Feedlot Performance of Hereford and Holstein Steers as Affected by Ration and Slaughter Weight

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FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF HEREFORD
AND HOLSTEIN STEERS AS AFFECTED BY RATION AND
SLAUGHTER WEIGHT

BY
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FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF HEREFORD AND HOLSTEIN STEERS AS AFFECTED BY RATION AND SLAUGHTER WEIGHT

This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable as meeting the thesis requirements for this degree, but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.
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INTRODUCTION

In 1918 the Bureau of Markets, now the Bureau of Agricultural Economics, of the United States Department of Agriculture inaugurated its market reporting service on livestock in Chicago. At that time a uniform standard was set up for market classes and grades of cattle. The use of these uniform descriptions for all classes and grades of cattle throughout the country by researchers, producers, selling and buying agencies and packers has contributed a great deal to the orderly marketing of cattle and to the reporting and exchange of research information.

The grade of a particular animal is determined by the apparent relative excellence and desirability of the animal for its particular use, be it for feeding or for slaughter. The grade for a feeder is based on its conformation, quality, breeding, constitution, capacity and condition. Slaughter cattle are graded on the basis of their relative excellence with respect to conformation, finish, quality and maturity or age (Snapp and Neumann, 1960). However, the grade placed on cattle does not necessarily always reflect the animal's ability to perform in the feedlot or its carcass quality.

Under present grading standards plainer, upstanding, rangy cattle as typified by dairy breeds are placed in the low standard feeder grade, and when sold on a live basis for slaughter are usually placed in the standard or good grade. However, recent research on carcass characteristics with this type of cattle and the beef breeds has not shown as wide differences in value of the carcass as were commonly
thought to exist. The fact that carcasses from dairy-bred cattle grade lower than those from beef type cattle is due mainly to their poorer conformation. Conformation has no effect on quality of the meat and Murphey et al. (1960) stated that finish was 4.5 times as important as conformation in predicting yields of closely trimmed, mostly bone-in retail cuts from the round, loin, rib and chuck. Recent changes in government grading standards, which put more emphasis on quality and less on conformation, has benefited plainer types of cattle somewhat on market grade.

It appears to have been common in the past to feed lower grading feeder cattle with a low energy ration and not attempt to feed them to the higher slaughter grades. Recent research, however, has questioned this practice and suggests that higher energy rations may improve the performance and slaughter grade of this type of cattle considerably.

The purpose of this investigation was to determine the effects of energy content of rations on performance of dairy-type and beef-type steers using Holsteins and Herefords as representatives of the two types. Another objective was to study the influence of final weight and condition on performance at each level of energy for the dairy-type and beef-type steers. Weight gains, feed consumption, feed efficiency and carcass characteristics were used as measures of performance.
Comparison of the Feedlot Performance and Carcass Characteristics Between Types of Cattle

Some work has been reported comparing various breeds of cattle which, in effect, is comparing types of cattle. Comparisons which have been reported between beef, Zebu and dairy breeds have often involved other factors such as age, weight and previous levels of feeding. Older animals with a previous history of restricted feeding may have an advantage in the feedlot. These factors should be taken into consideration in evaluating feedlot performance of groups of cattle which differ in feeder grade or "type" classification. The breeds of cattle within the beef, Zebu and dairy breeds may also differ in type and consequently in feedlot performance and carcass characteristics. It is well known that even within breeds animals vary considerably in gaining ability, feed efficiency and carcass traits. The following literature review will be concerned with work that has been reported comparing breeds and types of cattle differing in mature size and body conformation. Cross-breeding, as such, will not be considered because of the heterosis effect that may be encountered.

Only a limited amount of data has been published that has been concerned strictly in comparing beef breeds. Butler et al. (1962) compared 53 Hereford and 51 Angus steer calves that originated from several sires and ranch locations in the Edwards Plateau Region of Texas. The calves were fed a standard fattening ration for 186 days. They showed Herefords to have an advantage in daily gain (2.37 vs. 2.25
lb.) and a slightly better feed conversion. There was no significant difference in dressing percent, although Hereford hides were 16 lb. heavier. The Herefords had a carcass grade of high good while the Angus graded choice. No significant difference was found in tenderness as determined by the Warner-Bratzler shear test. A slightly higher yield of wholesale cuts was reported for the Herefords (46.29%) as compared to the Angus (44.95%). Somewhat in contrast to this trial was one reported by Powell et al. (1961) in which no differences were found in feedlot performance between 48 Hereford and 48 Angus steer calves fed for 185 days. Hides from Herefords were 12 lb. heavier which is in agreement with the studies of Butler et al. (1962). Rib-eye area was significantly larger for the Angus as was carcass yield, but backfat was equal. Although the Angus had superior conformation as scored by a U.S.D.A. grader, they had a lower cut-out value. The Angus also had better marbling scores, but they did not produce more tender meat.

Most of the work that has been reported comparing breeds and types of cattle has been done using beef, Zebu and dairy breeds. DeRouen et al. (1961) reported that Angus steers gained only slightly more (1.68 vs. 1.61 lb. daily) than Brahman steers when full-fed on pasture. The Angus steers graded good while the Brahman steers graded high standard. They found the group of 13 Angus steers to have an average shear value of 15.5 lb. while a like number of the Brahman steers had a shear value of 25.8 lb., the lower shear value indicating more tender meat. In contrast to the above experiment, Hargrove et al. (1959) reported Brahman to have a significant advantage in rate of
gain and feed efficiency over Shorthorns in a 70-day trial. They used 12 steer and 12 heifer calves that were 2 to 4 months old from each breed. Concentrates were fed ad libitum to half of each breed and sex and the other half at 2% of body weight with hay at 1 lb. per day.

Hereford, Brahman crossbred and Charlais steers weighing about 800 lb. were full-fed ground ear corn along with 2 lb. daily of alfalfa-brome hay and 2 lb. of soybean meal in a trial by Mieske et al. (1965). The steers were marketed when the average lot weight was 1100 lb. Herefords gained the fastest and reached 1100 lb. 21 days sooner than the Charlais and 49 days sooner than the Brahms. Feed per 100 lb. gain was 888, 934 and 951 lb. for the Herefords, Charlais and Brahms, respectively. Herefords rated higher on marbling, conformation and carcass grades while the Charlais had less backfat, larger rib eyes and a higher percent of retail cuts.

