823 Protozoa reduction in the rumen of grazing cattle fed mixtures of coconut and palm kernel oils. Oludotun O. Adelusi, Adebayo O. Oni*, Oluwaseun J. Idowu, Victoria O. Ojo, and Christopher F. Onwuka, *Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.*

A 12-wk study was conducted to investigate the effect of feeding ratios of coconut and palm kernel oils (CNO-PKO) on the rumen microbial population of grazing cattle. The experiment was carried out at Cattle Production Venture Farm, Federal University of Agriculture Abeokuta, Ogun State, Nigeria. Twelve (12) White Fulani cattle with average weight of 164 ± 2.81 kg were allotted into 4 treatments of CNO-PKO administration (0 g/day (control), 100:50 g/day (HCLP), 50:100 g/day (LCHP) and 75:75 g/day (ECP) in a completely randomized design. Rumen fluid samples were obtained from each cattle after oil administration period and microbial population was determined by total direct count of protozoa and fungal zoospores while bacteria analysis was carried out using anaerogen packs. Data were analyzed using one-way ANOVA (SPSS Statistics 20). The results showed that rumen bacteria in the genus *Bacteroides* spp. was not significantly ($P > 0.05$) affected by the treatments. *Clostridium* spp. count of those maintained in the control group recorded the greatest ($P < 0.05$) number with 6.08×10^6 cfu/mL while the least ($P < 0.05$) was recorded from cattle maintained on HCLP administration with 2.35×10^6 cfu/mL. *Lactobacillus* spp. count of cattle maintained in the control group and those on ECP administration recorded greater ($P < 0.05$) counts of 0.20×10^6 cfu/mL and 0.15×10^6 cfu/mL respectively while lesser ($P < 0.05$) counts were obtained from cattle maintained on HCLP and LCHP with both recording 0.05×10^6 cfu/mL. Rumen fungi count increased ($P < 0.05$) with LCHP administration recording 0.60×10^6 cfu/mL while the least ($P < 0.05$) was recorded with HCLP administration (0.10×10^6 cfu/mL). Rumen protozoa population of cattle was significantly ($P < 0.05$) reduced with the greatest ($P < 0.05$) count obtained from cattle maintained in the control group recording 755.99 FEC/g while the least ($P < 0.05$) was obtained from cattle maintained on ECP administration recording 0.00 FEC/g. Feeding 75 g/d each of coconut and palm kernel oils to grazing cattle reduced the protozoa population of the rumen and might therefore be employed as rumen modifier for methane mitigation.

Key Words: cattle, rumen, protozoa

824 Total-tract fatty acid digestibility responses to increasing levels of palmitic acid supplementation of dairy cows receiving low- and high-fat diets. Jonas De Souza*, J. Eduardo Rico, Courtney L. Preseault, Michael S. Allen, and Adam L. Lock, *Michigan State University, East Lansing, MI.*

Dose-dependent effects of a palmitic acid-enriched fat supplement (PA; 87% C16:0; Bergafat F-100) on total-tract digestibility responses of dairy cows were evaluated. Low and high basal dietary fatty acid (FA) diets (LF: 2.2% DM and HF: 3.5% DM) were used as a split-plot to determine relationships between basal dietary FA content and PA dose. Sixteen Holstein cows (149 ± 56 DIM) were assigned randomly to treatment sequence within basal FA groups. PA was supplemented at 0, 0.75, 1.50, or 2.25% of ration DM in a 4 × 4 Latin Square design within each basal FA group. Periods were 14 d with the final 4 d used for data collection. FA content of LF and HF diets was achieved by altering the proportion of soyhulls and cottonseed in diets. The statistical model included the random effect of cow and the fixed effects of basal FA group, PA dose, period, and their interactions. Linear, quadratic, and cubic contrasts were used to determine effects of PA dose. Compared with HF (with cottonseed), LF diets (with soyhulls) increased NDF digestibility (50 vs. 48%; $P < 0.01$). PA dose also increased NDF digestibility (46, 50, 51, and 52%; linear $P < 0.01$). There was a tendency for an interaction of treatments ($P = 0.12$) as NDF digestibility increased more for HF with increasing PA than for LF. Compared with HF, LF diets decreased 16-carbon FA digestibility (65 vs. 71% $P < 0.01$) and tended to increase 18-carbon FA digestibility (85 vs. 82%; $P = 0.07$). PA dose decreased 16-carbon FA digestibility (76, 67, 64 and 64%; quadratic $P < 0.01$) and increased 18-carbon FA digestibility (82, 83, 85 and 85%; linear $P < 0.05$) for 0, 0.75, 1.50, and 2.25% PA, respectively. PA dose linearly decreased the digestibility of total FA in LF diets (81, 76, 73, and 71%) but did not in HF diets (77, 76, 76, and 76%; interaction $P < 0.05$) for 0, 0.75, 1.50, and 2.25% PA, respectively. HF diets increased total FA absorbed compared with LF diets (0.94 vs. 0.71 kg/d; $P < 0.05$). Additionally, PA dose increased total FA absorbed (0.64, 0.77, 0.90 and 0.97 kg/d; linear $P < 0.01$) for 0, 0.75, 1.50, and 2.25% PA, respectively. In conclusion, the total-tract FA digestibility responses to PA dose were affected by the FA content of the basal diet.

