Cobalt, B12 (APF), and Meat Scraps for Growing-Fattening Swine

By W. E. Dinusson[1], Earle W. Klosterman[2], Earl L. Lasley[3], Glenn C. Holm[4], and M. L. Buchanan[5]

The trace mineral, cobalt, has proven to be a valuable addition to the rations of cattle and sheep in which this mineral appears to be lacking. Cobalt must be present if the rumen micro-organisms are to function normally. Because cobalt had to be fed and not injected into the blood stream of ruminants for best results, it was thought that the rumen bacteria, rather than the animal itself, utilized the cobalt. On the basis of these findings, and also on the observation that horses grazing the same cobalt-deficient pastures as sheep and cattle did not appear to need cobalt, it was thought that simple-stomached animals such as the pig could not utilize elemental cobalt. That this was a misconception was demonstrated by experiments at the North Dakota Agricultural Experiment Station.

Materials and Methods:

Four trials conducted with growing-fattening swine are presented here. The rations used in these studies were similar to many used by hog producers. These rations are presented in Table I.

Table 1. RATIONS USED IN SWINE EXPERIMENT

Ingredient and Ration	Ration Number I[1]	IIA[2]	IIB	IV
Corn	49.0	66.0	71.0	70.0
Barley	40.0	.....	.....	.....
Meat scraps	5.0	.....	8.0	5.0
Soybean oil meal	.....	27.0	15.5	17.5
Linseed meal	2.5	.....	.....	.....
Ground alfalfa	2.5	5.0	5.0	5.0
Brewer's yeast	.....	.....	.....	1.0
Steamed bonemeal	0.6	1.25	.....	1.0
Salt	0.4	0.75	0.50	0.5

[1]Free choice, self-fed
[2]Rations IIA and IIB were used in both Experiments II and III.

In the initial experiment the barley and corn were mixed and self-fed. The protein supplement was self-fed as was the mineral mix. In Experiments II and III a simpler basal ration was used. All ingredients were mixed together in a twin-spiral mixer and self-fed as was also the ration in Experiment IV. However, in the last mentioned ration meat scraps (55% protein) were included in all rations as well as Brewer's yeast (41% protein) to insure adequate vitamins.

In the initial experiment, conducted by E. W. Klosterman, the advantage of adding cobalt or a trace mineral salt (with added cobalt) is striking. The results are presented in Table II.

[1]Associate Animal Husbandman, [2]Associate Animal Nutritionist, [3]Assistant Animal Husbandman, [4]Veterinarian, [5]Animal Husbandman and Chief of Animal Industry.

Table II. EFFECT OF TRACE MINERALS ON GAIN AND FEED EFFICIENCY OF HOGS (1948)

Experiment I (Duroc Pigs) Lot number	I	II	III
Treatment	Iodized salt	Cobaltized salt[1]	Trace mineral salt[2]
Number pigs per lot	5	5	5
Initial weight, av. lb.	52.6	53.2	51.4
Final weight, av. lb.	163.8	184.2	192.6
Days on feed	98	98	98
Daily gain, av. lb.	1.13	1.34*	1.44*
Feed per cwt. gain, lb.	431.3	389.0	349.9

[1]Cobalt chloride added to iodized salt to supply 0.026% cobalt.
[2]Trace mineralized salt used contained the following amounts of minerals: Manganese 0.45%; Iodine 0.019%; Cobalt 0.026%; Iron 0.480%; and salt 96.0%.
*Differences from check lot significant at 5% level.

In this experiment, the additions of either cobalt or a trace mineralized salt increased the average daily gains by 0.2 to 0.3 pounds per day. There was also a saving in feed per pound of gain.

The results from this experiment were encouraging and it was desired to investigate this further. A simple ration of the corn-soybean oil meal type was formulated. Because of the discovery that the vitamin B_{12} contained cobalt as an essential part, this treatment was added to study a possible interrelationship. Further eight per cent meat scraps was included in a fourth ration as a positive control. In Experiment II, weanling Duroc pigs were used whereas in Experiment III, crossbred Duroc-Yorkshire pigs were weaned early at 42 days of age, which accounts for the low initial weights. They were put on the same rations and treatments.

Table III. EFFECT OF COBALT, B_{12} AND MEAT SCRAPS ON GROWING-FATTENING PIGS (1949)
(Two Experiments)

Experiment II (Duroc pigs)	I	II	III	IV
	Cobalt[1]	B_{12} (APF)[2]	Basal	Meat scraps 8%
Number pigs per lot	10	10	10	10
Initial weight, av. lb.	36.1	36.1	36.2	36.4
Final weight, av. lb.	178.1	181.1	178.0	179.6
Days to reach final weight	98	98	105	101
Average daily gain, lb.	1.45*	1.48*	1.35	1.43*
Feed per cwt. gain, lb.	375.4	379.2	370.5	361.7

Experiment III (Crossbred Duroc and Yorkshire)	I	II	III	IV
Number of pigs per lot	10	10	10	10[3]
Initial weight, av. lb.	21.3	21.3	21.3	21.3
Final weight, av. lb.	179.9	180.4	175.6	183.2
Days to reach final weight	121	115	136	121
Average daily gain, lb.	1.34*	1.38*	1.13	1.31*
Feed per cwt. gain, lb.	378.9	349.9	379.9	354.9

[1]Cobaltized salt contained .026% cobalt as cobalt carbonate.
[2]APF No. 3, supplied through the courtesy of D. F. Green, of Merck & Company, furnished 9.42 microgram of B_{12} per pound ration. (A microgram is one 28 millionth of an ounce).
[3]One pig removed because of sickness not due to treatment.
*Gains significantly greater than basal lots.

