pound more because they were more efficient in their gains. In recent years the prices paid per pound would likely have been the reverse of the above values because the genetic superiority or inferiority of sires was unknown to producers and feeders. The feeder who paid a premium price for the calves by sire 21 would have been at an economic disadvantage, while the producer of the calves by sire 158 would not be getting proper remuneration for his calves. However, the 543 lb. calves by 158 would bring the producer as many dollars at 28 cents per pound as would the 457 lb. calves by sire 21 at 33 cents per pound.

If strong pressure against heavy calves is encountered by a producer who has unusually rapid gaining calves, he could sell at younger ages to take advantage of the higher prices being offered for the lighter weight calves or he might wish to feed them for slaughter, himself. Because feeder demand for calves of different weights changes, varying with the price of feed and the price of fat cattle in relation to the price of feeder calves, the breeder and producer of feeder calves will do well to keep a long range objective in mind. Changes in genetic capacity are made only by considerable selection over a period of years. He can better meet temporary shifts in demand by altering management practices than by changing goals in selection. If heavy calves are in demand, he can creep-feed his calves and wean them at an older age. If light weight calves are more profitable to him, he can wean them at a younger age without creep. The breeder who produces cattle with superior genetic capacity for gains and grades is better able to make adjustments to changing demands. The breeder who knows the genetic capacity of his cattle is also better able to negotiate intelligently with his customer in arriving at a price which is fair to both.

Methods of Processing Milo for Fattening Steer Calves

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Grain sorghum is the chief concentrate for fattening cattle in most areas of the Southwest. During the past few years, several changes of importance relative to this feed grain have taken place. For one thing, new varieties of hybrid grain sorghum, heavy fertilization, and irrigation have greatly increased the yields per acre, and also may have affected the chemical composition of the grain, especially its protein content. Another change has taken place in the feeding of the grain. No longer is most of our grain processed on the farm. Today, new methods of processing (dry or steam rolling, pelleting, etc.) are available to either the large feeder or the small operator who buys a complete fattening ration from a well-equipped feed mill.

Table 1.—Cost Breakdown of a Typical Steer Fattening Ration.

Ingredient	Daily Intake (lbs.)	Cost per ton ($)	Cost per day	% of total feed cost
Ground or rolled milo	12.0	48.00	0.29	64.4
Cottonseed meal	1.5	70.00	0.05	11.1
Dehydrated alfalfa meal	1.0	55.00	0.03	6.6
Molasses	1.0	35.00	0.02	4.4
Cottonseed hulls	4.5	22.50	0.05	11.1
Mineral + Vitamin A	.2	--	0.01	2.2
Total	20.2		0.45	

This has emphasized the importance of finding the best way to process grains such as milo. Its relative importance in the fattening ration is apparent if we consider the costs of the various ingredients that make up a typical ration for a fattening steer in drylot, as illustrated in Table 1. From these calculated values, we can see that with milo at $48 per ton, about 64 percent of the total cost of the entire ration is accounted for by this grain alone. Obviously, the other ingredients in the ration, such as the protein oil meal and dehydrated alfalfa meal, are essential for rapid and efficient gains. Milo is by far the most costly item considering the ration as a whole, in fact nearly twice as costly as all other ingredients combined.

The milo kernel differs from other grains, being more dense and compact. Nearly 65 percent of the milo kernel is starch. Our laboratory tests show that the starch of milo is less available to enzymatic breakdown than the starch of a grain such as barley. It is important to remember that while the starch of different grains are similar in many properties, they may also differ considerably in others. One possibility is that they may respond differently to various methods of processing, such as steam heating.

All cattle feeders recognize the need to reduce the hard and flinty milo kernel to smaller size by grinding or rolling in order to improve its utilization by cattle. The appearance of large amounts of apparently undigested grain in the droppings, however, raises a question as to how fine a grain such as milo should be ground or rolled. Recently, new methods of processing grains such as steam rolling have become popular, and claims are made that this method of preparation will result in greater gains and feed efficiency. Since most new methods of processing the grain also increase its cost to the feeder, they must pay off in greater gains and feed efficiency to be profitable.

Results of Previous Tests

Since 1956, a series of tests have been underway at this station to explore the various methods of processing milo for fattening steer calves. A promising early lead from these studies was the effect of fine grinding and pelleting milo grain (3/8 inch cubes). A summary of the average results of four trials are shown in Table 2.