Key Words: dietary fat, digestibility, palmitic acid

825 Daily patterns of hydrogen and volatile fatty acid concentrations in relation to thermodynamic control on fermentation in the bovine rumen. Hendrikus J. van Lingen*[1,2], Jueeli D. Vaidya[1,3], Sanne van Gastelen[1,2], Bartholomeus van den Bogert[1,3], André Bannink[4], Caroline M. Plugge[3], Hauke Smidt[3], and Jan Dijkstra[2], *[1]Top Institute Food and Nutrition, Wageningen, Gelderland, the Netherlands, [2]Animal Nutrition Group, Wageningen University, Wageningen, Gelderland, the Netherlands, [3]Laboratory of Microbiology, Wageningen University, Wageningen, Gelderland, the Netherlands, [4]Animal Nutrition, Wageningen UR Livestock Research, Wageningen, Gelderland, the Netherlands.*

Elevated levels of both hydrogen and molar proportions of propionate to acetate and butyrate are found in the bovine rumen right after meals. Hydrogen is believed to thermodynamically control fermentation pathways in the rumen in favor of propionate production. Elevated levels of hydrogen inhibit reoxidation of NADH to NAD^+. Propionate production, however, enables this reoxidation and explains why elevated levels of hydrogen and propionate are hypothesized to occur simultaneously. Nonetheless, hydrogen partial pressure in the rumen headspace may not be high enough to inhibit NADH reoxidation. Furthermore, studies reporting diurnal patterns of volatile fatty acids (VFA) concentration and hydrogen pressure simultaneously, if any, are limited. The aim of this study is to monitor daily patterns of hydrogen pressure, pH, and VFA concentration in the bovine rumen and to calculate thermodynamic inhibition of specific fermentation pathways. Four rumen fistulated multiparous lactating cows were used in a crossover design with 2 17-d experimental periods and a control and treatment diet. Both diets consisted of 40% corn silage, 30% grass silage and 30% concentrates on DM basis. The treatment diet had a 2.5% higher fat content by supplementing the concentrate with linseed oil. On d 11, rumen headspace gas and fluid samples were taken at 0, 0.5, 1, 1.5, 2, 3, 4, 5, 6, 8, 10 h after morning feeding using a custom fistula lid enabling rumen gas and fluid sampling. Gas samples were analyzed for hydrogen pressure, and fluid samples for pH and concentrations of dissolved hydrogen as well as VFA. Fluid samples were also taken for transcriptome analysis

to monitor microbiome gene expression. From d 13 to 17 cows were housed in respiration chambers to relate rumen headspace pressure to emissions of hydrogen. An increase of hydrogen partial pressure by 2 orders of magnitude up to 30 mbar was observed following feeding. This finding might indicate hydrogen partial pressure to be high enough to inhibit NADH reoxidation.

