

Research Briefs

Research synopses of projects utilizing the MSU Beef Center, 2016-17



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[MAAA] = funded by Michigan Alliance for Animal Agriculture

COW/CALF

EFFECT OF BOVINE LEUKOSIS VIRUS (BLV) ON BEEF COW LONGEVITY

*Maeroff, J. *, O. Benitez, B. Norby, P. Bartlett and D. Grooms*

For decades it was widely regarded that the only significant impact of bovine leukemia virus (BLV) was from the small percentage of cattle that developed lymphosarcoma. Recent work has revealed that BLV is of much greater consequence for the dairy industry due to decreased immune function, depressed milk production and a shortened productive life span of cows. The objective of this study is to determine effect that BLV can have on cow longevity in beef herds. When the productive life span of cows is shortened by BLV, producers lose potentially profitable years of life from those infected animals. During the spring of 2016, 3,325 serum samples were collected from cows on 28 beef cow-calf herds in MI, OH, IN, IL, IA, and MT. At least one BLV positive cow was found on 71% of the farms. Of the cows tested, 39.1% were BLV positive. Data collected on each cow included farm of origin, breed, and age. These cows will be followed for the next two years to determine how long they remain on the farm and for what reasons they leave the farm = cow longevity.

ROLE OF BULLS IN TRANSMISSION OF BOVINE LEUKOSIS VIRUS (BLV) [MAAA]

*Benitez, O. *, J. Roberts, B. Norby, P. Bartlett and D. Grooms*

Bovine leukosis is a chronic lymphoproliferative disorder caused by bovine leukemia virus (BLV) that leads to economic losses in the beef and dairy industries. The USDA NAHMS Beef 1997 study estimated that 38% of cow-calf beef herds and 10.3% of individual adult cows in the US are BLV seropositive. Little is known about the prevalence of BLV in breeding bulls and few studies have evaluated semen or smegma as a potential route of BLV transmission. The primary objective of this study was to determine the prevalence of BLV in breeding bulls presented for breeding soundness exams (BSE) at Michigan State University (MSU). In our study, the prevalence of BLV in bulls was 45% (54/120). Of the farms that presented bulls for BSE, 48% (19/39) had at least one BLV positive bull. In this study, a high percentage of adult bulls were found to be BLV positive and could serve as a source of virus transmission within and between cow-calf herds. Ongoing studies are being conducted to determine risk of BLV transmission during breeding.



SURVIVAL OF MYCOBACTERIUM BOVIS DURING FORAGE ENSILING [MAAA & MMPA]

Grooms, D., J. Kaneene, D. Buskirk, S. Rust, M. Allen, S. Bolin, P. Durst, R. Smith, R. Mani, R. Abramovitch and J. Averill*

Understanding potential modes of transmission *Mycobacterium bovis* (MB), the causative agent of bovine tuberculosis, is important for mitigating the risk of cattle herd infections. Cattle feed contaminated by infected wild white tail deer in Northeast Michigan is believed to be a major route of MB transmission to nearby cattle herds. Enisled feeds are commonly fed to cattle in this region, but it is unknown if MB can survive the ensiling process. Forages (alfalfa, mixed forage with mostly grass, and corn) commonly ensiled in Northeast Michigan were harvested and ensiled under laboratory conditions. Prior to ensiling, forages were inoculated with MB. At days 0, 1, 2, 6, 8, 10 or 13, 15, 28, 56 or 66, and 112 (0 = immediately after inoculation), samples of forages were analyzed by culture and quantitative real-time PCR. MB was cultured out to day 2, 28, and 2 for alfalfa, mixed mostly grass and corn forages, respectively. The inability of MB to be cultured following ensiling suggests the risk of MB contaminated forages serving as source of transmission following ensiling is low. However, the PCR assay detected MB in all ensiled forage at all time points. Although MB could not be cultured for an extended period of time, DNA evidence of MB could be detected for an extended period of time.

