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Questions are frequently raised concerning the comparative feeding value of ground and rolled corn grain for finishing cattle. Coarsely prepared feeds are generally considered to be less digestible or to have a slower rate of disappearance from the digestive tract while finely prepared feeds are considered less palatable and more likely to cause digestive problems. Cattle feeders are interested in a system of processing corn which will make them the most profit.

Grinding corn grain with a hammer mill produces a high percentage of fine material even when using a screen large enough to obtain a coarse grind. This has been a criticism of ground corn grain for

cattle. Grain can be prepared to various degrees of fineness by rolling as well as grinding. However, rolled corn is commonly considered to have the advantage of more uniform particle size.

In three feeding trials with beef cattle, comparisons between ground and rolled corn grain were made along with other tests on various types of rations. Results obtained with ground and rolled corn are reported in this publication. Corn was fed with 50% ground alfalfa hay in one trial and with 20% ground alfalfa hay in two other trials. Digestion trials were conducted in conjunction with two of the feeding trials.

PROCEDURES FOR EXPERIMENT

Trial 1

Feeding Trial. Steer calves weighing about 480 pounds were allotted into six lots of 21 each for this trial. They were fed in large outside unpaved lots without shelter.

The rations were equal parts by weight of corn grain and ground alfalfa hay. Three lots of steers were fed ground corn and three lots rolled corn. The steers were also used in an experiment to study control of cattle grubs, but grub control treatments were balanced between corn preparation treatments.

Rolled grain was prepared with a commercial type mill with corrugated rollers set to produce a coarse-textured material. Ground corn was prepared with a hammer mill attempting to produce about the same size larger particles as for rolled grain. This appeared to be most nearly accomplished when corn was ground without using a screen in the hammer mill. Particle sizes of ground and rolled grain are shown in table 1.

The alfalfa hay was ground with a hammer mill using a 1-inch screen. The hay was mixed with corn in a twin-spiral mixer.

The cattle were fed once daily and raised gradually to a full feed. Thereafter, feed was offered in amounts to be available at all times. The rations were not supplemented

Table 1. Percent Retention of Ground and Rolled Corn Grain on Sieves*

Sieve diameter	Trial 1		Trial 2	
	Ground (no screen)	Rolled	Ground (½ in. screen)	Rolled
in.	%	%	%	%
0.3125	0	0	0	0
0.1870	1.3	3.5	1.4	20.7
0.0930	31.1	67.5	21.4	65.4
0.0460	28.8	17.1	34.5	9.0
0.0232	18.7	6.7	21.6	3.0
0.0198	2.9	0.8	1.3	0.4
0.0098	8.4	2.5	8.8	1.0
0.0058	5.4	1.3	4.5	0.3
0.0029	3.4	0.6	6.5	0.2

*Retention on various size sieves following shaking by hand until constant values were obtained.

with additional protein or vitamin A. Trace mineral salt and a mineral mixture of one part trace mineral salt and three parts dicalcium phosphate were offered free choice. All cattle were implanted with 24 mg. of diethylstilbestrol at the beginning of the 119-day trial.

Digestion Trial. Twelve steers were used to determine digestibility of the two rations fed in trial 1. They were fed individually twice daily and fastened in stanchions for about 3 hours after each feeding. At all other times, they were allowed access to an exercise area with a concrete floor.

The steers remained on the digestion trial for 46 days which included two 5-day fecal collections using the standard total collection method. Half the steers were fed rolled corn and the others ground corn during the first period of the digestion trial. The rations were then exchanged and the second fecal collection was made. Thus, each steer was fed both rations during the digestion trial.

Chemical composition of the rations determined from samples collected periodically during each period of the digestion trial is shown in table 2. Analyses were performed using procedures as outlined by the Association of Official Agricultural Chemists (A.O.A.C.). The same grain-hay mixes and supplements were fed in the feeding and digestion trials.