Table 2.—Dry Rolled vs. Finely Ground and Pelleted Milo for Fattening Beef Calves. (Avg. of Four Trials, 168 Days on Feed)

	Dry Rolled	Finely Ground and Pelleted (3/8 in.)	Advantage for Pelleting, %
Total calves/treatment	38	39	
Avg. daily gain, lb.	2.29	2.38	+ 3.9
Avg. daily milo intake, lb.	11.9	11.1	— 6.7
Milo required/cwt. gain, lb.	521	467	—10.4
Dressing percentage	64.5	63.4	
Carcass grade score[1]	6.8	7.0	

[1] Low Choice = 6.0; High Good = 7.0.

When compared to dry rolled milo (medium to course in texture), the finely ground and pelleted milo had little effect on rate of gain, but decreased the milo required per 100 lbs. gain by nearly 10 percent. However, in all tests, carcass grade and dressing percentage were slightly lower for the pelleted milo group. Nevertheless, the advantage in feed efficiency was consistent from trial to trial either on a live or carcass weight basis.

Several variables were present in these early trials. One was the difference in particle size between the two products. Another was the possible effect of steam heat and pressure during the pelleting process in altering the structure of the starch granule, and in some way improving feed efficiency.

Accordingly, a test was conducted in 1959-60 in which finely ground milo in the meal form was compared with the same product in pelleted form, or with reground pellets. Both forms of milo were also compared to the steam rolled product. Where steers were hand-fed rations containing either ground or ground and pelleted milo, the results showed a depression in grain intake and lowered rate of gain with the pelleted grain, with only a slight effect on feed efficiency.[1] Likewise, where the

[1] Okla. Agr. Exp. Station MP-61:134.

pellets were reground and fed in meal form, results were nearly equal to the unpelleted grain. Hence, the pelleting process itself appeared to have no beneficial effect on the same particle size product. Steam rolled milo in this initial test proved to be the form least efficiently utilized.

Interest was then centered on the effect of particle size to which the milo kernel is reduced during processing. Two tests have been initiated to study this effect and this report summarizes the results of Trial I (1960-61), which has been reported in preliminary form.[2] A subsequent study, Trial II, is now in progress. In both trials, fine vs. coarsely ground or steam rolled milos are compared in complete mixed rations, self-fed to weaner steer calves. In Trial II, the effect of steam heating either a finely ground or dry rolled milo is being studied. By steam heating, it is hoped that an alteration of the starch might occur which would lead to more efficient utilization.

Procedure

Trial I

Sixty, uniform, Hereford steer calves were selected from the Experiment Station herd and a commercial herd in the southern part of the state. They were allotted to six groups of 10 calves each on the basis of shrunk weight, source, and feeder grade. After an initial period to recover from the effects of weaning, the calves were started on experimental rations (see Tables 3 and 4). The calves were self-fed a complete mixed ration containing milo, cottonseed meal, molasses, dehydrated alfalfa meal, cottonseed hulls and additional calcium, salt, and

Table 3.—Composition of Self-Fed Mixtures for Fattening Steer Calves. (Percent)

Ingredients	Trial I (1960-61)	Trial II (1961-62)
Processed milo	50	60
Cottonseed meal (solvent)	9	9
Dehydrated alfalfa meal	8	9
Molasses	8	6
Cottonseed hulls	24	15
Calcium carbonate	.5	.5
Salt	.5	.5
Vitamin A premix[1]	.05	.05

[1]Supplied approximately 21,000 I.U. per steer daily.

[2]Okla. Agr. Exp. Sta. MP-64:82.

Table 4.—Percent Composition of Mixtures Fed in Trial I.

Lot No. and Mix	Dry Matter	Ash	Crude Protein	Ether Extract	Crude Fiber	N-Free Extract
Lot 1—Meal	88.12	4.14	11.31	2.47	13.36	56.84
Lot 2—Pellet	88.77	4.83	12.63	2.15	10.63	58.53
Lot 3—Meal	88.12	5.17	11.56	2.55	10.02	58.82
Lot 4—Pellet	89.80	5.15	13.50	3.32	11.12	56.71
Lot 5—Meal	88.56	4.30	11.06	2.17	13.03	58.00
Lot 6—Pellet	89.59	5.30	12.88	3.39	10.54	57.48

vitamin A. The mixture contained 50 percent milo processed in one of three different ways: Lots 1 and 2, finely ground through a high-speed hammer mill (3500 rpm) with an ⅛-inch screen; Lots 3 and 4, coarsely ground milo processed through the same hammer mill without a screen, and Lots 5 and 6, steam rolled by introducing live steam for approximately two minutes before passing through the rollers. In addition to the above treatments, the mixtures fed Lots 2, 4, and 6 were pelleted in 5/16-inch cubes. One half of the calves in each lot were implanted with 24 mg. stilbestrol, the remainder with 12 mg. All calves had access to a mineral mixture containing two parts salt and one part dicalcium phosphate, free choice. At the completion of the trial, the calves were slaughtered at Oklahoma City and detailed carcass data were obtained.

