RUMINANT NUTRITION V

0643 Methane emissions from lactating and dry dairy cows fed diets differing in forage source and NDF concentration. *K. J. Hammond*, D. J. Humphries, L. A. Crompton, P. Kirton, C. Green, and C. K. Reynolds, University of Reading, UK.*

Methane emission factors are lacking from different livestock species in various production states fed varying diets. The objectives of the present study were to measure effects of physiological state, silage type, and supplemental NDF on DMI, DM digestibility (DMD), and methane emissions of lactating and dry dairy cows using two 4 × 4 Latin squares (5-wk periods) with four lactating (114 DIM ± SEM 3.30; square 1) or four dry and non-pregnant (square 2) ruminally cannulated Holstein dairy cows. Measurements included DMI and DMD during wk 4, and methane production (respiration chambers) in wk 5. Four isonitrogenous treatment diets were fed as total mixed rations (TMR) with 50% silage (DM basis) offered ad libitum to lactating cows and at 1.2 × maintenance ME to dry cows. Silage was comprised of either 25:75 (MS) or 75:25 (GS) grass silage:maize silage on a DM basis, without or with additional NDF from chopped straw and soy hulls (+ 47 g NDF/kg TMR DM). Data for each square were analyzed using mixed models for fixed effects of silage, NDF, and their interaction, and random effects of cow and period. Data from each square were combined to test the effect of physiological state. Lactating cows fed MS had a greater DMI ($P < 0.02$; 21.1 kg/d) and methane production ($P < 0.10$; 484 g/d) and lower methane yield ($P < 0.02$; 22.8 g/kg DMI) than when fed GS (17.7, 440, and 24.9, respectively), however there was no effect of silage type on DMD. Added NDF increased methane yield for lactating cows fed MS (22.8 vs. 23.7 g/kg DMI), but not GS (silage by NDF interaction, $P < 0.02$). Except for DMI, which was higher ($P < 0.03$) for MS compared to GS diets (12.9 vs. 10.6 kg/d), diet did not affect methane production or yield or DMD for dry cows. Compared to dry cows, lactating cows had greater DMI (19.7 vs. 11.0 kg/d; $P < 0.02$), higher DMD (749 vs. 725 g/kg; $P < 0.01$), and lower methane yield (24.0 vs. 28.0 g/kg DMI; $P < 0.03$). The difference in methane yield between lactating and dry cows may be due to differences in DMI and rumen function, including digesta dynamics such as rumen outflow and retention time. Such differences may also explain why silage type affected methane yield in lactating cows, but not dry cows.

Key Words: methane, dairy cows, forage NDF

0644 Effects of cysteamine on ruminal fermentation parameters and methane production of water buffalo by in vitro gas production method. C. Zou[*1], Y. L. Huang[2], X. Liang[2], S. J. Wei[2], B. Lin[2], C. J. Yang[2], and X. W. Liang[2], *[1]Buffalo Research Institute, The Chinese Academy of Agricultural Sciences, Nanning, China, [2]Buffalo Research Institute, Chinese Academy of Agricultural Sciences, Nanning, China.*

