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Graduate Student Abstracts

GRADUATE STUDENT POSTER ABSTRACTS 000 - 000

Effects of the physical form of starter feed on intake, performance and health of young Holstein calves
Í.R.R. Castro, G.B.C. Leite, J.C.C. Chagas, G. Fields, A. Bartelheimer, A. Harder, D. Landin, and M.I. Marcondes.

Effect of iodine source on dairy cow colostrum production and growth and health of their calves
K.R. Johnston, D.C. Reyes, K.N. Klobucher, T.C. Stahl, P.S. Erickson, and A.F. Brito.

Botanical Composition and Quality of Beef Cattle Diets on a Burned and/or Unburned Rangeland
J.A. Kluth, N.G. Davis, S.A. Wyffels, C.B. Marlow, L.T. Vermeire, M.L. Van Emon, M.F. Nack, T.E. Sitz, T.G. Hamilton, J.J. Peterson, G.J. Collins, A.V. Rutledge, M.A. Whitehurst, and T. DelCurto.

Impact of improving the heat detection method on farm dietary costs, production, and profitability in Washington and Florida dairies
G.B.C. Leite, and M.I. Marcondes.

Effects of wildfire smoke $PM_{2.5}$ exposure on health and performance of dairy heifer calves
A. Pace, P. Rezamand, and A.L. Skibiel.

Performance of grazing beef cattle supplemented with increasing energy levels in a tropical environment
Luiza de Nazaré Carneiro da Silva, Robert Emilio Mora-Luna, Daniel Henrique Sousa Tavares, Mirelle Magalhães Souza, José Neuman Miranda Neiva, Fabrícia Rocha Chaves Miotto, and M.I. Marcondes.

Does transition milk and colostrum feedings provide benefits to dairy calves' gastrointestinal tract after feed restriction and fasting? Fecal immune and microbiota parameters assessment.
M. Tortadès, S. Martí, M. Devant, F. Fàbregas, and M. Terré.

Effects of weaning strategies on health, hematology, and productivity in Holstein dairy calves
A. Wolfe, P. Rezamand, B.C. Agustinho, D.E. Konetchy, and A.H. Laarman.

Effects of the physical form of starter feed on intake, performance and health of young Holstein calves

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Commercial starters are formulated containing coarsely rolled or ground grains, whole grains, protein, mineral, and vitamin supplements in their composition. The processing and physical form of starter feed (PFSF) can affect the palatability, acceptability, intake, and/or performance of dairy calves, which is critical to the rumen development and play a crucial role in easing the transition from pre-ruminant to mature ruminant state. Despite the relevance of this topic, the literature on the effects of different PFSF on calf performance is inconclusive. Thus, this study aimed to investigate the effects of the PFSF on feed intake, growth performance, and the health of dairy calves. Twenty-four female Holstein calves (5 days of age; 40.42 ± 3.86 of body weight; mean ± sd) were used in a completely randomized block design (*n* = 12 calves per treatment). Individually housed calves were randomly assigned to one of the two dietary treatments, including (1) texturized feed starter (TFS; a mix of a protein pellet with whole kernel corn, and (2) pelleted feed starter (PFS; protein pellet). Both starters had the same ingredients and nutrient compositions but differed in their physical forms. All calves were offered the same milk replacer (MR; 26% to 28% CP and 16% to 24% lipid, 6 L/d of MR until 30 d of age, 4 L/d of MR from 31 to 60 d, 3 L/d of MR from 61 to 62 d, 2 L/d of MR from 63 to 64 d and 1 L/d of MR from 65 to 66 d of age). Calves were weaned on d 67. All calves had free access to drinking water and the starter throughout the experiment, and the feed and water intakes were measured daily. Animals were weighed weekly during the trial and at 30 days (97 d of age) and 90 days (157 d of age) after weaning for performance evaluation. Data were analyzed as a randomized block design in a repeated measurements scheme using the GLIMMIX procedure of SAS (SAS Institute Inc., Cary, NC). Initial body weight (iBW) was included as a covariate. For health variables, as they usually do not follow a normal distribution, we tested all distributions available in the GLIMMIX procedure of SAS and used the best distribution according to the Bayesian Information Criterion (BIC). No interactions between time and treatment were observed on all variables (*P > 0.05*). There was no effect of the physical form of the starter on starter (*P > 0.05*) and water (*P > 0.05*) intakes. PFSF did not affect body measurements of body weight (BW), average daily gain (ADG), and withers height (WH) (*P > 0.05*). Clinical signs of disease, such as ear position, and cough incidence were not affected by PFSF (*P > 0.05*). Whereas general attitude (*P = 0.010*), presence of eye discharge (*P = 0.004*), total respiratory score (*P = 0.019*), fecal score (*P = 0.04*), and non-respiratory score (trend, *P = 0.087*) of animals receiving the texturized feed starter were superior to those fed the protein pellet. Overall, our results indicate that starter diets containing whole kernel corn as a texturizer cannot improve the intake and performance of young dairy calves compared with diets containing pelleted feed starter; however, we observed that the health of the group receiving the texturized feed starter was improved.

