

Experiment Station
of the
Kansas State Agricultural College
MANHATTAN.

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Ft. Hays Branch.

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Western Feeds for Beef Production.

The farming of Western Kansas is little diversified; nearly all are wheat growers and very little attention is given to any other branch of agriculture. This method necessitates a large force of men and horses to do the work during harvest and seeding time, and during the other eight months of the year there is little to do and many farmers are idle. As all the work thus comes at so nearly the same time, the farmer is compelled to pay such high wages for help that his net profits are not what they should be. Also, the question naturally arises: How long can the farm keep on producing crops when nothing goes back to the soil to enrich it? In the Eastern States, where the soil a generation ago was considered so rich in plant food that it was practically inexhaustible, today fertilizer is required to insure best results. With an abundance of alfalfa hay, which is the best-known roughage, it behooves the western farmer so to manage his affairs that a part of each crop, at least, may be fed on the farm and go back to the fields in the form of fertilizer.

In order to interest the people in a more general system of farming, the Fort Hays Branch Experiment Station decided to feed eight lots of two-year-old steers and test various rations of western-grown feeds. Sixty-four head of grade Shorthorn and grade Hereford cattle were secured for this purpose. Of these,

*The experiment here recorded was planned and begun under the superintendency of Mr. Haney, whose connection with the Station ceased December 31, 1904, and since which date Mr. Elling has been acting as superintendent.

thirty-two were bought on the Kansas City market, through Farrar-Davis Commission Company, in June, 1904; a part of these were natives, but quite a number were branded cattle from the South and West. Nineteen head were purchased in the vicinity of the Experiment Station, and thirteen were raised on the Station farm. The sixty-four head were divided equally according to weight, color, and individual characteristics, into eight lots of eight steers each, and each lot fed a different ration. They were taken directly off good pasture November 19 and, with the exception of a little roughage, no preliminary feed was given. On the 19th and 20th of November each lot was fed 50 pounds of the same kind of roughage that it was to get during the experiment, and November 21 the experiment proper began.

The steers were weighed individually on November 19, 20, and 21, and an average of these three weights taken as the beginning weight of each animal. They were very common cattle and showed few points of good breeding. The object in securing this medium grade of steers was to demonstrate what can be done with cattle such as are ordinarily handled by most feeders. All had been dehorned as yearlings and a part of them were accustomed to being handled, but quite a number were rather wild and difficult to weigh the first few times. Some would shy off to the further end of the lot while being fed at first, but this was soon overcome by careful handling.

FEED.

The roughage fed in the experiment was grown by the Experiment Station. The alfalfa hay was mostly of good quality, although a part of it was slightly stack burnt. The Kafir-corn and sorghum hays were cut just before the seed was ripe. They had been seeded rather thickly, and would not be called coarse hay, while on both sorghum and Kafir-corn there was more or less seed and the quality was fair.

The corn was all native grown and only of fair quality. The wheat would grade No. 3. The Kafir-corn fed was of good quality.

YARDS.

The experiment was conducted under rather unfavorable conditions, no different, however, from those which confront the average farmer. The winter being unusually severe, with snow-storms and cold blizzards at frequent intervals, it was impossible to secure as heavy gains as would be expected under more favorable conditions. The feed lots were identical in every respect, thus the comparison should not in any way be influenced by the unfavor-

able circumstances. Each lot was provided with a board shed for shelter, 16x 16 feet, open to the south. The size of the enclosure is 230 x 70 feet, fenced with woven wire. Salt and water were within easy reach of the cattle at all times.

THE PLAN.

Three major lines of investigation were conducted. The first was a test to determine the relative economy of feeding corn-and-cob meal, ground Kafir-corn, ground wheat, and a mixed ration, for beef production; the second one to determine the comparative value of alfalfa hay, Kafir-corn hay, sorghum hay, and mixed hays, when fed with the above concentrated feeds; the third, a study of a wide, a medium, and a narrow nutritive ratio. It will be seen that the first is a test of grain rations, the second of roughages and the third of balancing of rations.

The several lots of steers were given numbers, and rations apportioned them as follows:

- Lot I..... Corn-and-cob meal and alfalfa hay.
- Lot II..... Kafir-corn, ground, and alfalfa hay.
- Lot III..... Wheat, ground, and alfalfa hay.
- Lot IV..... Corn-and-cob meal and Kafir-corn hay.
- Lot V..... Kafir-corn, ground, and Kafir-corn hay.
- Lot VI..... Corn-and-cob meal and sorghum hay.
- Lot VII..... Kafir-corn, ground, and sorghum hay.
- Lot VIII..... Mixed ration: $\frac{1}{3}$ corn-and-cob meal, $\frac{1}{3}$ ground Kafir-corn, $\frac{1}{3}$ ground wheat. Roughage: $\frac{1}{3}$ each of alfalfa, Kafir-corn hay, and sorghum hay.

The object of the experiment was, in brief, to make a thorough test with western-grown feeds to determine the most economical and practical combination as a beef-producing ration. Further, to test very wide, medium and narrow rations with one that has the proper proportion of protein and carbohydrates in the feed to approximate the requirements of the feeding standard, even though not a balanced ration. Lastly, to interest the people in a more general system of farming.

THE FEEDING.

With all the lots, the roughage was fed whole in the bottom of the feed troughs and the chopped grain poured over it. The feeding was done twice daily, at regular hours morning and evening. The grain and hay was weighed out to each lot at every feed.

The advisability of feeding a heavy grain ration is frequently questioned by the practical feeder. Especially is this true in the West, where corn and other grains are usually scarce and, consequently, high priced, while, on the other hand, alfalfa and other roughage is abundant and low in price. The feeding was done with this fact in view.

The cattle were started on feed with all the roughage they would clean up, which was an average of 15 pounds per head, daily, and with a grain ration of $4\frac{1}{2}$ pounds per head, daily. The quantity of grain was gradually increased and the roughage cut down when it appeared necessary. As no hogs were to follow, the question of economy in the feed lot was considered, and all the grain was ground in order that the steer might produce the most possible pounds of flesh for each bushel of grain fed. At the close of the first month they were eating an average of $6\frac{1}{2}$ pounds of grain and 16 pounds of roughage per head, daily. At this time it was evident that the grain ration of lot III, on account of the loosening effect of alfalfa hay and ground wheat, would need to be increased very cautiously; and the lots fed ground Kafir-corn increased more slowly than those being fed corn-and-cob-meal. From the beginning to the close of the experiment it was the object to make as much of the gain with the roughage as is practicable, and all lots, with the exception of No. III, were given all the hay they would clean up readily. At the close of the third month, lots I, IV, and VI, fed corn-and-cob-meal as a grain ration, were getting $14\frac{1}{2}$ pounds of grain per head, daily, and those fed ground Kafir-corn, lots II, V, and VII, were getting $12\frac{1}{2}$ pounds of grain per head, daily, while lot III, was being fed but 10 pounds of ground wheat per head, daily, and not as much roughage as the other lots.

By the fifth month, the roughage of every lot had been materially decreased and all were getting as much grain as they would clean up well, which was about 21 pounds daily, except lot III, which was getting only 14 pounds per head, daily, because when more wheat was fed the cattle would scour.

The steers were weighed individually once every two weeks during the feeding to note the gain of each animal. April 20 to 22, they were weighed three days in succession, and the experiment proper closed on April 22. At this time it was evident that the lots getting no alfalfa would not be in a marketable condition soon enough, so their rations were gradually changed to corn and alfalfa and all the steers fed twenty-eight days longer to prepare the poorer lots for market.

The following tables, Nos. I to VIII, inclusive, give the gains and costs of gains for each lot by fourteen day periods, totals for the duration of the experiment, 152 days, and other data of interest in connection.

TABLE I.—LOT I. EIGHT STEERS FED CORN AND ALFALFA.

