Mitigating DON Through Optimal Use of Blood Plasma in Nursery Diets

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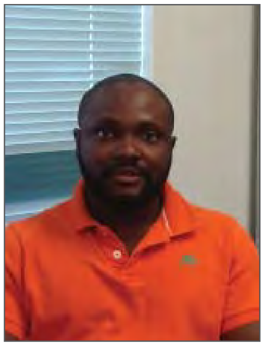

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SUMMARY

Previous research showed that nursery pigs fed deoxynivalenol (DON) contaminated diets supplemented with spray-dried porcine plasma (SDPP) had similar growth rate and feed intake as those consuming non-contaminated diets. In this study, two blocks of 100 weanling pigs were used to determine the optimal inclusion level of spray-dried bovine plasma(SDBP) required in nursery diets contaminated with DON to maintain growth performance. Growth performance was not statistically different for pigs fed the diets with DON contaminated diets and the diet without DON. Also, adding SDBP to the DON-contaminated diets had no effect on nursery pig growth performance. Therefore, we were not able to determine the optimal inclusion level of SDBP in the DON-contaminated nursery diet.

INTRODUCTION

Mycotoxins have become an important issue to local crop and livestock producers in Saskatchewan in recent years. Deoxynivalenol (DON; vomitoxin), a mycotoxin produced by various Fusarium species, contaminates grains such as wheat, barley, and corn. When cereal grains are contaminated with DON, they are downgraded and typically used for livestock feed rather than using such grains for human consumption. Among the livestock species, pigs are the most sensitive to DON and dietary exposure to levels above 1 ppm of complete diet has been reported to depress pig growth rate and feed intake and negatively impact pig health.

The most ideal solution is to replace DON contaminated grains partially or completely with clean grains for pig feed. However, this approach may not be a viable option in times when mycotoxin contamination of grains is rather high or widespread. Therefore, if pigs are to be fed cereal grains contaminated with DON, there is a need to develop cost effective strategies that will help to ameliorate the negative effects associated with dietary exposure to DON.

Spray-dried animal plasma (SDAP) has been reported in several experiments to promote feed intake and growth performance of nursery pigs and to confer health benefits when included in nursery diets. It follows that SDAP could be used as a dietary strategy to mitigate the negative effects of DON-contaminated feeds on nursery pig performance. Indeed, a previous study at Prairie Swine Centre showed that nursery pigs fed a DON-contaminated diet supplemented with spray-dried porcine plasma (SDPP) had similar growth rate and feed intake as those fed the diet without DON. However, because SDAP is expensive an optimal inclusion level that can mitigate the adverse effects associated with DON-contaminated nursery diets needs to be determined. Moreover, many producers have removed SDPP from their diets because of a reported association with the PEDv. Therefore, the objective of this study was to determine the most cost effective inclusion level of SDAP into DON-contaminated nursery diets that will maintain growth performance. Secondly, we wanted to see if spray-dried bovine plasma (SDBP) would have similar benefits to those previously observed with SDPP.

"Dietary exposure to DON levels above 1 ppm of complete diet has been reported to depress pig growth rate and feed intake and negatively impact pig health."

MATERIALS AND METHODS

Two blocks of 100 newly weaned pigs (26 ± 2 days of age) each were used for this 4-week growth trial. Piglets were housed in groups of 5 pigs/pen and pens were randomly assigned to 5 dietary treatments to obtain 8 pens per dietary treatment (40 pigs per diet). Pigs were allowed to acclimatize to their new environment and fed on a standard starter diet for 3 days post-weaning before introducing them to experimental diets (Table 1). Diets consisted of a negative control (NC; no DON, no SDAP), a positive control (PC; DON, no SDAP), and 3 PC diets supplemented with 2%, 4% or 8% SDBP The DON diets were produced by adjusting the inclusion of DON-contaminated wheat to obtain a final dietary DON concentration of 4 ppm. Diets were formulated to meet or exceed nutrient requirements for nursery pigs. Body weight and feed intake were recorded on days 0, 3, 11, 21, and 25 of the trial to calculate ADG, ADFI, and G:F. Diets were assayed for DON by liquid chromatography/mass spectrometry (Prairie Diagnostic Services, Saskatoon, SK).

RESULTS AND DISCUSSION

Diets

The NC, PC, 2% SDAP, 4% SDAP and 8% SDAP diets contained 0.3, 4.7, 4.6, 5.1, and 3.4 ppm of DON, respectively, representing 117%, 115%, 128% and 85%, of the target of 4 ppm DON. Sampling problems and uneven distribution of DON in the contaminated wheat is a potential cause of variability among the diets. The values reported are a composite of samples taken at each feeding.

Pig growth performance

Pigs showed no signs of diarrhea or vomiting throughout the trial. The NC and PC diet were not statistically different ($P > 0.10$) in any of the performance parameters measured. The final body weight, overall ADG, ADFI, and G:F were also not different ($P > 0.10$) between the NC and PC diets. The current findings contradict results of previous research showing that ingestion of diets contaminated with DON reduced growth rate and feed intake. For example, Beaulieu et al. (2007) reported that ADG and ADFI decreased by

5.6% and 4.9%, respectively, in nursery pigs exposed to 1.57 ppm of diet compared with a control diet. Analysis indicated that the NC diet used in the present study contained 0.3 ppm of DON, a level considered not harmful for pigs. However, this might have resulted in the inability to detect an effect due to DON in the current trial.

