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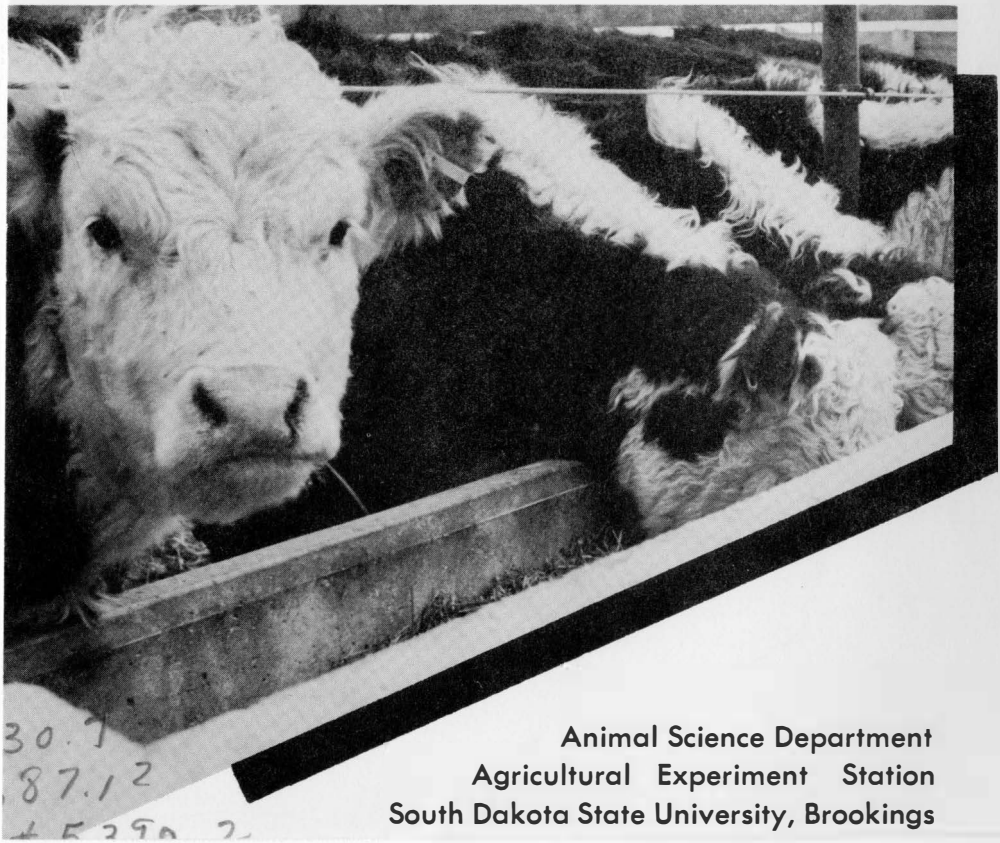
VALUE OF HAY AND MOLASSES

VALUE OF LEVELS OF HAY

VALUE OF PROTEIN SUPPLEMENT

VALUE OF ANTIBIOTICS

COMPARISON WITH CORN



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BARLEY RATIONS for Finishing Beef Cattle

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Barley is a good feed for beef cattle and it may be satisfactorily substituted for corn grain in various types of rations. Gains have been reported to be reduced in some instances but not in others. Feeding value for beef cattle is commonly quoted from 88 to 100% that of corn grain. Barley may vary widely in protein content and weight per measured bushel. These variations will influence its feeding value and should be considered when feeding rations which contain barley.

Other research at the South Dakota Agricultural Experiment Station (Technical Bulletin 13, 1953) showed that barley of different varieties grown at various locations in the state varied from 10.9 to 19.4% in total crude protein content. Average total crude protein content given in tables of feed composition is 12.7%. This value is somewhat higher than the average protein content of corn grain (about 8.7%). Therefore, less protein supplement is needed when barley is fed.

Barley is also higher in fiber content than corn grain. The fiber content will vary with test weight, but on the average the hulls form about 15% of the weight. Substituting barley for corn grain on an equal weight basis will lower total digestible nutrients in the ration and affect performance of animals. On the other hand, the higher fiber content may be used to an advantage under some conditions by reducing or eliminating the need for roughage ingredients in the ration.

Barley lacks carotene and special attention should be given to supplementing rations with vitamin A or carotene. Like corn grain, it is low in calcium but it contains more phosphorus than corn. The supplementary mineral needed will be mainly calcium. However, barley is also low in several trace minerals, but requirements for these appear to be adequately met through feeding trace mineral salt.

The acreage of cropland devoted to barley production in South Dakota during recent years has been less than 10% that for corn, with an average yield in bushels per acre generally somewhat less than for corn grain *(South Dakota Agriculture, 1965)*. While barley is a relatively minor crop in comparison with corn in the state, it is well suited

to some areas lacking sufficient rainfall and length of growing season for a dependable corn crop.

A considerable quantity of barley is available for feeding in the state, and there has been increased interest in feeding it during recent years. Several questions have been raised concerning methods of feeding, particularly feeding without additional roughage and types of supplements needed.

A series of experiments was conducted to provide answers to these questions. Various studies made in the experiments were as follows:

1. Value of additions of hay and molasses
2. Value of various levels of hay
3. Need for a protein supplement
4. Value of antibiotics
5. Value in comparison to corn-alfalfa rations, with and without dynafac.

No comparisons were made between methods of preparing barley. In these experiments it was fed as dry rolled barley.

Costs and returns are not presented in tables. The rates of gain and feed requirements per 100 pounds of gain can be used to calculate cost of gains based upon local and current costs. The carcass data can be used in estimating likely selling price under existing marketing conditions. These calculations will be useful in selecting the most appropriate feeding program under a given set of conditions.

In some trials, the objective was to determine the effects of various additions to rolled barley on the value of rations and performance of cattle. Therefore, the replacement value of these additions in terms of barley was of primary consideration. In other trials, the objective was to compare rations composed of rolled barley with other types of rations. The main considerations in these trials were the comparative performance of cattle fed various rations and the value of barley in relation to other feeds.

Value of Hay and Molasses in Barley Rations

An experiment was conducted at the North Central Substation, Eureka, to determine the value of including hay and molasses in rations composed of dry rolled barley. Two feeding trials were conducted with finishing steers.

PROCEDURES FOR THE EXPERIMENT

TRIAL 1

Forty steers previously wintered on rations composed of prairie hay and protein supplement for gains of about 1 pound daily were used in

this feeding trial. The steers were allotted to four groups of 10 steers each on the basis of shrunk weight (about 18 hours off feed and water) and wintering treatment. They were implanted with 36 milligrams of diethylstilbestrol at the beginning of the trial. The trial was started on May 25 when the cattle averaged about 520 pounds.

Four rations with dry rolled barley were used as follows:

1. Barley
2. Barley with 5% beet molasses
3. Barley with 15% hay
4. Barley with 5% beet molasses and 15% hay

The hay was ground with a hammer mill using a 1-inch screen. Alfalfa hay was fed initially but trouble from bloat was encountered. A mixed prairie hay of about average quality was substituted for alfalfa hay, also at 15% of the ration.

Barley was obtained as needed from a local feed mill. It was rolled at the feed mill and mixed with the ground hay and beet molasses. Test weight of the barley averaged about 47 pounds, with a protein content of 13.2% on a 10% moisture basis.

The rations were fed as single mixtures with 1 pound per head daily of a pelleted protein-mineral supplement. Ingredient composition of the supplement in percent was: soybean meal, 38.7; ground barley, 39.0; beet molasses, 5.0; ground limestone, 10.0; trace mineral salt, 6.0; and vitamin A premix, 1.3. The supplement contained approximately 22% protein and 30,000 I.U. of vitamin A per pound. Trace mineral salt and a mineral mixture composed of equal parts of ground limestone, dicalcium phosphate, and trace mineral salt were offered free choice.

The cattle were started on 4 pounds of the ration mixtures, 1 pound of the protein supplement and 4 pounds of prairie hay per head daily. The feeding plan was to increase the ration mixtures by 1 pound per head daily until the cattle were consuming about 10 to 12 pounds daily. Thereafter, daily increases were to be reduced to 0.5 pound until the cattle were on full feed. The hay was to be fed at 4 pounds daily during the first week, 2 pounds the second week, and then no hay except that in the appropriate mixtures.

