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

energy value for fattening steers, roughage has become more costly than grain in the typical Southwest ration.

Obviously, if large amounts of good roughage such as corn or sorghum silage can be produced under irrigation and handled mechanically, it is usually more profitable to feed as much of it as possible. However, where all feeds must be purchased and delivered to the feedlot, it becomes a different story. The general trend in the Southwest has been toward increased production of grain, and greater use of this grain in fattening more cattle.

Feeding experiments with rolled barley, rolled oats, or corn-and-cob meal, all of which have considerable fiber and bulk in the hull or cob portion, show that when these concentrates are properly supplemented, they can be fed as the sole ration for fattening cattle. On the other hand, milo differs considerably from these concentrates as it has less than ⅓ the fiber content of barley, and nearly 15% more weight per unit volume. Few attempts have been made to feed "all-milo and supplement" type rations to fattening cattle, although North Carolina and Georgia researchers have successfully fed ground corn-and-supplement rations.

Results are now available from two trials in which steamed-rolled milo and supplement constituted the entire ration. This was compared to a conventional fattening ration containing 25% cottonseed hulls as the roughage. A third trial is now in progress in which some of the factors that influence or regulate the feed intake of fattening cattle on "all-milo and supplement" rations are being studied.

Procedure

Preliminary results of Trial I were reported previously.[1] Complete results are available for the 193-day feeding trial, in which one lot of 10 steer calves was fed a conventional fattening ration containing 24% cottonseed hulls and 8% dehydrated alfalfa meal. The percent concentrates were: steam rolled milo, 50; C.S. meal, 9; molasses, 8; cottonseed hulls, 24; salt and calcium carbonate, 1; and vitamin A premix, .05. The experimental lot of 10 calves received an "all-concentrate" ration containing (by percent): steam rolled milo, 74; dehydrated alfalfa meal, 8; molasses, 8; cottonseed meal, 9; calcium carbonate and salt, 1, and vitamin A, .05.

Both groups were self-fed their respective fattening rations. The roughage in the "all-concentrate" ration was gradually reduced over a 6-week period, in a stepwise fashion. The cattle were maintained on concrete pens and bedded twice weekly with straw. Shrunk weights were taken at the start and completion of the trial, and carcass data were obtained upon slaughter at Oklahoma City. One-half the calves in each lot were implanted with 24 mg. stilbestrol.

Trial II, was conducted during the summer of 1962 with 3 lots of 7 or 8 yearling steers each. The steers were fed 112 days on either a

[1] See Oklahoma Agr. Expt. Sta. MP-64, p. 88.

Table 1.—Feeding All-Concentrate Rations Based on Steam Rolled Milo (Trial I)

Ration Fed	Normal 68% Concentrates 8% Dehyd.Alf. Meal 24% Cottonseed hulls	All-Concentrate 92% Concentrates 8% Dehyd. Alf.
No. steers/treatment	10	9[1]
Av. weights, lb.		
Initial	460	460
Final	886	896
Total gain—193 days	426	436
Av. daily gain, lb.	2.20	2.26
Av. daily feed intake, lb.	19.6	17.5
Feed required/cwt. gain, lb.	891	774
Feed cost per cwt. gain, $	19.60	18.58
Carcass and slaughter data:		
Dressing percentage	59.7	61.6
Marbling	Small	Moderate
USDA grades		
Choice		3
Good	9	6
Standard	1	

[1] Data on one steer in all-concentrate lot removed after 70 days for urinary calculi not included.

"normal" fattening ration with 25% cottonseed hulls, or one of two all-concentrate mixtures, using cottonseed meal or urea as supplemental protein (nitrogen). The composition of the mixtures fed is shown in Table 2. Note that it was possible to formulate rations to include 85 to 90% rolled milo.

The yearling steers were allotted to treatment on the basis of previous treatment, shrunk weight and feeder grade. Steers in Lots 2 and 3 were gradually advanced to the "all-concentrate" diet by stepwise removal of cottonseed hulls (25% initially) over a 4-week period. The cattle were fed in concrete-paved pens, bedded with sand. The area around the pens was treated to kill grass and weeds.

Trial III is now in progress to study some of the factors that influence appetite or feed intake when highly concentrated rations are fed. It is well recognized that cattle drop off in feed intake as the proportion of concentrate in the ration is increased.

To investigate some of the factors that regulate the feed intake of fattening cattle, a series of trials have been initiated. Preliminary results are available from the first experiment. Thirty yearling steers were purchased from the Daube Ranch near Ardmore in late September and divided into 5 uniform groups of 6 each. The steers were self-fed 5 fattening mixtures, formulated to differ in content of roughage, source of energy, or density (weight per unit volume). The rations fed, their relative densities and the estimated caloric value of each are shown in Table 3.

