
The objective of this study was to evaluate the efficacy of using ear canal placement of a temperature data logger as a predictor of vaginal temperature. Temperature data loggers are commonly used to sample body temperature in unrestrained animals. Temperature loggers have previously been placed in the vagina and(or) ear canal of cattle, horses and sheep. Two trials were conducted in Texas during summer (n = 7) and winter (n = 9) conditions when ambient temperature ranged from -2.0 to 9.5°C and 18.3 to 36.56°C respectively. Holstein-friesian cows were fitted with two iButton® temperature loggers programmed to sample every five min. The data loggers were placed vaginally using progesterone free CIDRs®. Data loggers were placed in the ear canal by first inserting the logger into the tip of a cotton infant sized sock which was then filled with polyester fiber batting. The data logger portion was placed in the ear canal and the batting packed firmly against the canal opening to insulate it from external thermal influence. Finally, the pinna of the ear was wrapped around the sock and taped closed using 3 inch wide Elastikon™ tape to hold the sock and batting in place. The resulting data was analyzed using the GLM procedure of the SAS® system. Ear canal temperature predicted vaginal temperature for the summer (r² = 0.58) and for the winter (r² = 0.70) trial. To adjust for variation due to moisture cooling the data loggers during udder washes or overhead sprinkling, the data were edited to drop outlying data points. Adjusting the data yielded a correlative value of r² = 0.75 for the summer trial and r² = 0.73 for the winter trial. Measuring ear canal temperature as described can be used for predicting vaginal temperature, although ear canal temperature may be susceptible to external influences, especially water.

Key Words: Cattle, Temperature, Data Logger

Ruminant Nutrition: Nitrogen Metabolism/Immunology

348 Effects of N solubility on metabolisable protein value of grass silage. P. Huhtanen*, M. Rinne1, and J. Nousiainen1, 1Cornell University, Ithaca, NY, 2MTT-Agrifood Research, Finland, 3Valio Ltd., Finland.

Proportion of soluble N in grass silage total N (SOLN) is related to protein degradability, especially determined in situ. Hence the concentration of metabolisable protein (MP) should decrease with higher SOLN. To test this hypothesis a meta-analysis based on 253 treatment means from 79 dairy cow production studies was conducted. In each study forage treatments (e.g. date of cut, fermentation quality and wilting) were investigated. Both the level and composition of concentrates were fixed within a study. Silage SOLN was divided into ammonia N and soluble non-ammonia N (SNAN). Silage MP was calculated as amino acids absorbed from the small intestine using constant values for ruminal protein degradability and intestinal digestibility of RUP. Mixed model regression analysis (SAS) with a random study effect (intercept random) was used to model milk protein yield (MPY), efficiency of N utilisation (NU) and milk urea N (MUN) associated bacteria, 33% in solids associated bacteria, and 19% of absorption, 19% escaped in the liquid phase, 14% in liquid associated compartments: grass silage SNAN, ammonia-N, bacteria-N associated with escapable N-fractions. To follow the ruminal metabolism of 15N-labelled N-fractions grab samples of ruminal digesta were collected at 0.5, 1.0, 1.5, 2, 3, 4, 6, 8, 11, 14, 17, 22, 27, 33, 39, 47, 55, 63 and 72 h after the dose. Digesta samples were treated with mercuric chloride, then fractionated into ammonia-N, SNAN, insoluble-N, and bacteria-N. Rumen liquid passage rate was determined using LiCoEDTA and particle passage rate was determined based on ADIN-15N excretion in feces. A dynamic mechanistic model was developed to describe the ruminal N metabolism. The model comprised five ruminal compartments: grass silage SNAN, ammonia-N, bacteria-N associated with non-escapable particles, bacteria-N associated with escapable particles, and liquid associated bacteria-N. The model indicated that of ammonia-N administered into the rumen 32% disappeared by absorption, 19% escaped in the liquid phase, 14% in liquid associated bacteria-N, and 36% in particle associated bacteria-N. Of grass silage soluble N 17% was absorbed as ammonia-N, 11% escaped the rumen in liquid phase as ammonia-N, 19% escaped the rumen in liquid associated bacteria, 33% in solids associated bacteria, and 19% of grass silage SNAN escaped the rumen as undegradable feed N. In conclusion, a greater proportion of silage soluble N compared with ammonia-N is incorporated into microbial N, and a considerable proportion of silage SNAN escapes rumen degradation.

