

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Animal Health And Production

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
301	Reproductive Performance of Animals	10%		15%	
302	Nutrient Utilization in Animals	10%		20%	
303	Genetic Improvement of Animals	10%		15%	
305	Animal Physiological Processes	0%		10%	
307	Animal Management Systems	20%		10%	
311	Animal Diseases	5%		20%	
315	Animal Welfare/Well-Being and Protection	25%		10%	
806	Youth Development	20%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.0	0.0
Actual Paid	0.0	0.0	10.3	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
24603	0	1131374	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
24603	0	1131374	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
197537	0	9587312	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities in 2014 included results suggesting that microneme secretion is a target that could be exploited for development of new drugs for the treatment of not only cryptosporidiosis but also other serious apicomplexan diseases such as toxoplasmosis, an exploration of how epithelial immunity may affect fly attractiveness in heifers, work to identify a minimally-invasive, easy-to-perform, and efficient means of providing pain management to piglets undergoing painful agricultural practices such as castration and tail docking, work demonstrating that an in vitro embryo production [IVP] technology can be utilized across two distant country borders, research with the goal of improving the quality of stover so it can be used as a forage replacement for feedlot cattle without impacting performance, a study with the goal of improving fertility when using frozen semen [resulting in increased use of cryopreserved boar semen for improving genetic merit and reducing potential for disease transmission], an effort to determine the effects of overfeeding energy on gene expression in mesenteric [MAT], omental [OAT], and subcutaneous [SAT] adipose tissue [AT] from nonpregnant and nonlactating Holstein cows, an exploration of the role of the first milk [colostrum] on the interaction between a balanced microbial population in the intestinal lumen and activation of the intestinal immune system in the neonatal animal [our aim was to make a positive impact on the management of newborn animals in terms of nutrition, prevention of infectious disease, and welfare], and studies to develop an average in vivo MRI-based atlas specific for the 4-week-old piglet and probabilistic tissue classification maps.

Activities also included a close examination of individual dietary macronutrients and other components known to affect microbial-derived fermentative metabolites and/or barrier function in growing pigs, the development of several diagnostic tools [dynamic light scattering and surface-enhanced Raman spectroscopy] that have the potential to reduce poultry morbidity and mortality as a result of early detection of avian influenza viruses, the finding that oral immunization may be the most efficacious PEDV immunization modality at this time, especially with regard to the production of milk antiviral antibody levels, work to educate poultry producers about the feeding of spray-dried bovine plasma protein on laying hen performance when exposed to high environmental temperatures, an effort to better understand the nutritional, metabolic, genetic, and endocrinological differences among animals [this will aid in the determination of why certain animals are more feed efficient than others and allow producers to manage beef cattle production systems in a manner that minimizes feed consumption relative to output], an analysis of gene expression in the anterior pituitary of two strains of silver foxes with different levels of stress reactivity and identification of significant differences in expression of genes involved in the regulation of HPG between the two strains [these findings provide a novel insight into the molecular mechanisms involved in the regulation of behavior and reproduction], the development of results

demonstrating that ingestion of a hypercaloric, high-fat diet had significant effects on gut morphology and function in Ossabaw gilts, work to identify the factors and signaling pathways that are involved in the cross-talk between the oocyte and the ovarian granulosa cells, research to improve our understanding of the impact that bacterial strain has on the inflammatory response to Lipopolysaccharide in horses, significant progress in research efforts aimed at defining the mechanism[s] by which porcine reproductive and respiratory virus [PRRSV] is able to inhibit the host interferon [IFN]-alpha response, and a project with the goal of developing needed reagents that could be used to evaluate equine sera for their immunoglobulin response to vaccination with a newly created modified live *Streptococcus equi* subsp. *equi* vaccine.

Conference presentations included the American Society of Animal Science, International Veterinary Emergency and Critical Care Society, Dudley Smith Summer Field Day, Farm Progress Show, Charolais Association, Orr Beef Research Center Field Day, Beef Quality Assurance Trainings, Driftless Area Beef Conference, Heart of America Grazing Conference, Beef Sire Selection and Management Seminar, Illinois Performance Tested Bull Sale, Jo Daviess County Beef Producer Meeting, Southern Illinois Cow Calf Conference, Illinois Cattle Feeders Meeting, Pike County Beef Association Meeting, Illinois Forage Institute, Midwest Animal Science Meeting, American Dairy Science Association, Canadian Society of Animal Science, Research Workers in Animal Disease, Beef Improvement Federation, Genes, Brain and Behavior Meeting, Association for Behavior Analysis, Society for Molecular Biology and Evolution, Symposium on Gut Health in Production of Food Animals, Illinois Dairy Summit, Four State Dairy Nutrition and Management Conference, and the 13th National Veterinary Scholars Symposium.

