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A. B. CONNER, DIRECTOR
COLLEGE STATION, BRAZOS COUNTY, TEXAS

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DIVISION OF RANGE ANIMAL HUSBANDRY

Fattening Lambs on Corn, Milo, Hegari, Wheat, and Oats, with Cottonseed Cake and Alfalfa



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**In cooperation with U. S. Department of Agriculture.

†In cooperation with Texas Extension Service.

†As of December 1, 1932.

††On leave.

Four feeding trials were conducted to compare lamb-fattening rations using different common grains with alfalfa hay as the roughage.

Cottonseed cake in rations with either threshed milo or oats and alfalfa produced greater gains and effected a considerable saving of grain and alfalfa.

Grinding the threshed milo or threshed hegari did not increase the efficiency of the ration.

The oats-fed lambs made satisfactory gains but they did not attain as high a finish as the milo-fed lambs in the same feeding period.

Ground ear corn with husk, threshed milo, wheat, and threshed hegari gave satisfactory results when fed with cottonseed cake and alfalfa.

The lambs fed shelled corn, cottonseed cake, and alfalfa hay made greater gains and had more finish than any other lot in these trials.

Light feeder lambs made more economical gains than the medium-weight lambs, but on account of less flesh at the beginning, they did not have as much finish as the medium-weight lambs.

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FATTENING LAMBS ON CORN, MILO, HEGARI, WHEAT, AND OATS, WITH COTTONSEED CAKE AND ALFALFA

A. K. MACKEY and J. M. JONES

The lamb-feeding trials reported in this Bulletin were made to gain additional information on the value of Texas-grown feedstuffs for fattening lambs. Five trials (11) at the Spur Substation (Texas Bulletin 379) developed feeding data on the value of ground threshed milo, ground threshed kafir, and ground threshed feterita as compared with ground shelled corn, when each is fed with cottonseed meal and alfalfa hay. Ground heads were compared with the ground threshed grain of each of these three grain sorghums.

The trials conducted by the Department of Animal Husbandry in cooperation with the Texas Agricultural Experiment Station were to obtain additional information for Texas feeders on the preparation of threshed milo and threshed hegari; to compare the feeding value of oats with that of threshed milo; and to compare ground ear corn (with husk), hegari, and wheat with shelled corn.

Feeders interested in fattening lambs have considered a protein supplement necessary to balance rations where legume hay is used as only part of the roughage. The need for a protein supplement where legume hay is the only roughage has been a matter of question. Feeding trials at other stations (2, 5, 6, 9, 10, 13, 14, 16) have indicated that the addition of cottonseed meal to shelled corn and alfalfa will increase daily gains, produce more finish, and reduce the amount of grain and hay required for 100 pounds of gain.

Feeders become interested in the feeding value of oats and wheat as compared with corn when prices for these grains are considered low. Results of feeding trials at other stations which compare oats (1, 6, 7, 8, 12, 13) and wheat (1, 6, 7, 10, 15, 17) with shelled corn indicate that they may have a place in lamb-fattening rations.

PURPOSE

The four experiments reported in this Bulletin were planned to determine:

- (1) The feeding value of cottonseed cake in a ration with whole threshed milo and alfalfa (Tables 3, 4, and 5) and in a ration with whole oats and alfalfa (Table 5).
- (2) The feeding value of ground threshed milo (Tables 3, 4, and 5) and of ground threshed hegari (Table 6) compared with the whole threshed grain.
- (3) The feeding value of oats and of a combination of oats and whole

threshed milo compared with milo as the grain when each is fed with cottonseed cake and alfalfa hay (Table 5).

(4) The feeding value of threshed hegari; wheat; equal parts hegari and wheat; and ground ear corn with husk as compared to shelled corn (Table 6).

(5) The comparative amounts of feed required to produce 100 lbs. of gain on "light" and on "medium weight" feeder lambs (Table 4).

LAMBS USED

Rambouillet wether lambs were used in all trials. They were fairly uniform and practically free from skin folds with the exception of a few small folds on the necks of some. All of the lambs were healthy and had fairly dense fleeces.

The lambs used during the 1927-28 trial ranged in weight from 54 to 69 pounds and averaged 61 pounds. Those used in the 1928-29 trial ranged from 40 to 71 pounds. From these, lambs ranging from 40 to 55 pounds were selected to make three lots of "light" lambs with an average weight of 49 pounds. Those ranging from 55.5 to 71 pounds were grouped into three lots of "medium weight" lambs averaging 60 pounds. The lambs used in the 1929-30 and the 1930-31 trials had a range in weight from 42 to 79 pounds and averaged 59 pounds.

MANAGEMENT

Feed Lots and Shelter

The lambs were fed in well-drained lots. The feed troughs were covered to protect the feed during rainy weather. The only shelter in each lot was a 12'x12' shed that was open on all sides.

