THE EFFECT OF GRINDING AND PELLETING GRAIN UPON UTILIZATION

by

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INTRODUCTION

In recent years livestock feeders have realized that increased feed efficiency can mean the difference between profit or loss in livestock feeding. Much work has been done with the physical preparation of feed to increase feed efficiency. Feeds have been finely ground, coarsely ground, rolled, and pelleted in attempts to increase feed efficiency.

Under certain climatic conditions, such as those prevailing in Kansas, it has been established that sorghum grains can be grown more economically than corn. Therefore, in these areas where climatic conditions limit corn production, sorghum grain is the principal grain grown for livestock feeding.

Digestion trials and feedlot studies have indicated that sorghum grain and corn produce similar gains when fed to livestock. However, it has been observed that sorghum grain is not so efficient on a pound for pound basis as corn in producing gains in livestock.

Chemical analyses have shown that sorghum grain and corn are very similar in their digestible protein and total digestible nutrient composition. Sorghum grain contains 8.8 per cent digestible protein and 80.1 per cent total digestible nutrients. Corn (Grade No. 2) contains 6.6 per cent digestible protein and 80.1 per cent total digestible nutrients. Sorghum grain and corn are also very similar in the composition of other nutrients.

The purpose of this experiment was to determine whether different methods of preparation of sorghum grain fed in wintering steer rations would increase feed utilization. Feed lot and metabolism studies were conducted.

REVIEW OF LITERATURE

Intensive studies have been conducted in attempts to improve feed utilization. Recently, much emphasis has been placed on the physical preparation of feeds.

Cattle

Smith et al. (24) conducted a study to determine the effect of grinding on the nutritive value of sorghum grain for fattening steer calves. It was concluded from the results of this test that as far as digestibility is concerned sorghum grain is best utilized when finely ground. It was observed that the calves receiving coarsely ground sorghum grain crowded the bunk at feeding time while the calves receiving finely ground sorghum grain ate more reluctantly. This indicated that the calves fed the finely ground sorghum grain found it unpalatable, or that they derived more value from their feed and therefore did not have as great an appetite.

Smith and Parrish (25) conducted a digestion trial comparing the digestibility of finely ground sorghum grain, cracked sorghum grain and rolled sorghum grain. In this study, the digestibility of dry matter, protein, crude fiber, ether extract, and nitrogen-free extract was higher for rations containing the rolled sorghum grain than for those with cracked or finely ground sorghum grain. With the exception of crude fiber, the digestibility of the nutrients of the cracked sorghum grain ration was the lowest of the three rations.

Baker and co-workers (4) conducted an experiment to study the effect of both fine grinding and pelleting of rations on the fattening performance of beef heifers. Rations used in this experiment contained corn which was

coarsely cracked, finely ground, and pelleted. It was observed that the cattle fed the coarsely cracked corn made significantly faster gains than the cattle fed the finely ground or pelleted rations. The feed efficiency of the cattle fed the pelleted ration was as high as that of the cattle fed the coarsely cracked corn, but lower feed consumption contributed to the lower gains of the cattle fed the pelleted ration. The absence of rumination was quite evident among the heifers on the finely ground and pelleted rations.

Baker et al. (5) conducted a study to determine if feeding limited quantities of natural roughage would stimulate feed consumption and permit normal rumination and normal gains of heifers fed pelleted rations. Rate of gain, rumination, and the general feed-lot performance were normal for the heifers fed the pelleted ration and a small quantity of alfalfa hay. The small quantity of coarse roughage appeared to be essential in obtaining a normal rate of gain and feed-lot performance from cattle fed pelleted rations.

Richardson et al. (21) conducted an experiment using rolled corn, finely ground pelleted sorghum grain, and rolled sorghum grain as the source of grain in three different rations. It was observed that the calves receiving corn were the first to reach a full feed of grain followed by those receiving pelleted sorghum grain. If permitted, the calves receiving the rolled sorghum grain would have consumed more grain than the others. The calves receiving the rolled corn consumed less grain per 100 pounds gain than the calves receiving the pelleted and rolled sorghum grain rations; however, pelleted sorghum grain was more efficient than non-pelleted.

Cox and Smith (9) compared rolled grain and ground grain for fattening yearling heifers. Barley was fed as the only grain for the first two-thirds of the test, and barley and corn were fed the remainder of the test. No differences occurred in grain consumption and efficiency of gain.

A similar experiment (10) was conducted using sorghum grain. A comparison of rolled, coarse ground, and fine ground sorghum grain was made for fattening steer calves. Only small differences in daily gain were noted, and the grain consumption was about the same for all lots. There was little or no difference in efficiency of gain or cost of production. Repeating the experiment, these workers found that the steers receiving rolled sorghum grain gained an average of .20 pound less per head daily than the lots fed the cracked and finely ground sorghum grain. The steers fed the finely ground sorghum grain were slightly more efficient in feed utilization.

Kick et al. (16) studied the effect of mechanical processing of feeds on the mastication and rumination of steers. From results obtained, it would appear that cutting hay for steers might conserve some metabolizable energy because of a reduction in the energy required for mastication, but no economy was effected because of a reduction in rumination. Ground hay required less work for both mastication and rumination. No economy of metabolizable energy was apparent from a decrease in rumination when shelled corn was ground. Grinding actually increased the work required for mastication. An important factor in the amount of mastication and rumination required on the rations studied was the proportion of grain and roughage in the ration.

The Dixon Springs Station (30) conducted an experiment on self-feeding yearling steers on complete pelleted fattening rations of varying ratios of concentrate to roughage. The ration for all lots consisted of timothy-alfalfa hay, ground shelled corn, and soybean oil meal. In Lots, 1, 2, and 3, the hay content of the ration was 25, 35, and 45 per cent respectively, the corn content being inversely proportional, or 65, 55, and 45 per cent of the total respectively. All rations contained 10 per cent soybean oil meal. The ration fed to Lot 4 had the same composition as that fed to Lot 2, but the material was much more finely ground before pelleting. Salt and a simple mineral-mix were offered free choice. The ration was fed in self-feeders. When the average daily gains for all steers in each lot were compared with the gains made by all the steers in each of the other lots, the differences were small but slightly favored the rations containing the higher levels of corn or energy and the lower levels of hay. Grinding the rations components very finely reduced gains somewhat but not significantly so.

A test was conducted at the Dixon Springs Experiment Station (31) to compare a timothy-alfalfa mixture harvested as hay and as silage and fed to steer calves for the wintering period. A first-year timothy-alfalfa mixture was harvested as baled hay and silage. That forage was fed to steer calves as baled hay, chopped hay, hay pellets, or silage. Performance of the steer calves eating baled hay and chopped hay was very similar and about as would be normally expected. Daily consumption was about 11 pounds, daily gain was about 0.63, or two-thirds pound, and 1728 pounds of hay were required for one hundred pounds of gain. Performance of steer calves eating hay pellets was outstanding. Daily consumption was

15.69 pounds, daily gain was 1.73 pounds, and only 906 pounds of pellets were required to produce one hundred pounds of gain. This outstanding performance can be explained in part by the much greater daily intake of hay in the pellet form compared with baled or chopped hay. The poor performance of steer calves fed silage and limited hay can be explained for the most part by low daily feed consumption on a dry-matter basis. The calves refused to eat the amount of silage normally expected. The silage was rather high in moisture and made without an additive, which may account for its poor acceptance by the calves.

Two tests have been conducted at the Dixon Springs Experiment Station (23) to compare the feeding value of roughages when fed as long hay, chopped hay, hay pellets or silage. The steers on the long and the chopped hay gained an average of 0.63 and 0.63 pound per day respectively. The steers fed on silage alone for the first 34 days, lost so much weight because of low intake that hay was added for the remainder of the time. Even though the steers gained at the rate of 0.6 pound daily after the addition of the hay, their average daily gain was but 0.05 pound for the entire 119 days. It must be remembered that this silage was made without preservative and was not readily consumed. The calves fed pellets gained an average of 1.73 pounds daily, which was of course highly significant compared with the gain of the other three lots. Consumption of pellets was high, but there was no wastage from the self-feeder. The combination of more rapid gain, better feed conversion, and elimination of wastage gave the calves fed pellets a big advantage in feed-cost per hundredweight gain, even when a $10 per ton grinding and pelleting charge was added. The silage was made without a preservative and was very wet (21.62

per cent dry matter). The result was low intake and poor performance by the steers. Either wilting the silage or adding preservative would very likely have corrected the poor performance on the silage.

In trial two, 90 steer calves from the station herd, or 9 lots of 10 calves each, were fed 112 days. As in Trial 1, alfalfa or timothy-alfalfa hay, when pelleted, produced very acceptable gains when self-fed as the complete ration - 1.77 and 1.33 pounds respectively. Dry-matter consumption of the hay was higher when it was fed as pellets than when fed as long hay or as a combination of long hay and silage. Lespedeza, although consumed at a fairly good level as pellets, did not produce gains comparable with those obtained from alfalfa and alfalfa-timothy pellets. No doubt this was due to its higher crude fiber content. Because feed intake of the non-pelleted rations was so low, most of the nutrients consumed were required for maintenance. Thus the costs of gains really were meaningless in these lots. Low total wintering costs were obtained in these lots and calves did make reasonable growth, but of course lost in condition.

Webb and Cmarik (29) conducted an experiment to compare the feeding of a ration as pellets and as a meal to yearling steers. The steers on pellets gained 22 pounds more per head on 227 pounds less feed than those on the ration in meal form. The steers on pellets made 100 pounds of gain on 729 pounds of feed, while those on meal required 845 pounds. Cost of feed per hundredweight of gain was less on pellets, being $16.86 compared with $19.29 on meal. Selling price was slightly more for the steers fed pellets, although dressing percentage was the same and the carcass grades were about equal.

Sheep

Pelleted rations for fattening sheep have been studied rather extensively at several experiment stations. The results indicate that the feed efficiency and rate of gain of sheep fed pelleted rations are superior to those of similar sheep fed the same ration non-pelleted.

