

# THE COLORADO EXPERIMENT STATION

## FORT COLLINS

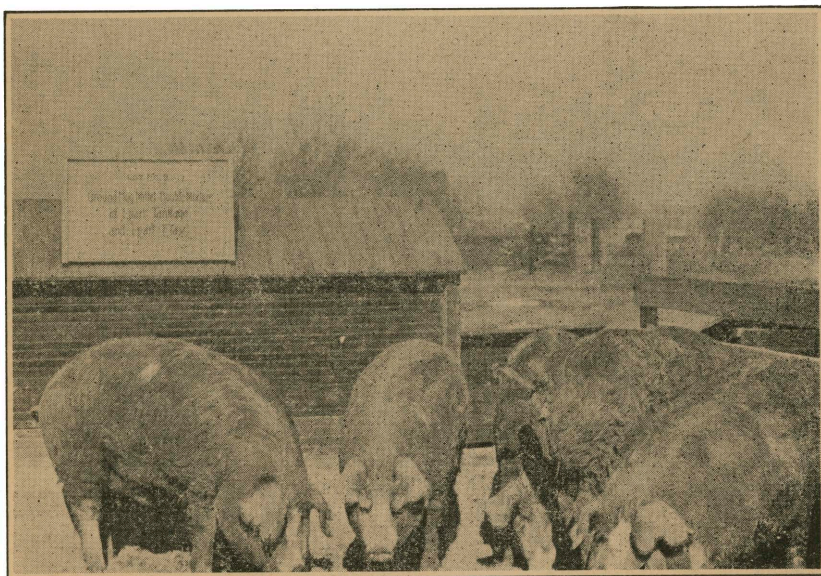
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### FATTENING RATIONS FOR HOGS

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#### Progress Report of Livestock Feeding Experiment 1932\*

BY GEORGE E. MORTON, H. B. OSLAND AND J. F. BRANDON



#### Summary of Test

1. Each ton of No. 1 feed barley replaced 1472.4 pounds of corn and 158.5 pounds of double mixture but required 1.1 pounds more mineral mixture and 1.1 pounds more salt, or in other words, had 90.9 percent the feed value of No. 1 yellow corn.
2. Cracked No. 3 hard winter wheat was equal to No. 1 yellow corn in the fattening ration for hogs.
3. The carcasses of wheat-fed pigs were as high grade as the carcasses of pigs fattened on corn.

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These experiments were conducted at the Akron Field Station, which is operated by the Division of Dry Land Agriculture, Bureau of Plant Industry, U. S. Department of Agriculture, in cooperation with the Colorado Agricultural Experiment Station. The agronomic phases of these experiments were under the supervision of Superintendent J. F. Brandon, who also supervised the labor employed in the feeding experiments.

4. Very finely ground hog (proso) millet weighing 54 pounds per bushel showed 97.01 percent the feeding value of No. 1 yellow corn.

5. Each ton of ground millet replaced 1524.1 pounds of corn and 183.2 pounds of double mixture but required .6 pounds more minerals and .6 pounds more salt.

6. Protein requirements per unit gain decreased with the following order of grains fed: Shelled corn, ground barley, ground millet and cracked wheat.

7. Taking costs into consideration, double mixture composed of one-third cottonseed meal and two-thirds tankage by weight was about equal to tankage in feed value.

8. Double mixture composed of one-half cottonseed meal and one-half tankage was the most efficient supplement used in the experiment.

9. Triple mixture was slightly more efficient than tankage considering the costs of the two feeds. Ingredients of triple mixture are 2 parts of tankage, 1 part cottonseed meal and 1 part alfalfa meal by weight.

10. Ground flaxseed, even tho it did not develop any digestive disturbances in the pigs, did not prove an efficient protein supplement when used to supplement ground hog millet. It produced a low rate of gain, and slaughter tests further condemned it because all the pigs showed very soft carcasses and also yellow fat.

11. Flax mixture containing one-third flax and two-thirds tankage by weight compared very favorably with straight tankage. This mixture had a tendency to produce a higher rate of gain than tankage but also required slightly more feed per unit of gain.

12. Indications are that flax can be used to replace some of the commercial protein supplements but that it should not be used as the only protein supplement in the ration.