Preliminary Feeding and Management

A few days previous to the start of each trial, the lambs were fed alfalfa hay in quantities similar to those used during the early part of the feeding trials. The lambs used in each of the last two years reported were given two treatments for stomach worms previous to the start of the trials.

Method of Feeding

Hand feeding of concentrates and hay was the method used in each trial. Half the daily ration of both concentrates and hay was fed at each of the two feedings. The pebble-size cottonseed cake was mixed with the grain in all rations in which it was fed. In all cases where cottonseed cake was fed, a proportion of one part of cake to nine parts of grain was used during the entire feeding period. Whenever a ground grain was fed, not over ten days' supply was ground at one time. All lambs were fed as nearly as possible according to appetites.

Feeds

All of the grains except the corn graded No. 2. The corn was light weight and white. Both shelled corn and ear corn were taken from the same lot. One hundred pounds of the ear corn produced 63.7 pounds of shelled grain. The alfalfa was fairly fine-stemmed and leafy. It was of such quality that it was completely consumed at each feeding. The cake was the standard 43% protein pebble-size cottonseed cake consisting of fine particles and small pieces capable of passing through a $\frac{3}{8}$ -inch round perforation. The analyses of the feeds used are given in Table 1.

Table 1. Composition of feeds used in experiments

(Analyses made by Division of Chemistry)

	Protein	Fat	Crude fiber	Nitrogen free extract	Water	Ash
	%	%	%	%	%	%
1927-28 test:						
Threshed milo	10.74	2.82	2.06	72.85	10.12	1.42
43% Protein Pebble-size cottonseed cake	46.06	7.57	9.03	25.29	7.26	4.79
Alfalfa hay	14.35	1.35	28.01	40.62	9.00	6.67
1928-29 test:						
Whole threshed milo	9.89	2.16	2.23	71.29	12.51	1.92
Ground threshed milo	9.76	1.23	2.24	71.53	13.67	1.57
43% Protein Pebble-size cottonseed cake	41.28	7.52	11.83	28.55	6.19	4.63
Alfalfa hay	15.01	1.41	25.84	39.81	10.15	7.78
1929-30 test:						
Threshed milo	10.16	3.12	2.08	71.79	11.22	1.63
Oats	10.30	4.12	10.81	61.51	9.73	3.53
43% Protein Pebble-size cottonseed cake	42.88	7.04	11.65	26.65	6.95	4.83
Alfalfa hay	14.70	1.84	29.32	37.40	9.86	6.88
1930-31 test:						
Whole threshed hegari	10.85	2.55	2.53	71.31	11.42	1.34
Ground threshed hegari	11.75	2.53	2.38	71.57	10.29	1.48
Ground ear corn with husk	9.94	2.66	11.90	63.79	9.82	1.89
Shelled corn	12.13	3.93	2.69	70.46	9.38	1.41
Wheat	13.49	1.44	2.55	70.23	10.59	1.70
43% Protein Pebble-size cottonseed cake	45.07	6.90	8.40	26.11	7.73	5.79
Alfalfa hay	14.44	1.52	31.50	37.06	8.32	7.16

Financial Considerations

Feed costs or other financial figures have not been included in this Bulletin because feed prices change constantly. In each of the summary tables the total average feed consumed per lamb is given so that the feeder with current prices may calculate his own feed bill. The feed which was required for each 100 pounds of gain is also given in order that a feeder may figure the cost of gain based on current prices.

RESULTS OBTAINED

Cottonseed Cake in a Ration With Threshed Milo and Alfalfa Hay

In the 1927-28 trial, the lambs that were fed 43% protein pebble-size cottonseed cake with whole threshed milo and alfalfa hay made an aver-

age daily gain of .29 pound, which was .03 pound greater than that made by those that received whole threshed milo and alfalfa hay. The results of this trial show that 42 pounds of cottonseed cake reduced the amount of grain and hay required for 100 pounds of gain by 35 and 34 pounds respectively (Table 3).

In the 1928-29 trial (Table 4), the lambs in Lot 2 that received cottonseed cake with the whole threshed milo and alfalfa hay made an average daily gain of .32 pound, which was .06 pound greater than that made in Lot 1, which did not receive cottonseed cake. The lighter lambs in Lots 5 and 4 that received rations of the same feeds showed exactly the same difference in rate of gain. Both groups of lambs received concentrates and hay in approximately the same proportions. In Lot 2, forty pounds of cottonseed cake replaced 74 pounds of the milo and 84 pounds of the alfalfa required to produce 100 pounds of gain in Lot 1. In Lot 5, in which cottonseed cake also was fed, 35 pounds of cake replaced 67 pounds of the milo and 62 pounds of the alfalfa required in Lot 4 for 100 pounds of gain. The lambs with cottonseed cake in their rations had carcasses of a higher average grade as a result of a better finish.