Addition of SDAP to the PC diet did not (P > 0.10) increase BW, ADG, ADFI compared with the PC diet. The varying levels of DON in the SDAP-supplemented diets make it difficult to determine the effect of SDAP on growth and intake responses of the pigs fed those diets. Therefore, we could not determine the optimal dietary inclusion rate of SDAP in DON-contaminated diets in the present study.

Table 1. Composition of nursery pig diets for Experiment 1 (as-fed basis)1

Ingredient, %	Dietary Treatment				
			SDAP		
	NC	PC	2%	4%	8%
Wheat (clean)	50.93	11.05	10.80	10.54	10.03
Wheat (DON)[2]	-	39.88	39.88	39.88	39.88
Barley	4.90	4.90	5.13	5.35	5.80
Soybean meal	19.00	19.00	18.78	18.55	18.10
Whey powder	11.70	11.70	11.63	11.56	11.43
SDAP	-	-	2.00	4.00	8.00
Fish meal	9.00	9.00	6.75	4.50	-
Canola oil	2.30	2.30	2.33	2.35	2.40
Amino acids[4]	0.497	0.497	0.470	0.444	0.39
Limestone	0.05	0.05	0.375	0.70	1.35
Monocalcium phosphate	0.60	0.60	0.85	1.10	1.60
Premix[5]	1.02	1.02	1.02	1.02	1.02

[1] NC, negative control; PC, positive control; SDAP, spray-dried animal plasma
[2] DON contaminated wheat was obtained from Southern Saskatchewan in 2015 and contained 10.9 ppm DON, upon analysis.
[3] American Protein Corporation (APC 920)
[4] Amino acids (using synthetic lysine, threonine, methionine and tryptophan) were added to meet amino acid requirements.
[5] Diets contained equal amounts of vitamin and mineral premixes, salt, choline chloride and CuSO4-5 H2O.

CONCLUSIONS

DON did not cause the expected detrimental effects on nursery pig growth performance in this study. Further, inclusion of SDBP in the DON-contaminated diet did not improve feed intake and growth rate relative to the positive DON control diet. Therefore, we could not confirm our hypothesis nor determine the optimal inclusion level because SDAP was not effective in this study. Research is ongoing to determine the mechanism of action of SDAP in DON-contaminated diets to explain the varying results.

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Table 2. Growth performance of nursery pigs fed diets without or with DON and supplemented with SDAP [1,2]

	Dietary Treatment					SEM
			SDAP			
	NC	PC	2%	4%	8%	
Body weight, kg						
Day 0	8.09	8.12	8.04	8.19	8.13	0.064
Day 3	8.41	8.40	8.30	8.49	8.54	0.086
Day 11	10.55	10.38	10.03	10.48	10.65	0.209
Day 21	15.89	15.45	14.85	15.38	15.98	0.278
Day 25	18.56	18.22	17.45	17.93	18.56	0.317
P-value, diet 0.14						
ADG, kg/day						
Day 0-3	0.14	0.11	0.10	0.12	0.16	0.022
Day 4-11	0.30	0.26	0.24	0.27	0.29	0.023
Day 12-21	0.56	0.53	0.51	0.51	0.54	0.020
Day 22-25	0.70	0.71	0.67	0.66	0.67	0.033
P-value, diet <0.10						
ADFI, kg/day						
Day 0-3	0.69	0.62	0.61	0.64	0.72	0.088
Day 4-11	1.46	1.34	1.24	1.38	1.52	0.108
Day 12-21	3.29	3.01	2.80	2.99	3.10	0.145
Day 22-25	4.51	4.39	4.21	4.36	4.20	0.169
P-value, diet 0.38						
G:F, kg/kg						
Day 0-3	0.12	0.15	0.14	0.16	0.19	0.033
Day 4-11	0.19	0.18	0.18	0.19	0.18	0.007
Day 12-21	0.17	0.17	0.18	0.17	0.17	0.006
Day 22-25	0.15	0.16	0.16	0.15	0.16	0.008
P-value, diet 0.79						

NC, negative control; PC, positive control; SDAP, spray-dried animal plasma
[1] Data was analyzed as repeated measures and the p-values represent the overall time points. Pooled SEM.
[2] The experiment was conducted for 28 days. Day 0 and 25 represent day 4 and 28 post-weaning, respectively.

Table 3. Average daily gain, average daily feed intake and gain:feed of nursery pigs over the entire experimental period

	Dietary Treatment					SEM	P-value
			SDAP				
	NC	PC	2%	4%	8%		
ADG (kg/d)	0.42	0.40	0.38	0.39	0.42	0.01	0.11
ADFI (kg/d)	2.52	2.37	2.22	2.37	2.44	0.12	0.28
G:F (kg/kg)	0.17	0.17	0.17	0.17	0.17	0.01	0.95

NC, negative control; PC, positive control; SDAP, spray-dried animal plasma.
ADG, average daily gain; ADFI, average daily feed intake; G:F, gain:feed.