13. Soybeans fed in quantities sufficient to balance a ration of ground hog millet, produce soft and flabby carcasses and therefore are not satisfactory as a protein supplement in fattening rations for pigs.

### **Objects of the Experiment**

1. To compare the fattening value of shelled corn, cracked wheat, ground barley and ground hog millet when self-fed with a suitable protein and simple mineral supplement.

2. To study the relative efficiency of available protein supplement in hog-fattening rations.

3. To determine the value of home-grown high-protein feeds as supplements to grain in fattening rations.

4. To study the effect of soybeans and flaxseed on the quality of pork produced.

#### **Pigs Used**

Seventy Poland China pigs averaging 72.5 pounds were bought in the vicinity of the station and used in the test. They were wormed and vaccinated before starting on test. The pigs were divided into 10 lots of 7 each, according to sex, origin, type and condition so that the lots were very uniform at the beginning of the test.

#### **Rations Fed**

Lot 1.—Shelled corn, double mixture (two-thirds tankage, one-third cottonseed meal), mineral mixture, salt.

Lot 2.—Ground barley, double mixture, (two-thirds tankage, one-third cottonseed meal), mineral mixture and salt.

Lot 3.—Cracked wheat, double mixture, (two-thirds tankage, one-third cottonseed meal), mineral mixture, salt.

Lot 4.—Ground hog millet double mixture, (two-thirds tankage, one-third cottonseed meal), mineral mixture, salt.

Lot 5.—Ground hog millet, double mixture, (one-half tankage, one-half cottonseed meal), mineral mixture, salt.

Lot 6.—Ground hog millet, triple mixture, (one-half tankage, one-fourth cottonseed meal, one-fourth alfalfa meal), mineral mixture, salt.

Lot 7.—Ground hog millet, tankage, mineral mixture, salt.

Lot 8.—Ground hog millet, flax mixture, (two-thirds tankage, one-third flax,) mineral mixture, salt.

Lot 9.—Ground hog millet, ground soybeans, mineral mixture, salt.

Lot 10.—Ground hog millet, ground flax, mineral mixture, salt.

#### **Feeds Used and Methods of Feeding**

The various lots of pigs were confined in dry pens, each furnished with a separate compartment self-feeder, temporary straw shed and automatic water-tank heater. All feeds in this experiment were self-fed. The grain, protein mixture, mineral mixture and salt were kept in separate compartments of each feeder at all times. The water was heated only during the coldest weather to prevent freezing.

**Shelled corn**, grown locally, weighed 56.5 pounds per bushel, tested 10.82 percent average moisture, and was graded No. 1 yellow according to U. S. Grain Standard.

**Ground barley** contained 12.37 percent moisture thruout the test. It was grown locally and according to U. S. Grain Standards, weighed 39.0 pounds per bushel and graded No. 1 feed barley. All the barley fed in this test was ground thru a hammer mill.

**Cracked wheat**, grown near the station, averaged 11.04 percent moisture. U. S. Grain Standard classified this wheat as No. 3 dark hard winter wheat weighing 56.5 pounds per bushel. The wheat was merely cracked before it was put into the self-feeder.

**Ground hog millet** was termed "good." It weighed 54 pounds per bushel. The average moisture content of hog millet was 10.46 percent thruout the fattening period.

**Tankage** contained 60 percent guaranteed protein. It was secured from one of the leading packing companies in Denver. Moisture analysis showed it to contain an average of 7.98 percent.

**Double mixture** composed of one-half tankage and one-half cottonseed meal was home-mixed. It contained 7.84 percent moisture and 51.5 percent protein.

**Double mixture** composed of two-thirds tankage and one-third cottonseed meal contained 54.33 percent protein and 7.88 percent moisture. This was also a home-mixed protein supplement.

**Triple mixture**, home-mixed, contained an average of 8.30 percent moisture during the experiment and 43.75 percent protein. This mixture was composed of two parts of tankage and one part of cottonseed meal and one part of alfalfa meal by weight.

**Flax** grown in Northern Colorado was good plump seed. A chemical analysis showed 22.84 percent protein and an average of 8.91 percent moisture. The flax was ground very finely with a hammer mill.

