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THE RELATIVE VALUES OF CORN AND BARLEY  
FOR  
MUTTON AND PORK PRODUCTION.

THESIS FOR THE DEGREE OF M.S.

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**THESIS**

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THE RELATIVE VALUES OF CORN AND BARLEY  
FOR  
MUTTON AND PORK PRODUCTION.

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## PART I.

### THE RELATIVE VALUES OF CORN AND BARLEY FOR MUTTON PRODUCTION.

#### I N T R O D U C T I O N.

Owing to the fact that barley may be grown in some localities in which it is impossible to grow corn, and hence may be available for fattening lambs, when corn is not, this experiment was undertaken to see if barley may not be as satisfactory a grain for fattening lambs as is corn.

An effort was also made to find as economical a ration as possible, and to this end a portion of the grain in both the corn and barley rations was replaced by old process linseed meal, and the necessary amount of oat straw replaced alfalfa, to balance the rations.

#### O U T L I N E    O F    E X P E R I M E N T.

Twenty lambs were divided into four lots as nearly equal in weight and quality as possible, and all lots were fed under exactly identical conditions, except as regards feeds. All lots were allowed a twelve day preliminary feeding period to accustom them to the feeds.

The feeding period proper extended over a period of eighty-four days, the lambs being slaughtered at the end of that time. The entire feeding period was divided into three feeding periods of four weeks each at the end of which time the lambs were weighed, the results of each feeding period being based upon these weights.





In all cases the total amounts of grain and roughage fed to each pen per day were the same, except where some was rejected, but varied in proportions and kind as shown by the following.

Ration I consisted of corn and alfalfa and was used as a check lot. The lambs in this lot averaged 63 pounds when the experiment was started January 7, after a twelve day preliminary feeding period at the beginning of which they averaged 61.86 pounds per head. At this time they were receiving one pound of corn and 1.75 pounds of alfalfa per head per day, the ration have a nutritive ratio of 1:5.78. This ration was fed until February 18, when the ration was gradually increased until the lambs were receiving 1.25 pounds of corn and 1.75 pounds of alfalfa per head per day; the nutritive ratio of this ration being 1:6.04. This ration was fed until the end of the experiment, April 1st.

The lambs in Lot II averaged 63.34 pounds when started on the 12-day preliminary feeding period, and 66 pounds when the experiment was started, January 7. They received at this time .9 pounds corn, .1 pound old process linseed meal, 1.75 pounds alfalfa and .3 pounds oat straw per head per day. This ration had a nutritive ratio of 1:5.8 and was fed until February 18th, after which date it was gradually increased until each lamb received 1.15 pounds corn, .1 old process linseed meal, 1.45 pounds alfalfa and .3 oat straw, per day. This ration had a nutritive ratio of 1:6.04, and was fed until April 1st. when the experiment ended.

The results obtained from Rations I and II would show

the effect of substituting .1 pound old process linseed meal for an equal amount of corn, this permitting .3 pounds of alfalfa to be replaced in the ration by .3 pounds of oat straw; the nutritive ratio remaining the same.

The lambs in Lot III averaged 57.86 pounds when started on the preliminary feeding period and 57.86 pounds at the beginning of the experiment proper. At this time they were receiving .9 pounds barley, .1 pound old process linseed meal, 1.25 pounds alfalfa, and .5 oat straw per head per day, the ration having a nutritive ratio of 1:5.77. This ration was fed until February 18th, after this date it was gradually increased until the lambs were receiving 1.15 pounds barley, .1 old process linseed meal, 1.15 pounds alfalfa and .6 oat straw, per head per day at the end of three days. This ration had a nutritive ratio of 1:6.1 and was fed until the end of the experiment.

The same amount of barley was fed in this ration as corn in ration II, the linseed meal remained the same, but it was possible on account of the higher protein and carbohydrate content of the barley to replace more of the alfalfa with straw in the ration containing the barley than in that containing the corn, keeping the nutritive ratio the same. Therefore, if these rations should give equally good results, it is evident that the one containing the barley would be the more economical providing barley and corn were valued at the same price.

Ration IV was to test the possibility of further substituting old process linseed meal for barley and oat straw



for alfalfa. The lambs of this lot averaged 62.2 pounds when started on the preliminary feeding period and 65.2 pounds when the experiment proper was started; at this time they were getting .8 pound barley, .2 pound old process linseed meal, 1 pound alfalfa, and .75 pound oat straw per head per day. This ration had a nutritive ratio of 1:5.71 and was fed until February 18th, when it was gradually increased to 1.05 pounds barley, .2 pounds linseed meal, .9 pounds alfalfa and .85 pound oat straw per head per day, having a nutritive ratio of 1:6.1. This ration was fed until April 1st, when the experiment ended.

It will be seen that by substituting .2 pound linseed meal for an equal amount of barley, it was possible to replace .85 pound of alfalfa with oat straw, as compared with a ration of barley and alfalfa only. Therefore, if these two rations gave equally good results there would evidently be a marked saving brought about by feeding Ration IV, tho both supply the same amount of nutrients in the same ratio.

All lambs used in the experiment were crosses between a Southdown buck and Montana range ewes, except three which were crosses between a Southdown buck and Shropshire ewes. All were very good lambs and in very good condition, when the experiment started.

When started on the preliminary feeding they had been receiving 1 pound of salvage oats per head per day and what clover hay they would clean up in a reasonable time. They did not take readily to the new feeds offered them. At first all refused to eat the alfalfa but gradually came to

like it very well. Those receiving straw did not care for it at first, especially Lot IV which received the largest proportion of it, but all gradually began to eat it and by January 1st all were cleaning up their roughage readily. Lot I which received only corn and alfalfa were the readiest to go off feed, and on several occasions corn was weighed back from their trough.

The ration of Lot III, barley, linseed meal, alfalfa and oat straw was the one most relished, and after they became accustomed to the feeds was always eaten up clean.

One lamb in Pen III started to scour badly on January 2nd, due to worms and tho drenched several times with gasoline never recovered and was removed from the pen March 2nd, weighing 50 pounds.

There was one case of scouring in Pen IV, also due to worms, but aside from that already mentioned there were no other cases. All cases were drenched with gasoline.

The lambs were divided into the four lots, receiving their respective rations as already explained, each lot consisting of five lambs. The lambs were shut in small pens in the sheep barn thruout the entire experiment. They were fed morning and evening, the ration being divided equally between the two feeds. Thruout the coldest periods they received water but once a day, the rest of the time receiving it twice a day. The grain was fed in a flat-bottomed trough about fourteen inches above the floor and very little was wasted. The hay was fed in an ordinary slanting rack over the grain trough, and tho some hay was pulled out and



wasted the loss was comparatively small. Salt was fed two or three times a week, the object being to keep it before them at all times.

The corn and barley were both fed whole; the old process linseed meal was fed because the pea size cake was not available. Where alfalfa and straw were fed, the two were mixed before being put into the rack for it was found that when fed otherwise the alfalfa was eaten and the straw was left.

#### COMPOSITION OF FEEDS.

All feeds used were of good quality, being especially bright and clean and analysed as follows:

	% Water	% Ash	% Crude Protein	% Carbohydrates Fibre	N Free Extract	% Fat
Corn	11.73	1.42	9.88	2.71	69.39	4.87
Barley	9.412	1.93	12.43	5.	69.38	1.837
Old Process Linseed Meal	8.29	5.175	33.64	7.42	34.29	6.182
Alfalfa	6.127	6.48	15.1	2.81	41.75	2.324
Oat Straw	6.52	6.1	3.82	35.89	45.5	2.17

In figuring the cost of production, the following figures were used:

Corn . . . . .	\$.1.60 per cwt.
Barley . . . . .	2.15 " "
Alfalfa. . . . .	.12.00 per ton.
Oat straw. . . . .	7.00 " "
Old Process Linseed Meal. . . . .	2.50 per cwt.



The prices are those paid for the feeds in Lansing on December 1st. with the exception of that for corn which is the Chicago quotation for December 1st. plus 5¢ per bushel for freight.

# F E E D I N G   P E R I O D .

January 7 - February 4.

