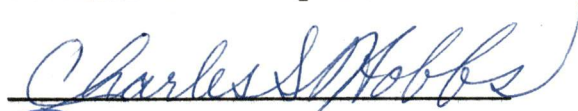
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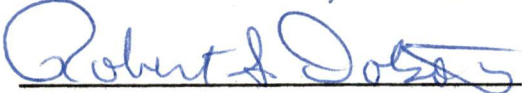
I am submitting herewith a thesis written by Earl C. Anderson entitled "The Effect of Ground Shelled Corn Full-Fed During the Latter Part of the Finishing Period Upon the Performance and Carcass Traits of Beef Steers and Heifers." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.



Major Professor

We have read this thesis and
recommend its acceptance:





Accepted for the Council:



Vice Chancellor for
Graduate Studies and Research

THE EFFECT OF GROUND SHELLED CORN FULL-FED DURING THE LATTER PART
OF THE FINISHING PERIOD UPON THE PERFORMANCE AND
CARCASS TRAITS OF BEEF STEERS AND HEIFERS

A Thesis
Presented to
the Graduate Council of
The University of Tennessee

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
Earl C. Anderson

August 1968

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ABSTRACT

Data collected on 120 steers and 40 heifers at the Middle Tennessee Experiment Station, Spring Hill, Tennessee, were used to determine the effects of a full-feed of concentrates during the last 56 to 74 days of the finishing period on the performance and carcass traits of beef steers and heifers. Choice, good, and medium steers, and heifers were fed a ration of corn silage ad lib. plus limited concentrates for 140 days. One-half of the animals within each sex and feeder grade received this high corn-silage limited concentrate ration until they were sold for slaughter. The other animals within each sex and grade were changed to a full-feed of concentrates during the last 56 to 74 days of the finishing period.

Daily gains were similar for the choice, good, and medium steers during the 140-day pre-experimental period when fed the high-silage limited concentrate ration (1.96, 1.99, and 1.97 pounds per head per day, respectively). However, gains made by the heifers (1.74 pounds per head per day) were significantly less than for the steers.

The cattle full-fed concentrates during the last 56 to 74 days of the finishing period gained 0.36 pounds per head per day more ($P < .01$) than those fed the high-silage ration. Differences in performance due to the two rations were similar and of relatively the same magnitude within each feeder grade and sex.

Concentrates full-fed in the latter part of the finishing period resulted in heavier cattle at slaughter which yielded heavier carcasses. Dressing percent, loin eye area per hundred pounds of carcass, marbling,

fat thickness at the twelfth rib, and percent kidney fat were not affected by this short full-feed of concentrates.

Feed cost per unit of gain was higher for the cattle fed the concentrate ration. However, the total selling price of these cattle was more than that of the cattle fed the high-silage ration and the return above feed cost was not significantly different for the two systems.

The increase in returns (above feed and initial cost) due to the high-concentrate ration was \$5.66 for good steers. However, the advantage was \$0.54 in favor of the high-silage ration when medium steers were fed.

These data indicate that relative cost of corn silage and shelled corn, the importance of a shorter feed period in the overall feedlot program, and the grade and sex of cattle being fed are all important economic considerations in determining the value of increasing the amount of concentrates during the latter part of the finishing period.

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CHAPTER I

INTRODUCTION

The production of short-yearling slaughter cattle has become an important phase of an expanding beef cattle industry in Tennessee and the South. Weanling beef calves, both steers and heifers, which have been raised in the feeders herd or purchased through feeder calf sales, auction sales, or central markets are generally started on feed in November. The finishing program recommended in Tennessee consists of two phases. The calves are fed corn silage ad lib. plus about 6 pounds of concentrates and 2-3 pounds of good quality hay per head per day for about 140 days. The second phase of this program consists of a 40- to 75-day full-feed of concentrates. The full-feed period has varied in length, depending on the type cattle and the rate of gain and degree of finish desired.

Feed cost per hundred pound of gain has consistently been higher during the period of full-feeding of concentrates than during the initial period in which corn silage was fed ad lib. (Anderson et al., 1964). The small margin of profit from a feeding operation makes maximum efficiency in silage utilization a necessity. Recently, the average length of the full-feeding phase has been reduced as a result of increased rate of gain and condition change during the silage-limited concentrate phase.

Although much progress has been made in increasing silage utilization and reducing finishing costs, further investigations are

needed to determine the maximum producing capability of corn silage. This experiment was designed to compare the performance and carcass characteristics of various grades and sexes of feeder cattle finished in drylot to an average slaughter grade. Two finishing rations were compared. They were (1) silage-limited concentrate ration from weaning to market, and (2) silage-limited concentrate ration for about 140 days followed by a short full-feed of concentrates.

CHAPTER II

LITERATURE REVIEW

Good, choice, and medium steers and heifers gained an average of 1.83 pounds per head per day during the fifth 28-day period (last weight interval) on a feeding program of silage-limited concentrates (Anderson et al., 1964). During the following 49-day period, when concentrates were full-fed, these cattle averaged 1.81 pounds per head per day. Perry et al. (1966) reported that weanling calves fed a high concentrate ration gained significantly faster than those fed a high corn silage ration (2.53 vs. 2.04 pounds per head per day). Burroughs et al. (1964) and Fontenot et al. (1967) finished steers using rations consisting of (1) corn silage with no corn, (2) corn silage and one-half full-feed of corn, and (3) full-feed of corn. Steers fed corn silage and no grain gained about 2.3 pounds per head per day. The addition of one-half full-feed of corn increased daily gain by 0.2 to 0.4 pounds per head. However, the rate of gain was not further increased when grain was full fed. Average daily gain of steers fed corn silage and 12 pounds of corn was 2.53 pounds compared to 2.04 pounds for those fed corn silage and 2 pounds of grain (Perry et al., 1964).

Richardson et al. (1961) suggested that beef cattle can be fattened economically on large quantities of roughage. They found that the highest daily gain was obtained when weanling heifers were

fed corn silage and ground corn in the ratio of 1:5 and the lowest when the ratio was 1:1. Steers fed corn silage at the rate of 80 to 90 percent of their dry matter intake plus limited amounts of cottonseed meal (Hammes et al., 1964) gained slower than those fed a high grain fattening ration. However, these differences were not significant. Young et al. (1962) compared steers and heifers fed similar total amounts of ground shelled corn at varying rates throughout the finishing period. They found that delaying the feeding of corn for 98 days, followed by a full feeding period, did not alter the total gain of the animals.

Feed efficiency, expressed by pounds of dry matter or total digestible nutrients (TDN) per pound of gain (Hammes et al., 1964), was highest when calves were fed corn silage as the only forage, or as 80 to 100 percent of the forage dry matter plus limited protein supplement. Richardson et al. (1961) reported a highly significant increase in total digestibility of 1:3 and 1:5 ratios of corn silage to ground corn over the 1:1 ratio ($P < .01$). Nitrogen-free extract (NFE) digestion was lowest for the 1:1 ratio. They suggested that protein digestibility was not affected by changes in the roughage-concentrate ratio. Weanling calves fed a high corn silage ration required 21 percent less TDN per pound of gain than those fed an all-concentrate ration and 16 percent less than those receiving one-half full-feed of concentrates during a 182-day finishing period (Burroughs et al., 1964). Perry and Beeson (1966) reported TDN requirements per pound of gain as 5.5, 5.4, 6.3, and 6.4 pounds, respectively.

for steers fed a corn silage-protein supplement rations with grain levels of 1 1/2 pounds per head daily, one-third full feed, two-thirds full feed, and full feed.

