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# Value of B-Vitamins in Rations for Growing-Fattening Swine

Experiments With Riboflavin, Pantothenic Acid,  
Nicotinic Acid, and Vitamin B<sub>12</sub> in Corn-  
Soybean Oil Meal and Corn-  
Tankage Rations.

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# Value of B-Vitamins in Rations for Growing-Fattening Swine

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The importance of the B-complex vitamins in rations for swine has been recognized for many years. Cereal grains and most of the protein supplements commonly used in swine feeds are deficient in some of these vitamins. Many swine producers have included in swine rations such feeds as good quality pasture, dried brewers yeast, alfalfa meal or other feeds rich in the B-vitamins to obtain maximum growth and feed efficiency.

During the past few years, crystalline vitamins and fermentation residues rich in the B-vitamins have become available in large quantities and at a price where they could be used in practical dry lot rations for swine. Their availability, therefore, has created the need to evaluate requirements of swine for the various vitamins and to investigate their value in practical rations.

This publication summarizes a series of experiments on the value of adding some of the crystalline B-vitamins to rations composed of corn and soybean oil meal and corn and tankage for growing-fattening swine in dry lot.

## REVIEW OF LITERATURE

Weaver (1937) found that a ration composed of corn and tankage was inadequate for weanling pigs in dry lot and that this ration was improved by the addition of liver meal, dairy by-products, alfalfa meal and pastures. All of these feeds are considered to be good sources of the B-vitamins.

Luecke *et al.* (1949) observed severe diarrhea followed by locomotor incoordination in pigs fed a ration of corn, casein, soybean oil meal and minerals. When this ration was supplemented with calcium pantothenate, good growth was obtained as well as an increase in the efficiency of food utilization. In a later experiment, Luecke *et al.* (1950) produced a pantothenic acid deficiency in pigs by feeding a low protein ration containing corn and soybean oil meal supplemented with thiamine, riboflavin, nicotinic acid and pyridoxine. The unsupplemented corn and soybean oil meal ration did not produce symptoms of locomotor incoordination, but the growth rates of the pigs were very poor. The addition of calcium pantothenate to the corn and soybean oil meal basal ration significantly increased the rate of gain of the pigs.

Luecke *et al.* (1949) made a detailed study of 80 cases of nutritional enteritis in pigs obtained from 11 different farms in Michigan. Evidence was found which indicated that deficiencies of nicotinic acid, pantothenic acid and possibly riboflavin were involved in producing the symptoms of the disease. Intraperitoneal injections of a solution of thiamine, riboflavin, nicotinic acid, pantothenic acid and pyridoxine, followed by supplementation of the feed with these same B-vitamins proved to be effective in curing 86 percent of the pigs suffering from this form of enteritis.

Krider *et al.* (1948) reported that the addition of thiamine, riboflavin, pyridoxine, nicotinic acid, pantothenic acid and choline to a basal ration of corn, soybean oil meal, vitamin A and D oil and minerals significantly improved survival, growth rate, red blood cell count and hemoglobin values of weanling pigs. When 1.5 percent of liver extract in addition to the six B-vitamins was added to the basal ration, the average daily gains of the pigs were significantly increased. Further studies showed that the basal ration plus the six B-vitamins was not deficient in biotin, inositol, para-aminobenzoic acid, pteroylglutamic acid, alpha tocopherol or vitamin K.

A 20 percent crude protein ration composed largely of corn and soybean oil meal was found to be nutritionally inadequate for weanling pigs in dry lot (Dyer *et al.* 1949). The addition of either 1.5 mg. of riboflavin, 6 mg. pantothenic acid or 250 mg. choline per pound of ration significantly increased the average daily gain, while neither thiamine, nicotinic acid nor pyridoxine had a significant effect on the rate of gain.

McMillen, Luecke and Thorp (1949) obtained a significant increase in daily gains and the feed required per unit of gain was reduced from 22 to 25 percent when a ration of corn, oats, expeller soybean oil meal, meat scraps, alfalfa meal and complex mineral mixture was supplemented with riboflavin, pantothenic acid and nicotinic acid for weanling pigs in dry lot. In two trials, supplements of thiamine, pyridoxine, and choline failed to further increase gains or lower feed efficiency. The addition of vitamin B<sub>12</sub> also failed to give a response above the increase due to the addition of riboflavin, pantothenic acid and nicotinic acid.

Powick *et al.* (1947) found that the absence of nicotinic acid in an otherwise adequate diet resulted in a significant depression of growth and a high incidence of necrotic lesions of the colon and cecum in pigs.

Gregory and Dickerson (1952) observed a pantothenic acid deficiency in weanling pigs in dry lot when a ration of corn, tankage, soybean oil meal and alfalfa meal was fed. The symptoms were alleviated by the addition of 4 mg. of pantothenic acid per pound of ration.

When Robison (1953) supplemented corn, soybean oil meal and dried distillers grain solubles or a B-vitamin concentrate with vitamin B<sub>12</sub> for weanling pigs in dry lot, the gains were increased 9.2 percent; feed consumption increased 7.8 percent and feed efficiency was slightly greater.

Anderson and Hogan (1949) found that a basal ration of corn and soybean oil meal for weanling pigs was improved by the addition of vitamin B<sub>12</sub>. Hale and Lyman (1949) obtained 31 percent faster gains in pigs in dry lot when vitamin B<sub>12</sub> was added to a corn soybean oil meal ration.

Luecke, Hoefler and Thorp (1952) reported that the addition of vitamin B<sub>12</sub> to a basal ration of corn soybean oil meal and fish solubles did not result in any significant growth response for weanling pigs.

These results indicate that practical rations for growing-fattening swine are most likely to be deficient in the B-vitamins, riboflavin, pantothenic acid and nicotinic acid. The response to vitamin B<sub>12</sub> appears to be quite variable with some workers reporting rather large responses upon the addition of B<sub>12</sub> to the ration and others reporting little or no response.

