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To the Graduate Council:

I am submitting herewith a thesis written by David M. Rowland entitled "Effects of Initial Subcutaneous Fat, Grade, and Weight of Feeder Heifers on Their Subsequent Feedlot Performance and Carcass Characteristics." 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

EFFECTS OF INITIAL SUBCUTANEOUS FAT, GRADE, AND WEIGHT
OF FEEDER HEIFERS ON THEIR SUBSEQUENT FEEDLOT
PERFORMANCE AND CARCASS CHARACTERISTICS

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

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

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David M. Rowland
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ABSTRACT

One hundred-eighty feeder heifers (150 Hereford, 29 Angus and one crossbred) of Choice, Good and Medium feeder grades were fed to determine the effects of initial subcutaneous fat thickness, feeder grade and initial weight on their feedlot performance and carcass quality and cutability. Heifers were purchased at graded feeder calf sales in East Tennessee.

After an adjustment period of three weeks, the heifers were fed corn silage ad libitum, treated at the time of ensiling with 10 pounds each of urea and ground limestone plus six pounds of concentrate per head per day, for 110 days, and then full-fed a concentrate ration of eight parts ground shelled corn to one part 41 percent cottonseed meal, to finish the heifers at an ultrasonically estimated fat thickness of 10 mm. or 8 mm.

Initial weight was found to have a small, but significant ($P < .05$) effect on roughage phase average daily gain, and a very highly significant ($P < .001$) effect on final weight, carcass weight, yield grade and estimated percent retail yield.

Feeder grade had a highly significant ($P < .01$) effect on dressing percent, and a very highly significant ($P < .001$) effect on carcass conformation grade. Variation in feeder grade did not significantly influence the other measures of performance or carcass characteristics. Simple correlations of feeder grade with roughage phase average daily gain, overall average daily gain, yield grade and percent retail yield were -0.06, -0.04, 0.14 and -0.17, respectively.

An additional 4.41 percent of the variation in overall average daily gain was explained by variation in initial subcutaneous fat when initial weight and grade were held constant. Initial fat also accounted for an additional 5.29 percent of the variation in carcass fat, 2.35 percent of the variation in yield grade, and 1.74 percent of the variation in retail yield. These percentages were small and non-significant ($P > .05$) in all cases. In comparison, fitting initial condition grade to the original model accounted for an additional 11.97 percent of the variation in overall average daily gain, 10.36 percent of the variation in carcass fat, 4.70 percent of the variation in yield grade, and 3.85 percent of the variation in estimated retail yield. The gross simple correlation between initial fat and initial condition grade was 0.57. The correlation between feeder grade and type grade was 0.88. Correlations were obtained for feeder grade with initial fat and initial condition grade of 0.41 and 0.76, respectively, and for type grade with initial fat and initial condition of 0.40 and 0.72, respectively. Partial correlation coefficients for type grade with initial fat and with initial condition were 0.09 and 0.14, respectively, indicating initial fat and initial condition are inseparable parts of feeder grade.

Heifers that were slaughtered when the ultrasonically estimated fat thickness reached 8 mm. produced carcasses comparable to those of heifers slaughtered at 10 mm. fat thickness. There were no significant ($P > .05$) differences between the two fat levels in carcass grade, yield grade and percent retail yield. The heifers fed to 8 mm. subcutaneous fat finished 10 days earlier than the 10 mm. level heifers,

and cost per hundredweight gain overall was in favor of the 8 mm. level heifers by \$0.85.

Results of this experiment indicate that either of the three grades may be fed with equal success, and that price spreads between feeder grades of equal weight may be the most important consideration in purchasing feeder heifers.

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CHAPTER I

INTRODUCTION

Tennessee has long been a leader in the marketing of feeder cattle through organized, graded feeder calf sales. These sales are designed to provide buyers with large, uniform lots of cattle of various weights and grades. This is accomplished by co-mingling ownership of calves in groups large enough to attract competitive bidding and consequently, yield highest gross returns to the calf producer. It then becomes important to determine the differences in feedlot performance and subsequent carcass characteristics of the grades of feeder cattle. The effects of differences in fatness and/or other measurable or observable differences in feeder cattle on performance and carcass value merits investigation.

Feeder heifers can normally be bought at a lower price per pound than steers of the same weight and grade. The magnitude of this difference is greater in lighter weight cattle. Price differences between slaughter steers and heifers are of lesser magnitude although steers sell for slightly more per pound than do heifers of the same slaughter grade. Since the margin between the purchase price of feeders and the selling price of slaughter cattle is generally more favorable for heifers than steers, it would appear that they offer an opportunity for profit-making to the Tennessee cattleman.

Tennessee has the potential to produce large amounts of corn silage and other roughages. If these roughages are to be marketed

for maximum return, marketing those of high quality, particularly corn silage, through finished cattle may be the method of choice.

The purpose of this experiment was to compare the feedlot performance and subsequent carcass characteristics of various grades, initial weights and estimated fat thickness of feeder heifers fed corn silage, and given a short finishing period of concentrate feeding to optimize carcass quality and quantity.

CHAPTER II

LITERATURE REVIEW

The amount of research dealing with finishing beef cattle and the carcass characteristics of these cattle is rather large. This review will relate to the work that has been done using subjective and objective measurements to predict feedlot performance and carcass yield of beef cattle.

I. LIVE MEASUREMENTS

Research dealing with the use of ultrasonics as an evaluation technique for the live animal is extensive. Errors associated with ultrasonic evaluation when compared to carcass measurements were attributed by Temple, Ramsey and Patterson (1965) to be due to animal variation, tissue changes during slaughter, interpretation, and machine manipulation. Very firm or very fat animals were more difficult to evaluate. Muscle and fat configurations differed greatly between live animal and the on-rail carcass with the location scanned on the live animal shifting as much as five centimeters in relation to the skeleton when the carcass was hung on the rail.

In a study conducted by Ramsey et al. (1965), sides laid on a table, or an unsplit carcass placed in a standing position to chill, had fat and muscle configurations closely resembling those of the live animal. From these results, Ramsey et al. (1965) indicated that changes in muscle areas during slaughter and chilling are not a major source of

error in ultrasonic evaluations, but that changes in fat and muscle configuration made interpretations more difficult.

Stouffer et al. (1961) suggested from limited data that the positional variation of ribeye area and fat thickness between the 12th and 13th ribs, changes in shape and size of the ribeye area due to slaughtering, hanging on the rail, and variability in the pressure of the transducer against the hide during probing are probable factors accounting for low relationships between ultrasonic estimates and carcass measurements.

Brown et al. (1964) and Davis, Temple and McCormick (1966) indicated a reasonable degree of repeatability using ultrasonic measurements. Brown et al. (1964) reported from measurements taken on 45 bulls, that the correlations between independent interpretations of the readings was 0.91 for ribeye area and 0.94 for fat thickness. Correlations obtained between ultrasonic and carcass measurements for ribeye area and fat thickness were 0.78 and 0.46, respectively. Davis et al. (1966) reported from a study on 27 cattle estimating ribeye area and fat thickness with two similar ultrasonic units and independent operators, that simple correlations between operators and units ranged from 0.86 to 0.91 for ribeye area and 0.64 to 0.85 for fat thickness. Subsequent correlations between ultrasonic live animal estimates and carcass ribeye area and fat thickness were highly significant, and ranged from 0.84 to 0.92 for ribeye area and from 0.57 to 0.75 for fat thickness. Temple et al. (1965) reported from two studies, that 80 percent of the fat thickness estimates were within 0.25 cm. of the carcass measurements and that all were within 0.80 cm.