Klosterman et al. (1965) found that dressing percent was significantly increased (2.89 percent) when ground ear corn was fed during the later periods. Data reported by Young et al. (1962) indicated that, when corn silage was full fed, delaying the feeding of additional concentrates for 98 days did not appear to alter the dressing percent of steers as compared to a continuous limited feed of 1.25 pounds of corn per hundred pounds of body weight.

Marbling scores and carcass grades increased as the level of grain was increased during the finishing period according to Richardson et al. (1961) and Young et al. (1962). However, Hammes et al. (1964) and Klosterman (1965) indicated that the level of concentrate feeding did not significantly affect carcass grade or marbling score of steers finished to slaughter weight on corn silage and various levels of concentrates. Carcasses of calves fed a high silage ration had about 0.40 sq. in. more loin eye area at the twelfth rib than those fed high corn diets (Perry et al., 1964 and Burroughs et al., 1965).

Garrigus et al. (1967) concluded that in some instances "all-concentrate" diets reduced the feed cost per unit of gain. They attributed this reduction in cost to the fact that "all concentrate" feeding permitted more complete mechanization which resulted in a lower labor input per unit of production. However, they suggested that this reduction in cost would be most likely to occur during

periods when roughage was "scarce" and relatively expensive per unit of feeding value.

Hall and Felts (1963) marketed two groups of heifer calves immediately after a 112-126 day period of silage-limited concentrate feeding. These heifers weighed about 650 pounds and graded good. They reported feed cost per pound of gain ranging from 10.3 to 13.5 cents for heifers that were fed corn silage from weaning to slaughter. Feed cost was 15.8 cents per pound of gain for similar groups of heifers that were full-fed concentrates for 68 days following the silage phase. However, Klosterman et al. (1961) reported that feed cost per pound of gain was the same for cattle full-fed concentrates or corn silage at various intervals during the finishing periods. Feed cost per pound of gain of steers fed corn silage ad lib. increased with each increase in grain level from no grain to full-feed (Fontenot et al., 1967). High silage rations produced more economical gains (15.1 cents vs. 16.1 cents per pound of gain) in trials conducted by Perry et al. (1964).

Burroughs et al. (1965) reported profit favorableness with high corn silage rations to be \$9.15 per head on the basis of present-day visual grade evaluation and \$23.17 per head based on estimated retail cut-out value. Cost of gains were generally higher during the full-feeding period than during the silage-limited concentrate phase. Anderson et al. (1964) states that data presented is adequate indication that the longer cattle are maintained on a full-feed of corn silage, the lower the overall feed cost will be per pound of gain.

Burroughs (1966) suggested that, if present marketing standards were to be revised in the future toward more leanness in beef carcasses, favorableness of using high-corn silage finishing rations would be increased still further as compared to high-grain rations.

CHAPTER III

EXPERIMENTAL PROCEDURE

I. EXPERIMENTAL ANIMALS

A total of 40 heifers and 120 steers were fed at the Middle Tennessee Experiment Station during the two years, 1965-66 and 1967-68. Weanling beef calves (Angus) were purchased at various feeder calf sales in the Middle Tennessee area. The feeder grades were determined by official graders at each of the sales.

Steers and heifers weighing 450-500 pounds and of the following feeder grades were fed during each of the two years: choice, good, and medium steers; and good or medium heifers. In 1965-66, good heifers were not available and medium heifers were fed. However, good heifers were fed in 1967-68. The calves were divided into comparable groups of five head within each sex and feeder grade on the basis of condition grade and body weight.

Four groups of each sex-feeder grade were fed a daily ration of corn silage ad lib., 5 pounds of ground shelled corn, 1 pound of cottonseed meal and 3 pounds of alfalfa-grass hay for about 140 days. At the end of the 140-day silage-limited concentrate (high-silage) phase, the four lots within each sex and feeder grade were assigned to one of the two finishing programs on the basis of performance during the preceding 140-day period. Two groups within each sex and feeder grade were continued on the high-silage ration that had been fed during the previous 140 days. The other two groups within each sex-feeder grade

were full-fed a concentrate mixture (1 part cottonseed meal to 7 parts ground shelled corn) plus about 8 pounds of corn silage and 3 pounds of alfalfa-grass hay for 56 to 74 days (concentrates).

The calves were started on experiment about December 1 each year and were marketed in May or June. Water, salt, and a mineral mixture (2 parts dicalcium phosphate and 1 part salt) were accessible at all times.

An average of two weights taken on consecutive days was used as the beginning and end weight for each experimental period. The calves were also weighed at 28-day intervals throughout the experiment. All calves were graded by at least two qualified graders at the beginning and end of each phase. Numerical codes used in analyzing grade differences between the groups are shown in Table 1. At the end of the full-feeding phase, the cattle were marketed at a packing plant in the Middle Tennessee area where carcass information was obtained.

Table 1. Numerical code for various conformation and condition grades

Numerical code	Type grade	Condition grade
7	Av. medium	Av. standard
10	Av. good	Av. good
13	Av. choice	Av. choice

After about 24 to 48 hours in the cooler, the carcasses were ribbed and U.S.D.A. grades were obtained. Tracings were made of each

loin eye at the twelfth rib, and a twelfth rib section 1 1/2 inches thick was taken from each carcass for cooking and shear tests. Carcass length, marbling score, and an estimate of percent kidney fat were obtained on each carcass.

II. FACILITIES

The experimental animals were fed in pole-type barns open to either the east or south with the west and north side of each barn completely walled. About one-half of each pen was outside with concrete floors which were scraped periodically with a tractor and blade. The covered portion of the pens had plain soil floors and were bedded with straw to provide a resting area. The fences in the barns were constructed of steel cables to allow maximum air movement through each pen.

III. FEED AND CATTLE PRICES

The feed prices used to compute feed cost are shown in Table 2. These prices are approximately the cost of each ingredient during the two years of this experiment. The prices of various feed ingredients will vary from year to year or even from day to day. However, feed cost per pound of gain can be computed by multiplying current or

Table 2. Feed prices used to compute feed cost

Ingredient	1965-66	1967-68
Ground shelled corn, bu.	\$ 1.35	\$ 1.55
Cottonseed meal, ton	80.00	90.00
Corn silage, ton	8.00	8.00
Alfalfa-grass hay, ton	40.00	35.00

applicable prices per pound of each ingredient times the amount of each ingredient required per pound of gain.

The initial value per hundredweight of the various grades and sexes of feeder cattle are shown in Table 3. The price per hundredweight was based on the average price paid for the respective weight, grade, and sex of Angus feeder cattle at all of the Tennessee feeder calf sales in the fall of 1965 and 1967.

Table 3. Purchase price of feeder cattle
(dollars per hundredweight)

	1965-66	1967-68
Choice, 450-500 lb. steers	\$26.41	\$27.95
Good, 450-500 lb. steers	25.59	27.61
Medium, 450-500 lb. steers	23.86	26.31
Good, 450-500 lb. heifers		24.40
Medium, 450-500 lb. heifers	19.99	

Initial value was based on the state average to provide a more realistic evaluation than would have resulted from the use of actual cost at the sales where the cattle were purchased. The cattle were sold on grade and yield basis and individual selling price was computed on the basis of live weight at the packing plant.

IV. STATISTICAL ANALYSIS

Differences between means for various performance traits were analyzed by methods outlined by Steele and Torrie (1960) for analysis of data with subsamples within the experimental units. The variation among animals in lots treated alike (experimental error) was considered

the appropriate error term for testing differences among treatment means.