The cattle reached an average feed consumption of about 10 pounds and went off feed. The amount of the ration mixtures was reduced and hay was added at 8 pounds per head daily using a mixture of about equal parts alfalfa and prairie hay. Hay was gradually reduced and barley increased during the next 3 weeks until no additional hay was being fed and consumption of the ration mixtures amounted to about 10 pounds per head daily.

This change in getting the cattle on full feed appeared to be satisfactory. However, after about 7 weeks when feed consumption amounted to approximately 17 pounds daily, bloat was encountered in both lots fed the mixes with 15% alfalfa hay. About one-half of the steers in each lot were affected one or more times over a period of a few days and two died.

The cattle were changed to the ration mixtures without hay for 1 week and bloating ceased. Then, prairie hay was substituted for alfalfa hay. Bloat was encountered

with only one steer with barley and prairie hay — near the end of the trial. This steer, fed barley with hay and molasses, became a chronic bloater and was removed from the experiment. No bloat occurred when barley was fed without hay.

The rations were fed once daily throughout the trial. After getting the cattle on full feed, they were fed in amounts so feed would be available all the time. The cattle had access to a shed with outside exercise lots. Feed was offered inside the shed.

After 209 days the trial was terminated and the cattle were trucked about 175 miles to market. Final shrunk weights were obtained by weighing individually at market. The carcasses were graded by a U. S. government meat grader.

TRIAL 2

This feeding trial was conducted at the same location and in a manner similar to trial 1. Yearling steers were used and bromegrass was the source of hay. Twenty of the steers had grazed native prairie pasture the previous grazing season. They received a protein supplement while on pasture from about the middle of October until early November. Thereafter, they were fed a light feed of grain, protein supplement, and roughage consisting of sorghum fodder and mixed hay until started on the experiment January 4.

Another 20 steers of similar weight and condition were purchased in early December and fed with the other group until the beginning of the trial. The cattle were allotted to the experiment on the basis of weight and origin. They were implanted with 36 milligrams of diethylstilbestrol at the beginning of the trial. Except for the kind of hay, ration treatments were the same as for trial 1, and the barley was of about the same quality and test weight.

The cattle were started at 5 pounds per head daily of the ration mixtures. In view of the trouble encountered from the cattle going off feed early in the first trial, feed increases were made at a more cautious rate of 0.5 pound per head daily. Additional bromegrass hay was fed at 10 pounds per head daily initially, and it was gradually reduced so no hay was being fed by the end of the fourth week except that in the appropriate ration mixtures. Even with these more cautious changes in the rations, some trouble from going off feed when the cattle reached intakes of around 10 to 12 pounds per head was encountered as in the first trial. The cattle fed barley without hay or molasses presented the most trouble, and their gains were somewhat lower than for the other lots during the first 2 months of the trial.

This feeding trial was terminated after 161 days using similar procedures as for the first one.

RESULTS OF THE EXPERIMENT

The results of the two feeding trials are reported separately even though the objectives were the same and they were conducted in a similar manner. The two trials differed in the initial weight, condition, and previous nutritional history of the cattle. The length of the trials and time of year conducted were also different. These are factors which might influence results obtained from the two feeding trials.

TRIAL 1

Results of the first trial with the lighter cattle are presented in table 1. The cattle fed rolled barley and protein supplement made an average daily gain of 2.46 pounds and required 741 pounds of beef per 100 pounds of gain (lot 1). When 5% of beet molasses was included in the ration (lot 2), rate of gain was 2.51 pounds. Feed consumption was also slightly higher, so total feed required per 100 pounds of gain was about the same. On the basis of feed required per 100 pounds of gain, molasses had about the same value per pound as rolled barley.

Cattle fed barley with 5% beet molasses presented less problems when raising to a full feed during the first few weeks of the experiment. They gained at a faster rate during this initial phase. Thus, molasses appeared to have a greater advantage during the early part of the experiment than for the entire trial. Cattle fed molasses also had a slightly higher dressing percent and carcass grade. However, differences of the magnitude obtained are prob-

Table 1. Value of Hay and Molasses with Dry Rolled Barley Experiment 1 — 209 Days (May-December)

	Barley	Barley with 5% molasses	Barley with 15% hay	Barley with 5% molasses and 15% hay
Lot	1	2	3	4
Number steers	10	10	8*	9†
Init. shrunk wt., lb.	518	517	511	520
Final shrunk wt., lb.	1032	1041	1062	1090
Av. daily gain, lb.	2.46	2.51	2.64	2.75
Av. daily ration, lb.				
Barley	16.6	16.1	16.5	17.0
Molasses	—	.8	—	1.1
Hay‡	.6	.6	3.5	3.8
Protein suppl.	1.0	1.0	1.0	1.0
Total	18.2	18.5	21.0	22.9
Feed per 100 lb. gain, lb.				
Barley	674	639	624	619
Molasses	—	34	—	39
Hay	26	25	134	139
Protein suppl.	41	40	38	36
Total	741	738	796	833
Dressing percent	59.0	60.1	60.7	60.0
Carcass grade§	17.5	18.1	18.0	18.8
Marbling score‖	4.3	4.5	4.5	5.3

*Two steers died from bloat and are not considered in the results.
†One chronic bloater removed and not considered in the results.
‡Includes hay fed at beginning of the experiment when getting the cattle on full feed and amounted to an average of 0.6 lb. per head daily.
§Carcass grade scores: Good, 17; Good +, 18; Choice —, 19.
‖Marbling scores: slight amount, 4; small amount, 5; modest, 6.

ably not important with the number of cattle involved. Therefore, other than for the apparent advantage when getting the cattle to a full feed, molasses at 5% of the ration would not appear to be an economical addition to rolled barley unless molasses costs no more per pound than barley.

Cattle fed rolled barley with 15% hay gained an average of 0.18 pound more daily than those fed barley without hay (lot 3 vs. lot 1). They also consumed more feed, but barley consumption was about the same as for the cattle fed barley without hay, and total feed required per 100 pounds gain was greater.

On the basis of feed required per 100 pounds of gain, 108 pounds of hay saved 50 pounds of barley in comparison to feeding barley without hay. This replacement value would give hay 46% the value of rolled barley in this experiment, disregarding the small difference in amount of protein supplement. This means that 15% hay could be economically included with barley on the basis of feed requirements if the cost per pound of hay was less than 46% that of rolled barley per pound. The cattle fed hay had only a slightly higher dressing percent and carcass grade. The faster rate of gain may, however, offer some additional advantage for including the hay.

The highest rate of gain and feed consumption were obtained when feeding rolled barley with 5% beet molasses and 15% hay. However, feed consumption was increased to a greater extent than was rate of gain—more feed was required per 100 pounds of gain than when feeding the hay without molasses. When molasses was fed with hay, the 39 pounds of molasses required per 100 pounds of gain had essentially no effect on barley, hay, and protein supplement requirements.

The hay also had a much lower value with molasses in comparison to hay without molasses. When fed with molasses, 114 pounds of hay saved only 20 pounds of barley per 100 pounds of gain (lot 4 vs. lot 2), a value of only about 18% that of barley per pound in comparison to 46% when fed without molasses (lot 3 vs. lot 1).

Carcass grades averaged slightly higher when molasses was fed with hay but dressing percent was slightly less. These are small differences in carcass characteristics, and it would appear that the molasses had no particular effect on the carcass characteristics.

These results would indicate that for best utilization of feed, it would not be advisable to add 5% of molasses to barley rations which also contain 15% hay. It is likely that the readily available sugars from molasses reduced digestibility of the fiber in this ration, resulting in a reduction in its over-all value.

TRIAL 2

Results of the second trial with the heavier cattle which had grazed native prairie pasture the previous grazing season are presented in table 2. Rate of gain made by the cattle fed rolled barley and protein supplement was lower than in the first trial, while gains for the other lots were higher. This resulted in a more apparent advantage for 5% beet molasses and bromegrass hay than in the previous trial.

