Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 10 *Swine Day (1968-2014)*

Article 1101

2007

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J R. Bergstrom

Michael D. Tokach

Jim L. Nelssen

See next page for additional authors

Recommended Citation

Bergstrom, J R.; Tokach, Michael D.; Nelssen, Jim L.; DeRouchey, Joel M.; Goodband, Robert D.; and Dritz, Steven S. (2007) "An evaluation of an enzyme blend (natuzyme®) in diets for weanling pigs," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 10. https://doi.org/10.4148/2378-5977.6941

An evaluation of an enzyme blend (natuzyme®) in diets for weanling pigs

Abstract

Two experiments were conducted to evaluate the effects of an enzyme blend (NatuzymeÂ®) on nursery pig growth performance. In Exp. 1, a total of 210 pigs (initially 13.6 lb) were used in a 35-d experiment to evaluate the effect of increasing levels of NatuzymeÂ® (0, 0.035, and 0.05%) on weanling pig performance. NatuzymeÂ® was added to either a negative or positive control diet as a 2 Ã— 3 factorial to form six dietary treatments. The negative control diet was a corn-soybean meal-based diet containing 12.5% soy hulls and no antibiotics. The positive control diet was a corn-soybean meal-based diet without soy hulls, and contained a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton). Pigs were blocked by weight and randomly allotted to treatment at weaning. Diets were fed in two phases from d 0 to 14 and d 14 to 35. For d 0 to 14, ADG and d 14 weight tended to improve (P<0.08) by feeding the positive control diets with a feed-grade antibiotic. There were also trends for improved (quadratic, P<0.09) ADG, ADFI, and d 14 weight with increasing NatuzymeÂ®. There were no differences in performance from d 14 to 35. For the overall trial (d 0 to 35), ADG and d 35 weight tended to be improved (linear, P<0.09; and quadratic, P<0.07; respectively) for pigs fed increasing NatuzymeÂ® and for pigs fed the positive control diets (P<0.07 and P<0.08, respectively) compared with pigs fed the negative control. In Exp. 2, a total of 180 pigs (initially 14.0 lb) were used in a 35-d experiment to further evaluate the effects of increasing NatuzymeÂ® in diets with or without an antibiotic. NatuzymeÂ® (0, 0.35, and 0.05%) was added to either a negative or positive control diet as a 2 Ã— 3 factorial to form six dietary treatments. The negative control diet was a corn-soybean meal-based diet without a feed-grade antibiotic. The positive control diet was similar to that of the negative control diet, however, it contained a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton). Pigs were blocked by weight, and at weaning, randomly allotted to treatment with two dietary phases (d 0 to 14 and d 14 to 35). From d 0 to 14, pigs fed the positive control diet had improved (P<0.01) ADG, F/G, and d 14 weight compared to pigs fed the negative control. Average daily feed intake tended to be greater (P<0.06) for pigs fed the positive control diets. Also, pigs fed increasing NatuzymeÂ® had improved ADG, F/G, and d 14 weight (linear, P<0.05). From d 14 to 35, pigs fed increasing NatuzymeÂ® had poorer F/G (linear, P<0.05). Overall (d 0 to 35), ADG, ADFI, and d 35 weight were improved (P<0.01) for pigs fed the positive control compared to the negative control diet. When the observations for pigs fed the positive control diets (diets containing feed-grade antibiotic) in both experiments were combined, ADG from d 14 to 35 was improved (linear, P<0.06 and quadratic, P<0.02) with increasing NatuzymeÂ®. Also, pigs fed increasing NatuzymeÂ® had improved ADFI from d 14 to 35 (linear, P<0.03 and quadratic, P<0.01). Overall (d 0 to 35), ADG, ADFI, and d 35 weight were improved (linear and quadratic, P<0.05) by including NatuzymeÂ® in the diet. In conclusion, pigs fed diets containing a feed-grade antibiotic had improved growth performance. The addition of NatuzymeÂ® to corn-soybean meal-based diets also improved pig performance, particularly when included in diets containing a feed-grade antibiotic. However, in these studies, there did not appear to be a benefit to feeding more than 0.035% NatuzymeÂ®.; Swine Day, 2007, Kansas State University, Manhattan, KS, 2007

Keywords

Kansas Agricultural Experiment Station contribution; no. 08-121-S; Swine day, 2007; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 985; Swine; Enzymes; Antibiotics

