CARCASS CHARACTERISTICS OF COMPREST AND CONVENTIONAL TYPE BEEF CATTLE

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INTRODUCTION

During the first part of this century, a gradual change took place in the slaughter cattle market. The large, well-matured animal, producing large-sized cuts of meat, slowly gave way to a smaller, earlier maturing animal with smaller cuts of meat. In the 1940's, this general trend was accelerated by the appearance of a new type of beef animal on the market and in the showring. It was a short-legged, compact bodied animal referred to as comprest. The purpose of this animal was to produce a smaller, well proportioned carcass which would have as much finish as older animals, but have smaller cuts of meat.

An article written in the Breeder's Gazette by Forbes in 1946 discussed the controversy among cattlemen over the relative merits of the comprest conformation type in Herefords. He described the comprest Hereford as being "...extremely low set on ideal underpinning, with smooth, bulging quarters and deep wide middles to match, with short, thick necks and beautiful heads..." Forbes expressed the opinion, supposedly shared by many cattlemen and packers at that time, that comprest cattle lacked enough scale for profit on grass and in the feed lot. It was also thought that comprest type beef cattle did not have the ability to withstand the rigors of the range.

The production of compress type beef animals spread over many parts of the country; partly as a result of showring honors and partly as a result of the belief that the compress type animals were what the packer and meat retailer needed.

Very few actual facts about the performance of the compress animal were known, other than the obvious difference in size and weight. Nevertheless, much discussion arose over the relative merits of the compress and non-compress type of conformation. Several experiments were initiated to study the compress type animal, but only a few actually involved a comparison between animals with the compress genotype and non-compress segregates.

It was the purpose of this study to present some evidence as to the carcass performance of young compress type animals. Three groups of these animals were compared with closely related non-compress segregates of similar age and under the same type of management. Pre-weaning and feed-lot performance data were obtained for both types of calves as supporting evidence to their final evaluation in the carcass.

REVIEW OF LITERATURE

In a three year study-sponsored jointly by the Colorado Experiment Station, the American Hereford Association and Fort Lewis A & M College-Stonaker et al. (1952) compared the feed lot and carcass characteristics of the conventional type Hereford with the comprest type. Twenty four weanling steer calves produced by comprest cows and bulls, and 63 weanling steer calves out of conventional type parents were fed until each calf reached a live grade of low choice.

Within any one year, no overlap in the height at withers nor in the length of cannon bone was found in the live slaughter measurements of the two types. The conventional type calves had significantly greater weaning weights than the comprest type. The slaughter weights and the daily gain figures of the conventional type steers were significantly greater than those from the comprest type. The comprest type steers required about a week less time to reach low choice.

The average dressing percent of the conventional type steers was one percent greater than the dressing percent of the comprest type steers. Average carcass weight of the conventional steers was also significantly greater than that of the comprest type. All of the wholesale cuts of the comprest steers (from one side) were consistently lighter than those from the conventional steers. The type differences were greatly reduced when these weights were converted to a percentage of side basis; and the ribs and chucks were the only cuts which showed a significant difference between types. Loin eye areas were significantly greater in the conventional type steers. Physical separation of the 9-10-11 rib cuts into fat, lean and bone yielded an almost identical percentage composition for the two types of steers.

Schliecher _et al._ (1950) reported on the differences in feed lot and carcass characteristics of individually fed small and conventional type steers, using data from the same animals described by Safley _et al._ (1950). The weights and gains of the small type steers were about 80 percent of those of the conventional type steers; the small type required about 95 percent as much time to reach high good grade. The feed consumption and rate of gain per day of the small type steers were about 95 percent as large as for the conventional type steers. Carcass measurements indicated that, at the points measured, the small type animals were 91-94 percent as large as the conventional type.

Actual weights of the wholesale cuts (from one side) were significantly lighter in the small type carcasses. However, differences between types in weights of wholesale cuts largely disappeared when weights were converted to a percentage of carcass. The average percentages of rib and chuck in the conventional type carcasses were significantly larger, and the percentages of brisket and flank were significantly smaller.

The amount of fat physically separated from the rib cut was consistently greater in the small type carcasses, but values for lean and bone were inconsistent. Conventional type steers had a .78 percent advantage in dressing percentage and a 5.68 square inch larger loin eye area than the small type steers. From the results of the experiment, the authors state that "the indications are that since the small type produces lighter cuts of equal finish and the carcasses are attractive to the eye, they should appear popular with the packer."

Safley _et_ _al_. (1950) examined the differences in body and carcass measurements between small and conventional type steers that had been individually fed over a two year period at the Colorado Station. Experimental material included: 18 small type steer calves sired by two small type bulls, and 39 conventional type steer calves sired by two small type bulls and five conventional type bulls. A type classification was given to each steer on the initial weigh day of the feeding trial. Weights and 20 linear body measurements were taken at the beginning of the feeding period and at 28 day intervals thereafter. Each steer was slaughtered when he reached a grade of high good to low choice. Twelve carcass measurements and two carcass cut-out measurements were taken at this time.

The conventional type steers were larger at all points measured. However, in relation to wither height, the small type steers averaged slightly wider and deeper in the body and slightly larger in the round. The authors suggested that a 20.1 cm. (7.9 in.) length of cannon bone; a 48.5 cm. (19.1 in.) height of chest floor; a 107.3 cm. (42.3 in.) hip height; and a 101.8 cm. (40.1 in.) wither height be used as guides in classifying small type, 12 months old Hereford steers. Length of cannon bone was the most efficient measurement for differentiating the two types, with height of chest floor being the next most efficient measurement.

An early investigation into the effect of conformation on carcass characteristics was reported by Black et al. (1938). Fifty animals of beef, dual-purpose and dairy breeding, weighting 900 $\pm$ 20 pounds, were slaughtered at the Beltsville Station. Body measurements were taken just prior to slaughter, and then correlated with various carcass characteristics. The authors concluded that when weight was held constant, the steer with less wither height, shorter legs and less depth of body was higher in efficiency of food utilization, had more fat, more edible meat and less bone than the steer with more wither height, longer legs and more depth of body. Body length showed a lower correlation with the production and carcass characteristics. Width of shoulder and width of chest were positively associated with all of the factors studied.

Willey et al. (1951), of the Texas Station, summarized data from Hereford calves of average feeder grade and classified as "regular" and "comprest". The seven regular calves were out of regular type cows and bulls; and the seven comprest calves were out of regular type cows and comprest bulls. Regular type calves were described as being "taller at the shoulders, longer of body, greater of depth of chest, and higher at the chest floor than the comprest calves." Following a preliminary period of 42 days on feed, both groups of calves were fed 285 days. The calves were fed to promote growth during the first 112 days of the feeding period. A fattening ration was fed during the remaining time in the feed lot. The calves were group fed the first 145 days of the test and then finished individually.

The regular type steers appeared to have sufficient finish for slaughter about 60 days later than the comprest steers. The comprest steers gained less rapidly and less efficiently and had a lower dressing percentage. The shank was the only wholesale cut which differed significantly when expressed as a percentage of the side weight. No type differences were found in average percent of fat, lean and bone separated from the 9-10-11 rib sections.

Blackwell and Cobb (1956) collected data from yearling Hereford steers visually classified into 35 large type and 36 compact type. They had been raised at the New Mexico Station and fed for approximately 200 days following weaning. The large type steers had higher carcass grades and thicker fat over the loin eye than the compact steers. The compact steers consistently produced carcasses with a higher percentage of round, but very little difference appeared in the percentages of the other cuts. The large type steers were 1.6 inches longer as determined by carcass length and 0.6 of an inch greater in carcass depth than the compact type steers. However, the average ratios of length of carcass to depth of body were nearly the same for the two types.

Knox (1957) reviewed the work that had been done on type differences in beef cattle and presented the findings of the

New Mexico Station on this subject. The carcass investigations gave evidence that in most cases the compact cattle were higher than the large type cattle in percentage of round and chuck and were lower in percentage of rib and loin.

One of the first experiments in which beef animals were compared by type was conducted at the Wyoming Station by Hultz (1927). Forty weanling steer calves of similar condition and breeding and weighing approximately 430 pounds were divided into four lots of ten each on the basis of their type classifications. The lots were designated as "extreme rangy", "rangy", "low set" and "very low set". Several body measurements were taken on the calves before going on feed. The calves were fed for six months to an average weight of 780 pounds and then measured again.

A comparison of type ratings with measurements gave evidence that the most important measurements for indicating low-setness were depth of chest, paunch circumference and height at withers. The measurements which gave the best description of type were the ratio of depth of chest to height at withers, and the ratio of paunch circumference to height at withers. In this study, the calves with a large paunch circumference in relation to height made more rapid gains and had lower dressing percentages. The very rangy group of calves made the most economical gains.

Woodward _et al._ (1942) studied large and small type Herefords at the Montana Station to determine which type of Hereford bull would produce the more desirable and profitable type of beef cattle. The study, which covered a nine year period, involved approximately 33 small type calves out of small type cows and bulls and 250 large type calves out of large type cows and bulls. The steer calves were put into the feed lot in four of the years. Heifers from each type herd were divided into two groups: one to be limited fed during the winter season; and the other to be full fed.

