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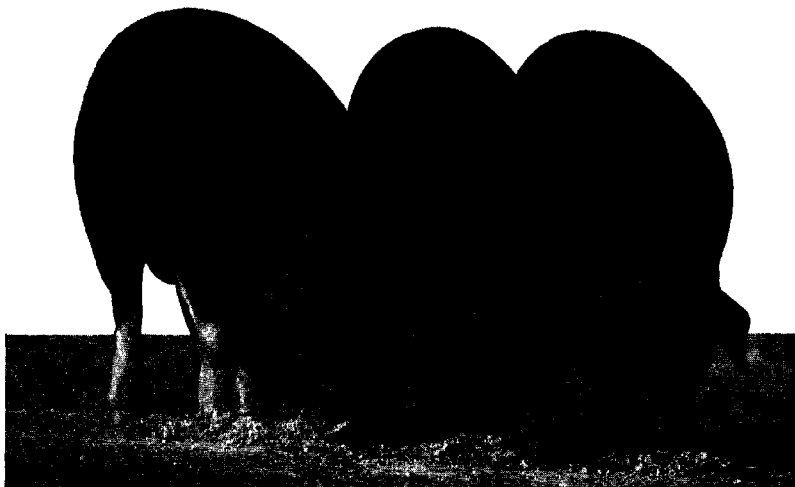
CIRCULAR 207

AGRICULTURAL EXPERIMENT STATION

KANSAS STATE COLLEGE OF AGRICULTURE
AND APPLIED SCIENCE

MANHATTAN, KANSAS

DEPARTMENT OF ANIMAL HUSBANDRY



Grand Champion pen of barrows, American Royal Livestock Show, Kansas City, Mo., 1940. Bred, fed and shown by the Department of Animal Husbandry, Kansas State College, Manhattan.

SWINE FEEDING INVESTIGATIONS, 1936 to 1940¹

BY C. E. AUBEL

Three swine-feeding problems studied by the Kansas Agricultural Experiment Station from 1936 to 1940 are reported in this circular: (I) The relative value of various protein supplements and protein supplementary mixtures for fattening swine. (II) Corn versus blackstrap molasses for fattening pigs. (III) Self-feeding sows and litters.

The pigs used in the tests were raised in the college herd. In order to obtain the greatest uniformity in all the lots, selection was carefully made according to weight, age, condition, sex, and breed. The initial and final weights represent the average of weights made on three successive days at the beginning and at the end of the experiment.

1. Contribution No. 142 from the Department of Animal Husbandry.

I. THE RELATIVE VALUE OF VARIOUS PROTEIN SUPPLEMENTS AND PROTEIN SUPPLEMENTARY MIXTURES FOR FATTENING SWINE

Pigs, because of their rapid growth, need rations containing liberal proportions of protein. This is often spoken of as one of the basic facts of swine feeding. In fact, many times the profitableness of swine feeding depends upon this feeding of protein.

Previous tests* at this station have shown that tankage or meat and bone scraps when fed as a protein supplement with corn or other grains is profitable whether the pigs are fed in the dry lot or on pasture. These protein supplements, although varying in price from time to time, are often considered too expensive by feeders, and as a consequence they desire to use other protein feeds because they are cheaper in price.

Experiments in swine feeding at the Kansas Agricultural Experiment Station the last few years for this reason have been conducted to determine the efficiency of substitutes for tankage or meat and bone scraps.

This group of experiments was conducted along two lines. (A) The relative value of various single protein supplements as compared with tankage, and (B) the relative value of various protein supplementary mixtures compared with tankage.

(A) THE RELATIVE VALUE OF VARIOUS SINGLE PROTEIN SUPPLEMENTS COMPARED WITH TANKAGE

Four swine-feeding problems comprised this series of experiments which were studied at this station from 1936 to 1940: 1. Tankage versus peanut oil meal. 2. Tankage versus whole soybeans. 3. Tankage versus soybean oil meal. 4. Tankage versus fish meal.

1. TANKAGE VERSUS PEANUT OIL MEAL

Peanut oil meal is generally easily procured and at times when it is low in price compared with tankage, feeders wish to substitute it for the tankage. It contains about 40 percent protein and is made from the residue of the peanut kernel after the oil has been pressed out. A test with this meal was carried on in the dry lot during the winter months of 1936. A mineral mixture was fed with the peanut oil meal since it is low in calcium. The protein supplements and mineral mixtures were self-fed in separate compartments. The mineral mixture was composed of 5 parts steamed bone meal, 5 parts ground limestone, and 1 part common salt. The detailed data is found in Table 1.

* Circular 188, Kan. Agr. Expt. Sta., November, 1937.

