

THE COLORADO EXPERIMENT STATION

FORT COLLINS

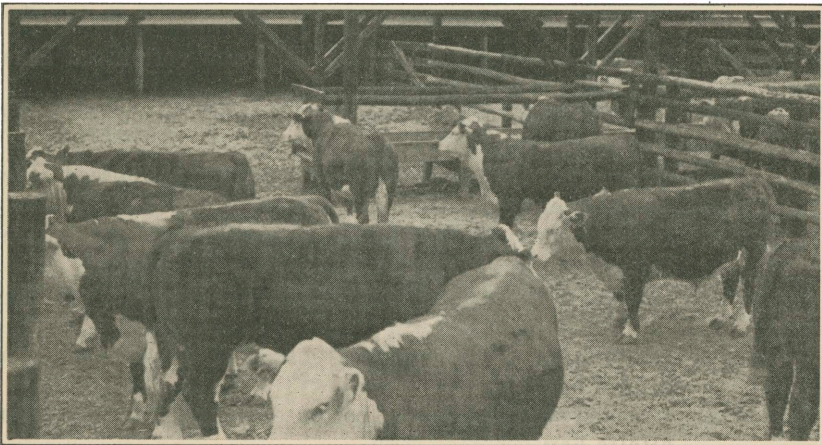
RATION EXPERIMENT WITH CALVES

PROGRESS REPORT OF LIVESTOCK FEEDING EXPERIMENT 1932

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Summary

1. One-half pound of cottonseed cake is sufficient for most economical gains and balances a standard beet by-product ration composed of grain, wet beet pulp and alfalfa hay for fattening calves.
2. Linseed oil cake produces the same gains as cottonseed cake but its higher cost makes its use prohibitive under Colorado conditions.
3. Ground flaxseed compares very favorably with cottonseed cake and linseed oil cake as a protein supplement.
4. At no time during the test were any abnormal digestive disturbances noticed among flax-fed calves.
5. Calves fed straight wheat were somewhat slow to go on full feed and took more time to clean up their grain than steers fed corn and barley, barley alone, or a mixture of corn and wheat. Aside from this, no difficulties were experienced.



Cattle fattened on a ration of corn, barley, ground flaxseed, wet beet pulp and alfalfa hay. They gained 2.35 pounds daily.

6. Wheat as the sole grain in the ration showed a tendency to produce growth rather than finish.
7. The addition of corn to wheat is profitable because it increases gain, and produces more condition on the calves which enhances selling price.
8. Barley is slightly superior to wheat when either of these two grains constitutes the entire grain ration but when corn is added to both these grains the reverse is true.
9. In a standard beet by-product ration composed of grain, cake, wet beet pulp and alfalfa hay, barley must be considered at least equal to the corn in a corn-barley grain mixture.

Objects of the Experiment

1. To determine the optimum amount of cake necessary to balance a standard beet by-product ration composed of grain, cake, wet beet pulp and alfalfa hay.
2. To compare the feeding value of various protein supplements, cottonseed cake, linseed oil cake, and flaxseed in a beet by-product ration.
3. To study the effects of ground flaxseed on fattening cattle.
4. To test the value of wheat fed alone and in combination with corn in a fattening ration for calves.
5. To compare the relative feeding value of wheat and barley in a standard beet by-product ration.

Calves Used

Eighty choice-quality grade Hereford steer calves were bought in the vicinity of the station and used in the test. They averaged about 420 pounds at the start. These calves were divided into eight as nearly uniform lots as possible by balancing the factors of weight, origin, type, breeding, condition and color.

Rations Fed

- Lot 1. Ground corn, ground barley, .5 pound cottonseed cake wet beet pulp, alfalfa hay.
- Lot 2. Ground corn, ground barley, 1 pound cottonseed cake wet beet pulp, alfalfa hay.
- Lot 3. Ground corn, ground barley, 1.5 pounds cottonseed cake wet beet pulp, alfalfa hay.
- Lot 4. Ground corn, ground barley, 1 pound linseed oil cake, wet beet pulp, alfalfa hay.
- Lot 5. Ground corn, ground barley, 1 pound flaxseed, wet beet pulp, alfalfa hay.
- Lot 6. Ground barley, 1 pound cottonseed cake, wet beet pulp, alfalfa hay.
- Lot 7. Cracked wheat, 1 pound cottonseed cake, wet beet pulp, alfalfa hay.
- Lot 8. Ground corn, cracked wheat, 1 pound cottonseed cake, wet beet pulp, alfalfa hay.

