

detergent fibre ( $P < 0.001$ ) and total VFA concentration ( $P < 0.05$ ) in B but had no significant effect in M and W. Both urinary and faecal pH were lower ( $P < 0.05$ ) in B- compared to M- and W-, however enzyme addition increased fecal and urinary pH ( $P < 0.05$ ) in B+.  $\text{NH}_3\text{-N}$  from B- was lower ( $P < 0.05$ ) than M- and W-. Enzyme addition increased ( $P < 0.05$ )  $\text{NH}_3\text{-N}$  by 58% in B and reduced ( $P < 0.05$ )  $\text{NH}_3\text{-N}$  by 27% in W. In conclusion, there appears to be interaction between cereals and enzymes in terms of nitrogen efficiency.

**Key Words:** Boars, Nitrogen Balance, Ammonia

**207 Effects of increasing calcium:phosphorus ratio in diets containing phytase on growth performance of grow-finish pigs.** S. M. Hanni\*, M. D. Tokach, R. D. Goodband, S. S. Dritz, and J. L. Nelssen, *Kansas State University, Manhattan.*

Our objective was to determine the effects of increased total calcium to phosphorus (Ca:P) ratio on growth performance of grow-finish pigs with diets containing phytase. A total of 144 grow-finish pigs (72 barrows and 72 gilts; initially 38.6 kg BW) were blocked by weight and sex, and then allotted to one of four dietary treatments. Each treatment had nine replications per sex and two pigs per pen. Diets were corn-soybean meal-based and fed in three phases. In each phase, diets were formulated to have Ca:P ratios of 1:1, 1.25:1, 1.5:1, or 2:1. Diets were formulated to contain 0.44, 0.39, and 0.34% phosphorus from 32 to 59, 59 to 86, and 86 to 113 kg, respectively. All diets contained 0.05% phytase from Natuphos<sup>®</sup>, providing 300 FTU/kg. For the overall experiment, increasing Ca:P ratio decreased ADG (linear  $P < 0.002$ ) and ADFI (linear  $P < 0.05$ ). However, the greatest decrease was observed when Ca:P ratio increased from 1.5:1 to 2:1. Feed efficiency was not affected by Ca:P ratio. As Ca:P ratio increased from 1.5:1 to 2:1 ratio, carcass weight decreased (linear  $P < 0.005$ ). There were no differences in percent yield, backfat, loin eye area, and fat free lean index. In conclusion, these data suggest that diets containing 300 FTU/kg phytase should not have total calcium to phosphorus ratio of greater than 1.5:1 when fed to growing-finishing pigs.

|           | Ca:P Ratio |        |       |      | SED   |
|-----------|------------|--------|-------|------|-------|
|           | 1.0:1      | 1.25:1 | 1.5:1 | 2:1  |       |
| ADG, kg   | 0.89       | 0.88   | 0.90  | 0.83 | 0.02  |
| ADFI, kg  | 2.49       | 2.46   | 2.51  | 2.39 | 0.05  |
| Gain/feed | 0.36       | 0.36   | 0.36  | 0.35 | 0.008 |

**Key Words:** Calcium, Phosphorus, Phytase

**208 Current status and review of factors involved in nutritional immunology of swine.** M. E. Spurlock\*, *Purdue University, West Lafayette, IN.*

Currently, pigs reared commercially achieve 70% or less of their genetic potential for growth and efficiency. The consensus opinion is that pathogenic and nonpathogenic disease factors culminate in a series of stress and immunological responses that attenuate the animals' ability to grow. Thus, a detailed understanding of immunology and stress biology may offer new strategies for improving growth and efficiency. Recent discoveries have established a new paradigm for the adipocyte that extends well beyond the simple storage of excess energy. This cell produces a myriad of hormones and cytokines that regulate energy balance, glucose and fatty acid utilization, and specific immune response pathways. Of particular interest, the adipocyte expresses the lipopolysaccharide receptor (Tlr-4) and the lipopolysaccharide binding protein. These critical signaling proteins enable the adipocyte to respond directly to lipopolysaccharide. Indeed, lipopolysaccharide signaling in pig adipocytes results in translocation of nuclear factor kappa-B to the nucleus and altered gene expression profiles. Energy balance and adiposity have been linked to the production of certain immune modulators in the adipocyte, and may influence the functionality of key pathways. This new paradigm for adipocyte biology, energy balance, and immunity will be discussed in light of the marked reduction in adiposity achieved in commercial genotypes in the past decade.

