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E. R. Peo, Jr.
University of Nebraska-Lincoln

D. B. Hudman
Nebraska Agricultural Experiment Station

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SUPPLEMENTATION OF PIG STARTERS WITH THYROPROTEIN [1]

E. R. Peo, Jr. and D. B. Hudman

Nebraska Agricultural Experiment Station,[2] Lincoln

IT has been reported that both gains and feed efficiency are improved when pigs are fed thyroprotein during the growth period from weaning to market weight (Reineke *et al.*, 1948; Beeson *et al.*, 1949; Perry *et al.*, 1950; Perry *et al.*, 1951). Contrary results have been reported by Braude (1947), Muhrer *et al.* (1947) and Vander Noot *et al.* (1948).

No similar research has been reported with baby pigs during the pre-weaning growth period. Therefore, it was the purpose of these experiments to determine the effect of supplementing rations with thyroprotein on gains and feed efficiency of baby pigs. In addition, since Lewis *et al.* (1955) reported that baby pigs cannot fully utilize plant proteins during the early growth period (from birth to five weeks of age), levels of thyroprotein were evaluated with sources of both plant (soybean oil meal) and animal (dried skimmilk) protein.

Experimental Procedure

Experiment 1. One hundred and forty crossbred (Yorkshire x Hampshire) pigs were allotted at random within weight outcome groups, within litters, to seven replications (replications were made over a two-year period) of five experimental treatments. The average initial weight and age of the pigs was 7.0 lb. and 8.6 days, respectively. The pigs were confined to concrete-floored pens which were equipped with self-feeders and waterers. Shavings were used for bedding and the pens were cleaned daily. The temperature of the experimental unit was regulated by a thermostatically controlled steam-heat, forced-air system. Unit temperature was reduced approximately 7° F. each week from an initial temperature of 85°.

The composition of the experimental rations is presented in table 1. Ration 1, which was formulated with 40% dried skimmilk as a protein source was used as the positive control ration. Ration 2 was formulated with soybean oil meal as the major source of protein and was fed with 0, 10, 20 and 40 mg. of thyroprotein per lb. of ration. All rations were fed in meal-form. Since baby pigs will usually start eating the more palatable rations first, all pigs were started with 1 lb. of a 24% protein pre-starter ration to equalize all treatments in this respect. The experiment was terminated

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after 28 days. However, three replications (5, 6 and 7) were continued on test and were fed a 16% protein grower ration without added thyroprotein for an additional 14 days to determine the effect of previous treatment upon subsequent performance of the pigs.

Experiment 2. Eighty Yorkshire x Hampshire x Landrace pigs which averaged 7.5 lb. live weight and 9.4 days of age were allotted at random within weight outcome groups to four replications of five experimental

TABLE 1. COMPOSITION OF EXPERIMENTAL RATIONS [a]

Ration treatment	1	2
Ration designation	Dried skimmilk basal [b]	Soybean oil meal basal [c]
Ingredients, lb.		
Sucrose	15.00	15.00
Cerelose	26.19	23.60
Dried skimmilk	40.00	.....
Dried sweet whole whey	.....	15.00
70% fishmeal	2.50	2.50
44% solvent soybean oil meal	9.50	36.00
Lard (stabilized)	3.00	3.00
Dried brewer's yeast	1.00	1.00
Trace minerals (high zinc) [d]	0.10	0.10
Salt (iodized)	0.50	0.50
Di-calcium phosphate	....	0.70
Ground limestone	0.21	0.60
Vitamin-antibiotic premix [e]	2.00	2.00

[a] Calculated protein content, 20%; calcium, 0.69%; phosphorus, 0.53%.

[b] Thyroprotein added to furnish 10, 20 and 40 mg. per lb. of complete ration for treatments 2, 3 and 4, respectively, for Experiment 2.

[c] Thyroprotein added to furnish 10, 20 and 40 mg. per lb. of complete ration for treatments 3, 4 and 5, respectively, for Experiment 1.

[d] Calcium Carbonate Company, Quincy, Ill. Standard swine trace mineral mix.

[e] Added at a rate so that each pound of complete ration contained the following amounts of vitamins and antibiotics: Vit. A, 2000 I.U.; vit. D_2, 400 I.U.; riboflavin, 4.0 mg.; calcium pantothenate, 8.0 mg.; niacin, 15.0 mg.; choline chloride, 630 mg.; vit. B_{12}, 10 mcg. and antibiotic (oxytetracycline), 25 mg.

treatments. Housing and management were the same as described previously for the first experiment.

The experimental ration treatments consisted of ration 1 (table 1) formulated with 0, 10, 20 and 40 mg. of thyroprotein per lb. of complete ration. In addition, one treatment consisted of pigs implanted in the right ear with a 20 mg. pellet of sodium-l-thyroxine to study mode of administration of a metabolic stimulant. As in the first experiment, all pigs were fed 1 lb. of a 24% protein pre-starter ration to equalize starting on all treatments. The initial phase of the experiment was terminated after 28 days but the pigs were continued on test and were fed a 16% protein grower ration without added thyroprotein for an additional 14-day period to determine the effect of previous treatment upon subsequent performance.

