Methods of Processing Milo for Fattening Cattle*

Robert Totusek, Larry Franks, Willie Basler, and Robert Renbarger

Milo (sorghum grain) is the most readily available and cheapest grain in many cattle feeding areas. The production of milo and its use as a livestock feed have tripled during the past 10 years. It will be fed in even greater quantity in the future.

However, there are some problems associated with the feeding of milo to fattening cattle. It is very variable in composition and feeding value, and lower in feeding value on the average than other feed grains. The lower feeding value seems to be due to a lower protein digestibility and a lower starch availability compared to corn and barley. The availability of starch is especially important, since starch comprises 70-75 percent of milo grain, and milo is included in the ration primarily as a source of energy. Some fattening rations today contain as much as 90 percent or more milo, so starch obviously makes up a large portion of the ration, and any change in starch availability has a direct and large influence on total ration efficiency.

Processing offers one means of altering starch availability. In the past milo has most commonly been coarsely ground, dry rolled, or steam rolled ("conventional" steam rolling, with short time exposure to steam). Considerable research at this station and elsewhere has indicated very little difference in feeding value of milo processed by these three methods.

Previous work at this station showed that pelleting milo improved its utilization 5 to 9 percent, but lowered carcass grade and dressing percent were rather consistently observed. The high cost of pelleting is a further and major deterant to its use. Previous work at this station has likewise indicated a 5 percent improvement in feed efficiency due to fine grinding of milo, compared to coarse grinding. However, fine grinding may present a problem with dust and "fines", and does not have a desirable texture in the opinion of many cattle feeders.

Two new methods of processing appear very promising. Research at the Kansas and Texas Stations has indicated a sizeable improvement in dry matter utilization due to high moisture (25-35 precent) harvesting of milo. A possible improvement has also been suggested from the reconstituting of milo (adding water to "dry" milo to raise the moisture level to about 30 percent, and subsequent fermentation with exclusion of air).

Work at the Arizona Station has indicated a 4 percent or greater improvement in feed efficiency, along with greater feed intake and faster gain, from the partial cooking of milo followed by "flaking" through a

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roller mill. The milo was partially cooked by exposure to steam for 20-25 minutes. Research at the California Station has indicated an occasional but inconsistent response from the pressure cooking of grain followed by flaking. The objective of this experiment was to compare five methods of processing milo.

Procedure

Forty-five Hereford steer calves with an average weight of 494 lbs. and an average age of 9 months were obtained from the Experiment Station herds. They were divided into three groups of 15 head each, and randomly allotted within each weight group into 5 pens of 3 steers each. The 5 pens within each group (replication) were fed milo processed by 5 different methods, along with a basal ration.

The basal ration was fed at a level to just meet the maintenance requirement of the steers, so that the gain of the steers could be attributed to milo. The basal ration was composed of (percent): chopped alfalfa, 35.0; cottonseed hulls, 23.0; cottonseed meal, 40.0; salt 1.0; and dicalcium phosphate, 1.0. Vitamin A was added at a level of 2000 I.U. per lb. of basal, and chlortetracycline was added at a level to result in an intake of approximately 75 mg. per steer daily. No hormones were fed or injected.

Milo was full-fed in addition to the basal. Processing methods which were compared were coarse grinding, fine grinding, reconstituting-rolling, steam process-flaking, and reconstituting-steam process-rolling.

Coarsely and finely ground milo were produced with a hammer mill, using 3/16 and ⅛ inch screens, respectively. Reconstituted milo was produced in 2 metal tanks with a capacity of 5000 lb. each. Milo in the tank was soaked in water for 60 minutes, then covered with a 6 mil plastic sheet covered with sand to keep the plastic in close contact with the milo and exclude as much air as possible. Milo was allowed to remain in the tanks at least 20 days before being rolled and fed. Very little feed spoilage was observed and no refusal of the reconstituted milo occurred. The reconstituted milo had a pleasant silage-like odor.

Steam process-flaking was accomplished by using the procedure reported by Hale and co-workers at the Arizona Station. Milo was subjected to steam (produced by a steam generator) in an unpressurized steam chamber for 20 minutes, then rolled immediately. The maximum temperature reached during steaming averaged 206°F.

