FTU Quantum Blue 5G/kg), a negative control (NC; PC with 15% less SID lysine and 1.5% lower NE), and 3 super-dosing treatments applied to the NC for a total of 1000, 1750, and 2500 FTU/kg. Feed and water were available ad libitum. Data were analyzed using the PROC MIXED procedure of SAS (9.4) with pen as the experimental unit and treatment as a fixed effect. Barrows grew faster than gilts (1.06 vs. 0.90 kg/d; $P < 0.05$), were heavier at marketing (123.6 vs. 120.6 kg; $P < 0.05$) and had a higher dressing percent (74.4 vs. 73.8%; $P < 0.05$). Barrows ate more feed (3.09 vs. 2.62 kg/d; $P < 0.05$) and were less feed efficient than gilts on PC (0.347 vs. 0.360) but not on NC diets (0.338 vs. 0.335 kg/d; Interaction: $P < 0.05$). Barrows responded to super-dosed phytase with improved feed conversion while gilts did not (interaction: $P < 0.05$). Compared to the NC, pigs on the PC were heavier at marketing (125.2 vs. 120.1 kg; $P < 0.05$) and grew faster (1.01 vs. 0.96 kg/d; $P < 0.05$). There was no difference in feed intake between the PC and NC ($P > 0.10$). Super-dosing phytase tended to improve final body weight compared with the negative control ($P = 0.058$). There was no effect of super-dosing phytase on growth rate, feed intake or carcass yield ($P > 0.10$). Super-dosing phytase tended to improve gain:feed on a liveweight basis ($P = 0.08$) although the interaction between treatment and sex was significant ($P < 0.001$): barrows (0.338, 0.339, 0.343, 0.344) vs. gilts: (0.335, 0.338, 0.337, 0.336 for NC, 1000, 1750 and 2500 FTU/kg, respectively); this was also true when feed efficiency was expressed on a carcass basis. In conclusion, super-dosing phytase tended to improve efficiency of gain, suggesting possibly enhanced energy and/or nutrient utilization.

**Key Words:** super-dose phytase, barrows, gilts

## 240 The effect of microbial phytase on the apparent and standardized total tract digestibility of calcium in feed ingredients of animal origin.

L. A. Merriman*[1], C. L. Walk[2], H. H. Stein[3], *[1]University of Illinois, Urbana-Champaign, [2]AB Vista, Marlborough, United Kingdom, [3]University of Illinois at Urbana-Champaign, Urbana.*

An experiment was conducted to determine effects of microbial phytase on the apparent (ATTD) and standardized total tract digestibility (STTD) of Ca in meat and bone meal (MBM), meat meal (MM), poultry by product meal (PBPM), or poultry meal (PM). Four corn-potato protein isolate-based diets were formulated to contain 0.70% Ca using MBM, MM, PBPM, and PM as the sources of Ca. All diets also contained 0.33% STTD P with extra P being supplied by monosodium phosphate if needed. Four additional diets that were similar to the previous diets except that they contained 500 units of microbial phytase and a Ca-free diet were also formulated. Growing barrows ($n = 72$; initial BW = 14.91 ± 0.19 kg) were allotted to a randomized complete block design with 9 dietary treatments and 8 replicate pigs per treatment. Experimental diets were provided for 12 d with the initial 5 d being the adaptation period. Total feces were collected for 5 d using the marker-to-marker approach. Results indicated that if no phytase was used, the ATTD and STTD of Ca in PBPM were greater ($P < 0.05$) than in MBM and MM, but values for PM were not different from any other ingredients (Table 240). However, if phytase was added to the diets, no differences in ATTD or STTD of Ca among ingredients were observed. If no phytase was used, no differences among the 4 ingredients were observed for ATTD of P, but if phytase was added, the ATTD of P was greater ($P < 0.05$) for PBPM compared with MM. In conclusion, the addition of microbial phytase did not affect the digestibility of Ca and P in ingredients of animal origin, and only small differences among the 4 ingredients were observed.

