T406 Evaluation of performance of lactating dairy cows supplemented with branched chain volatile fatty acids (Nutricattle). E. R. Val Neto*[1], R. P. Lana[1,2], H. N. Val[3], M. I. Leão[1], and A. B. Mâncio[1], [1]*Universidade Federal de Viçosa*, *Viçosa, MG, Brazil*, [2]*CNPq*, *Brasília, DF, Brazil*, [3]*Faculdades Associadas de Uberaba (FAZU)*, *Uberaba, MG, Brazil*.

Tropical pasture is the main source of cattle feed, but in the dry season it is deficient in protein, which is essential for microbial growth. The search for technology to increase animal performance may be a feasible alternative to reduce costs with dairy cattle nutrition. This work aimed to compare the performance and the efficiency of lactating cows on pasture, supplemented with concentrate containing 16% crude protein (CP) on dry matter basis using cottonseed meal with 38% CP as protein source, with or without a feed additive containing branched chain volatile fatty acids (Nutricattle). Twenty-four lactating Holstein × Gir crossbred cows were evaluated (average body weight = 436.5 kg, days in milk = 119, body condition score = 2.75, and average milk yield = 7.55 L/day). Animals were offered 1.0 kg/animal/day of concentrate in 2 milking times. In the first week, cows were fed the same diet. After the adaptation period, each lot was randomly assigned to feed the concentrate with or without 24 g of additive/cow/day. Data were analyzed in a randomized blocks design, including milk production and body condition score as covariates, using F test. Although there was a reduction in supplement intake in the fourth week, average milk yield of the additive treatment (8.3 L) was higher ($P = 0.01$) than the average milk yield of the control (7.3 L). There was no difference in the final body condition score between treatments ($P = 0.48$), but the additive increased 0.5 units during the experimental period. In relation to milk quality, no difference was observed in milk fat ($P = 0.21$) and cryoscopy ($P = 0.71$) between treatments. Therefore, although pastures usually have good quality during the rainy season, according to this result, the inclusion of Nutricattle additive was nutritionally efficient, increasing milk production by 12%.

Key Words: cattle, nutrition, volatile fatty acids

T407 Intake and apparent nutrient digestibility in dairy cows fed with different levels of sunflower cake in the ration. E. S. Pereira*[1], P. G. Pimentel[1], M. R. G. F. Costa[1], J. G. L. Regadas Filho[2], and J. E. L. Sousa[1], [1]*Universidade Federal do Ceará*, *Fortaleza, Ceará, Brasil*, [2]*Universidade Federal de Viçosa*, *Viçosa, Minas Gerais, Brasil*.

The aim of this study was to evaluate the intake and apparent nutrient digestibility of dairy cows fed rations containing increasing levels of sunflower cake (SC). The SC has an average 164.29 g/kgDM of crude protein (CP) and 116.28 g/kgDM of ether extract (EE). Eight multiparous Holstein × Zebu cows, between 50 and 74 d in milk and 20 ± 2 kg milk/day were allocated in a 4 × 4 double Latin square design. Sunflower cake was fed in the concentrate at the levels of 0; 7; 14 and 21% and Tifton hay was used as main forage in a 60:40 forage to concentrate ratio. The PROC GLM of SAS was used for the statistical analysis. Periods were 16 d long; the first 10 d of each period were for dietary adaptation, with weight and samples of diets, refusals and feces taken during d 11 to 16 of each period to determine the consumption and apparent digestibility of dry matter (DM) and nutrients. Meals were offered to allow 10% refusals according to the calculated ration consumed on the previous day. The internal marker indigestible acid detergent fiber was used to estimate the fecal DM excretion. The ether extract content of the experimental rations was, respectively, 27.14; 29.79; 31.15 and 35.41g/kgDM, to the levels 0; 7; 14 and 21% of SC inclusion. Dry matter intake of the rations was not affected by the treatments (14.06 kg/day, 2.75% of live weight and 130.89 g/kg of unit metabolic body weight). The intake of the rations without SC and at the level of 21% varied of 0.39 to 1.09 and 9.18 to 10.88 g/day, respectively, for EE and total digestive nutrients, showing linear increase ($P = 0.001$). The apparent digestibility of DM and neutral detergent fiber increased linearly with the addition of the byproduct (69.96 to 72.43 and 59.85 to 64.13%, respectively), while the digestibility of CP and EE showed quadratic behavior ($P < 0.05$). Sunflower cake can be recommended as a potential alternative for feeding dairy cows at the maximum level of inclusion of 21% in the concentrate.

Key Words: byproducts, lipids, ruminants

T408 Milk production and composition from cows with different levels of sunflower cake in the ration. E. S. Pereira*[1], P. G. Pimentel[1], M. R. G. F. Costa[1], J. G. L. Regadas Filho[2], and J. E. L. Sousa[1], [1]*Universidade Federal do Ceará*, *Fortaleza, Ceará, Brasil*, [2]*Universidade Federal de Viçosa*, *Viçosa, Minas Gerais, Brasil*.

The objective of this research was to evaluate the milk production and composition of dairy cows fed diets containing increasing levels of sunflower cake. The sunflower cake has an average 164.29 g/kgDM of crude protein and 116.28 g/kgDM of ether extract. Eight multiparous Holstein x Zebu cows, between 50 and 74 d in milk and 20 ± 2 kg milk/day were allocated in a 4 × 4 double Latin Square Design. Sunflower cake was fed in the concentrate at the levels of 0; 7; 14 and 21% and Tifton hay was used as main forage in a 60:40 forage to concentrate ratio. The PROC GLM of SAS was used for the statistical analysis. The milk production increased linearly with the addition of the byproduct (18.88 to 19.29 kg/day), while 4% fat-corrected milk yield showed linear decrease (18.28 to 17.05 kg/day, $P < 0.05$). The milk fat and protein content decreased linearly with greater proportions of sunflower cake in the ration (3.79 to 3.23 and 3.28 to 3.17%, respectively). The lactose content was not affected by increasing levels of sunflower cake in the ration, but the N-ureic in milk decreased linearly. The palmitic acid (C16:0) decreased linearly with the addition levels of the byproduct, although for the other saturated fatty acids, as well as to the monounsaturated and polyunsaturated fatty acids were not observed significant differences ($P > 0.05$). Sunflower cake can be recommended as a potential alternative for feeding dairy cows at the maximum level of inclusion of 21% in the concentrate.

Key Words: byproducts, lipids, ruminants

T409 Supplemental metabolizable lysine delivered with Megamine-L improves productive performance of lactating cows. E. Block*[1], E. Evans[2], and N. Clark[3], [1]*Church and Dwight Co., Inc.*, *Princeton, NJ,* [2]*Evans Technical Consulting Services, Bowmanville, ON, Canada,* [3]*Atlantic Dairy and Forage Institute, Fredericton Junction, NB, Canada.*

Sixteen cows were fed one of 4 diets in a 4 × 4 Latin square treatment arrangement designed to evaluate the delivery of intestinally available lysine in a new product, Megamine-L (MEG-L; 16% lysine). The control diet was formulated using CPM Dairy v3.0 for 35 kg of milk with 3.8% fat and 3.1% protein and contained methionine at 2.4% of the metabolizable protein (MP) and lysine at 6.1% of the MP using corn

and clover silages, corn and barley grain, soybean meal, urea, Megalac, and Smartamine-M. Excess metabolizable protein and energy were at zero in the final formulation. MEG-L was substituted for Megalac in the 3 treatment diets at 50, 100 and 150 g/cow/day. Results are shown in the table. Supplementing MEG-L in all diets resulted significant ($P < 0.05$) increases in production performance with the 100g/d feeding rate being closest to ideal lysine supplied. Using actual productive performance data and DMI for each cow in CPM Dairy resulted in an average metabolizable lysine estimate for MEG-L of 46%.