Two key programmatic thrusts characterize Extension livestock production outreach: increasing reproductive efficiency and reducing livestock production input costs. Two Extension educators located in research stations provided leadership for a number of programs that focused on beef production, such as statewide **Beef Quality Assurance** certifications, **Sire Selection and Management seminars**, the **Illinois Performance Tested Bull Sale** and **Illinois Beef Exposition**, the **Illinois Cattle Feeders meeting**, the **Illinois Forage Institute**, and the **Driftless Area Beef Conference** with the latter attended by participants from four states [Illinois, Iowa, Minnesota and Wisconsin]. Other local and regional programs included pasture walks, research farm field days, and regional **Cow/Calf Seminars**. Educational workshops for sheep and goat producers were offered in the southern and northeastern part of the state. Three **Dairy Summit meetings** were held throughout the state for dairy producers and included presentations on feeding strategies for 2014, transitioning with efficiency and calf management. The University of Illinois College Of Veterinary Medicine also offered the **Executive Pork Producers Program** which addressed essential skills for excellence in swine business management and the **Executive Veterinary Program in Swine Health Management** which covered the essential aspects of swine production medicine for veterinarians. **Certified Livestock Manager Training Workshops** targeted at manure management are examples of programs that were delivered by Extension staff to audiences at campus and off-campus sites.

A number of Extension campus faculty and staff members helped conduct the annual horse, poultry, dairy, meats, and livestock judging contests for 4-H members. Other 4-H activities include the state **Dairy Quiz Bowl**, regional and state **Horse Bowl/Hippology** and speech contests. The Extension faculty specialist in poultry taught teachers how to use the curriculum and incubators for the 4-H chick incubation and embryology project in 191 classrooms that included 12,161 youth during the 2013-14 school year [see the 4-H Youth Development planned program]. In addition, Illinois 4-H and FFA members completed the seven modules of the online **Quality Assurance and Ethics Certification** training and quiz for beef, dairy, goats, horses, sheep and swine covering topics related to care and administration of medicine for livestock. It is worth noting that 4-H members raising dogs and rabbits are now expected to complete the training and quiz.

2. Brief description of the target audience

Members of the target audience included academic, medical, veterinary, industrial and professional scientists and clinicians, entomologists, veterinary scientists and large animal veterinarians, feed companies, livestock producers, farmers, research scientists, reproduction companies, Extension agents, animal scientists, swine veterinarians and members of the swine production industry, poultry producers and researchers, breed associations, beef cow-calf producers, national and international dairy goat farmers, dairy nutritionists, and research scientists working on viral diseases of swine. Extension targets livestock producers, custom manure haulers, regulatory agency representatives, livestock commodity group representatives, veterinarians, horse owners and breeders, the livestock feed industry, companion animal owners, community leaders, and youth.

3. How was eXtension used?

Five Extension staff members are members of various animal-related eXtension Communities of Practice including Animal Welfare, Beef Cattle, Companion Animals, HorseQuest, Livestock and Poultry Environmental Learning Centers, Goats, and Sheep.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	488	5013	16001	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2014
 Actual: 1

Patents listed

TF 11130-US [Soybean-Based Porcine Reproductive and Respiratory Syndrome Virus Vaccine And Methods for Making and Using the Same].

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	40	40

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2014	12

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased Knowledge Of Livestock Care And Management
2	Treating Forages Prior To Feeding To Improve Feeding Value
3	Defining The Early Mechanisms Of Apicomplexa-Host Interactions
4	Improved Control Of Porcine Reproductive And Respiratory Syndrome
5	The Development Of Tools To Investigate Developmental Origins Of Behavioral Problems In Pigs
6	The Development Of New Therapeutic Agents To Treat Toxoplasma Gondii And Cryptosporidium Parvum
7	Demonstrating The Ability To Apply In Vitro Embryo Production [IVP] Technology Across Two Distant Country Borders
8	Determining The Effects Of Overfeeding Energy On Gene Expression In Adipose Tissue From Nonpregnant And Nonlactating Holstein Cows
9	Reducing The Economic And Public Health Impacts Of Enteric Disease In Cattle
10	Identification Of Molecular Pathways Involved In Regulation Of HPA Activity In Foxes
11	Identifying The Factors And Signaling Pathways That Are Involved In The Cross-Talk Between The Oocyte And The Ovarian Granulosa Cells
12	Increasing Postpartum Reproductive Performance In Dairy Cows