A comparison of the two types of calves within the cow age groups, showed the large type calves, in each case, to be heavier at birth and to have a larger daily gain from birth to weaning. The large type heifers were heavier than the small type in average weight as long as they were in the herd, although the difference narrowed with age. The same relationship held true for the fall weights of the full fed heifers as compared with the limited fed heifers. The large type steer calves averaged heavier in the feed lot all four years and, in two of the years, sold for more per head and returned a greater margin per steer.

Stanley and McCall (1945) analyzed the data collected over a period of six years at the University of Arizona from 389 steers fed from 80 to 120 days. All of these animals were approximately one year of age when they entered the feed lot. The steers were classified by type, feeder grade, feeder condition, size of bone, body width, disposition and hair color. No body measurements were taken to support the type classifications. The low set steers had a higher daily gain than the medium steers, but the upstanding steers had a higher rate of gain than the low set steers. Carcasses from the low set steers graded higher than the carcasses from the more up-standing steers. Wide bodied steers gained faster and produced carcasses which were superior to the narrow bodied steers.

Knox and Koger (1946) reported an experiment involving 350 grade Hereford steers of similar breeding raised under similar conditions at the New Mexico A & M College Ranch. The steers were visually classified as compact, medium, and rangy; and their performance was compared. The type classifications were made before and after a 168 day feed lot test, but no body measurements were taken. The average age at the beginning of the trial was about 19 months.

The rangy steers had a greater average initial weight, total gain and dressing percent than the more compact steers. The difference in dressing percent was attributed to a greater size of rumen in the compact steers. The compact steers graded slightly higher at slaughter than the rangy steers, but no difference was found in average carcass grades for the three types. The medium type steer was intermediate in performance in all cases.

Weber (1951) reported on a project sponsored by the American Hereford Association in which three agricultural experiment stations compared the grazing and feed lot performance of 288 steers sired by purebred Hereford bulls of small-, medium- and large-size. Each station received 96 steer calves; equal numbers of which were sired by bulls from each size group. The dams of the large-size calves were large size, but the dams of the other two groups were medium-size. Each experiment station tried three different feeding and management systems on each size group: (1) immediate full feeding following weaning; (2) deferred full feeding and (3) production of two-year old fat steers.

Rate of gain of the steers tended to be directly proportional to the size of their sire. Only small differences were observed in economy of gain between the two groups. The steers out of the large-size bulls tended to have slightly lower average carcass and slaughter grades than the other steers while under the deferred feeding and grass fattening programs. These differences were not evident under the immediate full feeding program.

EXPERIMENTAL ANIMALS AND PROCEDURES

Management of Experimental Animals Prior to Slaughter

In July of 1957, 24 steer and heifer calves sired by three paternal half-sibs were selected from the compress Hereford line at the Fort Reno Experiment Station for a study of type and its effect on performance. These calves were also to be used by the Oklahoma State University Meat Laboratory for a study of the effect of irradiation on beef of high and low fat content.

Eight of the calves were to be slaughtered at weaning time; eight were to be slaughtered as yearlings; and eight were to be slaughtered at approximately two years of age in the spring of 1959. The performance of the last group will not be discussed in this thesis.

At an average age of four and one-half months, 12 of the calves were visually classified as being of the non-compress type and 12 were visually classified as compress type animals by the project leader of the Animal Husbandry Department. At this time, the calves were sorted on the basis of type, sex, age and age of dam for the creep-feeding phase of the project. One half of each slaughter group were creep-fed the 79 days until weaning time and the other half were not creep-fed during this period. The gains made by the calves during this time are presented as "suckling gains".

Four non-comprest and four comprest calves were slaughtered at weaning. Four non-comprest and four comprest steers and heifers were fed for 154 days after weaning. The four calves that had been creep-fed prior to weaning were fed all they could consume during the post-weaning feed period. The four that were not creep-fed prior to weaning were given the same ration during the post-weaning period, but in an amount calculated to produce one-quarter of a pound less gain per day than the full-fed group. The ration consisted of the following feeds and amounts expressed as parts per 100 pounds of feed: corn and cob meal, 35; cottonseed hulls, 20; alfalfa hay, 10; oats, 10; wheat bran, 10; cottonseed meal, 10 and molasses, 5. This ration gave each animal approximately 63.4 pounds of TDN per 100 pounds of feed eaten.

In October of 1956, eight bull calves from the comprest Hereford line at the Fort Reno station and four Aberdeen Angus bull calves from the same station were weaned and put on full feed for part of the type and carcass performance study. Two sires were represented in each breed. These bull calves had not received a creep supplement prior to weaning and were considered to have been maintained on an equal nutritional level, except for differences in maternal influence. At time of weaning, the bull calves were visually classified into four Herefords of the non-comprest type, four comprest type Herefords, two Aberdeen Angus of the non-comprest type and two comprest type Aberdeen Angus.

The post-weaning treatment of the bull calves consisted of 174 days of individual feeding for six of the Herefords and three of the Aberdeen Angus, while two of the Herefords and one of the Aberdeen Angus were group-fed during the same period. Feed consumption data were available on four non-comprest and five comprest bulls during the first 156 days of the test and feed efficiency figures were calculated for these bulls during this time. All of the bulls received the same ration as previously described for the steer and heifer calves.

Other procedures for all slaughter groups, such as the taking of live and photographic measurements and the slaughter and evaluation of the carcasses, were the same for all animals in this project.

Table 1 diagrams the composition of the three slaughter groups described above. Further explanation of the composition of these groups will be given under "Description of Experimental Animals."

Description of Experimental Animals

The term "comprest type", as used in this thesis, refers to the combination or ratio of measurements which gave the animal a distinctive shortness of leg and compactness of body unlike the conformation of the more conventional type of animal, referred to as non-comprest. The low-setness of the comprest type was probably the most distinguishing feature of conformation noted among these animals. A blocky, compact body was associated with the comprest type to a lesser degree.

TABLE 1. EXPERIMENTAL ANIMALS

- 8 Weanling Calves
  - 4 Non-comprest Type
    - 2 Steers
      - 1 High
      - 1 Low
    - 2 Heifers
      - 1 High
      - 1 Low
  - 4 Comprest Type
    - 2 Steers
      - 1 High
      - 1 Low
    - 2 Heifers
      - 1 High
      - 1 Low

- 8 Yearling Steers and Heifers
  - 4 Non-comprest Type
    - 2 Steers
      - 1 High
      - 1 Low
    - 2 Heifers
      - 1 High
      - 1 Low
  - 4 Comprest Type
    - 2 Steers
      - 1 High
      - 1 Low
    - 2 Heifers
      - 1 High
      - 1 Low

- 12 Yearling Bulls
  - 6 Non-comprest Type
    - 4 Hereford
    - 2 Aberdeen Angus
  - 6 Comprest Type
    - 4 Hereford
    - 2 Aberdeen Angus

All of the comprest type Hereford animals used in this study were considered to have the heterozygous comprest genotype, which was noted as "Cc". The non-comprest Herefords were considered to be homozygous segregates from the comprest line of breeding with the "cc" genotype.

The Aberdeen Angus bulls were divided into comprest and non-comprest type classifications on the same basis as the Hereford bulls, but the presence or absence of the comprest genotype in the Aberdeen Angus breed was not implied.

The comprest animals considered in this study may not have been as extreme as the population described by Forbes (1946). However, it is thought that the basis for visual type classification used here might have been roughly comparable to that used by Stonaker et al. (1952), Safley et al. (1950), Schliecher et al. (1950) and Willey et al. (1951) for comprest or small type Herefords. Of the four classifications which Hultz (1927) placed on the Hereford steers that were used in a study of type, the "very low set" group was probably the most comparable with the comprest groups studied here. The "compact" type Hereford described by Knox and Koger (1946), Knox (1957), and Blackwell and Cobb (1956); the "low set" steers studied by Stanley and McCall (1945); and the "small type" Hereford studied by Woodward et al. (1942) do not directly correspond to the comprest conformation type animal discussed in this thesis. However, there may be some relationship to comprest animals on the basis of their total body size and weight.

All of the type classifications in this project were based on a visual appraisal and no body measurements were taken of the animals prior to their classification.

The exact set of measurements which is considered by the experienced eye when identifying the comprest animal is difficult to determine. After making their visual type classifications, Stonaker et al. (1952) almost completely separated the conventional steers from the comprest steers on the basis of wither height alone. In the present study, other devices were tried because considerable overlap occurred between types when they were separated according to their wither height.

An effort was made to derive a mathematical ratio, composed of body measurements, which would effectively separate the animals into the visually classified non-comprest and comprest type groups. Since no live measurements were taken on the calves at the time of classification, weaning photograph measurements were used for the ratios. The photographs of the steers and heifers were made approximately three months after they were classified by type. It was not known what effect this period of growth had upon the body proportions of of the two types of calves.

Height, depth and length were obtained from 14 non-comprest and 13 comprest animals. The procedure for obtaining these measurements is described under Experimental Methods and Carcass Evaluation. The photograph of comprest Angus #146 was missing, therefore his measurements were not available.