Type of cattle and ration effects were considered fixed. The individual errors associated with the experimental and sampling error were considered normally and independently distributed with zero mean and variance σ_e^2 and σ^2 , respectively.

Preliminary analysis by year indicated that the means and standard errors for the various performance and carcass traits of the medium and good heifers were not different with respect to the rank and deviation from the overall mean. Therefore, data with respect to medium and good grade heifers were pooled as a type of cattle effect in the within year analysis.

CHAPTER IV

RESULTS AND DISCUSSION

I. PRE-EXPERIMENTAL PERIOD

Four lots of each grade-sex of feeder cattle (choice, good, and medium steers, and good or medium heifers) were fed on a ration of high-quality corn silage ad lib., 5 pounds of shelled corn, 1 pound of cottonseed meal, and 3 pounds of alfalfa-grass hay for about 140 days prior to assignment to the two finishing rations. The pre-experimental data were analyzed to determine the relative performance of the various grades and sexes of feeder cattle on a high-silage ration.

Average Daily Gain

Daily gain was similar for steers of the three feeder grades (Table 4). However, heifers gained significantly slower ($P < .01$) than steers. This is in agreement with results reported by Anderson et al. (1964) in which steers of various grades gained significantly faster than heifers. Daily gain was about the same magnitude for each of the various grade-sex groups each year.

Condition Grades

Average condition grades increased about one full grade (high standard to high good) during the 140-day period of high-silage feeding. At the end of the 140-day period, the average slaughter grade of the choice steers, good steers, medium steers, and heifers were

Table 4. Performance of various grades and sexes of cattle during the pre-experimental period

	Choice steers	Good steers	Medium steers	Heifers
No. of animals	40	40	40	40
Days on feed	140	140	140	126
Av. wt. and gain/head, lb.				
Initial weight	504	507	494	476
Final weight	778	786	771	695
Total gain	274 ^a	279 ^a	275 ^a	219 ^b
Daily gain	1.96 ^a	1.99 ^a	1.97 ^a	1.74 ^b
Av. grades				
Initial condition	8.7 ^a	8.2 ^b	7.5 ^c	8.2 ^b
Final condition	11.8 ^a	11.3 ^b	10.2 ^c	11.0 ^b

^{a,b,c} Means not superscripted with the same letter are significantly different ($P < .05$).

11.8, 11.3, 10.2, and 11.0, respectively. The analysis of variance presented in Table 5 shows that there were significant differences among the mean condition grades at both the beginning and end of the 140-day period. The medium steers graded lower than the other groups both times. The increase in condition grade was significantly greater for choice and good steers than for medium steers and heifers.

Table 5. Analysis of variance of performance of various grades and sexes of cattle

Source	df	ADG	Mean square		
			Condition grade		
			Initial	Final	Change
Type of cattle	3	1.358**	16.09**	28.55**	9.84*
Within lots treated alike	12	.123	.58	2.06	2.41
Residual	143	.059	.65	.76	.80

*P<.05. **P<.01.

Feed Consumption, Requirements, and Cost

Medium steers consumed more ($P<.05$) silage per head per day than choice steers, good steers, and heifers (Table 6). The average daily silage consumption was 18.8, 17.6, 18.2, and 17.7 pounds per head per day for the various groups, respectively. These data suggest, although the differences were not statistically significant, that as initial type grade increased there was a tendency for average daily silage consumption to decrease. This variation in silage consumption may have been influenced by initial condition, since condition grade tended to increase with type grade.

Table 6. Feed consumption and requirements during
the 140-day pre-experimental period

	Choice steers	Good steers	Medium steers	Heifers
Av. da. feed, lb./hd.				
Shelled corn	5.0	5.0	5.0	5.0
Cottonseed meal	1.0	1.0	1.0	1.0
Alfalfa-grass hay	3.0	3.0	3.0	3.0
Corn silage ^a	17.6 ^b	18.2 ^b	18.8 ^c	17.7 ^b
Feed required/cwt. gain, lb.				
Shelled corn	252 ^b	247 ^b	254 ^b	284 ^c
Cottonseed meal	50 ^b	50 ^b	51 ^b	57 ^c
Alfalfa-grass hay	154 ^b	150 ^b	154 ^b	173 ^c
Corn silage	900 ^b	912 ^b	1,006 ^c	1,016 ^c
Feed cost per cwt. gain, lb. ^d	15.16 ^b	14.99 ^b	15.29 ^b	17.07 ^c

^aSilage was fed ad lib.

^{b,c}Means superscripted with the same letter are not different (P<.01), all others are significantly different.

^dFeed prices are shown in Table 2, page 10.

Heifers required more ($P < .01$) shelled corn, cottonseed meal, and hay per pound of gain than steers (Table 6). Medium steers and heifers required about 10 pounds more silage ($P < .01$) per pound of gain than choice or good steers. The increased silage consumption by the medium steers did not result in increased rate of gain or lower feed cost when compared to the other groups. Anderson et al. (1964) reported higher daily silage consumption and higher feed cost per unit of gain for medium steers than for choice and good steers.

Feed cost per hundred pounds of gain was about \$2.00 greater ($P < .01$) for heifers than for steers. Feed costs were \$15.16, \$14.99, \$15.29, and \$17.07 per hundred pounds of gain for choice, good, and medium steers, and heifers, respectively. These differences are similar to those found by Anderson et al. (1964), who reported lower gain and higher feed cost per unit of gain for heifers compared to steers.

The differences in feed cost between the various grades of steers were not statistically significant and were small numerically. However, if the price of feed ingredients were increased, the additional 10 pounds of shelled corn and 100 pounds corn silage required per hundred pounds of gain by the medium steers could be of practical importance when purchasing steers to feed.

II. EXPERIMENTAL PERIOD

Following the 140-day pre-experimental period, the lots were assigned to one of the experimental rations. Assignment was made on the basis of performance during the pre-experimental period. Two groups

within each sex-feeder grade subclass were designated to be full-fed a ground shelled corn and cottonseed meal ration. The remaining two groups within each subclass were continued on the same ration (corn silage ad lib., plus limited concentrates) that they had received during the 140-day pre-experimental period. The various groups were fed their respective rations until they reached an average slaughter grade of high good-low choice. All groups were fed for 56 days, except in the second trial when the medium steers were fed for 92 days.

Gains and Grades

The cattle full-fed the concentrate ration gained 0.36 pound per head per day more ($P < .01$) than those fed the high-silage ration (Table 7). The advantage with respect to rate of gain was about the same magnitude and in favor of the concentrate ration in both trials. The increase in rate of gain resulting from increased concentrates during the latter part of the finishing period could be an important factor when planning a marketing program or an overall feedlot program.

Average daily gain of the choice steers, good steers, medium steers, and heifers was 1.79, 1.88, 1.88, and 1.64 pounds per head per day, respectively. Within each subclass the groups fed the concentrate ration gained faster ($P < .05$) than those fed the high-silage ration. Differences in performance due to the two rations were similar and of relatively the same magnitude within each feeder grade (Figure 1).

Average slaughter grade, change in condition grade, and carcass grade of the animals full-fed concentrates during this period were

Table 7. Performance of cattle during the experimental period

	Ration	
	High-silage	Concentrate
No. of animals	80	80
Av. no. of days on feed	60	60
Av. wts. and gains, lb.		
Initial weight	758	756
Final weight	856 ^a	875 ^b
Total gain	98	119
Daily gain	1.63 ^a	1.99 ^b
Av. grade		
Initial condition	11.2 ^a	11.1 ^a
Final slaughter	11.7 ^a	12.1 ^a
Carcass grade, U.S.D.A.	12.0 ^a	12.2 ^a
Feed cost/cwt. gain, ^c \$	22.02 ^a	24.35 ^b
Selling price/cwt., \$	25.81 ^a	26.38 ^b

^{a,b} Means superscripted with the same letter are not different (P<.01), all others are significantly different.

