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Feeding Steers

On

Sugar Beet Pulp,
Alfalfa Hay and
Ground Corn.

BY W. L. CARLYLE AND C. J. GRIFFITH.

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THE VALUE OF SUGAR BEET PULP, ALFALFA HAY AND GROUND CORN IN FATTENING STEERS.*

By W. L. Carlyle and C. J. Griffith.

In bulletin number 97 of this Station is given the results of an experiment which was undertaken for the purpose of determining if sugar beet pulp is a suitable food when fed with alfalfa hay and farm grains for beef production. The results obtained were not considered final, though of importance as indicating that sugar beet pulp when fed in combination with alfalfa hay and farm grains will produce an excellent quality of beef at a very low cost.

The object of the experiment here reported was to determine more fully the comparative value of alfalfa hay, sugar beet pulp and corn, when fed singly and in various combinations to ordinary range steers.

Plan of Experiment.

In planning the experiment we had the hearty co-operation of the Fort Collins-Colorado Sugar Company, through its manager, Mr. R. M. Booraem, to whom the station is greatly indebted for many courtesies, as well as the stock, feed, corrals, labor, and all necessary conveniences for conducting the experiment.

The forty-eight steers selected for the experiment were taken from a lot that had been fed on alfalfa hay and beet pulp for some weeks, and, previous to that time, had been ranging on the beet fields and feeding upon beet tops. They were of mixed breeding,

*Other bulletins relating to the feeding of Sugar Beets and Sugar Beet Pulp have been published by the Experiment Station, and may be had on request of the Director.
73.—Part 1.—Feeding Value of Beet Pulp. Part 2.—Feeding Beet Pulp and Sugar Beets to Cows. By Buffum and Griffith, 1902.
74.—Swine Feeding. By Buffum and Griffith, 1902.
75.—Lamb Feeding Experiment. By Buffum and Griffith, 1902.
77.—Feeding Beet Pulp to Lambs. H. H. Griffin, 1902.
97.—Feeding Steers on Sugar Beet Pulp. Carlyle, Griffith and Meyer, 1905.

Shorthorn and Hereford blood predominating, and were below the average in quality. They were two years of age with one or two in each lot probably three years past. When the experiment was started on December 30, these steers averaged in weight between 950 and 960 pounds. They were divided as evenly as possible into four lots of twelve each, care being taken to have an equal number of promising and unpromising feeders in each lot. They were confined in four small corrals in close proximity to the Fort Collins sugar factory, water being provided in a large trough, a portion of which projected into each corral. The fences, feed racks and feed boxes provided for the pulp and grain were such as are used for this purpose by all feeders in Northern Colorado.

The different rations to be fed were as follows:

- LOT I.—Alfalfa hay, beet pulp and ground corn.
- LOT II.—Alfalfa hay and ground corn.
- LOT III.—Alfalfa hay and beet pulp.
- LOT IV.—Alfalfa hay.

The alfalfa hay was fed *ad libitum* to the steers in each of the lots and was weighed in bulk as it was hauled to the corrals and placed in a small enclosure where it could be readily forked close to the feed rack, from which place, on the ground, it was eaten. This system of weighing the feed in large quantities accounts for the wide variation in amounts charged to the steers in the various week-periods of the experiment.

The hay was much below the average of the best Northern Colorado alfalfa hay, as it was very coarse as a rule and had been much spoiled in curing.

The pulp fed to Lots I and III was also fed *ad libitum* and was placed fresh in the feed boxes or "bunks" twice each day.

The corn was of good quality, and was rather coarsely ground in a local mill, being fed in limited quantities once each day just after noon. The amount of corn meal fed was very small at the beginning, but was gradually increased. Two pounds per head was given the first week, three pounds the second week, and four pounds during the third and fourth weeks. Five pounds was given during the fifth and sixth weeks, and eight pounds during the seventh and eighth weeks, after which the amount was increased gradually until the last two weeks of the experiment, when each steer on the average in the two lots received eleven pounds daily. The amount of corn meal for each week's feeding was weighed out in advance, and approximately the same amount was fed each day, care being taken to see that all was fed out during the week, and as evenly apportioned as possible daily by measure.

The steers in each lot were weighed on Saturday of each week, the weights being recorded as they were taken.

Total Feed, Weight and Gain, With Average Weight and Gain of Each Steer.

Table I.—Lot I. Fed Beet Pulp, Hay and Ground Corn.