In the 1929-30 trial (Table 5), the addition of cottonseed cake to a ration of whole threshed milo and alfalfa increased the average daily gain from .30 pound to .36 pound. Comparing the amounts of feed required to produce 100 pounds of gain in Lots 2 and 1, forty-three pounds of cake replaced 29 pounds of the milo and 45 pounds of the alfalfa. The use of cottonseed cake in this trial also resulted in carcasses of higher grade.

Cottonseed Cake in a Ration With Oats and Alfalfa Hay

The lambs in the 1929-30 trial (Table 5), that received cottonseed cake with oats and alfalfa hay made an average daily gain of .35 pound, which was .06 pound greater than that made by those that did not receive cake. The carcasses also were graded higher because of more finish. The lambs receiving cake required 98 pounds less oats and 49 pounds less alfalfa for each 100 pounds of gain.

In each of the above trials the greater daily consumption of feed was most likely due to the increased appetites produced by the cottonseed cake.

Table 2. Replacement value of cottonseed cake when fed with milo and alfalfa or oats and alfalfa.

Year of Trial	1927-28	1928-29	1928-29	1929-30	1929-30
Length of feeding period (days).....	84	109	109	112	112
Grain fed with cottonseed cake and alfalfa	Milo 61.6	Milo 60.3	Milo 49.4	Milo 58.8	Oats 58.8
Average initial weight of lambs, lbs.					
Increased daily gain due to the addition of cottonseed cake	12%	23%	22%	20%	21%
Feed replaced by 1 lb. of cotton- seed cake in the amount required for 100 lbs. of gain:					
Milo .....	.83	1.85	1.91	1.84	
Oats					2.04
Alfalfa hay .....	.81	2.10	1.77	1.05	1.02

This in itself would account for the higher finish of the lambs that received cottonseed cake. In the four pairs of lots the differences in appetites were particularly noticeable during the latter part of each feeding period when the lambs were receiving a fairly liberal allowance of grain. These results are summarized in Table 2.

Ground Threshed Milo Compared With Whole Threshed Milo

In the 1927-28 trial (Table 3), the lambs that received ground threshed milo made an average daily gain of .30 pound, which was only .01 pound greater than that made by those that received the whole grain. In this trial the grinding of the grain resulted in 23 pounds less grain, 3 pounds less cottonseed cake, and 26 pounds less alfalfa hay being required for each 100 pounds of gain made by the lambs. No difference in appetites between these lots was noticed at any time during the entire feeding period of 84 days.

Table 3. Effect of grinding the milo and of adding cottonseed cake in a ration of milo and alfalfa hay (84 day period—December 9, 1927 to March 2, 1928.)

Lot No.	1	2	3
Ration:	Whole threshed milo, alfalfa hay	Whole threshed milo, cottonseed cake, alfalfa hay	Ground threshed milo, cottonseed cake, alfalfa hay
No. of lambs	25	25	25
Weights, lbs.			
Av. initial	61.1	61.6	61.5
Av. final	82.9	85.5	87.1
Gains, lbs.			
Av. gain	21.8	23.9	25.6
Av. daily gain	.26	.29	.30
Av. daily feed: lbs.			
Grain	1.07	1.07	1.07
43% protein, pebble-size cottonseed cake		.12	.12
Chopped alfalfa hay	1.12	1.13	1.13
Total feed per lamb: lbs.			
Grain	89.4	89.8	89.9
43% protein, pebble-size cottonseed cake		10	10
Chopped alfalfa hay	93.9	95	95
Feed for 100 lbs. gain: lbs.			
Grain	410	375	352
43% protein, pebble-size cottonseed cake		42	39
Chopped alfalfa hay	431	397	371

In the 1928-29 trial (Table 4), both lots of lambs receiving whole threshed milo made .02 pound greater daily gain than those that received the ground threshed milo. For the medium-weight lambs, 8 pounds less grain, 1 pound less cottonseed cake, and 9 pounds less hay were required for 100 pounds of gain when whole grain was fed. Likewise the light-weight lambs that received the whole grain required 8 pounds less milo, 1 pound less cottonseed cake, and 20 pounds less alfalfa hay for 100 pounds of gain. The average grade of the carcasses for both lots of lambs that were fed the whole milo was a little higher than for those that received the ground grain. The lambs on the whole grain were usually a little more eager at feeding time.

Table 4. Effect of grinding the milo and of adding cottonseed cake in a ration of milo and alfalfa hay. Light and medium weight lambs. (109 day period—Nov. 3, 1928 to Feb. 20, 1929.)

