ANIMAL HEALTH: CALF HEALTH

0854 (T001) Immune status of dairy heifer calves in the northern plains of Costa Rica. Year III. J. A. Elizondo-Salazar[*1], J. J. Arroyo-Arroyo[2], J. Sanchez-Salas[3], and J. Heinrichs[4], *[1]Estación Experimental Alfredo Volio Mata, Facultad de Ciencias Agroalimentarias, Universidad de Costa Rica, [2]Universidad de Costa Rica, San José, [3]Cooperativa de Productores de Leche Dos Pinos R.L, San Jose, Costa Rica, [4]Pennsylvania State University, University Park.*

The objective of this study was to characterize the immune status of dairy calves in the northern plains of Costa Rica. The results correspond to total serum protein (TSP) measurements obtained from 657 female calves in 23 dairy farms during the period of August and November 2012. Dam breeds were classified into Holstein, Jersey, Holstein x Jersey crosses, and other. Blood samples were collected between d 1 and 7 of age into serum (red top) Vacutainer tubes, refrigerated overnight, centrifuged, and the serum separated from clot within 24 h of collection. A hand-held refractometer was used to measure STP. For the purpose of this study, failure of passive immunity was considered when TSP concentration was less than 5.5 g/dL. GLM procedure was used to establish differences between parity and breed of the dams. Descriptive statistics were generated to define percentage of failure of passive transfer by breed and parity of the dam. TSP concentration ranged from 2.4 to 10.0, with an overall mean of 5.7 g/dL. Of all the calves evaluated, 44.9% presented failure of passive transfer. Calves born to Jersey and Holstein x Jersey crosses had significantly higher TSP concentrations than calves born to Holstein and other breeds. When considering lactation number of the dam, offsprings born to third lactation cows showed the lowest percentage of calves with inadequate transfer of immunity. The findings of this study suggest that colostrum management practices should be placed to minimize the risk of failure of passive transfer in dairy herds in the northern plains of Costa Rica.

Key Words: total serum protein, immunoglobulins, passive immunity

0855 (T002) Passive transfer of immunity of dairy calves in the central northern region of Costa Rica. J. A. Elizondo-Salazar[*1], O. A. Vargas-Villalobos[1], L. Noguera-Solera[2], and J. Heinrichs[3], *[1]Estación Experimental Alfredo Volio Mata, Facultad de Ciencias Agroalimentarias, Universidad de Costa Rica, [2]Cooperativa de Productores de Leche Dos Pinos R.L, Alajuela, Costa Rica, [3]Pennsylvania State University, University Park.*

The objective of this study was to characterize the immune status of dairy calves in the central northern region of Costa Rica. The data correspond to total serum protein (TSP) measurements obtained during the period of August and November 2012 in 47 dairy farms. Three hundred thirty-seven female and 127 male calves were sampled. Dam breeds were classified into Holstein, Jersey, Holstein x Jersey crosses, and other. For the purpose of this study, failure of passive immunity was considered when TSP concentration was less than 5.5 g/dL. TSP concentration ranged from 3.0 to 10.0, with an overall mean of 5.7 g/dL. Of all the animals evaluated, 40.5% had failure of passive transfer. When sex of the calves was considered, 39.2% of females and 44.1% of males failed to obtain adequate concentration of TSP, and there were no significant differences (5.8 vs. 5.7 g/dL, respectively) ($P > 0.05$). Calves born to Holstein cows had significantly lower TSP concentrations than calves born to other breeds ($P > 0.05$). When considering calving of the dam, there were no significant differences on TSP concentration of calves; however, offspring born to fourth lactation cows showed the highest percentage of animals with inadequate transfer of immunity. Calves that were allowed to suckle their dams showed a 48.8% failure of passive immunity against 34.1% of calves that were given colostrum by bottle. The findings of this study suggest that colostrum management practices should be placed to minimize the risk of failure of passive transfer in dairy herds in the central northern region of Costa Rica.