The reconstituted-steam-rolled milo was reconstituted as described above, then steam processed and rolled. Steaming did not exceed 10 minutes because longer steaming resulted in a product too wet and soft to roll satisfactorily. Maximum temperature within the steam chamber did not exceed 203°F.

Feeds were rolled daily, and feeding was done once daily in sufficient quantity to assure availability of feed until the next feeding.

Steers in each pen had access to an open sided shed and an outside lot, with water (warmed in winter) available at all times.

The feeding period started December 8, 1965 and lasted 171 days. Initial and final weights were taken after a 16 hour shrink with no feed and water. At the termination of the feeding trial the steers were slaughtered at the Harris Packing Company, Oklahoma City, and carcass data collected after a 48-hour chill.

Results

Note the effect of processing method on dry matter (100 % — % moisture), test weight per bushel (density) and particle size in Table 1. The air dry milo which was either coarsely or finely ground averaged approximately 13 percent moisture, while the reconstituting-rolling and steam process-flaking procedures increased moisture levels to 27 and 19 percent, respectively. The combination of reconstituting and steam process-rolling resulted in a moisture level of 31.3 percent.

All of the processing methods decreased the density of milo. Reconstituting-rolling, steam process-flaking, and reconstituting-steam process-rolling resulted in the greatest decreases in density, and there was little difference in the three processing methods in this regard. However, there was a big difference in the particle size of the three products. Steam process-flaking, compared to reconstituting-rolling, produced more large particles (flakes) and much less fine material. Steam process-rolling of the reconstituted milo resulted in a small increase in large particles but also a large increase in fines compared to reconstituting-rolling. The fine particles in either of the reconstituted products was very fluffy in nature, and this characteristic resulted in a test weight per bushel very similar to the "flaked" milo.

Table 1. Effect of Processing Method on Dry Matter, Weight Per Bushel and Particle Size of Milo.

	% Dry Matter	Lb. wt.[1] per bu.	% Remaining On Sieve Of Indicated Size, In Inches Diameter of Openings							% Remaining On 40 Mesh Sieve	% Passing Through 40 Mesh Sieve
			18/64	16/64	12/64	8/64	1/12	1/18	1/25		
Coarsely ground	87.0	47.9	0	0	0	2.4	9.1	22.4	20.4	22.3	23.4
Finely ground	87.7	44.4	0	0	0	0	1.6	14.4	22.1	27.4	34.5
Reconstituted-rolled	73.0	26.6	0	.2	17.6	40.3	16.8	7.9	3.8	5.6	7.8
Steam process-flaked	81.0	26.0	2.3	19.1	47.0	21.5	5.1	2.0	.9	1.0	1.1
Reconstituted-steam-rolled	68.7	25.1	2.0	8.3	28.3	20.6	9.1	7.9	5.6	8.9	9.3

[1]On 90 percent dry matter basis.

Feedlot performance is shown in Table 2, with a further summary showing the relationship of coarse grinding to the other processing methods in terms of rate of gain, feed intake, and feed efficiency in Table 3. Coarsely ground milo was used as the basis for comparison because through the years coarse grinding, dry rolling or steam rolling ("conventional") have been processing methods of choice of cattle feeders, and research has indicated very little difference among them from the standpoint of efficiency of utilization.

It is interesting to note that rates of gain in three instances were almost identical, while steers fed finely ground milo gained slightly faster and those fed stream process-flaked milo outgained all others. However, statistical analysis indicated no significant differences ($P<.05$) in the rates of gain.

Since all steers received a maintenance allowance of the basal ration, milo alone was considered with respect to intake and efficiency of utilization. Processing method had a significant ($P<.01$) influence on milo intake, as follows: steam process-flaking resulted in a higher intake than all other methods except coarse grinding, and coarse grinding resulted in a greater intake than reconstituting-steam rolling. Differences in other comparisons were not statistically significant ($P<.05$). Note in the summary shown in Table 3 that compared to coarse grinding, steam process-flaking resulted in an increased intake, while the other three methods resulted in decreased intakes.

