

Ruminant Nutrition: Beef I

M310 Effect of narasin in mineral mix to Nellore heifers fed with high forage. Renan G. Silva*¹, Marcos V. C. Ferraz Junior¹, Vinicius N. Gouvea¹, Daniel M. Polizel¹, Marcelo H. Santos¹, Alexandre A. Miszura¹, Thiago S. Andrade¹, Mariana F. Westphalen², Marcos V. Biehl², and Alexandre V. Pires^{2,1}, ¹University of São Paulo, Pirassununga, São Paulo, Brazil, ²University of São Paulo, Piracicaba, São Paulo, Brazil.

The use of feed additives for ruminants is a further tool that can improve feed conversion in animal protein. The objective of this study was to determine the effect of narasin in mineral mix (MM) of heifers fed high-forage diet. Thirty Nellore heifers (12 mo old) were penned (3 heifers / pen) by BW (222 ± 3.0). Heifers were fed daily with Tifton 85 haylage ad libitum. Experimental treatments were 0 (control); 650 and 1300 mg of narasin / kg MM (0N, 6.5N and 13N, respectively). The variables analyzed were dry matter intake (DMI), and mineral mix intake (MMI) daily, average daily gain (ADG) and feed:gain ratio. The experimental design was a change-over (all pens underwent all treatments) with 3 experimental periods of 28 d. Between periods there was a 7 d wash-out. Heifers were weighed at the beginning and end of each experimental period to determine ADG. The variables ADG and feed:gain were analyzed by PROC MIXED (SAS 9.3), MMI and DMI measures were analyzed as repeated measures over time. Treatments, periods and pens were placed in the model. The addition of narasin in MM did not effected MMI (0N - 60.70 ± 3.05 ; 6.5N - 55.62 ± 3.18 ; 13N - 57.44 ± 2.50 g / heifer / d, $P = 0.7497$), corresponding to 0; 7.30 and 15.62 ppm of narasin intake. There was no change on DMI (0N - 4.85 ± 0.09 ; 6.5N - 4.95 ± 0.11 ; 13N - 4.78 ± 0.09 kg / heifer / d, $P = 0.6944$). However, adding 1300 mg of narasin / kg MM increased ADG (0N - 0.486 ± 0.02 ; 6.5N - 0.512 ± 0.02 ; 13N - 0.582 ± 0.02 kg / d, $P = 0.0181$) and improved feed:gain ratio (0N - 12.71 ± 0.85 ; 6.5N - 11.70 ± 0.85 ; 13N - 9.50 ± 0.85 , $P = 0.0488$) compared with the control group. In conclusion, adding 1300 mg of narasin / kg MM increased ADG and improved the feed:gain ratio.

Key Words: narasin, Nellore, high-forage

M311 Ruminant microbiology of Nellore steers fed different sources of forage in diets with crude glycerin in feedlot. Telma T. Berchielli*, Andressa F. Ribeiro, Yury G. Salcedo, Antonio Jose Neto, Luis G. Rossi, Monaliza O. Santana, Ana Laura E. G. F. Carvalho, Erick E. Dallantonia, and Juliana D. Messana, Sao Paulo State University, Jaboticabal, Sao Paulo, Brazil.

The aim of this study was to evaluate the effect of alternative forages for corn silage such as sugar cane and sugar cane bagasse included in a similar forage NDF level (fNDF) in diets with crude glycerin (80.64% of glycerol) on ruminal microbiology. Nine ruminally cannulated Nellore steers (300.0 ± 30 kg of BW and 18 ± 2 mo of age) were used in a 3x3 Latin Square experimental design. Experimental periods were 15 d (14 d for adaptation and 1 d for ruminal sampling). Ruminal samples were taken 3 h after feeding. Protozoa population were preserved in formalin and quantified in Sedgewick-Rafter chamber. The technique to quantify total bacteria was qPCR. Data were analyzed using R software (version 3.1.1) as a triple Latin Square design with 3 treatments and 3 animals in 3 simultaneous triplicates. The fixed effects were treatments and Latin Square, and random effects were time, animal and error. The statistical test used was Tukey, and the significance was $P < 0.05$. The protozoa population was not influenced by the different sources of forage with

crude glycerin, except *Dasytricha* and *Isotricha*. The concentration of *Dasytricha* population was increased in animals fed with sugar cane which not differed from animals fed with corn silage diet ($P > 0.05$). Additionally, *Isotricha* population concentration increased ($P < 0.05$) in animals fed with sugar cane. The population of fibrolytic bacteria (*Ruminococcus flavefaciens*, *Ruminococcus albus* and *Fibrobacter succinogenes*) were similar ($P > 0.05$) among diets. On the other hand, the population of *Selenomonas ruminantium* increased ($P < 0.01$) in animals fed with corn silage. Corn silage and sugar cane included in 15% of fNDF in diets with crude glycerin (10% DM) altered ruminal microorganisms populations.

Key Words: bacteria, corn silage, protozoa

M312 Performance of young Nellore bulls during the dry season with two supplements. Marcella de Toledo Piza Roth*¹, Matheus Henrique Moretti², Flavio Dutra de Resende^{3,4}, Rodolfo Maciel Fernandes¹, Ana Paula de Toledo Piza Roth², and Gustavo Mazende Siqueira^{3,4}, ¹UNIFEB, Barretos, São Paulo, Brazil, ²Agrocercos Multimix, Rio Claro, São Paulo, Brazil, ³Agência Paulista de Tecnologia dos Agronegócios, Colina, São Paulo, Brazil, ⁴UNESP, Jaboticabal, São Paulo, Brazil.

The effects of 2 supplements on the performance of Nellore cattle in their post-weaning phase on a marandu-grass pasture during the dry season were evaluated. It was expected that differences would occur in the average daily gain (ADG), thereby modifying the carcass gain (CG) and carcass gain percent (CGP). The experiment was divided into 3 experimental periods (EP) with 35 d each (105 d), beginning in 08/2009. A total of 129 animals aged 8 ± 2 mo, with an initial BW of 204 ± 5.2 kg, were used in the experiment. The following supplements were tested: protein supplement (PS) ($1 \text{ g} \cdot \text{kg}^{-1}$ BW, low-moderate ADG rate) and protein energy supplement (PES) ($5 \text{ g} \cdot \text{kg}^{-1}$ BW, moderate-high ADG rate). Animals were weighed at the beginning and end of the EP (after 16 h deprivation) to determine the ADG. For the calculation of CG, the initial carcass weight was estimated through the equations obtained with 3 animals slaughtered at the onset. The CGP was calculated by dividing the carcass gain by the BW gain. The animals were allocated to a 48.2-ha pasture area (deferred in April 2009) divided into 18 paddocks (9 per treatment). The experimental design was completely randomized, with the paddock considered the experimental unit. To evaluate performance, 9 paddocks were considered per treatment (63 animals), while for the evaluations of carcass and body components, 3 animals were considered per treatment (6 animals); these results were subjected to ANOVA at 10% probability. Treatment PES provided a 44% higher ADG ($P < 0.01$) as compared with PS. The animals ADG was 0.72 kg (PES) and 0.50 kg (PS), resulting in a different BW at the end of the dry season ($P < 0.01$), which was 26 kg greater in the animals fed PES (285 kg) as compared with PS (259 kg). CG was not affected ($P = 0.35$) by the type of supplementation; however, the final carcass weight in the animals fed PES was 14.7% higher than in those which received PS ($P = 0.05$). The CGP (average $547.3 \text{ g carcass kg}^{-1}$ BW) was not affected ($P = 0.94$) by the supplements. Supplementation with PES increases the ADG and provides heavier carcasses.

Key Words: average daily gain, protein supplement, protein-energy supplement

M313 Transcriptional profiles of adipose tissue from finishing beef steers fed diets supplemented with *Aspergillus oryzae*. Kristen M. Brennan*, Daniel E. Graugnard, Allison C. Smith, Tatijana M. Fisher, and Leya F. Spangler, *Alltech Inc., Center for Animal Nutrigonomics and Applied Animal Nutrition, Nicholasville, KY.*

The objective of this study was to compare the transcriptional profiles in adipose tissue of steers fed diets supplemented with *Aspergillus oryzae* (Amaize, Alltech Inc.). Angus-cross steers were randomly assigned to one of 3 treatments (n = 9/treatment): basal diet (CON, control), basal diet plus 10g/hd/d of *A. oryzae* introduced gradually during the transition phase (GRAD, gradual), or basal diet plus 10g/hd/d of *A. oryzae* introduced at full level at the end of the transition phase (FULL). For the GRAD treatment, *A. oryzae* was added gradually to the ration by increasing the dose 2.5 g every 3 d until steers were receiving 10g/d at d 19. From receiving until d 21, starter and step-up diets were fed to transition steers to a low-forage finishing ration. On d 140, adipose tissue was biopsied. Samples were analyzed for gene expression using the Affymetrix Bovine Genome Array. Performance did not differ between treatment groups, however GRAD and FULL steers had numerically greater hot carcass weights ($P = 0.54$) and rib eye areas ($P = 0.15$) than CON steers. Relative to CON, there were 930 (396 upregulated, 534 downregulated) differentially expressed genes (DEG) in FULL steers and 425 (196 upregulated, 229 downregulated) DEG in GRAD steers. In FULL steers, DEG categorized to both the oxidative phosphorylation and mitochondrial dysfunction pathways were downregulated, suggesting a decrease in cellular energy production. Key DEG included components of complex I, III, and IV and the ATP synthase subunits. Surprisingly, these pathways were unaffected in GRAD steers. Although performance or carcass characteristics did not differ ($P < 0.05$) between treatment groups, the DEG suggest that, at least in FULL steers, energy production may be decreased. A future study is warranted to examine response to Amaize in terms of steer carcass composition and transcriptional patterns in skeletal muscle.