Noble et al. (19) reported that tests at Oklahoma State University showed a very slight increase in rate and efficiency of gain from lambs fed pelleted rations as compared to the gains made by lambs given similar but non-pelleted rations. When the feed cost was determined, it was higher for the pelleted ration due to the additional cost of pelleting.

In studies at the Garden City Branch Station conducted by Bell and Erhart (7), the entire ration consisting of fodder, sorghum grain, and protein was pelleted and compared to a similar but non-pelleted ration. The group receiving the pelleted ration gained faster and on less feed per hundred pounds of gain, but the cost of the processing and pelleting made the cost of gains much higher for lambs on the pelleted ration. The main processing expense in making the pelleted ration was the dehydrating of the roughage used.

Thomas et al. (27) found that lambs fed rations in pelleted form gained faster and more efficiently than lambs fed whole grain and long hay, but when the additional cost of pelleting was added to the total feed cost, the economic advantage was lost. Lambs fed pellets graded higher and sold for a higher price per hundred pounds, but the increased return did not compensate for the additional cost.

Jordan et al. (15) used a pelleted ration containing sixty per cent concentrate and forty per cent roughage. The lambs developed a craving

for roughage and began to chew on the feed bunks and fence posts. Because of this condition, one-third pound of long alfalfa hay was provided with the pellets, but no additional gain was obtained from this practice. As in previous reports, an increase in rate of gain and feed efficiency was reported in this trial with the pelleted feeds.

Tests at Washington State College (22) showed no increase in rate of gain or efficiency of gain from lambs hand or self-fed pelleted rations when compared to lambs getting non-pelleted rations.

Neale (18) conducted a feeding trial in which self-fed pellets were made from low quality alfalfa hay, sorghum grain, and molasses. The non-pelleted ration was composed of bright green, fairly fine-stemmed alfalfa hay and sorghum grain. The pelleted ration, in spite of the low quality hay used, produced an average increase of 0.13 pound daily gain per head and saved an average of 347 pounds of feed per 100 pounds of gain. The feeding period was also reduced by an average of 20 days by self-feeding the pellet rations. The rest of labor for self-feeding was much lower than for hand-feeding.

Studies were conducted at the Illinois Agricultural Experiment Station (8) to determine the effect of self-fed pelleted and self-fed meal rations of varied quality on the rate and economy of gain. Those trials indicated that pelleted alfalfa meal and corn were of slight value, hardly enough to warrant the cost of pelleting. The pelleting of rations containing timothy meal greatly increased economy as well as rate of gain. The lots eating pelleting rations in which timothy was the roughage outgained the control lots receiving alfalfa as a roughage, indicating that lambs will make satisfactory gains on low quality roughage if properly

prepared and supplemented.

John (14) obtained uniform results in digestion studies. He reported that the percentage of fiber digested in the pelleted rations was only half as great as the percentage of fiber digested in the non-pelleted rations. Digestion coefficients of the pelleted feeds were higher for protein and ether extract; therefore, there were no noticeable differences in the total digestible nutrients in the pelleted and non-pelleted rations. John also reported that the lambs fed the pelleted rations retained a much higher average per cent of nitrogen than the lambs on similar but non-pelleted feeds. This could be expected as the feeding trials showed an increase in rate of gain over lambs fed the non-pelleted rations. Also, there was a higher percentage of protein digested in the pelleted feeds which would make more nitrogen available for retention.

The Sutter Basin Land Company of California (11) made one of the first attempts at large scale feeding of pellets to feeder lambs. The company had 30,000 feeder lambs on a pelleted ration consisting of 70 per cent roughage and 30 per cent concentrate mix that contained 57 per cent dehydrated alfalfa meal, 35 per cent barley, and 8 per cent molasses. The lambs on the pelleted ration gained an average of 0.48 pound per day and were upgraded from strictly commercials to better than 90 per cent choice grade. The results of the large scale feeding showed an 800 pound consumption of loose feed compared to 625 pounds of pellets for the same number of sheep fed for the same number of days.

Swine

Aubel (2) conducted an experiment on the preparation of sorghum grain

for finishing pigs full-fed in dry lot. It was observed that slightly better results could be secured from rolling sorghum grain in preparation for full-feeding, fattening, and growing pigs, than by feeding it whole or grinding it. The ground sorghum grain and the rolled sorghum grain seemed more palatable than the whole sorghum grain.

Tests at Nebraska University (17) showed that whole sorghum grain appears to be more palatable than shelled corn for swine. Pigs fed sorghum grain and a protein supplement made slightly larger gains than those fed shelled corn and the same supplement. Sorghum grain varied from 80 to 95 per cent as efficient per unit of weight as corn in producing 100 pounds of gain. The average efficiency of the grain sorghums used was 89 per cent that of corn. There was no appreciable difference in dressing yield or carcass quality between corn and sorghum-fed pigs. In five trials conducted whole sorghum proved more palatable than the same grain coarsely ground.

No difference in rate of gain between the two groups was noted. On the basis of the amount of feed required to produce 100 pounds of gain, the coarsely ground sorghum grain proved 2 per cent more efficient than the whole sorghum grain when self-fed. Finely ground sorghum grain proved less palatable and the pigs made smaller gains upon it than on coarsely ground sorghum.

In more recent work by Aubel (3) the comparative value of corn and whole and ground sorghum grain as swine fattening feeds was studied. Five lots of pigs were self-fed in dry lot. Lot 1 received shelled corn; lot 2, whole sorghum grain; lot 3, dry rolled sorghum grain; lot 4, wet rolled sorghum grain; and lot 5, rolled sorghum grain with 5 per cent cane

mollasses added. The daily gains of the pigs receiving corn were slightly greater than for the pigs receiving whole or dry-rolled sorghum grain. With the wet-rolled sorghum grain daily gains of pigs were 0.23 pound less. The pigs getting rolled sorghum grain with molasses made the same daily gains as the corn-fed pigs. Thus the whole-or-dry-rolled sorghum grain on a pound-for-pound basis was about 3 per cent less efficient than corn. The wet rolled sorghum grain was about 13 per cent less efficient. The quantity of grain consumed per 100 pounds gain was greater in all the sorghum grain-fed lots than in the corn-fed lots, running from a little less than 1 per cent with wet-rolled sorghum grain to 21 per cent with the dry-rolled sorghum grain.

Poultry

Allred et al. (1) conducted studies to determine the effect of pelleting feeds upon the performance of chicks and poults and to determine the effect of animal tallow and protein level in relation to the response obtained by pelleting. It was observed that (1) pelleting the rations improved the growth rate and feed efficiency of both species. (2) A growth response to pelleting was obtained, even when the pellets were ground to a particle size and density similar to the original mash. (3) The pelleting effect of increased growth and efficiency was obtained whether or not animal fat was added to the ration. (4) Rations containing protein levels varying from 20 to 24 per cent gave the same response to pelleting. (5) It was concluded that a large part of the increased growth and feed efficiency effect obtained by pelleting may be due to some chemical change, possibly the inactivation of a growth inhibitor in the

ration.

Bearse et al. (6) made comparisons of growth rate and feed efficiency of light and heavy breed chickens fed rations of different fiber levels as mash and as pellets. Pelleted rations containing 8, 13, and 18 per cent fiber increased growth rate in Leghorn pullets. Differences between mash and pellets became more marked as fiber level increased. Heavy breed chickens were used to compare a 66 per cent corn ration with rations containing 35 per cent corn and 35 per cent barley, and 39 per cent corn and 35 per cent wheat mixed feed. At approximately ten and one-half weeks of age, the average weight was .16 pound greater for the pelleted corn ration than for the same mash. Pelleting the corn-barley ration increased the average weight by .28 pound. Similar treatment of the corn-wheat mixed feed ration increased average weight by .33 pound. Chickens fed the pelleted higher fiber rations, except the 18 per cent level, were heavier than those fed the high corn rations in mash form. Pelleting the various rations improved their efficiency for growth. This improvement was progressively greater as the fiber level of the ration increased.

Patten et al. (20) conducted an experiment to determine the relative nutritional value of the same feed, different only in physical form, as determined chiefly by the growth of single comb white leghorn chickens from the date of hatching to the end of the ninth week for the cockerels and the end of the twelfth week for the pullets and under controlled conditions. It would appear from this experiment that a feed formula in pellet form offers nutritional advantages, as manifested by greater total growth and greater growth per unit of food consumed, over the same feed formula in mash form and with specific reference to single comb white

leghorn chicks from one day to nine weeks of age. It would appear further that the water requirement of pellet-fed chicks is greater than that of corresponding mash-fed chicks under controlled conditions and with specific reference to single comb white leghorn chicks from one day to nine weeks of age.

Goodeal and Moore, (12) conducted an experiment comparing pelleted rations versus mash rations for turkeys. Using the same mash formula, the feeding of the starter and grower mash for turkeys in the form of pellets as compared to the regular dry mash mixture, promoted better growth from hatch to marketing at 26 weeks of age. The turkeys fed pellets when dressed for market had a better market finish, and greater freedom from pin feathers than those fed the dry mash. The difference in market quality of the turkeys fed pellets over the turkeys fed dry mash was much greater than the difference in growth.

Slinger et al. (23) conducted an experiment comparing pelleted and non-pelleted diets high in dehydrated green feeds for turkeys grown in confinement. Groups of Broad Breasted Bronze turkeys were fed mashes containing 10, 15, and 20 per cent of a mixture of equal parts of dehydrated alfalfa and dehydrated cereal grass in both pelleted and non-pelleted form. The results of this experiment indicate that while a slightly better growth rate was obtained from the lower levels of green feed, even the 20 per cent level gave satisfactory results. Much greater differences were found between the pelleted and non-pelleted mashes, than between the levels of the dehydrated products. The weights of all the groups receiving pellets were greater than those of any group receiving mash, significantly so in most cases. More advantage appears to be gained

by pelleting mashes containing 15 and 20 per cent of dehydrated products than one containing 10 per cent. Based on total feed consumption, efficiency of gain tended to be increased by pelleting, but the differences were not marked.

