134 Water- and Feed-Based Arginine Impacts on Gut Integrity in Weanling Pigs.

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Abstract: Two hundred and forty newly weaned pigs (PIC, Hendersonville, TN) were used to determine if supplementing with additional arginine either in the water or in the feed, and the combinations thereof, improved intestinal integrity and growth performance in the nursery. Three pigs (21 ± 2 d) per pen for a total of 80 pens, within 4 water lines, were randomly assigned to 1 of 3 arginine-dietary treatments across the 20 pens for a 4×3 factorial. With 4 water treatments: 0, 4, 8 and 12% Arg and 3 dietary treatments: basal level, 1.55 and 1.75% SID Arg. Pigs and feeders were weighed at the d0, d7 (water and diet change), d21 (diet change), and d41. Eighty pigs were euthanized at d7, for ileum evaluation of villus height and crypt depth. Remaining pigs were then taken off the arginine-water treatment portion of the experiment, and fed the diets formulated to contain 3 different levels of dietary arginine. Data were analyzed by pen as repeated measures (SAS 9.4). Feeding additional arginine resulted in an improvement (basal: 20.35, 1.55: 22.22, 1.75: 20.93 kg; $P = 0.04$) in pig body weight compared with basal. No interaction was detected when using arginine in the water and feed simultaneously, on piglet performance. The use of 8% arginine in the water resulted in a reduction in crypt depth (0:132.54, 4:140.70, 8:117.28, 12:131.99; $P < 0.01$) and 4% Arg reduced total villous height:crypt depth ratio (0:2.50, 4:2.09, 8:2.56, 12:2.43; $P < 0.02$). The feeding of arginine resulted in an improvement in final body weight of the pigs; however, there were no differences in intestinal villi when Arg is added to the feed. However, the use of Arg in the water resulted in an improvement in intestinal villi, but no phenotypical change in piglet growth in the nursery.

Keywords: arginine, nursery, pig

129 The Effect of Live Yeast and Yeast Extracts Included in Lactation and Nursery Diets on Nursery Pig Growth Performance.

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Abstract: Two experiments were conducted to determine the impact of diets with yeast-based direct fed microbials (DFM) in nursery pigs weaned from sows fed lactation diets with or without yeast additives. Treatment descriptions for both experiments are reviewed in Table 1. There was no evidence of sow and nursery treatment interactions for either experiment ($P > 0.05$). In Exp. 1, 340 weaned pigs, initially 5.1 kg ± 0.02, were used to evaluate previous sow treatment (control vs yeast additives; Phileo by Lesaffre, Milwaukee, WI) and nursery diets with or without DFM. Treatments were a 2×2 factorial with main effects of sow treatment and nursery treatment (control vs. yeast-based pre- and probiotic diet) with 5 pigs/pen and 17 replications/treatment. Progeny from sows fed yeast additives had increased ($P < 0.05$) ADG from d 0-24 and d 0-45. However, pigs that were fed yeast additives for the first 24 d in the nursery tended to have decreased d 0-45 ADG ($P = 0.079$). In Exp. 2, 330 weaned pigs, initially 5.8 kg ± 0.03, were used to evaluate diets with combinations of DFM. Treatments were arranged in a 2×3 with main effects of sow (same as Exp. 1) and nursery treatment with 6 pigs/pen and 8 to 10 replications/treatment. From d 0-10 post-weaning, progeny of sows fed yeast additives had increased ($P < 0.05$) ADG and G:F. From d 24-38 when pigs were fed common diets with no added yeast-based products, ADG for pigs previously fed DFM2 was greater ($P < 0.05$) than control. In conclusion, feeding sows yeast during lactation improved offspring nursery growth performance in both studies. Interestingly, feeding live yeast and yeast extracts reduced nursery pig performance in Exp. 1; however, feeding DFM 2 improved growth later in the nursery in Exp. 2.