Trial II

Fifty, uniform,Hereford steer calves were selected from the Dunkin ranch herds near Hominy and Fairfax. After a six-week preliminary period to permit the calves to recover from the effects of weaning and become adjusted to the feeds to be used during the trial, they were divided into five groups of 10 head each on the basis of shrunk weight (16 hours off feed and water) and grade. During the preliminary period, the calves received 350 mg. Aureomycin in the daily ration. The calves were started on a mixture containing 50 percent milo, plus cottonseed meal, dehydrated alfalfa, molasses, cottonseed hulls, calcium, salt, and vitamin A (see Table 3). After 40 days, they were advanced to a mixture containing 60 percent milo, and after 125 days to 62.5 percent milo, with a corresponding reduction in cottonseed hulls in each case. One-half the steers in each lot received 24 mg. stilbestrol implants at the start of the trial with the remainder receiving two 12 mg. implants 90 days apart.

All mixtures were self-fed. The finely ground milo fed Lots 1 and 2 was prepared as in Trial I. The dry rolled milo fed Lots 3 and 4, and steam rolled milo fed Lot 5 were processed through the same mill, with and without steam. For Lots 2 and 3, the processed milo was passed through the steam chamber of a commercial pelleting mill and subjected to a maximum quantity of steam heat in order to study the effect of steam heat with milo of two different particle sizes. Temperature readings upon emergence from the heating chamber exceeded 185°F., with a temperature of 170°F. persisting for over two minutes in the heated mass. With the steam rolled product, temperatures above 175°F. were recorded as the milo emerged from the rollers. Figure 1 shows the particle size distribution of the various products.