## Daily Ration.

Pen I.	Pen II.	Pen III.	Pen IV.
1# Corn.	.9# Corn.	.9# Barley	.8# Barley.
1.75 Alfalfa	.1# Linseed Meal.	.1# Linseed Meal.	.2# Linseed Meal.
Nutritive Ratio 1:5.7	1.45# Alfalfa	1.25# Alfalfa	1.# Alfalfa.
	.3# Oat Straw	.5# Oat Straw	.75# Oat Straw.
	Nutritive Ratio 1:5.8	Nutritive Ratio 1:5.77	Nutritive Ratio 1:5.71

The rations supplied the same amounts of concentrates and roughages to each pen, namely 1 pound of concentrates and 1.75 pounds of roughage per head per day. The nutritive ratios of the respective lots were very nearly the same as shown by the above table; the narrowest being 1:5.71, and the widest 1:5.8, the others being within these two limits.

## Digestible Nutrients per Pen per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	12.5	11.386	12.43	12.45
Crude Protein	1.307	1.217	1.21	1.20
Carbohydrates	6.88	6.42	6.59	6.33
Fat	.293	.253	.17	.199

The digestible nutrients consumed by the various pens varied somewhat more than they would had the feed been eaten up clean. Some of the feed was rejected by the lambs, this amount being subtracted from the amount fed. The lambs were not entirely accustomed to the feeds at the beginning of this period, tho they were all eating their feeds up clean by the end of this period, except Pen I which would refuse some of their feed occasionally.

Digestible Nutrients per Head per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	2.5	2.37	2.48	2.49
Crude Protein	.261	.24	.24	.24
Carbohydrates	1.376	1.28	1.31	1.266
Fat	.058	.051	.034	.0398

The digestible nutrients consumed by each lamb per day varied in the same proportion for the lambs in each lot as did the digestible nutrients per pen per day, depending upon the amount of food rejected.

GAINS. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Total Gain	47.5	46.5	35.5	40.
Average Gain per Head per Day	.339	.332	.253	.285

The lambs of all lots made larger gains during this period than during any other. Pen I gained 47.5 pounds, the largest gain made by any pen during any feeding period. Pen II was second, gaining 46.5 pounds in 28 days. Pen IV was third, producing 40 pounds; and Pen III was last, gaining

35.5 pounds. The lots ranked in the same order as regards average daily gain per head. During this period the lambs receiving alfalfa and corn only made practically the same gains as those receiving corn, linseed meal, alfalfa and oat straw. They averaged .044 pounds per head per day more than those receiving the barley, linseed meal, alfalfa and oat straw ration in which 20% of the barley was replaced by oat straw, and they averaged .086 pounds per head per day more than the lot in which 10% of the barley was replaced by linseed meal and 18% of the alfalfa by oat straw. As regards the gains of Lots II and III in which corn and barley were compared, supplemented with equal amounts of linseed meal and enough alfalfa and oat straw to balance the respective rations, the corn fed lot averaged .079 pounds per head per day more than did the barley fed lot.

#### Feed per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
2.88# Corn.	2.708# Corn.	3.61# Barley	2.79# Barley
5.12# Alfalfa	.301# Linseed Meal.	.39# Linseed Meal.	.598 Linseed Meal.
	4.33# Alfalfa	4.47# Alfalfa	3.996 Alfalfa
	.904# Oat Straw	1.97# Oat Straw	2.59# Oat Straw

During this, the first of the three fattening periods 2.88 pounds of corn and 5.12 pounds of alfalfa proved equal to 2.708 pounds of corn and .301 pounds of linseed meal, supplemented with 4.33 pounds of alfalfa and .904 pounds of oat straw or to 3.61 pounds of barley and .39 pounds linseed meal fed with 4.47 pounds of alfalfa and 1.97 pounds of oat straw,

or to 2.79 pounds of barley and .598 pounds of linseed meal, fed with 3.995 pounds of alfalfa and 2.59 pounds of oat straw.

Cost per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
7.68¢	9.18¢	12.10¢	10.76¢

The cost per pound gain was less during this period than during any other, due to the greatest gains being made during this period.

Digestible Nutrients per Pound Gain. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry matter	7.37	6.82	9.82	8.71
Crude protein	.77	.72	.935	.84
Carbohydrates	4.05	3.85	5.30	4.43
Fat	.1711	.152	.134	.139

Nearly equal amounts of digestible nutrients were offered the various lots except that Pens III and IV receiving barley received appreciably less fat than the corn fed lambs. The amount of digestible nutrients required per pound gain is therefore proportional to the gains produced.

# F E E D I N G   P E R I O D .

February 4 - March 4.

Daily Ration.  
Feb. 4 - Feb. 18.

Pen I.	Pen II.	Pen III.	Pen IV.
1# Corn.	.9# Corn.	.9# Barley	.8# Barley
1.75# Alfalfa	.1# Linseed Meal.	.1# Linseed Meal.	.2# Linseed Meal.
Nutritive Ration 1:5.75	1.45# Alfalfa.	1.25# Alfalfa.	1.# Alfalfa.
	.3# Oat Straw	.5# Oat Straw	.75# Oat Straw.
	Nutritive Ratio 1:5.8	Nutritive Ratio 1:5.77	Nutritive Ratio 1:5.71

Daily Ration.  
Feb. 18 - Mar. 4.

Pen I.	Pen II.	Pen III.	Pen IV.
1.25# Corn.	.15# Corn.	1.15# Barley	1.05# Barley
1.75# Alfalfa	.1# Linseed Meal.	.1# Linseed Meal.	.2# Linseed Meal.
Nutritive Ratio 1:6.04	1.45# Alfalfa	1.15# Alfalfa	.9# Alfalfa
	.3# Oat Straw	.6# Oat Straw	.85# Oat Straw.
	Nutritive Ratio 1:6.04	Nutritive Ratio 1:6.1	Nutritive Ratio 1:6.1

The ration of each lot was changed in the middle of this feeding period, being widened as indicated. All of the lambs ate the increased ration readily except those of Pen I which were slow to eat it up clean. The change in rations was brought about gradually, starting February 18, the feed was gradually increased until the lambs were receiving the wider ration in about five days, except those of Pen I which were a little slower to eat it.

Digestible Nutrients per Pen per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	13.10	13.07	13.01	12.22
Crude Protein	1.356	1.32	1.23	1.245
Carbohydrates	6.38	7.07	6.95	6.84
Fat	.32	.288	.184	.214

There is a noticeable difference in the amounts of digestible nutrients consumed during this period by the different pens. This is due to some pens being quicker to consume the heavier ration than others.

Digestible Nutrients per Head per Day (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	2.62	2.61	2.503	2.64
Crude Protein	.271	.264	.246	.248
Carbohydrates	1.26	1.416	1.390	1.367
Fat	.064	.0576	.0369	.0429

The same variation is noted in this table as in the preceeding one, Pen I being notably low in carbohydrates and Pen III low in fat.

Gains. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Total Gains	20.5	30.5	20.0	25.0
Average Gain per Head per Day	.146	.218	.143	.179

The gains made during this period were appreciably less than those made during the first period. Pen I which made the greatest gain during the first period gained 10 pounds less than did Pen II which made the greatest gain. During

this period corn and alfalfa alone produced almost exactly the same gains as the ration in which 10% of the barley was replaced by linseed meal and 18.7% of alfalfa by oat straw, both rations producing 4.5 pounds less gain than did the ration in which 20% of the barley was replaced by linseed meal and 48.7% of the alfalfa by oat straw. The ration in which 10% of the corn was replaced by linseed meal and 17.1% of the alfalfa was replaced by oat straw produced 10 pounds more gain than did the corn and alfalfa ration.

Feed per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
7.67# Corn.	4.96# Corn.	6.36# Barley	5.19# Barley
11.93# Alfalfa	.422# Linseed Meal.	.629# Linseed Meal.	1.11# Linseed Meal.
	5.72# Alfalfa	7.46# Alfalfa	5.32# Alfalfa
	1.37# Oat Straw	3.36# Oat Straw	4.45# Oat Straw.

