



**An Economic Evaluation
of Corn and Grain Sorghum Processing Alternatives
for Texas Feedlots**

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An Economic Evaluation of
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for Texas Feedlots

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I. INTRODUCTION

Feedlot managers must continually evaluate every aspect of their operation, especially during times of economic instability and soaring energy costs. Feed costs account for approximately 75% of the total cost of gain for beef cattle. Grain processing, being an integral component of feed related costs, is an area that has been under close scrutiny for many years with significant improvements reported for numerous processing techniques. Managers must continually evaluate grain processing methods with regard to total operating costs and animal performance.

During 1978, Texas feedlots produced 4.915 million head of grain fed cattle (USDA, 1979). Assuming that an average feedlot animal consumed 2,250 pounds of grain, then these 4.915 million cattle required over eleven billion pounds of grain. Therefore, even small changes in the cost of grain processing or the efficiency of converting grain into beef would have a large influence on the cost of producing beef and, subsequently, on the profitability of the feeding industry.

Many processing alternatives have been developed with the prospect of either increasing animal performance, reducing cost of gain or reducing the cost of processing grain. The commercial cattle feeding industry has utilized steam flaking more than any other grain processing technique. Yet other processing alternatives are of potential value to the industry and they too must be evaluated. Therefore, the five most prominent grain processing alternatives were compared under present economic conditions to assist in this important decision for feedlot managers.

The objectives of this study were:

- a. Determine the cattle performance responses to five methods of corn and grain sorghum processing,
- b. Estimate the processing cost associated with each process for feedlots of 5,000 and 20,000 head capacity,
- c. Present partial budgets to allow producers to evaluate these alternatives under their own specific production conditions of the future.

II. LITERATURE REVIEW

One of the primary aspects of an economic evaluation of grain processing is the expected performance of cattle when fed grain processed by each alternative. The published literature on grain processing provides a basis to develop comparative biological responses. This approach is not without limitations, but is considered to be a useful predictor when properly applied.

The following review of literature is devoted to assessing the relative gain and feed conversion of cattle fed high grain rations. Five methods of processing corn and grain sorghum reviewed were dry rolled, steam flaked, whole grain reconstituted, early harvested ground into trench silos and early harvested acid-treated grain.

Not all of the data published on grain processing is included in this review. Only feeding experiments conducted in North America were considered that had dry grain controls and reported grain content of ration or percentage changes due to the processed grain. In the case of the early harvested comparisons, grain moisture at time of harvest was limited to 22 to 30%. Other considerations of this nature are noted throughout this report to add uniformity between comparisons presented.

Each method of processing is briefly described to further establish limits acceptable to each system of processing. Grain processing responses are dependent upon rather specific criteria which have been considered in developing this literature review. All responses in conversion of grain to liveweight gain are presented in this manuscript on an absolute dry basis.

Dry rolling and grinding

Dry rolling and grinding grain were some of the earliest processing alternatives evaluated and will serve as the controls in this report. Dry processing is not presently used extensively in Texas feedlots.

Dry rolling, or cracking, of grain is accomplished by passing of grain, at a moisture of 10 to 15%, through rollers which are usually grooved on the surface. The product varies from very small to very coarse particles depending upon the tolerance set of the rolls; however, whole kernels should be avoided. Dry grinding generally results in smaller grain particles than

rolling, and is accomplished by various impact mills. These processes will be collectively referred to in this manuscript as dry processing.

Steam flaking

Steam flaking is accomplished by subjecting dry grain to steam at temperatures of around 200 degrees F for 15 to 40 minutes. The grain is then passed through roller mills set at near zero tolerance to produce a thin, flat flake which usually weighs from 22 to 28 pounds per bushel and contains 16 to 20% moisture. These are critical factors in the success of steam flaking.

Cattle responses to steam flaked corn and grain sorghum versus dry processing are summarized from the literature in tables 1 and 2, respectively. Steam flaked corn improved gain and grain conversion by an average 2.31 and 7.46%, respectively, compared to dry processed corn. Grain sorghum averaged 5.83% greater gain and 8.11% improved grain conversion.

Reconstitution

Reconstitution is accomplished by adding water to whole, dry grain to raise the moisture level of the grain to 25 to 30%. The product is then stored in an anaerobic atmosphere for 14 to 21 days. After ensiling the grain is either ground or rolled prior to feeding. White *et al.* (1969a) compared ground reconstituted and whole reconstituted grain sorghum with dry ground grain and reported an improvement of 11.6% in average daily gain and 9% in feed conversion for whole reconstituted over dry ground grain sorghum. A decrease of 1.8% in daily gain and 3.5% in feed conversion was observed for ground reconstituted grain sorghum when compared with dry ground, indicating that whole grain must be used for successful reconstitution.

Results from reconstitution research for corn and grain sorghum are shown in tables 3 and 4, respectively. Reconstituted corn improved grain conversion an average of 7.97% while gain was depressed .27% compared to dry processing. Reconstituted grain sorghum indicated 1.59% average greater gain with 12.32% less grain than dry processing.

Early harvested ground into a trench silo

Early harvesting involves a processing method that has been investigated since the early 20th century. Initial research was undertaken to

TABLE 1. CATTLE PERFORMANCE ON STEAM FLAKED VERSUS DRY PROCESSED CORN^a

No. of trials	Grain in rations, %	Gain	Change over dry processing, % ^b		Reference
			Ration conversion	Grain conversion	
1	69	1.89	-4.76	-6.90	Mies and Summers, 1980
1	50	0	6.35	12.70	Matsushima & Stenquist, 1967
1		3.74		3.40	Thompson et al., 1965
1	80	8.12	10.14	12.68	Davis et al., 1973a
3		2.37	9.88	12.59	Matsushima, 1966
1	63	-2.35	0	0	Burkhardt et al., 1969
Weighted average of 8 trials ^c		2.31	5.91	7.46	

^a Most studies reported an increase in dry matter intake for steam flaking.

^b Dry matter basis.

^c Weighted averages determined by algebraically adding values according to number of trials reported.

TABLE 2. CATTLE PERFORMANCE ON STEAM FLAKED VERSUS DRY PROCESSED GRAIN SORGHUM^a

No of trials	Grain in rations, %	Change over dry processing, % ^b		Reference
		Gain	Grain conversion	
1	72	-1.49	7.71	Mies & Summers, 1980
1	75	-3.23	8.89	Davis et al., 1973a
1		2.76	5.94	Brethour et al., 1969
1	83.4	5.65	9.80	White et al., 1969b
1	83.4	12.34	8.24	Newson et al., 1968
1		8.20	3.54	Totusek et al., 1967
3	68.4	9.41	4.78	Hale et al., 1966
Weighted average of 9 trials ^c		5.83	6.50	8.11

^a Most studies reported an increase in dry matter intake for steam flaking.

^b Dry matter basis.

^c Weighted averages determined by algebraically adding values according to number of trials reported.

TABLE 3. CATTLE PERFORMANCE ON RECONSTITUTED VERSUS DRY PROCESSED CORN

No. of trials	Grain in rations, %	Gain	Change over dry processing, % ^a		Reference
			Ration conversion	Grain conversion	
1	71	-5.50	6.50	9.15	Martin <u>et al.</u> , 1971 ^b
1	70	0	.60	.86	Tonroy <u>et al.</u> , 1974
1	81.5	-7.70	4.15	5.09	Burroughs, 1969
2	63	11.30	14.13	22.43	Baker, 1973
1	63	-11.00	-7.65	-12.14	Burkhardt <u>et al.</u> , 1969
Weighted average of 6 trials ^c		-.27	5.31	7.97	

^a Dry matter basis.