At the beginning of the experiment, flax was fed mixed with the grain in small proportions. The percentage of flax was rapidly increased until it was felt that no detrimental effects would result from feeding flax in a separate compartment of the self-feeder.

**Flax mixture** was composed of two parts of tankage and one part of flax for an average of the experiment. Because of lack of information in regard to flax, great care was exercised at the beginning of the test and the mixture was fed in the following proportions:

	60 percent protein Tankage	Ground Flax
At start .....	75 percent	25 percent
At 8th day .....	70 "	30 "
At 43rd day .....	65 "	35 "
At 51st day .....	60 "	40 "
At 88th day .....	50 "	50 "

**Soybeans** were ground and self-fed at all times. Chemical analysis showed them to contain 28.79 percent protein and an average of 8.91 percent moisture thruout the feeding experiment. These soybeans were grown in Eastern Colorado and were of the Ito San variety.

**Mineral mixture** was a home-mixed simple mixture composed of 40 percent steamed bonemeal, 40 percent high calcium carbonate limestone and 20 percent salt. The pigs had access to this mixture at all times.

**Salt** was No. 4.

Analysis of Feeds Used*							
	Crude		Carbohydrates		No.		
	Water	Ash	Protein	Fiber	N. F. E.	Fat	Analysis
Shelled corn ....	10.73	1.00	10.04	2.68	70.40	4.55	2
Gr. barley .....	10.46	3.20	13.20	8.38	62.50	2.26	2
Gr. wheat .....	10.65	2.20	16.27	3.68	65.45	1.75	2
Gr. hog millet....	10.62	4.05	10.39	10.48	60.10	4.36	2
Gr. flax .....	6.72	4.70	22.84	14.09	24.69	27.01	2
Gr. soybeans ....	8.60	5.50	28.79	8.78	33.08	15.27	2
Cottonseed meal	7.07	6.81	44.30	7.69	25.69	8.46	2
Alfalfa meal .....	9.41	6.93	12.25	36.12	33.93	1.37	2
Tankage .....	8.65	21.55	56.90	1.61	2.47	8.84	2

\*Moisture percentages given in this table vary from those reported under "Feeds Used and Methods of Feeding" due to the fact that moisture analyses were made every 10 days and complete analyses were determined only twice during the fattening test.

FIG. - FEEDING EXPERIMENT  
Colorado Experiment Station—7 Pigs per Lot Fed October 28, 1931, to January 26,  
1932—90 Days  
(Table Based on One Average Pig)

Lot Number	1	2	3	4
	Sh. Corn Double Mixture (% Tank- age, $\frac{1}{3}$ C. S. Meal)	Gr. Barley Double Mixture (% Tank- age, $\frac{1}{3}$ C. S. Meal)	Cr. Wheat Double Mixture (% Tank- age, $\frac{1}{3}$ C. S. Meal)	Gr. Hog Millet Double Mixture (% Tank- age, $\frac{1}{3}$ C. S. Meal)
Ration fed				
Minerals and salt self-fed				
Weight at start .....	71.8	71.6	74.7	73.0
Final weight )	211.4	195.7	197.7	216.3
Total gain ) at market*	139.5	124.1	123.0	143.2
Daily gain )	1.55	1.38	1.37	1.59
Shipping shrinkage (percentage) .....	.84	3.10	2.65	1.12
Average daily ration				
Shelled corn .....	4.33			
Ground barley .....		5.24		
Cracked wheat .....			5.54	
Ground hog millet .....				5.84
Double mixture .....	1.33	0.77	0.44	0.84
Mineral mixture .....	.01	.01	.01	.01
Salt .....	.01	.01	.01	.01
Feed required per cwt. gain at market*				
Shelled corn .....	279.6			
Ground barley .....		379.8		
Cracked wheat .....			391.0	
Ground hog millet .....				366.9
Double mixture .....	86.1	56.0	32.5	52.5
Mineral mixture .....	.6	.8	1.1	.7
Salt .....	.8	1.0	1.1	.9
Feed cost per cwt. gain at market* .....	\$3.02	3.47	3.66	3.21

\*In this progress bulletin results are given on the basis of weights and gains at Denver, a distance of 129 miles from Akron feedlots. This is in order that farmers who must look to net return, may use the figures more readily.

