DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

October 2023

Beef Cattle Research Update

United States Department of Agriculture, University of Arkansas, and County Governments Cooperating

What's Inside

Arkansas is Our Campus

Visit our website at:
http://www.uaex.uada.edu

A review of the effect of nutrient and energy restriction during late gestation on beef cattle offspring growth and development

Waldon, N., et al., Department of Animal Science, The Ohio State University, Wooster, OH; and Department of Animal Science, North Dakota State University Fargo, ND

Journal of Animal Science, https://doi.org/10.1093/jas/skac319 *(January 2023)*

It is becoming more evident that changes in the environment, including nutritional changes, can influence fetal and postnatal development of the offspring, which can result in differences in growth, metabolism, reproduction, and health later in life. Protein and energy restriction during late gestation seems to negatively affect some growth and carcass characteristics parameters; however, results are not consistent and it is unclear as to why. Therefore, the objective of this review is to summarize the current knowledge on the effect of protein and energy restriction during the last third of gestation to beef cows on growth performance of offspring, focusing principally on *Bos taurus* cows.

To understand the effect of nutrient or energy restriction during gestation on offspring growth first, we need to evaluate the equations used to predict requirements. The NASEM (2016) indicates that the prioritization of nutrients is for 1) basal metabolism, 2) activity to gather food, 3) growth, 4) basic energy reserves, 5) maintenance of pregnancy, 6) lactation to support an existing offspring, 7) accumulation of additional energy reserves, 8) estrous cycles and initiation of pregnancy, and 9) accumulation of excess energy reserves. When gestating cows are undergoing feed restriction, priorities 6 to 9 above likely are not relevant. The first priorities are the primary components contributing to maintenance requirements. Therefore, this results in 3 primary categories for nutrient utilization: maintenance, growth (particularly in heifers), and maintenance of pregnancy. However, the proposed and accepted hierarchy of nutrient utilization should be re-evaluated as this may be an oversimplification of priorities for nutrient use. Also, the efficiency of use of dietary energy for maintenance and production function should be further studied. Because current prediction equations may underestimate the needs of the heifer, future prediction equations may wish to consider animal body condition score (BCS) and heifer body weight (BW) at parturition as a percentage of the herd BW. Including these 2 parameters in future equations could allow researchers to contemplate the importance of conceptus free BW and BCS of the heifer.

Finally, we propose that future experiments are needed that better characterize energy use, partitioning, and requirements throughout gestation. We propose that moving forward, researchers should take into consideration the need for more accurately measuring nutrient and energy supply and use and subsequent epigenetic effects in the fetus to allow for a better understanding of nutritional effects during gestation on offspring performance and to aid in future meta-analyses of studies in this research area. ▪

Effects of implant strategy in extended stocker cattle programs and subsequent carcass characteristics

Garcia, T.J., et al., Department of Animal and Food Sciences, Oklahoma State University, Stillwater, OK; Elanco Health Inc., Greenfield, IN; and Southwest Research and Extension Center, University of Arkansas Division of Agriculture, Hope, AR

Translational Animal Science, https://doi.org/10.15232/aas.2022-02375 *(June 2023)*

Anabolic growth implants, herein referred to as implants, are a cost-effective tool to improve beef cattle performance in each phase of production because they improve ADG, DMI, feed efficiency, hot carcass weight, and rib-eye area. Decades of experiment station studies and industry field trials have demonstrated conclusively the growth and economic benefit of using implants. However, these performance gains do not come without risk; implants during the stocker/growing phase may decrease marbling score and QG, depending on the potency and number of implants. Therefore, it is important to develop lifetime implant strategies for all phases of production that optimize the balance between performance and carcass quality. Our objective was to understand the effects of different implant protocols in a long-duration stocker program on high-quality forage and potential carryover effects into later production phases.

Materials and Methods

In Oklahoma (OK) and Mississippi (MS), steers were grazed on cool-season annual pastures in fall 2018 through spring 2019. Steers were randomly assigned to 1 of 3 implant treatments: (1) Synovex One Grower (Zoetis) at day 0, (2) Component TE-G (Elanco Animal Health) at day 0, or (3) Component TE-G at day 0 and again at day 82 (OK) or day 85 (MS). Steers from each treatment were commingled in 2 (OK) or 3 (MS) pastures for 159 (OK) or 161 days (MS). At the end of the grazing season, steers were finished in commercial feedyards, where they were implanted identically upon arrival. Steers were slaughtered when the pen was visually estimated at 0.4 inches backfat. Carcass data included hot carcass weight, rib-eye area, back fat thickness, and marbling score.