Key Words: total serum protein, immunity, passive immunity

0856 (T003) Effects of added spray-dried whole colostrum and spray-dried plasma on veal calf health and performance. *D. Wood*, R. Blome, and J. Sowinski, Animix, Juneau, WI.*

The study objective was to evaluate the effects on calf health and performance from supplementing either whole spray-dried colostrum (SDC) or additional spray-dried plasma (SDP) on top of a spray-dried plasma-containing (5.2% plasma inclusion rate, otherwise all-milk) veal starter formula (fed d 1 to 57) and a spray-dried plasma-void veal finisher formula (fed d 58 to 140). Auction-sourced Holstein bull calves ($n = 128$; approximately 1 wk of age) were randomly placed in individual, raised stalls for 10 wk and were then reared as pairs loose-

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housed. Treatment pairs were equally placed within each row, i.e., calves in stalls 1 and 2 were fed supplemental WPC/dry fat blend control (WPC), calves in stalls 3 and 4 were supplemented SDP/dry fat blend, and calves in stalls 5 and 6 were supplemented SDC. SDC contained 13% IgG and SDP/dry fat blend was formulated to also contain 13% IgG. Both SDC and WPC were 44.3% CP and 18.1% fat. To be formulated with 13% IgG and 18.1% fat, SDP had to contain 57.3% CP, resulting in SDP-fed calves receiving an additional 200 g of CP over the feeding period verses SDC or WPC. Calves experiencing FPT (< 5.5 g/dL serum total protein) were 70.4, 76.2, and 83.3% of all calves in WPC-, SDP- and SDC-fed groups, respectively. The calves were fed formula and supplemented 25 g/feeding (2x/day) of the respective supplement wk 1, 15 g/feeding wk 2, 10 g/feeding wk 3 through 5, 5 g/feeding wk 6 and 7, and 2.5 g/feeding wk 8 through 20, when slaughtered. Accounting for total solids intake, calves were started on a 25:18 (CP:Fat), increased to 871 g/day of a 21:18 by 21 d age (medicated to d 21) and 1742 g per day of a 20:18 by 53 d age. Calves received no dry feed. Data was analyzed using F-test for variances and student t test comparing two means. Calves fed additional SDP outgained ($P < 0.05$) WPC by +2.52 kg d 1 through 53 (SDC was intermediary). SDC tended ($P < 0.077$) to outgain WPC by +8.57 kg d 53 through 140 (SDP was intermediary). SDP and SDC reduced incidences of refusals ($P < 0.05$). SDC tended ($P < 0.082$) to reduce the number of calves treated verses SDP (WPC intermediary). SDC and SDP improved intake. SDP improved 53-d gains.

Key Words: calf, colostrum, plasma

0857 (T004) Holstein calves fed non-saleable milk that was pasteurized or raw had decreased incidence of abnormal feces and hematology measures than calves fed accelerated milk replacer. L. E. Hulbert[*1], J. A. Noel[2], S. C. Trombetta[1], S. R. Montgomery[1], G. A. Hanzlicek[3], and B. J. Bradford[1], *[1]Dep. of Animal Sciences and Industry, Kansas State University, Manhattan, [2]Kansas State University, Manhattan, [3]Diagnostic Medicine Pathobiology, College of Veterinary Medicine, Kansas State University, Manhattan.*

