93 Effects of a Functional Oils Blend on Intestinal Health and Growth Performance of Nursery Pigs.

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This study was to investigate the role of castor oil and cashew nutshell liquid (functional oil blend, FOB) on intestinal health and growth performance of nursery pigs and to determine an optimal supplemental level. Newly weaned pigs (20 barrows and 20 gilts at 25 d of age, 7.02 ± 0.58 kg BW) were randomly allotted to 5 treatments in a RCBD and fed in 2 phases (13 and 21 d respectively) with increasing levels (0, 0.050, 0.075, 0.100, and 0.150%) of FOB. Growth performance was measured by each phase. Titanium dioxide (0.4%) was added to phase 2 diets as an indigestible marker to measure AID. On d 34, all pigs were euthanized to collect jejunum to measure immune status, oxidative stress status, microbiota, morphology, and crypt cell proliferation. Data were analyzed using Proc Mixed of SAS. Supplementation of FOB did not affect the overall growth performance. Supplementation of FOB tended to decrease (P = 0.064) the concentration of jejunal protein carbonyl (3.11 to 2.45 nmol/protein) and tended to increase villus height (P = 0.098, 401 to 453 μm) and crypt depth (P = 0.070, 86 to 99 μm). Increasing FOB reduced (P < 0.05) relative abundance of Helicobacteraceae (46.8 to 21.0%) and increased (P < 0.05) relative abundance of Prevotellaceae (7.9 to 13.1%), Burkholderiaceae (6.3 to 10.8%) and Pseudomonadaceae (0.1 to 1.0%), and increased (P < 0.05) alpha diversity of the jejunal mucosa-associated microbiota at the family level (Chao1 index 42.8 to 56.8%). In conclusion, FOB showed potential benefits on intestinal health of nursery pigs by increasing beneficial and reducing harmful bacteria reducing oxidative damages in the jejunal mucosa, and by enhancing villus structure, whereas without affecting the growth performance. The FOB at a range of 0.050% to 0.150% provided the most benefit for nursery pigs.

Keywords: cashew nutshell liquid, castor oil, feed efficiency, gut health, microbiome, newly weaned pigs

94 The Effects of Dietary Crude Protein, Acidifier, and Pharmacological Levels of Zinc on Growth Performance of Nursery Pigs.

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Weanling pigs (n = 360, DNA 200 × 400, initially 5.90 kg) were used to evaluate pharmacological levels of Zn (ZnO), diet acidification (sodium diformate; Addcon, Bitterfeld-Wolfen, Germany), and crude protein (18 or 21% CP) on pig performance. At weaning, pigs were assigned to treatments with 5 pigs/pen and 9 pens/treatment. Treatments were arranged in a 2×2×2 factorial with main effects of Zn (110 mg/kg from d 0 to 21 or 3,000 mg/kg from d 0 to 7, and 2,000 mg/kg from d 7 to 21), diet acidification (without or with 1.2% sodium diformate), and dietary CP (21 or 18%). The 21% CP diets were formulated to 1.40 and 1.35% SID Lys in phase 1 and 2, respectively, and 18% CP diets were formulated to 1.20% SID Lys. Experimental diets were fed from d 0 to 21 with a common diet from d 21 to 42. Fecal samples were collected weekly to determine fecal dry matter (DM). Data were analyzed using R Studio as a RCBD. From d 0 to 21, ADG and G:F increased (P < 0.05) for pigs fed pharmacological Zn, and sodium diformate. Overall, ADG tended (P ≤ 0.069) to increase for pigs fed added Zn or sodium diformate. Pigs fed 21% CP had increased (P < 0.05) ADG and G:F from d 0 to 21 and overall G:F compared with those fed 18% CP. Feeding 18% CP diets increased fecal dry matter on d 7 when pharmacological Zn and sodium diformate were not in the diet (Zn×acidifier×CP interaction, P < 0.05). From d 21 to 42, there was no evidence of difference in growth performance. In conclusion, reducing CP without acidification increased fecal DM when pharmacological Zn were not in the diet, but had little effect when it was in the diet. Adding sodium diformate and pharmacological Zn independently improved nursery pig growth performance.

