were: (%) 22.7 and 13.8 respectively for products A and B ($p<0.01$) (SED: 2.4). In conclusion, the higher transfer of retinol into milk with Microvit A Supra 1000 shows its better bioavailability in relation with its specific coating technology preventing it from ruminal degradation.

Key Words: Dairy cow, Vitamin A, Milk

Ruminant Nutrition: Rumen Fermentation Modifiers

T229 Effects of high and low inclusion rate yeast culture products on in vitro batch culture ruminal fermentations. H. M. Sullivan* and R. A. Halalsheh, *New Mexico State University*, *Las Cruces*.

In vitro mixed culture ruminal microorganism fermentations were conducted to determine the effects of two high (DVXP and WY2XP) and two low (WCC5 and YS) inclusion rate *Saccharomyces cerevisiae* cultures on batch fermentations of no substrate (NS), ground corn (GC), starch (S), high quality alfalfa hay (HA), low quality alfalfa hay (LA) and a dairy TMR (TMR). The TMR was formulated for a high producing cow to meet 2001 NRC requirements. Yeast products were included according to label directions for high and low dose products at 0.73 and 0.35 g/L. All substrates were fermented for 24 hours. Additional fermentations were conducted at 0, 24 and 48 hours using HA, LA and NS to determine in vitro DMD over time. Fermentations were done in duplicate over three days (n=6). Data were analysed using the GLM procedure of SAS. There was no significant difference among treatments in pH. The addition of each of yeast cultures increased ammonia concentrations in the presence of NS ($P < 0.05$). Ammonia concentrations were significantly lower for HA fermentations containing WCC5, DVXP and WY2XP ($P < 0.05$). Conversely, LA fermentations with DVXP and WY2XP had significantly higher ammonia concentrations ($P < 0.05$). Ammonia concentrations were numerically higher with yeast cultures for TMR; however, only WCC5, WY2XP and DVXP had significant increases. There was no difference among treatments in in vitro DMD of LA or HA. There was no significant difference among treatments in VFA concentrations of GC, LA, HA, S or TMR; however NS fermentations with yeast were significantly higher for all measured VFA. Lactate concentrations were not different among treatments. In conclusion, the incorporation of the high and low dose yeast culture products into mixed ruminal microorganism fermentations of GC, S, HA, LA and TMR had little effect on final pH and VFA products. Ammonia concentrations were lower in HA fermentations with yeast, especially for the high dose products, while the reverse was true for LA fermentations with yeast product added. The addition of yeast culture products to fermentations of alfalfa hay did not affect forage dry matter digestion in this study.

Key Words: In vitro, Yeast

T230 Evaluation of the protective effect of probiotics given to dairy cows during a lactic acidosis challenge. J. Chiquette*, *Dairy and Swine Research & Development Centre*, *Lennoxville, Quebec, Canada*.

Sub-acute rumen acidosis can be extremely costly when it occurs in dairy cows. The use of probiotic supplements to stabilize the rumen during the transition period could attenuate the symptoms of this metabolic disorder. Four ruminally-fistulated Holstein dairy cows in mid-lactation were assigned to the following experimental treatments in a 4 x 4 Latin Square design: 1) control; 2) 0.6g per head, per day of a fermentation extract of Aspergillus oryzae (AO-0.6); 3) 3g per head, per day of AO (AO-3.0); 4) a probiotic combination consisting of Enterococcus faecium and Saccharomyces cerevisiae (ES) at a level of 1 x 10^5cfu/ml of rumen fluid. Each period of the Latin Square consisted of 3 weeks of adaptation to the respective treatments followed by 4 days of lactic acidosis challenge and 3 days of resting period. During the week of induction of sub-acute ruminal acidosis (SARA), 30% of ad libitum intake of the TMR was replaced by pellets containing 50% ground wheat and 50% ground barley (WBP). Ruminal pH was recorded continuously using an indwelling pH probe, over a 24 h period for each week of the adaptation period and continuously over the 4 days of SARA induction. Average ruminal pH was lower during SARA than during the weeks of adaptation to the different treatments (5.6 vs 6.1) ($P < 0.0001$). The difference in average pH recorded during the adaptation weeks and the week of SARA was greater when animals were controls (0.73) than when they received AO-0.6, AO-3.0 or ES (0.32, 0.51, 0.24, respectively) ($P = 0.002$). The ES treatment tended to sustain a higher pH during the SARA period compared to the control (5.8 vs 5.4, $P = 0.06$). Accordingly, minimum pH recorded during SARA was higher when animals were on ES than control (5.0 vs 4.4, $P = 0.01$). Adding ES or AO-0.6 did not affect milk production compared to the control (average milk production = 26.6 kg per day) whereas milk production decreased (23.4 kg per day) ($P = 0.04$) when cows received AO-3.0.

Key Words: Probiotics, Acidosis, Dairy cows

T231 Effect of feeding Fermenten® to Holstein dairy cows on milk production, composition and blood metabolites. C. M. Martinez*[1], Y-H. Chung[1], M. E. White[1], E. Block[2], and G. A. Varga[1], [1]*The Pennsylvania State University*, *University Park*, [2]*Church & Dwight Co., Inc.*, *Princeton, NJ*.

The objective of this study was to evaluate the effects of feeding Fermenten to Holstein dairy cows on milk production, milk composition and blood metabolites. Thirty mature Holstein cows were assigned to either a control diet or to a diet formulated for the same nutrient specifications as the control diet but including FERMENTEN® based on ME305 and lactation number. FERMENTEN® feeding began the third week after calving and continued until week-8 of lactation. FERMENTEN® was fed at a rate of 0.37 kg/cow/day. Diets contained 15.5% CP, 34 % NDF and 1.64 Mcal NE_L/kg of DM. Milk yield and dry matter intake (DMI) were recorded daily. Blood, milk and TMR samples were taken weekly. Blood samples were taken 3 h after morning feeding. Data were analyzed using MIXED procedure of SAS and cow nested in treatment was used as the random effect. There were no differences in DMI or milk yield (23.3 ± 0.86 and 46.1 ± 1.95 kg/day, respectively). Cows supplemented with FERMENTEN® had numerically higher fat percentage (3.57%) compared to the unsupplemented group (3.39%). Protein percentage and protein yield were higher ($P<0.09$) for cows provided FERMENTEN®. Milk urea N concentration was higher (10.8 mg/dl, $P<0.04$) for the FERMENTEN® supplemented cows compared to the control group (9.67 mg/dl).

There were no differences in blood concentrations of urea N or glucose. Mature high producing Holstein cows did not respond to FERMENTEN® supplementation either in DMI or milk yield when compared to unsupplemented cows; however trends were observed for positive effects on milk composition.

Key Words: Fermenten, Milk composition

T232 Effect of Virginiamycin and Poulcox, or both, on performance of Holstein cows. L. Erasmus*[1], C. Muya[1], R. Coertze[1], S. Erasmus[2], and G. Catton[3], [1]*University of Pretoria*, *Pretoria, South Africa*, [2]*ARC-LBD*, *Irene, South Africa*, [3]*D.G.Catton*, *Irene, South Africa*.

