National Program 101 Food Animal Production
National Program Annual Report: FY2014

Introduction

The USDA-ARS National Program for Food Animal Production (NP 101) had another productive and dynamic year in 2014.

Food animal products fill a vital role in the diets of people around the world as valuable sources of high quality protein, fatty acids and minerals. The dramatic improvements in production efficiencies developed and harvested by ARS scientists help ensure international food security and directly impact human health and obesity by reducing the real cost of nutritionally valuable meat animal products, making animal products more available to those populations most in need. Ongoing improvements in production efficiencies also continually lessen the environmental impact of meat animal production by reducing grain and forage requirements and lessening the amount of manure produced. These improvements have dramatically reduced the amount of green house gas emissions produced by livestock and will continue to have impact.

NP 101 Vision Statement:
The vision for NP 101 is to furnish the scientific community and the food animal industries with scientific information, biotechnologies, and best management practices that (1) ensure that consumers have an abundant supply of competitively priced animal products that enhance human health, (2) ensure domestic food security, and (3) enhance the efficiency, competitiveness, and economic and environmental sustainability of the food animal industries.

NP 101 Mission Statement:
The mission of NP 101 is to foster an abundant, safe, nutritionally wholesome, and competitively priced supply of animal products produced in a viable, competitive, and sustainable animal agriculture sector of the U.S. economy by:

1. Safeguarding and utilizing animal genetic resources, associated genetic and genomic databases, and bioinformatic tools;
2. Developing a basic understanding of food animal physiology for food animal industry priority issues related to animal production, animal well-being, and product quality and healthfulness; and
3. Developing information, best management practices, novel and innovative tools, and technologies that improve animal production systems, enhance human health, and ensure domestic food security.

The scientific accomplishments of the USDA Agriculture Research Service and National Program 101 are truly remarkable and were again well documented in 2014. NP 101 scientists continue to make inroads toward a better understanding of food animal production challenges relating to genomic discovery science and application, growth and production efficiency, lifetime productivity, animal well-being, environmental adaptation, product quality and healthfulness, reduction of feed and energy inputs, enhancements in energy retention, and reduced environmental impact. Application of technologies developed or enhanced by NP 101 scientists promise to continue to address the high priority issues for consumers while enhancing the profitability and competitiveness of food animal producers across the United States in today's very competitive global agriculture community.

During FY 2014, 83 full-time scientists working at 13 locations across the United States were actively engaged in more than 150 independent research projects in the program. Research projects in NP 101 were approved through the ARS Office of Scientific Quality Review in 2012, making this the second year of implementation of these five-year project efforts. The gross fiscal year 2012 funding for NP101 was $48 million.

Personnel in NP 101

New additions to the NP 101 team in 2014 are:

Andrew Foote, Clay Center, Nebraska, joined the Nutrition and Environmental Management Research Unit staff as a Research Animal Scientist and is working to improve nutrient efficiency of beef cattle and swine.

Ken Kalscheur, Madison, Wisconsin, joined the Cell Wall Biology and Utilization Research Unit staff as a Research Animal Scientist and is working on aspects of dairy nutrition.

Geoff Zanton, Madison, Wisconsin, joined the Cell Wall Biology and Utilization Research Unit staff as a Research Animal Scientist and is working on aspects of dairy nutrition.

The following scientists retired from the ranks in NP 101:

Sam Coleman, Grazinglands Research Laboratory, El Reno, Oklahoma.

David Guthrie, Animal Biosciences and Biotechnology Laboratory, Beltsville, Maryland.

The distinguished record of service of these scientists is recognized world-wide and they will be missed in NP101.

The following scientists in NP 101 received prominent awards in 2014:

Gary Bennett, Clay Center, Nebraska, received the Pioneer Award from the Beef Improvement Federation.

Larry Kuehn, Clay Center, Nebraska, was awarded the Outstanding Young Researcher Award, Midwest Section, from the American Society of Animal Science.

Warren Snelling and **Larry Kuehn**, Clay Center, Nebraska, both received the Continuing Service Award from the Beef Improvement Federation.