^b Storage of reconstituted grain was in airtight bags.

^c Weighted averages determined by algebraically adding values according to number of trials reported.

TABLE 4. CATTLE PERFORMANCE ON RECONSTITUTED VERSUS DRY PROCESSED GRAIN SORGHUM

No. of trials	Grain in rations, %	Gain	Change over dry processing, % ^b		Reference ^c
			Ration conversion	Grain conversion	
1	83	11.60	9.00	10.84	White <u>et al.</u> , 1969a
1	85	8.82	15.60	18.35	Wagner <u>et al.</u> , 1971
1		.40	5.43	8.24	Totusek <u>et al.</u> , 1967
1	83.4	.40	9.49	11.38	Newsom <u>et al.</u> , 1968
1	84	-2.40	11.80	14.05	White and Totusek, 1969
1	83.4	0	9.54	11.44	White <u>et al.</u> , 1969b
1	75	1.08	7.92	10.56	Davis <u>et al.</u> , 1973b
1		7.40	9.20	10.62	Schake <u>et al.</u> , 1977
1	84	-12.63	8.3	9.88	Kiesling <u>et al.</u> , 1973
3		0	10.94	14.00	Riggs and McGinty, 1970
1	82	6.03	10.45	12.74	Bolsen <u>et al.</u> , 1974
Weighted average of 13 trials ^a		1.59	9.96	12.32	

^a Weighted averages determined by algebraically adding values according to number of trials reported.

^b Dry matter basis.

^c Grain reconstituted in airtight bags for first seven references cited.

determine the animal response to immature grain caused by unfavorable weather. This system required that grain be delivered to the feedlot at moisture levels between 22 and 30%. The grain is either ground or rolled and packed into a trench silo. The silo is usually covered with plastic sheets and tires to limit oxygen from entering the system to reduce spoilage. When needed for feeding, the grain is transferred from the trench silo to the mill and added directly to the ration without further processing.

The performance of cattle fed early harvested corn and grain sorghum that was ground and stored in a trench silo is shown in tables 5 and 6, respectively. This review indicates greater improvements in feed conversion than earlier reviews by Corah (1976) and Neumann (1977) because of the specifications of this literature review which excluded some previously cited research. Corn that was early harvested and ground before storage reduced average grain requirements by 11.14% with a slight (1.87%) reduction in gain compared to dry processing. Sorghum indicated a 5.79% increase in gain with 9.35% less grain dry matter.

Early harvested acid-treated

Acid-treatment of early harvested grain at moistures of 22 to 30% is accomplished by adding an organic acid(s) and storing in the whole form. The grain is then rolled prior to feeding. Acetic or propionic acids or combinations of both are the most common preservatives of early harvested acid-treated grain.

The amount of organic acids required to preserve grain depends upon the type of grain (corn vs. sorghum) and the moisture content of the grain. Marion et al. (1972) found that adding up to 4% of either acetic or propionic acid had insignificant effects on cattle performance. However, when levels of acids exceeded 4% cattle performance was adversely influenced. Most research indicated that 1% to 4% organic acid was required for proper preservation of the grain. There would be concern whether a single treatment of organic acids would preserve grains from fall harvest throughout subsequent spring and summer months. In many cases a second application of organic acids may be required.

The cattle responses to early harvested acid-treated corn and grain sorghum are shown in tables 7 and 8, respectively. This summary indicates

TABLE 5. CATTLE PERFORMANCE ON EARLY HARVESTED GROUND CORN STORED IN TRENCH SILOS VERSUS DRY PROCESSED CORN

No. of trials	Grain in rations, %	Change over dry processing, % ^b		Reference ^c
		Gain	$\frac{\text{Ration conversion}}{\text{Grain conversion}}$	
1	46	-5.77	1.90	Matsushima & Stenquist, 1967
1	70	-4.12	3.92	Tonroy <u>et al.</u> , 1974
1		-7.63		Perry, 1977
1	80	15.38	5.36	Forsythe <u>et al.</u> , 1972
1	71	-2.27	11.01	Martin <u>et al.</u> , 1971
5		-2.86	1.67	Neumann, 1977
Weighted average of 10 trials ^a		-1.87	3.39	11.14

^a Weighted averages determined by algebraically adding values according to number of trials reported.

^b Dry matter basis.

^c References cited were only those with grain moisture contents between 22 and 30%.

TABLE 6. CATTLE PERFORMANCE ON EARLY HARVESTED GROUND GRAIN SORGHUM STORED IN TRENCH SILOS VERSUS DRY PROCESSED GRAIN SORGHUM

No. of trials	Grain in ration, %	Gain	Change over dry processing, % ^b		Reference ^c
			Ration conversion	Grain conversion	
1	85	-1.12	2.54	2.99	Brethour & Duitsman, 1972
1	87.5	11.56	10.16	11.61	Brethour & Duitsman, 1970
1		8.62	4.43	3.94	Brethour et al., 1969
1	82	6.38	4.78	5.83	Cox et al., 1973
1	80	10.00	19.00	23.75	Martin et al., 1969
1		2.68		16.21	Brethour & Duitsman, 1962
1		2.41		1.10	Brethour & Duitsman, 1964
Weighted average of 7 trials ^a		5.79	8.18	9.35	

^a Weighted averaged determined by algebraically adding values according to number of trials reported.

^b Dry matter basis.

^c References cited were only those with grain moisture contents between 22 and 30%.

TABLE 7. CATTLE PERFORMANCE ON EARLY HARVESTED ACID-TREATED VERSUS DRY PROCESSED CORN

No. of trials	Grain in ration, %	Gain	Change over dry processing, % ^b		Reference
			Ration conversion	Grain conversion	
1	70	2.50	6.49	9.27	Tonroy et al., 1974
1	76.6	-13.86	-3.46	-4.52	Mies & Summers, 1980
1	80	7.69	7.14	8.93	Forsythe et al., 1972
2		4.87		3.27	Self, 1974
1		5.14		3.50	Beeson et al., 1971
1		6.80		4.69	Wilson et al., 1972
2	85	1.55	3.14	3.69	Hoffmann et al., 1975
Weighted average of 9 trials ^a		2.35	3.29	3.97	

^a Weighted averages determined by algebraically adding values according to number of trials reported.

^b Dry matter basis.

TABLE 8. CATTLE PERFORMANCE ON EARLY HARVESTED ACID-TREATED VERSUS DRY PROCESSED GRAIN SORGHUM

No. of trials	Grain in ration, %	Gain	Change over dry processing, % ^b		Reference
			Ration conversion	Grain conversion	
1	76	-4.46	9.92	13.05	Mies & Summers, 1980
1	82	4.60	4.80	5.85	Cox et al., 1973
1	90	-6.37	4.90	5.44	Brethour & Duitsman, 1972
Weighted average of 3 trials ^a			-2.08	6.54	8.11

^a Weighted averages determined by algebraically adding values according to number of trials reported.

^b Dry matter basis.

that early harvested acid-treated corn resulted in 2.35% greater rate of gain with 3.97% less grain dry matter than dry processed corn. Acid-treated grain sorghum improved average grain conversion by 8.11% in the presence of a 2.08% reduced gain when compared to dry processed grain. It should be noted that only three publications are reported for this processing alternative.