Key Words: rumen fermentation, thermodynamics, hydrogen

826 Effects of chitosan on ruminal metabolism and in situ degradability of beef cattle. Darren D. Henry*, Francine M. Ciriaco, Vitor R. G. Mercadante, Tessa M. Schulmeister, Martin Ruiz-Moreno, G. Cliff Lamb, and Nicolas DiLorenzo, *North Florida Research and Education Center, University of Florida, Marianna, FL.*

We determined the effects of supplementing chitosan, a natural biopolymer, on ruminal metabolism and in situ degradability in beef steers consuming hay. Eight ruminally cannulated crossbred steers (345 ± 81 kg BW) were used in a crossover design. Steers were stratified by weight and randomly assigned to 1 of 2 treatments: control (CTRL; no chitosan supplementation) or treatment (TRT; 80 g/d of chitosan). Chitosan was dosed daily via ruminal cannula and steers had ad libitum access to Tifton 85 bermudagrass hay and water throughout the study. Ruminal fluid was collected before dosing of chitosan (0 h) and every 3 h post-dosing for 24 h. Immediately after each collection, ruminal pH was measured. Ruminal fluid was analyzed for VFA and NH_3-N concentrations. Data were analyzed as repeated measures and the model included the fixed effects of treatment, time, and treatment × time interactions. In situ degradability of DM, NDF, and ADF was determined by incubating Tifton 85 bermudagrass hay in nylon bags within the rumen for 24, 48 or 72 h. Supplementing with 80 g/d chitosan had no effect ($P > 0.05$) on ruminal in situ degradability of DM, NDF or ADF. Chitosan did not affect ($P = 0.97$) NH_3-N concentrations (7.4 ± 0.58 m*M*) within the rumen. A treatment × time interaction was observed ($P < 0.001$) on ruminal pH. A treatment × time interaction ($P = 0.016$) was observed for acetate-to-propionate ratio (A:P), being decreased ($P < 0.05$) at h 21 and 24 for TRT vs. CTRL. Molar proportions of acetate and propionate had a treatment × time interaction ($P < 0.05$). Molar proportions of propionate were increased at h 18, 21 and 24 for TRT when compared with CTRL. Supplementing 80 g/d of chitosan to steers consuming ad libitum hay had no effect on in situ ruminal degradability; however, VFA molar proportions were shifted to an energetically more efficient composition by increasing propionate and decreasing A:P.

Key Words: chitosan, ruminal metabolism, in situ degradability

827 Ellipsoid equation improves accuracy and efficiency of estimating protozoal volume. Benjamin A. Wenner*, Brooklyn K. Wagner, and Jeffrey L. Firkins, *Department of Animal Sciences, The Ohio State University, Columbus, OH.*

Previous observations of protozoa in cultures treated with essential oils or ionophores indicated possible cell shrinkage due to deleterious effects on cell function. Cell volume reduction by formaldehyde preservation, combined with visually flattened or tapered morphology of rumen protozoa limited our ability to detect volume differences using common cylindrical derivations for protozoa. The advent of affordable, high definition imaging equipment enables recording of live protozoa from cultures treated with various additives that potentially shrink cells. We hypothesized that using still frames from video of protozoa swimming would improve accuracy of volume predictions by optimizing an approach to measure one maximal longitudinal measurement and both minimum and maximum diameter measurements perpendicular to the longitudinal axis, thus yielding a 3-dimensional estimation of protozoal volume. An ellipsoid formula (E, $^4/_3\pi abc$) was compared with previously published estimations using cylindrical [C, $L\pi(^W/_2)^2$] or species coefficient (SP, XLW^2) calculations. Testing this method on objects shaped similarly to protozoa demonstrated the ellipsoid is more accurate in predicting volume as measured by displacement. True displacement was 11.8 mL for 10 large particles, and estimated volumes were 12.7 to 27.1, 7.7 to 16.6, and 12.3 mL for C, SP, and E, respectively. For smaller particles with more surface area, true displacement was 4.5 mL, and estimated volumes were 5.6 to 13.1, 3.2 to 7.5, and 5.6 for C, SP, and E, respectively. Rumen fluid sampled from 2 lactating Jersey cows was flocculated and wet-mounted on a microscope fitted with an HD (1080p) camera. Residuals (SP − E) were plotted against predicted (E) centered to the mean (X – mean) to evaluate for both mean and slope bias. For entodinia (ENTO), $Y = 1.97 \times 10^4 (\pm 1.48 \times 10^3) + 0.248(\pm 0.0371)(X - 7.98 \times 10^4)$ μm^3, with significant slope ($P < 0.01$) and mean ($P < 0.01$) bias. For isotrichids (ISO), $Y = -1.21 \times 10^4 (\pm 4.86 \times 10^4) - 0.124(\pm 0.0685)(X - 2.54 \times 10^6)$ μm^3, where slope trended toward significance ($P = 0.08$) with no mean ($P > 0.10$) bias. For epidinia (EPI), $Y = 1.02 \times 10^5 (\pm 1.46 \times 10^4) + 0.372(\pm 0.219)(X - 1.45 \times 10^5)$ μm^3, with no slope ($P > 0.10$) and significant mean ($P < 0.01$) bias. This demonstrates that SP more likely overestimates volume for ENTO or EPI than for teardrop-shaped ISO. This ellipsoid method offers potential to advance prediction of treatment effects on protozoal viability and volume.