Herefords were compared to Charlais in another experiment by Klosterman et al. (1965) using two systems of management. In one system calves were creep-fed, fattened in drylot and slaughtered at 12 to 14 months of age. In the other system noncreep-fed calves were wintered, pastured one season, fattened in drylot and slaughtered at 18 to 20 months of age. No interactions between breeds and systems of management were noted. There were no large differences between breeds in feed efficiency, although the Charlais gained significantly faster while on feed. No differences were observed in dressing percent or tenderness score. Rib-eye area and percent edible portion were significantly
greater and fat thickness significantly less for Charlaïs while carcass grade and marbling score were significantly better for Herefords.

British, Zebu and dairy breeds were compared by Cole et al. (1963), Cole et al. (1964), Ramsey et al. (1963) and Ramsey et al. (1965) over a 5-year period. One hundred fifty-four steers of 6 breeds which included Angus, Hereford, Brahman, Santa Gertrudis, Holstein and Jersey were used in the study. All the cattle were full-fed a high-concentrate ration under similar conditions from 2 to 4 months of age to a weight of 900 lb. or 20 months of age. Of the two British breeds, Hereford steers gained slightly faster than Angus with a better feed efficiency. The Angus steers graded and dressed significantly higher and also had more marbling and kidney fat. Hereford carcasses had significantly longer loins and legs and plumper rounds. Both British breeds graded significantly higher, had more marbling, were fatter, and they had shorter carcasses, legs and loins than the other breeds. Holstein steers gained the fastest of all breeds with lower feed requirements, and they were followed in order by Santa Gertrudis, Hereford, Angus, Jersey and Brahman in average daily gain. Holstein carcasses graded lowest, had the least marbling and external fat covering, were deepest in the chest and longest legged of all the breeds.

Detailed carcass characteristics on these same cattle were reported by Ramsey et al. (1965). They stated that Jerseys had a significantly lower dressing percent than Holsteins and that both dairy breeds dressed significantly lower than the other breeds. Angus steers dressed highest followed by Hereford, Brahman and Santa Gertrudis. In
an earlier publication when only 32 animals had been observed from the 6 breeds, Cole et al. (1958) found only small differences in cutting yields of various wholesale cuts between breeds, although the dairy breeds had the highest total mean percent of round, loin and rib and the lowest percent of thin cuts. In further work on carcass characteristics, Cole et al. (1964) stated that the short shanked, blocky, thickly fleshed Angus carcasses had the lowest percent separable muscle, separable bone, moisture, protein, round, loin, chuck and foreshank and the highest percent separable fat, ether extract, flank and brisket. Herefords followed the Angus quite closely in all categories. The long shanked, long bodied, angular Holstein carcasses had the highest percent separable muscle, separable bone, moisture, protein, round and foreshank. They were lowest in percent separable fat, ether extract and flank. The Zebu breeds followed the Holsteins quite closely while the Jersey cattle varied somewhat in the various characteristics.

Ramsey et al. (1963) found both round and loin steaks from Zebu type steers were scored lowest on tenderness by a 6-member technical taste panel and a 30-member family taste panel. Dairy type steers scored highest and British types were intermediate. Shear values showed a similar relationship among types. Total cooking losses for both loins and round steaks were least for dairy types and greatest for Brahman.

In a trial comparing Holsteins and Herefords, Kidwell and McCormick (1956) used steers initially weighing about 758 lb. for both breeds. The Herefords were 20 months old and the Holsteins were 15 months old when the trial began, indicating the Holsteins had previously
grown faster than the Herefords. The 7 steers from each breed were individually full-fed a fattening ration for 140 days. Slaughter weight was 1090 lb. for the Holsteins and 1017 lb. for the Herefords. Average daily gains for the Holsteins and Herefords were 2.34 and 1.66 lb. This difference was highly significant as was feed efficiency in favor of the Holsteins. They reported a small advantage in dressing percent for the Herefords (59.5 vs. 59.0). In another experiment reported in the same publication where Herefords were fed a high-concentrate ration and Holsteins a high-hay ration, the Herefords dressed 62.2% while the Holsteins dressed only 57.9%. A higher proportion of fat and a lower proportion of bone and muscle were observed in the Herefords.

Several trials have been reported by Burroughs et al. (1963, 1964, 1965) comparing the feedlot performance of various grades of feeder steers. They reported that plainer cattle performed fully as well in the feedlot as higher quality feeder cattle. In 1962 the feeder grades of choice, good, medium and common were compared. (In 1964 the common and medium feeder grades were changed to standard to make feeder grades correspond to slaughter grades.) The choice and good grades were represented by Hereford breeding, the medium grade by dairy and beef crossbreeding and the common grade by Holstein or Brown Swiss breeding. The average initial weight was about 775 lb. for the 72 steers and the final weight ranged from 1150 to 1330 lb. The cattle received a full feed of ground corn plus 2 lb. of protein supplement daily for the 160-day feeding trial. One choice, one good, one medium and three common (2 Holstein and 1 Brown Swiss) feeders were allotted to each pen. The
choice and common grades each gained about 3.00 lb. daily while the good and medium grades gained 2.82 and 2.55 lb. daily, respectively. Although the authors reported feed efficiency, its accuracy is questionable because the assumption was made that all cattle ate the same amount of feed. It has been shown that consumption of feed varies considerably with type and weight of cattle. The upper three feeder grades had carcass grades of choice while the common grade feeders graded high good. Dressing percent decreased with lower feeder grades as choice, good, medium and common grades dressed 60.7, 60.2, 58.7 and 57.9%, respectively. Choice and good feeders had 0.06 in. fat cover per 100 lb. of carcass while medium had 0.05 in. and common 0.03 in. No differences were noted in rib-eye area.

The following year a similar trial was conducted. Only Holsteins were used to represent the common feeder grade because of the similarity of performance the previous year between Holsteins and Brown Swiss. Hereford breeding was again used for the choice and good grades while dairy and beef crossbreds were used for the medium feeder grade. Each grade was fed in separate lots so feed consumption could be measured. The cattle initially averaged about 760 lb. except for the Holsteins which averaged 824 lb. Slaughter weight was about 1270 lb. for all cattle except the Holsteins which weighed 1359 lb. A full feed of ground ear corn, 5 lb. of mixed hay and 1 lb. of a protein supplement were fed daily for the 198-day feeding trial. The common grading Holsteins had the best average daily gain (2.70 lb.) followed by good (2.67 lb.), medium (2.52 lb.) and choice (2.49 lb.). The average daily
ration and feed per 100 lb. of gain were (lb.): 21.9, 879; 23.0, 861; 22.2, 881 and 24.6, 911 for the choice, good, medium and common grades, respectively. The slightly higher daily gain by the common feeders was offset by the higher feed consumption resulting in slightly higher feed requirements for this group. Slaughter grades averaged low choice for the three upper feeder grades and good for the Holsteins. Dressing percent again favored the upper feeder grades amounting to 61.8, 61.4, 60.2 and 58.9%, respectively, from the highest to lowest feeder grade.