In our previous studies, supplement cysteamine (Cs) could increase the conjugated linoleic acids content in water buffalo milk, but we do not know whether Cs could reduce the methane production. Thus, the aim of this present study was to evaluate the effect of Cs on ruminal fermentation parameters and methane production of water buffalo by in vitro gas production method. In vitro fermentations were conducted in 180-mL serum bottles with a reading pressure in vitro gas production system. The oven-dried subtrate (187.50 mg maize grain, 56.25 mg soybean meal, 196.88 mg elephant grass, 140.63 mg brewers grains, and 168.75 mg cassava pulps, DM basis) was weighted with three replicates into 90-mL buffer medium. The ratio of concentrate to forage of substrate was 32.5:67.5. Cs was supplemented in concentrate at levels of 0, 0.2, 0.4, 0.6, 0.8, and 1.0% (dry matter basis), respectively. The water buffalo rumen contents obtained were mixed and strained through four layers of cheesecloth into a flask under CO_2 in the water bath at 39°C. The pressure and methane production were measured at 6, 12, and 24 h. At the end of the incubation (24 h), the incubation fluids were sampled and samples were stored at -20°C for an analysis of NH_3–N concentration and VFA composition. There were no significant differences for NH_3–N concentration (6.40, 6.53, 6.43, 7.07, 7.24, and 6.30 mg/dL for the levels of 0, 0.2, 0.4, 0.6, 0.8, and 1.0% Cs supplement, $P = 0.652$) and acetate (20.91, 20.95, 20.86, 20.44, 21.22, and 19.42 mmol/L, $P = 0.702$), propionate (7.06, 7.08, 6.71, 6.44, 6.71, 6.20 mmol/L, $P = 0.436$), total VFA (32.77, 32.81, 31.56, 30.98, 31.85, and 29.20 mmol/L, $P = 0.499$), and acetate/propionate (2.97, 2.97, 3.11, 3.17, 3.16, and 3.13, $P = 0.086$) among each treatments. Methane production at 6 h (0.14, 0.13, 0.10, 0.10, 0.08, and 0.09 mmol/L, $P = 0.03$), 12 h (0.37, 0.36, 0.25, 0.28, 0.26, and 0.28 mmol/L, $P < 0.0001$), 24 h (0.61, 0.61, 0.49, 0.54, 0.51, and 0.58 mmol/L, $P = 0.004$) were decreased with an increasing level of Cs. Butyrate content (4.80, 4.79, 3.99, 4.09, 3.92, and 3.59 mmol/L, $P = 0.037$) at 24 h were decreased with an increasing level of Cs. The results of in vitro gas production method indicate that Cs can promote rument microbe fermentation, but decrease methane production of water buffalo when supplemental level of Cs is 0.8%.

Key Words*:* cysteamine, methane emission, water buffalo

0645 Effect of lowered pH and increased passage rate on methane and volatile fatty acid production from continuous culture. B. A. Wenner*[1], F. Batistel[2], J. D. Souza[3], T. J. Hackmann[4], and J. L. Firkins[1], *[1]The Ohio State University, Columbus, [2]University of São Paulo, Piracicaba, Brazil, [3]University of Sao Paulo, Piracicaba, Brazil, [4]University of Florida, Gainesville.*

The present study was conducted as a 2 × 2 factorial treatment arrangement in a Latin square design using continuous culture fermenters (n = 4). Treatments were control pH (CpH; 6.3 to 6.9) or low pH (LpH; 5.8 to 6.4) factorialized with solids passage rates (k_p) of either low (Lk_p; 2.5%/h) or high (Hk_p; 5.0%/h); total dilution by buffer was constant at 7.0%/h. Fermenters were fed once daily (40 g DM; a 50:50 concentrate:forage diet) and periods lasted 10 d with 3 d of sample collection. The main effect of LpH decreased (P < 0.001) aqueous hydrogen compared with CpH by 3.82 μM, but there was no effect of k_p (P > 0.10). The main effect of LpH decreased headspace hydrogen (H_2(g); escaped from culture) by 60.1 mmol/L×d, and an interaction over time (P < 0.001) was explained by H_2(g) being greater for CpH/Hk_p than for LpH (both k_p) from 5 to 24 h post-feeding, and CpH/Lk_p being greater than LpH (both k_p) from 6 to 24 h post-feeding. Further, H_2(g) was greater (P < 0.05) with CpH/Hk_p compared with CpH/Lk_p from 15 to 24 h post-feeding. There was no main effect (P > 0.10) of pH on methane production, but the main effect of Hk_p tended (P = 0.08) to decrease methane production compared with Lk_p by 880 mmol/L×d. A treatment × time interaction (P < 0.01) was explained in that CpH/Lk_p had the greatest (P < 0.05) methane production from 11 to 23 h post-feeding, whereas LpH/Lk_p was not different (P > 0.05) from CpH/Lk_p at 24 h post-feeding. Acetate molar percentage was 61.8, 59.6, 58.2, and 54.7% for CpH/Lk_p, CpH/Hk_p, LpH/Lk_p and LpH/Hk_p, respectively. Both the main effects of LpH and Hk_p decreased acetate molar percentage (P = 0.01) compared with CpH and Lk_p, respectively. Propionate molar percentage was 22.5, 24.4, 23.9, and 26.2% for CpH/Lk_p, CpH/Hk_p, LpH/Lk_p and LpH/Hk_p, respectively. The main effect of LpH increased (P = 0.02) propionate molar percentage, decreasing (P = 0.002) A:P ratio from 2.61 to 2.34 compared with CpH. The main effect of Hk_p increased (P = 0.006) propionate molar percentage, decreasing (P = 0.002) A:P ratio from 2.62 to 2.34 compared with Lk_p. There were no effects on butyrate molar percentage or total VFA production (P > 0.10). The results indicate increasing $k_p$and decreasing pH decreased A:P ratio independent of the current diet.

