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Effect of weaning pace and age on the health measures and tissue gene expression of inflammatory markers in Holstein dairy calves

B. C. Agostinho¹, A. Wolfe², C. Y. Tsai¹, D. E. Konetchy¹, A. H. Laarman², P. Rezamand¹.

¹ Department of Animal, Veterinary & Food Sciences, University of Idaho, Moscow, Idaho, ² Agricultural, Life and Environmental Sciences, University of Alberta, Edmonton, Canada

Weaning is one of the most stressful events in dairy calves' life, which may induce inflammatory responses; however, the existing knowledge is limited. Therefore, the objective of this study was to evaluate the effect of the weaning at two ages (early at 49 vs. late at 63 d) and two weaning paces (abrupt over 3 d vs. gradual over 14 d) on selected health measures and local inflammation status of dairy calves. Forty Holstein calves were blocked by gender (20 male and 20 female) and body weight at birth and randomly assigned in a 2 × 2 factorial arrangement of treatment (weaning age; weaning pace). The treatments consisted of early-abrupt (EA), early-gradual (EG), late-abrupt (LA), and late-gradual (LG). Milk replacer was fed twice daily (24% CP, 17% fat; up to 1,200 g/d), and water, calf starter, and alfalfa hay were fed ad libitum. Health measures were obtained before and after weaning. Twenty males were terminated one-day post-weaning. Tissues from jejunum, large intestine, as well as abdominal and perirenal adipose tissues were collected and stored at -80°C, and gene expression was determined using rt-qPCR. The target genes included Interleukin-8 (IL-8), Tumor necrosis factor- α (TNF- α), and Nuclear factor κ -B (NF- κ B). Cycle threshold (Ct) of target genes was corrected by Ct of house-keeping genes (GAPDH and RPS-9) and were used (Δ Ct) for statistical analysis using the mixed model of SAS with significance declared at $P \leq 0.05$ and the tendency at $P \leq 0.10$. Calves weaned at late-stage had a greater respiration rate ($P = 0.07$) than calves weaned at an early-stage. Calves weaned abruptly had a greater heart rate ($P = 0.01$) than those weaned gradually. Body temperature was not affected by the treatment ($P > 0.16$). Calves weaned late-stage presented a greater expression of TNF- α in the jejunum and perirenal adipose tissue ($P = 0.01$; 0.02 , respectively) when compared with that of the early-stage. In addition, large intestinal expression of IL-8 tended to reduce in calves weaned abruptly ($P = 0.10$) when compared to gradually. The expression of TNF- α and NF- κ B tended to be greater ($P = 0.08$; 0.07 , respectively) in abdominal adipose tissue of calves weaned gradually than abruptly. In summary, weaning pace and age at weaning altered some health measures and inflammation status in the jejunum, large intestine, and adipose tissues.

Key words: dairy calf, inflammation, stress

Evaluation of Forage Quality of Alfalfa from 200 Varieties Produced in the Pacific Northwest

S. Dreger¹, D.A. Llewellyn¹, O.S. Norberg², S. Fransen³, G. Wang⁴, D. Combs⁵, G. Shewmaker⁶, E. van Santen⁷, L.X. Yu⁸

¹ Department of Animal Sciences, WSU, Pullman, WA, U.S., ² Franklin County Extension Office, WSU, Pasco, WA, U.S., ³ WSU IAREC, Prosser, WA, U.S., ⁴ Eastern Oregon Agricultural and Natural Resource Program, OSU, LaGrande, OR, U. S., ⁵ Department of Dairy Science, U of W, Madison, WI, U.S., ⁶ Kimberly R&E Center, U of I, Kimberly, ID, U.S., ⁷ Department of Agronomy, U of FL Gainesville, FL, U.S., ⁸ USDA ARS, Prosser, WA, U.S.