TABLE 1.—*Tankage versus peanut oil meal and minerals for fattening pigs self-fed corn and alfalfa hay in a dry lot (January 13 to May 4, 1936—112 days)*

RATION	Corn (self-fed), alfalfa hay (self-fed)	
	Tankage (self-fed)	Peanut oil meal, mineral mixture (self-fed)
Lot No.	1	2
Number of pigs per lot.....	10	10
Average initial weight per pig.....	<i>Pounds</i> 58.23	<i>Pounds</i> 57.78
Average final weight per pig.....	234.60	220.23
Average total gain per pig.....	176.37	162.45
Average daily gain per pig.....	1.57	1.45
Average daily ration per pig:		
Corn.....	5.32	4.94
Tankage.....	.50	
Peanut oil meal.....		.92
Alfalfa hay.....	.29	.38
Minerals.....		.03
Feed consumed per 100 pounds gain:		
Corn.....	338.10	340.29
Tankage.....	31.47	
Peanut oil meal.....		63.10
Alfalfa hay.....	18.37	25.86
Minerals.....		1.69

Observations

1. Tankage when compared with peanut oil meal as a protein supplement for fattening pigs in the dry lot, produced slightly more rapid daily gains and slightly better finish.
2. The pigs receiving tankage ate a little more corn per day, but consumed about the same amount for 100 pounds gain.
3. The pigs receiving peanut oil meal ate nearly two times as much of their supplement per day as did those receiving tankage. About the same ratio was observed in the amount required for a 100 pounds gain. The amount consumed indicated that the peanut oil meal was palatable.

Conclusions

The results obtained in this test indicate that peanut oil meal, when self-fed with a mineral mixture, makes a good protein supplement for hog feeding, but is not as efficient as tankage pound for pound. It would be a satisfactory substitute if it can be purchased at a little less than two-thirds of the cost of tankage.

2. TANKAGE VERSUS WHOLE SOYBEANS

In recent years the acreage in Kansas planted to soybeans has been gradually increasing. With the increasing amounts of beans harvested comes increasing inquiry as to their value as a hog feed. Since soybeans contain about 36 percent protein, it is naturally assumed that they would make an excellent protein supplement that could be fed in the place of tankage. The beans are not very palatable to swine. They are low in minerals and high in an oil which produces "soft pork" when the pigs consume too many beans.

Two tests were conducted to determine the value of soybeans as a protein supplement. In these tests the beans were self-fed whole with shelled corn and alfalfa hay, but no mineral mixture was supplied.

First Test.—The first of these test's was conducted during the winter of 1937-'38 in a dry lot. These pigs had free access to the shelled corn, alfalfa hay, whole soybeans, and the tankage. The results are reported in detail in Table 2.

TABLE 2.—*Tankage versus whole soybeans for fattening pigs self-fed corn and alfalfa hay in a dry lot*

(December 8, 1937, to April 2, 1938—116 days)

RATION	Shelled corn (self-fed), alfalfa hay (self-fed)	
	Tankage (self-fed)	Whole soybeans (self-fed)
Lot No.	1	2
Number of pigs per lot.	7	8
Average initial weight per pig.	<i>Pounds</i> 60.38	<i>Pounds</i> 58.79
Average final weight per pig.	226.90	185.50
Average total gain per pig.	166.52	126.71
Average daily gain per pig.	1.44	1.09
Average daily ration per pig:		
Shelled corn	5.12	3.78
Tankage . . . . .	.54	
Whole soybeans. . . . .		.83
Alfalfa hay . . . . .	.56	.46
Feed consumed per 100 pounds gain:		
Shelled corn	356.63	345.67
Tankage	37.53	
Whole soybeans.		75.87
Alfalfa hay	32.17	41.83

Observations

1. Tankage, when compared with whole soybeans alone self-fed as a protein supplement for fattening pigs in the dry lot, produced more rapid daily gains and better finish.

2. The pigs receiving tankage had better appetites and ate more corn per day than those receiving the whole soybeans.

3. At the close of the experiment when the pigs were slaughtered, all the carcasses of the pigs in lot 1 were graded firm. Of the eight carcasses from lot 2, in which the pigs were fed whole soybeans, six of them graded soft.

Second Test.—The second test, comparing the relative value of tankage and whole soybeans as protein supplements for pigs self-fed corn, was conducted during the summer of 1938. These pigs had free access to alfalfa pasture and were self-fed their protein supplement. The results are reported in detail in Table 3.

TABLE 3.—*Tankage versus whole soybeans for fattening pigs self-fed corn on alfalfa pasture*
(June 3 to September 23, 1938—112 days)

RATION	Shelled corn (self-fed), alfalfa pasture	
	Tankage (self-fed)	Whole soybeans (self-fed)
Lot No.	1	2
Number of pigs per lot.	8	10
Average initial weight per pig.	<i>Pounds</i> 68.12	<i>Pounds</i> 67.53
Average final weight per pig.	222.46	161.30
Average total gain per pig.	154.34	93.77
Average daily gain per pig.	1.38	.84
Average daily ration per pig:		
Shelled corn.	4.76	3.54
Tankage. ....	.24	.18
Whole soybeans. ....	.....	.18
Feed consumed per 100 pounds gain:		
Shelled corn.	345.76	422.52
Tankage.	17.62	.....
Whole soybeans. ....	.....	21.76

Observations

1. Tankage, when compared with whole soybeans alone self-fed as the protein supplement for fattening pigs on alfalfa pasture, produced more rapid daily gains and more finish.

2. The pigs receiving tankage had better appetites and ate more corn per day than those receiving the whole soybeans.

3. Three pigs from the whole soybean lot were slaughtered. Each produced a soft carcass. The carcasses from the tankage-fed pigs were all firm.

Conclusions

Whole soybeans apparently are not a satisfactory protein supplement when fed to fattening pigs on alfalfa pasture or in the dry lot. Although tests were not run to answer this question, it may be inferred that whole soybeans supplemented with minerals do not permit of satisfactory gains or finish.