Key Words: protozoa, imaging, rumen

828 Effect of monensin inclusion on ruminal fermentation parameters in *Bos indicus* and *Bos taurus* steers consuming bermudagrass hay. Natasha L. Bell*[1,2], Robin C. Anderson[3], Todd R. Callaway[3], Marcia O. Franco[4], and Tryon A. Wickersham[1], *[1]Texas A&M University, College Station, TX, [2]Texas A&M University-Kingsville, Kingsville, TX, [3]Southern Plains Agricultural Research Center, Agricultural Research Service, USDA, College Station, TX, [4]Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil.*

Effects of monensin inclusion and the subspecies of cattle on 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. Treatments consisted of 0 (CON) or 200 (MON) mg·hd^{-1} monensin (Rumensin 90; Elanco Animal Health, Greenfield, IN) fed daily in 0.91 kg DDGS. Steers were group housed during adaptation periods and moved to individual covered pens to facilitate sampling. Periods were 70 d in length allowing 42 d adaptation, and 28 d withdrawal between periods. Ruminal fluid was collected with a suction-strainer 0, 2, 4, 8, and 12 h after feeding on d 42 for analysis of pH, VFA, and ruminal ammonia-N. Ruminal contents were squeezed through 4 layers of cheesecloth into insulated containers 2 h after feeding on d 42 for determination of rate of ammonia production and CH_4-producing activity. No subspecies × treatment interactions were observed ($P \geq 0.14$). There was an effect of time after feeding ($P \leq 0.01$) on pH, ruminal ammonia-N, total VFA, acetate:propionate, and molar percentages of acetate and propionate. Total VFA concentration was greater ($P = 0.01$) in CON vs. MON steers (66.5 vs. 62.0 m*M*). Total VFA concentration was similar ($P = 0.28$) for BI and BT subspecies (62.7 and 65.8 m*M*, respectively). Monensin decreased the molar percentage of acetate ($P = 0.02$) from 72.5% to 71.2% and increased the molar percentage of propionate ($P < 0.01$) from 16.9% to 18.7%, reducing ($P < 0.01$) the acetate:propionate ratio from 4.34 to 3.85. Although CH_4- producing

activity was not significantly different ($P = 0.19$) between CON and MON, monensin feeding resulted in a 15.8% reduction in CH_4-producing activity. *Bos indicus* steers had greater ($P = 0.07$) CH_4-producing activity than BT steers (21.37 vs. 16.62 μmol $CH_4 \cdot mL^{-1} \cdot h^{-1}$). Monensin had no effect ($P \geq 0.19$) on pH, ruminal ammonia-N, or rate of ammonia production. Overall, monensin decreased the acetate:propionate ratio by decreasing acetate and increasing propionate and numerically reduced CH_4-producing activity. *Bos indicus* had greater CH_4-producing activity compared with BT steers.