Table 2. Chemical Composition of Rations (Trial 1)

Nutrient	Gr. corn—50% Gr. alfalfa hay —50%	Rolled corn —50% Gr. alfalfa hay—50%
	%	%
Dry matter, as fed	83.44	83.83
Composition of dry matter		
Crude protein	13.80	13.68
Ether extract	2.67	1.71
Crude fiber	16.83	15.53
Nitrogen-free extract	61.32	64.12
Ash	5.38	4.96

Trial 2

After trial 1, the steers were reallotted for an experiment to compare various types of high concentrate rations for finishing cattle. Rations composed of ground and rolled corn grain were compared when fed with 20% ground alfalfa hay. Each ration was fed to three lots of 8 and one lot of 7 steers. Two of the lots fed each ration received 2 grams of dynafac daily added to the protein-mineral supplement.

The feeds were prepared and mixed as for trial 1 except for the difference in the grain-hay ratio and use of a ½-inch screen in grinding corn. Particle sizes of ground and rolled corn are shown in table 1. The ½-inch screen resulted in very little change in texture of ground corn in comparison to that ground without a screen in trial 1.

A pelleted protein-mineral supplement was fed at 1 pound per head daily with each ration. The supplement contained approximately 20% protein and was composed of the following ingredients (in percents): soybean meal, 33.89; ground corn grain, 35.20; trace mineral salt, 15.00; molasses, 5.00; limestone,

4.30; dicalcium phosphate, 5.50; vitamin A premix, 0.11 and diethylstilbestrol premix, 1.00. The vitamin A and diethylstilbestrol premixes were included at rates to furnish 10,000 I.U. and 10 milligrams, respectively, per pound of supplement. When dynafac was included in the supplement it replaced an equal weight of soybean meal.

Samples of grain-hay mixes were taken periodically during the experiment and analyzed for moisture, protein and crude fiber. The average content for protein was 10.6% and for fiber 7.3% on a 12% moisture basis with only small differences between mixtures with ground and rolled corn. The average ration consumed (grain-hay mix and supplement) contained about 11% protein on a 12% moisture basis.

Since the cattle were full-fed rations composed of equal parts of corn grain and alfalfa hay prior to this trial, they were started at 12 pounds per head daily of the grain-hay mixes. This level of feeding did not increase the amount of grain they were eating at the time they were put on this trial. The amount of feed was increased gradually to a full feed over a period of about 2 weeks. Thereafter, they were fed once daily in amounts to be available at all times. They were fed in outside lots without shelter and paving except for an 8-foot strip of concrete at the feed bunk. All mineral supplements were included in the protein-mineral supplement.

The cattle were marketed on separate days after 153 and 155 days on trial. An equal number of lots from each treatment were marketed on each day. A final shrunk weight was taken after about 18 hours off feed and water. Individual weights were obtained at market after trucking about 75 miles. Carcass data were obtained following slaughter.

Trial 3

Feeding Trial. Yearling steers weighing about 700 pounds and of much lower condition than those fed in trial 2 were used in this trial. The trial was conducted in a manner similar to trial 2 using the same types of rations. The feeds were prepared in the same manner and the supplements were of the same ingredient composition.

The treatments were replicated with 10 steers per lot initially. Dynafac was fed at 2 grams per head daily to two lots fed rations with each type of corn preparation. The cattle were fed in outside concrete-paved lots but without shelter.

Since the cattle were not being fed grain prior to this trial, they were started at 4 pounds of grain-hay mix and 1 pound of supplement per head daily. The grain-hay mix was increased by 1 pound per head daily until the cattle were on full feed. Feeding was once daily. Additional hay was fed at 6 pounds per head daily for the first week of the trial, 3 pounds the second week and no hay thereafter except that in the grain-hay mix.

The trial was terminated after 204 days. The final shrunk weight represents the market weight after trucking about 60 miles. Carcass data were obtained following slaughter.