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Effect of iodine source on dairy cow colostrum production and growth and health of their calves

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Limited research exists on how the high iodine (**I**) concentration of seaweed supplements affects prepartum cow colostrum production and development of their calves. The objectives of this study were: (1) evaluate the effects of incremental amounts of *Ascophyllum nodosum* (**ASCO**) meal supplementation to prepartum cows on colostrum production and the growth and blood metabolite concentrations of their offspring, and (2) compare ASCO meal versus a common I source [ethylenediamine dihydroiodide (**EDDI**)] on the same variables under objective 1. Forty Holstein cows were blocked by lactation number and expected calving date and assigned to 1 of 4 treatments 28 d prior to parturition: (1) EDDI supplemented to meet recommended I intake [0.5 mg I/kg of dry matter intake (**CON**)], CON plus 57 g/d of ASCO meal (**LO**), CON plus 113 g/d of ASCO meal (**HI**), and CON plus EDDI (124.8 mg/d) supplemented to match the amount of I provided by HI (**EDDI**). Within 1 h of calving, colostrum was harvested and weighed. Colostrum was analyzed for fat, protein, total solids, I, and IgG. Forty-one calves were blocked based on their dams' treatments. At birth, calves were weighed and fed 300 g IgG via colostrum replacer. At 24 h old, calves were offered 676 g dry matter daily of milk replacer (**MR**) (25% crude protein, 16% fat) until 49 d, where they were offered 338 g of MR. Free choice textured starter (28% CP) and water were offered ad libitum at 24 h of life until study completion. Blood samples were collected at 0 h and 24 h of age for IgG and thyroid hormone (**TH**), at d 14, 28, and 56 for TH, and weekly for beta-hydroxybutyrate (**BHB**) analyses. On d 5 of life, a xylose challenge was conducted by supplementing 0.5 g/kg body weight (**BW**) of D-xylose in the MR, with plasma samples taken over a 12 h period. Plasma samples were analyzed for xylose and glucose concentrations to serve as a proxy for intestinal absorption. Weekly skeletal and BW measurements were recorded. Fat concentration of colostrum was greater in HI than EDDI cows, and there was a tendency for fat concentration to decrease linearly with ASCO meal supplementation. Plasma concentration of weekly total T_4, weekly BHB, and final BHB responded quadratically to ASCO meal supplementation, with the lowest concentration occurring with the LO treatment. There was a tendency for IgG apparent efficiency of absorption to be lower in EDDI versus HI calves. Overall, these data indicate that addition of ASCO meal to the dams' diet did not negatively impact calf growth and metabolism or colostrum production and composition. Additionally, ASCO may benefit colostrum composition and calf passive transfer when used as an I source compared to EDDI.