Table 1. Main effects of yeast and DFM treatments on growth performance of nursery pigs[1]

	Sow treatment				Nursery treatment			
Exp. 1 (d 0 to 24)	Control	Yeast[1]	SEM	$P =$	Control	Yeast[2]	---	SEM
ADG, g	266	289	5.7	0.006	280	275	---	5.7
ADFI, g	383	408	8.0	0.031	400	391	---	8.0
G:F, g/kg	695	711	7.6	0.153	703	703	---	7.6
	Sow treatment				Nursery treatment[3]			
Exp. 2 (d 0 to 38)	Control	Yeast[1]	SEM	$P =$	Control	DFM 1[4]	DFM 2[5]	SEM
ADG, g	402	406	5.8	0.596	391	410	411	7.2
ADFI, g	575	573	7.5	0.811	560	584	579	9.4
G:F, g/kg	698	709	4.6	0.080	698	703	711	5.7

[1] Actisaf Sc 47 HR+ at 0.10% and SafMannan at 0.025% (Phileo by Lesaffre, Milwaukee, WI) from d 110 of gestation until weaning.
[2] ActiSaf Sc 47 HR+ at 0.10%, 0.05% SafMannan, and 0.05% NucleoSaf from d 0-7 and then concentrations were lowered by 50% for d 7-24 (Phileo by Lesaffre, Milwaukee, WI).
[3] Nursery treatment; ADG, $P = 0.094$.
[4] DFM 1 was a yeast-extract blend with SafMannan (0.05% in phases 1, 2, and 3) and NucleoSaf (0.05% in phase 1, 0.025% in phase 2 and 0% in phase 3); Phileo by Lesaffre, Milwaukee, WI.
[5] DFM 2 was a *Bacillus* spp. and yeast-extract blend with MicroSaf (0.10% in phases 1, 2, and 3) and NucleoSaf (0.05% in phase 1, 0.025% in phase 2 and 0% in phase 3); Phileo by Lesaffre, Milwaukee, WI.

Keywords: bacillus, nursery pigs, yeast

132 Investigating Potential Additive Effects of Formic Acid and Glycerol Monolaurate in Nursery Pig Diets.

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Abstract: A total of 350 pigs (DNA 200 × 400; initially 5.7 ± 0.06 kg BW) were used in a 42-d study with 5 pigs per pen and 14 replicate pens per treatment. At weaning, pigs were assigned to pens based on BW, and pens were allotted in a completely randomized design to dietary treatments: 1) negative control (basal diet with no additives); 2) basal diet with 3,000 ppm zinc oxide (ZnO) included in phase 1 and 2,000 ppm ZnO in phase 2; 3) basal diet with 0.7% formic acid (Amasil NA, BASF, Florham, NJ); 4) basal diet with 0.18% glycerol monolaurate (GML) (Natural Biologics GML, Natural Biologics, Newfield, NY); and 5) basal diet with a 1.0% blend of formic acid, sodium diformate, and GML (FORMI 3G, ADDCON GmbH, Bitterfeld-Wolfen, Germany). Pigs were fed treatment diets from d 0 to d 28. A common diet was fed from d 28 to d 42. From d 0 to d 7, pigs fed a diet containing ZnO or the 1.0% blend of formic acid, sodium diformate, and glycerol monolaurate had significantly increased ($P = 0.03$) ADG compared with pigs fed the control, with no impact ($P > 0.05$) on feed intake. Overall, pigs fed GML had reduced ADG compared with their counterparts fed the negative control, ZnO, or FORMI diets. Fecal DM was evaluated from d 7 to d 28 and there was a significant treatment × day interaction ($P = 0.04$). Pigs fed GML had significantly less fecal DM % on d 7, but a greater fecal DM % on d 14 and 21 when compared with pigs fed all other treatments. Fecal DM standardized across treatments by d 28. In summary, there is potential for a blend of formic acid, sodium diformate, and GML to improve growth performance immediately post-weaning without negatively impacting fecal consistency.

