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Parakeratosis: A Nutritional Disease of Swine

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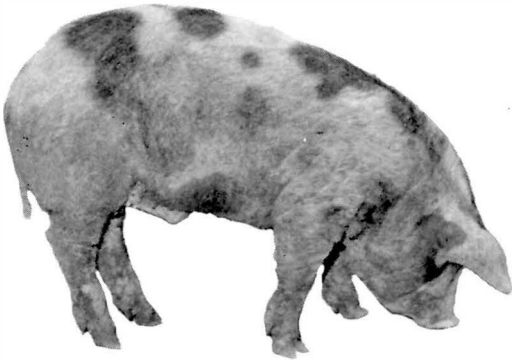
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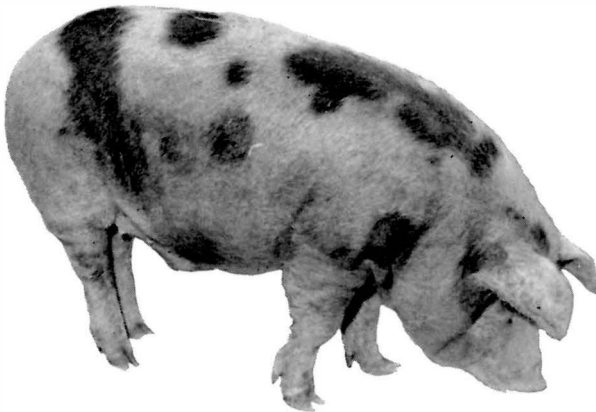
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parakeratosis

a nutritional disease of swine



Zinc treatment
for 32 days
brought this pig from
86 pounds (top photo)
to 160 pounds



ANIMAL HUSBANDRY DEPARTMENT
AGRICULTURAL EXPERIMENT STATION
South Dakota State College, Brookings



Pox-like lesions (left) is one of the earlier symptoms of parakeratosis. Crusty, scab-like lesions (right) develop later.

PARAKERATOSIS

a nutritional disease of swine

RICHARD C. WAHLSTROM

A skin disease of swine called parakeratosis has become increasingly prevalent in South Dakota and throughout the United States during the past few years. Minnesota investigators first described parakeratosis in 1953 and suggested that it was of nutritional origin. Recent research at several experiment stations has shown that high levels of calcium and phosphorus in the ration were associated with the disease and that the addition of zinc had a curative effect.

Swine affected by parakeratosis have reduced appetite, fail to grow normally, and often exhibit diarrhea during the early stages of the disease. The skin lesions appear almost simultaneously with these early symptoms. The condition is first noted by the reddening of the skin on the underline followed by pox-like lesions on the abdomen and between the front and rear flanks. Within a short time the crusty scab-like lesions develop on the legs, ears, tail, and, in severe cases, cover the entire body. This often causes the skin to form large folds or wrinkles.

There are great individual differences in the severity of the symptoms and duration of the disease.

On the same rations, some animals may not show any symptoms of the disease while others show mild or severe symptoms. Death losses are quite low but there is often an economic loss due to poor growth and poor feed efficiency.

Parakeratosis has occurred at the South Dakota Experiment Station at different times during the past few years. The condition has appeared most frequently in rations supplemented by plant proteins. It has been most prevalent from weaning age to 100 pounds during fall and winter feeding trials. When these trials were conducted it had not been observed at this station in pigs fed cereal grain and protein supplement free-choice.

The following experiment was designed to study the occurrence of parakeratosis on different type rations and to study the effect of calcium and zinc on the development of this disease.

THE EXPERIMENT

This experiment consisted of two trials, the first conducted during the winter of 1955-56 and the second during the summer and fall of 1956.

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Thirty-three weanling pigs averaging almost 20 pounds were separated into four lots of eight or nine pigs each in the first trial. They were allotted as equally as possible according to breed, litter, weight, and sex. All pigs were kept in a barn with concrete floored pens and had access to outside runways. The rations, shown in table 1, were self-fed and an automatic water supply was provided.