Cattle fed rolled barley without hay or molasses presented more problems in getting on full feed and

their gains were somewhat lower than the other lots during the first 2 months of the trial. Adding 5% beet molasses reduced this problem somewhat and these steers made an average daily gain of 0.31 pound more than those fed barley without molasses (lot 2 vs. lot 1). However, these cattle consumed more feed and required only 15 pounds less total feed per 100 pounds of gain than those fed barley without molasses. Despite the faster gains made when molasses was included in the ration, the molasses had a value per pound on the basis of feed required per 100 pounds of gain only slightly more than barley.

Cattle fed molasses had a higher dressing percent and carcass grade, as was true in the first trial. However, in this trial they weighed an average of 47 pounds more at market, which is probably a factor in the better yield and grade.

Cattle fed the ration with 15% hay also consumed more feed and gained at a faster rate than those fed no hay (lot 3 vs. lot 1). While they required 45 pounds more feed per 100

Table 2. Value of Hay and Molasses with Dry Rolled Barley
Experiment 2 — 161 Days (January-June)

	Barley	Barley with 5% molasses	Barley with 15% hay	Barley with 5% molasses and 15% hay
Lot	1	2	3	4
Number steers	8*	10	10	10
Init. shrunk wt., lb.	801	800	801	802
Final shrunk wt., lb.	1174	1221	1238	1254
Av. daily gain, lb.	2.31	2.62	2.72	2.81
Av. daily ration, lb.				
Barley	18.2	19.5	19.6	19.6
Molasses	—	1.0	—	1.2
Hay†	1.1	1.1.	4.4	4.6
Protein suppl.	1.0	1.0	1.0	1.0
Total	20.3	22.6	25.0	26.4
Feed per 100 lb. gain, lb.				
Barley	786	743	722	697
Molasses	—	39	—	44
Hay	46	40	161	164
Protein suppl.	43	38	37	36
Total	875	860	920	941
Dressing percent	60.8	61.2	61.3	61.5
Carcass grade‡	18.5	19.0	18.7	19.1
Marbling score§	5.9	6.2	6.3	6.3

*Nine steers initially. One steer paralyzed in rear quarters and removed from the experiment. Results are for eight steers.

†Includes hay fed at the beginning of the experiment when getting the cattle on full feed and amounted to 1.1 lb. and 0.9 lb. per head daily for lots with and without hay.

‡Carcass grade scores: Good +, 18; Choice —, 19; Choice, 20.

§Marbling scores: Small amount, 5; modest, 6; moderate, 7.

pounds of gain, they required 64 pounds less barley. In this comparison, 100 pounds of hay had a replacement value equal to 56 pounds of barley and 5 pounds of protein supplement. This would give the bromegrass hay a value per pound slightly over 60% that of rolled barley for equal feed costs of gains in this experiment. The heavier market weight of the cattle fed hay was probably an important factor in the small advantage shown for dressing percent and carcass grade.

It might appear from these results that bromegrass hay fed in this trial had a higher value in relation to barley than did prairie hay in the first trial. The difference is more likely due largely to the trouble encountered at first, resulting in the somewhat poorer performance of the steers fed barley without hay or molasses. Since molasses appeared to have a feeding value per pound about equal to barley in both experiments, a comparison between lot 2 fed barley with 5% molasses and lot 3 fed barley with 15% hay might help in evaluating the benefits of hay. On basis of this comparison in the second trial, 100 pounds of hay had a replacement value of 14 pounds of barley and 31 pounds of molasses (45 pounds total). The total value (barley plus molasses) agrees quite closely to that of 46% obtained for hay in comparison to barley in the first trial without molasses.

Gains were highest when feeding barley with 15% hay and 5% molasses, as was true in the first trial. Consumption of barley and hay was nearly the same as when barley and hay were fed without molasses (lot 3). Also, the consumption of barley and molasses was nearly the same as for the cattle fed barley and molasses without hay (lot 2). Even though rate of gain was highest for this lot, feeding hay and molasses together resulted in increased feed requirements per 100 pounds of gain in comparison to feeding either one alone with barley as was true in the first trial with the lighter cattle. Carcass characteristics measured were only slightly different from those fed either hay or molasses with barley.

SUMMARY

Results of the two feeding trials show quite similar effects from adding 5% beet molasses or 15% hay to barley rations for finishing beef cattle. Molasses appeared to offer some benefit in getting the cattle on full feed in comparison to those fed barley without hay or molasses. Difference in rate of gain appeared to be largely due to the better performance during early stages of the trials. The cattle making faster gains when fed molasses also consumed more feed, resulting in the molasses having about the same feeding value per pound as the barley. Therefore, molasses at 5% of the ration would not appear economical when the cost of molasses is more per pound than rolled barley.

Feeding 15% prairie or bromegrass hay with rolled barley increased rate of gain and feed consumption. Feed requirements per 100 pounds of gain were also increased. In the two trials, hay appeared to have a feed replacement value of 45 to 50% that of barley on the basis of feed requir-

ed per 100 pounds of gain. The hay also appeared to reduce feeding problems often associated with feeding all-concentrate rations. Results of the experiment indicate that 15% hay in barley rations would be advisable and likely economical when hay costs no more than 50% that of rolled barley per pound.

Afalfa hay fed at 15% of the ration initially in the first trial resulted in a serious bloat problem. This problem was not encountered with prairie or bromegrass hay.

Feeding 5% molasses in rations with 15% hay increased rate of gain and feed consumption over feeding hay without molasses. However, feed consumption was increased to a greater extent than was rate of gain, resulting in more feed required per 100 pounds of gain than with hay without molasses. The molasses had a rather low value in this comparison. Apparently this level of molasses reduced the over-all value of the ration composed of barley and 15% hay.

Value of Various Levels of Hay with Rolled Barley

This experiment was also conducted at the North Central Substation, Eureka. Since the previous experiment indicated some advantages for including hay in barley rations, this one was conducted to determine the comparative value of various levels of hay with rolled barley for finishing cattle. Four feeding trials were conducted over a 2-year period.

PROCEDURES FOR THE EXPERIMENT

GENERAL PROCEDURES FOR THE FOUR TRIALS

Four lots of steers were fed in two feeding trials in each of the 2 years of this experiment. Light steers which had been wintered for gains of about 1 pound per head daily were used in two trials which were started in the spring. Heavy steers were used in two trials started in late fall. Four ration treatments used in each trial of the experiment were:

1. Rolled barley
2. Rolled barley with 10% ground prairie hay
3. Rolled barley with 20% ground prairie hay
4. Rolled barley with free-choice prairie hay

Prairie hay was fed in all trials of the experiment because of the previous trouble encountered with bloat when feeding alfalfa hay with barley. The hay was a mixed upland prairie hay of about average quality. That used in the four trials ranged in protein content from 7.2 to 7.8% on a 10% moisture basis. The hay was ground with a hammer mill using a 1-inch screen. When offered free-choice, baled hay from the same source as that ground was supplied in a manger in an outside exercise

lot. In the last trial with yearling steers, the hay offered free choice was ground.

A good grade of barley was obtained at a local elevator as needed, averaging about 47 pounds test weight. The average protein content was about 11.7% with a range from 11.2 to 12.1% for composite samples from each trial of the experiment. The barley was dry rolled at the elevator and mixed with the ground hay.

The rations were fed as a single mixture of hay and barley, or barley alone, with and without free-choice hay, and 1 pound of a protein-mineral supplement. The supplement was similar in composition to the one fed in the previous experiment and contained about 22% protein. Ingredient composition was (%): soybean meal, 39; ground barley, 39; beet molasses, 5; ground limestone, 10; trace mineral salt, 6; and vitamin A premix, 1 (30,000 I.U. per pound of the supplement).

A mineral mixture composed of equal parts dicalcium phosphate, ground limestone and trace mineral salt and additional trace mineral salt were offered free choice. All cattle were implanted with 36 milligrams of diethylstilbestrol at the beginning of the feeding trials. The fall-fed yearling cattle had also been implanted at the same level at the beginning of the previous summer grazing period.

The cattle had access to a shed with outside exercise lots. Water was provided by electrically heated automatic waterers. The barley mixture was offered in mangers inside the shed. The free-choice hay was provided in a manger in the outside lot. All feeding was once daily and fed in amounts to be available all the time once the cattle were on full feed.

