undertaken, does not support the correct development of oocyte competence. Follicle size affects oocyte quality, potentially implicating mRNA or protein stores as factors involved in oocyte competence. Oocytes from preantral follicles grown in vitro are competent to resume meiosis, although development to the blastocyst stage is reduced. An offspring from oocytes produced using this technique was normal at birth but experienced delayed onset health issues, highlighting the importance of oocyte quality long after embryogenesis. Metabolism may play a critical role in oocyte quality, as glycolytic activity in mature oocytes is correlated with increased embryonic development. Communication between the oocyte and its surrounding cumulus cells is also important for the development of a competent oocyte. Ovarian stimulation causes delayed embryonic development, increased abnormal blastocyst formation, fetal growth retardation and increased fetal loss. Thus, although meiosis and even early development may be completed successfully, there are a variety of processes occurring within the cytoplasm of the oocyte that are required for complete developmental competence. However, the cellular mechanisms that impart oocyte quality are unclear. Until the mechanisms involved in oocyte quality are elucidated, any effort to utilize assisted reproductive technologies in animals for production or biomedical purposes will be inefficient at best.

Key Words: Gamete, Embryo, Assisted reproduction

16 Pre-ovulatory, post-ovulatory and post-maternal-recognition factors that affect establishment and retention of pregnancy in cattle. E. K. Inskeep*, *West Virginia University, Morgantown WV/USA*.

Although fertilization rate is very high when male fertility is normal in most situations that have been studied, pregnancy rates are well below expectations when defined by the birth of live offspring in response to first service. Factors that affect establishment and retention of pregnancy include: (1) preovulatory influences on the follicle and oocyte, (2) early postovulatory uterine and luteal function, (3) concentrations of hormones associated with trophoblastic and endometrial function during maternal recognition of pregnancy, and (4) less-well understood factors during the peri-attachment period. For example, decreased concentrations of progesterone during preovulatory follicular development lead to increased frequency of episodic secretion of LH, increased secretion of estrogen by a persistent follicle, premature resumption of meiosis and a high incidence of embryonic death between the 2- and 16-cell stages in the cow. Using the early-weaned postpartum cow as a model, absence of previous exposure to progesterone causes increased secretion of PGF2α during days 4 to 9 of the first estrous cycle. The elevated PGF2α not only causes luteolysis, but also has a direct embryotoxic effect during the morula to blastocyst transition. Ideal conditions during the peri-attachment period are not clearly defined and factors in pregnancy wastage may vary with species. Nominal increases in secretion of PGF2α between days 30 and 35 may be important for completion of attachment and placentation in the cow. Lower survival of embryos from day 30 to days 45 to 60 in the cow is associated with lower circulating concentrations of progesterone, but association with concentrations of estrogen has varied among experiments.

Key Words: Embryonic mortality, Follicular development, Luteal function

Breeding & Genetics Symposium: Molecular genetics: Lessons from past/new directions

17 Commercial application of marker- and gene-assisted selection in livestock: strategies and lessons. J. C. M. Dekkers*[1], [1]*Iowa State University*.

During the past decades, advances in molecular genetics have led to the identification of multiple genes or genetic markers associated with genes that affect traits of interest in livestock, including genes for single gene-traits and genes or genomic regions that affect quantitative traits (quantitative trait loci or QTL).This has provided opportunities to enhance response to selection, in particular for traits that are difficult to improve by conventional selection (low heritability or traits for which measurement of phenotype is difficult, expensive, only possible late in life, or not possible on selection candidates), as has been demonstrated in a number of simulation studies. The objective here is to review strategies for the use of genes or markers in genetic improvement, to assess the extent to which and how marker and gene information has been used in commercial livestock improvement programs, to assess the successes and limitations that have been experienced in such applications, and to discuss strategies to overcome these limitations. Focus will be on the use of QTL information from experimental populations, on detection, verification, and estimation of effects in commercial breeding populations, and on the integration of molecular data in methods for genetic evaluation and in selection strategies. Types of molecular information that will be considered include gene tests for causative mutations and linked markers in population-wide linkage equilibrium or disequilibrium with the QTL.

Key Words: Marker-assisted Selection, Genetics, Selection

18 Lessons from QTL analyses in mice. D Pomp* and E. J. Eisen, *University of Nebraska,* [2]*North Carolina State University*.