Authors

J R. Bergstrom, Michael D. Tokach, Jim L. Nelssen, Joel M. DeRouchey, Robert D. Goodband, and Steven S. Dritz

AN EVALUATION OF AN ENZYME BLEND (NATUZYME®) IN DIETS FOR WEANLING PIGS[1]

J. R. Bergstrom, M. D. Tokach, J. L. Nelssen, S. S. Dritz[2], J. M. DeRouchey and R. D. Goodband

Summary

Two experiments were conducted to evaluate the effects of an enzyme blend (Natuzyme®) on nursery pig growth performance. In Exp. 1, a total of 210 pigs (initially 13.6 lb) were used in a 35-d experiment to evaluate the effect of increasing levels of Natuzyme® (0, 0.035, and 0.05%) on weanling pig performance. Natuzyme® was added to either a negative or positive control diet as a 2 × 3 factorial to form six dietary treatments. The negative control diet was a corn-soybean meal-based diet containing 12.5% soy hulls and no antibiotics. The positive control diet was a corn-soybean meal-based diet without soy hulls, and contained a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton). Pigs were blocked by weight and randomly allotted to treatment at weaning. Diets were fed in two phases from d 0 to 14 and d 14 to 35. For d 0 to 14, ADG and d 14 weight tended to improve ($P<0.08$) by feeding the positive control diets with a feed-grade antibiotic. There were also trends for improved (quadratic, $P<0.09$) ADG, ADFI, and d 14 weight with increasing Natuzyme®. There were no differences in performance from d 14 to 35. For the overall trial (d 0 to 35), ADG and d 35 weight tended to be improved (linear, $P<0.09$; and quadratic, $P<0.07$; respectively) for pigs fed increasing Natuzyme® and for pigs fed the positive control diets ($P<0.07$ and $P<0.08$, respectively) compared with pigs fed the negative control.

In Exp. 2, a total of 180 pigs (initially 14.0 lb) were used in a 35-d experiment to further evaluate the effects of increasing Natuzyme® in diets with or without an antibiotic. Natuzyme® (0, 0.35, and 0.05%) was added to either a negative or positive control diet as a 2 × 3 factorial to form six dietary treatments. The negative control diet was a corn-soybean meal-based diet without a feed-grade antibiotic. The positive control diet was similar to that of the negative control diet, however, it contained a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton). Pigs were blocked by weight, and at weaning, randomly allotted to treatment with two dietary phases (d 0 to 14 and d 14 to 35). From d 0 to 14, pigs fed the positive control diet had improved ($P<0.01$) ADG, F/G, and d 14 weight compared to pigs fed the negative control. Average daily feed intake tended to be greater ($P<0.06$) for pigs fed the positive control diets. Also, pigs fed increasing Natuzyme® had improved ADG, F/G, and d 14 weight (linear, $P<0.05$). From d 14 to 35, pigs fed increasing Natuzyme® had poorer F/G (linear, $P<0.05$). Overall (d 0 to 35), ADG, ADFI, and d 35 weight were improved ($P<0.01$) for pigs fed the positive control compared to the negative control diet. When the observations for pigs fed the posi-

[1]Appreciation is expressed to SEM Minerals for partial financial support of this research.

[2]Food Animal Health and Management Center, College of Veterinary Medicine.

tive control diets (diets containing feed-grade antibiotic) in both experiments were combined, ADG from d 14 to 35 was improved (linear, $P<0.06$ and quadratic, $P<0.02$) with increasing Natuzyme®. Also, pigs fed increasing Natuzyme® had improved ADFI from d 14 to 35 (linear, $P<0.03$ and quadratic, $P<0.01$). Overall (d 0 to 35), ADG, ADFI, and d 35 weight were improved (linear and quadratic, $P<0.05$) by including Natuzyme® in the diet.

In conclusion, pigs fed diets containing a feed-grade antibiotic had improved growth performance. The addition of Natuzyme® to corn-soybean meal-based diets also improved pig performance, particularly when included in diets containing a feed-grade antibiotic. However, in these studies, there did not appear to be a benefit to feeding more than 0.035% Natuzyme®.

(Key words: enzymes, antibiotics.)