Digestion Trial. Four steers weighing about 550 pounds initially

Table 3. Chemical Composition of Rations (Trial 3)

Nutrient	Gr. corn—80% Gr. alfalfa hay—20%		Rolled corn—80% Gr. alfalfa hay—20%	
	Grain-hay mix	Protein suppl.*	Grain-hay mix	Protein suppl.*
	%	%	%	%
Dry matter, as fed	87.99	88.90	87.60	88.90
Composition of dry matter				
Crude protein	12.20	21.92	12.03	21.57
Ether extract	3.91	1.39	4.05	1.49
Crude fiber	7.95	3.69	7.22	3.65
Nitrogen-free extract	72.75	44.32	73.34	44.40
Ash	3.19	28.17	3.35	28.88

*Fed at 1 pound daily in feeding and digestion trials.

were used in a digestion trial to determine digestibility of the high concentrate rations with ground and rolled corn grain. Two steers were fed each type of ration during four periods of the digestion trial. One of the steers in each group was fed 2 grams of dynafac per head daily.

Each period of the digestion trial consisted of a 3-week preliminary period and a 5-day collection period. The steers were fed 1 pound daily of the protein-mineral supplements and the grain-hay mixes in amounts that would be consumed. Other procedures were essentially the same as described for the digestion trial conducted in conjunction with trial 1.

Feed samples were taken periodically during the digestion trial. Average chemical composition of the samples is given in table 3. The same grain-hay mixes and supplements were fed in the feeding and digestion trials.

RESULTS OF EXPERIMENT

Trial 1

Weight gain and feed data for trial 1 are in table 4. Steers fed ground corn at 50% of the ration with ground alfalfa hay gained 0.10 of a pound more (not statistically significant) daily than those fed rolled corn. Feed consumption was about the same for each type of ration resulting in a slightly lower feed requirement (3.4%) for ground corn.

Feed consumption and rate of gain were rather high for the size of cattle and for a 50% roughage ration. Since the trial was terminated after

Table 4. Performance of Cattle Fed Ground or Rolled Corn Grain Rations with 50% Ground Alfalfa Hay (Trial 1 — 119 days)

	Gr. corn—50% Alfalfa hay—50%	Rolled corn —50% Alfalfa hay—50%
Number of steers	61*	63
Initial shrunk wt., lb.	477	480
Final shrunk wt., lb.	801	792
Av. daily gain, lb.	2.72	2.62
Av. daily ration, lb.	20.2	20.1
Feed per 100 lb. gain, lb.	743	769

*One steer lost from pneumonia and one from bloat.

119 days when the steers averaged about 800 pounds in weight, it is not known how they might have gained during late stages of finishing on these rations.

One steer fed the ground corn ration died, apparently from bloat. Otherwise, bloat was not a problem with either ration during the experiment. In view of this low incidence, the loss cannot be attributed to the method of corn preparation.

Digestibility data for the rations are in table 5. Feed consumption was good during the digestion trial and about the same for each ration.

Digestibility of various nutrients was about the same for each ration except for ether extract. However, wide variation in digestibility of

Table 5. Digestibility of Ground and Rolled Corn Grain Rations (Trial 1)

	Gr. corn—50% Alfalfa hay—50%	Rolled corn —50% Alfalfa hay—50%
Number of steers	12	12
Av. initial wt., lb.	631	639
Av. daily ration, lb.	18.2	18.4
Apparent digestion coefficients, %		
Dry matter	62.8	63.0
Protein	57.1	57.6
Ether extract	70.6	49.3
Fiber	35.8	34.6
Nitrogen-free extract	72.8	74.0

Table 6. Performance of Cattle Fed Ground or Rolled Corn Grain with 20% Ground Alfalfa Hay, with and without Dynafac (Trial 2 — Rep 1 = 153 days; Rep 2 = 155 days).