Virginiamycin (VM) and ionophores, such as Poulcox (P), are antimicrobial feed additives approved for use in cattle to improve performance. The effect of VM on Gram positive bacteria is similar to that of P (active ingredient monensin sodium) although the modes of action differ. Very little information is available on the potential synergistic effects of VM and P, especially in dairy cattle diets. The objectives of this study were to investigate the effect of various combinations of VM and P on the performance of dairy cows. Forty high producing multiparous Holstein cows were blocked according to previous milk production and randomly allocated to one of the following lucerne based total mixed rations : 1) Control, no medication; 2) Control plus 20 ppm VM; 3) Control plus P (15 ppm monensin); 4) Control plus VM plus P. The experimental period was from 21 days prepartum until 60 days postpartum. Data were analysed according to a randomised block design, using the GLM procedure (SAS, 2001). Dry matter intake varied from 23.6 kg /d to 25.4 kg /d and did not differ between treatments (P > .10). Milk production was higher (P < .10) for cows receiving VM + P (41.2 kg /d) when compared to cows receiving only VM (36.6 kg /d), but did not differ from the other treatments (P > .10). Milk fat % was lower for cows receiving treatments P (3.88%) and the Control (4.11%) when compared to treatment VM + P (4.39%) (P < .10). Milk protein and MUN did not differ. Body weight loss, for the period from calving until day 60 postpartum, tended (P < .15) to be less for cows receiving VM + P (-8.1 kg) when compared to the Control (-34.2 kg) and P (-31.9 kg) treatments. Results suggest a positive synergistic interaction between Virginiamycin and Poulcox.

Key Words: Virginiamycin, Ionophores, Dairy cattle

T233 Effects of monensin and dietary soybean oil on milk fatty acid profile in lactating cows. O. AlZahal*[1], N. E. Odongo[1], M. Or-Rashid[1], T. Mutsvangwa[2], T. F. Duffield[1], R. Bagg[3], P. Dick[3], G. Vessie[3], and B. W. McBride[1], [1]*University of Guelph*, *Guelph, Ontario*, [2]*University of Saskatchewan*, *Saskatoon, Saskatchewan*, [3]*Elanco Animal Health, Division Eli Lilly Canada Inc.*, *Guelph, Ontario, Canada*.

Seventy-two lactating Holstein dairy cows (100-150 DIM) were used in a 2 x 3 factorial experiment to investigate the effects of monensin (MN; 0 and 22 ppm Rumensin Premix®, DM basis) and dietary soybean oil inclusion (SBO; 0, 1.7, and 3.5%, DM basis) on milk fatty acid (FA) profile. A TMR (% DM; corn silage, 34; haylage, 22.7; hay, 4.5; high moisture corn, 20; and protein supplement, 18.8 %) was offered *ad libitum*. The trial consisted of a 2-wk baseline period, a 3-wk adaptation period, a 2-wk treatment period, and a 4-wk wash-out period. Feed and milk samples were collected three times per wk and composited over each experimental period. Soybean oil linearly reduced total short- and medium-chain (≤ C_{14}) and saturated FA concentrations. Soybean oil linearly increased total mono- and polyunsaturated, t11-$C_{18:1}$, and total CLA. M0nensin had no effect on concentrations of total short- and medium-chain (≤ C_{14}), saturated, mono- and polyunsaturated FA. Monensin, SBO, and their interaction increased total trans- and t10-$C_{18:1}$ FA. This translated into a significant drop of 11 and 23% in fat percentage when MN was used with 1.7 and 3.5% SBO, respectively. These results show that MN lowers milk fat percentage and the magnitude of this response is dependent upon the level of dietary SBO inclusion.

Table 1.

	Control			Monensin			*P* value		
Item / SBO, %	0	1.7	3.5	0	1.7	3.5	A	B	C
Milk fat (%)	3.76	3.59	3.14	3.74	3.21	2.43	<0.01	<0.01	0.07
Total ≤ C_{14} (g/100g)	24.7	22.0	18.5	23.2	21.2	17.3	0.07	<.0001	0.93
Total Saturates	73.1	69.2	63.5	73.9	67.1	60.5	0.09	<.0001	0.17
Total Monosat	23.5	26.8	32.1	23.0	28.9	34.5	0.09	<.0001	0.25
Total Polysat	3.35	4.00	4.45	3.14	3.98	5.03	0.29	<.0001	0.01
Total *trans*-$C_{18:1}$	2.71	4.31	6.46	2.78	4.78	8.74	<0.01	<.0001	0.01
t10-$C_{18:1}$	0.32	0.62	1.39	0.37	0.84	2.62	0.02	<.0001	0.05
t11-$C_{18:1}$	0.90	1.47	2.12	0.91	1.64	2.74	0.02	<.0001	0.06
Total CLA	0.47	0.741	1.11	0.476	0.878	1.474	<0.01	<.0001	0.06

A = main effect of MN, B = main effect of SBO (linear), C = MN x SBO

Key Words: Monensin, Soybean oil, Milk fatty acid profile

T234 Effect of lasalocid or monensin supplementation on nitrogen metabolism in midlactating dairy cows. R. Martineau*[1], C. Benchaar[2], H. V. Petit[2], H. Lapierre[2], D. R. Ouellet[2], D. Pellerin[1], and R. Berthiaume[2], [1]*Université Laval*, *Québec, Canada*, [2]*Dairy and Swine R&D Centre, AAFC*, *Lennoxville, Québec, Canada*.

Six Holstein cows (BW=728 ± 59 kg; DIM=90 ± 30 d) were used in a replicated 3 x 3 Latin square design with 35-d periods to determine the effect of ionophore (IOP) supplementation on N metabolism. Cows were fed for *ad libitum* intake a legume silage-based TMR (17.5 % CP) without IOP (**C**) or either with lasalocid (**L**) or monensin (**M**) at a dose of 24 ppm on a DM basis. Orthogonal contrasts were used to compare IOP (**L** + **M**) vs. **C**, and **L** vs. **M**. Significance was declared at $P \leq 0.05$. Milk production and DMI averaged 36.6 and 23.5 kg, respectively and were not affected by IOP supplementation. Milk fat and milk protein concentrations were similar among treatments and averaged 3.35 and 3.38 %, respectively. Compared to **C**, IOP supplementation tended ($P=0.07$) to reduce ruminal NH_3-N concentration and significantly increased N apparent digestibility, but with no difference between **L** and **M**. Urinary urea N excretion was not different between **C** and IOP supplementation, but was lower with **L** than with **M** (112 vs. 143 g/d). In parallel, plasma urea N concentration tended ($P=0.06$) to be lower and milk urea N concentration was lower with **L** compared to **M** (11.0 vs. 12.3 mg/dL). Data from this study demonstrate that ionophores have similar effects on N metabolism in the gastrointestinal tract but differences in urea excretion and concentrations indicate a possible decrease in amino acid catabolism with lasalocid.

Key Words: Dairy cow, Lasalocid, Monensin

T235 Effects of rumensin and bovine somatotropin (bST) on productive and physiological parameters of Newzeland Holstein cows grazing alfalfa pasture. M. Tarazon*, S. Araiza, E. Rueda, and A. Nuñez, *Universidad de Sonora*, *Santa Ana, Sonora, Mexico*.