Keywords: immunoglobulin G, iodine, seaweed, colostrum production, calf development

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Botanical Composition and Quality of Beef Cattle Diets on a Burned and/or Unburned Rangeland

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Current management paradigms suggest deferring grazing rangeland for two years after a wildfire to avoid additional stress on native plant species, but there is little to no research supporting these recommendations. This experiment was conducted within and adjacent to the burn area of an August 2020 wildfire to evaluate the differences in diet quality, botanical composition, and foraging efficiency of beef cattle on both burned and unburned rangeland. A randomized complete block design with a 2x2 factorial arrangement of treatments contrasting burn versus no burn and June versus September grazing periods was used. Pastures (4 ha) within the burn area were grazed in either June 2021 or deferred to September 2021. Grazing occurred for two days by 20 cow/calf pairs in June and 16 cow/calf pairs in September. Cattle diet composition and masticate samples were collected during 20-minute bite-count periods using six ruminally cannulated cows in each pasture prior to and after two-day grazing periods. Cannulated cows grazed a pasture adjacent to the burn area to compare diet quality and composition between burned and unburned rangeland. Nutrient value of key grass species in the study area were 30% higher in crude protein in the burned area as compared to the unburned area (12.47 vs. 8.53%, respectively) for the June grazing period. Difference of diet quality of standing vegetation was similar in the September grazing period (6.53% CP). Foraging behavior was influenced by the previous year's fire for the June grazing period. Beef cattle grams per minute ($\bar{x}$ ± SD; 23.86 vs 7.22 ± 6.78), bites per minute (15.83 vs 9.4 ± 5.95), and grams per bite (1.53 vs 1.02 ± 0.85) were higher in unburned sites versus burned sites during the June grazing period. However, foraging behavior is similar in the burned and unburned areas during the September grazing period.

Keywords: diet quality, foraging behavior, grazing, season of use, wildfire

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Impact of improving the heat detection method on farm dietary costs, production, and profitability in Washington and Florida dairies

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The herd's reproductive performance vastly impacts the dairy's efficiency, not just because of the costs directly associated with the elected protocols but also indirectly on the performance, the permanence of the animals in the herd, and feed costs. Throughout the years, authors gathered data about the chosen heat detection method and economic and productive indexes of dairy farms, but they never linked those results with their consequences on diet costs. We aimed to evaluate the effects of the heat detection method (and reproduction efficiency) on the productivity and feed expenses of FL and WA dairy operations. A discrete Markov Chain model was used, simulating the 22-d period corresponding to one reproductive cycle, assessing the probabilistic performance of dairy cows and heifers over 10 years. We used the solver non-linear tool of Excel subjected to constraints of a minimum of 900 and a maximum of 1000 cows, and a minimum of 0% and a maximum of 40% voluntary culling rate of 3 or more lactation cows. The model was evolved over 10 years by changing (using the Solver function) the culling rate of 3 or more lactating cows and heifer calves sold at birth, aiming to reach a steady state herd and maximizing annual profit. The computed data of the last year was compiled to compare scenarios. Milk (class III) and other prices were obtained from the USDA (12/2022). The scenarios were created by computing differences in breeding detection using visual observation (VO), rump/tail markers (RM), or electronic detectors (ED, collars, or pedometers). We considered a 6% improvement in heat detection when changing from VO to RM and an improvement of 12% when changing from RM to ED. Lastly, we ran scenarios for two weather conditions (WA and FL states), totaling 6 scenarios for this study. The milk yield/cow increased by 0.8% and 2.3% using RM or ED, respectively, compared to VO in FL. In WA, this increase was 1.6 and 4.7%, respectively. Using RM in FL, we obtained a 0.6% increase in pregnant heifers and 15.3% pregnant cows, while using ED, these numbers go up to 3.3% and 34.9%. In WA, using RM, we observed 0.7% and 13.4% more pregnant heifers and cows, respectively; and using ED, 11.5% and 25.1%. The calving interval decreased from 13.1 mo using VO to 12.8 and 12.5 using RM and ED in FL. The same trend is observed for WA, showing a decrease from 12.7 to 12.4 (VO vs. RM) and down to 12.4 with ED and follows the same decreasing pattern in WA, with 12.7 (VO), 12.4 (RM), and 12.4 (ED) mo. When analyzing expenses with forage for diets, we observed that the more modern the heat identification method, the fewer expenses with forages, regardless of the region. Dairy operations in FL saved up to 2.9% from changing from VO to ED, and that number raised to 8.6% in WA. However, this relationship is inverse when we analyze expenses with concentrate, where FL producers increased their costs by 8.2% and WA producers increased by 22.6%. Overall, farms increased diet costs by 2.4% when changing from VO to RM; however, profit increased by 1.2%. In WA, farms increased diet costs by 3.5% when changing from VO to RM; however, profit increased by 3.3%. When switching from VO to ED, diet costs increased by 5.8 and 22% for WA and FL, respectively, but profit also improved by 8 and 38.7%, respectively. We concluded that the more specialized the heat detection system, the higher the dietary costs. Still, these costs are followed by increased milk production, improved reproduction, and higher profit.