Owing to the poor gains made during this period by all pens except No. II, the feed per pound gain was abnormally high. In pen I, the check lot, it took 7.67 pounds corn and 11.93 pounds alfalfa to produce a pound of gain, or a little more than twice as much of both corn and alfalfa as was required to produce a pound of gain in the same lot during the first feeding period. Pen II required 4.96 pounds corn, .422 pounds linseed meal, 5.72 pounds alfalfa, and 1.37 pounds oat straw per each pound of gain, which is approximately one and one-half times as much as was required per pound of gain during the first feeding period. Pen III required 6.36 pounds barley, .628 pounds linseed meal, 7.46

pounds alfalfa and 3.36 pounds of oat straw per pound of gain during this period or nearly one and two-thirds times as much as was required during the last period. Pen IV required approximately one and three-fourths times as much feed to produce a pound of gain during this period as in the former one, or 5.19 pounds of barley, 1.11 pounds linseed meal, 5.32 pounds alfalfa and 4.45 pounds of oat straw.

#### Cost per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
19.42¢	12.88¢	20.88¢	18.66¢

It cost more to produce a pound of gain in each pen during this period than during any other, due to the relatively small gains made. A pound of gain in Pen III cost 20.88¢ followed closely by Pen I in which a pound of gain cost 19.42¢ and this in turn was closely followed by Pen IV with a cost of 18.66¢ per pound gain. Pen II, due to having made the largest gain, produced a pound of gain for 12.88¢ and tho this was the most economical produced by any pen during this period it was .7¢ in excess of the highest price required per pound gain by any pen during the preceding feeding period.

#### Digestible Nutrients per Pound Gain. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	17.81	11.89	18.30	14.80
Crude Protein	1.83	1.20	1.72	1.39
Carbohydrates	8.67	6.43	9.73	7.66
Fat	.435	.261	.258	.239

The digestible nutrients consumed per pound gain produced during this period were relatively high, bearing approx-



imately the same ratio to those required per pound gain during the preceding period, as the feed required per pound gain during this period, bears to the feed required per pound gain during that time.

# F E E D I N G   P E R I O D

March 4 - April 1.

## Daily Rations.

Pen I.	Pen II.	Pen III.	Pen IV.
1.25# Corn.	1.15# Corn.	1.15# Barley	1.05# Barley
1.75# Alfalfa	.1# Linseed Meal.	.1# Linseed Meal.	.2# Linseed Meal.
Nutritive Ratio 1:6.04	1.45# Alfalfa	1.15# Alfalfa	.9# Alfalfa.
	.3# Oat Straw	.6# Oat Straw	.85# Oat Straw
	Nutritive Ratio 1:6.04	Nutritive Ratio 1:6.1	Nutritive Ratio 1:6.1

The ration, as indicated above is the same as that fed during the last part of the preceding feeding period. The lambs were well accustomed to the ration by the time this period started and were eating it up clean, except that Pen I refused some of their corn occasionally.

## Digestible Nutrients per Pen per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	12.98	13.68	11.17	14.03
Crude Protein	1.33	1.38	1.02	1.28
Carbohydrates	7.23	7.50	5.94	7.38
Fat	.32	.358	.162	.23



There were but four lambs in Pen III during this period which accounts for the difference in digestible nutrients consumed by this pen and the others. Pen I refused part of their feed, chiefly corn, and so lowered the amount of nutrients consumed.

Digestible Nutrients per Head per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	2.59	2.736	2.51	2.806
Crude Protein	.26	.276	.228	.256
Carbohydrates	1.450	1.5	1.336	1.476
Fat	.0645	.0717	.0363	.026

The digestible nutrients consumed per day per head by the lambs of the different lots varied in the same ratio as did the digestible nutrients consumed per pen per day, and for the same reason.

Gains.  
(Pounds.)

	Pen I.	Pen II.	Pen III.	Pen IV.
Total Gain	27	30 (4 lambs)	26	35
Average Gain per Head per Day	.193	.214	.232	.25

The gains made during this period were much better than those produced during the preceding period, tho considerably lower than those produced during the first period.

The two barley fed pens made the best gains during this period, Pen IV produced 35 pounds gain and Pen III 26 pounds gain but there were only four lambs in Pen III during this period so the gain per head per day was but .018 pounds less

for this pen than for Pen IV. Pen II, in which part of the corn and alfalfa were replaced by linseed meal and oat straw made the third largest gain averaging .214 pounds per head per day, or .036 pounds per day less than Pen IV which made the largest gain. Pen I, the check lot receiving corn and alfalfa, made the poorest gain, averaging .067 pounds per day less than Pen IV. Pens II and III received equal amounts of corn and barley respectively supplemented with linseed meal, alfalfa and oat straw, and made almost identical gains, tho there were .018 pounds of gain per head per day in favor of the barley fed lot.

#### Feed per Pound Gain.

Pen I..	Pen II.	Pen III.	Pen IV.
6.01# Corn.	5.35# Corn.	7.62# Barley	4.35# Barley
8.72# Alfalfa	.466# Linseed Meal.	.42# Linseed Meal.	.42# Linseed Meal.
	6.72# Alfalfa	4.62# Alfalfa	3.6# Alfalfa
	1.39# Oat Straw	2.55# Oat Straw	3.39# Oat Straw.

During this period it required more feed to produce a pound of gain in various lots than it did during the first feeding period, but not as much as was required during the second period. There were required 6.01 pounds of corn and 8.72 pounds of alfalfa to produce a pound of gain in Pen I as compared to 5.35 pounds of oat straw, or the ration in which 8% of the corn was replaced by linseed meal, and 17.1% of the alfalfa was replaced by linseed meal. In pen III, in which 8% of the barley was replaced by linseed meal and 34% of the alfalfa was replaced by oat straw, it required 4.62

of barley, .42 pounds linseed meal, 4.62 pounds alfalfa and 2.55 pounds of oat straw to produce a pound of gain, while in Pen IV, which was fed the ration in which 16% of the barley was replaced by alfalfa and 48.5% of the alfalfa was replaced by oat straw, there were required 4.35 pounds of barley, .79 pounds of linseed meal, 3.6 pounds of alfalfa and 3.39 pounds of oat straw.

Cost per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
14.84¢	14.23¢	14.64¢	14.76¢

The cost per pound of gain for the four pens was very nearly the same for this period. Pen II made the most economical gains, costing 14.23¢ per pound, which is .01¢ more than the most costly gain per pound, made by Pen IV.

Pens III and IV both made a larger gain per head per day than did Pen II and so required less feed per pound of gain, but the difference in price between the corn and barley more than offset this difference.

Digestible Nutrients per Pound Gain. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	13.49	12.76	12.06	11.22
Crude Protein	1.39	1.29	1.11	1.024
Carbohydrates	7.52	6.99	6.41	5.90
Fat	.33	.334	.174	.184

# S U M M A R Y.

## Average Daily Ration.

Pen I.	Pen II.	Pen III.	Pen IV.
1.06# Corn.	1.01# Corn.	1.01# Barley	.917# Barley
1.69# Alfalfa	.1 Linseed Meal.	.1# Linseed Meal.	.2# Linseed Meal.
	1.4# Alfalfa	1.18# Alfalfa	.952# Alfalfa
	.3# Oat Straw	.54# Oat Straw	.79# Oat Straw

It will be seen from the above that Pen I ate less concentrates per day, on the average than any other pen by .05 pounds all the rest eating the same amount, namely 1.11 pounds per day. The roughage per head per day averaged nearly the same.

## Total Feed Consumed.

Pen I.	Pen II.	Pen III.	Pen IV.
445# Corn.	425# Corn.	340# Barley	385# Barley
710# Alfalfa	42# Linseed Meal.	32.8# Linseed Meal.	84# Linseed Meal.
	600# Alfalfa	395# Alfalfa	400# Alfalfa.
	125# Oat Straw	181.44# Oat Straw	330# Oat Straw

Tho some feed was rejected occasionally by the various pens, the difference in amount eaten by the pens is scarcely noticeable bearing in mind that there were only four lambs in Pen III.