Outcome #1

1. Outcome Measures

Increased Knowledge Of Livestock Care And Management

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	4155

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Priorities in livestock production focus on production management [addressing new issues involving health, feeding, reproduction, genetics, and management] that enhance producers profitability while providing quality meat products for consumption. Illinois has a number of areas where land is more conducive to grazing animals than row crop production. These areas are primarily located in southern and western Illinois. Other areas and production units are challenged when grain prices are high and producers must adjust production management accordingly. Humane care of animals is a concern as is a safe food supply.

What has been done

Illinois has historically offered a number of Extension-sponsored beef production programs held annually to address issues facing beef producers and to share the latest research being carried out at the University of Illinois. In anticipation that moderating grain prices will likely allow profits to again return to cattle feeding, 38 cattlemen and farmers attended the annual Illinois Cattle Feeders Meeting held at a community college in northern Illinois in March of 2014. The one-day program featured five university and industry experts who shared information on strategies to maximize profits in cattle feeding. At the end of the program an evaluation was distributed and returned by 35 attendees. A summary of their responses follows.

Training was provided to 4-H youth enrolled in livestock projects via an online module on ethical treatment of animals that also included an examination to certify that they have the required knowledge. In addition, face-to-face training is offered in some locations that combines ethics and actual livestock production basics. This past year all counties made completion of the training a requirement for those youth enrolled in dairy, swine, beef, horses, rabbits, sheep, goats, and dogs.

Results

All thirty-five [92% of the 38 attendees] who completed the evaluation of the Illinois Cattle Feeders' Meeting indicated that their knowledge regarding feeding cattle increased and also felt that the content of this conference met their expectations. On a scale of 1-4 [four being 'A Lot' as high], respondents rated the topics that were covered at the meeting. Approximately two-thirds of the 35 producers checked that either they learned 'Quite a bit' or 'A lot' regarding: [1] The value of cattle manure to the grain farmer; [2] State and federal policy affecting beef production; [3] Improved livestock feeding facilities; and [4] Differences in cattle performance and manure value when looking at cattle fed out in lots, indoors, and in improved cattle feeding facilities. Nearly two-thirds described changes they planned to make in feeding, improving or adding new facilities, or in managing manure.

With respect to the required livestock ethics training, online module training records indicate that 4,120 youth were successfully certified in 2013-14.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection
806	Youth Development

Outcome #2

1. Outcome Measures

Treating Forages Prior To Feeding To Improve Feeding Value

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Defining The Early Mechanisms Of Apicomplexa-Host Interactions

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Improved Control Of Porcine Reproductive And Respiratory Syndrome

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The most recent estimate of the economic impact of porcine reproductive and respiratory syndrome [PRRS] to the pork industry is \$650 million dollars per year. Although not representative of the whole industry, the available data indicates that for the last four years the annual cumulative incidence of new PRRS infections in sow farms during the PRRS season is approximately 40-50%. None of the intervention strategies that have been tried to control PRRS outbreaks are adequate to deal with this costly disease. A likely reason for this is that the PRRS virus possesses unique properties that allow it to evade the immune system. A major feature exhibited by PRRS virus is the lack of stimulation of interferon [IFN]-alpha production. Thus, the aim of this project was to determine the mechanism behind the failure of PRRS virus to stimulate the production of IFN-alpha of porcine alveolar macrophages.

What has been done

We examined the ability of several wild-type PRRS virus isolates to stimulate porcine alveolar macrophages to secrete IFN-alpha. The host cell used in this study consisted of the porcine alveolar macrophage cell line ZMAC. The ZMAC cells are readily infected by PRRS virus and are fully functional with regard to the type I IFN signaling pathway, as evidenced by the fact that they produce large amounts of IFN-alpha in response to their stimulation with synthetic double stranded RNA, namely polyinosine-polycytidylic acid [polyI:C]. PolyI:C is a well known toll-like receptor 3 [TLR3] agonist that stimulates IFN-alpha production in myeloid and non-myeloid cells. While all of the wild-type PRRS virus tested failed to stimulate IFN-alpha production, a laboratory strain mutant termed 1198 exhibited the ability to stimulate copious amounts of IFN-alpha. Using a comparative approach, our experiments were focused on understanding the molecular basis of the IFN-alpha-stimulatory phenotype of 1198 strain and the lack of stimulation by the wild-type PRRS virus strains as well as two other laboratory strain that are nearly isogenic to 1198.

