Effects of Fiber Addition to a Low Excretion Diet on Swine Growth Performance and Slurry Characteristics during the Finishing Phase.

J.W. Bundy, S.D. Carter, M.L. Lachmann, S.K. Jenkins, Z. Marable

Story in Brief

A total of 88 crossbred pigs with an average initial body weight of 71 lb was used during an entire finishing period (final wt, 274 lb) in order to determine the effects of the addition of soybean hulls as a source of dietary fiber to a low excretion diet on pig performance and slurry characteristics. Treatments were applied in a 4x4 Latin Square design with four rooms and four phases. The four dietary treatments included: Diet 1 (control) was a fortified corn and soybean meal based diet; Diet 2 (LED) was formulated to contain lower CP, as well as lower P with amino acids and phytase included; Diet 3 (LED+1SH) was as Diet 2 with 7.5% soybean hulls; and Diet 4 (LED+2SH) was as Diet 2 with 15% soybean hulls. No differences in ADG, ADFI, and F:G were observed. Slurry pH was reduced in the LED diet when compared to the control diet. Additionally, there was a linear reduction in pH with the inclusion of 0, 7.5, and 15% soybean hulls. These results suggest that dietary treatment had no effect on pig performance while the slurry characteristics were more favorable for lowering ammonia emissions from the pit. Based on these results, soybean hulls can be added up to 15% to low excretion finishing diets with no negative effect on growth performance.

Introduction

Recently, one of the most important factors for concentrated animal feeding operations (CAFO's) is the excretion of nutrients that can potentially harm the environment. For many years, the main nutrients of concern have been nitrogen and phosphorus. The concern associated with nitrogen in animal effluent is due to the ability of nitrates to leach throughout the soil profile, as well as the volatilization of ammonia in to the air. While phosphorus is adsorbed onto soil particles and does not leach into ground water, it can erode into streams, lakes, and rivers (NRC, 1998). These two elements possess the greatest potential for pollution, especially water contamination. Several methods have been proven successful in reducing nutrient excretion including multiple phase feeding and formulating diets more closely to the animal requirements, in order to reduce the excess nutrients fed to pigs that are not utilized by the animals (Lachmann et al., 2006). The future of diet formulation in all phases of production will include manure nutrient management as a major priority of concern (NRC, 1998). The addition of fiber sources to swine diets has also been shown to have the ability to influence the characteristics of excreta (Shriver et al., 2003). Therefore, the objectives of this research were to determine the influence of the addition of soybean hulls as a source of fiber to a low excretion diet on pig performance and slurry characteristics during an entire 16-wk finishing period.

Materials and Methods

A total of 88 [Duroc x (Yorkshire x Landrace)] pigs (71 lb, initial wt) were used during an entire 16-wk finishing period. Pigs were stratified by body weight and placed into one of four identical rooms. The rooms consisted of four identical environmentally-controlled rooms located within one barn. Each room was equipped with a shallow pit, pull-plug drainage system. Each room was allotted to the treatments in a 4 x 4 Latin square design with four rooms and four, 4-wk, phases. Every room received one of the treatments during one phase only. Each sampling period lasted three wk with the first wk of the phase considered as a cleanout period. Diet 1 (control) was a fortified corn and soybean meal based diet. Diet 2 (LED) was formulated to contain lower CP, as well as lower P with amino acids and phytase included. Diet 3 (LED+1SH) was formulated as Diet 2 with 7.5% soybean hulls. Diet 4 (LED+2SH) was formulated as Diet 2 with an inclusion of 15% soybean hulls (Table 1).

Table 1. Composition of Phase I diets for all treatments[a].

Ingredient,%	Control	LED	LED+1SH	LED+2SH
Corn	68.1	76.5	67.0	57.4
Soybean meal	28.8	20.3	20.2	20.2
L-lysine HCL	--	.27	.27	.26
L-threonine	--	.08	.09	.09
DL-methionine	--	.01	.03	.04
L-tryptophan	--	.01	.01	.01
Soybean hulls	--	--	7.5	15.0
Soybean oil	1.0	1.0	3.1	5.2
Dical Phosphate	.58	.24	.32	.41
Limestone	.98	.94	.8	.65
Trace min/ vit mix	.25	.25	.25	.25
Antibiotic	.1	.1	.1	.1
Phytase	--	.022	.022	.022
Calculated composition				
CP, %	19.3	16.3	16.3	16.3
True dig lysine, %	.92	.92	.92	.92
P, %	.5	.4	.4	.4
ME kcal/kg	3384.2	3385.2	3384.6	3384.5

[a]Phases II, III, and IV follow similar formulations among treatments.

All dietary treatments were fed in four phases with .92, .79, .65, and .56% true digestible lysine in Phase I-IV, respectively. The control diet was formulated with % P levels of .50, .46, .43 and .40 for Phase I-IV, respectively. All LED diets were formulated to contain a 3% unit reduction in CP and a .1% unit reduction in P while maintaining isocaloric ME values (Table 2).

Table 2. Calculated composition of control diets for Phase I-IV[b].

	Phase I	Phase II	Phase III	Phase IV
True dig lysine, %	.92	.79	.65	.56
P, %	.50	.46	.43	.40
ME, kcal/kg	3,384	3,389	3,395	3400

[b]All diets were formulated to contain equal true digestible lysine and metabolizable energy. LED diets were formulated to contain a 3% unit reduction in CP as well as a .1% unit reduction in total P.