	Gr. corn§	Rolled corn§	No dynafac‖	Dynafac‖
Number of steers	30*	31	30	31
Init. shrunk wt., lb.	793	798	797	794
Final shrunk wt., lb.	1122	1139	1128	1134
Av. daily gain, lb.	2.13	2.22	2.14	2.21
Av. daily ration, lb.				
Corn-hay mix	18.9	19.8	19.1	19.6
Supplement	1.0	1.0	1.0	1.0
Total	**19.9**	**20.8**	**20.1**	**20.6**
Feed per 100 lb. gain, lb.				
Corn-hay mix	886	893	892	888
Supplement	47	45	47	45
Total	**933**	**938**	**939**	**933**
Carcass data				
Dressing percent	62.5	62.5	62.7	62.3
Marbling score†	4.9	5.2	4.8	5.2
Carcass grade‡	18.4	18.5	18.3	18.6
Condemned livers	9	3	7	5

*One steer died from pneumonia.
†Marbling scores: Slight, 4; Small, 5; Modest, 6.
‡Carcass grade scores: Good +, 18; Choice —, 19.
§Two lots with dynafac and two without.
‖Two lots with ground corn and two lots with rolled corn.

ether extract fraction in low fat rations such as these (about 1.5%) is not unusual and does not have much practical significance.

Trial 2

The steers from trial 1 gained at a lower rate when changed to rations with only 20% ground alfalfa hay (trial 2, table 6). They averaged nearly 800 pounds initially and were rather fleshy. Average feed consumption was also lower for the more concentrated rations.

Average daily gain was 0.09 of a pound more (not statistically significant) for the steers fed rolled corn. These steers also consumed 0.9 of a pound more feed daily than those fed ground corn. Feed efficiency was nearly the same for steers fed ground and rolled corn. Also, no difference appeared in dressing percent and carcass grade between the two rations. There were six more condemned livers in the group fed ground corn.

The steers fed dynafac had slightly greater gains and feed consumption in comparison to the group without dynafac. Feed efficiency, dressing per cent and carcass grade were about the same with and without dynafac. The difference in

Table 7. Performance of Cattle Fed Ground or Rolled Corn Grain with 20% Ground Alfalfa Hay, with and without Dynafac (Trial 3 — 204 days)

	Gr. corn‖	Rolled corn‖	No dynafac**	Dynafac**
Number of steers	36*	40	38	38
Init. shrunk wt., lb.	690	700	695	695
Final shrunk wt., lb.	1189	1217	1206	1200
Av. daily gain, lb.	2.44	2.53	2.50	2.48
Av. daily ration, lb.				
Corn-hay mix	22.6	23.1	22.9	22.7
Supplement	1.0	1.0	1.0	1.0
Hay†	0.3	0.3	0.3	0.3
Total	**23.9**	**24.4**	**24.2**	**24.0**
Feed per 100 lb. gain, lb.				
Corn-hay mix	924	910	916	918
Supplement	40	39	40	40
Hay†	12	12	12	12
Total	**976**	**961**	**968**	**970**
Carcass data				
Dressing percent	62.5	63.4	62.8	63.0
Marbling score‡	6.0	6.0	6.0	6.0
Carcass grade§	19.6	19.6	19.7	19.6
Condemned livers	3	7	6	4

*Two steers died apparently from overeating, one from urinary calculi and one removed.
†Hay fed to get the cattle on full feed of the high-concentrate rations.
‡Marbling scores: Small amounts, 5; Modest, 6; Moderate, 7.
§Carcass grade scores: Good +, 18; Choice —, 19; Choice, 20.
‖Two lots with dynafac and two without.
**Two lots with ground corn and two with rolled corn.

number of livers condemned for abscesses is not considered to be great enough to indicate a difference due to treatment.

Trial 3

The results of this trial with initially lighter steers fed for a longer time are given in table 7.

The steers fed rolled corn gained 0.09 of a pound more daily than those fed ground corn, the same amount of difference as was obtained in trial 2. Feed consumption was also slightly higher but with very little difference in feed efficiency. Dressing percent favored the rolled corn group but carcass grades were the same. The number of condemned livers was greater for the rolled corn group, the reverse of results from trial 2. Two death losses were diagnosed as resulting from overeating and both occurred in lots fed ground corn.