PERIOD.	No. of days.	Mean temp. °F.	Corn.			Alfalfa.			Nutritive ratio.	Weight in pounds.			Gain in pounds.			Cost of 100 pounds gain.		
			Pounds eaten.	Cost.	Pounds eaten daily av.	Pounds for 100 pounds gain.	Pounds eaten.	Cost.		Pounds eaten Daily av.	Pounds for 100 pounds gain.	Beginning of period.	End of period.	Av. per steer at close.	Total, of lot.		Av. per steer.	Av. per day per steer.
Nov. 21 to Dec. 3, '04.	12	43	442	\$ 2 84	36.8	529	1,390	\$ 2 78	115.8	1,853	1:5.15	6,740	6,815	\$ 52.0	23.12	1.78	\$ 7 49	
Dec. 3 to Dec. 17.	14	28	684	4 40	49.1	510	1,780	3 56	127.1	1,962	1:5.11	6,815	7,000	55.0	23.12	1.65	4 30	
Dec. 17 to Dec. 31.	14	30	784	5 04	56.0	534	1,820	3 64	130.0	2,053	1:5.25	7,000	7,335	917.0	41.87	2.99	2 59	
Jan. 1 to Jan. 14, '05.	14	20	976	6 27	69.7	1,591	1,820	3 64	130.0	2,090	1:5.87	7,335	7,405	925.7	8.75	0.62	14 16	
Jan. 14 to Jan. 28.	14	19	1,212	7 79	86.5	518	1,820	3 64	130.0	1,777	1:6.03	7,405	7,639	951.9	29.25	2.09	4 88	
Jan. 28 to Feb. 25*	28	14	3,218	20 69	114.9	483	3,530	7 06	126.0	1,730	1:6.77	7,639	8,305	1,028.0	83.25	2.97	4 16	
Feb. 25 to Mar. 11.	14	48	1,910	12 27	136.4	723	1,680	3 36	120.0	1,629	1:7.64	8,305	8,552	1,069.0	30.87	2.20	6 50	
Mar. 11 to Mar. 25.	14	50	2,074	13 33	148.1	730	1,680	3 36	120.0	1,526	1:7.52	8,552	8,871	1,109.0	39.87	2.58	2 58	
Mar. 25 to Apr. 8.	14	64	2,290	14 72	163.5	739	1,400	2 80	100.0	1,261	1:8.05	8,871	9,203	1,150.4	41.50	2.96	5 15	
Apr. 8 to Apr. 22.	14	48	2,426	15 61	173.3	1,006	1,120	2 24	80.0	1,161	1:8.92	9,203	9,444	1,180.5	30.13	2.15	7 36	
152 days†			16,016	\$102 96	105.3	592	18,040	\$36 08	118.7	667	1:6.79	6,740	9,444	1,180.5	2,704	338.00	2.22	\$ 5 13

*Three days blizzard prevented weighing at 14 day period. †Sold in Kansas City at \$5.25 after 180 days.

TABLE II.—LOT II. EIGHT STEERS FED KAfir-CORN AND ALFALFA.

PERIOD.	No. of days.....	Mean temp. °F.....	Kafir-corn.			Alfalfa.			Nutritive ratio.....	Weight in pounds.			Gain in pounds.			Cost of 100 pounds gain.....		
			Pounds eaten..	Cost.....	Pounds eaten daily av.....	Pounds for 100 pounds gain..	Pounds eaten..	Cost.....		Pounds eaten daily av.....	Beginning of period.....	End of period..	A. V. per steer at close.....	Total of lot....	A. V. per steer..		A. V. per day per steer.....	
Nov. 21 to Dec. 3, '04.....	12	43	442	\$ 3 63	36.8	401.0	1,390	\$ 2 78	115.8	1,263	1: 4.78	6,825	6,935	867.0	110	13.75	1.140	\$ 5 82
Dec. 3 to Dec. 17.....	14	28	684	5 62	49.1	621.0	1,780	3 56	127.1	1,618	1: 4.95	6,935	7,045	880.5	110	13.75	0.980	3 33
Dec. 17 to Dec. 31.....	14	30	784	6 44	56.0	257.0	1,820	3 64	130.0	596	1: 5.07	7,045	7,350	918.5	305	38.12	2.720	3 29
Jan. 1 to Jan. 14, '05.....	14	20	976	8 02	69.7	†	1,820	3 64	130.0	†	1: 5.29	7,350	7,280	910.0	70	8.75	0.625	†
Jan. 14 to Jan. 28.....	14	19	1,190	9 78	85.0	375.0	1,820	3 64	130.0	574	1: 5.06	7,280	7,597	949.5	317	39.62	2.830	4 23
Jan. 28 to Feb. 25.....	28	14	2,840	23 33	101.4	493.0	3,330	7 06	126.0	613	1: 5.79	7,597	8,173	1,021.5	576	72.00	2.570	5 28
Feb. 25 to Mar. 11.....	14	48	1,686	13 84	120.4	232.0	1,680	3 36	120.0	1,235	1: 5.58	8,173	8,309	1,038.5	136	17.00	1.210	12 59
Mar. 11 to Mar. 25.....	14	50	1,880	15 44	131.3	460.7	1,680	3 36	120.0	411	1: 6.27	8,309	8,717	1,089.5	408	51.00	3.640	4 60
Mar. 25 to Apr. 8.....	14	64	2,150	17 66	131.5	554.0	1,560	3 12	111.4	402	1: 6.57	8,717	9,105	1,138.0	388	48.50	3.460	5 35
Apr. 8 to Apr. 22.....	14	48	2,290	18 81	163.5	978.0	1,120	3 24	80.0	475	1: 6.54	9,105	9,341	1,167.6	236	29.50	2.100	8 98
152 days*			14,922	\$122 57	98.2	593.0	18,200	\$ 36 40	119.6	723	1: 5.86	6,825	9,341	1,167.6	2,516	314.50	2.060	\$ 8 30

*Sold in Kansas City at \$5.15 after 180 days. †No gain.

TABLE III.—LOT III. EIGHT STEERS FED WHEAT AND ALFALFA.

PERIOD.	No. of days.	Mean temp. °F.	Wheat.			Alfalfa.			Nutritive ratio.	Weight in pounds.			Gain in pounds.			Cost of 100 pounds gain.		
			Pounds eaten.	Cost.	Pounds eaten, daily av.	Pounds for 100 pounds gain.	Cost.	Pounds eaten, daily av.		Pounds eaten.	Cost.	Beginning of period.	End of period.	Av. per steer at close.	Total of lot.		Av. per steer.	Av. per day per steer.
Nov. 21 to Dec. 3, '04.	12	43	126	\$ 5 54	35.5	774	1,320	\$ 2 64	110.0	2,400	1 : 4.67	6,835	8,890	861.2	55	6.87	.57	\$14 86
Dec. 3 to Dec. 17.	14	28	621	8 12	44.5	378	1,640	2 23	117.1	994	1 : 4.71	6,830	7,055	882.0	165	20.62	1.47	7 50
Dec. 17 to Dec. 31.	14	30	701	9 15	50.3	265	1,630	2 26	120.0	634	1 : 4.75	7,055	7,320	915.0	265	33.12	2.36	4 70
Jan. 1 to Jan. 14, '05.	14	20	816	10 61	58.3	†	1,680	2 26	120.0	†	1 : 4.91	7,320	7,215	902.0	105	13.10	†	†
Jan. 14 to Jan. 23.	14	19	1,011	13 18	72.5	333	1,680	2 26	120.0	552	1 : 5.07	7,215	7,519	939.8	294	38.00	2.71	5 43
Jan. 23 to Feb. 25.	28	14	2,370	28 86	79.3	423	3,360	3 72	120.0	643	1 : 5.13	7,519	8,041	1,005.0	522	65.25	2.33	6 80
Feb. 25 to Mar. 11.	14	48	1,371	16 95	93.1	823	1,680	2 26	120.0	1,063	1 : 5.26	8,041	8,199	1,025.0	158	19.75	1.41	12 85
Mar. 11 to Mar. 25.	14	50	1,471	19 03	104.5	283	1,680	2 26	120.0	327	1 : 5.36	8,199	8,712	1,089.0	513	64.12	4.58	4 35
Mar. 25 to Apr. 8.	14	64	1,574	20 20	111.0	1,112	1,520	3 04	109.0	1,117	1 : 5.50	8,712	8,848	1,106.0	136	17.00	1.21	17 07
Apr. 8 to Apr. 22.	14	48	1,528	19 86	109.1	1,018	840	1 68	60.0	560	1 : 3.91	8,848	8,968	1,124.7	120	18.75	1.34	14 35
152 days*			11,654	\$151 50	76.7	538	17,080	\$34 16	112.3	789	1 : 5.16	6,835	8,998	1,124.7	2,163	270.30	1.77	\$ 8 56

*Sold in Kansas City at \$4.90 after 180 days. †No gain.

TABLE IV.—LOT IV. EIGHT STEERS FED CORN AND KAFIR-CORN HAY.

PERIOD.	No. of days.....	Mean temp. °F.....	Corn.				Kafir-corn hay.				Nutritive ratio.....	Weight in pounds.			Gain in pounds.			Cost of 100 pounds gain.....
			Pounds eaten..	Cost.....	Pounds eaten daily av.....	Pounds for 100 pounds gain..	Pounds eaten..	Cost.....	Pounds eaten daily av.....	Pounds for 100 pounds gain..		Beginning of period.....	End of period..	Av. per steer at close.....	Total, of lot.....	Av. per steer..	Av. per day per steer.....	
Nov. 21 to Dec. 3, '04.....	12	43	442	\$ 2 84	36.8	..... †	1,890	\$ 2 09	115.8	..... †	1:15.66	6,930	6,905	863.1	— 25	— 3.12	— .26 †
Dec. 3 to Dec. 17.....	14	28	684	4 40	49.1	..... †	1,780	2 67	127.1	..... †	1:15.32	6,905	6,880	880.0	— 25	— 3.12	— .22 †
Dec. 17 to Dec. 31.....	14	30	784	5 04	56.0	..... †	1,820	2 73	130.0	..... †	1:15.32	6,880	7,015	888.6	165	20.62	1.41 †
Jan. 1 to Jan. 14, '05.....	14	20	976	6 27	69.7	..... †	1,820	2 73	130.0	..... †	1:15.33	7,015	7,010	880.0	— 5	— 0.62	— .04 †
Jan. 14 to Jan. 28.....	14	19	1,212	7 79	86.5	..... †	1,820	2 73	130.0	..... †	1:15.12	7,010	7,254	906.7	214	26.70	1.92 †
Jan. 28 to Feb. 25.....	28	14	3,218	20 69	114.9	..... †	3,530	29 29	126.0	..... †	1:011	7,254	7,603	950.2	349	43.60	1.56 †
Feb. 25 to Mar. 11.....	14	48	1,876	12 06	134.0	..... †	1,680	2 52	120.0	..... †	1:14.91	7,603	7,806	975.7	203	25.40	1.41 †
Mar. 11 to Mar. 25.....	14	50	2,074	13 33	148.1	..... †	1,560	2 34	111.4	..... †	1:14.78	7,806	8,231	1,029.0	405	50.60	3.61 †
Mar. 25 to Apr. 8.....	14	64	2,290	14 72	163.5	..... †	1,560	2 34	111.4	..... †	1:14.77	8,231	8,150	1,056.2	219	27.40	1.95 †
Apr. 8 to Apr. 22.....	14	48	2,422	15 57	173.0	..... †	1,120	1 68	80.0	..... †	1:14.61	8,150	8,704	1,088.0	254	31.75	2.27 †
152 days*			15,978	\$102 71	105.0	..... †	18,200	\$27 30	119.6	1,025	1:14.98	6,930	8,704	1,088.0	1,774	221.70	1.45	\$7.32