^c Feed prices are shown in Table 2, page 10.

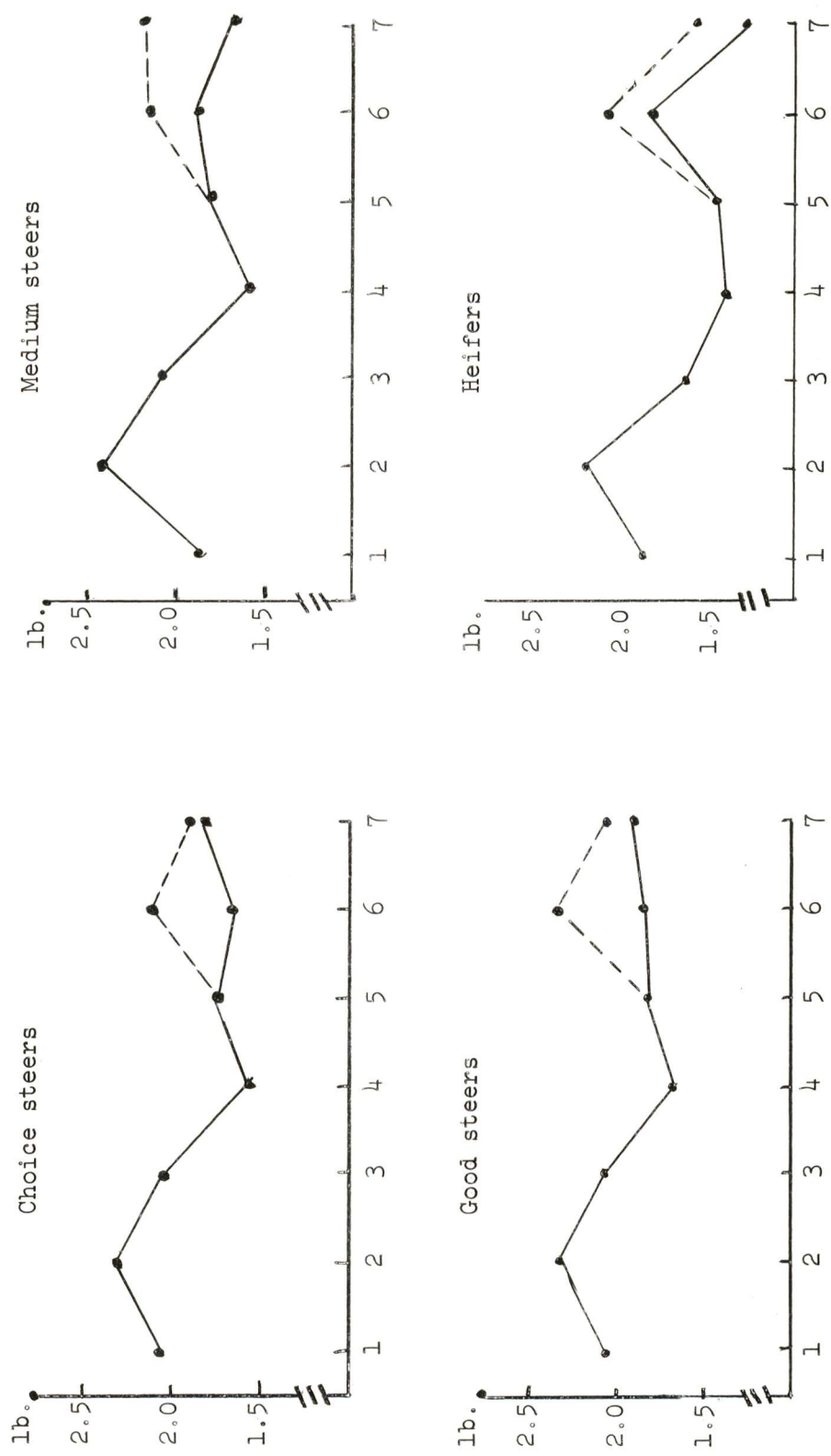


Figure 1. Average daily gain by 28-day periods.

not significantly different from those fed the high-silage ration from weaning to slaughter (Table 8). Choice steers and heifers graded higher ($P < .05$) at slaughter than the good or medium steers. The average slaughter grades were 12.4, 11.7, 11.2, and 12.2 for the choice steers, good steers, medium steers, and heifers, respectively.

Table 8. Analysis of variance of performance during the experimental period

Source	df	ADG	Mean square	
			Slaughter grade	Carcass grade
Ration	1	5.92**	7.80	6.31
Type of cattle	3	1.24	8.04**	11.81
Ration x type	3	.07	1.53	1.40
Ani./lots/tmt./yr.	8	.37	1.52	2.63
Ani./lots	143	.09	.74	.99

** $P < .01$.

Feed Consumption, Requirements, and Cost

Feed cost per hundred pounds of gain was \$2.32 higher ($P < .05$) for the animals full-fed the concentrates ration than for those fed the high-silage ration (Table 9). The average daily silage consumption of the animals on the high-silage ration increased during the experimental period as compared to the daily consumption during the 140-day pre-experimental period. However, average daily gain of each group fed the high-silage ration decreased.

Anderson et al. (1964) and Perry et al. (1964) suggested that feed cost per unit of gain increased during the latter part of the

Table 9. Feed consumption and requirements during the experimental period^a

	Ration	
	High-silage	Concentrates
Av. da. feed, lb./hd.		
Shelled corn	5.9	12.2
Cottonseed meal	1.0	1.7
Alfalfa-grass hay	3.0	3.0
Corn silage	25.8	8.5
Feed requirement/cwt. gain, lb.		
Shelled corn	359	617
Cottonseed meal	62	89
Alfalfa-grass hay	180	153
Corn silage	1,597	439
Feed cost per cwt. gain, ^b \$	22.02 ^c	24.35 ^d

^aFeed consumption and requirements by grade and sex of cattle are shown in the appendix.

^bFeed prices are shown in Table 2, page 10.

^{c,d}Means not superscripted with the same letter are significantly different ($P < .01$).

finishing period if cattle were changed to a concentrate ration after a period of high-silage feedings. These data indicate that the cost of gain also increases significantly during the latter part of the finishing period when cattle are fed a high-silage ration to slaughter weight. However, the increased cost per unit of gain was greater ($P < .01$) for animals full-fed concentrates during this latter period.

Feed consumption and requirements for the various grades and sexes are presented in the appendix. Feed cost per hundred pounds of gain was higher for the animals within each sex and grade when fed the concentrate ration than for those fed the high-silage ration. The cost of gain was higher during the experimental period regardless of type of cattle or ration when compared to the cost during the pre-experimental period.

Carcass Data

The animals full-fed the concentrate ration were heavier at slaughter and their carcasses were heavier ($P < .05$) than those fed the high-silage ration (Table 10). The increase in concentrate consumption during the last 60 days of the finishing period did not result in any statistically significant differences in dressing percent, ribeye area, marbling, fat thickness at the twelfth rib, percent shrink from farm to packing plant, or percent kidney fat.

