

THE COLORADO EXPERIMENT STATION

FORT COLLINS

Feedlot Fattening Rations for Lambs

Progress Report of Livestock Feeding Experiment—1930

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Summary

1. A No. 2 whole barley (Colcess) was worth 89.2 percent the value of a No. 3 re-cleaned yellow corn. Barley gave better fattening results when used along with other carbonaceous feeds such as wet pulp.

2. Cull potatoes of rather low grade showed a feed replacement value of \$5.96 per ton.

3. Cull-potato-and-corn-fodder silage consisting of 80 percent potatoes and 20 percent dry fodder ensiled in the spring and held over and fed the following winter was worth \$6.33 per ton.

4. Siloed beet pulp fed with barley and alfalfa hay produced the cheapest and most efficient gains in the experiment. The wet beet pulp costing \$2.06 per ton delivered to the lambs showed a replacement value of \$3.92 per ton fed.

5. The addition of a protein concentrate along with alfalfa hay to the various rations tested did not prove profitable.

6. A final discard beet molasses showed the highest feeding value followed in order by "foreign" beet molasses, Steffens discard and cane molasses. The relative feed replacement value per ton indicated in the feeding test was as follows: Final discard beet molasses \$23.07, "foreign" beet molasses \$19.55, Steffens discard beet molasses \$13.17, and cane molasses \$10.96.

Objects of the Experiment

Series 1

1. To compare shelled corn and whole barley for fattening lambs.

2. To compare cull potatoes, a cull-potato-and-corn-fodder silage and siloed beet pulp in fattening rations for lambs.

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3. To determine the value of adding a concentrated protein supplement (cottonseed meal) to the various lamb fattening rations.

Series 2

1. To compare cane molasses and the various kinds of sugar beet molasses available for livestock feeding purposes in beet-growing areas.

2. To determine the advantage of a cut mixture self-fed to fattening lambs.

3. To compare No. 2 alfalfa meal (guaranteed 13 percent protein) and No. 1 alfalfa stem meal (guaranteed 9 percent protein) when used in a cut mixture for lambs.

Lambs Used

Grade range lambs (Hampshire, Suffolk, Rambouillet cross) were purchased as feeders on the Denver market and were sorted into 15 pens of 25 head each for the experiment. Lambs in all pens were vigorous and thrifty and the different pens of lambs were uniform in size, weight, type and condition when the experiment started.

Rations Fed

Series 1

- Lot 1. Shelled corn, alfalfa hay.
- Lot 6. Whole barley, alfalfa hay.
- Lot 2. Whole barley, cottonseed meal, alfalfa hay.
- Lot 8. Whole barley, siloed beet pulp, alfalfa hay.
- Lot 10. Whole barley, siloed beet pulp, cottonseed meal, alfalfa hay.
- Lot 3. Whole barley, cull potatoes, alfalfa hay.
- Lot 15. Whole barley, cull potatoes, cottonseed meal, alfalfa hay.
- Lot 4. Whole barley, potato-and-corn-fodder silage, alfalfa hay.
- Lot 16. Whole barley, potato-and-corn-fodder silage, cottonseed meal and alfalfa hay.

Series 2

- Lot 1. Shelled corn, alfalfa hay.
- Lot 6. Whole barley, alfalfa hay.
- Lot 5. Shelled corn, beet molasses (final discard) alfalfa hay

- Lot 7. Shelled corn, beet molasses (Steffens discard) alfalfa hay.
- Lot 9. Shelled corn, beet molasses (foreign) alfalfa hay.
- Lot 11. Shelled corn, cane molasses, alfalfa hay.
- Lot 13. Barley, beet molasses (Steffens discard), cottonseed meal, No. 2 alfalfa meal (ground mixture self-fed).
- Lot 14. Barley, beet molasses, (Steffens discard) cottonseed meal, No. 1 alfalfa stem meal (ground mixture self-fed).

Feeds Used

Shelled corn, No. 3 yellow (recleaned), 14 percent moisture, secured from local elevator.

Barley, No. 2 (uncleaned Colceess), 47 pounds per bushel, 10.1 percent moisture. A hooded strain grown on the college farm.

Wet beet pulp was hauled from the silo of the local sugar factory and was stored temporarily in a small silo near the feedlots. Moisture content varied during the feeding period from 91.8 percent to 87.2 percent and averaged 89.8 percent. Charged at the average net factory price of \$1.04 per ton plus 50 cents handling charge, and with a 25.3 percent loss between factory weights and feeding weights, the price per ton weighed to the lambs was \$2.06.