The ratios which most effectively separated the two types employed measures of height at withers, depth of chest and height of chest floor. Three ratios were found which efficiently separated the two groups. Table 2 presents the type means, the standard error of the means, and a statement of the probability of no difference between types. The analysis used in obtaining the probability statement is described under Experimental Procedures and Carcass Evaluation.

TABLE 2. MEASUREMENT RATIOS - DESCRIPTIVE OF TYPE

Ratio	Non-compress	Compress	S. E.	Prob.
Depth of chest X 100 / Ht. at withers	52.2	55.7	0.21	$P<.005$
Ht. of chest floor X 100 / Depth of chest	90.6	79.5	0.78	$P<.005$
Ht. of chest floor X 100 / Ht. at withers	47.6	44.2	0.28	$P<.005$

The ratios listed in Table 2 did not completely separate the two type groups, but in all cases the same two compress animals slightly overlapped into the non-compress population. The probability statements given would suggest that the distribution of the individual values, within each type group, gave evidence that the three ratios were effectively describing two populations of animals.

The ratios of measurements were an attempt to mathematically describe two type groups. Their efficiency in classifying animals from other herds, other calf crops and other lines of compress Herefords or Aberdeen Angus was unknown.

The growth and measurement data, averaged by type within slaughter group, provided further descriptive information about the animals used in this study.

Table 3 presents the growth and measurement data on four non-compress and four compress weanling calves. Each type group was composed of two steers and two heifers; one of each sex was on each level of feeding. The means, standard errors of the means and the probability statements are given for the birth weights and gains in body weight during the suckling period. Similar statistics are shown for the live measurements taken on the day of slaughter, at an average age of 205 days.

Table 4 gives the growth and measurement data on the four non-compress and four compress steers and heifers slaughtered as yearlings. The non-compress animals were composed of two steers and two heifers which were divided equally among the two levels of feeding. Two steers and two heifers were in the compress class, and one of each sex were on each level of feeding. Means, standard errors of the means and probability statements are given for birth weights and pre- and post-weaning growth data. The same statistics are shown for the live measurements taken one day before slaughter, at an average age of 381 days.

The probability statements given in Tables 3 and 4 are based on a partitioning of variances due to type, sex, level of feeding and error or to type, sex and error as described under Experimental Procedures and Carcass Evaluation.

Table 5 is a summary of the growth and measurement data on six non-comprest and six comprest bulls, slaughtered as yearlings. Four Herefords and two Aberdeen Angus were in each group. Due to the small numbers in each breed, no breed comparisons were made in this study. Means are given for birth weight and performance test data. Means and standard deviations are presented for the measurements from the photographs, taken one day prior to slaughter at an average age of 380 days.

The non-comprest calves consistently averaged heavier at birth than the comprest calves in each slaughter group, although considerable overlapping occurred in individual weights.

The suckling gain data from the weanling calf and yearling steer and heifer slaughter groups were averaged together to reduce sampling variation. At the beginning of the suckling gain period, the non-comprest animals were 20 pounds heavier than the comprest type. By the end of the period, the non-comprest type animals of the two groups were 26 pounds heavier and had made 0.14 of a pound greater average daily gain than the comprests. The non-comprest yearling steers and heifers continued to outgain their comprest mates during the post weaning performance test.

The non-comprest bulls also were heavier than the comprest bulls during the pre-slaughter period. At the beginning of the 174-day performance test, the non-comprest bull calves were 12 pounds heavier than the comprest bulls. The difference had increased to 46 pounds by the end of the test.

TABLE 3. GROWTH AND MEASUREMENT DATA ON WEANLING CALVES BY TYPE

Item	Non-compress	Compress	Standard Error	Probability
No. of animals	4	4		
Birth wt. (lbs.)	72	67	3.82	$P>0.25$
Suckling Gains (79 da.)				
Initial age (da.)	124	128	13.45	$P>0.25$
Initial wt. (lbs.)	291	248	15.11	$P<0.25$
Final wt. (lbs.)	422	371	13.26	$P<0.10$
Av. da. gain (lbs.)	1.66	1.44	0.12	$P>0.25$
205-Day live measurements (in.)				
Ht. at withers	35.9	32.7	0.79	$P<0.05$
Ht. of chest floor	18.9	16.5	0.66	$P<0.10$
Depth of chest	18.7	17.9	0.27	$P<0.10$
Length of body	40.4	37.0	1.39	$P>0.25$
Width of chest	12.6	12.2	0.38	$P>0.25$
Heart girth	51.8	49.2	0.63	$P<0.05$

TABLE 4. GROWTH AND MEASUREMENT DATA ON YEARLING STEERS AND HIEFERS BY TYPE

Item	Non-compress	Compress	S. E.	Prob.
No. of animals	4	4		
Birth wt. (lbs.)	72	68	3.99	P>0.25
Suckling gains (79 da.)				
Initial age (da.)	157	140	7.76	P<0.10
Initial wt. (lbs.)	284	285	15.4	P>0.25
Final wt. (lbs.)	410	410	16.46	P>0.25
Av. da. gain (lbs.)	1.59	1.58	0.12	P>0.25
Performance test (154 da.)				
Initial age (da.)	236	219	7.76	P<0.10
Initial wt. (lbs.)	410	410	16.46	P>0.25
Final wt. (lbs.)	680	646	26.65	P>0.25
Av. da. gain (lbs.)	1.76	1.53	0.11	P>0.25
Lbs. feed/100 lbs. gain	865	911	30.02	P>0.25
381-Day live measurements (in.)				
Ht. at withers	40.9	38.6	0.57	P<0.05
Ht. of chest floor	20.1	18.1	0.37	P<0.05
Depth of chest	22.7	22.3	0.28	P>0.25
Width of chest	15.3	15.2	0.24	P>0.25
Heart girth	63.3	62.8	0.83	P>0.25

TABLE 5. GROWTH AND MEASUREMENT DATA ON YEARLING BULLS BY TYPE

Item	Non-comprest	Comprest
No. of animals	6	6
Birth wt. (lbs.)	74	66
Performance test (174 da.)		
Initial age (da.)	197	215
Initial wt. (lbs.)	482	470
Final wt. (lbs.)	933	887
Av. da. gain (lbs.)	2.59	2.40
Lbs. feed/100 lbs. gain	802	832
380-Day photographic measurements (in.)		
Ht. at withers	42.5 ± 0.87	40.6 ± 1.01
Ht. of chest floor	18.7 ± 0.45	17.4 ± 0.73
Depth of chest	23.6 ± 0.89	23.2 ± 0.41
Length of body	48.2 ± 2.88	48.3 ± 1.72

The yearling steers and heifers, fed over the winter, gained approximately two-thirds of the amount gained by the bulls during their performance test. However, in both slaughter groups the non-compress animals gained approximately two-tenths of a pound more per day on less feed per pound of gain than the comprest animals.

The heavier weight of the non-comprest animals in all of the slaughter groups was associated with greater average wither and chest height of these animals. There was little association between type and chest depth. In all groups the variability of the wither height measurement was greater in the comprest classes. This indicated somewhat more variation in skeletal size among the animals which were classified as comprest.

Length of body measurements were not taken on the yearling steers and heifers. Body length measurements on the photographs of the bulls indicated little difference between type classes in average length. However, the non-comprest weanling calves had a two and one-half inch greater body length than the comprest weanling calves.

Experimental Procedures and Carcass Evaluation

To provide a reasonable comparison among the slaughter groups and type classes, measurement and evaluation techniques were standardized as much as possible throughout the study.

Lateral view photographs were taken at weaning time of each steer, heifer and bull calf in the project. Similar photographs were also obtained on the day the bulls and the yearling steers and heifers completed their performance test.

All pictures were taken with the calf standing behind a calibrated grid. The photographs were used as a permanent record for obtaining height at withers, height of chest floor, depth of chest and length of body measurements. The measurements were taken with a ruler fitted to the known measurements of the grid as it appeared in the photograph.

The three ratios, previously discussed, were derived from the measurements taken from the weaning photographs. Some of the calves were photographed twice, while others were photographed only once. Where two photographs were available, the measurements from each photograph were averaged; otherwise, the figures used for analysis represented one set of photographic measurements.

The measurements taken from the photographs of the bulls, one day before slaughter, were used in an evaluation of the conformation of these animals at slaughter, because the live measurement data on the bulls were incomplete.

Upon completion of their respective feeding periods at Fort Reno, the three groups in this study were trucked to the Oklahoma State University Meat Laboratory at Stillwater for slaughter.

Live measurements were taken on the weanling calves and the yearling bulls a short time before they were slaughtered. The yearling steers and heifers were measured the previous day at Fort Reno.

Six live measurements were taken with a pair of calipers and a steel tape. These measurements were defined as follows:

(1) height at withers was the perpendicular distance from the top of the withers to the ground; (2) height of chest floor was the perpendicular distance from the chest floor to the ground at a point just posterior to the dewlap; (3) depth of chest was measured by a calipers and extended from a point immediately posterior to the top of the withers perpendicularly to the chest floor; (4) width of chest was the caliper thickness of the widest part of the chest behind the shoulders; (5) heart girth was measured by a tape held snugly around the chest at the point where the chest width measurement was taken; and (6) length of body was the distance along a line from the point of shoulders to the posterior edge of the pin bones. Each measurement was taken twice and the average computed for an analysis of the data.