Ziegenhagen et al. (32) studied feed particle size as a factor affecting performance of turkey poults. The rate of growth during the first eight weeks was significantly increased through the feeding of pellets or granular type feed. An important factor involved in the poor feed economy of the mash-fed birds was the amount of feed wasted. During the last four weeks of the trial, appreciable quantities of mash were found in the water troughs. This feed was carried in the mouths of the mash-fed birds. A tendency toward cannibalism was noted only in the lot fed gramular feed. There was no cannibalism among any of the poults started on mash or a mixture of mash and pellets. However in previous trials, cannibalism did occur among several of the lots fed pellets or granules alone.

Heywang and Morgan, (13) conducted six experiments in which an all-mash diet in the pelleted and non-pelleted forms were fed to two similar groups of white Leghorn chicks. The cockerels were removed from the groups when they were 12 weeks old, but the experiments were continued until the pullets were 22 weeks old. In all six experiments, the average live weight of the 12-week-old cockerels receiving the pelleted all-mash diet was significantly greater statistically than that of the cockerels receiving the non-pelleted all-mash diet. In five of the six experiments, when the pullets were 12 and 22 weeks old, the average weight of those receiving the pelleted all-mash diet was significantly greater statistically

than that of pullets receiving the unpelleted all-mash diet. The total average feed consumption per chick of all the chicks receiving the pelleted all-mash diet was slightly greater than that of all the chicks receiving the non-pelleted all mash diet.

In three trials, conducted by Stewart and Upp, (26) 900 white Plymouth Rock chicks were grown, day-old to twelve weeks of age, in tests in which three forms of feed-pellets, granules, and regular mash were compared. The form of feed did not greatly affect the rate of growth nor the feed efficiency. Cannibalism or feather picking was not a problem in the trials, although the tendency toward it was greater in the pellet and granule fed lots. No one form of feed produced especially superior dressed birds as compared to the others.

FEEDING TRIAL

Experimental Procedure

Forty-two head of choice quality Hereford steers averaging approximately 430 pounds in weight were used in this trial. The calves were all purchased from the same ranch which was located in the vicinity of Clovis, New Mexico.

Upon arrival at the Kansas State College Experimental Pens, the calves were placed in a large pen with access to prairie hay and water. After the steers had rested and had become familiar with the environment, each steer was branded with a hot iron for identification purposes. The steers were then divided as equally as possible on the basis of weight, size, and conformation into four lots with 1 lot containing 12 steers and 3 lots containing 10 steers each. By increasing the feed progressively

the steers were brought up to the amount which was to be fed during the test period which officially began December 7, 1958. Table 1 shows the rations fed per steer per day.

Table 1. Ingredients used in feedlot studies.

Lot	Alfalfa Hay	Atlas Sorghum Silage, av.	Soybean oil meal	Cracked sorghum grain	Cracked Corn	Pelleted sorghum grain	Fine ground sorghum grain
1	2 lb.	19.2 lb.	1 lb.	5 lb.			
2	2 lb.	17.6 lb.	1 lb.		5 lb.		
3	2 lb.	17.7 lb.	1 lb.			5 lb.	
4	2 lb.	17.8 lb.	1 lb.				5 lb.

The atlas sorghum silage used in this experiment was grown on the Kansas State College Experiment Station Farm. It was a good quality silage that contained a lot of grain. It had a good silage odor and retained much of the original green color, indicating that the carotene content was adequate to provide enough vitamin A for wintering beef cattle.

The soybean oil meal used contained 44 per cent crude protein, as indicated on the tag, and 42.56 per cent crude protein by chemical analysis.

The sorghum grain and corn used in this experiment was purchased from the Manhattan elevator and all preparation of the grain was made there.

The baled alfalfa hay used in this experiment was grown in the vicinity of Manhattan.

The four lots of steers were fed once daily in the morning except for the alfalfa hay which was fed in the afternoon. Silage was evenly

distributed in the bunks, then the grain and soybean oil meal were poured over the silage. Salt alone, and a mixture of two parts steamed bone meal and one part salt were fed free choice. Drinking water was available at all times.

The steers were individually weighed at the beginning of the study, once every twenty-eight days, and at the termination of the study on March 18, 1958. Records were kept daily of each lot's feed intake. At the end of the study, calculations were made to determine the average daily gain, daily feed intake per steer, feed intake per hundredweight of gain, and the cost per hundred pounds of gain.

Results and Discussion

The purpose of this study was to evaluate the effect of finely grinding and pelleting sorghum grain upon feed utilization. Wintering steer rations containing cracked sorghum grain, cracked corn, finely ground and pelleted sorghum grain, and finely ground sorghum grain were fed.

Statistical analysis showed no significant differences in rate of gain with the rations studied. A summary of the complete results of this study is shown in Table 2.

The steers fed cracked sorghum grain made slightly greater daily gains than steers fed rations containing cracked corn, finely ground sorghum grain, and pelleted sorghum grain. The steers fed cracked sorghum grain consumed more feed per hundred pounds of gain than did the steers fed cracked corn and pelleted sorghum grain and less feed per hundred pounds of gain than the steers fed finely ground sorghum grain.

The steers fed pelleted sorghum grain made slightly smaller daily

gains than steers fed rolled sorghum grain but made larger daily gains than steers receiving the rations containing cracked corn and finely ground sorghum grain. The steers fed pelleted sorghum grain had a considerably greater efficiency of feed utilization than the steers receiving the rations containing the other grain preparations. This lot contained two more animals than the other three lots.

The steers fed cracked corn had larger average daily gains than the steers fed finely ground sorghum grain and had smaller average daily gains than the steers fed pelleted sorghum grain and rolled sorghum grain. The steers fed cracked corn ranked second to the steers fed pelleted sorghum grain, in efficiency of feed utilization per hundred pounds of gain.

The steers receiving finely ground sorghum grain had the lowest average daily gains and also had the lowest efficiency of feed utilization per hundred pounds of gain. Two steers in this lot became lame during the study. Whether this had any effect on the results of this lot is not known.

It is of interest to note that all lots dropped in rate of gain during the extended period of extreme cold weather that occurred during this study.

The feed cost per hundred pounds of gain was calculated using the following current prices. Alfalfa hay $16.00 per ton, sorghum silage $7.00 per ton, cracked corn $2.30 per cwt., rolled and finely ground sorghum grain $2.00 per cwt., pelleted sorghum grain $2.10 per cwt., and soybean oilmeal $3.35 per cwt. The ration containing the rolled sorghum grain had the lowest feed cost per hundred pounds of gain and the ration containing the cracked corn had the highest feed cost per hundred pounds of

Table 2. Comparative results with cracked corn, cracked sorghum grain, finely ground sorghum grain and finely ground and pelleted sorghum grain in beef steer calf wintering rations.

	Cracked sorghum grain	Cracked corn	Pelleted sorghum grain	Finely ground S-grain
Lot	1	2	3	4
Number of calves per lot	10	10	12	10
Ave. initial wt. lbs.	431	432	426.3	432
Ave. final wt. lbs.	636	628	623.3	620
Ave. daily gain per calf lbs.	2.05	1.96	2.00	1.88
Ave. daily ration, lbs.				
Sorghum silage	19.2	17.6	17.7	17.8
Alfalfa hay	2.0	2.0	2.0	2.0
Soybean oil meal	1.0	1.0	1.0	1.0
Rolled milo	5.0	—	—	—
Corn	—	5.0	—	—
Pelleted milo	—	—	5.0	—
Fine ground milo	—	—	—	5.0
Lbs. feed per 100 lbs. gain				
Sorghum silage	938	897	870	945
Alfalfa hay	97.6	102.0	100.0	106.4
Soybean oil meal	48.8	51.0	50.0	53.2
Rolled milo	243.9	—	—	—
Corn	—	255.1	—	—
Pelleted milo	—	—	250.0	—
Fine ground milo	—	—	—	266.0
Total	1328.30	1305.1	1217.00	1370.60
Feed cost per 100 lbs. gain	10.57	11.54	10.76	11.26

gain. The pelleted sorghum grain and finely ground sorghum grain rations ranked second and third respectively in economy of gain per hundred pounds. However, the differences between all rations in feed cost per hundred pounds of gain was not of practical importance in this study.

Summary

Wintering steer rations containing rolled sorghum grain, cracked corn, pelleted sorghum grain, and finely ground sorghum grain were fed

to forty-two Hereford steer calves. The steers were randomly divided into four lots with three lots containing ten steers each and one lot containing twelve steers. In addition to the grain received each lot received sorghum silage, alfalfa hay, and soybean oilmeal.

Differences obtained in the rate of gain between the four different rations were not statistically significant. The steers receiving the ration containing the rolled sorghum grain made slightly greater average daily gains than the steers receiving the rations containing cracked corn, pelleted sorghum grain, and finely ground sorghum grain. The steers receiving the ration containing finely ground sorghum grain produced the lowest average daily gains. The steers fed the rations containing cracked corn and pelleted sorghum grain produced very similar average daily gains.

The rations containing cracked corn, rolled sorghum grain, and finely ground sorghum grain did not produce as efficient gains as did the ration containing pelleted sorghum grain. The ration with the finely ground sorghum grain was least efficient.

Using current prices to calculate the feed cost per hundred pounds of gain, the ration containing rolled sorghum grain was the most economical.

METABOLISM STUDIES

Experimental Procedure

Eight steers averaging 430 pounds were used in the metabolism trials of this study. The eight steers were transferred from the feedlot to the pavilion on November 26, 1957, where they were placed in pens of two animals each. Each pen of animals was immediately assigned to a specific ration and was started on the adjustment feeding period. The animals on the last

three collection periods were transferred to a small shed north of the pavilion for their adjustment feeding period. The ingredients fed in the first two trials were the same as those fed at the feed lot except for alfalfa hay. During the last six trials alfalfa hay was added to insure constant feed intake.

