

THE SORTING OF BEEF CATTLE BY HIP HEIGHT
AND SUBCUTANEOUS FAT DEPTH

by

Blake J. Flanders

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S. E. Brent

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INTRODUCTION

Feedlot operators feed cattle from diverse genetic and environmental backgrounds. The economic incentive to finish cattle to a Choice grade endpoint results in within-pen variability and increases cost of beef cattle production. First, beef cattle placed on feed have different levels of subcutaneous fat thickness. As intramuscular fat is the last fat deposited, some cattle may be overfattened in order for all cattle to reach the necessary Choice grade endpoint. The same problem occurs when cattle with a drastic difference in hip height are in the same pen and marketed together. Differences in hip height can be attributed to variation in age or biological type. The latter presents a problem to the feedlot operator as small framed cattle mature and thus deposit intramuscular fat at an earlier date compared to large framed, later maturing cattle. An added advantage of feeding cattle of similar beginning hip height and fat thickness could be increased consumer demand. Surveys have shown many consumers prefer a leaner product due to the adverse effects of fat consumption on their health. The early sorting of the cattle could prevent overfattened beef cattle from being placed on the market. Because consumption patterns of consumers have reflected a rejection of any food which contributes an unnecessary amount of fat to their diet, there is an obvious need for a supply of lean beef.

REVIEW OF LITERATURE

Length of Feeding

Length of feeding period affects qualitative and quantitative characteristics of steer carcasses. Carcass weight, fat trim, internal fat, dressing percentage, marbling score, and rib eye area all increase significantly as feeding period increases (Little et al., 1967).

Moody et al., (1970) assigned animals to feeding periods of 28, 56, 84 and 112 days and found: a) marbling increased as time on feed increased but with no significant difference between 84 and 112 days; b) rib eye area increased up to the 56th day; c) internal and external fat increased between 56 and 84 days, but not from 84 to 112 days.

In these studies, quality grades increased as time on feed increased (Leander et al., 1978; Tatum et al., 1980) and yield grade components increased with increases in both diet energy density and time on feed (Harrison et al., 1978; Burson et al., 1980). Similar results with increasing time on feed have been reported for carcass characteristics (Moody et al., 1970; Shinn et al., 1976; Dinito and Cross, 1978; Leander et al., 1978; Schroeder et al., 1980).

However, longer feeding (more than 195 days on full feed) did not improve quality grades significantly in a study by Stringer et al., (1968). Extended feeding, from 139 to 251 days increased fat percentage in the carcass and decreased percentages of retail cuts. However, Zinn and coworkers (1970) reported marbling and carcass grade increased significantly up to 240 days on feed. They determined intramuscular fat deposition was not a continuous process, but occurred "in spurts" at 60- to 90-day intervals.

Feeding length interacts with type of diet to influence carcass composition. Aberle et al., (1981) found cattle fed a low energy diet for longer periods (230 days) had less carcass fat, smaller rib eye area, lower marbling score, higher cutability, and lower quality grade than cattle fed a higher energy diet for 210 days.

The variability in these results confirm the fact that days on feed is only one determinant of carcass quality and feeding performance. To decide how many days on feed are needed, one needs information on the position of each animal on its growth curve. Reliable frame size, condition, and muscling estimation should help the feeder know how much time is needed, and may be the most important component in that decision.

Breeding

The differences between breeds are economically important in the beef production system. The introduction of new breeds for beef production has widened the range of performance characteristics from which to choose (Cundiff et al. 1981).

Breed type has an influence on growth rate of various carcass tissues (Fortin et al., 1981); growth rate of fat relative to muscle was greater in Angus than Holsteins when both were fed high energy diets.

Breed type influences average daily gain (Suess et al., 1966; Thrift et al., 1970; Bidner et al., 1976; Lipsey et al., 1978) and feed efficiency (Bradley et al., 1966; Bidner et al., 1976; Lipsey et al., 1978). Conflicting results were found by Barber and coworkers (1981) who reported feed conversion was not statistically different between Angus and Charolais. Studies with Charolais X Angus crossbred steers showed they had a higher average daily gain and feed conversion than straight bred Angus (O'May et al., 1979). Moreover, Marion and coworkers (1980) reported higher average daily gains for large type cattle, crossbreeds of Simmental-sired cattle with Maine Anjou, Hereford, Angus, and Charolais dams, than for Angus and Hereford crossbreed cattle. However, no significant differences in average daily feedlot gains of different breeds were found by Dikeman and Crouse (1975). Simmental X Angus tended to gain faster than Limousin X Angus and Hereford X Angus, but differences were not statistically significant. These results agree with Maino and coworkers (1981) who observed an absence of gain advantage for larger biological type cattle.