Kreg Leymaster and **Mike Heaton** (NP 103), Clay Center, Nebraska, received the ARS Technology Transfer Award.

Steven Shackelford, Clay Center, Nebraska, received the Distinguished Research Award from the American Meat Science Association.

Mark Peterson, Miles City, Montana, received the Montana Epsilon Sigma Phi Friend of Extension award for outstanding public service and support to state extension programs.

Heng Wei Cheng, West Lafayette, Indiana, received the 2014 Poultry Science Association's Poultry Welfare Research Award at the National meeting in Corpus Christi, Texas.

Paul VanRaden, Beltsville, Maryland, was recognized by Thomson Reuters as one of "The World's Most Influential Scientific Minds in 2014" for being among the world's most highly cited scientists over the last decade in the Agricultural Sciences.

Curt Van Tassell, Beltsville, Maryland, received the National Association of Animal Breeders (NAAB) Research Award and the World Dairy Expo "Industry Person of the Year Award."

George Wiggans, Beltsville, Maryland, and his co-authors received the *Journal of Dairy Science* "Most-Cited Award in Genetics and Breeding" for the paper titled "*The genomic evaluation system in the United States: Past, present, future*" published in their June 2011 issue. The work significantly impacts dairy research and the dairy industry.

Tad Sonstegard and **George Liu**, Beltsville, Maryland**,** were granted funding by ARS Headquarters to support postdoctoral research associates for projects titled "*Characterizing genetic diversity of goats: The 1000 Goat Genomes Project"* and "*Functional impacts of CNV on quantitative traits in Holstein dairy cattle*", respectively.

The quality and impact of NP 101 research was further evidenced in 2014 by following:

- Over 135 refereed journal articles published and 3 filed patents
- Three new cooperative research and development agreements with stakeholders
- Three patent applications were filed
- Administration or development of nine web sites for academia or stakeholders
- Additional funding of about $1.95 million was awarded to seven complementary projects with funding sources from U.S. Agency for International Development, the National Institute of Food and Agriculture, Brazil's Science without Borders Program, the Nebraska Beef Council, and the National Cattlemen's Beef Association

In 2013 NP 101 scientists participated in research collaborations with scientists in: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Denmark, Egypt, France, Germany, India, Ireland, Israel, Italy, Kenya, Mexico, Netherlands, New Zealand, Nigeria, Norway, Russia, Saudi Arabia, Scotland, South Africa, Spain, Sweden, Switzerland, Tunisia, Turkey, Uganda, United Kingdom and Uruguay.

Major Accomplishments in 2014

This section summarizes significant and high impact research results which address specific components of the FY 2013 – 2017 action plan for the Food Animal Production National Program. Each section summarizes accomplishments of individual research projects in NP101. Many of the programs summarized for FY 2014 include significant domestic and international collaborations with both

industry and academia. These collaborations provide extraordinary opportunities to leverage funding and scientific expertise for USDA - ARS research to ensure international food security by rapidly disseminating technology that enhances the productivity and efficiency of meat and milk production. Improved production efficiencies decrease the real cost of food and animal products and make these products more available to people worldwide.

NP 101 Top Accomplishments – FY2014

Old tool finds new use in reducing nitrogen emissions from dairy farms
Nitrogen is a key component of protein in the diet ration for dairy cattle. Maximum absorption of protein in the gut is crucial to avoiding the excretion of excessive nitrogen-containing compounds that may constitute greenhouse gases, affect air quality, and ultimately, human health and natural ecosystems. ARS scientists in Madison, Wisconsin, studied the use of milk urea nitrogen, a common tool applied to monitor feed efficiency in dairy herds, to evaluate the relationships between the amount of protein fed to lactating cows, nitrogen compounds in milk, and excreted nitrogen on dairy farms. A high correlation was found between milk urea nitrogen values and excreted nitrogen values. The findings demonstrated that monitoring of milk urea nitrogen on dairy farms can be used to optimize protein use in dietary rations that will reduce feed costs for dairy cows and negative effects to the environment.