IMPACT OF ANTRAL FOLLICLE COUNT AND FSH DOSAGE ON ASSISTED REPRODUCTIVE TECHNIQUES IN CATTLE WITH SMALL OVARIAN RESERVES

*Folger, J. * F. Jiminez-Krassel and J. Ireland*

Two major problems cause embryo transfer (ET) to be inefficient and expensive, which hinders widespread use of this technology by the cattle industry. Firstly, responsiveness to superovulation (technique used to stimulate multiple ovarian follicles to ovulate) is highly variable and unpredictable among cattle. Secondly, the high doses of follicle stimulating hormone (FSH) used to superovulate donor cows may be detrimental to ovarian function and oocyte quality thereby impairing capacity of eggs after fertilization to develop into healthy embryos, which in turn, hinders survival of these embryos after they are transferred into recipient cows. The purpose of our studies is to better understand how high FSH doses during superovulation impair ovarian function, oocyte quality and embryo survival, and to develop new low-dose FSH-based superovulation procedures to improve success of ET in cattle. The outcome of these studies will lead to a better understanding of how FSH impacts egg quality and embryo survival and may lead to new, more efficient, less expensive ET procedures in cattle. Because of similarities in reproductive systems and methods used for superovulation between cattle and women, results of our studies may also have application to assisted reproductive technologies (ART) in women.



EMBRYOTROPIC ACTIONS OF FOLLISTATIN: MECHANISMS AND TRANSLATIONAL RELEVANCE

*Folger, J. *, S. Rajput, M. Ashry, L. Montiel, K. Zhang, and G. Smith*

The goal of our experiments is to determine whether treatment of cattle embryos with a protein named follistatin (during embryo culture in the laboratory) can increase ability of such embryos to establish a pregnancy following transfer of embryos to recipient cows and enhance normal development of the placenta that helps provide nutrients and supports the pregnancy. If successful and our treatment has beneficial effects, results have potential application to infertile couples undergoing *in vitro* fertilization procedures as a means to have children, application to cattle reproduction through *in vitro* fertilization and application to biotechnologies used to propagate genetically valuable livestock.

REPRODUCTIVE IMPACTS OF LUTALYSE® ADMINISTRATION AT FIXED-TIME ARTIFICIAL INSEMINATION IN BEEF CATTLE

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Lutalyse® is a commercially available prostaglandin analogue used in estrous synchronization and fixed-time artificial insemination (FTAI) protocols. Prostaglandins have several effects in the female, including ovary contractions to expel the egg, uterine muscle contractions to assist sperm transport, and most notable, the regression of the corpus luteum (CL) on the ovary, resulting in removal of circulating progesterone. Limited data has shown that cows with high levels of progesterone at FTAI have reduced conception rates. Therefore, the objective of this trial is to evaluate the effect of adding a Lutalyse® injection at FTAI to an estrus synchronization protocol (7-day Co-Synch + CIDR) on conception rates in beef cows and heifers.

TRAITS INFLUENCING SALE PRICE OF PERFORMANCE TESTED BEEF BULLS IN MICHIGAN

*Rizzolo, K. *, and D. Buskirk*

For business and breeding decisions, seedstock bull producers need information on the phenotypic and genetic qualities most demanded by their markets. This study utilized data from the Michigan Cattlemen's Association/Michigan State University Bull Evaluation Program, which evaluates bulls from consignors throughout Michigan and Indiana, raising them in a central location for five months, while standardizing their environmental and feeding conditions. Bulls meeting the program criteria are offered for sale at auction. Traits listed in the sale catalog which influence the variation in sale price were analyzed for Angus, Simmental, and SimAngus bulls that sold through the program from 2010 to 2016 (n = 466). By understanding the monetary impacts of individual traits on sale price, bull producers can focus on breeding objectives that either emphasize or deemphasize particular traits, based on current market demand.