*Sold in Kansas City at \$4.85 after 180 days. †No gain.

TABLE V.—LOT V. EIGHT STEERS FED KAFIR-CORN AND KAFIR-CORN HAY.

PERIOD.	No of days.....	Mean temp. °F.....	Kafir-corn.				Kafir-corn hay.				Nutritive ratio.....	Weight in pounds.			Gain in pounds.			Cost of 100 pounds gain.....
			Pounds eaten..	Cost.....	Pounds eaten daily av.....	Pounds for 100 pounds gain..	Pounds eaten..	Cost.....	Pounds eaten daily av.....	Pounds for 100 pounds gain..		Beginning of period.....	End of period..	Av. per steer at close.....	Total of loc....	Av. per steer..	Av. per day per steer.....	
Nov. 21 to Dec. 3, '04.....	12	43	442	\$ 3 63	36.8	1,390	\$ 2 09	115.8	1,383	1: 13.81	6,840	6,725	840.6	115	11.93	.994	11.37	
Dec. 3 to Dec. 17.....	14	28	684	5 62	49.1	1,780	2 67	127.1	1,783	1: 13.50	6,725	6,755	844.3	30	3.75	.267	3.62	
Dec. 17 to Dec. 31.....	14	30	784	6 44	56.0	1,820	2 73	130.0	1,823	1: 13.40	6,755	6,875	859.4	120	15.60	1.070	17.63	
Jan. 1 to Jan. 14, '05.....	14	20	9.6	8 02	63.7	1,636	2 73	130.0	1,633	1: 13.00	6,875	6,935	867.0	60	7.50	.536	17.90	
Jan. 14 to Jan. 28.....	14	19	1,190	9 78	85.0	1,746	2 73	130.0	1,743	1: 12.67	6,935	7,010	876.2	75	9.37	.670	16.66	
Jan. 28 to Feb. 25.....	28	14	2,840	23 23	101.4	3,530	5 29	126.0	1,164	1: 12.44	7,010	7,314	914.2	304	38.00	1.360	9.41	
Feb. 25 to Mar. 11.....	14	48	1,646	13 81	120.4	1,740	2 52	120.0	1,737	1: 12.07	7,314	7,542	942.7	228	28.50	2.130	7.18	
Mar. 11 to Mar. 25.....	14	50	1,880	15 44	134.2	1,680	2 52	120.0	1,677	1: 11.96	7,542	7,822	977.7	280	35.00	2.560	6.42	
Mar. 25 to Apr. 8.....	14	64	2,148	17 61	153.4	1,712	2 34	111.4	1,709	1: 11.64	7,822	7,964	935.5	142	17.75	1.270	14.07	
Apr. 8 to Apr. 22.....	14	48	2,290	18 81	163.5	1,122	1 68	89.0	1,119	1: 10.92	7,964	8,156	1,019.5	192	24.00	1.710	10.62	
152 days*			14,920	\$122 55	93.2	1,133	\$ 27 30	119.7	1,383	1: 12.43	6,840	8,156	1,019.5	1,316	164.50	1.080	\$11.37	

*Sold in Kansas City at \$4.85 after 180 days. †No gain.

TABLE VI.—LOT VI. EIGHT STEERS FED CORN AND SORGHUM.

PERIOD.	No. of days.	Mean temp. °F.	Corn.				Sorghum.				Nutritive ratio.	Weight in pounds.			Gain in pounds.			Cost of 100 pounds rain	
			Pounds eaten.	Cost.	Pounds eaten, daily av.	Pounds for 100 pounds gain.	Pounds eaten.	Cost.	Pounds eaten, daily av.	Pounds for 100 pounds gain.		Beginning of period.	End of period.	Av. per steer at close.	Total, of lot.	Av. per steer.	Av. per day per steer.		
Nov. 21 to Dec. 3, '04.	12	43	442	\$ 2 84	36.8	1,390	\$ 2 09	115.8	1,270	1: 19.54	6,820	6,730	847.5	—40	—5.000	—	.625	11 73	
Dec. 3 to Dec. 17.	14	28	684	4 39	49.0	1,780	2 67	127.0	2,966	1: 18.80	5,720	6,810	855.0	60	7.500		.535	11 73	
Dec. 17 to Dec. 31.	14	30	784	5 04	56.0	1,820	2 73	130.0	1,460	1: 18.62	6,840	6,950	871.2	130	16.200		1.170	5 97	
Jan. 1 to Jan. 14, '05.	14	20	976	6 25	69.8	1,820	2 73	130.0	7,280	1: 18.21	6,970	6,935	874.3	25	3.100		.221	5 97	
Jan. 14 to Jan. 28.	14	19	1,212	7 78	86.5	1,820	2 73	130.0	1,213	1: 17.76	6,335	7,115	893.1	150	18.750		1.340	7 01	
Jan. 28 to Feb. 25.	28	14	3,178	20 43	113.5	3,450	2 57	123.2	1,112	1: 17.19	7,115	7,155	932.0	310	38.750		1.380	7 35	
Feb. 25 to Mar. 11.	14	48	1,910	12 07	136.4	1,680	2 52	120.0	893	1: 16.68	7,115	7,443	955.3	188	23.500		1.670	7 35	
Mar. 11 to Mar. 25.	14	50	2,074	13 33	148.1	1,480	2 22	105.7	567	1: 16.35	7,443	7,911	988.0	261	22.600		1.610	7 35	
Mar. 25 to Apr. 8.	14	64	2,290	14 71	163.5	1,380	2 07	98.5	4,660	1: 16.07	7,911	7,967	986.0	3			.375	5 97	
Apr. 8 to Apr. 22.	14	48	2,174	14 24	155.3	1,120	1 68	80.0	350	1: 15.83	7,967	8,227	1,028.3	320	40.000		2.850	5 97	
152 days*			15,724	\$101 08	163.4	1,117	17.740	\$ 26 61	116.6	1,261	1: 17.29	6,820	8,227	1,028.3	1,407	176.000		1.150	9 06

*Sold in Kansas City at \$4.75 after 180 days. †No gain.

Historical Document
Kansas Agricultural Experiment Station

Jan. 1906]

Western Feeds for Beef Production.

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TABLE VII.—LOT VII. SEVEN STEERS FED KAFIG-CORN AND SORGHUM.

PERIOD.	No. of days.	Mean temp. °F.	Kafir-corn.				Sorghum.				Nutritive ratio.	Weight in pounds.			Gain in pounds.			Cost of 100 pounds gain.	
			Pounds eaten.	Cost.	Pounds eaten daily av.	Pounds for 100 pounds gain.	Pounds eaten.	Cost.	Pounds eaten daily av.	Pounds for 100 pounds gain.		Beginning of period.	End of period.	Av. per steer at close.	Total of lot.	Av. per steer.	Av. per day per steer.		
Nov. 21 to Dec. 3, '04.	12	43	387	\$ 3 18	32.25	+	1,216	\$4 1.82	101.23	+	1: 17.02	5,945	5,725	336.4	-90	-12.80	-1.060	+	
Dec. 3 to Dec. 17.	14	23	538	4 91	42.71	5,980	1,538	111.23	+	1: 16.42	5,725	5,845	337.3	10	1.42	-1.102	+		
Dec. 17 to Dec. 31.	14	30	686	5 61	49.00	334	1,592	113.71	+	1: 16.13	5,845	6,040	337.1	205	29.28	2 090	\$11 64		
Jan. 1 to Jan. 14, '05.	14	20	251	7 02	61.60	+	1,592	113.71	+	1: 15.36	6,040	5,980	335.7	-80	-11.40	-1.810	+		
Jan. 14 to Jan. 28.	14	19	1,041	8 55	74.35	5,824	1,592	113.71	900	1: 14.73	5,980	5,167	321.0	177	25.20	1.800	+		
Jan. 28 to Feb. 25.	28	14	2,482	20 39	88.64	725	1,480	110.32	963	1: 14.26	5,167	5,340	329.3	312	48.80	1.740	13 30		
Feb. 25 to Mar. 11.	14	48	1,475	12 11	105.35	1,365	1,470	105.00	1,361	1: 13.56	5,340	6,317	345.2	193	15.40	1.100	26 18		
Mar. 11 to Mar. 25.	14	50	1,645	13 51	117.50	2,741	1,470	105.00	2,450	1: 13.34	6,317	6,477	351.0	60	8.57	.612	8 47		
Mar. 25 to Apr. 8.	14	64	1,880	15 44	134.28	912	1,448	96.28	651	1: 12.69	6,477	6,723	353.2	206	29.40	2.160	10 37		
Apr. 8 to Apr. 22.	14	43	2,156	17 66	153.57	1,156	1,430	77.85	586	1: 12.25	6,723	7,049	1,010.0	183	27.00	1.930			
152 days*			13,198	\$108 41	86.80	1,174	16,017		\$24 02	105.30	1,425	1: 14.17	5,945	7,069	1,010.0	1,124	160.60	1.050	\$11 74

*Sold in Kansas City at \$1.70 after 180 days. †No gain.