## MATERIALS AND METHODS

Pigs used in this series of trials were Chester White, Duroc, Hampshire and Duroc-Hampshire crossbreds. (All of the pigs were kept in dry lot from birth until they were started on the experiment.) The pigs were placed on experiment as soon after weaning as possible. The pigs were divided as uniformly as possible between lots on the basis of weight, sex, breed and litter.

The pigs which were fed in dry lot were housed in a shed open on the south with a concrete floor, and in an experimental barn which had outside concrete floored pens. The pasture plots contained one-half acre with rape being used in one summer trial and rye for two trials in the fall and winter.

Table 1 gives the basal rations used. The corn was ground and mixed with the other ingredients to insure consumption of the same proportion of

TABLE 1 -- RATIIONS

Ingredients:	SBOM	Basal	Basal	Tankage	Basal	Basal +
	Basal	+ B-Vits.	+ B12		Basal	+ B-Vits.
Ground yellow corn	68	68	68	79.3	79.3	79.3
Soybean oil meal <sup>1</sup>	29.5	29.5	29.5	---	---	---
Tankage <sup>2</sup>	---	---	---	20.2	20.2	20.2
Mineral Mix <sup>3</sup>	2.0	2.0	2.0	---	---	---
Cod Liver Oil <sup>4</sup>	0.5	0.5	0.5	0.5	0.5	0.5
B-Vitamins <sup>5</sup>	---	+	+	---	+	+
Vitamin B <sub>12</sub> <sup>6</sup>	---	---	+	---	---	+

<sup>1</sup>Solvent extracted 44% crude protein.

<sup>2</sup>Digester 60% crude protein.

<sup>3</sup>Mineral mix-salt 50 pounds, steamed bonemeal 100 pounds, limestone 50 pounds and in part of the experiments the following trace minerals were added to the above mineral mix ferrus sulfate 400 gms., cobalt chloride 30 gms., manganese sulfate 300 gms., copper sulfate 15 gms., and potassium iodide 30 gms.

<sup>4</sup>Contained 2250 I.U. of Vitamin A and 400 I.U. of Vitamin D per gram.

<sup>5</sup>Furnished 3.7 mg. riboflavin, 12.5 mg. calcium pantothenate and 18.5 mg. nicotinic acid per pound of total ration.

<sup>6</sup>Furnished 6.3 mcg. per pound of total ration.

ingredients between lots. Crystalline riboflavin, pantothenic acid, and nicotinic acid were pre-mixed with cerelese and then with soybean oil meal or ground corn before being mixed with the rest of the ingredients. The rations were mixed in 500-pound lots and kept before the pigs at all times in a self-feeder. The pigs were watered by hand at least twice daily.

Vitamin B<sub>12</sub> used in these experiments was a commercial vitamin B<sub>12</sub> supplement which contained 12.5 mg. of vitamin B<sub>12</sub> per pound. One-fourth pound of this material was used for each 500 pounds of feed. The vitamin B<sub>12</sub> supplement was pre-mixed with a small amount of soybean oil meal or ground corn before being mixed with the rest of the ration.

The pigs were weighed individually at weekly intervals and daily observations were made on the general health, thriftiness and condition of the pigs.

## RESULTS AND DISCUSSION

### I. Effect of Adding Riboflavin, Pantothenic Acid and Nicotinic Acid to Practical Rations for Growing Fattening Pigs.

*A. Corn-Soybean Oil Meal Rations:* The results of adding riboflavin, pantothenic acid and nicotinic acid to corn-soybean oil meal rations are shown in Table 2. The results include data from seven different feeding trials involving a total of 140 weanling pigs. Addition of the B-vitamins to the basal ration increased the rate of gain of the pigs an average of seven percent ( $P < .05$ ). This is in agreement with the work of Krider *et al.* (1948) and Dyer *et al.* (1949) on corn-soybean oil meal rations for swine.

From the average analysis figures for corn and soybean oil meal and the National Research Council's recommended allowances, this ration is probably deficient in pantothenic acid. However, the pigs on the basal ration did not exhibit gross deficiency symptoms typical of pantothenic acid (Hughes and Ittner, 1952) other than slow growth. Apparently, the ration contained enough of the vitamin to prevent characteristic gross deficiency symptoms but not enough for maximum growth. Leucke *et al.* (1950) were unable to produce typical pantothenic acid symptoms in pigs fed an unsupplemented corn-soybean oil meal ration but they observed the "goose stepping" condition in pigs fed a corn-soybean oil meal ration supplemented with thiamine, riboflavin, nicotinic acid, and pyridoxine. This indicates that imbalance of certain vitamins in relation to pantothenic acid may be an important factor in causing the "goose stepping" condition.

The pigs in the last two feeding trials were affected by a rather severe skin infection of undetermined origin, (Figure 1) and those receiving the B-vitamin supplements were more severely affected than those on the basal rations. This was especially true of the pigs in Trial 7 (Table 2). The con-

