

THE INFLUENCE OF THE AMOUNT OF RATION  
AND THE ADDITION OF A NITROGENOUS CON-  
CENTRATE UPON THE EFFICIENCY OF RA-  
TIONS FOR FATTENING PURPOSES

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INTRODUCTION

An experiment was conducted at the Illinois Agricultural Experiment Station by H. W. Mumford, H. S. Grindley, L. D. Hall and A. D. Emmett to study the effect of variations in the amount and character of the ration upon the nutrition of steers. As indicated by the title, this paper is a brief summation of the data relating (1) to the effect of the amount of the ration upon its efficiency for producing gains, and (2) to the effect of replacing a part of the corn by an equal amount of linseed meal upon the efficiency of the ration for producing gains.

The animals used were sixteen 2-year-old high-grade Hereford steers from the same herd grading as choice feeders and weighing from 750 to 1,000 pounds.

To determine the effect of variations in the amount of feed consumed upon the efficiency of the gains, the steers were divided into four lots of four animals each. One lot was given just enough feed to maintain the weights of the steers about constant, although as a matter of fact, they made considerable gain during the first and fourth periods of the experiment; another, as much as the steers would eat readily; another, an amount of feed equal to the maintenance ration plus one-third of the difference between the maintenance and the full-feed rations; and another an amount equal to the maintenance ration plus two-thirds of the difference between the maintenance and full-feed rations. In the discussion and tables of this paper the first of the above-described lots has been designated as the "maintenance" lot; the second, as the "full-feed" lot; the third, as the "one-third-feed" lot; and the fourth, as the "two-thirds-feed" lot.

The feeds used were ground corn and clover hay in different proportions and later, old process linseed meal. For the purpose of this discussion the experiment may be divided into four test periods varying in length from five to thirteen weeks.

Between the test periods were transitional periods of two or three weeks during which time gradual changes were made in the ration. Table 1 shows the test periods, the experimental weeks included in each, and the proportions of hay, corn and linseed meal in the ration of each period.

#### INFLUENCE OF AMOUNT OF RATION

The practical cattle feeder assumes that the larger the amount of feed fattening cattle consume the more efficient will be the gains. This assumption is based upon the fact that a certain amount of feed is required for maintenance under any condition. Consequently, the larger the amount of feed consumed, the more there is above the maintenance requirement available for production, and consequently the ration should be more efficient.

On the other hand, experiments at the Illinois, Missouri and other stations show that large rations are not as completely digested as smaller ones, especially when there is a considerable amount of crude fiber in the ration. Consequently, if one considers only the digestibility of the ration, one would expect the efficiency to be lessened as the ration is increased. Thus in studying the influence of the amount of ration upon efficiency, both of these factors, working in opposite directions, must be considered.

Table 1 shows the average amount of feed consumed per head daily by each lot during the different test periods. It will be noted from this table that the full feed consumed only a moderately heavy ration. Also it is seen that the amount of feed consumed decreased after Period 2.

The individual weights of the steers at the beginning and end of each period are given in Table 2. The average daily gains for each period and for the entire experiment are given in Table 3.

Disregarding the maintenance lot for obvious reasons, it is seen that the rate of gain decreased regularly during Periods 1, 2 and 3, even though the proportion of roughage to concentrates was considerably decreased. After the introduction of the linseed meal in Period 4 the gains were increased considerably.

Table 4 shows the amounts of feed consumed per pound of gain during each period and during the entire experiment. Table 5 shows the same results expressed in terms of total dry substance per pound of gain. Table 6 shows the individual results. (It should be noted that the values in Table 5 are not averages of the values in Table 6, but are obtained by dividing the total amount of dry substance consumed by each lot by the total gains made by the corresponding lot.) Referring to the data concerning the one-third, two-thirds and full-feed lots, it is found that in Period 1 the two-thirds-feed lot apparently was slightly more efficient than the full-feed lot. There does not seem to be much difference between the full-feed and one-third-feed lots. In Period 2 there is an indication that the one-third-feed lot was slightly more efficient than the two-thirds and full-feed lots, which seem about equal. However, the individual variations are so great that the results are not at all conclusive. In Period 3 there may be a slight indication that the efficiency of the ration varied inversely with the amount. Again the individual differences are so great that no definite conclusion is justified. In Period 4 the full-feed ration apparently was more efficient than either of the other rations, although the individual results again were rather variable. Taking the entire thirty-seven weeks of the experiment into consideration there seems to be no reason to conclude that the amount of feed consumed had any effect upon the efficiency of gains. As a matter of interest we have presented in Table 7 the coefficients of digestibility of the dry substance of the rations during the different periods.