Further work on carcass characteristics of these same cattle was reported by Mealy et al. (1964). They found Holstein steers to yield 53.2% of the carcass in estimated retail cuts as compared to 47.9% for choice Herefords. This higher cutability along with a smaller shrink about offset the lower dressing percent of the Holsteins so cutability on a live weight basis averaged about the same. Holsteins had 0.2 in. of fat over the 12th rib as compared to 0.7, 0.6 and 0.4, respectively, for the choice, good and medium grades. As in the earlier trial reported by Burroughs et al. (1963), essentially no differences were noted between breeds in the size of rib eye. The Warner-Brazier shear test showed the Holstein steers to have more tender meat. Choice Hereford steers had a shear value of 28.2 lb. as compared to the Holsteins which had a shear value of 21.7 lb. The meat from steers starting the trial as good and medium feeders had shear values of 22.1 and 25.0, respectively.

As part of a more comprehensive experiment, Burroughs et al. (1965) compared 491 lb. Holstein steers with 467 lb. Angus steers.
They were fed for 234 days on a full feed of corn silage, 6 lb. of cracked corn and 2 lb. of protein supplement. The Holsteins outgained the Angus steers (2.77 vs. 2.27 lb. daily) but ate more feed (21.7 vs. 17.6 lb. daily) which made the difference in feed per pound of gain very small (783 vs. 775 lb.). A taste panel noted no difference in tenderness, juiciness or flavor from meat from the two groups and no differences in tenderness were shown when the Warner-Bratzler shear test was used.

Summarizing the three trials conducted by Burroughs et al., the Holsteins consumed 10% more feed and gained 10% faster per animal than good and choice beef-bred animals, which made their feed required per unit of live gain about equal. Net returns favored Holstein steers all 3 years, averaging $24.00 more per steer when sold on a grade and yield basis, but this was due exclusively to lower purchase prices and also would have been wiped out had the Holsteins been sold on a live-bid basis. The Holsteins had a 3.1% lower dressing percent and averaged one-half grade lower in the carcass.

Eight steers each of the Holstein and Hereford breeds were selected on basis of equalized physiological age in a test by Carroll et al. (1964). The Holsteins were 28.4 months old and the Herefords were 22.2 months when put on feed. An attempt was made to get the Holsteins to reach the same degree of quality when slaughtered as obtained by the Herefords which resulted in a longer feeding period for the Holsteins. Average slaughter weights for the Holsteins and Herefords were 1227 and 1110 lb., respectively. Conformation, quality
and over-all carcass grade for the Holsteins was high standard, average choice and average good and for the Herefords was high choice, average choice and average choice. Although the Holsteins were over 100 lb. heavier at slaughter, they dressed only 58% compared to 62% for the Herefords. The Herefords had more outside fat, significantly larger rib-eye areas and less bone than Holsteins.

Dunsing (1959) compared consumer preference between Holstein and Hereford meat. The same cattle were used that Carroll used in his comparison of the carcass characteristics of Holsteins and Herefords. A taste panel was selected from married students in their early 20's at the University of California. Visual preferences did not appear to be related to breed except for color, a preference being indicated for the darker-colored steaks of the Holstein. Eating preferences were significantly related to breed and grade. The quality grade grouping gave a better indication of the effects of both breed and grade than did the carcass grade grouping. For the two groupings, eating preference of panel members tended to be reversed for the wholesale cuts; they were in favor of Holsteins for steaks from the short loin cut and of Herefords for those from the sirloin cut. Average differences between breed ratings for the over-all preference categories indicated that for Herefords the degree of preference was highest for tenderness, for Holsteins it was highest for taste.

In an experiment conducted over a 3-year period (1935-38) comparing the cutability and eatability of beef-type and dairy-type cattle, Branaman et al. (1962) used a total of 25 Holsteins and 23 Herefords
plus 2 Shorthorns. The cattle were fed for 188, 183 and 272 days in each of the 3 years. The beef-type steers had a 3% higher carcass yield and graded choice as compared to standard for the Holsteins. No appreciable differences were found between types in percent of high priced wholesale cuts or total trimmed retail steaks. Also, the difference in percent separable lean in the carcass was negligible. Roasts from beef-type steers had a greater shrinkage during cooking. They were rated significantly higher for intensity of lean flavor and for quality and quantity of juiciness. No significant difference was noted in tenderness as measured with either the Warner-Bratzler shear test or by taste panel scoring.

From the work that has been reviewed it appears that there are differences between breeds or types of cattle in feedlot performance and carcass characteristics. In some cases differences are consistent, while in others results are contradictory. Dairy breeds, especially the larger breeds such as Holsteins, have been shown to be at least equal, and often superior, to beef breeds in feedlot performance. Generally, Holsteins gained faster but also ate more feed. Cole et al. (1963) and Kidwell and McCormick (1956) reported Holstein steers as having lower feed requirements while Burroughs et al. (1965) reported equal feed requirements for dairy and beef breeds. When Zebu breeds were studied, they were between beef and dairy breeds in most respects.

Dairy type steers were reported to have the lowest carcass grade in all studies, with beef-type highest and other breeds falling in between. All reports agreed that dairy steers dressed significantly
less than beef steers except Kidwell and McCormick (1956) who reported no difference when Holstein and Hereford steers were fed similar rations. Charlaïs and Holsteins have generally been shown to have a higher percent of their carcass in boneless, trimmed retail cuts as compared to British breeds due mainly to their lower content of subcutaneous fat. Dairy-type cattle when compared to beef-type cattle seem to have a higher portion of the carcass as bone. Charlaïs have been reported to have larger rib eyes than British breeds of cattle. British breeds had larger rib eyes than dairy breeds in most reports; however, Mealy et al. (1964) and Burroughs et al. (1963) showed essentially no differences between breeds in the size of rib eye in their work with Holsteins and Herefords. Marbling scores are usually better for the beef breeds with the dairy breeds lowest and Zebu breeds in between. Most trials showed either no differences in tenderness and taste between meat from beef or dairy types, or they showed a slight advantage for the meat from dairy steers.

