

NONRUMINANT NUTRITION

19 The intestinal immune system: Gut reactions (or thereof) and growth of the pig. H. R. Gaskins, *University of Illinois at Urbana-Champaign*.

Neonatal morbidity and mortality and growth stasis at weaning are the major productive losses in the swine industry. Problems unique to newborn and weaning pigs include reduced feed intake, digestive inefficiency, malabsorption, and predisposition to diarrhea and enteric infection. These digestive maladies largely elicit integrated responses to environmental insults first encountered at gut mucosal surfaces. Thus, a complete understanding of the defense mechanisms that prevent or respond to mucosal insults, whether pathogenic microorganisms or dietary antigens, may lead to novel strategies to optimize neonatal pig performance. Intestinal defense mechanisms are generally classified as being either immunologic or immunologic in nature. Prominent nonimmunologic barriers in the intestine contributing to a "front line" of defense include the indigenous microbiota, the mechanical barrier formed by the epithelial monolayer, and the mucus coat that traps toxin and bacterial receptors present on individual epithelial cells. Actively acquired immunological components are well represented in the intestine, both as diffuse cell populations in the lamina propria and as organized cell aggregates (Peyer's patches, to ensure the elimination of specific pathogens). The newborn pig is particularly susceptible to enteric pathogens because active immune components in the intestine are anatomically and functionally immature. An overview of the development of the structure of intestinal defense mechanisms will be provided, followed by a discussion of interactions between the normal microbiota and host immunological components that may contribute to the development of active immunity in the pig intestine.

Key Words: Pig, Intestinal Immune System, Gut Microbiota

250 The effect of carbohydrate source and extrusion processing on growth performance of segregated early-weaned pigs. K. Hongtrakul¹, J. R. Bergstrom, R. D. Goodband, K. Behnke, W. B. Nessmith, M. D. Tokach, and J. L. Nelissen, *Kansas State University, Manhattan*.

A total of 350 segregated early-weaned pigs (initially 4.4 kg and 1 ± 2 d of age) was used to investigate the interactive effects of different carbohydrate sources and moist extrusion processing on growth performance. Treatments were arranged in a 5×2 factorial with main effects including carbohydrate source (corn, rye starch, wheat flour, rice, and grain sorghum) with or without moist extrusion processing. From d 0 to 7 postweaning, all diets contained 42% of the respective carbohydrate source, 20% dried whey, 10% moist extruded soy protein concentrate, 6.7% spray-dried plasma protein, and 6% select menhaden fish. Diets were formulated to 1.70% total lysine with all other amino acids above suggested estimates based on current ratios relative to lysine. The amounts of synthetic lysine and methionine varied slightly among experimental diets based on differences in lysine concentration of the carbohydrate sources. From d 7 to 21 postweaning, pigs were fed diets containing 47% of their respective carbohydrate source, 5.5% soybean meal, 10% dried whey, 5% select menhaden fish meal, and 3% spray-dried plasma protein. Diets were formulated to 1.5% total lysine. Surprisingly, from d 0 to 7 postweaning, pigs fed diets containing corn had decreased ($P < .01$) ADG compared with pigs fed other carbohydrate sources. Moist extrusion processing of the carbohydrate sources did not improve growth performance. For the cumulative study (d 0 to 21 postweaning), pigs fed corn had decreased ($P < .01$) ADG and G/F compared with those fed other carbohydrate sources. There were no differences in growth performance among pigs fed the other carbohydrate sources. Moist extrusion processing had no effect on growth performance. Under the conditions used in this study, moist extrusion processing of carbohydrate sources did not influence pig performance.

Key Words: Pigs, Extrusion, Carbohydrates

251 Protein source influences segregated early-weaned pig performance. W. B. Nessmith¹, Jr., M. D. Tokach, R. D. Goodband, J. L. Nelissen, J. R. Bergstrom, S. S. Dritz, J. A. Loughmiller, and J. W. Smith, II, *Kansas State University, Manhattan*.