Date.	Pulp.	Hay.	Corn.	Total Weight.	Total Gain.	Average Weight.	Av. Weekly Gain.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Dec. 30.....				11415		951	
Jan. 7.....	9830	6315	216	12210	795	1018	66
" 14.....	6980	2580	252	12405	195	1034	16
" 21.....	8895	785	336	12260	-145	1022	-12
" 28.....	10470	830	336	12365	105	1030	6
Feb. 4.....	8830	1290	420	12840	475	1070	40
" 11.....	5220	2905	420	*			
" 18.....	8617	1000	588	13120	280	1093	23
" 25.....	7849	2475	588	13075	- 45	1090	- 3
Mar. 4.....	6435		672	13425	350	1119	29
" 11.....	7447		672	13800	375	1150	31
" 18.....	9331	1555	750	14110	310	1176	26
" 25.....	8815	2360	840	14220	110	1185	9
Apr. 1.....	6113	1900	924	14645	425	1220	35
" 8.....	7285		924	14578	- 67	1215	- 5
Total	112117	23995	7944	14578	3163		19

*not weighed.

Table II.—Lot II. Fed Hay and Ground Corn.

Date.	Hay.	Corn.	Total Weight.	Total Gain.	Average Weight.	Av. Weekly Gain.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Dec. 30.....			11615		968	
Jan. 7.....	6530	216	12140	525	1012	44
" 14.....	2870	262	12365	225	1030	18
" 21.....	2725	336	12420	65	1035	5
" 28.....	1920	336	12295	-125	1025	-10
Feb. 4.....	3050	420	12760	455	1063	38
" 11.....	4120	420	*			
" 18.....	2430	588	12975	215	1081	-18
" 25.....	2105	588	12750	-225	1093	-18
Mar. 4.....	1005	672	12995	245	1083	20
" 11.....	1005	672	13285	290	1107	24
" 18.....	1550	856	13520	235	1127	20
" 25.....	3290	840	13535	15	1128	1
Apr. 1.....	2980	924	13725	190	1144	16
" 8.....	1940	924	13725	0	1144	0
Total	37520	7944	13725	2110		12.6

*not weighed.

Table III.—Lot III. Fed Beet Pulp and Hay.

Date.	Pulp.	Hay.	Total Weight.	Total Gain.	Average Weight.	Av. Weekly Gain.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Dec. 30.....			11290		941	
Jan. 7.....	11630	5375	11850	560	988	47
" 14.....	7700	2580	12110	260	1009	21
" 21.....	9055	785	11990	-120	999	-10
" 28.....	11085	830	12050	60	1004	5
Feb. 4.....	9550	1290	12260	210	1022	18
" 11.....	5220	2905	*			
" 18.....	8617	1060	12460	200	1036	16
" 25.....	7849	865	12625	165	1052	14
Mar. 4.....	7165	1650	12735	110	1061	9
" 11.....	7447	1055	13035	300	1086	23
" 18.....	9831	945	13310	275	1109	23
" 25.....	8730	3610	13265	- 45	1105	- 4
Apr. 1.....	6113	1500	13590	325	1132	27
" 8.....	7285	1880	13500	- 90	1125	- 7
Total	11677	26270	13500	2210		131

*not weighed.

Table IV.—Lot IV. Fed Hay.

Date.	Hay.	Total Weight.	Total Gain.	Average Weight.	Av. Weekly Gain.
	lbs.	lbs.	lbs.	lbs.	lbs.
Dec. 30.....		11620		962	
Jan. 7.....	8970	12515	695	1026	58
" 14.....	3380	12480	165	1040	14
" 21.....	2465	12375	-105	1031	- 9
" 28.....	3340	12480	105	1040	9
Feb. 4.....	2820	12515	35	1043	3
" 11.....	3940	*			
" 18.....	1480	12655	140	1055	12
" 25.....	2760	12665	230	1074	19
Mar. 4.....	2549	12795	- 90	1066	- 8
" 11.....	2260	13245	450	1104	38
" 18.....	3165	13155	- 90	1096	- 8
" 25.....	4250	13340	185	1112	16
Apr. 1.....	5165	13295	- 45	1108	- 4
" 8.....	3420	13380	95	1115	8
Total	49795	13380	1760		103

*not weighed.