Financial Statement Based on Average Feed Prices and Sale of Pigs  
(Table Based on One Average Pig)

Lot Number	1	2	3	4
				Gr.
Ration fed	Sh. Corn	Gr. Barley	Cr. Wheat	Hog Millet
Minerals and salt	Double	Double	Double	Double
self-fed	Mixture	Mixture	Mixture	Mixture
	(% Tank-	(% Tank-	(% Tank-	(% Tank-
	age, ½	age, ½	age, ½	age, ½
	C. S. Meal)	C. S. Meal)	C. S. Meal)	C. S. Meal)
Cost per pig at feedlot				
at \$5.00 per cwt .....	\$3.59	3.58	3.74	3.65
Feed cost per pig .....	4.21	3.93	4.50	4.60
Est. fixed cost including				
interest, labor and				
equip. ....	2.25	2.25	2.25	2.25
Shipping and selling				
expense .....	1.27	1.11	1.19	1.30
Total cost at market				
(Denver) .....	11.32	10.87	11.68	11.80
Selling price per cwt.* ....	3.70	3.50	3.65	3.85
Gross receipts, per pig ....	7.82	6.85	7.22	8.33
Loss per pig .....	3.50	4.02	4.46	3.47
Necessary selling price per				
cwt. to break even .....	5.36	5.55	5.91	5.46
Margin over purchase price				
per cwt needed to break				
even .....	0.36	0.55	0.91	0.46
Dressing percentage (based				
on warm weight) .....	79.61	80.68	82.40	82.21
Number of days required				
for 70-pound pig to reach				
220 pounds.....	97	109	109	94

\*Figures based on actual selling price and valuation placed on hogs by W. W. Swearingen, John Clay & Company and F. A. Hurlburt, Swift & Company.

#### Cost of feeds used:

Shelled corn .....	\$12.00 per ton	Triple mixture .....	\$26.50 per ton
Ground barley .....	12.00 per ton	Ground flax .....	30.00 per ton
Cracked wheat .....	16.00 per ton	Ground soybeans .....	30.00 per ton
Ground hog millet.....	13.00 per ton	Salt .....	20.00 per ton
Tankage .....	35.00 per ton	Mineral mixture .....	40.00 per ton
Double mix (½-½).....	28.50 per ton	(Lime cake .....	40 parts
Double mix (⅔-⅓) ....	30.65 per ton	(Steamed bonemeal ..	40 parts
Flax mixture .....	33.45 per ton	(Salt .....	20 parts
Cottonseed meal .....	22.00 per ton		

### Discussion of Results

**Shelled Corn vs. Ground Barley.**—Corn is considered the standard grain for fattening hogs; however, barley is also used quite extensively in hog rations. Past experimental results show that barley is not as palatable as corn to the pigs and this test substantiated this fact. Hulls of the ground barley are quite bulky and the pigs waste a certain percentage of the grain in an effort to root the hulls from the feeder.

Barley-fed pigs in this experiment did not produce as great a gain as pigs fed corn. This test shows that barley-fed pigs required 12 days more to reach a market weight of 220 pounds than pigs fed corn.

Each ton of barley replaced 1472.4 pounds of corn and 158.5 pounds of double mixture but required 1.1 pounds more mineral mixture and 1.1 pounds more salt. With present prices of feeds, each ton of barley was worth \$11.23 per ton or had 90.9 percent the feed value of corn.

An average of 3 years' earlier work conducted by the Colorado Experiment Station shows barley weighing 38.3 pounds per bushel has 82.2 percent the feed-replacement value of yellow corn weighing 54.4 pounds per bushel. Barley used in this test weighed 39 pounds per bushel and the corn 56.5 pounds.

A carcass study showed no apparent difference between corn and barley-fed hogs. All the carcasses from both lots were of good color, showed white and firm fat. The dressing percentage based on warm weight, head on and leaf lard in, was 1.07 percent greater for the barley-fed hogs than for the corn-feds. This is to be expected, considering the respective shrinkage to market of the corn and barley-fed lots. Lot 1 fed corn shrank .84 percent while Lot 2 fed barley showed 3.10 percent shrink to market. That means that the pigs in Lot 1, used to corn, ate more corn at the stockyards and because of this fill the dressing percentage was lower.