Table 2.—Ration Composition, Feedlot and Carcass Data on Steers Fed All-Concentrate Rations (Trial II)

Ration Designation		All-Concentrate	
Lot Number	Normal 1	With C.S. Meal 2	With Urea 3
Ration composition, %			
Steam rolled milo	58	85.5	89.5
Dehyd. Alf. meal	5	5	5
Cottonseed meal	8	5	--
Urea	--	--	1
Molasses	3	3	3
C.S. hulls	25	--	--
Salt	.5	.5	.5
Calcium carbonate	.5	1.0	1.0
Vit. A premix	.05	.05	.05
Cost per ton of feed delivered, $	53.00	55.00	54.00
Feedlot performance:[1]			
Av. daily gain, lb.	2.57	2.49	2.51
Av. daily feed intake, lb.	26.2	21.6	19.9
Feed per cwt. gain, lb.	1019	867	793
Feed cost per cwt. gain, $	27.01	23.85	21.41
Slaughter and carcass data:			
Dressed carcass wt., lb.	645	661	659
Dressing percentage	60.5	62.8	62.6
USDA carcass grade			
Choice	2		3
Good	5	8	5

[1] Seven steers in Lot 1, 8 each in Lots 2 and 3.

Lot A steers were fed a conventional fattening ration, with 30% cottonseed hulls. Lot B steers were gradually advanced from this to the "all-concentrate" mix without cottonseed hulls.

To increase the caloric content of the ration, 5% stabilized animal tallow replaced an equal quantity of milo in the mix fed Lot C. As a means of increasing the density of the "normal" fattening ration, 500 lb. of fine sand was added to each ton of the mixture fed Lot D. In order to study the effect of bulk *per se*, an inert material (polyethylene resin, Du Pont) replaced cottonseed hulls in the ration fed steers of Lot E.

The steers have been on test approximately 150 days and will continue on trial to observe any abnormalities that may result from the rations being tested. Upon slaughter, a close inspection will be made of the rumen and digestive tract. Results to date are presented.

Results

Value of "All-Concentrate" Rations Based on Steam-Rolled Milo. The results of Trial I, where 50% vs. 74% steam-rolled milo rations were compared, are shown in Table 1. Calves fed the 74% milo, "all-concentrate" ration gained slightly faster, consumed 2.1 lb. less feed per day, and required 87% less feed per cwt. gain than those receiving the

Table 3.—Ration Composition, Density and Net Energy Value of Rations Fed (Trial III)

Ration Designation	A	B	C	D	E
Ration composition, %[1]					
Steam rolled milo	51.4	83.9	45.9	Same	Same
Cottonseed meal	8.0	5.0	8.0	as A	as B
Dehyd. Alf. meal	5.0	5.0	5.0	plus	plus
Urea	1.5	1.5	1.5	500 lb.	400 lb.
Molasses	3.0	3.0	3.0	sand	inert
Stabilized animal tallow	--	--	5.0	per	bulk
Cottonseed hulls	30.0	--	30.0	ton	per
Salt	0.5	0.5	0.5		ton[2]
Calcium carbonate	0.5	1.0	0.5		
Increased weight per unit volume compared to Ration A, %[3]	--	37.0	—2.0	20.0	6.0
Net energy/cwt., Therms[4]	60.78	72.38	65.12	48.62	60.07
Av. daily gain, lb. (148 days)	2.50	2.56	3.15	2.90	2.95

[1] All mixtures supplied 30,000 I.U. vitamin A and 3 gm. trace mineral per steer daily.
[2] Polyethylene resin, Du Pont, used as filler.
[3] Based on weight per bushel unit; av. of 3 estimates.
[4] Calculated from Morrison's *Feeds and Feeding*, 22nd Ed., appendix Table 2.

conventional fattening ration. Carcass grade and yield data indicate that calves on the "all-concentrate" diet were fatter. Using feed prices current at the time of the experiment, it required $1.02 less to produce 100 lb. gain on the "all-concentrate" diet.

The calves in this 193-day trial were maintained in concrete paved lots, bedded with straw once or twice weekly. They appeared to show no greater desire for bedding than cattle fed rations with 24% cottonseed hulls. Some scouring and looseness was observed in the "all-concentrate" lot early in the trial, but became progressively less as the trial advanced. No founder was observed.

A decline in feed intake, which is characteristic on very concentrated rations, occurred when the "all-concentrate" ration was fed. This trend has been consistently observed in concentrate-to-roughage experiments, both at this station and elsewhere. Such a decline in feed consumption often prevents the feeder from increasing the daily energy intake by raising the grain level in the ration. The reasons for this reduced intake may be the result of a "ceiling" on caloric intake, or to other factors which are not understood, such as the density of the ration or rate of fermentation in the digestive tract. Thus, the factors which affect feed intake of cattle on fattening rations need further investigation.