Key Words: hydrogen, methane, volatile fatty acids

0646 Effects of encapsulated nitrate on nitrogen utilization and enteric methane emissions in beef cattle. C. Lee*[1], R. C. Araujo[2,3], K. M. Koenig[4], and K. A. Beauchemin[1], *[1]Lethbridge Research Centre, Agriculture and Agri-Food Canada, AB, Canada, [2]GRASP Ind. & Com. LTDA, Curitiba, Brazil, [3]EW|Nutrition GMBH, Visbek, Germany, [4]Agriculture and Agri-Food Canada, Lethbridge Research Centre, AB, Canada.*

Effects of encapsulated slow-release nitrate (EN; GRASP Ind. & Com. LTDA, Paraná, Brazil) on nitrogen (N) utilization and enteric methane emissions in beef cattle were investigated. Eight ruminally cannulated beef heifers (452 ± 21 kg BW) were used in a replicated 4 × 4 Latin square design. The basal diet (55:45 forage:concentrate ratio) included encapsulated urea [EU; 1.2% of dietary DM; Prote-N; GRASP Ind. & Com LTDA] for the control diet. The EN replaced a portion of EU and limestone with 1, 2, or 3% EN (0.8, 1.5, and 2.3% nitrate) in dietary DM. The diets (iso-nitrogenous; 12.7% CP) were fed once daily ad libitum. Each period consisted of 21 d of adaptation in a stepwise manner followed by 14 d of sampling (total collection for 4 d and enteric methane measurements in environmental chambers for 3 d). Dry matter intake tended to decrease (10.4 to 10.1 kg/d; P = 0.06) slightly with increases in EN, but body weight was not affected. Enteric methane emissions and intensity were linearly reduced (183 to 145 g/d and 21.3 to 17.4 g/kg DMI; P < 0.001) with increasing dietary EN where a treatment × hour interaction was observed (P < 0.001). Methane emissions with greater treatment effects occurred 0 to 12 h after feeding when cows consumed 87% of total feed offered. Nitrogen intake was not affected by EN. Plasma urea-N was linearly decreased (12.5 to 10.9 mg/dl; P < 0.001) with increasing dietary EN. Urinary N excretion tended to linearly decrease (100.2 to 86.5 g/d; P = 0.056) and the proportion of N intake was linearly reduced (46.1 to 39.2%; P = 0.03) with increasing dietary EN. Urinary urea-N excretion and the proportion of N intake were linearly decreased (75.9 to 56.2 g/d, P = 0.019 and 35.2 to 25.4%, P = 0.015, respectively) with increasing EN level. Fecal N excretion was not affected by EN. As a consequence, total N excretion and the proportion of N intake were linearly decreased (P = 0.047 and P = 0.001, respectively) with increasing dietary EN. In conclusion, supplementary nitrate in a protected form lowered enteric methane emissions in a dose–response manner. Urinary N excretion was reduced for heifers fed EN compared with EU, due to lower urea-N excretion in urine. The study demonstrates that feeding EN as a N source is environmentally beneficial compared with EU in beef cattle.

Key Words: encapsulated nitrate, enteric methane emissions, nitrogen utilization

0647 Correspondence between in vitro and in vivo rumen methane production obtained with different starch sources and starch levels. B. Hatew[*1], J. W. Cone[1], W. F. Pellikaan[1], S. C. Podesta[1], W. H. Hendriks[1], A. Bannink[2], and J. Dijkstra[1], *[1]Animal Nutrition Group, Wageningen University, Netherlands, [2]Wageningen UR Livestock Research, Wageningen University and Research Centre, Lelystad, Netherlands.*

