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Effect of the Feed Additive Fytera Start on Growth Performance and Stool Quality of Nursery Pigs Fed Nutritional and Pharmacological Copper and Zinc Diets

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Effect of the Feed Additive Fytera Start on Growth Performance and Stool Quality of Nursery Pigs Fed Nutritional and Pharmacological Copper and Zinc Diets[1]

Ty H. Kim, Jason C. Woodworth, Mike D. Tokach, Joel M. DeRouchey, Robert D. Goodband, Jordan T. Gebhardt,[2] and Chris P. A. van de Ligt[3]

Summary

A total of 340 barrows (DNA 200 × 400; initially 13.4 ± 0.17 lb BW) were used in a 38-d growth study to determine the effect of Fytera Start (Selko, Indianapolis, IN) in diets with or without pharmacological levels of Zn and Cu on growth performance and stool quality of nursery pigs. Fytera Start is a blend of botanical extracts that has recently been introduced for use in nursery pig diets. Pigs were weaned at approximately 21 d of age, randomly allotted to pens based on initial BW, and then allotted to 1 of 4 dietary treatments in a completely randomized design. There were 5 pigs per pen and 17 pens per treatment across two barns. Treatment diets were formulated in three dietary phases and fed from d 0 to 10, d 10 to 21, and d 21 to 38, respectively. Treatments were arranged in a 2 × 2 factorial with main effects of Fytera Start (none or 100 ppm) and nutritional vs. pharmacological levels of Zn and Cu. The nutritional mineral concentrations were 110 ppm Zn and 16.5 ppm Cu throughout phases 1 to 3. The pharmacological mineral concentrations were 3,000, 2,000, and 110 ppm Zn in phases 1, 2, and 3, respectively, combined with 250 ppm Cu throughout phases 1 to 3. To achieve expected levels of Zn and Cu in the diet, Zn from zinc oxide and Cu from copper sulfate were added. On d 0, there was an unintentional main effect of Fytera Start ($P = 0.008$) on BW. As a result, d 0 BW was used as a covariate for all other growth performance responses. From d 0 to 21 and d 0 to 38, there was a Fytera Start × Zn/Cu interaction on ADG and ADFI ($P < 0.05$) in which the addition of Fytera Start resulted in a numeric increase in ADG and ADFI in pigs not fed pharmacological levels of Zn/Cu; however, in pigs fed pharmacological levels of Zn/Cu, the inclusion of Fytera Start resulted in a numeric reduction in ADG and ADFI. There was a tendency for a main effect of Zn/Cu level on overall feed efficiency ($P < 0.10$) where pharmacological levels of Zn/Cu improved feed efficiency. For fecal dry matter, there was a Zn/Cu × day interaction ($P = 0.001$) in which there was no difference in fecal DM regardless of Zn/Cu level on d 10 ($P > 0.10$), but pigs fed pharmacological levels

[1] Appreciation is expressed to Micronutrients USA LLC DBA Selko USA (Indianapolis, IN) for partial financial support of this trial.
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of Zn/Cu had lower fecal DM ($P < 0.001$) compared to those not fed pharmacological levels of Zn/Cu on d 21. There was a main effect of day resulting in increased fecal DM ($P < 0.001$) on d 10 compared to d 21. There was a main effect of day on fecal score ($P = 0.010$) resulting in a lower frequency of softer feces at d 10 compared to d 21. The lower frequency of softer feces observed on d 10 is consistent with the higher fecal DM on d 10 compared to d 21. In summary, feeding pharmacological levels of Zn and Cu resulted in increased BW, ADG, and ADFI. The inclusion of Fytera Start numerically increased BW, ADG, and ADFI in pigs fed nutritional levels of Zn/Cu and numerically decreased BW, ADG, and ADFI in pigs fed pharmacological levels of Zn/Cu. There was no impact of Fytera Start or Zn and Cu level on fecal DM on d 10. However, feeding pharmacological levels of Zn and Cu resulted in lower fecal DM at d 21. Fecal DM was higher on d 10 compared to d 21, and fecal score was numerically lower on d 10 compared to d 21.