TABLE VIII.—LOT VIII. EIGHT STEERS FED MIXED GRAINS AND HAYS.

PERIOD.	No. of days.....	Mean temp., °F.....	Mixed grains.				Mixed Hays.				Nutritive Ratio.....	Weight in pounds.			Gain in pounds.			Cost of 100 pounds gain.....
			Pounds eaten..	Cost.....	Pounds eaten, daily av.....	Pounds for 100 pounds gain..	Pounds eaten..	Cost.....	Pounds eaten, daily av.....	Pounds for 100 pounds gain..		Beginning of period.....	End of period..	Av. per steer at close.....	Total, of lot.....	Av. per steer..	Av. per day per steer.....	
Nov. 2 to Dec. 3, '04.....	12	43	112	\$ 4 07	36.8	.....†	1,390	\$ 2 31	115.8	.....†	1: 9.50	6,815	6,680	835.0	135	16.80	1.600†
Dec. 3 to Dec. 17.....	14	28	534	6 21	49.0	318	1,780	2 96	127.0	827	1: 9.43	6,680	6,835	861.8	245	26.85	1.920†
Dec. 17 to Dec. 31.....	14	30	784	7 21	56.0	257	1,820	3 04	130.0	596	1: 9.31	6,855	7,200	900.0	365	28.12	2.720	\$ 4 35
Jan. 1 to Jan. 14, '05.....	14	20	976	9 00	69.7	650	1,820	3 04	130.0	1,213	1: 9.39	7,200	7,350	918.7	150	18.75	1.310†
Jan. 14 to Jan. 28.....	14	19	1,212	11 16	86.6	538	1,820	3 04	130.0	809	1: 9.35	7,350	7,575	947.0	225	28.12	2.000	6 29
Jan. 28 to Feb. 25.....	28	14	1,318	29 66	115.0	531	3,530	5 78	126.0	582	1: 9.31	7,575	8,181	1,022.6	666	75.75	2.700	5 27
Feb. 25 to Mar. 11.....	14	48	1,970	17 59	136.4	767	1,680	2 80	120.0	674	1: 9.45	8,181	8,430	1,053.7	249	31.12	2.220	8 17
Mar. 11 to Mar. 25.....	14	50	2,074	19 12	148.0	2,765	1,680	2 80	120.0	2,240	1: 9.42	8,430	8,505	1,063.1	75	9.37	0.670	29 14
Mar. 25 to Apr. 8.....	14	61	2,230	21 12	163.5	413	1,520	2 53	108.5	274	1: 9.51	8,505	9,060	1,132.5	555	69.37	4.950	4 25
Apr. 8 to Apr. 22.....	14	48	2,470	19 69	147.8	7,960	1,120	1 86	80.0	4,307	1: 9.56	9,060	9,066	1,135.7	26	3.25	0.116	80 35
152 days*.....			15,660	\$144 26	102.0	689	18,160	\$30 26	119.4	800	1: 9.50	6,815	9,086	1,136.0	2,271	284.00	1.870	\$ 7 67

*Sold in Kansas City at \$5.00 after 180 days. †No gain.

COMPARISON OF THE RESULTS IN RESPECT TO DIFFERENCES IN THE GRAIN RATION.

In table IX certain of the data have been collected for convenient comparison of the results obtained from different grains when used with the same roughage. Thus lots I, II and III are comparable; also IV and V, and VI and VII. Lot VIII is to be compared with all of the others.

TABLE IX.—Comparison of Grains of Rations.

Lot.	RATION.	Nutritive Ratio.	A. gain per head.	Gain per 100 lbs. gain.	Hay per 100 lbs. gain.	Cost of 100 lbs. gain.	Dressed weight, per cent.
I....	Corn-and-cob meal, alfalfa hay.....	1: 6.79	338.0	592	667	5 13	59.69
II....	Ground Kafir-corn, alfalfa hay.....	1: 5.86	314.5	593	723	8 30	59.55
III...	Ground wheat, alfalfa hay.....	1: 5.16	270.3	538	789	8 56	59.53
IV....	Corn-and-cob meal, Kafir-corn hay..	1:14.98	221.7	901	1,025	7 32	57.90
V....	Ground Kafir-corn, Kafir-corn hay...	1:12.43	184.5	1,133	1,383	11 37	56 46
VI...	Corn-and-cob meal, sorghum hay....	1:17.29	176.0	1,117	1,281	9 06	57.96
VII..	Ground Kafir-corn, sorghum hay.....	1:14.17	160.6	1,174	1,425	11 74	57.54
VIII.	Mixed grains, mixed hays.....	1: 9.56	234.0	689	800	7 67	56.23

It will be observed from the results given in the table that the steers fed ground Kafir-corn made nearly as good an average gain per animal as those fed corn-and-cob meal, and better than either of the other two lots getting ground wheat and the mixed grains, respectively. One pound more grain and 56 pounds more alfalfa were required to produce 100 pounds gain with the Kafir-corn ration than with the corn-and-cob meal ration. On account of the constipating effect of the Kafir-corn seed, more alfalfa hay may be fed with it than with corn-and-cob meal without any loosening effect on the steers. With Kafir-corn at 46 cents per bushel (56 pounds) and corn-and-cob meal at 45 cents per bushel (70 pounds), the cost of 100 pounds gain was \$3.17 more with the former than with the latter.

As would be expected with lots IV and V, where Kafir-corn hay was fed as roughage, there is a much greater showing in favor of corn-and-cob meal. Two hundred thirty-two pounds more of grain were required to make 100 pounds gain with the Kafir-corn ration than with the corn-and-cob meal ration, and the cost of gain with the ground Kafir-corn was \$4.05 more per 100 pounds. So when feeding Kafir-corn hay as a roughage, ground Kafir-corn is not equal, pound for pound, to corn-and-cob meal.

Also, in lots VI and VII with sorghum hay as roughage,

ground Kafir-corn does not compare as well with corn-and-cob meal as with alfalfa for roughage. Again, one pound of ground Kafir-corn is not equal to one pound of corn-and-cob meal, and the cost of 100 pounds of gain is \$2.68 more per hundred with the former.

It will be noticed that the cattle fed corn-and-cob meal dressed a trifle better than those fed ground Kafir-corn. Also, a trifle more hay was required to make 100 pounds of gain with the ground Kafir-corn. While Kafir-corn seed is not quite equal to corn for beef production, still, with alfalfa hay, it makes a very good ration. Steers can be finished for the market nearly as well with Kafir-corn and alfalfa as with corn and alfalfa, though with the former it is necessary to feed more hay. In this section of light rainfall, Kafir-corn is a very important crop on account of its ability to withstand drouth better than corn; consequently it is a surer crop. Alfalfa seems well adapted to both the soil and the climatic conditions of this so-called "semi-arid" region, and with these feeds at hand, cattle can be not only produced in Western Kansas, but also finished for the beef market.

Lot III, fed ground wheat, made the poorest average gain per head, and cost the most to make 100 pounds of gain. However, the cost of 100 pounds of gain with the ground wheat and alfalfa is only 26 cents more than the cost of the same gain with the ground Kafir-corn and alfalfa hay. Lots I, II and III dressed nearly the same, while lot VIII dressed 3 per cent lower than any of the other lots.

It has long been the opinion of many feeders that a ration made up of a variety of feeds gives better results than one of fewer feeds. Ordinarily this may be true, though in this case it appears that the more nearly the ration approaches corn and alfalfa the more economical was the gain on the steers; consequently we would conclude that corn and alfalfa of good quality is almost a perfect ration for beef production, and that ground Kafir-corn makes a good substitute for the corn, but not quite its equal, pound for pound.

COMPARISON OF THE RESULTS IN RESPECT TO DIFFERENCES IN THE ROUGHAGE RATION.