Results

In these studies the 1198 strain proved to further distinguish itself from all other PRRS virus strains in that, unlike all other strains tested, it stimulated the phosphorylation of IRF3 and induced type I IFN gene transcription. Extensive analyses revealed wild-type PRRS virus exhibits a novel mechanism of immune evasion that is missing in the 1198 strain. Using the PRRS virus strains that are nearly isogenic to the 1198 strain, we were able to determine that the mechanism of immune evasion was attributable to a unique mutation in the non-structural protein 2 [NSP2]. The role of the NSP2 mutation in the IFN-alpha stimulatory phenotype was confirmed by a revertant mutant of the 1198 strain, mutant 1198B [which had lost a unique amino acid change in NSP2].

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
307	Animal Management Systems
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #5

1. Outcome Measures

The Development Of Tools To Investigate Developmental Origins Of Behavioral Problems In Pigs

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Environmental insults during sensitive periods can affect brain development and function resulting in animals that are less resilient to stress. However, the ability to investigate how insults affect brain development and function in pigs has been limited by access to tools for assessing brain structure and composition in vivo. For example, magnetic resonance imaging [MRI] can be a

powerful tool to study neurodevelopment in piglets, but most MRI resources have been produced for adult humans.

What has been done

In studies completed this year we developed an average in vivo MRI-based atlas specific for the 4-week-old piglet. In addition, we developed probabilistic tissue classification maps. These tools can be used with brain mapping software packages [such as SPM and FSL] to aid in voxel-based morphometry and image analysis techniques. The atlas enables efficient study of neurodevelopment in piglets. Because piglets are a highly tractable translational animal with brain growth and development similar to humans, this tool is also of interest to the biomedical community.

Results

In follow up studies to assess the effects of early life infection on brain development, piglets were inoculated with PRRSV on postnatal day [PD] 7 and magnetic resonance imaging [MRI] was used to assess brain macrostructure [voxel-based morphometry], microstructure [diffusion tensor imaging] and neurochemistry [MR-spectroscopy] at PD 29 or 30. PRRSV piglets exhibited signs of infection throughout the post-inoculation period and had elevated plasma levels of TNF alpha at the end of the study. PRRSV infection increased the volume of several components of the ventricular system including the cerebral aqueduct, fourth ventricle, and the lateral ventricles. Group comparisons between control and PRRSV piglets defined 8 areas where PRRSV piglets had less gray matter volume, 5 areas where PRRSV piglets had less white matter volume, and 4 relatively small areas where PRRSV piglets had more white matter. Of particular interest was a bilateral reduction in gray and white matter in the primary visual cortex. PRRSV piglets tended to have reduced fractional anisotropy in the corpus callosum. Additionally, N-acetylaspartate, creatine, and myo-inositol were decreased in the hippocampus of PRRSV piglets suggesting disrupted neuronal and glial health and energy imbalances. These findings show in a gyrencephalic species that early-life infection can affect brain growth and development.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
307	Animal Management Systems
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #6

1. Outcome Measures

The Development Of New Therapeutic Agents To Treat Toxoplasma Gondii And Cryptosporidium Parvum

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Our laboratory has characterized a subset of long-chain polyunsaturated fatty acids [L-PUFFA], isolated from bovine colostrum, which block in vitro *Cryptosporidium parvum* and *Toxoplasma gondii* host cell infectivity as well as both *Toxoplasma gondii* and *Plasmodium gallinaceum* infectivity in vivo. Our current studies addressing the mechanism of L-PUFA-mediated inhibition of infectivity have led to the hypothesis that L-PUFA block a conserved apicomplexan microneme secretion pathway that regulates parasite motility.