Hedrick et al. (1962) compared ultrasonic measurements to tracings of the 1. dorsi and actual fat measurements. Correlations ranged from 0.58 to 0.89 ($P < .01$), and 0.11 ($P < .05$) to 0.63 ($P < .01$), respectively between ultrasonic estimates and actual ribeye area and measured fat thickness on 203 animals. These workers concluded ". . . the ultrasonic method is a good method for estimating ribeye area and fat thickness in live cattle." In contrast, Sumption et al. (1964) reported that correlations between live single point estimates and carcass ribeye area taken at 5, 9, and 13 cm. from the midline between the 12th and 13th rib, were generally too low to be useful predictors. Their correlations ranged from 0.007 to 0.72 on 14 groups of eight to 149 head per group of bulls, steers, and heifers. Correlations between estimated and actual fat thicknesses were generally higher at the 9 cm. and 13 cm. locations as compared to the 5 cm. location. Correlations between estimated and actual fat thickness using the average of either two or three measurements were generally no higher than with the single point estimates at 9 cm. or 13 cm. Correlations on the 14 groups ranged from 0.41 to 0.80.

McReynolds and Arthaud (1970) obtained correlations as high as 0.95 between predicted and actual ribeye area by using 100 acetate drawings of ribeye area of known size and dividing the area by the average of three depth measurements at 5, 9 and 13 cm. from the midline. This gave a constant that, when multiplied by the average depth of the three readings on the remainder of 270 animals, produced the high correlation between the predicted and actual ribeye area.

Davis et al. (1964) obtained high correlations for ultrasonic estimates of ribeye area and fat thickness with corresponding carcass measurements (0.87 and 0.90, respectively).

Brackelsberg, Willham and Walters (1967) obtained simple correlations ranging from 0.21 to 0.90 between live and carcass measurements of fat thickness between the 12th and 13th ribs on 380 bulls, steers, and heifers. Most of the simple correlations fell between 0.50 and 0.80.

II. PERFORMANCE

The weights, grades, and initial condition of calves being fed for slaughter does not always indicate expected performance and subsequent carcass quality and/or cutability. Minish et al. (1967) reported significantly ($P < .05$) higher average daily gains for Standard grade feeder steers than Choice grade steers. This study involved 128 steers fed four levels of concentrate plus a full-feed of corn silage. Concentrate per 45.4 kg. body weight. Within the Choice grade, average daily gains increased significantly ($P < .05$) as concentrate level increased to 0.454 kg. Within the Standard grade, the level of 0.681 was significantly ($P < .05$) higher than the other three levels.

Harrell (1971) reported feeder grade to have a significant ($P < .05$) effect on the average daily gain of 178 heifers through a 140-day roughage phase, and combined with a full-feed phase. Estimated initial fat thickness did not affect average daily gain on roughage or overall gain, but did significantly ($P < .05$) affect yield grade.

and percent retail yield. Medium grade heifers were superior to Choice in average daily gain, but no differences in average daily gain of Good and Choice, and Medium and Good heifers were found.

Corrick and Hobbs (1970) using 132 Good and Medium grade heifers in a feeding trial found no significant ($P < .05$) differences in average daily gains between grades for the roughage phase or overall. Good grade heifers averaged 49 pounds heavier than Medium initially, and 45 pounds heavier at the end of the test. Ribeye area was significantly ($P < .05$) larger for the good grade heifers than the medium heifers, and was the only carcass characteristic significantly affected by grade.

Anderson, High and Chapman (1964) found from a three-year study involving 149 heifers and 120 steers of Choice, Good and Medium feeder grade of varying weights, that steers, except in one comparison, generally had significantly ($P < .05$) higher average daily gains than heifers. Steers also took longer to finish to market condition than did heifers, regardless of grade. There were no significant ($P < .05$) differences in average daily gain of the steers regardless of grade and initial weight. Good grade heifers had significantly ($P < .01$) higher average daily gains than Medium grade heifers.

Stonaker, Hazaleus and Wheeler (1952) individually fed 87 Herefords divided into comprest and conventional types. These workers found comprest cattle gained as fast and efficiently as conventional cattle when fed to give a low Choice slaughter grade. There were significant differences in rate of gain and slaughter weights in favor of the conventional type. There were no differences in efficiency of gains, days on feed and slaughter age. Carcass composition was the same for both

types, and percent of carcass in retail cuts was comparable. Brungardt (1971) obtained similar results when cattle were selected for rate of gain and classified by size. Cattle which were heavier and larger at weaning were superior in rate of gain and feed efficiency when taken to a constant final weight, but that this did not hold true when final slaughter condition was the end point in question. This study involved Angus, Hereford and Charolais cattle of various sizes and weaning performance within breed. Cattle selected for weaning performance or a high growth rate reached a standard slaughter condition at significantly heavier weights but were not more efficient. The larger breeds also required a longer feeding period to reach slaughter condition.

From a two-year study involving 84 Hereford steers fed rations designed to provide low, intermediate, and high energy levels, and feeding to estimated fat thicknesses of 3 to 5, 8 to 10, and 13 to 15 mm., respectively, Backus et al. (1967) reported that the 3 to 5 mm. cattle produced carcasses with comparable eating quality of the fatter cattle with lower feed costs per kg. gain. The fatter cattle produced more high quality beef resulting in a greater profit to the producer.

Brown et al. (1964) using 45 young bulls reported correlations between performance traits and ultrasonic measurements of fat thickness to be low. However, correlations between ultrasonic estimates and carcass measurements for ribeye area and fat thickness were 0.78 and 0.46, respectively.

Hoornbeek et al. (1962) reported a three-year study comparing carcass traits between offspring of four sires. Type and condition scores were found to not accurately predict performance or carcass

characteristics. The sires were from four inbred lines. Calves sired by one line excelled in average daily gain and final weight; calves of a second line produced carcasses high in marbling, carcass conformation and percent fat; bulls of the third line sired calves with higher USDA carcass grade and dressing percent; and calves sired by bulls of the fourth line were inferior in all respects.

Stuedemann et al. (1967) reported the effects of varied nutritional levels from birth to eight months on further growth and development of full-fed beef calves. Sixty Hereford calves subjected to one of five nutritional levels from birth to eight months produced no significant differences in carcass size or composition. Calves on the lower levels early in life required a longer feeding period to reach desired market weight and tended to have a greater amount of fat cover.

Brinks, Clark and Kieffer (1962) reported that post-weaning average daily gain was nearly independent of all carcass traits studied; ribeye and fat depth at the 12th rib, and percent lean, fat and bone of the 9-10-11th rib cut. Fat thickness estimates appeared more promising than ribeye area for predicting carcass traits.

Bradley et al. (1966) fed 34 Hereford and 33 Hereford-Red Poll steers and heifers for slaughter in a two-year study. Steers had significantly ($P < .05$) higher pre- and post-weaning average daily gains as well as heavier birth, weaning, and final weights. After removal of the differences due to effects of initial weight, and differences between steers and heifers in carcass grade, marbling and ribeye area were small and insignificant.

III. CARCASS YIELD

Much research has been done in an effort to find simple and useful methods to predict the amount of muscling in beef carcasses.

Hedrick et al. (1964b) found significant differences between right and left side measurements on 295 Good and Choice carcasses. When an additional 47 Good and Choice carcasses were chilled without splitting, and wholesale ribs and short loins were removed intact, no significant differences were found between right and left side 1. dorsi and subcutaneous fat measurements at six anatomical locations. Differences between right and left sides were attributed to be due to errors in ribbing or measurement procedures.

Hoornbeek et al. (1962) reported that marbling was not related to percent of fat in the carcass. Percent fat in the carcass, conformation scores, and higher dressing percents were associated with heavier final weights.

Minish et al. (1967) found that Standard grade feeder calves had significantly ($P < .05$) higher estimated percent of boned, trimmed round, rib, loin, chuck, and less fat at the 12th rib than Choice grade calves. Choice calves were superior to Standard in conformation, marbling, carcass grade, ribeye area, and dressing percent ($P < .05$).