In table X a comparison is made of the roughages, alfalfa hay, Kafir-corn hay, and sorghum hay, when fed with ground Kafir-corn, and also when fed with corn-and-cob meal.

TABLE X.—Comparison of Roughages of Rations.

Lot.	RATION.	Nutritive ratio.....	Ay. gain lbs. per head.....	Grain per 100 lbs. gain.....	Hay per 100 lbs. gain.....	Cost of 100 lbs. gain..	Dressed weight per cent.....
II....	Alfalfa hay, ground Kafir-corn.....	1 : 5.86	314.5	593	723	\$ 8.30	59.55
V....	Kafir-corn hay, ground Kafir-corn...	1 : 12.43	164.5	1,133	1,583	11.37	57.96
VII..	Sorghum hay, ground Kafir-corn....	1 : 14.17	160.6	1,174	1,425	11.74	57.54
I.....	Alfalfa hay, corn-and-cob meal.....	1 : 6.79	338.0	592	667	5.13	59.69
IV....	Kafir-corn hay, corn-and-cob meal...	1 : 14.98	221.7	901	1,025	7.32	57.90
VI....	Sorghum hay, corn-and-cob meal....	1 : 17.29	176.0	1,117	1,261	9.06	57.96

Table X shows alfalfa hay to be superior to either Kafir-corn hay or sorghum when ground Kafir-corn is fed as concentrate. Also, Kafir-corn hay is superior to sorghum even when fed with the ground Kafir-corn. Again, the cost of 100 pounds of gain varies directly as the nutritive ratio, *i.e.*, when the carbohydrate equivalent is increased after it is already in excess of the requirement for a balanced ration, the pounds of feed to make 100 pounds of gain is increased and the cost of 100 pounds of gain is correspondingly greater. The cost of 100 pounds of gain with sorghum hay as roughage was \$3.44 more than with the alfalfa hay, and 37 cents more than with the Kafir-corn hay as roughage.

SUMMARY OF WEIGHTS, GAINS, AND LOSSES.

In table XI a summary is presented of weights at the beginning and at the end of the experiment, the gains made, feed consumed, gain from one bushel of grain, and the profit or loss.

TABLE XI.—Showing the beginning and closing Weights, average Gains, pounds of Feed consumed, and average Profit or Loss for the eight Lots of Steers.

Lot.	RATION.	Ay. wt. per head beginning, lbs..	Ay. wt. per head closing, lbs.	Daily av. gain per head, lbs.	Best daily av. gain, lbs.	Least daily av. gain, lbs.	Grain per head daily, lbs.	Hay per head daily, lbs.	Gain per bushel grain, lbs.	Ay. profit or loss per steer..
I.....	Corn-and-cob meal, alfalfa hay....	842.5	1,180.5	2.22	2.91	1.70	13.10	15.0	11.80	\$ 8.98*
II....	Kafir-corn, alfalfa hay.....	853.0	1,167.5	2.06	2.52	1.51	12.25	15.0	9.40	4.71*
III....	Wheat, alfalfa hay.....	854.4	1,124.7	1.77	2.16	1.41	9.62	14.0	11.20	3.31†
IV....	Corn-and-cob meal, Kafir-corn hay.	866.2	1,088.0	1.45	1.80	.97	13.10	15.0	7.10	0.90*
V....	Kafir-corn, Kafir-corn hay.....	855.0	1,019.5	1.08	1.41	.92	12.25	15.0	4.94	1.44†
VI....	Corn-and-cob meal, sorghum hay.	852.5	1,028.3	1.15	1.63	.89	13.00	14.5	6.26	1.66†
VII..	Kafir-corn, sorghum hay.....	849.4	1,010.0	1.05	1.48	.75	10.87	13.1	4.77	5.14†
VIII.	Mixed grain, mixed hay.....	852.0	1,136.0	1.87	2.34	1.46	12.75	15.0	9.00	0.06*

*Profit. †Loss.

STUDY OF THE NUTRITIVE RATIO.

"Nutritive ratio" is a common expression with students of feeding problems and should be understood by all, since it is a great aid in the study of feeding substances. The ratio of the amount of energy yielded by the digestible protein of a feed to the energy yielded by its digestible fat and carbohydrates is the *nutritive ratio*. Now, one pound of protein yields about as much energy to the animal body as one pound of carbohydrates, but a pound of fat yields about 2.4 times as much. Therefore, in order to compare the energy of the protein with that from the carbohydrates and fat we must multiply the weight of the fat by 2.4. The product is then added to the amount of the carbohydrates. The weight of the protein will bear the same ratio to this sum that the energy of the protein bears to the energy of the carbohydrates plus the fat. This ratio is the nutritive ratio as defined previously.

To illustrate: Alfalfa contains in 100 pounds of digestible nutrients, 10.6 pounds of protein, 37.3 pounds of carbohydrates, and 1.4 pounds of fat. Multiplying the 1.4 by 2.4 we get 3.36 as the proportional amount of energy that comes from the fat. This added to the weight of the carbohydrates gives 40.66 (37.3 + 3.36 = 40.66); as the weight of the protein is 10.6, the nutritive ratio is 10.6 : 40.66. However, to facilitate comparison of nutritive ratios it is customary to reduce the protein to unity in all cases by dividing both terms of the ratio by the number for protein.

$$\text{Thus: } \frac{10.6 : 40.66}{10.6} = 1 : 3.83,$$

the nutritive ratio in another form. For 1: 3.83 as 10.6 : 40.66.

When the fat is multiplied by 2.4 a number is obtained that expresses the quantity of carbohydrates that would be equivalent to the fat in yielding energy. This product may be called the carbohydrate equivalent of the fat, and if added to the amount of the carbohydrates, the sum may be called the carbohydrate equivalent of the non-protein. The addition of these two together is justified by the fact that fat and carbohydrates contain the same chemical elements, namely, carbon, hydrogen, and oxygen. The separate consideration of protein is required because it contains nitrogen and sulphur, and to a less extent other elements, in addition to carbon, hydrogen, and oxygen.

When food is not utilized in doing work, it may be stored in the body in the form of flesh or fat. When the carbohydrate equivalent is much in excess, as, for instance, when the nutritive ratio is 1:10, the feed has a wide ratio, while on the other hand a nutri-

tive ratio of 1:3 would be called narrow; midway between these two would be a medium nutritive ratio.

A balanced ration is an economical ration having these food constituents in the proper proportion, or ratio, to each other so that the digestive organs of the animal may do their work at their highest efficiency. It is simply a combination of feeds which contains the food constituents in such relative quantities, or proportions, as long experience has shown to give the best results under certain conditions. The ration must be balanced according to the end sought: for example, a growing calf requires the food constituents in a different ratio than a fattening steer.

It is not the purpose to fully discuss the balanced ration in this bulletin, as that would require considerable space; but referring to the column headed "Nutritive Ratio," in Tables IX and X, it will be noticed that the ration for lot I is given 1 to 6.79. This is nearly the desired ratio, or proportion, for fattening steers, which Wolff in his "Feeding Standards" gives as 1:6.5 for the first period and 1:6.0 for the finishing period: so there was fed only a fraction of a pound of carbohydrates too much for each pound of protein. However, this excess would do little injury. With such a combination of the food constituents, it required only 532 pounds of corn-and-cob meal and 667 pounds of hay to produce 100 pounds of gain on the steer, the cost of the same being \$5.13. But when a hay, such as Kafir-corn hay, richer in carbohydrates and containing less protein, was substituted for the alfalfa hay, the nutritive ratio was considerably changed and for every pound of protein given there were 14.98 pounds of carbohydrates fed; consequently the carbohydrate equivalent is considerably in excess and the ration is not balanced for the intended purpose. With such a combination of feed constituents, 901 pounds of corn-and-cob meal and 1025 pounds of hay were required to produce 100 pounds of gain, the cost being \$7.32. Sorghum hay, being still more highly carbonaceous and containing proportionately less protein, gives, when substituted for alfalfa hay, a nutritive ratio of 1 to 17.29, which is still more unbalanced than the ration fed lot IV. On examination of the column in table IX or X headed "Grain per 100 lbs. gain." we find that instead of 592 pounds of corn-and-cob meal, as with lot I, nearly double that amount, or 1117 pounds, were required and nearly double that amount of hay was fed in connection. The cost of 100 pounds of gain with the sorghum hay ration, when figuring the value of feeds at about local prices, was \$3.93 more than with the alfalfa hay ration, or \$9.06 per 100 pounds gain.

“Can we afford to balance our feeding ration in this Western country where such carbonaceous feeds as Kafir-corn, sorghum and millet are usually plentiful and low in price?” is frequently asked by the farmer. In table X, we observe that by substituting 667 pounds of alfalfa hay for 1261 pounds of sorghum we save 7.5 bushels of corn-and-cob meal on every 100 pounds the animal gained. Why is this? Because in the ration of lot VI the percentage of carbohydrates is in excess, when compared with the proteins. Instead of feeding six or seven pounds of carbohydrate equivalent with each pound of protein, 17.29 pounds were fed. The steer is able to utilize only a certain number of pounds of carbohydrates with each pound of protein, therefore at least one-half of the carbohydrates pass off undigested, or at any rate unassimilated, consequently worse than wasted; for, handling this excess becomes somewhat burdensome, as it adds to the labor of the organs of the animal.