To investigate the relationship between in vitro and in vivo methane (CH_4) production measured simultaneously, 16 rumen-cannulated lactating dairy cows were assigned to four blocks with a 2 × 2 factorial arrangement of treatments. The treatments were based on concentrates formulated to contain starch varying in source (slowly fermentable (S) vs. rapidly fermentable (*R*); native vs. gelatinized corn grain) and level of starch (low (L) vs. high (H); 270 vs. 530 g/kg of concentrate DM). The grass silage to concentrate ratio of the total diet was 60:40 (DM basis). After 12 d of adaptation, the cows were housed in respiration chambers for 5 d to measure CH_4 production, replicated in four periods. In each period rumen fluid was obtained from each of four donor cows adapted to one of the four different diets for about 16 d. Gas production (GP) and CH_4 was measured (in duplicate per period) for each substrate from the same diet as fed to individual donor cow using automated GP system with CH_4 measured at distinct time points. Rumen fermentable organic matter (OM) in concentrates was determined by in situ technique and in grass silage estimated by NIRS analysis. In vitro CH_4 production (24 h) was lower with R than with S starch (42.9 vs. 49.5 mL/g of incubated OM; $P = 0.004$), and higher with L than with H (49.8 vs. 42.6 mL/g of incubated OM; $P = 0.002$). In vivo, an increased rate of fermentation, but not increased level of starch, resulted in a lower CH_4 production per unit rumen fermentable OM (55.6 *vs*. 61.1 L/kg of fermentable OM; $P = 0.007$). Across the diets tested, in vitro CH_4 correlated well with in vivo CH_4 production expressed per unit fermented OM ($R^2 = 0.54$; $P = 0.040$), but not with in vivo CH_4 production expressed per unit ingested OM ($R^2 = 0.04$; $P = 0.878$). These results indicate the complexity of rumen fermentation conditions needs to be considered to predict in vivo CH_4 production from in vitro measurements. In conclusion, in vitro CH_4 production was only indicative of the trend of in vivo rumen CH_4 production from different combinations of source and level of starch when in vivo CH_4production was expressed per unit rumen fermented OM, but not when expressed per unit ingested OM.

Key Words: methane, in vitro, in vivo

Table 0647. Chemical composition (g/kg DM) of total mixed diet

Diet	CP	NDF
SL-diet	156	441
SH-diet	157	385
RL-diet	156	440
RH-diet	163	378

0648 The potential benefit of corn dried distillers' grain (co)products (DDG) in the mitigation of methane production in cattle: an in vivo analysis. M. A. Fonseca[*1], L. F. L. Cavalcanti[2], J. G. L. Regadas Filho[3], T. R. Callaway[4], G. E. Carstens[1], T. A. Wickersham[1], and L. O. Tedeschi[1], *[1]Texas A&M University, College Station, [2]Universidade Federal de Minas Gerais, Belo Horizonte, Brazil, [3]Universidade Federal de Vicosa, Vicosa, Brazil, [4]USDA-ARS, College Station, Texas.*

Our preliminary in vitro study indicated that feeding high-fat diets may decrease methane (CH_4) production by cattle. The objective of this study was to determine the impact of different levels of DDG on the digestibility of OM and the production of CH_4using two open-circuit respiration chambers at the Nutrition and Physiology Center, Texas A&M University, College Station, Texas. The respiration chambers monitored the inflow and outflow of CO_2, O_2 (fuel cell oxygen, FC-1B; Sable Systems, Henderson, NV), CH_4, and water vapor continuously, and all calculations were corrected for the standard temperature and pressure of the air mass flowing through the chambers (FLOWKIT 500H; Sable Systems, Henderson, NV). Relative humidity was measured and used to calculate the dew point and water vapor pressure. Gases measurements were performed using a flow-through system (RH-100). Air from each source (chambers A and B, and baseline) were sampled every 4 min. The diets were formulated to have same level of ME (Mcal/kg) and to contain 0, 20, or 40% of DDG (DM basis). Animals were adapted to the experimental diets for 7 d outside the chambers and then brought in for a 48-h period for consecutive gas exchange measurement. The intake was restricted to 2% of BW and fed twice daily. Six Angus steers were allocated in an incomplete Latin rectangle design (two animals/diet for three periods). The R software (R Core Team, Vienna, Austria) and PROC MIXED of SAS (SAS Inst., Cary, NC) were used to analyze the data using a repeated measure design. Diets were assumed to be fixed factors, and periods and animals were random factors. The analysis of CH_4 emissions (L/d) corrected for a 24-h period and the CH_4 adjusted to BW (L/kg/d) had significant ($P = 0.0081$) linear and nonlinear decay patterns between CH_4 emissions and levels of DDG. Although the 20 and 40% DDG levels (DM basis) did not differ in reducing CH_4 emissions ($P = 0.16$), the linear relationship showed that for each percentage unit increase in DDG (DM basis) in the diet, a decrease ($P = 0.0027$) of 0.005 L/kg of BW/d of CH_4 emissions was observed. We concluded that 20% of DDG (DM basis) is sufficient to promote a significant reduction in CH_4 emission by cattle receiving DDG.