Alfalfa forage quality is an important consideration for alfalfa growers, marketers, and plays a major role in variety selection, alfalfa breeding, livestock nutrition, and the related economic value. This study is an evaluation of 200 varieties using first cutting (bud stage) alfalfa quality data across two years (2018 and 2019), from three locations (Prosser, WA, LaGrande, OR, and Kimberly, ID). Data were subjected to a statistical cluster analysis to categorize the varieties into forage quality groupings ranging from high-quality to low-quality. The twelve measures of forage quality analyses are: Non-Fiber Components (CP, fat, and ash); Fiber (ADF, aNDF, and lignin); Calculated Values (RFQ, RFV, and TDN); Carbohydrates (starch, ESC, WSC). Analyses revealed four clusters of quality for the 200 varieties. This evaluation focused on the high-quality cluster to best serve alfalfa breeders, marketers, and agricultural production. The averages of all clusters had CP (N*6.25) contents ranging from ~24% for the high-quality cluster, to ~22.2% in the low-quality cluster. Fat concentrations were a minor component with a negative linear correlation from high to low quality. Low levels of ash and/or ash contamination with little variation were observed. The high-quality cluster had ADF concentrations ranging from 29.5% to 32% and aNDF ranged from 35% to 40%. The average concentration of lignin in the high-quality cluster was ~6.25%, compared with ~6.8% for the low-quality cluster. Starch, ESC, and WSC analysis resulted in low starch and sugar concentration with no clear separation between quality clusters. The high-quality cluster had exceptional values for RFQ and RFV, (RFQ=189 and RFV=162). TDN was greatest in the high-quality cluster ranging from 62.2% to 65%. In comparison, the low-quality cluster ranged from 59.3% to 61%. Using the high-quality cluster (34/200 varieties), the top 10 varieties for each analyte, were compared to each variety's frequency across all 12 analytes, providing the top 10 varieties across all parameters. The top two varieties (AFX142001 and CW104014) each had the highest frequency across analytes (9/12, 75%). In addition, Amina, Gold Finch, Mariner V, DT-3044 and D2645 all had frequencies of greater than 50%. Nine varieties out of the top 10 included ADF and aNDF, eight for lignin. The top 10 alfalfa varieties had lower ADF, aNDF, and lignin in comparison to the remaining 190 entries. RFQ, RFV, and TDN values were consistent with the fiber results. Only about half of the top 10 alfalfa varieties were associated with CP or fat, and none were associated with ash. In addition, data suggests that the highest quality alfalfa varieties in this evaluation were in Fall Dormancy 3 and 4, (1 for FD 2 and 6). Results suggest that cluster analysis paired with frequency can be used to identify high-quality alfalfa varieties from large data sets which may provide useful information to alfalfa growers, breeders, marketers, and nutritionists. Further investigations that incorporate yield along with forage quality is indicated.

Key words: alfalfa, forage quality, fall dormancy, fiber, protein

Management Strategies to Reduce Negative Health Outcomes in Transported Pre-weaned Calves

Kylee K. Elmore*, Pedram Rezamand*, Denise Konetchy*, Mireille Chahin, Bruna C. Agostinho*, Anne H. Laarman³, and Gwinyai E. Chibisa*

*Department of Animal, Veterinary, and Food Science, University of Idaho, Moscow ID

² Department of Animal, Veterinary, and Food, Twin Falls Research and Extension Center University of Idaho, Twin Falls, ID

³ Department of Agriculture, Food, and Nutrition Science, University of Alberta, Edmonton, AB

Poor colostrum management and subsequent transportation increases mortality and morbidity rates in pre-weaned calves. However, pre-transport administration of Meloxicam, a non-steroidal anti-inflammatory drug (NSAID), may reduce the negative health outcomes. Therefore, the objective of this study was to determine the effects and potential interaction of colostrum management and NSAID administration on markers of stress and inflammation, and health measures in transported pre-weaned calves. Forty-eight (24 Jersey and 24 Holstein) male calves were collected at birth from a commercial farm and randomly assigned to treatments; either colostrum feeding according to recommendations or no colostrum/milk replacer, and administration of either an NSAID (1 mg of Meloxicam/kg of body weight) or a placebo prior to transportation. Blood samples were collected, and rectal temperature (RT) and body weight (BW) were measured (<2 d old) prior to transportation (300 miles), on arrival, 12 h post transport, and at harvest (36 h post transport). Harvested plasma was analyzed for cortisol and thiobarbituric acid-reacting substances (TBARS). Adipose, muscle, and gastrointestinal tissue were harvested to quantify transcript abundance of markers of inflammation, including tumor necrosis factor alpha (TNF α), interleukin (IL) 6, IL-8, IL-1 β , intercellular adhesion molecule-1 (ICAM-1), and nuclear factor kappa B (NF κ B). Statistical analysis was conducted using the Mixed Procedure of SAS. There was no colostrum management \times NSAID administration ($P \geq 0.58$) for plasma cortisol and TBARS concentrations. However, feeding colostrum compared to milk replacer led to a decrease ($P < 0.01$) and a tendency for a decrease ($P = 0.06$) in plasma cortisol and TBARS concentrations, respectively. There was no colostrum management \times NSAID administration ($P \geq 0.25$) on rectal temperature and body weight. However, there was a tendency ($P = 0.06$) for colostrum management \times time on RT; it was greater at arrival than before transport and 36 h post transport in calves fed colostrum. Similarly, there was a colostrum management \times time ($P = 0.04$) for BW, which was lower at arrival and 36 h after arrival compared to prior to transportation for calves fed colostrum. There was no colostrum management \times NSAID administration interaction ($P \geq 0.15$) and NSAID administration effect ($P \geq 0.13$) on transcript abundance of markers of inflammation measured. However, feeding colostrum downregulated ($P \leq 0.02$) several markers of inflammation in the liver (TNF α , IL-6, IL-8, IL-1 β , and ICAM-1), rumen (IL-6 and ICAM-1), and jejunum (IL-6). In summary, feeding colostrum resulted in a decrease in the plasma concentration of indicators of stress, and downregulated gene expression for markers of inflammation in different organs, including the liver. However, pre-transport NSAID administration had no detectible effect on all measurements. This suggests that proper colostrum management is key to limiting the negative impact of transport-related stress on health outcomes in pre-weaned calves.