**Comparison of Concentrate to Roughage Ratios and Length of Feeding Period for Different Types of Cattle**

The fact that cattle fed high-concentrate rations usually gain faster than those fed high-roughage rations is quite well established. This is true because each pound of dry matter consumed contains more total digestible nutrients. As a result of this faster gain, cattle fed a high-concentrate ration usually finish faster and tend to grade higher than those fed a lower concentrate ration. Another fact that is generally well accepted is that as cattle are fed to heavier weights
their rate of gain slows down and their feed consumption goes up resulting in a poorer feed conversion. Both live and carcass grades are usually improved with a longer feeding period and fat covering is usually greater with the longer time on feed. However, the different types of cattle are not necessarily affected to the same degree with changes in energy level and length of feeding period.

Some work has been reported on how the concentrate level and the length of feeding period affects different types of cattle. Albert et al. (1965) in each of 2 years conducted a trial with 4 type groups of 16 steer calves each, comparing the influence of type, slaughter weight and energy level on live and carcass grades of steers. The four type groups were represented by Holstein, Angus x Holstein, Charlais x Angus and Angus. All the steers initially averaged 550 lb. and were slaughtered in four weight groups—675, 850, 1025 and 1200 lb. They were self-fed one of two dietary levels of energy which had 60% or 70% TDN. No interactions were reported between type, slaughter weight or energy level. Steers receiving the higher energy ration had a higher final slaughter grade. Also, the high-energy ration significantly \( (P<.01) \) increased the rate and efficiency of live and carcass gains. As the cattle became heavier, live and carcass grades improved, but at the expense of rate and efficiency of live gain. Holstein and Holstein x Angus cross gained significantly \( (P<.01) \) faster and more efficiently than the other two groups. As the amount of beef breeding increased, the carcass grades were improved.
Callow (1961) reported on a trial with Herefords, Dairy Shorthorns and Friesian steers. Twenty-four steers were used in this 4-year study that involved several planes of nutrition. The planes of nutrition are referred to as high-high, high-moderate, moderate-high, and moderate-moderate. The first level of feeding refers to the first 8 months while the second level refers to the rest of the feeding period, its duration depending upon how fast they gained. The steers were slaughtered when the average grade for the group was special (British grading system). Average age at slaughter was 744, 760, 923 and 1213 days, respectively, for high-high, moderate-high, high-moderate and moderate-moderate levels. Average weight on all planes of nutrition for the Friesians was 1419 lb. followed by Milking Shorthorns (1289 lb.) and Herefords (1208 lb.), indicating that Herefords fatten more rapidly than Milking Shorthorns and Milking Shorthorns faster than Friesians. There appeared to be no interactions between breeds and plane of nutrition. Herefords had 1.5% heavier hides than the Shorthorns and 1.8% heavier than the Friesians. The Friesians had a higher proportion of bone than the other two breeds. The milk breeds had a high proportion of fat in the body cavity, which includes kidney fat, and a low proportion in the subcutaneous layer of fatty tissue. This was reversed for the Herefords. Taste panels showed no differences between the breeds studied.

Burroughs et al. (1965) reported an interesting experiment using various energy levels and lengths of feeding period for Angus and Holstein steers of different initial weights. Angus steer calves
initially weighing 467 lb. were compared with 491 lb. Holstein steers. These calves were full-fed corn silage, 6 lb. of cracked corn and a protein supplement. The Holsteins were compared to another group of Holsteins with a similar starting weight but full-fed ground ear corn plus a protein supplement, and still another group of 491 lb. Holsteins were fed corn silage and supplement with no grain added. The group of Holsteins receiving a full feed of ground ear corn was compared with two other groups receiving the same ration. One of the groups had an initial weight of 617 lb. and the other group weighed 819 lb. initially. All the cattle were slaughtered at about 1150 lb. Days on feed ranged from 97 for the heavy Holstein group to 245 for the all roughage, light Holstein group. There were 12 steers in each group. Holstein steers gained best with the highest energy finishing ration containing substantial amounts of corn grain. As more grain was added, fewer pounds of feed were required per unit of gain, but total pounds of digestible nutrients required for each pound of gain were reversed, with the greatest amount being required with the highest amount of grain. As more grain was added, dressing percent and carcass grade improved.

The main difference between long-fed Holsteins and short-fed Holsteins was grade and yield. Even though the long-fed Holsteins yielded 2% higher and graded more than a full Federal grade higher than the short-fed steers, they did not show a greater finish prior to slaughter. The long-fed steers were sufficiently finished to grade 50% choice and 50% high good. Nevertheless, these steers had only 0.2 in.
loin fat cover which was only slightly more than the short-fed Holsteins and was substantially less than the similarly fed Angus steers. Burroughs stated that possibly the failure to show finish visually is why well-finished Holstein steers sell best on a grade and yield basis.

A trial dealing strictly with energy levels for Holstein steers was conducted by Miller et al. (1966). They started calves at about 400 lb. and sold them when the lot averaged 1000 lb. Rations were self-fed throughout the trial. Five pens of 6 Holstein steers were fed rations with a concentrate to roughage ratio of 11:1 for the entire feeding period. Five pens of similar steers were fed a ratio of 1:3 until they reached 750 lb. and were then switched to the ration with a concentrate to roughage ratio of 11:1. A similar number of steers were fed a ration with a concentrate to roughage ratio of 1:3 for their entire feeding period. Steers fed the high-hay ration to 750 lb. and then finished on the high-grain ration gained 2.82 lb. daily as compared to 2.56 lb. for those fed high-grain and 2.37 lb. for those fed high-hay during the entire feeding period. The faster gaining steers had higher carcass grades and returned more over initial and feed costs. Carcass grades ranged from high standard for the high-roughage group to average good for those fed high-roughage at first and finished on high-grain. Summarizing this experiment and a previous one conducted by the same workers where a concentrate to roughage ratio of 1:1 was used instead of 1:3, the authors stated that Holstein steers fed rations containing higher amounts of grain required less feed per 100 lb. gain than steers fed rations with higher amounts of hay. Feed
costs per 100 lb. gain, however, were in favor of steers fed concentrate to roughage ratios of 1:1 or 1:3. Carcass grade, marbling score and fat depth over the rib eye were higher for steers fed rations containing the higher proportions of grain. The authors suggest that, since those fed higher roughage diets did make economical gains, they could be fed longer to improve carcass characteristics.
METHODS OF PROCEDURE

Hereford and Holstein steers were fed two rations with different levels of energy using two lengths of feeding periods. Low moisture alfalfa-brome forage (haylage or "reconstituted" haylage) was fed at 50 and 20% of the ration to obtain the two levels of energy. One feeding period was selected as that necessary to obtain a market weight and finish considered desirable for the Holstein steers. This resulted in a feeding period of 216 days. The other feeding period was selected as that necessary to obtain a market weight and condition considered desirable for the Hereford steers. In this case the steers were fed for 265 days.