Key Words: abatement, greenhouse gas, respirometry

0649 Effects of including viginiamycin in feedlot diets containing monensin under commercial conditions in Mexico. M. Gorocica*[1], A. Gonzalez-Asif[2], and S. C. Loerch[3], [1]*Phibro Animal Health, Merida, Mexico,* [2]*SuKarne Agroindustrial, Culiacan, Mexico,* [3]*The Ohio State University, Wooster.*

A trial was undertaken to determine the effects of supplemental virginiamycin (VM) in combination with monensin (Mon) on finishing cattle performance. The trial was conducted in a large commercial feedlot in central Mexico. Upon arrival, 4874 crossbred bulls (LBW = 267.7 ± 21.32 kg) were dewormed, vaccinated against respiratory and clostridial pathogens and implanted with an estrogenic implant. At processing, cattle were randomly allotted to 84 pens with approximately 58 animals/pen. Two dietary supplement treatments were randomly allotted to the 84 pens: a corn-soybean based concentrate diet containing 400 mg/hd/d of Mon (MON), and the MON diet supplemented with 200 mg/hd/d of VM (MON+VM). Cattle were gradually adapted to their final diet (14% protein, 1.56 Mcal NEg/kg) over a 21–28 d period. When cattle were 60 DOF, they were reimplanted with a Trenbolone acetate implant (200 mg TBA + 20 mg Estradiol benzoate). Zilpaterol chlorhydrate was provided to all cattle at 0.15 mg/kg BW for 28 d and was withdrawn 3 d before harvest. Cattle in all pens were harvested after 130 DOF. At harvest, HCW were recorded. Data were analyzed using the PROC MIXED of SAS for a complete randomized design. Pen was used as the experimental unit. At reimplant, MON+VM cattle had greater ADG and G:F (both, $P < 0.01$) than MON (1.83 and 0.208 vs. 1.78 and 0.189, respectively). Hot carcass yield was greater ($P < 0.01$) in MON+VM cattle than MON (62.9 vs. 62.1% respectively). Total ADG and G:F were improved by 5% (both $P < 0.01$) when VM was included in the ration (MON+VM: 1.74 and 0.186 vs. MON: 1.67 and 0.177 for ADG and G:F respectively). Hot carcass weight was 5.2 kg greater ($P < 0.01$) in MON+VM than in MON cattle (306.0 vs. 300.8 respectively). Virginiamycin inclusion to feedlot diets containing Mon improved feedlot performance and carcass weight.

Key Words: virginiamycin, feedlot,

0650 Effects of extracts of *Perilla frutescens* (seeds) on in vitro rumen fermentation, methanogenesis, and microbial population. M. Liu*[1], J. X. Liu[2], and J. K. Wang[1], [1]*Institute of Dairy Science, Zhejiang University, Hangzhou, China,* [2]*Zhejiang University, Hangzhou, China.*