The objective of the current study was to evaluate the addition of Rumensin in the complementary diet and the injection of bST in Newzeland Holstein cows grazing alfalfa pasture on productive and physiological variables. Thirty-six cows averaging 15.6 kg/d of milk, 242.2 DIM, 448.2 BW and 2.96 BCS were assigned to one of the four treatments in a completely randomized block design with 2 x 2 factorial arrangement of treatments using milk production during a 14 d pretreatment period as the blocking criterion and balanced with DIM. Data from the pretreatment period were used for a covariate adjustment. Treatments were as follows: 1). CON, cows without Rumensin or bST; 2). RUM, cows with only Rumensin; 3). BST, cows with only Somatotropin; and 4). RYS, cows with Rumensin and Somatotropin. Cows were on treatment for 70 days. During both periods, cows were grazing alfalfa pasture and received 2 kg of commercial ration containing 16% protein and 3% fat. Cows were milked twice a day and milk productions were measured three times a week. All cows received a Rumensin Controlled releasing Capsule, containing 32 g of monensin for 95 d to control bloat. The ration of cows on Rumensin received 164 mg in the daily supplement and cows in bST were injected with 500 mg each 14 days. All cows were weighted and BCS determined at the beginning and final of the experimental period. Data were analyzed by ANOVA using GLM procedure of SAS (SAS Institute, 2001). Milk yields were increased by bST (P<0.01) from 14.3 to 16.4 kg/d, but were not influenced by Rumensin. Body weight and BCS were not altered by bST nor Rumensin.

Key Words: Rumensin & bST, Productive & physiological, Newzeland Holstein cows

T236 Effect of monensin supplement during prepartum and transition phase on rumen fermentation and microbial efficiency. D. Srichana*[1,2], M. S. Kerley[1], and J. N. Spain[1], [1]*University of Missouri*, *Columbia*, [2]*Thammasat University*, *Phathumthani, Thailand*.

The effect of monensin (M) supplement in transition dairy cow diets on fermentation and microbial efficiency (g N/Kg OM truly digested; MOEFF) was evaluated in 2 experiments using a continuous culture system. In experiment one, the treatments were arranged as completely randomized design with 12 replicates and 2 treatments, prepartum diet without M (control) and with M (24 mg/Kg DM). Fermentors were set at 6%/h dilution rate and incubated at 39°C and allowed to equilibrate for 3 days followed by 3 day collection phase. Data were analyzed using Proc GLM procedures of SAS. Ammonia, VFA and pH were measured at 2 h after feeding. Supplemetal M increased (P<0.05) propionic acid (14.8 vs 12.4 mM) and decreased (P<0.05) A:P ratio (3.6 vs 4.2) when compared to the control. Ammonia, total VFA, acetic acid, butyric acid, BCVFA and pH were not altered by M (P>0.05). There was no difference (P>0.05) in MOEFF for the diet with and without M (12.0 vs 14.4). In experiment two, the treatments (4 fermentors/treatment) were arranged as 2X2 factorial and analyzed using Proc GLM procedures of SAS that included two levels of M (without or with M, 24 mg/kg DM) and 2 phases of prepartum phase (fermentors fed dry cow diet; PP) and transition phase (fermentors fed lactating cow diet; TP) as main effects. Fermentors were set as in experiment one and allowed to equilibrate for 3 days followed by 3 day PP and 3 day collection phase (TP). Supplemental M during PP increased (P<0.05) total VFA (113.9 vs 110.1 mM), acetic acid (81.7 vs 73.6 mM), organic matter truly digested (OMTD; 31.52 vs 30.21 g) but did not alter (P>0.05) MOEFF (16.61 vs 14.93). Supplemental M during TP increased OMTD (31.3 vs 30.5 g) but did not alter (P>0.05) MOEFF (15.59 vs 15.96). There were no interactive effects of M supplement during PP and TP on fermentation products and MOEFF. In summary, the results of these experiments show that the addition of monensin during both phases of transition increased OMTD and Total VFA which would increase energy available to the transition dairy cow.

Key Words: Monensin, Prepartum and transition diet, Microbial efficiency

T237 Anise and capsicum as alternative to monensin in beef heifers fed a high-concentrate diet. I. Fandiño*[1], S. Calsamiglia[1], A. Ferret[1], and C. Kamel[2], [1]*Universitat Autonoma de Barcelona*, *Bellaterra, Spain*, [2]*Pancosma, SA*, *Bellegarde-sur-Valserine Cedex, France*.

Four Holstein heifers (229 ± 24 kg BW) fitted with ruminal trocars were used in a 4 x 4 Latin square design to evaluate the effects of monensin (MON), anise extract (ANI) and capsicum (CAP) on rumen fermentation. Heifers were fed a 10:90 forage:concentrate ratio (16% CP and 22% NDF). Treatments were: no extract (CTR), 35 mg/kg of MON, 500 g/d of ANI and 500 g/d of CAP. Each period consisted of 15 d of adaptation and 9 d for sampling. On d 16 to 21 of each period, dry matter intake (DMI) was measured. On d 22 to 24 ruminal content was sampled at 0, 4, 8 and 12 h after feeding to determine ruminal pH, and the concentration of volatile fatty acids (VFA), large peptide (LPep), small peptide plus amino acid (SPep+AA), and ammonia (NH3) N. Statistical differences were declared at P<0.05. Compared to CTR, MON reduced total VFA (from 112.6 to 108.8 mM), acetate proportion (from 55.3 to 54.4 mol/100 mol), acetate to propionate ratio (from 2.03 to 1.92), branch-chained VFA (BCVFA) concentration (from 2.5 to 2.1 mM) and NH3 N concentration (from 15.3 to 13.4 mg/100 mL), and increased propionate proportion (from 25.2 to 27.5 mol/100 mol), SPep+AA N (from 15.3 to 18.1 mg/100 mL) and LPep N (from 11.2 to 14.3 mg/100 mL). Compared to CTR, CAP increased DMI (from 6.57 to 7.42 Kg/d) and butyrate proportion (from 13.0 to 14.1 mol/100 mol), and reduced acetate proportion (from 55.3 to 54.0 mol/100 mol). Compared to CTR, ANI reduced total VFA (from 112.6 to 110.8 mM), acetate proportion (from 55.3 to 53.5 mol/100 mol), acetate to propionate ratio (from 2.03 to 1.90), BCVFA concentration (from 2.5 to 2.1 mM) and NH3 N concentration (from 15.3 to 13.6 mg/100 mL), and increased propionate proportion (from 25.2 to 26.9 mol/100 mol) and SPep+AA N (from 15.3 to 18.0 mg/100 mL). The effects of ANI were similar to MON with the exception of the effects on the molar proportion of butyrate, which suggests that it may have a different mode of action.

Key Words: Rumen fermentation, Plant extract

T238 Optimal dose and combination of anise and capsicum as modifiers of ruminal fermentation in beef heifers. I. Fandiño*[1], S. Calsamiglia[1], A. Ferret[1], and C. Kamel[2], [1]*Universitat Autonoma de Barcelona*, *Bellaterra, Spain*, [2]*Pancosma, SA*, *Bellegarde-sur-Valserine Cedex, France*.

