not be critical since excess quantities are available in most roughages and pasture. Phosphorus is apparently ample, or nearly so, for most weights and levels of production.

Summary

Estimates of milk production on more than 300 range beef cows, representing both spring and fall-calving herds, were analyzed to determine some of the factors that influence milk production. A wide individual difference in milk production among cows was observed. Milk production was highly correlated with daily gain of calves, accounting for 50 to 80% of the variation observed in calf gains to three months of age. Data on 49 four-year-old cows were analyzed to determine the effects of birth date, sex, and birth weight of calf on milk production. Time of calving in relation to the first sample had an important bearing on the first milk production estimate. Male calves and those with heavier birth weights were associated with a slight increase in milk production of the dam. Body size of the beef cow had little bearing on milk production, and fall body weights were negatively associated. Milk production was found to be a highly repeatable trait, hence good or poor producers tend to repeat their performance in relation to other cows in the herd. The feed level prior to and during lactation had a marked influence on milk yields.

The Comparative Value of Corn, Milo and Barley Rations For Fattening Calves

Robert Totusek, Dwight Stephens, Lowell Walters and G. R. Waller

Sorghum grain is the principal high energy feed available for fattening cattle in the Southwest. Barley has been an increasingly abundant grain in recent years and has been extensively used in cattle fattening rations by the small feeder in particular. Even more sorghum grain and barley may be available for beef rations in future years. Corn, which consistently produces good results and is the standard grain to which others are compared, is often used as the grain in cattle fattening rations in the eastern portion of the state.

Although considerable research has been done on the relative feeding value of grains, many of the previously reported feeding trials involved hand-feeding and often high concentrate rations. Furthermore, most of the comparisons have been with rations which contained constant levels of protein supplement and roughage, with the kind of grain as the only variable and no allowance made for differences in chemical composition of the grain as a basis for determining the amount of protein supplement and roughage fed. One objective of this experiment was to compare corn, milo, and barley under the following conditions:

(1) In a self-fed high roughage (about 40%) type of ration.

(2) In rations equivalent in protein, energy and fiber.

Another objective of this experiment was to compare simple rations containing corn or milo or barley to a ration containing a greater variety of feeds (eight) which has consistently produced excellent results when fed to bulls and steers on rate-of-gain tests at the Ft. Reno Livestock Experiment Station. This ration was first reported by Chambers, *et al.* in the 1956 Feeders Day Report. It has the following makeup:

	%
Corn-and-cob meal	35.0
Whole Oats	10.0
Wheat Bran	10.0
Cottonseed Meal	10.0
Molasses	5.0
Cottonseed hulls	20.0
Ground alfalfa hay	10.0
	100.0

The above ration, hereafter called the test ration, has proved to have several merits. Calves can be allowed free access to the ration immediately when placed in the feedlot without suffering digestive disturbances and can therefore be started on feed with a minimum of health problems and labor. (It is a relatively high roughage ration with a concentrate to roughage ratio of approximately 60:40). The ration promotes a rapid rate of gain, yet there has been little difficulty with founder, bloat, urinary calculi, and cattle "going off feed". Whether this particular ration has any special merits not explained merely by its chemical composition and physical balance has been a matter of speculation. Most cattle feeders use at least three or four ingredients in the ration and believe that cattle tend to "stay on feed" better during a long feeding period if the ration contains an even greater variety of feeds. Little experimental evidence on this point is available.

Procedure

The Calves

Eighty Hereford calves of known ancestory and with an average of approximately 7 months and an average weight of about 460 lbs. were obtained from the Experiment Station herds. They were divided into eight lots primarily on the basis of sire and weight, with the heavier calves assigned to Lots 1-4 and the lighter calves to Lots 5-8. The four lots in each of the two replicates were also comparable in average initial age and grade.

The feeding period was from October 19, 1961, to May 3, 1962, a period of 196 days. Initial and final weights were on a shrunk basis, with the calves allowed no access to feed or water for 16 hours. At the conclusion of the feeding period the calves were shipped to Oklahoma City for slaughter. Carcass data were obtained after a 48 hour chill.

The Rations

Four rations were fed, and their typical makeup is given in Table 1. The four rations—test, corn, milo and barley—were fed to Lots 1 through 4, and also to Lots 5 through 8, respectively. Each ration then was fed to two lots of calves, one lot in the replicate of heavier calves, and one lot in the replicate of lighter calves.