Cull potatoes, 83.0 percent moisture, were of rather poor quality. They were frozen at times when fed. With market potatoes high a close sorting caused culls to be distinctly lower in quality than in a year of moderate-priced potatoes. The culls were sliced in a hand-power root cutter.

Potato-and-corn-fodder silage, 61.8 percent moisture. A mixture by weight of 18 percent dry corn fodder and 82 percent cull potatoes was cut into the silo during the spring of 1929. Cull potatoes on the verge of spoiling were stored in this manner for use the following feeding season. There was little waste and the resultant silage proved to be a very palatable feed. It was charged at a production cost of \$7.65 per ton.

Cane molasses, 28.9 percent moisture, was secured from a shipment to local feeders.

Beet molasses (foreign), 21.8 percent moisture, came directly from the sugar factory and had not been desugared by any of the additional recovery processes.

Beet molasses (Steffens discard), 22.2 percent moisture, came from the local Steffens plant of the Great Western Sugar Company at Fort Collins where it had been subjected to the Steffens treatment with lime to precipitate additional sugar.

Beet molasses (Johnstown final discard), 22.1 percent moisture, came from the Great Western Sugar Company factory at Johnstown. It was steffenized molasses that had been further desugarized by the barium process employed at Johnstown.

Cottonseed meal, 7.75 percent moisture, was manufactured by the Graco Milling Company, Sherman, Texas, and carried a guaranteed analysis of 43 percent protein.

Alfalfa hay was grown locally. It was bright, leafy and of good quality thruout the test. Only second cutting was fed.

Alfalfa meal was secured from the mill and had a guaranteed analysis of not less than 13 percent protein, not less than 1 percent fat, not less than 35 percent nitrogen-free-extract and not more than 33 percent fiber.

Alfalfa stem meal was secured from the mill and had a guaranteed analysis of not less than 9 percent crude protein, not less than .8 percent fat, not less than 30 percent nitrogen-free-extract and not more than 40 percent crude fiber.

A No. 4 sheep salt was self-fed in all lots.

Method of Feeding

All concentrates were fed twice daily, one-half the amount in the morning and one-half in the afternoon. Grain was gradually increased from .1 pound to 1 pound per head daily at 50 days. Maximum daily feed of grain was $1\frac{1}{2}$ pounds of corn and $1\frac{1}{4}$ pounds of barley. Maximum feed of cottonseed meal was $\frac{1}{4}$ pound daily in all lots fed. Potatoes and potato-and-corn-fodder silage were fed at the rate of 2 pounds per head daily on a full feed. Molasses was increased gradually from $\frac{1}{10}$ pound to $\frac{1}{2}$ pound per head daily. The grain was spread on the molasses in the grain troughs. Alfalfa hay and the cut mixtures were self-fed as indicated.

The percentage composition of the mixed feeds used in Lots 13 and 14 was as follows:

	Ground Barley	Beet Molasses	Cottonseed Meal	Alfalfa Meal or Stem Meal
At start				100
At 6th day	4.5	4.5	2.0	89
At 19th day	15.0	7.5	2.5	75
At 26th day	20.0	12.0	5.0	63
At 48th day	30.0	17.0	8.0	45
From 58th day to end of test	35.0	17.0	8.0	40

Financial Statement

Lambs were shipped to Denver and sold separately by lot. Actual marketing cost is reported. An estimate of fixed costs including interest charges, equipment and labor cost, based on unpublished studies from the Economics Department of the Colorado Agricultural College is included in the financial statement.

Series 1.

Shelled corn vs. whole barley.—Check lots in which corn and barley have been fed in conjunction with alfalfa hay have made possible a comparison of these two concentrates altho straight grain and alfalfa rations have not proved as cheap nor efficient as rations containing additional home-grown feeds and by-products.

At feed prices used in this test, a No. 2 whole barley (Colcless) showed 89.2 percent the feeding value of shelled corn. Each ton of corn fed in the test replaced 1962.6 pounds of barley and 554.3 pounds of alfalfa but required 4.4 pounds additional salt. With corn at \$32.00 per ton, barley was worth \$26.80 per ton. A 3-year average, including this test, shows a No. 2 barley worth 91.6 percent the value of a No. 3 yellow corn. Lambs fattened on corn in the test gained 2 pounds more per head than the barley-fed lambs. They sold for the same price per cwt. but the dressing percentage was 2.3 percent lower where barley was fed. An average of three tests shows the corn-fed lambs dressing 48.77 percent as against 45.80 percent for the barley-fed lambs.

Barley gives much more satisfactory results in fattening rations for lambs when fed in connection with other carbonaceous concentrates or roughages.