Key Words: cattle subspecies, ionophore, VFA

829 Effect of monensin withdrawal on ruminal fermentation parameters in *Bos indicus* and *Bos taurus* steers consuming bermudagrass hay. Natasha L. Bell*[1,2], Robin C. Anderson[3], Todd R. Callaway[3], Marcia O. Franco[4], and Tryon A. Wickersham[1], *[1]Texas A&M University, College Station, TX, [2]Texas A&M University-Kingsville, Kingsville, TX, [3]Southern Plains Agricultural Research Center, Agricultural Research Service, USDA, College Station, TX, [4]Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil.*

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. Treatments were withdrawal from either 0 (CON) or 200 $mg \cdot hd^{-1} \cdot d^{-1}$ (MON) monensin (Rumensin 90; Elanco Animal Health, Greenfield, IN) in 0.91 kg DDGS, fed for 42 d. Withdrawal was evaluated for a 28 d period. Rumen fluid was collected 2 h after feeding on d 1, 4, 7, 14, and 21 after the cessation of MON feeding for determination of pH, VFA, ruminal ammonia-N, rate of ammonia production and methane-producing activity. No subspecies × treatment or subspecies × treatment × day interactions were observed ($P \geq 0.16$). Treatment × day interactions ($P \leq 0.01$) were observed for acetate:propionate ratio and molar percentages of acetate and propionate. There was a marked decrease in molar % propionate between d 1 and 4 from 19.1 to 18.0%; however, molar % propionate remained greater ($P \leq 0.09$) for MON than CON through d 7. Molar percentage of acetate increased with MON withdrawal from 68.8 to 69.8 between d 0 and 4. Acetate:propionate ratio was lower ($P \leq 0.01$) on d 0 for MON than CON (3.4 vs. 4.0). By d 4, MON had increased to 3.8, and was not different ($P = 0.14$) from CON. By d 14, no differences ($P \geq 0.88$) between MON and CON remained for acetate, propionate, and acetate:propionate ratio. Steers previously fed monensin had similar ($P \geq 0.12$) total VFA concentrations by d 4. Greater ($P < 0.01$) ruminal ammonia-N concentrations (1.88 vs. 1.73 m*M*) were observed in CON than MON steers. Monensin had no effect ($P \geq 0.69$) on rate of ammonia production or methane-producing activity. A treatment × day interaction occurred ($P \leq 0.05$) for pH with MON steers having higher pH than CON on d 1, 7, and 14. *Bos indicus* steers tended to have higher ($P = 0.08$) pH than BT (6.53 vs 6.46); no other subspecies effects were observed. Results indicate that the monensin induced reduction in acetate:propionate ratio persists for at least 7 d post-withdrawal.

Key Words: cattle subspecies, ionophore, VFA

830 Effects of solid feed level and roughage-to-concentrate ratio on ruminal drinking and passage kinetics of milk, concentrates, and roughage in veal calves. Harma Berends*[1], Joost van den Borne[1], Norbert Stockhofe[2], Myrthe Gilbert[1], Tamme Zandstra[1], Wilbert Pellikaan[1], Kees van Reenen[3], Eddie Bokkers[4], and Walter Gerrits[1], *[1]Animal Nutrition Group, Wageningen University, Wageningen, Gelderland, the Netherlands, [2]Central Veterinary Institute, Lelystad, Flevoland, the Netherlands, [3]Livestock Research, Wageningen, Gelderland, the Netherlands, [4]Animal Production Systems Group, Wageningen University, Wageningen, Gelderland, the Netherlands.*