All animals were slaughtered in accordance with procedures outlined by Deans (1951) and the carcasses were weighed before being shrouded and hung in the cooler.

After approximately 24 hours, the carcasses were unshrouded and reweighed. Four carcass measurements were taken at that time in accordance with the methods described by Naumann (1952). Both the right and left sides were measured and the average value was calculated. The measurements consisted of: (1) length of body, or the distance from the anterior edge of the aitch bone to the anterior edge of the first rib, just lateral to the junction with the first thoracic vertebra; (2) length of loin, or the distance from the anterior edge of the aitch bone to the middle of the 12th thoracic vertebra; (3) depth of body, or the distance from the dorsal side of the spinal canal, at the fifth thoracic vertebra, to the ventral side of the sternum with the tape held parallel to the floor; and (4) length of leg, or the distance from the anterior edge of the aitch bone to the highest point on the hock joint.

Tracings were made of the longissimus dorsi at a point midway between the 12th and 13th thoracic vertebra. The perimeter of the loin eye was traced and measured with a compensating polar planimeter. The carcass grade was designated by a member of the Animal Husbandry Department. The thickness of the fat covering the medial-lateral edge of the loin eye was also measured.

The carcasses were broken into nine wholesale cuts following a 48 hour chill, using the procedures described by Wellington (1953). Both sides of the carcass were broken because all of the cuts were to be used in other meat experiments. The total weight of each pair of wholesale cuts was used for analysis. Errors in splitting the rib, chuck and loin were minimized by this method.

The nine wholesale cuts included the chuck, brisket, rib, plate, foreshank, loin, round (rump on), flank and kidney knob. The percentage of the whole carcass weight was calculated for each pair of cuts.

The 9-10-11 rib section was removed from each wholesale rib and then weighed. Each section was physically separated into its fat, lean and bone components. The eye muscle was frozen for later proximate analysis of the protein, ash, moisture and fat percentages by the Biochemistry Department. Only the moisture and fat percentages were used in the analyses of the data because very little variation in the ash and protein content of the meat was detected. Physical separations and proximate analysis figures for each animal were the averages of the two sides.

Beginning at the posterior end of the remaining portion of the rib, several one inch thick steaks and one, two inch steak were removed in that order. The one inch steaks were frozen for taste panel evaluations. The two inch steak was frozen for later use in obtaining Warner-Bratzler shear values.

In order to obtain shear values, the two inch steaks were thawed for 24 hours at 33° F and then placed four inches below the flame in a gas broiler, preheated to 350° F. A dial type meat thermometer was inserted into the center of each steak for recording internal temperature. Each steak was then broiled to an internal temperature of 110° F and then turned over and allowed to cook to an internaltemperature of 160° F. The steaks were then taken from the broiler. Three one inch cores were taken from each steak. The locations were dorsal, medial and lateral. Two readings on the Warner-Bratzler shear were made on each core. This made, for the bulls and the weanling calves, a total of six readings for each steak and twelve readings for each animal. Three readings were made on each core from the yearling steers and heifers, making a total of nine per side and eighteen per animal. The average of the twelve or eighteen readings was used as the shear value for the rib steak of that carcass.

For taste panel evaluations, the one inch steaks were thawed and prepared similarly to the steaks used for obtaining shear values. Each steak was cut into chunks by standard procedure and tasted by members of the panel. Persons serving on this panel were non-professional, and members varied from six to eight. Each piece of meat was evaluated for four separate characteristics. Chews designated the number of times which a standard sized piece of meat had to be masticated before it was ready to be swallowed. Tenderness, flavor and juiciness scores were based on a scale of nine, in which the higher scores designated a greater amount of these meat characteristics.

The number of experimental units was necessarily small in this study because of the large cost in time, labor and money. Most interpretations of the data were based on the simple averages for the class of animals concerned.

Statistical procedures for the weanling calf and yearling steer and heifer slaughter groups consisted of: (1) calculation of the means of the various characteristics on the basis of type, sex and level of feeding; (2) a partitioning of variances for characteristics affected by type, sex and level of feeding as shown in part 1 of Table 6; (3) a partitioning of variances for characteristics affected by type and sex, but not by level of feeding, i.e., birth weight and initial suckling gain weight, as shown in part 2 of Table 6; (4) testing the significance of the variances by use of the F-ratio of variances; and (5) deriving the standard error of the mean from the error mean square, through the use of the following formula: standard error = square root of the error mean square/square root of n. All procedures used were outlined by Snedecor (1956).

Statistical procedures for the yearling bull slaughter group consisted of: (1) calculation of the means of the various characteristics on the basis of type; (2) a comparison between the means of the non-compress and compress type bulls, using the t-test described by Snedecor (1956) - differences between means were noted as non-significant (n.s.) when the probability of the difference being due to chance was greater than 0.4; and (3) calculation of the standard deviations of the individual characteristics of each type group.

The analysis of variance of the combined slaughter groups for the measurement ratios given in Table 2 was obtained by pooling the sums of squares for type and error as shown in part 3 of Table 6.

TABLE 6. SAMPLE ANALYSES OF VARIANCE

Part 1. Analysis of Variance Used for Characteristics Affected by Type, Sex and Level of Feeding

Carcass Wt. of Weanling Calves

Source	Degrees of Freedom	Sum of Squares	Mean Square	F - Ratio	Probability
Type	1	3486.13	3486.13	11.53	P<0.05
Sex	1	3160.13	3160.13	10.45	P<0.05
Level	1	5962.00	5962.00	19.72	P<0.05
Error	4	1209.12	302.28		
Total	7	13817.38			

Part 2. Analysis of Variance Used for Characteristics Affected by Type and Sex.

Birth Wt. of Yearling Steers and Heifers

Source	Degrees of Freedom	Sum of Squares	Mean Square	F - Ratio	Probability
Type	1	32.00	32.00	0.50	P>0.25
Sex	1	450.00	450.00	7.08	P<0.10
Error	5	318.00	63.60		
Total	7	800.00			

TABLE 6. (CONTINUED)

Part 3. Analysis of Variance for Combined Slaughter Groups[a] Using Pooled Sums of Squares.

Ht. of Chest Floor X 100 / Ht. at Withers

Source	Degrees of Freedom		Sum of Squares		Mean Square	F - Ratio	Probability
Type		2		56.42	28.21	17.52	$P < 0.005$
Bulls	(1)		(12.16)				
Strs. & Hfrs.	(1)		(44.26)				
Error		21		33.79	1.61		
Bulls	(9)		(19.06)				
Strs. & Hfrs.	(12)		(14.73)				
Total		23		90.21			

[a] Data from one comprest bull was not used. See explanation for Table 2.

RESULTS AND DISCUSSION

Performance at Slaughter

The means, standard errors of the means and probability statements of the slaughter and carcass measurement data from the non-comprest and comprest type classes are shown in tabular form for the weanling calves in Table 7 and the yearling steers and heifers in Table 8. Means and standard deviations of the individual measurements are shown in tabular form for the yearling bulls in Table 9.

The live slaughter weights of the animals were obtained at the Meat Laboratory approximately 24 hours after final weights were obtained at Fort Reno. Differences in average shrinkage loss were small between the type classes within the slaughter groups. The weanling calves had the largest shrinkage loss (14%). The bulls (1.7%) and the yearling steers and heifers (2.4%) had relatively small losses in weight.

The non-comprest animals were heavier at slaughter than their comprest mates in all three groups. The probability of the heavier weight of the non-comprest bulls being due to chance was less than 0.01. The probability of a chance difference in weight was less than 0.05 in the weanling calf group and greater than 0.25 in the yearling steer and heifer group.

TABLE 7. CARCASS MEASUREMENT AND SLAUGHTER DATA ON WEANLING CALVES BY TYPE

Item	Non-comprest	Comprest	Standard Error	Probability
No. of animals	4	4		
Age at slaughter (da.)	204	208	13.45	P>0.25
Live wt. at slaughter (lbs.)	400	346	10.41	P<0.05
Carcass wt. (lbs.)	240	198	8.69	P<0.05
Dressing percent	59.6	57.0	1.08	P<0.25
Carcass grade[a]	2.7	3.0	0.39	P>0.25
Carcass measurements (in.)				
Length of body	36.5	33.9	0.48	P<0.05
Length of loin	19.2	18.1	0.38	P<0.10
Depth of body	12.3	11.4	0.21	P<0.05
Length of leg	23.6	21.7	0.34	P<0.05
Loin eye area (sq. in.)	6.0	5.5	0.23	P>0.25
Width of fat over loin eye (in.)	0.1	0.1	0.01	P<0.25

[a] Grading system: 1 = Standard, 2 = High Standard, 3 = Low Good, 4 = Good, 5 = High Good and 6 = Low Choice.