Key words: colostrum management, non-steroidal anti-inflammatory drug administration, pre-weaned calves, transport related stress

Evaluation of Growth, Meat Quality, and Sensory Characteristics of Wool, Hair and Composite lambs

M.L. Heimbuch*, J.B. Van Buren*, B.S. Epperson*, O.F. Kayleen*, S.M. Jepson*, J.A. Nasados*, D.A. Vinci†, W.J. Price*, K.R. Vierck^, D.E. Konetchy*, P.D. Bass*, and M.J. Colle*.

*University of Idaho, Department of Animal, Veterinary & Food Sciences, Moscow, ID 83844

†University of Idaho, Palouse Research, Extension and Education Center, Moscow, ID 83844

^University of Arkansas, Department of Animal Science, Fayetteville, AR 72701

The objective of this study is to compare the growth rate, shoulder height, heart girth circumference, and carcass characteristics of wool, hair, and composite lambs. Twenty-seven lambs were purchased at weaning (~70 days of age). The wool lambs (Suffolk × Polypay/Targhee; n = 9) and composite lambs (Dorper × Polypay/Targhee; n = 9) were purchased from the UI Sheep Center, while the hair lambs (Dorper × Dorper; n = 9) were purchased from a local producer. Lambs were weighed and measurements of shoulder height (cm) and heart girth circumference (cm) were taken on day 0 and the two days prior to harvest. Hot carcass weight (HCW), back fat (BF), and rib eye area (REA) were collected at 48 h post-harvest. Data were analyzed using the MIXED procedure in SAS. Significance was determined at $P < 0.05$. There was not a significant difference among treatments for average daily gain ($P = 0.28$). In contrast, there were significant differences for finished weight ($P < 0.01$), shoulder height ($P < 0.01$), and heart girth circumference ($P < 0.01$). Wool lambs were heavier at harvest and had greater shoulder height and heart girth circumference than composite and hair lambs whereas composite lambs had greater shoulder height than hair lambs. No difference in backfat was observed among treatments ($P = 0.13$). Wool lambs had greater HCW ($P < 0.01$) and REA ($P = 0.02$) than the composite and hair treatments. Wool lambs grew to heavier weights, were larger framed, and were also higher volume. Furthermore, wool lambs had heavier carcasses and were heavier muscled. Research will continue to evaluate sensory characteristics; we can, however, conclude the physical characteristics of the composite compare more closely to the hair treatment than the wool treatment.

The effect of feeding supplemental zeolite (clinoptilolite) of two different particle sizes on measures of nitrogen utilization and nutrient digestibility in finishing beef heifers

Cheyenne A. Myers^{*}, Mario E. de Haro Marti², Mireille Chahine³, and Gwinyai E. Chibisa^{*}

^{*}Department of Animal, Veterinary, and Food Science, University of Idaho, Moscow ID

²Department of Animal, Veterinary, and Food, University of Idaho Extension, Gooding, ID

³Department of Animal, Veterinary, and Food, Twin Falls Research and Extension Center University of Idaho, Twin Falls, ID