Effects of solid feed (SF) level and roughage-to-concentrate (R:C) ratio on ruminal drinking and passage kinetics of milk, concentrate, and roughage in veal calves were studied. Eighty calves (2 wk of age, 45 kg bodyweight) were divided over 16 pens. Pens were randomly assigned to a low (LSF) or a high (HSF) SF level, and to one of 2 R:C ratios; 20:80 or 50:50 on a DM basis. Roughage was composed of 50% corn silage and 50% chopped straw on a DM basis. During the measurement period at 27 wk of age, SF intake was 1.2 kg DM/d for LSF and 3.0 kg DM/d for HSF, and milk (replacer) intake averaged 2.3 kg DM/d for LSF and 1.3 kg DM/d for HSF. To estimate passage kinetics of milk, concentrate, and straw, indigestible markers (respectively CoEDTA, hexatriacontane C_{36}, Cr-NDF) were supplied with the feed as a single dose at respectively 4, 24, and 48 h before slaughter. At slaughter, marker recovery was quantified in the rumen, abomasum, small intestine, and large intestine. Rumen Co recovery averaged 20% of the last milk meal. Recoveries of milk remained largely unaffected by SF level and R:C ratio. Ruminal recovery of C_{36} and Cr was unaffected by R:C ratio. Rumen fractional passage rate of concentrate was estimated from recovery of C_{36} in the rumen and increased ($P < 0.001$) from 3.3%/h for LSF to 4.9%/h for HSF. Rumen fractional passage rate of straw was estimated from Cr recovery in the rumen and increased ($P < 0.01$) from 1.3%/h for LSF to 1.7%/h for HSF. A greater SF level increased ($P < 0.001$) fresh and dry rumen contents. In HSF calves, pH decreased (from 6.9 to 6.0; $P < 0.01$) and VFA concentrations increased ($P < 0.05$) with a lower R:C ratio, indicating increased fermentation. The Cr:C_{36} ratio was similar in the small and large intestine, indicating that passage of concentrate and straw was mainly determined by rumen and abomasum emptying. In conclusion, SF level rather than R:C ratio influences rumen passage of concentrate and roughage. Our data provide insight in passage kinetics of milk and SF and may contribute to the development of feed evaluation models for veal calves.

Key Words: fractional passage rate, rumen retention time, marker recovery

831 Effect of dietary supplementation with resveratrol on nutrient digestibility, methanogenesis and ruminal microbial flora in sheep. Tao Ma[1], Dan-dan Chen[1], Yan Tu[1], Nai-feng Zhang[1], Bing-wen Si[1], Kai-dong Deng[2], and Qi-yu Diao*[1], *[1]Feed Research Institute, Chinese Academy of Agricultural Sciences, Key Laboratory of Feed Biotechnology of the Ministry of Agriculture, Beijing, China, [2]College of Animal Science, Jinling Institute of Technology, Nanjing, Jiangsu, China.*

Two experiments were conducted to evaluate the effect of resveratrol on methanogenesis and microbial flora in Dorper × thin-tailed Han crossbred ewes. In experiment 1, Eighteen ewes (60.0 ± 1.73 kg BW) were assigned to 2 dietary treatments, a basal diet and a basal diet supplemented with resveratrol (0.25 g/head·d), to investigate the effect of resveratrol on nutrient digestibility and nitrogen balance. In experiment 2, 6 ewes (64.0 ± 1.85 kg BW) with ruminal cannulas were assigned to the identical dietary treatments used in experiment 1 according to change over design, to investigate supplementary resveratrol on ruminal fermentation and microbial flora using q-PCR. The digestibility and nitrogen balance data were analyzed using *t*-test procedures in SAS. Data referring to ruminal fermentation parameters (ruminal pH, ammonia,

and volatile fatty acid) and microbial flora measured at each sampling time were analyzed using a repeated measures one-way ANOVA. Significant differences were accepted when $P < 0.05$. The results showed that supplementary resveratrol improved the digestibility of organic matter ($P < 0.001$), nitrogen ($P = 0.007$), neutral detergent fiber ($P < 0.001$), and acid detergent fiber ($P < 0.001$). The excretion of fecal N was reduced ($P = 0.007$), whereas that of urinary N increased ($P = 0.002$), which led to an unchanged N retention ($P = 0.157$). Both CO_2 and CH_4 output scaled to digestible dry matter intake decreased from 602.5 to 518.7 ($P = 0.039$) and 68.2 to 56.6 ($P < 0.001$), respectively. Ruminal pH ($P = 0.341$), ammonia ($P = 0.512$), and total volatile fatty acid ($P = 0.249$) were unaffected by resveratrol. The molar proportion of propionate increased from 13.1 to 17.5% ($P < 0.001$) while that of butyrate decreased from 11.0 to 9.55% ($P < 0.001$). The ratio of acetate to propionate decreased from 5.44 to 3.96 ($P < 0.001$). Supplementary resveratrol increased ruminal population of *F. succinogenes*, *R. albus*, and *B. fibrisolvens* ($P < 0.001$) while decreased protozoa and methanogens ($P < 0.001$). In conclusion, dietary resveratrol inhibited methanogenesis without adversely affecting ruminal fermentation.