It pays the stockman in dollars and cents to study the problem of feeding, not saying anything about the increased interest it affords a man to be more familiar with the details of his work. The steers fed the nearly balanced ration not only produced 100 pounds of gain at \$3.93 less expense, but when they were sold the entire weight of the animal was worth 50 cents per hundredweight more. In referring to the financial statements, it will be noted that the average profit per steer from lot I, after all expenses have been deducted, is \$8.98, while under the same conditions the steers from lot VI, fed a different ration, were fed at a loss of \$1.66 per head, a difference between the two lots of \$10.64 for each steer.

CHANGING FEED.

At the end of 152 days, the duration of the experiment proper, a change of feed was decided upon to fit the poorer lots for market. The rations of lots I and VIII were continued as before, while with all the other lots a corn-meal and alfalfa hay ration was gradually substituted for that originally fed. The steers took readily to the new feed, ate heartily, and no bad effects resulted from the change.

There was not so much difference in the quality of the steers in the various lots at the time they were sold as when the experiment closed, on account of the poorer lots making more rapid improvement after the change of feed than did lots I and VIII. During the 28 days this final feeding continued, lot I made an average gain of 1.90 pounds, daily, while all other lots made a better daily average gain than this, although for the entire feeding period of 180 days, lot I made an average gain of 2.17 pounds daily.

SALE OF THE CATTLE.

Before shipping, the steers were weighed individually on two successive days, and an average of these two weights taken as the final weight of the steers at the Experiment Station. Lots I, II, III and VIII made the best appearance; of these, lots I and II showed the best finish. The steers of lot I were about the same weight as those of lot II, though a little more rounded out, sleeker, and smoother. There was a marked difference in quality between the alfalfa-hay-fed cattle and those fed other roughage, as the Kansas City prices give evidence.

The number of its lot was cut in the hair of each animal with a pair of shears and the eight lots were driven to the railway station and shipped collectively. Upon reaching the stock yards at Kansas City, each lot was put in a pen by itself and sold upon its own merits. The steers were bought by the Fowler Packing Company. Mr. A. J. Maurer, their head cattle buyer, has had long experience in such work and is an excellent judge of cattle. After a careful examination, without knowing how the steers had been fed, he put the following prices on them:

Lot I.....	\$5.25	Fed ration of corn-and-cob meal and alfalfa hay.
Lot II.....	5.15	Fed ration of Kafir-corn and alfalfa hay.
Lot III.....	4.90	Fed ration of wheat and alfalfa hay.
Lot IV.....	4.85	Fed ration of corn-and-cob meal and Kafir-corn hay.
Lot V.....	4.85	Fed ration of Kafir-corn and Kafir-corn hay.
Lot VI.....	4.70	Fed ration of corn-and-cob meal and sorghum hay.
Lot VII.....	4.70	Fed ration of Kafir-corn and sorghum hay.
Lot VIII.....	5.00	Fed ration of mixed grain and mixed hay

The foregoing statement shows a range of prices from \$4.70 to \$5.25 per hundredweight, or a difference of 55 cents per hundredweight. These prices are a good measure of the quality of each lot when sold.

SHRINKAGE IN DRIVING AND SHIPPING.

The steers were driven one mile to the railway station and shipped from Hays, Kan., to Kansas City, a distance of nearly three hundred miles. They arrived at market a little late on May 24, and, sale being soon closed, had not taken on much of a fill when they were weighed. Table XII gives the last weights at the Experiment Station and selling weights at the Kansas City stock yards, with pounds and percentage of shrink of each lot.

TABLE XII.—Shrinkage.

LOT.	Individual Average at Expt. Station, pounds.	Individual Average at K. C. market, pounds.	Shrinkage, pounds.	Shrinkage, per cent.
I.....	9,869	9,410	459	4.60
II.....	9,896	9,370	526	5.30
III.....	9,528	9,010	518	5.40
IV.....	9,144	8,770	374	4.08
V.....	8,776	8,390	386	4.30
VI.....	8,821	8,400	421	4.70
VII.....	7,575	7,270	305	4.02
VIII.....	9,715	9,320	395	4.00
Totals and averages..	73,324	69,940	3,384	4.60

The percentage of shrink indicates no great variation among the different lots; however, lots II and III shrank a trifle more than the average of all, while lots IV, V, VII and VIII shrank a little less than the average of all. Each steer stood the trip to market well, and no bad scouring was observed.

THE SLAUGHTER TEST.

It was necessary to hold the cattle over one day after being sold before they could be slaughtered. The Fowler Packing Company killed the steers by lots, as they had been fed at the Experiment Station, and the results of the butchering were very carefully noted. By the courtesy of this company, the accompanying data, table XIII, on the slaughter results of the various lots are given.

TABLE XIII.—Slaughter test at the Fowler plant of the National Packing Company.

LOT.	Av. live wt., lbs.....	Price.....	Dressing, per cent.....	Av. dressed wt., lbs.....	Fat.		Tongues, lbs.....	Livers, lbs.....	Hearts, lbs.....	Hides.	
					Caul, lbs.	No. 2, lbs.				Grade.....	Weight, lbs.....
I.....	1,176	\$ 5 25	59.69	716.5	345	525	75	83	33	5 native.....	370
										3 butt brand.....	230
II.....	1,171	5 15	59.55	711.7	270	410	76	82	32	7 native.....	545
										1 Texas.....	70
III.....	1,126	4 90	59.53	684.0	250	390	73	74	30	6 native.....	460
										2 butt brand.....	171
IV.....	1,096	4 85	57.90	647.7	235	355	69	73	28	6 native.....	450
										2 butt brand.....	155
V.....	1,048	4 85	56.46	605.5	240	345	67	72	26	5 native.....	330
										3 Texas.....	210
VI.....	1,050	4 75	57.96	621.0	235	370	78	71	32	5 native.....	360
										3 Colorado.....	215
VII.....	1,038	4 70	57.54	609.7	210	300	60	64	27	3 native.....	215
										3 butt brand.....	205
										1 Texas.....	75
VIII.....	1,165	5 00	56.23	668.5	285	435	80	81	34	5 native.....	375
										1 Colorado.....	70
										3 butt brand.....	150

*Lot VII had Only seven steers in the slaughter test. each of *thee* others had eight.

The percentage of dressed weight indicates very nearly the condition, or ripeness, of the several lots at the time of shipment. The price per pound at which the lots sold compares favorably with the average dressed weight, with the possible exception of lot VIII. The steers of this lot were better finished than those of lots IV, V, VI, and VII, and compared well in quality of flesh with lots I, II, and III; thus the low percentage of dressed weight of lot VIII seems unaccounted for.

The packing company designated the grades of the carcasses by the terms: Western Good, B. Western Good, Western Choice, B. Western Choice, Native Good, B. Native Good, Native Choice, and B. Native Choice. By the term B. Western Good was meant the bullock grades better than a Western Good, but not quite prime enough to be termed Choice. The same applies to B. Natives. B. Choice means that the bullock was strictly prime, either Western or Native. The grading is given in table XIV.

TABLE XIV.—Showing the Number of Carcasses of the Respective Grades in each Lot of Steers.

LOT.	B. Native Choice.	Native Choice.	B. Native Good.	Native Good.	B. Western Choice.	Western Choice.	B. Western Good.	Western Good.
I.....		5	1	1		1		
II.....	2				1	2	3	
III.....			3	1		1	1	2
IV.....		2	1				3	2
V.....				3		1	3	1
VI.....		1		1	4			2
VII.....		1		3			3	
VIII.....			2	2	2			2
Totals.....	2	9	7	11	7	5	13	9

THE FINANCIAL SIDE OF THE EXPERIMENT.

In making up the financial statement for this experiment, there is to be considered the original cost of the steers, the value of feed consumed, and the expense of marketing. These are fixed conditions which any feeder must consider, although circumstances governing them permit a variation according to locality, and the methods by which both feed and cattle are produced, in home production or by purchase.

In the computation which follows, a separate bill is made out for each lot so that the comparison of costs, with profit or loss, can be the more readily observed. The 64 head of steers cost the Station an average of 3¼ cents per pound. Feed consumed by the different lots during the 180 days of feeding was charged as near local prices as possible, *i. e.*, corn-and-cob meal 45 cents, Kafir-corn 46 cents, wheat 78 cents, and oats, 45 cents per bushel, respectively. Alfalfa \$4.00, Kafir-corn hay \$3.00, sorghum \$3.00, and prairie hay \$3.00 per ton. Salt \$1.60 per barrel.

LOT I.—CORN AND ALFALFA RATION.

Dr.			
By eight steers, total weight 6,740 pounds, at 3¼ cents.....		\$219	05
309.60 bushels corn, at 45 cents.....		139	32
2.19 bushels oats, at 45 cents.....			98
10.15 tons alfalfa, at \$4.00.....		40	60
.24 ton prairie hay, at \$3.00.....			72
49.00 pounds salt.....			26
By expense of marketing:			
Freight.....	\$15	05	
Yardage.....	2	00	
Hay.....		22	
Commission.....	4	00	
Total.....			21 27
Total.....		\$422	20
Cr.			
To eight steers, total weight 9,410 pounds, at \$5.25.....	\$494	02	
Profit on eight steers.....			71 82
Grand totals.....	\$494	02	\$494 02
Average profit per steer.....			\$8 98

LOT II.—KAFIR-CORN AND ALFALFA RATION.

