

Ruminant Nutrition: Beef: Co-products

T239 Microbial community shifts during anaerobic digestion of finishing cattle manure with and without distillers grains in the diet. S. C. Fernando, A. K. Watson, Y. A. Wanniarachchi, T. J. Klopfenstein, G. E. Erickson, J. L. Harding, A. L. Shreck,* C. J. Johnson, and M. M. Klosterman, *University of Nebraska, Lincoln.*

Two diets were fed to finishing cattle and the manure was used to monitor methane production and microbial communities associated with anaerobic digestion of feedlot manure. Diet 1 contained 82.5% dry rolled corn (CONT) and diet 2 contained 40% wet distillers grains plus solubles (DM basis) replacing dry rolled corn (WDGS). Manure (feces and urine) was collected and frozen until used in anaerobic digesters. Continuously stirred anaerobic digesters ($n = 7$, 1 L capacity) were maintained for 5 mo to reach steady-state. Upon reaching steady-state, 50 mL of effluent was removed and replaced with 50 mL of manure/water slurry (9% DM) collected from CONT ($n = 4$) or WDGS ($n = 3$) fed animals on a daily basis. After a 35 d adaptation, samples were collected at 3-d intervals for microbial community analysis. The concentration of methane was measured under constant flow of N₂ gas and was 0.116 and 0.137 L/g OM fed into the digester ($P = 0.05$) from CONT and WDGS respectively. The microbial communities (Eubacterial and Archaeal) were identified using 454-pyrosequencing. An average of 10,000 and 3,000 sequences were generated from each sample to evaluate the Eubacteria and Archaea communities respectively. Community level analysis revealed structuring of microbial communities based on diet ($P < 0.001$). Bacteria belonging to the phylum *Chloroflexi* (65.7%) and *Bacteroidetes* (19.2%) dominated the microbial community in digesters receiving WDGS manure. Within phylum *Chloroflexi*, genus *Longilinea* (35.7%) and unclassified *Anaerolineaceae* (64.3%) accounted for most of the sequences. In contrast, digesters receiving CONT manure was dominated by phylum *Bacteroidetes* (68.2%) and *Chloroflexi* (24.5%). Within phylum *Bacteroidetes*, genus *Proteiniphilum* (50.6%) and unclassified *Porphyromonadaceae* (45.5%) accounted for a most of the sequences. These results suggest the microbial food chain that contributes toward methane production is greatly influenced by the diet fed to cattle, suggesting that dietary manipulation may provide opportunities to reduce (or increase if desirable) methane production from cattle manure.

Key Words: anaerobic digester, methane, microbial

T240 Effects of crude glycerin on in vitro gas production and VFA profiles in Nellore feedlot steers. E. H. C. B. van Cleef*^{1,2}, J. M. B. Ezequiel², A. P. D'Aurea^{1,2}, A. C. Homem Junior^{1,3}, F. B. O. Scarpino^{1,4}, R. M. P. Pardo⁵, and E. M. Ferreira⁶, ¹São Paulo State University, Jaboticabal, São Paulo, Brazil, ²FAPESP, ³CAPES, ⁴CNPq, ⁵Sucre University, Sincelejo, Colombia, ⁶University of São Paulo, Piracicaba, São Paulo, Brazil.

Two studies were conducted to evaluate the effects of crude glycerin on in vitro gas production and VFA profiles in feedlot Nellore steers. Ruminal fluid was collected from 5 rumen-cannulated steers fed finishing diets (70% concentrate) composed by corn silage, corn grain, soybean hulls, sunflower meal, mineral supplement and one of 5 concentrations (0, 7.5, 15, 22.5, or 30%) of crude glycerin (84% glycerol). Samples of 125 mL of ruminal fluid were placed into 250-mL flasks equipped with pipe collectors coupled to gasometers made with PET bottles. Total mixed rations were added at 1.7 g DM/flask, and consisted of the same ingredient mixture fed to each donor steer. Gas production (CH₄ and

CO₂) were determined after 12 h of incubation at 39°C and repeated for 5 d (periods). Study 2 used the same treatments and donor animals. To determine VFA profiles 25 mL were collected 1 h before feeding, 1, 2, 4, 6, and 8 h after feeding. Samples of 1.6 mL were centrifuged with 0.4 mL meta-phosphoric acid and formic acid solution, and 0.2 mL of 2-ethyl-butyric acid 100 mM. After centrifugation, 1.2 mL was analyzed for concentrations of VFA using a gas chromatograph. The statistical design used was a Latin square (5 × 5) and data were analyzed using the MIXED procedure of SAS, in which contrasts were used to determine linear and quadratic effects of crude glycerin, and control treatment vs. crude glycerin treatment. Adding crude glycerin decreased in vitro production of CH₄ ($P \leq 0.01$) and CO₂ ($P \leq 0.05$). VFA profiles were highly affected by addition of crude glycerin. Propionate, valerate and butyrate were increased ($P \leq 0.01$) and acetate concentration was decreased ($P \leq 0.01$) as well as acetate:propionate ratio ($P \leq 0.05$). These results suggest that the crude glycerin causes significant changes in VFA profile decreasing waste of energy by the animals, evidenced by the decrease in methane production.

Key Words: biodiesel, co-products, methane

T241 Effect of lipid sources addition on nutrient intake of steers finished at feedlot. G. Fiorentini*^{1,2}, I. P. C. Carvalho^{1,2}, J. F. Lage^{1,2}, R. C. Canesin^{1,2}, C. S. Ribeiro Junior^{1,2}, and T. T. Berchielli^{1,3}, ¹Universidade Estadual Paulista (UNESP) - FCAV, Jaboticabal, SP, Brasil, ²Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), São Paulo, SP, Brazil, ³Instituto Nacional de Ciência e Tecnologia em Ciência Animal (INCT-CA), Brasília, DF, Brazil.