3. TANKAGE VERSUS SOYBEAN OIL MEAL

The residue remaining after the removal of oil from the whole soybean is known as soybean oil meal. It contains about 42 percent protein. The meal is a better hog feed than the original beans because the objectionable "soft pork" producing oil has been removed. It is one of the best protein supplements of plant origin available for swine feeding, is also highly palatable and may be self-fed as a supplement to farm grains.

Studies pertaining to three problems in the use of this meal are reported in this circular. One problem concerns the advisability of supplementing the meal with minerals. Another problem relates to the value of meals that are made by different processes, and the third problem concerns the substitution of soybean oil meal for tankage.

Three tests pertain to the first problem, that is, the advisability of supplementing the meal with minerals. Soybean oil meal, like the beans from which it is derived, is low in the minerals necessary for successful hog feeding. Consequently whether to feed additional minerals with the meal is of considerable concern to the feeder. The minerals used in these tests were mixtures of 5 parts steamed bone meal, 5 parts ground limestone, and 1 part common salt. The mixture was self-fed in the lots that received minerals.

First and Second Tests.—The first and second tests were conducted in the summers of 1937 and 1938, respectively, and were carried on with pigs self-fed corn on alfalfa pasture. Two lots of pigs were used in each test. One lot in each test received soybean oil meal and minerals and the other lot received soybean oil meal alone. An average of these two tests is reported in Table 4, which gives the detailed data.

TABLE 4.—*Soybean oil meal plus minerals versus soybean oil meal without minerals for fattening pigs self-fed corn on alfalfa pasture*
 (Average of two tests, Summers of 1937 and 1938—105 days)

RATION	Shelled corn (self-fed), alfalfa pasture	
	Soybean oil meal, minerals (self-fed)	Soybean oil meal (self-fed)
Lot No.	1	2
Number of pigs per lot.	9	10
Average initial weight per pig.	<i>Pounds</i> 67.56	<i>Pounds</i> 65.73
Average final weight per pig.	209.45	158.16
Average total gain per pig.	141.89	87.43
Average daily gain per pig.	1.35	.83
Average daily ration per pig:		
Shelled corn.	4.13	3.30
Soybean oil meal. . . . .	.64	.55
Minerals. . . . .	.03	
Feed consumed per 100 pounds gain:		
Shelled corn.	305.33	394.37
Soybean oil meal.	47.80	66.53
Minerals.	2.50	

Observations

The pigs receiving soybean oil meal and minerals made greater daily gains, required less feed per 100 pounds gain, and made cheaper gains than those receiving soybean oil meal without minerals.

Third Test.—The third test was conducted in the winter of 1937-'38 and was carried on with pigs self-fed corn and alfalfa hay in the dry lot. Two lots of pigs were used in this test. One lot received soybean oil meal and minerals and the second lot received soybean oil meal, but no minerals. The detailed results are shown in Table 5.

TABLE 5.—Soybean oil meal plus minerals versus soybean oil meal without minerals for fattening pigs self-fed in the dry lot on corn and alfalfa hay
 (December 8, 1937, to April 2, 1938—116 days)

RATION	Shelled corn (self-fed), alfalfa hay (self-fed)	
	Soybean oil meal, minerals (self-fed)	Soybean oil meal (self-fed)
Lot No.	1	2
Number of pigs per lot.	8	8
Average initial weight per pig.	<i>Pounds</i> 59.42	<i>Pounds</i> 61.86
Average final weight per pig.	232.92	182.57
Average total gain per pig.	178.50	120.71
Average daily gain per pig.	1.50	1.04
Average daily ration per pig:		
Shelled corn.	4.96	4.11
Soybean oil meal.	1.03	1.01
Alfalfa hay. ....	.14	.18
Minerals. ....	.04	.....
Feed consumed per 100 pounds gain:		
Shelled corn.	331.70	404.63
Soybean oil meal.	68.81	96.21
Alfalfa hay.	9.08	17.75
Minerals.	2.67	.....

Observations

The pigs receiving soybean oil meal and minerals made greater daily gains, required less feed per 100 pounds gain and made cheaper gains per 100 pounds than those receiving soybean oil meal without minerals as a protein supplement.

Conclusions

The results of these tests indicate that soybean oil meal without minerals is not an efficient protein supplement for fattening pigs, either on pasture or in the dry lot, but when minerals are added to soybean oil meal the mixture is a satisfactory supplement.

The second problem concerning the relative value of expeller and solvent process soybean oil meal was studied in two tests. These meals are similar in their protein content, and differ mainly in the manner in which they are processed. The expeller meal is made from the residue of the beans after the oil has been extracted from the ground dried beans by means of an auger-like machine which exerts heat and great pressure. The solvent process consists of mixing the ground beans with a solvent, like benzine, which dissolves the fat or oil which is later removed by evaporating the solvent. The residue after the oil is extracted is the meal, and is usually given the name of the process by which this is accomplished.

A mineral mixture of 5 parts steamed bone meal, 5 parts ground limestone, and 1 part common salt was self-fed in each lot of both experiments.

First Test.—This test was carried on in the winter of 1937-'38 with pigs self-fed corn and alfalfa hay in the dry lot. The soybean oil meals were likewise self-fed. Two lots were used in each test. One lot received expeller process meal and the other lot received the solvent process meal. The detailed results are shown in Table 6.