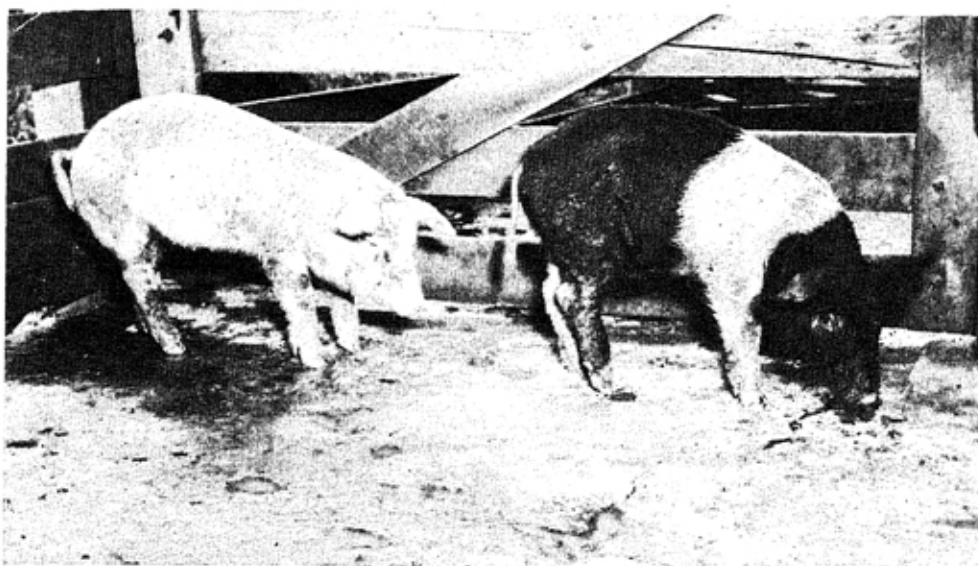


Fig. 1—Two pigs showing typical skin disorder observed in pigs in dry lot, summer, 1951. Ration: corn, soybean oil meal, vitamins A & D, minerals, riboflavin, nicotinic acid, pantothenic acid and vitamin B<sub>12</sub>.

TABLE 2 -- THE VALUE OF ADDING RIBOFLAVIN, PANTOTHENIC ACID AND NICOTINIC ACID TO CORN-SOYBEAN OIL MEAL RATIIONS FOR WEANLING PIGS IN DRY LOT

RATION - BASAL								
Trial No.	1	2	3	4	5	6	7	Average + Total
No. of pigs	10	10	10	10	10	10	10	70
Days on feed	84	89	91	95	95	91	98	92
Avg. init. weight	83.6	60.6	47.9	39.6	39.9	62.5	63.9	56.86
Avg. final weight	215.8	201.6	160.0	130.2	164.1	183.0	179.7	176.3
Avg. daily gain	1.58	1.58	1.23	0.95	1.31	1.32	1.19	1.30
Avg. daily feed	6.29	6.28	4.8	3.32	4.89	5.40	4.77	5.08
Feed/100 lbs. gain	400	396	390	349	374	408	401	390
RATION - BASAL + B-VITAMINS								
Trial No.	1	2	3	4	5	6	7	Average
No. of pigs	10	10	10	10	10	10	10	70
Days on feed	84	82	91	95	95	98	98	92
Avg. init. weight	85.6	60.6	48.1	39.8	39.5	62.6	62.7	57.0
Avg. final weight	232	202.5	161.2	167.5	171.3	190.4	165.4	184.3
Avg. daily gain	1.74	1.73	1.24	1.34	1.39	1.29	1.05	1.39*
Avg. daily feed	6.77	6.62	4.77	4.20	5.04	5.49	4.67	5.32
Feed/100 lbs. gain	390	383	384	312	363	424	445	384

\*Statistically significant difference ( $P < .05$ )

dition was first observed about two weeks after the pigs were placed on experiment. Gains of the affected pigs were very slow through the seventh week of the experiment. After this time, most of the pigs recovered rather rapidly and their gains were fairly satisfactory. This condition was very similar to the one observed in earlier experiments and is described in more detail in another section.

Feed consumption of the two groups of pigs was affected little by the addition of the crystalline vitamins, although the pigs which received the B-vitamin supplements ate slightly more feed and were a little more efficient in the utilization of their feed. Some feed was wasted by all lots of pigs, making it rather difficult to draw a definite conclusion on feed efficiency.

Figure 2 shows the average rate of gain of the pigs by weekly periods during the course of the feeding trials. This graph shows that the effect of