Milo required per lb. of gain was significantly ($P<.05$) affected by processing method. Coarse grinding resulted in a higher requirement of milo per lb. of gain than all other processing methods except steam process-flaking. Feed conversion of the steam process-flaked milo was very similar to that of coarsely ground milo, but not statistically different than the other three methods. Note in the Table 3 summary that steam process-flaking did not result in much change in feed efficiency

Table 2. Feedlot Performance (171 Days, 9 Steers Per Treatment)

	Method of Processing Milo				
	Coarsely Ground	Finely Ground	Reconstituted	Steam Process-Flaked	Reconstituted-Steam-Rolled
Av. initial wt., lb.	501	490	489	498	491
Av. final wt., lb	916	911	907	948	904
Av. daily gain, lb.	2.43	2.51	2.44	2.63	2.42
Av. daily feed, lb.					
Milo[1]	10.58(ab)	9.80(bc)	9.81(bc)	11.29(a)	9.28(c)
Basal	8.69	8.56	8.51	8.80	8.49
Total	19.27	18.36	18.31	20.09	17.78
Feed/lb. gain, lb.					
Milo[2]	4.37(a)	3.93(b)	4.01(b)	4.30(ab)	3.85(b)
Basal	3.57	3.41	3.48	3.35	3.51
Total	7.92	7.32	7.49	7.64	7.35

[1] Any 2 averages without a common letter differ significantly ($P<.01$).
[2] Any 2 averages without a common letter differ significantly ($P<.05$).

Table 3. Summary of Effect of Milo Processing Method on Feedlot Performance.

		% Change Compared to Coarsely Ground Milo			
	Coarsely Ground	Finely Ground	Reconstituted	Steam Process-Flaked	Reconstituted-Steam-Rolled
	lb.				
Av. daily gain	2.43	+ 3.3	+ .4	+8.2	— .4
Av. daily feed	10.58	— 7.4	—7.3	+6.7	—12.3[2]
Milo/lb. gain	4.37	—10.1[1]	—8.2[1]	—1.6	—11.9[1]

[1] Significantly different ($P < .05$) than value for coarsely ground milo.
[2] Significantly different ($P < .01$) than value for coarsely ground milo.
For statistical difference between other pairs of values, see Table 2.

compared to coarse grinding, while the other three processing methods resulted in sizeable and rather similar improvements in efficiency.

Slaughter and carcass information is presented in Table 4. Values for most of the traits were very similar for all treatments, and none of the traits were significantly ($P<.05$) affected by processing method. The greater weight of calculi in the cattle fed steam process-flaked milo was interesting and will be observed further in subsequent tests. However, calculi differences were not statistically different, and no clinical cases of urinary calculi were observed in the steam process-flaked milo cattle. One case of urinary calculi occurred in a steer receiving finely ground milo on the 160th day of the experiment.

Discussion

Steam process-flaking resulted in an increased intake of milo and a faster rate of gain, compared to other processing methods. Even though some of the differences were not statistically significant, these trends are similar to those reported from other research and are probably real. In other words, steam process-flaking apparently improves the palatability and consequently the intake of milo, which results in an increased rate of gain. However, the results of this trial suggest that the improvement in feed efficiency due to steam process-flaking is more apparent than real. Considering the entire ration, including the basal which was fed at a maintenance level, steam process-flaking resulted in a 3.5 percent improvement in feed efficiency (statistically non-significant, ($P<.05$) compared to coarse grinding. When milo alone is considered, the difference in feed efficiency is very small. Perhaps any improvement in feed efficiency due to steam process-flaking results from a faster gain due to greater intake, with the feed required for maintenance therefore spread over a greater gain.

Even if this is true, however, it is obvious that advantages in intake, rate of gain, and apparent feed efficiency are important economically. Furthermore, the faster gaining steers on the steam process-flaked milo could be marketed earlier, and this might result in a real improvement in feed efficiency not demonstrated in this experiment in which steers were fed a constant time rather than to a constant weight.