Effects of wildfire smoke $PM_{2.5}$ exposure on health and performance of dairy heifer calves

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The western United States experiences wildfires that are increasing in severity and emit dangerous pollutants into the atmosphere. Fine particulate matter ($PM_{2.5}$) in smoke is thought to be especially hazardous. Fine particulates can deposit in the lower airways and lungs, and enter circulation through the pulmonary system in humans, where it causes local and systemic inflammatory responses, resulting in disease. Yet, there is limited knowledge on how wildfire smoke $PM_{2.5}$ affects dairy calves. The present study aims to understand the effect of wildfire smoke exposure on dairy calf metabolic physiology and inflammatory response. Holstein heifer calves (n = 15) at the University of Idaho Dairy Center were followed from birth in July through weaning in September 2021, concurrent with the Pacific Northwest wildfire season. Blood samples were collected weekly to analyze hematology, blood metabolites [glucose, β-hydroxybutyrate (BHB), nonesterified fatty acids (NEFA)], and acute phase proteins [haptoglobin (Hp), serum amyloid A (SAA)]. Health scores, respiratory rates (RR), heart rates (HR), and rectal temperatures (RT) were recorded weekly. Hourly $PM_{2.5}$ concentrations and meteorology data were recorded from a monitoring station in close proximity to the farm. AirNowTech Navigator with HYSPLIT modeling was used to map active wildfires, wind trajectory, and $PM_{2.5}$ to assess if the detected $PM_{2.5}$ was derived from wildfires. Statistical analysis was conducted using mixed models with calf as a random effect and fixed effects of average daily $PM_{2.5}$, temperature-humidity index (THI), and their interactions, with separate models for lags (delayed responses) of up to seven days. Elevated $PM_{2.5}$ was concurrent with wildfires and ranged from 2.0 $\mu g/m^3$ to 118.8 $\mu g/m^3$, while THI ranged from 48 to 73. Initially, there was a positive interacting effect of $PM_{2.5}$ and THI on glucose and NEFA on lag day 1 (P < 0.01, P = 0.05, respectively) and a negative interacting effect on BHB at lag day 1. However, these relationships were reversed with subsequent lag days. Higher $PM_{2.5}$ and THI together increased SAA on lag days 1 and 7 (both P < 0.01), and increased Hp on lag days 0, 2, 3, and 4 (all P < 0.03). Together, higher $PM_{2.5}$ and THI increased RR (P = 0.04), HR (P < 0.01), and RT (P = 0.04) at lag day 0. Additionally, greater $PM_{2.5}$ and THI together elevated eosinophil count (P = 0.02) on lag day 0, decreased total white blood cell (P = 0.01) and neutrophil counts (P < 0.01) on lag day 3, and decreased lymphocyte count on lag day 2 (P = 0.03). Cough score (P < 0.01) and eye score (P = 0.02) increased with greater $PM_{2.5}$ and THI after a 3-day lag. A number of these effects persisted at subsequent days. Our findings indicate that exposure of calves to wildfire smoke $PM_{2.5}$, concomitant with higher THI, causes alterations in metabolism and the innate immune response, which could potentially compromise calf health and performance.

