vs. 13 ± 9 calls/4 h period on d 55 (P<0.0001). There was no effect of treatment on calf BW from d 1 to d 55. On d 56, calves were moved to group pens, mixed with other calves and observed for 15 d; grain, water and hay were available ad libitum via automatic feeders. After mixing, paired calves spent more time at the feeder than did the individual calves (88 vs. 66 ± 3 min/d; P<0.004). Similarly, paired calves consumed more grain (3.46 vs. 2.29 ± 0.17 kg/d; P<0.006). Both differences were greatest on the d of mixing. Weight gains after mixing were higher for paired than individual calves (e.g. 0.02 vs. -2.40 ± 0.57 kg/d on the d after mixing; P<0.0002); after 5 d, gain in the 2 groups were similar, averaging 0.45 kg/d. The results indicate that pairing calves minimizes behavioural responses and improves performance of dairy calves before and after weaning.

Key Words: social behavior, group housing, calf management

M15 Flavors affect the feeding behaviour of ewes fed two unpalatable feeds. A. Mereu[1], V. Giovanetti[2], G. Molle[2], I. Ipharraguerre[3], and A. Cannas*[1], [1]*Dipartimento di Scienze Zootecniche, University of Sassari, Sassari, Sardinia, Italy*, [2]*Agris Sardegna, DiRPA, Olmedo, Sardinia, Italy*, [3]*LUCTA SA, Barcelona, Spain*.

In a previous experiment canola meal and oat grains resulted very unpalatable to ewes. The objective of this study was to enhance the acceptability by ewes of these two feeds through the addition of flavors. In a first experiment (Exp 1), the palatability of canola meal fed alone (control) or combined with 13 different flavors, formulated to elicit sweet (1 to 8), umami (9 to 12) or bitter (13) taste, was tested. A second experiment (Exp 2) resembled the first one except that oat meal instead of canola meal was used. In each experiment, one hour after being fed a basal diet (grass hay, barley meal and urea) each ewe entered alone a pen in which 200 g of a feed + flavor combination were supplied for 6 min. Then, the ewe was taken out and a new one tested another combination. The same 14 multiparous dry ewes were used for the two experiments, carried out in sequence with a 2-w resting period, following 14 (days/animals) x 14 (feed combination) Latin square designs. The statistical model included 3 fixed factors (feed combination, day, ewe). In Exp 1, the DMI of canola meal flavored with products 12 and 2 was higher (P<0.05) than that of canola meal flavored with products 6 and 9. However, none of the treatments was significantly different from the control (only canola meal). There was a significant (P<0.05) and positive relationship between DMI and experimental days for all treatments, except for treatment 12. For several treatments (5, 7, 8, 4 and 9 in decreasing order), mostly sweet-based additives, this association was very high, ranging from R^2=0.85 (P< 0.001) found for flavor 5 to R^2=0.69 (P< 0.01) for flavor 9. In Exp 2 (oat meal based), no differences in DMI among treatments were observed. The day effect was significant for fewer treatments (in decreasing order of association: 6, 3, 1, 2, 5, 4, 12, control, and 8). The R^2 ranged from 0.50 (P< 0.05) to 0.26 (P< 0.09) for treatments 6 and 8, respectively. The experiments showed that some flavors (mostly sweet-based flavors) favored the adaptation of the animals to initially unpalatable feeds, reducing the variability of DMI among ewes.

Key Words: canola meal palatability, oat meal palatability, flavors

M16 When and where do cows defecate? M. Villettaz Robichaud*[1], A. M. de Passillé[2], and J. Rushen[2], [1]*Université Laval, Québec, Québec, Canada*, [2]*Agriculture and Agri-Food Canada, Agassiz, British Columbia, Canada*.

Many environmental and animal health problems of dairy production are due to accumulation of feces but little research has been done on cow defecation and urination in the past fifty years. In exp. 1, we observed each occurrence of defecation and urination of 48 lactating Holstein cows (DIM = 144.7 ± 38.0 d., BW = 667.1 ± 72.0 kg, parity = 2.8 ± 2.3) in free-stalls over a period of 48h. There were large differences between cows in frequency of defecation (mean ± SD, range; 10.0 ± 4.17/d, 3–20/d) and urination (7.58 ± 3.21/d, 2–18/d) and these were positively correlated (r=0.39 P=0.01). The frequency of urination and defecation were not strongly correlated with parity (r=-0.13 P=0.37;r=-0.27 P=0.06), milk production (r=-0.03 P=0.83;r=-0.16 P=0.29), body weight (r=0.14 P=0.33;r=-0.01 P=0.97) and DIM (r=-0.05 P=0.76;r=0.34 P=0.02). We observed 27.8% of defecation and 19.1% of urination in the area behind the stalls, occurred, 33.4% and 28.3% respectively in the feeding area and 20.7% and 38.4% when cows were standing with two feet in the stall and two feet in the alley. In exp. 2, we tested ways of stimulating defecation and urination. Twelve lactating Holstein cows were walked through a) an empty footbath or b) a footbath filled with water once a day for 6d. Cows were more likely to defecate in the water filled footbath (mean ± SE 0.67 ± 0.08 vs 0.42 ± 0.08). However when repeated 23d later, there was no difference between the treatments. In further tests, the cows stood for 2 min. in a) a dry footbath, b) a footbath filled with still water, c) a footbath filled with running water, or had d) air or e) water sprayed over their legs . There were no significant effects of treatments. Defecation frequency during tests decreased from d1 to d29 (mean ± SD d1 0.50 ± 0.52, d29 0.08 ± 0.29). Large differences between cows in the frequency of defecation and urination suggest that some are disproportionately responsible for spreading manure throughout the barn. The frequency of defecation and urination are not strongly related to production traits. A better understanding of factors controlling defecation and urination may help in developing more effective cleaning routines.

Key Words: elimination, defecation, urination

Animal Health: Stress, Respiratory Disease, Small Ruminants

M17 Effects of dehydration and rehydration on the thermoregulation of heat stressed Angus steers. B. Scharf*, L. E. Wax, T. J. Evans, and D. E. Spiers, *University of Missouri, Columbia*.