The rations were used in rotation until all steers had been on each for one collection period. The animals had an adjustment period of two weeks in the pens followed by one week preliminary adjustment in the metabolism stall. During the adjustment period the steers were fed the rations they were to receive in the subsequent collection period. Feces and urine was then collected separately and quantitatively from each animal daily for seven consecutive days. The first collection was made on December 15, 1957. Water and a mixture of salt and steamed bone meal was available to the steers at all times. Vitamin D was supplied to the steers every two weeks.

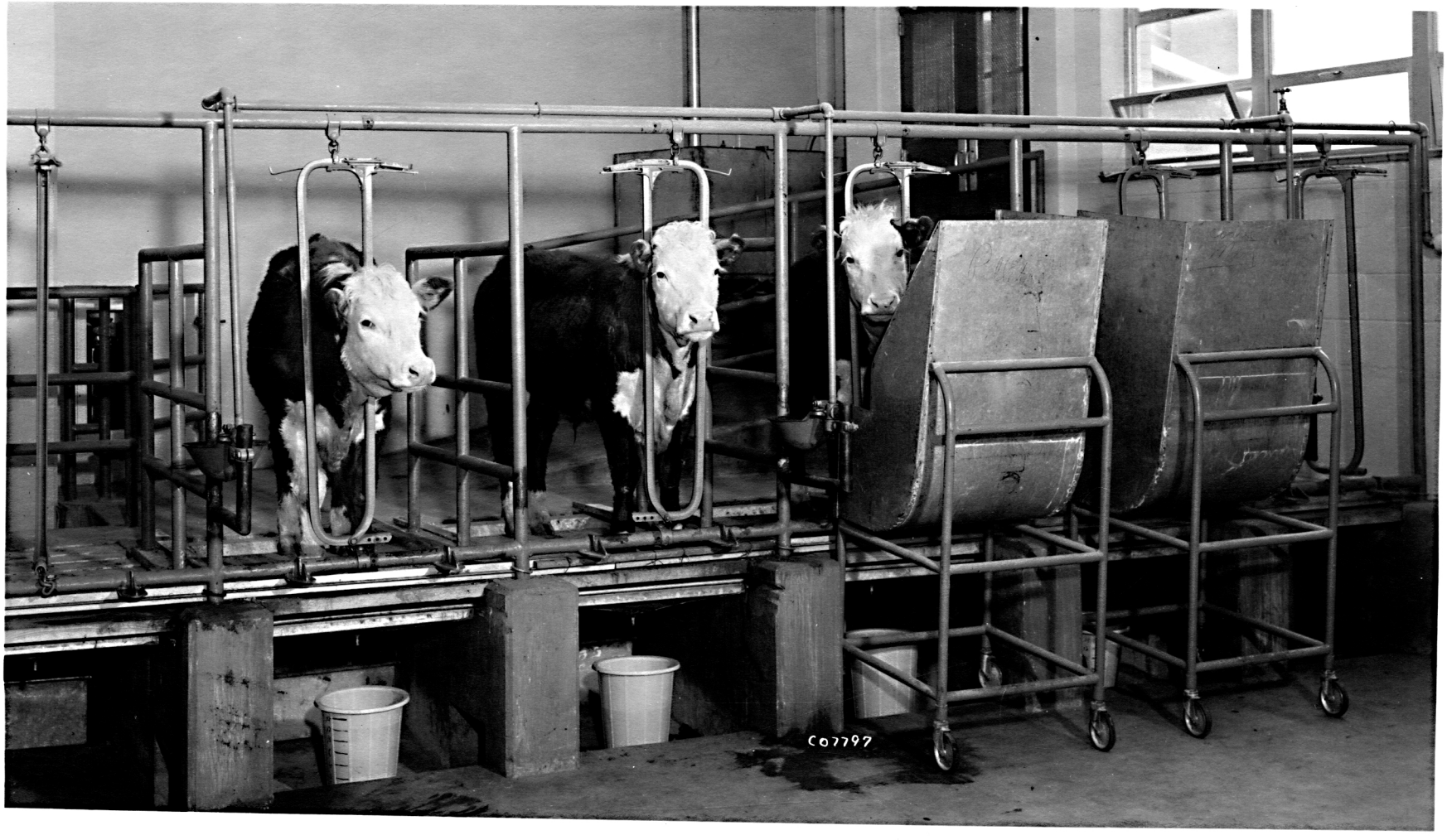
A 4 x 4 latin square design was the statistical plan used in this study.

Feces Collection. Each 24 hour feces collection was weighed and a 2 per cent aliquot was placed in a porcelainized pan. This pan was placed in a drying oven set at 100 degrees Centigrade. On the following day another 2 per cent aliquot was added to the pan and the pan returned to the drying oven. This procedure continued until seven consecutive collections were made. After the final aliquot was added, the feces remained in the drying oven until the feces were completely dry. The dry feces of the individual steers were weighed, transferred to glass jars, sealed, and taken to the college chemical service laboratory for quantitative

EXPLANATION OF PLATE I

Picture of metabolism stalls designed for the collection of feces and urine which was used for the metabolism studies.

PLATE I



analysis. The feces were analyzed to determine the percentage of protein, ether extract, crude fiber, moisture, mineral matter, and nitrogen free extract.

Urine Collection. The 24 hour urine collections of individual steers were measured each afternoon. An approximate two per cent aliquot of each was transferred to glass jars. Toluene was added as a preservative before the jars were sealed and placed in a refrigerator until the following day when another two per cent aliquot was added. This procedure continued until seven consecutive collections had been made. The urine was also taken to the college chemical service laboratory for a quantitative analysis of nitrogen content.

Method of Calculations. The coefficients of digestibility and percentage of the total digestible nutrients were calculated. To determine the amount of each nutrient that was consumed, the total weight of feed eaten was multiplied by the percentage composition of each nutrient. The values for excreted nutrients were obtained by multiplying the dry weight of the total amount of feces collected by the percentage composition of each nutrient. To obtain the amount of each nutrient apparently digested, the amount of each nutrient voided was subtracted from the amount of the nutrient consumed. Dividing the amount of the nutrient apparently digested by the amount of that nutrient consumed, the apparent digestibility was obtained, which when multiplied by 100, is expressed as a percentage. To obtain total digestible nutrients the amounts of digestible protein, nitrogen-free extract, crude fiber, and ether extract x 2.25 were added together. This sum of digested nutrients when divided by the total weight of feed consumed, gave the percentage of total digestible nutrients (T.D.N.).

The percentage of nitrogen retained by the individual steers were determined. To determine the amount of nitrogen in the feces, the dry weight of the total amount of feces collected was multiplied by the percentage of nitrogen in the feces sample. Dividing the amount of nitrogen in the feces by the amount of nitrogen consumed, the percentage of nitrogen in the total dry feces was obtained. To determine the amount of nitrogen in the urine, the total amount of urine collected was multiplied by the amount of nitrogen per milliliter of urine. Dividing the amount of nitrogen in the urine by the amount of nitrogen consumed, the percentage of nitrogen in the total urine was obtained. The percentage of nitrogen in the feces and urine was obtained by adding together the amount of nitrogen in the total dry feces collection and the amount of nitrogen in the total urine collection. This sum was divided by the total nitrogen consumed to obtain the per cent nitrogen voided in the feces and urine. This was subtracted from 100 to obtain the per cent nitrogen retained by the steer.

Results and Discussion

The complete results of the digestion and nitrogen balance studies are shown in the Appendix Tables 7 - 11. A summary of the treatment averages is shown in Table 3. The mean squares from analyses of variance to test differences between treatments are shown in Table 4. Where differences between treatments were statistically significant, Duncan's multiple range test was employed to determine which treatments differed from other treatments. The comparison of treatment differences is shown in Table 5.

There were no statistical differences between sorghum grain preparations with regard to all coefficients of digestibility. A look at the averages

Table 3. Averages of digestion and nitrogen balance studies with steers fed different preparations of sorghum grain and corn.

No. of steers	Ration	Digestion Coefficient							
		Protein	Ether Extract	Fiber	N.F.E.	T.D.N.	Dry Matter	Organic Matter[1]	Nitrogen Retained[2]
8	Cracked sorghum grain	68.04	73.48	73.43	81.30	46.95	73.59	77.38	30.84
8	Pelleted sorghum grain	71.08	70.88	64.98	81.32	48.01	79.56	75.25	32.37
8	Finely ground sorghum grain	69.67	71.54	62.82	80.57	42.68	72.11	74.97	28.03
8	Cracked corn	65.70	54.85	54.83	77.73	35.13	72.40	69.81	20.11

[1]Individual steer results are shown in Appendix Tables.
[2]Individual steer results are shown in Appendix Tables.

Table 4. Mean squares from analyses of variance.

Source of variation	d.f.	Mean Squares from Analyses of Variance							
		Protein	Ether Extract	Fiber	N.F.E.	T.D.N.	% Dry Matter	Organic Matter	% Nitrogen retained
Squares	1	.06	92.72	33.93	17.39	92.48	36.77	1.90	3.30
Periods within squares	6	21.08	29.95	83.34	12.01	1.24	14.24	17.45	13.78
Animals within squares	6	34.83	16.57	60.90	8.21	2.46	12.36	5.14	33.82
Treatments	3	42.81	595.45*	467.31*	23.24	273.67**	97.46	82.57*	238.23**
Error	15	42.27	110.15	111.44	18.16	32.11	49.59	24.25	34.36

*significant at the .05 level
**significant at the .01 level

Table 5. Comparison of treatment differences.*

	Protein	Ether Extract	Fiber	N.F.E.	T.D.N.	% Dry Matter	Organic Matter	% Nitrogen retained
Rolled vs pellet								
Rolled vs fine								
Pellet vs fine								
Rolled milo vs corn		+	+		+		+	+
Pellet milo vs corn		+			+			+
Fine milo vs corn		+			+			+

*+ designates statistically significant difference.
No † designates difference was not statistically significant.

of digestion coefficients of ether extract, crude fiber, and dry matter reveals that these coefficients were highest for the cracked sorghum grain. This is not in agreement with previous work conducted by Smith et al. (24). These workers found that the average crude fiber digestion coefficient was greatest for the whole sorghum grain and that the average ether extract digestion coefficient was greatest for the finely ground sorghum grain. Smith and Parrish (25) concluded from average digestion coefficients that ether extract and crude fiber were digested best when the sorghum grain was rolled.