## Total Digestible Nutrients. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	1049.31	1093.78	1016.28	1115.3
Crude Protein	109.26	110.4	115.26	105.81

	(Pen I)	(Pen II)	(Pen III)	(Pen IV)
Carbohydrates	584.81	589.71	536.48	581.55
Fat	25.52	27.56	14.68	18.24

Digestible Nutrients per Pen per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	12.36	13.02	12.10	13.17
Crude Protein	1.30	1.314	1.36	1.26
Carbohydrates	6.96	7.02	6.39	6.92
Fat	.303	.328	1.75	.216

Digestible Nutrients per Head per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	2.472	2.604	2.42	2.634
Crude Protein	.26	.2628	.272	.252
Carbohydrates	1.392	1.404	1.278	1.384
Fat	.0606	.0656	.035	.0432

As the above tables show, practically the same amount of all nutrients were supplied each lot. The fat in the rations of Pen II and Pen III was noticeably lower than that of the other two pens, otherwise they are very similar in amount.

Gains. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Total Gain	95	107 (4 lambs)	80.5	105
Average Gain per Head	19	21.4	20.1	21
Average Gain per Head per Day	.266	.252	.239	.25

As regards total gains, Pen II is first with a gain of 107 pounds. Pens II and IV gained almost exactly the same

amount per head per day, there being a difference of but .002 pound head per day difference in favor of Pen II, indicating that the barley ration in which 18.1% of the barley is replaced by linseed meal, and 45.4% of the alfalfa is replaced by oat straw, is equal to the corn ration in which 9.01% of corn is replaced by linseed meal and 17.1% of the alfalfa is replaced by oat straw.

The four lambs in Pen III made a total gain of 80.5 pounds which is .013 pounds per head per day less than that made by Pen II which made the largest gain. Pen I made the smallest total gain, and gain per head per day, averaging .026 pounds less than the lambs of Pen II. In this trial, the barley ration in which the most linseed meal and oat straw was fed proved superior to the corn and alfalfa ration and equal to the corn ration in which linseed meal and oat straw was fed, and slightly superior to the barley ration in which the lesser amounts of linseed meal and straw were contained. As regards the corn rations, the one containing the linseed meal and straw was superior to the one not containing these feeds.

#### Feed per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
4.68# Corn.	3.97# Corn.	4.25# Barley.	3.71# Barley.
7.46# Alfalfa	.392# Linseed Meal.	.4# Linseed Meal.	.857 Linseed Meal.
	5.6# Alfalfa	4.93# Alfalfa	3.8# Alfalfa
	1.16# Oat Straw	2.26# Oat straw	3.14# Oat Straw.

Owing to the fact that each pen consumed almost the same amounts of feed per head per day and made gains closely approximating each other, the amounts of feed required per



pound gain did not vary much, tho there is a slight variation, in proportion to the gains made.

Digestible Nutrients per Pound Gain. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	11.021	10.22	10.15	10.42
Protein	1.15	1.03	1.15	1.007
Carbohydrates	5.61	5.51	5.46	5.54
Fat	.27	.26	.16	.17

As the amounts of digestible nutrients furnished each lamb per day was nearly the same, and as the gains for the various lots so closely approximated each other, the amount of digestible nutrients required per pound gain for the different lots varied but little. What variation there is is in the same proportion as exists between the total gains of the various lots.

Financial Statement.

Lot I.

Cost:

315 pounds live weight	@ \$.105	\$33.075
445 pounds corn	@ .016	7.12
710 pounds alfalfa	@ .006	4.26
		<hr/> \$44.445

Income:

410 pounds live weight	@ \$.145	\$59.45
Total Income		\$59.45
Total Cost		<hr/> 44.45
Net Profit		\$15.00
Profit per Head		\$3.00

As will be seen from this, the lambs were valued at 10.5¢ per pound at the beginning of the experiment and 14.5¢ per pound at the close, making a margin of 4¢ per pound increased value per pound. In order that the lambs of this lot might break even a margin of 0.34¢ per pound would have been required.

Lot II.

Cost:

330 pounds live weight	@ \$.105	\$34.55
425 pounds corn	@ .016	6.80
42 pounds linseed meal	@ .025	1.05
600 pounds alfalfa	@ .006	3.60
125 pounds oat straw	@ .0035	.44
		<u>\$46.73</u>

Income:

437 pounds live weight	@ \$14.5	\$63.365
Total income		\$62.365
Total cost		<u>46.73</u>
Net profit		\$16.63
Profit per Head		\$3.326

The lambs of this lot would have required a margin of 0.19¢ per pound increased value, between the beginning and the close of the experiment, in order to pay for their feed.

Lot III.

Cost:

249.5 pounds live weight	@ \$.105	\$26.20
340 pounds barley	@ .0215	<u>7.31</u>
		\$33.51

(Forward)		\$33.51
32.8 pounds linseed meal	@ \$.025	.82
395 pounds alfalfa	@ .006	2.37
181.44 pounds oat straw	@ .0035	.635
		<hr/>
		\$37.335

The lambs of this lot required a margin of .83¢ per pound increased value in order to pay expenses.

Income:

330 pounds live weight	@ \$.145	\$47.85
Total income		\$47.85
Total cost		<hr/> 37.335
Net profit		\$10.515
Profit per Head		\$2.629

Lot IV.

Cost:

326 pounds live weight	@ \$.105	\$34.23
385 pounds barley	@ .0215	8.28
84 pounds linseed meal	@ .025	2.10
400 pounds alfalfa	@ .006	2.40
330 pounds straw	@ .0035	1.16
		<hr/>
		\$48.17

Income:

431 live weight	@ 14.5	\$62.49
Total income		\$62.49
Total cost		<hr/> 48.17
Net profit		\$14.32
Profit per head		\$ 2.86



This pen required a margin of .53¢ per pound between the buying and selling price in order to pay expenses.

As is shown by the above statement, Lot I, the check lot receiving corn and alfalfa only, returned a net profit of \$3.00 per head, being second to Lot II; the other corn fed lot, which received some linseed meal and oat straw in addition to corn and barley, and returned a net profit of \$3.26 per head, the greatest net profit produced by any lot. Lot III made the poorest return per head, being .37¢ per head behind the check lot, and 63¢ per head behind Pen II, which received the same amount of corn per head per day as Pen III received barley, both grains being supplemented with linseed meal, alfalfa, and oat straw. Pen IV which received the barley ration in which the largest amount of barley and alfalfa were replaced by linseed meal and oat straw, returned a net profit per head of \$2.86, being 14¢ per head behind Pen I, 40¢ per head behind Pen II and .23¢ per head ahead of Pen III which received the ration in which the smaller substitution of linseed meal and oat straw was effected.

The net profit per head, produced during this feeding period, indicate that where there is a difference in price between barley and corn as great as prevailed while this experiment was carried on, the best returns may be expected from a ration in which the concentrates consists of corn, linseed meal, alfalfa and oat straw, averaging 10 parts corn, to 1 part linseed meal and 15 parts alfalfa to 3 parts oat straw. The next best returns were received from a ration of corn and alfalfa, while the barley ration in which the con-

centrates were fed in proportion of nine parts barley to two parts linseed meal and the roughage in the proportion of approximately eight parts oat straw to nine and one-half parts alfalfa gave better returns than the barley ration in which there were ten parts barley to one part linseed meal and twelve parts alfalfa to five and one-half parts oat straw, tho both barley rations returned a less profit per head than did the corn ration. However, both barley rations produced better gains per head than did corn and alfalfa alone and nearly the same gains as the corn ration in which linseed meal and oat straw was fed, tho there was a slight advantage in favor of the corn ration.

Had the barley cost the same per cwt. as the corn, the profit on Pen III would have been \$3.10 per head or .10¢ per head more than Pen I, and .22¢ per head less than Pen II. The profit per head for Pen IV would have been \$3.29 or only 3¢ per head less than that for Pen II which made the greatest returns per head. These figures obtained in this trial indicate that when barley and corn cost the same per cwt. there is very little difference in net profit per head, to be expected from any of the rations considered, tho when straw is fed in conjunction with the feeds that it was fed with here it has a feeding value of \$7.00 per ton when the prices of lambs are as here quoted. Not only was this price realized from oat straw by feeding it in this trial but lambs fed on it kept in a more thrifty condition and consumed a larger amount of feed and made larger gains in a given period than did lambs receiving no oat straw. This was shown by the

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smaller total gains produced by the lambs of Pen I, and their readiness to go off feed.