Introduction

Recent increases in feed ingredient costs have motivated the swine industry to identify technologies that will improve feed utilization and reduce the cost per pound of gain. Since the mid-1980s, the addition of enzymes to animal feeds has been practiced in regions where wheat, rye, and barley are the primary feedstuffs. However, there have not been consistent improvements in growth or economic benefits to support supplementing corn-based diets with enzymes. Corn is a highly digestible energy source with relatively few antinutritional characteristics. However, continuing and intensive research and development of feed enzymes has the potential to increase their use in regions where corn is fed. In particular, the use of phytase enzyme in corn-based diets has become fairly common. The addition of phytase significantly reduces phosphorus excretion. Thus, the use of enzyme technology is improving nutrient utilization and the ability to manage nutrients in a manner that minimizes environmental impact.

Enzymes that assist animals in overcoming some of the species and/or age specific antinutritional characteristics of vegetable proteins (i.e., soybean meal) are also being developed. Therefore, products which contain a specific blend of enzymes may be able to provide multiple benefits. Natuzyme® is a commercially available enzyme blend containing α-amylase, xylanase, protease, and ß-glucanase enzymes. The objective of this experiment was to evaluate the effects of Natuzyme® on the growth performance of weanling pigs fed corn-soybean meal-based diets.

Procedures

Procedures used in both experiments were approved by the Kansas State University Animal Care and Use Committee.

Experiment 1. The experiment was conducted at the KSU Swine Teaching and Research Farm. Pens had a wire-mesh floor and provide approximately 3 ft^2 per pig. Each pen was equipped with a four-hole, dry, self-feeder and one nipple waterer to provide *ad libitum* access to feed and water. The facility was a mechanically ventilated room with a pull-plug manure storage pit.

A total of 210 pigs (initially 13.6 lb and 21 d of age) were weaned and used in a 35-d experiment to evaluate the effect of increasing Natuzyme® (0, 0.035, and 0.05%) on weanling pig performance. Pigs were blocked by weight and randomly allotted to one of six dietary treatments with five pens per treatment. Each pen contained 7 pigs. Two control diets were fed, which included a negative control diet containing 12.5% soy hulls and no feed-grade antibiotic, and a positive control diet without soy hulls that contained a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton). Natuzyme® (0, 0.035, and 0.05%) was added to each control diet at the expense of corn starch to achieve the six dietary treatments. Experimen-

tal diets were fed in meal form and fed in two dietary phases (Table 1). Phase 1 diets were fed from d 0 to 14 and Phase 2 diets were fed from d 14 to 35. Pigs and feeders were weighed on d 0, 7, 14, 21, 28, and 35 post-weaning to determine the response criteria of ADG, ADFI, and F/G.

Experiment 2. The experiment was conducted at the KSU Segregated Early-Weaning Facility. All pens had steel, "tri-bar" flooring and provided approximately 3 ft^2 per pig. Each pen was equipped with a four-hole, dry, self-feeder and one stainless-steel cup waterer to provide *ad libitum* access to feed and water. The facility was a mechanically ventilated room with a pull-plug manure storage pit.

A total of 180 pigs (initially 14.0 lb and 21 d of age) were weaned and used in a 35-d experiment to evaluate the effect of increasing levels of Natuzyme® (0, 0.035, and 0.05%) on weanling pig performance. Pigs were blocked by weight and randomly allotted to one of the six dietary treatments. Each treatment had six pens, and each pen contained 5 pigs. Two control diets were used. The negative control diet did not contain any feed-grade antibiotics, but was otherwise identical to the positive control diet in Exp. 1. The positive control diet was identical to that used in Exp. 1, and contained a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton). Natuzyme® (0, 0.035, and 0.05%) was added to each control diet at the expense of corn starch to achieve the six dietary treatments. Experimental diets were fed in meal form and maintained throughout two dietary phases (Table 2). Phase 1 diets were fed from d 0 to 14 and Phase 2 diets were fed from d 14 to 35. Pigs and feeders were weighed on d 0, 7, 14, 21, 28, and 35 post-weaning to determine the response criteria of ADG, ADFI, and F/G.

Statistical Analysis. Data in both experiments were analyzed as a randomized complete block design using the PROC MIXED procedure of SAS with pen as the experimental unit. Linear and quadratic polynomial contrasts were also used to determine the effects of increasing Natuzyme®. In addition, the data from pigs fed the positive control diets in both experiments were combined to analyze the overall effects of Natuzyme® in Phase 1 and Phase 2 diets that contained an antibiotic.

Results and Discussion

Experiment 1. There were no interactions observed ($P>0.15$) between pigs fed Natuzyme® and the those fed the control diet (Tables 3 and 4).