What has been done

Our results as well as others suggest microneme secretion is a target that could be exploited for development of new drugs for the treatment of not only cryptosporidiosis but also other serious apicomplexan diseases such as toxoplasmosis. To probe this hypothesis we have leveraged NC-1202 funding by partnering with Dr. David Sibley, Washington University School of Medicine, on an NIH grant entitled Designing Selective Inhibitors of Calcium-Dependent Kinases in Parasites. The goal of the University of Illinois portion of this project is to evaluate small molecule inhibitors of parasite-specific kinases belonging to the calcium-dependent protein kinase [CDPK] family. CDPKs are plant-like protein kinases that are not found in animal cells, yet they are expanded in apicomplexan parasites. Recent studies using molecular genetic and chemical biology approaches reveal that CDPK1 controls microneme secretion and that inhibition of this kinase leads to profound defects in parasite motility, invasion, and egress from host cells.

Results

The NC-1202 crypto project described above allowed us to leverage multistate funds to successfully compete for an NIH award. Subsequently, we also acquired funding in collaboration with Dr. Steven Beverley at the Washington University School of Medicine to examine the role of a recently-discovered symbiont RNA virus [Crypovirus], found in all mammalian *Cryptosporidium* isolates, in the pathogenesis of cryptosporidiosis. One-year pilot funding for this project was obtained from the Midwest Region Center of Excellence for Biodefense and Emerging Infectious Disease Research. Using rt-qPCR, we have screened a relatively large number of proprietary CPDK1 inhibitors and CpV antivirals for their ability to inhibit either or both the growth [or host cell invasion] of *Cryptosporidium* and CpV replication. The results indicate a relatively small number of putative drugs are capable of blocking growth of *Cryptosporidium* or CpV replication; however, the drugs selected for additional study appear selective, non-toxic in vitro and able to block *Cryptosporidium* growth in vitro at low to sub-micromolar concentrations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
305	Animal Physiological Processes
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #7

1. Outcome Measures

Demonstrating The Ability To Apply In Vitro Embryo Production [IVP] Technology Across Two Distant Country Borders

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

It has been previously demonstrated that Panama is applying the biotechnology of in vitro embryo production [IVP] into their bovine reproduction management systems. This present work demonstrates the ability to apply the IVP technology across two distant country borders. We have demonstrated that a country [Dominican Republic, DR] that does not have a bovine IVP lab can take advantage of fresh bovine IVP embryos for transfer using distant IVP facilities in another country [Panama, approximately 1,500 km away]. The objective of this study was to demonstrate that a model system for large-scale commercial in vitro bovine embryo production for beef and dairy producers that do not have IVP technology in their home country could be developed producing comparable results.

What has been done

Since the same laboratory provides IVP services to both countries, a special sanitary protocol was developed in order to legalize the exchange of biological materials [oocytes/embryos]. The data obtained in the Dominican Republic was compared to Panamanian client data because identical conditions were utilized for IVP. Cattle production systems were similar as Brahman [a Zebu type of cattle] is the most popular breed in both countries. Oocytes were collected from 10

different herds in Panama and 4 different herds in the DR. The oocytes were transported in a oocyte transporter in both instances. However, oocytes from the DR were transported in InVitro Brasil maturation medium from 12-18 hours and in Panama from 6-12 hours before they were placed in a standard CO2 incubator. In both cases the oocytes were matured for 24 hours before fertilization with conventionally frozen Brahman semen in InVitro Brasil fertilization medium followed by culture up to 7 days in InVitro Brasil embryo culture medium. The embryos were transferred on day 7, either in Panama or the DR. They were transported by car in Panama and via airplane back to the DR. A comparison of oocyte number and quality, cleavage, embryo production and pregnancy rate was made using the same in vitro production system for Brahman donors from September 2012 until May 2013. The difference between sites in the relative number of viable oocytes, relative number of cleaved oocytes among viable oocytes, relative number of embryos produced among cleaved oocytes and relative number of embryos produced among viable oocytes was tested using Fisher's exact test. Pregnancy rate was analyzed with X2.

Results

We realize that these results represent field data, however we believe the present work is a significant step in demonstrating the potential for wide commercial-scale dissemination of the IVP technology between distant countries. The number of embryos produced in Panama was slightly but significantly higher than those produced in the DR but this is likely due to the larger number of donors and oocytes from the Panama herds. However, the pregnancy rate was higher in the DR likely due to the health status of the DR recipients. These data illustrate that in vitro embryo production using Brahman donors could be used as a tool to improve and spread superior genetics. Furthermore, this technique can serve as a model for other Central American and Caribbean countries under similar management systems.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #8

1. Outcome Measures

Determining The Effects Of Overfeeding Energy On Gene Expression In Adipose Tissue From Nonpregnant And Nonlactating Holstein Cows

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Our objective was to determine the effects of overfeeding energy on gene expression in mesenteric [MAT], omental [OAT], and subcutaneous [SAT] adipose tissue [AT] from nonpregnant and nonlactating Holstein cows.