Feeding a by-product of ethanol to cattle maintains nutrient value and reduces production cost
Dietary fiber in diets given to cattle in feedlots promotes good digestion; however, fiber is the costly portion of the diet. ARS researchers in Clay Center, Nebraska, determined that adding an ethanol by-product, wet distillers grains with solubles, and reducing the amount of fiber before cattle go to market, increases the retention of nutrients. These studies demonstrate that wet distillers grains with solubles can be used to reduce the cost of feed and production expenses, and improves the types of nutrients available to cattle.

Validation of the value of DNA markers for tenderness
Meat quality traits, like tenderness, have been difficult to improve through traditional selection methods. Previously, DNA markers for two genes have been commercialized as selection tools, but the value of these markers on improving tenderness and other economic traits like growth and fertility have not been substantially validated. ARS researchers at Clay Center, Nebraska, conducted a series of genetic selection experiments to better estimate the effects of these two genes on cattle growth, carcass composition, and meat quality. These results demonstrated that each genetic marker signifying a copy of gene variant was associated with a 10% increase in meat tenderness. Therefore, meat from animals that had none of the gene variants for tenderness were 40% less tender than beef from animals with two copies of the two gene variants for tenderness. One of gene variants for meat tenderness was also associated with more uniform tenderness across animals, further reducing the risk of consumers getting tough beef. Seedstock cattlemen across multiple beef breeds can now confidently use these DNA markers to effectively select for increased meat tenderness to improve product quality without losing long term performance in animal growth.

A much more productive wool ewe

Maximizing the number of successful pregnancies and the live birth of healthy offspring is important for sheep farmers. Over a lifetime, ewes that lamb for the first time at 1 year of age are more productive than ewes that lamb for the first time at age 2, but wool producers are reluctant to adopt this strategy because of delayed puberty in wool-type ewes. ARS researchers in Dubois, Idaho, with cooperators at Virginia Tech University, developed a genetic-based measurement to better identify rams with specific genetic backgrounds that more likely confer early puberty and conception of daughters younger than 1 year. These measurements will enable wool sheep producers to improve overall production efficiency by more accurate selection of rams that produce offspring with an additional year of productivity compared with current flock averages in wool-type ewes.

Improving the reproductively competent pool of females in swine

Although significant advancements have been made in swine production, selection practices for improved reproductive efficiency, specifically the identification of newborn females that will be reproductively competent in adulthood, have lagged behind. Previous reports have indicated that a newborn piglet's environment can affect its growth, body composition, and reproductive potential as an adult female pig. In an experiment funded by the National Pork Board, ARS scientists in Clay Center, Nebraska, in collaboration with scientists at Iowa State University and Murphy Brown LLC, identified three criteria in young female pigs that are predictive of delayed puberty, increased puberty failure, and detrimental changes in the uterus. Incorporation of these measured criteria in the production setting could be used as a management tool to better select for female pigs destined for the breeding herd.

Selection to reduce ovine progressive pneumonia

Ovine progressive pneumonia, a viral disease, is one of the most costly sheep diseases in North America and management schemes to minimize and eliminate the prevalence of this disease are labor-intensive and expensive. ARS researchers in Clay Center, Nebraska, demonstrated that sheep with an unfavorable form of the gene associated with susceptibility to ovine progressive pneumonia had a much higher rate of infection compared with sheep lacking this gene variant. The scientists developed technology to identify animals with the high-risk gene variant so that sheep producers can now selectively breed and generate flocks that are genetically less susceptible to ovine progressive pneumonia. This should enhance the health of sheep flocks and increase economic profits for producers.

Yeast supplementation improves the well-being of stressed calves

Livestock management practices do not always provide optimal protection from disease. One of the most stressful times in the life cycle of a calf is removal from its mother and shipment to a feedlot where it mingles with other unfamiliar calves; and the resulting stress can increase the incidence of disease. Identification of feed supplements to ensure health, growth, and overall well-being is of benefit to livestock producers. ARS scientists in Lubbock, Texas, with colleagues at the University of Nebraska, determined that feeding a yeast supplement to calves that fail to grow or develop normally as a consequence of disease improved both the calves' health and growth. Yeast may prove to be a beneficial, antibiotic-free supplement for the livestock industry to manage stressed calves at highest risk for becoming ill.