TRIAL 1

Steers used in this trial were purchased in mid-April, 1962. They were full-fed prairie hay and 1 pound of a supplement with about 40% protein prior to the beginning of the trial on June 22. Average weight at this time was about 635 pounds. The steers were allotted into four lots of 10 head on the basis of weight and one lot fed each of the four rations previously listed. The initial weight was obtained after withholding feed and water overnight (about 18 hours).

The cattle were started at 4 pounds daily of the barley mixtures. The amount was increased 0.5 pound daily until the level of feeding reached 10 pounds per head daily. Thereafter, the feed increases were reduced to 0.25 pound daily until the cattle were on full feed. The lot fed hay free choice was given access to hay in a manger in the outside lot from the beginning of the trial. Cattle in the other lots were fed hay during the first 3 weeks of the trial. It was fed at a daily rate per head of 6 pounds for the first week, 4 pounds the second week, and 2 pounds the third. No hay was fed after 3 weeks except that mixed with barley or offered free choice to the appropriate lots.

This procedure in getting the cattle on full feed appeared satisfactory for those fed barley with 10 and 20% hay. However, the rate of increases in barley appeared to be too rapid for those not receiving hay mixed with the barley. Those fed hay free choice did not consume any more hay during the first week of the

trial than those fed the limited amount of hay. Some trouble from going off feed was encountered and one steer in the lot fed free-choice hay died from symptoms that resembled those resulting from overeating.

The cattle were marketed after 178 days on the trial. Final weights represent the market weight after being trucked about 180 miles. Carcass data were obtained upon slaughter.

TRIAL 2

Cattle used in this trial were purchased with those used in trial 1. They were allotted into two uniform groups for drylot feeding (trial 1) and for pasture (trial 2). Those used in trial 2 grazed native prairie pasture without supplemental feeding from June 22 to August 31. After this date they were fed rolled barley while on pasture. The barley was hand-fed to get the cattle on full feed and then self-fed from a self-feeder. During late fall, the steers had access to prairie hay as well as the pasture in addition to the self-fed barley.

There were only 38 steers in this group when the drylot feeding trial was started on December 20. They were allotted into four lots of 9 or 10 steers each. The average weight following an overnight stand without feed and water was about 965 pounds.

Since the steers were being full-fed barley at the time they were started on the experiment, 8 pounds of barley or barley and hay mixes were fed initialy and increased to a full feed over a 2-week period. Hay was fed at 2 pounds per head for 3 days to lots where hay was a part of the ration. It was fed at this level for 2 weeks where barley was to be fed without hay. Other procedures were similar to those for trial 1.

The cattle were marketed after 117 days on the trial using procedures similar to those for trial 1.

TRIAL 3

Steers used in this trial were purchased in the fall and wintered on prairie hay and protein supplement for gains of about 1 pound per head daily. They were started on the barley feeding trial April 23 when the average shrunk weight was about 550 pounds.

Procedures for this trial were about the same as for trial 1 except hay was fed at 2 pounds per head daily for 1 week longer in lots fed barley without hay. The trial was terminated after 232 days.

TRIAL 4

Steers used in this trial were from the same original group as those in trial 3. They grazed native prairie pasture without supplemental feeding from April 23 to October 27. Thereafter, until the beginning of the trial December 17, they were fed an average of about 4 pounds of barley, 5 pounds ground sorghum fodder, 1 pound soybean meal, and a full feed of alfalfa-bromgrass hay.

The steers were started at 6 pounds per head daily of the feed mixture; the amount was increased 0.5 pound daily until they were on full feed. Hay was fed at 12 pounds per head daily for the first week. It was then reduced by 3 pounds per head each week until no hay was fed after 4 weeks except for the appropriate treatments.

The trial was terminated after 149 days using similar procedures as for the other trials.

RESULTS OF THE EXPERIMENT

Feedlot performance in the experiment differed considerably between steers put on full feed following a wintering period and those put on full feed following one grazing season. However, performance was quite similar within age groups and results are presented as an average of the two trials for the two age groups.

LIGHT GROUP

Results obtained in the two feeding trials with steers put on full feed after a wintering period are presented in table 3. Steers fed the ration of rolled barley with 10% ground prairie hay gained 0.21 pound more daily than those fed barley without hay. They consumed the same amount of barley as those fed no hay.

Total feed required per 100 pounds of gain was only slightly higher when feeding rations with 10% hay than without hay. However, hay reduced the amount of barley and protein supplement required per 100 pounds of gain. On this basis, 100 pounds of hay fed at 10% of the ration saved about 88 pounds of barley and protein supplement.

In addition to the faster rate of gain and large saving in barley by feeding the 10% level of hay, cattle fed barley with hay went on full feed faster and presented less management problems, especially during the first few weeks of the trials.

Table 3. Dry Rolled Barley with Different Amounts of Prairie Hay (Light Group — Av. Trials 1 and 3)

	Level of hay (%)			
	0	10	20	Free choice
Number of steers*	19	19	19	19
Av. initial shrunk wt., lb.	593	586	591	592
Av. final shrunk wt., lb.	1093	1128	1105	1104
Av. daily gain, lb.	2.45	2.66	2.51	2.51
Av. daily ration, lb.				
Barley	18.2	18.2	16.7	17.4
Hay†	.4	2.4	4.5	4.5
Protein suppl.	1.0	1.0	1.0	1.0
Total	19.6	21.6	22.2	23.9
Feed per 100 lb. gain, lb.				
Barley	745	684	666	693
Hay†	19	92	183	179
Protein suppl.	41	38	39	39
Total	805	814	888	911
Dressing percent	61.0	61.2	60.7	60.9
Carcass grade‡	19.2	19.4	18.4	18.9
Marbling score§	5.9	5.9	5.4	5.7

*One steer died or removed from each lot during the two trials. The one fed barley with 10% hay appeared to be bloating and the one fed free choice hay appeared to be overeating. The others were from causes not related to the rations.

†Includes hay fed to get cattle on full feed.

‡Carcass grade scores: Good +, 18; Choice —, 19; Choice, 20.

§Marbling scores: small amount, 5; modest, 6; moderate, 7.

The most troublesome period appeared to be during the second week of the trials when the average barley consumption amounted to 8 to 12 pounds per head daily.

Steers fed the barley mixture with 20% hay gained at a lower rate than those fed the mixture with 10% hay. However, they gained slightly faster than those fed barley without hay. While this level of hay resulted in some increase in total feed consumption, there was a reduction in consumption of barley. The barley saved per 100 pounds of gain was somewhat less in the ration with 20% than with 10% hay. In this instance, 100 pounds of hay saved 49 pounds of barley and protein supplement in comparison to feeding barley without hay.

While the higher level of hay might be economical, depending on the price relationship between hay and barley, the 10% level resulted in a much greater value for the hay. The higher level did not appear to offer any added advantage during the early part of the trials when getting the cattle on full feed with the procedures used.

Steers fed hay free choice consumed the same average daily amount of hay and gained at the same rate as those fed barley with 20% hay . However, they consumed more barley per day with a greater requirement per 100 pounds of gain. Some hay was wasted under this system; the actual amount consumed was less then that shown in the table. On the basis of that fed, 100 pounds of hay saved only 34 pounds of barley and protein supplement per 100 pounds of gain in comparison to barley without hay.

With about the same average daily feed, hay offered free choice appeared to be utilized less efficiently than when ground and mixed with barley (20% of ration). Also, feeding hay free choice with barley did not appear to reduce management problems in getting the cattle on full feed as much as mixing it with the barley. Management problems appeared to be similar when feeding hay free choice or when offering a limited amount with unmixed barley when getting the cattle on full feed. Hay consumption was similar during the first 2 weeks under each system.

Feeding hay free choice with unmixed rolled barley would appear to be a satisfactory method of feeding under gradual and cautious increases in barley when raising the cattle to a full feed of the barley. Even with the higher feed requirements, the system would appear economical in comparison to rations with 20% hay when the cost of grinding the hay and mixing with the barley is taken into account.

There were only small differences in dressing percent and carcass grade between treatments in these two trials. The cattle which received the various treatments were fed for the same length of time. Apparently the differences in rate of gain and final weights between treatments were not enough to have much effect on carcass grade and yield.

