93 Efficacy of Bacterial 6-Phytase and its Optimal Supplementation Level on Bone Parameters, Nutrient Digestibility, and Growth Performance of Nursery Pigs. Vitor H. Moita[1], Marcos E. Duarte[1], Sung Woo Kim[1], [1]*North Carolina State University*

Abstract: This study aimed to determine the optimal supplemental level of bacterial 6-phytase (CJ BIO, Korea) based on bone parameters, nutrient digestibility, and growth performance of nursery pigs. Seventy-two weaned pigs (5.8 ± 0.5 kg BW) were allotted to 6 treatments based on RCBD with initial BW and sex as blocks and fed in 3 phases (P1/P2/P3 for 14/10/14 d, respectively). The treatments consisted of a negative control diet without phytase formulated meeting requirements of NRC, (2012). The other 5 treatments were a basal diet formulated with 0.12% Ca and P deficient with increased supplemental phytase (0, 500, 1,000, 2,000, and 5,000 FTU/kg feed). Titanium dioxide (0.4%) was added to P3 diets as an indigestible marker to measure AID of nutrients. On d 45, all pigs were euthanized to collect ileal digesta to measure AID, and third metacarpus to measure bone parameters. Data were analyzed using SAS 9.4. The supplementation of phytase from 0 to 950 FTU/kg feed increased ($P < 0.05$) the ADG (0.32 to 0.40 kg/d). Increasing phytase supplementation from 0 to 5,000 FTU/kg increased (linear, $P < 0.05$) AID of CP (76.8 to 79.5%), P content (4.6 to 5.2% of DM) and ash content (26.2 to 28.8%). The supplementation of phytase from 0 to 950 FTU/kg feed increased ($P < 0.05$) P content (17.6 to 18.1% of ash) and from 0 to 1,900 FTU/kg feed increased ($P < 0.05$) bone breaking strength (222 to 329 N). Phytase supplementation (0 vs. 1,000 to 5,000 FTU/kg) increased ($P < 0.05$) AID of EE (65 to 73%), and P (79 to 84%). In conclusion, phytase supplementation improved bone breaking strength, bone ash and P content, nutrient digestibility, and growth performance. The supplementation of phytase between 950 and 1,900 FTU/kg feed provided the most benefits for growth performance, bone parameters, and nutrient digestibility.

Keywords: apparent ileal digestibility, bone breaking strength, bone mineralization, growth performance, nursery pigs, phytase

92 Effects of Increasing Dose of a Novel *E. coli* Phytase on Total Tract Digestibility of Minerals and Energy in Pigs. Su A Lee[1], Hans H. Stein[1], [1]*University of Illinois at Urbana-Champaign*

Abstract: The objective was to test the hypothesis that an increasing dose of a novel thermostable 6-phytase that was derived from *E. coli* and expressed in a Pichia Pastoris yeast (Superphy; Hanley International, LLC, Belmont, MA) increases apparent total tract digestibility (ATTD) of minerals and energy by pigs. Forty-eight barrows (initial weight: 22.61 kg) were housed in metabolism crates and fed 6 diets based on corn and soybean meal. The positive control (PC) diet contained P at the requirement. The negative control (NC) diet contained no feed phosphate, but contained 0, 250, 500, 1,000, or 2,000 phytase unit/kg. Feces were collected for 4 d after 5 d of adaptation. Dried and ground fecal samples were analyzed for dry matter, energy, Ca, P and other minerals. Data were analyzed using a model that included diet as fixed variable and contrast statements were used to compare PC and NC diets and to demonstrate linear and quadratic effects of phytase. Results indicated that ATTD of dry matter and energy and concentration of digestible energy in NC without phytase were greater ($P < 0.05$) than in PC, but ATTD of ash, K, Mg, Na, Cu, Fe, Mn, and Zn was not different between the 2 diets. There was no effect of phytase on ATTD of dry matter and energy or on digestible energy in diets. As dietary phytase increased, ATTD of ash and Mg increased (linear, $P < 0.05$) and ATTD of Ca and the standardized total tract digestibility (STTD) of P also increased (quadratic, $P < 0.05$), but ATTD of K, Na, Cu, Fe, Mn, and Zn was not affected by phytase. In conclusion, the novel enhanced *E. Coli* based phytase increased ATTD of Ca, P, and Mg and STTD of P if included in a diet containing Ca and P below requirements.