Improved computer-assisted modeling of genetic traits to enhance milk production efficiency

Milk production, one of the largest agricultural animal-based commodities in the United States, is dependent on successful pregnancies and calving. Fertility rates in Holstein cattle, the primary dairy

breed in the United States, had been declining until recently; this has increased the cost of milk. To improve the prediction of fertility in dairy cattle, ARS scientists in Beltsville, Maryland, have developed computer models from extensive data sets going back to the 1960s that go beyond the previous single-trait, single-breed model to incorporate multiple traits, multiple breeds, inclusive of crossbreds and purebreds, and environment to more accurately predict the effect of genetic backgrounds associated with fertility. The new model correlated well with the previous model for Holsteins. Data were combined and implemented by ARS and the Council on Dairy Cattle Breeding in December 2013 to improve genetic evaluations for fertility. The past model reversed the fertility drop, and the inclusion of the new model is expected to improve the accuracy of predictions of genetic merit for fertility traits and allow breeders to make faster progress.

Mutations conferring heat tolerance in cattle identified

With global climate change and increasing demands for animal protein worldwide, there is a need to understand and accelerate the adaptation of agricultural animals to the environment. Cattle breeds in subtropical and tropical regions maintain a stable internal deep body temperature that is indicative of a genetic predisposition toward heat tolerance, however, variations in heat tolerance are evident among different tropical breeds. ARS scientists in Beltsville, Maryland, in collaboration with scientists at U.S. and foreign universities, identified distinct adaptive mutations in a single gene that regulates skin formation, hair growth, sweating rate, and body temperature in heat-tolerant breeds. Results from the study are being used by producers to guide future breeding decisions, and by researchers to better understand the biological processes involved in adaptation to climate change.

Conserving rare varieties of chickens

Conserving biodiversity protects potentially important genetic resources, which can ultimately provide solutions to food animal production in regions undergoing climate change, disease outbreaks, or striving for economic and environmental sustainability. The genetic resources in the national collection held in Ft. Collins. Colorado, underpin the livestock sector and provide researchers with genetic information tools for their research. Collection size continues to increase; but of specific note, six rare breeds and a valuable research line of chickens has been added to the collection by ARS scientists through the cryopreservation of ovaries and testes from day old chicks. These ovaries and testes can be matured in surrogate birds at a later date to help researchers or underserved chicken producers, who typically raise these breeds.

Defining genetic determinants to select for superior resistance to Marek's disease in poultry.

Marek's disease is an extremely contagious viral disease that is capable of causing major losses of chicken, one of the largest agricultural animal commodities in the United States. The disease is currently controlled through vaccines and biosecurity, but enhancing genetic resistance to it would be a more effective mode of disease control. ARS scientists in East Lansing, Michigan, in collaboration with scientists at Purdue University, demonstrated that a subset of previously identified genetic markers of Marek's disease can be used as predictive determinants for genetic resistance. Measuring the marker-gene association had higher accuracy (61 percent improvement) in identifying birds with superior genetic resistance compared with current state-of-the-art methods. If confirmed in commercial poultry lines, this approach could efficiently select for elite, healthy poultry to generate more economical poultry products for U.S. producers and consumers. The model may also have application in addressing genetic resistance to other infectious pathogens.

Enhancement of the beef carcass grading camera system to predict meat tenderness

Variation in the tenderness of beef results in consumer dissatisfaction; therefore, companies want technology to identify carcasses that excel in tenderness. ARS scientists in Clay Center, Nebraska, worked with the instrument manufacturer and beef industry to develop a system that uses a robust regression equation to extract information from digital images to predict tenderness at the time of beef carcass grading. This system has obtained approval from USDA's Agricultural Marketing Service, and the technology gives the beef industry a potentially more efficient way to measure USDA quality grade, yield based on grade, and tenderness. This application has been instituted in one packing plant, and other plants are considering implementation of this camera-based system. This new system is also expected to offer consumers a better way to select higher-quality meat.

