

ANIMAL PRODUCTION PORTFOLIO

Knowledge Area 305: Animal Physiological Processes

Highlights of FY2004 CSREES Investments (\$8.6 million)



USDA Goal 1:

Enhance Economic Opportunities for Agricultural Producers

CSREES Objective 1.5:

Contribute Science-Based Information, Analysis, and Education to Promote the Efficiency of Agricultural Production Systems

Novel Gene Identified in Skeletal Muscle Growth:

Scientists at **Purdue University** identified a novel gene (Asb-15) in muscle that is downregulated after administration of beta agonists. Although Asb-15 did not affect proliferating myoblasts, Asb-15 stimulated differentiation of myoblasts into myotubes. These findings are the first to show a direct association between the novel gene, Asb-15, and skeletal muscle growth. (NRI Grant; CRIS Accession Number 0196839)

Altered Gene Expression During Intestinal Repair:

Colic results in annual losses of ~\$177 million in the \$25.3 billion equine industry in the United States. Scientists at **North Carolina State University** have shown that cyclooxygenase isoforms are critical to intestinal repair following colic-related ischemic injury and that neutrophils augment the repair process by enhancing COX-2 expression. In addition, ~80 genes were identified that are either increased or decreased in recovering mucosa. (NRI Grant; CRIS Accession Number 0195651)

TGF Regulates Mammary

Development: Researchers at the **University of Vermont**

demonstrated that changes in the amounts of TGF-alpha and TGF-beta caused different rates of mammary epithelial and/or stromal cell growth and death as well as changes in gene expression and protein production. TGF-beta-1 also stimulated development of the bovine mammary gland by providing a matrix for epithelial cells to grow in after stimulation of the stroma during prepubertal development. Thus, TGF-beta could play a critical role in regulating milk production. (Hatch; CRIS Accession Number 0190540)

Glucagon Prevents Fatty Liver Disease: Up to 50% of dairy cows in the United States may have mild to pathological fatty liver disease during early lactation, which costs millions of dollars in treatment and lost milk production. Currently, fatty liver can neither be prevented consistently nor treated effectively. Scientists at **Iowa State University** demonstrated that glucagons, when administered on the day of calving and for 14 days after calving, prevented the onset of fatty liver disease. The prevention involves a decrease in fatty acid mobilization from adipose tissue and an increase in glucose availability via gluconeogenesis. Administration of glucagons to periparturient dairy cows should improve health of dairy cows and profitability for producers. (NRI Grant; CRIS Accession Number 0192651)

KNOWLEDGE AREA 305: PHYSIOLOGICAL PROCESSES (CONTINUED)

Improved Nutritional Recommendations for Dairy Cows:

Scientists at **Cornell University** have shown that increasing the supply of absorbable choline to periparturient cows decreased the rate of triglyceride accumulation in liver and increased milk yield. Feeding trans-10, cis-12 conjugated linoleic acid decreased milk fat synthesis; however, cows increased milk yield in response to reduced milk fat synthesis. Peripartum chromium supplementation increased dry matter intake and milk yield during the immediate postpartum period. Research and outreach efforts conducted by these scientists have improved the nutritional recommendations for periparturient dairy cows which have impacted more than 75% of the dairy cows in the United States. (Hatch; CRIS Accession Number 0182303)

Synthesis of Milk Proteins from Sows:

Scientists at the **University of Illinois** conducted *in vitro* studies to characterize the utilization of substrates by sow mammary tissue. Only ~30% of proteins synthesized *in vitro* by lactating porcine mammary tissue were milk-specific proteins. The major milk-specific proteins (alpha-lactalbumin and beta-lactoglobulin) were readily synthesized and secreted by porcine mammary tissue in culture, but the caseins were secreted at a lower than expected rate. (Hatch; CRIS Accession Number 0177987)

Biomarkers for Avian Medullary Bone

Metabolism: Eggshell breakage and bone fragility represent a multi-million dollar loss to the poultry industry in the United States. The poultry industry has tools to maximize dietary calcium utilization; however, there are no non-invasive tools to evaluate medullary bone metabolism. Researchers at **Pennsylvania State University** have shown that medullary bone has higher proteoglycan content than cortical bone and that keratin sulfate concentration in blood reflects medullary bone formation rather than degradation. Additional bone matrix proteins have been identified in the plasma of laying hens and further studies will determine if these proteins can be used as biomarkers for avian medullary bone metabolism. (Hatch; CRIS Accession Number 0188091)

Transcription Factors Control Muscle Fibers:

Understanding the mechanisms responsible for the formation of diverse muscle types in the early embryonic chicken may lead to methods to control the amount of white or red meat in poultry. Investigators at **Stanford University** showed that FGF-8 regulates myogenesis and chondrogenesis and is controlled by the transcription factor, *sonic hedgehog*. Pax-7 is another transcription factor that is expressed from early embryonic day 5 through adult and is a marker of commitment to the myogenic lineage. Understanding the mechanisms that alter the type and growth of muscle fibers could provide a genetic basis for control of meat quality and quantity from poultry. (NRI Grant; CRIS Accession Number 0193649)

ACTH Stimulates GH in Chick Embryos:

Scientists at the **University of Maryland** studied the mechanisms that control differentiation of the cells that secrete growth hormone (GH) during embryonic development. Their results demonstrate that administration of chicken adrenocorticotropin (ACTH) induces production of GH prematurely during chicken embryonic development. More than 350 genes in the chick embryonic pituitary gland were regulated by glucocorticoid. This information is now being used to identify genetic markers to select genetically superior breeding broilers with improved growth and feed efficiency traits. (NRI Grant; CRIS Accession Number 0193579)

Stair-Step Nutrition Enhances Lactation:

Research conducted at **North Dakota State University** showed that the stair-step compensatory nutrition regimen (a unique combination of dietary energy restriction and refeeding) has lasting effects on mammary development, differentiation, and lactation. This permanent enhancement of mammary gland growth and lactation potential suggests a link between nutritionally-induced compensatory growth, epigenetic control of mammary gene expression, and metabolic imprinting. The ability to influence heritable genes that regulate milk synthesis may be used to improve the quality and quantity of milk and the longevity of lactation. (Hatch; CRIS Accession Number 0187508)