Crystalline amino acids were added to LED diets to maintain ideal amino acid ratios within treatments. Pigs were weighed weekly. Feed and water intake was recorded and slurry samples were collected weekly. Prior to draining the pit, slurry pH, electroconductivity, and pit volume was measured. The pit was refilled with fresh water after draining. Weekly feed and pit samples were analyzed for DM, N, and P content according to AOAC (1998) approved methods. Data were analyzed as a 4 x 4 Latin square design. The room served as the experimental unit. Treatment means were separated with contrasts of Control vs LED. The three LEDs were contrasted for linear and quadratic effects of 0, 7.5, and 15% inclusion of soybean hulls.

Results and Discussion

No differences (P>.10) in ADG, ADFI, and F:G were noted between treatments (Table 3). Also, the initial and final weight for each collection period was similar (P>.10) for all dietary treatments.

Table 3. Effects of dietary treatment on pig performance

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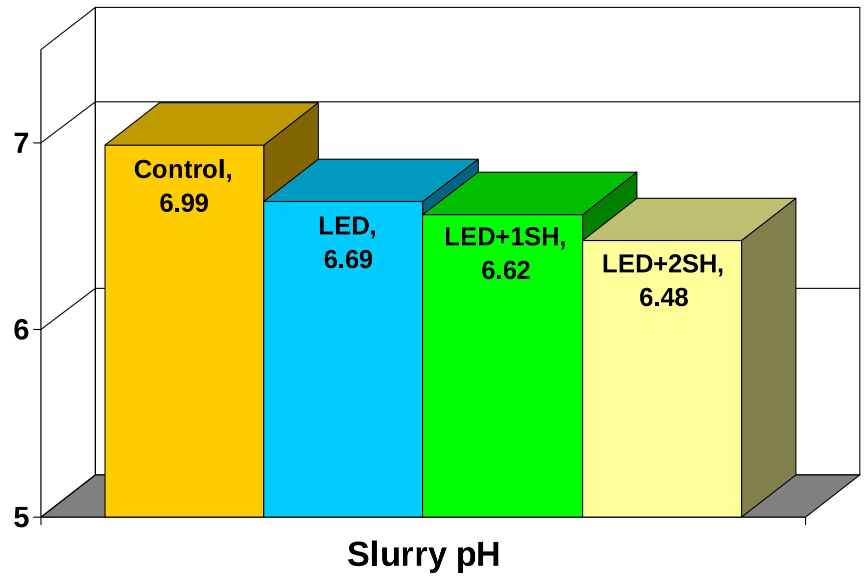
	Control	LED	LED+1SH	LED+2SH	SE
ADG, lbs	1.73	1.71	1.78	1.80	.05
ADFI, lbs	5.29	5.07	5.08	4.89	.16
F:G	3.03	3.00	2.88	2.86	.07

Con vs LED (P>.1) ; LED linear (P>.1)

Slurry pH was reduced (P<.01) in the rooms receiving the LED diet when compared to the control. Furthermore, slurry pH also decreased (P<.01) linearly with increasing soybean hull inclusion among the LED treatments (Figure 1). Electroconductivity of the slurry was also reduced (P<.05) in the rooms receiving the LED treatment when compared to the control. However, there was no linear or quadratic response (P>.10) with increasing fiber content.



Con vs LED (P<.01) ; LED linear (P<.01) ; SE=.03

Figure 1.. Average pH during all four phases by dietary treatment

Previous studies suggest that low excretion diets can be utilized to reduce nutrient excretion without negatively influencing pig performance during the finishing period. It has been reported that lowering crude protein by 3% units results in a decrease of N excreted by 30% (Lachmann et al., 2007). Furthermore, a reduction in .1% unit P with the addition of phytase can reduce the amount of P excreted by up to 35% (Lachmann et al., 2007). The results from the present study are in agreement with work previously completed at Oklahoma State University investigating feeding LED diets in order to decrease nutrient excretion. Further analysis of nutrient excretion and air emissions for this experiment will be published at a later date. Also, a decrease in the pH of the slurry from pigs fed low excretion diets when compared to control was similar to results from previous experiments conducted at Oklahoma State University, which also suggest a decrease in ammonia volatilization from the LED pits. Furthermore, other experiments conclude that increasing dietary fiber content in pig diets can further decrease slurry pH (Canh et al., 1998a; Shriver et al., 2003). The further decrease in slurry pH could be a result from additional volatile fatty acid production by increased microbial synthesis. Our findings are also in agreement with Kornegay (1981), who found that the inclusion of soybean hulls at 15% had no negative effect on growth performance. Based on these results, it can be concluded that an inclusion of up to 15% soybean hulls as a source of dietary fiber can be added to low excretion diets with no negative impact on pig performance. A 15% soybean hull inclusion to an LED diet can improve slurry characteristics by reducing overall excess nutrients excreted as well as reducing pH in order to possibly reduce ammonia volatilization for the entire finishing period.

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Acknowledgements

Authors

Bundy, Justin - Graduate Research Assistant

Carter, Scott - Associate professor

Lachmann, Mariela - Graduate Research Assistant

Jenkins, Sheritta - Graduate Research Assistant

Marable, Zath - Undergraduate Research Assistant