Clinoptilolite (CLN) could potentially improve nitrogen (N) utilization when fed to beef cattle as it can bind ruminal-ammonia-N ($\text{NH}_3\text{-N}$), limiting its loss and subsequent detoxification into urea-N, which is released into blood and is excreted in urine. However, the effectiveness of CLN is influenced by physical properties such as particle size. Although decreasing the particle size has been shown to increase the binding of ammonium *in-vitro*, this remains to be evaluated *in vivo*. Therefore, the objective of this study was to determine the effects of feeding CLN of two different particle sizes (30 and 40 μm) on ruminal $\text{NH}_3\text{-N}$ and plasma-urea-N (PUN) concentrations, ruminal pH, and nutrient intake and apparent total-tract digestibility. Six ruminally-cannulated beef heifers (mean initial BW \pm SD, 620.8 \pm 30.15) were used in a replicated 3 \times 3 Latin square design with 21 d periods (sample collection from d 15 to 21). Dietary treatments were 1) finishing ration with no supplement (CON), 2) CON +30- μm CLN (CL-30), and 3) CON + 40- μm CLN (CL-40). Clinoptilolite was top-dressed (2.5% of diet DM) during morning feeding. Intake was measured daily. Ruminal fluid was collected on d 19 for $\text{NH}_3\text{-N}$ analysis and blood was collected 3 h post-feeding on d 21 for PUN analysis. Indwelling pH loggers were used to measure ruminal pH (d 15 to 21) and grab fecal samples were collected from d 19 to 21 to determine total-tract nutrient digestibility. Statistical analysis was conducted using PROC MIXED in SAS. There was no treatment effect ($P \geq 0.13$) on ruminal $\text{NH}_3\text{-N}$ and PUN concentrations, ruminal pH, and nutrient (DM, OM, NDF, ADF and CP) intake and apparent total tract digestibility. In conclusion, feeding CLN to finishing heifers had no effect on measures of N utilization, ruminal pH and nutrient intake and apparent total-tract digestibility.

Key words: clinoptilolite, feedlot cattle, nitrogen utilization, nutrient digestibility

Impact of maternal nutrition on postnatal growth of crossbred beef steers

K.F. Oliver*, J.B. Van Buren*, J.B. Hall*†, M.L. Heimbuch*, S. Jepsen*, B. Epperson*, J.A. Nasados*, P.D. Bass*, and M.J. Colle*

*University of Idaho, Department of Animal, Veterinary & Food Sciences, Moscow, ID 83844

†University of Idaho, N.M. Cummings REC, Carmel, ID 83462

Maternal nutrition of beef cows is critical to programming the fetus for improved performance and meat quality. Cows pastured on range often have reduced forage quality compared to cows on irrigated pasture. Therefore, the objective of this study was to determine the effects of maternal nutrition on the subsequent growth and carcass characteristics of castrated male offspring from multiparous crossbred beef cows that were pastured on irrigated pasture (IRR) vs. rangeland (RAN) during early and mid-gestation. Twenty-four crossbred steers were weaned from their dams that were pastured on irrigated pasture (n = 12) or rangeland (n = 12) during early and mid-gestation. After weaning steers were placed on a backgrounding diet for four weeks, designed to gain 1.1 kg/d before being transitioned to a finishing ration. Steers remained on the finishing ration until an estimated backfat of 1.02 cm over the 12th and 13th rib was reached. Complete carcass data (skeletal and lean maturity, marbling score, quality grade, carcass weight, dressing percent, ribeye area, 12th rib fat thickness; percent kidney, pelvic, and heart fat; and yield grade) was collected and evaluated. Strip loin steaks were aged for four and fourteen days then assigned to Warner-Bratzler shear force (WBSF) for tenderness evaluation. Data were analyzed using the MIXED procedure in SAS. Significance was determined at $P < 0.05$. Hot carcass weight was heavier ($P = 0.02$) in RAN steers. Ribeye area trended towards significance ($P = 0.05$) for RAN compared to IRR steers, while yield grade ($P = 0.56$) and marbling score ($P = 0.94$) were not different between the two groups. For WBSF, there was not a treatment by aging period interaction ($P = 0.54$) or treatment difference ($P = 0.25$); however, steaks became more tender from day 4 to 14 ($P = 0.0005$). These initial findings suggest RAN steers are exhibiting compensatory growth, yielding heavier carcasses, and have comparable tenderness relative to that for IRR steers. Understanding the impact of maternal environment on steer performance will provide an opportunity for producers to improve profitability and the industry to produce more acceptable products for consumer consumption.

Key words: fetal programming, growth, carcass, beef

The effects of allyl isothiocyanate inclusion as an additive on whole-plant corn silage

Lucelia de M. Pereira¹, Pedram Rezamand², Bruna C. Agostinho², Gabriela L. D. Vigne¹, Denise Volpi¹, Natália N. de Mello¹, Queila G. Tavares¹, Patrick Schmid¹, Maity Zopollatto¹

¹Department of Animal Science, Federal University of Parana, Curitiba, Brazil

²Department of Animal, Veterinary & Food Sciences, University of Idaho, Moscow, ID