TABLE 6.—*Expeller process soybean oil meal versus solvent process soybean oil meal for fattening pigs self-fed corn and alfalfa hay in the dry lot.*

(December 8, 1937, to April 2, 1938—116 days)

RATION	Shelled corn (self-fed), alfalfa hay (self-fed)	
	Soybean oil meal (expeller process), minerals (self-fed)	Soybean oil meal (solvent process), minerals (self fed)
Lot No.	1	2
Number of pigs per lot.	8	8
Average initial weight per pig.	<i>Pounds</i> 59.17	<i>Pounds</i> 59.42
Average final weight per pig.	235.08	232.92
Average total gain per pig.	175.91	173.50
Average daily gain per pig.	1.52	1.50
Average daily ration per pig:		
Shelled corn.	4.84	4.96
Soybean oil meal (expeller process).	1.08	
Soybean oil meal (solvent process).		1.03
Alfalfa hay. . . . .	.26	.14
Minerals. . . . .	.03	.04
Feed consumed per 100 pounds gain:		
Shelled corn.	319.27	331.70
Soybean oil meal (expeller process).	70.99	
Soybean oil meal (solvent process).		68.81
Alfalfa hay.	16.84	9.08
Minerals.	2.13	2.67

Observations

Expeller process soybean oil meal when compared with solvent process soybean, oil meal, both fed with minerals, produced slightly more rapid daily gains. The two lots of pigs showed the same finish, although the expeller process produced a hundred pounds of gain with 12 pounds less corn. The amount of soybean oil meal consumed per 100 pounds gain was practically the same in the two lots.

Second Test.—This test was carried on in the summer of 1938 with pigs self-fed corn on alfalfa pasture. Two lots of pigs were used in each test, one receiving expeller process meal and the other solvent process meal. The detailed results are shown in Table 7

TABLE 7.—Expeller process soybean oil meal versus solvent process soybean oil meal for fattening pigs self-fed corn on alfalfa pasture
(June 8 to September 23, 1938—112 days)

RATION	Shelled corn (self-fed), alfalfa pasture	
	Soybean oil meal (expeller process), minerals (self-fed)	Soybean oil meal (solvent process), minerals (self-fed)
Lot No.	1	2
Number pigs per lot	8	9
Average initial weight per pig	<i>Pounds</i> 69.33	<i>Pounds</i> 69.00
Average final weight per pig	221.13	229.52
Average total gain per pig	151.80	160.52
Average daily gain per pig	1.36	1.43
Average daily ration per pig:		
Shelled corn	3.86	4.31
Soybean oil meal (expeller process) . . . . .	.93	. . . . .
Soybean oil meal (solvent process) . . . . .	. . . . .	.66
Minerals . . . . .	.04	.03
Feed consumed per 100 pounds gain:		
Shelled corn	285.08	300.55
Soybean oil meal (expeller process)	68.43	. . . . .
Soybean oil meal (solvent process) . . . . .	. . . . .	46.10
Minerals	3.05	2.18

Observations

Solvent process soybean oil meal when compared with the expeller process soybean oil meal, both fed with minerals, produced a little more rapid daily gains. The two lots showed the same finish. Fifteen pounds more corn per 100 pounds gain and 22 pounds less meal were required by the pigs receiving solvent meal than by the pigs receiving expeller meal.

Conclusions

Expeller process soybean oil meal and solvent process soybean oil meal possess equal value as protein supplements in hog fattening rations, the results of these tests indicate. In each test a little less meal of one kind was consumed than of the other. Both meals produced satisfactory gains, made a good utilization of feed, and produced hogs of excellent finish.

The third problem in soybean oil meal feeding concerning its relative value when compared with tankage, was studied in tests in dry lot feeding and in pasture feeding. Each lot receiving soybean oil meal was self-fed a mineral mixture also, consisting of 5 parts steamed bone meal, 5 parts ground limestone, and 1 part common salt.

The test in dry lot feeding was carried on in the winter of 1937-'38. Two lots of pigs were used, one lot received tankage and the other lot received soybean oil meal and minerals. The detailed data is given in Table 8.

TABLE 8.—Soybean oil meal supplemented with minerals versus tankage for fattening pigs self-fed corn and alfalfa hay in a dry lot
 (December 8, 1937, to April 2, 1938—116 days)

RATION	Shelled corn (self-fed), alfalfa hay (self-fed)	
	Tankage (self-fed)	Soybean oil meal (solvent process), minerals (self-fed)
Lot No.	1	2
Number of pigs per lot.	8	8
Average initial weight per pig.	<i>Pounds</i> 60.38	<i>Pounds</i> 59.42
Average final weight per pig.	226.90	232.92
Average total gain per pig.	166.52	173.50
Average daily gain per pig.	1.44	1.50
Average daily ration per pig:		
Shelled corn.	5.12	4.96
Tankage. . . . .	.54	
Soybean oil meal.		1.03
Alfalfa hay. . . . .	.46	.14
Minerals. . . . .		.04
Feed consumed per 100 pounds gain:		
Shelled corn.	356.03	331.70
Tankage.	37.58	
Soybean oil meal.		68.81
Alfalfa hay.	32.17	9.08
Minerals.		2.67

Observations

Tankage, when compared with soybean oil meal with minerals as a protein supplement for fattening pigs in the dry lot, did not produce quite as rapid daily gains, but the finish of the pigs was practically the same.