The objective of this study was to evaluate the effect of different lipid sources on nutrient intake of steers finished at feedlot. Forty-five Nellore steers (initial average body weight of 423kg, with 16 mo age) were feed on 60% maize silage and 40% concentrate, with 7% of ether extract on total diet. The fat sources were soybean grain (SG), protected fat (Lactoplus®) (PF), linseed oil (LO) and palm oil (PO) plus a control (CO) treatment, without additional fat. The supplements were based in corn and soybean meal. The animals were housed on individual stalls, for 90 d (divided in 3 periods of 30 d). The leftovers were removed and weighed every day. The feed and leftovers were analyzed for nutrient composition dry matter (DM), neutral detergent fiber (NDF) and crude protein (CP). The animals were assigned to a completely randomized design, with 5 treatments and 9 replications. The effect of diet type, period and its interaction were analyzed by ANOVA. When significant, differences were analyzed by the Tukey test. The results showed that the lipid source affected significantly ($P < 0.001$) the nutrient intake, evaluated as dry matter (DMI), neutral detergent fiber (NDFI) and crude protein (CPI), expressed in kg/animal/d. The period also affected significantly ($P < 0.01$) the DMI and CPI. There was no significant interaction between diet and period. Generally, in first and second period animals that received CO and PF showed greater intake of DM (8.7, 8.1, 7.6 and 7.6), NDF (3.1, 2.8, 2.8 and 2.7) and CP (1.4, 1.3, 1.2 and 1.2), respectively, while animals that received PO had the lowest intake of nutrients (3.8 and 4.2 kg DM, 1.9 and 1.94 kg NDF and 0.5 and 0.6 kg CP), respectively to first and second period. However, in third period the diets CO, PF and SG had greater DMI and CPI than PO while NDFI did not differ among diets. These results suggest that the addition of lipid sources at the level of 7% in diet influences the nutrients intake of feedlot steers. Diets with

PF and SG or CO provides a greater nutrient intake while the presence PO in the diet decreases the voluntary intake due to low acceptability.

Key Words: beef cattle, palm oil, protected fat

T242 Feeding distillers grains as an energy source to gestating and lactating beef heifers: Impact on steer progeny longissimus muscle fatty acid profile. P. J. Gunn^{*1}, G. A. Bridges², R. P. Lemenager¹, and J. P. Schoonmaker¹, ¹Department of Animal Sciences, Purdue University, Lafayette, IN, ²North Central Research and Outreach Center, University of Minnesota, Grand Rapids.

Angus-cross beef heifers pregnant to a single sire (n = 80) were used to assess the effects of feeding dried distillers grains with solubles (DDGS) as an energy source during late gestation and early lactation on LM fatty acid profile of the male progeny. From 192 d of gestation through 118 ± 0.2 d of lactation, dams were fed either a control diet of corn silage and haylage (CON; 10% CP prepartum; 11.8% CP postpartum) or corn stover and DDGS (DG; DDGS at 1.2% BW per d; 15.7% CP) diet. Due to bunk design, progeny access to diets was unable to be restricted. Male progeny (n = 36) were weaned, commingled, and started on a step-up diet at 186 ± 0.2 d of age. At 210 ± 0.2 d of age, steers were placed in individual pens and fed a finishing diet devoid of DDGS (12.7% CP, 1.36 kcal/kg NEg on DM basis), once daily for ad libitum consumption. Steers were harvested at a common 12th rib fat depth of 1.41 ± 0.22 cm. A LM sample from the 12–13th rib interface of the carcass was collected, ground, and extracted for analysis of fatty acid methyl esters. Data were analyzed using the MIXED procedures of SAS. Concentrations of myristoleic (14:1) and palmitoleic (16:1) acids tended to be greater ($P = 0.06$) in CON than DG progeny. Conversely, DG progeny had greater stearic (18:0; $P = 0.01$; 17.3 vs. 15.9 g/100 g) and eicosenoic acid (20:1 n-9; $P = 0.004$; 0.105 vs. 0.094 g/100 g) concentrations than CON progeny. All other fatty acids and classes of fatty acids (short chain, medium chain, long chain, saturated, monounsaturated, and polyunsaturated), as well as the proportion of omega 3 and omega 6 fatty acids did not differ due to maternal treatment ($P \geq 0.17$). In summary, feeding DDGS at 1.2% of BW per day to first-parity heifers marginally affected LM fatty acid profile in steer progeny.

Key Words: DDGS, developmental programming, steer

T243 Effect of distillers grain supplementation on fescue intake and utilization. C. A. Schaeffer,^{*} E. S. Vanzant, J. W. Lehmkueler, and K. R. McLeod, University of Kentucky, Lexington.

This experiment was conducted to determine effects of increasing level of supplemented dried corn ethanol distillers grains with solubles (EDG; 29% CP, 5% EE, DM basis) on intake and utilization of moderate quality tall fescue hay (12% CP; DM basis). Ruminally cannulated steers (n = 18, initial BW = 247 ± 6 kg) were used in a randomized complete block design. EDG was fed daily at 0, 0.25, 0.5, 0.75, 1.0, or 1.25% BW (DM basis). Hay was offered at 125% of the previous 5-d mean intake. Steers were adapted to diets for 14d before 2 sequential 7-d periods for intake and digestion measurement and 2d for determining ruminal fermentation and kinetic responses. Forage OM intake (FOMI, %BW), responded quadratically to treatment ($P = 0.05$) with little change in FOMI up to 0.75% BW EDG and decreasing FOMI thereafter. Total and digestible OM intakes (%BW) responded quadratically ($P = 0.05$), increasing from 0 to 0.75% BW EDG and plateauing between 0.75% and 1.25% EDG. OM digestibility responded cubically ($P = 0.07$) and was maximal at 0.5% BW EDG. NDF digestibility decreased linearly ($P = 0.06$) with increasing EDG. All ruminal fermentation variables demonstrated time x treatment interactions ($P \leq 0.10$). Ammonia