From d 0 to 14 (Phase 1), ADG and d 14 weight tended to be improved ($P<0.07$ and $P<0.08$, respectively) by feeding the positive control diets, and also tended to be improved (quadratic, $P<0.09$) by including Natuzyme® in the diet. Average daily feed intake also tended to be improved (quadratic, $P<0.06$) by including Natuzyme® in the diet. Feed efficiency was not influenced by dietary treatment.

There were no significant differences in performance for the Phase 2 period (d 14 to 35). Overall (d 0 to 35), pigs fed the positive control diets tended to have improved ADG ($P<0.07$) and d 35 wt ($P<0.08$). Adding Natuzyme® to the diets also tended to improve ADG (linear, $P<0.09$) and d 35 weight (quadratic, $P<0.07$). Feed efficiency was similar for all dietary treatments.

Experiment 2. For d 0 to 14, there was a trend ($P<0.08$) for a Control × Natuzyme® interaction for F/G. This resulted from the greater improvement observed when Natuzyme® was added to the negative control diet when compared to Natuzyme® addition to the positive control diet. Otherwise, ADG, F/G, and d 14 wt were improved ($P<0.01$) by feeding the positive control diets with a feed-grade antibiotic (Tables 5 and 6). Average

daily feed intake also tended to be greater ($P<0.06$) for pigs fed the positive control diets. There were also improvements (linear, $P<0.05$) in ADG, F/G, and d 14 wt associated with the inclusion of Natuzyme®.

From d 14 to 35, F/G was poorer (linear, $P<0.05$) for pigs fed Natuzyme®. For the overall trial (d 0 to 35), ADG, ADFI, and d 35 wt were increased ($P<0.01$) for pigs fed the positive control diets containing a feed-grade antibiotic.

Combined Data from Exp. 1 and 2 (Positive Controls). When the observations for the positive control diets in both experiments were combined, there were no differences in performance from d 0 to 14.

From d 14 to 35, ADG increased (linear, $P<0.06$ and quadratic, $P<0.02$) with increasing Natuzyme®. Likewise, ADFI was increased (linear, $P<0.03$ and quadratic, $P<0.01$) with increasing Natuzyme®.

Overall (d 0 to 35), ADG, ADFI, and d 35 wt were improved (linear and quadratic, $P<0.05$) by including Natuzyme® in the diet.

In summary, pigs had improved growth performance when fed diets containing a feed-grade antibiotic. Also, the addition of Natuzyme® to corn-soybean meal-based diets improved pig performance, particularly when included in a diet containing a feed-grade antibiotic. However, in these studies, there did not appear to be a benefit to feeding more than 0.035% Natuzyme®.

Table 1. Composition of Experimental Diets (Exp. 1)[a]

	Phase 1		Phase 2	
Ingredient	Negative control	Positive control	Negative control	Positive control
Corn	43.81	51.54	52.99	60.79
Soybean meal (46.5% CP)	26.21	30.14	31.09	35.00
Soy hulls	12.50	-	12.50	-
Select menhaden fish meal	3.75	3.75	-	-
Spray-dried edible whey	10.00	10.00	-	-
Corn starch	0.05	0.05	0.05	0.05
Soybean oil	1.00	1.00	-	-
Monocalcium P (21% P)	0.75	0.75	1.15	1.15
Limestone	0.60	0.75	0.90	1.00
Salt	0.35	0.35	0.35	0.35
L-lysine HCl	0.30	0.30	0.30	0.30
DL-methionine	0.14	0.13	0.14	0.13
L-threonine	0.14	0.14	0.13	0.13
Vitamin premix	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15
Antibiotic[b]	-	0.70	-	0.70
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Total lysine, %	1.50	1.55	1.40	1.45
True digestible amino acids				
Lysine, %	1.34	1.41	1.24	1.31
Isoleucine:lysine ratio, %	59	60	62	63
Leucine:lysine ratio, %	117	121	126	129
Methionine:lysine ratio, %	34	33	34	33
Met & Cys:lysine ratio, %	56	56	58	58
Threonine:lysine ratio, %	63	63	63	64
Tryptophan:lysine ratio, %	17	17	18	18
Valine:lysine ratio, %	64	66	68	69
Protein, %	21.30	22.40	20.80	21.90
ME, kcal/lb	1,440	1,514	1,417	1,492
TID lysine: ME ratio, g/Mcal	4.22	4.22	3.98	3.98
Ca, %	0.81	0.81	0.74	0.73
P, %	0.67	0.70	0.62	0.65
Available P, %	0.40	0.40	0.32	0.32

[a]Natuzyme® (0, 0.035, and 0.05%) was added to the basal diets at the expense of corn starch.
[b]Provided 140 g/ton of Neomycin and 140 g/ton of Oxytetracycline.