Skelley and coworkers (1980) found crossbred steers of exotic breeding had significantly heavier weights at slaughter than crossbred steers of English breeding. Conversely, Olson and coworkers (1978) reported very small differences in slaughter weights between straight breeds and crossbred steers. O'Mary et al., (1979) found steers of Charolais X Angus crosses were heavier at slaughter than Angus steers. Young et al., (1978) studied several different breeds, including Simmental, Charolais, and Hereford X Angus, and found very small differences in weights when the data were adjusted to a 468-day slaughter age. Differences due to sire in hot (Bidner et al., 1976) and cold carcass weight have been reported (Thrift et al., 1970). Bidner and coworkers (1976) reported the percent Brahman had both a negative linear and quadratic effect on hot carcass weight. Thrift and coworkers (1970) found calves sired by a high-gaining sire gained faster and had heavier slaughter weights than calves sired by a low-gaining sire. Quality grade and yield grade are also affected by breed type. Bidner and coworkers (1976) observed quality grade and yield grade were high for Angus straightbred calves, intermediate for Angus X Brahman crossbreeds and low for straightbred Brahman calves. Marion and others (1980) in a study of two biological types found no quality grade difference between British and continental-type cattle. These researchers noted the large cattle (Simmental-sired calves out of Maine-Anjou X Hereford, Maine-Anjou X Angus and Chianina X Angus dams) had lower yield grade scores than British cattle (Angus X Hereford). Sire effects on cutability have also been reported by Wilson et al., (1969). However, Adams et al., (1981) found sire within a breed had no effect on factors associated with yield or quality grade, and concluded it is difficult to obtain cattle within a breed which are distinctly different in carcass traits if they are managed and fed alike.

Fat distribution also affected by breed. Koch and coworkers (1976) found exotic breed crosses (Charolais, Simmental, and Limousin) had less external fat at slaughter (2 to 6 mm less) than British breed crosses (Hereford, Angus, Jersey, and South Devon). Charles and Johnson (1976) reported breed differences in distribution of fat between the subcutaneous and internal depots.

Hereford carcasses had more subcutaneous fat and less kidney and pelvic fat than those from Angus, Friesian, or Charolais crossbreeds. Moreover, subcutaneous fat increased more with increasing carcass weight in Hereford and Angus than in Charolais crosses (Charles and Johnson, 1976). Berber and coworkers (1981) observed greater fat deposition in Angus than in Charolais carcasses. Cole and coworkers (1963) showed Angus carcasses had more intramuscular fat than Hereford, Brahman or Holstein; but Jersey carcasses had the greatest percent kidney, pelvic and heart fat of all breeds studied. These researchers also observed British breeds had more subcutaneous fat than Zebu and dairy cattle, therefore, they concluded breed influenced the relationships between external and internal fat deposition.

Intramuscular fat (marbling) also appears to be affected by breeding. Cundiff et al., (1981) observed significant differences in marbling between breed groups of equal ages. They studied calves from Hereford, Angus, Charolais, Jersey, Limousin, Simmental, South Devon, Red Poll, Brown Swiss, Gelbvich, Maine-Anjou, Chianina, Tarentaise, Pinzgauer, Sahiwal, and Brahman sires bred to Hereford and Angus dams. Jersey, Red Poll, Hereford-Angus and South Devon crosses had the most marbling (Small⁺ and above), whereas Chianina, Limousin, Brahman, Gelbvich, Sahiwal and Simmental crosses had the least amount of marbling in the ribeye (Small⁻ and below). Differences in marbling between breed groups were also seen by Koch and coworkers (1976) after mating Hereford and Angus cows to Hereford, Angus, Jersey, South Devon, Limousin, Charolais, and Simmental sires. Marbling scores were significantly higher for Jersey and lower for Limousin crosses than for other breed crosses. Also, Skelley et al., (1980) reported marbling differences between breed groups when comparing Hereford X Angus, Charolais X Angus, Simmental X Angus and Holstein X Angus crossbred steers. Carcasses from Holstein X Angus steers possessed more marbling than those from the other three groups. Conversely, no breed differences in longissimus muscle fat content (measured by analysis) were reported by Barber and coworkers (1981) in a study utilizing Angus and Charolais steers.

