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Abstract

This trial was conducted to determine the effect of Viligen™ (Alltech, Lexington, KY), feed form (meal or pelleted) and storage time (0, 3, or 7 d) on reducing the fumonisin (FUM) concentration in diets. Three 1,000-lb batches of feed were manufactured and used as replications. Each batch was divided into 500-lb batches with or without Viligen at 0.15% of the diet. Diets were then left as a meal or pelleted and stored at room temperature for 0, 3, and 7 d to determine the reduction of FUM over time. The result indicated that there were no main or interactive effects ($P > 0.05$) of Viligen, feed form, and storage time. There were marginal ($P < 0.10$) 3- and 2-way interactive effects, but the magnitude of response likely was not large enough to have biological effects on nursery pig performance.

Keywords

fumonisin (FUM), Viligen, feed form, storage time

Cover Page Footnote

Appreciation is expressed to Hubbard Feeds Inc. (Mankato, MN) for financial support.

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K-STATE Research and Extension

SWINE DAY 2019

KANSAS STATE UNIVERSITY SWINE INDUSTRY DAY 2019

Effect of Viligen™, Feed Form, and Storage Time on Fumonisin Concentrations in Corn[1]

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Summary

This trial was conducted to determine the effect of Viligen™ (Alltech, Lexington, KY), feed form (meal or pelleted) and storage time (0, 3, or 7 d) on reducing the fumonisin (FUM) concentration in diets. Three 1,000-lb batches of feed were manufactured and used as replications. Each batch was divided into 500-lb batches with or without Viligen at 0.15% of the diet. Diets were then left as a meal or pelleted and stored at room temperature for 0, 3, and 7 d to determine the reduction of FUM over time. The result indicated that there were no main or interactive effects ($P > 0.05$) of Viligen, feed form, and storage time. There were marginal ($P < 0.10$) 3- and 2-way interactive effects, but the magnitude of response likely was not large enough to have biological effects on nursery pig performance.

Introduction

Recently, fumonisin contamination in corn has been an emerging issue in Kansas. Fumonisin was tested at 10 to 20 ppm in a large portion of the corn and at higher levels in some areas. Nursery pigs fed fumonisin-contaminated corn will have reduced growth performance and organ damage. Therefore, reducing fumonisin in feed is an urgent task. Viligen™ (Alltech, Lexington, KY) is a product consisting of short chain fatty acids, prebiotic components, and minerals for use in diets of weanling pigs to promote growth performance and support gastrointestinal health by reducing inflammation. However, according to recent field reports, adding Viligen in the diet may reduce FUM concentrations in corn via an unknown mechanism. The purpose of this experiment is to determine whether Viligen, in meal or pelleted diets, reduces FUM concentrations over time in diets containing FUM-contaminated corn.

Procedures

All diets were manufactured at the Kansas State University O.H. Kruse Feed Technology Innovation Center in Manhattan, KS (Table 1). There were 4 treatments

[1] Appreciation is expressed to Hubbard Feeds Inc. (Mankato, MN) for financial support.

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arranged as a 2 × 2 factorial with the main effects of additive (with or without Viligen at 0.15% of the diet) and diet form (meal or pelleted). Three replicates were used for each treatment. Within each replicate, a single batch of 1,000-lb phase 3 nursery pig diet was mixed. Feed was bagged off into 50-lb bags and every other bag was piled into two separate piles. Bags from the first pile were emptied into the 500-lb mixer and mixed for 7 min. Feed was discharged from the mixer and sacked off. Meal samples were collected via grain probe from sacks to obtain needed samples for chemical analysis. The same procedure was repeated with the second pile, except adding Viligen to the diet while mixing. Feed with or without Viligen was then pelleted using a 1-ton CPM 1012-2 HD Master Model pellet mill with a Wenger twin-staff preconditioner. The average conditioning temperature was 175°F, average hot pellet temperature 181.6°F. Retention time was 30 sec, and a 5/32 in × 1 1/4 in die size (L/D = 8.0), 1,560 lb/h production rate, and at approximately 72.8°F ambient temperature. Five pellet samples were taken throughout each treatment run immediately after the die, and cooled using a counter-flow research pellet cooler for 10 min. For each replicate, subsamples were collected, mixed, and stored at room temperature. Before any sampling time point, the sample was re-mixed, and divided into 2 subsamples with a riffle sample splitter. One subsample was used for FUM analysis (d 0, 3, and 7) and the second retained at K-State. Subsamples were frozen after collection on d 0, 3, and 7. The number of samples was: 3 (replications) × 4 (treatments) × 3 (time points) = 36 samples. All subsamples were analyzed for FUM concentration using HPLC (Neogen, Lansing, MI). Results were reported as Fumonisin B1 (FB1), Fumonisin B2 (FB2), and Fumonisin B3 (FB3).

Each analytical result served as an experimental unit. Results of FB1, FB2, and FB3 values were analyzed, as well as the sum of the 3. Accounting for heterogenous variance by treatment in the model improved model fit. Main effects and interactive means were determined. Linear and quadratic polynomial contrasts were performed to determine the effects of increasing storage time within treatment. Treatment differences were considered significant at $P \leq 0.05$ and marginally significant at $0.05 < P \leq 0.10$. All analyses were performed using the R program (R Core Team, Vienna, Austria) using the lme4 package for analysis.

Results and Discussion

By analyzing the interaction of FUM toxin singly (FB1, FB2, or FB3) or combined (FB1 + FB2 + FB3), there were no 2- or 3-way interactive effects ($P > 0.05$) of Viligen™, form of feed, and storage time observed; however, the 3- and 2-way interactions were marginally significant ($P < 0.10$) for FB1 and total FUM (Table 2).