Evaporative cooling via panting or sweating is the most effective means of maintaining core temperature of cattle exposed to heat for an extended period. Water restriction during heat stress alters this ability. Therefore, a study was conducted to determine if dehydration under a controlled heat challenge would compromise thermoregulation. Eight Angus steers were maintained for 5 days at thermoneutrality (TN; 19-21°°C) in the Brody Environmental Center (University of Missouri). This was followed by 14 days of cyclic heat stress (HS; 26-36°C). Water was removed starting on Day 5 of heat stress. After 3 days, water was returned starting the rehydration phase. Measurements included rectal temperature (Tre) and respiration rate (RR) measured six times daily. Body weight, feed and water intakes, and sweat rate at rump and shoulder were recorded daily during acclimation, dehydration and rehydration. During dehydration,

steers lost ~10% of their body weight, which they regained within 36 h of rehydration. As expected, feed intake decreased (~75%) within 24 h of dehydration, but quickly recovered during rehydration. Transition from TN to HS caused RR to double (40-80bpm; P<0.05). Dehydration reduced RR (~15bpm), which remained low throughout rehydration (P<0.05). Similar to RR, Tre increased during HS (0.6°C; P<0.05). However, no increase in Tre occurred during dehydration (P=0.41), while rehydration caused a 0.8°C drop before recovery. Shoulder and rump sweat rates sharply increased with HS, but dropped to TN levels during dehydration (P<0.05), before recovering when water was returned. Haematocrit did not provide a reliable indication of dehydration as it only slightly increased during dehydration, and was not different from TN level (P=0.08). Steers in the present study showed no lasting effects of dehydration, with the thermal status of the animal returning to normal after 48 hours of rehydration. Unexpectedly, core body temperature remained relatively unchanged despite dehydration, demonstrating their ability to adapt to changing conditions.

Key Words: dehydration, heat stress, cattle

M18 Heat stress augments plasma tyrosine-nitrated proteins and lactate-to-pyruvate ratio after repeated endotoxin (LPS) challenge in steers. T. Elsasser*[1], R. Rhoads[2], S. Kahl[1], R. Collier[2], L. Baumgard[2], C. Li[1], and T. Caperna[1], [1]*USDA-ARS, Beltsville, MD*, [2]*University of Arizona*, *Tucson*.

Nitrated proteins are usually function-impaired. Nitrotyrosine (NT) is the standard marker for nitrated proteins and proinflammatory nitrooxidative stress (PNoS) signifying the aberrant interactions between nitric oxide and superoxide anion that often result from tumor necrosis factor-(TNF) α-mediated mitochondrial dysfunction. We investigated whether heat stress altered the PNoS responses in Holstein steers after two LPS challenges. Ten steers (318 ± 49 kg BW) housed in climate chambers were subjected to either a thermoneutral (TN: constant 19°C) environment or heat stress (HS) conditions (cyclical daily temperatures; 32.2 to 40.0°C) for 9d. In order to minimize confounding effects of altered plane of nutrition, TN were pair-fed to HS. On d 4 and 7, steers received an LPS challenge (*E. coli* 055:B5, 0.2 µg/kg BW, i.v.) with blood samples collected at marker-appropriate times between 0 and 24 hours relative to the start of each challenge. Plasma concentrations of TNF-α, xanthine oxidase (XO), serum amyloid-A (SAA), lactate (L), pyruvate (P), nitrate + nitrite (NOx), NT, and IGF-1 were measured. Plasma TNF-α (P<0.002), XO (P<0.01), SAA (P<0.005), increased over time but were not different between TN and HS. The increases in NOx were higher in HS than TN (P<0.05); NT was increased transiently (P<0.05) over baseline in TN at 7 h after the first LPS challenge. Plasma NT remained elevated in HS through the entire first and second challenges. Plasma IGF-1 was lower (P<0.03) at time 0 in HS than TN and decreased more (P<0.05) following each LPS challenge. The plasma L:P (where higher values are indicative of impaired mitochondrial function) was higher in HS than TN at time 0 prior to either LPS (P<0.05) with a heat-stress-by-time interaction (P<0.01). The data are consistent with the concept that although heat stress leaves the primary PNoS response to low-level LPS administration intact (including the plasma markers of the tolerance response), energy functions of mitochondria may be challenged where heat stress exacerbates the interaction of PNoS mediators to form NT proteins.

Key Words: heat stress, oxidative stress, cattle

M19 Lack of adaptation to fescue toxicosis under thermoneutral and heat stress conditions. D. E. Spiers*, D. K. Kishore, P. A. Eichen, and E. Moran, *University of Missouri*, *Columbia*.

Intake of endophyte-infected tall fescue reduces feed intake, activity, and body weight gain. This study determined the potential for short-term adaptation to fescue toxicosis and heat stress. Male CD Outbred rats (n=24) were implanted with temperature transmitters (Respironics, Bend, OR) to measure core temperature (Tcore). Feed intake (FI) and body weight (BW) were measured daily. Experimental design included several shifts (7 days each) in treatment to detect adaptation. All rats were initially fed diets with ground, uninfected tall fescue seed (E-) and exposed to 21°C (thermoneutral; TN) to establish baseline values. In Period 1, all groups were maintained at TN for 7 days with one group fed a diet containing ground, infected tall fescue seed (E+; ~165µg ergovaline/kg BW/d) and two groups fed E- diet. This was followed by 7 days at 31°C (heat stress; HS; Period 2) on the same diets. All animals were fed E- diet during the second 7 days of HS (Period 3). In the final 7 days (Period 4), E+ diet was returned to the original group and fed to one E- group, with the third group remaining on E- diet. In Period 1, FI decreased by 40% with E+ treatment (α=0.05), with a comparable reduction in BW (α=0.05) after 4 days. Initial HS (Period 2) immediately reduced FI in all groups (α=0.05), and diminished differences between E+ and E- groups. Growth stopped in controls, and continued to decrease in E+ rats during HS. A shift from E+ to E- diets (Period 3) returned FI and growth to control levels. Treatment of the original E+ and one control group with E+ diet (Period 4) produced identical reductions in FI and BW (α=0.05). An expected reduction in Tcore with E+ treatment occurred at TN (α=0.05), followed by an increase during early HS (α=0.05). Removal of E+ in Period 3 produced a reduction in Tcore (α=0.05) that coincided with increase in FI. Both groups fed E+ in Period 4 exhibited similar Tcore responses with no increase from Period 3. Although feed intake and growth shows no sign of adaptation to fescue toxicosis, there is indication that adaptation to heat stress improves the thermal response.