**Key Words:** Growth, Immune Function, Stress

**209 Involvement of trace metals in immunocompetence.** M. L. Failla\*, *The Ohio State University, Columbus.*

Experimental, field and clinical trials with laboratory rodents, domestic animals and humans during the past several decades have clearly shown that both deficiencies and excesses of the essential trace metals impair defense against infectious agents. Both the innate and acquired branches of the immune system are susceptible to trace metal malnutrition. Descriptions of processes associated with the maturation, activation and effector activities of immune cells that are compromised in response to such malnutrition clearly demonstrate the central importance of these micronutrients in maintaining a robust host defense. Encouraging results from some trials also support the potential benefits of judicious supplementation for the prevention and reduction in severity of selective infectious diseases. However, insights regarding specific biochemical events that are dependent on an adequate supply of trace elements remain limited. The application of cellular and molecular methods are beginning to yield novel information about the importance of the micronutrients for the regulation of immune cell development and early events in host responses to infectious insults. In addition, the elegant studies of Beck and associates have provided a clear demonstration that changes in trace metal status have the potential to enhance the fitness of the infectious agent as well as to compromise host immune function. Changes in cellular redox status associated with deficiencies of micronutrients participating in the antioxidant defense system or excess levels of oxidative metals facilitate genotypic changes that induce virulence. Elucidation of biochemical events that are dependent on specific trace elements in host defense cells and the regulation of the transport and metabolism of these elements in health and disease provide intriguing challenges directed at defining optimal trace metal nutrition for immunocompetence (Supported by USDA NRICGP).

**Key Words:** Trace minerals, Immune function

**210 Involvement of vitamins in immunocompetence.** R. W. Johnson\*, *University of Illinois, Champaign-Urbana.*

Animals live surrounded by pathogenic microorganisms#bacteria, viruses, and parasites that can cause infectious disease. In spite of everything, animals become ill infrequently because they are equipped with a highly evolved immune system that affords protection against infectious microorganisms. Nutrition can profoundly impact both innate and adaptive immune responses of animals and thus their resistance to infectious disease. This presentation examines the effects of vitamins on immunocompetence. Special attention is given to antioxidants such as  $\alpha$ -tocopherol and selenium. Supplementation of animals with antioxidant vitamins has been shown to potentiate antibody responses to a variety of killed preparations or live organisms. Recent evidence suggests that vitamin E, as well as other antioxidants, may reduce inflammatory cytokine production in sick animals. The potential of vitamin supplementation to prevent infectious disease or to reduce the severity and duration of infectious disease is discussed.

**Key Words:** Vitamins, Immune Function

**211 Involvement of fatty acids in immunocompetence.** K. L. Fritsche\*, *University of Missouri, Columbia.*

The two major objectives of this presentation will be (1) to review the evidence that dietary fat affect the immune system and infectious disease resistance in domestic animals; and (2) to describe our current understanding of the mechanisms underlying these effects. This review will focus on animal feeding trials with poultry and swine. The current data suggest that the addition of certain fatty acids, particularly omega-3 polyunsaturated fatty acids (i.e., n-3 PUFA), to standard livestock rations can significantly alter in vivo inflammatory responses and improve host resistance to some pathogens. However, the data are still quite limited. An important area of research at present is defining the immunological parameters which predict the impact that diet manipulations have on host disease resistance. The current view for how fatty acids affect the immune system is centered on the ability of some to alter cytokine and eicosanoid production. The role of a novel family of transcription factors (i.e., peroxisome-proliferator activated receptors, PPARs) as conveyors of fatty acid modulation of immune cell function