Average dressing percentages were 59.8, 59.8, 59.6 and 60.2 percent for the choice steers, good steers, medium steers, and heifers, respectively (Table 11). These differences were not statistically

Table 10. Effects of ration on carcass traits

	Ration (last 60 days)	
	High-silage	Concentrates
Hot carcass wt., lb.	508	526
Dressing percent	59.3	60.4
Ribeye area, sq. in.	10.62	10.68
Ribeye area/cwt. carcass, sq. in.	2.14	2.08
Marbling score ^a	5.29	5.43
Fat thickness, in.	.42	.44
Shrink, percent ^b	2.80	2.72
Kidney fat, percent	2.78	3.03

^aTrace = 3, slight = 4, small = 5, modest = 6, moderate = 7.

^bFarm to packing plant.

^cFor ration during the pre-experimental period see Table 6, page 16.

Table 11. Effects of feeder grade and sex on carcass traits

	Choice steers	Good steers	Medium steers	Heifers
Hot carcass wt., lb.	522 ^a	532 ^a	540 ^a	470 ^b
Dressing percent	59.8 ^a	59.8 ^a	59.6 ^a	60.2 ^a
Rib eye area, sq. in.	10.69	10.74 ^a	10.83 ^a	10.35 ^b
Rib eye area/cwt. carcass, sq. in.	2.08 ^a	2.06 ^a	2.04 ^a	2.25 ^b
Marbling score ^c	5.39	5.37	5.16	5.52
Fat thickness, in.	.46	.42	.37	.46
Shrink, percent ^d	2.96	1.99	1.99	3.16
Kidney fat, percent	2.87 ^{a,b}	2.90 ^{a,b}	2.45 ^b	3.32 ^a

^{a,b}Means within a column superscripted with the same letter are not significantly different. All others differ significantly ($P < .05$).

^cTrace = 3, slight = 4, small = 5, modest = 6, moderate = 7.

^dFarm to packing plant, live weight shrink.

significant. Heifer carcasses had about two-tenth square inches more loin eye area per hundred pounds than steer carcasses. Marbling score, fat thickness at the twelfth rib, and shrink from farm to market was not significantly different among the various grades and sexes. Medium steer carcasses had about .45 percent less ($P < .05$) kidney fat than choice and good steer carcasses and .87 percent less ($P < .05$) than heifer carcasses.

III. ENTIRE FINISHING PERIOD

During the entire finishing period (pre-experimental and experimental periods) the cattle that were full-fed concentrates for the last 60 days gained 1.91 pounds per head per day compared to 1.85 pounds per day for those fed the high-silage ration both periods (Table 12).

Feed cost per hundred pounds of gain was \$0.57 higher ($P < .01$) for the animals which received the short full-feed of concentrates during the latter part of the finishing period. However, these animals sold for a higher price per hundred pounds and were heavier when slaughtered. This increase in selling price resulted in similar returns per head above feed and initial costs. The returns above feed cost were \$27.45 per head for the animals fed the high-silage ration during the entire finishing period and \$29.64 per head for those fed for 140 days on the high-silage ration and full-fed the concentrate ration for 60 days.

The animals full-fed concentrates the last 60 days were not significantly fatter and carcass grades were not higher than those

Table 12. Performance during the entire finishing period

	Ration during experimental period ^a	
	High-silage	Concentrates
No. of animals	80	80
No. of days	200	200
Av. daily gain/hd./da., lb.	1.85 ^b	1.91 ^c
Feed cost/cwt. gain, \$	17.42 ^b	18.17 ^c
Selling price/cwt., \$	25.81 ^b	26.38 ^c
Return/hd. above feed and initial cost, \$	27.45 ^b	29.64 ^b

^aBoth groups were fed high-silage ration during the 140-day pre-experimental period.

^{b,c}Means not superscripted with the same letter are significantly different ($P < .01$).

fed the high-silage ration. The increase in total selling price was due to the higher value of the heavier carcasses from the cattle full-fed concentrates in the latter part of the finishing period.

These data indicate that most carcass traits were not significantly changed by increasing the amount of concentrates during the last 60 days of the finishing period. However, the lower gain made by the cattle fed the high-silage ration during the entire finishing period resulted in lighter carcasses and lower selling price. A longer feeding period would be necessary for cattle fed a high-silage ration during the entire finishing period to reach the same market weight as those full-fed concentrates during the latter part of the finishing period. These differences are important considerations when planning an overall feedlot operation.

The increase in feed cost due to the short full-feed of concentrates was about the same for the three grades of steers. However, the cost of gain was not significantly different when the two rations were fed to heifers (Figure 2). Daily gains during the entire finishing period were higher for steers than heifers. However, when each grade and sex group was considered individually, the increase in rate of gain due to the high-concentrate ration was about .1 pound per head per day for each subclass.

The advantage in returns above feed and initial cost ranged from \$5.66 in favor of the concentrate ration with good steers to an advantage of \$0.54 to the high-silage ration when medium steers were fed (Figure 3). These data indicate that the grade and sex of the cattle