Key Words: heat, fescue, toxicosis

M20 Cyclic heat stress alters the diurnal thermal status of sows during lactation. E. A. Coate*, M. C. Lucy, T. J. Safranski, P. A. Eichen, A. M. Williams, and D. E. Spiers, *University of Missouri*, *Columbia*.

We have shown in earlier studies that heat stress has different effects on the average daily thermal status of sows during gestation, lactation, and breeding, with the greatest impact during lactation. The present analysis focused on the lactation period, with emphasis on diurnal shifts in thermal status. Primiparous sows (n=58) were initially housed during the last 3 weeks of gestation in the Brody Environmental Center (University of Missouri) in either thermoneutral (17.5 – 19.3°C; TN) or heat stress (23.8 – 30.9°C; HS) environments. Several days before farrowing, sows were moved to farrowing crates in two different chambers. They either went to the same thermal environment (TN-TN or HS-HS) or were to the other environment (TN-HS; HS-TN) until weaning. Respiration rate (RR) and rectal temperature (Tre) were measured daily (0800, 1200, 1600, and 2000). Likewise, skin temperature (trunk, extremities) was measured at the same times using infrared thermometry. Daily Tre increased 0.4°C in all treatment groups (α=0.05) to plateau on Day 10. There was a treatment effect on Tre (α=0.05), with only the TN-HS displaying a significantly higher value (0.3°C; α=0.05) than TN groups. Previous HS exposure reduced heat impact during lactation. Although Tre for HS groups were higher than TN groups at 1200 to 2000, they did not differ at 0800 (α>0.05), when Ta difference was 6°C. In contrast,

RR was 40% greater (42 vs 29 bpm; α=0.05) in HS groups compared to TN groups at 0800, and increased to 100.4% during the day (71 vs 35 bpm; α=0.05). Average skin temperature was at least 3.3°C higher (α=0.05) in HS vs TN sows. This difference decreased during lactation, when the TN values approached HS level. Despite differences in ambient temperature, heat loss as indicated by skin temperature and respiration rate was sufficient to minimize differences in rectal temperature of sows in the two environments during morning hours. However, heat loss was ineffective in preventing a separation of rectal temperature during warmer times of day.

Key Words: sow, lactation, heat

M21 Effects of bluetongue virus infection on sperm quality in German test-bulls. K. Kemmerling[1], D. Straet[1], U. Mueller[1], U. Janowitz[2], and H. Sauerwein*[1], [1]*Institute of Animal Science, Physiology & Hygiene Group, University of Bonn, North-Rhine-Westphalia, Germany*, [2]*Rinder-Union-West, Borken, North-Rhine-Westphalia, Germany*.

Bluetongue virus (BTV) is an arthropod-borne pathogen that is transmitted by *Culicoides midges* between ruminant hosts. BTV-infected sheep are prone to develop severe clinical signs, whereas cattle show only mild or no clinically apparent symptoms. For sheep, the recent BTV outbreak of BTV serotype 8 in Germany and the Benelux was shown to transiently alter many semen characteristics (Kirschvink et al. 2008, Vet. J.oi10.1016/j.tvjl.2008.06.008). For cattle no such data were available and we therefore evaluated semen quality in bulls that were naturally infected with BTV-8 in fall of 2007. Ejaculate volume, sperm concentration and post-thawing motility were recorded from 6 infected test bulls (BT group). BT status was assessed by serology and PCR commencing in July 2007. At that time, the 6 BT bulls were still negative but turned BTV-PCR positive in September to November 2007 without showing clinical signs. Between April and May 2008, all 6 bulls were again PCR negative and remained seropositive. Semen data from 31 non-infected test bulls that were recorded between 06 and 08 were matched for season and age and used as controls.

Key Words: bluetongue virus, semen quality, bulls

M22 The use of infrared thermography in the non invasive, automated detection of calves displaying bovine respiratory disease. A. L. Schaefer*[1], C. Bench[2], J. Basarab[3], N. Cook[3], E. Okine[2], J. Colyn[1], B. Chabot[1], D. Froehlich[3], L. Holt-Klemic[1], T. Liu[1], and P. Lepage[1], [1]*Agriculture and Agri-Food Canada, Lacombe, Alberta, Canada*, [2]*University of Alberta, Edmonton, Alberta, Canada*, [3]*Alberta Agriculture, Lacombe, Alberta, Canada*.

Bovine respiratory disease (BRD) is one of the most common afflictions in receiver calves causing harm to production economics and animal welfare. The purpose of the present study was to evaluate a non-invasive, automated infrared (IRT) detection system in the identification of calves displaying BRD. A total of sixty one multiple sourced, commingled commercial receiver steer calves averaging 225 kg liveweight were used. The calves were weaned and transported to the Lacombe Research Centre where they were blood sampled and placed into a pen with wood shavings bedding and ad-libitum access to cereal silage and water. All calves were fitted with RFID ear tags. An infrared scanning system consisting of an RFID reader, FLIR S60 camera and a computer were housed near the water bowl and when triggered by the presence of an RFID tag collected orbital (eye) images of the animal. For the sixty one (61) calves in the study, twelve (12) animals were identified as true positive (TP) for BRD and forty nine (49) as true negative (TN) or healthy. TP animals displayed a score of 3 or 4 out of 4 for core temperature (CT, rectal) > 40 C, clinical scores (Cl Sc, digestive, respiratory, temperature, disposition) of > 3 out of 20, a white blood cell (WBC) count of > 10,000/ul or < 7,000/ul and a neutrophile/lymphocyte ratio (N/L) of < 0.1 (neutropenia) or > 0.8 (neutrophilia). By contrast, TN animals displayed a score of 0 or 1 out of 4 for the above aberrations in CT, ClSc, WBC and N/L ratio. The average values for CT and Cl Sc for TP calves were 40.0 (0.45 SD) and 8.8 (2.5) respectively and for the TN calves 38.8 (0.19) and 1.8 (0.8) (P<0.01) respectively. Corresponding orbital IRT data were 36.7 (0.9) for TP and 35.7(0.3) C for TN respectively (P<0.01). The data suggest that a non invasive, automatic infrared screening system can be effective for detecting BRD in calves.