concentration peaked 3 h post feeding, was lowest at 9 h post feeding and generally increased linearly ($P < 0.10$) with increasing EDG. Pre-feeding ruminal pH increased linearly ($P < 0.01$) with increasing level of EDG. At all other sampling times, pH decreased linearly ($P \leq 0.02$) with increasing EDG. Increasing level of EDG had little impact ($P > 0.14$) on total VFA concentrations. Ratio of acetate to propionate responded cubically ($P \leq 0.07$) to treatment at most time points. However, the linear portion of the response explained most ($\geq 78\%$) of the variation in A:P at all sampling times except 0h, when A:P decreased as EDG increased. Liquid dilution rate was not affected by treatment ($P \geq 0.24$) nor was rumen content of OM (%BW) either just before ($P \geq 0.26$) or 4 h post ($P \geq 0.15$) feeding. Results suggest that, with growing cattle grazing fescue, increased growth would be expected as EDG supplementation increased to about 0.75% BW, with higher levels of EDG having little effect on gain.

Key Words: distillers grains, forage, intake

T244 Effect of soybean hull level on diet digestibility and growth performance of beef calves. J. R. Russell,^{*} M. S. Kerley, and W. J. Sexten, University of Missouri, Columbia.

The objective was to determine a breakpoint where the fiber:starch may benefit from exogenous methods to improve fiber digestion. Fiber digestibility should be greatest at a DM WSC intake of 0.4% BW (diet 80) and should decrease as fiber:starch changes. Five diets with increasing soybean hull (SH) to whole shelled corn (WSC) ratios (20, 60, 80, 90, and 100% SH) were fed to beef cattle to determine the effect of increasing fiber inclusion on digestibility of DM (DMd), NDF (NDFd), and ADF (ADFd) as well as DMI, ADG, and G:F. Cattle were blocked by sex and stratified by BW. The diets were distributed across 40 steers (347 ± 29 kg BW) and 50 heifers (374 ± 24 kg BW) and fed for 70 d. Titanium dioxide was included in the diet for the final 14 d with fecal samples collected on d 70. Diets were balanced for RDP and post-ruminal AA based on available ME. Individual DMI was measured using the Growsafe Feed Intake System. Means comparison was used to identify significance. Diet 20 and 80 did not differ ($P > 0.05$) in DMd, however 20 was greater ($P < 0.05$) than 60, 90, and 100. The DMd was not different ($P > 0.05$) between the 60, 80, 90, and 100 diets. Diet 80 had a tendency to be greater than 20 for NDFd ($P < 0.08$) and ADFd ($P < 0.06$), though neither 80 nor 20 differed ($P > 0.05$) from the other 3 diets. Diet 80 was greater ($P < 0.05$) for DMI than 60, 90, and 100 but did not differ ($P > 0.05$) from 20. There was no difference ($P > 0.05$) in DMI between 20, 60, 90, 100. Diet 20 was greatest ($P < 0.05$) for ADG. The ADG of diets 60 and 80 did not differ ($P > 0.05$) but 80 was greater ($P < 0.05$) than 90 and 100. Diets 60, 90, and 100 did not differ ($P > 0.05$) for ADG. Diet 20 had the greatest ($P < 0.05$) G:F while the other diets did not differ ($P > 0.05$). In this experiment SH had approximately 70% energy equivalence to WSC. Intake of WSC at 0.4% BW increased ADG but did not improve G:F. Methods are needed to improve fiber digestibility of SH to make animal performance on SH-based diets comparable to starch-based diets.

Key Words: digestibility, fiber, soybean hulls

T245 Ruminal fermentation and blood metabolites of Holstein steers fed diets differing in wheat processing and fat source. K. Erjaei, A. Zali, M. Ganjkanlou,^{*} and M. Dehghan-Banadaky, University of Tehran, Tehran, Iran.

To evaluate the effects of wheat processing and dietary fat source on ruminal fermentation and blood metabolites, Holstein steers (n = 28)

averaging 296 ± 56 kg were randomly allotted in 4 treatment (7 steers each). An experiment was conducted in a 2×2 factorial arrangement (2 methods of wheat processing: steam flake and treatment with formaldehyde and fat source: roasted soybean and Rumifat) with completely randomized design. On the last days of experiment, from each steer, blood samples were collected from the coccygeal vein and samples of ruminal fluid were collected by stomach tube. There were no significant differences among diets for ruminal pH, total volatile fatty acids (VFA) and ammonia nitrogen ($\text{NH}_3\text{-N}$) concentrations. Concentration of propionate was greater, in steers fed steam flake wheat ($P < 0.01$). Other VFA concentrations were not affected significantly by dietary treatments. Plasma cholesterol and triglyceride concentrations were significantly lower and higher respectively in steers fed roasted soybean ($P < 0.01$ and $P < 0.01$). Plasma glucose concentration was higher ($P < 0.01$) in steers fed wheat treatment with formaldehyde. Steers fed roasted soybean had lower blood urea nitrogen ($P < 0.01$). Plasma NEFA and total protein concentrations were unaffected by dietary treatments. Results of this study show that wheat treatment with formaldehyde might be expected to protect starch from rumen degradation. Also blood metabolites indicate that roasting of soybean may protect ether extract and protein from rumen degradation.