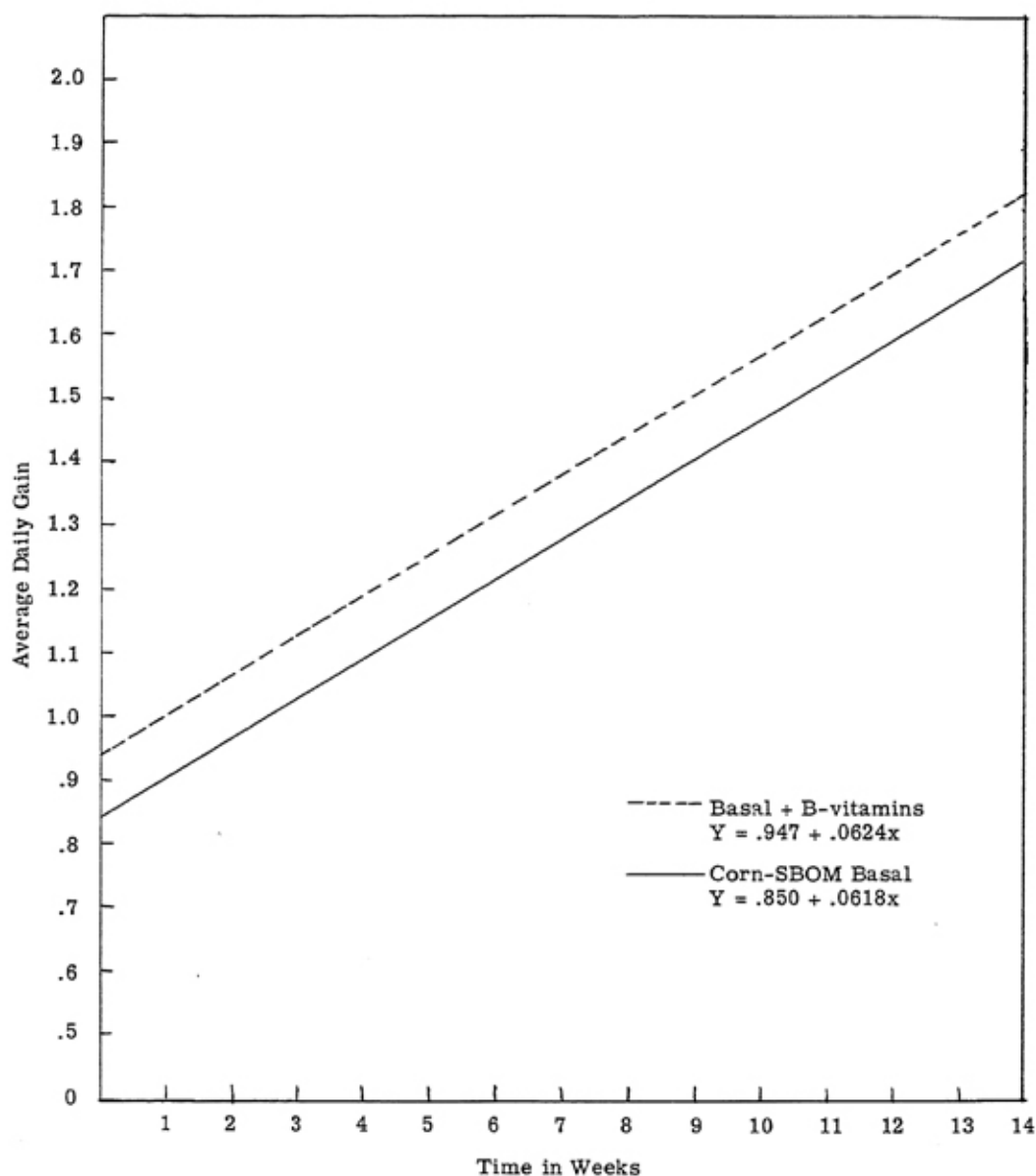


Fig. 2—Average daily gains by weekly periods for Pigs fed corn-soybean oil meal, basal ration and basal plus B-vitamins. (Average of 7 Trials.)



adding the B-vitamins on rate of gain was fairly uniform throughout the feeding period. The pigs on the basal ration showed no characteristic symptoms of a B-vitamin deficiency other than slow growth and poor feed efficiency. Apparently the basal ration contained a sufficient amount of these vitamins to prevent the appearance of gross deficiency symptoms, but not enough for maximum growth.

**B. Corn-Tankage Rations:** The results of supplementing a corn-tankage basal ration with riboflavin, pantothenic acid and nicotinic acid for weanling pigs fed in dry lot are shown in Table 3. The pigs which received the corn-

TABLE 3 -- EFFECT OF ADDING RIBOFLAVIN, PANTOTHENIC ACID AND NICOTINIC ACID TO CORN-TANKAGE FOR WEANLING PIGS IN DRY LOT RATION - BASAL

Trial No.	1	2*	3	4	5	Total & Average
No. of pigs	10	9	10	10	10	49
Days on feed	91	95	95	98	98	95.4
Avg. init. weight	47.5	40.6	40.1	63	63.5	50.9
Avg. final weight	161.1	142.9	156.6	159.4	157.4	155.5
Avg. daily gain	1.25	1.07	1.23	0.96	0.96	1.09
Avg. daily feed	4.88	4.05	4.38	4.75	4.69	4.55
Feed/100 lbs. gain	391	378	358	475	490	418

Trial No.	1	2*	3	4	5	Total & Average
No. of pigs	10	9	10	10	10	49
Days on feed	91	95	95	98	98	95.4
Avg. init. weight	47.8	39.4	39.6	62.9	63.3	50.6
Avg. final weight	177.8	171.4	162.1	196.5	188.3	179.2
Avg. daily gain	1.43	1.38	1.29	1.36	1.28	1.35**
Avg. daily feed	5.24	4.95	4.57	5.44	5.31	5.10
Feed/100 lbs. gain	368	358	355	399	416	379

\* One pig died in each lot of trial 2.

\*\* Highly significant difference ( $P < .01$ ).

tankage basal ration plus riboflavin, nicotinic acid and pantothenic acid made faster gains, consumed more feed and required less feed per unit gain than did pigs on the basal ration in each of five different trials. Summarizing the five trials, the pigs which received the B-vitamin supplements gained 24 percent faster ( $P < .01$ ), consumed 11 percent more feed per head per day and required 9 percent less feed per unit of gain than those on the basal ration.

The pigs on the corn-tankage basal ration made slower gains than those on the corn-soybean oil meal basal. A few pigs were observed to have an abnormal gait similar to the condition described for pigs on a pantothenic acid deficient diet (Hughes and Ittner 1942, Leucke *et al.* 1950 and Wiese *et al.* 1951).

This is not in agreement with the general opinion that animal protein sources contain more of the B-vitamins than plant protein sources. How-