Backus et al., feeding to produce levels of fat at the 12th rib of 3 to 5, 8 to 10, and 13 to 15 mm., found eating qualities of the 3 to 5 mm. cattle comparable to the fatter cattle. The fatter cattle (13 to 15 mm.) produced carcasses which were significantly heavier with higher dressing percentages, marbling scores, carcass grades, and weight of trimmed retail cuts than the other two fat thickness levels.

Murphey et al. (1960), Cole, Ramsey and Epley (1962), Brungardt and Bray (1963), and many other researchers have developed prediction equations for estimating retail yield in beef carcasses. Brungardt and Bray (1963) utilized 14 fat measurements of 33 left sides of steer carcasses. Each measurement was found to be negatively and highly correlated with percent retail yield. These correlations ranged from -.54 to -.90. A single fat measurement at the 12th rib and percent trimmed round were found to account for 81 percent of the variation in percent retail yield.

Cole et al. (1962) developed several equations utilizing measurements from 132 steer carcasses of various breeds. The most valuable equation incorporated only 12th rib fat thickness and carcass weight, and these variables accounted for over 70 percent of the variation in pounds separable lean.

Murphey et al. (1960) used fat thickness at the 12th rib, carcass weight, percent carcass kidney fat, and ribeye area to predict percent boneless retail cuts of the round, loin, rib and chuck.

Lewis, Brungardt and Bray (1964) indicted differences in distribution patterns of subcutaneous fat as a reason for difference in correlations between percent trimmed round and percent retail yield of 0.57 and 0.83 for heifers and steers, respectively. Comparison of heifer and steer carcasses showed percent kidney and pelvic fat was significantly ($P < .01$) higher in heifers.

Crown and Damon (1960) reported the 12th rib cut to be a useful predictor of carcass yield and meat quality in beef. Correlations were obtained between 12th rib cut and separable lean, separable fat, and

bone of 0.818, 0.962, and 0.750, respectively. In comparison, 9-10-11th rib cut yielded correlations of 0.943, 0.976 and 0.733 with separable lean, separable fat, and bone, respectively.

Nolan et al. (1965) reported a correlation between percent carcass fat and fat thickness at the 12th rib of 0.70. A correlation of 0.83 was obtained between percent carcass fat and percent fat from the 9-10-11th rib.

Hedrick et al. (1964a) found percent trimmed round and retail yield of the flank were more highly associated with retail yield of the primal cuts and side than were other wholesale cuts.

Thackston et al. (1967) and Powell and Huffman (1968) compared various beef carcass composition prediction equations. Thackston et al. (1967) compared the USDA Cutability Formula, Wisconsin Method, and the Tennessee Simplified Method. Correlations of 0.69, 0.78, and 0.61 were obtained between estimates and actual retail yield for the U.S.D.A., Wisconsin, and Tennessee methods, respectively. Sex was found to significantly affect the accuracy of the Wisconsin and Tennessee methods. The Tennessee Simplified Method, designed to estimate percent separable lean, was found least desirable in predicting percent retail yield. Powell and Huffman (1968) found the Hankins and Howe formula to be most accurate in predicting beef carcass composition. Methods included in the evaluation were Hankins and Howe Method, Tennessee Method, Wisconsin Method, USDA Yield Grade formula, Illinois and Oklahoma Methods. The USDA Yield Grade and Tennessee Methods were the most practical, and Yield Grade almost as accurate as the Hankins and

Howe formula. The Hankins and Howe Method was very impractical and Yield Grade was the best method overall.

Hedrick et al. (1965) reported from a study involving 1,097 Good and Choice steer carcasses ranging in weight from 350 to 850 pounds. Subcutaneous fat thickness measurements were associated with two to three times as much variation in retail yield as were 1. dorsi measurements. Similar results were obtained by Henderson, Goll and Kline (1966), Brungardt and Bray (1963), Allen, Merkel and Magee (1966), Gottsch, Merkel and Mackintosh (1961), Abraham et al. (1967), and Ramsey, Cole and Hobbs (1962). Swiger et al. (1964), defining retail products as pounds of retail product divided by carcass weight, reported carcass weight alone accounted for 93 percent of the variation in retail product. Fat thickness gave no additional accuracy when used in multiple correlation coefficients with live weight.

Henderson et al. (1966) reported correlations for percent separable muscle, percent retail yield, yield of four major wholesale cuts, and percent separable muscle of the four major wholesale cuts to be higher for fat thickness generally than for 1. dorsi area.

Allen et al. (1966) reported highly significant ($P < .01$) correlations between fat thickness and percent retail yield ranging from -0.38 to -0.68.

Gottsch et al. (1961) reported a correlation of -0.91 between carcass fat and total carcass lean.

Abraham et al. (1967) found significant correlations for average fat thickness and a single fat thickness with yield of boneless retail cuts of -0.66 and -0.72, respectively.

Ramsey et al. (1962) found a single measure of fat thickness to be more closely related to separable lean and fat than carcass grade and yield. Fitzhugh et al. (1965) obtained similar results.

CHAPTER III

EXPERIMENTAL PROCEDURE

Data for this study were collected between October, 1970 and May, 1971 from an experiment conducted at the University of Tennessee's Blount Farm, Knoxville, Tennessee.

I. EXPERIMENTAL ANIMALS

One hundred and eighty feeder heifers purchased through graded feeder calf sales in East Tennessee were used in this experiment. Breeds represented were 150 Hereford, 29 Angus, and one crossbred. Weights of the heifers ranged from 370 to 580 pounds.

II. MANAGEMENT AND FEEDING

Upon arrival at the experimental barn, the heifers were weighed, identified, and allowed to adjust to the environment and recover from the stress of weaning and sale for three weeks. They were fed ad libitum a ration of corn silage treated at time of ensiling with 10 lbs. per ton each of urea and ground limestone during the adjustment period.

Following the adjustment period, they were weighed and sonorayed for fat thickness. They were regraded for type and condition by members of the Animal Husbandry-Veterinary Science Department and implanted with 24 mg. of diethylstilbestrol. They were then randomly allotted by breed (the crossbred being substituted for an Angus), grade, and weight to ten pens of six heifers each by each of three grades; Choice,

Good, and Medium. One-half of the lots within each grade was designated to be removed from the experiment and sent to slaughter when an estimated fat thickness, determined ultrasonically, of either 8 mm. or 10 mm. was reached.

Heifers were placed on a ration of ad libitum corn silage treated at ensiling with 10 lbs. each of urea and limestone plus 6 pounds per head per day of concentrate designed to supply adequate protein for a roughage phase of 110 days. All heifers were then full-fed a ration of eight parts ground shelled corn to one part 41 percent cottonseed meal.

III. SOURCE OF DATA

Heifers were weighed at 14-day intervals for the first 56 days then at 28-day intervals to the end of the roughage phase. In addition, animals were sonorayed for subcutaneous fat thickness at 28-day intervals during the roughage phase. During the fullfeed (finishing) phase, animals were weighed and sonorayed at 14-day intervals. The initial, end of roughage phase, and final weights and sonoray measurements were taken at 7:00 a.m. after the heifers had been removed from feed and water the previous night at 8:00 p.m. Feed consumption records were maintained daily by pens.

At slaughter, the heifers were re-weighed at the packing plant, hot carcass weight was obtained prior to shrouding, and the remaining carcass measurements taken after the carcass had chilled for 48 hours. Physical measurements included actual fat thickness between the 12th and 13th ribs and rib-eye area following the procedures outlined by

the American Meat Science Association (Schoonover et al., 1967). Carcass grade, marbling score, conformation grade, and percent kidney, heart, and pelvic fat were obtained from a USDA grader. Calculated measurements included dressing percent, yield grade, and percent retail yield. Dressing percent was calculated using the hot carcass and the live packer weight. Yield grade and percent retail yield were calculated using the procedures outlined by Murphey et al. (1960).