Twelve Holstein heifers (229 ± 24 kg BW) fitted with ruminal trocars were used in three 4 x 4 Latin squares to evaluate the effects of different doses (100, 250 and 500 mg/d) and proportions of anise extract (A) and capsicum (C) (25%A+75%C, 50%A+50%C and 75%A+25%C)

on rumen fermentation and protein degradation. Heifers were fed a 10:90 forage:concentrate ratio diet (16% CP and 22% NDF). Each period consisted of 15 d of adaptation and 9 d for sampling. On d 16–21 of each period, dry matter intake (DMI) was measured. On d 22–24 ruminal content was sampled at 0, 4, 8 and 12 h after feeding to determine ruminal pH and the concentration of volatile fatty acids (VFA), large peptide N (LPep), small peptide plus amino acid N (SPep+AA) and ammonia N (NH3). Data were analyzed using PROC MIXED of SAS (1996). Contrasts were conducted within dose between each treatment and control, and differences were declared at P<0.05. Treatments had no effect on ruminal pH. At 100 mg/d treatments had no effect on DMI and rumen fermentation. At 250 mg/d, 75%A+25%C reduced the concentration of total VFA, the acetate proportion, the acetate to propionate ratio and the branch chained VFA (BCVFA) and the NH3 N concentration, and increased the propionate proportion and SPep+AA N concentration. At 500 mg/d, 25%A+75%C increased DMI and SPep+AA N concentration and reduced the BCVFA and the NH3 N concentration. At 500 mg/d, 50%A+50%C reduced the concentration of total VFA, the acetate proportion, and the BCVFA and the NH3 N concentration, and increased the propionate proportion and SPep+AA N concentration. At 500 mg/d, 75%A+25%C reduced the concentration of total VFA, the acetate proportion, the acetate to propionate ratio, and the BCVFA and the NH3 N concentration, and increased the propionate proportion and SPep+AA N concentration. Results indicate that 250mg/d of 75%A+25%C and 500mg/d of 75%A+25%C may be useful as modifier of rumen fermentation in beef production systems.

Key Words: Rumen fermentation, Plant extract

T239 Effects of alfalfa extract and a mixture of cinnamaldehyde and eugenol on rumen fermentation in beef heifers fed a high-concentrate diet. P. W. Cardozo[1], S. Calsamiglia*[1], A. Ferret[1], and C. Kamel[2], [1]*Universidad Autonoma de Barcelona*, *Bellaterra, Spain*, [2]*Pancosma SA*, *Bellegarde-sur-Valserine Cedex, France*.

Four Holstein heifers (360 BW) fitted with ruminal trocars were used in a 4x4 Latin square design to evaluate the effects of no extract (CTR), 30 g/d of alfalfa extract (AEX; 10% malate, and 1.5% saponins), a mixture of 180 mg/d of cinnamaldehyde and 90 mg/d of eugenol (CIE), and the combination of the two treatments (MIX) on rumen fermentation. Heifers were fed a 10:90 straw to concentrate ratio diet. Each period consisted of 15 d for adaptation and 6 d for sampling. On d 16, 17 and 18 of each period, DM and water intake were measured. On d 19, 20 and 21 ruminal content was sampled at 0, 3, 6, 9, and 12 h after feeding to determine ruminal pH and the concentrations of volatile fatty acids (VFA), L-lactate, large peptides (LPep), small peptides plus AA (SPep+AA), and ammonia N. On d 20 and 21, samples of rumen fluid were also taken at 0 and 3 h after feeding to determine protozoa counts. On the last day, rumen fluid was used to determine in vitro DM and CP degradation of alfalfa hay (AH), ryegrass hay, barley grain, wheat grain, corn grain (CG) and soybean meal (SBM) after 4 and 24 h incubation. Relative to CTR, CIE and AEX reduced (P<0.05) DM and water intake, and Entodiniomorphs counts, but did not affect pH, total VFA concentration, propionate and butyrate proportions, and LPep N concentration. The CIE tended (P=0.08) to reduce ammonia N, and to increase SPep+AA N concentrations. The AEX increased (P<0.05) the acetate to propionate ratio and reduced (P<0.05) Entodiniomorphs counts. The MIX tended (P=0.06) to reduce DM intake, water intake and ruminal pH. In vitro, CIE and MIX reduced (P<0.05) CP degradation of SBM and CG, and MIX also reduced (P<0.05) CP degradation of AH at 4 h after incubation, but all differences disappeared after 24 h of incubation. Results suggest that CIE and AEX had some effects on DM intake and rumen fermentation, but the effects of their combination were not additive.

Key Words: Rumen fermentation, Plant extracts

T240 Anise, capsicum, and a mixture of cinnamaldehyde and eugenol modified rumen fermentation in beef heifers fed a high-concentrate diet. P. W. Cardozo[1], S. Calsamiglia*[1], A. Ferret[1], and C. Kamel[2], [1]*Universidad Autonoma de Barcelona*, *Bellaterra, Spain*, [2]*Pancosma, PA*, *Bellegarde-sur-Valserine Cedex, France*.

Four fattening Holstein heifers (450 kg BW) fitted with ruminal trocars and fed a 10:90 straw to concentrate ratio diet were used in a 4x4 Latin square design to evaluate the effects of no extract (CTR), 2 g/d of anise oil (ANI; 10% of anethole), 1 g/d of capsicum extract (CAP; 15% of capsaicin), and a mixture of 0.6 g/d of cinnamaldehyde and 0.3 g/d of eugenol (CIE) on rumen fermentation. Each period consisted of 15 d for adaptation and 6 d for sampling. On d 16, 17 and 18 of each period, DM and water intake were measured. On d 19, 20 and 21 ruminal content was sampled at 0, 3, 6, 9 and 12 h after feeding to determine ruminal pH and the concentration of volatile fatty acids (VFA), L-lactate, large peptides (LPep), small peptides plus AA (SPep+AA) and ammonia N. On d 20 and 21, samples of rumen fluid were also taken at 0 and 3 h after feeding to determine protozoa counts. On d 21, rumen fluid was used to determine in vitro DM and CP degradation of alfalfa hay, ryegrass hay, barley grain, wheat grain, corn grain and soybean meal (SBM) after 4 and 24 h incubation. Relative to CTR, treatments had no effect on ruminal pH, total VFA concentration and butyrate proportion. The CAP increased (P<0.05) DM and water intake, and SPep+AA N concentration, reduced (P<0.05) acetate proportion and LPep N concentration. The CIE reduced (P<0.05) water intake, acetate proportion, L-lactate, and ammonia N concentrations, and total protozoa counts, and increased (P<0.05) propionate proportion and SPep+AA N concentration. The ANI reduced (P<0.05) acetate to propionate ratio, and ammonia N concentrations, and total protozoa counts. In vitro, ANI, CAP, and CIE reduced (P<0.05) CP degradation of SBM at 4 h after incubation, and only ANI reduced CP degradation of SBM at 24 h after incubation. Results indicate that CIE, ANI and CAP may be useful as modifiers of rumen fermentation in beef production systems.

Key Words: Rumen fermentation, Plant extract

T241 In vitro effects of eleven essential oils on ruminal fermentation. A. V. Chaves*[1], G. Fraser[2,1], Y. Wang[1], K. A. Beauchemin[1], T. A. McAllister[1], and C. Benchaar[3], [1]*Agriculture and Agri-Food Canada Research Centre*, *Lethbridge, AB, Canada*, [2]*Nova Scotia Agricultural College*, *Truro, NS, Canada*, [3]*Agriculture and Agri-Food Canada Research Centre*, *Lennoxville, QC, Canada*.