Key Words: Dairy Cow, Protein Utilization, Degradability
Forage maize (FM) was (harvested DM 29 ± 1.29 %) ensiled in experimental silos with: No additional additive and 100 ml of water / 100 kg FM (NA 0.5); No additional additive and 200 ml of water / 100 kg FM (NA 1); Sil-All fireguard at 0.25g/100kg FM (SAFS 0.5); Sil-All fireguard 0.5g/100kg FM (SAFS1); Maize All GS 0.5g/100kg FM (MAS 0.5); Maize All GS 1g/100kg FM (MAS 1). Replicate (3) silos were stored (constant 17 to 20 °C) for 30 d. On opening silage was analysed for: DM, pH, lactic acid, acetic acid, NDF, ADF, crude protein, ME and ash at 0, 24, 48, 96 and 168 h and aerobic stability (AS) was assessed. AS significantly increased in silage treated with SAFS FR and HR and MAS at FR. AS; HR (0.5) NA 29.4, SAFS 73.2, MAS 33.0, (sem 14), at FR (1) NA 41.1, SAFS 76.5, MAS 56.4, (sem 10.30). Time to maximum pH was significantly lower with additive applied at FR compared with HR, maximum pH (h); HR (0.5) 0 7.2, SAFS 7.4, MAS 6.3, (sem 0.34), FR (1), 0 7.3, SAFS 6.7, MAS 7.4 (sem 0.22). Lactic acid (g/kg DM) up to 168 hrs decreased significantly in all treatments, HR (0.5) NA -57.6, SAFS -53.3, MAS -50.7, (sem 2.01), FR (1) NA -53.2, SAFS -72.4, MAS -64.2, (sem 5.56). ME (g/Kg DM) was significantly higher at FR SAFS. ME level (g/kg DM); HR (0.5) NA 9.4, SAFS 9.4, MAS 9.5 (sem 0.03), FR (1) NA 9.4, SAFS 9.6, MAS 9.5 (sem 0.06).

Key Words: Silage, Forage Maize, Stability

Ruminal and post-ruminal DM and starch digestibility can be influenced by corn hybrid as well as processing method. An in situ trial, utilizing the mobile bag technique, was conducted to evaluate the effect of corn hybrid, processing, and interactions on ruminal and intestinal digestion. A finishing trial was conducted to evaluate feedlot performance and compare it with digestion characteristics. Two ruminally and post-ruminal and total-tract starch digestibility (r=0.73). Correlations among hybrids within both processing methods were not significant. We conclude that processing method has a larger impact than hybrid. HMC showed an improvement of 13.6% to 23.6% in total-tract starch digestion compared to DRC. The results of this trial suggest that hybrid as well as processing have an impact on starch digestion.

Key Words: Corn Hybrid, Corn Processing, Starch
Bull beef systems for manufacturing grade beef in New Zealand (NZ) account for almost 50% of the national beef output. Dairy calves comprise approximately 85% of bulls, with suckled beef breeds the remainder. From weaning stock are almost entirely pasture fed until target slaughter carcass weight (CW) 240-270 kg at 18-24m. This has led to intensified grazing management in the last decade. Liver abscessation in cattle is usually associated with cereal feeding systems, and was traditionally uncommon in pasture based NZ livestock, but anecdotal industry reports of slaughter bulls and clinical cases in dairy cows suggest the incidence is sharply increasing. There is no existing research on liver abscessation in NZ. This project sought to establish the mean, breed and seasonal incidences and CW effect of liver abscesses at slaughter in NZ bulls. A large commercial database of source farm, breed, CW, liver abscess scores (absent, mild, moderate or severe) from all bulls slaughtered in that operation between 2000 and 2005 was analysed. The mean incidence of abscessation over all years was 10% (range: 9-13%), and increased across the years studied. The incidence increased each month across spring and summer and declined in autumn and winter. There was great variation in incidence between farms (range: 2-45%). Dairy breeds had a twofold greater mean incidence (9.3%) compared to beef breeds (4.6%), with Friesians the highest at 11.2%. Severe grade comprised 66% of all abscess cases. In each year, the range of mean CW for each liver grade group was <20kg, and mean CW was lowest in the severe grade, greater for absent grade, and highest for mild or moderate grades. Conclusions: Liver abscess incidence at slaughter appears to be increasing in NZ beef bulls, and at similar levels to grain fed cattle systems internationally. Dairy breeds have a higher incidence, and there is a reduction in CW only with severe grade. Concurrent research in NZ suggesting the traditional understanding of rumen function in pasture fed cattle is inadequate for contemporary high intake dairy cows on high quality pastures under intensive management may help explain these findings.