VALIDATING ABILITY OF A COW-WORN SENSOR TO DESCRIBE SPACE USE AND SOCIAL INTERACTION IN CATTLE

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When cattle are mixed into new social groups as they are moved between barns, pastures, or pens, they form hierarchies. These hierarchies affect overall interactions among members of the group and the behavior of individuals. Animals at the lower end of the social hierarchy may have less access to feed and water or receive aggression or bullying. Understanding the hierarchy formation process as well as decoding the social hierarchy between cows can help us better improve their welfare. Although physical interactions are common when cows are first moved into new barns and start forming social hierarchy, such interactions appear less frequently once the hierarchy is formed and stable within the barn. Instead, animals rely on subtle signals of intention, such as a cow turning her head toward another cow or taking a step toward an individual that is lower on hierarchy, to enforce the social order or to gain access to a desired resource. It is hard to capture such subtle social interactions using visual observations or data from accelerometers that simply record amount of movement. Better, more detailed ways of examining subtle changes of behavior at the cow-level are needed to understand social signaling and subsequent influences on animal behavior, physiology, and performance that do not disrupt animal behavior and are not labor intensive. This project aims to examine the use of a mobile vision tracking system and wearable camera for behavioral research with cattle. The system will allow us to track movement and orientation of cows accurately within a group setting. The information collected using this device can provide new insight into cow behavior related to social interactions, space use, feeding and detection of illness or injury, and will allow us to develop new ways to decipher their behavior and improve their welfare.

REGULATION AND REGULATORY ROLE OF WNT SIGNALING DURING FOLLICULAR WAVES IN CATTLE

Folger, J., S. Rajput, M. Ashry, L. Montiel, and G. Smith

The goal of this project is to examine the role of Wnt signaling on follicular development and oocyte maturation in cattle. Wnt signaling involves a family of related proteins, known as Wnt ligands, binding to receptor proteins, called Frizzled, to regulate cellular functions in multiple cell types. Preliminary results in our laboratory suggest that the Wnt signaling system regulates production of steroid hormones (such as estradiol and progesterone) and oocyte maturation (the development of an egg to the point at which it could be fertilized) *in vitro* so we have designed a comprehensive set of experiments to test the role of Wnt signaling *in vivo*. These experiments will allow us to examine the regulation of components of the Wnt system *in vivo* during follicular development (the growth and changes in ovarian follicles, the structures that contain the maturing egg cell) and what, if any, effects blocking portions of the Wnt signaling system have on steroid production and oocyte maturation. These results will lead to a greater understanding of the mechanisms of follicular development and oocyte function in cattle.



USE OF UHF RFID FOR CONTINUOUS MONITORING OF CATTLE HEALTH AND INVENTORY MICHIGAN

Buskirk, D., D. Grooms, and J. Averill

The project objective was to demonstrate ultra high frequency radio frequency identification (UHF RFID; 902-928 MHz, ISO 18000-6C, EPC Gen 2 compliance) in a basic system which would monitor cattle attendance at water sources. The specific aim was to develop an on-farm UHF RFID-based system that could be used to monitor cattle health, cattle inventory, and water source status. Because water is an essential nutrient, and access is often a point source, gathering data on attendance at water sources would allow for near real-time monitoring of cattle inventories, cattle health, and water source viability. Our work indicates that water source status and inventory can be monitored with these systems. It will require additional study and more animals to determine the utility of water visitation to specifically monitor cattle health.

FEEDLOT

EFFECT OF NITRATE AND MONENSIN ON RUMEN FERMENTATION

*Capelari, M. ^{*1}, K. Johnson², B. Latack¹, J. Roth¹, and W. Powers³*

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Methane produced during enteric fermentation of ruminants is a potent greenhouse gas and a dietary energy loss for the host animal. The objective of this project is to identify a dietary strategy capable of long-term rumen methane mitigation. Our hypothesis is that the combination of nitrate and monensin reduces enteric methane production without compromising animal performance. Monensin and nitrate have proven beneficial effects on reducing methane production when added to the diet of ruminants by modifying rumen fermentation patterns through different mechanisms. In our experiments, we are testing the combination of the additives in different doses in order to arrive at a better dose-response to the variables of interest, such as diet digestibility, ammonia, volatile fatty acids and methane. We conducted several *in vitro* and an *in vivo* trials that confirmed an additive effect of additives on reducing methane production. Future work will focus on performance trials to confirm the potential use of the additives combination in commercial situations.