Feeds Used and Methods of Feeding

The grain-and-cake ration was fed twice daily, morning and evening. Pulp was hauled into the cattle pens shortly after the morning grain feed. Alfalfa, mineral mixture and salt were self-fed. The cattle were started on 1 pound of grain concentrate per head daily and gradually increased to 8 pounds daily except in Lot 6 where 7 pounds per head daily were fed on full feed. Cake was fed at the rate of .1 pound per head at first but increased quite rapidly to the specified amount in the ration. Wet pulp was fed as heavily as the calves would consume it and until 35 pounds per head per day was reached.

Corn used in this test was shipped-in Nebraska grain. It weighed 56.4 pounds per bushel, averaged 14.10 percent moisture thruout the feeding test and was graded No. 1 yellow according to U. S. Standard. All the corn fed in this experiment was ground medium.

Barley, grown locally, was used in this test. It weighed 44.0 pounds per bushel, tested 10.83 percent average moisture and was graded No. 3 Trebi barley. All the barley was finely ground.

Wheat fed in this experiment was secured from a local elevator and contained 60 percent hard winter wheat and 40 percent hard spring wheat. It weighed 58.8 pounds per bushel and contained an average moisture of 11.70 percent. All wheat was cracked or very coarsely ground.

Cottonseed cake had a guaranteed analysis of 43 percent protein. The average moisture content of the cake was 7.39 percent. Pea-sized cake was fed to the calves.

Linseed oil cake was old process cake and contained a guaranteed protein content of 34.0 percent. The average moisture content during the feeding period was 8.94 percent. Pea-sized cake was used.

Flaxseed was grown in Northeastern Colorado. It was ground very finely thru a hammer mill. The average moisture content was 8.25 percent and chemical analysis showed it to contain 22.84 percent protein.

Wet beet pulp was hauled directly from the silo of the local sugar factory to the calves as needed in order to duplicate conditions in commercial feedlots. The average cost of the pulp fed to the cattle was \$1.26 at the factory. To this was added a 50-cent hauling charge and 26.61 percent shrinkage worth 47 cents per ton making a total of \$2.23 per ton of wet pulp fed to the cattle. The average moisture content of the wet pulp was 88.67 percent.

Table 1.—CALF-FEEDING EXPERIMENT—Colorado Experiment Station
10 calves per lot—Fed 194 days, November 18, 1931 to May 30, 1932.

(Table based on one average calf)

Lot Number	1	2	3	4	5
Ration fed	Gr. Corn	Gr. Corn	Gr. Corn	Gr. Corn	Gr. Corn
Alfalfa, minerals and	Gr. Barley	Gr. Barley	Gr. Barley	Gr. Barley	Gr. Barley
salt self-fed in	.5 lb.	1 lb.	1.5 lbs.	1 lb.	1 lb.
all lots	C. S. Cake	C. S. Cake	C. S. Cake	L. O. Cake	Flaxseed
	Wet Pulp	Wet Pulp	Wet Pulp	Wet Pulp	Wet Pulp
Weight at start	423.0	422.5	427.3	420.7	420.8
Market weight					
at Denver.....	806.5	813.0	816.0	803.9	840.0
Gain at market	383.5	390.5	388.7	383.2	419.2
Daily gain at market..	1.98	2.01	2.00	1.97	2.16
Shipping shrinkage					
(percentage)	4.56	3.90	4.39	4.17	4.22
Average daily feed (pounds)					
Ground corn	2.46	2.46	2.46	2.46	2.40
Ground barley	2.46	2.46	2.46	2.46	2.40
Cottonseed cake .....	.49	.98	1.45		
Linseed oil cake .....				.98	
Ground flaxseed .....					.98
Wet beet pulp.....	25.65	25.49	25.50	25.31	25.01
Alfalfa hay	6.97	6.67	6.50	6.09	6.28
Mineral mixture .....	.02	.02	.02	.02	.02
Salt .....	.03	.03	.03	.03	.03
Maximum daily feed fed					
(pounds)					
Ground corn	4.00	4.00	4.00	4.00	4.00
Ground barley	4.00	4.00	4.00	4.00	4.00
Cottonseed cake .....	.50	1.00	1.50		
Linseed oil cake				1.00	
Ground flaxseed					1.00
Wet beet pulp.....	30.00	30.00	30.00	30.00	30.00
Alfalfa hay	7.63	7.23	6.77	6.19	6.60
Mineral mixture .....	.04	.02	.03	.02	.03
Salt .....	.01	.02	.01	.02	.01
Feed required per cwt.					
market gain (pounds)					
Ground corn	124.5	122.4	123.0	124.7	111.0
Ground barley	124.5	122.4	123.0	124.7	111.0
Cottonseed cake	25.0	48.8	72.6		
Linseed oil cake				49.7	
Ground flaxseed					45.4
Wet beet pulp.....	1,297.8	1,266.4	1,272.8	1,281.8	1,157.4
Alfalfa hay	352.8	331.4	324.4	308.6	290.6
Mineral mixture	1.2	.8	.8	1.0	.8
Salt	1.6	1.6	1.7	1.4	1.2
Feed cost per cwt.					
market gain	\$5.61	\$5.71	\$5.98	\$5.99	\$5.31