Introduction

Feed additives are commonly included in nursery pig diets to improve gut health and promote growth. Pharmacological levels of Zn from zinc oxide and Cu from copper sulfate are the most commonly used. However, the use of high levels of zinc or copper may be limited in the future, and alternative ingredients that can elicit similar performance benefits need to be investigated. Another class of feed additives that are increasing in popularity are phytogenics, or botanicals, which are derived from plants. Phytogenic feed additives are believed to have anti-inflammatory activity and antimicrobial and antioxidant properties while also having the ability to improve feed flavor and palatability.[4] As a result, these properties could lead to increased feed intake and performance comparable to that observed with pharmacological additions of Zn or Cu.

Fytera Start (Selko, Indianapolis, IN) is a blend of botanical actives that recently has been introduced for use in nursery pig diets. However, it has not been tested when included in diets containing pharmacological levels of Zn and Cu. Therefore, the objective of this study was to evaluate the effect of Fytera Start on growth performance and stool quality of nursery pigs when included in diets with or without pharmacological levels of Zn and Cu.

Procedures

The protocol used in this experiment was approved by the Kansas State University Institutional Animal Care and Use Committee. The study was conducted at the Kansas State University Segregated Early Weaning facility in Manhattan, KS. The facility has two identical barns that are completely enclosed, environmentally controlled, and mechanically ventilated. Each pen contained a 4-hole, dry self-feeder and a cup waterer for *ad libitum* access to feed and water. Pens (4 × 4 ft) had metal tri-bar floors and allowed approximately 2.7 ft^2/pig.

A total of 340 barrows (DNA 200 × 400; initially 13.4 ± 0.17 lb BW) were used in a 38-d growth study. Pigs were weaned at approximately 21 d of age, randomly allotted to pens based on initial BW, and then allotted to 1 of 4 dietary treatments in a completely

[4] Windisch, W., K. Schedle, C. Plitzner, and A. Kroismayr. 2008. Use of phytogenic products as feed additives for swine and poultry. Journal of Animal Science. 86:140-148. doi:10.2527/jas.2007-0459

randomized design. There were 5 pigs per pen and 17 pens per treatment across two barns (8 replicate pens in one barn and 9 replicate pens in one barn).

Treatments were arranged in a 2 × 2 factorial with main effects of Fytera Start (none or 100 ppm) and nutritional vs. pharmacological levels of Zn and Cu. The nutritional mineral concentrations were 110 ppm Zn and 16.5 ppm Cu throughout phases 1 to 3. The pharmacological mineral concentrations were 3,000, 2,000, and 110 ppm Zn in phases 1, 2, and 3, respectively, combined with 250 ppm Cu throughout phases 1 to 3. To achieve expected levels of Zn and Cu in the diet, Zn from zinc oxide and Cu from copper sulfate were added. The experimental diets were manufactured at the Kansas State University O.H. Kruse Feed Technology Innovation Center in Manhattan, KS. Phase 1 diets were in pellet form, and phase 2 and 3 diets were in meal form. Complete diet samples were taken during bagging of experimental diets from every fourth bag and pooled into one homogenized sample per dietary treatment. Samples were stored at -4°F until they were submitted for proximate and mineral analysis (Cumberland Valley Analytical Services, Waynesboro, PA).

Individual pigs were weighed and feed disappearance was recorded on d 0, 10, 17, 21, 31, and 38 to determine ADG, ADFI, and feed efficiency. Feed delivered was recorded for each pen.

Fecal samples were collected from the same three randomly selected pigs in each pen on d 10 and 21 of the experiment for fecal scoring and fecal dry matter analysis. Immediately after collection, the same individual assigned a score of 0, 1, or 2 to each sample with 0 being hard, 1 being soft, and 2 being diarrhea. Scores of samples were maintained separately for each pig and all 3 observations per pen were used for statistical analysis. After collection, fecal samples were dried at 55°C (131°F) in a forced air oven for 48 h, and the ratio of dried to wet fecal weight determined the fecal dry matter. Fecal samples were maintained separately for each pig and the average of the three samples from each pen was then used for statistical analysis.