#### INFLUENCE OF INTRODUCTION OF LINSEED MEAL

A comparison of Periods 3 and 4 provides data for studying the influence upon the efficiency of the ration of substituting linseed meal for an equal weight of corn in the ration. A study of Table 4 shows that in case of the one-third-feed lot, about 15 per cent more feed was required to produce a pound of gain, when no nitrogenous concentrate was fed than when linseed meal was substituted for an equal amount of corn. In the two-thirds-feed lot 23 per cent more feed was required to produce a pound of gain in the corn period than in the corn and linseed meal period. In the full-feed lot 54 per cent more feed was required to produce a pound of gain when corn was

the sole concentrate than when linseed meal was also used. In this connection one should remember that if the same ration had been fed in Periods 3 and 4 we would have expected that more feed would be required in Period 4, as the steers were more nearly finished in this period. However, before drawing any definite conclusions from these data one should refer to the data of the individual animals, owing to the small number in each lot. It will simplify the study if one speaks in terms of dry substance per pound of gain rather than in terms of corn, hay and linseed meal per pound of gain.

Referring again to Table 5 the same relative differences between lots are shown as in Table 4.

Table 6 shows the individual data pertaining to the amount of dry substance per pound of gain.

Concerning the individual steers of the one-third feed lot it is found that the ration of Steer 666 was much more efficient after the addition of the linseed meal. On the other hand, the ration of Steer 662 was considerably less efficient after the linseed meal was introduced into the ration. In case of the two steers of this lot the rations were slightly less efficient after the change was made. Consequently, in view of the wide variation in individual results, it does not seem safe to conclude that the introduction of oil meal had any effect upon the efficiency of the rations of the steers of the one-third-feed lot.

Referring to the data concerning the steers of the two-thirds-feed lot it is seen that the rations of Steers 668 and 665 were considerably more efficient after the introduction of linseed meal. Steer 652 also shows a slight difference in favor of the linseed meal. Steer 657 shows little influence of the linseed meal. This may be accounted for, in part at least, as this steer was off feed and scoured some for several days in Period 4. Taking this into consideration, it seems safe to conclude that the introduction of linseed meal into the ration of the two-thirds-feed lot materially increased the efficiency of the ration.

Considering the steers of the full-feed lot, it is seen that the introduction of the linseed meal increased the efficiency of the ration to a marked degree in some cases of Steers 659, 661 and 664. Steer 663 made less efficient gains after the introduction

of the linseed meal. This was doubtless due to the fact that this steer went off feed and scoured badly during the twenty-eighth, twenty-ninth and thirtieth weeks of the experiment. In fact he was so bad that he was removed from the experiment at the end of the thirtieth week and placed upon another ration. Taking this into consideration, it seems safe to conclude that the introduction of linseed meal into the ration of the full-feed lot caused a marked increase in the efficiency of the ration.

These results indicate at least that the introduction of linseed meal into the ration had a more beneficial effect in case of the full-feed lot than in case of the two-thirds-feed lot, and that it had a more beneficial effect in case of the two-thirds-feed lot than in case of the one-third-feed lot. As a matter of interest, we have presented in Table 8 the co-efficients of digestibility of the dry substance of the digestion steers in Periods 3 and 4.

#### CONCLUSIONS

1. In Period 1 when the ration consisted of clover hay one part and ground corn one part, the two-thirds-feed lot was slightly more efficient than the full-feed lot. There was no difference between the one-third and full-feed lots.
2. In Period 2 when the ration consisted of clover hay one part and ground corn three parts, there is an indication that the one-third-feed lot was slightly more efficient than the two-thirds or full-feed lots, which were about equal in efficiency.
3. In Period 3 when the ration consisted of clover hay one part and ground corn five parts there is a slight indication that the efficiency of the rations varied with the amounts fed.
4. In Period 4 when the ration consisted of clover hay one part, ground corn four parts and linseed meal one part, the full-feed lot apparently made more efficient gains than the other two lots.
5. Taking into consideration the entire feeding period, the amount of the ration had no effect upon the efficiency.