IV. STATISTICAL ANALYSIS

The data were analyzed using Least-Squares procedures (Harvey, 1968). Duncan's New Multiple Range Test, using values given by Freund, Livermore and Miller (1960), was used for separating differences in means when significance was indicated by the F test.

In a preliminary analysis, variation in the dependent variables was assumed to be due to variation in feeder grade and random error. Initial weights of the three feeder grades were significantly ($P < .01$) different; therefore, in subsequent analyses, initial weight was held constant. Least-squares means presented in the discussion were calculated using the following linear model:

$$Y_{ij} = \mu + g_i + w_j + e_{ijk}$$

where Y_{ij} = the observed value of a given variable for the ij^{th} individual,

μ = the population means for that given variable,

g_i = the effect of the i^{th} initial grade,

$i = 1$, Choice; 2 , Good; 3 , Medium;

w_j = the initial weight of the j^{th} individual,

e_{ijk} = random error associated with the ijk^{th} individual.

Results of the model $Y_i = \mu + g_i + e_{ij}$ are shown in Appendix A, Table XIII and Appendix B, Table XIV.

The original model was also fitted for the effects of initial subcutaneous fat thickness and initial condition score independently, and results of this comparison discussed.

CHAPTER IV

RESULTS AND DISCUSSION

Data from 180 feeder heifers purchased through graded Feeder Calf Sales in East Tennessee formed the basis of this study. They were fed to an ultrasonically estimated fat thickness (hereafter referred to as final fat) of either 8 or 10 mm. for slaughter. Means for selected variables are presented in Appendix A, Table XIII. Heifers ranged from 370 to 580 pounds in initial weight, and from one to nine millimeters in initial fat. Overall means and standard deviations are presented in Table I.

I. INITIAL WEIGHT

With feeder grade held constant, initial weight had a small, but significant ($P < .05$) effect on average daily gain on roughage, but no significant ($P < .05$) effect on overall average daily gain (Table II). For each one pound increase in initial weight, average daily gain on roughage increased 0.001 pounds. Harrell (1971) reported no significant effects of initial weight on average daily gain on roughage or overall. Total days fed decreased by one for each 10 pound increase in initial weight ($P < .001$). Initial weight had a very highly significant ($P < .001$) effect on final weight, and subsequently, carcass weight, yield grade and estimated percent retail cuts (Table III). Similar findings were reported by Harrell (1971). For each increase in initial weight of one pound, final weight

TABLE I
OVERALL MEANS AND STANDARD DEVIATIONS
FOR SELECTED VARIABLES

Variable	Mean	Standard Deviation
<u>Initial Observations:</u>		
Number of animals	180	
Weight lb.	487	49.8
Fat thickness (Sonoray) mm.	3.37	1.25
Condition grade	8.5	1.32
<u>Performance Measurements:</u>		
Average daily gain, roughage lb.	1.95	0.33
Average daily gain, overall lb.	1.93	0.27
Final weight lb.	800	67.6
Final fat thickness (Sonoray) mm.	9.72	1.50
Final condition grade	11.2	0.92
Days on feed	161.8	16.4
<u>Carcass Characteristics:</u>		
Carcass weight lb.	472	44.3
USDA carcass grade ^a	11.3	1.40
Fat thickness mm.	10.7	2.46
Ribeye area sq. in.	10.1	1.0
Marbling score ^b	4.9	1.09
Conformation grade ^a	12.4	1.10
Percent kidney fat	3.4	0.49
Dressing percent	59.6	1.89
Yield grade	2.4	0.43
Percent retail yield	50.4	1.00

^a10 = Average Good, 11 = High Good, 12 = Low Choice.

^b4 = slight amount, 5 = small amount.

TABLE II

ANALYSIS OF VARIANCE FOR AVERAGE DAILY GAIN, TOTAL DAYS ON FEED
AND DRESSING PERCENT ON INITIAL WEIGHT AND FEEDER GRADE

Source	d.f.	Mean Square			
		Average Daily Gain, Roughage	Average Daily Gain, Overall	Total Days on Feed	Dressing Percent
Initial weight	1	0.6459*	0.2127	3649.0632***	0.0565
Feeder grade	2	0.2191	0.0706	462.2349	22.4606**
Residual	176	0.1067	0.0744	247.9314	3.2652

*P < .05.

**P < .01.

***P < .001.

TABLE III

ANALYSIS OF VARIANCE FOR FINAL WEIGHT, CARCASS WEIGHT,
YIELD GRADE AND PERCENT RETAIL YIELD ON
INITIAL WEIGHT AND FEEDER GRADE

Source	d.f.	Mean Square			
		Final Weight	Carcass Weight	Yield Grade	Percent Retail Yield
Initial weight	1	257509.7119***	95323.3033***	2.1572***	16.6716***
Feeder grade	2	492.8101	1544.0472	0.0105	0.1110
Residual	176	2661.6730	1092.1887	0.1707	0.8827

***P < .001.

increased 0.9 pounds, carcass weight increased 0.5 pounds, yield grade increased 0.003 units, and retail cuts decreased 0.007 percent.

Variables not significantly ($P < .05$) affected by initial weight included dressing percent (Table II), percent kidney fat and ribeye area (Table IV). The relationship between initial weight and ribeye area agrees with results reported by Bradley et al. (1966).

Carcass grade was not affected by initial weight, whereas marbling score, carcass fat thickness and conformation grade were (Table V).

II. FEEDER GRADE

When initial weight was held constant, feeder grade had a highly significant ($P < .01$) effect on dressing percent (Table II) and a very highly significant ($P < .001$) effect on carcass conformation grade (Table V). Least-squares means for dressing percent and conformation grade by feeder grade are shown in Table VI.

No significant ($P < .05$) differences were found between feeder grade and average daily gain on roughage, average daily gain overall, total days on feed, final condition grade, carcass grade, carcass weight, ribeye area, carcass fat thickness, percent kidney fat, yield grade or percent retail yield (Tables II, III, IV and V). Other researchers have reported both similar and conflicting results.

Minish et al. (1967) reported Choice grade calves were significantly ($P < .05$) superior to Standard grade calves with respect to marbling score, ribeye area and carcass grade. Standard grade calves were significantly ($P < .05$) superior with respect to average daily

TABLE IV

ANALYSIS OF VARIANCE FOR RIBEYE AREA AND PERCENT KIDNEY, HEART
AND PELVIC FAT ON INITIAL WEIGHT AND FEEDER GRADE

Source	d.f.	Mean Square	
		Ribeye Area	Percent Kidney, Heart and Pelvic Fat
Initial weight	1	0.7305	0.2404
Feeder grade	2	1.8982	0.0562
Residual	176	0.9825	0.2450

TABLE V
ANALYSIS OF VARIANCE FOR CARCASS GRADE, MARBLING SCORE,
CARCASS FAT THICKNESS AND CARCASS CONFORMATION
ON INITIAL WEIGHT AND FEEDER GRADE

Source	d.f.	Mean Square			
		Carcass Grade	Marbling Score	Carcass Fat Thickness	Carcass Conformation
Initial weight	1	3.9956	5.1540*	50.7603**	18.3836***
Feeder grade	2	0.1208	0.1121	7.9872	16.4791***
Residual	176	1.9478	1.1629	5.3594	1.0398

*P < .05.