Table 1. Production responses of dairy cows fed 3 levels of Megamine-L (MEG-L)

	g/d MEG-L				
	Control (0)	50	100	150	P≥F
Milk, kg/d	31.1[a]	34.1[b]	35.4[c]	34.8[b]	0.047
3.5 FCM, kg/d	34.2[a]	37.5[b]	40.3[c]	39.1[c]	0.035
ECM, kg/d	31.2[a]	34.1[b]	35.4[c]	34.8[c]	0.041
DMI,kg/d	22.2	21.8	21.6	22.4	0.786
Fat Yield, kg/d	1.28[a]	1.40[b]	1.54[c]	1.48[bc]	0.040
Protein Yield, kg/d	973[a]	1.15[b]	1.18[b]	1.16[b]	0.038
Milk/DMI	1.40[a]	1.56[b]	1.64[c]	1.55[b]	0.028
Estimated metabolizable Lys from MEG-L, % of lysine	0	47.2	50.0	43.6	

[abc]Values with different superscripts differ ($P \leq 0.05$).

Key Words: metabolizable lysine, lactating cow, milk production

T410 A model to compare effects of supplemental fat sources on performance and dry matter intake in dairy cows: Effects of fat inclusion level. E. Block*[1] and E. Evans[2], [1]*Church and Dwight Co., Inc.*, *Princeton, NJ,* [2]*Evans Technical Consulting Services, Bowmanville, ON, Canada.*

Experiments conducted to evaluate the addition of fat to diets for dairy cows have involved a range in the amounts supplied. This study was conducted to assess production and dry matter intake responses to different sources of fat (calcium salts, prilled fatty acids, tallow, and vegetable oil) compared with control diets (no added fat) as influenced by level of dietary fat inclusion (normal levels, defined as lower dietary fat than milk fat output vs. excessive levels, defined as higher dietary fat than milk fat output). Data obtained from full peer reviewed manuscripts published since 1990 were used for model development if diets were considered typical (protein from 15 to 22%; NDF from 27 to 44%). Data were analyzed using a GLM procedure accounting for experiment and fat source. Treatment values were compared as differences from control. A Tukey's test was conducted to determine pairwise differences between treatments and control. Milk yield (MY), fat yield (FY), energy corrected milk (ECM), and ECM/DMI were improved ($P < 0.05$), protein yield (PY) was unchanged and DMI was reduced when fat was included in the normal range in diets. The model showed that the improvements in MY, FY and ECM caused by fat inclusion in the normal range were associated with studies involving calcium salts primarily with little effects of prills, tallow, and vegetable oils while tallow was primarily responsible for the decline in DMI when comparing fat additions to control diets. When dietary fat was excessive, there were no changes in MY, FY, PY or ECM compared with control diets. In diets containing excessive fat, NE intake increased, but DMI decreased relative to the controls.

Key Words: dietary fat, dairy cow, production performance

T411 A model to compare the effects of fat sources upon performance and dry matter intake in dairy cows: Effects of trial duration. E. Block*[1] and E. Evans[2], [1]*Church & Dwight Co., Inc.*, *Princeton, NJ,* [2]*Evans Technical Consulting Services, Bowmanville, ON, Canada.*

Fat contributes to energy balance as well as milk output, and there can be carryover effects in shorter term (ST, <28 d) changeover trials and Latin square trials that would lead to erroneous conclusions relative to long-term (LT) blocked feeding trials. This study was conducted to model responses to supplemental fat sources (calcium salts, prilled fatty acids, tallow, and vegetable oil) as determined from ST and LT trials. Data obtained from full manuscripts published since 1990 were used for model development if diets were typical (protein from 15 to 22%; NDF from 27 to 44%). Data were analyzed using a GLM procedure accounting for experiment and fat source. Treatment values were compared as differences from control. A Tukey's test was conducted to determine pairwise differences between treatments and control. In the ST model, milk yield (MY), fat yield (FY), energy corrected milk (ECM) and ECM/DMI increased ($P < 0.05$) with fat supplements relative to control. The increases in MY and ECM/DMI were associated with studies involving calcium salts only. Protein yield (PY) was not affected ($P > 0.05$). DMI and calculated NEI declined ($P < 0.05$) in ST with added fat and this was primarily associated with the feeding of tallow. In the LT model there were no trials using prilled fatty acids that fit the criteria for inclusion. In this LT model MY, ECM, NE balance, and ECM/DMI were improved with fat, with no effects of fat on FY or PY. The increase in NE balance was associated with vegetable oil while the improvement in ECM/DMI was associated with calcium salts. DMI did not change with added fat in the LT trials ($P > 0.05$). The magnitude of effects of feeding fat was much greater in LT than in ST trials.

Key Words: dietary fat, dairy cow, production performance

T412 Hourly effective rumen degradation ratio in wheat DDGS, Corn DDGS and Blend DDGS from bio-ethanol plants: Effect of bio-ethanol plant and DDGS type. W. G. Nuez-Ortín* and P. Yu, *Department of Animal and Poultry Science, College of Agriculture and Bioresources, University of Saskatchewan*, *Saskatoon, SK, Canada*.

The objectives of this study were to compare different types of DDGS and different bio-ethanol plants on hourly effective rumen degradation ratio (ED), determined based on the model published by Sinclair et al. in 1993. The corn DDGS, wheat DDGS and blend DDGS (70% wheat: 30% corn), and wheat and corn samples with 3 to 5 different batches were obtained. The data was analyzed using a mixed procedure of SAS with a CRD model. In dairy cows, the optimum ratio between the effective extent of degradability of N and OM to achieve maximum microbial synthesis and minimize N loss is 25 g N per kg OM truly digested in rumen. The results showed that (1) wheat exhibited higher than optimal ED ratio at all incubation times except at 2 h, ranging from 23 to 991 g N/kg OM, while corn showed less than optimal ratio during the entire incubation, ranging from 0 to 24 g N/kg OM. (2) Comparing with DDGS, the hourly ED ratios of N/OM for wheat were higher ($P < 0.05$) than those for DDGS samples at 0, 12 and 24 h, however, the ratios for corn were lower ($P < 0.05$) at all incubation times. (3) Comparing among the 3 types of DDGS, wheat DDGS had the highest ($P < 0.05$) ratios (26–103 g N/kg OM), while ratios for blend DDGS (29–89 g N/kg OM) were numerically higher ($P > 0.05$) than those for corn DDGS (14–56 g N/kg OM). The hourly ED ratios of N/OM tended to rise with increasing incubation time for wheat DDGS and blend DDGS; however, they remained constant for corn DDGS. This reflects a higher difference in the hourly effective degradation of N at later stages for blend DDGS

and wheat DDGS than for corn DDGS rather than differences in the hourly effective degradability of OM. (4) The bio-ethanol plant effect was significant at the beginning and end of incubations. The hourly ED ratios of N/OM for wheat DDGS from SK-Plant 1 was greater at 0 h (42 vs. 16 g N/kg OM) but lesser at 12 h (80 vs. 88 g N/ kg OM) and 24 h (85 vs. 114 g N/kg OM). The results shown here indicate that DDGS samples exhibited more than optimal rumen degradation ratio.