Cull potatoes for fattening lambs. In years of overproduction of potatoes the quality of markets may be held at a high standard by close culling and these culls offer a cheap source of succulent carbohydrate feed for use in lamb-fattening rations. In the present test the quality of cull potatoes fed was low due to the scarcity and high price of potatoes during the test. At existing prices these cull potatoes showed a feed replacement value of \$5.96 per ton or 29.8 cents per cwt.

Each ton of cull potatoes fed with barley and alfalfa hay, at the rate of 2 pounds per head daily on a full feed, replaced 237.8 pounds of barley, 411 pounds of alfalfa and .7 pounds of salt.

TABLE I—a
Lamb-Feeding Experiment—Colorado Experiment Station
25 Lambs per lot fed 127 days (October 23, 1929 to February 27, 1930)
 (Table based on one average lamb)

Lot Number	1	6	2	8	10	3	15	4	16
Ration, fed Alfalfa hay and salt in all lots	Shelled Corn	Barley	Barley C. S. meal	Barley Siloed pulp	Barley Siloed pulp C. S. meal	Barley Potatoes	Barley Potatoes C. S. meal	Barley Potato- Fodder silage	Barley Potato- Fodder silage C. S. meal
Weight at start, lbs.....	67.2	68.0	67.2	68.1	68.4	67.6	69.9	67.4	68.7
Final weight (Denver) lbs.	99.4	98.2	97.4	102.6	104.6	99.6	104.8	97.0	100.0
Gain at market	32.2	30.2	30.2	34.5	36.2	32.0	34.9	29.6	31.3
Average daily gain (market weight) .....	.25	.24	.24	.27	.29	.25	.27	.23	.25
Shipping shrink (percent)	2.93	0.81	3.75	3.21	4.04	1.24	3.21	2.22	3.47
Average daily feed, lbs.									
Shelled corn	1.03								
Whole barley .....		.95	.95	.82	.82	.82	.83	.82	.82
Siloed beet pulp				4.58	4.58				
Cull potatoes						1.55	1.58		
Potato-corn-fodder silage								1.44	1.45
Cottonseed meal .....			.20		.20		.21		.20
Alfalfa hay	2.12	2.26	2.14	1.79	1.64	2.07	1.88	1.77	1.65
Salt .....	.002	.001	.002	.002	.001	.001	.001	.001	.001
Feed required per 100 lbs. gain (at market)									
Shelled corn	406.3								
Whole barley		398.7	398.7	301.5	287.2	325.4	301.2	352.2	332.2
Siloed beet pulp				1686.1	1606.0				
Cull potatoes						616.6	575.4		
Potato-corn-fodder silage								619.7	586.2
Cottonseed meal			85.2		71.1		75.4		82.1
Alfalfa hay	836.8	949.4	900.9	658.1	573.8	822.7	684.6	760.0	670.8
Salt	6.2	5.3	6.7	6.6	4.1	5.1	4.0	4.5	2.6
Feed cost per 100 lbs. gain (at market)	12.62	11.90	13.73	10.33	11.24	11.61	12.12	12.32	13.37

TABLE I--b
Financial Statement Based on Average Feed Prices and Sale of Lambs

Lot Number	1	6	2	8	10	3	15	4	16
Ration fed Alfalfa hay and salt in all lots	Shelled corn	Barley	Barley C. S. meal	Barley Siloed pulp	Barley Siloed pulp C. S. meal	Barley Potatoes	Barley Potatoes C. S. meal	Barley Potato- Fodder silage	Barley Potato- Fodder silage C. S. meal
Cost per lamb @ \$12.65 cwt.	8.50	8.61	8.50	8.62	8.65	8.55	8.85	8.53	8.69
Feed cost per lamb	4.06	3.59	4.15	3.56	4.07	3.72	4.23	3.65	4.19
Estimated fixed cost including interest, equipment and labor .....	.95	.95	.95	.95	.95	.95	.95	.95	.95
Shipping and selling expense .....	.48	.48	.48	.48	.48	.48	.48	.48	.48
Total cost at market (Denver)	13.99	13.63	14.08	13.61	14.15	13.70	14.21	13.61	14.31
Selling weight (Denver)	99.4	98.2	97.4	102.6	104.6	99.6	104.8	97.0	100.0
Selling price per cwt.	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50
Gross receipts per lamb	8.45	8.35	8.28	8.72	8.89	8.46	8.91	8.25	8.50
Loss per lamb	5.54	5.28	5.80	4.89	5.26	5.24	5.30	5.36	5.81
Dressing percentage	49.0	46.6	48.0	48.6	50.2	47.5	49.1	48.0	48.4
Grade of carcass in cooler									
Choice	10	8	9	9	8	8	6	10	5
Good	1	5						2	2
Medium									
Choice Heavies	14	12	14	16	17	14	16	13	18
Good Heavies			2			2	1		
Cost of feeds used:									
No. 3 yellow corn		\$32.00 ton							\$ 2.06 ton
No. 2 whole barley		\$25.00 ton							\$ 7.68 ton*
Cottonseed meal		\$51.00 ton							\$ 5.00 ton
Alfalfa hay		\$14.50 ton							\$15.00 ton

*Corn fodder \$12.50 per ton. Cull potatoes \$3.53 per ton.