In tables I to IV is given the data in tabulated form of the amounts of feed eaten by the steers in each of the lots; also the gains made each week by each lot. As was the case in similar data given in bulletin No. 97, relating to the feeding of steers, there were a number of weekly weighings when the steers in each lot showed a loss as compared with the weights given the week previous. In this experiment, however, there was apparently no specific cause for the variation in the thrift of the animals. In the preceding experiment the steers in the different lots appeared to gain or lose weight in unison, but in this case there was more variation in the different lots from week to week, it being more apparent in Lot IV, in which the steers were fed only hay. The great variation in rate of gain in this lot might be accounted for by the more variable appetite of the animals when fed on a single kind of feed while the steers in the other lots that were receiving a mixed ration

would be more likely to have a greater relish for their food at all times.

It will be observed that the steers in Lot I that received a mixed ration composed of pulp, alfalfa hay and ground corn made an average weekly gain of 19 lbs. during the experiment, or an average daily gain for each steer of 2.7 lbs. The steers in Lot II receiving alfalfa hay and ground corn, the amount of the latter feed being exactly the same as was received by the steers in Lot I, made a gain of but 12.6 lbs. per week, or an average daily gain of but 1.8 lbs., a difference of .9 of a pound in the average daily gain of each steer. The steers in Lot III, receiving pulp and alfalfa hay, made an average weekly gain of 13.1 lbs., or an average daily gain of 1.9 lbs., and received no grain of any kind during the experiment.

The steers in Lot IV that received nothing but alfalfa during the entire experiment made an average weekly gain of 10.5 lbs. or an average daily gain on each steer of 1.5 lbs.

For this experiment, the prices charged for feed were such as the average feeder paid in the vicinity of Fort Collins, viz., alfalfa hay, \$5.00 per ton; corn, 85 cents per cwt., and beet pulp at 50 cents per ton. The pulp was received from the sugar factory at a cost of 35 cents per ton. As there is much more labor entailed in feeding steers on pulp than where alfalfa hay and ground corn only are fed, we charged the pulp up to the steers at 50 cents per ton, allowing 15 cents per ton above market price for the difference in cost of labor in feeding pulp over the cost of labor in feeding hay and corn.

Table V.—Average Amount Feed Required for One Pound of Gain, and Cost of the Same.

	FOOD FED.			COST.
	Alfalfa.	Pulp.	Corn Meal.	
	lbs.	lbs.	lbs.	cts.
Lot 1.....	7.69	35.45	2.51	4.22
Lot 2.....	17.78		3.76	7.68
Lot 3.....	11.89	52.83		4.28
Lot 4.....	28.29			7.04

In table V is given the data showing the amounts of the various kinds of feed required to produce a pound of live weight gain on a rather rough bunch of steers rising three years old. From this table it will be seen that in case of Lot IV it required 28.29 lbs. of alfalfa hay, below the average in quality, to produce one pound of gain. With an average lot of good feeding steers, and alfalfa hay of good feeding quality, the indications are that one pound of gain would be produced for each 25 lbs. of alfalfa hay on the average.

When beet pulp ad. libitum was added to the ration of alfalfa hay in the case of Lot III, the amount of the latter required for a

pound of gain was reduced to 11.89 pounds, the steers requiring 52.83 pounds of beet pulp to replace 16.4 pounds of hay in producing a pound of gain. In other words 3.22 pounds of beet pulp when fed to steers in combination with alfalfa hay are equivalent to one pound of hay in feeding value, when the hay is fed as the entire ration. With alfalfa hay selling at \$5 per ton, beet pulp is therefore worth 1.59 cents per ton to combine with alfalfa in the production of beef.

By adding ground corn to the ration of alfalfa hay in the case of Lot II, it will be seen that 3.76 lbs. of ground corn when added to the ration of alfalfa hay resulted in reducing the amount of hay required for one pound of gain from 28.29 lbs. to 17.78 lbs., the steers in this lot requiring 3.76 lbs. of ground corn to replace 10.51 lbs. of hay in producing a pound of gain. In this case 3.76 lbs. of corn was equivalent to 10.51 lbs. of hay, or one pound of corn was equal in feeding to 2.8 lbs. of hay when fed in conjunction with a ration of alfalfa hay in fattening steers. With alfalfa hay selling at \$5 per ton, ground corn, according to the results of this trial, should be worth at least \$17.85 per ton, which indicates that corn at 85 cents per hundred could be fed with practically equal profit with alfalfa hay at \$5 per ton.