Key Words: enzyme, gene expression, beef

M314 Earlage: Yield, harvest timing, composition, and in situ digestibility. L. Brown, S. Soderlund, and F. N. Owens*, *DuPont Pioneer, Johnston, IA.*

To increase return per hectare and profit, production of earlage (ensiled high-moisture harvested chopped corn ears) has increased. Compared with high moisture shelled corn grain (HMSC), yield of DM as earlage is 15 to 19% greater; field grain loss is less, harvest is simpler (grain need not be shelled from the cob), and "built-in-roughage" (cob and husk) reduces the need for added forage with no additional cost of production. Effects of harvest timing on yield, composition, and in situ digestibility were examined. In trial 1, ears from 6 hybrids grown at 2 locations harvested at 3 grain maturities (56 to 87% grain DM) were separated into grain, cob, and husk plus shank portions. Within the optimum harvest moisture for HMSC (minimum of 65% for maximum grain yield and maximum of 74% for adequate fermentation), earlage contained 4.0 to 5.6% less DM. Thereby; the optimum DM range for earlage harvest to parallel HMSC would be 60 to 69% DM. For simplicity, the optimum stage for harvest for earlage can be appraised by DM content of samples of shelled grain (optimum being 65 to 74% DM). Across hybrids and growing locations, ranges in percentage of earlage DM derived from grain, cob, and husk were 81 to 85%, 7.6 to 10.8%, and 5.7 to 8.9%, respectively. Heavier ears had less cob due to incomplete grain fill of cob tips, so high plant density or other factors that decrease ear size increase the percentage of cob in earlage. Irrigation timing and other traits (e.g., stay-green) may alter moisture distribution within ears. In trial 2, ears

from 4 hybrids, one being a BMR, were harvested on 6 dates (60.6 to 80.2% DM) and ensiled for 0, 30, 60, 120, or 240 d. NDF content of earlage differed with hybrid and maturity due to changes in the break point between the cob and the shank. In situ NDFD was greater ($P < 0.01$) for the BMR hybrid (67 vs 58 to 62%). Delaying harvest decreased NDF content from 26% to 20% and in situ NDFD at 48 h from 71 to 57% (due to cob maturation) without changing DM disappearance. With longer durations of storage, curvilinear decreases in NDF content (22 vs 24% of DM) and in situ NDFD (60 vs 65% of NDF) were detected, but ranking of hybrids was not altered by fermentation time.

Key Words: earlage, harvest, NDF digestibility

M315 Effect of prenatal trace mineral source on neonatal and growing calf mineral status. Deborah M. Price*¹, Alex F. Swain¹, Joseph M. Guevera², Carley R. Trcalek², Meaghan M. O'Neil¹, Max Irsik², Owen Rae², Matthew J. Hersom¹, and Joel V. Yelich¹, ¹*Department of Animal Sciences, University of Florida, Gainesville, FL*, ²*College of Veterinary Medicine, University of Florida, Gainesville, FL.*

The effect of cow prenatal trace mineral (TM) supplement source on calf TM status from birth through 30 d of age was examined. Factorial treatment (TRT) arrangements (Angus = AN, n = 95 and Brangus = BN, n = 96 cows; Inorganic = ING, n = 98, and Organic = ORG yeast, n = 93) utilized calves born to cows supplemented (3d/wk at a rate of 0.4 kg⁻¹454 kg BW⁻¹d in a pellet) with TM ≥ 90 d before expected parturition. Calf BW were collected at birth (n = 191). A subset of calves (n = 43) had BW, serum and plasma collected by jugular vein puncture at birth (0 h, before colostrum intake), 12 h, 24 h and 30 d of age. Processed samples were frozen at -20°C and plasma was refrigerated at 4°C until analyzed for TM (serum: Co, Cu, Fe, Mn, Mo, Se, Zn; plasma: Se), by ICP-MS. Data were analyzed in SAS using Proc Mixed and repeated measures, with TRT, breed and time as fixed effects. Breed, TRT, nor interactions affected ($P > 0.34$) BW at birth (36 \pm 0.4 kg) and 30 d (69 \pm 1.1 kg). With the exception of plasma Se, there were no ($P \geq 0.39$) 3-way interactions. Time affected ($P < 0.02$) all 0–24 h serum and plasma TM except for Co ($P = 0.60$). Calf Mn concentrations were undetectable at 0–24 h, but were 1.9 \pm 0.2 ng/mL at 30 d sample. Both serum Se (ING = 57.5 \pm 1.7 and 44.7 \pm 1.1 μ g/mL vs. ORG = 46.5 \pm 1.7 and 33.4 \pm 1.2 μ g/mL) and plasma Se (ING = 149.4 \pm 3.2, 129.9 \pm 3.2 vs. ORG = 118.7 \pm 3.3, 95.4 \pm 3.3 ng/mL) were affected ($P < 0.001$) by TM source at 0–24 h and 30 d, respectively. At 30 d, Co was greater ($P = 0.002$) for ING (2.0 \pm 0.3 ng/mL) than ORG (0.6 \pm 0.3 ng/mL). At 0–24 h, Fe and Se were greater ($P \leq 0.05$) in AN (87.1 \pm 5.9 μ g/dL and 54.7 \pm 1.7 ng/mL) than BN (70.1 \pm 5.8 μ g/dL and 49.2 \pm 1.7 ng/mL). At d 30, AN (40.7 \pm 1.2 ng/mL) serum Se was greater ($P = 0.048$) than BN (37.4 \pm 1.1 ng/mL). In contrast, BN had greater ($P < 0.01$) Cu (0.3 vs. 0.2 \pm 0.01 μ g/mL) than AN at 0–24 h and Mo (52.9 \pm 8.5 vs. 10.0 \pm 1.7 ng/mL) at 30 d, respectively. These data demonstrate calf TM status varies by time, prenatal TM source and breed. Pre-calving nutritional strategies need to consider TM source and calf breed.

Key Words: trace mineral, prenatal nutrition, calves

M316 Effects of feeding a complete pelleted feed consisting of treated corn stover and distillers byproducts on total tract digestion and performance of growing cattle. Jana L. Harding*, Curt J. Bittner, Dirk B. Burken, Galen E. Erickson, and James C. MacDon-ald, *University of Nebraska Lincoln, Lincoln, NE.*

Two studies evaluated the effect of replacing traditional growing diets with a complete pelleted feed. In Exp. 1, 6 steers were utilized in a 4 × 6 Youden square to evaluate the effects of a complete pelleted feed on total-tract digestion. Four treatments consisted of 2 control diets containing 18% modified distillers grains (MDGS), 18% solubles, and either 60% untreated corn stover (-CON) or 60% alkaline treated corn stover (+CON). The remaining 2 diets were 1 of 2 complete pelleted feeds (Pellet A or Pellet B). Pellets contained alkaline treated corn stover, dry distillers grains, solubles, and supplement. Corn stover used in Pellet A and B were harvested using different methods causing Pellet B to have less stem than Pellet A. In Exp. 2, a 92-d growing study utilized 360 (initial BW = 316 ± 22 kg) yearling steers to evaluate replacing a diet consisting of 60% corn stover, 18% solubles, and 18% MDGS with a complete pelleted feed on growing cattle performance. The pelleted feed was the Pellet A treatment in Exp. 1. Pellets were either pair-fed (Pel-PF) to the control (CON) treatment (CON fed ad libitum) or fed ad libitum (Pel-AL). In Exp.1, differences ($P < 0.01$) in total-tract digestibility of OM (OMD) and NDF (NDFD) between the 4 treatments were observed. Pellet B had the greatest OMD and NDFD (75.55% and 63.93%, respectively) and the -CON had the lowest (67.58% and 54.36%, respectively). The +CON and Pellet A were intermediate and statistically similar to one another ($P \geq 0.22$). In Exp. 2, there were no differences ($P > 0.50$) between the CON and Pel-PF in ending BW, DMI (by design), or ADG (1.29 ± 0.17 and 1.27 ± 0.22 kg/d, respectively). Greater DMI (12.18 ± 0.71 kg/d) and ADG (1.63 ± 0.20 kg/d) were observed for the Pel-AL compared with the CON and Pel-PF treatments ($P < 0.01$). The Pel-AL treatment (0.134) had lower G:F ($P = 0.05$) compared with the CON and Pel-PF treatments (0.143 and 0.140, respectively). Replacing a traditional growing diet with a complete pelleted feed resulted in similar or improved diet digestibility, depending on stover harvesting method. Pelleting increased DMI and ADG if cattle were fed ad libitum but decreased G:F.