A total of 64 feeding trials were summarized for the eight grain processing combinations presented in table 9. In all instances average grain conversion was improved compared to dry processing. Improvements in grain conversion for corn ranged from 3.97 to 11.14% compared to dry processed corn while similar values for grain sorghum ranged from 8.11 to 12.32%. Rate of gain was not consistently influenced by method of processing except in the case of steam flaking. These averages are in close agreement with summaries by Hale and Prouty (1980), May and Schake (1976), Perry (1977) and Schake et al., (1969).

III. PROCEDURE

Budgets were prepared for 5,000 and 20,000 head one-time capacity feedlots using dry rolling, steam flaking, whole reconstitution, early harvested ground into a trench and early harvested acid-treated grain processing facilities. These budgets utilized 1980 turn-key investment costs for all components pertaining to the actual processing of the grain and annual operating costs for each process. Annual fixed and variable costs were developed for each budget. The same costs of operating were used for both corn and grain sorghum, but it must be noted that some differences do exist for each grain. Estimates for these budgets were obtained through interviews with feedlot personnel, feed mill engineers, equipment dealers and construction consultants.

For comparison purposes, certain basic assumptions were necessary. These assumptions were:

1. Total grain requirement within each grain-feedlot comparison was constant.
2. Interest on both fixed and operating capital was charged at 15% per annum.
3. Sufficient quantities of grain and capital were available.

TABLE 9. SUMMARY OF COMPARISONS OF CATTLE RESPONSES TO GRAIN PROCESSING ALTERNATIVES^a

Grain	Processing alternative	Number of trials	Percent change over Gain	dry grain ^b conversion
Corn	Steam flaked	7	2.31	7.46
Corn	Reconstituted	6	-.27	7.97
Corn	Early harvested ground	10	-1.87	11.14
Corn	Early harvested acid treated	9	2.35	3.97
Sorghum	Steam flaked	9	5.83	8.11
Sorghum	Reconstituted	13	1.59	12.32
Sorghum	Early harvested ground	7	5.79	9.35
Sorghum	Early harvested acid treated	3	-2.08	8.11

^a Data presented are summaries of comparisons cited in literature.

^b Dry control was either rolled or ground grain.

4. Dry corn and grain sorghum was purchased at \$5.00 and \$4.50/cwt on an absolute dry matter basis. Early harvested grains were purchased at a 5% price advantage according to Southwest Scale of Grain Premiums and Discounts (1974) at an average of 25.5% moisture.
5. A standard feedlot occupancy of 90% was used for the dry processed control and a net gain of 450 pounds per head was used for all processes.
6. Equal managerial skill for all processes was assumed.

Cattle performance associated with each processing alternative, when compared to dry processing, are given in table 9. To extend these percentage responses to current industry conditions, daily gains and dry matter feed conversions from 1978-1979 industry averages were adapted from feedlot interfirm comparison data similar to those reported by Schake et al. (1979). Grain sorghum was assigned a feeding value of 95% that of corn (Schake et al., 1976). Appendix tables A, B, C and D outline the procedure applied to integrate cattle performance and grain processing cost with a fixed quantity of grain entering each system. This approach results in slightly different cattle inventories associated with each size feedlot and type of grain, therefore comparisons should be made only within each grain. No consideration was given to seasonal purchasing of grain for any system since all systems could elect to forward purchase their grain requirements. On the other hand, early harvested grain can only be purchased at time of harvest. Unique contractual and hedging arrangements have been negotiated for purchasing grains which are not reflected in these estimates. While some feedlots apply two or more grain processing techniques to grain, no attempt was made in this report to evaluate any combinations of processing.

IV. RESULTS AND DISCUSSION

Cost of processing

The budgets for each processing system in 5,000 and 20,000 head feedlots are shown in Appendix tables E through N. Dividing the total specified annual cost associated with each processing system (Appendix tables E through N) by the tons of grain purchased or by the total head produced (Appendix tables A through D), unit cost for each alternative were obtained and are presented in tables 10, 11, 12 and 13 for corn and grain sorghum. Since

TABLE 10. SUMMARY OF PROCESSING COSTS FOR CORN PROCESSING ALTERNATIVES IN A 5,000 HEAD FEEDLOT, DOLLARS

Item	Dry rolled	Steam flaked	Reconstituted	Early harvested	
				Ground ensiled	Acid treated
Initial investment per head capacity	17.07	31.92	36.82	33.39	28.67
Processing cost/ton, dry basis	2.57	9.79	6.11	12.55	15.69
Processing cost, \$/hd produced	3.34	11.81	7.33	14.66	20.02
Net value compared to dry rolling, \$/ton of grain dry matter ^a		.24	4.43	.60	-9.35

^a Calculated by evaluating both processing cost and animal performance responses.

TABLE 11. SUMMARY OF PROCESSING COSTS FOR CORN PROCESSING ALTERNATIVES IN A 20,000 HEAD FEEDLOT, DOLLARS

Item	Dry rolled	Steam flaked	Reconstituted	Early harvested	
				Ground ensiled	Acid treated
Initial investment per head capacity	13.15	22.74	26.14	24.88	20.60
Processing cost/ton, dry basis	1.74	6.37	3.79	11.45	14.01
Processing cost, \$/hd produced	2.26	7.68	4.55	13.38	17.88
Net value compared to dry rolling, \$/ton of grain dry matter ^a		2.83	5.92	.87	-8.50

^a Calculated by evaluating both processing cost and animal performance.

TABLE 12. SUMMARY OF PROCESSING COSTS FOR GRAIN SORGHUM PROCESSING ALTERNATIVES IN A 5,000 HEAD FEEDLOT, DOLLARS

Item	Dry rolled	Steam flaked	Reconstituted	Early harvested	
				Ground ensiled	Acid treated
Initial investment per head capacity	17.07	31.92	36.83	33.39	28.67
Processing cost/ton, dry basis	2.53	9.71	5.91	11.68	14.89
Processing cost, \$/hd produced	3.47	12.23	7.11	14.87	19.15
Net value compared to dry rolling, \$/ton of grain dry matter ^a		.12	7.71	-1.36	-5.42

^a Calculated by evaluating both processing cost and animal performance responses.

TABLE 13. SUMMARY OF PROCESSING COSTS FOR GRAIN SORGHUM PROCESSING ALTERNATIVES IN A 20,000 HEAD FEEDLOT, DOLLARS

Item	Dry rolled	Steam flaked	Reconstituted	Early harvested	
				Ground ensiled	Acid treated
Initial investment per head capacity	13.15	22.74	26.14	24.88	20.60
Processing cost/ton, dry basis	1.71	6.31	3.68	10.82	13.24
Processing cost, \$/hd produced	2.35	7.95	4.42	13.57	17.03
Net value compared to dry rolling, \$/ton ^a of grain dry matter		2.70	9.12	-1.11	-4.59

^a Calculated by evaluating both processing cost and animal performance responses.

expenses associated with each system are subject to change an opportunity is provided in Appendix tables E through N to include specific budget modifications.

Dry rolling cost per ton of grain dry matter for corn and sorghum was \$2.57 and \$1.74 for 5,000 and 20,000 head feedlots. Comparable values for grain sorghum were \$2.53 and \$1.71, respectively. These values reflect economies of size in rolling dry grain and will serve as a basis of comparison for the other processing techniques.