Most phenotypes with economic relevance are multifactorial traits controlled by complex contributions of genetics and environment. Genetic predisposition results from combinations of relatively small effects of sequence variation within a large number of polygenes, known as quantitative trait loci (QTL). Nearly 200 QTL have been reported for growth and body composition traits in the mouse, likely representing 50-100 distinct genes. Molecular biology has yielded significant advancements in understanding these traits at the metabolic and physiological levels. However, little has been learned regarding the identity and nature of the underlying polygenes due to the inherent inaccuracy of QTL localization and the inability to differentiate between co-localization and co-incidence when comparing QTL with potential candidates. This wide gap between our knowledge of physiological mechanisms underlying complex traits and the nature of genetic predisposition significantly impairs QTL discovery. Identification and genetic mapping of key transcriptional, proteomic, metabolomic and endocrine events will uncover large lists of significant positional candidates. However, integration of experimental approaches to jointly evaluate predisposition and physiology will increase success of QTL identification by combining the power of recombination with functional analysis. Measuring physiologically relevant sub-phenotypes (e.g. 10,000 expression phenotypes on an array) within a structured gene mapping population will facilitate pathway-specific prioritization among candidate genes. This would advance our understanding of the genetic architecture of complex traits by testing the hypothesis that genes controlling predisposition to a trait are primarily involved in trans-regulation of the physiological pathways that directly regulate the trait. An integrated ?polygene discovery database? will enable QTL identification and characterization. This will be critical for the success of marker assisted selection in livestock, given the inherent advantages of using directly predictive assays relative to within-family, linked-marker tests.

Key Words: Mouse, QTL, Marker assisted selection

19 Potential use of microarrays and related methodologies in animal breeding. B. Walsh*, *University of Arizona*.

The age of genomics offers biologists with powerful tools few could even dream of twenty years ago. Biology is being transformed by such tools, and animal breeding is no exception. Genome-wide studies of levels of mRNA expression in specific tissues and/or over time can be monitored by microarrays. The rigorous statistical analysis of such arrays is still being fine-tuned, and we will explore some of the resolved, and unresolved, issues. While microarrays offer an approach to gene discovery (i.e., candidate genes), they likely face many of the same issues as QTL mapping in moving from a powerful genetic tool to a particular tool for applied breeding. Microarrays are one tool of functional genomics, a discipline seeking to understand gene and metabolic networks. Another tool are two-hybrid screens that look for interactions between proteins

within a cell. Analysis of these data provide a crude estimate of gene networks, and these may prove to be of some interest to future breeders. Finally, an old tool from evolutionary genetics, Burns-Kascer sensitivity analysis for flux through biochemical pathway, is discussed. In conjunction with hopefully forthcoming data on gene and protein networks, sensitivity analysis may provide breeders with a powerful analytic approach to detect key points in pathways of interest. Knowledge of such points obviously serves a starting point for searches for useful genetic variation in traits of interest.

Key Words: Microarrays, Protein-protein interaction networks, Burns-Kascer sensitivity analysis

Food Safety Symposium: Food safety for animal agriculture: What producers need to know

20 Animal and egg production food safety: Introduction.

G. M. Jones*[1], B. Eastwood[2], and J. Mattison[3], [1]*Virginia Tech, Blacksburg, VA,* [2]*USDA CSREES, Washington DC,* [3]*The ADDS Center, Verona, WI.*

An on-farm food safety program has been developed for Extension specialists and agents and other food animal professionals to use for their own information or in developing educational programs for animal producers. The program consists of modules on various topics related to food safety, a database with selected references, and links to other food safety related websites and is available on CD-ROM through the ADDS Center. Its development and distribution was funded by USDA Food Safety and Inspection Service. Oversight was provided by a steering committee that included Extension agents and specialists representing food science, veterinary medicine, and animal and poultry science. Modules discuss importance of food safety and use of HACCP in development of quality assurance production practices. Specific modules include: causes of foodborne disease, drug use, residues, and resistance, HACCP, management practices that also involve feeds, and control of flies and rodents, farm advisory teams, and commodity assurance programs for aquaculture, beef, chick and poultry, egg, turkey, dairy, goat, veal, pork, and sheep. Primary emphasis was given to commodity programs. The modules and database were evaluated by the animal science committee of the National Association of County Agricultural Agents and the steering committee.