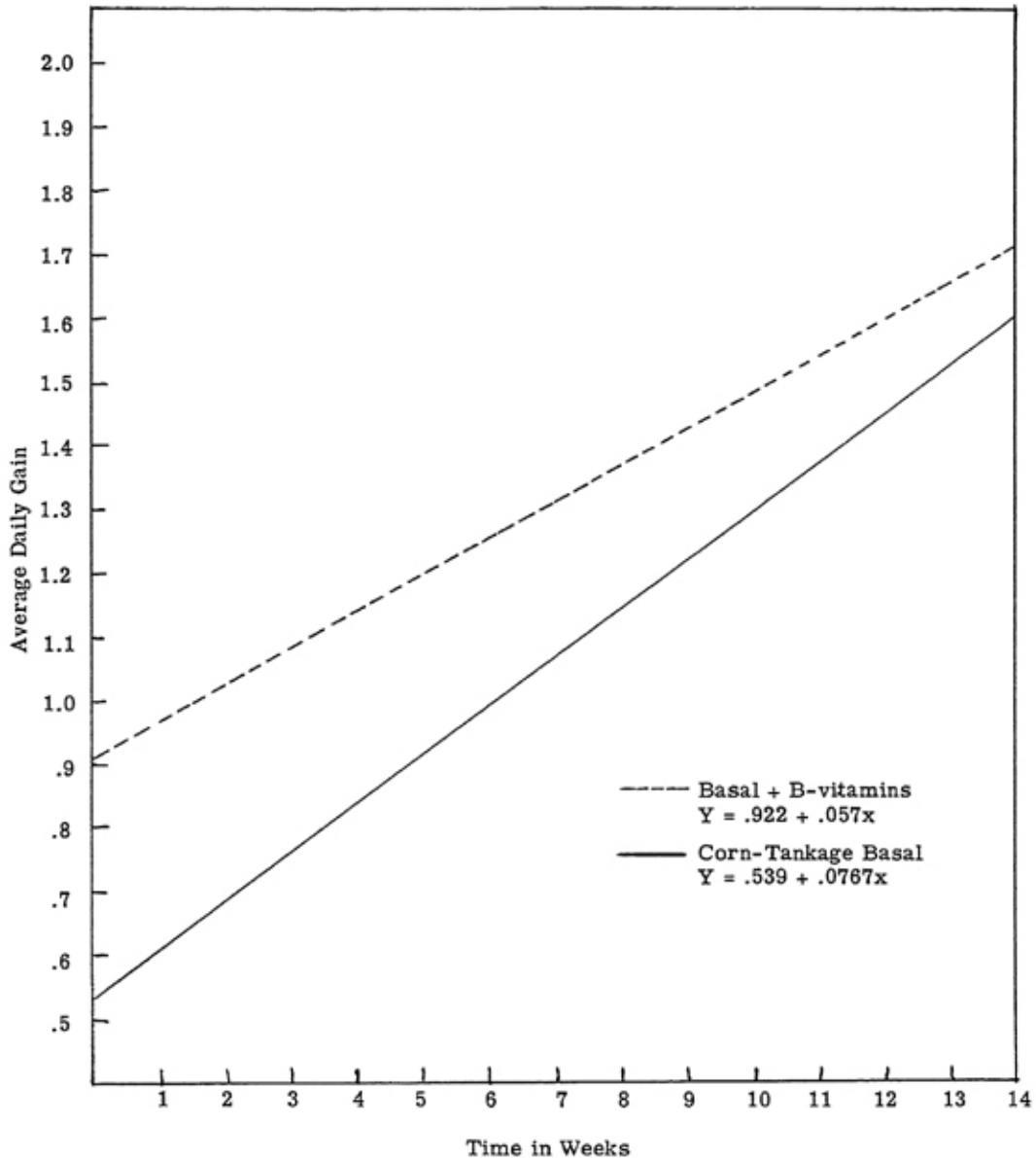


Fig. 3—Average daily gains by weekly periods for pigs fed corn-tankage basal ration and basal plus B-vitamins. (Average of five trials.)

ever, the results are readily explained when the pantothenic acid content of tankage is considered. Tankage contains only 1.2 mgm. of pantothenic acid per pound compared to 6.1 mgm. of pantothenic acid per pound for soybean oil meal (National Research Council, 1950).

The average daily gains by weekly intervals of the pigs fed the basal ration and the basal plus B-vitamins are shown in Figure 3. The difference in

rate of gain was greatest during the early part of the feeding period and became less as the experiment progressed. This indicates that the B-vitamin supplement was most valuable for younger, lighter weight pigs.

*C. Additions of B-Vitamin Supplements to the Rations of Pigs Fed on Pasture:* Three trials were completed on the value of pasture as a source of B-vitamins. The study included two with corn-soybean oil meal rations and one with corn-tankage rations. Two of the trials were conducted on rye and one on rape pasture.

Results are shown in Table 4. Trial 1 was conducted on rye pasture, using a corn-soybean oil meal ration. The pigs on pasture gained 0.25 pounds

TABLE 4 -- PASTURE AS A SOURCE OF B-VITAMINS FOR GROWING-FATTENING PIGS

Trial	1	2	3
Ration	Soybean Oil Meal Basal (dry lot)		Tankage Basal (dry lot)
No. of pigs	10	10	10
Days on feed	91	95	91
Avg. initial weight	47.9	39.9	47.5
Avg. final weight	160.0	164.1	161.1
Avg. daily gain	1.23	1.31	1.25
Avg. daily feed	4.80	4.89	4.88
Feed/100 lbs. gain	390	374	391
Trial	1	2	3
Ration	Soybean Oil Meal Basal Rye Pasture Rape Pasture		Tankage Basal Rye Pasture
No. of pigs	10	10	10
Days on feed	91	95	91
Avg. initial weight	47.3	39.1	48.0
Avg. final weight	185.1	157.2	177.8
Avg. daily gain	1.50	1.24	1.41
Avg. daily feed	5.90	4.96	5.43
Feed/100 lbs. gain	390	400	377
Trial	1	2	3
Ration	Soybean Oil Meal + B-Vitamins (dry lot)		Tankage Basal + B-Vitamins (dry lot)
No. of pigs	10	10	10
Days on feed	91	95	91
Avg. initial weight	48.1	39.5	47.8
Avg. final weight	161.2	171.3	177.8
Avg. daily gain	1.24	1.39	1.43
Avg. daily feed	4.77	5.04	5.24
Feed/100 lbs. gain	384	363	368

per head per day faster than pigs on the basal ration in dry lot. There was no difference in feed efficiency; however, the pigs on pasture were 20 pounds heavier at the end of the experiment and if the pigs on the basal ration had been carried to the same weight, some difference in feed efficiency would probably have existed.