The effects of eleven essential oils (EO) on ruminal fermentation were studied in vitro batch culture of mixed ruminal microbes to assess their potential for use as alternatives to antibiotics. Carvacrol, cinnamaldehyde, eugenol, thymol, D-limonene, L-limonene, and extracts of cinnamon leaf, clover leaf, sweet orange, oregano, and red thyme were included in anaerobic batch culture incubations of a forage:concentrate mixed diet (18% CP; 33% NDF) in buffered ruminal fluid. Gas production (GP), pH, NH_3, total VFA, and in vitro DM disappearance (IVDMD) were assessed after 24 h (n = 3). Data were analyzed by the PROC MIXED procedure of SAS . The EO were included at the lowest levels (ppm; vol/vol) at which each had

decreased ($P \leq 0.05$) GP during preliminary 24-h incubations with 0 to 100 ppm and then with 0, 200, 400, 800, and 1000 ppm EO included. Neither D- nor L-limonene at 1000 ppm affected GP ($P > 0.31$). The other nine EO were assessed in two incubation groups. In the first incubation, GP, IVDMD, and total VFA concentrations were decreased ($P \leq 0.002$) by eugenol (800) and carvacrol (400) as compared with control (no EO), cinnamon leaf (400), clover leaf (200), and thymol (200), whereas NH_3 concentrations were unaffected by EO. In the second incubation, GP was decreased ($P \leq 0.0001$) by red thyme (200), oregano (200), and cinnamaldehyde (200) compared to control, but was similar ($P \geq 0.054$) between control and sweet orange (200). Concentrations of NH_3 were unaffected although total VFA concentrations were decreased ($P \leq 0.035$) by cinnamaldehyde (200) compared to other treatments. Effects of EO on pH were variable. On the basis of these results, carvacrol and cinnamaldehyde will be validated in animal trials aiming at developing alternatives feed antibiotics in ruminant diets.

Key Words: Essential oils, Gas production, Ruminant

T242 Effects of enzymes and herbal extracts on in vitro fermentation kinetics of ruminant feeds. D. Colombatto*[1], A. D. Garciarena[2], G. Lagos[2], C. Lago[3], and F. Nahara[3], [1]*University of Buenos Aires*, *Argentina*, [2]*EEA Balcarce INTA*, *Argentina*, [3]*Porfenc SRL*, *Argentina*.

The potential of fibrolytic enzymes and herbal extracts (HE) as ruminal modifiers was examined in vitro in a completely randomized design with a factorial arrangement of treatments. Half gram of alfalfa hay, corn silage or a finishing feedlot diet consisting of 70% corn grain, 20% corn silage, and 10% sunflower meal (DM basis) were weighed in triplicate in fermentation flasks, to which 40 ml of anaerobic buffer and 10 ml ruminal fluid were added. Treatments consisted of control (CON), two fibrolytic enzyme cocktails (mainly xylanase and cellulase, denoted A and B), added at 25, 50 and 100 mg kg^{-1} (DM basis) (0.5X, 1X, and 2X, respectively), and HE added at 750, 1500, and 3000 mg kg^{-1} (DM basis). Gas production (GP) kinetics was determined using a portable manometer at 2, 4, 6, 8, 10, 12, 15, 19, 24, 30, 36, 48 and 72 h post inoculation. DM and fiber degradability (DEG) at 24 h incubation was also determined by incubating filter bags containing 0.5 g of each substrate in ruminal fluid (same proportions as above). The experiment was replicated on three occasions for GP, and on four for DEG. Enzymes A and B cubically tended to increase GP at 2 h incubation time in alfalfa hay (p=0.07 and p=0.09, respectively), with Enzyme B linearly increasing (p=0.05) GP at 4 h in corn silage. HE did not affect (p>0.05) GP at any time, but rate of alfalfa hay GP linearly decreased (p=0.04) with HE addition after 48 h incubation. HE also linearly decreased (p=0.02) rate of GP of corn silage after 10 h incubation. Enzyme A increased Alfalfa DM DEG at 1x (571.9 vs. 541.2 g kg^{-1} for 1x and CON, respectively), but decreased that of the feedlot ration when applied at 2x (536.7 vs. 581.5 g kg^{-1} for 2x and CON, respectively). Because fiber DEG remained unaffected, it is suggested that non-fibrous fractions were responsible for the differences in DM DEG with Enzyme A. Enzyme B did not affect any of the treatments. Addition of HE did not affect DM DEG, although a trend towards higher ADF DEG was detected in all forages. Although responses to enzymes and HE appear to be dose and feed-specific, some enzyme mixtures can positively impact ruminal degradation of alfalfa hay.

Key Words: Enzymes, Digestion

T243 Effects of specific herbal extracts on in vitro fermentation kinetics of oats, alfalfa hay or a total mixed ration. D. Colombatto*[1], A. D. Garciarena[2], A. J. Flores[2], J. M. Hernandez Vieyra[3], L. Mazuranok[4], and C. Ionescu[4], [1]*University of Buenos Aires*, *Argentina*, [2]*EEA Balcarce INTA*, *Argentina*, [3]*Argent Export SA*, *Argentina*, [4]*Pancosma Bioactives*, *France*.

The potential of herbal extracts (HE) as modifiers of ruminal fermentation was examined in vitro in a completely randomized design with a factorial arrangement of treatments. One gram of grazing oats, alfalfa hay, or a total mixed ration consisting of 30% oats, 30% corn silage, 22% corn grain and 12% sunflower meal (DM basis) were weighed in triplicate in fermentation flasks, to which 40 mL of anaerobic buffer and 10 mL ruminal fluid were added. Treatments consisted of control (CON); monensin (added to an equivalent of 300 mg $animal^{-1}$ d^{-1}; MON); and cinnamaldehyde (CIN), eugenol (EUG) or a combination of the two (62% eugenol and 38% cinnamaldehyde; MIX) added at the equivalent rates of 3, 30 and 300 mg $animal^{-1}$ d^{-1}. A cow that consumes 20 kg feed d^{-1} was used as standard for application rates. Gas production (GP) kinetics was determined using a portable manometer at 2, 4, 6, 8, 10, 12, 15, 19, 24, 48 and 72 h post inoculation. Dry matter (DM) and fiber degradability at 24 h was also determined by incubating filter bags containing 0.5 g of each substrate in ruminal fluid (same proportions as above). The experiment was replicated on three occasions. Effects of HE on rate and extent of GP varied according to the substrate, as the lowest level of CIN and MIX increased ($p<0.05$) GP in alfalfa hay at 24 h fermentation. Monensin decreased ($p<0.05$) both rate and extent of GP in all feeds. Adding CIN increased ($p<0.05$) DM degradability of oats (44.3, 44.2, 46.2 and 47.3 % for CON and the three CIN levels, respectively), and fiber degradability of alfalfa hay (5.6, 4.8, 4.9, and 8.5%). A trend ($p<0.10$) towards a quadratic increase in oats NDF and ADF degradability was also detected. No differences ($p>0.05$) were detected when EUG or MIX were added to the feeds. Addition of MON did not alter ($p<0.05$) DM degradability, but reduced ($p<0.05$) NDF degradability of alfalfa hay. Although responses to pure herbal extracts appear to be feed-specific, addition of cinnamaldehyde has the potential to positively impact fermentation and degradation of selected feeds.

Key Words: Herbal extracts, Rumen, Fermentation

T244 Effects of five botanicals on rumen microbial fermentation profile. M. Blanch*[1], S. Calsamiglia[1], P. Chicoteau[2], and B. Nielsen[2], [1]*Universidad Autonoma de Barcelona*, *Bellaterra, Spain*, [2]*NOR-FEED*, *Denmark*.