In Lot I, where both ground corn and beet pulp was added to the hay ration, it will be seen that the amount of hay required for a pound of gain was reduced to 7.59 lbs., this reduction being accomplished by the use of 35.45 lbs. of pulp and 2.51 lbs. of ground corn. We have seen from the comparison of nutrient values in pulp and hay, in the case of Lots III and IV, that one pound of hay was equivalent to 3.22 lbs. of pulp, and from the data in the case of Lots II and III, that one pound of corn was equivalent to 2.8 lbs. of alfalfa hay, consequently by reducing the amounts of pulp and corn, fed in conjunction with hay to the steers in Lot I, to their equivalent in hay, we should find, other things being equal, that this, together with the hay fed to Lot 1, should equal the amount of hay required by the steers in Lot IV for the production of a pound of gain.

It has been shown that 3.22 pounds of pulp equaled one pound hay; therefore 35.45 pounds of pulp is equal to 11 pounds of hay. We have also seen that one pound of corn is equal to 2.8 pounds of hay, therefore 2.51 pounds of corn is equal to 7.03 pounds of hay. The steers in Lot I therefore had the equivalent of 11 pounds of hay in the pulp fed them, and the equivalent of 7.03 pounds of hay in the corn fed, which, together with the amount of hay actually fed, amounting to 7.59 pounds, makes a total of 25.62 pounds of hay required for one pound of live weight gain. Since the steers in Lot I required 28.29 pounds of hay for one pound of gain, we therefore have a balance of 2.67 pounds of hay or 9.43 per cent. as the amount saved by feeding steers a combination of feeds rather than one kind singly.

Table VI.—Showing the Average Weights and Gains. Also the Average Amount of Feed Eaten and the Average Cost per Head for 100 Days.

	Average Weight at Beginning.	Average Weight at End.	Average Gain Made.	FOOD FED PER HEAD.			Cost of Feed Per Head.
				Alfalfa.	Pulp.	Corn Meal.	
Lot 1.....	951	1215	263	1999	9343	662	\$12.95
Lot 2.....	968	1114	176	3137		662	13.43
Lot 3.....	941	1125	184	2189	9729		7.90
Lot 4.....	968	1115	147	4149			10.32

Table VII.—Selling Price of Each Lot and Average Weight and Price of Each Steer at Denver,

			Average Weight	Average Price.
Lot 1.....	12 head, 13,890 lbs. at \$5.15 per cwt....	\$713.29	1157	\$59.44
Lot 2.....	9 head, 10,080 lbs. at \$5.15 } 3 head, 2,980 lbs. at \$4.75 } \$5.06	660.83	1037	55.06
Lot 3.....	12 head, 12,600 lbs. at \$5.00	630.90	1049	51.66
Lot 4.....	9 head, 9,820 lbs. at \$4.80 } 3 head, 2,980 lbs. at \$4.50 } \$4.72.	603.07	1062	50.25

In Table VI may be seen the average weight of each steer in the different lots at the beginning and close of the experiment, and the average amounts of the various kinds of feed eaten per head and the cost of the same. This table should prove of value to the prospective feeder, since from it by bearing in mind that the figures represent an average of 12 steers in each case, and that the time covered was just 100 days, it should be an easy matter to get a very close estimate of the amount of feed required for a lot of steers for any stated period; also the approximate amount of feed that will be required.

In Table VII is given the data gathered from the marketing of the steers. They were shipped to Denver and sold on the open market to the highest bidder. It is only fair to state here that none of the buyers in the yards knew anything of the kinds of feed given the different lots. It will be seen that Lots I and II sold for the same price with the exception that three steers from Lot II were cut back and were valued at 35 cents per hundred less than the rest of the lot. All of the steers in Lot III sold for the same price, while of those in Lot IV, three were cut 30 cents per hundred. It has been a noteworthy fact through the entire experiment that the steers in the pulp fed lots were more uniformly thrifty than those that had no pulp.

FINANCIAL STATEMENT.

Table VIII.—Lot I.

11,415 lbs. at 3c.....	\$342.45	
23,995 lbs. Alfalfa at \$5.00 per ton.....	59.98	
112,117 lbs. Pulp at 50c per ton.....	28.02	
7,944 lbs. Corn at 85c per cwt.....	67.72	
Labor.....	39.00	
Freight.....	14.44	
Yardage.....	3.00	
Feed at Stock Yards.....	8.40	
Total cost.....	\$563.01	
Sold for.....	715.33	
Profit.....	\$152.32	
Profit per head.....	12.60	

Table IX.—Lot II.