**Shelled Corn vs. Cracked Wheat.**—Cracked wheat was used in this test because experimental work has proved that rolled or coarsely ground wheat gives best results in hog-fattening rations; that whole or finely ground wheat is hard to masticate, and that it tends to become gummy and form pasty masses when chewed.

The pigs fed wheat made slightly lower daily gains than the pigs fed shelled corn. With corn at 60 cents per cwt. and wheat at 80 cents, the feed cost per unit of gain was 64 cents cheaper where corn was fed. Using the same feed-requirement figures as above, and an equal market price for both corn and wheat (60 cents per cwt.), the feed cost per unit gain is 14 cents cheaper when wheat instead of corn is used in the ration. In other words, if the market value of corn and wheat are the same, feeding wheat is slightly more economical than corn. However, with cracked wheat at \$16.00 per ton and corn only \$12.00 per ton, actual prices paid in this experiment, the reverse is true. This test shows that even tho a greater amount of wheat is required to produce cwt. gain than corn, the smaller protein-supplement required to balance the ration when wheat is fed gives wheat 97.6 percent the feeding value of corn on a market basis. Considering feedlot weights and feedlot gains, this experiment shows wheat equal to corn in the fattening ration. However, 1.81 percent greater shrinkage to market of the wheat-fed pigs slightly lowers its comparative value on a market-gain basis.



Previous work with wheat at various experiment stations shows the feed value of wheat varying from 100 to 114 percent when compared to corn, depending on the type and grade of wheat and grade of corn fed in the experiment. The wheat used in this test was a No. 3 hard winter wheat testing 16.3 percent protein.

In this experiment, each ton of wheat fed replaced 1430.2 pounds of corn and 274.2 pounds of double mixture, but required 2.6 pounds more mineral mixture and 1.5 pounds more salt, or at present feed values, was worth \$12.78 per ton.

The wheat lot of pigs had a high dressing percentage and the carcasses of the pigs were of the same high grade as those of the pigs fattened on corn.

**Shelled Corn vs. Ground Hog Millet.**—Great care was taken that the hog millet was ground extremely fine in order to insure complete utilization of the grain by the pigs. In one of the previous tests the millet was not ground to a flour-like consistency and it resulted in a lower feed value of that grain in the ration.

Millet used in this experiment was not quite as plump and mature as that used in previous tests and was graded only "good" on a comparative basis with the "excellent" millet fed previously. It weighed 54 pounds per bushel.

Each ton of ground hog millet in this experiment replaced 1524.1 pounds of corn and 183.2 pounds of double mixture, but required .6 pound more minerals and .6 pound more salt, or had a value of \$11.95 per ton with present prices of feeds. In other words ground hog millet had 97.01 percent the feed value of corn.

Taking all Colorado experiments with millet-fed hogs into consideration, ground hog millet weighing 56 pounds per bushel has proved to be worth fully as much as shelled corn in hog-fattening rations.

The millet-fed hogs showed the greatest rate of gain compared with pigs fed corn, barley or wheat. They also showed fully as much bloom as the pigs fed corn, and a carcass study revealed no difference between corn and millet-fed hogs.

**Protein-Supplement Requirement With Grain.** — Chemical analyses of the four grains fed in this experiment showed corn contained 10.05 percent protein, barley 13.20 percent, millet 10.39 percent and wheat 16.27 percent. Protein requirements per unit gain decreased with the following order of grain fed: Shelled corn, ground barley, ground millet and cracked wheat. In other words the protein content of these grains seems to have a direct relationship to the amount of supplement required to balance the ration. A reversal of barley and millet in that order is probably explainable on a basis of palatability. But even tho

**PIG - FEEDING EXPERIMENT**  
Colorado Experiment Station—7 Pigs per Lot Fed October 28, 1931 to January 26, 1932, 90 days.  
(Table Based on One Average Pig)