The effects of five botanicals on rumen fermentation were evaluated using the gas production technique. Treatments were: control (CTR, no additive), monensin (M, positive control), chestnut wood (CW), grape pomace (GP), Quillaja saponaria (QS), yucca (YC), and fenugreek (FG). Two levels of each additive were evaluated (CW1, CW2, GP1, GP2, QS1, QC2, YC1, YC2, FG1, FG2, M1 and M2; equivalent to 3, 30, 5, 50, 2, 20, 2, 20, 5, 50, 0.4 and 4 g per cow per day, respectively). The ruminal fluid inoculum was obtained from rumen fistulated heifers fed a 50:50 forage to concentrate ratio diet. The experimental diet consisted of a 15 g of 50:50 dairy cow diet (29.9% NDF, 16.8% CP). The production of gas was measured in each vial after 3, 6, 9, 12, 15, 24, 36 and 48 h in triplicate and two days (n=6). After incubation samples of fermentation fluid and the solid were collected to determine DM degradation, and volatile fatty acid (VFA) and ammonia-N concentrations. Differences were declared at $P<0.05$. The total gas production was higher in CW2 (+22%) compared with CTR. No

differences were observed in total VFA (75.0 mM). Acetate proportion in M2 was lower (-6%) compared with CTR. Propionate proportion of M2 was higher (+18%) compared with CTR. Butyrate proportions of CW2 and FG1 were higher (+15% and +10%, respectively) and M2 was lower (-18%) compared with CTR. The acetate to propionate ratio was lower in M2 (1.42) compared with CTR (1.86). The ammonia N concentration (mg/100mL) was higher in CW1 (23.0) compared with CTR (18.7) and M2 (16.2), and in GP1 (20.4) and YC2 (20.7) compared with M2. Botanicals may help modify rumen microbial fermentation, but effects are dose-dependent. Furhter research is necessary to study long terms effects on rumen fermentation and animal performance.

Key Words: Plant extracts, Rumen fermentation, Gas production

T245 Evaluation of level of plant botanicals in diets fed to lactating dairy cows. K. J. Daniels*, P. H. Doane, and M. J. Cecava, *ADM Animal Nutrition Research*, *Decatur, IN*.

Our objective was to examine the effect of specific plant botanicals on performance of lactating dairy cattle. Holstein cows (n=260) were divided into three groups balanced upon parity, stage of lactation (DIM), and mean milk production measured one week before the co-variant adjustment period. A 1-week, co-variant adjustment period was followed by a 42-day study. The standard lactation diet served as the control ration (CTL). Treatment diet was supplemented to provide 28 g/cow/d (LO) or 56 g/cow/d (HI) of plant botanicals (RumeNext D™; ADM Alliance Nutrition, Inc., Quincy, IL) to deliver 250 and 500 mg/d, respectively, of the active botanical components. Individual data was collected for milk production on a daily basis and milk composition on a weekly basis, while group DMI was calculated daily. Data was analyzed using the Proc Mixed procedure of SAS for a repeated measures, completely randomized design. There was no effect of treatment on milk protein content, milk yield or SCC. Milk urea nitrogen linearly decreased with treatment ($P<0.05$). There was an increase ($P<0.05$) in milk fat content for LO (3.20%, 3.33% for CTL and LO respectively) and a tendency ($P<0.06$) for increased fat yield (1277, 1328 g/d for CTL and LO, respectively). Feeding HI decreased ($P<0.01$) dry matter intake (23.5, 23.2 kg/d for CT and HI, respectively) and fat yield (1277, 1218 g/d for CT and HI, respectively; $P<0.01$). Milk fat yield decreased ($P<0.01$) by 110 g/d, which is indicative of the 1.9 kg/d decrease ($P<0.01$) in FCM yield for HI compared to LO. Additionally, HI cows consumed 0.2 kg/d less DM than LO ($P<0.01$). Plant botanicals improved animal performance at the LO feeding rate, but had negative effects at the HI rate. The negative effect of HI appeared related to intake. These results suggest feeding recommendations be based at 28 g/d to supply 250 mg/d of active botanical components.

Key Words: Botanicals, Dairy cattle, Lactation

T246 Evaluation of lactating dairy cattle performance when fed plant botanicals in a commercial field setting. K. J. Daniels*, J. L. Dunn, P. H. Doane, and M. J. Cecava, *ADM Animal Nutrition Research*, *Decatur, IN*.

Our objective was to evaluate the effects of specific plant botanicals on performance of lactating dairy cows in commercial settings under different management and forage conditions. Holstein cows (n = 173) were allotted to treatment in a completely randomized design on four herds in Pennsylvania and were fed standard lactation diets for 30 days before treatments were applied. Cows were housed in tie stalls and fed individually. The standard lactation diet served as the control (CTL), while the treatment diet (TRT) had an additional 56 g/cow/d of a specific blend of botanicals (RumeNext D™; ADM Alliance Nutrition, Inc., Quincy, IL). The TRT was fed for 60 days. Individual parameters for intake and production produced grouped means from repeated measures. Milk yield improved by 1.2 kg/d ($P<0.5$) for TRT. There were trends ($P<0.13$) for decreased milk fat and protein content when TRT was fed. However, milk fat ($P<0.30$) and protein ($P<0.10$) yield tended to increase because of increased milk yield. On a farm-specific basis, Farm C had a decrease ($P<0.05$) in milk fat content, but there tended to be increases ($P<0.15$) in total milk and milk protein yields for TRT. There were positive responses ($P<0.10$) to TRT for milk, fat-corrected milk and fat yield at Farm D, as well as a tendency ($P<0.11$) for increased protein yield. Both Farms A and B recorded numeric performance benefits for TRT. Results indicate that there may be farm-specific interactions with plant botanicals including management, basal diet, or production level. Plant botanicals may benefit performance of lactating cattle through a potential increase in milk and fat yield.

Key Words: Botanicals, Dairy cattle, Lactation

T247 Effect of carvacrol on ruminal fermentation *in vitro*. V. Noirot*[1] and C. Bayourthe[2], [1]*Génuol*, *Albi, France*, [2]*ENSAT*, *Castanet-Tolosan, France*.

The aim of this study was to investigate the effects of 0, 10, 100 and 1000 mg/L (CTR, C-10, C-100 and C-1000 respectively) of carvacrol (CAR) on *in vitro* ruminal fermentation of a substrate consisting of dactyle-fescue hay, corn silage and soybean meal. Ruminal fluid was collected from two dairy cows, mixed with phosphate buffer (1:1), and incubated (120 ml) anaerobically at 39°C for 4 and 16h with or without CAR, using 5 g (DM basis) of substrate. After each fermentation period, pH was determined in culture fluid. Samples were collected for the determination of $N\text{-}NH_3$ and volatile fatty acids (VFA) in the liquid phase and DM, CP, and NDF contents were analysed in the solid phase. CH_4 and CO_2 were calculated from VFA according to theoretical stoichiometric equations. Data were analysed using GLM of Systat®; differences between treatments were declared at $P< 0.05$ using the pairwise multiple comparison test of Tukey. Whatever the time, C-1000 resulted in higher acetate and lower propionate and valerate proportions, lower total VFA concentration, lower gas production, and lower drop in pH, compared with others treatments. C-1000 increased $N\text{-}NH_3$ concentration after 4 h (112.0 *vs* 49.4 mg/L for CTR)-probably due to less bacterial consumption according to the other data-, and decreased NDF degradation after 16h by 57.4% compared to CTR. Minor VFA concentration and CP degradation were unaffected by CAR, after 4 and 16h of incubation respectively. Compared to CTR, C-10 and C-100 did not significantly affect acetate and valerate proportions, and NDF degradation after 16h. After 4h, excluding for C-10, propionate proportion was decreased, and all doses increased the isobutyrate proportion when compared to CTR. After 16h of incubation, non different pattern was observed with C-10 and C-100: C-10 and C-100 decreased significantly compared to CTR total VFA, CH_4 and CO_2 production by 5.7, 7.8 and 8.0% respectively. These results showed that high dose of CAR resulted in a general inhibition of rumen microbial fermentation and suggested that lower doses can be used to reduce CH_4 production.