Dr.			
By eight steers, total weight 6,825 pounds, at 3¼ cents.....		\$221	81
273.97 bushels Kafir-corn, at 46 cents.....		126	02
73.20 bushels corn, at 45 cents.....		32	94
2.19 bushels oats, at 45 cents.....			99
10.23 tons alfalfa, at \$4.00.....		40	92
.24 ton prairie hay, at \$3.00.....			72
52.00 pounds salt.....			27
By expense of marketing:			
Freight.....	\$14	99	
Yardage.....	2	00	
Hay.....		22	
Commission.....	4	00	
Total.....			21 21
Total.....		\$444	88
Cr.			
To eight steers, total weight 9,370 pounds, at \$5.15.....	\$482	55	
Profit on eight steers.....			37 67
Grand totals.....	\$482	55	\$482 55
Average profit per steer.....			\$4 71

LOT III.—WHEAT AND ALFALFA RATION.

Dr.		
By eight steers, total weight 6,835 pounds, at 3½ cents		\$222 13
198.83 bushels wheat, at 78 cents.....		155 09
65.57 bushels corn, at 45 cents.....		29 50
2.19 bushels oats, at 45 cents.....		98
9.66 tons alfalfa, at \$4.00.....		38 66
.24 ton prairie hay, at \$3.00.....		72
54.00 pounds salt.....		28
By expense of marketing:		
Freight.....	\$14 41	
Yardage.....	2 00	
Hay.....	22	
Commission.....	4 00	
Total.....		20 63
Total		\$467 99
Cr.		
To eight steers, total weight 9,010 pounds, at \$4.90	\$441 49	
Loss on eight steers		26 50
Grand totals	\$441 49	\$441 49
Average loss per steer.....		\$3 31

LOT IV.—CORN AND KAFIR-CORN HAY RATION.

Dr.		
By eight steers, total weight 6,930 pounds, at 3½ cents		\$225 32
308.620 bushels corn, at 45 cents.....		138 87
2.190 bushels oats, at 45 cents.....		99
9.425 tons Kafir-corn hay, at \$3.00		28 27
.820 ton alfalfa, at \$4.00.....		3 28
.285 ton prairie hay, at \$3.00.....		85
52.000 pounds salt.....		27
By expense of marketing:		
Freight.....	\$14 03	
Yardage.....	2 00	
Hay.....	22	
Commission.....	4 00	
Total.....		20 25
Total.....		\$418 10
Cr.		
To eight steers, total weight 8,770 pounds, at \$4.85	\$425 34	
Profit on eight steers		7 24
Grand totals	\$425 34	\$425 34
Average profit per steer.....		\$0 90½

LOT V.—KAFIR-CORN AND KAFIR-CORN HAY RATION.

Dr.		
By eight steers, total weight 6,840 pounds, at 3½ cents.....		\$222 30
273.920 bushels Kafir-corn, at 46 cents.....		126 00
73.060 bushels corn, at 45 cents.....		32 88
2.190 bushels oats, at 45 cents.....		98
9.425 tons Kafir-corn hay, at \$3.00.....		28 27
.820 ton alfalfa, at \$4.00.....		3 28
.285 ton prairie hay, at \$3.00.....		85
42.000 pounds salt.....		22
By expense of marketing:		
Freight.....	\$13 42	
Yardage.....	2 00	
Hay.....	22	
Commission.....	4 00	
Total.....	<u>19 64</u>	
Total.....		<u>\$434 42</u>
Cr.		
To eight steers, total weight 8,390 pounds, at \$4.85....	\$406 91	
Loss on eight steers.....	27 51	
Grand totals.....	<u>\$406 91</u>	<u>\$406 91</u>
Average loss per steer.....		\$3 44

LOT VI.—CORN AND SORGHUM RATION.

Dr.		
By eight steers, total weight 6,820 pounds, at 3½ cents.....		\$221 65
306.770 bushels corn, at 45 cents.....		138 04
2.190 bushels oats, at 45 cents.....		99
9.195 tons sorghum, at \$3.00.....		27 58
.820 ton alfalfa, at \$4.00.....		3 28
.285 ton prairie hay, at \$3.00.....		85
53.000 pounds salt.....		28
By expense of marketing:		
Freight.....	\$13 44	
Yardage.....	2 00	
Hay.....	22	
Commission.....	4 00	
Total.....	<u>19 66</u>	
Total.....		<u>\$412 33</u>
Cr.		
To eight steers, total weight 8,400 pounds, at \$4.75....	\$399 00	
Loss on eight steers.....	13 33	
Grand totals.....	<u>\$399 00</u>	<u>\$399 00</u>
Average loss per steer.....		\$1 66

LOT VII.—KAfir-CORN AND SORGHUM RATION.

Dr.		
By seven steers, total weight 5,945 pounds, at 3½ cents.....		\$193 21
242.980 bushels Kafir-corn, at 46 cents.....		111 76
55.850 bushels corn, at 45 cents.....		25 13
2,010 bushels oats, at 45 cents.....		91
8.333 tons sorghum, at \$3.00.....		25 00
.800 ton alfalfa, at \$4.00.....		3 20
.275 ton prairie hay, at \$3.00.....		83
52.000 pounds salt.....		27
By expense of marketing:		
Freight.....	\$11 63	
Yardage.....	2 00	
Hay.....	22	
Commission.....	3 50	
Total.....		17 35
Total.....		\$377 66
Cr.		
To seven steers, total weight 7,270 pounds, at \$4.70....	\$341 69	
Loss on seven steers.....		35 97
Grand totals.....	\$341 69	\$341 69
Average loss per steer.....		\$5 14

LOT VIII.—MIXED GRAIN AND MIXED HAY RATION.

Dr.		
By eight steers, total weight 6,815 pounds, at 3½ cents.....		\$221 49
99.360 bushels corn, at 45 cents.....		44 71
111.800 bushels wheat, at 78 cents.....		87 20
119.810 bushels Kafir-corn, at 46 cents.....		55 11
2.190 bushels oats, at 45 cents.....		98
3.643 tons alfalfa, at \$4.00.....		14 57
3.268 tons Kafir-corn hay, at \$3.00.....		9 80
3.026 tons sorghum, at \$3.00.....		9 08
.375 ton prairie hay, at \$3.00.....		1 12
52.000 pounds salt.....		27
By expense of marketing:		
Freight.....	\$14 93	
Yardage.....	2 00	
Hay.....	22	
Commission.....	4 00	
Total.....		21 15
Total.....		\$465 48
Cr.		
To eight steers, total weight 9,320 pounds, at \$5.00....	\$466 00	
Profit on eight steers.....		52
Grand totals.....	\$466 00	\$466 00
Average profit per steer.....		06½

GENERAL CONCLUSIONS.

For beef production, ground Kafir-corn is about equal, pound for pound, to corn-and-cob meal when alfalfa hay is fed with either of these concentrates. However, with sorghum hay as roughage, it required 57 pounds more of the ground Kafir-corn than of the corn-and-cob meal to produce 100 pounds gain. As would naturally be expected when the Kafir-corn hay constitutes the roughage of the ration, 232 pounds more of the ground Kafir-corn than of the corn-and-cob meal were required to produce 100 pounds gain. Cattle can be well finished for the beef market on a ration of ground Kafir-corn and alfalfa hay.

Ground wheat and alfalfa hay, fed together, is not an economical ration for beef, on account of the loosening effect of these feeds on the steers and the expensiveness of the wheat. With corn-and-cob meal at 45 cents per bushel and wheat at 78 cents per bushel, the cost of 100 pounds gain, when both are fed with the alfalfa as roughage, is \$5.13 with corn-and-cob meal and with the wheat is \$8.56, or a difference of \$3.43 in favor of the former.

A matter of this experiment of considerable interest, especially to the western farmer, is the part that the various roughages play in beef production. A ration of alfalfa hay, at \$4.00 per ton, with corn-and-cob meal produced 100 pounds of gain for \$5.13; but when Kafir-corn hay at \$3.00 per ton was substituted for alfalfa hay, the cost of 100 pounds of gain was increased to \$7.32, while with sorghum hay at \$3.00 per ton substituted for the alfalfa hay the cost was increased to \$9.06. In other words, one bushel of corn-and-cob meal fed with alfalfa hay as roughage produced 11.8 pounds of flesh, while the same amount of corn-and-cob meal fed with sorghum hay as roughage gave in return only 6.25 pounds of flesh; thus, a difference of 5.5 pounds, or 88 per cent in favor of the alfalfa hay ration.