**P < .01.

***P < .001.

TABLE VI
LEAST-SQUARES MEANS FOR SELECTED VARIABLES, ADJUSTED
FOR VARIATION IN INITIAL WEIGHT
OF HEIFERS, BY FEEDER GRADE

Variable	Means		
	Choice	Good	Medium
<u>Initial Observations:</u>			
Number of animals	60	60	60
Weight lb.	487	487	487
Fat thickness (Sonoray) mm.	3.99 ^a	3.14 ^b	2.99 ^b
Condition grade	10.0 ^a	8.2 ^b	7.4 ^c
<u>Performance Measurements:</u>			
Roughage phase average daily gain lb.	1.89	1.93	2.02
Overall average daily gain lb.	1.89	1.94	1.97
Final weight lb.	799	797	803
Final fat thickness (Sonoray) mm.	9.93	9.62	9.61
Final condition grade	11.4	11.3	11.0
Days on feed	165.2	159.2	161.1
<u>Carcass Characteristics:</u>			
Carcass weight lb.	479	468	470
USDA carcass grade	11.4	11.3	11.2
Fat thickness mm.	11.1	10.6	10.3
Ribeye area sq. in.	10.3	10.1	9.9
Marbling score	4.9	4.9	5.0
Conformation grade	13.1 ^a	12.3 ^b	11.9 ^c
Percent kidney, heart and pelvic fat	3.4	3.4	3.4
Dressing percent	60.4 ^a	59.3 ^b	59.1 ^b
Yield grade	2.41	2.40	2.43
Percent retail yield	50.41	50.46	50.37

a,b,c Means on the same line bearing different superscript letters differ significantly ($P < .05$).

gains and percent retail yield. Significant ($P < .05$) differences between feeder grade and carcass conformation and dressing percent in this study agree with those of Minish et al. (1967). Hoornbeek et al. (1962) reported heavier final weights were associated with higher dressing percent and carcass conformation. Corrick and Hobbs (1970) reported no significant ($P < .05$) differences in average daily gains between Good and Medium grade heifers, and ribeye area was significantly ($P < .05$) larger in Good grade heifers.

III. INITIAL SUBCUTANEOUS FAT

Initial fat thickness and initial condition grade were individually fitted in the model $Y_{ij} = \mu + g_i + w_j + e_{ijk}$. These data are presented in Table VII. Corresponding linear regression coefficients are given in Table VIII. From Table VII, the addition of initial condition grade to the model accounted for an additional 11.97 percent of the variation in average daily gain overall, while initial fat accounted for only 4.41 percent. Initial condition also explained an additional 10.36 percent of measured carcass fat thickness, 4.70 percent of yield grade and 3.85 percent of retail yield. Differences in initial fat explained 5.29, 2.35 and 1.74 percent of these variables, respectively. Except for carcass grade, percent kidney fat and days on feed, the changes in R^2 values resulting from the addition of initial condition were higher than changes in R^2 values from the addition of initial fat. This can be explained by considering the differences found between the initial and final statistics of fat and condition. The mean for initial fat was 3.37 mm. and the mean for final fat was 9.92 mm., an

TABLE VII

THE ADDITIONAL VARIATION IN SELECTED DEPENDENT VARIABLES EXPLAINED BY FITTING INITIAL SUBCUTANEOUS FAT THICKNESS AND INITIAL CONDITION GRADE, RESPECTIVELY, TO THE MODEL $Y_{ij} = \mu + g_i + w_j + e_{ijk}$

Variable	$R^2{}^a$	$R^2{}^b$	$R^2{}^c$	$\Delta R^2{}_1$	$\Delta R^2{}_2$
<u>Performance Measurements:</u>					
Average daily gain roughage	.0389	.0530	.0747	.0141	.0358
Average daily gain overall	.0177	.0618	.1374	.0441	.1197
Final weight	.4276	.4660	.5040	.0384	.0764
Final fat (Sonoray)	.0174	.0271	.0297	.0097	.0123
Final condition grade	.0390	.0482	.0895	.0092	.0505
Days on feed	.0888	.1094	.1047	.0206	.0159
<u>Carcass Characteristics:</u>					
Carcass grade	.0210	.0376	.0301	.0166	.0091
Carcass weight	.4529	.4831	.5011	.0302	.0482
Ribeye area	.0484	.0522	.0626	.0038	.0142
Carcass fat	.1258	.1787	.2294	.0529	.1036
Percent kidney fat	.0086	.0240	.0144	.0154	.0058
Marbling score	.0310	.0519	.0539	.0209	.0229
Conformation grade	.1608	.1630	.1691	.0022	.0083
Yield grade	.0874	.1109	.1344	.0235	.0470
Percent retail yield	.1275	.1449	.1660	.0174	.0385
Dressing percent	.1000	.1011	.1049	.0011	.0049

$${}^aY_{ijk} = \mu + g_i + w_j + e_{ijk}$$

${}^bY_{ijk} = \mu + g_i + w_j + f_i + e_{ijk}$; f_k = initial subcutaneous fat thickness of the i^{th} individual.

${}^cY_{ijk} = \mu + g_i + w_j + c_k + e_{ijk}$; c_k = initial condition grade of the i^{th} individual.

$${}_1\Delta R^2{}_1 = R^2{}^b - R^2{}^a$$

$${}_2\Delta R^2{}_2 = R^2{}^c - R^2{}^a$$

TABLE VIII

LINEAR REGRESSION COEFFICIENTS AFFECTING SELECTED VARIABLES
 RESULTING FROM FITTING INITIAL SUBCUTANEOUS FAT THICKNESS
 AND INITIAL CONDITION GRADE, RESPECTIVELY, TO THE

$$\text{MODEL } Y_{ij} = \mu + g_i + w_j + e_{ijk}$$

Variable	b_{XY}	
	Initial Subcutaneous Fat	Initial Condition Grade
<u>Performance Measurements:</u>		
Average daily gain roughage	-0.035	-0.076
Average daily gain overall	-0.052	-0.114
Final weight	-11.94	-22.61
Final fat (Sonoray)	0.13	0.20
Final condition grade	0.08	0.25
Days on feed	-2.11	-2.49
<u>Carcass Characteristics:</u>		
Carcass grade	0.16	0.16
Carcass weight	-6.94	-11.77
Ribeye area	-0.06	-0.14
Carcass fat	0.51	0.96
Percent kidney fat	0.06	0.04
Marbling score	0.14	0.20
Conformation grade	-0.05	0.12
Yield grade	0.06	0.11
Percent retail yield	-0.12	-0.24
Dressing percent	-0.06	0.16

increase of 6.35 mm. The means for initial condition grade and final condition grade were 8.5 and 11.2, respectively, an increase of only 2.7 grades. The standard deviation decreased from 1.32 to 0.92 grades between initial and final condition, respectively. In contrast, the standard deviation increased from 1.25 to 1.50 mm. between initial and final fat.

In all cases, the differences between the percent of additional variation due to initial fat and initial condition, respectively, were small and insignificant ($P > .25$). Further, neither initial fat nor initial condition added significantly ($P > .05$) to the percent of variation in dependent variables explained by the original model. For increases of one millimeter in initial fat and one grade increase in initial condition, overall average daily gain decreased by 0.052 and 0.114 pounds per day, respectively (Table VIII). Other b values with respect to differences between initial fat and initial condition and their magnitude included final weight, -11.94 and -22.61 pounds; days on feed, -2.11 and -2.49 days; carcass weight, -6.94 and -11.77 pounds; carcass grade, 0.16 and 0.16 grade; yield grade, 0.06 and 0.11; and, retail yield, -0.12 and -0.24 percent, respectively.

The gross simple correlation coefficient between initial fat and initial condition grade was 0.57, while the partial correlation coefficient (feeder grade and initial weight held constant) between the same two variables was 0.43. This indicates further the relationship between initial fat and initial condition grade. Simple correlations of feeder grade with initial fat and with initial condition were 0.41 and 0.76, respectively (Table IX). Correlations of type grade with feeder grade,

TABLE IX

SELECTED GROSS AND PARTIAL CORRELATION COEFFICIENTS OF FEEDER GRADE AND TYPE GRADE
WITH INITIAL SUBCUTANEOUS FAT THICKNESS AND INITIAL CONDITION GRADE

	Feeder Grade		Type Grade	
	Gross Correlation	Partial Correlation	Gross Correlation	Partial Correlation
Initial fat thickness	0.41	0.00	0.40	0.09
Initial condition grade	0.76	-0.00	0.72	0.14

initial fat and initial condition were 0.88, 0.40 and 0.72, respectively. With feeder grade and initial weight held constant, partial correlations of type grade with initial fat and initial condition were 0.09 and 0.14, respectively, indicating that initial fat and initial condition are inherent parts of feeder grade, in spite of the grader's supposed attempt to disregard these variables.