Data analysis

Growth performance data were analyzed as a completely randomized design with pen serving as the experimental unit. Body weight at d 0 was used as a covariate for all responses except d 0 BW. The main effects of Fytera Start and Zn/Cu, as well as their interactions, were tested. Fecal DM data were analyzed as a completely randomized design with pen as the experimental unit with the fixed effects of day, treatment, and the associated interaction accounting for repeated measures over time. For fecal score analysis, data were analyzed as ordinal outcomes using a generalized linear mixed model using a multinomial response distribution using a cumulative logit link function. Pen was included in the model as a random intercept to account for multiple fecal score observations for each pen on each day. Data were summarized using the FREQ procedure of SAS and reported as percentage of observations within each fecal score category by Fytera Start inclusion, Zn/Cu inclusion, and day. Growth and fecal DM data were analyzed using the lmer package of R (version 4.2.2 (2022-10-31)). Fecal score data were analyzed using the FREQ and GLIMMIX procedures of SAS (v. 9.4, SAS Institute, Inc., Cary, NC). Differences were considered significant at $P \leq 0.05$ and marginally significant at $0.05 < P \leq 0.10$.

Results and Discussion

Analyzed Zn and Cu levels for all three phases were similar to the calculated values used in formulation (Tables 1 to 3).

There was an unintentional main effect of Fytera Start ($P = 0.008$) on d 0 BW. As a result, d 0 BW was used as a covariate for all other growth performance responses.

From d 0 to 10 (phase 1), there was a main effect of added Zn/Cu resulting in increased ADG, ADFI, and improved feed efficiency ($P < 0.001$) in pigs fed pharmacological levels of Zn/Cu. As a result, there was a main effect of added Zn/Cu ($P < 0.001$) on d 10 BW with pigs fed pharmacological levels being heavier than those not fed pharmacological Zn/Cu.

From d 10 to 21 (phase 2), there was a Fytera Start × Zn/Cu interaction observed for ADG and ADFI ($P < 0.05$) in which the addition of Fytera Start resulted in a numeric increase in ADG and ADFI in pigs not fed pharmacological levels of Zn/Cu; however, in pigs fed pharmacological levels of Zn/Cu, the inclusion of Fytera Start resulted in a numeric reduction in ADG and ADFI. As a result, there was a Fytera Start × Zn/Cu interaction on d 17 and d 21 BW ($P < 0.05$) in which the inclusion of Fytera Start numerically increased BW in pigs not fed pharmacological levels of Zn/Cu, but the addition of Fytera Start numerically decreased BW in pigs fed pharmacological levels of Zn/Cu. There was also a main effect of pharmacological Zn/Cu resulting in improved feed efficiency ($P = 0.034$).

From d 0 to 21 (phase 1 and 2), there was a Fytera Start × Zn/Cu interaction observed for ADG and ADFI ($P < 0.05$) in which the addition of Fytera Start resulted in a numeric increase in ADG and ADFI in pigs not fed pharmacological levels of Zn/Cu; however, in pigs fed pharmacological levels of Zn/Cu, the inclusion of Fytera Start resulted in a numeric reduction in ADG and ADFI.

From d 21 to 38 (phase 3), there was a Fytera Start × Zn/Cu interaction on ADG ($P < 0.05$) in which the addition of Fytera Start resulted in a numeric increase in ADG in pigs not fed pharmacological levels of Zn/Cu; however, in pigs fed pharmacological levels of Zn/Cu, the inclusion of Fytera Start resulted in a numeric reduction in ADG. As a result, there was a Fytera Start × Zn/Cu interaction on d 31 BW ($P < 0.05$) in which the inclusion of Fytera Start numerically increased BW in pigs not fed pharmacological levels of Zn/Cu, but the addition of Fytera Start numerically decreased BW in pigs fed pharmacological levels of Zn/Cu. There was a main effect of pharmacological additions of Zn/Cu on ADFI ($P = 0.029$) where ADFI was increased in pigs fed pharmacological additions of Zn/Cu. There was a tendency for a Fytera Start × Zn/Cu interaction on feed efficiency ($P = 0.078$).

