349 Interrelationships of animal agriculture, the environment and rural communities. M. G. Hogberg*[1], F. L. Kirschenmann[2], S. L. Fales[3], M. S. Honeymann[1], and J. A. Miranowski[4], [1]*Department of Animal Science, Iowa State University, Ames,* [2]*Leopold Center for Sustainable Agriculture, Iowa State University, Ames,* [3]*Department of Agronomy, Iowa State University, Ames,* [4]*Department of Economics, Iowa State University, Ames.*

Animal agriculture has an obvious, close interrelationship with both the natural environment and also with human systems such as the rural community. Accordingly, changes in animal agriculture can have broad ranging consequences to other areas. Tremendous change in animal agriculture has occurred during the past 50 years. In general this has involved an increase in size of production units, greater reliance on technology, a corresponding decrease in labor, increased animal confinement, and a general trend toward monoculture or specialized production systems. At least in part these changes were brought about by animal science research in nutrition, breeding, reproduction, growth, etc. A long-term goal of animal scientists has been to increase biological efficiency of production, and the success in reaching this goal could be said to be remarkable with the time to market, growth rates, milk and egg production, etc. per animal increasing as much as 2 to 3 times in the 50 years. The increase in the efficiency has brought about a parallel decline in food prices. But while animal science in one sense has been very successful, new questions or issues have emerged. The scale of animal systems today sometimes concentrates large numbers of animals into areas smaller than can easily handle the animal waste. Stream and ground water pollution is increasingly a concern in some regions. Odor is a nuisance problem that increasingly places urban growth in conflict with confinement animal systems. Possibly one of the biggest issues can be stated in terms of sustainability; i.e., are all current food animal production systems ones that can continue as they currently exist. Additionally, the decline in numbers of producers has impacted the sociology of rural communities and in some cases brought about the closure of small towns. Animal scientists typically contend that they serve the interests of producers and strive to promote practices that are environmentally sound. Bringing about a discussion among animal scientists as to whether these goals are always met, or could be better met, is considered to be a worthwhile endeavor.

Key Words: Animal Agriculture, Food Prices, Environment

350 Ethics and low-priced meat, milk and eggs: Too much of a good thing? R. J. Burkhardt*, *University of Florida, Gainesville.*

There can be little doubt that decreases in food prices are generally thought to be in consumers best interests. If we wish to base judgments about the ethical soundness of practices designed to reduce food prices on a human welfare-optimization, or utilitarian, ethical norm, then those practices are seemingly right. One assumption that has to be made in this regard is that prices are high enough to keep producers in business. Assuming that is true, one question that arises is whether lower prices are ethically sound for all foodstuffs. It could be argued, for example, that low wheat or corn or rice or vegetable prices are ethically sound because these are food staples, and in some form consumed by people from every socioeconomic and demographic category, both domestically and around the world. When we consider food from animals, the argument is not so easily made. It could be, for example, that lower meat, milk and egg prices means that more ostensibly "free" resources such as water are being consumed by the respective industry, and additional animal wastes are being introduced into the environment. These "hidden costs" are not to be ignored in a long-run utilitarian assessment of the ethics of lower animal-based food prices. However, the more significant ethical concern is whether lower prices encourage more consumption, and given connections between animal fats and risks to human health, should additional meat, milk and egg consumption be encouraged? This is made all the more important when we think about what economists call "substitution effects": will lower prices for animal products encourage the substitution of meat, milk and eggs for other food products, also essential to human well-being?

Key Words: Applied Ethics, Animal Agriculture, Food Costs

Lactation Biology: Symposia: Molecular Mechanisms Governing Mammary Development

351 Emerging genomic technologies for studying mammary development and mammary cancer. D. Porter*[1,2] and K. Polyak[1,2], [1]*Dana-Farber Cancer Institute, Boston, MA,* [2]*Harvard Medical School, Boston, MA.*

The breast cancer genetics lab at the Dana-Farber Cancer Institute is currently using genomic approaches to understand the biology of the mammary gland and breast tumorigenesis. This work has involved global gene expression profiling of normal and cancerous mammary tissue to identify diagnostic, prognostic, and therapeutic targets in breast cancer as well as follow-up experiments on candidate genes to more fully characterize gene expression and physiological function. SAGE (Serial Analysis of Gene Expression) is an expression profiling method that allows for global, unbiased, and quantitative characterization of transcriptomes. The expression of thousands of genes can be analyzed simultaneously without prior knowledge of their sequence, thus leading to the discovery of novel transcripts. Importantly, this makes SAGE a particularly useful tool for use in species with incompletely characterized genomes like the dairy cow. We have used SAGE to characterize normal and malignant gene expression patterns in the human breast, and we have identified genes involved in mammary epithelial cell differentiation, proliferation, and survival that may be involved in the initiation and/or progression of breast cancer in humans. In addition, we have combined immuno-magnetic cell sorting and SAGE to describe the comprehensive gene expression profiles of individual cell types composing breast tissue thus providing a molecular portrait of potential autocrine and/or paracrine interactions among cell types in the mammary gland. The application of these technologies in the dairy cow will lead to the discovery of important new genes and has the potential to yield important insights into the molecular basis of developmental processes in the mammary gland.