Key Words: CH_4, resveratrol, sheep

832 Essential oils from goat weed (*Ageratum conyzoides*) and African basil (*Ocimum gratissimum*) can reduce in vitro enteric methane production. Musibau A. Bamikole[1,2], Ibukun M. Ogunade*[1], Felipe Amaro[1], Yun Jiang[1], Thiago F. Bernardes[1], Vania R. Vasconcelos[1], Darren D. Henry[3], F. O. Ugiagbe[2], U. J. Ikhatua[2], Nicolas DiLorenzo[3], and Adegbola T. Adesogan[1], *[1]University of Florida, Gainesville, FL, [2]University of Benin, Benin City, Nigeria, [3]North Florida Research and Education Center, University of Florida, Marianna, FL.*

The potential of essential oils (EO) from leaves of goat weed (EOG) and African basil (EOB) to reduce in vitro enteric methane production and improve rumen fermentation was examined. A corn silage-based TMR (0.5 g; CP 16.6%; NDF 35.9%) was treated with EOG or EOB at rates of 0 (Control), 10 (Low), 20 (Med) and 30 (High) µL/50 mL of rumen fluid - buffer inoculum (ratio 1:2) and with monensin (0.6 mg/50 mL). Each suspension was incubated in a 120-mL gas-tight culture bottle in triplicate at 39°C for 24 h in each of 2 runs. Fermentation parameters, gas and methane production, in vitro DM digestibility (DMD), and fermentation efficiency (DMD g kg^{-1}/gas volume) were measured. Data for each EO were separately analyzed with the Glimmix procedure of SAS. Compared with respective Controls, monensin and High EOG or EOB reduced ($P < 0.05$) gas volume (66.8, 71.7 and 49.3 vs. 85.0), DMD (526, 520, and 514 vs. 555 g/kg) and methane percentage in total gas (7.95, 9.02 and 7.19 vs. 10.4%) and increased ($P < 0.05$) fermentation efficiency (7.92, 7.39, and 11.58 vs. 6.58). The respective reductions in methane production (mg/g DM digested) were 36.9, 24.1, 57.2%. Ammonia nitrogen concentration, pH of EOB and VFA concentrations of EOG were unaffected ($P > 0.05$) by treatment. However, monensin and High EOG increased ($P < 0.05$) the pH (5.75, 5.75 vs. 5.66, respectively) and monensin and High EOB increased ($P < 0.05$) molar proportions of butyrate and High EOB decreased ($P < 0.05$) that of propionate. Low rates of EOB and EOG increased ($P < 0.05$) CH4 production (mg/g DM digested) and Med rates decreased ($P < 0.05$) DMD. Low EOG increased ($P < 0.05$) gas volume and methane production (mg/g DM digested), and decreased ($P < 0.05$) fermentation efficiency. A high dose of essential oils from goat weed and African basil leaves improved fermentation efficiency and reduced DMD and methane production in a manner that is comparable with monensin.

Key Words: essential oil, medicinal plant, in vitro fermentation

833 Effects of supplemental energy and protein source on performance of steers grazing irrigated corn residue. Benjamin T. Tibbitts*[1], Cody A. Welchons[1], Robert G. Bondurant[1], Fred H. Hilscher[1], James C. MacDonald[1], and Rick N. Funston[2], *[1]University of Nebraska-Lincoln, Lincoln, NE, [2]University of Nebraska West Central Research and Extension Center, North Platte, NE.*