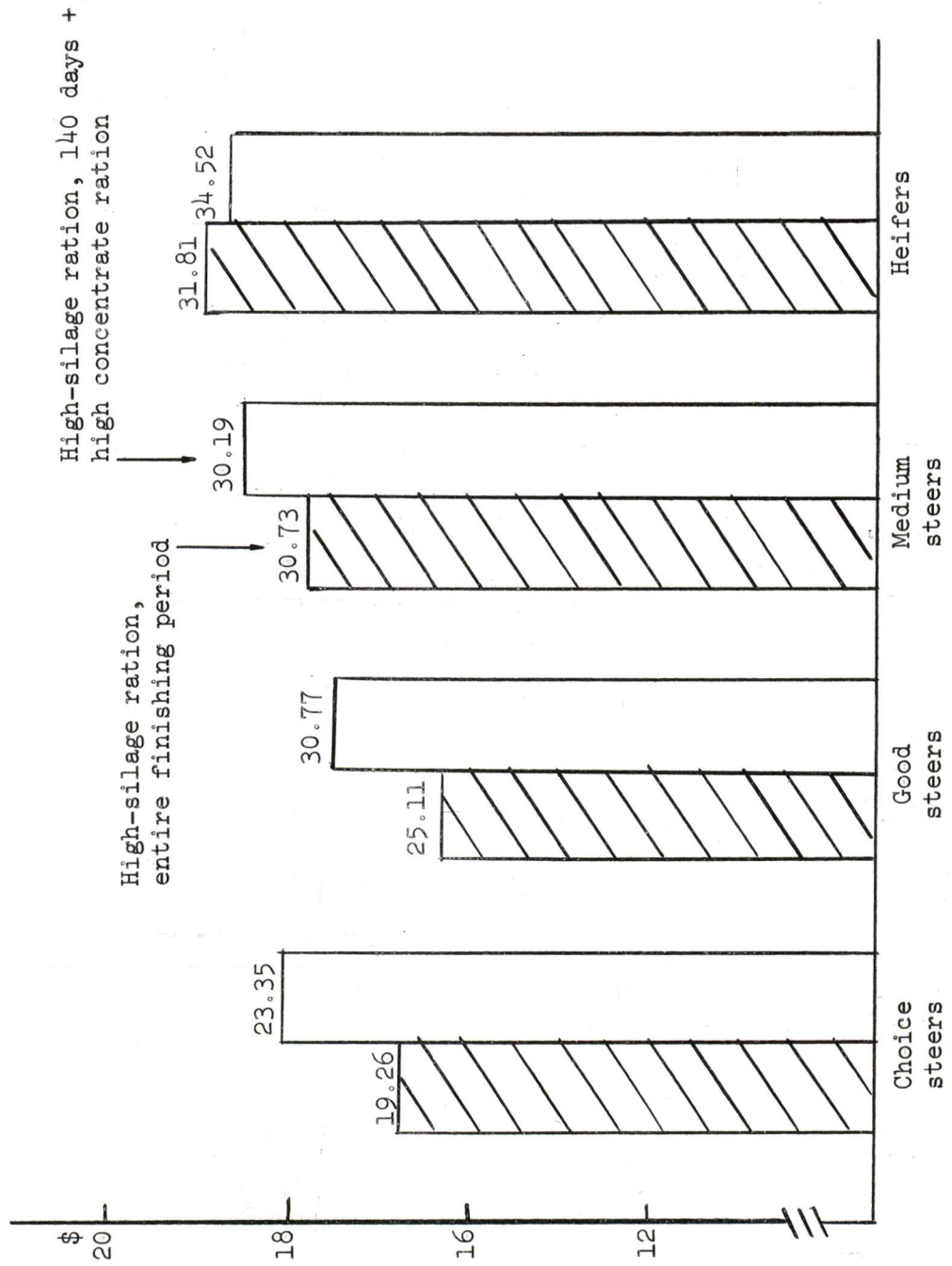


Figure 2. Feed cost per hundred pounds of gain (entire finishing period).

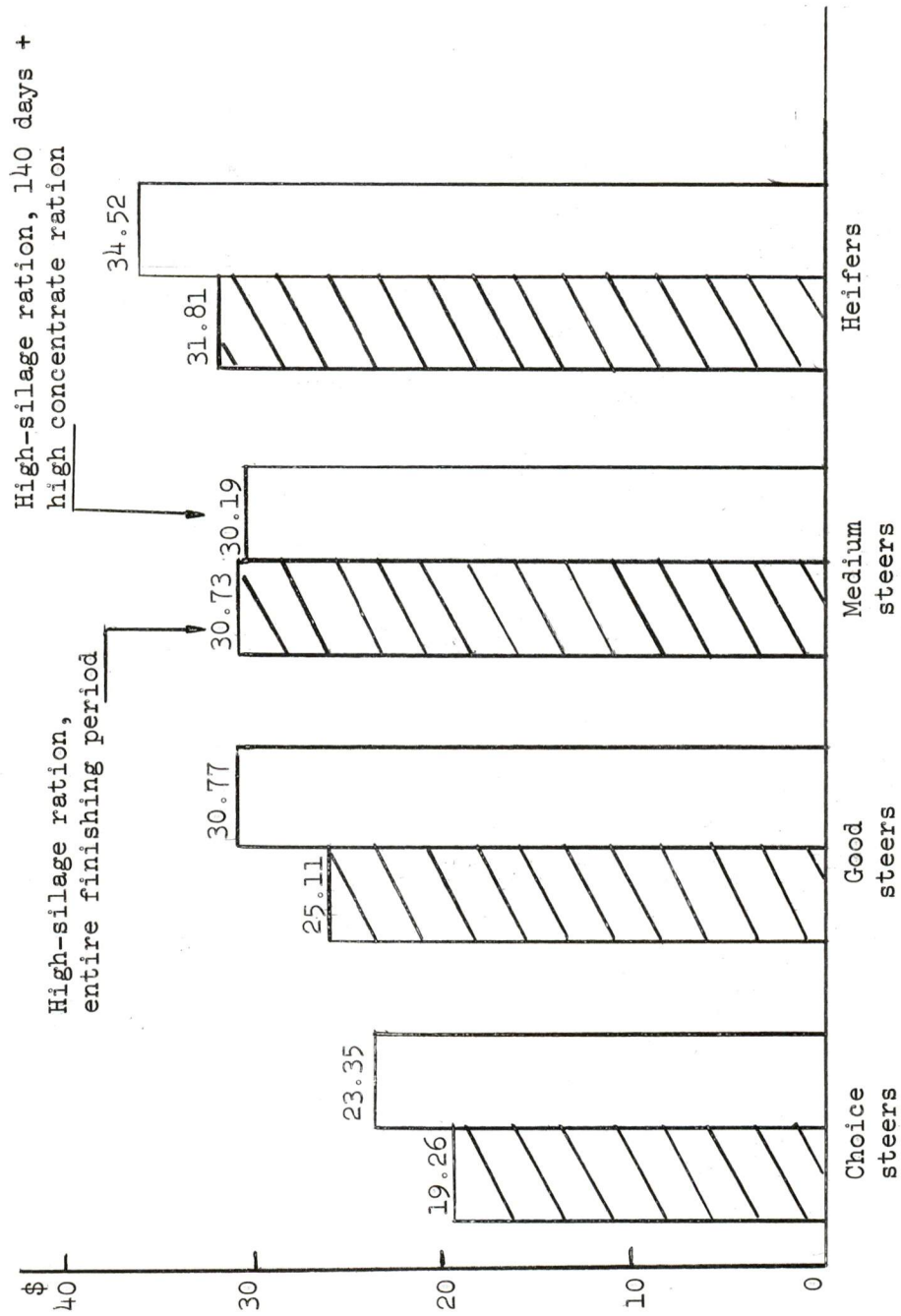


Figure 3. Returns per head above feed and initial cost

being fed is an important economic consideration in determining the value of increasing the amount of concentrates during the latter part of the finishing period. Also, market preference for heavier carcasses and the time required to reach similar weight should also be considered.

CHAPTER V

SUMMARY

Data collected on 120 steers and 40 heifers at the Middle Tennessee Experiment Station, Spring Hill, Tennessee were used to determine the effects of a full-feed of concentrates during the last 56 to 74 days of the finishing period on the performance and carcass traits of beef steers and heifers. Choice, good, and medium steers, and heifers were fed a ration of corn silage ad lib. plus limited concentrates for 140 days. One-half of the animals within each sex and feeder grade received this high corn-silage limited concentrate ration until they were sold for slaughter. The other animals within each sex and grade were changed to a full-feed of concentrates during the last 56 to 74 days of the finishing period.

Daily gains were similar for the choice, good, and medium steers during the 140-day pre-experimental period when fed the high silage-limited concentrate ration (1.96, 1.99, and 1.97 pounds per head per day, respectively). However, gains made by the heifers (1.74 pounds per head per day) were significantly less than for the steers.

The cattle full-fed concentrates during the last 56 to 74 days of the finishing period gained 0.36 pounds per head per day more ($P < .01$) than those fed the high-silage ration. Differences in performance due to the two rations were similar and of relatively the same magnitude within each feeder grade and sex.

Concentrates full-fed in the latter part of the finishing period resulted in heavier cattle at slaughter which yielded heavier carcasses.

Dressing percent, loin eye area per hundred pounds of carcass, marbling, fat thickness at the twelfth rib, and percent kidney fat were not affected by this short full-feed of concentrates.

Feed cost per unit of gain was higher for the cattle fed the concentrate ration. However, the total selling price of these cattle was more than that of the cattle fed the high-silage ration and the return above feed cost was not significantly different for the two systems.

The increase in returns (above feed and initial cost) due to the high-concentrate ration was \$5.66 for good steers. However, the advantage was \$0.54 in favor of the high-silage ration when medium steers were fed.

These data indicate that relative cost of corn silage and shelled corn, the importance of a shorter feed period in the overall feedlot program, and the grade and sex of cattle being fed are all important economic considerations in determining the value of increasing the amount of concentrates during the latter part of the finishing period.