6. The introduction of linseed meal into the ration of the one-third-feed lot apparently had little or no effect upon the efficiency of gains.

7. The introduction of linseed meal into the ration of the two-thirds-feed lot caused a considerable increase in the efficiency of the ration.

8. The introduction of linseed meal into the ration of the full-feed lot caused a marked increase in the efficiency of the ration.

9. The introduction of linseed meal into the ration caused a greater increase in the efficiency of the full-feed lot than in the efficiency of the two-thirds-feed lot.

TABLE 1.—AVERAGE FEED CONSUMED DAILY PER LOT  
(Results expressed in pounds)

Period	No. of weeks	—Maintenance Lot—			—One-third Feed Lot—			—Two-thirds Feed Lot—			Full Feed Lot		
		Ratio of corn to hay	Clover hay	Ground corn	Clover hay	Ground corn	Oil meal	Clover hay	Ground corn	Oil meal	Clover hay	Ground corn	Oil meal
1	1-5	1:1:0	5.48	5.48	7.88	7.88	.....	10.29	10.29	.....	12.13	12.13	.....
2	8-13	1:3:0	2.22	6.65	3.74	11.22	.....	5.26	15.79	.....	6.45	19.36	.....
3	17-22	1:5:0	1.36	6.78	2.23	11.12	.....	3.11	15.54	.....	3.53	17.62	.....
4	25-37	1:4:1	1.62	6.47	2.33	9.31	2.33	2.97	11.87	2.97	3.52	14.09	3.52



TABLE NO. 3—AVERAGE DAILY GAINS PER STEER PER PERIOD  
(Results expressed in pounds)

Period	No. of weeks	Ratio of hay to corn to oil meal	Maintenance Lot				Animal Average
			Animal 653	Animal 650	Animal 656	Animal 658	
1	1-5	1:1:0	1.97	1.57	1.97	0.34	1.46
2	8-13	1:3:0	0.05	0.12	0.07	0.00	0.00
3	17-22	1:5:0	0.12	0.05	0.10	0.14	0.04
4	25-37	1:4:1	1.73	2.11	0.47	0.57	1.22
Total	1-37		0.88	1.05	0.48	0.37	0.70
			One-third Feed Lot				
			Animal 667	Animal 666	Animal 669	Animal 662	Animal Average
1	1-5	1:1:0	1.69	2.51	1.97	2.14	2.08
2	8-13	1:3:0	1.93	1.33	1.31	1.98	1.64
3	17-22	1:5:0	1.40	0.55	1.29	1.26	1.12
4	25-37	1:4:1	1.57	1.87	1.15	0.81	1.35
Total	1-37		1.39	1.34	1.23	1.30	1.32
			Two-thirds Feed Lot				
			Animal 668	Animal 652 <sup>1</sup>	Animal 665	Animal 657	Animal Average
1	1-5	1:1:0	2.51	3.03	3.37	2.57	2.87
2	8-13	1:3:0	1.71	2.24	1.57	1.83	1.84
3	17-22	1:5:0	1.64	1.50	1.02	1.74	1.48
4	25-37	1:4:1	2.23	1.56	1.58	1.53	1.72
Total	1-37		1.80	1.75	1.78	1.81	1.79
			Full Feed Lot				
			Animal 659 <sup>2</sup>	Animal 663 <sup>3</sup>	Animal 661	Animal 664	Animal Average
1	1-5	1:1:0	3.03	3.40	2.54	2.94	2.98
2	8-13	1:3:0	2.62	2.14	1.95	2.40	2.28
3	17-22	1:5:0	1.64	2.12	0.90	1.33	1.50
4	25-37	1:4:1	2.65	1.81	2.45	2.35	2.31
Total	1-37		2.29	2.13	1.98	2.10	2.13

<sup>1</sup>Removed at end of 34th week.

<sup>2</sup>Removed at end of 33rd week.

<sup>3</sup>Removed at end of 30th week.