Key Words: hourly effective rumen degradation ratio, bioethanol co-products, dried distillers grains with solubles

T413 Production response of Holstein lactating cows to roasted or electron beam irradiated whole soybean. A. Akbarian[1], G. Ghorbani[1], M. Khorvash[1], P. Showrang[3], M. Dehghan-Banadaky*[2], and M. Jafari[1], [1]*Isfahan University of Technology*, *Isfahan, Iran*, [2]*University of Tehran*, *Karaj, Tehran, Iran*, [3]*Nuclear Science and Technology Research Institute, Atomic Energy Organization of Iran*, *Tehran, Iran*.

Nine lactating Holstein cows (130 ± 15 DIM, 39 ± 2 kg/d milk yield) were used in a duplicated 3 × 3 Latin square design experiment with 3 21 d periods. Cows were fed with rations with 60% concentrate and 40% forage. Treatments consisted of untreated, roasted and electron beam irradiation (63 kGy) formulated to meet energy and protein requirements recommended by the NRC (2001). The amount of feed and orts offered were measured daily for individual cows to calculate dry matter and crude protein intake. Cows were milked 3 times daily. The data were analyzed with Proc Mixed of SAS. The statistical model included fixed effects of treatment, square and their interaction. The effects of period and cow within the square were random. Dry matter and crude protein intake were not significantly different among treatments ($P > 0.05$, Table 1). Milk production and energy corrected milk of cows fed ration containing roasted whole soybean tended to increase ($P > 0.05$). Fat, protein and lactose contents of milk were not differ ($P > 0.05$) among treatments. There was a significant effect on milk efficiency of cows fed different diets ($P < 0.05$). Results showed that feeding roasted whole soybean improved milk production efficiency of cows.

Table 1. Production performance for Holstein cows fed diets contained untreated, roasted or irradiated whole soybean

	Diets			
Items	Untreated	Roasted soybeans	Irradiated whole soybean	SEM
DMI (kg/day)	26.7	24.9	27.1	0.63
CP Intake (kg/day)	4.5	4.4	4.5	0.2
Milk yield (kg/day)	38.1	39.4	38.6	0.99
ECM (kg/day)	41.5	41.9	42.5	1.01
Milk efficiency (milk yield/DMI)	1.4[b]	1.6[a]	1.4[b]	0.04
Fat %	4.1	4.1	4.2	0.07
Protein %	3.3	3.2	3.2	0.03
Lactose %	4.6	4.6	4.6	0.05

[a,b] Means with different letters differ ($P < 0.05$).

Key Words: whole soybean, roasted, electron beam irradiated

T414 The relationship between nitrogen use efficiency and N isotopic fractionation in dairy cows using milk samples collected in the morning or afternoon. L. Cheng*[1], R. Dewhurst[2], J. Larkin[2], F. Buckley[3], C. Thackaberry[3], and G. Edwards[1], [1]*Lincoln University*, *Christchurch, Canterbury, New Zealand*, [2]*Teagasc*, *Dunsany, Co. Meath, Ireland*, [3]*Teagasc*, *Fermoy, Co. Cork, Ireland*.

This study investigated the potential to use fractionation of N isotopes among milk fractions to assess NUE. Nine Holstein-Friesian cows grazing on ryegrass and white clover mixture pasture only were used in this study. All cows were milked twice daily, one morning and afternoon milk samples from each cow were collected for analysis. Milk samples were defatted by centrifugation and protein was precipitated using acetone (4 acetone: 1 milk (vol/vol)). Whole milk, protein pellet (PP) and the supernatant (NPN) were freeze-dried and analyzed for ^{15}N (delta-^{15}N units; per ml). The ^{15}N in milk fractions, between am and pm samples, and the relationship between N isotope fractionation and milk urea N (MUN; mg/dL) were compared using one-way ANOVA (ANOVA) with cow as experimental block and linear regression. The mean ^{15}N in PP (7.05; SD = 0.248) was significantly ($P < 0.001$) higher than in whole milk (6.81; SD = 0.265), while ^{15}N in NPN was significantly ($P < 0.001$) lower (1.61; SD = 0.448). The correlation between am and pm values was weaker for MUN ($P < 0.05$) than for ^{15}N in milk fractions ($P < 0.001$). ^{15}N in NPN was lower for am samples (1.41 vs. 1.91; SED = 0.172; $P < 0.05$), while MUN tended to be higher (17.5 vs. 16.1; SED = 0.77; $P = 0.07$). There was a positive linear relationship ($y = 2.58x + 12.51$; $r^2 = 0.35$; $P = 0.05$) between MUN (y) and ^{15}N in average NPN (x), but this differed between am and pm samples. This may be related to differences in N isotopic discrimination between urea derived from excess N in the rumen or tissues, or differences in the other components of milk NPN. In conclusion, there were consistent differences between cows in the ^{15}N content of milk and milk fractions, though further work is needed to elucidate the effects of different pathways on N isotopic discrimination.

Key Words: stable nitrogen isotopes, milk urea nitrogen, discrimination

T415 Effect of replacing blood meal with rumen-protected amino acids on milk production and composition in lactating dairy cows. G. E. Aines*[1], G. F. Schroeder[2], M. Messman[2], and M. J. de Veth[1], [1]*Balchem Corporation*, *New Hampton, NY*, [2]*Cargill Animal Nutrition, Innovation Campus*, *Elk River, MN*.

A study was conducted to determine the effects on milk production and composition when lysine (Lys) and histidine (His) supplied by porcine blood meal were replaced by lipid-encapsulated rumen-protected forms (Balchem Corporation) of these 2 amino acids. Forty-four Holstein cows (mean 102 DIM) were used in a randomized block design. Treatments were: 1) Positive Control (PC) = diet which contained blood meal (0.4% of DM) and was balanced to meet metabolizable Lys and His, 2) Negative Control (NC) = similar to PC but removing blood meal, meeting a minimum of 80% of the metabolizable Lys and His requirements, 3) NC+His = NC diet supplemented with rumen-protected His to provide the same total level of His supply as the PC, and 4) NC+His+Lys = similar to NC+His but supplemented with rumen-protected Lys to provide the same levels of the 2 amino acids as the PC. NC and PC diets contained 17.0 and 17.8% CP, respectively. His and Lys were top dressed twice daily. DMI and milk yield were recorded daily and averaged by week. Milk composition was analyzed on the last day of each week. Data was analyzed using the PROC Mixed procedure of SAS with repeated measures and pretreatment milk yield was used as a covariate. Cows on NC treatment produced less milk (40.4 kg) compared with PC (42.5 kg, $P < 0.05$). NC+His had similar milk yield (39.9 kg) compared with NC, however, NC+His+Lys increased milk yield (42.6 kg) compared with NC and NC+His indicating that Lys was first limiting or co-limiting with His. PC and NC+His+Lys milk production were not different.

Milk components, DMI and feed efficiency were not different among treatments. MUN (mg/dl) was significantly ($P < 0.01$) lower for NC, NC+His and NC+His+Lys (11.8, 12.2 and 11.5, respectively) compared with PC (16.7), indicating that protein was used more efficiently in the lower protein diets. The results suggest that replacing the essential amino acids Lys and His that are supplied from porcine blood meal with equal levels from rumen-protected sources can maintain milk yield despite lower CP levels.

Key Words: blood meal, histidine, lysine

T416 Fatty acid composition of milk from Holstein cows fed diet supplemented with fish oil and canola oil from transition period to early lactation. T. S. Vafa, A. Heravi Moussavi*, A. A. Naserian, M. Danesh Mesgaran, and R. Valizadeh, *Ferdowsi University of Mashhad, Excellence Center for Animal Science, Faculty of Agriculture, Mashhad, Khorasan Razavi, Iran*.