Table 1. Effects of feeding formic acid and glycerol monolaurate alone or in combination on the growth performance of nursery pigs[1]

	Dietary Treatment						*P* - value	
Item;	Control	ZnO[2]	Formic Acid[3]	Glycerol Monolaurate[4]	FORMI-3G[5]	SEM	Treatment	ZnO vs. Acids[6]
BW, kg								
d 0	5.62	5.69	5.77	5.66	5.61	0.06	0.340	0.916
d 7	5.96	6.21	6.09	6.18	6.21	0.06	0.033	0.501
d 28	13.95^{bc}	15.34^{a}	13.97^{bc}	13.18^{c}	14.58^{ab}	0.21	< 0.0001	< 0.0001
d 42	23.77^{b}	25.14^{a}	23.24^{bc}	22.50^{c}	24.24^{ab}	0.32	< 0.0001	< 0.0001
Phase 1 (d 0 to 7)								
ADG, kg/d	0.05^{b}	0.09^{a}	0.06^{ab}	0.07^{ab}	0.09^{a}	0.02	0.003	0.146
ADFI, kg/d	0.11	0.13	0.13	0.11	0.14	0.01	0.162	0.619
G:F	0.40^{b}	0.62^{ab}	0.45^{b}	0.69^{a}	0.62^{ab}	0.06	0.002	0.606
Phase 2 (d 7 to 28)								
ADG, kg/d	0.38^{b}	0.42^{a}	0.38^{ab}	0.33^{c}	0.40^{ab}	0.01	< 0.0001	< 0.0001
ADFI, kg/d	0.58	0.63	0.58	0.57	0.59	0.02	0.058	0.007
G:F	0.65^{a}	0.67^{a}	0.64^{a}	0.59^{b}	0.68^{a}	0.01	< 0.0001	0.026
Overall Treatment (d 0 to 28)								
ADG, kg/d	0.29^{bc}	0.33^{a}	0.30^{bc}	0.27^{c}	0.32^{ab}	0.01	< 0.0001	< 0.0001
ADFI, kg/d	0.46	0.50	0.47	0.46	0.48	0.01	0.120	0.027
G:F	0.64^{a}	0.67^{a}	0.63^{ab}	0.59^{b}	0.67^{a}	0.01	< 0.0001	0.008
Common Phase 3 (d 28 to 42)								
ADG, kg/d	0.70	0.70	0.68	0.67	0.69	0.02	0.247	0.137
ADFI, kg/d	0.98	0.99	0.98	0.94	0.98	0.03	0.555	0.400
G:F	0.73	0.71	0.69	0.72	0.71	0.02	0.732	0.921
Overall Experiment (d 0 to 42)								
ADG, kg/d	0.43^{ab}	0.45^{a}	0.42^{bc}	0.40^{c}	0.44^{ab}	0.01	< 0.0001	0.001
ADFI, kg/d	0.63	0.66	0.64	0.62	0.64	0.04	0.846	0.860
G:F	0.68	0.69	0.66	0.65	0.69	0.01	0.139	0.017

[abc]Means within a row that do not share a common superscript differ ($P < 0.05$).
[1]A total of 360 weanling pigs (DNA 200 × 400, initially 5.67 ± 0.06 kg BW) were used in a 42-d growth study with 5 pigs/pen and 14 replicates/treatment.
[2]Zinc oxide (ZnO) was provided at 3,000 ppm in Phase 1 and at 2,000 ppm in Phase 2.
[3]Formic acid (Amasil-NA; BASF Corp. Florham, NJ) was included in the diet at 0.7% in both Phase 1 and Phase 2.
[4]Glycerol monolaurate (Natural Biologics, Newfield, NY) was included in the diet at 0.18% in both Phase 1 and Phase 2.
[5]FORMI-3G (Addcon Gmbh, Bitterfeld-Wolfen, Germany) was included in the diet at 1.0% in both Phase 1 and Phase 2.
[6]Contrast statement used to evaluate means from pigs fed ZnO compared to those fed Formic Acid, Glycerol Monolaurate, and FORMI-3G.