TABLE 8. CARCASS MEASUREMENT AND SLAUGHTER DATA ON YEARLING STEERS AND HEIFERS BY TYPE

Item	Non-comprest	Comprest	Standard Error	Probability
No. of animals	4	4		
Age at slaughter (da.)	391	374	7.76	$P>0.25$
Live wt. at slaughter (lbs.)	666	629	25.51	$P>0.25$
Carcass wt. (lbs.)	397	365	12.94	$P<0.25$
Dressing percent	59.5	58.0	0.48	$P<0.10$
Carcass grade[a]	4.0	5.5	0.39	$P<0.10$
Carcass measurements (in.)				
Length of body	42.1	40.4	0.72	$P<0.25$
Length of loin	22.2	21.1	0.38	$P<0.10$
Depth of body	14.4	13.4	0.36	$P<0.25$
Length of leg	26.4	24.7	0.42	$P<0.05$
Loin eye area (sq. in.)	8.7	8.5	0.11	$P>0.25$
Width of fat over loin eye (in.)	0.4	0.5	0.47	$P<0.25$

[a] Grading system: 1 = Standard, 2 = High Standard, 3 = Low Good, 4 = Good, 5 = High Good and 6 = Low Choice.

TABLE 9. CARCASS MEASUREMENT AND SLAUGHTER DATA ON YEARLING BULLS BY TYPE

Item	Non-comprest		Comprest		Significance of difference
No. of animals	6		6		
Age at slaughter (da.)	372	±22.7	390	±24.4	P<0.40
Live wt. at slaughter (lbs.)	921	±87.3	868	±72.4	P<0.01
Carcass wt. (lbs.)	537	±43.4	510	±46.9	P<0.40
Dressing percent	58.4	± 1.14	58.4	± 1.54	P>0.40
Carcass grade[a]	3.7	± 0.82	3.5	± 0.84	P>0.40
Carcass measurements (in.)					
Length of body	46.0	± 0.94	44.5	± 1.72	P<0.10
Length of loin	23.8	± 0.45	23.3	± 1.00	P<0.40
Depth of body	14.2	± 0.50	14.0	± 0.84	P>0.40
Length of leg	28.1	± 0.62	26.9	± 0.79	P<0.05
Loin eye area (sq. in.)	10.6	± 0.65	10.8	± 0.66	P>0.40
Width of fat over loin eye (in.)	0.3	± 0.11	0.3	± 0.12	P>0.40

[a] Grading system: 1 = Standard, 2 = High Standard, 3 = Low Good, 4 = Good and 5 = High Good.

The non-compress bulls and yearling steers and heifers were also less variable in live weight than the compress animals in these classes.

The non-compress animals within each slaughter group produced heavier carcasses than the compress animals. This weight difference was most evident in the weanling calves (42 pounds). The least difference in average carcass weight, between type classes, was found in the yearling bull group (27 pounds). The small mean differences between types were low in significance, except in the weanling calves where the probability of a chance difference was less than 0.05. These differences in carcass weight were not as large as those found by Stonaker et al. (1952). In their study, the conventional type steer carcasses weighed approximately 100 pounds more than the compress carcasses. Blackwell and Cobb (1956) observed a 46 pound average spread between carcass weights in favor of the large type steer.

The non-compress weanling calves had a yield of 59.6% which was 2.6% larger than the 57.0% yield of the compress calves. In the yearling steer and heifer slaughter group, the non-compress animals had a yield of 59.5% which was 1.5% greater than the 58.0% yield of the compress animals. Average dressing percentages were equal for the two types of yearling bulls.

Except for the bulls, the above results were consistent with dressing percentages observed by Hultz (1927), Willey et al. (1951), Blackwell and Cobb (1956), Knox and Koger (1946), Schliecher *et al.* (1950) and Stonaker *et al.* (1952). Knox and Koger (1946) explained the higher dressing percent of the rangier animal as being due to the greater paunchiness of the compact animal. Hultz (1927) found that steers with a large paunch circumference, in relation to height, had a lower dressing percent. Black *et al.* (1938) studied steers which varied in both type and breed. Results indicated that when weight was held constant, the taller, leggier steers tended to have a lower dressing percent than the shorter, lower set steers.

A greater skeletal size in the non-compress animals, within all slaughter groups, was indicated by their consistently larger average carcass measurements. This was in accord with carcass measurements taken on yearling steers by Stonaker *et al.* (1952), Safley *et al.* (1950) and Blackwell and Cobb (1956).

The average length of foreleg was the most effective indicator of type among the four measurements taken on the carcasses of the bulls and the yearling steers and heifers. Depth of body and the length of body measurements were of somewhat less importance in separating the two types in these two slaughter groups. All of the carcass measurements on the non-compress weanling calves were larger than those on the compress calves and reached the 0.05 level of significance.

The carcass measurements of the compress animals, within each slaughter group, were consistently more variable than the non-compress carcass measurements.

The grade given to each carcass was based on the U. S. D. A. standard. The compress carcasses in the yearling steer and heifer slaughter group were approximately one-half of a grade higher than the non-compress carcasses. This conformed with results of studies by Blackwell and Cobb (1956). Knox and Koger (1946) found no difference in average carcass grade between rangy and compress steers. In the present study, the bulls and the weanling calves showed little variation in average grade between the two conformation types, within each group.

The loin eye areas of the non-compress weanling calves and the yearling steers and heifers were only slightly larger than the loin eye areas of their compress mates. The non-compress bulls actually had smaller loin eyes than the compress bulls. The probability of a chance difference between types was high in all groups. Stonaker _et al._ (1952) and Schliecher _et al._ (1950) obtained different results on steers fed to a constant grade. The conventional type steers had significantly larger average loin eye areas than the compress or small type steers.

The measurement of external fat over the loin eye was thought to be at least a partial indication of the amount of external fat present on the carcass. The largest difference in width of fat between type classes was expressed in the yearling steer and heifer group. However, the one-tenth inch advantage of the compress yearlings was only significant at less than the 0.25 level. The compress yearlings were more variable in individual fat widths. No difference in average fat width was found between the two conformation types in the yearling bull and the weanling calf slaughter groups. The above results only partially agree with those of Stonaker *et al.* (1952). They found that compress type steers, fed to a constant grade, had more fat over the loin eye than the conventional type steers.

Measures of Carcass Merit

The means, standard errors of the means and probability statements for carcass data from the non-comprest and comprest type classes are given in tabular form for the weanling calves in Table 10 and for the yearling steers and heifers in Table 11. Means and standard deviations of the individual items are given in tabular form for the yearling bulls in Table 12.

Among the weanling calves, the non-comprest ribs, chucks, plates and foreshanks averaged heavier than the comprest cuts ($P<0.05$). Other type differences were low in significance. All of the non-comprest cuts in the yearling steer and heifer slaughter group were heavier than the comprest cuts except the brisket. The probability that these differences were due to chance exceeded 0.10 in all cases. The non-comprest yearling bulls had heavier average wholesale cut weights than the comprest bulls except for the kidney knob, rib and brisket. All differences in this slaughter group were significant at levels greater than 0.20.

Type differences in the weights of the wholesale cuts were greater in the steers studied by Stonaker *et al.* (1952) and Schliecher *et al.* (1950). They found that all of the

TABLE 10. CARCASS DATA ON WEANLING CALVES BY TYPE

Item	Non-comprest	Comprest	S. E.	Prob.
No. of animals	4	4		
Percent rib	7.4	7.4	0.09	P>0.25
" chuck	25.1	24.5	0.58	P>0.25
" plate	7.5	7.4	0.11	P>0.25
" brisket	4.6	4.7	3.04	P>0.25
" foreshank	5.5	5.3	0.14	P>0.25
" round (rump on)	26.7	27.2	0.39	P>0.25
" loin	14.4	14.6	0.04	P<0.05
" flank	5.6	5.8	0.37	P>0.25
" kidney knob	3.2	3.0	0.52	P>0.25
Comp. 9-10-11 rib (%)				
Lean	54.5	55.5	1.66	P>0.25
Fat	25.4	23.8	1.80	P>0.25
Bone	20.0	20.3	1.52	P>0.25
Prox. anal. - rib eye (%)				
Moisture	74.4	73.8	0.19	P<0.10
Fat	0.8	1.2	0.10	P<0.05
Shear test - rib steak (lbs.)	12.1	13.2	0.87	P>0.25
Taste panel (rib steak)				
No. of chews	21.5	19.8	1.02	P>0.25
Tenderness	6.8	7.3	0.24	P>0.25
Flavor	6.4	7.0	0.17	P<0.10
Juice	6.7	6.9	0.21	P>0.25