The pigs receiving tankage required more corn per 100 pounds gain than those receiving the soybean oil meal. Nearly twice as much protein supplement, however, was required by the soybean oil meal-fed pigs.

Tests on alfalfa pasture were carried on in three tests during the summer months from 1938 to 1940. Two lots of pigs were used in each test. One lot in each test received tankage and the other lot received expeller process soybean oil meal supplemented with minerals. The results of the three tests have been averaged together and the detailed results are given in Table 9.

TABLE 9.—*Soybean oil meal supplemented with minerals versus tankage for fattening pigs self-fed corn on alfalfa pasture*

(Average of three tests, summers of 1938 to 1940—111 days)

RATION	Shelled corn (self-fed), alfalfa pasture	
	Tankage (self-fed)	Soybean oil meal (expeller process), minerals (self-fed)
Lot No.	1	2
Number of pigs per lot.	8	9
Average initial weight per pig.	<i>Pounds</i> 66.75	<i>Pounds</i> 67.11
Average final weight per pig.	223.36	227.72
Average total gain per pig.	156.61	160.60
Average daily gain per pig.	1.40	1.44
Average daily ration per pig:		
Shelled corn.	4.42	3.70
Tankage. ....	.24	.....
Soybean oil meal (expeller process). ....	.....	1.18
Minerals. ....	.....	.03
Feed consumed per 100 pounds gain:		
Shelled corn.	335.21	272.35
Tankage.	18.33	.....
Soybean oil meal (expeller process). ....	.....	81.86
Minerals. ....	.....	2.37

Observations

Tankage, when compared with soybean oil meal and minerals as a protein supplement for fattening pigs on alfalfa pasture, produced slightly less daily gain and not quite as well finished pigs.

The amount of corn consumed per 100 pounds gain by the soybean oil meal-fed lot was considerably less than that consumed by the tankage lot. The soybean oil meal consumed daily per 100 pounds gain was high contrasted with the tankage consumed.

Conclusions

The experiments comparing soybean oil meal with tankage whether in the dry lot or on pasture indicate that the soybean oil meals with minerals were more efficient than tankage as protein supplements for fattening pigs in the dry lot.

4. TANKAGE VERSUS FISH MEAL

Fish meal is considered by many as one of the better protein feeds of animal origin. It is rich in protein and minerals and is palatable to swine. Fish meal is sometimes difficult to procure in midwestern markets at prices that justify its use. It generally sells for con-

siderably more per ton than tankage. Nevertheless it was used in one experiment in competition with tankage in the summer of 1939. The results of this experiment are given in Table 10. Pilchard meal, containing 67 percent protein, was fed.

TABLE 10.—*Tankage versus Pilchard fish meal for fattening pigs self-fed corn on alfalfa pasture*
 (June 13 to September 30, 1939—109 days)

RATION	Shelled corn (self-fed), alfalfa pasture	
	Tankage (self-fed)	Fish meal (self-fed)
Lot No.	1	2
Number of pigs per lot.....	9	8
Average initial weight per pig.....	<i>Pounds</i> 69.44	<i>Pounds</i> 70.20
Average final weight per pig.....	220.70	227.62
Average total gain per pig.....	151.26	157.42
Average daily gain per pig.....	1.38	1.44
Average daily ration per pig:		
Shelled corn.....	4.17	4.17
Tankage.....	.26	
Fish meal.....		.55
Feed consumed per 100 pounds gain:		
Shelled corn.....	334.60	289.11
Tankage.....	20.94	
Fish meal.....		38.28

Observations

1. The pigs fed tankage made smaller daily gains than those receiving fish meal.
2. The amount of corn consumed daily by each group was the same, but the fish-meal-fed pigs consumed twice as much fish meal daily as the tankage-fed pigs consumed tankage.
3. Less corn per 100 pounds gain was consumed by the fish meal-fed pigs than by the tankage-fed pigs. More fish meal per 100 pounds gain was used than tankage in their respective lots.

Conclusions

In daily gains and consumption of corn the fish meal-fed pigs made a good showing, but the large amount of fish meal consumed per 100 pounds gain made the feeding of this supplement rather expensive as fish meal almost always costs more than tankage.

If fish meal could be purchased at approximately the same price as tankage it would be an excellent substitute for tankage, as it is palatable and has a high percentage of desirable proteins.

Fish meal could be expected to make a better showing when self-fed with corn on alfalfa pasture than it did in this test which was made in the dry lot.

(B) THE RELATIVE VALUE OF VARIOUS PROTEIN SUPPLEMENTARY MIXTURES COMPARED WITH TANKAGE

It has long been known that a protein supplement is necessary for successful hog feeding. For many years single protein supplements were used, in late years the mixing of two or more high protein feeds to make a protein supplement has been common. Many commercial protein mixtures are on the market.

Several factors should be considered in determining the value of mixed protein feeds for hogs. One of these items is the content of fiber. Crude fiber adds bulk to feeds and is of little value because it does not furnish net energy. A protein concentrate should not contain more than 7 percent crude fiber.

The function of protein concentrates is to supplement with its high amount of protein the low protein of farm grains. The protein problem is twofold, that is, one of quantity and one of quality. The problem of quantity is not difficult because it can easily be calculated. If a feed contains 60 percent protein and costs \$3 per hundred pounds, then each pound of protein will cost five cents.