Table 1. Effects of increasing phytase dose on ATTD of GE, DM, Ash, Ca, and P, and STTD of P in diets fed to growing pigs (n = 8)

Item	PC	NC				SEM
Phytase, unit/kg		0	250	500	1,000	2,000	
ATTD of DM[1], %	88.97	90.80	90.12	90.21	90.59	90.62	0.73
ATTD of GE[1], %	88.11	89.94	88.92	89.09	89.44	89.39	0.87
DE in diet[1], kcal/kg	3,456	3,575	3,535	3,542	3,555	3,554	35
ATTD of minerals, %							
Ash[2]	65.21	66.37	71.03	70.96	73.41	75.36	1.54
Ca[1,2,3]	72.48	63.24	74.31	73.18	77.54	79.00	3.44
P[1,2,3]	56.89	42.38	57.92	59.50	66.95	73.81	2.48
K	84.23	85.61	86.59	86.68	87.70	87.28	1.66
Mg[2]	40.14	42.51	44.57	44.98	44.43	52.28	3.69
Na	83.74	87.39	85.11	87.41	89.60	86.00	1.80
Cu	45.06	36.61	41.74	37.42	37.18	42.24	3.46
Fe	2.91	9.99	9.08	1.58	2.03	0.15	25.64
Mn	26.25	32.00	34.25	29.03	26.30	33.45	4.53
Zn	28.51	33.62	35.60	33.94	33.38	36.42	4.14
STTD of P[1,2,3], %	59.66	46.64	62.17	63.75	71.20	78.06	2.48

[1]PC vs. NC containing no phytase ($P < 0.05$).
[2]Linear effects of increasing phytase dose in the NC diets ($P < 0.05$).
[3]Quadratic effects of increasing phytase dose in the NC diets ($P < 0.05$).

Keywords: digestibility, minerals, superdosing phytase

91 Meta-Analysis of 4 Trials: The Effect of Multi-Enzyme Containing Xylanase, β-glucanase, Amylase and Protease on Growth Performance in Weaned Pigs.

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Abstract: A meta-analysis was conducted to evaluate the effect of a multi-enzyme complex (MEC) on growth performance in weaned piglets [initial body weight (BW) of 7.6±1.2 kg]. Database was constructed using 4 unpublished studies, contributing 306 data points. The dietary treatments consisted of a conventional diet (CC) with highly digestible nutrients, a high-fiber, low-digestible protein diet (NC), and the NC supplemented with MEC. All diets were corn/wheat/soybean meal based, formulated to meet or exceed NRC specification for weaned piglets. The NC contained ingredients such as barley, distiller's dried grains with solubles, wheat middling, rye and rapeseed meal depending on the geographic location of the study. In all studies, MEC provided 4,000 U/kg Xylanase, 200 U/kg β-glucanase, 100 U/kg Amylase, and 2,000 U/kg Protease. All diets contained 750 FTU/kg of a commercial Buttiauxella phytase. Piglets were fed experimental diets over 2 phases for 42 d, from d 1 of weaning. Growth performance was recorded bi-weekly. Data were analyzed using Mixed Model by JMP 14.0. The average daily gain of piglets fed MEC supplemented diets was increased by 7.4% vs NC (P = 012) during phase 1. The final BW (d 42) was improved by 1.1 kg (4.1%; P = 0. 037) in piglets fed MEC supplemented diets compared with NC. Respective improvements ($P < 0.05$) in feed conversion ratio during phase 1 and overall were 11% (16 points) and 4.4% (7 points) in MEC supplemented diets when compared with NC, which indicates better nutrient digestibility. In conclusion, supplementing a high fiber weaner diets with a multi-enzyme complex improved final BW and feed efficiency in piglets.