Table 2. Composition of Experimental Diets (Exp. 2)[a]

	Phase 1		Phase 2	
Ingredient	Negative control	Positive control	Negative control	Positive control
Corn	51.54	51.54	60.79	60.79
Soybean meal (46.5% CP)	30.14	30.14	35.00	35.00
Select menhaden fish meal	3.75	3.75	-	-
Spray-dried edible whey	10.00	10.00	-	-
Corn starch	0.05	0.05	0.05	0.05
Soybean oil	1.00	1.00	-	-
Monocalcium P (21% P)	0.75	0.75	1.15	1.15
Limestone	0.75	0.75	1.00	1.00
Salt	0.35	0.35	0.35	0.35
L-lysine HCl	0.30	0.30	0.30	0.30
DL-methionine	0.13	0.13	0.13	0.13
L-threonine	0.14	0.14	0.13	0.13
Vitamin premix	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15
Antibiotic[b]	-	0.70	-	0.70
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Total lysine, %	1.55	1.55	1.45	1.45
True digestible amino acids				
Lysine, %	1.41	1.41	1.31	1.31
Isoleucine:lysine ratio, %	60	60	63	63
Leucine:lysine ratio, %	121	121	129	129
Methionine:lysine ratio, %	33	33	33	33
Met & Cys:lysine ratio, %	56	56	58	58
Threonine:lysine ratio, %	63	63	64	64
Tryptophan:lysine ratio, %	17	17	18	18
Valine:lysine ratio, %	66	66	69	69
Protein, %	22.40	22.40	21.90	21.90
ME, kcal/lb	1,514	1,514	1,492	1,492
TID lysine: ME ratio, g/Mcal	4.22	4.22	3.98	3.98
Ca, %	0.81	0.81	0.73	0.73
P, %	0.70	0.70	0.65	0.65
Available P, %	0.40	0.40	0.32	0.32

[a]Natuzyme® (0, 0.035, and 0.05%) was added to the basal diets at the expense of corn starch.
[b]Provided 140 g/ton of Neomycin and 140 g/ton of Oxytetracycline.

Table 3. The Effect of Dietary Addition of Natuzyme® on Nursery Pig Growth Performance – Interactive Means (Exp. 1)[a]

								P <			
		Negative control [b]			Positive control [b]				Negative vs		Enzyme [c]	
Item	Natuzyme®, %	0	0.035	0.05	0	0.035	0.05	SE Mean	Positive	Enzyme	Linear	Quadratic
D 0 to 14												
ADG, lb		0.37	0.45	0.43	0.45	0.52	0.45	0.04	0.07	0.12	-	0.09
ADFI, lb		0.42	0.52	0.48	0.49	0.56	0.48	0.04	-	0.10	-	0.06
F/G		1.13	1.16	1.12	1.09	1.06	1.07	0.06	-	-	-	-
D 14 to 35												
ADG, lb		1.28	1.28	1.26	1.24	1.36	1.33	0.04	-	-	-	-
ADFI, lb		1.84	1.86	1.81	1.80	1.97	1.89	0.07	-	-	-	-
F/G		1.43	1.46	1.43	1.46	1.44	1.42	0.03	-	-	-	-
Overall, D 0 to 35												
ADG, lb		0.91	0.94	0.93	0.92	1.03	0.98	0.03	0.07	0.08	0.09	0.12
ADFI, lb		1.26	1.32	1.27	1.27	1.40	1.32	0.05	-	0.14	-	0.10
F/G		1.38	1.40	1.37	1.38	1.36	1.35	0.02	-	-	-	-
Pig weight, lb												
D 0 wt, lb		13.63	13.62	13.62	13.63	13.62	13.63	0.84	-	-	-	-
D 14 wt, lb		18.88	19.93	19.67	19.87	20.96	19.89	1.06	0.08	0.12	-	0.09
D 35 wt, lb		46.01	47.00	46.20	45.97	49.58	47.83	1.52	0.08	0.06	0.12	0.07

[a]A total of 210 pigs were used in a 35-day experiment with five replications and 7 pigs per pen. Diets were fed in two phases with phase 1 from d 0 to 14 after weaning, and phase 2 from d 14 to 35.
[b]The negative control diet contained 12.5% soy hulls and no feed-grade antibiotic. The positive control diet did not contain soy hulls, but did contain a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton).
[c]No Interactions, $P>0.15$.