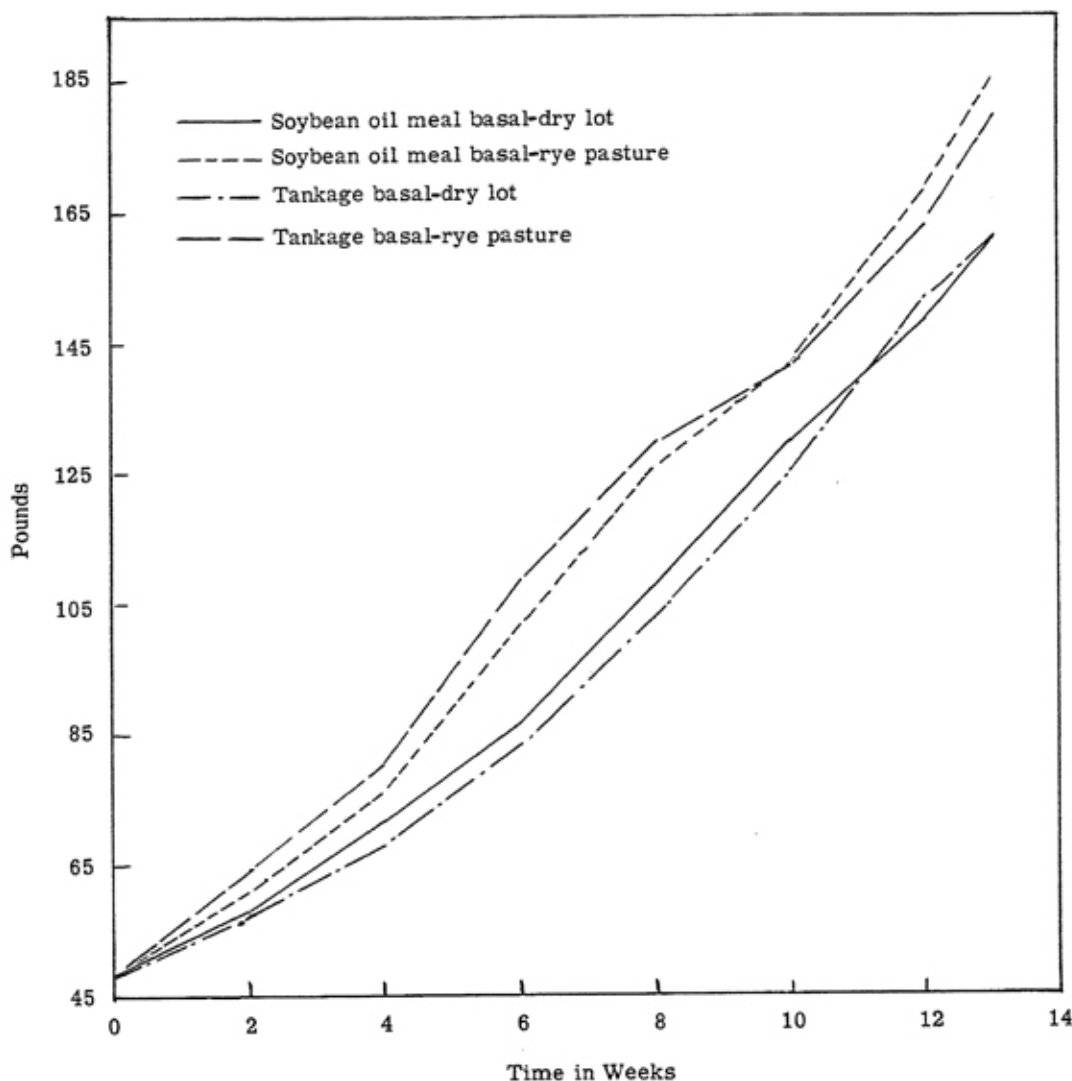


Fig. 4—Value of rye pasture for weanling pigs fed corn-soybean oil meal and corn-tankage rations.

In the second trial, pigs on rape pasture made slower gains and required more feed per 100 pounds of gain than pigs on the basal ration in dry lot. This trial was conducted during the summer and the weather was very hot during the course of the experiment. The pigs were cooler and more comfortable in dry lot than on pasture during this hot weather. Results of this trial show the effects of environmental conditions rather than a difference in nutrition.

In Trial 3, the pigs were fed the corn-tankage basal ration, and those on rye pasture made 12 percent faster gains than those fed the basal ration in dry lot. This was the same rate of gain as made by the pigs on the basal plus

B-vitamins in dry lot (Table 4). It appears in this case that the pasture furnished B-vitamins equal to those supplied in the B-vitamin supplement in dry lot.

The growth rates of the pigs in Trials 1 and 3 are shown graphically in Figure 4. Rye pasture was very effective as a supplement to corn and soybean oil meal and corn and tankage rations.

## II. Effect of Adding Vitamin B<sub>12</sub> to Practical Rations for Weanling Pigs in Dry Lot.

The basal ration used for this series of experiments was the basal ration plus B-vitamins shown in Table 1. Two trials were conducted with a corn-tankage ration and four with a corn soybean oil meal ration. The results of three of the trials with corn-soybean oil meal rations are given in Table 6. The fourth trial was not considered in the results due to a severe skin disorder in the pigs on the B<sub>12</sub> supplemented ration.