Table 2.—Financial Statement Based on Average Feed Prices and Sale of Calves.
(Table based on one average calf)

Lot Number	1	2	3	4	5
Ration fed	Gr. Corn	Gr. Corn	Gr. Corn	Gr. Corn	Gr. Corn
Alfalfa, minerals and	Gr. Barley	Gr. Barley	Gr. Barley	Gr. Barley	Gr. Barley
salt self-fed in	.5 lb.	1 lb.	1.5 lbs.	1 lb.	1 lb.
all lots	C. S. Cake	C. S. Cake	C. S. Cake	L. O. Cake	Flaxseed
	Wet Pulp	Wet Pulp	Wet Pulp	Wet Pulp	Wet Pulp
Cost per calf at feedlot at \$5.75 cwt.....	24.32	24.29	24.57	24.19	24.20
Feed cost per calf.....	21.51	22.30	23.24	22.95	22.28
Est. fixed costs includ- ing, interest, labor, equipment*.....	4.23	4.26	4.31	4.28	4.25
Shipping and selling expense	2.87	2.89	2.90	2.86	2.99
Total cost at market (Denver)	52.93	53.74	55.02	54.28	53.70
Selling price per cwt.**	5.75	5.75	5.75	5.75	5.50
Gross receipts per calf	46.37	46.75	46.92	46.22	46.20
Loss per calf	6.56	6.99	8.10	8.06	7.50
Necessary selling price per cwt. to break even	6.56	6.61	6.74	6.75	6.39
Margin over purchase price per cwt. needed to break even.....	.81	.86	.99	1.00	.64
Dressing percentage (based on warm weight)	60.77	61.56	62.05	60.80	62.49
Grade of carcass in cooler					
Good	4	6	3	2	5
Medium	5	4	7	7	5
Fair	1	0	0	0	0

*Developed from studies of Economics Department, C. A. C.

**Figures based on actual selling price and valuation placed on calves by representatives of John Clay and Company and Blayney-Murphy Company.

Cost of feeds used:

Ground corn	\$22.00 per ton
Ground barley	17.00 per ton
Cottonseed cake	23.00 per ton
Linseed oil cake	35.00 per ton
Flaxseed	30.00 per ton
Wet pulp	2.23 per ton
Alfalfa hay	8.00 per ton
Mineral mixture	33.60 per ton
Salt	18.00 per ton

Chemical Analysis of Feeds Used

	Water	Ash	Crude Protein	Carbohydrate		Fat	No. of Analysis
				Fiber	N. F. Extract		
Corn	12.78	1.40	11.00	1.94	68.94	3.94	2
Barley	11.68	2.32	13.06	5.25	65.74	1.95	2
Wheat	10.64	2.21	16.26	3.69	65.45	1.75	2
Cottonseed							
cake	7.58	6.10	43.89	8.46	26.28	7.69	2
Linseed oil							
cake	8.76	6.35	36.67	7.48	35.28	5.46	2
Flaxseed	8.68	4.21	22.84	5.12	22.97	36.18	2
Wet beet							
pulp*		2.71	13.95	39.26	41.46	2.62	2
Alfalfa hay	4.53	8.85	12.15	37.47	34.73	2.27	2

*Dry basis.

Alfalfa hay was grown locally and was bright, leafy and of good quality. First-cutting hay was used. It was self-fed thru covered bunks.

