Symposium: Physiology and Endocrinology: Emerging Concepts on Dietary Components that Influence the Physiology and Endocrinology of Domestic Farm Animals

300 Reproductive consequences of nutritionally-induced changes in the pH of the bovine reproductive tract. G. A. Perry*, *South Dakota State University*, *Brookings*.

During some production situations cattle are fed excess protein. However, increased protein intake during early pregnancy has been associated with decreased fertility and increased embryonic mortality. Increased protein intake elevated blood urea nitrogen and decreased uterine pH, during the luteal phase, but did not influence pH of other bodily fluids. Ionic composition of both oviduct and uterine fluids is derived from ions from the blood and ions secreted from oviduct and uterine epithelium. The oviductal and uterine microenvironment plays a central role in pregnancy success. At the initiation of estrus uterine pH declines to that of semen (≈6.8); pH at this time likely plays a role in sperm survival. Uterine pH can influence sperm motility and longevity and has been associated with pregnancy success following fixed-time AI. This decrease in pH at the initiation of estrus appears to be estradiol dependent since elevated concentrations of estradiol prior to ovulation, even when estrus was not induced, decreased uterine pH. Intake of excess protein (UIP or DIP) did not influence uterine pH at estrus; however, it decreased uterine pH during the luteal phase. Following the pH nadir during estrus, pH increased prior to ovulation and remained neutral (≈7.0) during the luteal phase. During early embryonic development, the embryo is dependent on nutrients provided by oviduct and uterine fluids for growth and survival. Alterations in pH during these early stages of embryonic development when the embryo's ability to regulate pH is limited can likely influence distribution of mitochondria as well as membrane permeability and severely inhibit embryo development. When embryos that were not able to regulate pH (blocking of NA+/H+ antiporter or HCO3-/Cl- exchanger) were exposed to acidic or alkaline conditions, embryonic development to the blastocyst stage was significantly reduced. In summary, excess dietary protein can influence uterine pH during early embryo development, and changes in pH during early pregnancy, a time when the embryo can not adjust pH, can greatly reduce pregnancy success.

Key Words: Uterine pH, Pregnancy Success

301 Performance, metabolism and immunity in domestic animals fed diets contaminated with *Fusarium* mycotoxins. T. K. Smith*, *University of Guelph*, *Guelph, ON, Canada*.

A series of experiments was conducted with gestating and lactating sows, mature horses and lactating dairy cows to determine the effect of feed-borne *Fusarium* mycotoxins on performance, metabolism and immunity. Blends of naturally-contaminated corn and wheat were found to contain deoxynivalenol (DON, vomitoxin) as the major contaminant. In all experiments, animals were fed: (1) control diet (2) diet containing contaminated grains or (3) contaminated grains + 0.2% polymeric glucomannan mycotoxin adsorbent (GMA, Mycosorb, Alltech Inc., Nicholasville, KY). Sows were fed experimental diets for 21 days before farrowing and for 21 days post-farrowing. Horses were fed the experimental diets for 21 days. Dairy cows were fed test rations for 56 days. The feeding of diets containing contaminated grains signficantly reduced sow weight gain during gestation and this was partially prevented by the feeding of GMA. The feeding of contaminated grains significantly increased the incidence of stillborn piglets, however, this was prevented by the feeding of GMA. The feeding of diets containing contaminated grains in the lactation period resulted in significantly reduced feed intake and greater weight loss compared to controls. Horses fed contaminated diets significantly reduced feed intake and had elevated blood activity of gamma-glutamyltransferase compared to controls. The feeding of GMA prevented these effects. There was no effect of diet on milk production, feed intake, milk somatic cell counts or milk composition when fed to dairy cows. The feeding of contaminated feedstuffs, however, significantly reduced serum concentrations of IgA and also resulted in a significant elevation of serum urea concentrations. The feeding of GMA prevented these effects. It was concluded that mature pigs, horses and dairy cows are all adversely affected by feed-borne Fusarium mycotoxins and that contaminted feedsuffs should be fed only with caution and with an appropriate mycotoxin adsorbent.

Key Words: *Fusarium* Mycotoxins, Pigs, Dairy Cows

302 Effectiveness of supplemental antioxidants for enhancing reproductive function in cattle. P. J. Hansen*, *University of Florida*, *Gainesville*.

Production of reactive oxygen species (ROS) is an inherent feature of oxygen metabolism. About 1-2% of the oxygen consumed by cells is incompletely reduced to water. The ROS formed as a result can damage plasma membranes, proteins, and DNA. An increase in oxygen consumption, for example during lactation, hyperthermia or following exercise, results in increased ROS production. The major source of ROS is the mitochondrion but specific enzymes such as myeloperoxidase and cyclooxygenase also cause generation of ROS. Reproductive responses to supplementation are likely to depend upon the magnitude of ROS generation, the efficacy of the supplement for altering redox status and the availability of antioxidants in the control diet. One period in which supplemental antioxidants can affect reproduction is the periparturient period. At this time, dry matter intake is reduced, antioxidants are secreted into the colostrum, and ROS generation from leukocytes is high because of the need for placental expulsion, clearance of lochia from the postpartum uterus, and immunological adjustments to lactation. Administration of vitamin E and selenium alone or in combination can reduce incidence of retained placenta and uterine infectious disease. Similar effects have been reported for administration of β-carotene. Fertility responses to vitamin E and selenium have been mixed; there is some evidence for greater responses for second service than for first service. Another condition that may increase ROS generation is heat stress. One study found increased ROS metabolites in erythrocytes in cows during summer as compared to winter. Feeding supplemental β-carotene increased the proportion of cows pregnant by 120 d postpartum in the summer but not the winter. However, administration of other antioxidants in the summer, including vitamin E or vitamin E and selenium, did not affect fertility. Future research into effectiveness of antioxidant supplementation in cattle is likely to involve nutraceutical molecules that may be more effective in affecting tissue redox status than antioxidant supplements that are commonly used today.

Key Words: Antioxidants, Reproduction, Cattle

303 Phytase: Not just for environmental protection-novel roles in system physiology. X. G. Lei*[1] and J. M. Porres[2], [1]*Cornell University*, *Ithaca, NY*, [2]*University of Granada*, *Granada, Spain*.

Phytase is a phosphohydrolytic enzyme that initiates the stepwise removal of phosphate from *myo*-inositol hexakisphosphate or phytate. The heightened environmental awareness of phosphorus pollution originating from animal manure during the past two decades has led to an exciting era of phytase research and a widespread application of the enzyme in animal feeding. It is well-documented that supplemental phytase improves bioavailability of phytate-phosphorus to swine and poultry by 20-45%. This improvement results in up to 50% reduction in manure phosphorus excretion by animals and prevents nearly 22,000 tons of manure phosphorus from entering the environment annually in the USA from marketing pigs alone. However, potentials of phytase are far beyond just environmental protection. This presentation will review past research on the unique roles of phytase in system physiology, and explore novel application of the enzyme in improving animal and human health. Alleviation of iron-deficient anemia by phytase depicts its roles in the circulatory system. Releasing the phytate-chelated zinc enables phytase to modulate growth and immune function. While hydrolysis of phytate into various forms of inositol phosphates may produce bioactive signal transducers, it could also alter the susceptibility of digestive system to oxidative stress. Impacts of phytase on the skeleton system have been focused on its benefits to bone strength and mineral content in animals fed low-phosphorus diets. In fact, dietary phytase affects bone metabolism-related hormones, and still can improve bone property and function even in animals fed a high-phosphorus diet. These intriguing actions of phytase underscore its broad and complex roles in physiology.

Key Words: Anemia, Immune, Phytase