From d 0 to 38 (overall), there was a Fytera Start × Zn/Cu interaction on ADG and ADFI ($P < 0.05$) in which the addition of Fytera Start numerically increased ADG and ADFI in pigs not fed pharmacological levels of Zn/Cu; however, in pigs fed pharmacological levels of Zn/Cu, the inclusion of Fytera Start numerically decreased ADG and ADFI. On d 38, there was a Fytera Start × Zn/Cu interaction on BW ($P < 0.05$) in which the inclusion of Fytera Start numerically increased BW in pigs not fed pharmacological levels of Zn/Cu, but the addition of Fytera Start numerically decreased BW in pigs fed pharmacological levels of Zn/Cu. There was a tendency for a main effect of Zn/Cu level on overall feed efficiency ($P < 0.10$) with pigs fed pharmacological additions of Zn/Cu being more efficient than those fed nutritional levels of Zn/Cu.

For fecal dry matter, there was a Zn/Cu × day interaction ($P = 0.001$) in which there was no difference in fecal DM regardless of Zn/Cu level on d 10 ($P > 0.10$), but pigs fed pharmacological levels of Zn/Cu had lower fecal DM ($P < 0.001$) compared to those not fed pharmacological levels of Zn/Cu on d 21. There was a main effect of day resulting in higher fecal DM ($P < 0.001$) on d 10 compared to d 21. There was a main effect of day on fecal score ($P = 0.010$) resulting in a lower frequency of softer feces at d 10 compared to d 21. The lower frequency of softer feces observed on d 10 is consistent with the higher fecal DM on d 10 compared to d 21.

In summary, feeding pharmacological levels of Zn and Cu resulted in increased BW, ADG, and ADFI. The inclusion of Fytera Start numerically increased BW, ADG, and ADFI in pigs fed nutritional levels of Zn/Cu and numerically decreased BW, ADG, and ADFI in pigs fed pharmacological levels of Zn/Cu. There was no impact of Fytera Start or Zn and Cu level on fecal DM on d 10. However, feeding pharmacological levels of Zn and Cu resulted in lower fecal DM at d 21. Fecal DM was higher on d 10 compared to d 21, and fecal score was numerically lower on d 10 compared to d 21.

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Table 1. Composition of phase 1 diets (as-fed basis)[1]

	Zn/Cu[2]:	Low		High	
Ingredient, %	Fytera Start[3]:	No	Yes	No	Yes
Corn		45.29	45.28	44.76	44.75
Soybean meal, 46.5% CP[4]		15.60	15.60	15.63	15.64
Fish meal		4.50	4.50	4.50	4.50
Whey powder		25.00	25.00	25.00	25.00
HP 300		5.00	5.00	5.00	5.00
Soybean oil		2.00	2.00	2.00	2.00
Limestone		0.25	0.25	0.25	0.25
Monocalcium P		0.65	0.65	0.65	0.65
Salt		0.30	0.30	0.30	0.30
L-Lys-HCl		0.40	0.40	0.40	0.40
DL-Met		0.21	0.21	0.21	0.21
L-Thr		0.18	0.18	0.18	0.18
L-Trp		0.04	0.04	0.04	0.04
L-Val		0.13	0.13	0.13	0.13
Trace mineral premix		0.15	0.15	0.15	0.15
Vitamin premix without phytase		0.25	0.25	0.25	0.25
Ronozyme HiPhos 2700[5]		0.06	0.06	0.06	0.06
Zinc oxide		----	----	0.40	0.40
Copper sulfate		----	----	0.09	0.09
Fytera Start		----	0.01	----	0.01
Total		100	100	100	100
Calculated analysis					
CP, %		20.5	20.5	20.4	20.4
Ca, %		0.71	0.71	0.71	0.71
STTD P, %		0.63	0.63	0.63	0.63
Analyzed Ca:P ratio		1.00	1.00	1.00	1.00
Zn, ppm		110	110	3,000	3,000
Cu, ppm		16.5	16.5	250	250
Fytera Start, ppm		----	100	----	100
Analyzed composition[6]					
Zn, ppm		149	154	3,103	2,597
Cu, ppm		23.4	21.6	250.1	258.3

[1]Diets were fed from d 0 to d 10.
[2]Zinc from zinc oxide and copper from copper sulfate.
[3]Fytera Start (Selko, Indianapolis, IN) is a blend of botanical actives.
[4]CP = crude protein.
[5]Ronozyme HiPhos (DSM, Parsippany, NJ) included at 1,486 FYT/kg provided an estimated release of 0.12% STTD P.
[6]Complete diet samples were taken during bagging of experimental diets from every fourth bag and pooled into one homogenized sample per dietary treatment. Samples were stored at -4°F until they were submitted for proximate and mineral analysis (Cumberland Valley Analytical Services, Waynesboro, PA).