Steam flaking corn in 5,000 and 20,000 head feedlots cost \$9.79 and \$6.37 per ton while respective per head costs were \$11.81 and \$7.68. Grain sorghum cost \$9.71 and \$6.31 per ton or \$12.23 and \$7.95 per head for 5,000 and 20,000 head feedlots, respectively. These costs are considerably higher than dry rolling because of the energy and maintenance requirements of steam flaking equipment. Initial investment cost per head capacity for 5,000 and 20,000 head steam flaking feedlots was \$31.92 and \$22.74 compared to \$17.01 and \$13.15 for dry rolling.

Cost for reconstituting corn for 5,000 and 20,000 head feedlots was \$6.11 and \$3.79 per ton and \$7.33 and \$4.55 when expressed on a per head basis. Corresponding cost for grain sorghum was \$5.91 and \$3.68/ton and \$7.11 and \$4.42/head. These values reflect a lower fuel requirement for reconstitution than steam flaking. However, the highest initial investments (\$36.83 and \$26.14 per head of capacity) were observed for 5,000 and 20,000 head feedlots with reconstitution.

The early harvested ground ensiled corn system cost \$12.55 and \$11.45 per ton for 5,000 and 20,000 head feedlots while the per head costs were \$14.66 and \$13.38, respectively. Similar per ton costs for grain sorghum were \$11.86 and \$10.82 while per head costs were \$14.87 and \$13.57. The higher cost of this processing technique is attributed to cost of interest for a year's supply of grain. Initial investment costs per head of capacity for 5,000 and 20,000 head feedlots were \$33.39 and \$24.88, respectively.

Processing costs of early harvested acid-treated corn in 5,000 and 20,000 head feedlots were \$15.69 and \$14.01/ton. Comparable per head cost were \$20.02 and \$17.88. Corresponding values for grain sorghum were \$14.89 and \$13.24 per ton and \$19.15 and \$17.03 per head. Early harvested acid-treatment of grain exhibited the highest operating cost when purchasing a

year's supply of grain plus acid. In many areas a second application of acid would be required. The cost of a second application of acid was not calculated in these budget estimates. Investment cost per head of capacity for 5,000 and 20,000 head feedlots using acid-treatment of grain were \$28.67 and \$20.60, respectively. In all instances processing costs were lower for the 20,000 head feedlots which agrees with previous research by Dietrich and Schake (1974).

Net value of processing

Table 9 reveals an improvement in grain conversion of 7.46% for steam flaking corn compared to dry rolled corn. Therefore a grain savings of 149.2 pounds per ton would be realized if steam flaking was used. Multiplying the savings of 149.2 pounds by the price of corn (\$.05/pound of absolute dry matter) indicated that \$7.46 less grain cost was possible if steam flaked grain was fed. But steam flaking costs \$7.22 more per ton than dry processing (table 10), resulting in a net value of \$.24 per ton when compared to dry rolling. These observations of little or no benefit for steam flaking corn in a 5,000 head feedlot are supported by data presented at a recent industry conference by Hale and Prouty (1980) and Mies and Summers (1980). Calculations for each grain-feedlot comparison are given in Appendix tables O, P, Q and R, and are summarized in tables 10, 11, 12 and 13 applying the above procedure.

For 5,000 head feedlots utilizing corn (table 10) the most beneficial processing alternative was whole reconstitution followed by early harvested ground into a trench silo, steam flaked, dry rolled and early harvested acid-treatment. The net value of reconstituted corn compared to dry rolled corn was \$4.43/ton of grain dry matter. Steam flaked and early harvested ground corn indicated minimum net benefits of \$.24 and \$.60/ton of grain dry matter compared to dry rolled corn while early harvested acid-treated corn revealed a negative net value of \$9.35/ton of grain dry matter.

The most beneficial system using corn in 20,000 head feedlots (table 11) was reconstitution with a net value of \$5.92/ton of grain dry matter. Reconstitution was followed by steam flaked and early harvested (ground into a trench silo) with net values of \$2.83 and \$.87/ton of grain dry matter when compared to dry rolled corn. Dry rolled corn was followed by early harvested acid-treated corn being the least beneficial system

with a negative net value of \$8.50/ton of grain dry matter compared to dry rolled corn.

Reconstitution was also the most beneficial system in 5,000 head feedlots using grain sorghum (table 12). A net value of \$7.71/ton of grain dry matter was realized by reconstituted grain sorghum followed by \$.12/ton for steam flaked when compared to dry rolled grain sorghum. Early harvested ground and early harvested acid-treated grain sorghum realized negative net values of \$1.36/ton and \$5.42/ton when compared to dry rolled sorghum.

For 20,000 head feedlots utilizing grain sorghum (table 13) the most beneficial system was reconstitution followed by steam flaked, dry rolled early harvested ground into a trench and early harvested acid-treated grain sorghum. Net values for reconstituted, steam flaked, early harvested ground and early harvested acid-treated grain sorghum were \$9.12/ton, \$2.70/ton, -\$1.11/ton and -\$0.59/ton of grain dry matter, respectively.

In all systems reconstituted grains were the most beneficial. Steam flaking indicated relatively modest net benefits in both 5,000 and 20,000 head feedlots for both grains. In the case of early harvested grains only early harvested ground corn exhibited a net benefit when compared to dry rolled grain. However, early harvested grains may yet be competitive if grain can be purchased at prices significantly under average yearly market value combined with hedging strategies.

V. SUMMARY

A literature review established cattle responses to five processing methods for corn and grain sorghum. Improvements in dry matter grain conversion for steam flaked, reconstituted, early harvested ground and early harvested acid-treated corn, when compared with dry processed corn, were 7.46%, 7.97%, 11.14% and 3.97%, respectively. Comparable values for grain sorghum were 8.11%, 12.32%, 9.35% and 8.11%. These responses are similar to previous summaries by Hale and Prouty (1980), May and Schake (1976), Neumann (1977) and Perry (1977). Budgets were estimated for each of the processing alternatives to establish their annual operating costs per ton of grain dry matter and per head produced for both 5,000 and 20,000

head capacity feedlots. An economic evaluation for each processing alternative was developed using projected animal responses for the estimated operating costs. These economic evaluations (tables 10, 11, 12 and 13) identified reconstitution as the system with the most desirable net value for all grain-feedlot comparisons. In all comparisons steam flaked grain also exhibited net benefits when compared to dry rolled grain. Early harvested ground ensiled corn was the only early harvesting option which produced a positive net value when compared to dry rolled grain. In 5,000 head feedlots, utilizing corn, net benefits of reconstitution, early harvested ground, steam flaked and early harvested acid-treated corn were \$4.43, \$.60, \$.24 and -\$9.35/ton of grain dry matter, when compared with dry rolled corn. Net values for reconstituted, steam flaked early harvested ground and early harvested acid-treated corn in 20,000 head feedlots were \$5.92, \$2.83, \$.87 and -\$8.50/ton of dry matter, respectively. For 5,000 head feedlots feeding grain sorghum net values for reconstitution, steam flaked, early harvested ground and early harvested acid-treated grain were \$7.71, \$.12, -\$1.36 and -\$5.42/ton of grain dry matter when compared with dry rolled grain sorghum. Comparable values for the 20,000 head feedlot were \$9.12, \$2.70, -\$1.11 and -\$4.59/ton of grain sorghum dry matter, respectively, when compared with dry rolled grain sorghum.

These estimates were based on the conditions and assumptions set forth in this study during the first quarter of 1980. Changes in these conditions would alter the outcome as presented in Appendix tables E through N. Feedlot managers may use this study as a basis for grain processing evaluation by altering inputs to meet the specifications of each feedlot in question.