Table 4. The Effect of Dietary Addition of Natuzyme® on Nursery Pig Growth Performance – Main Effects (Exp. 1) [a]

	Controls		Natuzyme®, %				*P* <			
						SE	Negative vs		Enzyme[c]	
Item	Negative[b]	Positive[b]	0	0.035	0.05	Mean	Positive	Enzyme	Linear	Quadratic
D 0 to 14										
ADG, lb	0.42	0.47	0.41	0.49	0.44	0.04	0.07	0.12	-	0.09
ADFI, lb	0.47	0.51	0.45	0.54	0.48	0.04	-	0.10	-	0.06
F/G	1.14	1.07	1.11	1.11	1.09	0.06	-	-	-	-
D 14 to 35										
ADG, lb	1.27	1.31	1.26	1.32	1.30	0.04	-	-	-	-
ADFI, lb	1.83	1.89	1.82	1.92	1.85	0.07	-	-	-	-
F/G	1.44	1.44	1.45	1.45	1.42	0.03	-	-	-	-
Overall, D 0 to 35										
ADG, lb	0.93	0.97	0.91	0.98	0.95	0.03	0.07	0.08	0.09	0.12
ADFI, lb	1.29	1.33	1.26	1.36	1.30	0.05	-	0.14	-	0.10
F/G	1.38	1.37	1.38	1.38	1.36	0.02	-	-	-	-
Pig weight, lb										
D 0 wt, lb	13.63	13.63	13.63	13.62	13.63	0.84	-	-	-	-
D 14 wt, lb	19.49	20.24	19.37	20.45	19.78	1.06	0.08	0.12	-	0.09
D 35 wt, lb	46.41	47.79	45.99	48.29	47.02	1.52	0.08	0.06	0.12	0.07

[a]A total of 210 pigs were used in a 35-day experiment with five replications and 7 pigs per pen. Diets were fed in two phases with phase 1 from d 0 to 14 after weaning, and phase 2 from d 14 to 35.
[b]The negative control diet contained 12.5% soy hulls and no feed-grade antibiotic. The positive control diet did not contain soy hulls, but did contain a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton).
[c]No Interactions, $P>0.15$.

Table 5. The Effect of Dietary Addition of Natuzyme® on Nursery Pig Growth Performance – Interactive Means (Exp. 2) [a]

								P <			
	Negative control [b]			Positive control [b]			SE	Negative vs		Enzyme[c]	
Item Natuzyme®, %	0	0.035	0.05	0	0.035	0.05	Mean	Positive	Enzyme	Linear	Quadratic
D 0 to 14											
ADG, lb	0.21	0.29	0.29	0.30	0.34	0.35	0.03	0.01	0.10	0.04	-
ADFI, lb	0.34	0.37	0.37	0.38	0.41	0.42	0.03	0.06	-	-	-
F/G	1.66	1.30	1.38	1.27	1.25	1.23	0.09	0.003	0.04	0.02	-
D 14 to 35											
ADG, lb	1.02	0.99	1.01	1.09	1.15	1.09	0.03	0.001	-	-	-
ADFI, lb	1.36	1.34	1.39	1.51	1.62	1.54	0.05	0.001	-	-	-
F/G	1.33	1.35	1.37	1.38	1.41	1.42	0.02	0.001	0.11	0.04	-
Overall, D 0 to 35											
ADG, lb	0.70	0.71	0.72	0.78	0.82	0.79	0.03	0.001	-	-	-
ADFI, lb	0.95	0.95	0.97	1.06	1.12	1.09	0.04	0.001	-	-	-
F/G	1.36	1.34	1.36	1.36	1.37	1.38	0.02	-	-	-	-
Pig weight, lb											
D 0 wt, lb	14.00	14.01	14.03	14.00	14.01	14.01	0.79	-	-	-	-
D 14 wt, lb	16.95	18.02	18.00	18.23	18.72	18.90	0.87	0.01	0.10	0.04	-
D 35 wt, lb	38.45	38.81	39.47	41.18	43.15	42.00	1.24	0.001	-	-	-

[a]A total of 180 pigs were weaned at an avg. 14.01 lb BW and used in a 35-day experiment with six replications and 5 pigs per pen. Diets were fed in two phases with phase 1 from d 0 to 14 after weaning, and phase 2 from d 14 to 35.