Table 2. Composition of phase 2 diets (as-fed basis)[1]

Zn/Cu[2]:	Low		High	
Ingredient, % Fytera Start[3]:	**No**	**Yes**	**No**	**Yes**
Corn	57.57	57.55	57.18	57.17
Soybean meal, 46.5% CP[4]	23.32	23.32	23.34	23.35
Whey powder	10.00	10.00	10.00	10.00
HP 300	5.00	5.00	5.00	5.00
Limestone	0.83	0.83	0.83	0.83
Monocalcium P	1.18	1.18	1.18	1.18
Salt	0.55	0.55	0.55	0.55
L-Lys-HCl	0.50	0.50	0.50	0.50
DL-Met	0.22	0.22	0.22	0.22
L-Thr	0.22	0.22	0.22	0.22
L-Trp	0.04	0.04	0.04	0.04
L-Val	0.14	0.14	0.14	0.14
Trace mineral premix	0.15	0.15	0.15	0.15
Vitamin premix without phytase	0.25	0.25	0.25	0.25
Ronozyme HiPhos 2700[5]	0.06	0.06	0.06	0.06
Zinc oxide	----	----	0.26	0.26
Copper sulfate	----	----	0.09	0.09
Fytera Start	----	0.01	----	0.01
Total	100	100	100	100
Calculated analysis				
CP, %	20.7	20.7	20.7	20.7
Ca, %	0.77	0.77	0.77	0.77
STTD P, %	0.56	0.56	0.56	0.56
Analyzed Ca:P ratio	1.14	1.14	1.14	1.14
Zn, ppm	110	110	2,000	2,000
Cu, ppm	16.5	16.5	250	250
Fytera Start, ppm	----	100	----	100
Analyzed composition[6]				
Zn, ppm	141	143	2,069	1,990
Cu, ppm	20.7	24.3	265.5	268.8

[1]Diets were fed from d 10 to d 21.
[2]Zinc from zinc oxide and copper from copper sulfate.
[3]Fytera Start (Selko, Indianapolis, IN) is a blend of botanical actives.
[4]CP = crude protein.
[5]Ronozyme HiPhos (DSM, Parsippany, NJ) included at 1,486 FYT/kg provided an estimated release of 0.12% STTD P.
[6]Complete diet samples were taken during bagging of experimental diets from every fourth bag and pooled into one homogenized sample per dietary treatment. Samples were stored at -4°F until they were submitted for proximate and mineral analysis (Cumberland Valley Analytical Services, Waynesboro, PA).

Table 3. Composition of phase 3 diets (as-fed basis)[1]

Zn/Cu[2]:	Low		High	
Ingredient, % — Fytera Start[3]:	No	Yes	No	Yes
Corn	65.75	65.74	65.65	65.64
Soybean meal, 46.5% CP[4]	30.52	30.52	30.53	30.53
Limestone	0.81	0.81	0.81	0.81
Monocalcium P	0.83	0.83	0.83	0.83
Salt	0.60	0.60	0.60	0.60
L-Lys-HCl	0.48	0.48	0.48	0.48
DL-Met	0.20	0.20	0.20	0.20
L-Thr	0.21	0.21	0.21	0.21
L-Trp	0.04	0.04	0.04	0.04
L-Val	0.12	0.12	0.12	0.12
Trace mineral premix	0.15	0.15	0.15	0.15
Vitamin premix without phytase	0.25	0.25	0.25	0.25
Ronozyme HiPhos 2700[5]	0.06	0.06	0.06	0.06
Copper sulfate	----	----	0.09	0.09
Fytera Start	----	0.01	----	0.01
Total	100	100	100	100
Calculated analysis				
CP, %	20.8	20.8	20.8	20.8
Ca, %	0.65	0.65	0.65	0.65
STTD P, %	0.44	0.44	0.44	0.44
Analyzed Ca:P ratio	1.14	1.14	1.14	1.14
Zn, ppm	110	110	110	110
Cu, ppm	16.5	16.5	250	250
Fytera Start, ppm	----	100	----	100
Analyzed composition[6]				
Zn, ppm	139	164	160	128
Cu, ppm	26.0	33.2	252.5	228.2