The objectives were to determine the health and blood parameters before, during, and after weaning of 114 Holstein heifers fed either accelerated milk-replacer (Mrp; 28% CP, 18% fat) or non-saleable milk (3.59 ± 0.28% True-Protein; 4.12 ± 0.37% fat) that was either pasteurized (Pst) or raw (Raw; refrigerated and fed < 24 h after collection). Calves were randomly assigned feeding treatments at age 0 d. Colostrum (1 L) was fed in less than 14 h after birth (Mrp and Pst = pasteurized colostrum; Raw = raw colostrum). All calves were bottle-fed 1.8 ± 0.20 SD L, 3x/day; all calves were provided fresh water and grain ad libitum throughout the experiment. Calves began step-down weaning at age 5 wk and completed weaning at age 6 wk. Blood samples were collected at ages 3, 5, and 7 wk and were analyzed for complete blood counts (CBC) using a Procyte Idexx Analyzer. In addition, whole blood was tested for bactericide capacity against live *E. coli* 51813 (%Bact). Fecal scores were observed twice daily, on a 1-to-3 scale (FS1 = normal, FS2 = loose, FS3 = scours). The Mrp-fed calves had more ($P < 0.01$) observations (% obs) with FS2 than the Pst- and Raw-fed calves (13.2 vs. 7.32 and 8.9 ± 0.69% obs, respectively), although there were few scouring (FS3; 0.36 ± 0.01% obs) incidences in this experiment. Likewise, Mrp-fed calves had greater hematocrit % compared to the other calves ($P < 0.01$), but Pst- and Raw-fed calves had similar hematocrit % (32.4 vs. 27.9 and 28.4 ± 0.55%, respectively). At age 3 wk, Mrp-fed calves had greater circulating monocytes ($P = 0.02$) compared to the other calves, but there were no differences between Pst- and Raw-fed calves (10.4 vs. 9.2 and 8.2 +0.40%, respectively). Although there were no differences among treatments for % Bact or other hematological measures ($P > 0.10$), all calves had lower neutrophil:lymphocyte, more circulating monocytes and greater % Bact at age 7 wk compared to ages 3 and 5 wk ($P < 0.05$), suggesting that the change in diet from milk or MR to grain influences innate immune and hematological measures. The increased incidence of abnormal fecal scores among Mrp-fed calves and higher hematocrit percentages needs further consideration, especially before age 3 wk. In addition, these findings suggest that raw milk may be adequate for maintaining healthy CBC and fecal score measures on a well-managed, low-disease incidence dairy.

Key Words: milk replacer, pasteurization, calves, hematology

0858 (T005) Effects of Celmanax supplementation to prepartum dairy cows on colostrum quality and the subsequent growth and health of their calves. C. Campos-Granados[*1], A. Rojas-Bourrillon[1], and C. C. Elrod[2], *[1]University of Costa Rica, San Jose, [2]Vi-COR, Inc., Mason City, IA.*

The objective of this study was to assess the effects of supplementing prepartum dairy cows with a product derived from yeast culture and enzymatically hydrolyzed yeast cell wall (Celmanax (CEL), Vi-COR, Mason City, IA) on colostrum quality and the subsequent' health and performance of their calves. Thirty prepartum multiparous Jersey cows were blocked by parity, body condition 21 d before expected calving date and productive and reproductive performance, and randomly assigned within block to one of two treatments ($n = 15$) from 21 d before expected calving date until calving. Rations were top-dressed with CEL at the rate of 0 or 40 g/d throughout the experiment. Calves were fed 3 L of colostrum from their dam within 2 h of birth and then 4 L of whole milk daily through wk 8. Total Ig in colostrum from each cow was evaluated at 25°C from the first milking with a Colostrometer, and a sample was taken for determination of IgG by ELISA.

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Approximately 48 h after birth, a blood sample was drawn by venipuncture from each calf for the determination of serum protein by refractometer and IgG by ELISA. Daily feed intake, weekly weight and hip height, and the incidence of pneumonia and scours were recorded. Data were analyzed using mixed models with repeated measures over time. Total Ig in colostrum was significantly increased by CEL treatment ($P < 0.05$; 90.06 ± 23.74 vs. 105.94 ± 17.59 mg/mL for 0 and 40 g/d, respectively) but there was no effect on colostrum yield or IgG content ($P > 0.05$). There was no effect of treatment on birth weight, serum protein, or serum IgG ($P > 0.05$). Average daily gain (382.86 ± 61.20 vs. 410.94 ± 51.22 g/day for 0 and 40 g/day, respectively), hip height increase (1.45 ± 0.33 vs. 1.70 ± 0.31 cm/week for 0 and 40 g/d, respectively), and feed consumption (446.67 ± 9.92 vs. 439.01 ± 6.12 g/day for 0 and 40 g/d, respectively) were not affected by treatment ($P > 0.05$). Odds ratios were calculated and the odds of a calf presenting with scours or pneumonia were 3.5 and 5.0, respectively, times more likely in the calves whose dams did not consume CEL prepartum. CEL supplementation prepartum improved colostrum quality and calf health.

Key Words: immunity, transition cow, calf, health, yeast culture.