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VII. APPENDIX

APPENDIX TABLE A. CATTLE RESPONSES TO CORN USING FIVE PROCESSING ALTERNATIVES FOR A 5,000 HEAD FEEDLOT

Item	Dry rolled	Steam- flaked	Recon- stituted	Early Harvested	
				Ground ensiled	Acid- Treated
Daily gain, lb.	2.62	2.68	2.61	2.57	2.68
Pounds of grain/ pound of gain	5.79	5.36	5.33	5.14	5.56
Days on feed ^a	172	168	172	175	168
Annual turnover rate	2.12	2.17	2.12	2.09	2.17
Grain per head, pounds	2605.5	2412	2398.5	2313	2502
Total tons of grain purchased ^b	12428	12428	12428	12428	12428
Total tons of grain after shrink	12428	12428	12428	12304	12179
Total head produced ^c	9540	10305	10363	10639	9735

^aAssumes net gain of 450 pounds per head

^bTotal tons of grain purchased was calculated for dry rolling by multiplying the grain required per head (2605.5 pounds) times the total head produced (9540) or 12,428 tons of grain. This amount of grain was used for all processes.

^cCalculated with 90% average occupancy for dry rolling, 5000 head x 90% x 2.12 (turnover) = 9540 head produced per year.

APPENDIX TABLE B. CATTLE RESPONSES TO CORN USING FIVE PROCESSING ALTERNATIVES FOR A 20,000 HEAD FEEDLOT

Item	Dry rolled	Steam- flaked	Recon- stituted	Early harvested	
				Ground ensiled	Acid treated
Daily gain, lb	2.62	2.68	2.61	2.57	2.68
Pounds of grain/ pound of gain	5.79	5.36	5.33	5.14	5.56
Days on feed ^a	172	168	172	175	168
Annual turnover rate	2.12	2.17	2.12	2.09	2.17
Grain per head, pounds	2605.5	2412	2398.5	2313	2502
Total tons of grain purchased ^b	49713	49713	49713	49713	49713
Total tons of grain after shrink	49713	49713	49713	49216	48719
Total head produced ^c	38160	41221	41453	42556	38944

^aAssumes net gain of 450 pounds per head.

^bTotal tons of grain purchased was calculated for dry rolling by multiplying the grain required per head (2605.5 pounds) times the total head produced (38,160) or 49,713 tons of grain. This amount of grain was used for all processes.

^cCalculated with 90% average occupancy for dry rolling, 20,000 head x 90% x 2.12 (turnover) = 38160 head produced per year.

APPENDIX TABLE C. CATTLE RESPONSES TO GRAIN SORGHUM USING FIVE PROCESSING ALTERNATIVES FOR A 5,000 HEAD FEEDLOT

Item	Dry rolled	Steam- flaked	Recon- stituted	Early harvested	
				Ground ensiled	Acid- treated
Daily gain, lb	2.50	2.65	2.54	2.64	2.45
Pounds of grain/ pound of gain	6.09	5.60	5.34	5.52	5.60
Days on feed ^a	180	170	177	170	184
Annual turnover rate	2.03	2.15	2.06	2.15	1.98
Grain per head, pounds	2740.5	2520	2403	2484	2520
Total tons of grain purchased ^b	12517	12517	12517	12517	12517
Total tons of grain after shrink	12517	12517	12517	12392	12267
Total head produced ^c	9135	9934	10418	9977	9736

^aAssumes net gain of 450 pounds per head.

^bTotal tons of grain purchased was calculated for dry rolling by multiplying the grain required per head (2740.5 pounds) times the total head produced (9135) or 12,517 tons of grain. This amount of grain was used for all processes.

^cCalculated with 90% average occupancy for dry rolling, 5000 head x 90% x 2.03 (turnover) = 9135 head produced per year.

APPENDIX TABLE D. CATTLE RESPONSES TO GRAIN SORGHUM USING FIVE PROCESSING ALTERNATIVES FOR A 20,000 HEAD FEEDLOT

Item	Dry rolled	Steam-flaked	Reconstituted	Early harvested	
				Ground ensiled	Acid-treated
Daily gain, lb.	2.50	2.65	2.54	2.64	2.45
Pounds of grain/pound of gain	6.09	5.60	5.34	5.52	5.60
Days on feed ^a	180	170	177	170	184
Annual turnover rate	2.03	2.15	2.06	2.15	1.98
Grain per head, pounds	2740.5	2520	2403	2484	2520
Total tons of grain purchased ^b	50069	50069	50069	50069	50069
Total tons of grain after shrink	50069	50069	50069	49568	49068
Total head produced ^c	36540	39737	41672	39910	38943

^aAssumes net gain of 450 pounds per head.

^bTotal tons of grain purchased was calculated for dry rolling by multiplying the grain required per head (2740.5 pounds) times the total head produced (36,540) or 50,069 tons of grain. This amount of grain was used for all processes.

^cCalculated with 90% average occupancy for dry rolling, 20,000 head x 90% x 2.03 (turnover) = 36540 head produced per year.

APPENDIX TABLE E. DRY ROLL BUDGET, 5,000 HEAD FEEDLOT

Estimate of Investment Requirements

Item	Dollars	Your Estimate
Equipment ^a		
1 - 9 x 18 roller grinder (10 hp) 10 ton/hr. capacity	8,042	_____
1 - 5,000 bu. dry storage bin	23,330	_____
1 - 1,000 bu. overhead holding bin	20,000	_____
1 - 1,500 cu. ft. storage bin	22,500	_____
1 - elevator leg (10 hp)	9,500	_____
1 - substructure	2,000	_____
Initial investment	85,372	_____
Investment per head capacity	17.07	_____

Estimated Operating Costs per Year

Repairs	3,840	_____
Utilities (17,768.73 @ \$.05 kwh)	888	_____
Labor (4 hrs/day @ \$4.50/hr. for 365 days)	6,570	_____
	11,298	_____
Grain sorghum (204,960 lb. @ \$4.50/cwt of dry matter) ^b	9,223	_____
Total capital requirement	20,251	_____

Annual Specified Costs

Fixed costs		
Interest on initial investment @ 15%	6,402	_____
Depreciation (straight-line method, 9 yrs.) ^c	9,241	_____
Taxes and insurance	1,707	_____
Total annual fixed costs	17,350	_____
Variable costs		
Repairs, utilities, labor	11,298	_____
Interest on grain @ 15%	1,383	_____
Interest on operating capital @ 15%	1,695	_____
Total annual variable costs	14,376	_____
Total specified annual costs	31,726	_____

^aInstallation charges are included.

^bNecessary inventory for continuous operation. This budget is based on grain sorghum valued at \$4.50/cwt of absolute dry matter. Comparable values for corn are now shown, however, the interest cost associated with dry rolling of corn, valued at \$5.00/cwt of absolute dry matter, would become \$1,537 and the total operating cost would become \$31,880.

^cRepresents the average useful life of the various components of the system. No salvage value was assumed.