Key Words: Carvacrol, *In vitro*, Rumen

T248 Effect of plant extract supplementation on rumen fermentation and metabolism in young Holstein bulls receiving a high-concentrate diet. A. Anglada[1], M. Devant*[1], and A. Bach[1,2], [1]*IRTA*, *Barcelona, Spain*, [2]*ICREA*, *Barcelona, Spain*.

Ninety male Holstein bulls were used in a complete randomized design to study the effect of a blend of cynarin, gingsen and fenugreek (Biostar, Phytosynthese, France) supplementation on performance, rumen fermentation, and metabolism of Holstein bulls fed high-concentrate diets. Three treatments : control (CTR), supplementation of 32 mg/kg DM of were tested sodium monensin (MON, positive control), and supplementation of 2.8 g/kg DM of Biostar (BIO) over a 109-d period. Animals were weighed (303 ± 3.6 kg of initial BW) and randomly distributed by BW in 6 pens. Concentrate and straw were both offered *ad libitum*. Animal BW, and group concentrate and straw consumptions were recorded every 3 wks. Rumenocentesis was performed to all bulls starting at 63 d of study at 0900 during 3 consecutive days to determine rumen pH, ammonia N, and VFA concentrations. Blood samples from all bulls were taken starting at 7, 35, and 71 d of study at 0900 during 3 consecutive days to determine cortisol, glucose, insulin, and leptin. Final BW at 109 d of study of MON (463 kg ± 4.1) and BIO (466 kg ± 4.1) bulls was greater ($P < 0.05$) than CTR bulls (452 kg ± 4.1). Neither monensin nor Biostar supplementation affected feed consumption, and feed efficiency. Rumen pH was lower ($P < 0.001$) in MON and BIO treatments than in CTR. Rumen molar proportion of propionic acid increased ($P < 0.05$) in MON and BIO treatment bulls compared to CTR bulls. Bulls supplemented with Biostar had greater ($P < 0.05$) insulin and glucose plasma levels than MON or CTR bulls. Monensin or Biostar supplementation increased ($P < 0.001$) cortisol levels in bulls at 7 and 71 d of study compared to CTR treatment. Serum leptin concentration increased ($P < 0.01$) from 35 to 71 d of study; however, in MON bulls the increase was not as pronounced as in BIO and CTR bulls. In bulls fed a high-concentrate diet Biostar supplementation had similar effects on rumen fermentation to monensin supplementation.

Key Words: Rumen fermentation, Plant extracts, Leptin

T249 Evaluation of tannins on ammonia release of soybean meal protein under in vitro ruminal conditions. H. Carneiro*[1], T. A. Corrêa[2], and J. C. F. Lima[2], [1]*Empresa Brasileira de Pesquisa Agropecuária*, *Juiz de Fora, MG, Brazil*, [2]*Universidade Federal de Juiz de Fora*, *Juiz de Fora, MG, Brazil*.

The objective of this experiment was to examine the effects of two types of tannins quebracho (TQ) (Schinopsis spp) and sorghum bicolor (TS) on in vitro degradation of soybean meal. The extent of binding to soybean protein commercial tannin from TQ and TS was evaluated incubating them under in vitro ruminal conditions for 48h. The protein binding activity was estimated measuring changes in ammonia concentration when the tannin was incubated with soybean meal at a proportion of 8% of the dry weight. Soybean meals (0.5g) were weighted in 100 mL plastic tubes and 0.01, 0.02 and 0.04g (2, 4, 8%) of one the tannin sources dissolved in McDougall buffer (5mL) was added. Triplicate tubes were used for each tannin level and for the control (no tannin). Tubes were placed in water bath at 39°C for 12hs to allow tannin and protein to react. Tilley and Terry procedure was used to determine degradation by rumen bacteria and degradation by rumen bacteria plus pepsin. ANOVA analysis was performed and differences among means were tested using Tukey's test. As compared to soybean meal alone (control equal 87% degradation), ammonia concentration decreased by 35% for TC from TQ and 31% for TC from TQ. Ammonia concentration decreased and also in vitro DM degradation with addition of tannins to soybean meal. Crude Protein increased in the residual degradation. Reduction of ammonia per unit of tannin added was higher for TQ than TS ($p<0.05$). Linear regression equation was calculated using ammonia concentration, rumen bacteria DM degradation and rumen bacteria plus pepsin DM degradation as dependent variable. Coefficients for linear relation were higher for commercial tannin R^2 98% than sorghum R^2 78%. The results showed that TQ were more efficient in protecting soybean meal from in vitro degradation by rumen bacteria with the lowest negative effect on in vitro rumen bacteria plus pepsin degradation as compared to TS. Although in vitro results can not be extrapolated to the whole animal, it suggest that CT from TQ could have a beneficial effect in vitro by increasing rumen escape protein but microbial ruminal protein formation could be depressed.

Key Words: Condensed tannin, Sorghum, Ammonia

T250 Effects of nitroethane on methane production and fermentation balance in fed steers. H. Gutiérrez-Bañuelos*[1], L. J. Slay[1], G. E. Carstens[1], N. Ramlachan[2], S. Horrocks[2], T. R. Callaway[2], T. S. Edrington[2], R. C. Anderson[2], and D. J. Nisbet[2], [1]*Texas A&M University*, *College Station*, [2]*USDA/ARS, Food & Feed Safety Research Unit*, *College Station, TX*.

Objectives of this study were to examine the effects of a methane-inhibitor (nitroethane; NE) on methane (CH_4) emissions, and ruminal CH_4-producing activity in Holstein steers (403 ± 26 kg BW). Steers were fed a 50% concentrate diet and orally administered NE twice daily at 0 (0X), 80 (1X) or 160 (2X) mg NE/kg BW d^{-1} for 14 d. Methane emissions were measured for 22 h/d on d 0, 6 and 13 of the study, using the sulfur hexafluoride tracer gas technique. Ruminal and fecal contents were collected on d -1, 1, 2, 7 and 14 of treatment for measurement of VFA and CH_4 -producing activity. Compared to control steers (14.6; 1.24 kg/d), DMI and ADG were higher ($P<0.01$) in 1X-treated steers (15.0; 1.49 kg/d), but lower ($P<0.01$) in 2X treated steers (13.1; 0.86 kg/d). Methane emissions (L/d) decreased ($P<0.07$) as NE dose increased (283, 270 and 246 ± 11 for 0X, 1X and 2X steers, respectively). Methane emissions per unit gross energy intake (% GEI) were also lower ($P<0.03$) in 1X-(3.76 ± 0.14%) compared to control steers (4.22 ± 0.14 %). However, lower DMI of 2X-treated steers resulted in similar CH_4 emissions between 2X- (4.15 ± 0.14%) and control steers. Methane emissions were not affected by day of study or day x treatment. Ruminal CH_4 producing activity (8.5, 7.9 and 4.7 ± 0.5 umol/g h^{-1}) and calculated ruminal CH_4 based on fermentation balance (23.1, 23.1 and 19.1 ± 1.3 mol CH_4 /100 mol VFA) were lower ($P<0.01$) in 2X- compared to 0X- and 1X-treated steers. Fecal CH_4 producing activity was lower in 1X- and 2X-treated steers compared to 0X-steers (3.9, 1.4 and 1.4 ± 0.4 umol/g h^{-1}). Day of study affected ruminal CH_4 activity, but day x treatment was not significant. Results from both in vivo and in vitro measurements of CH_4 production suggest that NE inhibits methanogenesis in steers for up to 14 d.