Lot No.	Medium Weight			Light Weight		
	1	2	3	4	5	6
Ration:	Whole threshed milo, alfalfa hay	Whole threshed milo, cottonseed cake, alfalfa hay	Ground threshed milo, cottonseed cake, alfalfa hay	Whole threshed milo, alfalfa hay	Whole threshed milo, cottonseed cake, alfalfa hay	Ground threshed milo, cottonseed cake, alfalfa hay
Number of lambs	24*	25	25	25	25	25
Weights: lbs.						
Av. initial	60.5	60.3	60.7	49.1	49.4	49.3
Av. final	88.9	94.6	93.8	78.9	84.9	82.9
Gains: lbs.						
Av. gain	28.4	34.3	33.1	29.8	35.5	33.6
Av. daily gain	.26	.32	.30	.27	.33	.31
Average daily feed: lbs.						
Grain	1.12	1.12	1.11	1.04	1.02	.99
Cottonseed cake**		.13	.12		.11	.11
Hay	1.15	1.12	1.11	1.10	1.11	1.11
Total feed per lamb: lbs.						
Grain	122.3	122.4	120.9	113.8	111.6	108.4
Cottonseed cake**		13.6	13.4		12.4	12.0
Hay	125.2	122.4	121.3	120.0	121.2	121.3
Feed for 100 pounds gain: lbs.						
Grain	431	357	365	382	315	323
Cottonseed cake**		40	41		35	36
Hay	441	357	366	403	341	361
Weight in Fort Worth, lbs.	86.0	89.4	89.0	76.0	79.2	78.2
Shrinkage in marketing, lbs.	2.9	5.2	4.8	2.9	5.7	4.7
Dressing percentage†	48.4	49.1	48.5	46.4	47.3	46.6
Carcass grades††						
Prime			1			
Choice	5	12	10		3	1
Good	13	7	10	11	12	11
Medium	6	6	4	14	10	12
Cull						1

* One lamb was removed on Nov. 7 because it was sick

** 43% protein, pebble-size cottonseed cake was fed

† Based on selling weights, and warm weights of carcasses with a shrinkage of 2.3%

†† The slaughter data were secured through the courtesy of Swift & Co., Fort Worth

The results of the 1929-30 trial (Table 5) are in agreement with those of the 1928-29 comparisons. In this trial the lambs that received the whole threshed milo made .04 pound greater daily gain. They also required 15 pounds less milo, 2 pounds less cake, and 27 pounds less alfalfa to produce 100 pounds of gain. This is a greater difference in the amount of feed required than was found in the 1928-29 test. The grades of the carcasses did not show a significant difference. The lambs that received the whole grain had keener appetites than those that were fed ground milo.

The results of the 1928-29 and 1929-30 tests, in which whole threshed milo was compared with the ground grain, point toward the conclusion that the whole grain has some advantages. In these three tests, a little less feed was required for 100 pounds of gain. The lambs ate the whole

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grain more readily and it was easier to keep the troughs clean. While the 1927-28 test did not agree with the later tests, the difference in amount of feed required for 100 pounds of gain was small.

Table 5. Effect of grinding the milo and of adding cottonseed cake and of substituting oats as the grain in a ration of grain and alfalfa hay (112 day period, November 7, 1929 to February 27, 1930.)

Lot No.	1	2	3	4	5	6
Ration:	Whole threshed milo, alfalfa hay	Whole threshed milo, cottonseed cake, alfalfa hay	Ground threshed milo, cottonseed cake, alfalfa hay	Whole oats, alfalfa hay	Whole oats, cottonseed cake, alfalfa hay	Whole oats, whole threshed milo, cottonseed cake, alfalfa hay
No. of lambs	25	24*	23†	25	25	24**
Weights, lbs:						
Average initial	59.0	58.8	58.1	58.8	58.8	59.5
Average final	92.7	98.7	94.4	91.8	98.0	94.9
Gains, lbs:						
Av. gain	33.7	39.9	36.3	33.0	39.2	35.4
Av. daily gain .....	.30	.36	.32	.29	.35	.32
Average daily feed: lbs.						
Milo	1.41	1.38	1.31	-----	-----	.54
Oats	-----	-----	-----	1.56	1.50	.89
Cottonseed cake*†	-----	.15	.15	-----	.17	.16
Hay	1.14	1.19	1.17	1.06	1.08	1.01
Total feed per lamb: lbs.						
Milo	157.8	155.0	146.3	-----	-----	60.8
Oats	-----	-----	-----	174.2	168.3	99.3
Cottonseed cake*†	-----	17.2	16.3	-----	16.8	17.8
Hay	128.1	133.7	131.3	118.5	121.3	113.1
Feed for 100 lbs. gain: lbs.						
Milo	468	389	404	-----	-----	172
Oats	-----	-----	-----	528	430	281
Cottonseed cake*†	-----	43	45	-----	48	50
Hay	380	335	362	359	310	320
Weight in Fort Worth	86.8	91.0	86.3	84.8	89.4	87.9
Shrinkage in marketing, lbs.	5.9	7.7	8.1	7.0	8.6	7.0
Dressing percentage‡	47.8	49.0	48.4	47.1	47.6	47.5
Carcass grades‡‡						
Choice — Medium	-----	1	-----	-----	-----	-----
Heavy	1	2	-----	-----	-----	-----
Good — Light	-----	2	7	3	6	5
Medium	13	9	9	6	10	8
Heavy	1	2	1	2	2	1
Medium — Light	7	6	5	10	7	9
Medium	-----	2	1	1	-----	-----
Common — Light	3	-----	-----	3	-----	1

* One lamb had leg broken.