TABLE 11. CARCASS DATA ON YEARLING STEERS AND HEIFERS BY TYPE

Item	Non-comprest	Comprest	S. E.	Prob.
No. of animals	4	4		
Percent rib	7.6	7.7	0.10	P>0.25
" chuck	25.5	24.6	0.37	P<0.25
" plate	8.0	8.6	0.19	P<0.10
" brisket	4.9	5.5	0.13	P<0.05
" foreshank	5.1	4.9	0.21	P>0.25
" round (rump on)	25.7	25.0	0.55	P<0.25
" loin	15.8	15.7	0.36	P>0.25
" flank	6.4	6.3	0.53	P>0.25
" kidney knob	1.0	1.0	0.14	P>0.25
Comp. 9-10-11 rib (%)				
Lean	55.7	51.5	3.32	P>0.25
Fat	30.9	33.2	1.87	P>0.25
Bone	13.4	16.5	1.70	P>0.25
Prox. anal. - rib eye (%)				
Moisture	72.7	72.1	0.46	P>0.25
Fat	2.4	3.5	0.66	P>0.25
Shear test - rib steak (lbs.)	15.7	15.9	1.32	P>0.25
Taste panel (rib steak)				
No. of chews	24.6	23.7	1.97	P>0.25
Tenderness	7.4	7.6	0.25	P>0.25
Flavor	7.3	7.3	0.10	P>0.25
Juice	7.3	7.2	0.00	P>0.25

TABLE 12. CARCASS DATA ON YEARLING BULLS BY TYPE

Item	Non-comprest	Comprest
No. of animals	6	6
Percent rib	7.2 ±0.52	7.6 ±0.37
" chuck	27.5 ±0.57	26.6 ±1.08
" plate	8.5 ±0.48	8.6 ±0.57
" brisket	5.0 ±0.39	5.5 ±0.54
" foreshank	5.3 ±0.37	5.2 ±0.14
" round (rump on)	24.5 ±1.20	23.9 ±0.97
" loin	13.3 ±0.56	13.2 ±0.30
" flank	6.2 ±0.63	6.4 ±0.85
" kidney knob	3.4 ±1.18	3.5 ±0.86
Composition 9-10-11 rib (%)		
Lean	56.3 ±2.04	59.3 ±4.49
Fat	26.0 ±4.81	26.0 ±5.87
Bone	17.7 ±5.87	14.7 ±1.63
Prox. analysis - rib eye (%)		
Moisture	73.5 ±0.91	72.9 ±1.04
Fat	3.2 ±0.85	3.5 ±0.62
Shear test - rib steak (lbs.)		
Taste panel (rib steak)		
No. of chews	28.8 ±3.75	29.9 ±3.83
Tenderness	6.8 ±0.60	6.4 ±0.40
Flavor	7.3 ±0.45	6.4 ±0.85
Juice	7.6 ±0.42	6.9 ±0.77

wholesale cuts of the comprest or small type steers were significantly lighter in weight than the cuts from the conventional type steers.

In the present study, many of the carcasses and wholesale cuts from the comprest animals could be visually distinguished from those of the non-comprest animals by their shortened and compact appearance. However, in most cases there was a gradual merging of the two types.

The differences between the means of the two conformation types, in all slaughter groups, were greatly reduced by converting the actual weights of the wholesale cuts to percentages of the carcass. The data from the weanling calves showed that only minor differences existed between the two types in distribution of carcass weight. The comprest calf loins were heavier than the non-comprest loins by only two-tenths of one percent. The probability of a chance difference in percentage was less than 0.05 because of the low variability of individual loin weights. Differences between types, for the other cuts, were minor and low in significance.

The two type classes in the yearling steer and heifer slaughter group showed some difference in average percentage of round, brisket, chuck and plate, while the other wholesale cut averages were nearly the same. The non-comprest yearlings had a greater percentage of chuck and round ($P<0.25$) while the comprest animals had a higher percentage of brisket ($P<0.05$) and plate ($P<0.10$). It should be noted, however, that the largest difference between means was nine-tenths of one percent. This difference amounted to only 3.6 pounds in a 397 pound carcass (the average weight of the non-comprest carcasses in this group).

Changing the actual weights of the wholesale cuts to percentage of carcass tended to equalize the differences between means of the two types of bulls. However, the non-comprest bulls had higher percentages of chuck ($P<0.20$) and round ($P<0.40$), and the comprest bulls had a greater percentage of rib ($P<0.20$) and brisket ($P<0.20$). In the case of the rib and brisket, converting their actual weights to percentage of carcass lowered the probability of a chance difference between types from greater than 0.4 to a probability less than 0.2.

Little tendency was shown for one conformation type to vary more than another in the percentage of all the wholesale cuts. Likewise, age and total weight of the carcass did not seem to have a marked or consistent effect on the variability of the weight of the cuts.

Data obtained by other workers only partially agreed with the results of the present study. The wholesale cut percentages calculated by Schliecher <u>et al.</u> (1950) showed that the conventional type steer carcasses were significantly larger (.05 level) in average percentage of rib and chuck, and significantly smaller in average percentage of brisket and flank. Stonaker <u>et al</u> (1952) tested only the relative carcass percentages of the rib, chuck, loin and round. The rib and chuck were significantly larger (.05 and .01 level, respectively) in the conventional type steer carcasses. Willey et al. (1951) found the percentage of foreshank was the only cut significantly heavier (.05 level) in the regular type steer carcasses.

The percentage composition of the 9-10-11 rib section was determined in order to estimate the effect of conformation type on the composition of the animal body. The percentage of lean in the 9-10-11 rib section was higher in the comprest classes in the weanling calf ($P>0.25$) and yearling bull ($P<0.20$) slaughter groups and lower in the comprest class of the yearling steer and heifer group ($P>0.25$).

The average fat content of the 9-10-11 rib sections was somewhat lower in the comprest ribs in the weanling calf group ($P>0.25$) and higher in the yearling steer and heifer group ($P>0.25$). No difference between types was shown in this regard by the bulls.

The yearling steer and heifer rib sections were approximately eight percentage points higher in average fat content than the weanling calf rib sections. However, the bulls were only slightly higher than the weanling calves in average percent fat content.

Bone comprised the smallest percentage of the total weight of the 9-10-11 rib section in all slaughter groups. In the yearling steer and heifer group, the non-comprest rib sections had less percent bone ($P>0.25$) than the comprest rib sections. The reverse was true in the yearling bull group, where the non-comprest rib sections were heavier in percent bone. In the weanling calf group, the two conformation types had nearly the same average percent bone content in their rib sections.

The above estimates of the fat, lean and bone content of the 9-10-11 rib sections only partially agreed with the results of studies conducted by Schliecher et al. (1950). They reported that the small type 9-10-11 rib cuts had 0.73 percent more average fat than the conventional type rib cuts from steers fed to equal grade. The other composition values were inconsistent in trend. Stonaker et al. (1952) determined the rib compositions to be nearly the same for the two types of steers fed to equal grade. Willey et al. (1951) found significant differences in fat, lean and bone percentages between compress and regular type steers fed on a time constant basis. Black et al. (1938) physically separated the entire carcasses of steers weighing approximately 900 pounds. When weight was held constant, the carcasses from the taller, leggier steers tended to have less fat and percent of total edible meat than the carcasses from the shorter, lower set steers.

While the physical separation procedure determined the composition of the whole rib section, the proximate analysis figures were obtained from the rib eye muscle alone. The non-compress classes in each slaughter group were consistently higher in percent of moisture in the rib eye. The difference approached the 0.05 level of significance in the weanling calf slaughter group, but was lower in significance in the other two groups.

The percent of fat in the rib eye muscle was greater in the compreSt animals than in the non-compreSt animals, in each slaughter group. This trend only partially agreed with the results of the physical separation of fat from the whole 9-10-11 rib section. However, it was realized that chemical measures of rib eye fat included estimates of intramuscular fat (marbling). Measures of rib section fat (by physical separation) were, for the most part, estimates of extramuscular fat deposition. The compreSt genotype may have affected these two measures in different ways. The lowest probability of the difference in percentage of rib eye fat being due to chance ocurred in the weanling calf slaughter group ($P<0.05$). Probabilities of differences in percentage of fat in the rib eye being due to chance were greater in the other two groups.

There have been no reports in the literature of comparisons between non-compreSt and compreSt type animals in regard to meat tenderness as measured by the Warner-Bratzler shear. In this study, the small differences between type classes, within slaughter groups, were low in significance due to the large variation and overlap in shear values. The non-compreSt weanling calves and yearling bulls had larger standard deviations for this characteristic than the compreSt animals. The non-compreSt yearling steers and heifers had a smaller standard deviation of shear values than the compreSt yearlings.

A definite difference between slaughter groups in average shear values was detected by the Warner-Bratzler shear.

When the groups are arranged according to shear force required, they are, in descending order, yearling bulls, yearling steers and heifers, and weanling calves.

The meat from the two conformation classes was further evaluated by means of a taste panel. The average number of chews required for the rib steak samples from each type class were not in agreement with the average shear values of the rib eye. No large differences in the average number of chews were obtained between type classes in any of the slaughter groups. The trend in average number of chews required for each slaughter group did agree with the trend in shear values, but was less pronounced.

The meat tenderness scores were intended as a supplement to the number of chews data. However, the direction of difference between type classes in average tenderness score was directly opposite to that shown by the average number of chews. Also, the differences between slaughter groups, as exhibited by the shear test values and the number of chews required, were not evident in the tenderness scores.

Differences between type classes, in regard to meat flavor and juice, were difficult to detect by the taste panel. In all slaughter groups, the discrepancy between the means of the conformation type classes amounted to less than one score point. In view of the variability of the human taste mechanism, it was felt that a difference of several score points, between conformation types, would be necessary for reliable predictions of real differences in flavor.