In summary, differences due to breeding exist in the palatability characteristics of meat. Production of beef can be improved by the use of crossbreeding combinations which increase rate of gain and total amount of lean meat. Breeds and their characteristics are as follows: Angus purebreds have higher quality grades, a greater abundance of marbling, and consistently greater amounts of kidney, pelvic, and heart fat than Hereford straightbreds (Cole et al., 1963; Ramsey et al., 1963; Glimp et al., 1971).

Herefords gain at a faster rate (Glimp et al., 1971), have higher feed efficiency, and greater loin eye size than Angus steers (Cole et al., 1963).

Exotic breeds (Charolais, Limousin, and Simmental crossbreeds), compared with Hereford and Angus crossbreeds are faster gaining (Smith et al., 1976b), and possess less subcutaneous and trimmable fat, lower numerical yield grades, lower quality grades and larger ribeyes (Adams et al., 1977; Maino et al., 1981).

Brahman steers are slower gaining, have lighter carcass weights, and higher quality grades than Brahman X British crosses (Cole et al., 1963).

Jersey cattle, are smaller with a slower growth rate (Smith et al., 1976b); possess a greater amount of subcutaneous fat (Young et al., 1978), a higher percentage of kidney, pelvic, and heart fat (Koch et al., 1976; Young et al., 1978), smaller loin eyes (Koch et al., 1976; Young et al., 1978); and higher quality grades (Young et al., 1978) when compared to British breeds.

When compared with British breeds, carcasses from Holstein cattle have lower quality grades, less marbling, and a smaller degree of fat cover (Cole et al., 1963), a lower percentage of kidney, pelvic and heart fat, and a higher cutability (Young et al., 1978).

Ultrasound

Developments in ultrasonics have made possible the estimation of subcutaneous fat thickness and longissimus muscle area in live animals. The ultrasonic instrument utilizes a portable head

which contains a number of transducers. After a medium of mineral oil is applied, the transducer head is placed on the animal and a dynamic picture is presented on an oscilloscopic screen. The picture may be recorded on a video cassette recorder, and the longissimus muscle area traced later. Calipers, adjusted by the skilled technician, are utilized to measure subcutaneous fat thickness during the ultrasonic scanning of the animal.

Extensive research has been conducted evaluating the accuracy of ultrasonic backfat and loin eye measurements in swine (Stouffer et al., 1961; Fortin et al., 1981; Alliston et al., 1982). Stouffer and coworkers (1961) evaluated forty-two hogs using a Reflectoscope. Fifteen to twenty readings were made at nine sites approximately over the 12th rib at one inch intervals. A scalpel was then used to make small cuts in the skin at each site so the carcass could be broken in the same place for comparison with carcass measurements. Correlation coefficients between repeated ultrasonic measurements and physical measurements at slaughter were 0.95 for fat thickness and 0.84 for rib-eye area. Alliston and coworkers (1982) took ultrasonic measurements of 39 Large White males one week prior to slaughter. In comparing three machines they found the Danscanner developed by the National Institute of Animal Science and the Institute of Bio-Medical Engineering in Denmark gave a more precise prediction of fat depth than the Sanogram developed by J. R. Stouffer. The Scanogram, however, was more precise for the prediction of longissimus muscle area.

Temple et al. (1956) indicated that ultrasonic measurements were readily obtained in live cattle. Stouffer et al. (1961) measured 16 steers using a Reflectoscope. Correlation coefficients between ultrasonic measurements of fat thickness and rib-eye area and physical measurements at slaughter were .54 for fat thickness and .85 for rib-eye area.

The beef business is increasingly "consumer driven." The housewife wants a lean product. The hotel-restaurant institutional trade wants a product, with dependable quality and accurate portion control. That translates into packers desiring a high degree of uniformity within each pen of cattle. Several packers are paying a premium for "specification" cattle, where carcass weights

yield grades and quality grades are agreed to, perhaps even before cattle are placed on feed. For a feeder to be successful in this arena, technology needs to be implemented that will allow sorting feeder cattle into groups that will meet specifications at slaughter. Assessing growth potential through frame measurements and ultrasonic estimates of condition and muscling may be viable techniques for reducing within-pen variability and identifying cattle that will meet packer specifications.

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EXPERIMENTAL PROCEDURE

This experiment was conducted at Kearney County Feeders, Lakin, Kansas, using six hundred and six steers of diverse biological type.