The objective of this study was to examine the effects of feeding fish oil and canola oil from transition period to early lactation on milk fatty acid composition. Experimental diets were supplemented with either 0% oil (Control, n = 9), or 2% oil (supplemented, 1% canola oil-1%fish oil, n = 9), and fed 2 times a day from day −21 to 50 related to calving. Cows were blocked by parity, previous 305–2x milk production and expected calving time. Milk samples of first, third and sixth week of lactation were collected for fatty acids analysis using gas chromatography. All milk fatty acid results were expressed as g/100g of total fatty acids. The data repeated in time were analyzed by using a mixed model for a completely randomized design with repeated measures. Significance was declared at $P < 0.05$. As revealed in table1, total short (SCFA; C4:0- C8:0) and medium (MCFA; C10:0- C16:0) fatty acids decreased and total poly unsaturated fatty acids (PUFA) increased in supplemented diet. The proportion of C16:0, C16:1 and C18:0 decreased in supplemented diet. The proportion of trans (t) 10, cis (c) 12–18:2, c9, t11–18:2, c9, c12–18:2, t9, t11–18:2, t-18:1, eicosapentanoic acid (EPA) and docosahexaenoic acid (DHA) increased in supplemented diets, but the proportion of c11–18:1 and c9–18:1 were similar between diets. The results of this study demonstrate that feeding a combination of fish oil and canola oil had significant effect on milk fatty acids composition.

Table 1. Effects of pre- and post calving feeding of fish oil and canola oil on milk fatty acids composition (g/ 100 g FA)

Fatty acids	Control	Supplemented	SE	P-value
16:0	22.72	20.53	1.33	**
16:1	0.71	0.60	0.01	**
18:0	12.9	11.59	0.32	*
t 18:1	0.15	0.18	0.07	*
c9 18:1	23.81	26.13	1.9	ns
t9,t12-18:2	0.16	0.23	0.01	**
t9,t11-18:2	0.02	0.05	0.002	***
t10,c12-18:2	0.03	0.05	0.007	**
c9,t11-18:2	0.38	0.65	0.02	***
EPA	0.05	0.11	0.01	**
DHA	0.08	0.14	0.005	**
SCFA	7.88	6.92	0.12	**
MCFA	14.59	11.61	0.63	**
PUFA	3.59	4.76	0.06	***

ns = not significant; *$P < 0.05$, **$P < 0.01$, ***$P < 0.0001$.

Key Words: fish oil, canola oil, milk fatty acids

T417 Partial replacement of soybean meal by encapsulated urea in commercial dairy herds. V. A. Silveira[1], N. M. Lopes[1], R. C. Oliveira[1], B. Gonzales[1], A. V. Siqueira[1], L. P. P. Bier[2], M. S. Zoni[3], W. Giardini[4], R. Almeida*[2], and M. N. Pereira[1], [1]*Universidade Federal de Lavras, Lavras, MG, Brazil*, [2]*Universidade Federal do Paraná, Curitiba, PR, Brazil*, [3]*Milkonsult, Castro, PR, Brazil*, [4]*Alltech do Brasil, Brazil*.

Two on-farm trials were conducted to evaluate the partial replacement of soybean meal by encapsulated urea (OptigenII, Alltech do Brasil, Brazil). From a control treatment, 1 kg of soybean meal was replaced by 160 g of Optigen plus 2.5 kg of corn silage in trial 1 or 150 g of Optigen plus 0.85 kg of ground corn in trial 2. Researchers were responsible for manually mixing the treatments in proportion to the offered TMR and performing data collection in each farm. Trial 1 started with 68 Holsteins (243 DIM) paired blocked based on parity and yield and allocated to a treatment for 21 d, after a 5-d standardization period. Trial 2 started with 120 cows (291 DIM), also paired blocked and allocated to a sequence of 2 treatments in a crossover design with 21-d periods. Seven cows were lost in trial 1 and 23 were lost in trial 2. Response variables were measured on d 17 to 21 of treatment allocation, during which feed offered and orts were sampled daily. Data for trial 1 was analyzed with the GLM of SAS with a model containing the effects of covariate (measure of the same variable at the end of the standardization period), block and treatment. Data from trial 2 used a model containing the effects of cow, period, and treatment. Orts as a percentage of the offered diet fresh matter was 4.7 and 5.3% for trial 1 and 2.7 and 2.3% for trial 2, for Control and Optigen treatments, respectively. The DM, CP and NDF content of the offered diets and orts were similar across treatments, as well as cow′s body weight and body condition score. Milk yield was 38.4 kg for Control and 38.9 kg for Optigen in trial 1 ($P = 0.62$), and 27.0 kg and 27.2 kg in trial 2 ($P = 0.64$), respectively. No difference in milk solids secretion was detected ($P > 0.44$). Optigen increased MUN from 16.3 to 17.3 mg/dL in trial 1 ($P < 0.01$), but did elicit such a response in trial 2 ($P = 0.14$). Optigen tended to increase the group ratio of milk to feed in trial 2 ($P = 0.08$). Replacing soybean meal by Optigen did not induce lower performance, although increased MUN was observed when Optigen combined with corn silage replaced soybean meal.

Key Words: non-protein nitrogen, slow-release urea, Optigen

T418 The effect of feeding a prototype of ruminally protected lysine (RPL) on production performance and plasma amino acid profile of early lactation dairy cattle. J. E. Nocek[1], M. Miura[2], and I. Shinzato*[2], [1]*Spruce Haven Farm and Research Center, Auburn, NY*, [2]*Ajinomoto Co., Inc., Tokyo, Japan*.

Thirty-six lactating Holstein cows were used to examine the effects of ruminally protected lysine (RPL) supplementation and dosage on production performance and plasma amino acid profile of high-producing dairy cows. Multiparous cows were balanced across treatments based on their 4 week of lactation average milk production as follows: Control, 75, 150, 225 g/d of RPL. These treatments were designed to deliver 0, 4.5, 9.0 and 13.5 g/cow/d of supplemental intestinally available lysine, respectively. Cows started the experimental period on the fifth week post-calving and remained on treatment for 4 weeks. Prior to treatment administration, all cows received the control diet, which contained 75% of forage from corn silage, for one week. Control diet was fed to all cows throughout the experimental period, however, in addition, cows received 500 g/d of corn meal premix top dressed once daily to deliver 0, 75, 150 or 225 g/d of RPL. Dry matter intake was the highest for cows receiving 225g RPL compared with Control or 150g RPL. As a percentage of body weight, DMI remained higher for cows receiving 225g RPL

compared with 75g RPL. Mean milk yield was higher ($P < 0.05$) for cows receiving 75g RPL than Control (43.4 vs. 40.2 kg), with 150g and 225g RPL not being different than either. Fat percentage was higher ($P < 0.05$) for 150g and 225g RPL compared with 75g (3.83 vs. 3.35%, respectively), with control not being different. However, fat percentage for 75g RPL increased with time on treatment. Fat yield reflected this same numeric tendency ($P = 0.08$). Protein percentage was higher for control compared with 75g RPL with 150g and 225g not being different from either. Protein yield, lactose, MUN and SCC were not affected by RPL treatment. There were no significant ($P > 0.10$) or notable effects of RPL level on plasma AA concentration. These results demonstrated lysine is limiting in high corn silage diets for milk production.

Key Words: ruminally protected lysine, milk production, plasma amino acids

T419 Effect of HMBi supplementation on splanchnic methionine metabolism in postpartum transition cows. M. Larsen*, K. F. Dalbach, B. M. L. Raun, and N. B. Kristensen, *Faculty of Agricultural Sciences, Aarhus University*, *Tjele, Denmark*.