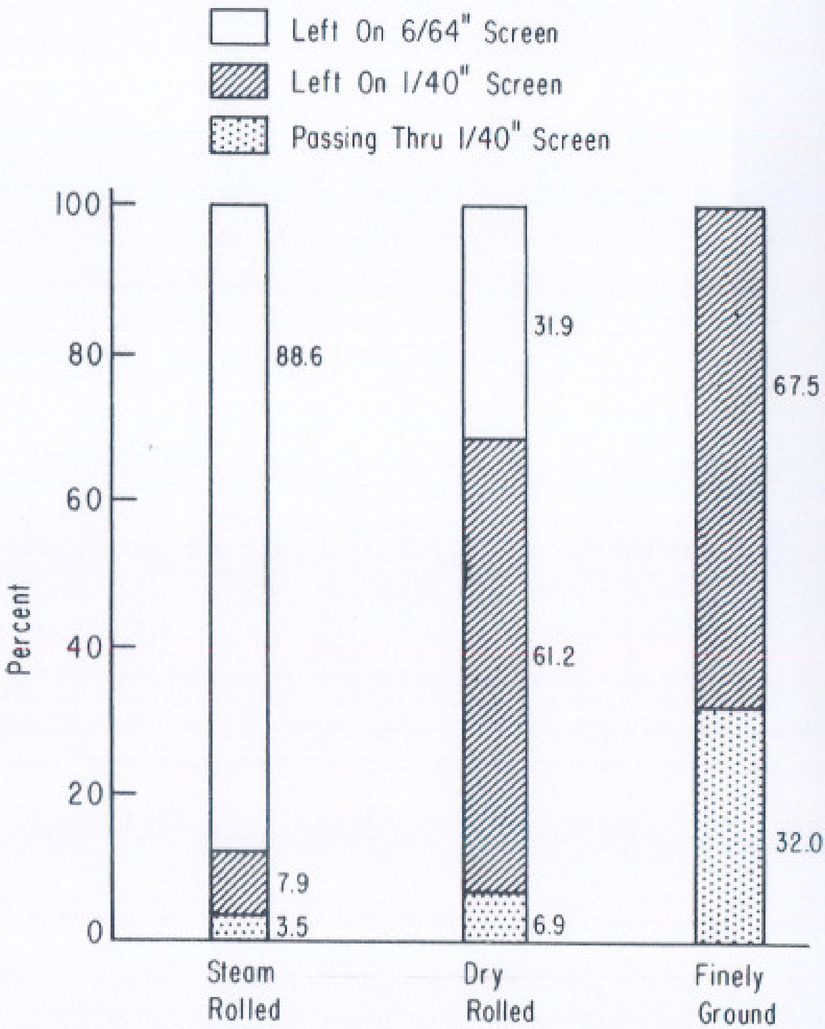

Figure 1. Particle Size Distribution of Milo Processed In Three Ways.

The calves were full-fed for days. Upon slaughter at Oklahoma City, detailed carcass data was obtained. A digestion trial, using additional calves, is now in progress. Basic laboratory tests on the enzymatic breakdown of milo starch in differently processed forms are also underway.

Results

A summary of the average results obtained in Trial I are shown in Table 5. While no significant difference in average daily gains from different processing of milo was obtained, the calves fed the finely ground milo in meal rations (Lot 1) gained slightly better than those fed coarse or steam rolled milos. This was also reflected in improved feed efficiency with nearly 60 and 30 lbs. less total ration required for the finely ground ration vs. the coarse or steam rolled mixtures (Lots 1 vs. 3 and 5).

Table 5.—Trial I: Feedlot Performance and Carcass Data from Calves Fed Differently Processed Milo in Meal Vs. Pelleted Rations.[1] (193 Days on Test)

Milo preparation	Finely Grd. Milo		Coarsely Grd. Milo		Steam Rolled Milo	
Lot no.	1	2	3	4	5	6
Ration form	Meal	Pellet	Meal	Pellet	Meal	Pellet
No. calves[2]	8	10	9	9	10	10
Avg. initial wt., lbs.	479	460	463	463	460	460
Avg. daily gain, lbs.	2.31	2.24	2.16	2.21	2.20	2.35
Avg. daily feed intake, lbs.	19.8	18.2	19.8	18.4	19.5	19.4
Feed required per cwt. gain, lbs.	857	813	917	833	886	826
Feed cost per cwt. gain,[3] $	18.43	18.29	19.72	18.74	19.49	19.00
Dressing %[4]	60.8	59.1	60.4	59.2	59.7	58.9
USDA Carcass grade score[5]	6.6	7.6	7.0	7.8	7.3	7.3

[1]One-half of the steers in each lot implanted with 12 mg. stilbestrol, the remainder with 24 mg.

[2]Two calves in Lot 1 and one from Lot 3 removed for urinary calculi; one calf removed from Lot 4 with sickness of unknown origin. Data on these calves not included.

[3]Based on Stillwater weights and warm carcass weights shrunk 2.5 percent.

[4]Carcass grade score: Good = 7; Top Good = 6.

[5]Feed costs were: Lots 1 and 3, $2.15 per cwt; Lots 2 and 4, $2.25; Lot 5, $2.20 and Lot 6, $2.30 per cwt.

However, when the rations were fed in pelleted form, little difference was apparent between finely ground and coarsely ground milo rations and both produced slightly less gain than the same rations in meal form (Lots 2 and 4 vs. 1 and 3). Pelleting the steam rolled milo ration (Lot 6) appeared to give a slight boost in gains, and in this form the pelleted ration was superior to the ground milo mixtures. Hence, pelleting the more bulky ration fed Lot 6 may result in a slight increase in gain, although feed intake was not improved. With the increase in gain, Lot 6 calves required 60 lbs. less per cwt. gain than Lot 5.

Overall, pelleting the three types of rations caused a 5 percent decrease in feed intake with slight effect on daily gain, but resulted in 7 percent less feed per 100 lbs. gain. However, this advantage largely disappears when the lower dressing percentages of pellet-fed calves are considered.

This trend is consistent with research at a number of stations which shows that pelleting a fattening type ration containing over 65 percent concentrates will depress feed intake and rate of gain. It can be calculated that at the prices prevailing during this test, the savings in feed cost per cwt. gain for pelleting of $1.37 was nearly offset by the increased pelleting cost of $1.03. Hence, there was little economic advantage from pelleting. No adverse effects in terms of looseness of droppings or founder were observed from any of the mixtures fed, possibly because a relatively low level of milo was used.