Cattle were weighed and sorted based on hip height and 12th rib fat depth. The first two pens had beginning backfat measurements of $\leq .4$ mm and hip height of $<47''$ (Pen 1, n=68) and $\geq 47''$ (Pen 2, n=113). The next two pens had backfat measurements of $\geq .5$ mm and hip height of $<47''$ (Pen 3, n=66) and $\geq 47''$ (Pen 4, n=89). A randomly selected group of steers were assigned as controls (Pen 5, n=155).

The initial 12th rib fat depth was measured by experienced technicians using a DX210¹ real time ultrasound machine. The machine's internal display caliper system was used for this measurement. In addition, rib eye area was also ultrasonically determined by recording the image on a video cassette recorder, and later playing back the image on a calibrated video screen and measuring the ribeye area with a planimeter.

Steers were fed ad libitum a ration consisting of 4% alfalfa, 14.2% corn silage, 36.8% flaked milo, 36.8% flaked corn, 2.5% fat, 5.7% liquid supplement (as-fed).

Pen average daily feed consumption was monitored during the feeding period, allowing average daily feedlot gain and feed efficiency to be computed on a pen basis. Cost of gain included processing costs of \$4.42/hd and veterinarian costs of \$1.25/hd. The remainder was feed expense.

Steers were marketed when they subjectively reached a low-choice endpoint. Hot carcass weights were collected at slaughter. Carcass fat depth, marbling score, and rib eye area were measured following an overnight chilling. Yield grades were calculated assuming 2% kidney, heart, and pelvic fat for all carcasses. Initial backfat, weight, hip height, and rib eye area pen standard errors and least square means were calculated (SAS, 1982) and were compared to final standard errors and least square means of carcass weight, twelfth rib fat depth, marbling score, rib eye area and yield grade.

¹Corometrics Medical Systems, Inc., 61 Barnes Park Road North, P. O. Box 333, Wallingford, CT 06492-0333.

RESULTS AND DISCUSSION

This trial was conducted to evaluate the performance and carcass traits of steers sorted by hip height and backfat versus unsorted steers. However, upon visual observation following pen assignment, the steers allotted to the unsorted or control pens showed greater Brahman characteristics than the four sorted treatment pens.

The four treatment pens will be referred to by their numerical labels in this discussion, and the Control pen referred to as pen 5. The initial measurements and their standard errors are shown in Table 1.

Feedlot performance data are shown in Table 2. Ending weights were live weights at the yard after 4% pencil shrink. Average daily gain and cost of gain were taken from feedyard close-out sheets. Because cattle were not fed individually, no statistics were performed on the data. Pen 1 ($\leq .4$ mm backfat and <47 " high height) had lower average daily feedlot gain (2.51 lbs/day) than all other groups. This is consistent with Marion (1980) and Smith et al. (1976), who noted cattle of a large biological type were faster gaining than small earlier maturing cattle. However, pen 3, which also contained cattle < 47 inches at the hip, was no different in average daily feedlot gain (2.74 lbs/day) than other pens. This agrees with Dikeman and Crouse (1975) and Maino et al. (1981), who observed average daily gain was indifferent between cattle of different biological types.

Slaughter weights were higher for pen 2 (1161 lbs) when compared to pen 1 (1099 lbs). Skelley (1980), also found slaughter weights significantly increased for larger, exotic type cattle when compared to cattle of smaller biological type. However, Olson (1978), and Young (1978) disagree, for they noted cattle slaughter weights remained consistent between cattle of diverse biological type. Pen three and Pen four's results were incomparable as each pen's feeding period differed in length of days.

Carcass data are shown in Table 3. Marbling scores (Pen 1, Sm¹⁷) (Pen 2, Sl⁹⁷) (Pen 3, Sm⁰) (Pen 4, Sm⁰) across pens were very similar. Previous research conducted by Marion (1980) found quality grades similar between cattle of diverse biological type. Conversely, Adams (1977) and Maino (1981) noted a decrease in quality grades for cattle of larger biological type. In the present

experiment, both pens of cattle with starting external fat estimates of $\leq .4$ mm were fed 131 days, while the two pens with $\geq .5$ mm external fat required 102 and 110 days. Since there were so little differences between pens in carcass quality and yield grades, the subjective estimation of days required to reach low Choice appeared quite accurate. Expressed another way, if the $\geq .5$ mm cattle had been fed 131 days, their advantage in cost of gain would have probably disappeared.