Key Words: Liver Abscess, Dairy Beef

356 Metaphylaxis therapy interacts with temperament to influence performance of growing beef steers. Z. D. Paddock,1 J. E. Sawyer,1 G. E. Carstens1, R. R. Gomez,2 B. M. Bourg,2 D. K. Lunt,3 S. A. Moore,3 and D. S. DeLaney,3 1Texas A&M University, College Station, 2Texas A&M University, McGregor, 3King Ranch, Kingsville, TX.

The effects of metaphylactic therapy on growth, intake, and feeding behavior traits were evaluated using 119 Santa Gertrudis steers (initial BW 265 ± 24 kg). Steers were preconditioned at the source of origin, transported 550 km, and allowed to rest overnight before processing. At processing, steers were weighed, blocked by weight, and randomly assigned within weight block to receive 1.5 mL/45.5 kg BW ceftriaxone crystalline free acid (EXC) administered at the base of the ear, or to receive no antimicrobial (CON). Steers within blocks receiving both treatments resided in common pens. Mean exit velocity (EV) was measured on d 0 and 28, as rate of distance traveled exiting from a chute, and used as an objective measure of temperament. Steers were weighed on d 0, 14, and 28. Meal frequency, duration, and DMI were recorded continuously using a GrowSafe feeding system. Data were analyzed as a mixed model with block as a random effect, treatment as a fixed effect, and EV as a covariate. An unequal slopes model was fit for treatment by EV interactions, with treatment differences tested at the mean EV and at ± 1 SD. Meal frequency increased with EV for EXC steers, but was unaffected by EV in CON steers (P = 0.02). Meal


duration was similar for steers with low EV, but decreased at a greater rate for CON than EXC steers (P = 0.01); at high EV, EXC steers had greater meal duration. Intake declined with increasing EV in CON steers, but was unaffected by EV in EXC steers (P = 0.01). High EV steers treated with EXC consumed more feed than high EV steers that were untreated. Interactions between EV and metaphylaxis resulted in differences in ADG from d 0 to 14 (P < 0.01) and d 0 to 28 (P = 0.01). At low EV, ADG was similar among treatments, but at mean or high EV, steers treated with EXC had greater ADG, and treatment differences increased with EV. Only one steer was clinically morbid during this trial. Results demonstrate that metaphylaxis therapy resulted in positive effects on ADG, DMI and feeding behavior during the receiving period for steers with high EV, whereas, metaphylaxis therapy had less utility for steers with low EV.

Key Words: Metaphylaxis, Temperament, Morbidity

357 Effects of Mannheimia haemolytica challenge on blood flow and net splanchnic flux of amino acids in fed or fasted steers. L. O. Burciaga-Robles1, C. R. Krehbiel2, D. L. Step3, C. A. Loest2, L. Chen1, M. Montelongo2, A. W. Confer2, J. N. Gilliam2, B. P. Holland2, and C. L. Goad1. 1Department of Animal Science, 2Department of Health and Veterinary Sciences, 3Department of Statistics, Oklahoma State University, Stillwater, OK, 4Department of Animal and Range Sciences, New Mexico State University, Las Cruces, NM.

This experiment evaluated blood flow and net splanchnic flux of AA during a bovine respiratory disease (BRD) challenge. Twenty two steers (BW = 320±24 kg) with chronic catheters to measure blood flow and net flux across the portal drained viscera (PDV) and liver were used. Arterial, portal, and hepatic blood samples were collected at 1.5-h intervals on d 0, 1, 2, and 3. Treatments (2×2 factorial arrangement) applied to steers were: 1) ad libitum feeding and not challenged (FED/CON); 2) ad libitum feeding and challenged (d 0) with M. haemolytica via a tracheal tube (FED/CH); 3) 72-h fasting and not challenged (FAST/CON); 4) 72-h fasting and challenged (FAST/CH). All data were analyzed using repeated measures and first-order autoregressive covariance structure. Diet affected (P < 0.05) portal, hepatic, and arterial blood flow, which were greater for FED compared with FAST steers (461, 708, and 170 vs 427, 522, and 97 L/h, respectively). Challenge increased haptoglobin concentration, and was greater for FAST/CH than FAST/CON steers. Nonessential concentrations of essential AA were not different (P = 0.22), CH vs. CON steers. Similar to total AA, there was a net removal of nonessential AA (-52.8 mmol/h) by the liver for CH and a net release for CON steers (42.5 mmol/L; P = 0.02). These results suggest that BRD increases removal of AA by the liver of steers, potentially in support of an acute phase response.