PART II.

THE RELATIVE VALUES OF CORN AND BARLEY FOR  
PORK PRODUCTION.

I N T R O D U C T I O N .

This experiment was undertaken to determine as far as possible the comparative values of corn and barley when fed in conjunction with linseed meal and alfalfa hay.

Alfalfa is coming more and more to be recognized as a feed for swine, usually being chopped up and wet before being fed. Fed in this way alfalfa readily finds a place in the ration of the breeding stock, and is often used to help carry pigs thru the winter until they can be put on spring pasture. In this trial an effort was made to see if it might not well find a place in the ration of growing fattening swine.

An effort was also made to find the most economical ration for pork production, and with this end in view the different rations namely barley and alfalfa; barley, old process linseed meal and alfalfa; corn, barley, old process linseed meal and alfalfa; and corn, barley and old process linseed meal, were tried.

O U T L I N E    O F    E X P E R I M E N T .

Twenty pigs were divided into four lots, as nearly equal in weight as possible, and all lots were fed under the same conditions. All were given a ten day preliminary feeding period to get them accustomed to the feeds.

The feeding period proper started January 30, and ended May 8, covering a period of 98 days. The entire period was divided into periods of four weeks each with the exception of the last one, which was of two weeks duration. The pigs were weighed at the end of the feeding periods and the results for the different periods were based upon their respective weights at these times.

The ration of each lot contained the same amounts of concentrates and alfalfa, as that of all others. This was kept constant except where the ration was increased or decreased to suit the amount required by the different pens.

Ration I consisted of barley and alfalfa. The five pigs of this lot weighed 249.6 pounds when the experiment was started January 30, after being on a preliminary feeding period of 10 days, during which time the five of them had gained 23.3 pounds. At the beginning of the experiment they were receiving 2.8 pounds barley and .7 pound alfalfa per head per day; this ration having a nutritive ration of 1:7.2. This ration was fed until March 16 when it was gradually increased until the animals were getting 3.2 pounds barley and .8 pounds alfalfa per head per day. This ration has a nutritive ratio of 1:7.2. It was fed until the close of the experiment, May 8.

Included in this pen were three pigs that had been vaccinated for cholera just previous to being put on the preliminary feeding period, and developed a state of chronic cholera. These pigs were removed March 2, and three Berkshires were put in their places.



The pigs of Lot II weighed 306.6 pounds on January 30, when the experiment was started. This was 22 pounds more than they had weighed on January 20, the beginning of the preliminary feeding period. The ration of this lot consisted of 2.45 pounds barley, .35 pounds linseed meal and .7 pounds alfalfa per head per day from January 30 to March 16, when it was gradually increased until each animal was receiving 2.8 pounds barley, .4 pounds linseed meal and .8 pounds alfalfa. The first ration had a nutritive ratio of 1:5.3 and the second ration a nutritive ratio of 1:5.59.

The results obtained from Pens I and II would show then, the results of adding old process linseed meal to a ration of barley and alfalfa. In this case 12.3% of the barley was replaced by linseed meal or .35 pounds per head per day.

Ration III consisted of 1.23 pounds corn, 1.23 pounds barley, .35 pounds linseed meal and .7 pound alfalfa. The five pigs of this lot weighed 336.6 pounds when the experiment was started, after being on a ten day preliminary feeding period, during which they had gained 26.1 pounds. This ration had a nutritive ratio of 1:6.05. It was fed until March 16 when it was gradually increased until the animals were getting 1.6 pounds corn, 1.6 pounds barley, .45 pounds linseed meal and .8 pound alfalfa per head per day. This ration has a nutritive ratio of 1:6.05. It was fed until May 8, when the experiment closed.

The results obtained from Pen III would show the results of replacing one-half the barley in ration II with corn,



thus giving a ration in which corn and barley were fed in equal amounts, together with linseed meal and alfalfa.

Ration IV was used primarily as a check lot, being the same as Ration III except that the alfalfa was omitted; thus giving a ration in which corn and barley were fed in equal amounts, together with linseed meal. The pigs of this lot weighed 283 pounds when the experiment was started on January 20; the beginning of the preliminary feeding period they weighed 222.3 pounds, showing an increase in weight of 20.7 pounds at the end of ten days. The ration consisted of 1.53 pounds barley, 1.53 pounds corn, and .44 pound linseed meal. This ration had a nutritive ratio of 1:6.4. It was fed thruout the entire feeding period.

The results obtained from Pen III and Pen IV would then show the results of feeding a ration in which corn and barley were fed in equal amounts in conjunction with linseed meal, with and without alfalfa. The animals used in this experiment were chiefly large Yorkshires, tho there were one or two cross breeds, and as already mentioned, three Berkshires replaced three animals that were started on the experiment.

There was considerable difference in the weights of the lots at the beginning of the experiment, owing to the fact that there was a large difference in the weights of the individuals, and an effort was made to divide them into lots such that no individual within a pen would be able to hog the feed, at the expense of the rest. They had all been farrowed in July and August and as a result were approximately six months old. As their weights indicate, they were very small for their age, weighing less than 60 pounds per

head. At no time did they show a thrifty condition, as pigs would be expected to show, in order to return a profit in the feed lot.

All of the animals were vaccinated for cholera on February 9, and they made very poor gains during the ensuing week.

When started on the preliminary feeding period they had been receiving between 2.5 and 3 pounds per head per day of a mixture of 100 pounds of middlings, 75 pounds corn flakes, 25 pounds ground oats and 8 pounds tankage.

The animals of all pens ate the alfalfa readily at all times tho the same was not true of the grain mixture. The barley fed was salvage and had some rye mixed in it. The pigs did not care for this feed at first, especially those of Pen I which received only the barley and alfalfa, but once they became accustomed to it, they ate it readily.

A little of the alfalfa was pulled from the rack and wasted, tho this loss was very small. The corn was fed as coarse corn meal and the barley was fed whole. The grain was made into a mash with warm water during the cold periods, cold water being used after about April 1. Salt was mixed with the grain three times a week.

The alfalfa and corn were of very good quality, the barley as has been pointed out, was salvage, and had some rye mixed with it.

The feeds had the following composition:

	% Water	% Ash	% Crude Protein	Carbohydrates. % Fibre	% N.Free Extract.	% Fat.
Corn	11.93	1.42	9.88	2.71	69.39	4.87
Salvage barley	7.785	2.71	11.27	3.28	73.615	1.34
Linseed meal	8.29	5.175	33.64	7.42	34.29	6.182
Alfalfa	6.127	6.48	15.1	28.1	41.75	2.324

The prices of feeds used in figuring the cost of production are those for Lansing, December 1st, with the exception of that for corn which is the Chicago quotation of December 1st plus 5¢ per bushel for freight.

Corn . . . . . \$1.60 per cwt.  
 Salvage barley . . . . . 1.35 " "  
 Linseed meal . . . . . 2.50 " "  
 Alfalfa . . . . . 12.00 per ton.

#### F E E D I N G P E R I O D.

January 30 - February 27.

#### Daily Ration.

Pen I.	Pen II.	Pen III.	Pen IV.
2.8# Barley	2.45# Barley	1.23# Corn.	1.53# Barley
.7# Alfalfa	.35# Linseed Meal.	1.23# Barley	1.53# Corn.
	.7# Alfalfa	.35# Linseed Meal.	.44# Linseed Meal.
		.7# Alfalfa.	

These rations supplied Pens I, II, and III with 2.8 pounds of concentrates and .7 pound alfalfa per head per day and Pen IV with 3.5 pounds of concentrates per day. As was shown there was some difference in the nutritive ratios



of the different lots, but this could not be overcome and still have the rations bear the same relation to each other that they did.