For trial 2, the pigs were allotted in a manner similar to trial 1. They were separated into 10 lots of six pigs each. Each of the five rations shown in table 2 was fed to two lots of pigs. Rations 1, 2, and 3 were complete mixed rations that were similar to those used in trial 1. Ration 4 was similar to 2 and 3 except that the mineral supplement was fed free-choice instead of being mixed into the ration. Shelled corn and protein supplement fed free-choice made up ration 5. B-vitamin and antibiotics were added as

indicated in footnotes to tables 1 and 2.

It has been reported that soybean oil meal is often consumed in excessive quantities when fed as the only source of protein supplement. One recommendation that has been given to prevent excessive consumption is to add 10 to 12 percent of a mineral mixture to the soybean meal to reduce its palatability. Therefore, ration 5 was designed to see if adding this amount of limestone and steamed bone meal would cause parakeratosis by increasing the calcium content of the protein supplement.

The housing and management conditions were similar to those described for trial 1. The trial was conducted for 77 days and then zinc was added to the ration of four of the pigs showing the most severe symptoms of parakeratosis. These pigs were continued on this curative treatment for an additional 32 days.

Table 1. Composition and Chemical Analyses of Rations Used in Trial 1 (Percent)*

	Lot 1	Lot 2	Lot 3	Lot 4
Ground corn	79.5	81.0	85.5	79.5
Soybean oil meal.....	17.0	17.0	3.0	17.0
Tankage	—	—	10.0	—
Steamed bone meal.....	2.0	0.5	0.5	2.0
Ground limestone	1.0	1.0	0.5	1.0
Trace mineral salt.....	0.5	0.5	0.5	0.5
Zinc carbonate	—	—	—	0.011
Crude protein	15.1	15.1	15.4	15.1
Calcium	1.00	0.65	1.13	1.10
Phosphorus	0.52	0.39	0.58	0.54

*All rations were supplemented with the following vitamins and antibiotics per pound of ration: vitamin A, 500 USP units; vitamin D, 62.5 USP units; niacin, 4.5 mg.; pantothenic acid, 2 mg.; riboflavin, 1 mg.; vitamin B₁₂, 4.5 mcg.; and penicillin-streptomycin, 10 mg.

RESULTS AND DISCUSSION

Trial 1. The results of the first trial are presented in table 3. Only three cases of parakeratosis were observed and these were all in lot 1, which received the plant protein ration containing a high level of calcium. Two of these pigs were only mildly affected while one had a severe case of parakeratosis. After 8 weeks on this trial the pigs in lot 1

averaged 87.1 pounds compared with 101.1, 92.8, and 102.7 pounds for the pigs in lots 2, 3, and 4, respectively.

Although at this time the pigs in lot 3 averaged about 10 pounds less than those in lots 2 and 4, there was no evidence of parakeratosis. The slower growth of this lot may have been due to a poorer quality of protein in this ration. As these

Table 2. Composition and Calculated Analyses of Rations Fed in Trial 2 (Percent)*

	Ration No.				
	1	2	3	4	5
Ground corn	83.75	80.8	79.5	83.0	†
Soybean oil meal.....	10.0	17.0	17.0	17.0	—
Tankage	5.0	—	—	—	—
Steamed bone meal.....	0.25	1.0	1.0	‡	—
Ground limestone	0.5	0.7	2.0	—	—
Trace mineral salt.....	0.5	0.5	0.5	—	—
Crude protein	15.3	15.2	15.0	15.3	40
Calcium	0.63	0.64	1.13	—	3.97
Phosphorus	0.49	0.48	0.48	—	0.88

*Rations 1, 2, 3, and 4 were supplemented with a B-vitamin supplement at the rate of 2 pounds per ton and chlortetracycline (Aureomycin) at the rate of 10 gm. per ton. The protein supplement in ration 5 was supplemented with these ingredients at a rate of 6 pounds and 60 gms. per ton, respectively.