Key Words: wheat processing, roasted soybean, ruminal fermentation

T246 Feedlot performance and fatty acid composition of muscles from Holstein steers fed diets differing in wheat processing and fat source. K. Erjaei, A. Zali, M. Ganjkanlou,* and M. Dehghan-Banadaky, *University of Tehran, Tehran, Iran.*

To evaluate the effects of wheat processing and dietary fat source on performance and fatty acid composition of muscles, Holstein steers ($n = 28$) averaging 296 ± 56 kg were randomly allocated in 4 treatment (7 steers each). An experiment was conducted in a 2×2 factorial arrangement (2 methods of wheat processing: steam flake and treatment with formaldehyde and fat source: roasted soybean (RSB) and Rumifat) with completely randomized design. The study lasted 98 d (14d adaption). Dry matter intake (DMI) and average daily gain (ADG) of calves were measured daily and monthly respectively. Following the final weighing at 85d, To measure the traits related with carcass characteristics 3 steers per treatment were slaughter. No significant differences were detected for DMI, ADG and feed efficiency. Carcass traits were not affected by dietary treatments. The amount of C18:2, C18:3, C24:0 and polyunsaturated fatty acids were greater ($P < 0.01$) in muscles from steers fed RSB. Also the amount of C18:0 and conjugated linoleic acid were greater ($P < 0.02$) in muscles from steers fed RSB. In contrast the amount of C: 16 and saturated fatty acid were greater ($P < 0.01$ and $P < 0.05$, respectively) in muscles from steers fed Rumifat. It was concluded that no difference were detected in performance of steers by fed diets differing in wheat processing and fat source but the use of RSB in the diet improved the fatty acid composition of muscles in terms of human health.

Key Words: roasted soybean, fatty acids, Holstein steers

T247 Evaluation of the ruminal bacterial diversity of cattle fed diets containing citrus pulp pellets (CP) using bacterial tag-encoded FLX amplicon pyrosequencing (bTEFAP). P. R. Broadway*¹, T. R. Callaway², J. A. Carroll³, N. C. Burdick³, J. R. Donaldson⁴, R. J. Rathmann¹, B. J. Johnson¹, J. T. Cribbs¹, L. M. Durso⁵, D. N. Miller⁵, D. J. Nisbet⁶, and T. B. Schmidt⁶, ¹*Department of Animal and Food Sciences, Texas Tech University, Lubbock*, ²*Food and Feed Safety Research Unit, Southern Plains Agricultural Research Center, USDA-Agricultural Research Service, College Station, TX*, ³*Livestock*

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The rumen microbial ecosystem has been extensively studied, but remains a mystery from a quantitative perspective. Dietary components and changes cause shifts in the ruminal microflora that can affect animal health and productivity, but the majority of these changes remain unknown. The objective of this study was to analyze the diversity of bacterial populations in the rumen of cattle fed various amounts of citrus pulp (CPP). Heifers ($n = 18$; 298.7 ± 5.1 kg) were fed a basal feedlot diet and randomly assigned to 1 of 3 diets ($n = 6/\text{diet}$). Diets containing CPP (0, 10, or 20%) were formulated to be exchanged with steam flaked corn on a 1:1 basis. Using bacterial tag-encoded FLX amplicon pyrosequencing (bTEFAP), the normal ruminal microbiota was examined to understand how different concentrations of a common by-product feedstuff affect ruminal microbial ecology. Bacteria in the genera of *Prevotella* and *Eubacterium* were found to be the predominate bacteria that populated the rumen comprising 34% and 6%, respectively, of the bacterial population. The Firmicutes:Bacteroidetes ratio tended to increase ($P = 0.07$) in animals fed CPP when compared with controls. Also, *Butyrivibrio* and *Carnobacterium* populations increased in number with increasing amounts of CPP in the feed ration. In contrast, a decline ($P = 0.009$) in the population of *Dialister* and *Catonella* occurred with increasing CPP. An increase ($P = 0.04$) in the proportion of Bacilli bacteria in the ruminal microflora was associated with increases in dietary CPP. Overall, there were relatively few changes observed in ruminal microbial populations highlighting the functional flexibility of the rumen and demonstrating that feeding CPP at rates up to 20% does not adversely affect ruminal microbial ecology. The lack of major changes in ruminal microflora may possibly be due to a lack of essential oils in the CPP which may play a greater role in the alteration of ruminal microbial populations and may also explain the lack of apparent effect seen in other studies.

Key Words: bacterial diversity, citrus pulp

T248 Rumen dynamics of neutral detergent fiber in grazing steers supplemented with lipid sources. I. P. C. Carvalho*^{1,4}, T. T. Berchielli^{1,3}, G. Fiorentini^{1,4}, E. Detmann², L. G. Rossi¹, J. F. Lage^{1,4}, Y. T. G. Salcedo¹, and C. S. Ribeiro Junior^{1,4}, ¹*Universidade Estadual Paulista Julio de Mesquita Filho, Jaboticabal, Brazil*, ²*Universidade Federal de Viçosa, Viçosa*, ³*INCT/CA member, Brazil*, ⁴*FAPESP, Sao Paulo, Brazil.*

This study was carried out to evaluate the effects of lipid sources in supplements on the flow kinetics of fibrous particles and neutral detergent fiber (NDF) degradation profile using Nellore steers on *Brachiaria brizantha* 'Xaraes' pasture. Ten fistulated Nellore steers with average live weight of 350 ± 9.5 kg were randomly assigned to a double 5×5 Latin square design. Different lipid sources (linseed oil, palm oil, soybean grain and calcium salts (Lactoplus) was added to the supplements (100 g/kg DM) and offered at 1.0% body weight. The control treatment was composed of a corn and soybean meal supplement with no additional fat. The transit kinetics of fibrous particles was done through a pulse dose of ytterbium mordant fiber. Fecal samples were collected at 0, 3, 6, 9, 12, 24, 36, 48, 72, 96 and 120 h after marker administration. In situ fiber incubation was carried out to estimate the rumen degradation parameters of NDF, with the incubation times corresponding to the fecal sampling. The transit kinetics parameters were estimated through adjustment of

a gamma-2 time-dependent model to the ytterbium excretion profiles. All adjustments of non-linear models were performed according to the Gauss-Newton iterative algorithm. The effectively degraded fraction of potentially degradable NDF (EDF), discrete lag (LAG) and mean retention time in the rumen (MRTR) are secondary parameters, derived from the rumen flow of fibrous particles (γ) and common rate of lag and degradation (λ), therefore, not subject to statistical analyses. The potentially degradable and undegradable fraction of pasture NDF were 52.83 and 47.17g/Kg, respectively. The time of intestinal transit (τ) was not affected ($P > 0.05$) by lipid supplementation. Animals fed palm oil had a reduction on γ and λ ($P < 0.05$). EDF and LAG were also lower on palm oil diet. This results indicates that the inclusion of palm oil in the supplement of grazing animals impair fibrous substrates utilization.