The chemical composition of the test ration, corn, milo and barley is given in Table 2. These analyses, along with those of other feeds used, served as the basis for the formulation of rations. The test ration contained 12.3% crude protein and 16.9% crude fiber, and was estimated to contain 63.0% total digestible nutrients (TDN). The rations containing corn, milo and barley were accordingly formulated to contain equivalent levels of protein, fiber, and TDN. All rations contained 10.0% alfalfa and 7.5% molasses, while the levels of grain, cottonseed meal and cottonseed hulls in the corn, milo and barley rations were varied to control ration composition in terms of protein, fiber and TDN as indicated necessary by chemical analyses. The feed ingredients of the test ration remained constant throughout the feeding period.

All rations were self-fed throughout the trial. A mineral mixture of equal parts salt and ground limestone was offered free-choice at all times. Water (heated in winter) was readily available, and an ample area of both open shed and outside pen was provided for each lot. Feeds which were ground were prepared with a hammer mill, using the following sized screens: Shelled corn, ear corn and alfalfa hay—1½ inch, milo—5/16 inch, and barley—½ inch.

Table 1.—Ingredient Makeup of Rations (Percent)[1]

	Ration			
Feed	Test	Corn	Milo	Barley
Corn-and-cob meal	32.5	---	---	---
Corn, ground	---	39.0	---	---
Milo, ground	---	---	39.2	---
Barley, ground	---	---	---	44.2
Oats, whole	10.0	---	---	---
Wheat bran	10.0	---	---	---
Cottonseed meal	10.0	13.5	13.8	11.8
Molasses	7.5	7.5	7.5	7.5
Cottonseed hulls	20.0	30.0	29.5	26.5
Alfalfa hay, ground	10.0	10.0	10.0	10.0

[1] Composition of rations was varied during the feeding trial as indicated necessary by chemical analyses of different batches of feed.

Table 2.—Chemical Composition of Test Ration and Grains (Percent)

	Dry Matter	Crude Protein	Crude Fiber	N-Free Extract	Ether Extract	Ash
Test Ration	91.1	12.3	16.9	52.8	3.4	4.5
Corn	90.0	9.2	1.3	73.6	4.3	1.5
Milo	89.7	8.7	1.5	74.0	3.8	1.7
Barley	90.2	10.7	4.4	70.3	2.2	2.6

Results

Feedlot Performance

Gain and feed data are summarized in Table 3, with each figure for each ration actually representing 20 calves in two lots. The results within each of the two replicates were remarkably similar. The four lots of calves on the four different rations in each of the two replicates ranked in identical order in rate of gain, feed intake and feed efficiency, and differences were of the same magnitude. This certainly justified confidence in the results, and on this basis the data for the two lots on each ration were combined.

All 20 calves on the test ration completed the trial. Previous observations have indicated that cattle fed this ration have a low mortality from common feedlot disorders. Only one calf was lost on the corn ration (prolapsed rectum) and this was probably due to an anatomical defect rather than to ration effect. Losses on the milo ration (one from bloat, one from urinary calculi) and on the barley ration (two from urinary calculi) could be more logically attributed to the ration. Although definite conclusions regarding losses from disease require a larger number of observations than was possible in this one experiment, the results do agree with the experience of many feeders. Losses from urinary calculi on milo rations are especially troublesome in certain areas.

The rate of gain of the calves as a group was excellent, especially considering the initial age and weight of the calves, the bulkiness of the ration, the length of the feeding period, and the fact that stilbestrol was not used. Average daily gains produced by the test ration and the corn ration were almost identical (2.55 vs. 2.54 lb.). Gains of the milo calves were only slightly (.07 lb.) lower while the barley calves gained considerably (.2 lb.) more slowly than the corn group. The lower rate of gain on the barley ration was probably due at least in part to low feed consumption. Feed intake on the barley ration was 7 and 14% lower than on the corn and milo rations, respectively.

The most efficient gains were made on the corn ration. The barley ration was essentially as efficient (less than 1% more feed required per 100 lb. gain), the test ration was slightly less efficient (4.5% more feed required) and the milo ration was much less efficient (10.8% more feed required—91 lb. more per 100 lb. gain) than the corn ration. The milo was palatable and was consumed in greater quantity than any of the rations, but it produced a lower rate of gain and was consequently less efficient than the corn ration. This poor feed utilization is typical of milo rations.