Keywords: air pollution, inflammation, calf health

Performance of grazing beef cattle supplemented with increasing energy levels in a tropical environment

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The correct synchronization between nitrogen and carbohydrates favors the high efficiency of the ruminal microbiota, promoting improvements in digestibility and feed efficiency. Thus, we aimed to evaluate the effects of increasing energy supplementation on the performance of grazing beef cattle in a tropical pasture. The project was developed at the Tocantins Federal University, in the Araguaína - TO, in northern Brazil, between February and May 2021, totaling 73 days. Twenty-four zebuine calves with a mean age of 12 months and an initial average weight of 150 kg were used. The treatments consisted of the evaluation of supplements composed of whole grain corn and protein pellet with increasing energy supply while maintaining protein intake from the supplement: Treatment 1 - Concentrated feed composed of 100% of protein pellet and supply to 0.25% of body weight (BW); Treatment 2 - Concentrate composed of 50% protein pellet and 50% corn, at 0.50% BW; Treatment 3 - Concentrate composed of 34% protein pellet and 66% corn, at 0.75% BW; Treatment 4 – Concentrated diet in the proportion of 25% of protein pellet and 75% of corn, at 1% BW. The animals were run in a rotating stocking system with seven days of occupation and twenty-one days of rest. A completely randomized design was used with four treatments and two sets of paddocks (each replication represented by a paddock with three animals). The experimental grazing area comprised 4 hectares of pasture formed with Megathyrsus maximus grass cv. Mombasa. Stocking management was variable, in which the put-and-take technique composed of testing and regulatory animals was used (Mott; Luke, 1952). Before entering and after the animals left the paddocks, pasture height and availability of total dry matter were measured. Supplements were provided once a day at 8:00 a.m. The animals were weighed at the beginning and end of the experiment and each 24-day cycle to monitor weight development. The data were submitted to normality (Shapiro-Wilks) and homoscedasticity (Levene) tests, and once the assumptions were met, they were submitted to analysis of variance following a completely randomized design. The treatment effects were evaluated with polynomial orthogonal contrast for linear and quadratic effects using a 5% probability level. Performance and DM intake increased linearly as energy supplementation increased ($P < 0.050$). The same behavior was observed for Final weight ($P = 0.041$), total weight gain ($P = 0.021$), average daily gain ($P = 0.021$), stocking density (animals/hectare; $P< 0.001$), and total weight gain per ha/day ($P = 0.001$). Based on these results, we speculate that the increase in the energy supplementation allowed better efficiency of the ruminal microbiota, minimizing nitrogen loss and consequently maximizing animal production. Furthermore, since carbohydrates are the primary energy source for microbial growth, possibly the greater energy intake promoted an increased supply of microbial protein to the small intestine and, consequently, animal performance. Therefore, providing supplementation with a higher proportion of corn can be helpful as a strategy to reduce the duration of the rearing phase.

2023 Pacific Northwest Animal Nutrition Conference Proceedings

Does transition milk and colostrum feedings provide benefits to dairy calves' gastrointestinal tract after feed restriction and fasting? Fecal immune and microbiota parameters assessment.