† Two lambs died. Post-mortem showed fluid in the abdomen.

** One lamb died from pneumonia.

*† 43% protein, pebble-size cottonseed cake was fed.

‡ Based on selling weights of lambs and warm carcass weights with a shrinkage of 2½%.

‡‡ Grades recorded on killing floor.

NOTE:—Lot 6 was fed one pound of oats and cake each day. Increases in ration were made with milo and cake.

The slaughter data were secured through the courtesy of Armour and Company, Fort Worth.

Ground Threshed Hegari Compared With Whole Threshed Hegari

The lambs that were fed the ground threshed hegari made .42 pound average daily gain, which was only .01 pound greater than that made

by those that were fed the whole grain. The lambs that were fed ground grain required a little less feed for 100 pounds of gain, and had a little higher average grade of carcass (Table 6). The appetites of the two groups of lambs were the same.

Comparison of Shelled Corn and Ground Ear Corn

In the 1930-31 trial (Table 6), the lambs that received shelled corn made a slightly greater daily gain than those that were fed ground ear corn with husk, and more of the carcasses were in the higher grades because of better finish.

The 387 pounds of ground ear corn with husk required for 100 pounds

Table 6. Comparison of hegari, corn and wheat in rations with cottonseed cake and alfalfa and of grinding the hegari and ear corn.
(92 day period, December 3, 1930 to March 4, 1931.)

Lot No.	1	2	3	4	5	6
Ration:	Whole threshed hegari, cottonseed cake, alfalfa hay	Ground threshed hegari, cottonseed cake, alfalfa hay	Ground ear corn with husk, cottonseed cake, alfalfa hay	Shelled corn, cottonseed cake, alfalfa hay	Whole wheat, cottonseed cake, alfalfa hay	Whole wheat & whole threshed hegari (equal parts), cottonseed cake, alfalfa hay
No. of lambs	24*	25	25	25	25	25
Weights, lbs.						
Av. initial	59.4	59.1	59.5	59.4	59.4	60.0
Av. final	97.3	97.4	96.0	97.7	97.1	99.1
Gains, lbs.						
Av. gain	37.9	38.3	36.5	38.3	37.7	39.1
Av. daily gain	.41	.42	.40	.42	.41	.43
Average daily feed: lbs.						
Grain	1.28	1.28	1.54	1.29	1.30	1.33
Cottonseed cake†	.14	.14	.17	.14	.14	.15
Hay	1.43	1.43	1.30	1.42	1.52	1.52
Total feed per lamb: lbs.						
Grain	117.7	117.9	141.4	118.3	119.6	122.3
Cottonseed cake†	13.1	13.1	15.7	13.2	13.3	13.6
Hay	181.8	181.8	119.4	131.0	139.8	139.8
Feed for 100 lbs. gain: lbs.						
Grain	311	307	387	309	317	313
Cottonseed cake†	35	34	43	34	35	35
Hay	348	344	327	342	371	357
Weight in Fort Worth, lbs.	86.7	86.4	84.4	88.0	86.6	89.0
Shrinkage in marketing	10.6	11.0	11.6	9.7	10.5	10.1
Dressing percentage‡	50.5	49.8	49.2	50.7	49.9	49.5
Carcass grades:						
Choice — Light					2	
Medium				10	4	1
Heavy			2	3		1
Good — Light	1			7	7	4
Medium	4	10	9	8		
Medium — Light	8	9	6	1	5	8
Medium	8	1	7	2	4	4
Common — Light	1	4			1	
						1

* One lamb removed on account of abnormally thin condition at close of trial.

† 43% protein, pebble-size cottonseed cake was fed.

‡ Based on selling weights of lambs, and warm carcass weights with a shrinkage of 2½%.

The slaughter data were secured through the courtesy of Armour and Company, Fort Worth.

of gain, consisted of 247 pounds of grain and 140 pounds of cob and husk. When the latter figures are compared with the amount of feed required for 100 pounds of gain made by the lambs in lot 4, which required 309 pounds of shelled corn, they show that 140 pounds of cob and husk and nine pounds of cottonseed cake replaced 62 pounds of shelled corn and 15 pounds of alfalfa.