In both experiments, pig weights and feed data were collected at weekly

intervals. The data were analyzed according to Snedecor (1956) and all statements concerning statistical significance are at a probability level of 5% or less.

Results

Experiment 1. The results of this experiment are presented in table 2. For the first 14 days of the test period, the pigs fed the dried skimmilk ration (treatment 1) made a significantly greater gain than those fed the

TABLE 2. EFFECT OF THYROPROTEIN ON BABY PIG PERFORMANCE IN EXPERIMENT 1

Treatment	1	2	3	4	5
Ration designation	Dried skimmilk basal	Soybean oilmeal basal	Soy-basal +10 mg./lb.[a, b]	Soy-basal +20 mg./lb.[a, b]	Soy-basal +40 mg./lb.[a, b]
Pens per treatment, no.	7	7	7	7	7
Pigs per pen, no.	4	4	4	4	4
Av. initial wt., lb.	6.9	7.0	7.0	7.0	6.9
Av. gain (first 14 days), lb.[c]	4.6	3.3	3.3	3.5	3.2
Av. feed per lb. gain (first 14 days), lb.[c]	2.03	2.83	2.77	2.45	2.93
Av. gain (28 days), lb.[c]	14.9	12.1	13.2	14.3	13.0
Av. feed per lb. gain (28 days), lb.[c, d]	1.63	2.09	1.95	1.88	1.97
Subsequent performance,[e] 14 days					
Av. gain, lb.[c]	12.3	15.1	14.8	15.4	17.3
Av. feed per lb. gain, lb.[c, d]	2.00	1.85	1.72	2.07	1.91

[a] Milligrams of thyroprotein per pound of ration.
[b] Quadratic regression of thyroprotein levels on feed required per lb. gain (28 days) significant at P=0.05 or less.
[c] Means underscored by same line are not significantly different at P=0.05 or less.
[d] Means underscored by broken lines are not significantly different at P=0.05 or less.
[e] Average of 3 replications, 4 pigs per pen.

other rations. There were no significant differences in the gains made by the pigs fed the soy-basal rations supplemented with different amounts of thyroprotein during this first period. In general, the same trend was observed for feed conversion. The pigs fed the dried skimmilk ration required less feed per pound of gain than those fed the other rations. Although there was no significant difference in gain, pigs fed the soy-basal plus 20 mg. of thyroprotein (treatment 4) required less feed per pound of gain than those fed the soy-basal (treatment 2) and the soy-basal plus 10 or 40 mg. of thyroprotein (treatment 3 and 5, respectively).

For the entire test period (28 days), again, the pigs fed the dried skimmilk ration showed the greatest gain. However, this was not significantly

greater than the gain made by the pigs fed the soy-basal rations with or without thyroprotein. The greatest difference in gain (2.8 lb.) was between the pigs fed the dried skimmilk ration and those fed the unsupplemented soy-basal diet. The pigs fed the dried skimmilk diet gained only 0.6 lb. more than those fed the soy-basal plus 20 mg. of thyroprotein. Pigs fed the soy-basal diets supplemented with 10 and 40 mg. of thyroprotein gained 1.1 and 0.9 lb. more, respectively, than those fed the unsupplemented soy-basal diet.

A statistical analysis of the regression of thyroprotein levels failed to reveal a significant regression. However, the major portion of the variation due to regression was in the quadratic component as might be expected from the data. Gains increased as the level of thyroprotein increased up to the 20-mg. level and then showed an apparent decrease at the 40-mg. level.

The pigs on treatment 1 (dried skimmilk) required the least amount of feed (1.63 lb.) per pound of gain, this amount being significantly less than was required by those on treatments 2, 3 and 5; the difference between treatments 1 and 4 (0.25 lb.) was not significant. The quadratic regression of thyroprotein levels on feed required per pound of gain for the 28-day test period was statistically significant.

Previous test treatments appeared to have an effect on subsequent performance. The pigs fed the basal dried skimmilk ration during the test period made the least gains during the subsequent 14-day period. The removal of thyroprotein from the diet of the pigs did not affect gain performance of those that had been fed 10 and 20 mg. However, the removal of 40 mg. resulted in the greatest gain (17.3 lb.) during the subsequent 14-day period. This suggests that the 40-mg. level was probably too high and may have produced a hyperthyroid condition in these pigs during the initial test period. The pigs on treatments 1 and 4 showed the best feed conversion during the test period but required more feed per pound of gain during the subsequent period than those on treatments 2, 3 and 5.