[b]The negative control diet did not contain a feed-grade antibiotic, and the positive control diet contained Neo-Terramycin at 140 g of neomycin and 140 g of oxytetracycline per ton.

[c]Tendency for an interaction ($P<0.08$) for D 0 to 14 F:G. All other, $P>0.15$.

Table 6. The Effect of Dietary Addition of Natuzyme® on Nursery Pig Growth Performance – Main Effects (Exp. 2) [a]

	Controls		Natuzyme®, %			SE	*P* <			
							Negative vs		Enzyme [c]	
Item	Negative[b]	Positive[b]	0	0.035	0.05	Mean	Positive	Enzyme	Linear	Quadratic
D 0 to 14										
ADG, lb	0.26	0.33	0.26	0.31	0.32	0.03	0.01	0.10	0.04	-
ADFI, lb	0.36	0.40	0.36	0.39	0.40	0.03	0.06	-	-	-
F/G	1.45	1.25	1.46	1.28	1.30	0.09	0.003	0.04	0.02	-
D 14 to 35										
ADG, lb	1.01	1.11	1.06	1.07	1.05	0.03	0.001	-	-	-
ADFI, lb	1.36	1.56	1.44	1.48	1.46	0.05	0.001	-	-	-
F/G	1.35	1.40	1.36	1.38	1.39	0.02	0.001	0.11	0.04	-
Overall, D 0 to 35										
ADG, lb	0.71	0.79	0.74	0.76	0.75	0.03	0.001	-	-	-
ADFI, lb	0.96	1.09	1.00	1.04	1.03	0.04	0.001	-	-	-
F/G	1.35	1.37	1.36	1.36	1.37	0.02	-	-	-	-
Pig weight, lb										
D 0 wt, lb	14.01	14.01	14.00	14.01	14.02	0.79	-	-	-	-
D 14 wt, lb	17.66	18.62	17.59	18.37	18.45	0.87	0.01	0.10	0.04	-
D 35 wt, lb	38.91	42.11	39.82	40.98	40.74	1.24	0.001	-	-	-

[a]A total of 180 pigs were weaned at an avg. 14.01 lb BW and used in a 35-day experiment with six replications and 5 pigs per pen. Diets were fed in two phases with phase 1 from d 0 to 14 after weaning, and phase 2 from d 14 to 35.

[b]The negative control diet did not contain a feed-grade antibiotic, and the positive control diet contained Neo-Terramycin at 140 g of neomycin and 140 g of oxytetracycline per ton.

[c]Tendency for an interaction ($P<0.08$) for D 0 to 14 F:G. All other, $P>0.15$.

Table 7. The Effect of Dietary Addition of Natuzyme® on Nursery Pig Growth Performance (Exp. 1 and 2 Combined, Positive Controls Only) [a]

	Natuzyme®, %				*P* <	
Item	0	0.035	0.05	SE Mean	Linear	Quadratic
D 0 to 14						
ADG, lb	0.37	0.42	0.39	0.03	-	-
ADFI, lb	0.43	0.47	0.45	0.03	-	-
F/G	1.19	1.17	1.15	0.05	-	-
D 14 to 35						
ADG, lb	1.16	1.25	1.20	0.04	0.06	0.02
ADFI, lb	1.64	1.78	1.70	0.06	0.03	0.005
F/G	1.42	1.42	1.42	0.02	-	-
Overall, D 0 to 35						
ADG, lb	0.84	0.91	0.87	0.03	0.04	0.02
ADFI, lb	1.15	1.25	1.19	0.04	0.05	0.01
F/G	1.37	1.37	1.37	0.01	-	-
Pig weight, lb						
D 0 wt, lb	13.83	13.83	13.84	0.55	-	-
D 14 wt, lb	18.97	19.74	19.35	0.67	-	-
D 35 wt, lb	43.36	46.07	44.65	1.15	0.007	0.003

[a]A total of 195 pigs were used from two 35-day experiments. The positive controls from Exp. 1 and 2 were combined to provide eleven replications and 65 pigs per treatment. Diets were fed in two phases with phase 1 from d 0 to 14 after weaning, and phase 2 from d 14 to 35.