Seventy-five crossbred steer calves (235 ± 1.1kg) grazing irrigated corn residue were blocked by BW and randomly assigned to 5 treatment groups (n = 15) to evaluate the effects of protein and energy supplementation on steer performance. Steers were supplemented daily at 1100–1200 via a Calan gate system for 86 d. Treatment supplements consisted of 60% soy-pass + 40% soybean meal (SP), dried distillers grains (DDG), 89% Corn/6% Molasses/5% Urea (C + RDP), corn only (CRN), and control (NS) fed at 1.59, 1.36, 1.82, 1.7, and 0.0 kg DM/d respectively. Supplements were fed at different DM amounts to provide equal TDN intake. Estimated TDN values by supplement were 87% (SP), 104% (DDG), 87% (C + RDP), and 83% (CRN). Ending BW ($P < 0.05$) differed among treatments and was 291, 286, 254, 245, and 229 (SEM 4.9) kg for SP, DDG, C + RDP, CRN, and NS respectively. Average daily gain among treatments was 0.67, 0.6, 0.24, 0.14, and - 0.09 kg (SEM 0.06) for SP, DDG, C + RDP, CRN, and NS respectively and was significantly different ($P < 0.05$) among all treatments. Treatment groups supplemented with SP and DDG achieved average daily acceptable gains above 0.5 kg, while C + RDP, CRN, and NS treatment groups achieved average daily gains lower than 0.5 kg. The SP treatment provided a combination of RDP and RUP which resulted in greatest ADG among treatments when supplement TDN was similar.

Key Words: beef steers, corn residue grazing, supplementation

834 Variability in predicted weaning weight of nursing calves using four models. Phillip A. Lancaster*[1] and Luis O. Tedeschi[2], *[1]Range Cattle Research and Education Center, University of Florida, Ona, FL, [2]Department of Animal Science, Texas A&M University, College Station, TX.*

The objective of this study was to assess the variability surrounding predicted weaning weight (WW) of nursing beef calves at 210 d of age using 2 models developed to predict milk yield (MY) and calf forage DMI. These models were developed to predict calf WW based on peak milk (PKMK), calf BW, and forage DE. Equations to predict calf forage DMI were published by Tedeschi et al. (2006; Nutrient Digestion and Utilization in Farm Animals; TED06) and Tedeschi et al. (2009; J. Anim. Sci. 87:3380; TED09). Additionally, we evaluated 2 equations to predict MY: Wood (1967; WOD) and the NRC (2000; NRC). Calf ADG was computed using NRC (2000) equations for energy requirements assuming ME content of 5.29 Mcal/kg for milk. A Monte Carlo simulation with 5,000 iterations assumed normal distribution with mean and SD of 3 ± 0.5 Mcal/kg for forage DE, 35 ± 2 kg for calf birth weight (CBW), and 550 ± 50 kg for final shrunk BW (FSBW), and uniform distribution with minimum and maximum at 3 and 12 kg/d for PKMK. Although predicted WW overlapped for all model combinations, their mean and SD varied considerably: 147 ± 72.9, 219 ± 95.1, 262 ± 91.6, and 278 ± 82.2 kg for NRC&TED09, WOD&TED09, NRC&TED06, and WOD&TED06, respectively. Their predicted WW tended to follow

normal distributions, except for NRC&TED09 that was skewed to the right. The percentage of predicted WW within 100 and 300 kg were 75.3, 76, 67, and 62.8%, respectively, and within 200 and 300 kg were 10.1, 36.1, 42.4, and 46.4%, respectively. Forage DE had the greatest Spearman correlation ($0.74 < r < 0.86$) with WW, followed by PKMK ($38 < r < 44$), FSBW ($0.16 < r < 0.18$), and CBW ($r = 0.01$). Forage DE also had the greatest standardized regression coefficient (SRC) for WW: 073, 0.84, 0.81, and 0.80 for NRC&TED09, WOD&TED09, NRC&TED06, and WOD&TED06, respectively, and PKMK had the second greatest SRC: 0.28, 0.39, and 0.43 for WOD&TED09, NRC&TED06, and WOD&TED06, respectively. For NRC&TED09, FSBW had the second greatest SRC (0.18). We concluded that forage DE is the most influential factor that affects calf WW and these predictive models have distinct prediction patterns for calf WW. Future analysis should focus on consolidating predicted MY between these models.

Key Words: beef, growth, modeling simulation