Table 4. Slaughter and Carcass Information

	Method of Processing Milo				
	Coarsely Ground	Finely Ground	Reconstituted	Steam Process-Flaked	Reconstituted-Steam-Rolled
Dressing %[1]	60.8	61.2	61.4	61.7	60.6
Fat thickness, in.[2]	.50	.48	.58	.64	.52
Ribeye area, sq. in.[3]	10.5	11.0	10.7	11.3	10.7
Cutability, %					
Carcass basis[4]	51.0	51.5	50.8	50.6	51.1
Live basis[5]	31.0	31.5	31.2	31.2	31.0
Carcass grade[6]	9.6	8.2	9.4	9.7	9.3
Av. wt. of calculi, gm.[7]	2.4	2.6	2.5	10.8	3.7

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

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

[3] Determined by measurement of tracings of ribeye.

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

[5] Trimmed retail cut yield as determined in footnote 4 multipled by dressing percent.

[6] USDA carcass grade converted to following numerical designations: high prime — 15, average prime — 14, low prime — 13, high choice — 12, average choice — 11, low choice — 10, high good — 9, average good — 8, low good — 7.

[7] Represents average total weight of calculi removed from bladder.

Reconstituting-rolling resulted in an improvement in feed efficiency, with no sacrifice in rate of gain, accompanied by a decreased grain intake, compared to coarse grinding. Steam processing of the reconstituted milo resulted in a further improvement in feed efficiency, with a further decline in feed intake but no decline in rate of gain. Even though these changes were not statistically significant, the possibility that further improvement in nutrient availability may be accomplished beyond the reconstitution process is recognized.

Fine grinding of milo resulted in good performance in this trial, as it has in previous experiments at this station. Feed efficiency was improved, and rate of gain did not decline. The decreased feed intake observed with this processing method, as with the reconstituted milos, was probably due to its greater utilization. Energy intake is one factor which governs feed intake; if utilization of a grain is increased, less is required to provide the same amount of energy. (The interesting observation in this regard is that steam process-flaking seems to improve palatability sufficiently to result in an increase in energy intake).

It should also be pointed out that the "coarse ground" milo used in this trial, ground through a hammer mill using a 3/16 inch screen, was considerably finer than that used in many feedlots which is undoubtedly utilized much more poorly than the "coarsely ground" milo used in this trial.

The results obtained in this experiment, as well as those reported from other stations, suggest interesting possibilities in milo processing. Many questions remain unanswered, and more information may be desirable before a change in processing method is made in many situations.

Equipment costs are an important consideration. The storage of high moisture grain in trench type facilities as well as air tight structures is a definite possibility.

Additional Information

Net energy values and volatile fatty acid production as affected by the processing methods used in this experiment will be reported later. The experiment itself is also being repeated. In addition, a trial is now in progress in which the following milo processing methods are being compared in a high concentrate (90 percent) ration: coarse grinding, fine grinding, dry rolling, steam process-flaking, reconstituting-rolling, and reconstituting-fine grinding.

Note: The particle size of milo, as influenced by the methods of processing, is illustrated in Figure 1, on page 101.

Influence of Level of Nitrogen Application to Wheat Pasture on Vitamin A Status of Beef Calves

Gale Thompson, S. A. Ewing and Robert Renbarger

Some producers have reported the occurrence of vitamin A deficiency symptoms among beef cattle grazing wheat pasture that had been fertilized with 50 or more pounds of actual nitrogen. The experiment reported is the first of a series of tests concerning level of nitrogen fertilization and the vitamin A status of calves grazing the forage.

Procedure

Twenty weaner heifer calves were selected from the Ft. Reno herd to serve as experimental animals. Five of the twenty heifers were selected at random for liver biopsy to obtain the initial levels of liver vitamin A and carotene prior to the grazing season. The remaining 15 calves were allotted to three groups and assigned to three wheat pasture fields which had been seeded with 16 lbs. of nitrogen per acre in a starter application. One field (control) received no additional nitrogen and the other two received applications of either 34 or 84 pounds of additional nitrogen after the wheat was up and prior to the beginning of the grazing season in November. As a result the three experimental pastures received 16, 50 and 100 lb. of actual nitrogen per acre prior to the grazing period. The stocking rate was approximately 1.1 acres per head. The grazing period consisted of 121 days from November 17, 1965 to March 18, 1966. The forage was sampled for nitrate analysis at the beginning and end of the grazing season and at one point (January) within the grazing period.