Key Words: Mannheimia Haemolytica, Amino Acids, Steers


Bacterial lipopolysaccharide (LPS) stimulates the immune system and mimics metabolic responses of gram(-) bacterial infection in cattle. Effects of LPS and dietary protein on N metabolism and serum concentrations of cortisol and haptoglobin (HAPT) in 24 steers (250 ± 2.8 kg BW) were studied. Treatments were a 2×3 factorial of LPS (0 vs 1.5 µg/kg BW; -LPS vs +LPS) and diets containing (DM basis): 1) 14.5% CP, 11.6% DIP and 2.9% UIP (CP14.5CON); 2) 16% CP, 13.3% DIP and 2.7% UIP (CP16DIP); and 3) 16% CP, 11.3% DIP and 4.7% UIP (CP16UIP). Source of DIP was casein and sources of UIP were fish meal and corn gluten meal. Steers were adapted to diets (+1.2 Mcal/kg NE; DM fed = 1.8% BW) for 14 d, and were infused (i.v. 1 mL/min) with LPS (in 100 mL saline) on d 15. Blood samples were collected before LPS infusion and every 2 h for 12 h thereafter. Feces, urine, and orts were collected for 5 d starting d 16 and composited. Serum cortisol and HAPT increased (P ≤ 0.05) in response to +LPS, but were not affected by diet. Serum cortisol of +LPS steers increased at 2 h, peaked at 4 h (5.4 vs 75.6 mg/mL for -LPS vs +LPS), and remained elevated for 12 h (P ≤ 0.05); serum HAPT of +LPS steers were elevated at 4, 6, 10, and 12 h (P ≤ 0.05). Dietary DM and N intakes were lower (P ≤0.05) for +LPS vs -LPS steers, and N intakes were greater (P ≤ 0.05) for higher CP diets. There was a LPS × diet interaction (P = 0.06) for N retained (% of intake); diet did not alter N retention of -LPS steers, but +LPS steers retained more N when fed CP16DIP and CP16UIP than CP14.5CON. These results imply that growing steers exposed to endotoxin may require greater dietary protein concentrations to offset altered intake and metabolic demand.

Table 1.

<table>
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<th>Nitrogen, g/d</th>
<th>CP14.5-CON</th>
<th>-LPS</th>
<th>CP16-DIP</th>
<th>CP16-UIP</th>
<th>CP14.5-CON</th>
<th>+LPS</th>
<th>CP16-DIP</th>
<th>CP16-UIP</th>
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<td>118</td>
<td>116</td>
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<td>39</td>
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<td>30</td>
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<td>Retainedab</td>
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<td>24</td>
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</tbody>
</table>

aN Retention, % intakeab
cDiet effect (P ≤ 0.05).

Key Words: Stress, Protein, Cattle


An experiment was conducted to determine the effects of dietary boron (B) on the performance and immune response of growing steers. Thirty-six Angus and Angus-cross steers (average initial BW 270...
kg) were blocked by weight within breed and randomly assigned to treatments. Treatments consisted of: 1) control (no supplemental B), 2) 5 mg/kg of supplemental B, 3) 50 mg/kg of supplemental B. Supplemental B was supplied from sodium borate. The control diet contained 10.2 mg/kg of B. Steers were housed in slotted floor pens with 2 animals per pen. Weights were taken at 14 d intervals. Jugular blood was obtained from steers on either d 42 or 44 for assessment of lymphocyte blastogenesis. One-half of the steers in each treatment group were sampled on each date. Supplemental B tended (P = 0.12) to increase the blastogenic response of T lymphocytes to pokeweed mitogen, but did not affect proliferation of T lymphocytes when stimulated with concanavalin A or phytohaemagglutinin (PHA). Humoral immunity was assessed on d 49 by injecting steers IM with a pig red blood cell (PRBC) suspension. Blood samples were collected at d 0, 7, 14, and 21 following PRBC administration for determination of antibody titers. Specific anti-PRBC IgG titers were affected by a treatment × day interaction (P < 0.07). Boron supplemented steers had greater (P < 0.05) IgG titers than controls on d 7 but not on d 14 or 21 post-injection. Cell-mediated immune response was also evaluated following an intradermal injection of PHA on d 77 of the study. Skinfold thickness following PHA injection was not affected by dietary B. Performance of steers during the 77 d study was not affected by dietary B. Results of this study indicate that supplemental B did not affect the performance of growing steers, but may affect the immune response.