APPENDIX TABLE F. DRY ROLL BUDGET, 20,000 HEAD FEEDLOT

Estimate of Investment Requirements

Item	Dollars	Your Estimate
Equipment ^a		
1 - 10 x 42 roller grinder (40 hp) 25 ton/hr. capacity	11,087	_____
4 - 5,000 bu. dry storage bins	93,000	_____
2 - 1,500 bu. overhead holding bins	55,980	_____
2 - 3,000 cu. ft. storage bins	90,000	_____
1 - elevator leg (10 hp)	9,500	_____
1 - substructure	3,500	_____
Initial investment	263,067	_____
Investment per head capacity	13.15	_____

Estimated Operating Costs per Year

Repairs	11,838	_____
Utilities (69,805.71 kwh @ \$.05/kwh)	3,490	_____
Labor (5.5 hrs/day @ \$4.50/hr. for 365 days)	9,034	_____
	<u>24,362</u>	_____
Grain sorghum (820,176 lb. @ \$4.50/cwt of dry matter) ^b	36,908	_____
Total capital requirement	61,270	_____

Annual Specified Costs

Fixed costs		
Interest in initial investment @ 15%	19,730	_____
Depreciation (straight-line method, 9.5 yrs.) ^c	27,240	_____
Taxes and insurance	5,261	_____
Total annual fixed costs	52,231	_____
Variable costs		
Repairs, utilities, labor	24,362	_____
Interest on grain @ 15%	5,536	_____
Interest on operating capital @ 15%	3,654	_____
Total annual variable costs	33,552	_____
Total specified annual costs	85,783	_____

^aInstallation charges are included.

^bNecessary inventory for continuous operations. This budget is based on grain sorghum valued at \$4.50/cwt of absolute dry matter. Comparable values for corn are not shown, however, the interest cost associated with dry rolling of corn valued at \$5.00/cwt of absolute dry matter, would become \$6,151 and the total operating cost would become \$86,398.

^cRepresents the average useful life of the various components of the system. No salvage value was assumed.

APPENDIX TABLE G. STEAM FLAKE BUDGET, 5,000 HEAD FEEDLOT

Estimate of Investment Requirements

Item	Dollars	Your Estimate
Equipment ^a		
1 - extra heavy duty 18 x 36 roller mill (60 hp)	21,795	_____
1 - stainless steel ventilated steam chamber	5,122	_____
1 - 100 hp broiler with water softener	35,808	_____
1 - 50 hp airlift with airlocks, 60 ft. travel	13,900	_____
1 - 5,000 bu. dry storage bin	23,330	_____
1 - 1,000 bu. overhead holding bin over roller mills	20,000	_____
1 - 1,500 cu. ft. flake storage bin	22,500	_____
1 - 1,000 bu./hr. rotary drum scalper (5 hp)	5,630	_____
1 - elevator leg (10 hp), 60 ft. height	9,500	_____
1 - substructure	2,000	_____
Initial investment	159,585	_____
Investment per head capacity	13.15	_____
Estimated Operating Costs per Year		
Fuel (14,343.95 mcf @ \$2.00/mcf)	28,688	_____
Repairs	11,578	_____
Utilities (386,469.77 kwh @ \$.05/kwh)	19,323	_____
Labor (8.5 hr./day @ \$4.50/hr. for 365 days)	13,961	_____
	<u>73,550</u>	_____
Grain sorghum (204,960 lb. @ \$4.50/cwt of dry matter) ^b	9,223	_____
Total capital requirement	82,773	_____
Annual Specified Costs		
Fixed costs		
Interest on initial investment @ 15%	11,696	_____
Depreciation (straight-line method, 7.7 yrs.) ^c	20,403	_____
Taxes and insurance	3,192	_____
Total annual fixed costs	35,564	_____
Variable costs		
Fuel, repairs, utilities, labor	73,550	_____
Interest on grain @ 15%	1,383	_____
Interest on operating capital @ 15%	11,033	_____
Total annual variable costs	85,966	_____
Total specified annual costs	121,530	_____

^aInstallation charges are included.

^bNecessary inventory for continuous operation. This budget is based on grain sorghum valued at \$4.50/cwt of absolute dry matter. Comparable values for corn are not shown, however, the interest associated with steam flaking corn, valued at \$5.00/cwt of absolute dry matter, would become \$1,537, and the total operation cost would become \$121,684.

^cRepresents the average useful life of the various components of the system. No salvage value was assumed.

APPENDIX TABLE H. STEAM FLAKE BUDGET, 20,000 HEAD FEEDLOT

Estimate of Investment Requirements

Item	Dollars	Your Estimate
Equipment ^a		
4 - extra heavy duty 18 x 36 roller mills (60 hp)	87,185	_____
4 - stainless steel ventilated steam chambers	20,490	_____
2 - 100 hp boilers with water softener	61,615	_____
2 - 50 hp airlifts with airlocks	27,800	_____
4 - 5,000 bu. dry storage bins	93,000	_____
2 - 1,500 bu. overhead holding bins over rolls	55,980	_____
2 - 3,000 cu. ft. flake storage bins	90,000	_____
1 - 1,000 bu./hr. rotary drum scalper (5 hp)	5,630	_____
1 - elevator leg (10 hp) 60 ft. height	9,500	_____
1 - substructure	3,500	_____
Initial investment	454,799	_____
Investment per head capacity	22.74	_____

Estimated Operating Costs per Year

Fuel (42,409.9 mcf @ \$2.00/mcf)	84,820	_____
Repairs	32,988	_____
Utilities (978,549 kwh @ \$.05/kwh)	48,927	_____
Labor (8.5 hr./day @ \$4.50/hr. for 365 days)	13,961	_____
	<u>180,696</u>	_____
Grain sorghum (820,176 lb. @ \$4.50/cwt of dry matter) ^b	36,908	_____
Total capital requirement	217,604	_____

Annual Specified Costs

Fixed costs		
Interest of initial investment @ 15%	34,103	_____
Depreciation (straight-line method, 7.7 yrs.) ^c	59,405	_____
Taxes and insurance	9,094	_____
Total annual fixed costs	102,602	_____
Variable costs		
Fuel, repairs, utilities, labor	180,696	_____
Interest on grain @ 15%	5,536	_____
Interest on operating capital @ 15%	27,104	_____
Total annual variable costs	213,336	_____
Total specified annual costs	315,938	_____

^aInstallation charges are included.

^bNecessary inventory for continuous operation. This budget is based on grain sorghum valued at \$4.50/cwt of absolute dry matter. Comparable values for corn are not shown, however, the interest cost associated with steam flaking corn, valued at \$5.00/cwt of absolute dry matter, would become \$6,151, and the total operating cost would become \$316,553.

^cRepresents the average useful life of the various components of the system. No salvage value was assumed.

APPENDIX TABLE I. RECONSTITUTION BUDGET, 5,000 HEAD FEEDLOT^a

Estimate of Investment Requirements		
Item	Dollars	Your Estimate
Equipment ^b		
2 - 20' x 70' upright sealed storage units (7.5 hp unloader)	107,424	_____
1 - 5 hp reconstitution unit	5,400	_____
1 - 16 x 48 extra heavy duty roller mill (60 hp)	20,000	_____
1 - 5,000 bu. dry storage bin	23,350	_____
1 - elevator leg (15 hp) 120 ft. height	28,000	_____
Initial investment	184,154	_____
Investment per head capacity	36.83	_____
Estimated Operating Costs per Year		
Repairs	10,808	_____
Utilities (51,402 kwh @ \$.05/kwh)	2,570	_____
Labor (6 hr./day @ \$4.50/hrs. for 365 days)	9,855	_____
	<u>23,533</u>	_____
Grain sorghum (2,503,984 lb. @ \$4.50/cwt for dry matter) ^c	112,679	_____
Total capital requirement	135,912	_____
Annual Specified Costs		
Fixed costs		
Interest on initial investment @ 15%	13,812	_____
Depreciation (straight-line method, 14.3 yrs.) ^d	12,898	_____
Taxes and insurance	3,683	_____
Total annual fixed costs	30,393	_____
Variable costs		
Repairs, utilities, labor	23,253	_____
Interest on grain @ 15%	16,902	_____
Interest on operating capital @ 15%	3,488	_____
Total annual variable costs	43,643	_____
Total specified annual costs	74,036	_____

^aThis system could also utilize early harvested grains during harvest seasons.