HEAVY GROUP

Results obtained when feeding barley with the various levels of hay to the heavier cattle are presented in table 4. These cattle

Table 4. Dry Rolled Barley with Different Amounts of Prairie Hay (Heavy Group — Av. Trials 2 and 4)

	Level of hay (%)			
	0	10	20	Free choice
Number of steers	19*	20	19*	20
Av. initial shrunk wt., lb.	884	873	882	872
Av. final shrunk wt., lb.	1148	1136	1137	1128
Av. daily gain, lb.	1.96	1.95	1.92	1.90
Av. daily ration, lb.				
Barley	19.7	19.0	18.2	18.8
Hay†	.7	2.8	5.3	4.7
Protein suppl.	1.0	1.0	1.0	1.0
Total	21.4	22.8	24.5	24.5
Feed/100 lb. gain, lb.				
Barley	1015	932	950	990
Hay†	38	189	273	249
Protein suppl.	51	51	51	52
Total	1104	1172	1274	1291
Dressing percent	60.6	60.7	60.5	59.7
Carcass grade‡	18.0	18.2	18.2	18.8
Marbling score§	5.0	5.3	5.2	5.5

*Nine steers per lot initially in these two lots in one trial.
†Includes hay fed to get the cattle on full feed.
‡Carcass grade scores: Good, 17; Good +, 18; Choice —, 19.
§Marbling scores: slight amount, 4; small amount, 5; modest, 6.

were more fleshy then the lighter cattle used in the other trials. They consumed more feed daily but made lower rates of gain.

Rate of gain was about the same for the various treatments. There was a decrease in barley consumption but an increase in total amount of feed with increasing amounts of hay in the ration. While hay at 10 and 20% of the ration resulted in some saving in barley per 100 pounds gain, the saving was less with these larger cattle than for the lighter cattle fed for a longer period (trials 1 and 3). On the basis of feed per 100 pounds gain, 100 pounds of hay at 10 and 20% of the ration saved 55 and 28 pounds of barley in comparison to barley without hay.

Hay had a higher value at 10% than at 20% of the ration, as was true in the trials with the lighter cattle. However, beneficial effects of the hay appeared to be less for the heavier cattle. This was also true during the first few weeks of the trials when getting the cattle on full feed. However, the fact that these heavier cattle were being fed barley prior to the experiment may have been an important factor in less problems in getting them on full feed.

Cattle fed hay free choice consumed less hay than those fed barley mixed with 20% hay. However, they consumed enough more barley to give the same total feed consumption. These steers required only 25 pounds less barley but

211 pounds more hay per 100 pounds of gain than those fed barley without hay. On this basis, the hay had a low value in relation to barley, 100 pounds of hay saving only 12 pounds of barley. Thus, the hay had a lower value when fed free choice than when mixed with barley at 20% of the ration as with the lighter cattle.

Carcass grade and dressing percent do not indicate any important differences between the treatments in these trials.

SUMMARY

Effects of various levels of hay with rolled barley on rate of gain, feed consumption, and efficiency of feed utilization by finishing cattle appeared to vary somewhat with initial weight and condition of the cattle. Calves, following a wintering period, gained at a faster rate when fed barley with hay than without. On the basis of feed required per 100 pounds of gain, hay at 10% of the ration resulted in a greater saving of barley than when fed at 20% of the ration, about 88 and 49 pounds per 100 pounds of hay, respectively, for the 10 and 20% levels.

With more fleshy yearling cattle, there were only minor differences in gain when no hay, 10%, or 20% hay was fed with rolled barley. However, barley consumption was decreased but total feed consumption increased with increasing amounts of hay in the ration. The saving in barley on the basis of feed requirements in these comparisons amounted to 55 and 28 pounds per 100 pounds of hay at the 10 and 20% level.

Offering baled hay free choice (chopped in one trial) did not result in as efficient feed utilizaton as when consumed at approximately the same rate when ground and mixed with barley (20% level) in trials with both weight groups of steers. Barley consumption was higher when hay was fed free choice, but gains were about the same as when the hay was mixed at 20% of the ration. There was some hay wasted under this system with the actual amount consumed being less than shown in the tables. Even with the higher feed requirements, the system would appear economical in comparison to the rations with 20% hay when the cost of grinding the hay and mixing with barley is taken into account.

Carcass grade and dressing percent did not show any important differences between treatments with either weight-group of cattle.

Results of these feeding trials indicate that feeding some hay with rolled barley for finishing cattle is advisable from a management standpoint and that 10% of the ration appears to be an adequate amount. This level appeared more beneficial with lightweight cattle than with heavy yearling cattle. Higher levels of hay resulted in lower values for hay in terms of barley saved, especially when fed to yearling cattle and when offered free choice. However, yield, selling price and costs of grinding, mixing, and feeding need to be considered as well as the barley replacement value of hay in the over-all economy of the various levels of hay.

Value of Protein Supplement with Full-Fed Barley Rations

Barley generally contains a higher percentage of protein (often 12% or more) than is considered necessary in the total ration for finishing beef cattle (10-11%). Therefore, it would appear that an additional source of protein is not needed when barley comprises the major portion of the ration. Two feeding trials with yearling steers were conducted to determine the need for a protein supplement when feeding rolled barley rations without additional roughage.

PROCEDURES FOR THE EXPERIMENT

TRIAL 1

Forty yearling steers with considerable variation in initial weight and condition were fed in the first trial. They were divided into two uniform lots of 20 each on the basis of weight, condition, and previous treatments. An initial shrunk weight was taken after withholding feed and water overnight.

Each lot of cattle was full-fed rolled barley and 2 pounds per head daily of a supplement during the trial. They had been fed a high level of grain for a short time prior to the experiment, and they were started on the rolled barley at a level of 10 pounds per head daily. The barley was raised 0.5 pound per head daily until the cattle were on full feed. No trouble was encountered in getting them on full feed, and, after 28 days, the average daily barley consumption was 18 pounds.

Average test weight of the barley fed during the trial was about 53 pounds and it contained slightly over 12% total crude protein. It was rolled to a medium degree of fineness using a commercial-type roller mill with corrugated rollers. It was fed once daily in amounts so feed would be available all the time after the cattle were on full feed.

The 2 pounds of supplement fed to the control lot (no protein supplement) contained the following ingredients (%): ground barley, 80.2; trace mineral salt, 6.0; and ground limestone, 13.2. Vitamin A, vitamin D, and diethylstilbestrol premixes made up the remainder of the supplement, and they were used at levels to supply 10,000 I.U. of vitamin A, 1,000 I. U. of vitamin D, and 5 milligrams diethylstilbestrol per pound of the supplement.

Supplement fed to the protein-supplemented lot contained about 25% protein and 48.8 pounds of soybean meal was used to replace an equal weight of the ground barley per 100 pounds of the control supplement. Otherwise, the two supplements were the same and were fed in the meal form. No other mineral supplements were offered the cattle.

Cattle were fed in unpaved outside lots without shelter. They were bedded with straw as con-

sidered necessary, depending on weather and lot conditions.

This trial was started in December and terminated after 131 days. Some of the heavier cattle were removed for slaughter during the course of the trial. Final shrunk weights and carcass data were obtained on these cattle as well as those fed until the end of the trial. These cattle were removed from each lot so that total cattle days for the two lots were about the same. Average number of days fed for the cattle in each lot was 110.

TRIAL 2

Fifty-four yearling steers with an average initial shrunk weight of about 840 pounds were fed in this trial. They were allotted into four lots of 13 or 14 each on the basis of weight. They were fed rolled barley with and without a protein supplement as in trial 1, with two lots receiving each treatment.

The barley was prepared as for trial 1. Average test weight was about 50 pounds and average protein content was approximately 13%. It was full-fed once daily along with 2 pounds of a supplement after the cattle were on full feed. Since the cattle had not been fed grain prior to the experiment, they were started at 4 pounds of rolled barley per head, 6 pounds of bromegrass hay, and 2 pounds of supplement. Barley was increased 0.5 pound per head daily until the steers were on full feed. Hay was fed at 6 pounds daily the first week, 4 pounds the second, 2 pounds the third, and none thereafter.