Sixty-four steers from each of the two breeds were purchased for the experiment. The Hereford steers were purchased from a rancher in central South Dakota. They arrived in Brookings early in January, 1965, where they were put on a full feed of alfalfa-brome hay and 2 lb. of a protein supplement prior to the start of the trial. The Holstein steers were purchased by a cattle buying firm in northern Minnesota. They arrived in Brookings early in February and were treated similar to the Herefords prior to the start of the trial. One of the Holsteins died before the experiment was started.

On February 10, 1965, all the cattle were weighed for an initial filled weight. The steers were stratified according to weight within their respective breed and randomly assigned to one of 16 lots with 8 steers per lot except for 1 lot of 7 Holsteins. The following morning, after withholding feed and water for about 18 hours, initial shrunk
weights were taken and the steers sorted into their respective lots. At this weighing the average weight was about 500 lb. for each group.

Half of the lots of each breed were randomly assigned to the 20% roughage-80% grain ration and the other half to the 50% roughage-50% grain ration. Half of each breed and roughage level were fed for 216 days and half were fed for 265 days.

All the steers were implanted with 36 mg. of diethylstilbestrol 1 week after the beginning of the experiment and again 6 months later. Trace mineral salt, dicalcium phosphate and limestone were offered separately on a free-choice basis. The steers were fed in 24' x 32' paved lots without shelter. Feed was fed in fenceline bunks, and water was provided from an automatic watering cup connected to a continuous circulating system.

The roughage used for the first part of the trial was "reconstituted haylage" which was stored in a concrete stave silo or an air-tight silo with an equal number of lots being fed from each silo. The haylage was made from alfalfa-brome hay that had been baled the preceding summer and stored under a pole-type hay shed. In late October and early November of 1964 the silos were filled. The hay was chopped by means of a forage chopper with a hay head attachment and blown into automatic unloading forage wagons. Water was added as the forage was chopped. The loads were all weighed and the forage was blown into the silos with water added again at the blower. Samples were taken prior to the addition of water at the blower for moisture and protein analyses. Average moisture content of the forage at this
point was 32.8% for the concrete stave silo and 31.2% for the air-tight silo. Average moisture content as fed averaged 45.7% for the concrete stave and 35.3% for the air-tight silo.

On July 24, 1965, the air-tight silo was emptied. Lots fed from this structure were then fed ground alfalfa-brome hay until the silo could be refilled, which was 4 days later. Roughage to concentrate ratios were readjusted so the same proportion of dry matter was furnished by the ground hay as by the haylage. The silo was refilled with second-cutting alfalfa haylage with a moisture content of about 50%. The steers were again fed from the air-tight silo at the same roughage to concentrate ratio as when they were initially put on trial.

On August 12, the concrete stave became empty and the lots that had been fed from this silo were also transferred to the haylage from the air-tight silo. Thereafter, all lots received the forage from this silo.

Shelled corn that had been rolled to a minimum degree of fineness was used as the concentrate source. A protein supplement of 44% soybean meal with 10,000 I.U. of vitamin A per pound was fed at 1 lb. daily to the cattle receiving the 20% roughage ration. Those fed the 50% roughage ration received no protein supplement.

Steers receiving the 20% roughage ration were started on feed with 8 lb. of haylage and 4 lb. of rolled shelled corn per head daily. Haylage was decreased at the rate of 0.5 lb. per head daily and corn was increased by the same amount until the steers reached the 20-80 ratio. The total amount of feed was then raised daily until the cattle
were on full feed after about 3 weeks. The forage and grain were fed separately but in the proper ratio once each day.

Steers fed the 50-50 roughage to concentrate ration were also fed 8 lb. of haylage and 4 lb. of rolled shelled corn per head daily initially. The haylage was decreased and the corn increased by 0.5 lb. per head daily until the 50-50 ratio was reached. After this point was reached, the total feed fed was raised by 1.0 lb. per head daily until the cattle were on full feed after about 2 weeks. Thereafter, feeding was in the same manner as for those fed the lower roughage rations.

Individual weights were obtained approximately every 28 days and also when each silo became empty. Average lot weight, daily gain, feed consumption and feed efficiency for each period were calculated.

Samples of the corn and haylage were taken weekly for moisture determinations. Samples were dried for 1 week in a forced-air oven at 86° C. A composite sample was made of each type of feed once each month. This composite was ground and then analyzed for moisture and protein.

The experiment was terminated for the steers fed for 216 days on September 14, 1965. They were weighed at about 5:00 a.m. for a final filled weight and trucked 75 miles to a slaughter plant. Upon arrival at the plant (about 9:00 a.m.) the steers were again individually weighed, this weight being the shrunk weight. Weight gains for the experiment were calculated on the basis of initial and final shrunk weights. The cattle were slaughtered shortly after being weighed and the livers and digestive tracts were examined for abnormalities.
The carcass data were collected the following day. A government grader placed the conformation, quality and over-all carcass grade on each animal along with the marbling score, maturity, color score, firmness score and estimated percent kidney fat. The hot carcass weight was obtained and the cold carcass weight was calculated from this figure by multiplying by 0.9825. The cold carcass weight was then used in calculating dressing percent. Tracings were made of the rib-eye area for measurements of the area of lean and fat thickness.

The yield of boneless, trimmed retail cuts from the round, loin, rib and chuck was estimated using the U.S.D.A. formula for estimating retail cuts (Murphey et al., 1960). The formula is as follows: 51.34 - (5.784 x fat thickness over the rib eye in inches) - (0.0093 x carcass weight in pounds) - (0.462 x estimated kidney fat as a percent of carcass weight) + (0.74 x rib-eye area in square inches). This formula was developed using actual yield of cuts on 162 steer, heifer and cow carcasses of prime through canner grades and most of the conventional weights. The simple correlation coefficient between this estimated yield of cuts and the corresponding actual yield of cuts was .906 on these cattle.