†Shelled corn and protein supplement fed free-choice. The protein supplement consisted of soybean oil meal 88, ground limestone 8, steamed bone meal 2, and trace mineral salt 2.

‡A mineral supplement consisting of 2 parts steamed bone meal, 2 parts ground limestone, and 1 part trace mineral salt was fed free-choice.

Table 3. Results of Trial 1 (Winter 1955-56)

	Lot 1	Lot 2	Lot 3	Lot 4
No. of pigs.....	8	9	8	7*
Av. initial wt., lb.....	27.6	27.6	29.1	26.3
Av. 8-week wt., lb.....	87.1	101.1	92.8	102.7
Av. final wt., lb.....	203.0	212.8	213.8	223.3
Av. daily gain, lb.....	1.54	1.59	1.59	1.70
Av. daily feed per pig, lb.....	4.31	4.08	4.62	4.63
Av. feed per cwt. gain, lb.....	280	257	267	274
No. of pigs showing symptoms.....	3	0	0	0

*One pig died of unknown cause.

pigs became older and their requirements less critical, they grew at a more satisfactory rate. In fact, there was essentially no difference in rate of gain of lots 1, 2, or 3 at the end of the trial.

The affected pigs in lot 1 recovered without treatment. A slightly lower rate of gain was evident in this lot at the end of trial, but it was due almost entirely to the one pig that had done very poorly for several weeks. Slightly more feed was required per unit of gain for this lot too, although all lots were efficient in their feed conversion.

The pigs in lot 4, which received the same high calcium level ration as lot 1 plus 62 parts per million of zinc (100 grams of zinc carbonate per ton), gained 0.16 pound per day faster than lot 1 and 0.11 pound per day faster than lots 2 or 3. Zinc supplementation completely counteracted the harmful effects of the high calcium level.

Trial 2. A summary of the results of the second trial is given in table 4. Rations 1 and 2, which contained essentially the same amount of cal-

cium and phosphorus but differed in the source of these elements, supported very good gains. The slightly slower rate of gain for the pigs fed ration 2 can be attributed entirely to the slower gain of the one pig in this lot that developed parakeratosis early in the trial.

Five definite cases of parakeratosis were observed in lot 3. The ration fed to these pigs was similar to ration 2 except that it contained 1.3 percent more ground limestone which increased its calcium content about 0.5 percent. A reduced growth rate was noted in most of the pigs fed ration 3, although some of them did not show visible signs of parakeratosis. This trial points out quite clearly that the level of calcium in the ration must definitely be considered or a good ration may become a poor one just by excessive calcium supplementation.

Ration 4 also consisted of ground corn and soybean oil meal, but the mineral supplement was fed free-choice rather than being mixed in the feed as it was in rations 2 and 3. The pigs fed this ration made fast

Table 4. Results of Trial 2 (Aug. 14-Oct. 30, 1956)

	Ration No.				
	1	2	3	4	5
No. of pigs.....	12	12	12	12	12
Av. initial wt., lb.....	31.4	31.4	31.2	31.2	31.2
Av. final wt., lb.....	164.7	161.3	119.2	166.2	142.9
Av. daily gain, lb.....	1.73	1.68	1.14*	1.75	1.45†
Av. daily feed per pig, lb.	5.27	5.13	3.78	5.31	4.42
Av. feed per cwt. gain, lb.	304	304	331	303	305
No. of pigs showing symptoms	0	1	5	0	0

*Significantly less than lots 1, 2, or 4 at the 1% level and lot 5 at the 5% level.

†Significantly less than lots 1 or 4 at the 1% level and lot 2 at the 5% level.

and efficient gains and did not show signs of parakeratosis.

There was no indication of parakeratosis in the pigs fed ration 5, where limestone and steamed bone meal were added to the soybean meal, but their rate of gain was significantly reduced compared with that of the pigs fed rations 1, 2, or 4. The feed consumption of the pigs fed ration 5 was also reduced. This may have been due to the high content of minerals present in the soybean meal although the supplement was consumed in adequate amounts to balance the ration in protein content.