In this trial, there were essentially no differences in feedlot performance and carcass characteristics between steers fed rations with and without dynafac.

Digestibility data for the rations fed in this trial are in table 8. The steers weighed about 550 pounds initially and gained about 200 pounds during the 4 months of the digestion trial. Feed consumption was low for the average weight of the steers used and considerably less than for steers in digestion trial 1 with 50% hay rations.

Digestion coefficients obtained with the high concentrate rations were low but with only small differences between rations with ground or rolled corn.

Digestibility of the nutrients in rations with dynafac was slightly higher than for rations without dynafac, but the difference was not statistically significant. Similar results were obtained for ground and rolled corn, with and without dynafac.

DISCUSSION AND SUMMARY

In three trials, corn grain was rolled or ground so the larger grain particles would be about the same size. Grinding resulted in a higher percentage of fine particles.

Results of the three trials showed only a small difference in feedlot performance of steers fed ground or rolled corn grain. Rate of gain was

Table 8. Digestibility of Ground and Rolled Corn Rations with and without Dynafac (Trial 3)

	Gr. corn†	Rolled corn†	No dynafac‡	Dynafac‡
Number of steers	8	8	8	8
Av. daily ration, lb.	11.8	11.2	11.6	11.5
Apparent digestibility, %				
Dry matter	60.5	61.7	59.2	63.0
Protein	55.6	53.6	53.0	56.2
Ether extract	74.6	68.4	69.5	73.6
Carbohydrates*	62.0	64.9	61.8	65.1

*Crude fiber plus nitrogen-free extract.
†Four steers with dynafac and four without.
‡Four steers with ground corn and four with rolled corn.

0.10 of a pound more for steers fed ground corn when the ration contained 50% ground alfalfa hay. In this instance, feed consumption did not appear to be affected by the greater percentage of fine particles from corn ground with a hammer mill. The slightly greater gain with about the same feed consumption resulted in 3.4% less feed required per 100 pounds of gain.

Rate of gain was 0.09 of a pound more daily for rolled corn in each of two trials where the rations contained only 20% ground alfalfa hay. Feed consumption was slightly higher with rolled corn rations, but feed efficiency was about the same for steers fed rolled and ground corn.

Type of corn preparation did not appear to affect dressing percent or carcass grade. The number of livers condemned for abscesses was about the same for each method of corn preparation over the two trials with the high concentrate rations. Three death losses were attributed to digestive disturbances and all were from lots fed ground corn.

In digestion trials, no difference appeared in digestibility of rations with ground or rolled corn when fed with either 50% or 20% alfalfa hay. Feed consumption was low in the trial with 20% hay in the ration and digestibility did not appear to be improved over that obtained in the first digestion trial using rations with 50% hay. Low apparent digestion coefficients with such high concentrate rations have been reported by other researchers.

Direct comparisons were not made between 50% and 80% grain rations in either the feeding or digestion trials. However, other feeding trials have shown that higher levels of grain result in improved weight gains and feed efficiency. Apparently, the energy available from high concentrate rations is greater than indicated from the digestion trial in this experiment.

Results of this experiment indicate that the larger amount of fine grain particles resulting from grinding corn with a hammer mill will probably not affect feed consumption when fed in rations which contain a high percentage of roughage. Under such conditions, weight gains and feed efficiency may be improved to a small extent by feeding finely prepared grain.

With high concentrate rations, the larger percentage of fine particles resulting from grinding with a hammer mill is likely to reduce feed consumption. Weight gains may be reduced slightly but with only a small effect on feed efficiency. Digestive problems and losses may be greater when feeding finely prepared grain in a high concentrate ration. Other factors such as initial, operation and maintenance costs of equipment and uses in preparing other feeds should be considered as well as differences which may be obtained in feeding value of ground or rolled grain.

Dynafac appeared to offer no consistent benefit in the two trials with high concentrate rations. The higher digestibility obtained for rations with dynafac has not been a consistent finding in other experiments.