Eight second lactation Holstein cows implanted with permanent indwelling catheters in major splanchnic blood vessels were used to study the effect of dietary supplementation with the methionine hydroxyl analog (2-hydroxy-4-methylthio butanoic acid isopropyl ester; HMBi; Adisseo, France) on splanchnic methionine (Met) metabolism. At calving, cows were assigned to 1 of 4 diets in a 2 × 2 factorial design with one factor being HMBi supplement (2.6 g/kg dry matter) compared with no supplement (CTRL). The second factor was source of alcohol (ethanol vs. propanol). Diets were fed ad libitum in equally sized meals at 8 h intervals. Eight hourly sets of arterial, portal vein, and hepatic vein samples were obtained at −15 ± 5 d prepartum as well as 4, 15, and 29 d in milk (DIM). Met was analyzed in pooled plasma by GC-MS. The statistical model included both factors, DIM and possible interactions, where DIM was considered as a repeated measure. No interactions were observed between factors studied. Postpartum, milk yield and dry matter intake were unaffected by HMBi supplementation ($P \geq 0.32$) and averaged 34 ± 1 and 18 ± 1 kg/d, respectively. Casein content in milk tended to decrease at a lower rate with HMBi compared with CTRL as lactation progressed (interaction, $P = 0.06$). Milk fat content tended ($P = 0.07$) to be greater with HMBi. The change in arterial Met concentration from prepartum to 4 DIM differed ($P < 0.01$) between HMBi (from 20 to 23 μM) and CTRL (from 21 to 17 μM). Postpartum, arterial Met concentrations tended ($P = 0.09$) to remain greater with HMBi. The net portal and net splanchnic releases of Met were unaffected ($P \geq 0.50$) by HMBi and averaged 7.7 ± 0.3 and 5.3 ± 0.3 mmol/h, respectively. The net hepatic removal of Met tended ($P = 0.08$) to be greater with HMBi as compared with CTRL (2.7 and 2.0 ± 0.3 mmol/h, respectively). In conclusion, dietary HMBi supplementation to postpartum transition cows prevented a decrease in plasma Met in the first week postpartum without requiring time for adaptation to HMBi feeding. The greater hepatic removal of Met with HMBi indicates that Met was supplied in excess relative to other amino acids.

Key Words: transition, methionine, metabolism

T420 The effect of abomasal infusion of histidine and proline on milk composition and amino acid utilization in high producing lactating dairy cows. M. W. Hofherr*, D. A. Ross, and M. E. Van Amburgh, *Cornell University*, *Ithaca, NY*.

Histidine has been shown to be a limiting amino acid in grass fed lactating dairy cows and to alter fat secretion under certain conditions. A significant increase in milk protein output and a reduction in arginine uptake by the mammary gland were observed when proline was infused into the duodenum of 2 cows. The objective of this experiment was to determine the effects of abomasal infusion of histidine and proline on lactation performance in cows fed more conventional diets and to measure amino acid utilization by the mammary gland. Four rumen-fistulated Holstein cows (52 ± 19 DIM) with indwelling intercostal arterial catheters were used in a 4 × 4 Latin square experiment. Experimental treatments were continuous abomasal infusion of water (control), His (10g/d), Pro (20 g/d), and His (10 g/d) + Pro (20 g/d), with 7-d treatment periods. Cows were fed a TMR (14.4% CP, 2.3 Mcal/kg ME) once per day for ad libitum intake and refusals were measured and analyzed. The CNCPS v6.1 was used to formulate a diet to exceed the metabolizable energy requirement, provide 95% of the predicted metabolizable protein requirement, and supply adequate amounts of all essential amino acids, except Arg. Fat corrected milk yields were not affected by treatment (51.8 kg/d, TRT C; 50.6 kg/d, TRT H; 49.0 kg/d TRT H^+P; 52.4 kg/d TRT P), however abomasal infusion of Pro decreased feed intake and improved feed efficiency by 0.17 kg 3.5% FCM per kg dry matter ($P < 0.05$). Pro infusion increased lactose percentage ($P < 0.05$) but not yield. The lactose response suggests that longer infusions might have resulted in increased milk yield. A similar effect for lactose and feed efficiency was observed for the H^+P treatment. In this experiment abomasal infusion of His resulted in no performance difference or change in efficiency. Our results indicate that postruminal supplementation of Pro might increase milk fat production and feed efficiency in high producing dairy cows.

Key Words: amino acids, feed efficiency, infusion

T421 Response of dairy cows to the supplementation of fatty acids from calcium salts of soybean oil or heated soybeans. G. S. Dias Júnior[1], N. M. Lopes[1], L. L. Bitencourt[1], V. A. Silveira[1], G. G. S. Salvati[1], N. N. Morais Júnior[4], E. O. S. Saliba[3], R. A. N. Pereira[2], and M. N. Pereira*[1], [1]*Universidade Federal de Lavras*, *Lavras, Brazil*, [2]*Empresa de Pesquisa Agropecuária de Minas Gerais*, *Lavras, Brazil*, [3]*Universidade Federal de Minas Gerais*, *Belo Horizonte, Brazil*, [4]*Instituto Federal de Educação Ciência e Tecnologia do Espirito Santo*, *Colatina, Brazil*.

This study evaluated the effect of supplementing corn silage based diets with fatty acids from calcium salts of soybean oil (Megalac E, Química Geral do Nordeste SA, Nova Ponte, Brazil) or from cracked whole roasted soybeans (Alfa Nutrisoja, Cooperalfa, Chapecó, Brazil). The content of Megalac was 1.4% of diet DM and the content of heated soybeans was 5.4. The dietary EE content was 4.3% of DM for Control and 6.0 for the fat supplemented diets. Diets contained 42.3% of DM from corn silage, 14.2% from high moisture corn, and 0.9% from bicarbonate. The dietary content of soybean meal and citrus pulp were 22.1 and 18.6 for Control, 18.4 and 16.9 for Soybean, and 22.5 and 16.8 for Megalac; diets CP content were 16.3, 16.7, and 16.6, respectively. Twenty-four Holsteins (638 kg, 216 DIM) received a sequence of the treatments in 8 concurrently run 3 × 3 Latin Squares, with 28-d periods, and 21 d of adaptation. Daily milk yield was 31.7 kg for Control, 32.7 for Soybean, and 31.8 for Megalac ($P = 0.43$). Megalac reduced daily DMI from 21.4 to 20.5 kg compared with Control ($P = 0.05$). There was a trend for decreased time of the first daily meal with Megalac ($P = 0.07$). Milk to feed ratio was 1.56 for Megalac and 1.48 for Control ($P = 0.07$). Megalac decreased milk fat content from 3.11 to 2.64% and daily fat yield from 0.986 to 0.828 kg ($P < 0.01$), resulting in lowered daily milk energy secretion ($P = 0.04$). Soybean had no effect on milk solids ($P > 0.33$). Rumen protozoa count was decreased by both fat supplements ($P < 0.01$), no difference was detected in MUN ($P = 0.92$)

or the daily excretion of allatoin in urine ($P = 0.54$). Supplementation of corn silage based diets with fatty acids from calcium salts of soybean oil decreased milk fat secretion and diet intake, and tended to increase feed efficiency, while the same fat content from whole roasted soybeans did not induce a similar response.

Key Words: calcium soap, fat, soybean oil

T422 Variability of estimated protected proteins of feather meals. J. A. Davidson*, K. B. Cunningham, H. C. Puch, and B. L. Miller, *LongView Animal Nutrition Center, Land O'Lakes Purina Feed, Gray Summit, MO*.