Supplement fed the control lots (no added protein) contained the following ingredients (%): ground barley, 85.8; trace mineral salt, 2.5; ground limestone, 6.6; molasses, 5.0; and vitamin A premix, 0.1 (15,000 I.U. per pound of supplement). Supplement fed the protein-supplemented lot contained about 25% protein, and 48.8 pounds of soybean meal was used to replace an equal weight of barley per 100 pounds of the supplement.

A lower level of mineral was used in the supplements than in trial 1, and diethylstilbestrol was not included. Mineral supplements were also offered free choice—trace mineral salt and a mineral mixture of equal parts trace mineral salt and dicalcium phosphate. The cattle were implanted with 36 milligrams of diethlystilbestrol at the beginning of the trial.

Supplements were fed as meal for 60 days of the trial. Thereafter, they were pelleted to insure more uniform consumption and to prevent separation of the ingredients. Molasses was not used in the formula until this time and it replaced an equal weight of ground barley in the supplements.

Cattle in this trial were fed in outside paved lots. Lots were bedded with straw only during freezing weather. The trial was started January 31 and terminated after 163 days.

Carcass data were obtained upon slaughter as for trial 1.

RESULTS OF THE EXPERIMENT

Results for the two trials are presented in table 5. The cattle in trial 1 fed rolled barley with

Table 5. Dry Rolled Barley With and Without Protein Supplementation

	Trial 1 (Dec. 22—May 2)		Trial 2 (Jan. 31—July 13)	
	Control	Protein-supplemented	Control	Protein-supplemented
Init. number steers	20*	20*	27†	27‡
Init. shrunk wt., lb.	904	903	842	842
Final shrunk wt., lb.	1194	1205	1235	1224
Av. daily gain, lb.	2.64	2.76	2.41	2.39
Av. daily ration, lb.				
Rolled barley	18.2	19.2	20.4	20.5
Supplement	2.0	2.0	2.0	2.0
Bromegrass hay	—	—	.5	.5
Feed per 100 lb. gain, lb.				
Rolled barley	691	696	848	838
Supplement	75	72	82	82
Bromegrass hay	—	—	19	19
Dressing percent	60.1	60.1	61.0	61.4
Carcass grade§	19.1	19.1	18.8	18.2

*Some of the heavier cattle slaughtered during the trial, three not sold and two removed from the trial. Length of the trial was 131 days and average days fed was 110.
†Two steers foundered and were removed.
‡One death loss.
§Carcass grades based on: Good=17, Good+=18, Choice—=19 and Choice=20.

additional protein supplement gained 0.12 pound more daily than those not fed the protein supplement. They also consumed 1 pound more barley daily, resulting in about the same feed requirement per 100 pounds gain as for the cattle fed barley without the protein supplement. Carcass grade and dressing percent were the same for the two treatments.

In trial 2, rate of gain was somewhat less than in trial 1 but about the same for cattle with barley without the protein supplement. Feed consumption and feed efficiency were also about the same between the two treatments. The additional protein also did not appear to offer any improvement in carcass grade and yield.

SUMMARY

In two trials with yearling cattle, there appeared to be no advantage in feedlot performance and carcass characteristics from supplementing a full-fed ration composed of good quality rolled barley with additional protein. However, barley is low in calcium, some trace minerals, and vitamin A value. Supplementary sources of these are needed. If provided in a supplement to be fed with barley, the supplement need not be high in protein.

Value of Antibiotics in High Barley Rations

In previous experiments with high-barley finishing rations for cattle, some problems were encountered with digestive disorders, founder, and a high incidence of abscessed livers. It was not unusual to encounter condemnations of 30% or more of livers from abscesses when feeding high-barley rations. To determine the effectiveness of antibiotics in overcoming these problems, an experiment was conducted in which chlortetracycline (Aureomycin) and bacitracin were fed with rations composed of rolled barley without additional roughage.

PROCEDURES FOR THE EXPERIMENT

Fifty-one steers were started on this experiment. They were from a group depleted of vitamin A reserves for an experiment on the vitamin A requirements of finishing cattle and represented the heavy and light end of these cattle. Because of the weight differences, the cattle were divided into a heavy group of 27 and a light group of 24 head and allotted to three lots for each group. The three treatments were: control, chlortetracycline, and bacitracin.

The cattle had been in the feedlots about 4 months and were on about a full feed of barley at the time this experiment was started. When put on the experiment, the level of barley was reduced to 10 pounds per head daily. It was raised back to a full feed at rate of 1 pound per head daily. After getting to full feed, the barley was fed in amounts so it would be available all the time. No additional roughage was fed.

A pelleted supplement with about 20% protein was fed at 2 pounds per head daily. The supplement fed to the control lot was formulated with the following ingredients (%): ground alfalfa hay, 60; soybean meal, 24.5; cane molasses, 5; ground limestone, 5; trace mineral salt, 5; and diethylstilbestrol premix, 0.5 (5 milligrams diethlystilbestrol per pound of supplement). Vitamin A palmitate was added to furnish 10,000 I.U. of vitamin A per pound of supplement. Chlortetracycline and bacitracin were added to the supplement. The antibiotic premixes were used to replace an equal weight of the soybean meal. Antibiotics were fed at 350 milligrams per head daily for 2 weeks and then at 70 milligrams daily for the remainder of the experiment.

Cattle were fed in outside lots without shelter. They were offered free-choice trace mineral salt, and a mineral mixture composed of equal parts trace mineral salt, dicalcium phosphate, and ground limestone.

Initial weight was taken after an overnight stand without feed and water. Final weight represents the market weight after trucking about 75 miles. Livers were examined at slaughter and carcass data were obtained.

RESULTS OF THE EXPERIMENT

Results of this experiment are presented in table 6. The heavy group was fed 88 days and the light group 201. Some losses occurred as noted in the table. Results are presented for those finishing the trial. The feed was adjusted by subtracting an average amount of feed per steer for the days on the experiment.

There were only small differences in rate of gain between the cattle fed either of the antibiotics and the control lots. Those fed bacitracin gained less than the control lot in the heavy group but slightly more in the light group. Apparently neither antibiotic had much influence on rate of gain under the conditions of this experiment. Feed consumption was also quite similar except the heavy group fed bacitracin consumed less feed and had a lower rate of gain.

There was a tendency for the dressing percent to be higher when antibiotics were fed. Since carcass grade was also as high or slightly higher when feeding the antibiotics, the antibiotic-fed cattle should have a slightly higher selling price.

Losses occurred only in the lots fed bacitracin. Two of these were from urinary calculi, and it is doubtful if lack of effectiveness of the antibiotic was responsible for the other losses. No problems from founder were encountered during the experiment.

Nine of 17 livers were condemned in the control group. Only 2 of 17 were condemned when feeding chlortetracycline and 2 of 13 when feeding bacitracin. Inci-

Table 6. Antibiotic Supplementation with Barley Rations for Finishing Cattle

	Heavy group			Light group		
	Control	Chlortetra-cycline	Bacitracin	Control	Chlortetra-cycline	Bacitracin
Number steers	9	9	8*	8	8	5*
Days fed	88	88	88	201	201	201
Init. shrunk wt., lb.	900	891	901	665	660	678
Final shrunk wt., lb.	1174	1172	1154	1135	1136	1162
Av. daily gain, lb.	3.12	3.19	2.87	2.34	2.37	2.41
Av. daily ration, lb.						
Rolled barley	22.4	22.8	21.5	19.5	19.4	19.1
Supplement	2.0	2.0	2.0	2.0	2.0	2.0
Feed per 100 lb. gain, lb.						
Rolled barley	720	716	751	834	820	794
Supplement	64	63	70	85	83	83
Dressing percent	60.2	61.2	60.8	60.5	61.4	62.3
Marbling score†	4.9	5.2	5.0	6.1	6.6	8.2
Carcass grade‡	18.6	18.7	18.8	19.7	20.2	21.0
Condemned livers	5	2	1	4	0	1

*Two losses from urinary calculi, one from a general septicemia, and one from an undetermined cause.

†Marbling scores: Slightly abundant, 8; moderate, 7; modest, 6; small, 5.

‡Carcass grades: Prime, 23; Choice, 20; Good, 17.

dence of 30% or more has been common in other experiments when feeding high-barley rations. It would appear that both antibiotics were effective in reducing the incidence of liver abscesses.