Key Words: byproducts, pellet, treated corn stover

M317 Additives in supplements to fed Nelore young bulls in pasture. Erick Escobar Dallantonia¹, Josiane Fonseca Lage^{*2}, Elias San Vito¹, Gabriela Moraes Delamagna¹, Patricia Baldi Garrido¹, Lutti Maneck Dellevatti¹, Ricardo de Andrade Reis¹, Marco Antonio Alvares Balsalobre², and Telma Teresinha Berchielli¹, ¹*Universidade Estadual Paulista Julio de Mesquita Filho, Jaboticabal, São Paulo, Brazil*, ²*Trouw Nutrition Brazil, Mirassol, São Paulo, Brazil.*

This trial aimed to evaluate the blood parameters and growth of Nelore young bulls finished in pasture in the rainy season supplemented with monensin (MON), virginiamycin (VM) or both associated. Ninety animals were used with the initial BW of 360 kg ± 24.98 kg, receiving daily supplementation in 0.3% of BW, distributed in 12 paddocks of *Brachiaria brizantha* 'Xaraés', with about 2 ha each (3 paddocks/treatment) and fed daily with supplement without additives (SUP), with MON (SUPM - 80 mg/kg), with VM (SUPV - 150 mg/kg) and supplement with MON and VM (SUPMV - 80 and 150 mg/kg, respectively). Supplements had 25% of CP. After 14 d of adaptation, 8 animals were slaughtered as a reference group to obtain the initial dressing percentage (DP) to calculate the carcass gain (CG) at the end of the experiment. The remaining animals (n = 82) were allotted in paddocks (7 animals/paddock). In one paddock were allotted 5 animals, due to the smaller size

of the area. Blood was collected after 14 h withdrawal period from feed and water at the 0, 63 and 118 d of feeding. To obtain the ADG, animals were weighted in shrunk. Animals were slaughtered after 140 d of trial. Data were analyzed using the Proc Mixed of SAS with a randomly design (5% of probability). The inclusion of additives in supplements does not affect the insulin ($P = 0.81$) and glucose ($P = 0.29$) concentrations. The inclusion of the additives in supplements does not affect the final BW ($P = 0.11$), hot carcass weight ($P = 0.45$), DP ($P = 0.14$) and CG in relation the ADG ($P = 0.91$). However, the ADG was affected ($P = 0.03$) by inclusion of additives in supplements. Young bulls fed SUPM had similar ADG (0.867 kg/d) in relation young bulls fed SUPV (0.896 kg/d), but lower ADG than animals fed SUP (0.949 kg/d) and SUPMV (0.969 kg/d). Animals fed SUPV had similar ADG than animals fed SUP, but lower than animals fed SUPMV. The inclusion of MON, VM or both associated in supplements to fed bulls in pasture at the rainy season not promotes additional weight in carcass or BW.

Key Words: beef cattle, monensin, virginiamycin

M318 Relationship between infrared thermography and heat production in young bulls. Mario L. Chizzotti², Rafael A. Gomes^{*1,3}, Karina C. Busato¹, Marcio M. Ladeira¹, Matheus C. Galvão¹, Priscilla D. Teixeira¹, Aline C. Rodrigues¹, Antonio Henrique Ribeiro Junior¹, and Maria Helena Oliveira¹, ¹*Universidade Federal de Lavras, Lavras, MG, Brazil*, ²*Universidade Federal de Viçosa, Viçosa, MG, Brazil*, ³*Washington State University, Pullman, WA.*

Infrared thermography (IRT) was tested for predicting heat production in Nelore and Angus young bulls. A total of 32 animals with initial body weight (BW) of 380.6 ± 6.1 kg were housed in individual stalls. Eight animals of each breed were fed ad libitum with a whole shell corn (WSC) diet (85% whole shell corn and 15% of a pellet based on soybean meal) or a silage/concentrate (SC) diet (30% silage and 70% concentrate based on corn and soybean meal). After 50 experimental days, skin and eyeball temperatures were obtained by infrared thermal images (Fluke Ti 55ft, Fluke Corporation) and the pictures were analyzed using the software SmartView 3.0. The daily intake was measured and a metabolic trial was conducted with total collection of feces and urine to estimate the metabolizable energy intake (MEI). With 90 d of growth, the cattle were slaughtered. The retained energy (RE) was calculated using comparative slaughter technique. Heat production (HP) was calculated as the difference between MEI and RE. The data were analyzed using the GLM and REG procedures of SAS adopting significance level of 0.05. Angus cattle show greater daily MEI, daily HP and body temperatures than Nelore (Table 1). SC diets show greater MEI and HP, but similar eye and skin temperatures. We found a moderate correlation ($P < 0.05$) between daily HP and maximum ($r = 0.46$) and average skin ($r = 0.47$) and maximum ($r = 0.44$) and average eyeball ($r = 0.40$) temperatures. We concluded that IRT technique has a potential to be used to evaluate HP in cattle.

Contd.

Table 1 (Abstr. M318). Metabolizable energy intake (Mcal/d), heat production (Mcal/d), and maximum and average temperatures of skin and eyeball (°C) of Nellore and Angus bulls fed whole shell corn (WSC) or a silage/concentrate (SC) diets

Item	Nellore		Angus		SEM	P-value		
	SC	WSC	SC	WSC		Breed	Diet	Breed × Diet
ME intake	26.3 ^c	21.1 ^d	38.1 ^a	32.7 ^b	1.8	<0.0001	0.006	NS
Heat production	21.6 ^{bc}	17.2 ^c	31.2 ^a	26.0 ^b	1.6	<0.0001	0.006	NS
Temperature								
Maximum skin	35.9 ^b	36.4 ^b	36.8 ^a	36.6 ^a	0.2	0.0118	NS	NS
Average skin	34.6 ^b	35.1 ^b	35.6 ^a	35.7 ^a	0.2	0.0015	NS	NS
Maximum eye	36.6 ^b	36.8 ^b	37.2 ^a	37.1 ^a	0.2	0.0184	NS	NS
Average eye	34.8 ^b	35.3 ^b	35.5 ^a	35.5 ^a	0.2	0.0328	NS	NS

Key Words: Nellore, Angus, metabolizable energy intake

M319 Intake, digestibility and rumen fermentation in beef cattle fed warm-season legume (*Stylosanthes* ‘Campo Grande’) silage with two dietary protein levels. Leandro D. Silva, Odilon G. Pereira*, Thiago C. Silva, Sebastião C. Valadares Filho, and Karina G. Ribeiro, *Universidade Federal de Viçosa, Viçosa, MG, Brazil.*

The *Stylosanthes* ‘Campo Grande’ (*Stylosanthes capitata* + *S. macrocephala*) is adapted to tropical conditions and exhibit a nutritional value comparable to other high efficiency feeds being used in the tropics. The objective of this study was to evaluate the nutrient intake, total apparent digestibility, ruminal pH and ammonia concentration and the microbial efficiency of beef cattle fed *Stylosanthes* ‘Campo Grande’ (StS) or corn silages (CS) with 2 dietary protein levels (PL). Four Nellore rumen cannulated, average (BW) of 449.8 ± 9.47 kg were assigned to a 4 × 4 Latin square with a 2 × 2 factorial design of treatments with 4 16-d periods. The treatments were StS and CS with 2 PL (11% and 13% CP on DM basis). Data were analyzed including in the model the fixed effects of silage (S), PL and the interaction S × PL, and the random effects of animal and period. The intake and digestibility were not affected ($P > 0.01$) by the interaction S × PL. However, the diets containing StS showed lower ($P < 0.01$) TDN intake than CS (4.52 vs. 6.01 kg/d). Similar pattern was observed for DM, OM, CP and NDF digestibilities. The ruminal pH and ammonia concentration were affected ($P < 0.01$) by S and PL, respectively. The microbial efficiency estimated from urinary purine derivatives was not affected ($P > 0.01$) by treatments (average of 75.77 g/kg TDN). The StS resulted in lower TDN intake and lower total apparent digestibility of DM, OM, CP and NDF without affecting the microbial efficiency. Supported by Fapemig, CNPq and INCT-CA.