The appetites of the lambs fed the ground ear corn with husk were fairly good. They preferred the corn which was finely ground to that which was coarse. The daily feed of ground ear corn with husk and cottonseed cake was gradually increased during the entire feeding period. As much as 25 to 30 minutes at a feeding was required for them to eat the ground ear corn with husk and cake during the latter part of the feeding period.

Oats Compared With Threshed Milo

In the 1929-30 trial (Table 5), the lambs that received the milo and alfalfa made .30 pound average daily gain, which was only .01 pound greater than that made by those that were fed oats and alfalfa. The grain was increased and hay decreased during the feeding period according to the appetites of the lambs in the two lots. This method gave the lambs fed oats more grain and less hay than the milo-fed lambs. As a result, 60 pounds more oats than milo and 21 pounds less alfalfa were fed to produce 100 pounds of gain. The average carcass grade was a little higher because of better finish for the lambs fed milo.

In Lots 2 and 5 of this trial, in which the lambs were fed milo and oats respectively with cottonseed cake and alfalfa, the milo-fed lambs made .36 pound average daily gain, which was only .01 pound greater than that made by the oats-fed lambs. Again in this comparison the oats-fed lambs were given a more rapid increase in daily concentrates than the milo-fed lambs. This increase in grain and cake caused a decrease in consumption of hay. In this case, 41 pounds more oats than milo, 5 pounds more cake, and 25 pounds less alfalfa were fed to make 100 pounds of gain. About the same difference in the average carcass grade existed between the lambs of Lots 2 and 5 as was found between Lots 1 and 4 of these trials.

The lambs in Lot 6 (Table 5) were quickly raised to 1 pound of oats and cottonseed cake, and after that all increases in concentrates were made with a mixture of milo and cake. This method of feeding did not, in this trial, produce as satisfactory results as either of the single grains fed with cottonseed cake and alfalfa hay.

Shelled Corn Compared With Threshed Hegari

The lambs fed shelled corn made .42 pound average daily gain, which was only .01 pound greater than that made by those receiving whole threshed hegari and the same gain as those that received ground threshed hegari. The amounts of the different feeds required for 100 pounds of gain

were practically the same in each of the three lots. The carcasses of the lambs that received the shelled corn had better finish, and the packer grader preferred the color of the carcasses of these lambs (Table 6).

Shelled Corn Compared With Wheat

The lambs fed shelled corn made only .01 pound greater daily gain than the wheat-fed lambs. They required 8 pounds less grain, 1 pound less cottonseed cake, and 29 pounds less alfalfa hay for each 100 pounds of gain. The carcasses from the shelled-corn lot showed more finish and on the average were graded a little higher. The wheat-fed lambs had better appetites. They were started on 1.52 pounds of alfalfa and this amount was never lowered, while they were gradually raised on wheat and cake to 2.16 pounds daily for each lamb by the end of the period (Table 6).

Equal Parts Wheat and Threshed Hegari

The lambs in Lot 6 (Table 6) were fed equal parts of wheat and threshed hegari. This mixture was used to determine the advantage, if any, of such a combination as compared with either of the grains fed separately. This group of lambs made an average daily gain of .43 pound, which was .01 pound greater than that made by those that received shelled corn. They made .02 pound greater daily gain than the lambs fed wheat or threshed hegari. The difference in the amount of feed required for 100 pounds of gain was small. The average carcass grade for these lambs was higher than it was for the lambs of Lot 1 fed whole threshed hegari, but not as high as it was for those of Lot 5, that received wheat alone as grain. The lambs of Lot 6 were always more eager for their feed than any other lot of lambs in this trial. They started on 1.52 pounds of alfalfa hay and this amount was not reduced, while the concentrates were gradually increased to 2.16 pounds daily for each lamb at the close of the trial.

Light Lambs Compared With Medium-Weight Feeder Lambs

Rambouillet feeder lambs coming off the range vary in weight because of differences in age, size of frame, and fleshing. For the lambs used for this comparison in the 1928-29 trial (Table 4), the difference was largely a matter of fleshing. In the three pairs of lots where the feeds were the same, the light lambs made .01 pound greater daily gain for each comparison and required less feed for 100 pounds of gain than the medium-weight lambs. The carcass data show that the average grades for the medium-weight lambs were higher. This was a result of better finish, probably due to the fact that medium-weight lambs had more flesh at the beginning of the trial.

Average Daily Ration in Relation to the Length of Feeding Period

A study of these results shows that an average daily ration of 1.25 to 1.30 pounds of shelled corn, wheat, threshed milo, or threshed hegari,

.14 to .15 pounds of cottonseed meal or cake, and 1.4 to 1.5 pounds of good alfalfa hay for a 90 to 100 day feeding period should give satisfactory results for Rambouillet feeder lambs averaging about 60 pounds.

All lambs were fed as nearly as possible according to their appetites. Gradual increases in concentrates were made according to the eagerness of the lambs. Care was taken not to make such rapid increases that all the lambs would not stay at the trough and eat their grain in a relatively short time. They were started on a rather liberal allowance of alfalfa with gradual reductions at times when they did not seem eager for the increase in grain.

