Spray Dried Bovine Plasma for DON Contaminated Nursery Diets

V. Iyer, A.D. Beaulieu, D. Columbus

Denise Beaulieu

Dan Columbus

SUMMARY

The mycotoxin, deoxynivalenol (DON) is a concern to swine producers as it causes reduced feed intake, growth and health problems. Spray-dried porcine plasma (SDPP) has been shown to mitigate the effects of DON. This study aimed to determine the effect of DON and spray-dried bovine plasma (SBBP) inclusion in the diet on feed intake, growth performance and gut health in newly-weaned pigs. Seventy-two nursery pigs were divided into six treatment (trt) groups :1) Diet A (no DON or SDBP), full-fed, 2) Diet B (with DON no SDBP), full-fed, 3) Diet A, limit-fed, 4) Diet C (no DON with SDBP), full-fed, 5) Diet D (with both DON and SDBP), full fed, and 6) Diet C, limit fed. No significant difference in average daily gain (ADG), body weight (BW) or feed efficiency (FI) were found between the control diet (treatment1) and DON (treatment2) or SDBP diet (treatment4), indicating that DON and SDBP had no detrimental or beneficial effect on performance of nursery pigs, respectively. Moreover, there was no significant difference among the treatment groups for gut morphology, indicating no harmful effects on gut health. However, there was a significant decrease in ADG and BW for treatment5 (DON and SDBP) when compared to treatment1 (no DON or SDBP). No differences were found between the full fed and the pair-fed (limit fed) group, indicating that the effects of DON and SDBP were not due to feed intake. Further research is needed to better understand the effect of DON and SDBP inclusion in diets on growth performance of pigs.

INTRODUCTION

Mycotoxins have become an increasingly growing concern among livestock and crop producers all over the world, including in Canada. Mycotoxins can induce a variety of detrimental effects in swine such as reduced average daily gain, feed intake, immunosuppression, negative effects on intestinal health and impairment of reproductive functions ultimately reducing animal performance and the livestock producer's profit. One of the major mycotoxins of concern in the swine industry is deoxynivalenol (DON) also known as vomitoxin. DON is the most prevalent mycotoxin worldwide in crops used for food and feed preparation and swine are the most sensitive species to DON when compared to other monogastric or ruminant animals. In a previous study at PSCI (see Annual Report 2007) reductions in ADG and ADFI in pigs were observed at 1.57ppm DON. Due to this sensitivity it is recommended that swine diets contain less than 1ppm DON.

The best way to avoid DON contamination in feed is to avoid the use of contaminated grains. However, this is not always realistically or financially possible as the levels of DON contaminated grain have increased and on some years clean grain can be difficult to obtain. Therefore, researchers have tried to find various strategies to mitigate or reduce mycotoxin contamination in livestock feed. One of the strategies used to mitigate the effects of mycotoxin contamination of feed is the addition of feed additives or ingredients to the feed. Spray-dried porcine plasma (SDPP) is one feed ingredient that has been shown to reduce the negative effects of DON. Spray-dried animal plasma (SDAP) is the generic term for an animal by-product that is obtained from slaughter houses from porcine or bovine sources and has been shown to improve feed intake and growth performance of nursery pigs. Plasma that is obtained from a single species may be identified as porcine (SDPP) or bovine (SDBP). Including SDAP in swine diets has been shown to increase feed efficiency, growth performance and improve health status and gut morphology. A study at PSCI (see Annual Report 2012) showed that including SDPP in diets of newly weaned pigs diets could mitigate the negative effects of DON by increasing the ADG and ADFI. However, the mechanism behind the mitigation of DON by the inclusion SDAP is not very well understood and it is not known if the improvement is due to appetite stimulation or the immunoglobulin content of the SDPP. Even though SDPP may be beneficial in mitigating the effects of DON, due to its association with porcine epidemic diarrhea virus many producers have stopped using SDPP in their diets. SDBP may be an ideal alternative as it doesn't have any association with porcine epidemic diarrhea.

"DON only modestly reduced feed intake and growth in this eperiment and there was no response to bovine plasma"

MATERIALS AND METHODS

Seventy-two newly weaned pigs (approx. 21 days of age and 6 kg body weight) were used in the trial. At weaning the pigs were housed in the production nursery for 3 days prior to selection for the trial. On day 4 post-weaning the selected pigs were moved to individual pens and switched to experimental diets. The experiment used 4 dietary treatments distributed among 6 treatment groups as described in Table 1. In order to evaluate the effect of the reduction in feed intake that is observed when pigs are fed diets containing DON, the pigs assigned to treatments 3 and 6 were feed restricted with their feed allowance based on the feed intake of the pigs fed the corresponding DON diet (pair-fed). The pair-fed pigs were one week younger and started the trial one week later than the full-fed pigs.

The pigs were weighed and feed disappearance measured on days 0, 7, 14, 21 and 25 of the trial. On day 25, a subset of pigs were euthanized to obtain tissue samples. Samples were obtained from the small intestine (jejunum and ileum) and sections stained for gut histology. The stained slides were analyzed for villus height (measured from tip of the villi to the base, excluding the crypt), villus width (measured halfway between the base and the tip) and crypt depth (measured from the transition between the crypt and the villi to the base of the crypt).

Table 1. Description of diets and feeding treatments

Treatment Number	Dietary Treatments	Full-fed/Pair-fed Group	Diet composition 1,2
1	A	Full-fed	No DON, No SDBP
2	B	Full-fed	DON, No SDBP
3	A	Pair-fed to treatment 2	No DON, No SDBP
4	C	Full-fed	No DON, SDBP
5	D	Full-fed	DON, SDBP
6	C	Pair-fed to treatment 5	No DON, SDBP

1 Target DON level: 4mg/kg (ppm), actual ranged from 3.1 to 3.8ppm over 3 dietary phases
2 SDBP inclusion level: 8%

RESULTS AND DISCUSSION

Effect of DON

In the current experiment, ADFI was reduced in pigs consuming DON (trt2) compared to the control diet (trt 1) but no significant difference was observed in any of the growth parameters such as ADG, BW or feed efficiency between the diet with DON (trt 2) or the control diet (trt 1).