[1]Diets were fed from d 21 to d 38.
[2]Zinc from zinc oxide and copper from copper sulfate.
[3]Fytera Start (Selko, Indianapolis, IN) is a blend of botanical actives.
[4]CP = crude protein.
[5]Ronozyme HiPhos (DSM, Parsippany, NJ) included at 1,486 FYT/kg provided an estimated release of 0.12% STTD P.
[6]Complete diet samples were taken during bagging of experimental diets from every fourth bag and pooled into one homogenized sample per dietary treatment. Samples were stored at -4°F until they were submitted for proximate and mineral analysis (Cumberland Valley Analytical Services, Waynesboro, PA).

Table 4. Interactive effect of Fytera Start and zinc and copper supplementation on nursery pig growth performance and fecal dry matter[1]

Zn/Cu[2]:	Low		High			P =		
Item[3] Fytera Start[4]:	No	Yes	No	Yes	SEM	Fytera × Zn/Cu	Fytera Start	Zn/Cu
BW, lb								
d 0	13.4	13.4	13.3	13.4	0.17	0.545	0.008	0.608
d 10	15.0	15.2	16.1	15.9	0.35	0.242	0.932	< 0.001
d 17	20.6[b]	21.3[b]	24.2[a]	23.1[a]	0.40	0.018	0.683	< 0.001
d 21	24.5[b]	25.6[b]	28.7[a]	27.5[a]	0.58	0.007	0.886	< 0.001
d 31	35.8[b]	37.4[b]	41.2[a]	39.7[a]	0.66	0.010	0.985	< 0.001
d 38	46.7[c]	48.7[bc]	52.9[a]	50.5[ab]	0.76	0.002	0.811	< 0.001
d 0 to 10 (Phase 1)								
ADG, lb	0.16	0.18	0.28	0.25	0.034	0.242	0.932	< 0.001
ADFI, lb	0.24	0.25	0.31	0.29	0.035	0.184	0.630	< 0.001
F/G	1.68	1.51	1.22	1.22	0.139	0.351	0.390	< 0.001
d 10 to 21 (Phase 2)								
ADG, lb	0.87[b]	0.94[b]	1.13[a]	1.05[a]	0.030	0.008	0.922	< 0.001
ADFI, lb	1.02[b]	1.12[b]	1.38[a]	1.28[a]	0.038	0.006	0.993	< 0.001
F/G	1.18	1.19	1.22	1.22	0.020	0.749	0.694	0.034
d 0 to 21 (Phases 1 and 2)								
ADG, lb	0.53[b]	0.58[b]	0.71[a]	0.67[a]	0.034	0.032	0.888	< 0.001
ADFI, lb	0.65[b]	0.70[b]	0.86[a]	0.81[a]	0.034	0.019	0.942	< 0.001
F/G	1.23	1.23	1.21	1.21	0.018	0.914	0.910	0.276
d 21 to 38 (Phase 3)								
ADG, lb	1.30[b]	1.36[ab]	1.42[a]	1.36[ab]	0.025	0.006	0.909	0.011
ADFI, lb	1.83	1.90	1.95	1.92	0.036	0.114	0.632	0.029
F/G	1.40	1.39	1.37	1.41	0.017	0.078	0.330	0.666
d 0 to 38 (Overall)								
ADG, lb	0.88[c]	0.92[bc]	1.03[a]	0.98[ab]	0.021	0.007	0.892	< 0.001
ADFI, lb	1.18[c]	1.23[bc]	1.35[a]	1.30[ab]	0.030	0.048	0.780	< 0.001
F/G	1.34	1.34	1.31	1.33	0.012	0.102	0.462	0.091
Fecal DM,[5] %								
d 10	25.6	23.8	25.1	25.5	0.93	0.154	0.323	0.398
d 21	24.1	23.8	20.5	21.7	0.93	0.271	0.578	< 0.001