What has been done

Eighteen cows were randomly assigned to either a low energy [LE, net energy for lactation NE[L] = 1.35 Mcal/kg of dry matter [DM]] or high energy [HE, NE[L] = 1.62 Mcal/kg of DM] diets for 8 weeks. Cows were then euthanized and subsamples of MAT, OAT, and SAT were harvested for transcript profiling via quantitative PCR of 34 genes involved in lipogenesis, triacylglycerol [TAG] synthesis, lipolysis, lactate signaling, transcription regulation, and inflammation. The interaction of dietary energy and AT depot was only significant for LPL, which indicated a consistent response among the 3 sites. The expression of key genes related to de novo fatty acid synthesis [FASN] and desaturation [SCD] was upregulated by HE compared with LE. Other genes associated with those processes, such as ACLY, ACACA, ELOVL6, FABP4, GPAM, and LPIN1, were numerically upregulated by HE. The expression of lipolytic [PNPLA2 and ABHD5] genes was upregulated and the antilipolytic lactate receptor HCAR1 was downregulated with HE compared with LE. The putative transcription regulator THRSP was upregulated and the transcription regulator PPARG tended to be upregulated by HE, whereas SREBF1 was downregulated. Among adipocytokines, HE tended to upregulate the expression of CCL2, whereas IL6R was downregulated.

Results

Overall, results indicated that overfeeding energy may increase AT mass at least in part by stimulating transcription of the network encompassing key genes associated with de novo synthesis. In response to energy overfeeding, the expression of PPARG rather than SREBF1 was closely associated with most adipogenic or lipogenic genes. However, the transcriptional activity of these regulators needs to be verified to confirm their role in the regulation of adipogenesis or lipogenesis in bovine AT. Overfeeding energy also may predispose cows to greater lipolytic potential by stimulating expression of TAG hydrolysis genes while inhibiting signaling via hydroxycarboxylic acid receptor [HCAR1], which is a novel antilipolytic regulator. Our results do not support an overt inflammatory response in adipose tissues in response to an 8-week energy overfeeding.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
315	Animal Welfare/Well-Being and Protection

Outcome #9

1. Outcome Measures

Reducing The Economic And Public Health Impacts Of Enteric Disease In Cattle

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Enteric disease represents an important source of economic loss to the cattle industry and raises significant public health concerns regarding antimicrobial use. The alteration of gut physiology and homeostasis relies on the modification of the complex interaction of host, microbial, and environmental factors.

What has been done

In this study we wanted to explore the role of the first milk [colostrum] on the interaction between a balanced microbial population in the intestinal lumen and activation of the intestinal immune system in the neonatal animal. Our aim was to make a positive impact on the management of newborn animals in terms of nutrition, prevention of infectious disease, and welfare. Previous studies exploring the impact of colostrum on the health of young animals have focused on its influence on systemic immunity.

Results

The results of this study show that colostrum plays a significant role in determining the number and type of bacteria that become established in the calf intestine. As we explore the management factors that may influence how this takes place, we anticipate being able to apply this work directly to young stock rearing systems. In view of the universal importance of colostrum on disease prevention, this work is likely to have universal benefits to animal health and production, and is likely to attract the interest of nutritional and pharmaceutical companies with a stake in young stock disease management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
307	Animal Management Systems
311	Animal Diseases

Outcome #10

1. Outcome Measures

Identification Of Molecular Pathways Involved In Regulation Of HPA Activity In Foxes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Identification of the molecular sources of individual variation in response to the changing environment will provide a foundation for developing effective methods for the assessment of stress-related behaviors and the potential improvement of livestock through selection. Anterior pituitary is one of the key regulators of the hypothalamic-pituitary-adrenal [HPA] axis, a major neuroendocrine system involved in adaptation to stress, and the hypothalamic-pituitary-gonadal [HPG] axis, the system which is involved in regulation of reproduction and development. In the current project we analyzed gene expression in the anterior pituitary of two strains of silver foxes with different levels of stress reactivity and identified significant differences in expression of genes involved in regulation of HPG between the two strains. These findings provide a novel insight into the molecular mechanisms involved in the regulation of behavior and reproduction.