Key Words: stylo silage, microbial efficiency, ruminal pH

M320 Performance of Nellore bulls supplemented with energy sources associated crude glycerin on finishing phase. Antonio Jose Neto*, Luis Gustavo Rossi, Erick Escobar Dallantonia, Monaliza de Oliveira Santana, and Telma Teresinha Berchielli, *Department of Animal Science, São Paulo State University, UNESP, Jaboticabal, SP, Brazil.*

The objective of this study was to evaluate the effects of crude glycerin (Gly) combined with energy sources on performance and carcass characteristics of Nellore bulls fed tropical pasture during the finish phase. Sixty Nellore bulls (424 ± 34 kg; 20 ± 2 mo) were distributed in a completely randomized design (5 animals per paddock and 3 paddocks per treatment) with 4 experimental treatments in a 2 × 2 factorial arrangement (high or low starch, with or without a source of oil). The

experimental period lasted 133 d, divided in adaptation (21 d) and 4 periods of 28 d each. The animals were allocated into 12 paddocks of 1.8 ha, consisting of *Brachiaria brizantha* ‘Xaraés’ in the dry season, and supplemented at the rate of 1000 g · 100 kg⁻¹ of BW, daily, at 1000 h. The supplements were: T1 - Gly with high starch (corn), T2 - Gly with low starch (soybean hulls), T3 - Gly with high starch associated with a source of oil (corn and soybeans), and T4 - Gly with low starch associated with a source of oil (soybean hulls and soybeans). Crude glycerin (83.9% of glycerol), a byproduct from the biodiesel agroindustry, was used in all supplements to replace (28% of DM) corn or soybean hulls. Average daily gain (ADG) was measured by weight changes during successive weightings of the animals in each experimental period. After 133 d of feeding, all the animals were slaughtered with 546 ± 43 kg of shrunk BW and was determined the hot carcass weight (HCW), dressing percent (DP), and daily carcass gain (CrG). Data were analyzed using the PROC MIXED of the SAS with $\alpha = 0.05$ and F-test, animal was the experimental unit. There was no interaction between starch × oil for final BW, ADG, HCW, DP, and CrG ($P = 0.11$). However, animals supplemented with oil increased final BW ($P = 0.01$), ADG ($P = 0.02$), HCW ($P < 0.01$), and CrG ($P = 0.01$). Independently of starch level utilized, there was an increase of 7.4% (ADG), and 2.5% (HCW) for animals fed with oil compared with without oil. Oil supplementation associated with Gly may be effective to improve performance and final carcass characteristics of Nellore bulls finished on pasture.

Key Words: beef cattle, glycerol, oil

M321 Ruminant health of feedlot beef cattle fed with crude glycerin during adaptation period or finishing time. Josimari Regina Paschoaloto*, Jane Maria Bertocco Ezequiel, Marco Tulio Costa Almeida, Ivaldo Monsignati, Vanessa Barbosa Carvalho, Henrique Leal Perez, Antonio Carlos Homem Junior, Henrique Boselli Bussioli, Rhaony Gonçalves Leite, Anibal Garcia Camargo Junior, and Gustavo Leite Vieira, *São Paulo State University, UNESP/FCAV, Jaboticabal, São Paulo, Brazil.*

This trial evaluated the inclusion of glycerin in high concentrate diets as an ingredient is able to of reducing ruminal metabolic problems. Sixty Nellore cattle (initial BW of 300 ± 50kg) were used in a completely randomized block. Diets consisted of corn silage, corn, crude glycerin (83% glycerol), urea, sunflower meal, soybean hulls and mineral. Finishing diets presented 15% of roughage and 85% of concentrate. The crude glycerin derived from vegetable used is soybean oil and 30% was included in the diets of DM. Four treatments were used: glycerin during adaptation step up and finishing period (1) or glycerin just during adaptation period (2); absence glycerin during adaptation and finishing period (3) or absence of glycerin during adaptation and finishing period (4). The animals were housed in individual pens with free access to water. The diets were offered twice daily at 0800 and 1600h. Hepatic abscesses incidence (HAI) was determined according the presence and severity. At harvest rumenitis incidence (RI) was determined, on the entire washed rumen, using a scale of 0 (no lesions noted) to 10 (severe ulcerative). A fragment of 1 cm² of each rumen was collected from ventral sac. Manually, the number of papillae per cm² of rumen wall (NOP) was determined and 10 papillae were randomly collected from each fragment; scanned, and mean papillae area (MPA) in cm² was measured by software for image analysis. RASA in cm² was calculated as follows: 1 + (NOP × MPA) – (NOP × 0.002). The data were analyzed using GLM procedure of SAS statistical software 9.2 and were compared the means by Tukey’s test (5%). No significant ($P > 0.05$) effect was observed for RI, HAI, MPA and NOP between diets, however there are difference for ASA and PSA ($P < 0.05$). Diets without

glycerin during adaptation showed reduction on absorptive surface area per cm² of rumen wall and lower participation of rumen papillae in the total area of absorptive surface (%). Use of glycerin during adaptation led to greater development of ruminal epithelium, which may represent a new technology to control rumen acidification.

Key Words: Nellore, papillae, rumenitis

M322 Feeding behavior of feedlot beef cattle fed with high level of crude glycerin with crude glycerin during adaptation period or finishing time. Josimari Regina Paschoaloto*, Jane Maria Bertocco Ezequiel, Marco Tulio Costa Almeida, Bruno Henrique Ferreira Araujo, Vanessa Barbosa Carvalho, Henrique Leal Perez, Ivaldo Monsignati, Henrique Boselli Bussioli, Rhaony Gonçalves Leite, Anibal Garcia Camargo Junior, and Gustavo Leite Vieira, *São Paulo State University-UNESP/FCAV, Jaboticabal, São Paulo, Brazil.*

This trial evaluated the inclusion of glycerin in high concentrate diets as an ingredient is able to of reducing ruminal metabolic problems, for this was evaluated the behavior feeding of 60 Nellore cattle (initial BW of 300 ± 50 kg) assigned in a completely randomized block. Diets consisted of corn silage, corn, crude glycerin (83% glycerol), urea, sunflower meal, soybean hulls and mineral. Finishing diets presented 15% of roughage and 85% of concentrate. The crude glycerin derived from vegetable used is soybean oil and 30% was included in the diets of DM. Four treatments were used: glycerin during adaptation step up and finishing period (1) or glycerin just during adaptation period (2); absence glycerin during adaptation and finishing period (3) or absence of glycerin during adaptation and finishing period (4). The animals were housed in individual pens with free access to water. The diets were offered twice daily at 0800 and 1600h with 50% of total in each meal. The data were analyzed using GLM procedure of SAS statistical software 9.2 and were compared the means by Tukey's test considering 5% of significance level. There were no difference treatments among the variables: ruminating time, total idle, ruminating efficiency, bolus number and mastication per day ($P > 0.05$). The exceptions were the variables: dry matter intake, feeding time, feeding dry matter efficiency ($P < 0.05$). Diets with glycerin finishing promoted greater feeding time and lower dry matter intake, probably this effect is due to energy contribution of glycerin, which modulated the animal intake. Glycerin increases the frequency of meals and reduces meal size which is beneficial for ruminal fluid pH. It is concluded, that the use of glycerin results in better synchronization in time between feed intake (acid production) and rumination (saliva production).

Key Words: feed intake, Nellore, ruminating time

M323 Supplementary levels of *Macleaya cordata* plant extract Sangrovit-RS on feedlot performance and carcass traits of finishing bullocks. Rubén Barajas*¹, Billy J. Cervantes², Ingo Rogge³, Alejandro Plascencia-Jorquera⁴, Alejandro Camacho¹, and Marco A. Osuna¹, ¹FMVZ-Universidad Autónoma de Sinaloa, Culiacán, Sinaloa, México, ²Ganadera Los Migueles, S.A. de C.V., Culiacán, Sinaloa, México, ³Phytobiotics Futtermittelzusatzstoffe GmbH, Eltville, Germany, ⁴FMVZ-Universidad de Baja California, Mexicali, Baja California, México.

Macleaya cordata, is a plant of the *Papaveraceae* family that contains quaternary benzophenanthridine and protopine alkaloids, showing systemic anti-inflammatory effects. Despite *Macleaya cordata* plant extract being used in Europe as feed additive for livestock (Sangrovit RS; Phytobiotics, Eltville, Germany), its effects on feedlot cattle per-

formance are not well documented. Hence, 60 bullocks (368 ± SD 44.7 kg) were used to determine the effect levels of *M. cordata* plant extract Sangrovit-RS (S-RS) supplementation level on feedlot performance and carcass traits of finishing bullocks. Animals were crowded by breed in groups of 5 placed in 12 dirt-floor pen and randomly assigned to receive treatments as follows: 1) A 90% concentrate finishing diet (Control); 2) Control plus daily supplementation of 3 g of Sangrovit-RS (SRS)/bullock (SRS3); and 3) Control plus daily supplementation of 8 g of SRS/bullock (SRS8). Results were analyzed as a completely randomized design. Pen was the experimental unit. Body weight at d -21 and hot carcass weight were used as the associated co-variables, for performance and carcass characteristics, respectively. The influence of SRS level was analyzed using unequal spaced polynomials. Feed efficiency (Gain/feed ratio) responded quadratically to inclusion level of SRS ($P = 0.04$), with means of 0.17, 0.19 and 0.15 kg/kg for Control, SRS3, and SRS8, respectively; bullocks in SRS3 shown the best response, with 12% improved feed efficiency compared with Control (0.19 vs. 0.17 kg gain/kg DM). Dry matter intake tended ($P = 0.08$) to respond quadratically to SRS supplementation level, with the lowest value for SRS3. Hot carcass dressing was augmented linearly ($P = 0.03$) by SRS level. KPH-fat tended to decrease linearly as SRS intake was increased ($P = 0.11$). Results of this experiment suggest that feeding Sangrovit-RS in doses close to 3 g/day improves feed efficiency of finishing bullocks.