Results of Trial II, which was conducted during the summer of 1962 with three lots of yearlings steers, are shown in Table 2. One lot was fed a normal ration with 25% cottonseed hulls. Two different "all-concentrate" diets were employed, one with cottonseed meal as the source of supplemental protein, and the other with urea replacing cottonseed meal. The composition of rations fed, the cost per ton

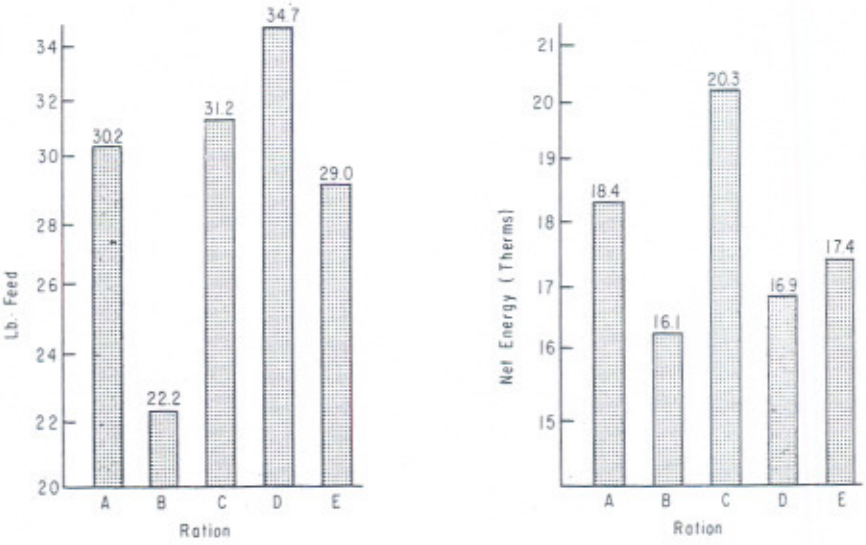

Figure 1.—Average Daily Feed and Eenergy Intake of Steers in Trial III.

delivered, average daily gains, feed efficiency and carcass grades have been summarized in Table 2.

Note that in Lots 2 and 3 it was possible to increase steam rolled milo to 85.5% or 89.5% of the ration. Such levels of milo are higher than those commonly employed in swine rations. The calculated net energy content of the rations fed indicate a much higher energy value per lb. for the two "all-concentrate" diets.

Results of the 112-day feeding test show little difference in average daily gains, but a marked reduction in feed intake and feed required per cwt. gain when the "all-concentrate" rations were fed. Daily feed intake was reduced 17% in Lot 2, and 24% in Lot 3, as compared to the Lot 1. Corresponding reductions in feed required per cwt. gain were 15% and 22% for Lots 2 and 3, respectively.

Dressing percentage data indicate a fatter carcass or higher yield from feeding the "all-concentrate" rations, although the trend in carcass grade was inconsistent. This was due to small differences in marbling among the treatments. No abnormalities of the rumen wall were observed upon slaughter in any of the cattle. Using current feed prices, it was possible to reduce the cash outlay for 100 lb. gain by $4.16 and $5.60 for Lots 2 and 3, respectively, vs. Lot 1. This illustrates the potential of high-grain rations when all feed must be purchased and roughage is costly relative to grain.

Again, the trend toward lowered feed consumption on the "all-concentrate" rations was observed. With high-energy rations, it appears that urea may be used to reduce costs and increase the level of grain in the ration.

Factors Affecting Feed Intake of Fattening Cattle. A trial is now in progress in which some of the factors that influence feed intake are being studied. Specifically, the effect of additional calories, the density of the ration, and the role of bulk *per se,* are being investigated. Five lots of 6 yearling steers each are being used in a preliminary trial to gain some insight into the factors responsible for feed intake, and to test rations that can be used in future studies on the problem. The different formulas, and their energy and density values are shown in Table 3.

Data on feed and energy intake are presented graphically in Figure 1 for the first 148 days of the trial. Note that as the energy level of the ration was increased by removal of the roughage (Lot A vs. B) the feed intake declined, although the net energy intake was less affected. When fat was added to the ration to provide a higher caloric content (Lot C vs. A), feed intake was little affected, while the actual caloric intake was increased. This suggests that additional calories as fat may be consumed at a higher level by ruminants than additional calories taken in as carbohydrate.

Where the ration was made more dense in Lot D, so as to weigh more per unit volume, an increase in feed intake was obtained over the Lot A basal diet. Energy consumption was slightly less, but it appeared that the steers were attempting to consume more of the heavier ration to attain the same energy intake as Lot A. Such a trend is also apparent from the results with Lot E steers, where the addition of an inert material (polyethylene resin) to the "all-concentrate" formula fed Lot B increased average daily feed intake. Again, feed intake appeared to be limited by the caloric content of the total diet, not by its weight or density.

From a practical standpoint, the results with Lots A and E point up the low energy value of cottonseed hulls for fattening cattle, which appears to be mostly a "filler" for fattening cattle.

Summary

Calves and yearlings fattened on "all-concentrate" rations based on steam-rolled milo, properly supplemented, gained as rapidly as those fed conventional fattening rations with 25% cottonseed hulls. Further a marked saving was possible in total feed required per cwt. gain, and in feed cost. Cattle fattened on the all-concentrate diet had a higher dressing percentage, but no consistent advantage in carcass grade. Preliminary results indicate that the caloric content of the diet is a more important factor controlling feed intake of fattening cattle than bulk or density of the ration.