The averages of digestion coefficients of protein, nitrogen-free extract, and total digestible nutrients were greatest for the pelleted sorghum grain. The finely ground sorghum grain had a higher protein digestion coefficient than did the cracked sorghum grain. This agrees with previous work by Smith et al. (24) and also Smith and Parrish (25). The nitrogen-free extract and total digestible nutrient digestion coefficients were greater for cracked sorghum grain than for the finely ground sorghum grain. However, the previous work cited above showed that the nitrogen-free extract digestibility of finely ground sorghum grain was greater than cracked sorghum grain.

It is of interest to note that during the third collection period of all animals, the protein digestibility decreased markedly. This marked decrease in protein digestibility might possibly have been caused by two factors occurring during the third collection period: (1) a change from indoor housing to outdoor housing during the adjustment feeding period, therefore creating an environmental stress on the animals. (2) The feeding of inferior quality alfalfa hay and sorghum silage brought about

by replenishing the feed supply.

No statistical differences occurred between all treatments in digestion coefficients of protein, nitrogen-free extract or dry matter. The average digestion coefficient of protein and nitrogen-free extract of all sorghum grain preparations was greater than cracked corn. The organic matter digestion coefficient was higher for the cracked sorghum grain and pelleted sorghum grain than for cracked corn. The finely ground sorghum grain average digestion coefficient was only 0.29 hundreds less than the cracked corn.

All sorghum grain preparations were statistically superior to cracked corn with respect to ether extract and nitrogen-free extract digestion.

The crude fiber and organic matter digestion coefficients of rolled sorghum grain were statistically superior to corn. The differences between corn and the other sorghum grain preparations approached statistical significance.

There were no statistical significant differences between all sorghum grain in per cent nitrogen retained. The pelleted sorghum grain had the highest percentage of nitrogen retained of any of the grain preparations studied. The finely ground sorghum grain had the lowest percentage of nitrogen retained of any of the sorghum grain preparations studied. All sorghum grain preparations retained a larger per cent nitrogen than the cracked corn ration.

Summary

Eight good quality Hereford steers were divided as equally as possible by size, weight, and conformation into two groups and used in

digestion studies to determine the effect of grinding and pelleting grain upon utilization when used in wintering steer rations. The design of this experiment was a series of two latin squares with a common daily ration of soybean oil meal, one pound; sorghum silage, nine pounds; and alfalfa hay, 1.32 pounds. Grain was added at the rate of three pounds per head daily. Preparations of cracked sorghum grain, finely ground pelleted sorghum grain, finely ground sorghum grain, and cracked corn were used.

There were no statistical differences between the sorghum grain treatments in digestion coefficients of all nutrients. There were also no differences between any of the treatments in the protein, nitrogen-free extract and dry matter digestion coefficients. These results were not in agreement with previous work by Smith et al. (24) and Smith and Parrish (25).

All sorghum grain treatments were superior to corn in respect to ether extract digestibility and total digestible nutrient values and also per cent nitrogen retained.

Cracked sorghum grain was superior to corn in crude fiber and organic matter digestibility. The differences between corn and the other sorghum grain preparations approached statistical significance.

GENERAL SUMMARY

The purpose of this experiment was to study the effects of grinding and pelleting grain upon utilization when used in wintering steer rations. Forty-two good quality Hereford steers were used in the feedlot trial. The steers were randomly divided into four lots with three lots containing

ten steers each and one lot containing twelve steers. The daily ration in all lots consisted of one pound soybean oil meal, five pounds of grain, two pounds of alfalfa hay and all of the sorghum silage the animals would clean up. The grain in each lot was either cracked sorghum grain, finely ground sorghum grain, finely ground and pelleted sorghum grain or cracked corn.

There were no statistically significant differences between the four different rations fed. The steers receiving the ration containing cracked sorghum grain made slightly greater average daily gains than those receiving rations containing pelleted sorghum grain, finely ground sorghum grain, or cracked corn. The steers receiving the ration containing pelleted sorghum grain had the greatest feed efficiency per pound of feed than any of the rations studied.

In the metabolism studies the 7-day collection method was used. Eight steers were used in this study. The design of this experiment was a series of two latin squares with a common daily ration of soybean oil meal, on pound; sorghum silage, nine pounds; and alfalfa hay, 1.32 pounds. Preparation of cracked sorghum grain, finely ground pelleted sorghum grain, finely ground sorghum grain, and cracked corn were added to the common daily ration at the rate of three pounds per head daily to constitute four different rations.

There were no statistical differences between the sorghum grain treatments in digestion coefficients of all nutrients. There were also no differences between any of the treatments in the protein, nitrogen-free extract and dry matter digestion coefficients.

All sorghum grain treatments were superior to corn with respect to

ether extract digestibility, total digestible nutrient values and per cent nitrogen retained.

Cracked sorghum grain was superior to corn in digestibility of crude fiber and organic matter. The differences between the other sorghum grain preparations and cracked corn approached statistical significance.

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APPENDIX

Table 6. Chemical analysis of feeds used in this experiment.

Feeds	Moisture	Protein	Ether Extract	Fiber	N-free extract	Mineral Matter	Carbohydrates
				Per cent			
Alfalfa Hay 1*	9.87	13.63	1.13	33.66	34.28	7.47	67.94
Alfalfa Hay 2**	8.79	16.44	1.31	27.84	36.67	8.95	64.51
Alfalfa Hay 3***	7.94	16.19	1.52	27.91	38.02	8.42	65.93
Corn	14.05	10.13	3.84	1.78	69.31	1.25	71.09
Rolled sorghum grain	13.53	10.94	2.91	2.05	68.80	1.77	70.85
Finely ground sorghum grain	13.70	10.13	2.63	1.81	70.27	1.46	72.08
Pelleted sorghum grain	13.62	11.25	2.41	2.39	68.43	1.90	70.82
Sorghum silage 1#	47.50	4.13	1.02	13.63	28.97	4.75	42.60
Sorghum silage 2##	70.83	2.42	0.67	7.47	16.05	2.56	23.52
Soybean oil meal	13.14	42.56	2.04	5.94	30.78	5.54	36.72

*Alfalfa Hay 1 was fed in metabolism trial 1A-4B.
**Alfalfa Hay 2 was fed in metabolism trial 5B-4C.
***Alfalfa Hay 3 was fed in metabolism trial 5C-8D.
#Sorghum silage 1 was fed in metabolism trial 1A-4C.
##Sorghum silage 2 was fed in metabolism trial 5C-8D.

Table 7. Digestibility study with steers using rolled sorghum grain fed with basal ration.

Steer and Trial No.	Ingredient	Grams	% Prot.	Grams crude protein	% E. E.	Grams E. E.	X2.25	% Crude Fiber	Grams C. F.	% N.F.E.	Grams N.F.E.	Total Nutrients Digested	% T.D.N.
50													
5A	S. Silage	28602	4.13	1181.26	1.02	291.74		13.63	3898.45	28.97	8286		
	Alf. hay												
	Grain	9534	10.94	1043.02	2.91	277.44		2.05	195.45	68.80	6559.39		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	41314		3576.84		634.01			4282.67		15823.58		
	Feces	5332.28	19.68	1049.39	2.71	144.50		16.77	894.22	49.52	2640.55		
	Amt. Digest			2527.45		489.51	1101.40		3388.45		13183.03	20200.33	
	Dig. Coeff.			70.66		77.21			79.12		83.31		48.89
60													
1D	S. Silage	28602	2.42	692.17	.67	191.63		7.47	2136.57	16.05	4590.62		
	Alf. hay	4200	16.19	679.98	1.52	63.84		27.91	1172.22	38.02	1596.84		
	Grain	9534	10.94	1043.02	2.91	277.44		2.05	195.45	68.80	6559.39		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	45514		3767.72		597.74			3693.01		13725.04		
	Feces	8359.96	17.05	1425.37	4.20	351.12		22.82	1907.74	44.16	3691.76		
	Amt. Digest			2342.35		246.62	554.90		1785.27		10033.28	14715.81	
	Dig. Coeff.			62.17		41.26			48.34		73.10		35.62
61													
5D	S. Silage	28560	2.42	691.15	.67	191.35		7.47	2133.42	16.05	4583.88		
	Alf. hay	4200	16.19	679.98	1.52	63.84		27.91	1172.22	38.02	1596.84		
	Grain	9520	10.94	1041.49	2.91	277.03		2.05	195.16	68.80	6549.76		
	SBOM	3150	42.56	1340.64	2.04	64.26		5.94	187.11	30.78	969.57		
	Total	45430		3753.26		596.48			3687.91		13700.05		
	Feces	6272.97	17.70	1110.32	2.94	184.43		20.75	1301.64	47.84	3000.99		
	Amt. Digest			2642.94		412.05	927.11		2386.27		10699.06	16655.38	
	Dig. Coeff.			70.42		69.08			64.71		78.10		36.66

Table 7. (cont.)