EFFECT OF DRIED DISTILLERS GRAINS WITH SOLUBLES ON NITROGEN EMISSIONS FROM BEEF CATTLE

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Dried distillers grains with solubles (DDGS) is a common ingredient in feedlots diets. Cattle are often fed diets containing as much as 60% DDGS, replacing primarily corn and some soybean meal. Increasing the amount of DDGS in the diet leads to an increase in dietary nitrogen which may impact emissions of ammonia (NH₃) and nitrous oxide (N₂O), an important greenhouse gas. During manure storage and following land application, NH₃ and N₂O may be released. The objective of this study was to determine the

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effect on NH₃ and N₂O emissions in housing and following land application of manure when steers were fed diets containing 20% or 40% DDGS.

USE OF REAL-TIME CHUTE-SIDE BLOOD TESTING TO REDUCE ANTIMICROBIAL TREATMENTS OF FEEDLOT CATTLE [MAAA]

*Frey, E. *, A. Huff, B. Norby*, P. Bartlett, and S. Rust*

Bovine respiratory disease (BRD) is costly and a persistent animal health issue seen in feedlots across North America. Currently, it is the industry standard for incoming high-risk cattle to undergo metaphylaxis treatment in which entire groups receive antibiotic treatment on arrival in an effort to prevent BRD. Studies have shown that 87% of incoming cattle do not have bacterial BRD, and thus receive unnecessary treatment. As pressure from consumers to decrease antimicrobial usage in the food system and concern regarding antimicrobial resistance rises, updated treatment practices in feedlots are needed. This study aims to address these issues by improving diagnostic techniques using new chute-side technology to assess the need for antimicrobial treatment on an individual animal basis. With this technology, a single drop of blood obtained from the tail head or jugular vein can be analyzed to provide a differential white blood cell count in approximately 45 seconds. If successful, this study will lead to improved accuracy and earlier detection of BRD, minimize performance loss due to morbidity, decrease treatment costs for producers, and preserve antimicrobial effectiveness for future generations.

CHARACTERIZATION AND MITIGATION OF LAMENESS IN INDOOR CONFINED FEEDLOTS [MAAA]

*Curtis, C. *, S. Rust, L. Kroll, and D. Grooms*

Lameness is the second most important health issue for fed cattle in the U.S. and is viewed as a major welfare issue. Lameness is particularly problematic for cattle housed in indoor confined feedlots (ICF's) on slatted concrete floors. Additionally, tail injuries have been identified as a major health issue in ICF's. The goal of our research team is to identify management strategies to reduce lameness and tail injuries in ICF's. Rubber covered slatted floors have been proposed to reduce the incidence of lameness and tail injuries in cattle housed in ICF's. The objective of this study was to compare health and performance of cattle when housed in ICF's with (RC) and without (NC) rubber covered slats. Angus-based (n=56) and Holstein (n= 56) steers were randomly assigned to pens with NC or RC. Each pen contained 7 steers at a stocking density of 6.9 m²/steer. Cattle were on feed for 110-131 days. Locomotion scores were used to assess lameness every 28 days using a scale of 0-3 (0 = normal and 3 = severely lame). Pedometers were attached to a subset of Holstein steers and multiple activity parameters were assessed. Tails were evaluated every 28 days using a scale of 0-3 (0 = normal and 3 = severe necrosis). To assess performance, average daily gain, feed conversion efficiency, and carcass traits at slaughter were measured. Cattle housed on RC had an increased motion index, took more steps, and spent more time lying down. RC cattle had an increased average daily gain, but a decrease in quality grade at slaughter. Average dry matter intake, feed conversion efficiency, locomotion scores, and incidence/severity of tail lesions were similar among the treatment groups. In our study, rubber covered concrete slats had minor impacts on cattle lameness, tail injuries and performance.



