Influence of Dietary Manipulation on DM, N, and P Excretion of Pigs during an Entire Finishing Period.

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Story in Brief

The size of swine operations has grown dramatically and, with it, the volume of manure produced in specific geographic areas. The fate of manure is land application. Nutrients applied in excess of crop requirements can be associated with environmental pollution. Excess of nutrients, such as nitrogen (N) and phosphorus (P), can leach or runoff into water bodies. Therefore, in order to reduce N and P excretion in swine manure, an experiment was conducted to determine the effect of reducing dietary levels of protein (CP) and P on dry matter (DM), N, and P excretion during an entire finishing period. A total of 48 Yorkshire barrows weighing 66.4 lb, were housed in an environmentally-controlled building, with a shallow pit, pull plug system. A typical corn-soybean meal diet served as the control, and a low excretion diet (LED) with 4% unit reduction in CP and 0.1% unit reduction in P served as the experimental diet. Pigs were weighed every week, feed intake was measured and slurry samples were taken. Feed and slurry samples were analyzed for DM, N and P. The data were analyzed using a randomized complete block design including the effects of diet, repetition and the interaction. Pigs fed the LED took 7 d longer to reach slaughter weight. Daily and cumulative DM excretion was not affected by dietary treatment. N and P excretion were reduced by 40 and 25% daily, and 38 and 20% cumulative during the 112-d experiment, respectively. The use of LED resulted in a reduction of 1.36 kg of N/pig and 0.14 kg of P/pig during the finishing period.

Key Words: Nutrient Excretion, Nitrogen, Phosphorus, Pigs.

Introduction

It is well known that nutrients applied to the land in excess of crop requirements can result in environmental pollution. Application of excessive N and P can cause these nutrients to runoff into surface water or leach into ground water. If N and P concentration in water increases, it can induce algae growth and, with it, the reduction of oxygen needed to preserve aquatic life. In order to decrease N and P excretion in swine manure, some dietary manipulations have been proposed, including a reduction in the dietary level of CP with the addition of crystalline amino acids (Kerr et al., 2003a, Kerr et al., 2003b, Otto et al., 2003) and reduction of P level in the diet (Cromwell et al., 1995). However, most experiments have been performed using individually-fed animals, and very little data is available for N and P excretion under commercial conditions. Therefore, the overall objective of this experiment was to determine the effect of reducing dietary levels of CP and P on DM, N and P excretion during the finishing period.

Materials and Methods

A total of 48 Yorkshire barrows weighing 66.4 lb, were housed in an environmentally-controlled building, with 4 identical rooms. Each room contained a shallow pit, pull plug system. Pigs were blocked by weight and assigned to a diet, using 12 pigs per room and 2 rooms per treatment. The dietary treatments consisted of a typical corn soybean meal diet (control), and a low excretion

diet (LED) with 4% unit reduction in CP and 0.1% unit reduction in P. The composition of the diets is presented in Table 1.

Table 1. Composition of diets

Phase	1 (66 - 112 lb)		2 (112 - 187 lb)		3 (187 - 240 lb)	
Diet	Control	LED	Control	LED	Control	LED
Ingredients, %						
Corn	68.98	80.11	74.44	85.39	79.73	90.68
Soybean meal	25.84	14.51	20.68	9.33	15.54	4.19
L-lysine	-	.35	-	.36	-	.36
DL-methionine	-	.01	-	.01	-	-
L-threonine	-	.10	-	.11	-	.10
L-tryptophan	-	.03	-	.03	-	.04
Soybean oil	3.00	3.00	3.00	3.10	3.00	3.10
Dicalcium phosphate	.68	.39	.52	.24	.36	.08
Limestone	.96	.95	.82	.78	.82	.81
Salt	.25	.25	.25	.25	.25	.25
Vitamin Mix	.15	.15	.15	.15	.15	.15
Trace Mineral Mix	.10	.10	.10	.10	.10	.10
Calculated composition, %						
CP	18.00	14.00	16.00	12.00	14.00	10.00
True digestible lysine	.83	.83	.71	.71	.58	.58
P	.50	.40	.45	.35	.40	.30

Pigs were weighed, feed intake was measured, and slurry samples were taken each week during the entire finishing period (112 d). The finishing period ended when pigs reached a target weight of 240 lb. Feed and slurry samples were analyzed for DM, N, and P. The data were analyzed using a randomized complete block design including the effects of treatment, block and the interaction.

Results and Discussion

All pigs were fed to a target weight of 240 lb. The finishing period for pigs fed the LED was 7 d longer (P<.05) as compared with pigs fed the control diet. This reduction in growth rate was not observed by other researchers working with similar reductions in dietary CP level (Kerr et al., 2003a, Kerr et al., 2003b). However, in this experiment P was also reduced, which may be associated with the decrease in growth rate.

DM intake and daily excretion were similar for both treatments. Also, when DM excretion was analyzed as percentage of intake, it was similar between diets, mainly due to similar feed intake and DM content of the diets. The data is presented in Table 2.

Table 2. Excretion data for DM, N and P.