Table 1. Evaluating the effects of pharmacological levels of zinc oxide, sodium diformate, and crude protein on growth performance of nursery pigs

	No added zinc oxide				Added zinc oxide			
	No acidifier		Added acidifier[1]		No acidifier		Added acidifier[1]	
	21% CP[2]	18% CP	21% CP	18% CP	21% CP	18% CP	21% CP	18% CP
Item[3,4]								
d 0 to 21								
ADG, g[5,6,7]	225	195	243	240	257	249	279	260
ADFI, g[5]	331	323	342	360	368	382	369	370
GF, g/kg[5,6,7]	676	607	709	669	706	652	754	702
d 0 to 42								
ADG, g[5,6]	414	393	431	435	438	429	446	428
ADFI, g	603	592	620	639	627	640	642	627
GF, g/kg[7]	687	664	696	680	699	671	692	683
d 7 Fecal DM[8]	24.4	28.1	26.3	25.2	25.7	23.8	24.8	25.6
d 21 Fecal DM	23.9	25.6	24.3	24.1	23.1	23.4	23.6	23.7

[1] Sodium Diformate (Formi-NDF, Addcon, Bitterfeld-Wolfen, Germany) was included in the diet at 1.2% from d 0 to d 21.
[2] Dietary CP 21 or 18% CP corresponding to 1.40 or 1.20% SID Lys from d 0 to 7 and 1.35 or 1.20% SID Lys from d 7 to 21.
[3] CP = Crude Protein, BW = Body Weight, ADG = Average Daily Gain, ADFI = Average Daily Feed Intake, G:F = Feed efficiency
[4] The SEM for d 0 to 21 for ADG, ADFI, and G:F are 11.3, 15.8, and 17.4 respectively. The SEM for d 0 to 42 for ADG, ADFI, and G:F are 12.7, 18.2, and 7.5 respectively. The SEM for d 7 and d 21 fecal DM are 0.01 and 0.01 respectively.
[5] Main effect of diet containing ZnO, ($P \leq 0.05$)
[6] Main effect of diet containing an acidifier, ($P \leq 0.05$)
[7] Main effect of crude protein level, ($P \leq 0.05$)
[8] Interaction ZnO × acidifier × crude protein, ($P < 0.05$). All 2-way interactions were found to be nonsignificant ($P \geq 0.11$).

Keywords: Acidifier, crude-protein, Zinc

95 Growth Performance, Bone Mineralization, and Nutrient Digestibility of Nursery-grower Pigs Fed Phytase-supplemented Calcium and Phosphorus-deficient Diets.

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A 36-d experiment evaluated effects of supplemental OptiPhos Plus phytase (Huvepharma, Peachtree City, GA) on growth, bone mineralization, Ca and P digestibility of nursery-grower pigs. Individually housed crossbred pigs (n = 42; initial body weight [BW], 16.1 ± 0.4 kg) were randomly allotted to 7 dietary treatments based on BW and sex. A positive control (PC) diet was formulated to contain 0.601% Ca and 0.296% standardized total tract digestible (STTD) P, which were marginally lower than NRC (2012) requirement estimates for 25–50 kg pigs. A negative control (NC) diet (0.431% Ca and 0.164% STTD P) was developed by the removal of dicalcium phosphate from the PC diet and replacement with limestone and sand. Diets were: 1) PC, 2) NC, and 3–7) NC + 250, 500, 750, 1,000 and 1,500 FTU phytase/kg diet. On d 36, all pigs were euthanized for femur and metacarpal measures. Compared with NC, pigs fed the PC diet provided greater (P < 0.05) response for ADG (966 vs. 730 g/d), ADFI (1,660 vs. 1,329 g/d); bone measures (37.1 vs. 17.4 g ash/femur and 71.9 vs. 29.3 kg for metacarpal strength), and apparent total tract digestibility (ATTD) of Ca (69.5 vs. 63.5%) and P (62.5 vs. 49.3%). As supplemental phytase increased from 0 to 1,500 FTU/kg of diet, linear and quadratic increases (P < 0.002) occurred in overall ADG and ADFI, femur mineral content, metacarpal breaking strength, and ATTD of Ca and P. Responses statistically similar to PC were achieved at 250 or 500 FTU/kg and peak responses occurred at 750 to 1,500 FTU/kg that were numerically greater than PC for all but metacarpal strength. In conclusion, supplemental OptiPhos Plus improved growth, bone mineralization, Ca and P digestibility of pigs fed Ca and P-deficient diets, demonstrating enhanced Ca and P utilization of corn-soybean meal-based diets by nursery-grower pigs.

Keywords: apparent total tract digestibility, phytase, pigs