Simple correlation coefficients of live estimates with actual carcass fat thickness were 0.36 for initial fat and 0.40 for final sonorayed fat thickness. These values agree with results reported by Hedrick et al. (1962) and Brown et al. (1964), and closely approach those reported by Sumption et al. (1964) and Brackelsberg et al. (1967).

Correlation coefficients for both live animal estimates of fat thickness and actual carcass fat with yield grade and percent retail yield are presented in Table X. The correlations of carcass fat thickness with yield grade and estimated percent retail cuts of 0.73 and -0.74, respectively, are comparable to those reported by Allen et al. (1966), Henderson et al. (1966) and Abraham et al. (1967).

IV. ADDITIONAL VARIABLES SUBJECTED TO ANALYSIS

Feed Costs by Feeder Grade

The beef cattle feeder is always greatly concerned with feed costs as it represents the major portion of the total cost of the feeding operation. Another factor of importance is turnover, or how many times the feeder can fill and empty his lots in a given time period. This makes days on feed, as well as feed costs, important considerations in determining profits. Feed costs in this study were

TABLE X
CORRELATION COEFFICIENTS FOR YIELD GRADE AND FOR PERCENT RETAIL
YIELD WITH INITIAL SUBCUTANEOUS FAT THICKNESS, FINAL
SUBCUTANEOUS FAT THICKNESS, CARCASS FAT
THICKNESS AND RIBEYE AREA

	Yield Grade	Percent Retail Yield
Initial subcutaneous fat thickness	0.24	-0.24
Final subcutaneous fat thickness	0.21	-0.23
Carcass fat thickness	0.73	-0.74
Ribeye area	-0.64	0.59

calculated from costs of feedstuffs only. The summary of costs and gains by grade are presented in Table XI. In this experiment, Medium heifers made the cheapest gains on roughage and overall, and Good grade heifers finished in fewer days. Gains cost \$19.59 per hundredweight overall for the Choice grade, \$19.21 for Good grade heifers, and \$19.02 for Medium grade heifers, the largest difference being between Choice and Medium grades (\$0.57 per hundredweight gain overall). Good grade heifers averaged fewest days on feed (159.8), followed by Choice (161.5) and Medium (164.3), with a difference between Good and Medium grades of 4.5 days. Based on these data, feeder grade would not be the only factor on which a feeder should base his buying. If initial weights by grade were equal, and performance and carcass grade, yield grade and percent retail yield comparable between grades at slaughter, price spread between feeder grades at purchase should be a more important consideration.

Carcass Grade Percentages by Feeder Grade

Of the 180 heifers, 46.7 percent had carcass grades of Choice (which included one carcass that graded Low Prime), and 53.3 percent that graded Good. Of the Good grade carcasses, 39.6 percent graded High Good. Choice feeder heifers had 51.7 percent Choice carcasses, Good grade feeders had 50.0 percent Choice carcasses, and Medium grade heifers had 38.3 percent Choice carcasses. Overall, 67.8 percent of the heifers graded High Good-Low Choice or above.

Final Fat Thickness - 10 mm. and 8 mm.

One-half of the heifers in each feeder grade were removed when they reached an ultrasonically estimated fat thickness of 10 mm. and

TABLE XI
SUMMARY OF GAINS AND COSTS PER HUNDREDWEIGHT GAIN ON
ROUGHAGE AND OVERALL BY FEEDER GRADE

	Feeder Grade		
	Choice	Good	Medium
Number of animals	60	60	60
Average initial weight	522	481	457
Average weight-end of roughage	735	693	676
Average final weight	831	792	777
Average gain in weight-end of roughage	213	212	219
Average gain in weight-overall	309	311	320
Feed costs per cwt. gain-roughage	\$15.48	\$15.19	\$14.68
Feed costs per cwt. gain-overall	\$19.59	\$19.21	\$19.02
Average total days on feed	161.5	159.8	164.3

the other half were removed at 8 mm. Results of the analysis for fat level (10 mm. or 8 mm.) disregarding feeder grade are shown in Table XII. The most outstanding differences were in days on feed and the cost per hundredweight gain overall. These two factors are of utmost importance to the beef cattle feeder. It required ten days less time to finish the heifers to 8 mm. final fat thickness, and 85 cents less cost per hundredweight gain overall compared to the heifers removed at 10 mm. final fat thickness. Further breakdown of feeding costs leaves a question regarding the accuracy of the sample. Cost per hundredweight gain on the 110-day roughage phase for the 8 mm. heifers was \$14.97 compared to \$16.13 for the 10 mm. heifers, a difference of \$1.16 in favor of the 8 mm. fat level. Cost per hundredweight gain during the full-feed phase for the 8 mm. heifers was \$28.67 compared to \$25.55 for the 10 mm. heifers, a difference of \$3.12 in favor of the 10 mm. fat level. There were differences in days on feed during the fullfeed phase but not on the roughage phase. The net effect of the overall cost per hundredweight gain was in favor of the 8 mm. heifers at \$18.85 to \$19.70 for the 10 mm. heifers.

There were no differences in the initial measurements between the two fat levels, but significant ($P < .05$) differences were found in final fat, final condition grade, days on feed, carcass weight, percent kidney, heart and pelvic fat, conformation grade and dressing percent. This can be explained by the fact that the final fat was measured prior to slaughter and the significant differences were, for the most part, on variables which depend to a large extent on carcass fat measurements. Carcass fat was not significantly ($P > .05$) different

TABLE XII

UNADJUSTED MEANS AND COST FIGURES OF HEIFERS BY ULTRASONICALLY
ESTIMATED FINAL FAT THICKNESS OF 10 MM. AND 8 MM.

Variable	Means	
	10 mm.	8 mm.
<u>Initial Observations:</u>		
Number of animals	90	90
Initial weight lb.	484	490
Initial fat mm.	3.41	3.33
Initial condition grade	8.54	8.54
<u>Performance Measurements:</u>		
Roughage phase average daily gain lb.	1.92	1.98
Overall average daily gain lb.	1.92	1.95
Final weight lb.	806	794
Final fat mm.	10.38 ^a	9.07 ^b
Final condition grade	11.41 ^a	11.10 ^b
Days on feed	166.9 ^a	156.8 ^b
<u>Carcass Characteristics:</u>		
Carcass weight lb.	479 ^a	465 ^b
Carcass grade	11.13	11.48
Carcass fat mm.	10.98	10.39
Ribeye area sq. in.	10.2	9.9
Percent kidney fat	3.5 ^a	3.3 ^b
Marbling score	4.8	5.0 ^b
Conformation grade	12.7 ^a	12.1 ^b
Yield grade	2.44	2.39
Percent retail yield	50.34	50.49
Dressing percent	59.9 ^a	59.3 ^b
<u>Feed Costs:</u> ^c		
Cost per hundredweight gain-roughage	\$16.13	\$14.97
Cost per hundredweight gain-fullfeed	25.55	28.67
Cost per hundredweight gain-overall	19.70	18.85

^{a,b} Means on the same line bearing different superscript letters differ significantly ($P < .05$).

^c No analysis was made for significant differences in feed costs.

between the two fat levels (10.98 mm. and 10.39 mm. for the 10 mm. and 8 mm. levels, respectively). This indicates a better job could have been done in determining final fat thickness ultrasonically. The simple correlation between final estimated fat thickness and carcass fat thickness was 0.40. There were no significant ($P > .05$) differences in carcass grade, yield grade and percent retail yield. Based on the results of this study, it would appear to be more economical for the feeder to attempt to market his finished cattle with slightly less external fat cover and consequently, in a shorter period of time.