Mineral mixture composed of 40 parts steamed bonemeal, 40 parts high calcium carbonate lime cake and 20 parts salt was self-fed in all lots.

Salt. All lots were self-fed No. 4 salt.

Discussion of Results

Amount of cottonseed cake necessary in a beet by-product ration composed of a half-and-half mixture of corn and barley, wet beet pulp and alfalfa hay. Previous Colorado experiments have shown that the addition of cottonseed cake to beet by-product rations was beneficial both from a rate-of-gain standpoint and because of economy of gain. It is very essential that only the minimum required amount of protein supplement be added to the ration because of the relative high market cost of these commercial feeds.

In this test varying amounts of cottonseed cake were added to the same ration. Lot 1 was fed .5 pound daily, Lot 2, 1 pound and Lot 3, 1.5 pounds. Results after feeding these calves 194 days showed that increasing the amount of cake increased gains but also increased cost of gains. Considering total feed consumed per calf, the experiment shows that the total amount of cake fed per steer in excess of .5 pound daily was worth \$1.09 in Lot 2 and \$2.14 in Lot 3; and that this additional cake returned only 67 cents in Lot 2 and 70 cents in Lot 3. Considering .5 pound of cottonseed cake daily as 100 percent efficient, this test shows that an extra .5 pound of cake is only 61.43 percent as efficient and each additional pound above .5 pound daily is only 32.22 percent as valuable. In other words this experiment indicates that .5 pound of cottonseed cake is sufficient for most economical gains and balances a standard beet by-product ration for fattening calves.

Cottonseed Cake vs. Linseed Oil Cake.—Linseed oil cake and cottonseed cake are generally considered the two standard protein supplements for cattle-fattening rations. Our earlier experimental work showed that linseed oil cake produced the same gains as cottonseed cake but the higher cost of the linseed oil cake made its use prohibitive. These general results are repeated in this experiment. Linseed oil cake (Lot 4) produced very nearly the same rate of gain as cottonseed meal (Lot 2) and its feed-replacement value shows that the two protein supplements are equal pound for pound. The cost of producing unit gains, however, was greater where linseed oil cake was used and therefore the loss per calf was \$1.07 less using cottonseed cake in the standard beet by-product ration. The selling price was the same for both lots and a carcass study in the packing house coolers showed six good and four medium carcasses where cottonseed cake was fed and only two good and seven medium carcasses in the lot fed linseed oil cake as the protein supplement.

Flax vs. Cottonseed Cake vs. Linseed Oil Cake.—Flax is not generally used for livestock feeding because of its high commercial value in the linseed-oil industry, its comparative low yield per acre which averages 5 to 6 bushels in Colorado, and the suspected danger of poisoning which is so prevalent among livestock. It is thought that in some instances flaxseed may contain a compound which, when

acted upon by an enzyme in the seeds, yields a poison, prussic acid. Colorado feeders who have used flaxseed as a protein supplement, however, have not experienced any difficulties in their feedlots. Work conducted at the Colorado Station in feeding flax to hogs and sheep has never shown ill results. Feeding flax to fattening calves in this experiment was no different than feeding cottonseed cake or linseed oil cake. The calves took to flax just as readily as to the other protein supplements and were on full feed at the same time as the others. At no time during the test were any abnormal digestive disturbances noticed among the flax-fed calves. It should be remembered that flaxseed must be ground for cattle in order to get maximum utilization of the feed and to prevent waste.

The calves fed flax as protein supplement in a standard beet by-product ration (Lot 5) produced the second highest gain of the experiment, 2.16 pounds per head per day. The cost of producing each 100 pounds of gain was \$5.31 or 40 cents less than the cost where cottonseed cake was used to supply the protein in the same ration and 68 cents less where linseed oil cake was used.

Each ton of flaxseed replaced 2,149.78 pounds of cottonseed cake, 502.2 pounds of corn, 502.2 pounds of barley, 4,801.77 pounds of wet pulp, 1,797.36 pounds of alfalfa and 17.62 pounds of salt or, at present prices of feeds, was worth \$47.21 per ton.

Comparing flaxseed with linseed oil cake (Lots 5 and 4), this test shows that each ton of flaxseed replaced 2,189.43 pounds of linseed oil cake, 603.52 pounds of corn, 603.52 pounds of barley, 5,480.18 pounds of wet pulp, 792.95 pounds of alfalfa, 8.81 pounds of minerals and 8.81 pounds of salt, or was worth \$59.60 per ton.