Major Effects of Sex and Level of Feeding On Slaughter and Carcass Performance

The means, standard errors of the means and probability statements of the growth, carcass measurement and slaughter data from the two sex classes are presented in Tables 13 and 14 for the weanling calf and yearling steer and heifer slaughter groups, respectively. The same statistics for the carcass evaluation data from the two sex classes are presented in Tables 15 and 16 for the weanling calf and yearling steer and heifer slaughter groups, respectively.

In both slaughter groups, the steers were heavier than the heifers in average slaughter and carcass weight and had larger loin eye areas. The steers also gained more rapidly and efficiently in pre- and post-weaning feed tests. Furthermore, the average carcass measurements of the steers were consistently larger than those of the heifers, although in many cases the differences were small.

The weanling steers had a 1.4 percent advantage in average dressing percent over the weanling heifers. For the yearling steers, the advantage over the heifers was only 0.7 of one percent.

The difference between sexes in average cut-out percentages were small in the weanling calf group. The weanling steers had a higher percentage of rib and a lower percentage of plate and loin than the heifers. The other differences

TABLE 13. GROWTH, CARCASS MEASUREMENT AND SLAUGHTER DATA ON WEANLING CALVES BY SEX

Item	Steers	Heifers	S. E.	Prob.
No. of animals	4	4		
Birth wt. (lbs.)	71	68	3.82	P>0.25
Suckling gains (79 da.)				
Initial age (da.)	130	123	13.45	P>0.25
Initial wt. (lbs.)	291	248	15.11	P<0.25
Final wt. (lbs.)	436	358	13.26	P<0.05
Av. da. gain (lbs.)	1.71	1.39	0.12	P<0.25
Age at slaughter (da.)	210	203	13.45	P>0.25
Live wt. at slaughter (lbs.)	403	343	10.41	P<0.05
Carcass wt. (lbs.)	238	199	8.69	P<0.05
Dressing percent	59.0	57.6	1.08	P>0.25
Carcass grade[a]	3.2	2.5	0.39	P<0.25
Carcass measurements (in.)				
Length of body	36.0	34.5	0.48	P<0.10
Length of loin	18.9	18.4	0.38	P>0.25
Depth of body	12.0	11.7	0.21	P>0.25
Length of leg	23.2	22.1	0.34	P<0.10
Loin eye area (sq. in.)	6.7	4.9	0.23	P<0.01
Width of fat over loin eye (in.)	0.1	0.1	0.13	P>0.25

[a] Grading system: 1=Standard, 2=High Standard, 3=Low Good, 4=Good, 5=High Good and 6=Low Choice.

TABLE 14. GROWTH, CARCASS MEASUREMENT AND SLAUGHTER DATA ON YEARLING STEERS AND HEIFERS BY SEX

Item	Steers	Heifers	S. E.	Prob.
No. of animals	4	4		
Birth wt. (lbs.)	78	65	3.99	P<0.10
Suckling gains (79 da.)				
Initial wt. (lbs.)	285	284	15.36	P>0.25
Final wt. (lbs.)	424	396	16.46	P>0.25
Av. da. gain (lbs.)	1.84	1.34	0.12	P<0.25
Performance test (154 da.)				
Initial wt. (lbs.)	424	396	16.46	P>0.25
Final wt. (lbs.)	688	639	26.65	P>0.25
Av. da. gain (lbs.)	1.71	1.58	0.11	P>0.25
Lbs. feed/100 lbs. gain	859	917	30.02	P>0.25
Age at slaughter (da.)	375	390	7.76	P=0.25
Live wt.- slaughter (lbs.)	670	625	25.51	P>0.25
Carcass wt. (lbs.)	396	365	12.94	P<0.25
Dressing percent	59.1	58.4	0.48	P>0.25
Carcass grade[a]	4.0	5.5	0.39	P<0.10
Carcass measurements (in.)				
Length of body	41.7	40.7	0.72	P>0.25
Length of loin	21.7	21.6	0.38	P>0.25
Depth of body	14.0	13.8	0.36	P>0.25
Length of leg	25.9	25.2	0.42	P>0.25
Loin eye area (sq. in.)	9.5	7.7	0.11	P<0.01
Width of fat - loin eye (in.)	0.3	0.5	0.05	P<0.10

[a] Grading system: 3=Low Good, 4=Good, 5=High Good and 6=Low Choice.

TABLE 15. CARCASS DATA ON WEANLING CALVES BY SEX

Item	Steers	Heifers	S. E.	Prob.
No. of animals	4	4		
Percent rib	7.7	7.1	0.09	P<0.10
" chuck	24.7	25.0	0.58	P>0.25
" plate	7.2	7.7	0.11	P<0.05
" brisket	4.6	4.7	3.04	P>0.25
" foreshank	5.5	5.3	0.14	P>0.25
" round (rump on)	27.4	26.6	0.39	P<0.25
" loin	14.4	14.6	0.04	P<0.05
" flank	5.5	5.9	0.37	P>0.25
" kidney knob	3.0	3.2	0.52	P>0.25
Comp. 9-10-11 rib (%)				
Lean	54.1	55.9	1.66	P>0.25
Fat	23.2	26.1	1.80	P<0.25
Bone	22.3	18.0	1.52	P>0.25
Prox. anal. -rib eye (%)				
Moisture	74.2	74.0	0.19	P<0.10
Fat	1.0	1.1	0.10	P>0.25
Shear test - rib steak (lbs.)	12.6	12.8	0.87	P>0.25
Taste panel (rib steak)				
No. of chews	22.2	19.2	1.02	P<0.25
Tenderness	6.9	7.2	0.24	P>0.25
Flavor	6.6	6.9	0.17	P>0.25
Juice	6.7	6.9	0.21	P>0.25

TABLE 16. CARCASS DATA ON YEARLING STEERS AND HEIFERS BY SEX

Item	Steers	Heifers	S. E.	Prob.
No. of animals	4	4		
Percent rib	7.7	7.6	0.10	P>0.25
" chuck	25.3	24.7	0.37	P>0.25
" plate	8.2	8.4	0.19	P>0.25
" brisket	5.1	5.2	0.13	P>0.25
" foreshank	5.4	4.6	0.21	P<0.10
" round (rump on)	26.1	24.7	0.27	P<0.05
" loin	15.6	15.9	0.36	P>0.25
" flank	6.3	6.5	0.53	P>0.25
" kidney knob	0.8	1.2	0.14	P<0.25
Comp. 9-10-11 rib (%)				
Lean	55.7	51.5	3.32	P>0.25
Fat	26.6	37.4	1.87	P<0.05
Bone	15.6	14.3	1.70	P>0.25
Prox. anal. -rib eye (%)				
Moisture	72.2	72.6	0.46	P>0.25
Fat	3.2	2.6	0.66	P>0.25
Shear test - rib steak (lbs.)	14.0	17.5	1.32	P<0.25
Taste panel (rib steak)				
No. of chews	25.8	22.5	1.97	P>0.25
Tenderness	7.3	7.7	0.25	P>0.25
Flavor	7.3	7.3	0.10	P>0.25
Juice	7.4	7.2	0.00	P>0.25

in weight distribution were of minor significance. The yearling steers had a higher percentage of round and foreshank than the heifers but other differences were of minor significance.

The average percent fat in the 9-10-11 rib sections of the weanling and yearling heifers was considerably higher than the amount separated from the rib sections of their steer mates. The yearling steers had a greater percent lean in the 9-10-11 rib sections than the heifers, but the trend was reversed in the weanling calf group.

The means, standard errors of the means and the probability statements of the growth, carcass measurement and slaughter data from the high and low level of feeding groups are presented in Tables 17 and 18 for the weanling calf and yearling steer and heifer slaughter groups, respectively. The same statistics for the carcass evaluation data from the two level of feeding groups are presented in Tables 19 and 20 for the weanling calf and yearling steer and heifer slaughter groups, respectively.

The high level animals of both groups gained more rapidly and were heavier in average slaughter and carcass weights. It was evident that at least part of this weight advantage consisted of fat. This was demonstrated by the higher percent fat content of the high level 9-10-11 rib sections and the thicker layer of fat over the rib eyes of the high level animals. The greater finish of the high level animals may also have contributed to the higher average carcass grades of this group.