[1]A total of 340 nursery pigs (DNA 200 × 400; initially 13.4 ± 0.17 lb BW) were used in a 38-d growth trial with 5 pigs per pen and 17 replications per treatment.
[2]Zinc from zinc oxide was included in the diet at 110 or 3,000 ppm in phase 1, 110 or 2,000 ppm in phase 2, and 110 ppm in phase 3 and copper from copper sulfate was included in the diet at 16.5 or 250 ppm throughout the 38-d study, for the Low and High treatments respectively.
[3]BW d 0 was used as a covariate for all responses except BW d 0.
[4]Fytera Start (Selko, Indianapolis, IN) is a blend of botanical actives and was included in the diet at either 0 or 100 ppm throughout the 38-d study.
[5]Fytera × Zn × Day, $P = 0.817$; Fytera × Zn/Cu, $P = 0.075$; Fytera × Day, $P = 0.275$; Zn/Cu × Day, $P = 0.001$; Fytera, $P = 0.758$; Zn/Cu, $P = 0.026$; Day, $P < 0.001$.

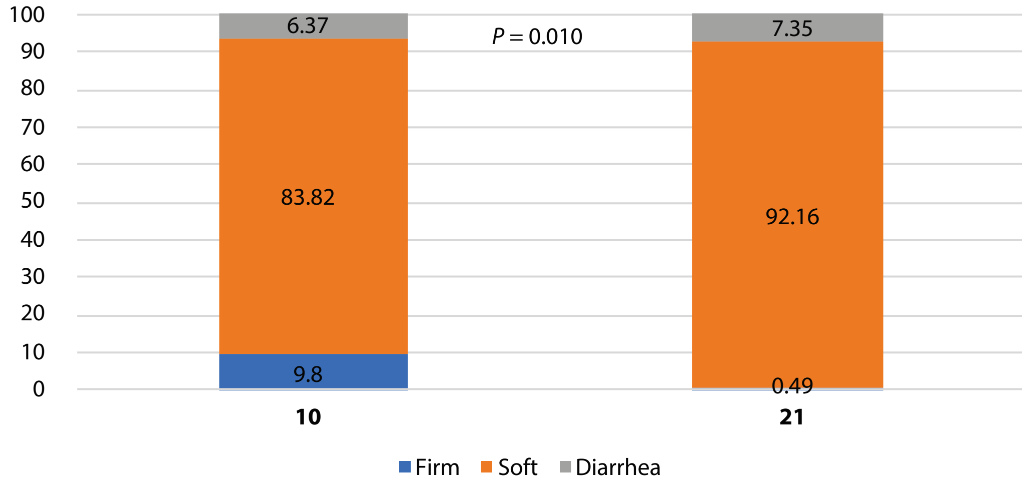

Figure 1. Fecal score frequency by day, $P = 0.010$.

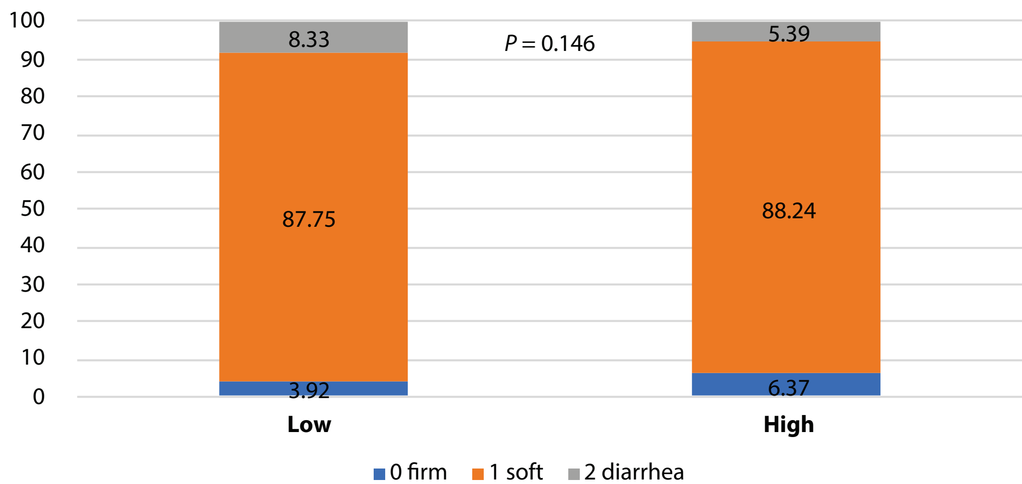

Figure 2. Fecal score frequency by Zn/Cu dietary level, $P = 0.146$.