Key Words: Animal production food safety, Training/teaching modules, Extension education

21 Food safety for animal agriculture: What producers need to know about causes of foodborne illness.

D. B. Griffin*, *Texas A&M University, College Station, TX.*

This module reviews CDC foodborne disease incidence, types of foodborne illness and prevalence, trends in causes of foodborne illness over past century, symptoms and susceptibility, and specific pathogens and sources found in animal products using baseline data of USDA FSIS. Brief discussions are provided of: *E. coli, Salmonella, Staphylococcus aureus, Listeria, Campylobacter, Yersinia, Bacillus cereus, Clostridium botulinum, Giardia, Cryptosporidium*, and BSE. The relationship between *Mycobacterium paratuberculosis* and Johne's disease with Crohn's disease in humans is explored. The module outlines the roles of pasteurization and irradiation in preventing disease outbreaks.

Key Words: Animal production food safety, Foodborne illness, Extension education

22 Food safety for animal agriculture: What producers need to know about drug use, resistance, and residues.

B. Jayarao*, *Pennsylvania State University, University Park, PA.*

This module reviews uses of antibiotics in animal agriculture, extent of residues and causes, benefits of subtherapeutic drug use, antibiotic resistance and relation to drug use in food-producing animals, extra label drug use, and role of animal producers in minimizing risk. The module looks at the importance of antibiotics to animal production, while discussing why antibiotics are of concern to public health. It discusses the extent of drug residues, using USDA FSIS residue test results, and summarizes some of the causes and/or errors in drug use. Relationship between drug use in food producing animals and antibiotic resistance in humans is examined. Extra label drug use is defined and requirements for use are listed. The role of antibiotic susceptibility tests is outlined. The advantages of subtherapeutic (for growth promotion), prophylactic (disease prevention), and therapeutic (treatment of infections) antibiotic use in animals are presented as well as concerns over excessive use.

Key Words: Animal production food safety, Drug use, Extension education

23 Food safety for animal agriculture: What producers need to know about HACCP and management practices.

G. M. Jones*, *Virginia Tech, Blacksburg, VA.*

HACCP (hazard analysis critical control points) is a system that identifies specific hazards, implements effective control measures, and monitors procedures used to prevent hazards. It is a tool used to protect food against microbiological, chemical, and physical hazards. An illegal drug residue in milk or meat is a hazard. HACCP is a process that collects and analyzes information on hazards and conditions leading to their presence and to decide which are significant. Critical control points are the steps at which control can be applied and are essential to prevent or eliminate a food safety hazard or to reduce it to an acceptable level. Quality assurance programs are generally based on HACCP concepts and these are embedded in residue avoidance programs. HACCP includes keeping records to trace problems and to measure effects of intervention strategies and the monitoring of progress in controlling hazards. The HACCP module includes: definition/description, potential hazards and their significance, on-farm critical control points, corrective actions, role of quality assurance programs and their benefits, and brief introduction to various commodity Quality Assurance Programs. The management practices module includes sources of hazards and stressors on the farm, on-farm critical control points, animal health (immune system, nutrition, environment), management strategies and practices, biosecurity, transportation of animals, handling disabled animals, and dead animal disposal.

Key Words: Animal production food safety, HACCP, Management practices

24 Food safety for animal agriculture: What producers need to know about quality assurance programs.

J. W. Oltjen*, *University of California, Davis, CA.*

Virtually all food animal commodity organizations have implemented quality assurance education programs (QAP) to maintain or increase food safety, wholesomeness, and quality. The goal of all food animal industries is to produce high quality, safe products. QAP focus on helping producers supply products that are as free as possible of microbial hazards and drug and chemical residues, although QAPs originally focused on residue avoidance. Benefits of QAP include improved management practices, avoidance of violative drug residues, decreased production costs, and increased awareness of food safety concerns. QAPs are important because they: promote animal health and welfare, ensure proper drug and antibiotic use, provide records to assure purchasers of good production practices, are proven to reduce residue violations, potentially reduce pathogens through good hygiene and animal health, and improve production efficiency and quality of animals. QAPs take into consideration feedstuffs (additives, medications, mycotoxins, pathogens, clean mixing equipment), cleanliness and ventilation of facilities, appropriate drug use and records, extralabel drug use, identification and tracking of treated animals, injection site blemishes and hazards, and biosecurity. Self-review is important in QAPs, and some utilize third party verification. This module reviews basic concepts behind quality assurance programs, benefits, residue violations, drug withdrawal times, preharvest testing, sensitivities and specificities, false positive and false negative test results, and presents a brief introduction to commodity QAPs.

Key Words: Animal production food safety, Quality assurance programs, Extension education