Allyl Isothiocyanate (AIT) is a natural compound used as a food additive. This additive is a well-recognized antimicrobial agent that plays an important role in mitigating the growth of microorganisms that cause food spoilage. Undesirable microorganisms can proliferate during the ensiling, storage, and aerobic phase of silage, reducing nutritional quality and increasing the fermentative losses. Therefore, the objective of this study was to determine the effect of AIT inclusion on the fermentative losses, microbiology, and aerobic stability of whole-plant corn silage. Four AIT levels were tested in a completely randomized block design: 0, 5, 10, 20 mg/kg of fresh matter of whole-plant corn, with five replicates per treatment, totaling 20 experimental units. The AIT was applied and mixed with the material at ensiling. Each experimental unit consisted of one 8-L plastic bucket with an average density of 468 kg/m³. The silos were opened 90 days after ensiling. Data were analyzed using a MIXED model procedure of SAS with significance declared at $P \leq 0.05$ and the tendency at $P < 0.10$. The gas production, total dry matter (DM) losses, and molds decreased linearly ($P < 0.01$; 0.01; 0.03, respectively) with the AIT inclusion levels. Although aerobic stability linearly increased ($P = 0.02$), DM losses showed a quadratic increase ($P = 0.02$) with the AIT levels during aerobic deterioration. Furthermore, pH and heterolactic account tended to linearly decrease ($P = 0.06$ for both), whereas DM concentration and yeast account tended to linearly increase ($P = 0.09$; 0.08, respectively) with AIT levels. Effluent production and homolactic account were not however affected by treatment. Overall, the inclusion of AIT at ensiling affected the fermentative losses, microbiology, and aerobic stability of whole-plant corn silage.

Key words: aerobic stability, essential oil, silage fermentation,

Impacts of heifer post-weaning intake classification on performance measurements of lactating and non-lactating two-, five- and eight-year-old Angus beef females

K. R. Wellnitz,[†] C. T. Parsons,* J. M. Dafoe,* S. A. Wyffels,* D. L. Boss,* T. DelCurto,[†] and M. L. Van Emon[†]

[†]Department of Animal and Range Sciences, Montana State University, Bozeman, MT 59717

*Northern Agriculture Research Center, Montana State University, Havre, MT 59501

ABSTRACT: Data used in these studies were part of a larger project as described by Parsons et al., (2021). These studies evaluated heifer postweaning intake classification on performance measurements of two-, five- and eight-year-old lactating or non-lactating Angus beef females. We analyzed the intake and production data of fifty-seven pregnant, non-lactating (Study 1) and fifty-four, lactating, non-pregnant (Study 2) females. Heifer postweaning intake was calculated over 80 test days following weaning from the dam using GrowSafe units. Heifers were categorized based on intake as either low (< -0.05 SD from the mean), average (± 0.05 SD from the mean), or high (> 0.50 SD from the mean) within year. The non-lactating females (Study 1) showed an age effect ($P \leq 0.05$) for cow body weight (BW), DMI rate (grams/minute), and time spent at the feeder (minutes/day). As cow age increased, cow body weight also increased. In addition, intake rate was greater in five- and eight-year-old cows when compared to two-year-old cows, and eight-year-old cows spent more time at the feeder than two- and five-year-old cows. Cow BW for non-lactating cows was significant for age ($P < 0.001$), intake classification ($P = 0.03$) and showed a tendency for age*intake interaction ($P = 0.10$), with older cows weighing more than younger cows. In lactating cows (Study 2), Julian birth date of calves showed an age*intake interaction ($P < 0.001$) with two-year-old cows calving earlier in the calving season than five- and eight-year-old cows. Calf birth weights differed by age classification ($P < 0.001$) and showed an age*intake classification ($P = 0.001$) with offspring from eight-year-old cows having heavier birth weights than two- and five-year-old cows, however, an intake effect was not observed ($P = 0.95$). As expected, post-partum interval was greater for 2-year-old cow when compared to five- and eight-year-old cows ($P < 0.001$). Milk production expressed as kilograms and grams per kilogram of BW of the cow had an age*intake ($P < 0.001$) effect. Two-year-old cows with low and average intake classifications had greater daily milk production and milk produced as grams per kilogram of BW than two-year-old cows with high intake classification. Additionally, five-year-old cows with average and high intake classifications had greater daily milk production and grams of milk produced per kilogram of BW compared to five-year-old cows classified as low intake. There was no effect of intake classification ($P \geq 0.56$) for lactating females on DMI/kg of BW, DMI rate (grams/minute), coefficient of variation for intake, or time spent at the feeder (minutes/day). In summary, heifer post-weaning intake classification had minor impacts on beef female performance measurements in lactating and non-lactating commercial beef females.

Key words: beef cattle, heifer, intake, lactating, non-lactating, post-weaning