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Bovine colostrum (**BC**) and Transition milk (**TM**) are rich in nutrients and bioactive molecules, which may help calves to recover digestive tract functionality from stressful periods such us marketing and transport. The objective of our study was to evaluate the digestive tract recovery of feeding either BC, TM, or milk replacer (MR) after an episode of feed restriction (**FR**) and fasting. In this conference, we will assess our objective through fecal biomarkers of immune response and microbiota. The FR and fasting was simulated by feeding 2L of an oral rehydration solution twice daily for 3 days and 19 h of fasting to 35 male calves (22 ± 4.8 days old) and then randomly assigned the calves to one of 5 treatments (n=7; day 1 of study): feeding either pooled BC during four (**C4**) or ten (**C10**) days, pooled TM during four (**TM4**) or ten (**TM10**) days, or MR for ten days (**CTRL**) at the rate of 720 g/d DM content in a total volume of 3L. After, all calves were fed the same feeding program, decreasing MR gradually from 3L twice daily to 2L once daily at 12.5% DM until weaning (d 42 of study). Concentrate feed, water, and straw were offered ad libitum. Feed, MR, and straw intake were recorded daily, and body weight on d -3, 1, 2, 5 and 11, and weekly afterwards. Volatile fatty acids, lactoferrin, IgA and microbiota (Firmicutes to Bacteroidetes ratio and *Faecalis prausnitzii*) were analyzed in feces from samples obtained on d 5 and 11 before the morning feeding. Data were analyzed with a mixed-effect model accounting for the random effects of animal and the fixed effect of treatment, time, and its interaction. Calf performance, intake, fecal lactoferrin concentrations, and microbiota quantification were similar among treatments throughout the study. Fecal IgA concentrations were greater ($P < 0.05$) in C10 than in CTRL, TM4, and TM10 calves, and in C4 and TM10 than in CTRL animals. Fecal propionate proportion was less abundant in C10 calves than in CTRL, TM4 and TM10 ones, while butyrate was greater in C4 and C10 calves than in TM4 and CTRL ones. Results showed that TM and BC provide gut immune protection and BC may promote butyrate-producing bacteria in calves after a FR and fasting episode.

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Effects of weaning strategies on health, hematology, and productivity in Holstein dairy calves

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Weaning strategies in dairy calves vary considerably, though the impact on animal health is unclear. This study examined the effects of calf weaning age (6 vs. 8 wk) and pace (abrupt vs. gradual) on health parameters in dairy calves. Holstein calves (n = 72), blocked by sex and birth weight, were randomly assigned to one of four treatments (n = 18 per): Early-Abrupt (EA), Early-Gradual (EG), Late-Abrupt (LA), and Late-Gradual (LG). Milk replacer (24% CP, 17% fat; up to 1200 g/d) was fed twice daily; water, calf starter (18% CP), and chopped alfalfa hay were fed ad libitum. Daily intakes of milk replacer, calf starter, and forage were recorded. Body weight, health measures, blood hematology, and fecal scores were obtained prior to, and after weaning. Calves were orally bolused with a rumen pH logger for the last three days of the weaning transition and rumen pH was measured continuously. Calves also had fresh blood analyzed using an HM5 hematology unit during weaning to determine immune function. Data was analyzed with age and pace as fixed effects. Age at weaning increased respiration (P = 0.02), while gradual weaning groups had lower respiration rate (P = 0.01). Heartrate was lower in gradual than in abrupt groups (P = 0.01). Fecal score tended to increase in late-weaned groups (P = 0.06) and gradually-weaned groups (P = 0.04). No difference was detected in body core temperature by age or pace. During the weaning transition, average daily gain was lower in LA than EA (0.62 vs. 0.11 Kg/d, P < 0.01) and gradually-weaned groups had increased ADG (0.65 kg/d, P = 0.02). Change in grain intake, but not forage intake, was greater in gradually-weaned groups (P < 0.01). Mean rumen pH tended to increase from EG to LG (7.65 vs. 8.84, P = 0.1) and from LA to LG (7.89 vs. 8.84, P = 0.1). No difference was detected among treatments in red or white blood cell counts, and hemoglobin. Procalcitonin tended to be different depending on the age × pace interaction with the LA group having the highest percentage of procalcitonin (0.18%, P = 0.07). Blood hematocrit increased in abruptly-weaned groups (41.3 %, P = 0.01). Overall, calf health is affected by both age and pace of weaning, though the health parameters impacted by age and pace differ.

Keywords: calf health, weaning pace, weaning age

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