CHAPTER V

SUMMARY

The purpose of this experiment was to determine the effects of initial subcutaneous fat thickness, feeder grade and weight of 180 feeder heifers on their subsequent feedlot performance and carcass characteristics. Heifers were purchased at graded feeder calf sales in East Tennessee, and consisted of 150 Hereford, 29 Angus and one crossbred in the Choice, Good and Medium feeder grades.

Initial weight was found to have a small, but significant ($P < .05$) effect on roughage phase average daily gain. Initial weight had a very highly significant ($P < .001$) effect on final weight, carcass weight, yield grade and estimated percent retail yield.

Feeder grade had a highly significant ($P < .01$) effect on dressing percent, and a very highly significant ($P < .001$) effect on carcass conformation grade. No other significant ($P < .05$) differences were found between feeder grade with performance measurements or carcass quality and cutability characteristics. Simple correlations of feeder grade with roughage phase average daily gain, overall average daily gain, yield grade and percent retail yield were -0.06, -0.04, 0.14 and -0.17, respectively.

Initial subcutaneous fat thickness accounted for an additional 4.41 percent of the variation in overall average daily gain when initial fat was fitted to the original model. Initial fat was also

responsible for an additional 5.29 percent of the variation in carcass fat, 2.35 percent of the variation in yield grade, and 1.74 percent of the variation in retail yield. These percentages were small and non-significant ($P > .05$) in all cases. In comparison, fitting initial condition grade to the original model accounted for an additional 11.97 percent of the variation in overall average daily gain, 10.36 percent of the variation in carcass fat, 4.70 percent of the variation in yield grade, and 3.85 percent of the variation in estimated retail yield. The gross simple correlation between initial fat and initial condition grade was 0.57. The correlation between feeder grade and type grade was 0.88. Correlations were obtained for feeder grade with initial fat and initial condition grade of 0.41 and 0.76, respectively, and for type grade with initial fat and initial condition of 0.40 and 0.72, respectively. Partial correlation coefficients for type grade with initial fat and with initial condition were 0.09 and 0.14, respectively, indicating initial fat and initial condition are inseparable parts of feeder grade.

Heifers removed for slaughter at 8 mm. ultrasonically estimated fat thickness produced carcasses comparable to heifers removed at 10 mm. There were no significant ($P > .05$) differences between the two fat levels in carcass grade, yield grade and percent retail yield. The 8 mm. fat level heifers finished 10 days earlier than the 10 mm. level heifers, and cost per hundredweight gain overall was in favor of the 8 mm. level heifers by \$0.85.

Results of this experiment indicate that either of the three grades may be fed with equal success, and that price spreads between feeder grades of equal weight may be the most important consideration in purchasing feeder heifers.

LITERATURE CITED

LITERATURE CITED

- Abraham, H. C., Z. L. Carpenter, G. T. King and O. D. Butler. 1967. Determinants of beef carcass cutability. J. Ani. Sci., 26:892 (Abstr.).
- Allen, D. M., R. A. Merkel and W. T. Magee. 1966. Relationship of some linear carcass fat measurements to total physically separable fat and retail beef yield. J. Ani. Sci., 25:1279 (Abstr.).
- Anderson, J. M., T. W. High, Jr. and E. J. Chapman. 1964. The performance of feeder cattle of different weights, grades and sexes. University of Tennessee Agricultural Experiment Station Bulletin 381.
- Backus, W. R., J. W. Cole, C. B. Ramsey and C. S. Hobbs. 1967. Minimum fatness for efficient beef production. J. Ani. Sci., 26:209 (Abstr.).
- Brackelsberg, P. O., R. L. Willham and L. E. Walters. 1967. Probing beef cattle to predict carcass fatness. J. Ani. Sci., 26:713.
- Bradley, N. W., L. V. Cundiff, J. D. Kemp and T. R. Greathouse. 1966. Effects of sex and sire on performance and carcass traits of Hereford and Hereford-Red Poll calves. J. Ani. Sci., 25:783.
- Brinks, J. S., R. T. Clark and N. M. Kieffer. 1962. Relationship of performance and ultrasonic measurements with certain carcass traits. J. Ani. Sci. 21:664 (Abstr.).
- Brown, C. J., R. S. Temple, C. B. Ramsey and P. K. Lewis, Jr. 1964. Ultrasonics and carcass measurements of young bulls. J. Ani. Sci., 23: 847 (Abstr.).
- Brungardt, V. H. 1971. Efficiency and profit differences of Angus Charolais and Hereford cattle varying in size and growth. Pub. of the Dept. of Meat and Ani. Sci., University of Wisconsin, Madison.
- Brungardt, V. H. and R. W. Bray. 1963. Estimate of retail yield of the four major cuts in the beef carcass. J. Ani. Sci., 22:177.
- Cole, J. W., C. B. Ramsey and R. H. Epley. 1962. Simplified method for predicting pounds of lean in beef carcasses. J. Ani. Sci., 21:355.
- Corrick, J. A., Jr. and C. S. Hobbs. 1970. Feedlot performance of feeder heifers with average initial type grades of Good and Medium. Tenn. Farm and Home Science Progress Report Number 73:10.

- Crown, R. M. and R. A. Damon, Jr. 1960. The value of the 12th rib cut for measuring beef carcass yields and meat quality. J. Ani. Sci., 19:109.
- Davis, J. K., R. A. Long, R. L. Saffle, E. P. Warren and J. L. Carmon. 1964. Use of ultrasonics and visual appraisal to estimate total muscling in beef cattle. J. Ani. Sci., 23:638.
- Davis, J. K., R. S. Temple and W. C. McCormick. 1966. A comparison of ultrasonic estimates of ribeye area and fat thickness in cattle. J. Ani. Sci., 25:1087.
- Fitzhugh, H. A., Jr., G. T. King, F. A. Orts, Z. L. Carpenter and O. D. Butler. 1965. Methods of predicting the weight of boneless roast and steak meat from easily obtained beef carcass measurements. J. Ani. Sci., 24:168.
- Freund, J. E., P. E. Livermore and I. Miller. 1960. Manual of Experimental Statistics. Prentice-Hall, Inc., Englewood Cliffs.
- Gottsch, A. H., R. A. Merkel and D. L. Mackintosh. 1961. Relationship of muscle, fat, bone and some physical measurements to beef carcass cutability. J. Ani. Sci., 20:917 (Abstr.).
- Harrell, I. J. 1971. The effects of initial subcutaneous fat thickness and grade of feeder heifers upon subsequent feedlot performance, carcass grade and yield. Master's thesis. University of Tennessee.
- Harvey, W. R. 1968. Instructions for use of LSMLGP (Least-Squares and Maximum Likelihood General Purpose Program). Ohio State University.
- Hedrick, H. B., J. C. Miller, G. B. Thompson and R. R. Freitag. 1965. Factors affecting longissimus dorsi area and fat thickness of beef and relation between these measurements and retail yield. J. Ani. Sci., 24:333.
- Hedrick, H. B., J. C. Miller, G. B. Thompson and R. R. Freitag. 1964a. Indices of beef carcass cutout. J. Ani. Sci. 23:860 (Abstr.).
- Hedrick, H. B., J. C. Miller, G. B. Thompson, R. R. Freitag and W. E. Meyer. 1964b. Factors affecting ribeye area and fat thickness of beef. J. Ani. Sci., 23:860 (Abstr.).
- Hedrick, H. B., W. E. Meyer, M. A. Alexander, S. E. Zobrisky and H. O. Naumann. 1962. Estimation of ribeye area and fat thickness of beef cattle with ultrasonics. J. Ani. Sci. 21:363.
- Henderson, D. W., D. E. Goll and E. A. Kline. 1966. Relationships of muscling and finish measurements from three different groups of beef carcasses with carcass yield. J. Ani. Sci., 25:323.