Key Words: Methane, Nitroethane, Rumen

T251 Effects of hop acids. I. *In vitro* ruminal fermentation. M. A. Schmidt and M. L. Nelson*, *Washington State University*, *Pullman*.

Two randomized complete block *in vitro* experiments were conducted to 1) determine if hop (*Humulus lupulus* L.) beta acids altered ruminal fermentation in vitro and, 2) determine if five other hop acids altered ruminal fermentation similar to monensin. Experiment 1 had treatments

of 0, 1.25, 2.50, or 3.75 ppm beta acids and either barley or alfalfa substrate. Experiment 2 had treatments of control, 2 ppm alpha acids, 2 ppm beta acids, 2 ppm hexahydro-iso-alpha acid, 2 ppm iso-alpha acid, 2 ppm rho-iso-alpha acid, 2 ppm tetrahydro-iso-alpha acid, 6 ppm monensin and either alfalfa, barley, or corn substrate. Addition of beta acids in Exp.1 decreased ($P < 0.01$) gas production, pH, DM disappearance, microbial purines and increased ($P < 0.01$) lactate production when barley was the substrate. When alfalfa was the substrate, addition of beta acids decreased ($P < 0.01$) DM disappearance, pH, NDF disappearance, total gas production and rate of gas production. Beta acids decreased ($P < 0.01$) total VFA production with both barley and alfalfa substrates. However, with beta acids addition to barley, the molar proportions of acetate and propionate increased ($P < 0.01$), whereas, butyrate decreased ($P < 0.01$). In contrast, beta acids addition to alfalfa decreased ($P < 0.01$) the molar proportions of acetate and butyrate and increased ($P < 0.01$) propionate. Protozoal numbers and microbial purines decreased ($P < 0.01$) for barley, but only microbial purines decreased for alfalfa. In Exp. 2, beta acids showed the most favorable response of the hop acids with decreased ($P < 0.01$) gas production, increased propionate but not acetate. Significant decreases ($P < 0.01$) in DM and starch disappearance were observed, suggesting the rate of fermentation decreased. Monensin increased ($P < 0.01$) propionate and decreased ($P < 0.01$) protozoal numbers and bacterial purines compared to the control. Beta acids at approximately 2 ppm appeared to have beneficial effects on *in vitro* ruminal fermentation.

Key Words: Hop acids, *In vitro*, Fermentation

T252 Effects of hop acids. II. Beta acids on ruminal methane emission, protozoal population, fermentation, and CoM concentration in cannulated finishing steers. M. A. Schmidt, M. L. Nelson*, J. J. Michal, and H. H. Westberg, *Washington State University*, *Pullman*.

The objective of this study was to determine if beta acids (lupulones) from hops (*Humulus lupulus* L.) had an impact on *in vivo* ruminal fermentation. Four ruminally cannulated steers were randomly assigned to a 4 × 4 Latin Square design. The steers were fed a 90% corn, 10% alfalfa haylage diet with treatments added to the supplement. The treatments included 0, 0, 16.5, or 33 g beta acid/1000 kg diet. Two control treatments (0 g beta acid/1000 kg diet) were included to allow testing for carryover. Intake of DM and GE and methane emission decreased ($P < 0.10$) quadratically. Ruminal pH and lactic acid concentration increased ($P < 0.01$) linearly with beta acids addition. The molar proportions of acetate and propionate were quadratically affected ($P < 0.05$) to a maximum with addition of beta acids. However, the ratio of molar proportions of acetate and propionate was not affected by beta acids addition. There was a linear decrease ($P < 0.10$) in the rate of *in situ* DM disappearance but the extent of disappearance was quadratically affected ($P < 0.05$) with beta acids addition. There was no effect on ruminal volume; however, ruminal mass increased ($P < 0.05$) quadratically when beta acids were fed. Beta acids had no effect on DM, NDF, ADF, starch, or nitrogen digestibility. Coenzyme M concentration in the fluid and particulate fractions increased ($P < 0.10$ and $P < 0.05$, respectively) with beta acids addition. Total protozoa and *Entodinium* spp. quadratically increased ($P < 0.0001$) with addition of beta acids. There was no change in microbial purines when beta acids were added. Therefore, addition of beta acids to the diet resulted in more efficient ruminal fermentation and starch digestion.

Key Words: Corn hop, Beta acids, Methane

T253 Use of sodium bicarbonate and an exovenous fibrolytic enzymatic compound on diets for Holstein steers. O. D. Montañez Valdez*[1], J. R. Bárcena Gama[2], S. S. González Muñoz[2], M. E. Ortega Cerrilla[2], M. A. Cobos Peralta[2], L. Landois Palencia[2], E. O. García Flores[3], J. H. Avellaneda Ceballos[4], and I. E. Morales Zambrano[1], [1]*Centro Universitario del Sur. Universidad de Guadalajara*, *Ciudad Guzmán, Jalisco, México*, [2]*Colegio de Postgraduados*, *Montecillos, Texcoco, Estado de México, M\eacute;xico*, [3]*Centro Universitario de la Costa Sur. Universidad de Guadalajara*, *Autlán, Jalisco, México*, [4]*Universidad Técnica Estatal de Quevedo*, *Quevedo, Los Ríos, Ecuador.*

The objective of this study was to evaluate the effect of sodium bicarbonate (SB) and the buffering capacity (BC) of the diets on the in situ digestibility of DM, ADF and NDF and ruminal fermentation. Five Holstein steers fitted with rumen cannula (BW 450±15 kg) were randomly assigned to a 5 x 5 latin square and they were housed in individual pens. Each period was 15 d, 10 for adaptation to diets and 5 to collect samples. Diet was 70% concentrate (47% ground sorghum, 8 % soybean meal, 7% molasses cane, 6. 8% corn gluten meal and 1.2 % mineral premix) and 30% forage (15% alfalfa hay and 15% corn silage) with different concentrations of SB and one exogenous fibrolytic enzymatic (Fibrozyme®; EFE) used to evaluate changes in fiber digestion. The treatments were: T1) control; T2) 0% SB + 3 g EFE; T3) 1.5% SB + 3 g EFE; T4) 3% SB + 3 g EFE; T5) 4.5% SB + 3 g EFE. There were no differences ($P \geq 0.05$) among treatments on the in situ digestibility of DM, NDF, ADF, VFA, and protozoa concentration. The N-NH3 was different between treatments ($P \leq 0.05$) on 2, 4 and 6 h postfeeding, with a higher concentration in T3 (21.23 mg/dL) and lower in T2 (17.20 mg/dL) compared with T1 (19.17 mg/dL). The cellulolityc bacteria were higher in T3 and lower in T2. There was no effect of BC, SB and EFE on high concentrate diets on the in situ digestibility of fiber, VFA or ruminal pH, but improved the N-NH3 and cellulolityc bacteria concentration.

Key Words: Buffering capacity, Enzyme, Digestibility

Swine Species

T254 Protein source affects feed palatability in piglets. D. Solà-Oriol[1], E. Roura*[2], and D. Torrallardona[1], [1]*IRTA-Centre de Mas Bové*, *Reus, Spain*, [2]*Lucta SA*, *Barcelona, Spain*.

The choice of a protein source for piglet diets is mainly driven by their nutritive value. However, the palatability of these proteins may also play an important role in feed intake and weight gain. The palatability of different protein sources in piglet diets was studied using a double choice preference test (two trials of 36 pens; 4 animals/pen) in which a reference basal diet (REF) with 20% of a soy protein product low in anti-nutritional factors (56% CP) was used. Each pen was offered free access to two different diets in two feeders: either the REF diet or