Key Words: Genomics, Mammary, SAGE

352 Hormonal regulation of mammary growth, morphogenesis, and breast cancer. R. C. Hovey* and J. F. Trott, *University of Vermont, Burlington.*

Mammary development in all species is regulated by a complex interplay of hormones that reflects the reproductive state of a female, ultimately in preparation for lactation. These changes translate to phases of ductal development with associated branching and lobulogenesis, alveologenesis, secretory activation, and subsequent involution. Separately, breast cancer can arise as a function of disregulated growth by normal mammary epithelial cells. Notably, these changes occur in a tissue microenvironment that can act as a site of local mediation for hormonal cues. Our lab has addressed questions concerning the hormonal regulation of normal mammary gland development and the local changes that mediate this input during processes associated with cell proliferation, morphogenesis and breast cancer. In particular, we have addressed the combinatorial regulation that occurs with alterations in the pituitary-ovarian axis in several species. Our data demonstrates that hormonal cross-talk and its local mediation by autocrine and paracrine factors is a key determinant of specific proliferative and morphogenic events. It also serves to regulate changes in supporting tissues such as the vascular endothelium and surrounding stromal. Currently we are delineating some of the transcriptional mechanisms underlying these changes with the objective of defining key pathways downstream of hormonal regulation during mammary development and breast cancer progression.

Key Words: Mammary Gland, Hormones, Gene Expression

353 Developmental and nutritional regulation of steroid receptor mRNA expression and epithelial cell proliferation in the prepubertal bovine mammary gland. M. J. Meyer*[1], A. V. Capuco[2], A. Hummel[2], E. E. Connor[2], Y. R. Boisclair[1], and M. E. Van Amburgh[1], [1]*Cornell University, Ithaca, NY,* [2]*USDA-ARS, Beltsville, MD.*

Estrogen and its alpha receptor (ERα) are thought to mediate the ovaries influence on prepubertal mammary epithelial cell proliferation (MEP) in the bovine. The ER beta isoform (ERβ) and the estrogen-related receptor α1 (ERRα1) may also play a role in estrogen mediated MEP. To better understand these relationships, the developmental and nutritional regulation of ERα, ERβ, and ERRα1 mRNA abundance was determined in prepubertal bovine mammary parenchyma (PAR) and fat pad (FP) by real-time RT-PCR. Holstein heifers (n = 72) were fed to grow at 950 (E) and 650 (R) g/d from birth to slaughter at 50kg increments between 100 to 350kg BW. MEP was assessed by BrdU labeling and estrogen responsiveness by quantity of progesterone receptor (PR) transcript. ERβ mRNA abundance was exceedingly low and appeared unregulated. E-heifers tended to have greater abundance of ERα, ERRα1, and PR mRNA in PAR ($P < 0.10$) and greater ERα mRNA abundance in FP ($P < 0.05$) than R-heifers. Furthermore, expression of ERα was localized to FP fibroblasts by immunohistochemistry. ERα, ERRα1, and PR mRNA abundance decreased linearly ($P < 0.08$) with increasing BW in PAR but not in FP. At 100kg, E- had greater MEP than R-heifers ($P < 0.05$). Beyond 100kg, MEP decreased rapidly with increasing BW and was similar between treatments. Among all heifers, MEP and PAR PR mRNA were positively correlated with PAR ERα mRNA abundance (r = 0.42 and 0.80, respectively, $P < 0.05$). Data suggest that expression of ERα, ERRα1 and PR are developmentally regulated within PAR but not FP, implying tissue specific regulation of these genes. Energy intake appears to increase PAR expression of these transcripts, but has no effect on MEP.

Key Words: Heifer, Mammary Development, Estrogen Receptor

354 Estrogen and progesterone response networks in the mouse mammary gland. D. J. Jerry*, S. Lu, A. L. Roberts, and K. A. Dunphy, *Department of Veterinary & Animal Sciences, University of Massachusetts, Amherst.*

A majority of mammary gland development occurs post-natally and is controlled by many environmental factors including nutrition, exposure to environmental compounds and endogenous hormone status. The complement of signals not only influence milk yield in subsequent lactations in livestock, but have a striking effect on subsequent risk of breast cancer in humans. The p53 tumor suppressor protein senses cellular stresses and arbitrates the decision of whether a cell should undergo arrest, senescence or apoptosis. Given the gravity of these decisions, it would be expected that levels of p53 activity should be constrained within physiological limits so that cells are not removed inappropriately resulting in loss of secretory epithelium. Nor should levels of p53 be impaired excessively as cells bearing genetic alterations would be allowed to survive raising the risk of cancer. The physiologic role of p53 in the mammary gland is most evident in the fact that impaired p53 function results in delayed involution in rodents. Similarly, activity of p53 is enhanced by estrogen and progesterone, presumably to enforce heightened surveillance of cells undergoing replication to ensure that genomic integrity is maintained. Therefore, we undertook a series of experiments to map the transcriptional responses initiated by these hormones that are crucial to both growth and development of the mammary epithelium as well as suppression of mammary tumorigenesis.