*A. Corn-Tankage Rations:* Results of adding vitamin B<sub>12</sub> to corn-tankage rations for pigs in dry lot are shown in Table 5. The pigs made

TABLE 5 -- EFFECT OF ADDING VITAMIN B<sub>12</sub> TO CORN-TANKAGE RATIIONS OF GROWING-FATTENING PIGS IN DRY LOT

Ration Trial	Tankage Basal		Average
	1	2	
No. of pigs	10	9	19
Days on feed	91	95	93
Avg. initial weight	47.8	39.4	43.6
Avg. final weight	179.6	171.4	175.5
Avg. daily gain	1.45	1.38	1.42
Avg. daily feed	5.54	4.95	5.25
Feed/100 lbs. gain	382	358	370
Ration Trial	Tankage Basal + B <sub>12</sub>		Average
	1	2	
No. of pigs	10	10	20
Days on feed	91	95	93
Avg. initial weight	47.4	39.7	42.7
Avg. final weight	185.9	174.6	180.3
Avg. daily gain	1.52	1.42	1.47
Avg. daily feed	6.03	5.15	5.69
Feed/100 lbs. gain	396	363	380

slightly faster gains when the ration was supplemented with vitamin B<sub>12</sub>, but the difference was not significant. There was little difference between the two groups in feed consumption or feed efficiency.

*B. Corn-Soybean Oil Meal Rations:* The results of adding vitamin B<sub>12</sub> to a corn-soybean oil meal ration supplemented with riboflavin, pantothenic acid, and nicotinic acid for weanling pigs in dry lot are shown in Table 6.

In two of the feeding trials there was no effect on rate of gain or feed efficiency when vitamin B<sub>12</sub> was added to the basal ration. The pigs used in

TABLE 6 -- EFFECT OF ADDING VITAMIN B<sub>12</sub> TO CORN-SOYBEAN OIL MEAL RATIONS OF GROWING-FATTENING PIGS IN DRY LOT

Ration Trial	Soybean Oil Meal Basal			Average
	1	2	3	
No. of pigs	10	10	10	30
Days on feed	82	84	91	86
Avg. initial weight	60.6	85.6	47.5	64.6
Avg. final weight	202.5	232	169.1	201
Avg. daily gain	1.73	1.74	1.34	1.59
Avg. daily feed	6.62	6.77	5.29	6.20
Feed/100 lbs. gain	383	390	396	390
Ration Trial	Soybean Oil Meal Basal + B <sub>12</sub>			Average
	1	2	3	
No. of pigs	10	10	10	30
Days on feed	82	84	91	86
Avg. initial weight	60.6	75.1	47.9	61.2
Avg. final weight	200.2	213	182.2	198.5
Avg. daily gain	1.70	1.65	1.48	1.60
Avg. daily feed	6.8	6.32	5.24	6.1
Feed/100 lbs. gain	399	385	355	380

these two trials were well grown and thrifty and weighed from 60 to 85 pounds at the start of the experiment. However, these pigs had been in dry lot since birth and had been maintained on a corn-soybean oil meal ration from weaning until the beginning of the experiment. In the third experiment with pigs placed on the experiment when they weighed about 50 pounds, the addition of vitamin B<sub>12</sub> did increase the rate and efficiency of gains.

The response of pigs to vitamin B<sub>12</sub> evidently depends upon previous treatment and body stores of vitamin B<sub>12</sub>. Emerson *et al.* (1949), in work with rats, found that the young were able to store B<sub>12</sub> during the suckling period when their mothers' diets contained adequate amounts of vitamin B<sub>12</sub>. The pigs in the first two experiments apparently had sufficient stores of vitamin B<sub>12</sub> to carry them through the growing-fattening period.

When all trials are considered, there was no advantage in supplementing a corn-soybean oil meal or corn-tankage ration with vitamin B<sub>12</sub> for growing-fattening pigs in dry lot under the conditions of these experiments.

### III. Skin Disorder Observed in Pigs Receiving a Corn-Soybean Oil Meal Ration in Dry Lot.

A severe skin disorder was observed in the summer and fall of 1951 in some of the experimental pigs on the corn-soybean oil meal rations. None of the pigs on the corn-tankage rations were affected, and only part of the pigs on the corn-soybean oil meal rations were affected.

Symptoms were first observed about one month after the pigs were started on experiment in the summer of 1951 and about 2 weeks after the start of the experiment in December of 1951.

The lot of pigs most severely affected by the skin disorder was the one which received the corn-soybean oil meal basal ration plus riboflavin, nicotinic acid, pantothenic acid and vitamin B<sub>12</sub>. This lot of pigs first showed a brown skin exudate. Skin on their hind legs became scaly and cracked. The pigs appeared puffy around the eyes and the eyes were watery. Most of the pigs were affected with a severe watery scours. Later some of the pigs developed large sores which contained large amounts of pus. The most severely affected pig in this lot was sacrificed and examined by the veterinary pathology section and the following is the post mortem report for this pig. (Figure 5.)

"All four legs, the base of the ears, the vulva, and the tail head were edematous and swollen. Deep, penetrating ulcers were present on the legs. Several small ulcers were found in the stomach. The kidneys showed severe cloudy swelling. Small isolated abscesses were present in the diaphragmatic lobe. The paratids, submaxillary, anterior cervicals, external inguinals and a number of smaller lymph nodes about the head were greatly enlarged and contained numerous abscesses. The lymph vessels of the legs were enlarged, tortuous, and infected. The sphenoid sinus was full of pus.

"On direct smears, actinomyces necrophorus appears to be the most prominent organism. A Hemolytic Staphylococcus and a Proteus were also isolated on culture."