Digestible Nutrients per Pen per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	11.91	13.21	15.08	9.89
Crude Protein	1.13	1.605	1.78	1.26
Carbohydrates	7.88	8.26	9.26	7.16
Fat	.165	.30	.457	.397

There was a considerable difference in the amount of dry matter and nutrients consumed per pen per day. The greatest difference is in the dry matter, due to the fact the Pen IV received no alfalfa. The feeds of some of the pens was reduced in amount during short periods depending upon the readiness with which they cleaned up their feed, thus accounting for the differences found between Pens I, II, and III.

Digestible Nutrients per Head per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	2.38	2.64	2.01	1.98
Crude Protein	.226	.321	.256	.252
Carbohydrates	1.576	1.552	1.852	1.432
Fat	.022	.06	.0914	.0794

The digestible nutrients consumed per head per day varied in amount as did those consumed per pen per day, due to the fact that all pens were not able to consume the same amount of feed.



Gains. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Total Gains	30.	63.	99.	52.
Average Gain per Head per Day	.213	.45	.707	.371

The gains produced during this period varied greatly for the different pens. Pen III receiving corn, barley, linseed meal, and alfalfa made the greatest gains, producing 99 pounds in 28 days, which was more than three times as much as produced by Pen I which received only barley and alfalfa. Pen II receiving barley, linseed meal, and alfalfa produced 63 pounds of gain as compared with 30 pounds for the pen receiving barley and alfalfa but no linseed meal. Pen III produced one and one-third times as large a gain as Pen II which received the ration of barley, linseed meal, and alfalfa, but no corn, which was contained in the ration of Pen III. Pen IV receiving corn, barley and linseed meal in the same proportions as Pen III but no alfalfa produced but slightly more than one-half as good gains as did Pen III which received the alfalfa.

Feed per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
11.35# Barley	4.77# Barley	1.61# Barley	2.6# Barley
2.11# Alfalfa	.66# Linseed Meal.	1.61# Corn.	2.6# Corn.
	1.67# Alfalfa	.446# Linseed Meal.	.73# Linseed Meal.
		.9# Alfalfa.	

During this period, it required 11.35 pounds of barley

and 2.11 pounds of alfalfa to produce a pound of gain in Pen I. This pen received barley and alfalfa only and did not eat the barley readily during this period nor did they make satisfactory gains on it, thus accounting for the high feed cost per pound of gain. Pen III produced each pound of gain at a cost of 1.61 pounds of barley, 1.61 pounds of corn, .446 pounds of linseed meal and .9 pound alfalfa, as compared to 4.77 pounds of barley, .66 pounds linseed meal and 1.67 pounds of alfalfa which it took to produce a pound of gain in Pen II. Here again, as between Pens I and II there is an appreciable saving produced, in the first instance caused by adding linseed meal to a barley and alfalfa ration and in the second instance by adding corn to a barley, linseed meal and alfalfa ration. Pen IV required 2.6 pounds barley, 2.6 pounds corn, and .73 pounds linseed meal to produce a pound of gain which shows an increased cost of production of 1 pound of corn and 1 pound of barley and .28 pound of linseed meal, as compared to a saving of .9 pound of alfalfa, resulting from feeding barley, corn and linseed meal without alfalfa.

Cost per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
16.52¢	8.54¢	5.26¢	9.50¢

The cost per pound of gain is dependent on the feed required per pound gain. Pen III receiving corn, barley, linseed meal and alfalfa produced the most economical gain, while Pen II receiving barley, linseed meal and alfalfa was second, being approximately 1¢ per pound cheaper than



Pen IV receiving the same ration as Pen III without the alfalfa, while Pen I receiving only barley and alfalfa produced by far the most costly gains.

Digestible Nutrients per Pound Gain. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	12.60	5.16	4.26	5.22
Crude Protein	1.14	.723	.503	.66
Carbohydrates	8.47	3.84	2.69	3.77
Fat	.139	.135	.13	.21

As shown above, there was a wide variation in the amounts of the various digestible nutrients required to produce a pound of gain in different pens. This was due to the widely differing amounts of feed required by the different pens to produce a pound of gain, which in turn was directly dependent upon the gains made by each pen. The fact that the different rations supplied the different nutrients in different proportions would have caused a slight variation had each pen produced the same gain, but the chief cause of the wide variation shown, is as has been pointed out the great difference in gains made.



# F E E D I N G   P E R I O D .

February 27 - March 27.

## Digestible Nutrients per Pen per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter.	15.21	15.58	17.53	10.74
Crude Protein	1.45	1.89	2.06	1.27
Carbohydrates	9.67	9.68	11.09	7.03
Fat.	.237	.295	.50	.42

There was a considerable difference in the amount of nutrients consumed by the different pens per day. Pen III required a much larger amount of food than any other; Pens I and II required about the same, tho less than Pen III, and Pen IV.required the least, showing but a very slight increase over the amount consumed per day during the preceding period.

## Digestible Nutrients per Head per Day (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	3.042	3.116	3.506	2.15
Crude Protein	.29	.378	.412	.254
Carbohydrates	1.934	1.936	2.218	1.406
Fat	.0474	.059	.1	.084

The digestible nutrients consumed per head per day by the animals of the different lots varied as did the amount consumed per pen per day for the respective lots.

## Gains. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Total Gain	80.	88.	116.	56.
Average Gain per day per Head	.571	.614	.828	.4





In regard to total gains, Pen III ranked first during this period as it did during the preceding period. Pen II was second as formerly but during this period Pen I produced a larger gain than Pen IV, the opposite of which was true during the first period.

As shown by the total gains, the ration which contained corn, barley, linseed meal and alfalfa produced much greater gains than did any other. There was but a slight difference between Pens I and II, the addition of linseed meal to the ration of barley and alfalfa not having as marked an effect during this period as during the first one. By a comparison of Pens II and III it is seen that there was again a marked benefit derived from adding corn to the ration of barley, linseed meal, and alfalfa. Pen IV receiving corn, barley, and linseed meal but no alfalfa made the poorest gain, producing only about one-half that made by Pen III. The gains of these two pens were in about the same ratio during the first period.

#### Feed per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
4.01# Barley	3.62# Barley	1.58# Barley	1.96# Barley
1.15# Alfalfa	.466# Linseed Meal.	1.58# Corn.	1.96# Corn.
	1.1# Alfalfa	.430# Linseed Meal.	.663# Linseed Meal.
		.94# Alfalfa.	

There was a wide variation in the total gains produced but there was a variation in the amount of food consumed, closely approximating it, so that the amount of food required

per pound of gain during this period did not vary a great amount between any of the lots.

It required .39 pounds more barley and .04 pounds more alfalfa but .466 pounds less linseed meal to produce a pound of gain in Pen I than in Pen II. Between Pen II and Pen III, it required 2.04 pounds barley, .036 pound linseed meal, and .07 pound of alfalfa to equal 1.58 pounds of corn, making the cost per pound of gain for these two pens very close. Between Pens III and IV, .94 pound of alfalfa fed with corn, barley, and linseed meal, caused a saving of .38 pound of barley, .38 pound of corn, and .233 pound of linseed meal for every pound of pork produced, as compared to a ration in which corn, barley, and linseed meal were fed without alfalfa.

Cost per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
6.1¢	6.71¢	6.40¢	7.43¢

There was not a great difference in the cost of producing a pound of gain between any two pens during this period. Pen I which ranked third as regards total gain, ranked first as regards economical production, the cost per pound gain being 6.1¢. Pen III which ranked first in total gain was second in economy of production, producing its gain at 6.4¢ per pound. Pen II which ranked second in total gain was third in regard to economy of gain, costing 6.71¢ per pound and Pen IV was fourth both in total gain and cost. The above shows that the Pen III was able to produce the largest gain during this period, it was at the expense of more feed per

pound than required by Pen I which ranked third in total gain. In the same way, Pen II which produced a larger total gain than did Pen I, cost .3¢ per pound more for each pound of gain than did Pen I. Pen IV producing the smallest gain, did so at a greater expense than any other.