Key Words: cattle, infrared, disease

M23 Orbital thermal topography in calves with bovine respiratory disease. A. L. Schaefer[1], C. Bench[2], N. Cook[3], J. Colyn*[1], T. Liu[1], E. Okine[2], M. Stewart[4], and J. Webster[4], [1]*Agriculture and Agri-Food Canada, Lacombe, AB, Canada*, [2]*University of Alberta, Edmonton, AB, Canada*, [3]*Alberta Agriculture, Lacombe, AB, Canada*, [4]*AgResearch, Hamilton, New Zealand*.

The fever response to viral infection in mammals is typically identified using core or rectal temperatures. However, this approach to diagnostics is usually invasive, inconvenient and often appears subsequent to fever presentation. The purpose of the present study was to examine the radiated thermal topography of the orbital or eye region in calves known to be true negative (TN) or true positive (TP) for bovine respiratory disease (BRD). Fourteen multiple sourced, commingled, transported and weaned steer receiver calves averaging 225 kg were used. The calves were maintained on conventional cereal silage diets. Calves were identified as TP if their core temperature was > 40 C, their white blood cell count was < 7,000 or > 10,000 /ul, the neutrophile/lymphocyte ratio was <0.1 (neutropenia) or > 0.8 (neutrophilia) and their clinical score for respiratory distress was > 3 out of 20. A TP animal had to display three out of the four aforementioned attributes and a TN could only display 0 or 1. Eight of the fourteen calves were verified as TP and six as TN. All calves were scanned daily with a broad band infrared camera (FLIR S60) from a distance of 1 m. An area of 2825 pixels basically covering the eye and approximately 1 cm of surrounding skin was analysed and divided into five thermal groups of 24-26.9, 27-29.9, 30-32.9, 33-35.9, and 36-38 C. In a healthy animal the proportion of pixel area was measured as; 24-26.9 C, 6.8%; 27-29.9 C, 15.1%; 30-32.9 C, 31%; 33-35.9 C, 40.1% and 36-38 C, 4.7%. On the day the TP calves were identified as clinically ill the thermal range of 36-38 C was significantly higher (10.5% of pixels, P<0.05) compared to TN calves. Of interest was the observation that the thermal profile for the 36-38 C was also significantly higher for the TP calves the day before apparent clinical illness (36.4% of pixels, P<0.05) and for two days before identified clinical illness for the 33-35.9 C profile (66.1% of pixels, P<0.05). The data suggest that a radiated thermal profile of the orbital area may assist in the diagnosis of BRD in calves.

Key Words: infrared, BRD, eye

M24 Relationship between ex vivo neutrophil function in response to an enteropathogenic *Escherichia coli* and measures of health and performance of dairy calves. L. G. D. Mendonça*[1], G. Lopes Jr.[1], M.

A. Ballou[2], and R. C. Chebel[1], [1]*Veterinary Medicine Cooperative Extension, University of California Davis*, *Tulare*, [2]*Department of Animal and Food Sciences, Texas Tech University*, *Lubbock*.

Calves are extremely susceptible to disease during the first few weeks of life, and neutrophils are an integral component of the innate immune system. The objective of this study was to evaluate the relationship between neutrophil function and measures of health and production. Calves (n=64) were fed colostrum after birth. At 36±6 h of life, body weight (BW) was recorded and blood sampled for total serum protein. From 2 to 25 d of age calves were fed hospital milk and from 26 to 60 d of age calves were fed hospital milk blended with milk replacer. Blood was sampled at 3, 24, 45, and 66 d of age to determine the percentage of neutrophils phagocytizing (PHAG) and producing an oxidative burst (OB) against an enteropathogenic *Escherichia coli*. Calves were weighted at 25 and 60 d of age. Starter intake, attitude and fecal scores, antibiotic (ATB), anti-inflammatory (AINF), and oral electrolyte treatments were recorded daily. Median percentage of PHAG and OB positive neutrophils were calculated for 3, 24, 45, and 66 d and calves were stratified as above or below the median. Proportions of neutrophils PHAG or producing an OB were affected by time ($P < 0.01$). Neither PHAG nor OB positive measurements at 3 d were correlated with health parameters. However, calves with above median PHAG over all sampling times were less likely to be treated with ATB (AOR=0.13, CI95%=0.03-0.53) and AINF (AOR=0.03, CI95%=0.01-0.34) drugs, and were less likely to experience fever (AOR=0.12, CI 95%=0.01-1.0). Calves with above median PHAG were treated with ATB (0.2±0.2 vs. 0.8±0.2d) and AINF (0.1±0.1 vs. 0.4±0.1d) drugs for fewer days. Similarly, calves with above median OB positive neutrophils received ATB (0.3±0.1 vs. 0.7±0.2d) and AINF (0.1±0.1 vs. 0.3±0.1d) drugs for fewer days. Neither neutrophil PHAG nor OB on d 3 of live were correlated with performance. These data indicate that the percentages of neutrophils PHAG or producing OB positive against an enteropathogenic *E. coli* are related to measures of health of neonatal dairy calves.

Key Words: dairy calves, immunity, health

M25 Replacing milk proteins with nucleotides in milk replacers for pre-weaned dairy calves. J. A. Elizondo-Salazar*[1,2], C. M. Jones[1], R. F. Leuer[1], and A. J. Heinrichs[1], [1]*The Pennsylvania State University*, *University Park*, [2]*Estación Experimental Alfredo Volio Mata*, *Facultad de Ciencias Agroalimentarias. Universidad de Costa Rica*.