TABLE 4—AMOUNT OF FEED CONSUMED PER POUND OF GAIN PER LOT PER PERIOD  
(Results expressed in pounds)

Period wks.	No. of steers	Ratio of hay to corn to oil	Maintenance Lot		One-third Feed Lot		Two-thirds Feed Lot		Full Feed Lot			
			Clover hay	Ground corn	Oil meal	Clover hay	Ground corn	Oil meal	Clover hay	Ground corn	Oil meal	
1	1-5	1:1:0	3.74	3.74	.....	.....	3.58	3.58	.....	.....	4.19	4.19
2	8-13	1:3:0	..... <sup>2</sup>	..... <sup>2</sup>	2.29	3.79	2.86	8.58	.....	.....	2.83	8.49
3	17-22	1:5:0	32.52 <sup>1</sup>	162.60 <sup>1</sup>	.....	.....	2.11	10.53	.....	.....	2.35	11.74
4	25-37	1:4:1	1.33	5.30	1.33	1.72	1.72	6.88	1.72	1.72	1.53	6.13
Total	1-37		3.29	9.20	0.87	7.55	2.63	7.51	0.62	0.62	2.75	7.68

<sup>1</sup>One or more steers in lot lost in weight.

<sup>2</sup>Lot made no gain.

TABLE 5—DRY SUBSTANCE CONSUMED PER LOT PER POUND GAIN  
(Results expressed in pounds)

Period	No. of weeks	Ratio of hay to corn to oil meal	Mainten- ance Lot	One-third Feed Lot	Two-thirds Feed Lot	Full Feed Lot
1	1-5	1:2:0	6.53	6.61	6.25	7.33
2	8-13	1:3:0	..... <sup>1</sup>	7.95	9.96	9.86
3	17-22	1:5:0	171.60	10.43	11.08	12.41
4	25-37	1:4:1	6.94	9.03	9.03	8.06
Average	1-37		11.67	9.51	9.40	9.63

TABLE 6—TOTAL DRY SUBSTANCE CONSUMED PER STEER PER POUND GAIN

(Results expressed in pounds)

Period No. of weeks	Ratio of hay to corn to oil meal	Maintenance Lot No. 653		Lot No. 655		One-third Feed Lot No. 667		Feed Lot No. 666		Animal No. 669		Animal No. 662	
		Animal	No.	Animal	No.	Animal	No.	Animal	No.	Animal	No.	Animal	No.
1	1-5	4.78	6.11	4.87	28.00	8.17	5.35	7.03	6.49				
2	8-13	151.55	110.91	10.91	50.23	6.57	9.84	10.12	6.78				
3	17-22	5.66	4.73	14.94	12.36	8.05	20.30	9.38	9.96				
4	25-37					8.44	6.77	9.82	14.28				
Total	1-37	9.40	8.34	16.07	20.92	9.17	9.20	10.04	9.68				

  

Period No. of weeks	Ratio of hay to corn to oil meal	Two-thirds Feed Lot No. 668		Feed Lot No. 663		Animal No. 661		Animal No. 664	
		Animal	No.	Animal	No.	Animal	No.	Animal	No.
1	1-5	7.21	5.74	5.37	7.08	7.38	6.02	8.71	7.60
2	8-13	10.61	7.78	11.85	10.38	8.27	9.35	12.06	10.25
3	17-22	9.70	9.91	16.47	10.23	11.67	7.64	20.16	15.64
4	25-37	7.47	9.14	9.84	10.39	7.27	8.22	8.05	8.62
Total	1-37	9.48	8.95	9.49	9.64	9.03	8.41	10.43	10.47

<sup>1</sup>Steer lost in weight.  
<sup>2</sup>Steer made no gain.

TABLE 7—COEFFICIENTS OF DIGESTIBILITY OF DRY SUBSTANCE

Period	Maintenance Lot	One third Feed Lot	Two-thirds Feed Lot	Full Feed Lot
1	69.29	65.91	63.84	62.55
2	77.73	71.88	68.82	64.68
3	78.74	75.80	73.61	69.68
4 <sup>1</sup>	79.56	76.90	75.04	76.01

<sup>1</sup>Includes only 25th to 30th week.

TABLE 8—COEFFICIENTS OF DIGESTIBILITY OF DRY SUBSTANCE IN PERIODS 3 and 4

Period	One-third Feed Steer		Two-thirds Feed Steer		Full Feed Steer	
	No. 666	No. 669	No. 652	No. 665	No. 663	No. 661
Period 3.....	75.10	76.51	76.13	71.09	74.06	65.31
Period 4 <sup>1</sup> .....	76.79	76.61	77.53	72.35	79.09	74.10

<sup>1</sup>25th to 37th week except in cases of those steers which were removed from the experiment before the 37th week.