#### Digestible Nutrients per Pound Gain.

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	5.48	5.07	4.27	5.18
Crude Protein	.508	.616	5.03	.615
Carbohydrates	3.47	3.15	2.72	3.40
Fat	.085	.096	.121	.201

There was much less variation in the amounts of the different nutrients required to produce a pound of gain during this period than during the former one, for tho there was a wide variation in the amounts of feed consumed there was a corresponding variation in the gains produced.

#### F E E D I N G P E R I O D .

March 27 - April 24.

#### Daily Ration.

Pen I.	Pen II.	Pen III.	Pen IV.
3.2# Barley	2.8# Barley	1.6# Barley	1.53# Barley.
.8# Alfalfa	.4# Linseed Meal.	1.6# Corn.	1.53# Corn
	.8# Alfalfa	.45# Linseed Meal.	.44# Linseed Meal.
		.8# Alfalfa.	

The animals had become well accustomed to the heavier

ration by the start of this period, for it had been started at the beginning of the last seven days in the preceding period. Pen IV refused any extra feed offered them so their ration was not increased.

Digestible Nutrients per Pen per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	16.83	17.59	18.71	10.75
Crude Protein	1.67	1.96	2.22	1.28
Carbohydrates	11.82	10.89	11.80	8.96
Fat	.28	.375	.608	.407

Though there was a noticeable variation in the nutrients consumed per pen per day the amounts were nearer to each other than they had been up to this time. Pen IV was comparatively low in dry matter, due to the fact that they received no alfalfa while the other three pens did.

Digestible Nutrients per Head per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	3.366	3.518	3.742	2.15
Crude Protein	.334	.392	.444	.256
Carbohydrates	2.364	2.178	2.36	1.792
Fat	.056	.075	.1216	.0814

The digestible nutrients consumed per head per day by the animals of the different pens, varied in the same ratio as did the nutrients consumed per pen per day for the different lots.

Gains. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Total Gain	57.	94.	57.	43.
Average Gain per Head per Day	.407	.671	.407	.307

During this period Pen II made the largest total gains, exceeding Pens I and III each of which produced 57 pounds during the 28 days, by 37 pounds. Pen IV again produced the smallest gain as was the case in the two preceding periods. During this period, the ration in which linseed meal was added to barley and alfalfa produced 37 pounds more gain than did the ration in which no linseed meal was fed. Contrary to the results obtained during the two former periods the ration of barley, linseed meal, and alfalfa produced a larger gain than did the ration of corn, barley, linseed meal and alfalfa. In this case the difference was 37 pounds. The ration of barley, and alfalfa produced the same gain as the ration of corn, barley, linseed meal and alfalfa which had produced the largest gain during the two preceding feeding periods. The ration of corn, barley and linseed meal, produced less than one-half as large a gain as the ration of barley, linseed meal, and alfalfa and approximately four-fifths of that produced by the ration of barley and alfalfa and by the ration of corn, barley, linseed meal and alfalfa.

Feed per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
8.05# Barley	4.16# Barley	3.78# Corn.	3.21# Corn.
1.82# Alfalfa	.58# Linseed Meal.	3.78# Barley	3.21# Barley
	1.11# Alfalfa	1.02# Linseed Meal.	.9# Linseed Meal.
		2.# Alfalfa	

Tho the animals received more feed per day during this period than during any previous period the gains were, on the

average, smaller hence were made at a high feed cost per pound.

As regards the addition of linseed meal to a ration of barley and alfalfa, .58 pound linseed meal when fed with barley and alfalfa, effected a gain equal to that produced by 3.89 pounds of barley and .71 pound linseed meal. Contrary to the results previously obtained, the addition of corn to the ration of barley, linseed meal, and alfalfa caused a greater consumption of food per pound gain, than was required in the ration of barley, linseed meal and alfalfa. During this period it required 3.78 pounds corn, 3.78 pounds barley, and 1.02 pounds linseed meal and 2 pounds alfalfa to produce as much gain as 4.12 pounds barley, .58 pound linseed meal and 1.11 pounds alfalfa. The ration containing no alfalfa produced less gain during this period than did any other ration, as was the case in both of the previous periods.

Cost per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
11.95¢	7.72¢	14.89¢	11.73¢

The cost of production was exceedingly high during this period for all lots. Pen II which made the largest total gains and at the least cost per pound produced each pound of gain at a cost of .3¢ in excess of that of the most costly gains during the preceding periods, made by the same pen.

Pen III which produced 57 pounds gain, or the second largest, produced them at a cost of 14.89¢ per pound, as

compared with 7.72¢ for Pen II. The cost per pound gain for Pen III during this period was more than double that of the preceding period. Pen I which also made 57 pounds gain produced each pound of gain at a cost of 11.95¢ per pound or almost double the cost per pound for the preceding period. Pen IV made the smallest total gain but ranked second as regards economy of production, costing 11.73¢ per pound.

Digestible Nutrients per Pound Gain. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	8.73	5.41	9.19	6.69
Crude Protein	.867	.604	1.09	.799
Carbohydrates	6.13	3.35	5.8	4.93
Fat	.135	.115	.3	.253

Due to the fact that the gains produced during this period were made at a high feed cost per pound, the digestible nutrients required per pound gain were also very high. Pen II which made the largest total gain required noticeably less nutrients per pound gain than did any other pen. Pen IV making the smallest total gain ranked second except as regards fat, requiring more fat per pound gain than did Pen III. Pens I and III made the same gains, but Pen III receiving corn, barley, linseed meal and alfalfa, as compared to barley and alfalfa received by Pen I, required more of all nutrients except carbohydrates, per pound gain.



# F E E D I N G   P E R I O D .

April 24 - May 8.

This feeding period covered a period of 14 days, being but one-half as long as the three preceding ones.

## Daily Ration.

Pen I.	Pen II.	Pen III.	Pen IV.
3.2# Barley	2.8# Barley	1.6# Corn.	1.53# Corn.
.8# Alfalfa	.4# Linseed Meal.	1.6# Barley.	1.53# Barley.
	.8# Alfalfa	.45# Linseed Meal.	.44# Linseed Meal.
		.8# Alfalfa.	

## Digestible Nutrients per Pen per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	16.21	17.70	19.92	10.88
Crude Protein	1.49	2.10	2.315	1.52
Carbohydrates	10.85	10.88	12.58	7.46
Fat	.23	.375	.63	.44

As shown by the above table there was a great variation in the amounts of digestible nutrients consumed by the various pens per day, due of course to the fact that some pens consumed a much greater amount of feed than did others.

## Digestible Nutrients per Head per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	3.242	3.54	3.984	2.176
Crude Protein	.298	1.02	.463	.304
Carbohydrates	2.17	2.176	2.516	1.492
Fat	.046	.075	.126	.088

The digestible nutrients consumed per head per day during this period varied greatly for the animals of the different lots, the variations being in the same proportions as existed between the nutrients consumed per pen per day by the different lots.

	Gains. (Pounds)			
	Pen I.	Pen II.	Pen III.	Pen IV.
Total Gain	24	37	56	46
Average gain per Head per Day	.343	.529	.8	.657

Pen III made a larger gain during this period than did any other, followed by Pen IV, which up to this time had made a smaller gain, during each period, than any other pen, with the exception of Pen I during the first period. Pen II which produced the largest gain during the period just preceding this one, made the third largest gain and Pen I produced the smallest gain.

As regards the gains made during this period, Pen I receiving barley, and alfalfa, made two-thirds as good a gain as the pen receiving barley, linseed meal and alfalfa, three-sevenths as good a gain as the pen receiving corn, barley, linseed meal and alfalfa, and approximately one-half as good a gain as the pen receiving the corn, barley and linseed meal. This shows that during this period the gains were increased one-half as much again by adding linseed meal to a ration of barley and alfalfa, seven-thirds by adding corn and linseed meal to the barley and alfalfa ration and were doubled by adding corn and removing the alfalfa.

Feed per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
9.35# Barley	5.43# Barley	2.# Barley	1.58# Barley
2.71# Alfalfa	.78# Linseed Meal.	2.# Corn.	1.58# Corn.
	1.52# Alfalfa	.55# Linseed Meal.	.48# Linseed Meal.
		1.25# Alfalfa.	