LITERATURE CITED

LITERATURE CITED

- Anderson, J. M., T. W. High, Jr., and E. J. Chapman. 1964. The performance of feeder cattle of different weights, grades, and sexes. Tenn. Agr. Exp. Sta. Bul. 381.
- Burroughs, W., C. Ludwig, A. Mukhtar, and H. Trenkle. 1965. Completion of new cattle concentrate (Iowa 80 premix) experiment with emphasis upon the comparative merits of corn silage vs. corn grain fattening rations. Iowa Agr. Exp. Sta. A.S. Leaflet R69.
- Burroughs, W., A. Mukhtar, C. Ludwig, and H. Trenkle. 1964. A new cattle-concentrate-premix for mixing with grain in finishing rations with and without corn silage. Iowa Agr. Exp. Sta. A.S. Leaflet R59.
- Clark, J. H., O. G. Hall, and J. H. Felts. 1967. Performance of beef steers fed different protein supplements and hays in the feedlot. Tenn. Agr. Exp. Sta. Bul. 417.
- Duncan, D. B. 1955. Multiple range and multiple F test. Biometrics 11:1.
- Fontenot, J. P., J. S. Copenhaver, and R. C. Carter. 1967. Different levels of supplemental grain for fattening weanling steer calves fed high corn silage rations. V. Agr. Exp. Sta. Res. Rpt. 122.
- Garrigus, V. S., E. E. Hatfield, W. W. Albert, P. E. Lama, and F. G. Hinds. 1967. Experiences with "all-concentrate" cattle rations. Ill. Agr. Exp. Sta. Beef Cattle Day Report, 1967.
- Hall, O. G. and J. H. Felts. 1963. Comparative feeding value of different silages for the production of slaughter beef heifers. Tenn. Agr. Exp. Sta. Bul. 360.
- Hammes, R. C., Jr., J. P. Fontenot, H. T. Bryant, R. E. Blaser, and R. W. Engel. 1964. Value of high-silage rations for fattening beef cattle. J. Animal Sci. 23:795.
- Klosterman, E. W., V. R. Cahill, L. E. Kunkle, and P. Althouse. 1961. The effect of corn silage or ground ear corn full-fed at various stages during growth and fattening upon carcass composition of beef cattle. Ohio Agr. Exp. Sta. Beef Cattle Res. Rpt., 1961.
- Klosterman, E. W., P. G. Althouse, and V. R. Cahill. 1965. Effect of corn silage or ground ear corn full fed at various stages of growth and fattening upon carcass composition of beef cattle. J. Animal Sci. 24:519.

- Kramer, C. Y. 1957. Extension of multiple range tests to group correlated adjusted means. *Biometrics* 13:13.
- Perry, T. W. and W. M. Beeson. 1966. Corn silage for fattening cattle. *Ill. Agr. Expt. Sta. Res. Rpt.* 254.
- Perry, T. W., C. H. Nickel, D. Webb, and W. M. Beeson. 1964. Yearling steers vs. steer calves fed on low and high energy fattening rations. *Ill. Agr. Expt. Sta. Res. Rpt.* 113.
- Richardson, D., E. F. Smith, F. H. Baker, and R. F. Cox. 1961. Effects of roughage-concentrate ratio in cattle fattening rations on gain, feed efficiency, digestion, and carcass. *J. Animal Sci.* 20:316.
- Steel, R. G. D. and J. H. Torrie. 1960. *Principles and Procedures of Statistics.* McGraw-Hill Book Co., New York.
- Young, L. G., G. A. Branaman, and R. J. Deans. 1962. Influence of rate of grain feeding on gain and carcass characteristics of calves. *J. Animal Sci.* 21:621.

APPENDIX

Table 13. Feed consumption and requirements by ration and type of cattle during the experimental period^a (Average of two trials)

	Ration									
	High-silage					Concentrates				
	Choice steers	Good steers	Medium steers	Heifers	Choice steers	Good steers	Medium steers	Heifers		
No. of animals	20	20	20	20	20	20	20	20	20	20
No. of days	56	56	74	56	56	56	74	56	56	56
Av. da. feed, lb./hd.										
Shelled corn	5.9	5.9	5.9	5.9	12.9	12.9	12.5	10.6		
Cottonseed meal	1.0	1.0	1.0	1.0	1.8	1.8	1.8	1.8		
Alfalfa-grass hay	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
Corn silage	24.6	24.6	26.0	26.0	8.0	8.0	8.8	9.3		
Feed requirement/cwt. gain, lb.										
Shelled corn	332	337	359	407	648	594	645	582		
Cottonseed meal	63	56	60	67	93	85	94	83		
Alfalfa-grass hay	192	172	185	204	152	138	154	169		
Corn silage	1,568	1,410	1,655	1,756	400	372	458	527		
Feed cost/cwt. gain, ^b \$	22.28	19.88	21.85	24.06	25.60	23.16	25.54	24.62		

^aThe experimental period was the last 56 to 74 days of the finishing period.

^bFeed prices are shown in Table 2, page 10.

Table 14. Feed consumption and requirements by ration and type of cattle during the experimental period^a (1965-66)

	Ration							
	High-silage				Concentrates			
	Choice steers	Good steers	Medium steers	Heifers	Choice steers	Good steers	Medium steers	Heifers
No. of animals	10	10	10	10	10	10	10	10
No. of days	55	55	55	55	55	55	55	55
Av. da. feed, lb./hd.								
Shelled corn	6.8	6.8	6.8	5.9	12.3	12.3	12.3	12.3
Cottonseed meal	1.0	1.0	1.0	1.0	1.8	1.8	1.8	1.8
Alfalfa-grass hay	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Corn silage	23.7	23.6	23.6	22.9	7.1	7.1	7.1	7.1
Feed requirement/cwt. gain, lb.								
Shelled corn	471	385	395	500	655	545	575	674
Cottonseed meal	67	55	56	71	94	78	82	96
Alfalfa-grass hay	208	170	175	221	160	133	140	164
Corn silage	1,644	1,342	1,374	1,685	376	313	331	387
Feed cost/cwt. gain, ^b \$	24.73	20.21	20.73	26.01	24.17	20.11	21.20	24.85

^aThe experimental period was the last 55 days of the finishing period.

^bFeed prices are shown in Table 2, page 10.

Table 15. Feed consumption and requirements by ration and type of cattle during the experimental period^a (1967-68)

	Ration							
	High-silage				Concentrates			
	Choice steers	Good steers	Medium steers	Heifers	Choice steers	Good steers	Medium steers	Heifers
No. of animals	10	10	10	10	10	10	10	10
No. of days	56	56	92	56	56	56	92	56
Av. da. feed, lb./hd.								
Shelled corn	5.0	5.0	5.0	5.0	13.5	13.5	12.7	8.6
Cottonseed meal	1.0	1.0	1.0	1.0	1.8	1.8	1.8	1.8
Alfalfa-grass hay	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Corn silage	25.4	25.6	30.0	29.1	8.9	9.0	10.4	11.5
Feed requirements/cwt. gain, lb.								
Shelled corn	294	289	323	314	640	644	715	489
Cottonseed meal	59	58	65	63	92	92	106	70
Alfalfa-grass hay	176	174	194	188	143	144	168	174
Corn silage	1,493	1,479	1,936	1,827	423	432	585	667
Feed cost/cwt. gain, ^b \$	19.84	19.57	22.99	22.11	26.04	26.21	29.83	22.40

^aThe experimental period was the last 56 to 92 days of the finishing period.

^bFeed prices are shown in Table 2, page 10.