**Table 240. Apparent total tract digestibility (ATTD) of Ca and P and standardized total tract digestibility (STTD) of Ca in meat and bone meal (MBM), meat meal (MM), poultry product meal (PBPM), and poultry meal (PM).**

| Item | ATTD Ca | STTD Ca | ATTD P |
|---|---|---|---|
| Without phytase | | | |
| MBM | 74.54[b] | 76.83[b] | 76.00[b] |
| MM | 74.61[b] | 76.97[b] | 76.01[b] |
| PBPM | 85.34[a] | 87.76[a] | 78.30[ab] |
| PM | 80.74[ab] | 82.41[ab] | 80.12[ab] |
| With phytase | | | |
| MBM | 79.66[ab] | 81.94[ab] | 80.48[ab] |
| MM | 83.25[ab] | 85.75[ab] | 75.79[b] |
| PBPM | 83.51[ab] | 86.66[ab] | 85.99[a] |
| PM | 74.31[b] | 76.06[b] | 77.11[ab] |

**Key Words:** calcium, phosphorus, pigs

## 241 Stability of commercial phytase products stored under different environmental conditions.

J. A. De Jong*[1], J. M. DeRouchey[1], M. D. Tokach[1], R. D. Goodband[1], J. C. Woodworth[1], C. K. Jones[1], C. R. Stark[1], C. L. Bradley[2], J. A. Loughmiller[3], J. R. Bergstrom[4], *[1]Kansas State University, Manhattan, [2]AB Vista Feed Ingredients, Marlborough, United Kingdom, [3]Maverick Nutrition, Fairmont, MN, [4]DSM Nutritional Products, Parsippany, NJ.*

A 300-d study evaluated the stability of 4 phytase products stored under varied environmental conditions. The 4 products were: 1) Quantum Blue 5G (AB Vista, Marlborough, United Kingdom); 2) Ronozyme HiPhos GT 2700 (DSM Nutritional Products, Parsippany, NJ); 3) Axtra Phy TPT (Dupont, Wilmington, DE); and 4) Microtech 5000 Plus (Guangdong VTR Bio-Tech Co., Ltd., Guangdong, China). Products were stored as pure forms at −20, 4, 22, or 35°C (75% humidity), or in a vitamin or vitamin trace mineral (VTM) premix at 22 and 35°C (75% humidity). Samples were stored in paper bags and sampled on d 30, 60, 90, 120, 210, and 300. Stability was determined as amount of residual phytase activity (% of initial). For pure forms, all interactive and main effects of product,

**Table 241.**

| | Residual phytase activity, %[1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sampling, d | | | | | | | Probability, $P <$ |
| Item | 30 | 60 | 90 | 120 | 210 | 300 | SEM | Storage form main effect |
| Pure product | 95.1 | 96.8 | 97.2 | 93.5 | 90.7 | 82.0 | 5.30 | 0.001 |
| Vitamin premix | 106.9 | 100.8 | 100.4 | 96.6 | 88.3 | 77.9 | | |
| VTM | 95.5 | 58.5 | 77.2 | 78.0 | 54.6 | 39.0 | | |

[1] Stability was measured as the analyzed phytase concentration divided by d 0 phytase concentration.

time, and temperature were significant ($P < 0.05$). From d 30 to 300, products had similar reductions in phytase activity at the 3 highest temperatures; however, Quantum Blue 5G, Ronozyme HiPhos GT 2700, and Axtra Phy TPT had reduced ($P < 0.05$) phytase activity compared to Microtech 5000 Plus at −20°C. As storage time increased, residual phytase activity was reduced ($P < 0.05$) regardless of product and storage temperature. Also, when product was stored at 4 and 22°C, phytase activity was improved compared to −20 and 35°C. For vitamin and VTM premixes, a time×temperature × product interaction ($P < 0.05$) was observed as a result of, Axtra Phy TPT and Microtech 5000 Plus having reduced residual phytase activity ($P < 0.05$) compared to the other 2 products when stored at 22°C, while activity of Axtra Phy TPT was reduced ($P < 0.05$) even further than the other 3 products when stored at 35°C regardless of form. From d 30 to 300, Axtra Phy TPT and Microtech 5000 Plus had the lowest ($P < 0.05$) residual phytase activity compared to the other 2 products. The VTM had decreased ($P < 0.05$) residual phytase activity compared to the pure product and vitamin premixes. In conclusion, phytase stored for longer than 90–120 d at 35°C or −20°C in pure form, or when stored as a VTM premix had reduced residual phytase activity.