^bInstallation charges are included.

^cNecessary inventory for continuous operation. This budget is based on grain sorghum valued at \$4.50/cwt of absolute dry matter. Comparable values for corn are not shown, however, the interest cost associated with reconstitution of corn, valued at \$5.00/cwt of absolute dry matter, would become \$18,780, and the total operating cost would become \$75,914.

^dRepresents the average useful life of the various components of the system. Sealed storage units were assumed to have half of initial cost as salvage value.

APPENDIX TABLE J. RECONSTITUTION BUDGET, 20,000 HEAD FEEDLOT^a

Estimate of Investment Requirements

Item	Dollars	Your Estimate
Equipment ^b		
4 - 35' x 90' upright sealed storage units (7.5 hp unloader)	351,068	_____
2 - 5 hp reconstitution units	10,800	_____
2 - 16 x 48 extra heavy duty roller mills (60 hp)	40,000	_____
4 - 5,000 bu. dry storage bins	93,000	_____
1 - elevator leg (15 hp) 120 ft. height	28,000	_____
Initial investment	522,868	_____
Investment per head capacity	26.14	_____

Estimated Operating Costs per Year

Repairs	30,745	_____
Utilities (177,004.55 kwh @ \$.05/kwh)	8,900	_____
Labor (9 hrs./day @ \$4.50/hr. for 365 days)	14,783	_____
	54,428	_____
Grain sorghum (6,036,016 lb. @ \$4.50/cwt of dry matter) ^c	271,621	_____
Total capital requirement	326,049	_____

Annual Specified Costs

Fixed costs		
Interest on initial investment @ 15%	39,215	_____
Depreciation (straight-line method, 16.8 yrs.) ^d	31,037	_____
Taxes and insurance	10,457	_____
Total annual fixed costs	80,709	_____
Variable costs		
Repairs, utilities, labor	54,428	_____
Interest on grain @ 15%	40,743	_____
Interest on operating capital @ 15%	8,164	_____
Total annual variable costs	103,335	_____
Total specified annual costs	184,044	_____

^aThis system could also utilize early harvested grain during harvest season.

^bInstallation charges are included.

^cNecessary inventory for continuous operation. This budget is based on grain sorghum valued at \$4.50/cwt of absolute dry matter. Comparable values for corn are not shown however, the interest associated with reconstitution of corn, valued at \$5.00/cwt of absolute dry matter, would become \$45,270 and the total operating cost would become \$188,571.

^dRepresents the average useful life of the various components of the system. Sealed storage units were assumed to have half of initial cost as salvage value.

APPENDIX TABLE K. EARLY HARVESTED GROUND INTO A TRENCH, 5,000 HEAD FEEDLOT^a

Estimate of Investment Requirement

Item	Dollars	Your Estimate
Equipment ^b		
1 - 50' x 650' concrete lined trench silo	133,775	_____
Tires to cover plastic	4,188	_____
1 - truck to haul grain from silo to mill	29,000	_____
Initial investment	166,963	_____
Investment per head capacity	33.39	_____

Estimated Operating Costs per Year

Fuel (712.8 gal. of diesel @ \$.80/gal.)	570	_____
Repairs	5,510	_____
Labor (2.25 hrs./day @ \$4.50/hr. for 365 days)	3,694	_____
Lease on grinding and packing @ \$.083/bu.	36,974	_____
Plastic to cover pit	1,387	_____
Shrink on grain @ 1%	10,908	_____
	<u>59,043</u>	_____
Grain sorghum (25,485,992 lb. @ \$4.28/cwt of dry matter) ^c	1,090,800	_____
Total capital requirement	1,149,843	_____

Annual Specified Costs

Fixed costs		
Interest on initial investment @ 15%	12,522	_____
Depreciation (straight-line method)	12,698	_____
Taxes and insurance	3,339	_____
Total annual fixed costs	28,559	_____
Variable costs		
Fuel, repairs, labor, lease, plastic, shrink	59,043	_____
Interest on grain @ 15%	52,358	_____
Interest on operating capital @ 15%	8,856	_____
Total annual variable costs	120,257	_____
Total specified annual costs	148,816	_____

^aAssumes grain purchased at 25.5% moisture, but adjusted to absolute dry matter basis for budget.

^bInstallation charges are included. Loader was assumed to be available.

^cNecessary inventory for continuous operation. This budget is based on grain sorghum valued at \$4.28/cwt of absolute dry matter. Comparable values for corn are not shown, however, the interest cost associated with early harvesting of corn, valued at \$4.75/cwt of absolute dry matter, would become \$58,108 and the total operating cost would become \$155,944.

^dRepresents the average useful life of the various components of the system. No salvage value was assumed.

^eSchedule of payment for early harvested grain was 1/3 at delivery, 1/3 after 3 months and the remaining after 6 months. Interest was charged against an inventory that decreased at 15-day intervals.

APPENDIX TABLE L. EARLY HARVESTED GROUND INTO A TRENCH, 20,000 HEAD FEEDLOT^a

Estimate of Investment Requirements		
Item	Dollars	Your Estimate
Equipment ^b		
2 - 100' x 650' concrete lined trench silo	420,050	_____
Tires to cover plastic	16,750	_____
1 - truck to haul grain from silo to mill	35,000	_____
1 - receiving pit for grain	25,730	_____
Initial investment	497,530	_____
Investment per head capacity	24.88	_____
Estimated Operating Costs per Year		
Fuel (1,995.8 gal. of diesel @ \$.80/gal.)	1,597	_____
Repairs	6,418	_____
Labor (6.75 hrs./day @ \$4.50/hr. for 365 days)	11,087	_____
Lease on grinding and packing @ \$.083/bu.	147,900	_____
Plastic to cover pits	5,548	_____
Shrink on grain at 1%	42,709	_____
	<u>215,259</u>	_____
Grain sorghum (99,788,014 lb. @ \$4.28/cwt of dry matter) ^c	4,270,927	_____
Total capital requirement	4,486,186	_____
Annual Specified Costs		
Fixed costs		
Interest on initial investment @ 15%	37,315	_____
Depreciation (straight-line method, 16 yrs.) ^d	30,127	_____
Taxes and insurance	9,951	_____
Total annual fixed costs	77,393	_____
Variable costs		
Fuel, repairs, labor, lease, plastic, shrink	225,305	_____
Interest on grain @ 15% ^e	205,004	_____
Interest on operating capital @ 15%	33,796	_____
Total annual variable costs	464,105	_____
Total specified annual costs	541,498	_____

^aAssumes grain purchased at 25.5% moisture, but adjusted to absolute dry matter basis for budget.

^bInstallation charges are included. Loader was assumed to be available.

^cNecessary inventory for continuous operation. This budget is based on grain sorghum valued at \$4.28/cwt of absolute dry matter. Comparable values for corn are not shown, however, the interest cost for corn, valued at \$4.75/cwt of absolute dry matter, would become \$227,517, and the total operating cost would become \$569,405.

^dRepresents the average useful life of the various components of the system. No salvage value was assumed.

^eSchedule of payment for early harvested grain was 1/3 at delivery, 1/3 after 3 months and the remaining 1/3 after 6 months. Interest was charged against an inventory that decreased at 15-day intervals.