In an earlier test at this station in which a better quality of cull potatoes was used each ton fed replaced 115.5 pounds of shelled corn and 848.6 pounds of alfalfa showing a replacement value at present feed costs of \$8.00 per ton.

The addition of $\frac{1}{4}$ pound per head daily of cottonseed meal to the barley-potato-alfalfa ration increased the gain 2.9 pounds per lamb, increased the feed cost 51 cents per cwt. gain and did not affect the selling price per cwt. Under the existing conditions it did not pay to use the protein concentrate.

Cull-potato-and-corn-fodder silage. A problem is sometimes presented in the utilization of potatoes and culls held until late in the spring. The advisability of attempting to carry them over by ensiling them with some dry filler has been tested in this experiment. In April of 1929, 57 tons of cull potatoes were cut into an upright silo with 13 tons of dry corn fodder. There was no additional moisture used. The resultant ensilage was held during the summer and was fed to the lambs the following winter.

This potato-and-corn-fodder silage was worth \$6.33 per ton in replacement value at existing feed prices.

Each ton fed equaled 150.1 pounds of barley, 611.3 pounds of alfalfa and 2.6 pounds of salt. The addition of $\frac{1}{4}$ pound of cottonseed meal increased the gain per lamb 1.7 pounds but increased the feed cost \$1.05 per cwt. and as there was no increase in valuation applied, the use of the protein concentrate increased the loss 45 cents per head.

Siloed beet pulp. Fed with barley and alfalfa hay siloed beet pulp produced the cheapest and most efficient gains in the experiment. Wet beet pulp fed in this standard beet by-product ration showed a replacement value of \$3.93 per ton fed. It cost \$2.06 per ton delivered to the lambs. Each ton of pulp fed to the lambs replaced 115.1 pounds of barley and 345.5 pounds of alfalfa but required 1.5 pounds more salt.

The addition of $\frac{1}{4}$ pound of cottonseed meal to the wet pulp-barley-alfalfa combination increased the gain per lamb 1.7 pounds but increased the feed cost per cwt. gain by 91 cents and increased the loss per lamb by 37 cents.

The addition of a protein concentrate (cottonseed meal) at the rate of $\frac{1}{4}$ pound per head daily did not produce customary increases in gain evident in earlier tests. It did not pay to use the protein supplement in any of the comparisons made in the present test.

Series 2.

Molasses for Fattening Lambs

There is considerable interest in the comparative feeding value of different kinds of molasses for livestock. The sugar beet and sugar cane at present supply the molasses used for animal feeding in this country.

In the production of beet sugar the residue molasses depending on available equipment is now subjected to special processes for the further extraction of sugar. The original discard molasses known as "foreign" molasses is first steffenized, a process consisting of the addition of lime under proper conditions. The molasses discarded after this operation is known as Steffens molasses. A newer recovery process makes use of barium which is used on the Steffens molasses for further recovery of sugar and a final molasses residue which altho much smaller in total volume than the original amount may contain as much or even more feed nutrients per pound than the original.

According to chemists the character of the feeding value of all molasses from whatever source varies within rather narrow limits. They state that when sugar is crystallized from the syrup and the crystals are separated, a mother liquor remains which contains all of the impurities which were originally in the juice together with an amount of sugar of rather fixed proportions. The impurities present in the syrups are always associated with a definite ratio of sugar which is non-crystallizable in the final molasses. This ratio is approximately 60 parts of sugar for each 40 parts of impurities.

When a part of the sugar in the "foreign" beet molasses is precipitated with lime in the Steffens process a part of the impurities are also precipitated and carried into the syrups. These impurities associate themselves with sugar in the 60-40 ratio and the final molasses is very similar to the original except that it is much reduced in volume. The same procedure again takes place when the barium process is used on the Steffens discard molasses but in this case the final discard molasses in addition to its quota of sugar contains about 15 percent of raffinose, which is a carbohydrate and which should enhance its value over the other discard molasses.

A direct comparison of the feeding value of cane molasses and the various kinds of discard beet molasses was made with a shelled-corn and alfalfa ration.