What has been done

Differential expression of genes between tame and aggressive fox strains was assessed using the DESeq2 v. 1.6.2 program. For each gene in the input data, DESeq2 returns the log₂ fold change of that gene's expression levels compared between the two groups [here, tame and aggressive foxes], the base mean expression levels in read counts, and the p value to indicate significance. A total of 339 genes were differentially expressed between the two fox strains at p=0.05 with no adjustment for multiple comparisons. Using DESeq2, the list of differentially

expressed genes was identified.

Results

Differential expression of several genes associated with the HPG system was identified. EGR1 [early growth response protein 1] showed lower expression in tame foxes [$p = 0.003$; a log₂ fold change of -1.025]. EGR1 is a DNA-binding transcription factor which mediates regulation of follicle-stimulating hormone [FSH] and luteinizing hormone [LH] by the pulse frequency of gonadotropin-releasing hormone [GnRH] release. EGR1 expression is downregulated by the protein output of NAB2, which also showed differential expression between the tame and aggressive foxes [$p = 9.833e-05$]. As expected, NAB2 levels were higher in tame foxes [a log₂ fold change of 1.2]. We also found differential regulation of the ACVR2A gene [$p = 0.017$, -0.564 log₂ fold change; lower expression in tame foxes]. This gene codes for activin receptor type 2A, which binds activin A, activin B, and inhibin A. Activin is responsible for FSH biosynthesis and secretion, while inhibin inhibits FSH biosynthesis and secretion. The PER1 gene, which is involved in biological rhythms and regulation of the timing of the reproductive cycle, also showed differential expression between the tame and aggressive strains [$p = 0.016$, -0.806 log₂ fold change; lower in tame]. These findings strongly indicate a link between selection for behavior and reproduction.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
305	Animal Physiological Processes
315	Animal Welfare/Well-Being and Protection

Outcome #11

1. Outcome Measures

Identifying The Factors And Signaling Pathways That Are Involved In The Cross-Talk Between The Oocyte And The Ovarian Granulosa Cells

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The overall goal is to identify the factors and signaling pathways that are involved in the cross-talk between the oocyte and the ovarian granulosa cells. We employed microarray-based gene expression profiling to identify genes that are expressed in the ovary prior to ovulation. We used the well-characterized rodent superovulation model in which oocytes are released from the follicle in a controlled time-dependent manner. We hypothesized that this unbiased approach will allow us to identify factors and signaling molecules that are involved in cell-cell communication between oocytes and ovarian granulosa cells immediately prior to ovulation.

What has been done

The microarray analysis uncovered approximately three hundred genes whose expression was significantly altered in the ovaries at a time that shortly precedes follicular rupture. Among these genes, we focused our studies on signaling molecules that might be potentially involved in oocyte-granulosa cell communication. We initially focused our studies on the role of endothelin 2 [ET-2], a potent vasoactive molecule, in ovarian function. The endothelin family of ligands is composed of three structurally-related isoforms: endothelin-1 [ET-1], endothelin-2 [ET-2], and endothelin-3 [ET-3]. While the temporal expressions of ET-1 or ET-3 do not change significantly during the ovulatory period, ET-2 is robustly induced in the ovarian follicles prior to follicular rupture.

To address the role of ET-2 in ovulation, we employed antagonists of endothelin receptors [AETRs]. We used AETR-A [BQ-123], a specific inhibitor of ETR-A, AETR-B [BQ-788], a specific inhibitor of ETR-B, and AETR-AB [bosentan], which inhibits both subtypes, ETR-A and ETR-B. In superovulation experiments, each inhibitor was administered intra-peritoneally at 8 hours after hCG priming. Since the progesterone receptor is known to be critical for follicular rupture, in a subset of animals we also administered ulipristal acetate [UPA], a progesterone receptor modulator. The impact of these drugs on ovulation was assessed by counting the number of released oocytes at 18 hours following hCG injection. Whereas administration of UPA or AETR-A led to a statistically significant reduction [approximately 20%, $p < 0.05$] in the number of released oocytes compared to the vehicle treated control group, similar treatment with AETR-B or AETR-AB resulted in a more severe decline in the rate of ovulation. We observed approximately 75-80% inhibition in oocyte release when either of these drugs was given only 4 hours before the time of ovulation. Endothelin receptor-dependent signaling, therefore, appeared to play a critical role in ovulation.