APPENDIX TABLE M. EARLY HARVESTED ACID-TREATED BUDGET, 5,000 HEAD FEEDLOT^a

Estimate of Investment Requirements

Item	Dollars	Your Estimate
Equipment ^b		
1 - 40' moveable auger	1,800	_____
1 - wheel loader	80,000	_____
1 - 9 x 18 roller grinder (10 hp) two ton/hr. capacity	8,042	_____
1 - 1,000 bu. storage bin over rolls	20,000	_____
1 - 1,500 cu. ft. storage bin	22,500	_____
1 - elevator leg (10 hp) 60' height	9,500	_____
1 - substructure	1,500	_____
Initial investment	143,342	_____
Investment per head capacity	28.67	_____

Estimated Operating Costs per Year

Fuel (5,475 gal. @ \$.80/gal.)	4,380	_____
Repairs	7,884	_____
Utilities (17,768.73 kwh @ \$.05/kwh)	888	_____
Labor (5 hrs./day @ \$4.50/hr. for 365 days)	8,213	_____
Acid (\$.19 per cwt of grain dry matter)	48,442	_____
Shrink on grain @ 2%	21,816	_____
	91,623	_____
Grain sorghum (25,485,992 lb. @ \$4.28/cwt of dry matter) ^c	1,090,800	_____
Total capital requirement	1,182,423	_____

Annual Specified Costs

Fixed costs		
Interest on initial investment @ 15%	10,751	_____
Depreciation (straight-line method, 9.5 yrs.) ^d	15,088	_____
Taxes and insurance	2,867	_____
Total annual fixed costs	28,706	_____
Variable costs		
Fuel, repairs, utilities, labor, acid, shrink	91,623	_____
Interest on grain @ 15%	52,358	_____
Interest on operating capital @ 15%	13,743	_____
Total annual variable costs	157,724	_____
Total specified annual costs	186,430	_____

^aAssumes grain purchased at 25.5% moisture, but adjusted to absolute dry matter basis for budget.

^bInstallation charges are included.

^cNecessary inventory for continuous operation. This budget is based on grain sorghum valued at \$4.28/cwt of absolute dry matter. Comparable values for corn are not shown, however, the interest cost associated with corn valued at \$4.75/cwt of absolute dry matter, would become \$58,108, and the total operating cost would become \$194,935.

^dRepresents the average useful life of the various components of the system. No salvage value was assumed.

^eSchedule of payments for early harvested grain was 1/3 at delivery, 1/3 after 3 months and the final 1/3 after 6 months. Interest was charged against an inventory that decreased at 15-day intervals.

APPENDIX TABLE N. EARLY HARVESTED ACID-TREATED BUDGET, 20,000 HEAD FEEDLOT^a

Estimate of Investment Requirements

Item	Dollars	Your Estimate
Equipment ^b		
1 - pit, elevator leg (10 hp) and auger system with asphalt area for stacking	172,000	_____
2 - 500 bu. overhead holding bins	55,980	_____
2 - 3,000 cu. ft. storage bins	90,000	_____
1 - 10 x 42 roller grinder (40 hp) 25 ton/hr. capacity	11,087	_____
1 - wheel loader	80,000	_____
1 - substructure	2,500	_____
Initial investment	412,067	_____
Investment per head capacity	20.60	_____

Estimated Operating Costs per Year

Fuel (14,600 gal. of diesel @ \$.80/gal.)	11,680	_____
Repairs	22,664	_____
Utilities (69,805.71 kwh @ \$.05/kwh)	3,490	_____
Labor (9 hrs./day @ \$4.50/hr. for 365 days)	14,783	_____
Acid (\$.19 per cwt of grain dry matter)	189,597	_____
Shrink on grain @ 2%	85,419	_____
	327,633	_____
Grain sorghum (99,788,024 lb. @ \$4.28/cwt of dry matter) ^c	4,270,927	_____
Total capital requirement	4,598,560	_____

Annual Specified Costs

Fixed costs		
Interest on initial investment @ 15%	30,905	_____
Depreciation (straight-line method, 9.8 yrs) ^d	42,190	_____
Taxes and insurance	8,241	_____
Total annual fixed costs	81,336	_____
Variable costs		
Fuel, repairs, utilities, labor, acid, shrink	327,633	_____
Interest on grain @ 15%	205,004	_____
Interest on operating capital @ 15%	49,145	_____
Total annual variable costs	663,118	_____
Total specified annual costs	774,454	_____

^aAssumes grain purchased at 25.5% moisture, but adjusted to absolute dry matter basis for budget.

^bInstallation charges are included.

^cNecessary inventory for continuous operation. This budget is based on grain sorghum valued at \$4.28/cwt of absolute dry matter. Comparable values for corn are not shown, however, the interest cost associated with corn, valued at \$4.75/cwt of absolute dry matter, would be \$227,517 and the total operating cost would become \$696,418.

^dRepresents the average useful life of the various components of the system. No salvage value was assumed.

^eSchedule of payment for early harvested grain was 1/3 at delivery, 1/3 after 3 months and the final 1/3 after 6 months. Interest was charged against an inventory that decreased at 15-day intervals.

APPENDIX TABLE O. ECONOMIC EVALUATION PER TON FOR CORN IN 5,000 HEAD FEEDLOTS (SUMMARIZED IN TABLE 10), \$

Item	Steam flaked	Reconstituted	Early harvested	
			Ground ensiled	Acid-treated
A. Grain reduction	7.46	7.97	10.58	3.77
B. Processing cost difference	7.22	3.54	9.98	13.12
C. Net benefit	.24	4.43	.60	-9.35

APPENDIX TABLE P. ECONOMIC EVALUATION PER TON FOR CORN IN 20,000 HEAD FEEDLOTS (SUMMARIZED IN TABLE 11), \$

Item	Steam flaked	Reconstituted	Early harvested	
			Ground ensiled	Acid-treated
A. Grain reduction	7.46	7.97	10.58	3.77
B. Processing cost difference	4.63	2.05	9.71	12.27
C. Net benefit	2.83	5.92	.87	-8.50

The following step-wise procedure was utilized in Appendix tables O, P, Q and R to estimate net value of each processing method compared to dry processing:

1. Grain requirement was calculated by multiplying the percent improvement (table 9) in grain conversion x 2,000 pounds to obtain pounds saved per ton. This value was multiplied by the grain cost to obtain the dollar savings per ton.
2. The processing costs per ton (from the budgets in Appendix tables E through N) were compared with the processing costs of dry rolling.
3. The net benefit was derived by subtracting the value in step B from that of step A.

APPENDIX TABLE Q. ECONOMIC EVALUATION PER TON FOR GRAIN SORGHUM IN 5,000 HEAD FEEDLOTS
(SUMMARIZED IN TABLE 12), \$

Item	Steam flaked	Reconstituted	Early harvested	
			Ground ensiled	Acid-treated
A. Grain reduction	7.30	11.09	8.00	6.94
B. Processing cost difference	7.18	3.38	9.36	12.36
C. Net benefit	.12	7.71	-1.36	-5.42

APPENDIX TABLE R. ECONOMIC EVALUATION PER TON FOR GRAIN SORGHUM IN 20,000 HEAD FEEDLOTS
(SUMMARIZED IN TABLE 13), \$

Item	Steam flaked	Reconstituted	Early harvested	
			Ground ensiled	Acid-treated
A. Grain reduction	7.30	11.09	8.00	6.94
B. Processing cost difference	4.60	1.97	9.11	11.53
C. Net benefit	2.70	9.12	-1.11	-4.59

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