Table 1. Estimated parameters of fibrous particles kinetics and neutral detergent fiber degradation profile according to lipid source supplementation

Treatment	γ (h ⁻¹)	λ (h ⁻¹)	τ (h)	EDF (%)	LAG (h)	MRTR (h)
Control	0.0319	0.060	5.75	72.19	4.70	62.70
Palm	0.0185	0.021	6.95	54.73	13.42	108.11
Linseed	0.0318	0.054	5.90	70.12	5.22	62.89
C. Salts	0.0234	0.056	6.74	79.93	5.03	85.47
Soybean G.	0.0330	0.058	6.47	67.73	4.86	60.61
P-value	<0.0001	<0.0001	0.8746	-	-	-

Key Words: beef cattle, degradation rate, oil

T249 Effects of supplementation with a pressed dried distillers grain block on beef cow performance and hay intake during late gestation. C. L. Marshall^{1*}, J. D. C. Molle¹, J. M. Kern¹, R. A. Vraspir¹, A. N. Scheaffer², S. L. Lake¹, and A. M. Meyer¹, ¹Department of Animal Science, University of Wyoming, Laramie, ²SweetPro LLC, Walhalla, ND.

Multiparous crossbred beef cows (n = 72; BW = 600.2 ± 6.2 kg, BCS = 4.3 ± 0.4, age = 6.9 ± 0.1 yr) in late gestation were blocked by expected calving date and randomly allocated by BW to 1 of 3 treatments: ad libitum chopped grass hay (CON; 6.5% CP and 56.8% NDF, DM basis), CON hay with ad libitum access to a pressed dried distillers grain block (BLOCK; SweetPro 16; 16.0% CP and 5.0% fat), and CON hay with 0.57 kg/cow per day of a positive control supplement (POS; 57% corn and 43% DDGS; 16.0% CP and 6.0% fat). Each treatment had 6 replicates (n = 4/pen), and the trial consisted of 2 periods (period 1: d 1 to 41; period 2: d 42 to 70). Hay was weighed and fed twice daily and refusals weighed once weekly to determine pen hay intake. All CON and POS cows had ad libitum access to a trace mineralized salt, whereas macro and trace minerals were provided by the BLOCK supplement. Data were analyzed with treatment, block, and treatment x block as fixed effects in the model for performance measures. Week and week x treatment were also fixed effects in the model for hay intake. Means were separated using LSD and considered significant when $P \leq 0.10$ or tendencies when $P < 0.15$. Hay intake was affected ($P = 0.06$) by treatment, where cows receiving the BLOCK treatment consumed less ($P = 0.02$) hay than CON (15.07, 15.43, 15.26 ± 0.11 kg for BLOCK, CON, and POS, respectively). Although BW change was not affected ($P = 0.29$) by treatment during period 1, BLOCK and POS had greater BW change during period 2 ($P \leq 0.07$) and for the overall trial ($P = 0.005$). During period 1, cow BCS change tended to be affected ($P = 0.11$) by treatment, where BLOCK and POS had greater ($P \leq 0.09$) BCS change than CON. Body condition score change during period 2 and overall was unaffected ($P \geq 0.46$) by treatment. Additionally, treatment did not affect ($P \geq 0.35$) ultrasonic backfat thickness, LM depth, or marbling

score. These data suggest that the ad libitum pressed dried distillers grain block used was not only able to improve cow performance in a similar manner to supplement fed daily, but also reduced hay intake compared with control.

Key Words: beef cows, gestation, supplementation

T250 Supplementing urea in beef finishing diets containing 25% modified distillers grains has no influence on cattle performance, but does decrease marbling in yearling steers. L. J. Garbel* and B. P. Holland, South Dakota State University, Brookings.

Finishing diets containing elevated levels of distillers grains may contain excessive concentrations of CP, yet still be deficient in degradable intake protein (DIP). To address this situation, finishing diets containing 25% modified distillers grains (MDGS), 40% dry rolled corn, 20% high moisture corn, 12% corn silage, and 3% dry supplement (DM basis) were supplemented with 0 (CON), 0.36 (Low-U), or 0.72% (High-U) urea. Diets contained 13.3 and 6.6, 14.2 and 7.6, and 15.2 and 8.5% CP and DIP for CON, Low-U, and High-U, respectively. Two hundred 51, predominately Angus yearling steers were blocked by source and randomly allotted to 24 pens. Steers in block 1 (n = 71; BW = 388 ± 41 kg) were housed in 9 partially roofed concrete-surfaced pens. Block 2 cattle (n = 180; BW = 375 ± 24 kg) were housed in 15 soil-surfaced dry lot pens. Cattle were fed for 98 and 144 d for blocks 1 and 2, respectively, before harvest at a commercial abattoir. Preplanned contrasts evaluated CON v supplemental urea, and Low-U v High-U, respectively. Calculated DIP requirements for microbial needs were 68 g/d deficient for CON, but in excess 33.7 and 132.6 g/d for Low-U and High-U ($P < 0.001$). Body weights, ADG, and G:F were not different between treatments ($P \geq 0.08$). Marbling score was increased ($P = 0.04$) in CON (524) steers compared with Low-U (495) and High-U (491). This resulted in 60.0% of carcasses in upper 2/3 Choice and Prime grades for CON compared with 40.6% for Low-U and 46.5% for High-U ($P = 0.05$). No other carcass trait differences were observed ($P \geq 0.28$). Results suggest that urea supplementation to finishing diets containing 25% MDGS does not improve feedlot performance, but can decrease quality grade yearling steers.