The problem of quality is more difficult because the feeder can not calculate it accurately because the proteins are complex compounds that have different feed values. They are of two sources generally—those of animal origin as meat, milk and fish; and those from plant sources as cottonseed, linseed and soybean oil meal. Animal proteins are usually of higher quality than vegetable proteins. Their quality cannot easily be determined and in general, the proteins from single sources such as the plant proteins are deficient in certain nitrogen compounds essential to animal nutrition. The deficiencies are not the same for different protein feeds and so mixtures may be made in which the lack of a specific protein in one is made up by another of the feeds in the mixture. This is the reason for compounding mixtures of protein supplements. However, it does not follow that because the protein supplement is mixed, it is better than a single supplement. Quality of protein is more important in dry lot feeding than in pasture feeding because green feeds may supply some of the essential proteins that might be lacking in the processed supplement.

Three feeding experiments were carried on during the years 1939-40. One of these tests was in the dry lot and the other two on pasture. The objects of these tests were to determine the value of various protein feed mixtures as supplements to shelled corn for fattening pigs.

First Test.—This test was conducted during the summer of 1939 and four lots of pigs were fed, each received shelled corn in a self-feeder on alfalfa pasture. Each of the four lots received a different protein supplement. Lot 1 was self-fed 60 percent digester tankage; lots 2, 3 and 4 had different mixed protein supplements which were self-fed free choice with corn. Other protein supplements were 67 percent Pilchard fish meal and 41 percent expeller process soybean oil meal. The ingredients and proportions of each are shown in Table 11 as well as the detailed results of the experiment.

TABLE 11.—Comparative value of tankage and mixtures of various protein supplements for pigs self-fed corn on alfalfa pasture
(June 18 to September 30, 1939—109 days)

RATION	Shelled corn (self-fed), alfalfa pasture			
	Tankage (self-fed)	Supplement A (self-fed)	Supplement B (self-fed)	Supplement C (self-fed)
Lot No.	1	2	3	4
Number of pigs per lot.....	9	9	9	9
Average initial weight per pig.....	Pounds 69.44	Pounds 69.77	Pounds 69.92	Pounds 70.11
Average final weight per pig.....	220.70	215.64	229.22	223.44
Average total gain per pig.....	151.26	145.87	159.30	153.33
Average daily gain per pig.....	1.38	1.33	1.46	1.40
Average daily ration per pig:				
Shelled corn.....	4.17	4.09	4.31	3.89
Tankage.....	.26	.36	.16	.24
Fish meal.....		.18	.16	
Soybean oil meal.....			.40	.30
Cottonseed meal.....			.08	.06
Feed consumed per 100 pounds gain:				
Shelled corn.....	334.60	306.06	295.66	277.17
Tankage.....	20.94	27.00	11.88	21.88
Fish meal.....			11.88	
Soybean oil meal.....		13.50	29.70	27.35
Cottonseed meal.....			5.94	5.47

Supplement A. Wet rendered tankage 2 parts, soybean oil meal 1 part. Protein content 47.3 percent.

Supplement B. Soybean oil meal 5 parts, tankage 2 parts, fish meal 2 parts, cottonseed meal 1 part. Protein content 50.2 percent.

Supplement C. Soybean oil meal 5 parts, tankage 4 parts, cottonseed meal 1 part. Protein content 45.8 percent.

Observations.

1. The lot fed protein supplement A showed the lowest daily gain of all the lots fed.
2. The lot fed protein supplement B made the largest daily gains of all the lots.
3. The lot fed protein supplement C made good daily gains.

Second Test.—This test was conducted during the winter of 1939-40. Each of the five lots of pigs received shelled corn in a self-feeder and a mineral mixture of 5 parts steamed bone meal, 5 parts ground limestone, and 1 part common salt. The mineral mixture was fed in a separate compartment of the feeder.

Each of the five lots received a different protein supplement as indicated in Table 12. Where protein mixtures were fed they were compounded in the proportions indicated and the mixture self-fed. The alfalfa hay fed in lot 1 was self-fed in a rack. The tankage was wet rendered, 60 percent protein. The fish meal was 67 percent protein Pilchard meal, and the soybean oil meal was expeller process of 41 percent protein.

A summary of the results follow in Table 12.

TABLE 12.—*The comparative value of some protein feed mixtures as supplements to shelled corn for fattening pigs in the dry lot*

(December 21, 1939, to April 19, 1940—120 days)

RATION	Shelled corn (self-fed), mineral mixture (self-fed)				
	Tankage, alfalfa hay (self-fed)	Supplement A (self-fed)	Supplement B (self-fed)	Supplement C (self-fed)	Supplement D (self-fed)
Lot No.	1	2	3	4	5
Number of pigs per lot.	8	8	8	8	8
Average initial weight per pig.	Pounds 70.41	Pounds 73.75	Pounds 71.42	Pounds 71.20	Pounds 73.70
Average final weight per pig.	236.30	243.33	271.03	266.00	265.91
Average total gain per pig.	165.90	169.58	199.60	184.90	192.21
Average daily gain per pig.	1.38	1.41	1.66	1.54	1.60
Average daily ration per pig:					
Shelled corn.	5.39	5.06	5.42	5.24	5.78
Tankage. ....	.42				
Alfalfa hay. ....	.38				
Protein supplement. ....		.76	.74	.745	.701
Mineral mixture. ....	.009	.010	.011	.012	.011
Feed consumed per 100 lbs. gain:					
Shelled corn.	390.52	358.16	326.27	340.45	361.45
Tankage.	30.74				
Alfalfa hay.	27.50				
Protein supplement.		55.17	53.14	51.70	44.80
Mineral mixture. ....	.67	.73	.68	.81	.68

Supplement A. Wet rendered tankage 2 parts, soybean oil meal 1 part, alfalfa meal 1 part. Protein content 43.5 percent.