EVALUATION OF SILO-GUARD II AS A SILAGE AMENDMENT TO ENHANCE FERMENTATION AND IMPROVE RETENTION OF HARVESTED NUTRIENTS

Kulon, K. and S. Rust**

Silo Guard II is a silage additive that is reported to improve rate of fermentation and reduce molds and yeast. The additive acts as an oxygen scavenger. It is also reported to improve animal performance. The product is comprised of sulfur compounds and enzymes. The objectives of this experiment are two-fold, 1) evaluate the effects of Silo-Guard II on digestibility and lignin content of haylage and corn silage and 2) to evaluate the use of Silo Guard II on nutrient recovery and mold and yeast counts of ensiled high moisture corn. Haylage and corn silage were harvested at 46 and 40% dry matter, respectively and ensiled for 60 days in mini-silos. The three treatments included control (no additive) and Silo-Guard II at 1 (recommended rate) or 2 pounds per ton of wet silage. Haylages exhibited typical changes expected during fermentation. The addition of Silo-Guard II at twice the recommended application rate improved recoveries of DM, NDF, S and starch. Extent of fermentation was typical for corn silage as pH was 3.78 and lactic acid content was greater than 4% of DM. Silo-Guard II slightly improved aerobic stability after 10 days in the fermented corn silage. The amount of nitrogen solubilization appears to increase slightly with the addition of Silo-Guard II silage additive. Yeast and mold counts were similar among all treatments used within the haylage and corn silages. The effects of Silo-Guard II on fermentation profile and aerobic stability of high moisture corn is ongoing. Silo-Guard II may be an effective fermentation amendment under certain conditions.

A COMPARISON OF BEEF TRACEABILITY MODELS DURING SERIAL AND PARALLEL PROCESSING

Foster, T., J. Schwehofer, D. Grooms, R. Clarke, and D. Buskirk

Traceability of beef attributes through supply chains is a market barrier. Automatic identification and data capture technologies offer the feasibility of maintaining animal and product data through carcass fabrication. In this study, individual animal identity of beef carcasses were maintained through a supply chain, where carcasses were fabricated into wholesale cuts using a serial processing method (SPM) or a parallel processing method (PPM). The goal of this study was to identify labeling techniques for two different processing methods, SPM and PPM, in tracking wholesale meat cuts back to the original animal in mid-sized processing facilities. The objectives were to 1) determine the cost of additional labor required for traceability; 2) determine both consumable and fixed costs of traceability; and 3) test traceability accuracy utilizing DNA matching.



CATTLE, CORN STOVER AND BIOENERGY: A SUSTAINABLE INTEGRATED SYSTEM

Jean, M., D. Pennington, K. Thelen, and S. Rust

Corn stover is the non-grain portion of the corn plant, including the husk, cob, stalk, tassel, silk and leaves. After harvesting corn grain, stover is the remainder of the crop often referred to as residue. The Michigan Corn Stover Project was a collaborative effort at Michigan State University to investigate the uses of corn stover and potential impacts of harvest in Michigan. This effort was comprised of on-farm and small scale research conducted across the lower peninsula of Michigan. It included a cattle feeding study, integration of a cover crop, bale storage study, harvest time evaluation and the impact of stover removal on yield of the subsequent crop. One to two ton of stover was removed from field plots. Subsequent crop yields were increased by 7% when some of the stover was removed. Storing bales under cover (roof or plastic) reduces storage losses and provides opportunity for long-term storage (>120 days). Storing bales outside uncovered works well through the winter, but when the weather warms up in the spring and summer, dry matter losses will increase significantly, particularly with high-moisture bales. Cattle were fed diets containing 0, 10 and 20% corn stover. Feed conversion efficiency decreased as the amount of stover in the diet increased. To utilize corn stover in a ration, it is important to have a ration with 25-35% moisture or a ration conditioner. The calculated NEg value for corn stover in a high concentrate diet was .09 Mcal/lb.