Yield grades, although slightly lower for the control pen (2.7) were also similar across all four pens (Pen 1, 3.0; Pen 2, 2.9; Pen 3, 3.2; Pen 4, 3.1). This differs from Maino (1981), Adams (1977), and Marion (1980), who reported decreased yield grades for large type cattle when compared to cattle of smaller type.

The smaller framed cattle had smaller loin eye areas (Pen 1, 12.0 in²; Pen 3, 11.8 in²) versus the larger frame pens (Pen 2, 12.6 in²; Pen 4, 12.4 in²) and the control pen (Pen 5, 12.6 in²). This is in agreement with Adams (1977), Maino (1981), Koch et al., (1976) and Young et al., (1978) for all reported smaller loin eye areas in cattle of small biological type versus large type cattle.

When comparing final backfat measurements (Table 3) between the cattle with similar initial backfat measurements we found the large frame cattle deposited less subcutaneous fat (Pen 2, 11.98 mm) than small framed cattle (Pen 3, 15.7 mm). This agreed with previous research by Cole (1963), Adams (1977), Maino (1981), Koch et al. (1976), and Young et al. (1978), who also noted an increase in fat deposition in small type cattle versus cattle of large biological type.

Standard errors in the control pen were numerically less than those for the treatment pens for marbling score and hot carcass weight. A possible explanation of these results may be the increased amount of Brahman influence visually observed within the control pen at the beginning of the trial.

Most correlations for carcass and production traits were low and insignificant (Table 4). However, a significant positive correlation for hot carcass weight with initial hip height was observed. This is in general agreement with Skelley et al. (1980), who observed cattle of larger biological type had significantly heavier weights at slaughter. Olson and coworkers (1978), however, reported very small differences in slaughter weights between straightbreed and crossbreed steers.

A negative correlation for initial backfat with days on feed was found. This agrees with Brethour (1989) who found backfat increased exponentially, not linearly. Cattle in the present trial were slaughtered at similar compositioned end points, an exponential increase in backfat during the feeding period should definitely decrease the days on feed of cattle with greater amounts of initial subcutaneous backfat.

A positive correlation for yield grade with with final fat depth was observed. As USDA yield grades are calculated, 12th rib fat depth is the principal component of the yield grade equation.

In conclusion, sorting beef cattle by hip height and fat depth at the beginning of the feeding trial seems to be a viable method for predicting carcass traits as well as days on feed. This technology should enable the sorting of cattle into outcome groups resulting in lower costs of gain and increased feedlot performance. Continued research should perfect the precision of projecting carcass merit; however, the procedure appears sufficiently developed for profitable application at this time.

Table 1. Means for Performance Traits by Treatment

	Cost per cwt gain	Selling price \$/cwt	Average mkt price c/wt	Beginning weight, lb	Ending weight, lb	Avg daily feedlot gain, lb	Days on feed
Pen 1	\$54.87	\$71.00	65.00	770	1099	2.51	131
Pen 2	52.00	71.00	65.00	808	1161	2.69	131
Pen 3	47.01	67.00	62.48	781	1060	2.74	102
Pen 4	47.75	68.00	62.48	826	1132	2.78	110
Pen 5	53.84	68.50	62.48	821	1099	2.53	110

Table 2. Means and Standard Errors for Carcass Traits

Pen	12th rib fat depth, mm	Hot carcass weight, lb	Loin eye area, in ²	Yield grades	Marbling score ^a
1	13.2 ± .51	713 ± 6.4	12.0 ± .12	3.0 ± .06	317 ± 6.3
2	11.9 ± .51	750 ± 5.6	12.6 ± .14	2.9 ± .07	297 ± 7.1
3	15.7 ± .51	675 ± 5.3	11.7 ± .07	3.2 ± .07	309 ± 5.4
4	13.7 ± .51	736 ± 5.4	12.4 ± .07	3.1 ± .07	300 ± 4.7
5	11.4 ± .51	697 ± 4.7	12.6 ± .06	2.7 ± .06	300 ± 4.6

^a300 = Sm⁰ marbling score; 310 = Sm¹⁰ marbling score.