- Hoornbeek, F. K., J. A. B. McArthur, R. Bogart and W. Kennick. 1962. Performance and carcass characteristics in beef cattle. J. Ani. Sci., 21:664 (Abstr.).
- Lewis, R. W., V. H. Brungardt and R. W. Bray. 1964. Estimating retail yield from the four major wholesale cuts in heifer carcasses. J. Ani. Sci., 23:861 (Abstr.).
- McReynolds, W. E. and V. H. Arthaud. 1970. Estimating fat depth and longissimus muscle area by use of ultrasonics in beef cattle. J. Ani. Sci., 30:503.
- Minish, G. L., H. W. Newland, H. E. Henderson and R. A. Merkel. 1967. Concentrate level and calf grade related to growth and carcass. J. Ani. Sci., 26:224 (Abstr.).
- Murphey, C. E., D. K. Hallett, W. E. Tyler and J. C. Pierce, Jr. 1960. Estimating yields of retail cuts from beef carcasses. J. Ani. Sci., 19:1240 (Abstr.).
- Nolan, J. C., Jr., R. A. Field, C. O. Schoonover and G. E. Nelms. 1965. Relation between carcass and 9-10-11th rib characteristics of bulls. J. Ani. Sci., 24:592 (Abstr.).
- Powell, W. E. and D. L. Huffman. 1968. An evaluation of quantitative estimates of beef carcass composition. J. Ani. Sci., 27:1554.
- Ramsey, C. B., J. W. Cole and C. S. Hobbs. 1962. Relation of beef carcass grades, proposed yield grades and fat thickness to separable lean, fat and bone. J. Ani. Sci., 21:193.
- Ramsey, C. B., R. S. Temple, R. L. Sliger and D. L. Huffman. 1965. Changes in beef muscle area and configuration during slaughter. J. Ani. Sci., 24:283 (Abstr.).
- Schoonover, C. O., V. A. Brungardt, J. W. Carpenter, J. J. Guenther, G. T. King, F. A. Orts, A. Z. Palmer, C. B. Ramsey, R. E. Rust and D. W. Zinn. 1967. Recommended guide for beef carcass evaluation and contests. American Meat Science Association, Chicago, Illinois.
- Stonaker, H. H., M. H. Hazaleus and S. S. Wheeler. 1952. Feedlot and carcass characteristics of individually fed compressed and conventional type Hereford steers. J. Ani. Sci., 11:17.
- Stouffer, J. R., M. V. Wallentine, G. H. Wellington and A. Drekmann. 1961. Development and application of ultrasonic methods for measuring fat thickness and ribeye area in cattle and hogs. J. Ani. Sci., 20: 759.

- Stuedemann, J. A., J. J. Guenther, S. A. Ewing and R. D. Morrison. 1967. Effect of nutritional level imposed from birth to eight months of age on subsequent growth and development patterns of full-fed beef calves. J. Ani. Sci., 26:225 (Abstr.).
- Sumption, L. J., L. A. Swiger, V. H. Arthaud and K. E. Gregory. 1964. Ultrasonic estimation of fatness of beef cattle. J. Ani. Sci., 23: 864 (Abstr.).
- Swiger, L. A., K. E. Gregory, L. J. Sumption and B. C. Breidenstein. 1964. The importance of measuring cut-out in cattle. J. Ani. Sci. 23:854 (Abstr.).
- Temple, R. S., C. B. Ramsey and T. B. Patterson. 1965. Errors in ultrasonic evaluation of beef cattle. J. Ani. Sci., 24:282 (Abstr.).
- Thackston, G. R., J. W. Cole, C. B. Ramsey and C. S. Hobbs. 1967. Comparison of three beef quantity prediction equations. J. Ani. Sci., 26:212 (Abstr.).

APPENDIXES

APPENDIX A

TABLE XIII

UNADJUSTED MEANS FOR SELECTED VARIABLES OF
HEIFERS BY FEEDER GRADE

Variable	Means		
	Choice	Good	Medium
<u>Initial Observations:</u>			
Number of animals	60	60	60
Weight lb.	522 ^a	481 ^b	458 ^c
Fat thickness (Sonoray) mm.	4.13 ^a	3.12 ^b	2.87 ^b
Condition grade	9.9 ^a	8.3 ^b	7.4 ^c
<u>Performance Measurements:</u>			
Roughage phase average daily gain lb.	1.94	1.92	1.98
Overall average daily gain lb.	1.92	1.94	1.94
Final weight lb.	831 ^a	792 ^b	777 ^b
Final fat thickness (Sonoray) mm.	9.98	9.62	9.57
Final condition grade	11.4 ^a	11.3 ^{a,b}	11.0 ^b
Days on feed	161.5	159.8	164.3
<u>Carcass Characteristics:</u>			
Carcass weight lb.	498 ^a	466 ^b	454 ^b
USDA carcass grade	11.5	11.3	11.2
Fat thickness mm.	11.58 ^a	10.55 ^b	9.92 ^b
Dressing percent	60.4 ^a	59.3 ^b	59.1 ^b
Yield grade	2.50	2.39	2.36
Percent retail yield	50.2 ^a	50.5 ^{a,b}	50.6 ^b

a,b,c Means on the same line bearing different superscript letters differ significantly ($P < .05$).

APPENDIX B

TABLE XIV

SIMPLE CORRELATION COEFFICIENTS AMONG SELECTED VARIABLES

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Feeder grade	1.00	.53	.41	.76	-.06	-.04	.33	.11	.19	-.07	.41	.28	.10	.29	.14	-.17
2. Initial weight		1.00	.35	.37	.13	.08	.65	.10	.13	-.26	.67	.33	.14	.17	.29	-.36
3. Initial fat			1.00	.57	-.10	-.19	.05	.15	.16	-.18	.10	.36	.17	.11	.24	-.24
4. Initial condition				1.00	-.16	-.26	.04	.16	.28	-.10	.17	.41	.13	.28	.24	-.25
5. Roughage ADG					1.00	.78	.47	.16	.19	-.25	.37	.13	.04	-.09	.04	-.08
6. Overall ADG						1.00	.64	.09	.14	-.10	.50	-.03	-.16	-.21	-.12	.07
7. Final weight							1.00	.13	.12	.22	.94	.08	-.13	.05	.04	-.13
8. Final fat								1.00	.64	-.03	.19	.40	.22	.15	.21	-.23
9. Final condition									1.00	-.14	.19	.41	.43	.19	.24	-.26
10. Days on feed										1.00	.26	-.31	-.26	.14	-.18	.16
11. Carcass weight											1.00	.16	-.08	.34	.08	-.18
12. Carcass fat												1.00	.31	.22	.73	-.74
13. Carcass grade													1.00	.17	.31	-.30
14. Dressing percent														1.00	.19	-.22
15. Yield grade															1.00	-.99
16. Percent retail yield																1.00

VITA

David Marcus Rowland was born in Knoxville, Tennessee on July 15, 1945. He attended elementary and high school in Jonesboro, Tennessee, graduating from Jonesboro High School in June, 1963. He entered East Tennessee State University in September, 1963, and transferred to The University of Tennessee in September, 1964. In January, 1967, he entered the military service, attaining the rank of First Lieutenant, Corps of Engineers, U.S. Army, before being honorably discharged in September, 1969. In September, 1969, he re-entered The University of Tennessee and received a Bachelor of Science degree in Animal Husbandry in August, 1970. In September, 1970, he entered the Graduate School of The University of Tennessee as a graduate Assistant, and received a Master of Science degree in Animal Husbandry in March, 1972. He is married to the former Sue Bowman of Johnson City, Tennessee.