Results and Discussion

Implant program had no significant effect on animal performance (weight and ADG) during the stocker phase, but marbling score tended to be greater in the single Component TE-G versus the other 2 treatments.

Implications and Applications

No evidence was found to recommend an extended-release implant or stocker-phase reimplanting even in a relatively long grazing phase (up to approximately 160 days), and producers should consider selecting the least-cost implant protocol. ▪

Weight and reproduction response to a peanut skins plus corn supplement offered to heifers grazing spring wheat pasture during artificial insemination breeding

Gadberry, S., et al., University of Arkansas, Division of Agriculture, Livestock and Forestry Station, Batesville, AR; University of Arkansas, Division of Agriculture, Department of Animal Science, Fayetteville, AR; and University of Arkansas, Division of Agriculture, Southwest Research and Extension Center, Hope, AR

Journal of Animal Science, Volume 101, Issue Supplement 1; https://doi.org/10.1093/jas/skad068.104 (May 2023)

The objective was to assess heifer weight and reproduction response to a peanut skins plus corn supplement during spring wheat grazing. In spring of 2021 and 2022, 10 and 8 pastures (4 acres/pasture) of fall overseeded wheat were randomly assigned to supplement (SUP) or control (CONT) constrained to the same number of replications per treatment. Pastures were stocked with 6 heifers/pasture each year. The ini¬tial goal was to use peanut skins as a single ingredient; however, testing palatability in year 1, before spring grazing, demonstrated a need to create a mixed supplement for improved acceptance. Over 5 weeks from initiation of grazing to breeding, heifers were transitioned from a 33:67 to a 50:50 peanut skins:corn mix. Supplement was offered at 0.5% BW, as-fed, at the start of spring wheat grazing in early March. An additional 2.4% and 8.3% inclusion of dried molasses was incorp¬orated to further enhance acceptance in year 1 and 2, respectively. Estrous synchronization (ES) began March 31 and April 5 for each year. Data were analyzed across year with year considered as a random effect and pasture the experimental unit. Initial weight was 26 ± 13 pounds greater for SUP. Weight at ES tended to be 20.7 ± 12.2 pounds greater for SUP. Reproduction tract score was similar, averaging 4.2 ± 0.13, and heifers were of similar age (405 ± 4.1 days) at time of insemination. Average daily gain from initial wheat grazing until removal for natural service breeding did not differ between treatments and averaged 2.2 ± 0.46 pounds. Body condition score was similar at ES and averaged 5.7 ± 0.7. The heavier initial BW of SUP heifers was sustained through wheat grazing. Ultrasound determined pregnancies averaged 66.7 and 50.0 ± 6.6% for SUP and CONT, respectively, for an odds ratio of 2.1 ± 0.79 at 30 days after insemination. Overall pregnancy rates following natural service averaged 88.9 and 79.6 ± 4.88% for SUP and CONT, respectively with an odds ratio of 2.1 ± 1.12. High dietary protein has been associated with reduced reproductive performance. Using the peanut skins plus corn supplement was hypothesized to improve reproduction on a high protein diet due to the possible effect of peanut skins tannins on dietary protein utilization and corn al¬tering the rumen degradable protein to organic matter ratio. While the fixed time artificial insemination pregnancy rates for CONT would not be considered poor, there was a tendency for SUP to secure more pregnancies among heifers of similar age, reproductive tract score, and body condition. ▪

Effect of bovine respiratory disease on the respiratory microbiome: a meta-analysis

Howe S., et al., Department of Animal Science, University of Arkansas Division of Agriculture, Fayetteville, AR; and Medical Laboratory Sciences Program, College of Health and Human Sciences, Northern Illinois University, DeKalb, IL

Frontiers in Cellular and Infection Microbiology; https://doi.org/10.3389/fcimb.2023.1223090 (September 2023)

Bovine respiratory disease (BRD), also referred to as bovine bronchopneumonia, is the most devastating disease affecting North American cattle producers. BRD is the leading cause of death in pre-weaned dairy calves and is one of the leading causes of disease affecting feedlot cattle, specifically in the first 50 days post feedlot arrival. It accounts for 70-80% of total feedlot morbidity and 40-50% of total feedlot mortality. The USDA APHIS Feedlot study estimated that BRD costs, on average, $23.60/case. The costs associated with BRD can be attributed to the cost of treatment and decreased carcass quality grade. In the early 2000s, BRD was estimated to cost approximately $800-900 million annually, and more recently, it has been estimated to be between $1-3 billion annually in the United States.