The steers on the 265 day feeding period were marketed November 2, 1965. The same marketing procedures were used on these as on the previous group and the same carcass data were collected. The data were analyzed by analysis of variance according to the procedures described by Steele and Torrie (1960).
RESULTS AND DISCUSSION

Feedlot Performance

There appeared to be no important difference in performance between steers fed haylage from the concrete stave and air-tight silos at either level of the forage. Therefore, the results from the steers fed from the two structures have been combined and presented in table 1.

All the treatments had 16 steers except for the Holsteins fed the 50% roughage ration. The group fed for 216 days started the trial with only 15 steers, one died and one was removed because of a leg injury. One steer also died in the group fed for 265 days. Results are presented only for those finishing the trial. An average amount of feed was deducted when a loss occurred.

Weight Gains. Some sizable differences in rate of gain were obtained between types of steers, roughage level of rations and days fed. However, none of the differences were statistically significant in this experiment.

A faster rate of gain was obtained from the higher energy ration with both breeds of cattle and for each length of feeding period. However, the higher energy ration showed a more favorable response when fed for 216 days in comparison to the longer feed of 265 days. Herefords and Holsteins gained 1.68 and 19.5% more when fed the rations with 20% haylage for 216 days than when fed the 50% haylage rations but only 5.8 and 10.2% more when fed for 265 days. Apparently Holsteins responded better to the higher energy rations than did Herefords.
Table 1. Feedlot Performance

<table>
<thead>
<tr>
<th>Haylage level</th>
<th>Hereford</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>20%</td>
<td>50%</td>
<td>20%</td>
<td>50%</td>
<td>20%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Days on feed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>216</td>
<td>265</td>
<td>216</td>
<td>265</td>
<td>216</td>
<td>265</td>
<td></td>
</tr>
<tr>
<td>No. steers</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>Init. shrunk wt., lb.</td>
<td>506</td>
<td>505</td>
<td>505</td>
<td>504</td>
<td>494</td>
<td>490</td>
<td>492</td>
</tr>
<tr>
<td>Final shrunk wt., lb.</td>
<td>1107</td>
<td>1178</td>
<td>1019</td>
<td>1138</td>
<td>1168</td>
<td>1207</td>
<td>1055</td>
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<tr>
<td>Av. daily gain, lb.</td>
<td>2.78</td>
<td>2.54</td>
<td>2.38</td>
<td>2.40</td>
<td>3.12</td>
<td>2.70</td>
<td>2.61</td>
</tr>
<tr>
<td>Av. daily feed consumption, lb.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Haylage, air-dry</td>
<td>2.80</td>
<td>2.63</td>
<td>7.91</td>
<td>8.08</td>
<td>3.18</td>
<td>3.01</td>
<td>9.72</td>
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<tr>
<td>Rolled shelled corn</td>
<td>15.64</td>
<td>15.48</td>
<td>12.33</td>
<td>13.39</td>
<td>18.06</td>
<td>17.88</td>
<td>14.69</td>
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<tr>
<td>Protein supplement</td>
<td>0.99</td>
<td>0.99</td>
<td>0.99</td>
<td>0.99</td>
<td>0.99</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>Feed per 100 lb. gain, lb.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haylage, air-dry</td>
<td>100</td>
<td>104</td>
<td>332</td>
<td>338</td>
<td>102</td>
<td>111</td>
<td>374</td>
</tr>
<tr>
<td>Rolled shelled corn</td>
<td>562</td>
<td>609</td>
<td>528</td>
<td>560</td>
<td>580</td>
<td>662</td>
<td>567</td>
</tr>
<tr>
<td>Protein supplement</td>
<td>35</td>
<td>39</td>
<td>860</td>
<td>898</td>
<td>714</td>
<td>810</td>
<td>941</td>
</tr>
<tr>
<td>Total, air-dry</td>
<td>697</td>
<td>752</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

*Holstein*
Rate of gain was reduced by the longer feeding period for both breeds of cattle when fed 20% haylage rations, amounting to 8.6 and 13.5%, respectively, for Herefords and Holsteins. Only Holsteins showed a lower rate of gain for the longer feeding period when fed rations with 50% haylage (6.1%). It would thus appear that the Holsteins slowed down in rate of gain earlier than did Herefords and to a greater extent with the lower energy rations.

**Feed Consumption**

Haylage values shown in table 1 have been converted to a 12% moisture basis. Percent of roughage in the rations was calculated on an as-fed basis which is the reason for the amounts consumed varying from the 20 or 50% levels shown in the headings for the table. On an air-dry basis the roughage levels amounted to about 15 and 39% of the ration.

Average daily feed consumed was greater for steers fed the higher level of roughage. However, the larger amount of haylage reduced intake of concentrates with the reduction being slightly greater for the shorter feeding period and for Herefords in comparison to Holsteins. The reduction in intake of corn and supplement per pound of air-dry haylage for Herefords amounted to 0.84 and 0.57 lb., respectively, for the 216- and 265-day periods and 0.67 and 0.51 lb. for Holsteins.

Average daily feed consumed was reduced by the longer feeding period when steers were fed the 20% haylage rations. However, feed consumption was greater for steers fed the longer time on the 50% haylage rations. Holsteins consumed significantly ($P<.05$) more feed
than did Herefords with the difference being greater with 50% haylage rations.

Feed Efficiency

Rather low feed requirements were obtained from the 20% haylage rations when fed for 216 days. While Holstein steers gained faster than Hereford steers on this ration, they also consumed more feed resulting in only small differences in feed efficiency between types of cattle in this comparison.

When fed the 20% haylage ration an additional 49 days (265 total), feed requirements were increased. The increase over the shorter feeding period was greater for Holstein than for Hereford steers, amounting to 13.4 and 7.9%, respectively. The Holstein steers were heavier than Hereford steers when fed the same number of days. Herefords fed the 20% haylage ration for 265 days and Holstein steers fed this ration 216 days had about the same final weight. In this comparison, Holsteins required 5.1% less feed per 100 lb. of gain.

Increasing the haylage level to 50% of the ration resulted in higher feed requirements for each length of feeding period and each breed of cattle. For Herefords, the increase in feed requirements amounted to 23.4 and 19.2% for the 216- and 265-day feeding periods. Each 100 lb. of additional air-dry haylage in the 50% haylage ration saved 14.6 lb. of corn grain and 15.1 lb. of protein supplement per 100 lb. of gain for the 216-day feeding period and 20.9 lb. of corn grain and 16.7 lb. of protein supplement when fed for 265 days.
Holsteins fed the 50% haylage ration required 31.5 and 26.4% more feed for the 216- and 265-day feeding than those fed rations with 20% haylage. Each 100 lb. of additional air-dry haylage in the 50% haylage ration saved 4.8 lb. of corn and 11.8 lb. of protein supplement when fed for 216 days and 9.7 lb. of corn and 13.3 lb. of protein supplement when fed for 265 days.