11,680 lbs. at 3c.....	\$348.60	
37,520 lbs. Alfalfa at \$5 per ton.....	93.80	
7,944 lbs. Corn at 85c.....	67.72	
Labor.....	39.00	
Freight.....	14.44	
Yardage.....	3.00	
Feed at Stock Yards.....	8.40	
Total cost.....	\$574.96	
Sold for.....	660.67	
Profit.....	\$ 85.71	
Profit per head.....	7.14	

Table X.—Lot III.

11,290 lbs. at 3c.....	\$338.70	
26,270 lbs. Alfalfa at \$5 a ton.....	65.67	
116,757 lbs. Pulp at 50c a ton.....	29.18	
Labor.....	39.00	
Freight.....	14.44	
Yardage.....	3.00	
Feed at Stock Yards.....	8.40	
Total cost.....	\$498.39	
Sold for.....	630.00	
Profit.....	131.61	
Profit per head.....	10.97	

Table XI.—Lot IV.

11,620 lbs. at 3c.....	\$348.60	
49,795 lbs. Alfalfa at \$5.00 a ton.....	124.48	
Labor.....	39.00	
Freight.....	14.40	
Yardage.....	3.00	
Feed at Stock Yards.....	8.40	
Total cost.....	\$537.88	
Sold for.....	603.07	
Profit.....	\$ 65.19	
Profit per head.....	5.43	

Tables 8 to 11 inclusive give a very complete financial statement for each lot of steers. While it is not the primary object of these experiments to make them financially successful, yet it is gratifying to learn that in all cases and with all kinds of feed rations, there is a fair margin of profit which is certainly encouraging to the general feeder in Colorado.

SUMMARY.

Table XII. — Giving Data for an Average Steer in Each Lot

	Lot 1.	Lot 2.	Lot 3.	Lot 4.
Weight at beginning of experiment (lbs.)..	951	968	941	968
Value at 3 cents per pound ..	\$28.53	\$29.04	\$28.23	\$29.04
Cost entire period, 100 days ..	\$12.95	\$13.44	\$ 7.90	\$10.39
Cost of feed for 100 lbs. gain ..	\$ 4.60	\$ 7.63	\$ 4.29	\$ 7.04
Cost of labor in feeding ..	\$ 3.25	\$ 3.25	\$ 3.25	\$ 3.25
Weight finished steer at feed lots. (lbs.)..	1214	1144	1125	1115
Sale weight of steer at Denver (lbs.)..	1157	1088	1050	1062
Shrinkage in shipping (lbs.) ..	57	56	75	53
Selling price per hundred pounds ..	\$ 5.15	\$ 5.06	\$ 5.00	\$ 4.73
Value at selling price ..	\$50.58	\$55.05	\$52.25	\$50.25
Cost of marketing ..	\$ 2.15	\$ 2.15	\$ 2.15	\$ 2.15
Net profits ..	\$12.70	\$ 7.16	\$10.97	\$ 5.44

In Table XII is given a complete summary showing the average of each steer in the various lots. In this table is given very complete data covering the various points of comparison in the results obtained with the average steer in each lot.

CONCLUSIONS.

1. An average "feeder" steer two years old will make a gain of 1.5 lbs. per day on alfalfa hay alone, and will require approximately 28 lbs. of hay to make one pound of gain.

2. The addition of ground corn to the ration of alfalfa hay will increase the daily gain, increase the market price of the steer by finishing him better in a given time, and will add to the profits if the corn can be procured below 90 cents per hundred pounds.

3. A pound of ground corn is equal in feeding value to 2.8 lbs. of alfalfa hay and to 9 pounds of sugar beet pulp for feeding two-year-old fattening steers.

4. Sugar beet pulp at present prices is a cheaper and better feed than ground corn when fed with alfalfa hay for fattening mature steers.

5. That 3.22 of beet pulp is equivalent in feeding value to one pound of alfalfa hay, when fed in conjunction with the hay, giving two-year-old steers all they will eat of both feeds.

6. With alfalfa hay at \$5 a ton, it will pay to feed a light ra-

tion of ground corn with the hay, provided the corn can be purchased at from 85 to 90 cents per hundred weight.

7. With poor alfalfa hay at \$5 per ton, sugar beet pulp is worth \$1.50 per ton to combine with the hay for fattening mature steers.

8. Fattening steers will gain approximately a pound a day more on a ration composed of alfalfa hay, ground corn and beet pulp than they will on a ration made up of alfalfa hay and ground corn or on a ration composed of alfalfa hay and sugar beet pulp, and they will gain almost one and a half pounds more each day on the above ration than when fed alfalfa hay alone.