SUMMARY

Only small differences in rate of gain and feed efficiency were obtained between cattle fed chlortetracycline or bacitracin and cattle not fed an antibiotic. Both of the antibiotics appeared effective in reducing the incidence of condemned livers from abscesses when the cattle were full-fed rolled barley without added roughage.

Rolled Barley Compared with Corn and Alfalfa Hay Rations

Barley is considered worth about 90% that of corn grain for finishing beef cattle. This value appears to be based primarily on results of experiments where barley and corn grain were compared in rations which contained about the same amount of roughage. Since barley hulls make up about 15% of the average weight of barley, camparisons between barley and corn grain fed with equal amounts of roughage also involve comparisons of proportions of concentrates and roughages.

The higher fiber content of barley may be used to an advantage under some conditions by reducing the amount of roughage needed in the rations. A more accurate value of barley in relation to corn grain would appear to be obtained when the rations are equalized in fiber content by feeding less roughage with barley.

Two feeding trials and one digestion trial were conducted to compare barley rations with those composed of rolled shelled corn with 20% ground alfalfa hay. No roughage was added to the barley ration, but the cattle were fed 2 pounds daily of a pelleted supplement which contained about 80% ground alfalfa hay. Each ration was fed with and without dynafac to test the value of this compound with high-concentrate rations. Dynafac is a surfactant chemical compound supposedly having antibacterial and antifungal properties, and it is sometimes referred to as a "chemobiotic."

PROCEDURES FOR THE EXPERIMENT

TRIAL 1

Sixty-two steers which had previously been full-fed rations of equal parts ground alfalfa hay and rolled or ground shelled corn were used in this trial. They were fed these rations about 4 months and had made an average daily gain of 2.66 pounds. They averaged about 800 pounds and were rather fleshy.

The steers were allotted into eight lots of seven or eight steers each on the basis of weight. Four lots of steers were fed the corn-hay mixture and four lots were fed

rolled barley. Two lots fed each ration received 2 grams of dynafac per head daily in the pelleted protein supplement.

Alfalfa hay was ground with a hammer mill using a 1-inch screen. Barley was rolled with a commercial-type roller mill having corrugated rollers set tight enough to prevent any whole kernels. Corn was rolled to a medium degree of fineness with the same roller mill and mixed with the hay.

A protein-mineral supplement was fed with each type of ration. Ingredient composition of the supplements and the protein and fiber contents of the rations are shown in table 7. Supplements were formulated to furnish rations about equal in content of protein, fiber, calcium, and phosphorus when fed at the levels shown in the table.

When dynafac was fed, it was added to the supplements to furnish 2 grams per head daily. It replaced an equal weight of soybean meal in the supplements.

Since the cattle had been on a full feed of rations composed of equal parts corn grain and alfalfa hay, they were started at 12 pounds per head daily of the experimental rations. This level of feeding did not increase the amount of grain they were consuming prior to this trial. Increases in feed of 0.5 pound per head daily were attempted in getting the cattle on full feed. Several days of rainy weather shortly after the trial began reduced feed consumption, and feed increases were not made as rapidly as planned during the first 2 weeks.

The cattle did not change readily from the corn-alfalfa ration to the one of rolled barley. Level of feeding had to be reduced and some hay was fed for the first 2 weeks.

After the cattle were on full feed, they were fed once daily so feed would be available all the time. They were fed in outside lots which were unpaved except for an 8-foot concrete strip adjacent to the feed manger.

The cattle were marketed on two separate days after 153 and 155 days on the trial. One lot fed each ration was marketed each day in order to have uniform marketing conditions between treatments. A final shrunk weight was obtained after withholding feed and water for about 18 hours. Individual weights were also taken at market and used in calculating the dressing percent. The livers were examined at slaughter for abscesses. Carcass data were obtained and tracings were made of the rib eye for measurements of the area of lean and depth of fat.

TRIAL 2

Feeding Trial. In view of the rather low rates of gain in trial 1, another trial was conducted using lighter cattle with less condition than in the first one. The rations and feed preparation were the same as for trial 1 (table 7). Two lots of 10 steers per lot received each ration treatment.

The cattle were fed in outside paved lots. In this trial, they were started on the experimental rations at a rate of 4 pounds of the basal mixtures plus 1 pound of the protein-mineral supplements. The feed was then raised 1 pound per head daily until the cattle were on full feed. Thereafter, they were fed once daily in amounts so feed would be available all the time.

Table 7. Composition of Feeds (Trial 1)

	Ration	
	80% R. sh. corn 20% Alf. hay	Rolled barley
Ingredient composition of supplements, %		
Soybean meal	33.89	—
Alfalfa hay	—	79.39
Corn grain	35.20	—
T.M. Salt	15.00	7.50
Molasses	5.00	5.00
Limestone	4.30	7.50
Dicalcium phosphate	5.50	—
Vitamin A premix*	0.11	0.11
Diethylstilbestrol premix†	1.00	0.50
Protein content of rations, dry basis, %		
Basal mix	11.88	13.27
Supplement	21.68	12.05
Total ration	12.35	12.98
Crude fiber content of rations, dry basis, %		
Basal mix	8.46	5.93
Supplement	2.90	23.00
Total ration	8.19	7.79
Rate of supplement feeding, lb./ head daily	1.0	2.0

*10,000 I.U. of vitamin A per pound of supplement.
†To furnish 10 mg. of diethylstilbestrol per head daily.

Alfalfa-brome hay was fed to all lots during the first 2 weeks of the trial. The rate of feeding was 6 pounds per head daily the first week and 3 pounds the second week.

The cattle were marketed after 204 days on the trial. Final shrunk weight represents market weight after being trucked about 60 miles. Carcass weights and grades were obtained following slaughter.

Digestion Trial. Four steers weighing about 550 pounds initially were used in a digestion trial to compare digestibility of the rations with corn or barley. Two steers were fed each type of ration used in the feeding trial during four periods of the digestion trial with one receiving 2 grams of dynafac in the supplement.

Each period of the digestion trial consisted of a 3-week preliminary period and a 5-day collection period. The steers were fed individually twice daily and fastened in stanchions about 3 hours for each feeding. At all other times, they were allowed access to an exercise area with a concrete floor.

Chemical composition of the rations determined from samples collected periodically during each period of the digestion trial is shown in table 8. Analyses were performed using procedures as outlined by the Association of Official Agricultural Chemists (A. O.A.C.). The same feed sources were used in the feeding and digestion trials.

RESULTS OF THE EXPERIMENT

TRIAL 1

Results of trial 1 are presented in table 9. There were only small and statistically nonsignificant differences in feedlot performance and carcass characteristics between the steers fed rations with and without dynafac. Some bloating and foundering occurred during the experiment and dynafac did not appear to reduce the incidence of either. There were fewer condemned livers when dynafac was fed. However, in other trials dynafac has not appeared to reduce this condition.

The steers fed rolled shelled corn with 20% alfalfa hay gained 0.25 pound more daily than those

Table 8. Chemical Composition of Rations Fed in Digestion Trial

Nutrient	Corn-alfalfa			Barley		
	Basal mix	Supplement		Basal mix	Supplement	
		Control	Dynafac		Control	Dynafac
	%	%	%	%	%	%
Dry matter, as fed	87.60	88.60	89.21	89.49	88.89	89.53
Composition of dry matter						
Crude protein	12.03	22.64	20.50	12.84	16.25	16.13
Ether extract	4.05	1.39	1.59	2.38	2.23	2.37
Crude fiber	7.22	3.64	3.66	6.07	19.59	21.90
Nitrogen-free extract	73.74	43.93	44.85	75.54	35.26	35.77
Ash	3.35	28.38	29.39	3.16	26.66	23.82

Table 9. Performance of Cattle Fed Barley and Corn-Alfalfa Rations
[Trial 1 (May-Oct.) — Repl. 1, 153 Days; Repl. 2, 155 Days]