TABLE II—a
Lamb-Feeding Experiment—Colorado Experiment Station **25 Lambs per lot fed 127 days (October 23, 1929 to February 27, 1930)**
 (Table based on one average lamb)

Lot Number	1	6	5	7	9	11	13	14
Ration fed	Shelled corn	Whole barley	Shelled corn Beet mol. (final discard)	Shelled corn Beet mol. (Steffens discard)	Shelled corn Beet mol. (Foreign)	Shelled corn Cane mol.	Gr. mix. Barley Beet Molasses C. S. meal Alf. meal	Gr. mix. Barley Beet Molasses C. S. meal Alf. stem meal
Weight at start—lbs.	67.2	68.0	67.9	68.2	68.8	68.6	69.1	69.4
Final weight (Denver) lbs.	99.4	98.2	101.0	100.2	101.5	100.0	101.8	102.2
Gain at market	32.2	30.2	33.1	32.0	32.7	31.4	32.7	32.8
Average daily gain (market weight) .....	.25	.24	.26	.25	.26	.25	.26	.26
Shipping shrink	2.93	.81	3.63	6.88	2.60	2.91	5.57	5.02
Average daily feed—lbs.								
Shelled corn	1.03		.79	.79	.79	.79		
Barley .....		.95					.95	.93
Beet molasses (Final discard) .....			.36					
Beet molasses (Steffens discard) .....				.36			.49	.47
Beet molasses (Foreign) .....					.37			
Cane molasses .....						.36		
Cottonseed meal .....							.23	.22
Alfalfa hay	2.12	2.26	2.16	2.20	2.18	2.24		
No. 2 Alfalfa meal							1.74	
No. 1 Alfalfa stem meal								1.74
Salt .....	.002	.001	.001	.001	.001	.001	.001	.001
Feed required per 100 lbs. gain (at market)								
Shelled corn	406.3		303.7	313.8	308.6	320.1		
Barley		398.7					370.3	358.8
Beet molasses (Final discard)			139.3					
Beet molasses (Steffens discard)				143.6			188.9	182.7
Beet molasses (Foreign)					143.4			
Cane molasses						146.9		
Cottonseed meal							89.6	86.9
Alfalfa hay	836.8	949.4	830.1	870.3	847.0	906.0		
No. 2 Alfalfa meal							673.9	
No. 1 Alfalfa stem meal								672.3
Salt	6.2	5.3	3.6	4.1	4.8	4.4	4.4	5.5
Feed cost per 100 lbs. gain (at market)	12.62	11.90	12.30	12.80	12.55	13.19	15.38	15.06

Chemical Analysis of Molasses Used in the Experiment—(Dry Basis)

	Ash	Crude Protein	N. F. Extract
Johnstown final discard molasses	6.25	1.86	91.89
Steffens discard molasses	8.34	5.75	85.91
Foreign beet molasses	12.11	6.44	81.45
Cane molasses	14.16	3.41	82.43

Final discard beet molasses produced the heaviest gains, lowest feed cost per cwt. gain and least loss per head. At present prices it had a feed replacement value of \$23.07 per ton. Each ton of final discard beet molasses fed with shelled corn and alfalfa replaced 1473.1 pounds of corn, 96.2 pounds of alfalfa and 37.5 pounds of salt. This molasses proved to be just as palatable as any of the other kinds in fact slightly more palatable than the cane molasses.

“Foreign” beet molasses showed a feed replacement value of \$19.55 per ton. Each ton of molasses fed with shelled corn and alfalfa hay replaced 1362.6 pounds of shelled corn and 19.53 pounds of salt but required 142.3 pounds more alfalfa.

Steffens discard beet molasses showed a feed replacement value of \$13.17 per ton. Each ton of molasses fed with shelled corn and alfalfa replaced 1089 pounds of shelled corn and 29.3 pounds of salt but required 466.6 pounds of additional alfalfa.

Cane molasses showed the lowest feed replacement value in the test. Each ton of cane molasses fed replaced 1173.6 pounds of alfalfa and 24.5 pounds of salt but required 942.1 pounds additional alfalfa. At existing feed prices the cane molasses showed a replacement value of \$10.96 per ton.

A cut mixture of ground barley, beet molasses, cottonseed meal and alfalfa did not prove as cheap nor efficient as ordinary hand-fed rations containing whole grain, whole hay and by-products for fattening lambs.

An alfalfa stem meal (guaranteed 9 percent protein) showed slightly better results than an alfalfa meal (guaranteed 13 percent protein) when used in a self-fed mixture containing beet molasses, barley and cottonseed meal. There was apparently very little difference between the two roughages.