Steer and Trial No.	Ingredient	Grams	% Prot.	Grams crude protein	% E. E.	Grams E. E.	X2.25	% Crude Fiber	Grams C. F.	% N.F.E.	Grams N.F.E.	Total Nutrients Digested	% T.D.N.
62													
1C	S. Silage	28560	4.13	1179.53	1.02	291.31		13.63	3892.73	28.97	8273.83		
	Alf. hay	4200	16.44	690.48	1.31	55.02		27.84	1169.28	36.67	1540.14		
	Grain	9534	10.94	1043.02	2.91	277.44		2.05	195.45	68.80	6559.39		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	45472		4265.59		688.60			5446.23		17351.55		
	Feces	6842.07	17.32	1185.05	2.25	153.95		22.09	1511.41	47.32	3237.67		
	Amt. Digest.			3080.54		534.65	1202.96		3934.82		14113.88	22332.20	
	Dig. Coeff.			72.22		77.64			72.25		81.34		49.11
63													
5B	S. Silage	28560	4.13	1179.53	1.02	291.31		13.63	3892.73	28.97	8273.83		
	Alf. hay	4200	16.44	690.48	1.31	55.02		27.84	1169.28	36.67	1540.14		
	Grain	9520	10.94	1041.49	2.91	277.03		2.05	195.16	68.80	6549.76		
	SBOM	3150	42.56	1340.64	2.04	64.26		5.94	187.11	30.78	969.57		
	Total	45430		4252.14		687.62			5444.28		17333.30		
	Feces	6818.19	16.40	1118.83	2.51	171.14		21.90	1493.18	49.14	3350.46		
	Amt. Digest.			3133.31		516.48	1162.08		3951.10		13982.84	21869.33	
	Dig. Coeff.			73.69		75.11			72.57		80.67		48.13
65													
5C	S. Silage	28560	2.42	691.15	.67	191.35		7.47	2133.43	16.05	4583.88		
	Alf. hay	4200	16.19	679.98	1.52	63.84		27.91	1172.22	38.02	1596.84		
	Grain	9534	10.94	1043.02	2.91	277.44		2.05	195.45	68.80	6559.39		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	45472		3766.71		597.46			3689.87		13718.30		
	Feces	7889.98	18.23	1438.34	2.35	185.41		40.91	1649.79	46.22	3646.75		
	Amt. Digest.			2328.37		412.05	927.11		2040.08		10071.55	15367.11	
	Dig. Coeff.			61.81		68.97			55.29		73.42		33.79

Table 7 (concl.)

Steer and Trial No.	Ingredient	Grams	% Prot.	Grams crude protein	% E. E.	Grams E. E.	X2.25	% Crude Fiber	Grams C. F.	% N.F.E.	Grams N.F.E.	Total Nutrients Digested	% T.D.N.
82													
1B	S. Silage	28560	4.13	1179.53	1.02	291.31		13.63	3892.73	28.97	8273.83		
	Alf. hay	4200	13.63	572.46	1.13	47.46		33.66	1413.72	34.28	1439.76		
	Grain	9520	10.94	1041.49	2.91	277.03		2.05	195.16	68.80	6549.76		
	SBOM	3150	42.56	1340.64	2.04	64.26		5.94	187.11	30.78	969.57		
	Total	45430		4134.12		680.06			5688.72		17232.92		
	Feces	7732.70	16.44	1271.26	2.51	194.09		23.34	1804.81	47.83	3698.55		
	Amt. Digest.			2862.86		485.97	1093.43		3883.91		13534.37	21374.57	
	Dig. Coeff.			69.25		71.46			68.27		78.54		47.05
90													
1A	S. Silage	28602	4.13	1181.26	1.02	291.74		13.63	3898.45	28.97	8285.99		
	Alf. hay												
	Grain	9533	10.94	1042.91	2.91	277.41		2.05	195.43	68.80	6558.70		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	41313		3576.73		633.98			4282.65		15822.88		
	Feces	5163.74	17.44	900.56	2.76	142.52		17.48	902.62	51.16	2641.77		
	Amt. Digest.			2676.17		491.46	1105.79		3380.03		13181.11	20343.10	
	Dig. Coeff.			74.85		77.52			78.92		83.30		49.15

Table 8. Digestibility study with steers using pelleted sorghum grain fed with basal ration.

Steer and Trial No.	Ingredient	Grams	% Prot.	Grams crude protein	% E. E.	Grams E. E.	X2.25	% Crude Fiber	Grams C. F.	% N.F.E.	Grams N.F.E.	Total Nutrients Digested	% T.D.N.
50													
6B	S. Silage	28560	4.13	1179.53	1.02	291.31		13.63	3892.73	28.97	8273.83		
	Alf. hay	4200	16.44	690.48	1.31	55.02		27.84	1169.28	36.67	1540.14		
	Grain	9520	11.25	1071.00	2.41	229.43		2.39	227.53	68.43	6514.54		
	SBOM	3150	42.56	1340.64	2.04	64.26		5.94	187.11	30.78	969.57		
	Total	45430		4281.65		640.02			5476.65		17298.08		
	Feces	6922.51	16.61	1149.83	2.69	186.22		27.91	1932.07	41.00	2838.23		
	Amt. Digest.			3131.82		453.80	1021.05		3544.58		14459.85	22157.30	
	Dig. Coeff.			73.15		70.90			64.72		83.59		48.77
60													
2A	S. Silage	28602	4.13	1181.26	1.02	291.74		13.63	3898.45	28.97	8286		
	Alf. hay												
	Grain	9534	11.25	1072.58	2.41	229.77		2.39	227.86	68.43	6524.12		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	41314		3606.40		586.34			4315.08		15788.31		
	Feces	7886.72	17.36	1369.13	2.99	235.81		19.74	1556.84	48.02	3787.20		
	Amt. Digest.			2237.27		350.53	788.69		2758.24		12001.11	17785.31	
	Dig. Coeff.			62.04		59.78			63.92		76.01		43.05
61													
6A	S. Silage	28602	4.13	1181.26	1.02	291.74		13.63	3898.45	28.97	8286		
	Alf. hay												
	Grain	9534	11.25	1072.58	2.41	229.77		2.39	227.86	68.43	6524.12		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	41314		3606.40		586.34			4315.06		15788.31		
	Feces	5778.04	19.69	1137.69	2.98	172.19		19.31	1115.74	48.02	2774.61		
	Amt. Digest.			2468.71		414.15	931.84		3199.34		13013.70	19713.59	
	Dig. Coeff.			68.45		70.63			74.14		82.43		47.72

Table 8 (cont.)

Steer and Trial No.	Ingredient	Grams	% Prot.	Grams crude protein	% E. E.	Grams E. E.	X2.25	% Crude Fiber	Grams C. F.	% N.F.E.	Grams N.F.E.	Total Nutrients Digested	% T.D.N.
62													
2D	S. Silage	28602	2.42	692.17	.67	191.63		7.47	2136.57	16.05	4590.62		
	Alf. hay	4200	16.19	679.98	1.52	63.84		27.91	1172.22	38.02	1596.84		
	Grain	9534	11.25	1072.58	2.41	229.77		2.39	227.86	68.43	6524.12		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	41314		3797.29		550.07			3725.42		13689.77		
	Feces	7677.20	17.61	1351.95	3.67	281.75		25.79	1979.95	40.49	3108.50		
	Amt. Digest.			2445.34		268.32	603.72		1745.47		10581.27	15375.80	
	Dig. Coeff.			64.40		48.78			46.85		77.29		37.22
63													
6C	S. silage	28560	2.42	691.15	.67	191.35		7.47	2133.43	16.05	4583.88		
	Alf. hay	4200	16.19	679.98	1.52	63.84		27.91	1173.22	38.02	1596.84		
	Grain	9534	11.25	1072.58	2.41	229.77		2.39	227.86	68.43	6524.12		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	45472		3796.27		549.79			3722.28		13683.03		
	Feces	6645.14	18.84	1251.94	2.97	197.36		25.13	1669.92	40.50	2691.28		
	Amt. Digest.			2544.33		352.43	792.97		2052.36		10991.75	16381.41	
	Dig. Coeff.			67.02		64.10			55.14		80.33		36.03
65													
6D	S. Silage	28560	2.42	691.15	.67	191.35		7.47	2133.42	16.05	4583.88		
	Alf. hay	4200	16.19	679.98	1.52	63.84		27.91	1172.22	38.02	1596.84		
	Grain	9520	11.25	1071.00	2.41	229.43		2.39	227.53	68.43	6514.54		
	SBOM	3150	42.56	1340.64	2.04	64.26		5.94	187.11	30.78	969.57		
	Total	45430		3782.77		548.88			3720.28		13664.83		
	Feces	7123.89	17.37	1237.42	2.68	190.92		27.12	1932.00	40.90	2917.76		
	Amt. Digest.			2545.35		357.96	805.41		1788.28		10747.07	15886.11	
	Dig. Coeff.			67.47		65.22			48.07		78.65		34.97

Table 8 (concl.)

Steer and Trial No.	Ingredient	Grams	% Prot.	Grams crude protein	% E. E.	Grams E. E.	X2.25	% Crude Fiber	Grams C. F.	% N.F.E.	Grams N.F.E.	Total Nutrients Digested	% T.D.N.
82													
2C	S. Silage	28560	4.13	1179.53	1.02	291.31		13.63	3892.73	28.97	8273.83		
	Alf. hay	4200	16.44	690.48	1.31	55.02		27.84	1169.28	36.67	1540.14		
	Grain	9534	11.25	1072.58	2.41	229.77		2.39	227.86	68.43	6524.12		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	45472		4295.15		640.93			5478.64		17316.28		
	Feces	6317.45	18.88	1192.73	2.70	170.57		24.10	1522.51	41.34	2611.63		
	Amt. Digest.			3102.42		470.36	1058.31		3956.13		14704.65	22821.51	
	Dig. Coeff.			72.23		73.39			72.21		84.92		50.19
90													
2B	S. Silage	28560	4.13	1179.53	1.02	291.31		13.62	3892.73	28.97	8273.83		
	Alf. hay	4200	13.63	572.46	1.13	47.46		33.66	1413.72	34.28	1439.76		
	Grain	9520	11.25	1071.00	2.41	229.43		2.39	227.53	68.43	6514.54		
	SBOM	3150	42.56	1340.64	2.04	64.26		5.94	187.11	30.78	969.57		
	Total	45430		4163.63		632.46			5721.09		17197.70		
	Feces	6424.90	16.88	1084.52	2.51	161.26		28.87	1854.87	40.78	2620.07		
	Amt. Digest.			3079.11		471.20	1060.20		3866.22		14577.63	22583.16	
	Dig. Coeff.			73.95		74.50			67.58		84.76		49.71

Table 9. Digestibility study with steers using finely ground sorghum grain fed with basal ration.