(Appendix 1). Additional Significant Accomplishments for NP 101 in FY 2014 by Subject Matter

Section One: Genetics, Genomics and Meta-genomics:

Bovine gene expression differences associated with feed intake and body weight gain

Feed is the single largest input cost associated with beef production. Cattle differ in their inherent ability to convert feed to meat. ARS researchers at Clay Center, Nebraska, determined that expression differences in genes associated with fat deposition in females and muscling in males was significantly correlated with variation in feed intake. The gene expression differences found in cow muscle was also correlated with variation in average daily gain. These data support earlier DNA marker associations with feed intake and body weight gain and also suggest that sex, age and/or nutrition-specific interactions play a role in regulating the biological activity of these genes in the muscle and adipose tissues of beef cattle.

Genetic Regulation of steroid production

Ovarian sex steroid levels play a critical role in the attainment of puberty, maintenance of pregnancy, regulation of normal estrous cycles, sexual behavior, and overall fertility. Research conducted by ARS scientists at Clay Center, Nebraska, in collaboration with researchers from South Dakota State University (Brookings) and the University of Nebraska at Lincoln, identified mechanisms controlling production of sex steroids in cow ovaries. Differences in genes regulating steroid production indicate that there are heritable components to ovarian sex steroid production that may contribute to fertility. Some of these genes have been reported to have negative relationships with carcass and growth traits. These results demonstrate the importance of balanced selection between growth and carcass traits relative to sex steroid production to insure fertility in the cow herd is not negatively impacted.

Discovery of DNA markers associated with respiratory disease.

Bovine respiratory disease (BRD) is the primary health issue in beef cattle production, costing the industry hundreds of millions of dollars per year in total for losses and treatment. BRD is also the primary reason for the health-related use of antibiotics in the industry that has come under increased scrutiny as antibiotic-resistant bacteria become a more common problem in human disease. Testing locations across the bovine genome, scientists at Clay Center, Nebraska, identified 84 DNA markers associated with the observation of lung lesions at slaughter, which is a symptomatic indicator of BRD. Many of these markers found near genes with functions related to immunity and tissue regeneration can now be used to test the hypothesis that DNA marker-assisted breeding or selective management can reduce the incidence of BRD and the need for antibiotic use in beef cattle.

Section Two: Reproductive Physiology:3

Cryodiluent supplement improves fertility of frozen/thawed turkey and rooster semen

Cryopreserved poultry semen historically yields very low fertility rates (0-5%) that prevent any meaningful application of semen repositories for long-term preservation and distribution of elite genetics. ARS scientists from Beltsville, Maryland, investigating the biological basis for this low fertility, demonstrated that sugar residues on the surface of the sperm membrane change under cryopreservation and thawing conditions. Different sugars supplement treatments were tested to reveal that adding sialic acid into semen extender can boost the fertility rates from 7-40% for frozen/thawed turkey and from 3-10% for frozen/thawed rooster semen. This represents a significant advance in poultry semen freezing technology with real potential for application towards line regeneration from genetically-valuable poultry semen.

Age at first calving is influenced by ovarian follicle numbers
Previous studies have demonstrated that heifers, who conceive early in their first breeding season, remain in the herd longer and produce calves that have greater weaning weights. To investigate the underlying mechanisms of this phenomenon, ARS researchers at Clay Center, Nebraska, used ultrasonography to confirm early conception was correlated with a greater number of eggs in ovaries of heifers prior to their first breeding season. This finding supports use of ultrasonography as a selection tool for producers to better select replacement heifers with a better chance of remaining in the herd as productive females.