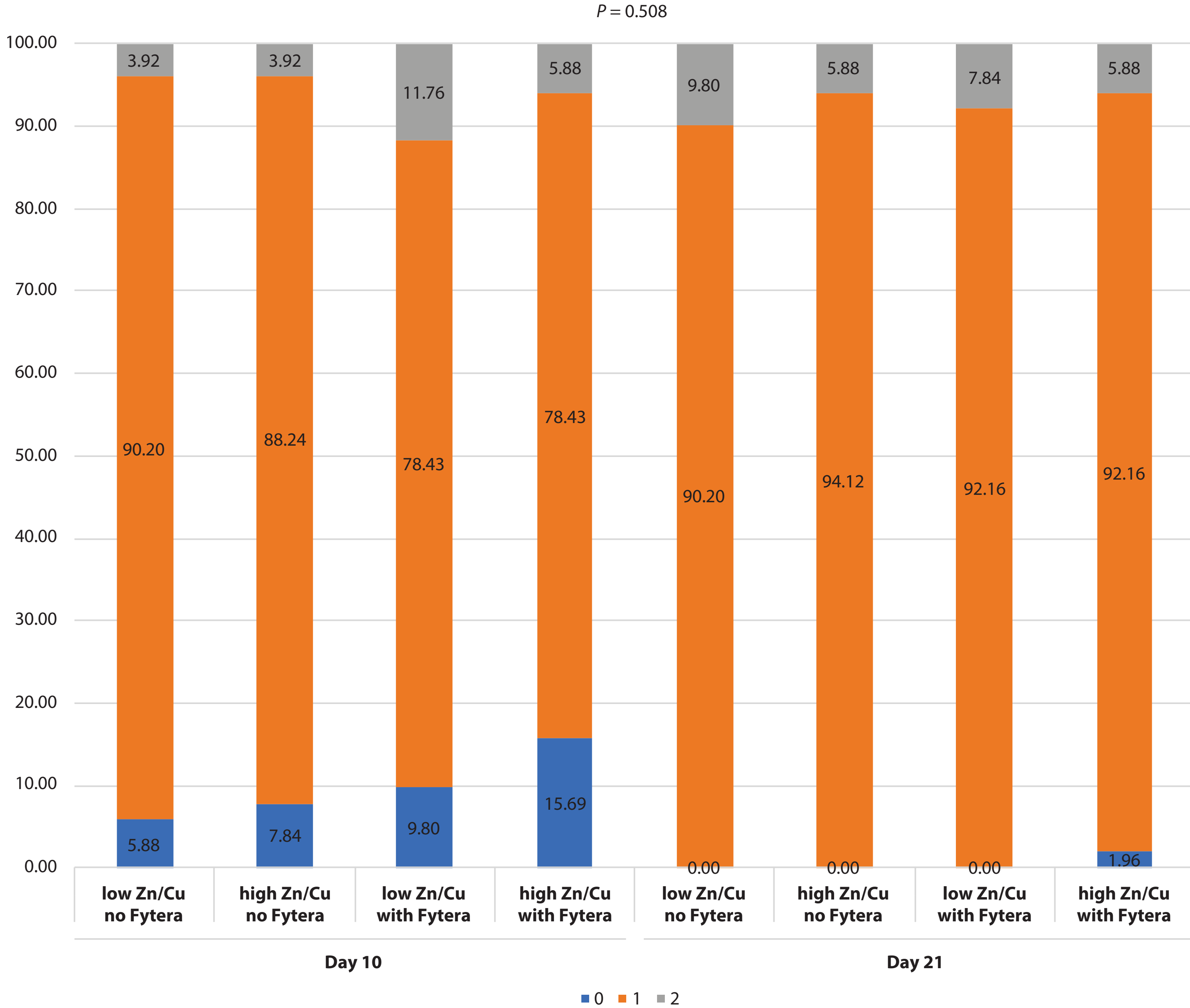

Figure 3. Interactive effect of Fytera Start, Zn/Cu dietary level, and day on fecal score frequency, $P = 0.508$.