**Key Words:** phytase, storage, stability

## 242 Effect of a dry acidulant coating on the palatability of dry extruded dog food.

A. M. Jeffrey*[1], G. C. Aldrich[1], A. R. Huss[1], C. J. Knueven[2], C. K. Jones[1], [1]*Kansas State University, Manhattan,* [2]*Jones-Hamilton Co., Walbridge, OH.*

In the pet food industry, *Salmonella* is getting greater scrutiny because it is considered a "reasonably foreseeable hazard" with the implementation of the Food Safety Modernization Act. Specifically, there is zero tolerance for any serotype of *Salmonella* in pet foods. *Salmonella* contamination was responsible for 78% of the Class I recalls in pet food according to the most recent Reportable Food Registry Report (FDA, 2015). One potential method of *Salmonella* mitigation shown to be effective was through coating the exterior of the kibble with a powdered dry acidulant, such as sodium bisulfate (SBS; Jones-Hamilton, Co.). Sodium bisulfate coating on both dog and cat kibbles was shown to provide complete mitigation of *Salmonella* within 14-d storage (Jeffrey et al., 2014). However, it is thought that the use of dry acidulant with a palatant for coating kibble may negatively impact palatability of a dry dog food. Therefore, the objective of this experiment was to determine if the use of a dry acidulant, SBS, would influence the palatability of a dry dog food. A single dry extruded all life stages dog food was collected from a commercial pet food manufacturer before the coating step. The kibble was coated with either 2.2% spray dried chicken liver + 0.2% SBS or 2.2% spray dried chicken liver + 0.2% powdered silica (control). A total of 20 beagles were used in a standard 2-bowl forced choice palatability test method for 2 d. Dogs were fed 400 g of both diets once per day, with bowls rotated daily to address side bias. Results were analyzed using the GLIMMIX procedure of SAS (Cary, NC). The inclusion of SBS did not affect daily preference of diet ($P = 0.23$). Furthermore, there was no effect of day ($P = 0.18$) or the interaction of treatment × day ($P = 0.98$). These results demonstrate that palatability is not affected by the inclusion of SBS with a palatant in the coating of dog food kibble. Considering that the inclusion of SBS has been shown to be effective at mitigating *Salmonella* in pet food and no negative effects on palatability were observed, the use of a dry acidulant in a dog food coating gives the industry a promising method to control *Salmonella* contamination of finished dog foods.

**Key Words:** dog food, palatability, *Salmonella*

## 243 Effects of a novel phytase on growth performance and metacarpal bone ash in weanling pigs.

Y. Liu*[1], J. C. González-Vega[1], M. Vázquez-Añón[2], J. Zhao[2], J. Escobar[2], F. N. Almeida[2], H. H. Stein[3], [1]*University of Illinois, Urbana,* [2]*Novus International, Inc., St. Charles, MO,* [3]*University of Illinois at Urbana-Champaign, Urbana.*

The objective of this experiment was to determine effects on growth performance and metacarpal bone ash of adding a novel next generation phytase (CIBENZA® PHYTAVERSE® G10) to diets for weanling pigs. A total of 160 pigs (initial BW: 9.79 ± 1.22 kg) were allotted to 4 diets with 10 replicated pens per treatment and 4 pigs per pen using a randomized complete block design. The experiment was conducted in 2 phases of 14 d each. Four diets within each phase were formulated based on corn and soybean meal, including a positive control (PC) that met or exceeded NRC (2012) nutrient requirements, a negative control (NC) that was similar to the PC diet with the exception that digestible P was reduced to 58% of the requirement in phase 1 and 56% of the requirement in phase 2. Two additional diets were formulated by adding 250 or 500 phytase units (FTU) per kg to the NC diet. At the conclusion of the experiment, 2 pigs per pen were euthanized and the third and fourth metacarpals from the right foot were collected. Data were analyzed by PROC GLM of SAS and means