Table 16. Performance of various grades and sexes of cattle during the experimental period^a (average of two trials)

	High-silage ration				Full-fed concentrates			
	Choice steers	Good steers	Medium steers	Heifers	Choice steers	Good steers	Medium steers	Heifers
No. of animals	20	20	20	20	20	20	20	20
No. of days on feed	56	56	74	56	56	56	74	56
Av. wts. and gain/hd., lb.								
Initial weight	778	790	771	695	778	782	770	696
Final weight	866	880	890	778	890	904	912	795
Total gain	88	98	119	83	112	122	142	99
Daily gain	1.57	1.76	1.64	1.49	2.01	2.19	1.98	1.79
Av. grades								
Initial condition	11.9	11.5	10.3	11.0	11.8	11.4	10.2	10.9
Final slaughter	12.3	11.4	11.0	12.0	12.4	12.0	11.5	12.4
Carcass, U.S.D.A.	12.4	12.4	11.6	12.0	12.6	12.2	11.8	12.3
Feed cost/cwt. gain, ^b \$	22.28	19.89	21.68	24.06	25.10	23.16	25.52	23.62
Selling price/cwt., \$	25.96	25.84	25.80	25.64	26.52	26.52	26.31	26.16

^aThe experimental period was the last 56 to 74 days of the finishing period.

^bFeed costs are shown in Table 2, page 10.

Table 17. Performance of various grades and sexes of cattle during the experimental period^a (1965-66)

	High-silage ration				Full-fed concentrates			
	Choice steers	Good steers	Medium steers	Heifers	Choice steers	Good steers	Medium steers	Heifers
No. of animals	10	10	10	10	10	10	10	10
No. of days on feed	55	55	55	55	55	55	55	55
Av. wts. and gain/hd., lb.								
Initial weight	759	770	769	725	755	768	756	737
Final weight	840	869	865	801	861	896	876	839
Total gain	81	99	96	76	106	126	120	102
Daily gain	1.46	1.80	1.38	1.38	1.92	2.29	2.18	1.85
Av. grades								
Initial condition	11.4	11.8	11.1	11.2	11.8	11.6	10.9	11.5
Final slaughter	12.2	11.5	11.4	12.2	12.6	12.1	11.4	12.7
Carcass, U.S.D.A.	11.7	12.6	11.4	11.9	12.1	11.3	11.7	12.6
Feed cost/cwt. gain, ^b \$	24.73	20.21	20.73	26.01	24.17	20.11	21.20	24.85
Selling price/cwt., \$	25.34	25.31	25.29	25.26	25.85	25.78	25.78	25.95

^aThe experimental period was the last 55 days of the finishing period.

^bFeed costs are shown in Table 2, page 10.

Table 18. Performance of various grades and sexes of cattle during the experimental period^a (1967-68)

	High-silage ration				Full-fed concentrates			
	Choice steers	Good steers	Medium steers	Heifers	Choice steers	Good steers	Medium steers	Heifers
No. of animals	10	10	10	10	10	10	10	10
No. of days on feed	56	56	92	56	56	56	92	56
Av. wts. and gain/hd., lb.								
Initial weight	796	810	773	665	800	796	783	654
Final weight	891	907	915	754	918	913	947	751
Total gain	95	97	142	89	118	117	164	97
Daily gain	1.70	1.73	1.54	1.59	2.10	2.09	1.78	1.73
Av. grades								
Initial condition	12.4	11.2	9.5	10.8	12.2	11.2	9.6	10.3
Final slaughter	12.4	11.4	10.6	11.8	12.2	12.0	11.6	12.0
Carcass, U.S.D.A.	13.0	12.2	11.7	12.1	13.2	13.0	11.8	12.0
Feed cost/cwt. gain, ^b \$	19.84	19.57	22.99	22.11	26.04	26.21	29.83	22.40
Selling price/cwt., \$	26.59	26.36	26.31	26.01	27.20	27.25	26.97	26.37

^aThe experimental period was the last 56 to 92 days of the finishing period.

^bFeed costs are shown in Table 2, page 10.

Table 19. Effects of ration and type of cattle on carcass traits

	Ration fed during experimental period ^a							
	High-silage				Concentrates			
	Choice steers	Good steers	Medium steers	Heifers	Choice steers	Good steers	Medium steers	Heifers
Hot carcass wt., lb.	509	524	528	465	536	540	552	476
Dressing percent	59.2	59.2	59.0	59.8	60.3	60.3	60.1	60.5
Ribeye area, sq. in.	10.44	10.74	10.83	10.48	10.94	10.74	10.83	10.22
Ribeye area/cwt. carcass, sq. in.	2.08	2.08	2.09	2.30	2.07	2.04	1.98	2.19
Marbling score ^b	5.32	5.24	5.10	5.52	5.46	5.50	5.22	5.53
Fat thickness	.42	.40	.35	.48	.50	.44	.39	.44
Shrink, percent ^c	3.24	2.94	2.06	2.98	2.69	2.96	1.92	3.34
Kidney fat, percent	2.82	2.72	2.32	3.22	2.92	3.18	2.58	3.42

^aThe experimental period was the last 56 to 74 days of the finishing period.

^bTrace = 3, slight = 4, small = 5, modest = 6, moderate = 7.

^cFarm to packing plant.

Table 20. Analysis of variance of feed consumption, requirements and costs among various grades and sexes of feeder cattle during the 140-day pre-experimental period

Source	Mean square					
	Pounds of silage consumed /head/day	Feed cost per cwt. gain	Ration			Corn silage
			Shelled corn	Cottonseed meal	Hay	
Type of cattle	3	12.00**	2,350.0**	133.8*	838.2**	51,735**
Residual	27	.33	310.8	5.0	44.1	2,968

*P<.05.

**P<.01.

Table 21. Analysis of variance of various performance traits

Source	df	Mean square							ADG entire finishing period		
		Ribeye area Dressing percent	carcass score	Marbling score	Fat thickness	Percent shrink	Percent kidney fat	Percent Loin eye area (total)		Selling Carcass price wt.	
Ration	1	40.99	0.18	0.52	.024	1.30	1.46	1.06	10.99**	15,879**	.325
Type of cattle	3	6.34	0.54**	4.75	.078	17.53	5.85*	2.89	1.84*	56,170**	.579
Ration x Type of cattle	3	1.19	0.02	2.24	.042	4.95	.56	1.21	.20	34,615**	.040
Animals within lots treated alike	8	12.47	0.07	2.64	.033	5.17	1.02	1.68	.42	1,226	.434
Residual	143	1.27	0.04	0.85	.011	1.21	.21	.73	.33	495	1.105

*P<.05.

**P<.01.

VITA

Earl C. Anderson was born October 16, 1918 in Decatur County, Tennessee. He attended public schools at Parsons, Tennessee where he graduated from high school in 1936. During the next six years he attended Chillicothe Business College, at Chillicothe, Mo., engaged in farming for a time, worked as a member of a survey party and as a Junior Medical Aide for TVA. He married Dorothy L. Groom in December, 1938. In 1942 he joined the Navy and served for 35 months as a Pharmacist's Mate during World War II with 21 months service aboard an L.S.T.

After being discharged from the Navy in 1945 he enrolled in the College of Agriculture, University of Tennessee, Knoxville, Tennessee. He graduated in December, 1948 with a Bachelor of Science degree in Agriculture with a major in Agricultural Education.

He began his service with the University of Tennessee Agricultural Extension Service in January, 1949 as Assistant County Agent in Lawrence County. He later served in Davidson County and is presently serving in Perry County. He has attended Graduate School for four quarters and taken numerous short courses over the state during this time. While in Davidson County he completed the first year at Y.M.C.A. Law School.