Two experiments were carried out to evaluate the effect of substituting milk protein in milk replacer with nucleotides derived from cell contents of *Saccharomyces cerevisiae* (NuPro; Alltech, Inc.). The first trial utilized 16 Holstein bull calves (4/treatment), and nucleotide product replaced 0, 5, 10, or 20% of whey protein concentrate in milk replacer. The second trial utilized 20 Holstein bull calves (5/treatment), and 0, 25, 50 , 75, or 100% of whey protein concentrate was replaced by nucleotide product. For both trials, intake and health were monitored daily and growth measurements were taken weekly. At 6 wk of age, xylose absorption was determined, and, calves were slaughtered. Within 5 min of death, two 1-cm sections were taken from each of the duodenum, jejunum, and ileum for morphometric analysis. Calf health growth measurements, small intestinal villus height, and xylose absorption were not different ($P > 0.10$) between treatment groups in either trial. In Trial 1, small intestinal crypt depth was lowest ($P < 0.03$) for the 5% treatment, with no differences between 0, 10 and 20% nucleotide groups. Also the total intestinal weight was greater for calves in the 10 and 20% nucleotide groups than the other treatments. In these studies, substituting yeast cell contents for milk protein in milk replacer did not affect health or growth of neonatal dairy calves. Nucleotides in the yeast cell contents may have improved intestinal growth and increased small intestinal crypt depth; however, this effect was not consistent in both studies.

Key Words: nucleotide, small intestine, milk replacer

M26 Association of bovine Fc receptor alpha-chain promoter gene heliotypes with IgG transfer into milk of Chinese Holstein cows. S. S. Li, J. Q. Wang*, H. Y. Wei, D. P Bu, G. L. Liu, X. L. Dong, and K. L. Liu, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences*, *Beijing, China*.

The Fc receptor α–chain gene (FCGRT, which encodes the α–chain of FcRn) transports immunoglobulin G (IgG) across the epithelial cell layers into the secretions of mammary gland. The purpose of this study was to detect the association of FcRn promoter gene heliotypes with milk IgG concentration and transfer. We collected 189 individual milk and blood samples randomly from more than 2,800 Chinese Holstein cows across six dairy farms in the greater Beijing area. Determination of IgG concentration in milk and blood samples was performed by a commercial sandwich enzyme–linked immunosorbent assay (ELISA) using the Bovine IgG ELISA Quantitation Kit. The SNP stream system (Beckman Coulter, USA) was used for identifying single nucleotide polymorphisms (SNPs) in promoter of FcRn gene, and genotyping the 189 individuals. Haplotype block and main diplotypes were inferred by phase 2.1 software. The results indicated that four SNPs, assorted into six haplotypes, were identified in promoter of FcRn. Duncan′s multiple–range test showed the least square mean of blood IgG concentration, milk IgG concentration and mass of different diplotypes were not significantly different ($P>0.05$). Therefore, the haplotypes of FcRn promoter were not correlative with milk IgG concentration and transfer.

Key Words: FcRn, SNP, immunoglobulin

M27 Predictive measures of fetal distress in calves during delivery. K. E. Hard* and H. D. Tyler, *Iowa State University*, *Ames*.

The objective of this experiment was to evaluate accuracy of changes in tongue parameters for determining the extent of fetal stress during parturition. Fifty eight calves (Holstein, Jersey, and Jersey × Holstein) were monitored during calving. From the time the tongue was first visible, measurements of tongue color, length, and reflex were taken approximately every two minutes until umbilical cord rupture. Tongue color was determined using a color chart with 17 discrete colors. Tongue length was measured from the middle point of the nose to the tip of the tongue. Tongue reflex was assessed with a sharp pinch on the tongue on a scale from 0 to 3. Arterial blood samples were drawn within 20 minutes after birth. Fetal oxygenation parameters were analyzed using a blood gas analyzer (ABL77; Radiometer, Copenhagen). Three color categories were determined from the original 17 colors. Both initial and final tongue colors were significantly different ($P<.0001$). However, parameters reflecting oxygen delivery were not correlated to color categories (P_{O2} P=.0843, P_{CO2} P=.2944, and pH P=.9461), suggesting that dark tongue color is a poor predictor of stress. Mean tongue length tended to be positively correlated with P_{CO2} (P=.0534) and tended to be negatively correlated with pH (P=.1369), indicating that calves with longer tongues tended to have lower pH and higher P_{CO2}. However, tongue length was not significantly correlated with oxygen delivery parameters (P_{O2} P=.6583). This suggests that tongue length is

a good predictor of acidosis but not hypoxia. However, tongue reflex was not correlated to parameters of acidosis or hypoxia suggesting that reflex alone is a poor predictor of stress. If a calf presents with a long tongue, reduced reflex, and dark color stress is more likely than if there is only a single indicator present. Six calves in the study that had long tongues (greater than 55 mm), dark color (color 3 or lower), and poor responsiveness (reflex equal to 1). Five out of the six calves were stressed (pH $\leq$ 7.25, P_{O2}< 50, and P_{CO2} > 60), however, there were an additional six stressed calves in which changes in tongue parameters were not predictive of fetal stress.

Key Words: birth stress, calves, tongue color

M28 Automated measurement of feeding behavior to detect illness in milk-fed calves. F. T. Borderas[1,3], J. Rushen[2], M. A. G. von Keyserlingk[1], and A. M. de Passillé*[2], [1]*University of British Columbia, Vancouver, BC, Canada*, [2]*Agriculture and Agri-Food Canada, Agassiz, BC, Canada*, [3]*Universidad Autónoma Metropolitana-Xochimilco, Coyoacán, Mexico*.

There is a need for improved methods of detecting illness among group-housed milk-fed calves. Automated monitoring of feeding behavior may be one possibility. We examined whether illness in group-housed dairy calves fed with an automated milk feeder changed their feeding behavior, and whether these changes were affected by milk rations. Unweaned Holstein calves were housed in groups of 3 to 16 animals and fed either high (12L/d or ad libitum) or low (4-6L/d) amount of milk or milk replacer. From birth, calves were subjected to regular health checks that included general condition, rectal temperature, lung auscultation and faecal scoring. Forty-eight calves became ill from gastro-intestinal or respiratory problems or both before 21d of age, with no differences between feed level (P>0.10). We paired 22 calves that succumbed to only one bout of illness with healthy calves on the same feeding level and of the same age. During the 2d prior to the day of illness detection, there were no differences between the sick and healthy calves in any measure of feeding behavior (P>0.10). In the days following clinically identified illness, sick calves fed high levels of milk or milk replacer showed a decrease in milk or replacer intake (-2.59 ± 0.7 L/d), a reduced frequency of visits to the milk feeder (-2.43 ± 0.3 visits/d), and an increase in the duration of each visit to the milk feeder (1.66 ± 0.5 min/visit), as compared to the matched healthy calves (PROC MIXED; P<0.05). This was apparent up to 3d after illness detection. However, sick calves fed low levels of milk or milk replacer only showed a decrease in the duration of each visit to the milk feeder (-1.35 ± 0.2 min/visit; P<0.05) compared to healthy calves, with no differences in intake of milk or replacer or frequency of visits to the milk feeder (P>0.10). Illness results in changes in feeding behavior of calves which can be monitored with automated milk feeding equipment but feeding level affects the types of changes in feeding that occur.