Supplement B. Soybean oil meal 4 parts, wet rendered tankage 2 parts, fish meal 2 parts, cottonseed meal 1 part, alfalfa meal 1 part. Protein content 47 percent.

Supplement C. Soybean oil meal 5 parts, wet rendered tankage 2 parts, fish meal 2 parts, alfalfa meal 1 part. Protein content 47 percent.

Supplement D. Soybean oil meal 5 parts, wet rendered tankage 4 parts, alfalfa meal 1 part. Protein content 45.8 percent.

Lot 1, receiving tankage and alfalfa hay as a protein supplement, made the poorest showing of all.

Lot 2, in which soybean oil meal was added to the tankage and alfalfa meal replaced the alfalfa hay, made a better showing than lot 1, both in rapidity and economy of gains.

Supplement B (lot 3), composed of soybean oil meal 4 parts, digester tankage 2 parts, fish meal 2 parts, cottonseed meal 1 part, and alfalfa meal 1 part was the most efficient supplement in the experiment as determined by the rate of gain and feed requirement.

Supplement C (lot 4), a modification of Supplement B in that the 1 part of cottonseed meal was replaced by another part of soybean oil meal, produced the next most efficient supplement as determined by the feed requirement per 100 pounds gain.

Supplement D (lot 5), another modification of Supplement B and of C, produced the second most rapid gains of the experiment. This lot had the smallest consumption of protein supplement of any of the lots.

The supplements containing fish meal were more efficient than those without the fish meal.

Third Test.—This test was conducted during the summer of 1940 with pigs self-fed corn on alfalfa pasture. Six lots of pigs were self-fed different protein feed mixtures with shelled corn and a mineral mixture composed of 5 parts steamed bone meal, 5 parts ground limestone, and 1 part salt. The detailed results are presented in Table 13.

TABLE 13.—*The comparative value of some protein feed mixtures as supplements to shelled corn for fattening pigs on alfalfa pasture*
(June 20 to October 10, 1940—112 days)

RATION	Shelled corn (self-fed), mineral mixture (self-fed), alfalfa pasture				
	Tankage, (self-fed)	Supple- ment A	Supple- ment B	Supple- ment C	Supple- ment D
Lot No.....	1	2	3	4	5
Number of pigs per lot.....	10	10	10	10	10
Average initial weight per pig.....	<i>Pounds</i> 62.70	<i>Pounds</i> 62.30	<i>Pounds</i> 62.80	<i>Pounds</i> 63.30	<i>Pounds</i> 63.60
Average final weight per pig.....	226.93	230.16	230.73	235.40	242.66
Average total gain per pig.....	164.23	167.86	167.73	172.10	179.06
Average daily gain per pig.....	1.46	1.49	1.49	1.53	1.59
Average daily ration per pig:					
Shelled corn.....	4.76	4.57	4.22	4.60	4.61
Tankage.....	.24				
Protein supplement.....		.66	.88	.72	.84
Mineral mixture.....	.009	.010	.017	.012	.010
Feed consumed per 100 lbs. gain:					
Shelled corn.....	325.27	305.19	281.82	299.47	288.39
Tankage.....	18.44				
Protein supplement.....		45.03	59.73	48.48	53.78
Mineral mixture.....	.63	.71	1.14	.79	.71

Supplement A. Wet rendered tankage 1 part, soybean oil meal 1 part. Protein content 50 percent.

Supplement B. Wet rendered tankage 1 part, soybean oil meal 2 parts. Protein content 47.3 percent.

Supplement C. Soybean oil meal 5 parts, wet rendered tankage 2 parts, fish meal 2 parts, cottonseed meal 1 part. Protein content 50 percent.

Supplement D. Soybean oil meal 5 parts, wet rendered tankage 4 parts, cottonseed meal 1 part. Protein content 48.8 percent.

Observations

Lot 1, which received tankage, had the lowest daily gain of all the lots but a low consumption of tankage per 100 pounds gain,

Supplement D (lot 5) and Supplement B (lot 3) made very good showings and were the best of the mixed protein supplements. Lot 5 had the largest daily gain of all lots and a low consumption of corn per 100 pounds gain. Lot 3 had the lowest corn consumption per 100 pounds gain of all the mixed protein fed lots, but the highest consumption of mixed protein supplement.

II. CORN VERSUS BLACKSTRAP MOLLASSES FOR FATTENING PIGS

When the price of corn becomes very high, hog feeders look about for a substitute feed. In the winter of 1936-'37 corn was high in price and blackstrap molasses was relatively cheap. Consequently, attention was focused upon it as a possible substitute for corn in hog fattening raions. A test was started in the winter of 1937 to determine the feeding value of blackstrap molasses as compared with corn as a feed for fattening hogs. The pigs in this test were fed in a dry lot; alfalfa hay was self-fed under cover. The corn was hand-fed twice daily and 0.4 pound of tankage fed with it once a day. Where the pigs received molasses the daily allowance was divided into two portions and poured over the corn and tankage.