Key Words: Mammary, Estrogen, Progesterone

Ruminant Nutrition: Science of Ruminant Nitrogen Metabolism and Its Application to Feeding Cows

355 What is the true supply of amino acids? H. Lapierre*[1], D. Pacheco[1], R. Berthiaume[1], D. R. Ouellet[1], C. G. Schwab[2], G. Holtrop[3], and G. E. Lobley[3], [1]*Lennoxville Research Centre, AAFC, Lennoxville, QC, Canada,* [2]*University of New Hampshire, Durham,* [3]*BIOSS, Rowett Research Institute, Aberdeen, UK.*

Improving the prediction of milk protein yield relies on knowledge of both protein supply and requirement. Definition of protein/amino acid (AA) supply in ruminants is a challenging task, due to feedstuff variety and variability, and to the remodeling of nutrient intake by the rumen microflora. So, how and where should we measure the real supply of AA in the dairy cow? This review will follow the downstream flow of AA from duodenum to peripheral tissue delivery, with a glance at the efficiency of transfer into milk protein. Duodenal AA flow comprises rumen undegradable feed, microbial protein, and endogenous secretions. Most attention has been directed towards definition of the first two contributions, but the latter fraction can represent up to 20% of flow and more information is needed on what factors affect its magnitude and overall impact. Once digested, AA are absorbed into the portal vein. The ratio of portal absorption to small intestinal apparent digestion varies among AA, from 0.50 (threonine) to 0.85 (histidine), due to pre-duodenal endogenous secretions, non-reabsorption of intestinal endogenous secretions and gut oxidation of AA. Few data are available on these phenomena in dairy cows, but the evidence indicates that they alter the profile of AA available for anabolic purposes. Recent comparisons of estimated duodenal flux and measured portal flux have prompted a revisit of the NRC (2001) approach to estimate AA flows at the duodenum. New equations are proposed that yield predictions that better fit the current knowledge of AA metabolism across the gut. Absorbed AA flow first to the liver, where substantial and differential net removal occurs, varying from zero for the branched-chain AA to 0.50 of portal absorption for phenylalanine. This process alters the pattern of net supply to the mammary gland. Overall, intermediary metabolism of AA between the duodenum and the mammary gland biologically explains the decreased efficiency of the transfer of absorbed AA into milk protein as maximal yield is approached. Therefore, variable, rather than fixed factors for transfer efficiencies, must be incorporated into future predictive models.

Key Words: Dairy Cows, Amino Acids, Splanchnic

356 Impacts of the source and amount of crude protein on the intestinal supply of nitrogen fractions and performance of lactating dairy cows. J. H. Clark* and I. R. Ipharraguerre, *Department of Animal Sciences, University of Illinois, Urbana.*

At the onset of a new century, increasing cow productivity and concerns about the environment and safety of food for human and animal consumption in combination with shrinking profits of dairy producers have renewed the challenge first faced by scientists almost 100 years ago. That is, it is fundamental to establish the minimum amount of protein required by todays high-producing dairy cows for achieving optimal milk production. In addition, it is important to identify protein sources that will accomplish that goal with maximum efficiency from a nutritional and economical standpoint. The main objective of this paper is to review and summarize the impacts of the source and amount of dietary crude protein on the supply of nitrogen fractions to the small intestine and the consequential performance of lactating dairy cows. An attempt will be made to quantitatively integrate literature data into a summary that will contribute to our understanding of the flow of protein fractions from the rumen of dairy cows and their effects on dietary protein requirements. Specifically, this approach will focus on providing estimates of the magnitude and significance of documented alterations in the supply of nitrogen fractions to the lower gastrointestinal tract and performance of dairy cows in response to manipulations of the amount and source of dietary crude protein. The ultimate goal of this review is to provide information that may be helpful for identifying areas where further research is required, for comparing new research outcomes, or for evaluating parameterization of computer-based models currently used for predicting the response of lactating cows to the feeding of different diets.

Key Words: Crude Protein, Dairy Cows, Review

357 Nitrogen Supply to the Lower Gut and Its Relationship to Animal Performance in Beef Cattle. T. J. Klopfenstein* and G. E. Erickson, *University of Nebraska, Lincoln.*

Beef cattle require amino acids for maintenance and growth. The amino acids are supplied to the lower gut as microbial protein and undegraded