The objective was to evaluate the quality of sources of feather meal in regard to ruminal undegraded protein and available protein. Nine feather meal samples along with control samples of SurePro (non-enzymatically browned soybean meal) and SBM were evaluated utilizing in sacco techniques. Samples prepared in 51-μm polyester bags were exposed for 12 h within a ruminally-cannulated steer fed a forage:concentrate diet of 60:40 at DMI of 3.5% of BW. Additional subsets of bags were utilized to determine a 0-h protein disappearance and protein disappearance after digestion with pepsin (0.1 *N* HCl) for an additional 12 h. The RUP value was calculated as percent remaining after 12-h exposure in rumen and available protein (AP) was the difference between % protein disappearance at 12-h exposure in rumen and 12-h pepsin digestion. The mean ± SE estimated RUP for the feather meals, SurePro, and SBM were 78 ± 1.9%, 81 ± 0.6%, and 40%, respectively. The mean ± SE AP for the feather meals, SurePro, and SBM were 25 ± 3.9%, 70 ± 0.9%, and 38%, respectively. In comparison, the NRC 2001 estimates of RUP as % CP for feather meals were 62 to 65% with a RUP digestibility of 65 to 70%; 69 to 79% RUP with 93% digestibility for SurePro; and 31 to 43% RUP with 93% digestibility for SBM. Thus, the NRC 2001 described the AP of feather meal, SurePro, and SBM as 40 to 46%, 64 to 73%, and 29 to 40%, respectively. Based on our measurements, the AP of feather meal is 15% lower than those of NRC 2001, whereas SurePro and SBM were within the reported range. In conclusion, this data set demonstrates the need to continually monitor and evaluate protected protein sources. In sacco methods along with pepsin digestion are tools to characterize the consistency and quality of RUP and AP from multiple sources. Feather meal as a source of RUP for lactating cow diets does not consistently have high digestibility and is a poor alternative to other feed ingredients.

Key Words: protected protein, feather meal, in sacco methods

T423 Milk fat responses to dietary short and medium chain fatty acids in lactating dairy cows. D. Vyas*, B. B. Teter, and R. A. Erdman, *University of Maryland, College Park*.

During diet induced milk fat depression, the short- and medium-chain fatty acids (SMCFA), synthesized de novo in the mammary gland, are reduced to a much greater extent than the long-chain fatty acids (LCFA) originating from the diet. Our hypothesis was that SMCFA limit milk fat synthesis even under conditions when milk fat is not depressed. Our objective was to test the potential limitation of SMCFA on milk fat synthesis via dietary supplementation. Sixteen lactating Holstein cows (86 ± 41 DIM) randomly assigned in groups of 4 per pen and fed corn silage based TMR were supplemented with 1 of 4 dietary fat supplements (600g/d) in a 4 × 4 Latin square design with 21-d experimental periods. Treatments consisted of fat supplements containing mixtures of calcium salts of LCFA (Megalac; M) and a SMCFA mixture (S) (C8:0- 3.3%, C10:0- 7.6%, C12:0- 9.85%, C14:0- 32.12% and C16:0- 47.11%) that contained 0, 200, 400, and 600 g/d S substituted for M (S0, S200, S400, and S600, respectively). No significant changes were observed with dry matter intake, milk yield, and fat corrected milk (FCM), whereas milk fat concentration was increased ($P = 0.008$) by 0.17, 0.25, and 0.33 percentage units for the respective S treatments. Fat yield peaked with S200 and milk protein content and yield were reduced at the higher S levels due to a trend toward reduced milk yield in the S600 treatment. In conclusion, SMCFA supplementation increased milk fat content in a linear fashion but the trend toward reduced feed intake and milk production at the highest level of supplementation might have masked the effects of SMCFA on total milk fat synthesis.

Table 1. Production responses to increasing SMCFA

SMCFA, g/d	0	200	400	600	SEM	P-value
DMI, kg/d	26.5	26.4	26.5	25.5	0.53	0.24
Milk, kg/d	43.6	43.9	42.7	41.1	1.1	0.08
3.5%FCM, kg/d	45.04	46.75	45.98	44.75	1.8	0.36
Milk fat, %	3.75^{b}	3.92^{ab}	4.0^{a}	4.08^{a}	0.16	0.008
Milk fat, g/d	1614	1709	1694	1663	89.9	0.28
Milk protein,%	3.10^{ab}	3.12^{a}	3.09^{ab}	3.06^{b}	0.05	0.03
Milk protein, g/d	1351	1373	1318	1257	41.5	0.05

$^{a–b}$Least squares means within a row with different superscripts differ.

Key Words: milk fat, short-chain fatty acids

T424 Effect of feeding varied levels of crude protein and absorbable methionine on milk yield in lactating dairy cows. G. A. Broderick*[1], R. A. Patton[2], W. Heimbeck[3], and C. Parys[3], [1]*U.S. Dairy Forage Research Center, Madison, WI*, [2]*Nittany Dairy Nutrition, Inc., Mifflinburg, PA*, [3]*Evonik Degussa GmbH, Hanau, Germany*.

Supplementing with limiting AA should allow less CP to be fed; reducing dietary CP will decrease urinary N and ameliorate the environmental impact of dairying. Rumen-protected Met (RPM) fed as Mepron to provide 9 g/d of absorbable Met allowed similar milk yield at 15.8% CP as at 17.1% CP without RPM (Broderick et al., J. Dairy Sci. 92:2719, 2009). A lactation trial was conducted to assess response to RPM at different CP levels. TMR were prepared from alfalfa and corn silages, dry and high moisture corn, and solvent and expeller soybean meals. Diets were formulated to 28% NDF and 12, 14, 16 or 18% CP (DM basis); at each level of CP, RPM provided 0, 4.5, 9.0 and 13.5 g/d of absorbable Met, assuming 25 kg/d of DMI and 0.6 g absorbed Met/g of Mepron (total = 16 diets). Sixty-four cows were blocked by DIM into 16 squares and randomly assigned to balanced 4 × 4 Latin squares. The 4 levels of RPM were fed at each CP level for 4, 4-wk periods. Data from the last 2-wk of each period were analyzed for linearity of response to dietary CP and RPM using the Mixed model of SAS; LS means are reported. Analysis of TMR extracts with the Met-nitroprusside reaction confirmed that RPM was fed in desired amounts but CP was higher than formulated. Dietary CP increased DMI, BW gain and yield of milk, 3.5% FCM, fat and protein but did not affect milk/DMI. Production was not increased when diets contained 15.8% or more CP. Although the NRC model indicated that diets had Lys/Met ratios ranging from 3.3 to 3.7, and observed milk yield was more than MP-allowable milk on 12.9 and 15.8% CP, more absorbable Met had no effect on production in this trial.

Table 1. Production data

	Dietary CP, %				
Item	12.9	15.8	18.2	20.2	P > F
DMI, kg/d	24.2[b]	26.6[a]	27.1[a]	27.0[a]	0.04
Milk, kg/d	38.6[b]	44.8[a]	45.9[a]	45.8[a]	0.04
FCM, kg/d	40.5[b]	47.5[a]	50.1[a]	49.0[a]	0.03
Fat, kg/d	1.47[b]	1.73[a]	1.86[a]	1.78[a]	0.06
Protein, kg/d	1.13[b]	1.38[a]	1.39[a]	1.38[a]	< 0.01
MUN, mg/dL	7.3[d]	12.9[c]	16.9[b]	19.3[a]	< 0.01
	Absorbable Met, g/d				
	0	4.5	9.0	13.5	P > F
DMI, kg/d	26.5	26.3	26.0	26.2	0.31
Milk, kg/d	44.0	44.1	43.5	43.4	0.27
FCM, kg/d	46.8	47.3	46.0	46.9	0.45
Fat, kg/d	1.70	1.73	1.68	1.73	0.51
Protein, kg/d	1.32	1.33	1.30	1.32	0.51
MUN, mg/dL	14.2	14.0	14.3	14.0	0.78

[a–d] ($P < 0.05$).