Results

We also performed a histological analysis of the ovaries of mice treated with AETR at 8 hours after hCG injection. Ovarian sections of vehicle-treated control mice showed numerous corpora lutea, indicating successful ovulation. In contrast, ovarian sections from AETR-AB-treated mice showed many unruptured follicles and only a few corpora lutea. These results indicated that the blockade of ETR effectively suppressed ovulation by inhibiting follicular rupture.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
303	Genetic Improvement of Animals

305	Animal Physiological Processes
315	Animal Welfare/Well-Being and Protection

Outcome #12

1. Outcome Measures

Increasing Postpartum Reproductive Performance In Dairy Cows

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The 6 to 8 week period centered on parturition, known as the transition or periparturient period, is critical to the welfare and profitability of individual cows. Fertility of high-producing cows is compromised by difficult transitions. Deficiencies in either nutritional or non-nutritional management increase risk for periparturient metabolic disorders and infectious diseases, which decrease subsequent fertility.

What has been done

A primary factor impeding fertility is the extent of negative energy balance [NEB] early postpartum, which may inhibit timing of first ovulation, return to cyclicity, and oocyte quality. In particular, pronounced NEB during the first 10 days to 2 weeks [the time of greatest occurrence of health problems] is critical for later reproductive efficiency. Avoiding over-conditioning and preventing cows from over-consuming energy relative to their requirements in late gestation results in higher dry matter intake [DMI] and less NEB after calving. A pooled statistical analysis of previous studies in our group showed that days to pregnancy are decreased [by 10 days] by controlling energy intake to near requirements of cows before calving compared with allowing cows to over-consume energy.

Results

To control energy intake, total mixed rations [TMR] must be well balanced for metabolizable protein, minerals, and vitamins yet limit total DM consumed, and cows must uniformly consume the TMR without sorting. Dietary management to maintain blood calcium and rumen health around and after calving is also important. Opportunities may exist to further improve energy

status in fresh cows. Recent research to manipulate the glucogenic to lipogenic balance and the essential fatty acid content of tissues is intriguing. High-producing cows that adapt successfully to lactation can have high reproductive efficiency, and nutritional management of the transition period both pre- and post-calving must facilitate that adaptation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
305	Animal Physiological Processes
307	Animal Management Systems
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

At the end of the **Illinois Cattle Feeders** state meeting in Northern Illinois an evaluation was distributed and returned by 35 of the 28 attendees. Participants were asked to rate their level of learning for each topic by selecting from four choices: 'Nothing new', 'A little bit', 'Quite a bit', and 'A lot'. All 35 of those who answered the question indicated that their knowledge increased 'Quite a bit' or 'A lot' with respect to at least one topic. Ratings for the meeting topics follow and are listed in order of the number of individuals who checked either 'Quite a bit' or 'A lot'.

23 of 34 [68%] learned quite a bit or a lot about the value of cattle manure to the grain farmer.

23 of 35 [66%] learned quite a bit or a lot about state and federal policy affecting beef production.

22 of 35 [63%] learned quite a bit or a lot about improved livestock feeding facilities [question and answer session].

21 of 33 [64%] learned quite a bit or a lot about differences in cattle performance and manure value when looking at cattle fed out in lots, indoors, and in improved cattle feeding

facilities.

18 of 32 [56%] learned quite a bit or a lot about management strategies to improve manure issues on the farm.

11 of 32 [34%] learned quite a bit or a lot about evaluation of different protein sources in corn silage based rations.

Nearly two-thirds [23 of 32] of the cattlemen described changes they planned to make. Nine listed planned changes in feeding [new rations or alternate sources]. Eight referenced improvements to existing facilities or adding new facilities [buildings, tube shelters, sprinkler systems, concrete lots]. Five planned to take action with respect to manure management [handling, utilization, and exploring new options]. Other changes mentioned included looking into wind breaks, EQUIP funding, contemplating expansion, and more thorough close-out analysis.

Key Items of Evaluation

All 35 participants in the **Illinois Cattle Feeders' Meeting** who answered the question indicated that their knowledge increased 'quite a bit' or 'a lot' with respect to at least one topic. The greatest amount of knowledge was gained with respect to learning about the value of cattle manure to the grain farmer, state and federal policies affecting beef production, and improved livestock feeding facilities. Nearly half of the cattlemen plan to apply what they learned with respect to manure handling, facilities, and feeding cattle.