Supporting the lack of treatment effect on growth in the current experiment it was found that there were no significant effects of treatment on gut morphology, suggesting that inclusion of DON in swine diets did not affect the gut morphology which is completely contradictory to the finding of previous studies, where pigs fed with DON-contaminated diets had decreased villus height in both jejunal and duodenal tissue samples and increased crypt depth in the jejunum.

Additionally, no significant difference was observed between the pair-fed and full-fed treatment groups for the growth parameters or gut morphology, suggesting that DON showed no detrimental effects when feed intake was not a confounding factor. However growth was variable and thus despite a 24% reduction in ADG when DON was included in the diet, this did not achieve statistical significance.

Effect of Spray Dried Bovine Plasma

In the current experiment no significant difference was observed between the control diet and the diet with SDBP, for growth parameters, suggesting that SDBP did not improve the growth parameters when included in the diet. Moreover, when the diet contained both SDBP and DON, the BW, feed intake, and ADG were decreased relative to Trt 1 (no DON, no SDBP). These results differ from a previous study conducted at PSCI, which showed that inclusion of SDPP in DON contaminated diets improved the growth parameters of pigs to performance equal to those without DON in their diet. However, in this current study we used SDBP instead of SDPP and the difference in effectivenss could be due to differences between SDBP and SDPP. For example, growth-related improvements observed with SDPP have been found to be associated with high immunoglobulin content of the ingredient and, therefore, SDBP may be less effective due to its lack of porcine specific antibodies. However, the results of other studies are inconsistent, with some finding that both SDBP and SDPP are equally effective while other research has found that SDBP in DON diets was unable to alleviate the negative effects of DON.

CONCLUSION

Overall, the results were found to be contrary to the previous experiments. The current experiment showed that DON did have a detrimental effect on ADFI and also showed some negative effects on ADG. Moreover, SDBP showed a beneficial effect on ADFI when present with DON in the diet but did not have a beneficial effect on ADG. Finally, DON and SDBP showed no detrimental or beneficial effects, respectively on pair-fed pigs compared to their corresponding full-fed pigs. Hence, the effects of DON and SDBP were not due to its effect on feed intake. Further research is needed in order to better understand the mechanism behind the effects of DON and SDBP in pigs and the ability of SDBP to mitigate the negative effects of DON in weaned pigs.

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Table 2. Body weight, average daily gain, average daily feed intake, average daily feed intake per body weight and feed efficiency of nursery pigs*

	Dietary Treatments						
	1	**2**	**3**	**4**	**5**	**6**	SEM
Diet	A	B	A	C	D	C	
Feeding strategy	Ad lib	Ad lib	To 2*	Ad lib	Ad lib	To 5*	
DON	No	Yes	No	No	Yes	No	
SDBP	No	No	No	Yes	Yes	yes	
BW, kg							
Day 3	5.84	5.8	5.99	5.87	5.91	5.95	0.24
Day 7	6.11	5.83	5.98	6.03	5.94	6.07	0.24
Day 14	7.45	6.96	6.86	7.35	6.77	7.07	0.24
Day 21	9.98a	9.3a	8.8b	9.66a	8.69b	8.88ab	0.24
Day 24	11.45a	10.4a	10.21b	11.16a	9.69b	10.22a	0.24
Overall	8.16a	7.66ab	7.57ab	8.01ab	7.4b	7.64ab	0.19
P Value, repeated measures: Treatment 0.02; Day <0.001; Treatment x Day <0.001							
ADG, kg/day							
Day 3-6	0.07	0.01	0.00	0.04	0.01	0.03	0.027
Day 7-13	0.19	0.16	0.13	0.19	0.12	0.14	0.027
Day 13-20	0.36	0.33	0.28	0.33	0.28	0.26	0.027
Day 21-24	0.37	0.28	0.35	0.37	0.25	0.34	0.027
Overall	0.25a	0.19ab	0.19ab	0.23a	0.16b	0.19ab	0.015
P Value, repeated measures: Treatment <0.01; Day <0.001; Treatment x Day 0.26							
ADFI, kg/day							
Day 3-6	0.14	0.09	0.09	0.09	0.10	0.09	0.02
Day 7-13	0.24	0.20	0.19	0.23	0.21	0.20	0.02
Day 13-20	0.52a	0.46a	0.38b	0.51a	0.45a	0.43ab	0.02
Day 21-24	0.70a	0.60ab	0.54b	0.68a	0.63ab	0.57b	0.02
Overall	0.4a	0.34b	0.3b	0.38a	0.35ab	0.32b	0.40
P Value, repeated measures: Treatment <0.001; Day <0.001; Treatment x Day 0.01							
Gain/Feed							
Day 3-6	0.21	0.01	-0.06	-1.63	-0.96	0.24	0.49
Day 7-13	0.81	0.76	0.65	0.81	0.50	0.70	0.49
Day 13-20	0.71	0.73	0.74	0.64	0.61	0.61	0.49
Day 21-24	0.52	0.47	0.66	0.55	0.38	0.59	0.49
Overall	0.56	0.49	0.5	0.09	0.13	0.53	0.25
P Value, repeated measures: Treatment 0.60; Day <0.001; Treatment x Day 0.88							

*pair fed to treatment 2 or treatment 5