Four of the pigs that developed severe symptoms of parakeratosis when fed ration 3 were used to study the curative effect of adding zinc to the ration. Fifty grams of zinc carbonate were added to 1,000 pounds of ration 3. This is equivalent to 62 parts per million of zinc.

An immediate improvement in appetite was noted when the zinc was added to the feed. Although these pigs had gained an average of 0.76 pound per day previous to treatment, their rate of gain for the week prior to treatment was 0.50 pound per day. During the first week on the zinc ration these pigs gained 2 pounds per day and their average gain for the 32 days they were on this ration was 2.3 pounds per day. The disappearance of the skin lesions was gradual but marked improvement was noted by the end of the 32 days on the curative ration.

In recent trials at this station on another experiment, parakeratosis

developed in pigs fed corn or oats free-choice with a protein supplement. The protein supplements fed in these trials contained 30 to 40 percent meat and bone scrap but no added limestone or steamed bone meal. Meat and bone scrap is high in calcium and phosphorus.

Therefore, it appears that parakeratosis may occur whether the pigs are fed free-choice or complete mixed rations. A protein supplement containing 3.5 percent or more of calcium could result in parakeratosis since excessive calcium is a predisposing factor in the incidence of parakeratosis.

SUMMARY AND CONCLUSIONS

Two trials were conducted to study the development of parakeratosis in pigs fed rations varying in the amount and source of calcium. Another purpose was to determine the value of zinc as a preventive or cure for the disease. In all, 93 weanling pigs were used.

Feeding of a corn-soybean meal ration containing approximately 0.65 percent calcium resulted in good growth, however, a 5 percent incidence of parakeratosis was noted. This type of ration, containing 1 percent or more of calcium, resulted in poorer growth and a 40 percent incidence of parakeratosis.

Adding zinc to this high calcium ration at a level of 62 parts per million prevented symptoms of parakeratosis and increased growth rate. Where symptoms were already present, zinc supplementation resulted in a marked increase in growth rate and an alleviation of the skin lesions.

Rations containing an animal protein and a calcium content of 0.63 and 1.13 percent supported good growth with no incidence of parakeratosis. However, recently we have observed several cases of parakeratosis in pigs fed rations containing animal protein. There was no incidence of parakeratosis when the mineral supplement was fed free-choice with a mixture of ground corn and soybean oil meal. Adding 12 percent of ground limestone, steamed bone meal, and trace mineral salt to soybean oil meal and feeding this mixture (4.0 percent calcium) free-choice with corn resulted in poor growth; however, no symptoms of parakeratosis were observed.

The symptoms of parakeratosis observed in these trials were reduced appetite, poor growth, scouring, and skin symptoms. The skin lesions were first noted on the underline as red pox-like areas. Crusty scab-like lesions developed on the hocks, ears, and tail. In severe cases thickening of the skin and formation of folds or wrinkles over the the body was apparent. The skin of some pigs also became cracked, with an oozing of fluid from the cracked area. This result-

ed in matted hair and accumulation of dirt and a dark, dirty, greasy appearance.

The results of these trials indicate the importance of avoiding excessive calcium supplementation of rations, at least for the young growing pig. Since many protein supplements may contain 3.5 percent or more of calcium, it is possible that when these supplements are used to make a mixed ration the total calcium content may approach 1 percent. The same could be true when the supplements are fed free-choice.

Parakeratosis often develops when rations this high in calcium are fed; sometimes it occurs on rations of lower calcium content. Thus, it appears that the addition of zinc to rations for young growing swine is a practical way of eliminating swine parakeratosis. In these trials a level of 62 parts per million of zinc as zinc carbonate gave excellent protection and completely cured all symptoms. Other work indicates that 20 parts per million of zinc will also give good results in preventing parakeratosis. The effective level may vary with the calcium content of the ration.