Lot Number	4	5	6	7	8	9	10
Ration fed	Gr. Hog Millet	Gr. Hog Millet	Gr. Hog Millet		Gr. Hog Millet		
Minerals and salt self-fed	Double Mixture ( $\frac{2}{3}$ Tank- age, $\frac{1}{3}$ C. S. Meal)	Double Mixture ( $\frac{1}{2}$ Tank- age, $\frac{1}{2}$ C. S. Meal)	Triple Mixture ( $\frac{1}{4}$ C. S. Meal, $\frac{1}{4}$ Alf. Meal $\frac{1}{2}$ Tankage)	Gr. Hog Millet Tankage	Flax Mixture ( $\frac{2}{3}$ Tankage $\frac{1}{3}$ Flax)	Gr. Hog Millet Soy beans	Gr. Hog Millet Gr. Flax
Weight at start .....	73.0	72.8	71.3	73.8	71.5	71.5	74.9
Final weight )	216.3	222.7	220.9	213.3	229.0	192.3	157.0
Total gain ) at market* .....	143.2	149.9	149.6	139.5	157.5	120.8	82.1
Daily gain )	1.59	1.67	1.66	1.55	1.75	1.34	.91
Shipping shrinkage (percentage).....	1.12	1.23	1.77	1.41	1.36	1.07	1.52
Average daily ration							
Ground hog millet .....	5.84	5.37	6.30	5.94	6.72	5.25	4.08
Tankage .....				0.63			
Double mixture .....	0.84	0.92					
Triple mixture .....			3.81				
Flax mixture .....					0.79		
Ground soybeans .....						1.47	
Ground flax .....							0.80
Mineral mixture .....	.01	.01	.01	.01	.01	.02	.02
Salt .....	.01	.01	.01	.02	.01	.03	.02
Feed required per cwt. gain at market*							
Ground hog millet .....	366.9	343.8	379.1	382.9	384.3	391.3	447.9
Tankage .....				40.4			
Double mixture .....	52.5	55.0					
Triple mixture .....			48.8				
Flax mixture .....					45.3		
Ground soybeans .....						109.5	
Ground flax .....							87.6
Mineral mixture .....	.7	.7	.5	.7	.7	1.5	2.5
Salt .....	.9	.9	.8	1.0	.8	2.3	1.8
Feed cost per cwt. gain at market* .....	\$3.21	\$3.03	\$3.13	\$3.22	\$3.28	\$4.23	\$4.29

\*In this progress bulletin results are given on the basis of weights and gains at Denver, a distance of 129 miles from Akron feedlots. This is in order that farmers, who must look to net return, may use the figures more readily.

Financial Statement Based on Average Feed Prices and Sale of Pigs  
(Table Based on One Average Pig)

Lot Number	4	5	6	7	8	9	10
	Gr. Hog Millet Double Mixture ( $\frac{2}{3}$ Tank- age, $\frac{1}{2}$ C. S. Meal)	Gr. Hog Millet Double Mixture ( $\frac{1}{2}$ Tank- age, $\frac{1}{2}$ C. S. Meal)	Gr. Hog Millet Triple Mixture ( $\frac{1}{4}$ C. S. Meal, $\frac{1}{4}$ Alf. Meal $\frac{1}{2}$ Tankage)	Gr. Hog Millet Tankage	Gr. Hog Millet Flax Mixture ( $\frac{2}{3}$ Tankage $\frac{1}{3}$ Flax)	Gr. Hog Millet Gr. Soy beans	Gr. Hog Millet Gr. Flax
Cost per pig at feedlot at							
\$5.00 per cwt. ....	3.65	3.64	3.56	3.69	3.58	3.57	3.75
Feed cost per pig .....	4.60	4.54	4.68	4.49	5.16	5.11	3.52
Est. fixed cost including							
interest, labor and equip. ....	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Shipping and selling expense .....	1.30	1.34	1.33	1.28	1.37	1.15	.94
Total cost at market .....	11.80	11.77	11.82	11.71	12.36	12.08	10.46
Selling price per cwt.* .....	3.85	3.75	3.85	3.65	3.65	3.65	3.25
Gross receipts per pig .....	8.33	8.35	8.50	7.78	8.36	7.02	5.10
Loss per pig .....	3.47	3.42	3.32	3.93	4.00	5.06	5.36
Necessary selling price per							
cwt. to break even .....	5.46	5.28	5.35	5.49	5.40	6.28	6.66
Margin over purchase price per							
cwt. needed to break even .....	0.46	0.28	0.35	0.49	0.40	1.28	1.66
Dressing percentage (based							
on warm weight) .....	82.21	83.28	82.67	82.15	83.77	88.77	80.29
No. days required for 70-lb.							
pig to reach 220 pounds .....	94	90	90	97	86	112	165