When the rates of feeding or the average daily rations for the four years are studied, it is apparent that in the 1927-28 trial the average daily consumption of concentrates (1.19 lbs.) and hay (1.12 lbs.) was not sufficient to produce good gains or satisfactory finish in 84 days (Lot 2, Table 3).

During the 1928-29 trial the medium-weight lambs consumed an average of 1.24 pounds of concentrates daily and 1.12 pounds of hay. These lambs made .03 pound greater daily average gain and were fed 25 days longer than those in the first trial. In the 109-day feeding period this group of lambs made more efficient use of their feed and showed a satisfactory finish (Lot 2, Table 4).

In the 1929-30 trial of 112 days a comparable lot of lambs received an average daily feed of 1.53 pounds of concentrates and 1.19 pounds of hay. This lot made an average daily gain of .36 pound, which was .04 pound greater than that made by the group in the second trial. However, they did not make more economical gains nor have any higher finish (Lot 2, Table 5).

In the 1930-31 trial of 92 days a similar lot of lambs consumed an average daily feed of 1.42 pounds of concentrates and 1.42 pounds of hay. They made .41 pound average daily gain, which was higher than that made in any of the first three trials. These lambs required less total feed for 100 pounds of gain than either of the above lots and had a good finish (Lot 1, Table 6).

Table 7. Average rations for Lot 4 of 1930-31 test by weeks

Week of feeding period	Shelled corn 9 parts, cottonseed cake, 1 part, pounds daily	Alfalfa hay, pounds daily
1	.48	1.52
2	.87	1.52
3	1.06	1.52
4	1.19	1.52
5	1.35	1.52
6	1.44	1.45
7	1.44	1.36
8	1.58	1.36
9	1.63	1.36
10	1.77	1.36
11	1.87	1.36
12	2.05	1.36
13*	1.79	1.32
Average	1.43	1.42

*There were a few warm rainy days during this week and the feed was reduced.

CHANGES IN DAILY AMOUNT OF FEED

The amount of concentrates and roughages, together with the changes made in each during the feeding period, is generally recognized as being an important factor in securing satisfactory gains and finish in fatten-

ing lambs. The average daily ration fed to Lot 4 of the 1930-31 test is presented by weeks in Table 7. This group of lambs made .42 pound average daily gain for the entire feeding period. They showed more finish than any of the other lots during the four series of tests reported in this Bulletin.

PRODUCTIVE ENERGY CALCULATED FROM FEEDING EXPERIMENTS

The productive energy of the various feeds compared in the feeding experiment was calculated by the Division of Chemistry using the method described fully in (3) Bulletin 436. In this method the productive value of a feeding stuff of well established value was used as a standard for comparing the other feeds. The results of the comparison are given in Table 8. The productive values calculated from the analysis for the feed used, as given in Table 1, by means of the production coefficients (4) given in Bulletin 461, are also stated in the Table.

Cottonseed cake. The productive value calculated for cottonseed cake added to a ration of threshed milo and alfalfa is appreciably greater than when the cottonseed cake is compared with another protein feed fed in a balanced ration. This fact was brought out in Bulletin 436. The supplementary action of the protein in cottonseed meal increases the digestion of the mixture or the capacity of the animal to utilize the productive energy of the other feeds, or else it decreases the maintenance requirements of the animals so as to leave more of the productive energy for the production of fat and flesh. In any case, the effect of the cottonseed meal and other high-protein feeds when added to certain rations is to cause a gain in the weight greater than that which can be ascribed to the cottonseed meal itself and must be due to the increased utilization of other feeds in the ration. However, the feeding value of the cottonseed meal is actually the higher value assigned to it in such experiment, since the increased value of the other feeds must be credited to the action of the cottonseed meal. The productive energy of cottonseed meal calculated in this way is somewhat variable as can be seen both in Table 8 and in the calculations given in Bulletin 436.

Ear Corn with Husk. The productive value of this feed calculated from the feeding experiment is very nearly the same as that calculated from the analysis of the feed used and the production coefficients already referred to.

Hegari. The productive value of the ground threshed hegari compared with corn was the same as that calculated from the analysis and the production coefficient. The productive value of the whole threshed hegari is slightly less than that of the ground threshed hegari, but the difference is small.