Key Words: feedlot performance, *Macleaya cordata*, sanguinarine

M324 Energy requirements of Nellore and Angus young bulls. Rafael A. Gomes*^{1,3}, Mario L. Chizzotti², Karina C. Busato¹, Jose Rodolfo R. Carvalho¹, Marcio M. Ladeira¹, Matheus C. Galvão¹, Maria Helena Oliveira¹, Aline C. Rodrigues¹, and Priscilla D. Teixeira¹, ¹Universidade Federal de Lavras, Lavras, MG, Brazil, ²Universidade Federal de Viçosa, Viçosa, MG, Brazil, ³Washington State University, Pullman, WA.

Fourty-8 animals with initial body weight (BW) of 380.2 ± 4.73 kg were used to determine energy requirements of Nellore and Angus young bulls using comparative slaughter technique. Four animals of each breed were slaughtered at beginning of the experiment (baseline animals). The remainder were housed in individual stalls. Eight animals of each breed were fed ad libitum with a whole shell corn (WSC) diet (85% WCS and 15% of a pellet based on soybean meal) or a silage/concentrate (SC) diet (30% silage and 70% concentrate based on corn and soybean meal). Other 4 animals of each breed were fed with the SC diet at 50% of feed restriction, based on dry matter intake adjusted for metabolic BW of animals that received the SC diet ad libitum. We measured the daily intake and a metabolic trial was conducted with total collection of feces and urine to estimate the metabolizable energy intake (MEI). At 90 d of growth, the bulls were slaughtered. Heat production (HP) was calculated as the difference between MEI and retained energy (RE). The net energy requirements for maintenance (NE_m) was estimated considering the intercept of the equation $HP = a \times e^{(b \times MEI)}$. The metabolizable energy requirements for maintenance (ME_m) was calculated by iteration, assuming the value which HP and MEI are the same. The efficiency of ME utilization for maintenance (k_m) was obtained as the NE_m divided by the ME_m. The slope of the regression of RE on MEI was assumed to be the efficiency of energy utilization for growth (k_g). The data were analyzed using the GLM and NLIN procedures of SAS adopting significance level of 0.05. NE_m was different between Angus and Nellore (99.8 vs 75.8 kcal/kg EBW^{0.75}/d). The ME_m was 150 and 122 kcal/kg EBW^{0.75} and the k_m was 67 and 62% for Angus and Nel-

lore cattle, respectively. We did not find difference between breeds ($P > 0.05$) in k_g (20%).

Key Words: maintenance, growth

M325 Influence of particle size of sugar cane and concentrate level on intake and digestibility of nutrients, and rumen fermentation in crossbred steers. T. C. da Silva*, O. G. Pereira, D. R. da Costa, R. M. Martins, M. C. N. Agarussi, L. D. da Silva, K. G. Ribeiro, and S. C. Valadares Filho, *Universidade Federal de Vicosa, Vicosa, Minas Gerais, Brazil.*

The objective of this study was to evaluate the nutrient intake, ruminal and intestinal digestibility, and the ruminal fermentation of beef cattle fed fresh sugarcane (SC) chopped in 2 particle sizes (PS) and 2 levels of concentrate (40 and 60%, DM basis). The treatments were: 1) Fine-chopped sugarcane and 40% C (FSC-40); 2) Fine-chopped sugarcane and 60% C (FSC-60); 3) Coarse-chopped sugarcane and 40% C (CSC-40); and 4) Coarse-chopped sugarcane and 60% C (CSC-60). Four Holstein \times Zebu steers (average BW of 510 ± 11 kg) were used, distributed in a 4×4 Latin square design, with a 2×2 factorial. The experiment lasted 64 d and was divided in 4 periods of 16 d each (10 d for adaptation and 6 d for samples and data collection). Data from intake and digestibility were analyzed including in the model the fixed effects of PS, C and the interaction PS \times C, and the random effects of animal and period. For the ruminal fermentation data, a scheme of time-repeated measurements was used considering the sampling time (before feeding, 2, 4 and 6 h after feeding). The geometric means (X_{gm}) were 8.30 and 15.92 mm for the FSC and CSC, respectively. The intake of DM, OM and NDF were affected by the interaction PS \times C ($P < 0.05$). The diet containing FSC showed higher intake of these nutrients than CSC-diet when 60% C was added. The amounts of OM and NDF digested in the rumen were affected by the interaction PS \times C ($P < 0.05$). The diet FSC-60 had higher amounts of OM and NDF digested in the rumen than the diet CSC-60. The amounts of OM and NDF digested in the intestine were higher in the diets containing 60% than the diets with 40% C ($P < 0.05$). The diet FSC-60 had the lowest ($P < 0.05$) pH (5.75). The ruminal ammonia-nitrogen was affected by sampling time ($P < 0.05$) and had a quadratic behavior. We concluded that fine-chopped sugarcane ($X_{gm} = 8.30$ mm) in diets with 60% of concentrate increases the intake and digestibility of nutrients without compromise the ruminal fermentation of crossbred steers.

Key Words: effective fiber, ruminal digestibility, ruminal pH

M326 Supplementation with a DHA-rich microalgae alters muscle gene expression profiles in finishing beef heifers. Kristen M. Brennan*, Daniel E. Graugnard¹, Allison C. Smith¹, James S. Drouillard², and Kate A. Jacques¹, ¹Alltech Inc., Center for Animal Nutrigenomics and Applied Animal Nutrition., Nicholasville, KY, ²Kansas State University, Manhattan, KS.

The objective of this study was to determine gene expression patterns in the muscle tissue of finishing heifers fed diets supplemented with DHA-rich algae. Angus-cross heifers ($n = 285$; 453 ± 24 kg initial BW) were randomly assigned to one of 4 treatments: control (CON) or 50, 100, or 150 g/d of DHA-rich microalgae (ALG, *Schizochytrium limacinum* CCAP 4087/2, Alltech Inc., Nicholasville, KY). Muscle samples ($n = 9$ per treatment) were obtained via biopsy from the *Longissimus dorsi* and gene expression was analyzed using the Affymetrix Bovine Gene 1.0 ST Array. Relative to the CON, a total of 2047 differentially expressed genes (DEG, 919 upregulated and 1128 downregulated), 711 genes (343

upregulated and 368 downregulated), 956 genes (440 upregulated and 516 downregulated), were differentially expressed in the 50, 100 and 150 g/d treatment groups, respectively. In the 50-g treatment group, DEG encoding enzymes involved in the synthesis of n-3 PUFA included ELOVL2 (-1.15 fold), ACOX1 (1.19 fold) and SCP2 (1.22 fold). These genes were unchanged in the 100-g and 150-g treatment groups. Biological functions commonly enriched in all 3 treatment groups included cellular development and lipid metabolism. DEG involved in free radical scavenging, including catalase (1.16 fold), superoxide dismutase (1.18 fold) and peroxiredoxin (1.14 fold) were increased in the 150-g treatment group, supporting previous findings that markers of lipid oxidation in muscle were increased in this group. Overall, these results suggest that supplementing finishing heifer diets with ALG alters the expression of genes involved in lipid metabolism and lipid accumulation in muscle tissue, and that these alterations are dose dependent.

Key Words: microalgae, gene expression, omega-3 fatty acid

M327 Influence of a tannins extract preparation supplementation level on the feedlot performance of feedlot bullocks. Rubén Barajas*, Billy J. Cervantes², Juan A. Vázquez², Alejandro Camacho¹, and Javier A. Romo¹, ¹FMVZ-Universidad Autónoma de Sinaloa, Culiacán, Sinaloa, México, ²Ganadera Los Migueles, S.A. de C.V., Culiacán, Sinaloa, México.

Eighty Brahman cross bullocks ($399.3 \pm SD 19.41$ kg) were utilized in a 56-d experiment to evaluate the influence of a tannins extract preparation supplementation level on the feedlot performance of feedlot bullocks. Bullocks were individually weighed and blocked by weight. Groups of 5 bullocks were placed in 16 dirt-floor pens (6×12 m). Pens within a block were randomly assigned to treatments follows: 1) Finishing diet (13.6% CP, 2.11 Mcal NE_m/kg) formulated with ground corn (Control, CTL); 2) Control added with 2 g of tannins extract preparation/ kg of DM (TE2); 3) Control supplemented with 4 g of tannins extract preparation/ kg of DM (TE4); and 4) Control added with 6 g of tannins extract preparation/ kg of DM (TE6). The tannins extract preparation (TE) was provided as TMP Protein Enhancer + ByPro (Tecnica Mineral Pecuaria, Mexico, that contains 50% of condensed and hydrolysable tannin blend. TE treatments were top dress on the diet in the feed bunk. Results were analyzed by ANOVA for a randomized complete block design. Three orthogonal contrasts were performed: I = 0 vs. 2 + 4 + 6 g of TE/kg DM; II = 0 vs. Two g of TE/kg DM; and III = 2 vs. Four + 6 g of TE/kg DM. and the linear, quadratic or cubic trend were tested by polynomial contrasts. The final weight of TE2 bullocks was higher than CTL ($P = 0.05$), and a tendency for a quadratic response was observed ($P = 0.10$). TE2 increased 13.8% ($P = 0.05$) the ADG respect to CTL (1.53 vs. 1.35 kg/d). ADG show a quadratic tendency ($P = 0.10$). Dry matter intake was not affected by treatments ($P > 0.20$). Feed efficiency tended ($P = 0.06$) to be better in TE2 treatment than CTL (0.174 vs. 0.156 kg gain/kg food). Gain/feed ratio responded in a quadratic manner ($P = 0.05$) as TE supplementation was increased, the best level was calculate by polynomial regression as 3 g of TE by kg of diet DM ($R^2 = 0.3$; $P = 0.05$). It is concluded that performance of feedlot bullocks respond in a quadratic manner to tannins extract supplementary level, and the best response could be expected with addition of 3 g of tannins extract by kg of diet DM.