Key Words: methionine, rumen-protection, milk yield

T425 Methionine supplementation to diets varying in rumen undegradable soy protein. N. N. Morais Júnior[3], V. A. Silveira[1], N. M. Lopes[1], G. S. Dias Júnior[1], G. Pessoa Júnior[1], G. G. S. Salvati[1], C. O. Faria[5], R. A. N. Pereira[2], N. D. Luchini[4], and M. N. Pereira*[1], [1]*Universidade Federal de Lavras*, *Lavras, Brazil*, [2]*Empresa de Pesquisa Agropecuária de Minas Gerais*, *Lavras, Brazil*, [3]*Instituto Federal de Educação Ciência e Tecnologia do Espirito Santo*, *Colatina, Brazil*, [4]*Adisseo*, *Alpharetta, GA*, [5]*Better Nature Research*, *Ijaci, Brazil*.

Methionine (Met) is one of the 2 amino acids (AA) that limits milk production. The objective of this study was to evaluate the effect of supplementing a source of Met to 2 diets with different rumen undegradable protein content. Twenty Holsteins were allocated to 5 4x4 Latin Squares in a 2 × 2 factorial arrangement of treatments. Each period lasted 21 d of which the last 7 were for data collection. Treatments consisted of feeding a diet composed of 38.5% corn silage, 7.8% tifton hay, 24.2% corn, 5.0% soybean meal, 8.3% citrus pulp, and 13% of raw or roasted soybeans (Alfa Nutrisoja, Cooperalfa). The Met supplement (isopropyl ester of 2-hydroxy-4-(methylthio) butanoic acid. MetaSmart, Adisseo) was orally given twice a day to the allocated cows. Diet CP content was 15.8% and EE was 6%. No significant results were observed for the interaction of amino acid and soybean main effects ($P > 0.15$). Roasted soybeans increased milk yield from 34.7 to 37.7 kg, protein yield from 1.003 to 1.078 kg, and fat yield from 1.060 to 1.162 ($P < 0.01$). The milk to feed ratio was 1.49 for raw and 1.59 for roasted soybeans ($P < 0.01$). MetaSmart induced non-statistically detectable increases in milk yield from 36.0 to 36.4 kg ($P = 0.46$), protein from 1.032 to 1.049 kg ($P = 0.29$), and fat from 1.101 to 1.120 kg ($P = 0.45$). Daily DMI was 24.0 kg for cows on MetaSmart and 23.4 for controls ($P = 0.13$). The milk urea nitrogen was 13.1 mg/dL for raw and 12.5 for roasted soybeans ($P = 0.04$). There were no detectable treatment effects on total tract digestibility ($P > 0.62$) and plasma glucose ($P > 0.76$). MetaSmart decreased the daily excretion of urinary allatoin and the ratio of allantoin to digestible OM intake ($P = 0.02$). Plasma urea nitrogen (PUN) content of 10 samples obtained over a 24-h period was analyzed as repeated measures over time with Mixed of SAS. Raw soybeans increased PUN from 14.3 to 15.4 mg/dL ($P < 0.01$), while MetaSmart decreased it from 15.1 to 14.6 ($P = 0.05$). For these soybean based diets, the response to increased flow of dietary AA in the metabolizable protein was larger than the response to Met, suggesting than other amino acids may have been more limiting to milk production.

Key Words: amino acid, methionine, protein

T426 Effects of level of rumen degradable protein and corn distillers grains in corn silage-based diets on milk production and ruminal fermentation in lactating dairy cows. G. I. Zanton* and A. J. Heinrichs, *The Pennsylvania State University*, *University Park*.

Two of the potential obstacles precluding inclusion of higher levels of dry distillers grains with solubles (DDGS) in corn-based, dairy cow diets are the low levels of rumen degradable protein (RDP) and the fatty acid content and composition of DDGS. Therefore, the objective of this experiment was to evaluate the production and rumen responses to dietary alterations in the level of RDP and DDGS for dairy cows fed a high corn silage diet. The experimental design was a replicated, 4 × 4 Latin square with 21 d periods: 14 d of adaptation and 7 d of sampling; 16 uncannulated cows and 4 rumen cannulated cows were blocked and assigned randomly to treatment sequences. Rations (basal ingredients: 47% corn silage, 3% long grass hay, 12% finely ground corn, 4% extruded soybean meal, 7.5% canola meal; mean composition: 17.4% CP, 36% NDF, 36% NFC, 1.69 Mcal NE_L/kg) were provided as total mixed rations and were formulated to be high or low RDP, with or without DDGS replacing soybean-based concentrates: high RDP, no DDGS (HDRP0); low RDP, no DDGS (LRDP0); low RDP, 10% DDGS; and low RDP, 20% DDGS. Contrasts of interest were HRDP0 vs. LRDP0 and linear and quadratic effects of level of DDGS; differences were declared at $P < 0.05$. Body weight (696 kg) and dry matter intake (26.6 kg/d) were not affected by treatment ($P > 0.50$). Rumen ammonia concentration was greater for HRDP0 than LRDP0 ($P < 0.01$), but was unaffected by level of DDGS inclusion. Mean and minimum rumen pH and time < pH 5.5 was not different between diets ($P > 0.25$). Milk production tended to be lower for cows fed HRDP0 than LRDP0 ($P < 0.06$) and tended to be linearly reduced as DDGS inclusion increased ($P < 0.07$). Milk protein yield tended to be greater for cows fed LRDP0 than HRDP0 ($P < 0.07$), but was unaffected by DDGS level. Milk fat production, concentration, and fat corrected milk were linearly reduced by increasing levels of DDGS ($P < 0.01$).

Key Words: dry distillers grains with solubles, rumen degradable protein, corn silage

T427 Effect of quebracho-chestnut tannin extracts at two dietary crude protein levels on performance and rumen fermentation of dairy cows. M. J. Aguerre*[1], M. A. Wattiaux[1], M. C. Capozzolo[1], P. Lencioni[2], and C. Cabral[2], [1]*University of Wisconsin-Madison*, *Madison*, [2]*Silvateam, Indunor S. A*, *Argentina*.

The objective of this study was to determine the effects of a dietary tannin mix on lactating cow performance and rumen fermentation, and whether any responses were affected by dietary CP. Eight ruminally cannulated and 16 noncannulated multiparous Holstein cows (669 ± 55 kg BW; 89 ± 36 DIM) were randomly assigned to a diet of 15.5 or 16.8% CP (%DM) and to 1 of 4 levels of tannins in three 4 × 4 Latin squares within each level of dietary CP. Rice hull was removed from 50:50 forage to concentrate ratio (%DM) total mixed rations as a tannin extract mixture from Quebracho and Chestnut trees was included at 0 (control), 0.45, 0.90 and 1.8% of dietary DM. There was no interaction between dietary CP and tannin supplementation. Reducing dietary CP had no effect on measurements, except for reducing milk urea N (MUN; 18.8 vs. 15.6mg/dL, $P < 0.05$) and ruminal NH_3-N (11.0 vs. 9.3 mg/dL, $P < 0.05$). Overall, milk yield (40.4 kg/d), 3.5%FCM (40.3 kg/d), milk

fat and lactose content and yield, and ruminal pH were not affected by tannin. The *P*-values for a linear increase in BW gain (0.46 kg/d), a linear increase in feed efficiency (1.68 kg milk/kg of DMI) and a linear decrease in DMI (24.4 kg/d) with incremental levels of tannin extracts in the diet were 0.11, 0.15 and 0.07, respectively. Relative to control (2.87%), milk true protein content increased to 2.91% ($P < 0.05$), did not change (2.86%) and decreased to 2.83% ($P < 0.05$) when tannin was 0.45, 0.90 and 1.8% of dietary DM respectively. Also, relative to control (1.14 kg/d), milk protein yield did not change with inclusion of tannin, but it was higher ($P < 0.05$) at the 0.45 than the 0.9 or 1.8% inclusion level (1.16, 1.12 and 1.11 kg/d, respectively). Relative to other treatments, the 1.8% tannin in the diet lowered MUN (13.8 vs. 12.9 mg/dL, $P < 0.05$) and rumen NH_3-N (10.6 vs. 8.1 mg/dL, $P < 0.05$). Results indicate that regardless of dietary CP, 0.45% tannin extract in the diet had a small positive effect on milk protein content independently of a reduction in ruminal protein degradation, which was observed along with a reduction in MUN, only at the 1.8% level of inclusion.