0859 (T006) Maternal energy status during mid-gestation affects the immune response in the resultant beef offspring. A. R. Taylor[*1], D. A. Mohrhauser[1], R. Neiger[1], E. J. Blom[1], K. R. Underwood[1], R. H. Pritchard[1], A. E. Wertz-Lutz[2], B. P. Holland[3], and A. D. Weaver[4], [1]*South Dakota State University, Brookings, [2]ADM Alliance Nutrition, Inc., Quincy, IL, [3]Merck, Volga, SD, [4]South Dakota State University, Rapid City.*

Fetal or developmental programming relates the effects of maternal stressors on the developing fetus and potential consequences later in life. Specifically, beef cattle may experience decreased forage availability and quality during gestation, potentially altering nutrient availability and ultimately fetal development. Immune function has major economic implications in the beef industry; however, the understanding of maternal environment on development of the immune system in beef offspring is limited. Therefore, the objective of this study was to determine the effects of maternal energy status during mid-gestation on humoral immune response and tissue morphology of immunologically relevant tissues in beef offspring during the feedlot phase. Beef cows were allotted to one of two treatments: 1) Positive Energy Status (PES; $n = 76$)-fed to maintain BCS 5.0–5.5; or 2) Negative Energy Status (NES; $n = 75$)-fed to lose 1 BCS over the ensuing 91-d mid-gestation period (84 ± 11 d). Following treatment, cows were commingled and managed as a common group through weaning. Calves were weaned, shipped, and allotted into feedlot pens according to gender, dam energy status, and stratified by weight. A subsample ($n = 30$) of calves were subcutaneously injected with 4 mg ovalbumin antigen at d 0 of antigen challenge and again on d 28 of antigen challenge, with blood collected every 7 d from d 0 through d 56 to measure antibody titers. An ELISA was used to determine serum antibody titers in response to the ovalbumin challenge. Additionally, a subsample of calves were harvested following the receiving ($n = 12$) and finishing period ($n = 12$) for histological examination with hematoxylin and eosin stain of lymph nodes, spleen tissue, and gut-associated lymphoid tissue. Ovalbumin data were analyzed as a repeated measures model using the PROC MIXED of SAS (SAS Inc., Cary, N.C.). No morphological differences were observed in tissues. There were no differences ($P > 0.05$) in gender main effects in response to a novel antigen. An anamnestic response was observed over time ($P < 0.05$), which was expected following second exposure to the antigen. There was a difference ($P < 0.05$) between treatments over the sampling period with calves from PES cows having a greater antibody titer of 13.44 compared to calves from NES cows with an antibody titer of 12.38. These results suggest cows in a NES during mid-gestation produce calves with a decreased ability to produce antibodies to a novel antigen and thus a decreased humoral immune response.

Key Words: cattle, fetal programming, immunology

0860 (T007) Comparison of ivermectin and extended-release eprinomectin deworming treatment on stocker and subsequent feedlot performance and carcass characteristics of fall-born Angus heifers. C. A. Clark[*1], B. J. Dedrickson[2], J. L. Sorensen[2], and P. J. Gunn[3], [1]*Armstrong Memorial Research and Demonstration Farm, Iowa State University, Lewis, [2]Merial, Duluth, GA, [3]Iowa State University, Ames.*

The objective of this study was to compare the effects of ivermectin and extended-release eprinomectin on stocker and feedlot performance as well as carcass characteristics. Sixty purebred, fall-born Angus heifers (277 ± 23 kg BW; 4.90 ± 0.34 BCS) were blocked by BCS and BW, and allotted to one of two injectable deworming treatments after 35 d of grazing summer pasture: 1) ivermectin (Ivomec; IVO), or 2) extended-release eprinomectin (LongRange; LR). Concurrent fecal samples were taken at treatment initiation. Heifers were placed back on the same pasture until the pasture was no longer suitable for grazing (total of 63 d). Interim BW was taken 27 d after treatment initiation, and fecal samples, BW, and BCS were taken at grazing termination. At grazing termination, heifers were transported to a feedlot where they remained commingled and fed a finishing ration for 150 d. Upon arrival, heifers were stratified by BW within grazing treatment and allotted to either receive (Ivomec; DWRM) or not receive a deworming treatment at processing (NO). Fecal samples were collected 4 d before transport for slaughter. Carcass data were collect by the Tri-County Steer Carcass Futurity. Binary