Appraised valuation of the different lots made by stockyard market representatives was lowest on the flaxseed-fed cattle. The objection to the cattle was lack of condition. Slaughter data, however, show the carcasses of these cattle to grade among the best of all the lots and until more work is done it is not justifiable to say that this feed combination of corn, barley, flaxseed, wet pulp and alfalfa hay produces growth rather than finish.

Judging from this test, indications are that ground flaxseed is not dangerous for fattening cattle, that it can be used to good advantage as a protein supplement in a beet by-product ration and that it does give the feeders a home-grown feed which can replace cottonseed cake and linseed oil cake when the commercial value of flax in the linseed-oil industry permits.

Wheat.—Wheat has usually been of too-high commercial value to be considered a feed for livestock and consequently experimental work with wheat has been very limited until the past 2 years. General conclusions based on tests with wheat at other stations are:

1. Low-grade wheat is a good cattle feed.
2. Wheat, even tho comparatively high in protein, must be supplemented with a protein-rich feed.
3. Wheat should be ground coarsely or rolled to overcome its tendency to form pasty masses when chewed, which in turn cause digestive disturbances.
4. A grain mixture with wheat is better than feeding wheat alone.
5. Wheat alone is unpalatable.

Lot 7 in this experiment was fed cracked or coarsely ground wheat with cottonseed cake, wet beet pulp and alfalfa hay. The steers were somewhat slow to go on full feed and even after reaching 8 pounds of wheat per head per day they were much slower cleaning up that amount of grain than the steers fed corn and barley, barley alone, or wheat and corn. Aside from this no difficulties were experienced. The bulk of the wet beet pulp may probably have been helpful in overcoming some of the objections noticed at other stations when wheat was the only grain fed. The steers produced an average daily gain of 1.98 pounds based on market weight and produced unit gains for \$5.34. It was slightly noticeable at the end of the test that the steers in this lot were a little more growthy and lacked somewhat in condition when compared to other lots in the experiment.

Wheat vs. a Mixture of Wheat and Corn.—Using a half-and-half mixture of wheat and corn in the ration increased gain .27 pound daily over wheat alone and also slightly cheapened the cost of producing each 100 pounds of gain. Furthermore, the addition of corn increased the selling price 15 cents per cwt. and decreased the loss \$1.59 per head.

Table 3.—CALF-FEEDING EXPERIMENT—Colorado Experiment Station
10 calves per lot—Fed 194 days, November 18, 1931 to May 30, 1932.
(Table based on one average calf)

Lot Number	2	6	7	8
Ration fed	Gr. Corn	Gr. Barley	Cr. Wheat	Gr. Corn
Alfalfa, minerals and salt	Gr. Barley	Gr. Barley	Cr. Wheat	Cr. Wheat
self-fed in all lots	C. S. Cake	C. S. Cake	C. S. Cake	C. S. Cake
	Wet Pulp	Wet Pulp	Wet Pulp	Wet Pulp
Weight at start	422.5	421.5	423.8	422.4
Market weight at Denver.....	813.0	809.0	807.5	859.4
Gain at market	390.5	387.5	383.7	437.0
Daily gain at market.....	2.01	2.00	1.98	2.25
Shipping shrinkage				
(percentage)	3.90	3.58	3.87	3.19
Average daily feed (pounds)				
Ground corn	2.46			2.47
Ground barley	2.46	4.58		
Cracked wheat			4.93	2.47
Cottonseed cake .....	.98	.98	.98	.98
Wet beet pulp	25.49	25.50	24.31	25.19
Alfalfa hay	6.67	5.84	6.20	7.43
Mineral mixture .....	.02	.02	.02	.03
Salt .....	.03	.04	.02	.02
Maximum daily feed fed (pounds)				
Ground corn	4.00			4.00
Ground barley	4.00	7.00		
Cracked wheat			8.00	4.00
Cottonseed cake	1.00	1.00	1.00	1.00
Wet beet pulp	30.00	30.00	30.00	30.00
Alfalfa hay	7.23	6.83	6.27	7.89
Mineral mixture .....	.02	.03	.01	.01
Salt .....	.02	.02	.02	.02
Feed required per cwt.				
market gain (pounds)				
Ground corn	122.4			109.4
Ground barley	122.4	229.4		
Cracked wheat			249.2	109.4
Cottonseed cake	48.8	49.1	49.6	43.6
Wet beet pulp	1,266.4	1,276.7	1,229.3	1,118.0
Alfalfa hay	331.4	292.1	313.3	330.0
Mineral mixture .....	.8	1.2	1.1	1.3
Salt	1.6	2.1	1.1	1.1
Feed cost per cwt.				
market gain	\$5.71	\$5.15	\$5.34	\$5.23