Seeds of *Perilla frutescens* are rich in linolenic and linoleic acid. An in vitro incubation was performed to investigate the effects of extracts from *Perilla frutescens* seeds on rumen fermentation, methanogenesis, and microbial population. Five-hundred milligrams of substrate (mixture of Chinese wild rye and corn meals at 70:30, w/w) were incubated in 120-mL serum bottles. The fermentation medium was 5 mL of sheep rumen fluid and 45 mL of buffer medium. The seeds of *Perilla frutescens* were extracted by 70% ethanol. To accurately add 20 mg of extracts, the freeze-dried extracts were dissolved into dimethyl sulfoxide (DMSO) to a concentration of 40 mg/ml, and then 500 mL of the DMSO solution was added to the incubation system. In the control, 500μL of DMSO was used without extracts. After 24 h of incubation at 39°C, rumen fermentation parameters were measured and absolute abundance of total bacteria, protozoa, fungi, and methanogens were quantified using real-time PCR based on the 16S, 18S rDNA and *mcr*A gene, respectively. Total volatile fatty acids and ammonia nitrogen concentrations were not affected ($P > 0.05$) by extracts, while methane production was decreased by 63.6% ($P < 0.01$), from 0.723 to 0.263 mmol/g DM substrate. Addition of extracts induced a dramatic shift in the population of rumen microbota (Table 0650), indicating the decreased protozoa (99.5%, $P < 0.01$) and fungi numbers (99.5%, $P < 0.01$) and reduced methanogens (62.2%, $P < 0.01$). These data indicate that ethanol extracts from seeds of *Perilla frutescens* have potential to reduce rumen methanogenesis by inhibiting protozoa and activity of methanogens without adversely affecting rumen fermentation.

Key Words: methanogenesis, *Perilla frutescens*, rumen fermentation

Table 0650. Effects of extracts of *Perilla frutescens* (seeds) on microbial population (copies/g centrifuged fermentation mixtures)

	Control	Extracts	SEM	*P*-value
Total bacteria ($\times 10^{11}$)	7.12	6.81	0.472	> 0.05
Protozoa ($\times 10^{7}$)	666.9	3.4	98.7	< 0.01
Fungi ($\times 10^{5}$)	1684.3	8.3	239.5	< 0.01
Methanogens ($\times 10^{8}$)	11.8	4.5	1.39	< 0.01

0651 Effect of tannin or inoculum as silage additives on silage quality and rumen fermentation kinetics. V. J. Taha*[1], J. A. Huntington[1], R. G. Wilkinson[1], and D. A. Davies[2], [1]*Harper Adams University, Newport, UK,* [2]*Silage Solutions, Aberystwyth, UK.*

Tannin has the ability to bind with different compounds including protein and carbohydrate to form complex undegradable compounds. Tannin-protein complexes form in the rumen (pH 6–7) and disassociate in the abomasum (pH < 3.5) enhancing duodenal supply of dietary protein. The in vitro gas production technique can be used to predict rumen fermentation kinetics. The effect of additional tannin (hydrolyzable, chestnut) and a bacterial inoculant as additives at ensiling on final silage quality and in vitro rumen fermentation kinetics were investigated. Whole crop grass, pea, and bean forages were harvested on July 14, 2011, and ensiled in triplicate in experimental silos (25kg). Before ensiling, each forage was treated with one of four additives: 40 g/kg fresh weight (FW) tannin (HT), 20 g/kg FW tannin (LT), an inoculant (*L. plan-*

tarum) 10^6 colony-forming units/g FW (In), or untreated (C). A standard volume of water (1 mL/kg FW) was applied to all treatments. Silos were opened after 100 d and subsamples stored (-20°C) before analysis for: pH, NH_3–N, DM, NDF, CP, and water soluble DM component (WS). Rumen fluid was collected from four mature wethers (fitted with permanent rumen cannula) fed straw plus concentrates (80:20 DM basis) with ad libitum access to water. Gas production (in vitro) was measured as described by Theodorou et al. (1994; J. Feed Sci. Tech. 48:185–197) and results fitted to an exponential decay curve (SigmaPlot12). Duplicate samples were incubated for 72 h with four experimental periods. The experiment was analyzed as 3 × 4 factorial design using Genstat 15 (VSN International, UK). The addition of tannin significantly reduced NH_3–N compared to control silages (41.60, 48.76, 55.66 and 60.01 g/kg total N for HT, LT, In, and C respectively, SED = 1.976, $P < 0.001$). Moreover, both tannin levels reduced the WS compared to In and C (197.2, 235.4, 258.5, and 263.7 g/kgDM for HT, LT, In, and C, SED = 8.154 $P < 0.001$). There was no significant effect ($P > 0.05$) on other proximate analysis. Effect of additive on rumen fermentation kinetics for mean silages showed that additional tannin reduced the total gas pressure (300.3, 329.6, 370.1, and 375.1 kPa for HT, LT, In, and C, respectively, SED = 26.32, $P < 0.05$) and the rate of fermentation (0.034, 0.037, 0.039, and 0.043, SED = 0.0046, $P < 0.05$) for HT, LT, In, and C, respectively. Addition of tannin at ensiling reduced crop protein degradation in silo and reduced rumen fermentation potentially increasing the supply of UDP to the small intestine.