These results show a greater saving in terms of corn grain and protein supplement for the higher level of haylage when the cattle were fed for the longer time and greater for Hereford than for Holstein steers. Differences in final weights were greater between the 20% and 50% haylage rations at 216 days than at 265 days. Apparently the steers fed the higher energy rations were reaching a weight and condition by 216 days where gains were becoming slower and more costly. Results of the experiment indicate this to be more apparent for Holstein steers than for Herefords.

Steers fed the 20% haylage ration for 216 days and those fed 50% haylage for 265 days offered a better comparison between the rations when fed to similar final weights. Hereford steers fed the 50% haylage ration for 265 days averaged 31 lb. more than those fed the 20% haylage ration for 216 days. Corn grain per 100 lb. of gain was nearly the same, and the 238 lb. additional air-dry haylage saved 35 lb. of protein supplement. Holstein steers, fed the 50% haylage ration for 265 days averaged 29 lb. less than those fed the 20% haylage ration for 216 days. In this comparison, those fed the higher roughage ration not only consumed 287 lb. more air-dry haylage per 100 lb. gain but also
55 lb. more corn. This ration would not appear economical in view of the saving of only 32 lb. of protein supplement for the greater amount of haylage and grain.

**Carcass Characteristics**

Data pertaining to various carcass characteristics and measurements are presented in table 2.

**Dressing Percent.** Dressing percent calculated from slaughter weight and cold carcass weight showed some large differences between breeds of cattle, roughage level of rations and days fed. Carcass yield was improved by feeding the higher energy ration and by increasing the time on feed. Hereford steers had a higher dressing percent than Holsteins under all conditions of the experiment. Differences between days on feed were statistically significant (P<.05), and the other differences approached significance.

Increasing the time on feed had about the same effect in improving dressing percent with either level of roughage; however, the improvement was slightly greater for Herefords than for Holsteins. The higher level of energy improved dressing percent to about the same degree for each length of feeding period. The effect with Hereford steers was again slightly greater than for Holsteins.

Steers fed the higher energy rations and for the longer time had heavier final weights. This appears to be an important factor in dressing percent within breeds but not between breeds. The heaviest
<table>
<thead>
<tr>
<th>Table 2. Carcass Characteristics</th>
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<tbody>
<tr>
<td>Haylage level</td>
</tr>
<tr>
<td>Days on feed</td>
</tr>
<tr>
<td>Final shrunk wt., lb.</td>
</tr>
<tr>
<td>Cold carcass wt., lb.</td>
</tr>
<tr>
<td>Dressing percent</td>
</tr>
<tr>
<td>Gain adjusted to equal dressing percent, lb.</td>
</tr>
<tr>
<td>Conformation</td>
</tr>
<tr>
<td>Marbling</td>
</tr>
<tr>
<td>Maturity</td>
</tr>
<tr>
<td>Firmness</td>
</tr>
<tr>
<td>Color</td>
</tr>
<tr>
<td>Carcass grade</td>
</tr>
<tr>
<td>Rib-eye area, sq. in.</td>
</tr>
<tr>
<td>Rib-eye area per 100 lb. carcass wt., sq. in.</td>
</tr>
<tr>
<td>Fat covering, in.</td>
</tr>
<tr>
<td>Est. percent kidney fat</td>
</tr>
<tr>
<td>Est. percent retail cuts</td>
</tr>
<tr>
<td>Total retail cuts, lb.</td>
</tr>
<tr>
<td>Feed per 100 lb. retail cuts, lb.</td>
</tr>
</tbody>
</table>

a Prime, 23; Choice, 20; Good, 17. Graded to 1/3 of a grade.
b Moderate, 7; Modest, 6; Small, 5.
c Lower number means more mature.
d Higher number means firmer meat.
e Higher number means darker color.
Holsteins had a dressing percent only 1.0 percentage unit higher than the lightest Herefords but a weight difference of 188 lb.

**Gain Adjusted to Equal Dressing Percent.** Since Holstein steers had carcass yields of 2.9 to 3.5 percentage units less than Herefords under the same treatments, much of the advantage they had in rate of gain would be lost on the basis of carcass yield. Gains were adjusted for equal dressing percent using the Herefords as the base. These adjusted gains are presented in table 2 and represent gain necessary to obtain the carcass weights shown in the table on the basis of the same dressing percent as for the Herefords. On this basis, there were only small differences in gain between Herefords and Holsteins, except for Herefords having a higher rate of gain when fed the 50% haylage ration for 265 days. Since feed efficiency favored the Hereford steers on the basis of observed rates of gain, their advantage would be more pronounced on the basis of gain in carcass weight.

**Conformation.** Steers fed the higher energy rations and having heavier market weights graded slightly, but not significantly, higher on conformation. However, the longer feeding period, which also resulted in heavier final weights, did not result in any improvement in carcass conformation.

Hereford steers graded about 1 1/3 grade higher on carcass conformation than Holsteins which was statistically significant (P < .05). Level of energy in the ration and days fed did not appear to have any important and consistent effect between the two breeds.
Marbling. Degree of marbling was improved by the higher level of energy and by the longer time on feed for both breeds of cattle. The effect of energy content of the ration was slightly greater for the steers fed for 265 days.

Holstein steers scored higher on marbling when fed 20% haylage rations, but there were no differences between breeds with the 50% haylage ration. Market weight appeared to be a major factor influencing degree of marbling. When the final weight was about the same for the two breeds, degree of marbling was also about the same.

Maturity. At the beginning of this experiment it appeared that the Holsteins were older than the Herefords as indicated by skeletal development in relation to body weight. However, carcasses showed essentially no difference in maturity between breeds at the time of slaughter. As would be expected, roughage level had no effect on maturity. Steers fed for only 49 days longer appeared more mature as judged by the carcass.

Firmness. Firmness was increased somewhat by feeding Holsteins the low-roughage ration as compared to the high-roughage ration. It was also increased in the Herefords but to a lesser extent. Neither time on feed nor slaughter weight appeared to have any effect on firmness. Holsteins had slightly firmer meat when fed the low-roughage ration, but no differences were noted at the high-roughage level between Holsteins and Herefords. All carcasses were quite acceptable on firmness with treatments averaging moderately firm to firm.
Color. There was no evidence in this experiment of any differences in color between roughage levels, lengths of feeding period or breeds. The color of lean appeared very desirable with treatments averaging about light cherry red.