These rations were mixed in a twin-spiral mixer and self-fed. All lots were kept on concrete floors which were washed clean daily to prevent the swine from eating their own excreta. All lots were weighed off experiment at about 180 pounds in order to make maximum use of limited equipment. The pertinent results are presented in Table III.

In the fourth experiment a different basal ration was used. It was noted in Experiments II and III that additions of meat scraps increased the rate of gain above that secured on the basal ration. It was also desired to see if these advantages for cobalt and B_{12} would be apparent on a ration containing 5% meat scraps (55% protein) and 1% Brewer's yeast (41% protein) in addition to the previous basal ration. Not only would the meat scraps improve the quality of protein and furnish some vitamins but the Brewer's yeast would supply vitamins, notably riboflavin and pantothenic acid, which are often on the borderline of deficiency in North Dakota swine rations. The ingredients of this ration are presented in Table I. The pertinent data from this experiment are found in Table IV.

Table IV. THE EFFECT OF COBALT, B_{12}, STREPTOMYCIN FOR SWINE (ON FEED 82 DAYS) (1950)

Experiment IV (Duroc pigs)

Lot	Basal	Cobalt[1]	B_{12}[2] APF	Cobalt plus B_{12}	B_{12} plus Streptomycin[3]	Cobalt plus B_{12} plus Streptomycin[3]
	I	II	III	IV	V	VI
Initial weight, lb.	54.1	56.0	53.9	52.0	55.5	56.3
Final weight, lb.	175.4	179.3	177.7	184.6	185.5	187.3
Total gain per pig lb.	121.3	123.3	123.8	132.6	130.0	131.0
Av. daily gain, lb.	1.48	1.50	1.51	1.62	1.59	1.60
Av. feed per day, lb.	5.46	5.48	5.73	5.72	5.51	5.53
Feed per cwt. gain, lb.	369.0	364.4	379.3	353.3	343.0	365.4

[1]885 micrograms of elemental cobalt per pound feed (35 grams $CaCO_3$ mixed with 100 pounds iodized salt and 0.5% salt included in ration).
[2]B_{12} supplied as Merck's APF No. 3, graciously furnished by D. F. Green of Merck & Company. Supplied 12.5% micrograms of B_{12} per pound of ration.
[3]Streptomycin included at levels of 15 milligrams per pound of ration. Also furnished by Merck & Company.

Results and Discussion:

In the first trial (Table II) the additions of either cobalt or a trace mineral salt with added cobalt gave striking increases in rate of gain as compared to the basal diet. There was also a saving of feed by these treatments.

In the second and third experiments (Table III) additions of either cobalt or B_{12} gave significantly greater daily gains than the basal lot. Although the rate of gain is different between the two experiments, the differences between treatments are about the same. Either treatment increased the rate of gain about 0.1 to 0.2 pounds above the basal per day. Additions of meat scraps at the expense of soybean oil meal also significantly increased gains above the basal diet (Table I). Although the data on feed efficiency is erratic and the differences are not statistically significant, it appears that the pigs receiving 8 per cent meat scraps required slightly less feed per hundred pounds of gain.

In the fourth experiment the effects of cobalt and B_{12} were erratic. Lots II and III (Table IV, Experiment IV) did not indicate any increase in rate of gain nor saving of feed by these treatments. However, lots IV, V, and VI (Table IV) did show an increase of 0.1 pound a day gain over the basal lot. This can be explained partially by the fact that the corn used in this experiment was shipped in and not grown locally. Therefore it is possible the corn from another area may have contained more cobalt than that grown locally. It was impossible to check this because of inadequate methods for analysis of cobalt in feedstuffs. It is noteworthy that Experiment V, just brought to completion at this station and not ready for publication at this time, again demonstrates the advantage of cobalt when added to four different rations which were formulated from grains produced locally.

The B_{12} did not give as great a response as in previous trials (Table III Experiments II and III). However, all rations contained 5 per cent meat scraps of excellent quality. Therefore enough B_{12} may have been present in the meat scraps. It is known that B_{12} is usually found in natural feedstuffs associated with animal proteins. It is also known that the B_{12} content of animal proteins varies considerably. Additions of streptomycin did not show any advantages in this experiment. The pigs on this treatment were relatively disease-free and were kept under unusually sanitary conditions. The concrete floors were washed daily. Reports from other experiment stations indicate that antibiotics give greater benefits where the pigs are unthrifty and subject to intestinal disorders.

About 35 days after the start of the experiment the lots receiving the antibiotic appeared to be gaining faster than the other lots. However, the advantage was slight and as the lots reached about 180 pound average and were weighed off, the differences became less and no benefit could be attributed to streptomycin. This data on antibiotics is in no way conclusive and in the light of reports from other stations should be re-investigated.

SUMMARY

1. Additions of small amounts of cobalt (about 885 micrograms per pound of feed) as cobalt chloride or cobalt carbonate, to rations formulated from locally grown grains increased the rate of gain of growing-fattening pigs by 0.1 to 0.2 pounds per day.

2. Additions of vitamin B_{12} to simple all-plant rations, such as corn, soybean oil meal, and minerals for swine significantly increased the rate of gain.

3. Additions of 15 milligrams of streptomycin per pound of feed did not significantly increase gains of swine which were healthy and maintained under strict sanitation.

References

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