For samples of meal diet with Viligen, FB1, FB2, and total toxin decreased (linear, $P < 0.01$) when the storage time increased (Table 3). For samples of pelleted diet without Viligen, FB3 marginally decreased (linear, $P = 0.089$) and total toxin decreased (linear, $P < 0.05$) as storage time increased. The FB1, FB2, FB3, and total toxin increased on d 3 then reduced on d 7 (quadratic, $P < 0.05$). For samples of pelleted diet with Viligen, FB1 (quadratic, $P < 0.05$), FB2 (quadratic, $P = 0.083$), and total toxin (quadratic, $P = 0.055$) increased on d 3 then reduced on d 7. There appeared (linear, $P < 0.01$) to be evidence that Viligen reduced FUM content in meal diets over time, suggesting one or more of the components might have mitigation properties. However,

based on previous work with FUM, the magnitude of reduction is likely not large enough to have an appreciable effect on nursery pig performance.

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Table 1. Diet composition (as-fed basis)

Item	Diet
Ingredients, %	
Fumonisin corn	64.71
Soybean meal	28.00
Soybean oil	3.00
Monocalcium phosphate	0.85
Calcium carbonate	0.75
Sodium chloride	0.60
L-Lysine HCl	0.55
DL-Methionine	0.21
L-Threonine	0.23
L-Tryptophan	0.06
L-Valine	0.16
Vitamin premix	0.25
Trace mineral premix	0.15
Phytase[1]	0.08
Viligen[2]	--[2]
Total	100
Standard ileal digestible (SID) amino acids, %	
Lysine	1.30
Isoleucine:lysine	53
Leucine:lysine	111
Methionine:lysine	36
Met and cysteine:lysine	56
Threonine:lysine	63
Tryptophan:lysine	20.0
Valine:lysine	69
Histidine:lysine	35
Net energy, kcal/lb	1,151
Crude protein, %	19.8
Calcium, %	0.61
STTD P,[3] %	0.44

[1]Ronozyme HiPhos GT 2700 (DSM Nutritional Products, Basel, Switzerland) provided 306 FTU per lb of feed and an expected P release of 0.10%.
[2]Viligen™ (Alltech, Lexington, KY) was added (0.15%) at the expense of fumonisin corn for diet with Viligen.
[3]STTD P = standardized total tract digestible phosphorus.

Table 2. The effect of Viligen™, feed form, and storage time (day) on fumonisin concentrations[1,2]

	Without Viligen™						With Viligen™									
	Meal			Pellet			Meal			Pellet			Probability, $P^{3,4}$			
Item	d 0	d 3	d 7	d 0	d 3	d 7	d 0	d 3	d 7	d 0	d 3	d 7	V×F×D	V×F	V×D	F×D
FB1	30.3	30.1	31.2	29.0	30.3	28.1	31.0	30.5	28.5	29.4	31.3	29.4	0.072	0.778	0.061	0.893
FB2	7.5	7.5	7.7	7.2	7.6	7.0	7.6	7.4	7.0	7.3	7.7	7.3	0.169	0.925	0.103	0.127
FB3	3.9	3.8	4.0	3.7	3.9	3.6	3.8	3.8	3.6	3.8	3.9	3.7	0.274	0.486	0.176	0.138
Total	41.6	41.4	42.9	39.9	41.7	38.7	42.4	41.7	39.2	40.5	43.0	40.4	0.090	0.907	0.067	0.093

[1]Fumonisin was analyzed using HPLC (Neogen, Lansing, MI).
[2]SEM were calculated by each treatment:
Meal without Viligen: FB1 (1.033), FB2 (0.221), FB3 (0.123), Total (0.123).
Pellet without Viligen: FB1 (0.461), FB2 (0.118), FB3 (0.049), Total (0.049).
Meal with Viligen: FB1 (0.486), FB2 (0.143), FB3 (0.068), Total (0.068).
Pellet with Viligen: FB1 (0.795), FB2 (0.195), FB3 (0.113), Total (0.113).
[3]V = with or without Viligen. F = meal or pelleted form. D = storage time (0, 3, and 7 d).
[4]Main effects are not shown as there was no evidence of differences ($P > 0.10$).

Table 3. The effect of storage time on fumonisin concentrations within treatment[1]

	Storage time (d)				Probability, *P*	
Item	0	3	7	SEM	Linear	Quadratic
Meal without Viligen™						
FB1	30.3	30.1	31.2	0.976	0.471	0.612
FB2	7.5	7.5	7.7	0.217	0.490	0.717
FB3	3.9	3.8	4.0	0.120	0.534	0.612
Total	41.6	41.4	42.9	1.296	0.474	0.625
Meal with Viligen™						
FB1	31.0	30.5	28.5	0.348	< 0.001	0.185
FB2	7.6	7.4	7.0	0.136	0.007	0.756
FB3	3.8	3.8	3.6	0.063	0.202	0.387
Total	42.4	41.7	39.2	0.660	< 0.001	0.272
Pellet without Viligen™						
FB1	29.0	30.3	28.1	0.312	0.205	< 0.001
FB2	7.2	7.6	7.0	0.110	0.191	0.005
FB3	3.7	3.9	3.6	0.041	0.089	0.001
Total	39.9	41.7	38.7	0.454	0.038	< 0.001
Pellet with Viligen™						
FB1	29.4	31.3	29.4	0.719	0.837	0.041
FB2	7.3	7.7	7.3	0.190	0.748	0.083
FB3	3.8	3.9	3.7	0.110	0.676	0.224
Total	40.5	43.0	40.4	1.090	0.800	0.055

[1]Fumonisin was analyzed using HPLC (Neogen, Lansing, MI).