Steer and Trial No.	Ingredient	Grams	% Prot.	Grams crude protein	% E. E.	Grams E. E.	X2.25	% Crude Fiber	Grams C. F.	% N.F.E.	Grams N.F.E.	Total Nutrients Digested	% T.D.N.
50													
7C	S. Silage	28560	2.42	691.15	.67	191.35		7.47	2133.43	16.05	4583.88		
	Alf. hay	4200	16.19	679.98	1.52	63.84		27.91	1172.22	38.02	1596.84		
	Grain	9534	10.13	965.79	2.63	250.74		1.81	172.57	70.27	6699.54		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	45472		3689.48		570.76			3666.99		13858.45		
	Feces	7661.60	17.43	1335.42	2.97	227.55		23.96	1835.72	45.00	3447.72		
	Amt. Digest.			2354.06		343.21	772.22		1831.27		10410.73	15368.28	
	Dig. Coeff.			63.80		60.13			49.94		75.12		33.80
60													
3B	S. Silage	27480	4.13	1134.92	1.02	280.29		13.63	3745.52	28.97	7960.96		
	Alf. hay	4000	13.63	545.20	1.13	45.20		*33.66	1346.40	*34.28	1371.20		
	Grain	9160	10.13	927.91	2.63	240.91		1.81	165.80	70.27	6436.73		
	SBOM	3100	42.56	1319.36	2.04	63.24		5.94	184.14	30.78	954.18		
	Total	43740		3927.39		629.64			5441.86		16723.07		
	Feces	7463.16	16.64	1241.87	2.77	206.73		25.14	1876.24	45.49	3394.99		
	Amt. Digest.			2685.52		422.91	951.55		3565.62		13328.08	20530.77	
	Dig. Coeff.			68.38		67.17			65.52		79.70		46.94
61													
7B-	S. Silage	28560	4.13	1179.53	1.02	291.31		13.63	3892.73	28.97	8273.83		
	Alf. hay	4200	16.44	690.40*	1.31	55.02		27.84	1169.28	36.67	1540.14		
	Grain	9520	10.13	964.38	2.63	250.38		1.81	172.31	70.27	6689.70		
	SBOM	3150	42.56	1340.64	2.04	64.26		5.94	187.11	30.78	969.57		
	Total	45430		4174.95		610.97			5427.43		17473.24		
	Feces	7434.97	17.92	1332.35	3.17	235.69		24.03	1786.62	44.79	3330.12		
	Amt. Digest.			2842.60		425.28	956.88		3634.81		14143.12	21577.41	
	Dig. Coeff.			68.09		63.34			67.05		80.94		47.50

Table 9 (cont.)

Steer and Trial No.	Ingredient	Grams	% Prot.	Grams crude protein	% E. E.	Grams E. E.	X2.25	% Crude Fiber	Grams C. F.	% N.F.E.	Grams N.F.E.	Total Nutrients Digested	T.D.N.
62													
3A	S. Silage	28602	4.13	1181.26	1.02	291.74		13.63	3898.45	28.97	8286		
	Alf. hay												
	Grain	9534	10.13	965.79	2.63	250.74		1.81	172.57	70.27	6699.54		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	41314		3499.61		607.31			4259.79		15963.73		
	Feces	5947.68	18.88	1122.92	3.14	186.76		16.42	976.61	49.35	2935.18		
	Amt. Digest.			2376.69		420.55	946.24		3283.18		13028.55	19634.66	
	Dig. Coeff.			47.25		69.25			77.07		81.61		47.53
63													
7D	S. Silage	28560	2.42	691.15	.67	191.32		7.47	2133.42	16.05	4583.88		
	Alf. hay	4200	16.19	679.98	1.52	63.84		27.91	1172.22	38.02	1596.84		
	Grain	9520	10.13	964.38	2.63	250.38		1.81	172.31	70.27	6689.70		
	SBOM	3150	42.56	1340.64	2.04	64.26		5.94	187.11	30.78	969.57		
	Total	45430		3676.15		569.80			3665.06		13839.99		
	Feces	7519.16	18.64	1401.57	3.14	236.10		23.50	1767.00	42.73	3212.94		
	Amt. Digest.			2274.58		333.70	750.83		1898.06		10627.05	15550.52	
	Dig. Coeff.			61.87		58.56			51.79		76.79		34.23
65													
7A	S. Silage	28602	4.13	1181.26	1.02	291.74		13.63	3898.45	28.97	8286		
	Alf. hay												
	Grain	9534	10.13	965.79	2.63	250.74		1.81	172.57	70.27	6699.54		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	41314		3499.61		607.31			4259.79		15963.73		
	Feces	4746.64	18.84	877.18	2.73	129.58		16.79	796.96	50.62	2402.75		
	Amt. Digest.			2622.43		477.73	1074.89		3402.83		13560.98	19721.13	
	Dig. Coeff.			74.93		78.66			81.29		84.95		47.73

Table 9 (concl.)

Steer and Trial No.	Ingredient	Grams	% Prot.	Grams crude protein	% E. E.	Grams E. E.	X2.25	% Crude fiber	Grams C. F.	% N.F.E.	Grams N.F.E.	Total Nutrients Digested	% T.D.N.
82													
3D	S. Silage	28602	2.42	692.17	.67	191.63		7.47	2136.57	16.05	4590.62		
	Alf. hay	4200	16.19	679.98	1.52	63.84		27.91	1172.22	38.02	1596.84		
	Grain	9534	10.13	965.79	2.63	250.74		1.81	172.57	70.27	6699.54		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	45514		3690.50		571.04			3570.13		13865.19		
	Feces	7222.28	17.72	1279.80	3.61	260.72		23.62	1705.90	43.15	3116.41		
	Amt. Digest.			2410.70		310.32	698.22		1964.23		10748.78	15821.93	
	Dig. Coeff.			65.32		54.34			53.52		77.52		34.76
90													
3C	S. Silage	28560	4.13	1179.53	1.02	291.31		13.63	3892.73	28.97	8273.83		
	Alf. hay	4200	16.44	690.40	1.31	55.02		27.84	1169.28	36.67	1540.14		
	Grain	9534	10.13	965.79	2.63	250.74		1.81	172.57	70.27	6699.54		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	45472		4188.28		661.90			5423.35		17491.70		
	Feces	5536.48	17.11	947.29	2.52	139.52		26.72	1479.35	40.22	2226.77		
	Amt. Digest.			3240.99		522.38	1175.36		3944.00		15264.93	23625.28	
	Dig. Coeff.			77.38		78.92			72.72		87.27		51.96

Table 10. Digestibility study with steers using cracked corn fed with basal ration

Steer and Trial No.	Ingredient	Grams	% Prot.	Grams crude protein	% E. E.	Grams E. E.	X2.25	% Crude Fiber	Grams C. F.	% N.F.E.	Grams N.F.E.	Total Nutrients Digested	% T.D.N.
50													
8D	S. Silage	28560	2.42	691.15	.67	191.32		7.47	2133.42	16.05	4583.88		
	Alf. hay	4200	16.19	679.98	1.52	63.84		27.91	1172.22	38.02	1596.84		
	Grain	9520	10.13	964.38	3.48	331.30		1.78	169.46	69.31	6598.31		
	SBOM	3150	42.56	1340.64	2.04	64.26		5.94	187.11	30.78	969.57		
	Total	45430		3676.15		650.72			3662.21		13748.60		
	Feces	7734.48	16.03	1239.84	2.75	212.70		22.85	1767.33	47.12	3644.49		
	Amt. Digest.			2436.31		438.02	985.55		1894.88		10104.11	15420.85	
	Dig. Coeff.			66.27		67.31			51.74		73.49		33.94
60													
4C	S. Silage	28560	4.13	1179.52	1.02	291.31		13.63	3892.73	28.97	8273.83		
	Alf. hay	4200	16.44	690.48	1.31	55.02		27.84	1169.28	36.67	1540.14		
	Grain	9534	10.13	965.94	3.48	331.78		1.78	169.71	69.31	6608.02		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	45472		4188.50		742.94			5420.49		17400.18		
	Feces	5607.73	16.95	950.51	2.22	124.49		24.11	1352.02	45.06	2526.84		
	Amt. Digest.			3237.99		618.45	1391.51		4068.47		14873.34	23571.31	
	Dig. Coeff.			77.31		83.24			75.00		85.48		51.84
61													
8C	S. Silage	28560	2.42	691.15	.67	191.35		7.47	2133.43	16.05	4583.88		
	Alf. hay	4200	16.19	679.98	1.52	63.84		27.91	1172.22	38.02	1596.84		
	Grain	9534	10.13	965.94	3.48	331.78		1.78	169.71	69.31	6608.02		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	45472		3689.63		651.80			3664.13		13766.93		
	Feces	7328.00	17.34	1270.68	3.03	222.04		24.98	1830.53	43.46	3184.75		
	Amt. Digest.			2418.95		429.76	966.96		1833.60		10582.18	15801.69	
	Dig. Coeff.			65.56		65.93			50.04		76.87		34.75

Table 10 (cont.)