Carcass Grade. Within breeds of steers, energy level of the rations and days on feed had relatively small effects on carcass characteristics affecting grade except for degree of marbling. Steers fed the higher energy ration with 20% haylage had better marbled carcasses which graded slightly higher than the carcasses from steers fed rations with 50% haylage. Also, carcasses from steers fed for the longer time graded slightly higher than those fed for 216 days.

Hereford steers graded higher than Holsteins in all direct comparisons between breeds. Lower conformation grades were responsible for the lower carcass grades for the Holsteins. They rated higher than Herefords on degree of marbling when fed the 20% haylage ration and about equal when fed rations with 50% haylage so differences in carcass grade between the two breeds were smaller when higher energy rations were fed. The higher energy ration also resulted in more favorable gain and feed efficiency for Holsteins in comparison to Herefords.

Increasing the time on feed had about the same effect on carcass grade for Holsteins and Herefords. However, carcass grade was improved more by the higher energy rations for Holsteins. With this ration, carcass grade was the same for Holstein steers fed for 265 days and Herefords fed for 216 days. In view of the higher feed requirements for
Holsteins in comparison to Herefords when fed to the same carcass grade, this would not appear to be an economical practice.

**Rib-Eye Area.** Rib-eye area was less for steers receiving rations with the lower level of energy when fed for 216 days. With the longer time on feed, energy level of the ration had little, if any, effect on the size of the rib eye. However, when rib-eye area is expressed per unit of carcass weight, the energy level of the ration had no effect during the shorter feeding period, but size per 100 lb. of carcass weight was slightly greater for the 50% haylage ration when fed for 265 days.

Hereford steers had larger rib eyes than Holsteins, both in total are and per 100 lb. of carcass, in all comparisons between breeds.

**Fat Covering.** A small amount of subcutaneous fat is a characteristic of dairy breeds. This appears to be true even when they are fed to heavy weights on high energy rations. Depth of fat over the 12th rib was small for all treatments with the Holstein steers in this experiment.

An increasing amount of subcutaneous fat with increasing weight and condition is characteristic for beef-type cattle. Depth of fat over the 12th rib was considerably more for Hereford than for Holstein steers ($P < .01$). Both energy level of ration and time on feed resulted in an increase in depth of fat. Differences between energy levels approached statistical significance while differences between number of days fed were significant ($P < .05$).
Kidney Fat. Estimated kidney fat as percent of carcass weight was increased by energy content of rations and length of feeding period. However, days on feed appeared to have the greatest effect and these differences were significant (P < .05).

In contrast to subcutaneous fat, Holstein steers had about the same amount of kidney fat as Herefords in most comparisons between breeds.

Yield of Retail Cuts. Yield of retail cuts was not obtained in the experiment. However, yield was calculated as explained under Methods of Procedure. The formula used is based on carcass weight, fat thickness, kidney fat and rib-eye area.

The lower energy ration and shorter feeding period resulting in lighter carcasses with less fat covering and kidney fat resulted in higher yields of boneless, trimmed retail cuts.

Holsteins had more of their carcass as boneless, trimmed retail cuts than did Herefords, mainly because of the smaller amount of subcutaneous fat. While the lower dressing percent of Holsteins resulted in about the same amount of gain in carcass weight even though daily gain was more, the higher yield of retail cuts resulted in more gain for Holsteins on this basis.

The higher roughage ration and longer time on feed resulted in more feed per 100 lb. of retail cuts. Feed requirements for Holsteins on this basis were also greater than for Herefords. Differences were more pronounced when feeding the rations with 50% haylage.
The effect of a high- or low-energy ration fed for 216 or 265 days on the feedlot performance and carcass characteristics of Holstein and Hereford feeder steers was studied. Roughage levels fed were 20% and 50% of the ration on an as-fed basis (15 and 39% air-dry basis). The length of feeding period was determined by selling half of each grade and roughage level when the Holstein steers reached a typical market weight and grade and the other half when a typical market weight and grade for the Hereford steers was reached.

Steers fed the lower roughage ration had higher average daily gains and lower feed requirements. Holsteins responded better to the high-energy ration in weight gain and feed efficiency than did Herefords.

Dressing percent, marbling, conformation, firmness, carcass grade, fat covering and kidney fat were increased by feeding the high-energy ration. Energy level of the ration appeared to have no effect on maturity, color and rib eye per 100 lb. of carcass weight. Although percent retail cuts (calculated on basis of U.S.D.A. formula) was reduced when the higher energy ration was fed, total retail cuts were increased. Carcass characteristics appeared to be improved more for Holsteins than for Herefords by feeding the high-energy ration.

Average weight gains were reduced and feed requirements increased when steers were fed longer. These effects were more pronounced with Holsteins than with Herefords.

Steers fed for a longer time had a higher dressing percent, degree of marbling and carcass grade. They were more mature, had more
subcutaneous and kidney fat, and yielded more pounds of retail cuts. Length of feeding period appeared to have no important effect on conformation, firmness, color and rib-eye area. Steers fed the longer time had a lower percent of their carcass in retail cuts.

Holsteins gained better than Herefords but consumed more feed resulting in a poorer feed efficiency for Holsteins both on a live-weight and retail-cut basis. Herefords dressed higher than Holsteins while Holstein carcasses had a better cut-out value which resulted in a similar yield of retail cuts from both breeds. Herefords had higher carcass grades than Holsteins which was a result of their differences in conformation. Holsteins had considerably less fat covering than Herefords, especially at the low-roughage levels. Over-all feedlot performance and carcass traits were nearly comparable between breeds when they were fed high-energy rations for 216 days, but Herefords appeared to have an advantage when high-roughage rations were fed for 265 days.

This experiment and others have quite conclusively disproven the theory that low-grading feeder cattle are the best type of cattle to utilize large amounts of roughage. On the contrary it has been shown that beef breeds perform better than plainer cattle on high-roughage rations; and if large amounts of roughage are to be fed, especially for a long feeding period, Holstein-type cattle cannot be expected to perform comparable to beef breeds or to produce carcasses that are as desirable. If large-framed cattle with heavy mature weights such as Holsteins are to be fed, they should be fed a relatively
high-energy ration. If they are fed this type of a ration, they can be expected to perform comparable to beef-type cattle in the feedlot and to produce desirable carcasses.
LITERATURE CITED