Experiment 2. The results of this experiment are presented in table 3. During the first 14 days, the pigs fed dried skimmilk plus 20 mg. of thyroprotein made the greatest gain (5.9 lb.). However, this gain was not significantly greater than that made by the pigs on the other ration treatments. The same general trend was apparent for feed conversion. For the entire 28-day test period, gains increased as the level of thyroprotein increased up to 20 mg. per pound. Gains decreased at the 40 mg. level but were greater than the gains observed for the pigs fed the dried skimmilk basal ration.

The pigs fed dried skimmilk basal plus 20 mg. of thyroprotein required less feed (1.59 lb.) per pound of gain than those on the other treatments. There was also no significant difference in feed required per pound of gain between treatments 1, 2 and 4.

As in experiment 1, the regression of thyroprotein levels was not statis-

tically significant. However, most of the variation due to regression was in the quadratic component for both gains and feed required per pound of gain.

The pigs on treatment 5 were implanted in the right ear with a 20-mg. pellet of sodium-l-thyroxine. The level selected was based on previous work with older swine (Hudman and Peo, 1958). It is apparent from the data that this level was probably too high; or, mode of administration of thy-

TABLE 3. EFFECT OF THYROPROTEIN ON BABY PIG PERFORMANCE IN EXPERIMENT 2

Treatment	1	2	3	4	5
Ration designation	Dried skimmilk basal	DSM-basal +10 mg./lb.[a, b]	DSM-basal +20 mg./lb.[a, b]	DSM-basal +40 mg./lb.[a, b]	DSM-basal +20 mg. implant[c]
Pens per treatment, no.	4	4	4	4	4
Pigs per pen, no.	4	4	4	4	4
Av. initial wt., lb.	7.5	7.5	7.6	7.5	7.5
Av. gain (first 14 days), lb.[d]	5.3	5.6	5.9	4.7	4.3
Av. feed per lb. gain (first 14 days), lb.[d]	1.69	1.73	1.58	1.93	2.37
Av. gain (28 days), lb.[d, e]	17.7	19.4	20.8	18.8	16.4
Av. feed per lb. gain (28 days), lb.[d, e]	1.72	1.65	1.59	1.66	1.91
Subsequent performance, 14 days					
Av. gain, lb.	10.8	10.3	12.8	10.9	11.4
Av. feed per lb. gain, lb.	2.16	2.06	2.08	2.18	2.17

[a] Milligrams of thyroprotein per pound of ration.
[b] Regressions of thyroprotein levels not significant at P=0.05 or less.
[c] 20-milligram pellet of sodium-l-thyroxine implanted in right ear.
[d] Means underscored by same line are not significantly different at P=0.05 or less.
[e] Means underscored by broken lines are not significantly different at P=0.05 or less.

roxine may have a different effect on pig performance (gains and feed efficiency) since the pigs implanted with sodium-l-thyroxine made significantly less gain than those fed the dried skimmilk diet supplemented with 20 mg. of thyroprotein. In addition, significantly more feed per pound of gain was required by the pigs which were implanted than by those on treatments 2, 3 and 4.

In this experiment, previous treatment had little effect on subsequent performance. Thus, it appears from the results of these two experiments that thyroprotein can be used effectively to stimulate gains and increase feed efficiency of baby pigs without affecting their subsequent performance if it is abruptly withdrawn from rations which follow the pig-starter period.

Discussion

In these experiments, the supplementation of pig-starter rations with thyroprotein (up to 20 mg. per lb. of complete ration) resulted in an increase in gains and an improvement in feed efficiency of baby pigs fed both plant (soybean oil meal) and animal (dried skimmilk) sources of protein.

The 18% increase in gains and 9% improvement in feed efficiency are of the same general magnitude as those reported by Lewis *et al.* (1955) for soy-basal diets supplemented with proteolytic enzymes. The nature of the response to thyroprotein is not known and additional evidence will be needed to arrive at the mode of action of thyro-active compounds. It appears, however, that the level of thyro-active compounds is quite critical as evidenced by a reduction in gains and feed efficiency of the pigs when thyroprotein was increased from 20 to 40 mg. per lb. of complete ration or when pigs were implanted with a 20-mg. pellet of sodium-l-thyroxine. This observation agrees with those reported by Reineke *et al.* (1948) and Perry *et al.* (1951) for older swine.

Summary

Two experiments were conducted with 220 early-weaned baby pigs to evaluate thyroprotein as a metabolic stimulant for baby pigs. Thyroprotein, when fed at levels of 10, 20, and 40 mg. per lb. of ration, was most effective in stimulating gains and increasing feed efficiency when fed at the 20-mg. level. Gains were increased approximately 18% with both a soybean oil meal and a dried skimmilk basal diet. Feed efficiency (feed per pound of gain) was improved approximately 9%.

The abrupt withdrawal of thyroprotein from the diet did not adversely affect subsequent pig performance.

In addition to level, mode of administration of thyroxine may be of significance as evidenced by a reduction in the gains and feed efficiency of pigs implanted in the ear with a 20-mg. pellet of sodium-l-thyroxine.

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