Key Words: feedlot, distillers grains, metabolizable protein

T251 Effects of alternate day feeding of dried distillers grains plus solubles on ruminal ammonia concentration, blood urea nitrogen, nonesterified fatty acids, and insulin-like growth factor I in forage-fed steers. S. I. Klein^{1*}, A. M. Meyer², Q. P. Larson¹, J. S. Caton¹, and C. R. Dahlen¹, ¹Department of Animal Sciences, North Dakota State University, Fargo, ²Department of Animal Sciences, University of Wyoming, Laramie.

Our objective was to examine the effects of feeding dried distiller's grains plus solubles (DG) or grass hay on alternate days on ruminal ammonia (NH₄), blood urea nitrogen (BUN), nonesterified fatty acids (NEFA), and IGF₁ in forage-fed steers. Four ruminally, duodenally, and ileally cannulated Holstein steers (448.8 ± 7.3 kg BW) received each of 4 dietary treatments (TRT) in a 4 × 4 Latin square: 1) ad libitum hay only (CON); 2) hay and 0.4% BW DG daily (DG7); 3) hay daily and 0.8% BW DG on alternate days (DG3); and 4) hay only or 0.8% DG only on alternate days (DGA). Treatment periods consisted of 13 d of adaptation and 8 d of blood and ruminal sample collection. Supplemented days (SUP) and non-supplemented days (NSUP) were defined as days when DG3 and DGA did or did not receive DG, respectively. Ruminal ammonia was similar ($P > 0.10$) for all treatments at feeding on SUP.

Four h post-feeding on SUP, DG7 had greater (TRT × time; $P = 0.002$) NH_4 compared with CON and DGA whereas DG3 was intermediate. At feeding and 6 h post-feeding on NSUP DGA had increased (TRT × time; $P < 0.001$) NH_4 compared with all other treatments. At 4 and 6 h post-feeding on NSUP DGA had increased (TRT × time; $P < 0.001$) NH_4 compared with CON, DG7, and DG3. Steers fed DGA had less ($P < 0.01$) BUN on SUP compared with all other treatments (5.5, 7.9, 8.3, and 7.8 ± 0.4 for DGA, CON, DG7, and DG3, respectively). Similarly, BUN was greater ($P < 0.01$) for DGA on NSUP compared with CON, DG7, and DG3 (11.8, 8.1, 8.6, 8.9 ± 0.5 mmol/L for DGA, CON, DG7, and DG3, respectively). There were no differences ($P > 0.10$) in NEFA among treatments on SUP however, on NSUP DGA (209.5 ± 12.7 mmol/L) steers had increased ($P < 0.01$) NEFA compared with all other treatments (84.4, 88.0, and 77.7 ± 12.7 mmol/L for CON, DG7, and DG3, respectively). All treatments had similar ($P > 0.10$) concentrations of IGF₁ throughout the collection period (114.0, 126.3, 128.8, 128.9 ± 6.6 ng/mL for CON, DG7, DG3, and DGA, respectively). The feeding strategy DGA altered NH_4 , BUN, and NEFA, but did not influence IGF₁.

Key Words: distillers grains, metabolism, supplementation frequency

T252 Carcass traits of steers finished in feedlot fed crude glycerin. J. F. Lage,* T. T. Berchielli, E. San Vito, A. F. Ribeiro, R. A. Silva, E. E. Dallantonia, L. M. Delevatti, B. O. Felipe, M. Machado, P. M. França, and R. A. Reis, *Universidade Estadual Paulista "Júlio de Mesquita Filho," Jaboticabal, São Paulo, Brazil.*

This trial aimed to evaluate the effects of feeding crude glycerin (CG) - 80% of glycerol - included on 10% of diet dry matter, replacing corn or soybean hulls in different concentrate levels (60:40 or 40:60) on carcass traits of steers finished in feedlot. Sixty intact male (Nellore), with 18 mo of age and 373.73 ± 24.67 initial body weight, were randomly assigned to 6 treatments, with 10 replicates in factorial arrangement (2 levels of concentrate x 3 feeding regimens). The diets were: control diet, without inclusion CG, containing corn in the concentrate (CN); diets with inclusion CG with high level of starch, containing corn in the concentrate (CGC) and diets with inclusion CG with low level of starch, containing soybean hulls in the concentrate (CGS). The diets were isonitrogenous and formulated to meet the requirements for maintenance and gain of the animals according to Brazilian recommendations. After 94 d on feed, the shrunk body weight (SBW) was recorded and the animals were slaughtered. The carcasses were weighed for obtained the hot carcass weight (HCW) and dressing percentage (DP). The carcass were refrigerated for 24 h at 0°C and then rib fat thickness (RFT) and ribeye area (REA) were measured in the region between 12 and 13 th rib. Data were analyzed using the GLM procedure of SAS and the effects of treatments were considered significant at $P < 0.05$. The interaction between concentrate levels and feeding regimens was not significant ($P > 0.05$). Differences were detected ($P < 0.05$) in the DP among the feeding regimens. The animals fed with the diet CGC had higher mean values for DP (57,23%) than the animals fed the diets CN (56,34%) and CGS (55,92%). No difference were detected ($P > 0.05$) for SBW, HCW, RFT and REA among the treatments, with mean values 498.36 kg, 281.57 kg, 5.13 mm and 76.11 cm², respectively. The variables evaluate were not altered ($P > 0.05$) by the concentrate allowance levels assessed (60:40 or 40:60). The inclusion of 10% of crude glycerin in diets with high starch increase the dressing percent, however, does not affect the shrunk body weight, hot carcass weight, ribeye area and rib fat thickness.