The detailed results of this test, follow in Table 14.

TABLE 14.—*Corn versus blackstrap molasses for fattening pigs in the dry lot*
 (February 27 to April 26, 1937—58 days)

RATION	Alfalfa hay (self-fed)			
	Shelled corn, tankage (self-fed)	Shelled corn, tankage 1 pound molasses per head per day (hand-fed)	Shelled corn, tankage 2 pound molasses per head per day (hand-fed)	Shelled corn, tankage 3 pounds molasses per head per day (hand-fed)
Lot No.	1	2	3	4
Number of pigs per lot.	8	8	8	8
Average initial weight per pig.	<i>Pounds</i> 122.00	<i>Pounds</i> 121.75	<i>Pounds</i> 121.63	<i>Pounds</i> 121.28
Average final weight per pig.	238.71	222.21	224.38	224.04
Average total gain per pig.	116.71	100.46	102.75	102.76
Average daily gain per pig.	2.01	1.73	1.77	1.77
Average daily ration per pig:				
Corn.	7.68	6.54	6.43	5.98
Tankage. ....	.40	.40	.40	.40
Alfalfa hay. ....	.40	.67	.72	.66
Molasses. ....		.99	1.94	2.87
Feed consumed per 100 pounds gain:				
Corn.	381.61	377.39	362.77	337.80
Tankage.	19.71	22.89	22.38	22.38
Alfalfa hay.	20.03	38.95	40.88	31.69
Molasses.		57.11	109.61	158.99

Observations

1. There was no excessive scouring in any lot, but as the amount of molasses in the ration was increased, scouring was more noticeable.

2. Molasses did not increase the palatability of any ration. Those pigs receiving molasses were slower to "clean up" than those receiving only corn.

3. The average daily gain was lower in the lots that received molasses than in the lot that did not receive it.

4. The pigs that received no molasses, lot 1, required 381 pounds of corn per 100 pounds gain, whereas the pigs that received 1 pound of molasses (11.5 percent of the ration) per head daily, lot 2, required 377 pounds of corn and 57 pounds of molasses. The pigs in lot 3, that received 2 pounds of molasses (20.3 percent of the ration) per head daily, required 362 pounds of corn and 109 pounds of molasses. And the pigs in lot 4, that received 3 pounds of molasses (29.4 percent of the ration) per head daily, required 337 pounds of corn and 158 pounds of molasses for each 100 pounds gain.

5. In this test, therefore, 100 pounds of molasses saved 7 pounds of corn with the pigs that received 11.5 percent of their ration as molasses, and 18.1 pounds of corn with those that received 20.3 percent; and 27.1 pounds with those that received 29.4 percent of the ration.

III. SELF-FEEDING SOWS AND LITTERS ON ALFALFA PASTURE

The swine grower often gives too little attention to the handling and care of his brood sows and their litters during the suckling period. This time in the life of the pig is most important.

Slop feeding is the usual method of handling and caring for the sow and litter. This method requires much labor for the man who has 20 or more sows and litters. Therefore, any method of handling that will reduce the labor, and at the same time do the work efficiently should be of interest to the producer. A test was conducted in the summer of 1940 to obtain information regarding the value of self-feeding as compared with hand-feeding.

One lot was self-fed shelled corn and tankage and shorts free choice in a feeder and a creep was provided with shelled corn for the little pigs. Another lot was hand-fed a shorts slop and tankage beginning at the rate of about 5 pounds of shorts and 1¼ pounds of tankage as a slop twice a day. This was gradually increased so that by the end of the test the sows in the hand-fed lot were getting about 10 pounds of shorts and 4 pounds of tankage as a slop twice a day. In addition all the shelled corn was fed that they would clean up and a creep with shelled corn was provided for the pigs.

The results of this test are given in detail in Table 15.

TABLE 15.—*Self-feeding sows and litters on alfalfa pasture*
(May 10 to July 1, 1940—51 days)

	Self-fed	Hand-fed
Number of sows with litters	3	3
Number of pigs in tests	22	25
Age of pigs start of test (days)	19	17
Age of pigs end of test (days)	70	68
Average initial weight of sows (pounds)	393.3	409.6
Average final weight of sows (pounds)	391.6	390.3
Average loss of sows during test (pounds)	1.7	19.3
Average initial weight of pigs (pounds)	10.8	9.6
Average final weight of pigs (pounds)	45.5	43.8
Average total gain per pig (pounds)	34.7	34.2
Total feed consumed by sows and litters (pounds):		
Corn	2,385.0	2,040.5
Shorts	309.0	599.0
Tankage	109.0	158.1
Totals	2,803.0	2,797.6
Feed required per 100 pounds gain (pounds):		
Corn	314.5	255.9
Shorts	40.7	75.1
Tankage	14.8	19.8
Totals	369.5	350.8

Observations

In this test the hand-fed pigs produced pork a little more economically than the self-fed pigs, but did not gain quite as much daily as the self-fed pigs during the test. The hand-fed sows lost more weight during suckling than the self-fed sows.

The total feed consumed by the hand-fed sows and pigs was about the same as that consumed by the self-fed sows and pigs, but the hand-fed sows had three pigs more in their litters and this produced about 100 pounds of pork more per lot, which reduced the feed consumed per 100 pounds gain