Key Words: calf, Illness detection, welfare

M29 Age-dependent health status in the goat. M. Worku*, R. C. Noble, and H. Mukhtar, *North Carolina A&T State University, Greensboro*.

Animal health status and acquired resistance to infection can differ with age. The objectives of this study were to compare health and infection indicators in yearling and adult goats. Twenty eight (14 yearling and 14 adults) Boer × Spanish cross goats housed at the North Carolina Agricultural and Technical State University farm were used. Animals were maintained under the same management conditions. The body weight, packed cell volume, fecal egg counts, FAMACHA, and body condition scores of yearling and adult goats were evaluated. After sample collection and readings, the tabulated data of the above parameters for each age group was compared to that of the other using a t-test. Correlation analysis was also used to assess the correlation amongst the different parameters. The study showed that adult goats had better body condition (p<0.0006), heavier body weight (p<0.0001), and more resistance against internal parasites (FAMACHA p<0.047), than yearling goats. The correlation analysis results showed there was a weak negative correlation between the body condition and FAMACHA (r=-0.4023). Age specific management practices may be needed to ensure improvements in the health status of yearling goats.

Key Words: goat, health, age

M30 Effect of vitamin E supplementation on naturally acquired parasite infection in lambs. C. E. MacGlaflin[1], A. M. Zajac[2], K. A. Rego[1], C. S. Petersson-Wolfe[2], and K. H. Petersson*[1], [1]*University of Rhode Island, Kingston*, [2]*Virginia Tech, Blacksburg*.

The emergence of anthelmintic resistant nematodes is a significant problem for the sheep industry. The naïve immune system of lambs makes them particularly susceptible to gastrointestinal nematode infections. Host nutritional status has been identified as a key component of immune function. Vitamin E (VE) is known to have broad effects on immune function and a VE deficient diet has been shown to reduce resistance to helminth infections in mice. The objective of this study was to determine the effect of vitamin E supplementation on naturally acquired parasite infection in lambs. Dorset lambs were assigned to one of two treatment groups at birth, 30 IU d-α-tocopherol / kg body weight (VE, n=9) or placebo (P, n=9). VE or P injections were administered every two weeks from birth through 7 months of age. All animals were weaned at 3 months of age. At 3-4 months of age all animals were de-wormed with albendazole (10 mg/kg) and levamisole (8.8 mg/kg). Lambs were housed together and allowed to graze on a field that was known to be contaminated with free-living nematodes. Fecal egg counts (FEC) were estimated using the Modified McMaster′s method. Weekly jugular blood samples were used to determine PCV. Serum vitamin E concentration was determined every two weeks. Composite fecal cultures were taken at the beginning and end of the study for parasite identification. Lambs were weighed every other week throughout the study. At seven months, lambs were slaughtered and abomasal and intestinal contents were collected at necropsy for quantification and identification of nematodes. Preliminary results: *Haemonchus contortus* and *Trichostrongylus columbriformis* larvae were recovered from the pooled fecal culture prior to deworming. FEC increased over time (P < 0.05) and PCV decreased over time (P < 0.05). There was no effect of vitamin E supplementation on FEC, PCV or average daily gain. Ewe lambs had higher PCV than ram lambs (P < 0.05) and younger animals had greater FEC than older animals (P < 0.05). Larval identification from the final composite fecal cultures and quantification and identification of nematodes recovered at necropsy are pending.

Key Words: sheep, parasite, vitamin E

M31 Analysis of the lipopolysaccharide profiles of *Escherichia coli* O118 and O151 O antigen gene clusters. J. W. Allen*[1], C. DebRoy[2], L. P. Fratamico[3], and A. R. Byers[1], [1]*North Carolina A & T State Uni-*

versity, Greensboro, [2]*The Pennsylvania State University, University Park,* [3]*U.S. Department of Agriculture, Agricultural Research Service, Eastern Regional Research Center, Wyndmoor, PA.*

In an earlier study by the authors, the DNA sequence of the O antigen gene cluster of an *Escherichia coli* serogroup O118 strain was determined, and 13 ORFs were identified, encoding genes required for O antigen sugar biosynthesis, transfer, and processing. The wzx (O antigen flippase) and wzy (O antigen polymerase) genes in the O antigen gene cluster of *E. coli* O118 shared little homology with similar genes in other *E. coli*; therefore, PCR assays targeting these genes were designed for identification of these serogroups. Specificity testing using strains belonging to *E. coli* O118 isolated from various sources, representative strains of 167 other *E. coli* O serogroups, and 20 non-*E. coli* bacteria revealed that the PCR assays were specific for *E. coli* O118. The focus of this study was to further characterize the lipopolysaccharide (LPS) profiles of these *E. coli* O118 and O151 strains. Although the lipopolysaccharide (LPS) profiles of O118 and O151 showed differences, multilocus sequence typing (MLST) of *E. coli* O118 and O151 strains only revealed minor variation at the nucleotide level; over a total of 3753 bp, only 61 sites (1.6%) differed among the isolates examined. Since *E. coli* O118 strains are more frequently isolated from humans, animals, and the environment than *E. coli* O151, serogroup O151 may likely be a minor variant of *E. coli* O118.