Table 4.—Financial Statement Based on Average Feed Prices and Sale of Calves.
(Table based on one average calf)

Lot Number	2	6	7	8
	Gr. Corn Gr. Barley C. S. Cake Wet Pulp	Gr. Barley C. S. Cake Wet Pulp	Cr. Wheat C. S. Cake Wet Pulp	Gr. Corn Cr. Wheat C. S. Cake Wet Pulp
Ration fed				
Alfalfa, minerals and salt self-fed in all lots				
Cost per calf at feedlot at \$5.75 cwt.	24.29	24.24	24.37	24.19
Feed cost per calf	22.30	19.96	20.49	22.86
Est. fixed costs including interest, labor, equipment*	4.26	4.16	4.18	4.26
Shipping and selling expense	2.89	2.88	2.87	3.06
Total cost at market (Denver)	53.74	51.24	51.91	54.49
Selling price per cwt.**	5.75	5.70	5.55	5.70
Gross receipts per calf	46.75	46.11	44.82	48.99
Loss per calf	6.99	5.13	7.09	5.50
Necessary selling price per cwt. to break even.....	6.61	6.33	6.43	6.34
Margin over purchase price per cwt. to break even.....	.86	.58	.68	.59
Dressing percentage (based on warm weight)	61.56	59.53	61.31	61.47
Grade of carcass in cooler				
Good	6	3	3	2
Medium	4	7	7	7
Fair	0	0	0	0

*Developed from studies of Economics Department, C. A. C.

**Figures based on actual selling price and valuation placed on the calves by representatives of John Clay and Company and Blayne-Murphy Company.

Cost of feeds used:

Ground corn	\$22.00 per ton
Ground barley	17.00 per ton
Cracked wheat	17.00 per ton
Cottonseed cake	23.00 per ton
Wet beet pulp	2.23 per ton
Alfalfa hay	8.00 per ton
Mineral mixture	33.60 per ton
Salt	18.00 per ton

Comparing Lot 7 fed wheat alone and Lot 8 fed one-half wheat and one-half corn, it is seen that each ton of corn fed replaced 2,555.75 pounds of wheat, 109.69 pounds of cottonseed cake, 2,034.75 pounds wet beet pulp but required 305.30 pounds more alfalfa and 3.66 pounds more mineral mixture. In other words with present prices of feeds each ton of corn fed was worth \$23.97.

Indications are that even tho wheat can be fed as the only grain in a beet by-product ration, the addition of corn is profitable because it increases gain, slightly decreases cost per unit gain and enhances the selling price per cwt.

Wheat vs. Barley.—Feeding wheat or barley alone without the addition of corn, (Lots 6 and 7) showed that ground barley produced slightly greater gains, cheaper gains, increased selling price 15 cents per cwt. and gave a feed replacement value of 101 percent that of cracked wheat. However, when corn was added to the ration (Lots 2 and 8), the wheat-corn mixture produced greater gains, cheaper gains, raised the selling price within 5 cents per cwt. of the corn-barley-mixture-fed lot and showed a 34.51 percent greater feed replacement value than barley in the barley-corn mixture. In other words barley is slightly superior to wheat when either of these two grains constitute the entire grain ration but when corn is added the reverse is true.

Barley vs. a Mixture of Barley and Corn.—Adding ground corn costing \$1.10 per cwt. to ground barley costing only 85 cents per cwt. did not pay because the addition of corn did not increase gains very materially or enhance the selling price to any great extent.

A comparison of corn and barley, made when a carbohydrate concentrate makes up only a relatively small proportion of the total ration, cannot be expected to show such clearly defined differences as are brought out when grain and hay alone are fed. In a standard beet by-product ration composed of grain, cake, wet beet pulp and alfalfa hay, barley must be considered at least equal to the corn in a barley-corn grain mixture.