Key Words: bovine, feedlot performance, tannin

M328 Effect of monensin withdrawal on intake and digestion in *Bos indicus* and *Bos taurus* steers consuming bermudagrass hay.

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Effects of monensin withdrawal and subspecies of cattle on the utilization of bermudagrass hay (13.7% CP) were evaluated using ruminally cannulated steers (5 *Bos indicus*, BI and 5 *Bos taurus*, BT; 398 kg BW). Subspecies were concurrently subjected to a 2 period, 2 treatment crossover design. Each period consisted of a 42 d adaptation phase with treatments including 0 (CON) or 200 (MON) mg·hd⁻¹ monensin, fed in 0.91 kg DDGS daily. Withdrawal of monensin was then evaluated for a 28 d phase following adaptation. Hay, ort, and fecal grab samples were collected d 23–27 after the cessation of MON feeding for determination of intake and digestion. Steers were group housed throughout the trial, but moved to individual covered pens to facilitate sampling. Data were analyzed using the MIXED procedure of SAS 9.3 (SAS Inst. Inc., Cary, NC) with terms in the model including treatment, subspecies, subspecies × treatment and period, with animal as a random effect. No subspecies × treatment interactions were observed ($P \geq 0.15$). A tendency for greater ($P = 0.09$) forage OM intake (FOMI; 21.2 vs 19.2 g/kg BW) and greater ($P < 0.01$) OM digestibility (OMD; 72.4 vs 63.0%) resulted in greater ($P < 0.01$) total digestible OM intake (TDOMI; 16.8 vs 13.2 g/kg BW) in BT vs BI steers. Previous monensin feeding had no effect ($P \geq 0.45$) on FOMI, OMD, or TDOMI. Greater ($P = 0.04$) forage NDF intake (FNDFI; 16.68 vs 14.94 g/kg BW) and greater ($P < 0.01$) NDF digestibility (NDFD; 73.8 vs 65.6%) led to greater ($P < 0.01$) total digestible NDF intake (TDNDFI; 12.9 vs 10.3 g/kg BW) in BT vs BI steers. Previous monensin feeding had no effect on FNDFI, NDFD, or TDNDFI. Increased FOMI, FNDFI, OMD, NDFD, TDOMI, and TDNDFI by BT steers suggest they are better able to utilize the bermudagrass hay offered them than BI steers. Results also indicate that upon treatment withdrawal, no intake or digestibility differences are observed between steers previously fed monensin and control.

Key Words: cattle subspecies, ionophore, digestibility

M329 The influence of pellet size and a pellet binder on rumen fermentation and total tract digestibility in beef heifer.

Katie M. Wood*¹, Faustin Joy¹, John Smillie¹, Rodrigo Kanafany Guzmán¹, Gillian Gratton¹, Tom A. Scott¹, Herbert (Bart) A. Lardner^{2,1}, and Gregory B. Penner¹, ¹Dept of Animal and Poultry Science, University of Saskatchewan, Saskatoon, Saskatchewan, Canada, ²Western Beef Development Center, Lanigan, Saskatchewan, Canada.

Using by-product feeds can be a means of reducing feed costs, however, challenges with the pelleting process may affect pellet quality. The effect of pellet size and durability of a by-product based pellet was evaluated in 8 crossbred ruminally cannulated heifers. The experiment was conducted as a replicated 4 × 4 Latin square design with a 2 × 2 factorial treatment arrangement. Pellets were prepared using a 3.96 mm (SP) or 12 mm (LP) die and contained Nutraflex Plus (3 kg/T) and Ameri-Bond 2X (5 kg/T) as binding agents (B) or no binding agent (NB). Heifers were fed a partial mixed ration (81.8% grass hay and 18.2% oat hull, DM basis) ad libitum and pellet was offered separately at a rate of 0.09% of BW. Heifers were provided 15 d for adaptation followed by 3 d for total fecal and urine collection, rumen fluid sampling and continuous rumen pH measurement using indwelling pH probes. Statistics were conducted using PROC MIXED in SAS with the fixed effect of

pellet size, binder inclusion, and the interaction. Tukey's adjusted post hoc mean separation test was used to compare treatment means where significance was declared at $P \leq 0.05$. Heifers fed pellet with binder had increased ($P \leq 0.05$) ADG and G:F, did not differ ($P \geq 0.33$) in DM intake. The molar proportion of acetate was greater (interaction, $P = 0.03$) in heifers fed large pellet with binder (66.0%) compared with small pellet with binder (63.9%) whereas the large and small pellets without binder were intermediate (64.6 and 63.9%, respectively). Propionate was greater (interaction, $P = 0.05$) in heifers fed large pellet (17.7%) with no binder than with binder (15.6%) and was intermediate for heifers fed the small pellet with and without binder (17.6 and 17.2%, respectively). Heifers fed binder had butyrate concentrations that were 0.68% greater ($P = 0.05$) than without binder. Total-tract digestibility was not affected. The results of this experiment indicate that overall digestibility of a by-product based range pellet was not influenced by size or binder; however, pellet size and use of a binder may influence rumen fermentation, ADG, and feed conversion.

Key Words: pellet size, binder, beef

M330 Effect of monensin concentration on rumen pH, short-chain fatty acid absorption, total-tract digestibility, and barrier function in beef heifers.

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The objective of this study was to evaluate whether the monensin concentration affects DMI, rumen fermentation, short-chain fatty acid (SCFA) absorption across the rumen and total-tract barrier function. Four ruminally cannulated Hereford × Angus heifers were used in a 4 × 4 Latin square design with 24-d periods. Heifers were fed a barley-based finishing diet (76% rolled barley grain, 12% barley silage, 8% mineral and vitamin supplement, and 4% canola meal) containing either 0, 22, 33 or 48 ppm monensin. Urinary recovery of Cr-EDTA was used as an indicator of total-tract barrier function (d 18 to 20). Days 20 to 23 were used to evaluate rumen fermentation and total-tract digestibility measurements, and SCFA absorption was measured on d 24. Data were analyzed using PROC MIXED of SAS with linear and quadratic contrasts. Increasing monensin inclusion decreased DMI linearly (10.0, 9.9, 9.3, and 9.1, kg/d DM respectively, $P = 0.01$), but as the dose of monensin increased, BW, ADG and G:F ratio were not affected ($P \geq 0.11$). Total Cr-EDTA recovery was not ($P \geq 0.61$) affected by increasing dose of monensin, nor was rumen pH (mean, minimum, maximum, duration <5.5, area under curve; $P \geq 0.21$). The acetate-to-propionate ratio decreased linearly (1.9, 1.8, 1.4, 1.3, respectively, $P = 0.03$) as dose of monensin increased. A quadratic response (35.7, 47.5, 41.8, 35.4%, respectively, $P = 0.02$) for the absorption of acetate was detected with a maximal value at 22 ppm. Ethanol soluble carbohydrate digestibility increased linearly (77.2, 84.7, 88.0, 94.0%, respectively, $P = 0.003$) with increasing doses of monensin. Starch digestibility showed a quadratic response (93.8, 93.9, 88.0, 94.0%, respectively, $P < 0.001$), where 33 ppm inclusion had a minimal value. The results from this study indicate that increased monensin inclusion decreases DMI without affecting SCFA concentrations, SCFA absorption, and total-tract barrier function.

Key Words: monensin, digestibility, barrier function

M331 Effects of essential oils and exogenous enzymes on in vitro rumen fermentation kinetics. Camila Delveaux Araujo Batalha¹, Lucas Jado Chagas¹, João Ricardo Rebouças Dórea^{*2}, Tiago Sabella Acedo², Luis Fernando Tamassia², Cristina Simões Cortinhas², and Flávio Augusto Portela Santos¹, ¹University of São Paulo, Piracicaba, SP, Brazil, ²DSM Produtos Nutricionais Brasil SA, São Paulo, SP, Brazil.