Table 3. Means and Standard Errors for Initial Hip Height, Backfat, Weight, and Loin Eye Area

	Hip height, in	Backfat, mm	Live weight, lb	Loin eye area, in ²
Pen 1	45.4 ± 1.3	.38 ± .005	770 ± 7.5	8.6 ± .14
Pen 2	48.0 ± 0.8	.38 ± .005	808 ± 4.5	8.6 ± .13
Pen 3	45.4 ± 1.3	.58 ± .011	781 ± 7.4	8.1 ± .22
Pen 4	48.0 ± 0.9	.56 ± .105	826 ± 5.4	8.6 ± .09

Table 4. Simple Correlations For Production and Carcass Traits.

	Hip height	Initial backfat	Loin eye area 1	Hot carcass weight	12th rib fat depth at slaughter	Marbling	Loin eye area 2	Yield grade	Days on feed
Initial hip height	1.00000	-0.03813	0.10821	0.44845	-0.06502	-0.08329	0.04827	-0.01193	0.14681
Initial backfat	-0.03813	1.00000	0.00814	-0.18320	0.3241 ^a	0.2062 ^a	0.4643 ^a	0.8565 ^a	0.0253 ^a
Loin Eye area 1	0.10821	0.00814	1.00000	0.12479	-0.04504	-0.00463	0.10621	-0.12812	0.11575
Hot carcass weight	0.44845	-0.18320	0.12479	1.00000	0.5973 ^a	0.9567 ^a	0.2117 ^a	0.1314 ^a	0.1732 ^a
12th rib fat depth	-0.06502	0.3241 ^a	-0.04504	0.09106	1.00000	-0.05933	0.02372	0.28407	0.35047
Marbling	-0.08329	-0.04716	-0.00463	-0.05933	0.0770 ^a	1.00000	0.6474 ^a	0.0001 ^a	0.0001 ^a
Loin Eye Area 2	0.04827	-0.04790	0.10621	0.09106	0.0000 ^a	0.01856	-0.04123	0.71475	-0.13539
Yield Grade	-0.01193	0.10060	-0.12812	0.0770 ^a	0.0000 ^a	0.7191 ^a	0.4266 ^a	0.0001 ^a	0.0084 ^a
Days on Feed	0.14681	-0.76250	0.11575	0.35047	-0.13539	1.00000	-0.01581	0.01778	0.06147
	0.0253 ^a	0.0001 ^a	0.1732 ^a	0.0001 ^a	0.0084 ^a	0.2331 ^a	0.7605 ^a	0.7319 ^a	0.2331 ^a
							1.00000	-0.19338	-0.04242
							0.0000 ^a	0.0002 ^a	0.4133 ^a
							0.0000 ^a	0.0000 ^a	0.00329
							0.0002 ^a	0.0000 ^a	0.9494 ^a
							-0.04242	0.00329	1.00000
							0.4133 ^a	0.9494 ^a	0.0000 ^a

^aProbability.

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THE SORTING OF BEEF CATTLE BY HIP HEIGHT

AND SUBCUTANEOUS FAT DEPTH

by

Blake J. Flanders

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ABSTRACT

This study was designed to evaluate the variance in performance and carcass traits of steers sorted by hip height and backfat versus unsorted steers differing in these parameters.

Six hundred and six steers of diverse biological type were weighed and sorted based on hip height and 12 rib fat depth. The first two pens had beginning backfat measurements of ≤ 4 mm and hip height of < 47 " (Pen 1) and ≥ 47 " (Pen 2). The next two pens had backfat measurements of ≥ 5 mm and hip height of < 47 " (Pen 3) and ≥ 47 " (Pen 4). A randomly selected group of steers were assigned as a control pen. Steers were slaughtered when they subjectively reached a low-choice endpoint.

Initial variabilities between treatment pens for hip height backfat weight and loin eye area were not statistically different ($P < .05$).

The data suggest a trend for steers in pen one (≤ 4 mm backfat and < 47 " hip height) have a lower average daily feedlot gain (2.51 lbs/day) than the remaining pens.

Slaughter weights were greater for steers in pen 2 (≤ 4 mm backfat, ≥ 47 ") reaching a weight of 1161 lbs than pen 3 (≥ 5 mm backfat, ≤ 47 ") which averaged 1060 lbs when slaughtered.

Marbling scores were similar across all pens, while yield grades were slightly lower for the control pen (2.7) when compared with the treatment pens (2.9-3.2).

Smaller framed cattle had smaller loin eye measurements versus the large framed and control pens.

Large frame cattle deposited less subcutaneous fat (Pen 2 - 11.8 mm) than small framed cattle (Pen 3 - 15.5 mm).