Section Three: Growth Physiology, Nutrient Use Efficiency and Nutrient Cycling:
Feasible options to extend dairy grazing season in northern climates
Dairy producers in northern climates often need to extend the grazing season due to shortages in fall forage caused by drought or other conditions. Researchers from ARS and University of Wisconsin at Marshfield, Wisconsin, completed a two year study with pregnant dairy replacement heifers that confirmed fall-grown oat should be managed as stockpiled forage for deferred grazing. Good utilization of fall-oat forage was accomplished by efficient, one-time removal of standing forage using a single 'lead' wire (electric fence) advanced daily to prevent waste. Concentrations of protein and energy for fall-oat pasture exceeded requirements for dairy heifers weighing 1000 to 1200 lbs, and these animals were comparable in performance to heifers maintained on a blended control diet within a confinement operation. This production system offers an additional effective tool for extending the grazing season into late November within northern climates.

Improved modeling for nutrient requirements for grazing cattle
The current 2000 National Research Council (NRC) model for predicting intake by grazing beef cattle was an improvement over previous models; however, refinement is needed to improve prediction capability in extensive arid environments. For example, assessments of female energy and protein balance and efficiency in extensive grazing settings have occurred on a nominal basis over short time intervals; thus, the data used to inform nutrient requirement models representing yearly or lifetime nutrient utilization are imprecise. Research by ARS scientists at Miles City, Montana, and El Reno, Oklahoma, indicated that cattle adapted to extensive rangeland environments maintain productivity at dietary levels of energy and protein that fall below the model derived values published in NRC. As a result, a broad-based database was used to develop new equations for consideration for inclusion in the new NRC model. These new equations to predict intake should help the new NRC model be more robust in its ability to account for the wide variation in cow environment, dietary characteristics, and metabolic demands. Also, improved modeling in beef systems allow researchers, extension personnel, and producers to refine current U.S. feeding and supplementation regimens to be more nutrient-use efficient, economical, and profitable. As an example, producers using requirements to assess nutrient needs in arid environments may improve economic efficiency by using values at least 5% less than NRC suggests.

Breed differences in prenatal glycogen metabolism linked to swine neonatal survival
The neonatal mortality rate in commercial swine herds is approximately 13.5%, which has a significant impact on the production efficiency. In European pig breeds, the majority of piglet mortality is significantly influenced by birth weight and within-litter birth weight variability. However, in some Asian pig breeds lower birth weights are not correlated with preweaning mortality rates. ARS researchers at Clay Center, Nebraska, completed a study to evaluate how energy dynamics during

prenatal development influences piglet survival. Specifically, piglets from Asian genetics had increased liver glycogen levels during late gestation caused by increased availability of glucose, fructose, and insulin. These results illustrate some Asian breeds have gene variants that support physiological development that enhances early neonatal survival. These genetic lines serve as a resource for further studies to better understand the biology underlying better neonate survivability.

Crude glycerin a byproduct of biodiesel production can be used as a feed resource for cattle

The cost of traditional feed resources has fluctuated with drought conditions, and the use of corn for biofuels. ARS researchers at Clay Center, Nebraska, and Bushland, Texas, investigated the use of crude glycerin, a biodiesel byproduct, as an alternative feed source. The results demonstrated that body weight gain increased in steers eating diets with a moderate amount of glycerin (<7.5%) substituted for corn; however, when glycerin was increased in the diet ration body weight gain decreased. Feed efficiency also decreased with increased substitution of glycerin for corn. These studies suggest the moderate inclusion of glycerin in beef cattle diets can be used as a strategy to reduce diet cost; and adding glycerin to cattle diets is more effective when it replaces alfalfa hay rather than corn.

Impact of maternal nutrition on daughter reproductive performance

Nutrient status during key developmental stages can have life-long impacts on whole animal physiology. ARS researchers at Clay Center, Nebraska, examined the impact of nutrient restriction or nutrient excess to the mother during the second or third trimester of pregnancy on daughter reproductive performance. Maternal diets had no impact on the age at which daughters reached puberty or the numbers of eggs that the daughters had in their ovaries immediately prior to their first breeding season. However, daughters that were born to mothers being fed an increased amount of nutrients during the third trimester conceived earlier in their first breeding season. Efficient feeding of the cow during late pregnancy can improve daughter reproductive performance.