Our study investigated the effect of BRD on the alpha (intra-sample) diversity of the cattle respiratory microbiome, which fills the knowledge gap between respiratory microbiome alpha diversity and BRD. The multi-level model concluded that healthy calves had an increased Shannon Diversity Index, and no difference was observed for richness measures (Observed or Chao1). Overall, these results indicate that Shannon Index in calves with BRD is lower than in healthy calves. Furthermore, publicly available sequences were combined and re-analyzed for four datasets. ANOSIM, based on Bray-Curtis and Jaccard distances, found that, although significant, health status was the smallest source of variation, and sampling location and dataset were the largest sources of variation, respectively. Additionally, in the nasal cavity, ASV19_*Corynebacterium* and ASV37_*Ruminococcaceae* were healthy control-associated ASVs, and ASV5_*Mycoplasma* was the only BRD-associated ASV. Based on SECOM analysis, ASV19_*Corynebacterium* was negatively associated with ASV4_*Mannheimia*, ASV1_*Mycoplasma_hyorhinis*, ASV54_*Mycoplasma*, ASV7_*Mycoplasma*, and ASV8_*Pasteurella*, and positively correlated with ASV376_*Mycoplasma*, and ASV37_*Ruminococcaceae*, the other healthy control-associated ASV. Taken together, these results indicate that additional research is needed into the role of *Corynebacterium* in the bovine respiratory microbiota and that sampling location and other factors significantly affect microbial structure and need to be considered. ▪

Genomic loci involved in sensing environmental cues and metabolism affect seasonal coat shedding in *Bos taurus* and *Bos indicus* cattle

Durbin, H. J., et al., Genetics Area Program, University of Missouri, Columbia, MO; Syngenta; Division of Animal Sciences, University of Missouri, Columbia, MO; University of Tennessee Institute of Agriculture, Knoxville, TN; Institute for Data Science and Informatics, University of Missouri, Columbia, MO; Department of Animal Science, Iowa State University, Ames, IA; and Department of Animal Science, Division of Agriculture, University of Arkansas, Fayetteville, AR

G3:Genes, Genomes, Genetics, https://doi.org/10.1101/2022.12.14.520472 (December 2022)

Most mammals replace their coat or molt either completely or incompletely at annual or bi-annual intervals as an adaptive response to seasonal and climatic variation. In cattle, molting occurs annually in the late spring and early summer when thick winter coats are exchanged for shorter ones in preparation for warmer temperatures. Generally, the onset of seasonal shedding is driven by hormone cascades initiated by the hypothalamus–pituitary–gonadal axis in response to environmental cues such as hours of sunlight per day (day length) and changes in temperature. Among ungulates and other mammals, the effects of temperature and day length interact to induce seasonal molting. This interaction has never been explicitly demonstrated in cattle, although Yeates (Yeates 1955) showed that artificial manipulation of day length can be used to perturb the timing of hair coat shedding regardless of temperature, while Murray (Murray 1965) found a moderate effect of temperature on hair coat shedding among cattle at similar latitudes.

Hair shedding scores were collected over 9 years by 77 beef cattle producers and university groups, with most scores collected between 2016 and 2019. Hair shedding was classified on an integer 1-5 scale based on the systems developed by Gray et al. (2011), where a score of 5 indicated 100% winter coat remaining and a score of 1 indicated 0% winter coat remaining. Participants were asked to hair shedding score cattle when they observed the greatest amount of variation in shedding between contemporary individuals. Most herds were hair shedding scored once per year between mid-April and mid-June, but some groups chose to score cattle multiple times across the span of several months. This resulted in between 1 and 8 scores per animal per year. Most cattle were scored in at least two separate years (8,839 or 66.11% of all individuals).

We confirm once again that hair shedding is moderately heritable with consistent estimates of heritability and repeatability between datasets. Using a crossbred and multi-breed dataset, we were able to show that a previously published association found on chromosome 5 in American Angus cattle is likely driven by multiple causal variants at this locus. Together, these results point towards important roles of daylight sensing and temperature in regulating bovine seasonal hair coat shedding and provide compelling candidate regions for functional analyses. Particularly, there appears to be a clear relationship between variation in hair shedding and ocular function. Despite a vast body of research exploring the biological mechanisms regulating seasonal molting across the tree of life, to our knowledge there have been no previous studies of how genetic loci contribute to individual variation in seasonal molting. Additionally, the photoperiodic and light-sensing mechanisms regulating most seasonal phenotypes, including coat shedding, is largely shared across species. Therefore, this work also provides an important stepping off point for research in other species. ▪

Excerpts of articles were edited for length and style.