Key Words: tannin, silage, gas production

0652 Improving the performance of dairy cattle with a xylanase-rich exogenous enzyme preparation. J. J. Romero*[1], E. G. Macias[2], Z. Ma[1], R. M. Martins[3], B. Y. Coy[1], F. M. Silva[4], D. H. Garbuio[4], I. A. Brody[1], C. L. Curry[1], K. J. Mills[1], M. G. Zenobi[1], C. R. Staples[1], and A. T. Adesogan[1], *[1]Dep. of Animal Sciences, University of Florida, Gainesville, [2]Dep. de Zootecnia, Universidad Nacional Agraria La Molina, Lima, Peru, [3]Dep. de Zootecnia, Universidade Federal de Viçosa, Minas Gerais, Brazil, [4]Universidade Estadual Paulista, São Paulo, Brazil.*

The objective was to compare effects of two *Trichoderma reesei* exogenous fibrolytic enzyme preparations (EFE) on the performance of lactating dairy cattle fed a bermudagrass- and corn silage-based TMR. The first EFE (MIX) had increased the efficiency of feed utilization by lactating dairy cows in a previous study and the second xylanase-rich EFE (XYL) was the best of 18 EFE candidates at improving in vitro NDFD and rumen-like fermentation of bermudagrass haylage. Endoglucanase and xylanase activities of MIX and XYL were 2087 and 2714 and 10,549 and 26,926 µmol/min per g, respectively. Sixty-six lactating Holstein dairy cows in early lactation (588 ± 75 kg; 21 ± 5 DIM) were grouped by previous milk production and parity and randomly assigned to control (CON), XYL, or MIX treatments. The XYL and MIX EFE were added to the diet just before feeding at rates of 1 and 3.4 mL/kg of TMR DM, respectively. Cows were fed experimental diets for 70 d after they were fed a common diet for an 11-d covariate period. The statistical model included effects of enzyme, parity, week and their interactions, as well as covariate milk production or DMI. The random effect was cow nested within treatment and parity. Body weight and condition score were not affected by treatment. Compared to CON, application of XYL increased ($P < 0.05$) intake (kg/d) of DM (28.6 vs. 27.4), OM (26.7 vs. 25.5), and CP (4.7 vs. 4.5), but MIX did not. Cows fed XYL had greater milk yield (kg/d) during wk 3 (41.2 vs. 39.8; $P < 0.10$), 6 (41.9 vs. 40.1; $P < 0.05$), and 7 (42.1 vs. 40.4; $P < 0.05$), as did those fed MIX during wk 6 (41.5 vs. 40.1; $P < 0.10$), 8 (41.8 vs. 40.0; $P < 0.05$), and 9 (40.9 vs. 39.5; $P < 0.10$). Cows fed XYL tended ($P < 0.10$) to produce more (kg/d) FCM (41.8 vs. 40.7) and fat yield (1.48 vs. 1.44) than those fed CON. Feeding with the EFE increased milk production by dairy cows.

Key Words: dairy cattle, enzyme, TMR

0653 Effects of feeding chitosan on nutrient digestibility in beef heifers. D. D. Henry*, F. M. Ciriaco, V. R. G. Mercadante, T. Schulmeister, D. Demeterco, A. Marin, G. C. Lamb, and N. DiLorenzo, *University of Florida, Marianna.*