Section Four: Animal Stress and Well-Being:

Reducing stress in pre-weaned dairy calves

Dairy calves are typically housed separately shortly after birth, because previous epidemiological studies suggest that grouping calves increases the risk of disease outbreaks. In contrast, dairy calves have been shown to have more play and locomotion when housed in groups, which can be associated with reduced animal stress. ARS researchers at West Lafayette, Indiana, completed a seminal study to find a balancing point in managing disease transmission and animal stress. The results demonstrated that grouping calves, in groups of 3 with individual hutches, at 14 days of age resulted in the greatest growth, compared with grouping at 3 and 7 days of age. However, immune measures did not reflect a difference among the groups. Based on these results calves may be better served by housing in groups after 14 days of age, which will allow producers to optimize animal growth while decreasing incidence of disease among pre-weaned dairy calves.

Chlorate salt supplements reduce scours in lambs

Neonatal scours, classic livestock dysentery, is second to pneumonia as a leading disease in lambs, resulting in morbidity rates as high as 17%. Pathogenic *Escherichia coli* are the primary cause, which are shed in the environment from the ewe and picked up by the lamb from environments that are soiled with feces. By using chlorate salts that were dissolved in the drinking water of the ewes, ARS researchers at Dubois, Idaho, simultaneously reduced the amount of generic *E. coli* in the lower intestine of both the ewe and nursing lamb. Compared with traditional antibiotics, which are used to combat

neonatal scours, chlorate salts do not result in antibiotic resistance and are more affordable and easier to apply. Application of this finding goes beyond sheep production systems and can be applied in beef and dairy systems to achieve similar results.

Altered metabolism in flighty cattle

Previous studies revealed that high-strung or flighty cattle are immunologically different from calmer cattle, and flighty cattle use a different energy source, even when their health is in jeopardy. To further define differences between these two behavioral classes of cattle, scientists from the ARS Livestock Issues Research Unit in Lubbock, Texas, and Mississippi State University, conducted a study to evaluate metabolic differences based on three different dietary treatments. We found that flighty cattle generally maintain higher levels of blood glucose and blood lipids as compared to calm cattle, and that flighty cattle are less sensitive to insulin. This information on differences in behavior relative to animal metabolism provides clear evidence that flighty and calm cattle should be managed differently in the feedlot in order to maximize animal health, productivity, and ultimately profitability.

Beta-agonists have no effect on animal well-being

Feeding beta-agonist compounds to enhance muscle growth and improve feed efficiency in livestock has been a routine management strategy for over 20 years. However, the use of beta-agonists has recently come under scrutiny due to reports suggesting adverse effects on the well-being of cattle being fed these supplements. To determine whether or not feeding beta-agonists to cattle prevents them from appropriately responding to stressful stimuli, a collaborative study was conducted by scientists from the ARS Livestock Issues Research Unit in Lubbock, Texas, and the University of Nebraska, to evaluate the physiological stress response of cattle fed a beta-agonist for 20 days. The results demonstrated that cattle fed the beta-agonist had slightly altered body temperatures, stress hormone concentrations, and immune cell profiles when exposed to a simulated stressful condition, but these alterations were not indicative of a significant reduction in the well-being of treated cattle.

Mitochondria content as a potential biomarker for meat quality

Long-term stress can deplete the muscle of glycogen in feeder cattle resulting in abnormal pH decline in the post-harvest carcass. Often times, the resultant carcass yields an unattractive dark-colored ribeye associated with off-flavors, decreased tenderness, and rapid spoilage; thus, carcasses displaying this condition are severely discounted in price. ARS scientists at Clay Center, Nebraska, demonstrated that muscles from carcasses exhibiting the dark ribeye condition have greater concentrations of mitochondria than contemporary carcasses from the same production lot displaying normal ribeye color. Moreover, carcasses displaying the dark ribeye condition were found to have different muscle physiology than their normal cohorts and are less able to deal with stress. This is the first identification of a pre-existing difference in live animals that produce carcasses with dark colored ribeyes. This knowledge may lead to diagnostic technology in live animals to reduce or eliminate incidence of the dark ribeye condition.