Trial II

Results for the 177-day trial show that with mixtures containing 60 percent or more of the differently processed milos, averaged daily gains favored Lots 3 and 4 (dry rolled product). These calves gained about 7 percent faster than those of Lots 1 and 2 fed the finely ground milo rations, and slightly faster than the steam rolled milo group (Lot 5). However, it can be seen that the differences in gain are small in each case. Calves of Lot 1 have been most efficient, consuming about 1.5 lbs. less of the daily ration, and requiring nearly 65 lbs. less feed per cwt. gain than calves of Lot 3. Feed efficiency with steam rolled milo, (Lot 5) has been intermediate. The only advantage to finely ground milo appears to be the greater feed efficiency of Lot 1. Carcass grades and yield were essentially the same.

Calves fed the finely ground milo rations exhibited more difficulty from bloat and scouring than those fed the dry or steam rolled products. Hence, the contention of cattle feeders that coarsely processed grain is safer to feed seems justified.

Steam heating, whether applied before or after rolling or grinding, appeared to have little, if any, beneficial effect. Laboratory tests have indicated, however, that when a starch-slitting enzyme was applied to each of the differently processed milos, those treated with steam were more readily attacked. However, in the overall economy of the ruminant, a more readily available starch may not be desirable since it may also adversely affect the efficiency of rumen fermentation of pH.

Refering to the earlier results from pelleting milo, the steam heat associated with the pelleting process does not appear to be the reason for the increased efficiency of milo utilization. This is supported by earlier work in which reground, pelleted milo gave no improvement over untreated milo in fattening rations. The reason for the observed greater feed efficiency from pelleting milo, therefore, may be due to the slightly lower grain intake when pellets are fed, resulting in better feed economy, rather than to the pelleting process itself. The slightly lower dressing percentage shown in Table 2 tends to bear this out.

Table 6.—Trial II: Effect of Different Methods of Processing Milo in Fattening Rations for Steer Calves (177 days on test)

Milo preparation	Fine Ground		Coarsely Ground		Steam
	Unheated	Steam Heat	Unheated	Steam	Rolled
Lot Number	1	2	3	4	5
No calves per lot	9[1]	9[1]	10	10	9[1]
Avg. weights, lb.					
Initial, Nov. 8, 1961	478	471	477	480	484
Final, May 5, 1962[2]	904	879	919	930	917
Total gain	426	408	442	450	433
Avg. daily gain	2.41	2.31	2.50	2.54	2.45
Avg. daily feed intake, lb.	21.2	22.4	23.8	24.0	21.8
Feed required per cwt. gain, lb.	880	970	952	945	890
Feed cost per cwt. gain, lb.[3]	23.32	27.16	25.23	26.46	24.48
USDA Carcass grades:					
Avg. Choice		2	1		
Low Choice	1	1		2	2
High Good	2		1	1	2
Avg. Good	3	1	6	3	3
Low Good	3	2	1	3	
High Standard		3	1	1	2
Dressing percentage[4]	62.6	61.7	62.7	62.0	62.4
Avg. on-fat value per cwt., based on yield and carcass grade	24.45	23.96	24.45	24.15	24.34

[1]One calf removed from each of Lots 1 and 2 for urinary calculi; one calf removed from Lot 5 for founder. Data on these calves not included.
[2]Based on initial and final shrunk weights.
[3]Cost per cwt. = Lots 1 & 3, $2.65; Lots 2 & 4, $2.80; Lot 5, $2.75.
[4]Hot carcass weights shrunk 2%; values based on Stillwater shrunk weights.

Summary

Earlier trials have shown that fine grinding and pelleting milo vs. dry rolling for fattening steers would decrease the milo required per 100 lbs. gain by about 10 percent. Subsequent trials have failed to show that this is due either to (1) the particle size of the milo, since no consistent advantage has been observed with different preparations of milo for fattening steer calves, or (2) to the effect of steam heating as might occur during the pelleting process. The milo kernel may differ from corn or other grains in that its dense, compact nature and characteristic starch are more impervious to the effects of steam heat. In the trials to date, no consistent advantage has been obtained for fine vs. coarse grinding or rolling of milo for fattening steer calves.

Steam rolled milo has not proven superior to the best ground or rolled product in any of the trials thus far. Hence, the additional cost and effort of steam rolling cannot be justified by feedlot performance. However, one possible advantage to the bulky, steam rolled grain is that a higher grain ration can be safely fed, thus lowering the feed required to produce 100 lbs. gain.