\*Figures based on actual selling price and valuation placed on the hogs by W. W. Swearingen of John Clay and Company and F. A. Hurlburt, Swift, and Company

Cost of Feeds Used:

Shelled corn .....	\$12.00 per ton	Triple mixture .....	\$26.50 per ton
Ground barley .....	12.00 per ton	Ground flax .....	30.00 per ton
Cracked wheat .....	16.00 per ton	Ground soybeans .....	30.00 per ton
Ground hog millet .....	13.00 per ton	Salt .....	20.00 per ton
Tankage .....	35.00 per ton	Mineral mixture .....	40.00 per ton
Double mix ( $\frac{1}{2}$ - $\frac{1}{2}$ ) .....	28.50 per ton	(Lime cake .....	40 parts
Double mix ( $\frac{2}{3}$ - $\frac{1}{3}$ ) .....	30.65 per ton	(Steamed bonemeal .....	40 parts
Flax mixture .....	33.45 per ton	(Salt .....	20 parts
Cottonseed meal .....	22.00 per ton		

the protein requirement decreases, especially when wheat or millet is fed, it should not be interpreted to mean that these grains can be fed without a protein supplement. Wheat or millet alone does not constitute a balanced ration and will not give maximum returns in production of pork unless supplemented by a protein-rich feed.

**Tankage vs. Double Mixture** composed of one-third cottonseed meal and two-thirds tankage by weight. The pigs fed on ground millet and these two supplements made approximately the same rate of gain during the experiment and produced unit gains for very nearly the same cost—\$3.21 where the double mixture was fed and \$3.22 where tankage supplied the protein. The pigs, fed double mixture, however, showed more finish and sold 20 cents per hundredweight over the tankage-fed pigs.

Each ton of double mixture, when compared to tankage, replaced 1539.1 pounds of tankage, 609.5 pounds of ground hog millet and 3.8 pounds of salt, or, at present feed prices, double mixture was worth \$30.93.

Taking costs into consideration, this type of double mixture and tankage were about equal in feeding value. Double mixture shows 89.5 percent the feed value of tankage and its market cost was 87.6 percent that of tankage.

**Tankage vs. Double Mixture** composed of one-half cottonseed meal and one-half tankage by weight (50-50 double mixture) proved the most profitable protein supplement in the experiment. The pigs fed on this type of double mixture, in addition to ground hog millet, produced the second highest rate of gain and also produced the cheapest gain—\$3.03 per hundredweight gain.

Each ton of double mixture replaced 1469.1 pounds of tankage, 1421.8 pounds of ground hog millet and 3.6 pounds of salt, or was worth \$34.99 at present feed prices. In other words, double mixture had a feed-replacement value very nearly equal to the market price of tankage, yet its cost was only 80 percent that of tankage.

Care is necessary in feeding this supplement to pigs weighing less than 50 pounds because of its tendency to cause scours. No difficulties whatsoever were experienced in this test using 70-pound feeder pigs.

**Tankage vs. Triple Mixture**, composed of half tankage, one-fourth cottonseed meal and one-fourth alfalfa meal by weight. Triple mixture produced greater and cheaper gains than tankage when used as a protein supplement with ground hog millet. The pigs fed this protein mixture also showed more finish at the end of the experiment and outsold the tankage-fed pigs 20 cents per cwt.

Each ton of triple mixture replaced 1655.7 pounds of tankage, 147.5 pounds of ground hog millet, 8.2 pounds of minerals and 8.2 pounds of salt, or, at present feed prices, was worth \$30.18.

Taking market costs into consideration, triple mixture proved slightly more efficient than tankage alone. Triple mixture showed 88.1 percent the feed value of tankage whereas its market price was only 75.7 percent.

**Tankage vs. Flaxseed.**—On account of the high commercial value of the oil it contains, flaxseed is not very generally used for feeding stock. Instead of starch which most seeds carry as reserve building material, flax stores its reserves largely as oil and pentosans. The oil of the flaxseed is extracted thru pressure or heat and the remaining residue is known as linseed-oil meal.