and continuous data were analyzed using the GLIMMIX and PROC MIXED of SAS, respectively. Heifer BW and BCS did not differ between treatments throughout the grazing period ($P \geq 0.67$). Although ADG did not differ during the first 27 d, LR heifers had greater overall ADG and increased BW change ($P = 0.01$) during the grazing period. Although fecal egg count (FEC) did not differ at treatment initiation, FEC was greater in IVO (5.138 eggs/g) than LR (0.073 eggs/g) heifers at grazing termination ($P < 0.01$). Final fecal egg counts were nearly undetectable before transport to slaughter and did not differ ($P \geq 0.16$). There were no differences in feedlot performance or carcass characteristics due to grazing period, feedlot period or the interaction between the two treatments ($P \geq 0.09$). Based on data presented in this study, in cattle that have been effectively managed to reduce or eliminate internal parasite infection during a grazing period, there may be no benefit to deworming at feedlot arrival. However, even at extremely low, subclinical levels of infection during the stocker phase, parasites can have a significant impact on performance. These data highlight the importance of parasite control during the stocker phase, even at subclinical infection levels.

Key Words: feedlot, parasite, stocker

0861 (T008) Effect of rumen and fecal inocula from calves fed either milk replacer or whole milk fed on intestinal cells and digestive tract microbiota.
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The objective of this study was to evaluate cell viability and inflammatory status of intestinal cells incubated with rumen and fecal inocula obtained from Holstein calves fed either a milk replacer or whole milk. Liquid rumen and fecal samples were obtained from 10 calves at 5 wk of age. Calves were either fed a milk replacer supplemented with *Enterococcus faecium* at the rate of 1.5×10^9 cfu/kg (MR), or whole milk (WM). Samples from each group of animals (five animals per group) were pooled, centrifuged, and suspended with PBS at 3%. *Lactobacillus and Bifidobacteria* were quantified by qPCR from the rumen and fecal-pooled samples. The experiment was repeated twice with 10 other calves fed similarly. Jejunum tissue from 12-mo-old bulls was collected at a slaughterhouse to obtain jejunum primary cells and perform further in vitro experiments. Jejunum cells were cultured during 6 h with the fecal and ruminal inocula in 24-well plates at 37°C under a 5% CO_2 atmosphere. After the incubation, the supernatant was recovered to determine LDH activity as a cell damage marker. Cells were washed and lysed with TriZol (Invitrogen) to extract RNA and quantify, by qPCR, the expression of TNFα as an inflammation marker. Data were analyzed with a mixed-effects model considering sample and milk type as fixed effects, and period as random effect. *Bifidobacteria* and *Lactobacillus* contents were greater ($P < 0.05$) in feces (15.6 ± 1.04 and 14.1 ± 0.73 Ct, respectively) than in rumen (21.8 ± 1.04 and 21.8 ± 0.73 Ct, respectively) samples, and *Bifidobacteria* contents tended ($P = 0.10$) to be greater in samples from MR than in those from WM calves (17.1 vs. 20.2 ± 1.04 Ct, respectively). Viability of jejunum cells and the expression of TNFα were similar when cultured with rumen inoculum from MR and WM calves. However, LDH activity was greater ($P < 0.05$) in jejunum cells (less cell viability) when incubated with fecal inoculum from WM (0.50 ± 0.296 mU/mL) than from MR (0.14 ± 0.296 mU/mL) calves. The expression of TNFα was greater ($P < 0.05$) when cells were incubated with MR ($8.8 \times 10^5 \pm 8.89 \times 10^6$) than with WM ($3.2 \times 10^5 \pm 8.89 \times 10^6$) fecal inoculum. In conclusion, fecal inoculum from MR calves improve cell viability and trigger the inflammatory status of intestinal jejunum cells when compared with WM fecal inoculum. These effects might be mediated by the greatest amount of *Bifidobacteria* in the fecal samples from MR calves, which might be favored, by the presence of *Enterococcus faecium* in the milk replacer.