Key Words: food safety, microbiology, swine

M32 Association of tumor necrosis factor-α *(TNF-α)* gene promoter polymorphisms with hyper-responsiveness to endotoxin (LPS) in calves. S. Kahl*, T. H. Elsasser, M. Proszkowiec-Weglarz, and E. E. Connor, *USDA, Agricultural Research Service, Beltsville, MD.*

Previously, we identified a subpopulation of beef calves that failed to develop normal immune tolerance as defined by the patterns and magnitude of changes in plasma *TNF-α* concentration after 2 repeated LPS challenges. In these hyper responding calves (HRC), impaired LPS tolerance was related to exacerbated metabolic and clinical signs and prolonged recovery time. Recently, we identified 2 linked SNP located in the promoter region of the *TNF-α* gene in Angus × Hereford calves and showed that G to A (-526) and C to T (-701) transitions were associated with increased *TNF-α* mRNA expression in white blood cells, increased plasma TNF-α concentration, and decreased tolerance to repeated LPS challenges. In the present investigation, we applied a logistic regression analysis (LRA) to retrospectively determine whether the G to A (-526) polymorphism may aid in identifying at-risk HRC. Altogether, across 5 separate trials over 8 yr, 96 Angus × Hereford calves were genotyped and challenged with 2 consecutive LPS injections 4 d apart (0.2 μg *E. coli* 055:B5/kg BW, i.v.). Blood samples were obtained at 0, 1, 2, 3, and 4 h relative to each LPS injection. Plasma TNF-α was measured by RIA with TNF-α response calculated as area under the time × concentration curve (AUC). Within each experiment, HRC were identified using an algorithm to normalize AUC after each LPS challenge. In total, 18.7% of calves were recognized as HRC; genotype frequencies were 21.9%, 45.8%, and 32.3% for AA, AG, and GG, respectively. The LRA indicated an AA genotype was associated with a 10-fold higher risk for HRC vs. a GG genotype (odds ratio [OR], 10.3; 95% confidence interval [CI], 2.4 - 44.5; $P < 0.001$) and an 11-fold higher risk for HRC vs. AG (OR, 11.0; CI, 2.9 - 41.9; $P < 0.001$). No differences in OR for HRC were found between AG and GG genotypes. The results suggest that this *TNF-α* gene promoter polymorphism may be useful in identifying calves with a propensity to exhibit excessive or prolonged pathological responses to LPS-related infections.

Key Words: cattle, SNP, tumor necrosis factor-α

M33 Effect of calf-specific *Bacillus* on health and growth of young calves. D. Wood*, J. Sowinski, and R. Blome, *Animix, Juneau, WI.*

There is considerable published data on probiotic use in calves; however, few studies investigate *Bacillus*. The objective of this study was to evaluate health benefits of supplementing calf-specific *Bacillus* to newly arrived Holstein bull calves. Three trials were conducted. Previously, *Bacillus* were screened to inhibit growth of *Salmonella, E. coli* and *Clostridia* found in feces of over 1000 scouring calves in CA, WI, OH, IN and PA. In the three trials all calves were auction sourced, app. 1 wk of age and were randomly placed and randomly assigned to one of two diets (Bac and Ctrl). Trial design and results are shown in table 1. In Exp. 1, calves (initial BW=44.5kg) were placed into individual raised, slatted stalls. Calf diets were 1) 1 billion cfu *Bacillus* fed twice daily in CMR until weaning d 55 (Bac), 2) no added supplement, only basal formula (Ctrl). In Exp. 2, calves (initial BW=45.2 kg) were placed into individual veal stalls. Calf diets were: 1) 1 billion cfu *Bacillus* fed twice daily in CMR until d 29 (Bac), 2) no added supplement (Ctrl). In Exp. 3, calves were placed into individual raised, slatted stalls. Calf diets were: 1) 3 billion cfu *Bacillus* fed twice daily in CMR for initial 4 d, and again at peak scours, d 11, for 2 d (Bac), 2) no added supplement (Ctrl). Calf specific *Bacillus* reduced incidence and severity of enteric disease when 20-33% of calves required treatments. The 6 day treatment regiment performed as well as 29 or 55 d. Under duress of severe enteric disease with treatment rates of 70%, there was no effect. There was no effect on ADG or mortality in any study.

Table 1.

Trial	n	Strategy	Calves Treated†	Treats/ calf†	Mort/ cull	ADG	Days	Type
Exp 1, Bac	60	2 B cfu, 52 d	14	1.78[a]	7	1.29	0-52	Grain Fed
Exp 1, Ctrl	60	0	20	2.85[b]	5	1.26	0-52	Grain Fed
Exp 2, Bac	100	2 B cfu, 21 d	68	3.6	6	1.66	0-49	Veal
Exp 2, Ctrl	100	0	71	3.55	7	1.66	0-49	Veal
Exp 3, Bac	75	6 B cfu, 6 d	8[a]	2.375[a]	1	N/A	-	Grain Fed
Exp 3, Ctrl	75	0	17[b]	3[b]	2	N/A	-	Grain Fed

†During the week of peak scours. Values within rows with different superscripts differ *(P=0.05)*

Key Words: calf, probiotic, *Bacillus*

M34 Feeding colostrum with an esophageal feeder does not reduce IgG absorption in neonatal dairy heifer calves. J. A. Elizondo-Salazar*[1,2] and A. J. Heinrichs[1], [1]*The Pennsylvania State University, University Park,* [2]*Estación Experimental Alfredo Volio Mata, Facultad de Ciencias Agroalimentarias. Universidad de Costa Rica.*

Esophageal feeders are used to administer colostrum to calves that are weak or reluctant to nurse or to ensure rapid delivery of a consistent quantity of colostrum. However, feeding colostrum with an esophageal feeder has been associated in some studies with lower apparent efficiency of IgG absorption and slightly lower serum IgG concentration compared to feeding colostrum by nipple bottle. For this reason 40

newborn Holstein heifer calves were studied to compare absorption of immunoglobulins, total serum protein concentration, and apparent efficiency of absorption. Calves were separated from their dams before suckling occurred and a single feeding of 3.8 L of pooled colostrum was fed by 1.5 to 2 h of age using a nipple bottle, an esophageal feeder, or a combination of both. A jugular blood sample was collected from each calf at 0, 24, and 48 h of age. There were no differences between treatments when examining total IgG concentration (P=0.84), total serum protein concentration (P=0.85) or apparent efficiency of absorption (P=0.89). In this study, feeding colostrum with an esophageal feeder did not reduce IgG absorption, total serum protein concentration or apparent efficiency of absorption in neonatal dairy heifer calves.