It is a common belief that there is some danger in feeding flax to livestock because of a compound present in the seed which, when acted upon by an enzyme in the seed, yields a poison, prussic acid. This enzyme is destroyed by heat to which the ground flax is ordinarily subjected in both the old and new process of oil extraction.

Flax containing 20 to 22 percent protein, can be grown in certain sections of Colorado and some of our livestock men have used it as a protein supplement in the fattening ration without any apparent ill effects to the livestock.

Ground flax fed as the only supplement with ground hog millet, made the lowest and most expensive gains of the experiment. However, flax had no apparent ill effects on the hogs because at no time thruout the test did the pigs show a lack of thrift. The average daily consumption of flax was .80 pound per head.

Each ton of flax, when fed as the sole protein supplement, replaced 922.9 pounds of tankage but required 1484.9 pounds more ground hog millet, 38.8 pounds more minerals and 18.3 pounds more salt, or was worth \$5.54 per ton. This value is far below production cost, of course, and judging from this test it does not pay to use flax alone as a protein supplement with ground hog millet.

Slaughter test further condemned flax as the only protein supplement because all the pigs in this lot showed very soft carcasses and also yellow fat.

**Tankage vs. Flax Mixture** composed of one-third flax and two-thirds tankage by weight. Pigs fed the flax mixture produced the greatest gain in the experiment. This lot of pigs was ready for market 11 days sooner than the pigs fed tankage. Comparing flax mixture with flax alone, the experiment showed

that the addition of tankage to flax almost doubled gains, lowered feed cost \$1.01 per 100 pounds of gain and produced market hogs in about one-half the time.

Each ton of flax mixture, when compared to straight tankage, replaced 1783.7 pounds of tankage and 8.8 pounds of salt, but required 61.8 pounds more millet, or, at present feed prices, was worth \$30.90 per ton.

Slaughter tests showed the carcasses of this flax-mixture-fed lot to be just as white and firm as those of the tankage-fed pigs.

Judging from this experiment, flax, a home-grown product, can be used to replace some of the commercial protein, but it should not be used as the only protein supplement in the ration because of its tendency to produce slow and expensive gain, soft and yellow pork.

Flax is rather difficult to grind because the oil has a tendency to clog the screens of the hammer mill.

It is suggested that flax be ground with the grain at the rate of 5 pounds of flax to 100 pounds of grain for hogs. The grain will absorb most of the oil and prevent clogging of the screens in the grinder. The tankage used in the ration should be self-fed in a separate compartment of the feeder in order that the pigs may balance their ration.

**Tankage vs. Soybeans.**—Soybeans are another protein-rich feed which can be grown in Colorado. They contain about 36 percent protein and their energy value is high due to the high percentage of oil (18 percent). This oil is of low melting point and causes soft pork when soybeans are fed in too large amounts.

Pigs fed soybeans in this test made only a fair rate of gain. They consumed an average of 1.47 pounds of soybeans per head per day in addition to 5.25 pounds of ground millet. The pigs did not show quite the bloom and finish which was apparent where the other supplements were used. More rooting of the ground was noticed in this lot even with a simple mineral mixture available, which probably indicates a lack of some element in the ration.

Each ton of soybeans replaced 737.9 pounds of tankage but required 153.4 pounds more millet, 14.6 pounds more minerals and 23.7 pounds more salt, or had a value of \$11.38 per ton with present prices of feeds.

Slaughter tests showed every one of the carcasses from hogs fed soybeans in addition to ground hog millet to be soft and flabby.

This test checks very closely with work conducted at the Minnesota and Illinois Stations where it was also found that

soybeans fed in quantities sufficient to balance a ration of corn, produce soft pork.

These results largely condemn soybeans as a sole protein supplement for fattening pigs. However, soybeans can be fed to breeding stock with good results. Brood sows relish them and as a feed they are well adapted to sows suckling pigs because of the high energy value. There is some risk in scouring on account of the high oil content; consequently, other protein feeds should make up about one-half of the protein supplement. Whole soybeans usually give better results than ground soybeans.