The objective of this study was to determine whether adding the biopolymer chitosan would increase efficiency of beef heifers by improving apparent total tract nutrient digestibility of a low quality diet. Twenty-four crossbred heifers (318 ± 35 kg) were used in a randomized block design replicated in two experimental periods. Heifers were stratified by weight and randomly assigned to 12 pens (two heifers/pen), and pens were randomly assigned to one of six treatments in a 2 × 3 factorial arrangement. Factors included diet [a high concentrate (85% concentrate; HC), and a low concentrate (36% concentrate; LC)], and chitosan inclusion level (0.0, 0.5, and 1.0% of dietary DM). Heifers were housed in the University of Florida–Feed Efficiency Facility in Marianna, FL, where diets were offered ad libitum and individual intake was recorded by a GrowSafe system. Feed and fecal samples were collected for four consecutive days to determine apparent total tract digestibility of DM, OM, CP, NDF, and ADF using indigestible NDF (iNDF) as an internal digestibility marker. Feed samples were collected once a day, and fecal samples were collected by rectal grab twice daily (0700 h and 1500 h). Feed and fecal samples were pooled within pen and heifer, respectively. Concentrations of iNDF in feed and feces were determined by in vitro incubations conducted using a 4:1 buffer to ruminal fluid ratio for 288 h. Data were analyzed using PROC MIXED of SAS with heifer as the experimental unit, including the fixed effects of

diet and chitosan inclusion level, and the random effect of period. Orthogonal polynomial contrasts were conducted to determine linear and quadratic effects of chitosan inclusion level on nutrient digestibility. There was a diet × chitosan interaction for digestibility of DM ($P = 0.05$) and OM ($P = 0.04$). Inclusion of chitosan in LC at up to 1% diet DM linearly increased ($P < 0.05$) digestibility of DM and OM as compared to control (40.3 vs. 33.2%, and 41.1 vs. 34.5% for DM and OM digestibility, respectively). No differences ($P > 0.10$) were found for digestibility of CP, NDF, or ADF. In conclusion, adding 1% chitosan to low concentrate diets increased apparent total tract digestibility of DM and OM by 21 and 19%, respectively.

Key Words: beef, chitosan, digestibility

0654 Effect of *Saccharomyces cerevisiae* fermentation product (XP) on energetic efficiency of diet fed to high producing dairy cows during the hot season.

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The objective was to test whether *Saccharomyces cerevisiae* fermentation product (XP, Diamond V, Cedar Rapids, IA) could compensate for lower energy density in diets by increasing digestive efficiency. Forty-two multiparous Israeli-Holstein dairy cows were divided into two treatment groups according to milk production, parity, DIM and BW. Treatments consisted of: 1) control, a common Israeli diet containing 1.78 Mcal NE_L/kg DM; 2) XP, a diet contained 1.75 Mcal NE_L/kg DM and supplemented with 50 g XP/cow/day. Diets were isonitrogenous and consisted of the same ingredients. The study was conducted for 14 wk during the typical hot season. Milk yield, DMI, rumination time, and lying time were recorded daily, and milk components were measured weekly. Rumen and blood samples were taken at the 12th wk of the study: -2, 0, 2, and 4 h relative to feeding time for rumen pH, VFA and ammonia, and plasma glucose and urea. Data were analyzed using the PROC MIXED model of SAS. Milk yields tended to be higher ($P < 0.1$) in control than in XP group, and FCM (4%) yields and milk components percentages and yields were similar between treatments. No treatment effect was observed for daily rumination and resting time. The energy intake was lower (48.9 and 50.5 Mcal/d, respectively; $P < 0.05$), and DMI tended to be lower ($P < 0.1$) in cows supplemented with XP than in control cows. Energy in milk per energy consumed tended to be higher ($P < 0.1$) in cows supplemented with XP, and resulted in similar feed efficiency (milk, ECM, or FCM/DMI). Plasma glucose concentrations were higher in cows supplemented with XP than in control cows (66.2 and 63.8 mg/dL, respectively; $P < 0.05$). Plasma urea concentrations were 15% lower ($P < 0.001$), and rumen ammonia concentrations were also lower in cows supplemented with XP than in control cows (125.8 and 157.2 μg/ml, respectively; $P < 0.001$). Rumen pH was higher in cows supplemented with XP than in the control group (6.76 and 6.57, respectively; $P < 0.05$). Rumen propionic, butyric, and total VFA concentrations were higher ($P < 0.05$) in control cows than cows supplemented with XP, whereas the acetic/propionic ratio tended to be higher ($P < 0.1$) in cows supplemented with XP. In conclusion, supplementation of 50 g XP/d to dairy cows fed a lower energy diet increased energy availability, potentially through improved ruminal nitrogen metabolism and increased supply of glucose for milk production.

Key Words: energetic efficiency, XP, nitrogen metabolism