The objective with this trial was to evaluate the combination of essential oils and exogenous enzymes on ruminal DM degradation kinetics in feedlot diets. The treatments were MON (Monensin, Tortuga – 26 mg/kg DM), CRINA (Essential Oils: Crina Ruminants, DSM – 90 mg/kg DM), CRINA+MON (90 and 26 mg/kg DM, respectively), CRINA+RUM (CRINA + α -amylase: Ronozyme RumiStar, DSM – 90 and 560 mg/kg DM, respectively) and CRINA+RUM+P (CRINA+RUM+Protease: Ronozyme Proact, DSM – 90; 560 and 840 mg/kg DM, respectively). The incubated diets were composed by corn (82.5%), sugarcane bagasse (8.5%), soybean meal (5%), mineral (3%) and urea (1%). The experimental design was completely randomized, with 5 treatments and 3 replicates per incubation time. The estimated parameters of rumen degradation kinetics were soluble fraction (A), potentially degradable fraction (B), degradation rate (kd), lag time (Lag), potential degradability after 120 h of incubation time (PD = A+B). The substrate (1 g) was incubated with rumen inoculum (10 mL) and bath culture (90 mL). For each incubation time (0, 2, 4, 8, 16, 24, 48, 72, 96 and 120 h) the flask contents were filtered, dried and weighted to determine de DM disappearance. The rumen degradation parameters were analyzed using SAS system. The A and B fractions and kd were not affected by treatments ($P > 0.05$). The MON diet had higher Lag ($P < 0.05$) in comparison with other treatments. The reduction on lag is related to the increases on dry matter PD for CRINA+MON, CRINA+RUM and CRINA+RUM+P diets, probably because the rumen microorganisms starts the DM degradation earlier, reaching more extension of degradation compared with MON. In conclusion, the use of enzymes (amylase and protease) improves rumen DM degradation.

Table 1 (Abstr. M331). Combination of essential oils and exogenous enzymes on in vitro rumen fermentation kinetics

Parameter	MON	CRINA	CRINA +MON	CRINA +RUM	CRINA +RUM+P	P-value	SEM
A	20.16	20.97	19.48	21.79	19.83	0.6986	1.24
B	56.56	57.55	58.22	58.36	58.98	0.7486	1.32
kd	0.0822	0.0687	0.0739	0.0698	0.0723	0.7317	0.0064
Lag	5.34 ^a	3.74 ^b	3.07 ^{bc}	2.78 ^{bc}	2.16 ^c	0.0025	0.40
PD	76.71 ^c	78.51 ^{abc}	77.70 ^{bc}	80.15 ^a	78.80 ^{ab}	0.0700	0.73

M332 Effects of essential oils and exogenous enzymes for finishing Nellore cattle in feedlot during the adaptation period. Murillo Alves Porto Meschiatti¹, Diandra Leziér¹, João Ricardo Rebouças Dórea², Tiago Sabella Acedo^{*2}, Luis Fernando Tamassia², Cristina Simões Cortinhas², and Flávio Augusto Portela Santos¹, ¹University of São Paulo, Piracicaba, SP, Brazil, ²DSM Produtos Nutricionais Brasil SA, São Paulo, SP, Brazil.

The objective with this trial was to evaluate the combination of essential oils and exogenous enzymes during the adaptation period on performance of Nellore bulls finished in feedlot. Three hundred Nellore bulls (initial BW = 330 ± 33 kg) were fed diets containing 82.5% corn, 8.5% sugarcane bagasse, 5% soybean meal, 3% mineral, 1% urea and were randomly allocated to 50 pens. Animals were blocked based on initial BW. The treatments were MON (Monensin, Tortuga – 26 mg/kg DM), CRINA (Essential Oils: Crina Ruminants, DSM – 90 mg/kg DM),

CRINA+MON (90 and 26 mg/kg DM, respectively), CRINA+RUM (CRINA + α -amylase: Ronozyme RumiStar, DSM – 90 and 560 mg/kg DM, respectively) and CRINA+RUM+P (CRINA+RUM+Protease: Ronozyme Proact, DSM – 90; 560 and 840 mg/kg DM, respectively). Response variables included: dry matter intake (DMI), average daily gain (ADG), feed efficiency (FE, G:F) after 28 d on feed. The data were analyzed using PROC MIXED of SAS and means were compared by Tukey test considering the block as random effect and treatments as fixed effects. Cattle fed CRINA and CRINA+RUM diets presented greater ($P < 0.05$) DMI in comparison with the other treatments. The improvements on DMI were 7.8% and 9.1% for CRINA and CRINA+RUM, respectively, compared with MON. For ADG the improvements were 14.5% and 23.3% for CRINA and CRINA+RUM, respectively, compared with MON. Feed efficiency was greater ($P < 0.05$) for cattle fed CRINA+RUM diets. In conclusion, the use of essential oils and its combination with amylase improved DMI, ADG during the adaptation period. Nellore bulls were 12.4% more efficient when diets containing Amylase and essential oils were fed compared with monensin diets.

Table 1 (Abstr. 332). Combination of essential oils and exogenous enzymes on feedlot performance of finishing Nellore bulls during the adaptation period

Parameter	MON	CRINA	CRINA +MON	CRINA +RUM	CRINA+ RUM+P	P-value	SEM
Initial BW, kg	330.8	330.8	330.9	330.6	330.7	0.5422	10.9
Final BW, kg	382.5 ^b	388.2 ^a	382.8 ^b	391.2 ^a	379.6 ^b	0.0050	11.0
DMI, kg/d	7.73 ^b	8.26 ^a	7.73 ^b	8.41 ^a	7.63 ^b	0.0160	0.31
ADG, kg/d	1.352 ^b	1.549 ^a	1.354 ^b	1.667 ^a	1.251 ^b	0.0050	0.080
FE, G:F	0.177 ^{bc}	0.190 ^{ab}	0.177 ^{bc}	0.199 ^a	0.166 ^c	0.0440	0.010

M333 Shifts in rumen microbiota in response to inoculation with *Propionibacterium acidipropionici* strain P169. Elnaz Azad^{*1}, Nelmy Narvaez², Hooman Derakhshani¹, Awfa Y. Alazze^{2,3}, Yuxi Wang², Tim A. McAllister^{2,1}, and Ehsan Khafipour¹, ¹Department of Animal Science, University of Manitoba, Winnipeg, MB, Canada, ²Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB, Canada, ³Department of Clinical Nutrition, College of Applied Medical Sciences, University of Hail, Hail, Saudi Arabia.

Inoculation of cattle with *Propionibacterium acidipropionici* strain P169, a commensal rumen bacterium known for its lactate and glucose utilizing properties, has been reported to modify the profile of ruminal VFAs in favor of increased propionate production. The objective of this study was to document shifts in rumen microbiota as a result of rumen inoculation with P169. Eight ruminally cannulated steers (434 ± 33 kg) were either not inoculated (control) or inoculated with P169 (1×10^{11} cfu/head/day) by including it in the diet for 101 d. Rumen samples from liquid and solid fractions were collected every 3 wks. Genomic DNA was extracted and subjected to qPCR for quantification of P169 and Illumina sequencing of the V4 region of the 16S rRNA gene for community profiling. On average, 36,250 high quality sequences were generated per sample, resulting in identification of 16 and 15 bacterial phyla in liquid and solid fractions, respectively. No significant difference was detected in α -diversity indices between treatments. While PERMANOVA analysis of the UniFrac distances of microbial communities revealed distinct clustering of rumen liquid from solids ($P = 0.03$), β -diversity did not differ between treatments. Quantitative PCR identified a trend for an increase ($P = 0.06$) in the abundance of P169 in inoculated steers. Partial Least square discriminant analysis of sequence data found that the proportion of members of the Firmicutes (Clostridiaceae, Lachnospiraceae, and Ruminococcaceae, and *Phascolarctobacterium*), Bacteroidetes (Bacteroidales, families

RFP12 and BS11), and Synergistetes (Pyramids) were increased ($P < 0.05$) in response to P169 ($R^2 = 0.86$, $Q^2 = 0.57$). Data suggest that while inoculation with P169 altered the proportions of bacteria within the rumen, it did not change the α or β diversities of bacteria in either liquid or solid bacterial communities.

Key Words: *Propionibacterium acidipropionici* (P169), rumen microbiota, 16S rRNA sequencing

M334 A comparative assessment of dried distillers grain, ionophore, bambermycin, saponin, and condensed tannin for methane emission abatement in beef cattle. M. A. Fonseca*¹, L. O. Tedeschi¹, T. R. Callaway², and W. L. Crossland¹, ¹Texas A & M University, College Station, TX, ²USDA-ARS, College Station, TX.

