Reasons for limiting soybean meal use in nursery pig diets explored

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MANY nutritionists limit the use of soybean meal in the diets immediately following weaning of young pigs. This reduction will often continue until the pig is 25-35 lb. before unrestricted use of soybean meal is allowed.

Many researchers have explored the reasons for performance concerns associated with soybean meal in the weaning diet. Li et al. (1991) provided insight into the pig immune response against some of the protein antigens that are present in soybean meal.

In another article discussing soy product utilization in piglets, Stein et al. (unknown date) also discussed how soybean carbohydrates (especially the oligosaccharides) negatively affect the young pig. Some of complex sugars found in soybean meal are indigestible in the small intestine of the pig. These sugars can lead to the potential for inappropriate hindgut bacterial fermentation and may increase the incidence of diarrhea-related observations.

Clearly, soybean meal contains several components that are difficult for the piglet to utilize, but the question remains whether the trade-off between performance and formulation value can be managed to achieve acceptable pig performance.

One historical formulation approach to reduce soybean meal in the weaning diet was to use fish meal or other animal byproduct meals to provide amino acids, thereby reducing the reliance on soybean protein. Due to high fish meal costs, whole businesses emerged with a focus on reducing the anti-nutritional compounds found in commodity soybean meal. These processed proteins are used to supply soy protein without the anti-nutritional properties found in commodity soybean meal.

On the positive side, several articles have discussed the opportunity for soybean isoflavones to assist in viral clearance in the pig. The seminal papers on this topic were those of Greiner et al. (2001a and 2001b).

Several researchers have tried to replicate the original work with intact soy isoflavone, with limited success at improving porcine reproductive and respiratory syndrome (PRRS) virus clearance compared to the Greiner papers when using intact soybean meal instead of purified genistein or daidzein.

A study by Moran et al. (2017) challenged the idea that soybean meal inclusion in the nursery pig diet has an upper limit in commercial management situations, with the hypothesis being that a super dose of phytase may increase that limit by degrading the phytate molecule found in the diet due to soybean meal use and, thus, improve the tolerance to soybean meal. This is an interesting area that deserves further consideration.

The authors conducted two large-scale studies with similar soybean meal level-by-phytase level factorial designs. Both studies evaluated the performance of a phase 1 diet over a 10-day period, followed by a phase 2 diet for days 11-20 postweaning and a phase 3 diet continuing to 42 days postweaning.

The first trial used 2,550 pigs with an average weaning age of 20.5 days. Soybean meal levels of 15.5% and 25.0% were fed in phase 1, followed by 19% and 29% in phase 2, respectively, and phytase levels of 0, 1,250, 2,500 or 3,750 phytase units (FTU) per kilogram were applied to each soybean meal level, for a total of eight treatments. The balance of essential amino acids and energy were maintained at similar levels, with substitutions for poultry meal, amino acids and additions of choice white grease.

In the second trial, soybean meal levels of 15.0%, 22.5% and 30.0% were fed in phase 1, followed by levels of 20%, 27% and 35% in phase 2, respectively, and phytase levels of 600 and 2,600 FTU/kg were applied at each soybean meal level, for a total of six treatments.

In the second trial, amino acids, a plant protein mixture of a fermented soybean meal protein, a source of nucleotides and choice white grease were used to balance amino acids and energy across diets. The 2,112 pigs, with an average weaning age of 21 days, were intentionally derived from a PRRS-positive sow herd and vaccinated against PRRS to create a disease challenge model and test for an improved disease response when fed soybean meal isoflavone.

In the first study, in phase 1, increasing soybean levels improved weight gain and did not significantly affect feed intake (Table). Phytase inclusion resulted in improved feed intake, regardless of the soybean level in the diet. During phase 2, soybean level again was significant, with improved gain in pigs fed the high-soybean meal diets. Interestingly, the high-soybean meal diets caused a mild depression in phase 2 feed intake and, when taken with elevated gain, resulted in improved feed efficiency.

In addition to the typical performance measurements, the authors also measured fecal scores during the phase 1 period, with higher scores indicating an increase in looseness or diarrhea. The expected elevation in fecal score due to high soybean meal inclusion was observed only on day 2 postweaning. Over

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Effect of dietary soybean meal levels and phytase on growth performance in nursery pigs

	------Low soybean meal------				-----High soybean meal-----			
	0	1,250	2,500	3,750	0	1,250	2,500	3,750
Criteria	----------Phytase level----------							
Average daily gain, g								
Phase 1*	147	167	165	160	159	179	174	189
Phase 2*	379	390	397	383	393	395	403	397
Phase 3	507	531	525	516	534	499	525	514
Average daily feed intake, g								
Phase 1**	154	168	163	167	161	165	169	174
Phase 2*	479	496	497	503	468	473	472	475
Phase 3	810	820	814	799	842	785	791	802
Gain:feed								
Phase 1*	953	995	1,013	960	986	1,085	1,031	1,085
Phase 2*	791	786	798	761	840	835	854	837
Phase 3***	625	646	644	645	633	635	663	640

Note: Phase 1 = weaning to day 10. Phase 2 = days 11-20. Phase 3 = days 21-42.
*Main effect of soy level ($P < 0.05$).
**Main effect of phytase ($P < 0.05$).
***Quadratic effect of phytase ($P < 0.001$).

the course of the study, this single-day observation seems to be of minor importance.

There were no phytase-by-soybean level interactions in this study, suggesting that the phytase addition did not improve pigs' tolerance to soybean meal level.

In the second study with the PRRS challenge, the authors did not observe any statistically significant responses in growth performance or feed efficiency to either soybean level or to phytase inclusion. There was a statistical reduction in removal and treated pigs with increasing soybean meal levels (averages: low soy = 11.1%, medium soy = 9.1% and high soy = 8.35%).

Phytase appeared to improve performance in the first study, but the response was not as apparent in the second study. In both experiments, no soybean meal-by-phytase interactions were observed. This interaction was somewhat anticipated within the construct of the experimental design and could indicate that the high-soybean meal diets did not contain enough additional phytate to result in the interaction or that phytate is not a likely culprit of any reduced performance noted by higher soybean meal levels.

The Bottom Line

This study again shows that it is difficult to replicate the performance challenges observed in the field using high-soybean meal diets in a research situation. The study does not confirm the viral clearance properties of soy isoflavones, but it is not clear that levels of isoflavone were high enough to elicit the expected response.

Phytase performance response was independent of soybean meal inclusion.

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