Whole Versus Ground Threshed Milo. The productive value of the ground threshed milo is slightly lower than that of the whole milo

Table 8. Productive energy calculated from feeding experiments

Name of feed	Therms productive energy in 100 lbs. calculated from experiment	Therms productive value calculated from analyses	Feed compared with	Table No.
Threshed milo, ground	87.8	---	Whole milo 84.6	3
Threshed milo, ground (Lot 2)	78.2	---	Whole milo 81.1	4
Threshed milo, ground (Lot 5)	69.5	---	Whole milo 81.1	4
Threshed milo, ground	78.4	---	Whole milo 83.7	5
Hegari, whole threshed	81.3	---	Corn 83.0	6
Hegari, ground threshed	83.2	83.5	Corn 83.0	6
Ear corn with husk, ground	67.3	70.4	Corn 83.0	6
Cottonseed cake added to threshed milo and alfalfa	78.3	72.6	Milo & Alfalfa	3
Cottonseed cake added to threshed milo and Alfalfa (Lot 3)	89.2	70.2	Milo & Alfalfa	4
Cottonseed cake added to threshed milo and Alfalfa (Lot 6)	183.6	70.2	Milo & Alfalfa	4
Cottonseed cake added to threshed milo and Alfalfa	148.7	69.1	Milo & Alfalfa	5
Oats, whole (Lot 4)	75.2	71.7	Whole milo 83.7	5
Oats, whole (Lot 5)	76.7	71.7	Whole milo 83.7	5
Oats, whole (with milo)	122.0	71.7	Whole milo 83.7	5
Wheat, whole	77.6	78.8	Corn 83.0	6
Wheat, whole (with hegari)	88.1	78.8	Corn 83.0	6

with which it was compared in three of the four tests. The differences are probably within the limits of error of the experiment.

Oats. The whole unground oats compared with whole milo had a slightly higher value when calculated from the feeding experiments than when calculated from the production coefficients and the chemical analysis. The whole oats fed with milo seem to have some supplementary value, as the productive energy calculated from the feeding experiment was comparatively high.

Wheat, Whole. The productive value of the whole wheat calculated from the feeding experiment is practically the same as that calculated from its chemical composition by means of the production coefficients. Fed with hegari, the wheat seemed to have some supplementary value.

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SUMMARY

1. The addition of one part of cottonseed cake to nine parts of grain in a ration of alfalfa and grain resulted in a considerable reduction of the amounts of both grain and hay required for 100 pounds of gain.
 - (a) In the 1927-28 trial, one pound of cottonseed cake replaced .83 pound of threshed milo and .81 pound of alfalfa.
 - (b) In the 1928-29 trial with the medium-weight lambs, one pound of cake replaced 1.85 pounds of threshed milo and 2.10 pounds of alfalfa. In the case of the lighter lambs fed at the same time, one pound of cake replaced 1.91 pounds of milo and 1.77 pounds of alfalfa.
 - (c) In the 1929-30 trial, one pound of cake replaced 1.84 pounds of milo and 1.05 pounds of alfalfa.
 - (d) In the 1929-30 trial, one pound of cake replaced 2.04 pounds of oats and 1.02 pounds of alfalfa.
2. The addition of cottonseed cake to a ration of whole threshed grain and alfalfa produced greater gains than rations of grain and alfalfa alone.
 - (a) In the first trial of 84 days, a 12 per cent greater daily gain was made by the lambs that received cottonseed cake.
 - (b) In the second series of trials with a 109-day feeding period, the medium-weight group of lambs receiving cottonseed cake

made a 23 per cent greater daily gain and the lighter group 22 per cent.

- (c) In the third series of trials with a 112-day feeding period, the lambs fed milo with cottonseed cake made a 20 per cent greater daily gain, and those fed oats with cottonseed cake made 21 per cent more than those that did not receive cottonseed cake.
3. The productive value calculated for cottonseed cake added to a ration of threshed milo and alfalfa is appreciably greater than when it is evaluated in a balanced ration.
 4. The carcasses of the lambs that received cottonseed cake graded higher because of more finish.
 5. The lambs that received cottonseed cake were always more eager for their concentrates. During the latter part of each trial, it was possible to increase the concentrates much more rapidly in the lots where the cottonseed cake was fed.
 6. Ground threshed milo and ground threshed hegari showed no advantages as compared with the whole threshed grain.
 7. Light feeder lambs required less feed for 100 pounds of gain than the medium-weight lambs. They did not show as much finish as the medium-weight lambs. This indicates that the same finish on lighter lambs would require a longer feeding period.
 8. Oats produced satisfactory gains when cottonseed cake was added to the ration. The feeding of oats according to the appetites of the lambs effected a saving of alfalfa.
 9. Although the lambs fed ground ear corn with husk did not show as much finish as those fed shelled corn, they made good gains and required less actual grain and hay for 100 pounds of gain.
 10. The gains made by the lambs that were fed wheat, or hegari, or a combination of both were practically the same as those produced by shelled corn. However, the carcasses of the lambs fed shelled corn showed a better finish than those fed wheat. The carcasses from the wheat-fed lambs in turn showed a better finish than those fed hegari.
 11. Productive energy values calculated from the feeding experiments agreed well with those calculated from production coefficients and the analyses of the feed.

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