There is yet much to learn about the most profitable combination of western feeds for western conditions, though the evidence is certainly good that it pays the stockman in dollars and cents to study this feeding problem as far as it is worked out by science and wait for further results. It is the opinion of the writer that the western feeds grown without irrigation have the chief food constituent's in a slightly different proportion from those grown under more favorable conditions, though the nutritive ratio, of the rations fed, and the profit per steer have a direct relation to each other. For practical work the results would be little changed by this difference in composition.

The nutritive ratio of the corn and alfalfa ration was 1 : 6.79, or

practically a balanced ration, and the average profit per steer was \$8.98; the nutritive ratio of the corn and Kafir-corn hay ration was 1 : 14.98, or an unbalanced ration, and the average profit per steer was 90½ cents; while the nutritive ratio of the corn and sorghum hay ration was 1 : 17.29, or much too low in protein and a decidedly unbalanced ration, the average loss per steer being \$1.66. The difference, then, between feeding a balanced and an unbalanced ration was an average profit, per steer, of \$8.98 with the former and an average loss, per steer, of \$1.66 with the latter; or \$10.64 per steer in favor of the balanced ration.

The results of the feeding test with 56 calves conducted at the Experiment Station the previous year also showed alfalfa hay superior for beef production to prairie hay, oats straw, or sorghum. With alfalfa hay as roughage, 545 pounds of corn were fed for each 100 pounds of gain; with prairie hay as roughage, 641 pounds; with oats straw, 717 pounds, and with sorghum hay as roughage, 715 pounds of corn were required to make, in each case, 100 pounds of gain. From this test it was also demonstrated that barley and alfalfa hay make a very good ration for fattening calves, though not quite the equal of corn and alfalfa hay. However, with more mature animals, it may not compare so favorably with the corn ration. Wheat, at the present price, did not make an economical ration with alfalfa as roughage for feeding either baby beef or more mature animals.

By increasing the acreage of alfalfa on the farm, giving more study *to* the proper methods of tillage for the conservation of soil moisture, and 'by growing crops best adapted to the soil and climatic conditions, the feeds necessary for the perfect development of the stock industry can be grown in Western Kansas with a marked degree of certainty. The West has long been the home of the cattle industry, but only in a crude way; in fact, the range cattle business chiefly, and not with the best grade of stock. Cattle were grown to sufficient maturity and shipped to the feed lots within the corn belt to be finished for the beef market. Of course, beef production has its drawbacks, and it must be done in a judicious manner if best results are to be expected; nevertheless, the stock industry must not be neglected if our farms are to retain their fertility. Some noted herds of pure-bred cattle are already located in the West, and it is hoped that improvement along this line will be continued in the future.



PLATE 1.—A steer from Lot 1. Average daily gain 2.91 pounds.

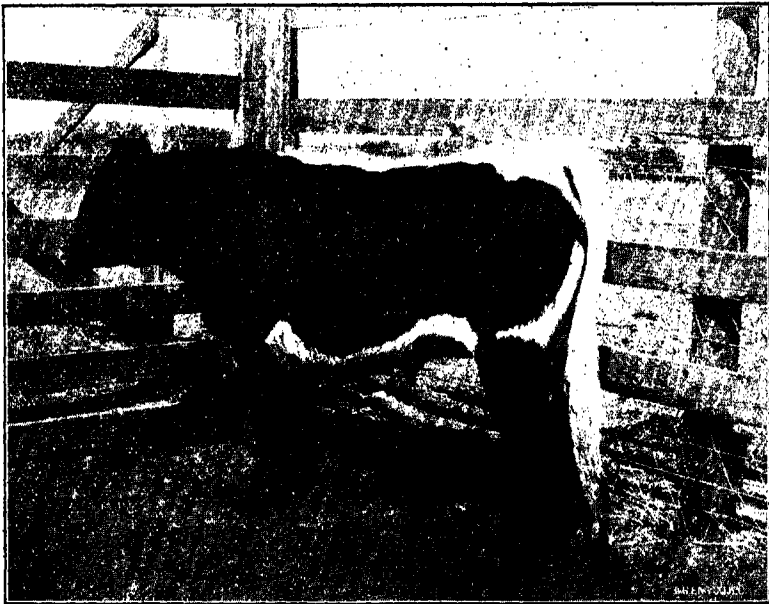


PLATE 2.—A steer from Lot 1. Average daily gain 1.7 pounds.



PLATE 3.—Lot 1 at close of Experiment.

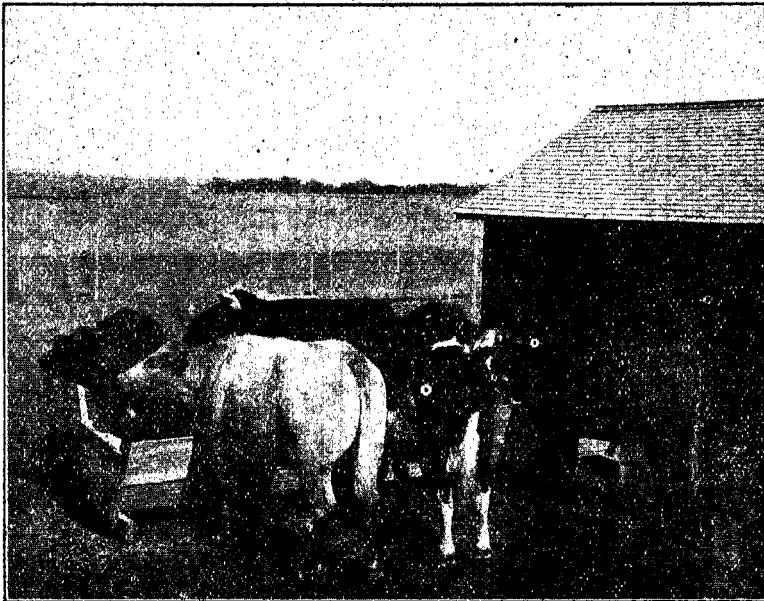


PLATE 4.—Lot 2 at close of Experiment.

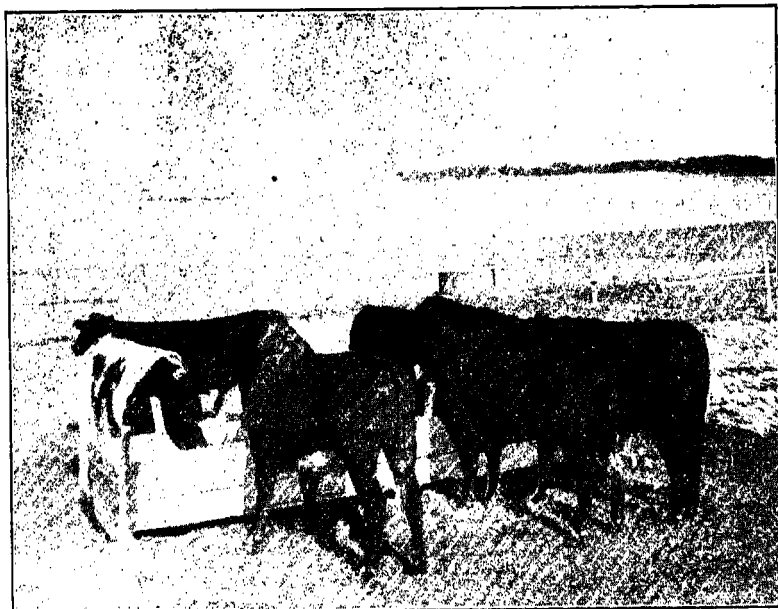


PLATE 5.—Lot 3 at close of Experiment.



PLATE 6.—Lot 4 at close of Experiment.

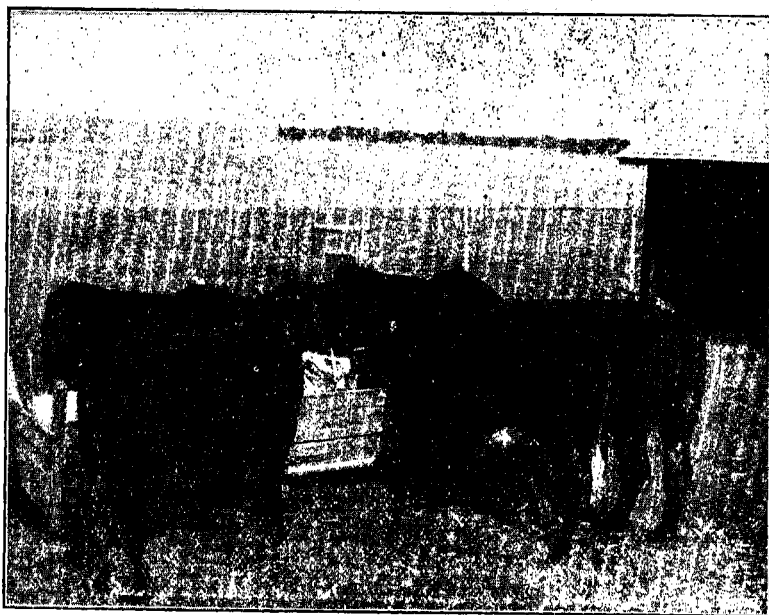


PLATE 7.—Lot 5 at close of Experiment.



PLATE 8.—Lot 6 at close of Experiment.



PLATE 9.—The Steers When Shipped.