The objectives of this study was to assess in vitro (IV) potential abatement of CH₄ production rate of 4 commercially available products [ionophore (I), bambermycin (B), saponin (S), and condensed tannin (CT)] when fed in combination with dried distillers grain (DDG) on growing feedlot type diets. The IV gas production technique was used to determine the fermentability of 3 base diets with 3 levels of DDG (0, 20, and 40% DM). Diets contained alfalfa hay, ground corn, and Bermudagrass hay. The 15 diets (DDG0, DDG20, DDG40, I0, I20, I40, B0, B20, B40, S0, S20, S40, CT0, CT20, and CT40) were incubated in duplicates, 6 times each (15 × 2 × 6 × 2; n = 360 bottles), and the alfalfa hay was incubated alone in each run as standard. Blanks (n = 2 bottles/incubation time), containing rumen fluid and medium only, were used to adjust the CH₄ production. Methane was computed as adjusted CH₄ concentration divided by the amounts of NDF (CH₄NDF, mM/g NDF), NFC (CH₄NFC, mM/g NFC), fermentable carbohydrate (FCHO = sugar + starch + available NDF) (CH₄FCHO, mM/g FCHO), OM (OM = 100 – Ash) (CH₄OM, mM/g OM), and fermentable OM (FOM = OM – Ash) (CH₄FOM, mM/g FOM). The PROC MIXED of SAS (SAS Inst., Cary, NC) was used to analyze the CH₄ data assuming a completed randomized design. Diets, products, and products within levels were assumed to be fixed factors and replicate within diet to be random. The convergence method was REML. Products affected CH₄ production for total concentration ($P = 0.0003$), Adj CH₄ ($P < 0.0001$), CH₄NDF ($P < 0.0001$), CH₄NFC ($P < 0.0001$), CH₄FCHO ($P < 0.0001$), CH₄FOM ($P < 0.0001$), and CH₄OM ($P < 0.0001$). Ionophores had the greatest effect ($P > 0.05$) among all tested products to further decrease CH₄ production, being the only significantly different from the DDG control diets. Levels (0, 20 and 40% DM) of DDG were not significant ($P > 0.2076$) in decreasing CH₄ production. This is probably because the fat content in the diets were not high enough. Previous IV data from our laboratory had shown that responses in CH₄ mitigation due to fat content in the diet was only significant when DDG levels were over 50% or 7.3% EE in the diet. These IV results suggested that ionophores have the potential to further decrease methane production from ruminants fed DDG based diet.

Key Words: greenhouse gas emissions, dried distillers grain (DDG), methane mitigation

M335 Effect of dietary supplementation of β -mannanase in Hanwoo growing heifers. Jakyeom Seo¹, Jeongsoo Park*¹, Junsung Lee¹, Jae-Hwan Lee², Jung-Jin Lee², Dong Keun Kam³, and Seongwon Seo¹, ¹Department of Animal Biosystem Sciences, Chungnam National University, Daejeon, Republic of Korea, ²CTC Bio Inc., Seoul, Republic of Korea, ³Cargill Agri Purina Inc., Seongnam, Republic of Korea.

Supplementation of β -mannanase, an enzyme that breaks down mannan, in a diet composed of high mannan contained feedstuffs (e.g., palm kernel meal, copra meal, soy hull; HMCF) improves utilization of feeds not only in monogastric animals, but also in goats and Holstein calves. No study, however, has been conducted to evaluate the effect of β -mannanase supplementation in Hanwoo (*Bos taurus coreanae*) growing heifers. Moreover, little is known whether β -mannanase supplementation also has beneficial effects in conventional corn-soy based diets (CS). The objective of this study was thus to investigate the effect of supplementation of β -mannanase in Hanwoo growing heifers fed a diet composed of either a CS or HMCF based concentrate mix. For this purpose, a feeding trial was conducted for 12 weeks using a total of 40 Hanwoo growing heifers (BW: 236.2 kg \pm 1.1 kg, 11 mo of age). Total mixed rations (250 g/kg of ryegrass and 750 g/kg of concentrate mix) were offered ad libitum. The experimental design was 2 × 2 factorial approach with 2 different concentrate mixes (CS or HMCF based) and with or without a commercial feed β -mannanase (800,000 U/kg DM) product (CTCZYME, CTC Bio Inc., Seoul, Korea) at a level of 1 g/kg in concentrate mixes. In both diets, supplementation of β -mannanase significantly increased ADG of Hanwoo heifers by 95 g/d on average (111 g/d or 90 g/d for CS and HMCF, respectively; $P < 0.05$). No significant difference was observed in DMI among treatments ($P > 0.10$), and thus, β -mannanase supplementation tended to decrease feed conversion ratio (DMI/ADG) by 1.3 on average ($P = 0.06$). The ADG of CS (943 g/d) was significantly greater than that of HMCF (854 g/d), as expected ($P < 0.05$). These results indicated that supplementation of β -mannanase enhanced growth rate and feed efficiency of Hanwoo heifers regardless of the basal diets. Therefore, we conclude that supplementation of β -mannanase can be beneficial to improve the feed utilization in Hanwoo growing heifers.

Key Words: β -mannanase, growing heifer, growth rate

M337 Calculating residual feed intake using high-frequency partial body weights. Ann Kenny*¹, David Benfield², Camiel Huisma², and Kevin Garossino², ¹University of Missouri, Columbia, MO, ²GrowSafe Systems Ltd., Airdrie, AB, Canada.

Residual feed intake (RFI) calculations were compared using either conventional chute weighing (CW) or partial body weights (PBW) collected with specialized data acquisition systems (DAS). Per-second PBW, CW and feed intake (FI) data of beef cattle (n = 3743) from 49 contemporary groups located throughout Canada, Australia and USA was compiled. Data for PBW and FI was collected using automated DAS which non-invasively collected per-second information on individual animals while eating or drinking (GrowSafe Systems Ltd., Airdrie, AB, Canada). Chute weights were taken at varying time points while cattle were on feed. Total BW was converted from PBW using a constant conversion factor. Correlations of RFI calculation, between FI and metabolic weight ($W^{0.75}$) and between FI and ADG using CW, PBW or a combination of CW and PBW (COMB) were examined. Paired T-Tests were performed to compare calculated R² values. Linear regression on CW and PBW demonstrated a high degree of correlation ($R^2 = 0.962$), which remained similar when data were sorted by sex (Bull n = 5077 $R^2 = 0.962$; Heifer n = 4942 $R^2 = 0.953$; Steer n = 4331 $R^2 = 0.972$). The R² values of the calculated RFI were greater (0.614 vs 0.590; $P = 0.0016$) for CW compared with PBW. The correlation between FI and ADG also had greater R² values for CW vs COMB ($P = 0.0224$). The correlation between FI and $W^{0.75}$ tended to have lower R² values for PBW compared with CW ($P = 0.0551$) and COMB ($P = 0.0551$). Comparison of individual animal RFI calculations using PBW or CW identified differences in RFI values of greater than one standard

deviation (SD) in 2.7% of animals and greater than 2 SD in 0.2% of animals. These differences were associated with chute weight errors and nonlinear growth. RFI rankings within contemporary groups changed < 23% in 90% of animals evaluated when weighing techniques were compared. The use of DAS for collecting PBW and FI measurements was determined to be a viable method for RFI ranking of animals within contemporary groups. High-frequency PBW information also provided the ability to calculate RFI with better rejection of errors caused by incorrect chute weights and issues caused by nonlinearity in growth.

Key Words: residual feed intake, body weight

M338 Effect of different supplementation strategies on grazing and ingestive behavior in cattle finished on pasture. Guilherme Felipe Berti¹, Rodolfo Maciel Fernandes², Matheus Henrique Moretti², Mauricia Brandao Silva³, Paloma Helena Gonçalves¹, Michele Aparecida Prado Alves¹, Flávio Dutra Resende^{4,2}, and Gustavo Rezende Siqueira^{4,2}, ¹Centro Universitario de Barretos, Barretos, Sao Paulo, Brazil, ²Universidade Estadual Paulista, Jaboticabal, Sao Paulo, Brazil, ³Universidade Estadual Paulista, Botucatu, Sao Paulo, Brazil, ⁴Agencia Paulista de Tecnologia dos Agronegocios, Colina, Sao Paulo, Brazil.

The objective of this observational study was to describe grazing and ingestive behavior of Nelore cattle under field conditions fed 2 grain supplementation strategies during the dry season. Forty-eight finish Nelore bulls (± 340 kg of initial body weight and ± 20 mo of age)

were blocked by body weight and assigned to 6 paddocks of 2.4 ha each of *Brachiaria brizantha* 'Marandu' pastures. The experiment was conducted as a randomized complete block experiment with 2 treatment factors for 140 d from May to September 2012. Treatment factors consisted of 2 levels of grains supplementation - 1.5% BW/daily (DMI) (SUPL1.5) and 2.0% BW/daily (DMI) (SUPL2.0) offered once a day (at 8 a.m.). Were evaluated the animals daily grazing time and time spent near the trough (min/day) during continuous 72h after supplementation, with intervals of 5 min. The observation occurred in 2 different period – Day (8 a.m. until 7:59 p.m.) and Night (8 p.m. until 7:55 a.m.). Data were analyzed using the MIXED procedure of SAS with sampling time serving as a repeated measure. Paddocks served as the experimental unit. The SUPL1.5 animals had greater ($P < 0.01$) grazing activity than SUPL2.0 (298.5 min and 244.2 min, respectively). Although, SUPL2.0 animals spend 20% more time near to the trough compared with SUPL1.5 animals ($P < 0.01$). Period significantly affected grazing time, with animals spend more time in grazing activity during the day (166.6 min) compared with the night (104.7 min; $P < 0.01$). The time spend near to the trough was greater during the day period ($P < 0.01$), increased rapidly in the firsts 3 h after the grain supplementation. This study indicates that the high supplementation (2.0% of the body weight) decrease the grazing time and increase the time spent near to the trough. Supported by CNPq/BELLMAN.

Key Words: beef cattle, grazing behavior, finishing pasture supplementation