A total of 390 pigs (initially 4.2 kg and 13 ± 2 d) was used in a 26 d growth assay to evaluate different protein sources as replacements for spray-dried plasma. Dietary treatments (d 0 to 14 postweaning) were arranged in a 2×6 factorial with an additional control treatment. All diets contained 25% dried whey, 5% lactose, and 6% select menhaden fish meal (SMF). All experimental diets were formulated to contain 1.7% lysine and at least .48% methionine. The control diet contained 75% plasma and 15.7% soybean meal (SBM). Main effects included six protein sources (spray-dried blood meal (SDBM), spray-dried egg protein (SDEP), spray-dried wheat gluten (SDWG), extruded soy protein concentrate (ESPC), SMF, and SBM) and two protein source levels. The protein sources replaced 2.5 or 5.0% plasma in the control diet on a lysine basis except in the diets containing SDWG. In these diets, plasma was replaced on a protein basis and synthetic lysine was added to compensate for the lysine difference. From d 0 to 14, pigs fed diets containing SMF or ESPC had increased ($P < .05$) ADG compared to pigs fed diets containing SDBM, SDEP or SDWG. In addition, pigs fed SBM had similar ADG to pigs fed other protein sources, but greater ($P < .05$) than pigs fed diets containing SDEP. Protein source level did not affect ADG or feed efficiency (G/F). A protein source \times level interaction ($P < .05$) was observed for ADFI. Pigs fed increasing levels of SDBM, SDEP, or SBM had decreased ADFI; however, increasing levels of SMF, ESPC, and SDWG had no influence or increased ADFI. Feed efficiency (G/F) was decreased ($P < .05$) for pigs fed diets containing SDEP as compared to pigs fed diets containing SDBM, SMF, or ESPC. For the high-health pigs used in this trial, SMF, ESPC, and SBM appear to be effective in replacing a portion of the spray-dried plasma in the SEW diet.

Key Words: Protein source, Weanling pigs

252 Effect of dietary carbohydrate source and level on early-weaned pig growth performance. B. T. Richert¹, K. R. Cera², A. P. Schinckel¹. ¹*Purdue University, West Lafayette*, ²*Countrymark Cooperative, Inc., Indianapolis, IN*.

Five hundred thirty-one pigs weaned between 10 and 14 d of age were used in two experiments. Experiment 1 ($n=341$) evaluated two levels of lysine and three levels of simple sugars provided by either lactose (lact) or lact+dextrose (dext). Phase 1 diets were fed from d 0 to 14 postweaning and contained 1.5 or 1.7% lysine and either 24 or 36% lact, or 24% lact +12% dext. Phase 2 diets were fed from d 14 to 21 postweaning and contained the same lysine levels as Phase 1 diets but simple sugar levels were reduced to 16 or 24% lact or 16% lact+8% dext. Phase 3 diets were fed from d 21 to 28 postweaning and contained 1.25 or 1.5% lysine and either 12 or 18% lact or 12% lact+6% dext. Dietary lysine level had no effect on pig growth performance during Phase 1. As dietary simple sugar levels increased, ADG ($P < .07$) increased during the second and third weeks (+30 g/d) postweaning. Substituting dextrose for part of the dietary lactose increased ADG ($P < .10$) during the second and third weeks postweaning. At the start of Phase 3, pigs were reallocated across treatments. Increasing dietary lysine and simple sugar level during Phase 3 increased ADG ($P < .001$, .02, respectively). Increasing simple sugar level increased ADFI ($P < .05$), whether it was provided by either lact or dext. Experiment 2 ($n=180$) evaluated combinations of oats and lactose. The six Phase 1 diets contained either 17.5 or 35% oats and either 20, 28, or 36% lact and were fed from d 0 to 14 postweaning. Phase 2 diets were fed d 14 to 21 postweaning and contained either 0 or 17.5% oats and either 12, 18, or 24% lact. Increasing dietary lactose increased ADG (linear, $P < .06$) and ADFI (linear, $P < .009$) from d 0 to 7 postweaning. Increasing dietary oats decreased ADFI ($P < .05$) but improved feed efficiency ($P < .09$) during the first and second weeks postweaning. Increasing dietary simple sugars increased pig growth rate and feed intake up to 42 d of age.

Key Words: Lactose, Oats, Weanling pig