Key Words: beef cattle, glycerol, rib fat thickness

T253 Performance of Nellore steers receiving protected linseed oil during different periods of feedlot. W. Henrique*¹, V. G. Carvalho², T. M. Pivarro², J. L. V. Coutinho Filho¹, A. A. M. Sampaio², E. A. Oliveira^{2,3}, and B. L. Rosa², ¹Sao Paulo Agency for Agribusiness Technology, Sao Jose Rio Preto, Sao Paulo, Brazil, ²FCAV/Sao Paulo State University, Jaboticabal, Sao Paulo, Brazil, ³FAPESP Post-doctorate fellowship, Sao Paulo, Sao Paulo, Brazil.

The objective was to assess the use of linseed oil protected from ruminal degradation during different periods of confinement or linseed oil, as ingredients of the diet, for 35 Nellore steers. The animals were housed in individual pens for 105 d at the Sao Paulo Agency for Agribusiness Technology, in Sao Jose do Rio Preto, Brazil. In addition to the control diet and with linseed oil during all the feedlot, it was evaluated the addition of protected linseed oil during the last 35 d, the last 70 d or during all the feedlot. The roughage used was corn silage exclusively, in the proportion of 40% in dry matter diet. All diets were isonitrogenous and those with the addition of oil were also isoenergetic. The proportion of protected linseed oil was 4.0% and linseed oil 3.4% in dry matter diet. The feedstuffs and the leftovers were analyzed and the animals were weighed at the beginning and at the end of the experiment, preceded by total fasting for 15 h. The experimental design was a randomized block one, balanced by animal weight, and means were compared by Student's *t*-test at 5% of probability. There were no differences for initial (392.94 kg) and final body weight (522.72 kg), average daily gain ($1.236 \text{ kg} \cdot \text{day}^{-1}$), dry matter intake, per day (9.392 kg) or related to the body weight (2.05%), and feed efficiency ($0.131 \text{ kg gain} \cdot \text{kg DM intake}^{-1}$). The addition of protected linseed oil during different periods of confinement or linseed oil did not bring additional benefits for the performance of fattening cattle in feedlot.

Key Words: cattle, fattening, weight gain

T254 Performance of crossbred heifers and steers fed increasing linseed oil levels. W. Henrique*¹, B. L. Rosa², E. A. Oliveira^{2,3}, A. A. M. Sampaio², T. M. Pivarro², A. T. Andrade², and V. G. Carvalho², ¹Sao Paulo Agency for Agribusiness Technology, Sao Jose Rio Preto, Sao Paulo, Brazil, ²FCAV/Sao Paulo State University, Jaboticabal, Sao Paulo, Brazil, ³FAPESP Post-doctorate fellowship, Sao Paulo, Sao Paulo, Brazil.

The objective was to assess the increasing linseed oil supplementation (1, 3.8 and 5.2% in DM diet) fed to crossbred cattle Nellore × Canchim and its influence on the average daily gain (ADG), slaughter weight (SW), feed efficiency (FE) and dry matter intake per day (DMI) and as a percentage of body weight (DMI%BW). Fifteen steers (427.80 ± 42.01 kg and 24 ± 2 mo old) and 14 heifers (400.57 ± 33.79 kg and 24 ± 2 mo old) were housed in individual pens at Jaboticabal, campus of Sao Paulo State University and fed diets with 80% concentrate in DM and sugarcane IAC 86–2480 as exclusive roughage source. The experiment was a randomized block design one, arranged in a 3×2 factorial scheme (oil ratios x sexual condition) and means were compared by Student's *t*-test at 5% of probability. After fattening period, the animals were slaughtered in a staggered way by blocks. There were no interactions ($P > 0.05$) between sexual conditions and oil levels for all variables. Steers showed higher ($P < 0.05$) SW (535.07 and 494.79 kg), ADG (0.982 and 0.857 kg/d) and DMI (9.098 and 8.070 kg/d) when compared with heifers, respectively. The FE and DM%BW did not showed difference ($P > 0.05$) for sexual condition. No difference ($P > 0.05$) was observed to ADG among diets (0.92 kg/d). Diets containing 1 and 3.8% presented higher values ($P < 0.05$) for DMI than 5.2% of oil (9.046, 8.764 and 8.040 kg/d, respectively). Similar results ($P < 0.05$) were observed for DMI%BW (1.93, 1.88 and 1.74%, respectively). Animals fed diets

with 1 and 3.8% of oil were less efficient ($P < 0.05$) than animals fed diets with 5.2% of oil (0.094, 0.104 and 0.123 kg of ADG/kg of DMI, respectively). Increasing linseed oil in diets to crossbred beef cattle can improve feed efficiency by decreasing the dry matter intake and keeping the daily gain.