Diet	Control	LED	P value
Pig's final Wt, lb	239.8	237.6	>.1
Duration of finishing period, d	105	112	<.05
DM intake, kg/pig/d	1.89	1.83	>.1
DM excretion, g/pig/d	274	269	>.1
DM excretion, as % of intake	14.5	14.5	>.1
N intake, g/pig/d	53	38	<.01
N excretion, g/pig/d	34.7	20.6	<.02
N excretion, as % of intake	65	53	<.01

P intake, g/pig/d	9.3	7.1	<.01
P excretion, g/pig/d	6.8	5.1	<.02
P excretion, as % of intake	72	72	>.1

N intake was reduced by 28% (P<.01) and daily N excretion by 40% (P<.02) with the LED (Table 2). This reduction in N excretion is in agreement with previous reports where a 10% reduction in N excretion was observed for each percent unit reduction in dietary CP (Shriver et al., 2003). The N excretion value measured for the control diet (34.7 g/d of N) is in agreement with the value estimated by Carter et al. (2003) (39.9 g/d N) using their prediction model for standard production conditions. Also, when the performance values of the animals used in this experiment and diet characteristics were used with their prediction model, the N excretion values predicted with the model for the control and LED were very close to the values measured in this experiment. When N excretion was analyzed as percentage of intake it decreased by 18% with the LED (P<.01). This decrease in N excretion is consistent with previous reports (Kerr and Easter, 1995, Shriver et al., 2003) and may be due to an increase in essential amino acid digestibility (Otto et al., 2003).

P intake was reduced by 24% (P<.01) with the LED. Daily P excretion was reduced by 25% (P<.02) (Table 2). The value measured for P excretion with the control diet (6.8 g/d of P) is similar to the value estimated by Carter et al. (2003) (6.7 g/d of P) using their prediction model for standard production conditions. When the performance values of the experimental pigs and diet characteristics were used with their prediction model, the daily P excretion predicted for the control and the LED were similar to the values measured in this experiment. When P excretion was analyzed as percentage of intake, it was not affected by dietary treatment. The P excretion values as percentage of intake obtained in this experiment were consistent with previous reports using individually-fed animals (Kornegay and Harper, 1997).

When cumulative excretion was analyzed, N and P excretion for the entire finishing period tended to decrease by 38 and 20%, respectively, as presented in Figure 1. The use of the LED resulted in a reduction of 1.36 kg of N and 0.14 kg of P per finisher pig. These reductions in N and P excretion represent a possibility to reduce the total amount of N and P excreted in swine manure in US commercial operations per year. If the total number of head slaughtered in 2005 (103.4 million) is used to estimate the possible reduction in nutrients excreted per year, N and P

excreted could be reduced by 140,624 and 14,476 metric tons, respectively.

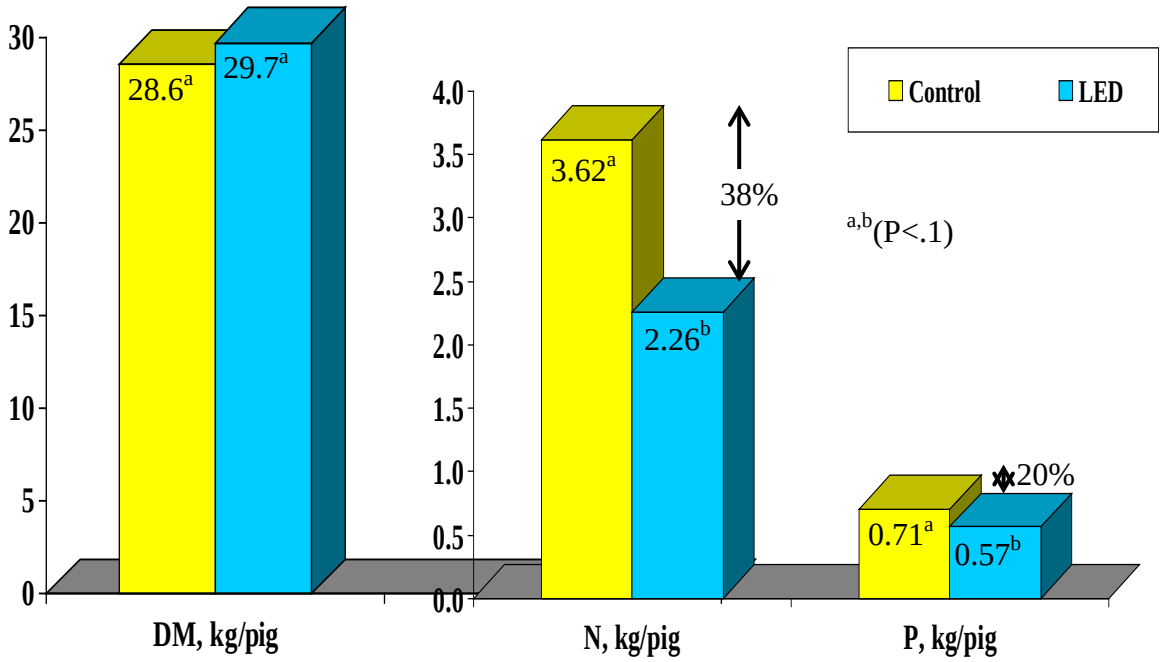

Figure 1. Cumulative DM, N and P excreted per pig during the finishing period

In summary, a reduction of 4% unit of CP and 0.1% unit of P in grower-finisher diets decreased daily N and P excretion by 40 and 25%, respectively. It also tended to decrease cumulative N and P excreted by 38% and 20%, respectively, during a 112-day finishing period.

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