**Key Words:** Cattle, Boron, Immunity

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**Ruminant Nutrition: Opportunities to Improve Forage Utilization and Rumen Function**

**360 Utilizing fats and carbohydrates in forage-based diets for lactating cows.** M. S. Allen*, Michigan State University, East Lansing.

Forages contain relatively high concentrations of fiber that is slowly and incompletely digested, limiting energy intake for high producing cows. Therefore, cows with high energy requirements are fed forage-based diets supplemented with feeds containing readily digested carbohydrates and (or) fats. However, specific fuels can have physiological effects that alter intake and utilization of dietary energy. The profile and pattern of absorption of fuels depend on the composition of the diet, including not only its chemical composition, but physical characteristics which influence ruminal fermentation and dynamics. Rapidly fermented carbohydrates and some fat sources can decrease feed intake, ruminal fiber digestibility, efficiency of microbial protein production, and increase flow of intermediates from fatty acid biohydrogenation from the rumen. Physiological effects of specific fuels might involve alteration of hormone or enzyme concentrations affecting gluconeogenesis, lipolysis and lipogenesis in tissues, fat and protein production by the mammary gland, gut motility, or feeding behavior. These physiological effects can influence energy intake, yield of milk and milk components, and body condition independent of the energy contributed by the fuel itself. Furthermore, physiological and production responses to specific fuels are dependent upon animal characteristics (e.g. glucose demand, lipolytic state, adiposity). Therefore, physiological effects of energy concentrates must be considered when formulating diets rather than formulating for energy density alone. The objective of this presentation to discuss physiological effects of specific fuels and how these effects can be utilized to optimize diets for cows in different stages of lactation.

**Key Words:** Feed Intake, Energy Partitioning, Physiological State

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**361 The role of ionophores in improving utilization of forage and forage-based diets.** V. Fellner*, North Carolina State University, Raleigh.

Ionophores have been routinely added to non-lactating ruminant diets to improve animal performance and efficiency of feed utilization. Although several ionophores have received FDA approval, the most common and widely studied ionophore is monensin that is now also approved for use in lactating cow rations. Benefits of ionophores are attributed, almost exclusively, to changes that occur in the rumen. A shift in the ruminal acetate:propionate ratio, with a concomitant decrease in methane and ammonia, are classical responses to feeding ionophores. The magnitude of change can vary, however, and is not always predictable. Preferential binding of ionophores to specific ions, level of ionophore inclusion in the diet, and dietary composition are some of the reported factors contributing to the variability in ionophore action. Managing the diet is perhaps the most critical factor in maximizing the benefit of ionophores, irrespective of type or level of inclusion. With high forage diets a lower dose of ionophore elicits maximal ruminal response. This is in contrast to high concentrate diets that typically provide for a greater ionophore response at higher doses. Generally, the fiber digesting microbes are most sensitive to ionophores whereas starch fermenters tend to be more resistant. Yet, a decrease in nutrient digestibility, specifically fiber, is more pronounced in diets having low, rather than high forage content. Changing the forage:concentrate ratio alters several factors, including intakes, passage rates and pH, all of which impact microbial shifts. Among the predominant fibrolytic bacteria, some that may even be resistant to ionophores, there is considerable difference in kinetics of microbial growth in response to ionophores. The major starch utilizing bacteria are less sensitive to ionophores but seem to alter their metabolism with source and level of starch. The driving force in ruminant production is energy whether it’s from grain or forage. Varying dietary ingredients varies the substrate for the microbes as well as ruminal kinetics, both of which interact to determine the response to ionophores.

**Key Words:** Ionophore, Forage, Rumen