Slaughter and Carcass Information

Information concerning the dressing percent and carcass characteristics of the calves is given in Table 4. Average chilled carcass weights largely reflect differences in liveweight of the calves, plus a slightly lower dressing percentage in the case of the barley calves. The test ration and corn ration groups had identical dressing percentages, with the milo calves only slightly lower.

Differences in quality grade, trimmed retail cut yield, ribeye area, and fat covering were small, but for the most part were in the same

Table 3.—Feedlot Performance of Steer Calves Fed Various Grain Rations (196 days)

Lot No. Ration	1 & 5 Test	2 & 6 Corn	3 & 7 Milo	4 & 8 Barley
No. calves completed test	20	19[1]	18[1]	18[1]
Av. initial wt. lb.[2]	460	460	462	462
Av. final wt. lb.[2]	961	958	944	921
Av. daily gain, lb.	2.55	2.54	2.47	2.34
Av. daily feed intake, lb.	22.4	21.3	23.0	19.8
Feed per cwt. gain, lb.	877	839	930	846

[1] One calf was removed from Lot 2 due to prolapsed rectum, one calf died in Lot 3 due to bloat, and one calf was removed from Lot 7 due to urinary calculi. These calves are not included in the data. Two calves were removed from Lot 4 two days before the end of the feeding period due to urinary calculi but are included in the data.

[2] Initial and final weights were taken after a 16 hour shrink without feed and water.

Table 4.—Slaughter and Carcass Information of Calves Fed Various Grain Rations.

Lot No. Ration	1 & 5 Test	2 & 6 Corn	3 & 7 Milo	4 & 8 Barley
Carcass Weight (chilled), lb.	593	591	580	556
Dressing %[1]	61.7	61.7	61.4	60.4
Quality Grade[2]	10.2	10.0	9.6	9.8
Trimmed Retail Cut Yield, %[3]	48.4	48.5	48.8	49.1
Ribeye Area, sq. in.[4]	11.1	10.9	10.8	10.6
Av. Fat Over Ribeye, in.[5]	.65	.61	.59	.56

[1] Calculated on basis of shrunk Ft. Reno live weight and chilled carcass weight.

[2] U.S.D.A. quality grade converted to following numerical designations: 15—high prime, 14—average prime, 13—low prime, 12—high choice, 11—average choice, 10—low choice, 9—high good, 8—average good, 7—low good.

[3] Calculated as follows: % of carcass as boneless trimmed retail cuts from the four major wholesale cuts = 51.34 − 5.78 (fat thickness) − .462 (% kidney fat) + .740 (ribeye area) − .0093 (carcass weight).

[4] Determined by measurement on tracings of the ribeye.

[5] Average of three measurements determined on tracings of the ribeye.

order as the rate of gain. This is logical since faster gaining cattle tend to be fatter and consequently will show more marbling and yield less of the trimmed retail cuts than comparable cattle on a ration which produces slower gains. Faster gaining cattle also produce heavier carcasses with larger ribeyes.

Summary and Discussion

Considering both feedlot performance and carcass merit, the test ration and corn ration produced very comparable results and were superior to the milo and barley rations. The milo ration resulted in a slightly lower rate of gain and carcass grade, and much poorer feed efficiency, while the barley ration produced slightly lower carcass grade and dressing percentage, and a considerably lower rate of gain than the corn ration.

No comparative figures summarizing the value of the grains and rations as determined in this experiment are reported here. Prices of both cattle and feed change, so the most meaningful financial comparisons would result by applying current prices to the results of this experiment.

Milo is often the most economical grain in this area in spite of its poor feed efficiency. It is similar to corn in composition. The reason for its poor utilization is not known but research concerning this problem is now in progress and additional research is being planned for the future.

The relatively good feed efficiency of the barley ration may be somewhat misleading. About 15 additional days would have been required for the barley cattle to reach the same weight as the corn cattle, and considerably more feed would have been required for the additional 40 pounds gain. Barley is probably better suited to high concentrate rations which will benefit from its high fiber content than to high roughage rations of the type fed in this experiment.

It should be recognized that the composition of feeds will vary, and in some instances grains will have different relative values than those observed in this experiment.

Fattening Cattle on "All-Concentrate" Rations Based on Steam-Rolled Milo

L. S. Pope, L. E. Walters, G. Waller and W .D. Campbell

Due to the high cost of roughage relative to grain, there has been a significant shift toward the use of high-energy rations in large commercial feedlots. Increased quantities of grain are now available for fattening cattle in the Southwest. When the costs of harvesting, transporting and processing roughage are considered, together with its lower net