When barley and alfalfa were fed together during this period it required 9.35 pounds of barley and 2.71 pounds of alfalfa to equal 5.43 pounds of barley, .78 pound linseed meal and 1.52 pounds of alfalfa in producing pork, or .78 pounds of linseed meal added to a ration of barley and alfalfa saved 3.92 pounds of barley and 1.19 pounds alfalfa for every pound of pork produced. The addition of 2 pounds corn and .55 pounds linseed meal to a ration of barley and alfalfa resulted in the saving of 7.35 pounds of barley and 1.46 pounds of alfalfa for each pound of pork produced while Pen IV receiving corn, linseed meal, and alfalfa required 1.58 pounds corn and .48 pounds linseed meal in place of 7.67 pounds of barley, to produce a pound of gain.

Cost per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
14.25¢	10.19¢	8.03¢	5.86¢

Pen IV which made the second largest gain during this period, produced each pound at a cost of 5.86¢ or 2.17¢ per pound cheaper than the gain produced by Pen III which was second in economy of gain, tho it produced the largest total gain. Pen III which ranked third in total gain was third in economy of gain, each pound costing 10.19¢. Pen I, was fourth

in both total gain and economy of production. Each pound of gain in this lot cost 14.25¢ or 8.39¢ per pound more than it cost to produce a pound of gain in Pen IV.

Digestible Nutrients per Pound Gain. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	17.35	7.07	5.16	3.26
Crude Protein	1.06	.84	.6	.46
Carbohydrates	7.59	4.3	3.12	2.27
Fat	.173	.15	.167	1.35

Owing to the widely differing gains produced by the lots, during this period, the amounts of nutrients required per pound of gain also varied widely. This variation varies but little from the ratio existing between the amounts of feed required per pound gain for the respective lots.

S U M M A R Y.

Average Daily Ration.

Pen I.	Pen II.	Pen III.	Pen IV.
2.64# Barley.	2.40# Barley.	1.31# Corn.	.95# Barley
.61# Alfalfa	.33# Linseed Meal.	1.31# Barley	.95# Corn.
	.64# Alfalfa	.37# Linseed Meal.	.28# Linseed Meal.
		.77# Alfalfa.	

The figures above show the average amount of feed eaten per head per day by the animals of the different lots. There was a wide variation in the amounts of concentrates consumed by the animals of the different lots, per day. Of those re-

ceiving alfalfa, Pens I and II ate nearly the same amount, tho both received about nine-elevenths as much as Pen III.

Total Feed Consumed.

Pen I.	Pen II.	Pen III.	Pen IV.
1294.5# Barley	1177.7# Barley	665.06# Corn.	469# Corn.
298.5# Alfalfa	161.54# Linseed Meal.	665.05# Barley	464# Barley
	314.5# Alfalfa	182.06 Linseed Meal.	138.4# Linseed Meal.
		380# Alfalfa.	

Pen IV which received no alfalfa ate much less concentrates than did any other pen, indicating that the animals under consideration in this trial were able to consume much more feed when receiving alfalfa as part of the ration than when receiving no alfalfa. Pen III receiving corn, barley, linseed meal, and alfalfa, was able to consume 65 pounds more alfalfa and 20 pounds more linseed meal than Pen II and 665.05 pounds corn and 665.15 pounds barley in place of 1177.7 pounds barley consumed by Pen II, as a result of adding corn to the ration, in place of one-half of the barley. Pen II was able to consume 16 pounds more alfalfa than Pen I and 1177.7 pounds barley and 161.54 pounds linseed meal in place of the 1294.5 pounds barley consumed by Pen I, as a result of adding linseed meal to the ration of barley and alfalfa.

Total Digestible Nutrients.

(Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	1475.39	1531.98	1722.99	973.34
Crude Protein	140.28	181.12	202.59	118.12
Carbohydrates	967.13	947.46	1070.50	645.29
Fat	23.32	32.89	55.21	37.32

The total digestible nutrients consumed by the different pens varies in approximately the same ratio as did the total amount of feed consumed by the respective pens.

Digestible Nutrients per Pen per Day. (Pounds)

	Pen I.	Pen II.	Pen III.	Pen IV.
Dry Matter	2.622	3.126	3.516	1.986
Crude Protein	.286	.368	.412	.242
Carbohydrates	1.934	1.934	2.184	1.316
Fat	.0476	.069	.1126	.0762

The same variation existed between the nutrients consumed per pen per day and per head per day as existed between the total nutrients consumed by the various lots.

Gains.

	Pen I.	Pen II.	Pen III.	Pen IV.
Total Gain	191.	280.4	328.4	197
Average Gain per Head	38.2	56.08	65.68	39.4
Average Gain per Head per Day.	.39	.572	.670	.402

The pen receiving corn, barley, linseed meal and alfalfa made the largest total gain, and hence the largest gain per head and gain per head per day. Pen II which received barley, linseed meal, and alfalfa, but no corn was second, making a



gain of about seven-eighths of that produced by Pen III. Pens I and IV made gains very nearly alike, both producing about five-eighths of that produced by Pen III, indicating that as regards total gain produced during a given period a ration of barley and alfalfa and one of corn, barley and linseed meal were in this trial almost equally effective.

#### Feed per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
6.78# Barley	4.21# Barley	2.03# Corn.	2.38# Corn.
1.56# Alfalfa	.577# Linseed Meal.	2.03# Barley.	2.38# Barley.
	1.13# Alfalfa	.555# Linseed Meal.	.703# Linseed Meal.
		1.16# Alfalfa.	

During this experiment it required 6.78 pounds of barley and 1.56 pounds of alfalfa to produce a pound of gain in Pen I and 4.21 pounds barley, .577 pounds linseed meal and 1.12 pounds alfalfa to produce a pound of gain in Pen II, showing that .577 pound of linseed meal fed with barley and alfalfa produced a gain equal to that produced by 3.57 pounds barley and .44 pound of alfalfa fed alone, for every pound of gain produced, as a result of adding linseed meal to a ration of barley and alfalfa. Between Pens II and III, there was a saving of 2.18 pounds barley, .03 pound alfalfa and .022 pound linseed meal for every pound of gain produced brought about by the consumption of 2.07 pounds corn. Taking alfalfa from a ration of corn, barley, linseed meal and alfalfa caused 1.16 pounds of alfalfa to replace .35 pounds corn, .35 poundd barley and .148 pound of linseed meal. In Pen III which received alfalfa, togehter with corn, barley and linseed meal, 1.1



pounds of alfalfa produced a gain equal to that produced in Pen III by .35 pounds barley, .35 pounds corn and .148 pounds linseed meal, the latter pen receiving no alfalfa.

Cost per Pound Gain.

Pen I.	Pen II.	Pen III.	Pen IV.
10.09¢	7.79¢	8.07¢	8.77¢

Pen II which made the second largest total gain produced its gain at a less cost per pound than any other pen, namely 7.79¢. Pen III which made the largest total gain exceeded this cost per pound of gain by .28¢. Pen IV making the smallest total gain of any lot was third as regards economy of gain, with 8.77¢ per pound, or .98¢ per pound more than required by Pen II and .7¢ per pound more than required by Pen III. Pen I, which received only barley and alfalfa, produced its gains at a cost of 10.09¢ per pound, or 2.30¢ per pound more than was required by Pen II, 2.02¢ per pound more than required by Pen III and 1.32¢ per pound more than required by Pen IV. As is seen from this, the ration of barley, linseed meal, and alfalfa was the most economical one during this experiment, tho it produced the second largest gain. The ration of corn, barley, linseed meal and alfalfa, tho producing the largest total gain, did so at the next to lowest cost per pound. The rations of barley and alfalfa, and barley, corn and linseed meal were about equal as regards total gain produced but the latter ration was third as regards economy and the former was last, exceeding the cost per pound of gain of Pen IV by 1.32¢. Thus it will be seen that as regards economy of gain the rations

ranked as follows:

First: Barley, linseed meal and alfalfa.

Second: Barley, corn, linseed meal and alfalfa.

Third: Corn, barley, and linseed meal.

Fourth: Barley and alfalfa.

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