	R. sh. corn (80) Gr. alf. hay (20)			Rolled barley		
	Control	Dynafac	Av.	Control	Dynafac	Av.
Number steers	16	15	31	15	16	31
Init. shrunk wt., lb.	796	799	798	801	796	798
Final shrunk wt., lb.	1146	1132	1139	1111	1092	1101
Av. daily gain, lb.	2.27	2.16	2.22	2.01	1.93	1.97
Av. daily ration, lb.						
Basal mix	20.3	19.3	19.8	15.7	15.3	15.5
Supplement	1.0	1.0	1.0	2.0	2.0	2.0
Hay*	—	—	—	.2	.2	.2
Total	21.3	20.3	20.8	17.9	17.5	17.7
Feed per 100 lb. gain, lb.						
Basal mix	895	892	893	779	793	786
Supplement	44	46	45	99	103	101
Hay*	—	—	—	10	10	10
Total	939	938	938	888	906	897
Carcass data						
Dressing percent	63.0	62.0	62.5	61.5	61.1	61.3
Marbling score†	4.8	5.6	5.1	4.9	4.5	4.7
Area of rib eye, sq. in.	11.8	11.9	11.8	11.5	11.5	11.5
Fat depth, in.	.84	.76	.80	.81	.70	.76
Carcass grade‡	18.2	18.8	18.5	18.5	18.2	18.3
Condemned livers	5	2	7	5	3	8

*Hay used to get on full feed.
†Marbling scores: Slight, 4; small, 5; modest, 6.
‡Carcass grade scores: Good +, 18; Choice —, 19.

fed rolled barley. The rations were similar in total protein and fiber content (table 7). Average daily feed consumption was 3.1 pounds more for steers fed the corn-hay ration and they consumed 4.6% more feed per 100 pounds of gain.

There were only small differences between rations in the carcass characteristics studied. However, the steers fed the corn-hay rations and making the faster gain rated slightly higher in all carcass characteristics measured. The heavier weight was likely an important factor in the higher condition of these steers.

The larger rate of gain and slightly higher dressing percent indicate an advantage for the corn-hay rations. However, barley had an advantage on the basis of fed efficiency. When 80% of the supplement fed with the barley rations is considered as hay, the feed replacement value of 100 pounds of barley was equal to 91 pounds of corn grain, 12 pounds of hay and 3 pounds of protein supplement. At typical feed prices for these ingredients, barley would be about equal to corn on the basis of feed required per 100 pounds of gain when fed in rations about equal in fiber and protein contents.

TRIAL 2

Results of the second feeding trial are presented in table 10. There was only a small difference in rate of gain with and without dynafac when the corn-alfalfa ration was fed. With the barley ration, rate of gain was 0.21 pound more daily with dynafac, which differs from the first trial. The lower rate of gain for the control group was due to a rather poor performance of one of the two lots. In other trials with var-

Table 10. Performance of Cattle Fed Barley and Corn-Alfalfa Rations
[Trial 2 (Jan.-Aug.) — 204 Days]

	R. sh. corn (80) Gr. alf. hay (20)			Rolled barley		
	Control	Dynafac	Av.	Control	Dynafac	Av.
Number steers	20	20	40	20	20	40
Init. shrunk wt., lb.	701	698	700	692	698	695
Final shrunk wt., lb.	1212	1223	1217	1155	1202	1178
Av. daily gain, lb.	2.50	2.57	2.54	2.26	2.47	2.37
Av. daily ration, lb.						
Basal mix	23.1	23.1	23.1	19.9	20.3	20.1
Supplement	1.0	1.0	1.0	2.0	2.0	2.0
Hay*	.3	.3	.3	.3	.3	.3
Total	24.4	24.4	24.4	22.2	22.6	22.4
Feed per 100 lb. gain, lb.						
Basal mix	924	896	910	882	824	853
Supplement	40	38	39	88	80	84
Hay*	12	12	12	14	12	13
Total	976	946	961	984	916	950
Carcass data						
Dressing percent	63.7	63.0	63.4	61.8	61.2	61.5
Marbling score†	6.4	5.6	6.0	5.6	6.1	5.8
Carcass grade‡	20.2	19.2	19.6	19.1	19.8	19.5
Condemned livers	1	2	3	8	6	14

*Hay used to get on full feed.
†Marbling scores: small, 5; modest, 6; moderate, 7.
‡Carcass grade scores: Choice —, 19; Choice, 20; Choice +, 21.

ious types of rations, the effect of dynafac has also been inconsistent. In view of the lack of consistency in results with dynafac, this compound appears to be of questionable value in rations for finishing cattle.

Gains were somewhat larger than in trial 1. The difference in favor of the corn-alfalfa ration amounted to an average of 0.17 pound daily. Feed consumption was also higher for the cattle fed corn-alfalfa rations (2.0 pounds), but feed efficiency was nearly the same for the two rations. On the basis of feed required per 100 pounds of gain, 100 pounds of barley was equal to 85 pounds of corn grain, 15 pounds hay, and 3 pounds supplement.

Degree of marbling of the rib eye and carcass grade were about the same for the corn and barley rations. Dressing percent was lower for barley, as was true in trial 1.

Digestibility of these high-concentrate rations was quite low (table 11). Difficulty was encountered in getting the cattle to consume adequate quantities of the rations during the digestion trial. Feed consumption was considerably less than obtained in the feeding trials, taking into consideration that steers used in the digestion trial had a smaller average weight.

The barley ration was higher in protein and digestibility of protein was higher for the barley ration. The corn-alfalfa ration was higher in ether extract and digestibility of this fraction was higher for the corn-alfalfa ration. Digestibility of dry matter and carbohydrates was about the same for the two rations.

Digestibility data for both rations were slightly higher when fed with dynafac. However, the difference was not statistically significant.

Table 11. Digestibility of Corn-Alfalfa and Barley Rations

	Corn-alfalfa		Barley	
	Control	Dynafac	Control	Dynafac
Number steers	4	4	4	4
Av. daily ration, lb.				
Basal mix	11.5	12.1	12.1	11.4
Supplement	1.0	1.0	2.0	2.0
Apparent digestibility, %				
Dry matter	60.1	63.3	59.0	63.5
Protein	53.3	53.9	56.8	61.0
Ether extract	65.8	71.1	60.8	60.3
Carbohydrates*	63.5	66.4	63.4	65.9

*Crude fiber plus nitrogen-free extract.

SUMMARY

In two feeding trials, steers fed a ration composed of 80% rolled shelled corn and 20% ground alfalfa hay with 1 pound of supplement gained faster (0.25 and 0.17 pound daily) than those fed a ration of dry rolled barley with 2 pounds of supplement. Feed consumption was also higher with the corn-alfalfa ration. Feed efficiency favored the barley ration in one trial but was nearly the same in the other.

Hay included in the supplement fed with barley plus that fed to get the cattle on full feed amounted to about 9% of the average ration. On the basis of feed required per 100 pounds gain, 100 pounds of barley from this ration of barley with 9% hay was equal to 88 pounds of corn grain, 13 pounds of hay and 3 pounds of protein supplement, averaged for the two trials.

Since barley is higher in fiber and protein than corn, less added roughage and protein supplement can be fed with it to obtain rations equal in fiber and protein as indicated in the above feed replacement equation. Therefore, the value of barley in relation to corn should depend partly on the prices of roughages and protein supplements. Equations such as the one above can be used to estimate the comparative value on the basis of feed costs per 100 pounds of gain.

In other trials reported in this publication, a rolled barley ration was improved by adding hay, with about 10% hay appearing to be the optimum amount. Such a ration appears to be about equal on the basis of feed required per 100 pounds of gain to one of corn grain with 20% hay and enough protein supplement to meet the requirements of the cattle.

The lower dressing percent with barley in comparison to corn was consistent in this experiment (1.2 and 1.9 percentage units). Since cattle fed barley will likely need a feeding period as much as 10% longer to be marketed at the same weight and grade as those fed corn, nonfeed costs will increase accordingly. In view of this and a likely lower yield, as indicated in this experiment, the over-all value of barley in relation to corn will probably be slightly less than that on the basis of feed requirements only. Results of this experiment show that the comparative value will also vary some with the prices of hay, supplements and nonfeed costs.

Digestibility data indicated only small differences in value of the corn-alfalfa hay and barley rations.

Dynafac appeared to be of questionable value as an additive to these high-concentrate finishing rations.