Table 1. Description of treatments and blood parameters at 24 h of age in calves fed colostrum by nipple bottle, esophageal feeder, or a combination of both.

	Treatment					
Item	1	2	3	4	5	SEM
Number of calves	13	6	7	7	7	-
Amount fed, L						
Nipple bottle	3.80	2.84	1.89	0.95	0.00	----
Esophageal feeder	0.00	0.95	1.89	2.84	3.80	----
IgG_1, g/L	22.3	23.4	24.2	22.8	24.6	1.64
IgG_2, g/L	1.1	1.2	1.4	1.2	1.2	0.08
Total IgG, g/L	23.4	24.5	25.6	24.0	25.8	1.69
TSP, g/L	63.0	66.0	65.0	66.0	63.0	1.50
AEA, %	35.4	34.6	35.5	31.8	35.2	2.73

Key Words: immunoglobulin, serum protein, esophageal feeder

M35 High bacterial concentration in colostrum does not interfere with IgG absorption in neonatal dairy bull calves. J. A. Elizondo-Salazar*[1,2] and A. J. Heinrichs[1], [1]*The Pennsylvania State University, University Park*, [2]*Estación Experimental Alfredo Volio Mata, Facultad de Ciencias Agroalimentarias. Universidad de Costa Rica*.

The objective of this study was to determine the effects of feeding heat-treated colostrum and unheated colostrum with differing bacterial counts on passive transfer of immunity in neonatal calves. First milking colostrum with > 50 g IgG/L was collected from Holstein cows. After pooling colostrum, one third was transferred to 1.89-L plastic containers and frozen at -20°C, (unheated-low bacteria); one third was heat-treated at 60°C for 30 min, transferred to 1.89-L plastic containers, then frozen at -20°C, (heat-treated). The final third was transferred to 1.89-L plastic containers and stored at room temperature (20°C) for bacteria to grow during 24 h (unheated-high bacteria). Colostrum was then placed into a freezer at -20°C until needed for feeding. Samples of all colostrum were examined for standard plate count, coagulase-negative staphylococci count, environmental streptococci count, coliform count, gram-negative noncoliform count, Streptococcus agalactiae count, and Staphylococcus aureus count. Thirty Holstein bull calves weighing ≥ 30 kg at birth were randomly enrolled into 1 of the 3 treatment groups (in blocks of 3). Calves were separated from their dams at birth before suckling occurred. For the first feeding, 3.8 L of colostrum were fed via esophageal feeder between 1.5 to 2 h of age. Blood samples were collected at birth, 24 and 48 h of age to determine serum IgG and total protein (STP) concentrations. Batch heat treatment of colostrum resulted in lower bacteria concentration while maintaining colostral IgG concentration. Calves fed heat-treated colostrum had greater (P<0.01) total protein, serum IgG, and apparent efficiency of absorption (AEA) at 24 h (STP = 62.5 g/L; IgG = 26.7 g/L; AEA = 43.9%) compared with calves fed unheated-low bacteria colostrum (STP = 57.0 g/L; IgG = 20.2 g/L; AEA = 35.4%) or unheated-high bacteria colostrum (STP = 56.2 g/L; IgG = 20.1 g/L; AEA = 32.4%). In this study, a high load of naturally occurring bacteria in colostrum did not interfere with IgG absorption, and heat treating colostrum significantly improved IgG absorption.

Key Words: immunoglobulin, passive transfer of immunity, apparent efficiency of absorption

M36 Abrupt weaning alters leukocyte subsets and functional activity of granulocytes in beef calves. E. M. Lynch*[1,2], B. Earley[1], M. McGee[3], and S. Doyle[2], [1]*Teagasc, Animal Bioscience Centre, Dunsany, Co. Meath, Ireland*, [2]*Department of Biology, National University of Ireland, Maynooth, Co Kildare*, [3]*Teagasc, Grange Beef Research Centre, Dunsany, Co. Meath, Ireland*.

The objective was to determine the effect of abrupt weaning on leukocyte subsets and functional activity of granulocytes using 16 beef calves (mean age and weight (s.d.): 227 (18.2) days (d) and 310 (31.1) kg, respectively) that previously grazed with their dams. At the end of the grazing season, calves were either abruptly weaned (AW, n=8) on d 0, housed in a slatted floor shed and offered grass silage *ad libitium* or not weaned (control) (NW, n=8), housed with their dam and offered the same diet. Blood samples were collected by jugular venipuncture at d -7, 0, 2, 7 and 14. Neutrophil, lymphocyte and monocyte number were determined. Lymphocyte subsets ($CD4^+$, $CD8^+$, $WC1^+$), MHC Class II^+ cells, $G1^+$ neutrophils, neutrophil CD62L (L-selectin) surface expression and the phagocytic and oxidative burst activity of granulocytes (neutrophils and monocytes) were characterised by flow cytometry. On d 2, neutrophil number increased (P<0.001) and lymphocyte number decreased (P<0.01) in AW compared with d 0, but did not differ (P>0.05) in NW during the study. Neutrophil CD62L surface expression, neutrophil phagocytic activity and % $WC1^+$ lymphocytes decreased (P<0.05) on d 2 compared with d 0 in AW and NW but the decrease was greater (P<0.001) in AW. Monocyte phagocytic activity decreased (P<0.05) on d 2 to 14 in AW but did not differ (P>0.05) in NW compared with d 0. Monocyte number, neutrophil and monocyte oxidative burst activity did not differ (P>0.05) in AW and NW during the study. On d 2, the % $CD4^+$ and $CD8^+$ lymphocytes decreased (P<0.001) in AW but remained unchanged (P>0.05) in NW compared with d 0. The % MHC Class II^+ cells and $G1^+$ neutrophils increased (P<0.01) on d 2 in AW and NW compared to d 0 but the increase was greater (P<0.001) in AW. In conclusion, abrupt weaning resulted in neutrophilia however the potential of neutrophils to traffic effectively and the ability of granulocytes to phagocytose efficiently were impaired. Together with the decreased lymphocyte number and larger changes in lymphocyte subsets and MHC Class II^+ cells, this suggests a greater transitory reduction in immunity in AW than NW beef calves.

Key Words: weaning, leukocytes, phagocytosis