Key Words: feed efficiency, Nellore \times Canchim, weight gain

T255 Performance of growing Nellore steers on pasture in the dry season fed crude glycerin. E. San Vito,* T. T. Berchielli, J. F. Lage, R. C. Canesin, R. A. Reis, C. S. R. Junior, L. M. Delevatti, M. Machado, E. E. Dallantonia, A. F. Ribeiro, and R. A. Silva, *Universidade Estadual Paulista "Julio de Mesquita Filho," Jaboticabal, São Paulo, Brazil.*

The aim of this work was to evaluate the effect of crude glycerin (CG) inclusion as a substitute to corn grain in the average daily gain (ADG) and shrunk body weight final of growing Nellore steers on pasture, supplemented in the dry season. The CG used was derived from soybean biodiesel production (80% glycerol). Fifty Nellore steers with initial shrunk body weight of 279.52 ± 16.31 kg were randomly assigned to 5 treatments, with 10 replicates. The animals were distributed in 10 paddocks, with 1.8 ha each (2 paddocks per treatment), of *Brachiaria brizantha* 'Xaraés'. Treatments were constituted by 5 levels of CG inclusion in the supplement: (0, 7, 14, 21 and 28% of CG based on dry matter) as a substitute to the corn grain. The animals were supplemented daily in a proportion of 0.7% of body weight, and it contained 40% of crude protein based on dry matter. The supplement was constituted of corn grain, soybean meal, urea, gluten meal and mineralized salt. The experiment was executed in 136 d, and the animals were weighed in the beginning and in the end of the experiment, after 14 h of solids and liquids shrunk to evaluate the average daily gain. Data was analyzed using the GLM procedure of SAS program and the effects of treatments (linear and quadratic) were considered significant at $P < 0.05$. There was an increased linear effect of glycerin levels ($P < 0.05$) on the final live weight ($r^2 = 0.73$) and daily average gain ($r^2 = 0.35$), and the following equations were adjusted: $FW = 374.38 + 0.72 \times \% \text{ of CG in the supplement}$ and $ADG = 0.65 + 0.041 \times \% \text{ of CG in the supplement}$. Final shrunk body weight of animals was 375.4, 377.4, 381.8, 389.9 and 398.1 kg and the average daily gain was 0.704, 0.719, 0.752, 0.812 e 0.871 kg to the inclusion of 0, 7, 14, 21 and 28% of CG in the supplement, respectively. It is possible to conclude that an increase in crude glycerin levels (up to 28%) in the supplements of growing steers on pasture in the dry season can increase the average daily gain and final body weight of the animals.

Key Words: biodiesel, by-product, forage

T256 Palatability of post-extraction algal residue as a protein supplement for cattle. M. L. Drewery,* J. E. Sawyer, and T. A. Wickersham, *Texas A&M University, College Station.*

Market value of post-extraction algal residue (PEAR) is driven by its ability to compete with commonly fed protein sources; for example cottonseed meal (CSM) and dried distillers' grains (DDG). An initial step in evaluating PEAR (20% CP, 59% OM) is to determine palatability when fed as a protein supplement. Accordingly, we evaluated the palatability of PEAR-containing supplements in cattle consuming a basal diet of

Bermudagrass (13% CP, 76% NDF). Twelve steers were used in a 12×12 Latin square experiment consisting of 12 4-d periods. Each period included 3-d where steers were fed a test supplement and a 1-d washout where steers were fed DDG. Supplements were formulated with different carrier ingredients (DDG, CSM, or liquid supplement, LS) and different levels of PEAR inclusion (0, 20, 40, and 60% for DDG and CSM and 0, 33, 66, and 100% for LS). Intake and time required for consumption were recorded daily. A significant ($P < 0.05$) treatment \times day interaction for g consumed per min (GPM) was observed. This interaction resulted from changing rates of consumption as cattle adapted to supplements. Supplements containing DDG had the greatest rates of consumption (177 – 187 GPM), followed by CSM supplements (148 – 166 GPM). Blends including PEAR and LS had slower rates of consumption (58 – 93 GPM). Supplement formulation significantly ($P < 0.05$) affected the amount of supplement consumed and time required for complete consumption. Supplements which contained DDG or CSM were consumed in less than 11 min; complete consumption was observed 92 – 100% of the time. Treatments containing LS required more time for complete consumption (21 – 33 min) and were finished 77 – 96% of the time. Our results suggest PEAR can be blended (up to 60%) with existing ingredients utilized in beef rations to create suitable protein supplements. However, PEAR is not palatable when offered alone (complete consumption of 100% PEAR occurred 77.5% of the time and required 31.5 min) or incorporated into LS. Additional research is necessary to determine the impact of PEAR on nutrient utilization in cattle.

Key Words: supplementation, post-extraction algal residue, dried distillers grains

T257 Protein sources and nitrogen associated with the residual biodiesel glycerin supplements to fattening cattle during the rainy season: performance productive. A. J. Neto¹, J. T. Zervoudakis¹, L. da Silva Cabral¹, L. K. H. Zervoudakis*¹, R. L. Galati¹, P. V. R. Paulino², L. C. R. P. Silva¹, R. P. da Silva¹, J. Q. Soares¹, and T. de Paulo Trindade¹, ¹Universidade Federal de Mato Grosso, Cuiabá, Mato Grosso, Brazil, ²Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil.

The objective was to evaluate the effect of protein sources and nitrogen associated with the residual biodiesel glycerin in the diet of beef cattle grazing in the rainy season on performance. Twenty Nelore steers age and initial body weight average of 25 months and 422 kg were used, during the experimental period of 84 days. The area consisted of 4 paddocks of 1.6 ha each formed with *Brachiaria brizantha* 'Marandu', with a mass of forage and potentially digestible dry matter of 1552.71 and 1146.01 kg/ha, respectively. The experiment was structured in a completely randomized design to evaluate the following supplements: control (only mineral); GU – glycerin with urea; GFS - glycerin with soybean meal and GFA - glycerin with cottonseed meal as a function of the variables: gain total weight and average daily gain. The supplementation was provided daily at 10 a.m., with supply of 2.0 kg of supplement/animal. The productive performance of animals was 0.992; 1.095; 0.997 and 1.010 kg/animal/day for the supplements: MM, GU, GFA, and GFS. There was no difference ($P = 0.60$) between the levels of supplementation and the control group on average daily gain of animals. The combination of glycerin with protein sources and nitrogen promotes good animal performance under grazing.

Key Words: glycerol, pasture, weight gain