The organisms found on direct smears from the sores were probably secondary invaders and were not responsible for the initial skin exudate. It is hard to believe that the disorder was of a nutritional origin as only part of

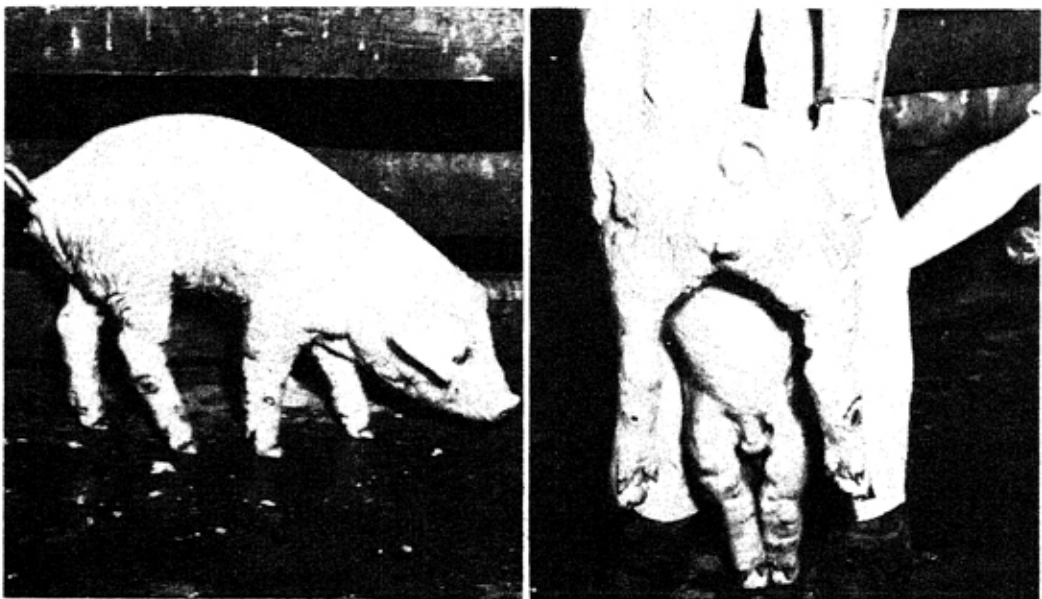


Fig. 5—Two views of pig suffering from severe skin disorder. This pig was sacrificed and a post mortem was obtained.

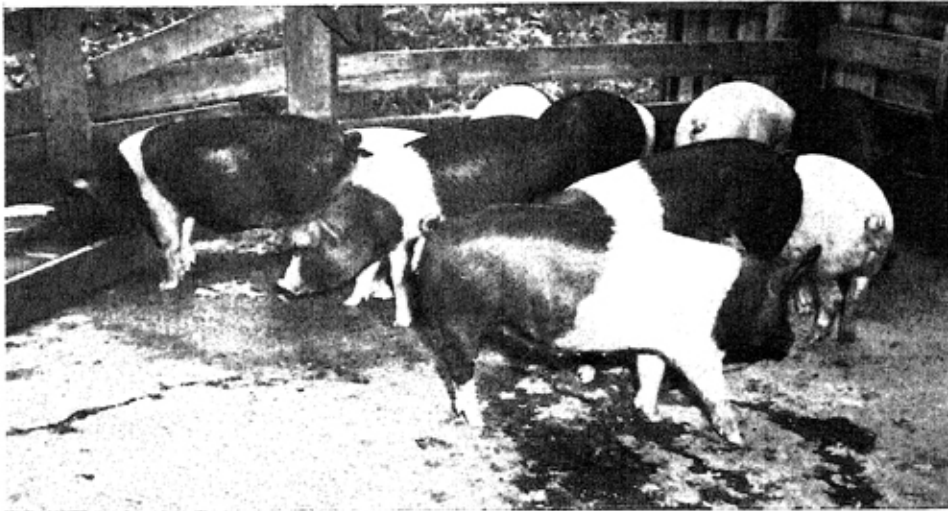


Fig. 6—Pig from corn-soybean oil meal basal lot, summer, 1951. No cases of skin disorder were observed in this lot.

the pigs in a lot were affected and pigs on similar rations were not affected. On the other hand, the condition was observed only on pigs which received corn and soybean oil meal and did not occur on pigs which were fed corn and tankage.

Hogan and Johnson (1940 and 1941) observed a skin disorder in suckling pigs reared by sows fed in dry lot. The pigs had a brown exudate, watery eyes, diarrhea and a general unthrifty appearance. They attributed the skin lesions to a deficient ration of the sows during lactation. Although the con-



Fig. 7—Pigs fed corn-soybean oil meal basal plus B-vitamins and vitamin B<sub>12</sub>, summer, 1951. About half of the pigs in this lot were affected by skin disorder.



ditions observed by these workers appear similar to those observed in our experiments, it is not known if they are the result of a common cause.

The skin disorder was first thought to be mange but treatment by dipping in a Lindane solution had no effect on the condition. No additional treatment was attempted and the pigs recovered from the disorder approximately six weeks after the first symptoms were observed.

### SUMMARY

1. A ration composed of corn, soybean oil meal, minerals and vitamins A and D was deficient for weanling pigs in dry lot in one or more of the following B-vitamins, riboflavin, pantothenic acid and nicotinic acid.

2. The addition of vitamin B<sub>12</sub> to a corn-soybean oil meal ration increased the rate of gain 10 percent in one trial but failed to improve the same ration in two trials with older and heavier pigs.

3. A corn-tankage ration was greatly improved by the addition of riboflavin, nicotinic acid and pantothenic acid for weanling pigs in dry lot. The addition of the vitamins resulted in 24 percent faster gains ( $P < .01$ ), 11 percent greater feed consumption and 9 percent less feed per 100 pounds of gain.

4. The addition of vitamin B<sub>12</sub> to a corn-tankage ration did not significantly improve the ration for weanling pigs in dry lot.

5. Rye pasture improved corn-soybean oil meal and corn-tankage rations for weanling pigs. Pigs on the basal ration plus rye pasture made gains equal to those made by pigs in dry lot being fed the basal ration plus B-vitamins.

6. A severe skin disorder was observed in some of the pigs on the corn-soybean oil meal rations fed in dry lot. The cause of this disorder was not determined.

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