Steer and Trial No.	Ingredient	Grams	% Prot.	Grams crude protein	% E. E.	Grams E. E.	X2.25	% Crude Fiber	Grams C. F.	% N.F.E.	Grams N.F.E.	Total Nutrients Digested	% T.D.N.
62													
4B	S. Silage	26520	4.13	1095.28	1.02	270.50		13.63	3614.68	28.97	7682.84		
	Alf. hay	3900	13.63	531.57	1.13	44.07		*33.66	1312.74	*34.28	1336.92		
	Grain	8840	10.13	895.49	3.48	307.63		1.78	157.35	69.31	6127.00		
	SBOM	2930	42.56	1247.01	2.04	59.77		5.94	174.04	30.78	901.85		
	Total	42190		3769.35		681.97			5258.81		16048.61		
	Feces	7080	15.76	1115.81	2.80	198.24		25.67	1817.44	43.54	3082.63		
	Amt. Digest.			2653.54		483.73	1088.39		3441.37		12965.98	20149.28	
	Dig. Coeff.			70.40		70.93			65.44		80.79		47.76
63													
8A	S. Silage	28602	4.13	1181.26	1.02	291.74		13.63	3898.45	28.97	8286		
	Alf. hay												
	Grain	9534	10.13	965.94	3.48	331.78		1.78	169.71	69.31	6608.02		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	41314		3499.76		688.35			4256.93		15872.21		
	Feces	5404.41	17.05	921.45	2.36	127.54		17.27	933.34	53.74	2904.33		
	Amt. Digest.			2578.31		560.81	1261.82		3323.59		12967.88	20131.60	
	Dig. Coeff.			73.67		81.47			78.07		81.70		48.73
65													
8B	S. silage	28560	4.13	1179.53	1.02	291.31		13.63	3892.73	28.97	8273.83		
	Alf. hay	4200	16.44	690.48	1.31	55.02		27.84	1169.28	36.67	1540.14		
	Grain	9520	10.13	964.38	3.48	331.30		1.78	169.46	69.31	6598.31		
	SBOM	3150	42.56	1340.64	2.04	64.26		5.94	187.11	30.78	969.57		
	Total	45430		4175.03		741.89			5418.58		17381.85		
	Feces	7306.24	16.14	1179.23	2.68	195.81		26.03	1901.81	43.93	3209.63		
	Amt. Digest.			2995.80		546.08	1228.68		3516.77		14172.22	21913.47	
	Dig. Coeff.			71.76		73.61			64.90		81.53		48.24

Table 10 (concl.)

Steer and Trial No.	Ingredient	Grams	% Prot.	Grams crude protein	% E. E.	Grams E. E.	X2.25	% Crude Fiber	Grams C. F.	% N.F.E.	Grams N.F.E.	Total Nutrients Digested	% T.D.N.
82													
4A	S. Silage	28602	4.13	1181.26	1.02	291.74		13.63	3898.45	28.97	8286		
	Alf. hay												
	Grain	9534	10.13	965.79	3.48	331.78		1.78	169.71	69.31	6608.02		
	SBOM	3178	42.56	1352.56	2.04	64.83		5.94	188.77	30.78	978.19		
	Total	41314		3499.61		688.35			4256.93		15872.21		
	Feces	5983.94	16.12	964.61	3.07	183.71		19.47	1165.07	48.41	2896.83		
	Amt. Digest.			2535.00		504.64	1135.44		3091.86		12975.38	19737.68	
	Dig. Coeff.			72.44		73.31			72.63		81.75		47.77
90													
4D	S. Silage	28584	2.42	691.73	.67	191.51		7.47	2135.22	16.05	4587.73		
	Alf. hay	4200	16.19	679.98	1.52	63.84		27.91	1172.22	38.02	1596.84		
	Grain	9528	10.13	965.19	3.48	331.57		1.78	169.60	69.31	6603.86		
	SBOM	3166	42.56	1347.45	2.04	64.59		5.94	188.06	30.78	974.49		
	Total	45478		3684.35		651.51			3665.10		13762.92		
	Feces	7434.84	16.03	1191.80	3.07	228.25		26.69	1984.36	42.33	3147.17		
	Amt. Digest.			2492.55		223.26	502.34		1680.74		10615.75	15291.38	
	Dig. Coeff.			67.65		34.27			45.87		77.13		33.62

Table 11. Nitrogen Balance, 1957-58.

Steer	Total grams nitrogen consumed	Grams feces	Grams protein in feces	Total grams nitrogen in feces	% N voided in feces	Total Ml urine	Grams N per Ml urine	Total gram N in urine	% N voided in urine	Total N voided in feces and urine	% N voided in feces and urine	Total grams N retained	% N retained
						Cracked Sorghum Grain							
50 5A	572.30	5332.28	1049.39	167.90	29.34	25865	.00816	211.06	36.88	378.96	66.22	193.33	33.78
60 1D	602.84	8359.96	1425.37	228.06	37.83	29095	.00985	286.59	47.54	514.65	85.37	88.19	14.63
61 5D	600.52	6272.97	1110.32	177.65	29.58	34205	.00782	267.48	44.54	485.13	75.12	155.39	25.88
62 1C	682.49	6842.07	1185.05	189.61	27.78	57950	.00503	291.49	42.71	481.10	70.49	201.39	29.51
63 5B	680.34	6818.19	1118.83	179.01	26.31	26683	.00955	254.82	37.46	433.83	63.77	246.51	36.23
65 5C	602.67	7889.98	1438.34	230.13	38.19	34579	.00555	191.91	31.84	422.04	70.03	180.63	29.97
82 1B	661.46	7732.70	1271.26	203.40	32.54	54240	.00446	241.91	36.57	445.31	67.32	216.15	32.68
90 1A	572.29	5163.74	900.56	144.09	23.05	100580	.00255	226.31	39.54	370.40	64.72	201.89	35.28
						Pelleted Sorghum Grain							
50 6B	685.06	6922.51	1149.83	183.97	26.85	29696	.00863	256.28	37.41	440.25	64.26	244.81	35.74
60 2A	577.02	7886.72	1369.13	219.06	37.96	33445	.00736	246.16	42.66	465.22	80.62	111.80	19.38
61 6A	577.02	5778.04	1137.69	182.03	29.12	29745	.00763	226.95	39.33	408.98	70.88	168.04	29.12
62 2B	607.57	7677.20	1351.95	216.31	35.60	73767	.00298	219.83	36.18	436.14	71.78	171.43	28.22
63 6C	607.40	6645.14	1251.94	200.31	32.98	31632	.00920	291.01	47.91	491.32	80.89	116.08	19.11
65 6D	605.24	7123.89	1237.42	197.99	32.71	114306	.00239	273.19	45.14	471.18	77.85	134.06	22.15
82 2C	687.22	6317.45	1192.73	190.83	30.63	77030	.00405	311.97	45.40	502.80	73.16	184.42	26.84
90 2B	666.18	6424.90	1084.52	173.52	26.05	176040	.00163	286.95	43.07	460.47	69.12	205.71	30.88
						Finely Ground Sorghum Grain							
50 7C	602.67	7661.60	1335.42	213.67	34.88	28477	.00932	265.41	44.04	479.08	79.49	123.59	20.51
60 3B	628.38	7463.16	1241.87	198.70	31.62	73110	.00396	289.52	46.07	488.22	77.70	140.16	22.30
61 7B	667.99	7434.97	1332.35	213.18	31.91	33059	.00693	229.10	34.30	442.28	66.21	225.71	33.79
62 3A	559.94	5947.68	1122.92	179.67	28.75	45383	.00409	185.62	33.15	365.29	65.24	194.65	34.76
63 7D	588.18	7519.16	1401.57	224.25	38.13	48983	.00552	261.57	44.47	485.82	82.60	102.36	17.40
65 7A	559.94	4746.64	877.18	140.34	22.45	43375	.00552	239.43	42.76	379.77	67.82	180.17	32.18
82 3D	590.48	7222.28	1279.80	204.77	34.68	66792	.00415	277.19	46.94	481.96	81.62	108.52	18.38
90 3C	670.12	5536.48	947.29	151.57	22.62	157210	.00181	284.55	42.46	436.12	65.08	234.00	34.92
						Cracked Corn							
50 8D	581.94	7734.48	1239.84	198.34	34.08	23805	.01188	282.80	48.60	481.14	82.68	100.80	17.32
60 4C	670.16	5607.73	950.51	152.08	22.69	22600	.01254	283.40	42.29	435.48	64.98	234.68	35.02
61 8C	590.34	7328.00	1270.68	203.31	34.44	20800	.01055	219.44	37.17	422.75	71.61	167.59	28.39
62 4B	603.10	7080.00	1115.81	178.53	29.60	48300	.00537	259.37	43.01	437.90	72.61	165.20	27.39
63 8A	559.96	5404.41	921.45	147.43	26.33	29785	.00839	249.90	44.63	397.33	70.96	162.63	29.04
65 8B	668.00	7306.24	1179.23	188.68	28.25	35674	.00596	212.62	31.83	401.30	60.07	266.70	39.93
82 4A	559.96	5983.94	964.31	154.34	27.56	23380	.00940	219.77	39.25	374.11	66.81	185.85	33.19
90 4D	589.50	7434.84	1191.80	190.69	32.35	188017	.00360	388.86	65.96	579.55	98.31	9.95	16.88

THE EFFECT OF GRINDING AND PELLETING GRAIN UPON UTILIZATION

by

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The purpose of this study was to evaluate the effects of grinding and pelleting grain upon utilization when used in wintering steer rations.

Forty-two good quality Hereford steers were used in the feedlot trial. The steers were randomly divided into four lots with three lots containing ten steers each and one lot containing twelve steers. The daily ration in all lots consisted of 1 pound soybean oil meal, 5 pounds of grain, 2 pounds of alfalfa hay and all the sorghum silage the animals would clean up. The grain in each lot was either rolled sorghum grain, finely ground sorghum grain, finely ground and pelleted sorghum grain or cracked corn.

There were no statistically significant differences between the four different rations fed. The steers receiving the ration containing rolled sorghum grain made slightly greater average daily gains than those receiving rations containing pelleted sorghum grain, finely ground sorghum grain, or cracked corn. The steers receiving the rations containing pelleted sorghum grain had the greatest feed efficiency per pound of feed than any of the rations studied.

Eight steers were used in the metabolism studies and the 7-day collection method was used. The design of the experiment was a series of two latin squares with a common daily ration of soybean oil meal, one pound; sorghum silage, nine pounds; and alfalfa hay, 1.32 pounds. Preparations of rolled sorghum grain, pelleted sorghum grain, finely ground sorghum grain, and cracked corn were added to the common daily ration at the rate of three pounds per day to constitute four different rations.

There were no statistical differences between the sorghum grain

treatments in digestion coefficients of all nutrients. There were also no differences between any of the treatments in the protein, nitrogen-free extract and dry matter digestion coefficients.

All sorghum grain treatments were superior to corn with respect to ether extract digestibility total digestible nutrient values and also per cent nitrogen retained.

Cracked sorghum grain was superior to corn in digestibility of crude fiber and organic matter. The differences between corn and the other sorghum grain preparations approached statistical significance.