TABLE 17. GROWTH, CARCASS MEASUREMENT AND DLAUGHTER DATA ON WEANLING CALVES BY LEVEL OF FEEDING

Item	High	Low	S. E.	Prob.
No. of animals	4	4		
Birth wt (lbs.)	68	71	3.82	—
Suckling gains (79 da.)				
Initial age (da.)	131	122	13.45	$P>0.25$
Initial wt. (lbs.)	288	241	15.11	—
Final wt. (lbs.)	435	359	13.26	$P<0.05$
Av. da. gain (lbs.)	1.84	1.34	0.12	$P<0.05$
Age at slaughter (da.)	211	202	13.45	$P>0.25$
Live wt. at slaughter (lbs.)	406	340	10.41	$P<0.05$
Carcass wt. (lbs.)	248	189	8.69	$P<0.05$
Dressing percent	61.1	55.5	1.08	$P<0.05$
Carcass grade[a]	4.5	1.2	0.39	$P<0.01$
Carcass measurements (in.)				
Length of body	36.1	34.4	0.48	$P<0.01$
Length of loin	19.1	18.2	0.38	$P<0.25$
Depth of body	12.1	11.5	0.21	$P<0.25$
Length of leg	23.5	21.8	0.34	$P<0.05$
Loin eye area (sq. in.)	5.9	5.6	0.23	$P<0.01$
Width of fat over loin eye (in.)	0.2	0.0	0.13	$P<0.01$

[a] Grading system: 1=Standard, 2=High Standard, 3=Low Good, 4=Good, 5=High Good and 6=Low Choice.

TABLE 18. GROWTH, CARCASS MEASUREMENT AND SLAUGHTER DATA ON YEARLING STEERS AND HEIFERS BY LEVEL OF FEEDING

Item	High	Low	S. E.	Prob.
No. of animals	4	4		
Birth wt. (lbs.)	73	67	3.99	——
Suckling gains (79 da.)				
Initial wt. (lbs.)	268	301	15.36	——
Final wt. (lbs.)	412	408	16.46	P>0.25
Av. da. gain (lbs.)	1.84	1.31	0.12	P<0.05
Performance test (154 da.)				
Initial wt. (lbs.)	412	408	16.46	P>0.25
Final wt. (lbs.)	688	639	26.65	P>0.25
Av. da. gain (lbs.)	1.78	1.50	0.11	P<0.10
Lbs. feed/100 lbs. gain	909	867	30.02	P>0.25
Age at slaughter (da.)	379	386	7.76	P>0.25
Live wt. - slaughter (lbs.)	672	623	25.51	P>0.25
Carcass wt. (lbs.)	407	355	12.94	P<0.05
Dressing percent	60.6	56.9	0.48	P<0.01
Carcass grade[a]	5.8	3.8	0.39	P<0.05
Carcass measurements (in.)				
Length of body	41.1	41.4	0.72	P>0.25
Length of loin	21.4	21.9	0.38	P>0.25
Depth of body	13.8	14.0	0.36	P>0.25
Length of leg	25.2	25.9	0.42	P>0.25
Loin eye area (sq. in.)	9.0	8.2	0.11	P<0.01
Width fat - loin eye (in.)	0.5	0.3	0.47	P<0.10

[a] Grading system: 3=Low Good, 4=Good, 5=High Good and 6=Low Choice.

TABLE 19. CARCASS DATA ON WEANLING CALVES BY LEVEL OF FEEDING

Item	High	Low	S. E.	Prob.
No. of animals	4	4		
Percent rib	7.4	7.4	0.09	P>0.25
" chuck	24.1	25.5	0.58	P<0.25
" plate	7.5	7.4	0.11	P>0.25
" brisket	4.7	4.6	3.04	P>0.25
" foreshank	5.2	5.6	0.14	P<0.25
" round (rump on)	26.5	27.5	0.39	P<0.25
" loin	14.6	14.4	0.04	P<0.01
" flank	6.3	5.1	0.37	P<0.01
" kidney knob	3.7	2.5	0.52	P<0.25
Comp. 9-10-11 rib (%)				
Lean	51.5	58.6	1.66	P<0.05
Fat	28.5	20.7	1.80	P<0.05
Bone	20.0	20.3	1.52	P>0.25
Prox. anal. - rib eye (%)				
Moisture	73.8	74.4	0.19	P<0.10
Fat	1.3	0.7	0.10	P<0.01
Shear test - rib steak (lbs.)	14.2	11.2	0.87	P<0.10
Taste panel (rib steak)				
No. of chews	22.8	18.6	1.02	P<0.05
Tenderness	6.7	7.4	0.24	P<0.10
Flavor	6.5	6.9	0.17	P<0.25
Juice	6.6	7.0	0.21	P<0.25

TABLE 20. CARCASS DATA ON YEARLING STEERS AND HEIFERS BY LEVEL OF FEEDING

Item	High	Low	S. E.	Prob.
No. of animals	4	4		
Percent rib	7.8	7.5	0.10	P>0.25
" chuck	24.6	25.4	0.37	P<0.25
" plate	8.6	8.1	0.19	P<0.25
" brisket	5.3	5.0	0.13	P>0.25
" foreshank	4.8	5.2	0.21	P<0.25
" round (rump on)	25.3	25.4	0.27	P>0.25
" loin	15.4	16.1	0.36	P<0.25
" flank	6.4	6.4	0.53	P>0.25
" kidney knob	1.1	0.9	0.14	P>0.25
Comp. 9-10-11 rib (%)				
Lean	55.8	51.4	3.32	P>0.25
Fat	34.5	29.6	1.87	P<0.25
Bone	12.9	17.1	1.70	P<0.25
Prox. anal. - rib eye (%)				
Moisture	72.6	72.3	0.46	P>0.25
Fat	2.5	3.3	0.66	P>0.25
Shear test - rib steak (lbs.)	15.5	16.0	1.32	P>0.25
Taste panel (rib steak)				
No. of chews	23.8	24.5	1.97	P>0.25
Tenderness	7.5	7.5	0.25	P>0.25
Flavor	7.3	7.3	0.10	P>0.25
Juice	7.3	7.2	0.00	P>0.25

The loin eye areas and the dressing percentages of the high level animals were larger than those of the low level animals. The high level weanling calves had a somewhat greater percentage of flank and loin in the carcass than the low level calves. Although some of the other differences were larger, they were of lower significance due to more overlapping of individual weights between levels of feeding.

Differences between high and low level of feeding groups in regard to average weight distribution were small and minor in significance in the yearling steer and heifer slaughter group.

SUMMARY

Three groups of cattle, from the Fort Reno Experiment Station, were visually classified into 14 non-comprest and 14 comprest animals at weaning time. Photographs taken of each animal at weaning were used to determine the main points considered in classifying the two types. Three ratios were devised from the weaning photograph measurements which effectively separated the two populations. These involved measures of height at withers, height of chest floor and depth of chest.

The three slaughter groups consisted of : (1) four non-comprest and four comprest Hereford weanling calves with an equal distribution of steers and heifers among the two types, and with each sex and type equally represented on a high (creep-fed) and low (non creep-fed) level of feeding regime; (2) four non-comprest and four comprest Hereford steer and heifer yearlings with an equal distribution of sexes among the high and low levels of feeding and (3) four non-comprest and four comprest Hereford and two non-comprest and two comprest Aberdeen Angus yearling bulls maintained from birth to slaughter on the same nutritional level.

Each group was fed and slaughtered on a time constant basis. Data on growth, feedlot performance, carcass grade, dressing percent, carcass measurement and carcass merit (using both sides) were collected from each animal.

Statistical analyses of the weanling calf and yearling steer and heifer slaughter data consisted of computing the means on the basis of type, sex and level of feeding. Probability statements were based on an F-ratio of variances resulting from the partitioning of variances according to type, sex, level of feeding and error.

Analyses of the yearling bull slaughter group observations consisted of calculating the means and standard deviations on the basis of type. Comparisons were made between the non-comprest and comprest bulls, using the t-test.

Probability statements given for the measurement ratios were based on a pooling of sums of squares for type and error from the two steer and heifer groups with the sums of squares for type and error from the yearling bull group.

The non-comprest class in all groups consistently differed from the comprest class in several ways. The non-comprest classes had: (1) heavier birth, slaughter and carcass weights; (2) higher rates of gain; (3) more economy of gain, where measured; (4) increased wither and chest floor height, but no consistent increase in chest depth; (5) consistently larger carcass measurements, especially in the length of leg; (6) higher percent moisture and lower percent fat in the 9-10-11 rib eyes and (7) consistently different live measurement ratios involving height of chest floor, height at withers and depth of chest.

Characteristics in which no consistent average differences were measured between type classes in all slaughter groups were: (1) carcass grade; (2) loin eye area; (3) distribution of carcass weight, as measured by the percentage of the various wholesale cuts in the carcass; (4) shear values of rib eyes and (5) organoleptic evaluation of rib steaks.

Additional differences between the non-compress and compress classes that were observed within one or two slaughter groups only were: (1) a higher carcass grade for the compress weanling calves and yearling steers and heifers; (2) heavier non-compress ribs, chucks, plates and foreshanks in the weanling calf group; (3) heavier non-compress rounds in the yearling steer and heifer group; (4) a slight increase in percentage of plate and brisket in the compress yearling steers and heifers; (5) heavier chucks in the non-compress yearling bulls; (6) a greater percentage of chuck and round and a lesser percentage of rib and brisket in the non-compress yearling bulls; (7) a greater percent of lean in the 9-10-11 rib section of the compress bulls and (8) a higher yield in the non-compress weanling calves and yearling steers and heifers.

It was concluded that the compress animals observed in this study were not consistently different from the non-compress animals in either weight distribution or important measures of carcass quality. Unless a premium were being paid for the animal of smaller size, no marked advantage was seen for the compress type animal over its non-compress type segregate.

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