USE OF JS360 TO MINIMIZE NITROGENOUS LOSSES FROM THE MANURE DEPOSITED IN FEEDLOT PENS

Grooms, D. and S. Rust

The general public and regulatory agencies are concerned about the human health and environmental issues caused by nitrogenous emissions from cattle operations. Consumed nitrogen that is not utilized in the body is excreted mainly in the urine and feces producing a common waste referred to as manure. Manure has significant fertilizer value but up to 60% can be lost due to volatilization and runoff. Jumpstart 360 is the trade name of a mold inhibitor for use in livestock and poultry feeds in Canada. It has been approved for use in the U.S. under the trade name of js360. Preliminary studies in poultry and swine demonstrated increased performance when mold infested grain was fed. The objective of this study was to evaluate the impact of js360 on the performance of cattle fed a high concentrate diet and the amount of nitrogen retained in the manure of each pen. The js360 feed additive was palatable and readily consumed by the cattle on test. Cattle performance and carcass quality were similar for the control and js360 fed cattle. Numerically, js360 resulted in the capture of 7.5% more nitrogen in the manure than control pens.



EFFECTS OF TAIL DOCKING ON BEHAVIOR, PERFORMANCE AND HEALTH OF BEEF CATTLE RAISED IN CONFINED FEEDLOTS

Kroll, L., J. Siegford, J. Schwehofer, and D. Grooms

Tail docking of feedlot cattle is a management practice used in some confined, slatted floor feedlots of the Midwestern United States. Justification for tail docking is to reduce tail injuries and their sequelae, and improve performance. Limited evidence exists to support these claims and the practice of routine tail docking is an animal welfare concern in regards to pain and loss of the tail for communication and fly avoidance. The primary objective of the research conducted for this thesis was to determine the effect of routine tail docking on performance and health parameters of feedlot cattle housed in a confined slatted floor feedlot facility and behavioral response following tail docking. Cattle were randomly assigned to 1 of 2 treatment groups; docked (DK) or control (CN). All calves received the same pre- and post-operative analgesia and DK calves had the distal two-thirds of their tail removed with pruning shears. For all performance trials, we found no significant effect of treatment on performance, carcass, morbidity, mortality or lameness. Tail injuries persisted among 60-76% of cattle that were not tail docked. Behavior studies demonstrated increased fly avoidance activity and signs of acute pain in DK calves. We were unable to identify a performance or health advantage to tail docking, and we observed signs of compromised welfare in feedlot cattle following tail docking. However, tail tip injuries persisted in cattle raised in slatted floor facilities. Because routine tail docking of cattle housed in confined, slatted floor facilities does not appear to improve performance and cattle welfare is compromised, alternative solutions to reduce the incidence of tail tip injury should be considered.

ACTIVELY REDUCING ANTIBIOTIC RESISTANCE IN UNTREATED ANIMALS

Norby, B., S. Henderson, D. Stern, C. Finley, and A. Como

The Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO) have identified antibiotic resistance (AR) as one of the greatest threats to human health worldwide, and it is a threat to economic growth, public health, agriculture, economic security, and national security. Research by us and others have shown that the reduction of AR occurs very slowly after antibiotic use is reduced or ceased. Our group hypothesizes that it is possible to reduce AR faster and more effectively than merely relying on reducing (or ceasing) antibiotic use. The aim of this project was to test our hypothesis by feeding a probiotic culture of nine different *E. coli* strains derived previously from healthy and thriving calves. The probiotic culture was fed to newborn calves twice per day for 28 days. Control calves did not receive the probiotic culture. Fecal samples were collected from all of the calves daily for 28 days. *E. coli* that are resistant and susceptible to common antibiotics will be counted as well as over 150 resistance genes in the intestinal bacterial community. Initial results have not revealed significant differences between treatment groups (which may have been due to a delayed start, because some calves became ill with fever and unspecific symptoms), however microbiome and resistome work is underway.