Key Words: jejunum primary cells, milk replacer, whole milk

0862 (T009) The effect of four antiseptic compounds on umbilical cord healing and infection rates in the first 24 h in dairy calves from a commercial herd.
A. L. Robinson*, L. L. Timms, K. Stalder, and H. D. Tyler, *Iowa State University, Ames.*

The objective of this study was to compare the effect of four umbilical dips on the healing rate and incidence of infection of umbilical cords in newborn calves ($n = 60$). Late gestation Jersey cows were monitored at a commercial farm (Sioux Jersey; Salix, IA) and newborn purebred ($n = 30$) and crossbred ($n = 30$) calves were obtained within 30 min after birth. Calves were alternately assigned by birth order to four treatment groups: 7% iodine, 1000 ppm chlorine created using a novel chlorine disinfectant technology (ECAlogix System– Zurex Pharmagra), chlorohexidine, and ZuraLac (Zurex Pharmagra). Before dipping (within 30 min of birth), diameter of the umbilical cords (as an indicator of cord drying and healing) were determined using digital calipers. In addition, as an indicator of umbilical infections, surface temperature of the umbilical stump (along with a reference point at the midpoint of the sternum) was determined using a dual laser infrared thermometer (model 42570, Extech Instruments Nashua, NH). These measurements were all repeated at 24 ± 1 h of age. All data were analyzed using mixed model methods (PROC MIXED, SAS version 9.2). All models included the fixed effects of breed (Jersey or Jersey cross), sex (bull or heifer) and treatment. Fixed effect interactions were not included in the statistical model due to the relatively small sample size. There were no treatment differences ($P > 0.05$) for healing rate of umbilical cords. Initially, mean umbilical cord diameter was 22.84 ± 3.89 mm, and they healed to a mean diameter of 7.64 ± 4.12

mm at 24 h of age. Similarly, there were no treatment effects ($P > 0.05$) on incidence of umbilical infections. Mean surface temperature of the umbilical stump was $33.1 \pm 2.2°$ at birth ($1.5 \pm 1.6°$ higher than the sternal reference temperature) and at 24 ± 1 h of age the mean temperature of the umbilical stump was $33.0 \pm 4.3°$ ($0.5 \pm 1.8°$ lower than the sternal reference temperature). These data suggest that these dips are equally effective for preventing infections and permitting healing of the umbilical cord when used within 30 min of birth.

Key Words: calves, umbilical cord, umbilical dip

0863 (T010) Relationship between birth weight and calving ease with passive transfer of immunoglobulins in neonatal beef calves.
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The absorption of immunoglobulins (Ig) found in the colostrum is a passive transfer of immunity that neonatal calves will receive from their dams. Calves that do not receive adequate levels of Ig from their dams can experience increased morbidity and mortality. Primiparous commercial crossbred beef heifers ($n = 53$) were used to evaluate the relationship of Ig absorption from colostrum and passive transfer of immunity on various neonatal traits. Heifers calved in March and April. Females were kept in a dry lot and fed a total mixed ration meeting 100% of NRC requirements through parturition. Onset of the third stage of labor, time to birth, time to stand, and time of first nursing were recorded. Calving ease (CE; 1 = no assistance, 5 = caesarian section), calf vigor (CV), birth weight, and 24-h blood samples for serum Ig were taken from each calf via jugular venipuncture. Mothering score, colostrum samples for colostral Ig, weight, body condition score, udder suspension (1 = broken floor, 9 = very tight), and teat size (1 = very large, 9 = very small) were recorded from the dams. All statistical analyses were conducted using PROC Reg and PROC Corr in SAS. There was a negative correlation between serum IgG and CE ($P = 0.01$), positive correlations between birth weight and CE ($P < 0.001$), and udder suspension and teat size ($P = 0.001$). A tendency for a negative correlation was found between serum IgG and birth weight ($P = 0.11$) and a positive correlation between serum IgG and teat size ($P = 0.10$). After correlations were found, stepwise regression calculations were completed on all significant correlative variables. A linear regression was found between CE and serum IgG ($P = 0.01$), and quadratic regression between birth weight and serum IgG ($P = 0.04$). Difficulties during third stage labor increased as calf birth weight increased. The increases in CE scores were associated with decreased serum IgG found in the calf after 24 h. This depression of serum IgG due to calving difficulty may impair the ability of calves to adequately defend against pathogen exposure and may influence subsequent growth and performance.

Key Words: beef, immunoglobulins, neonate