Key Words: tannin, performance, protein

T428 Effect of quebracho-chestnut tannin extracts at two dietary crude protein levels on nitrogen partitioning in lactating dairy cows. M. J. Aguerre*[1], M. A. Wattiaux[1], M. C. Capozzolo[1], P. Lencioni[2], and C. Cabral[2], [1]*University of Wisconsin-Madison, Madison*, [2]*Silvateam, Indunor S. A.*, *Argentina*.

Our objective was to determine the effects of a dietary tannin mix on nitrogen (N) partitioning and whether responses were affected by the level of dietary CP. Eight multiparous Holstein cows (708 ± 41 kg of BW; 125 ± 41 DIM) were randomly assigned to a diet of 15.5 or 16.8% CP (%DM) and to one of 4 levels of tannin in a 4 × 4 Latin squares within each level of dietary CP. Rice hull was removed from 50:50 forage to concentrate ratio (%DM) total mixed rations as a tannin extract mixture from Quebracho and Chestnut trees was included at 0 (control), 0.45, 0.90, and 1.8% of dietary DM. Nitrogen mass balance was conducted by a 3-d total fecal and urine collection. There was no CP by tannin interaction for any of the measured variables. Reducing dietary CP had no effect on DMI (24 kg/d), N intake (613 g/d), milk N (172 g/d) and N efficiency (milk protein N/N intake; 0.28) but increased fecal N (214 vs. 257 g/d, $P = 0.07$) and decreased (all Ps < 0.05) urinary N (232 vs. 167 g/d), urinary urea N (164 vs. 99 g/d) and apparent N digestibility (65.4 vs. 57.2%). Although manure N (fecal N + urinary N; 435 g/d) remained unaltered, lowering dietary CP from 16.8 to 15.5% resulted in a 40% reduction in urinary to fecal N ratio (1.10 vs. 0.66; $P < 0.05$). Tannin did not affect N intake, milk N, or N efficiency, however, it increased fecal N relative to control (214 vs. 243 g/d; $P < 0.05$) with no differences among inclusion levels. In addition, urine N was lower when tannin inclusion rate was 1.8% of dietary DM compared with 0, 0.45 and 0.9% inclusion rates (211 vs. 177 g/d; $P < 0.05$). Inclusion of tannin in the diet did not alter manure N, but it lowered the urinary N to fecal N ratio. Relative to control, urinary N to fecal N ratio was decreased by 18% in the 2 intermediate tannin inclusion rates (1.05 vs. 0.87, respectively; $P < 0.05$), the latter value being further reduced ($P < 0.05$) to 0.72 at the 1.8% inclusion rate (a 31% reduction compared with control). Results indicated that reducing dietary CP and inclusion of tannin extract in the diet had additive effects on altering urinary to fecal N ratio.

Key Words: tannin, nitrogen, manure

T429 Digestibility of amino acids in rumen undegraded corn silage determined by the modified three-step procedure. S. M. Fredin*[1], S. E. Boucher[2], D. Sapienza[3], N. L. Whitehouse[1], and C. G. Schwab[1], [1]*University of New Hampshire, Durham*, [2]*William H. Miner Agricultural Research Institute, Chazy, NY*, [3]*Sapienza Analytica, LLC, Slater, IA*.

Five corn silage (CS) hybrids were utilized in an evaluation of the modified 3-step procedure (mTSP) to estimate intestinal (ID) and total tract digestibility (TTD) of crude protein (CP) and AA. Samples were ground to 2-mm and ruminally incubated in situ for 16 and 24 h in 2 lactating cows averaging (mean ± SD) 43 ± 8 d in milk fed a 58% forage, 42% concentrate ration. Two time points were chosen to evaluate differences in ID due to ruminal incubation time using the MIXED procedure of SAS. After ruminal incubation, rumen undegraded CS was incubated for 1 h in a pepsin-HCl solution and for 24 h in a pancreatin solution. Estimates of ruminal degradability, ID, and TTD of CP and AA were calculated. In vivo estimates of ruminal degradability, ID, and TTD of CP and AA were previously determined for the same CS samples using the mobile bag technique (MBT). Coefficients of determination between in vivo and mTSP data were calculated using the REG procedure of SAS. With the mTSP, average ruminal degradability of CP and total AA for all CS samples (incubated for either 16 or 24 h; n = 10) was 74.0 ± 5.85 and 78.9 ± 3.91%, respectively. Estimates of ruminal degradability of CP and total AA were 13.3 and 9.5% greater for the mTSP compared with ruminal degradability estimates from the MBT evaluation. No difference was observed ($P > 0.05$) for in vitro estimates of ID of CP and AA ruminally incubated for 16 or 24 h. Intestinal digestibility of CP and total AA measured with the mTSP for all rumen undegraded CS samples were 10.6 ± 5.15 and 36.9 ± 8.13%, respectively. Estimates of ID obtained using the mTSP and the MBT were not correlated (R2 = 0.07 for CP and R2 = 0.23 for total AA). The mTSP tended to under-predict intestinal digestibility of CP and total AA by 16 and 13%, respectively. Correlations between the 2 methods were improved for TTD of CP (R2 = 0.92), total AA (R2 = 0.82), and essential AA (averaged R2 = 0.72). The mTSP may not be an acceptable in vitro method to determine ID of AA in rumen undegraded CS, but, it may be suitable to determine TTD of AA.

Key Words: corn silage, amino acid digestibility, modified three-step procedure

T430 Evaluation of sampling protocols to estimate ruminal microbial protein production using urinary excretion of purine derivatives. S. E. Boucher*, H. M. Dann, P. K. Krawczel, H. M. Gauthier, J. D. Darrah, and R. J. Grant, *William H. Miner Agricultural Research Institute, Chazy, NY*.

Urinary excretion of purine derivatives (PD) is a technique commonly used to estimate ruminal microbial protein production. However, urine sampling protocols for this technique reported in the literature vary. The objective of this experiment was to evaluate 2 urine sampling protocols to estimate ruminal microbial protein production in lactating cows. Sampling protocols (SP) were employed on cows concurrently enrolled in a 4 × 4 Latin square trial with 21-d periods designed to evaluate the effects of a feed additive and dietary rumen undegraded protein content on ruminal microbial protein production. Urine samples were collected: 1) 4 h post-feeding (1630) on d 18 and 19 of each period and analyzed separately (SP1) or 2) at 0200 and 1630 on d 18, 19, and 20 of each period and composited by cow by period for analysis (SP2). At each time point a minimum of 40 mL of urine was collected. Aliquots of samples were analyzed for allantoin, uric acid, and creatinine concentrations. In cattle, allantoin and uric acid are the primary PD excreted in urine, and creatinine is used as a marker for urine volume. Daily excretion of urinary PD and microbial N production calculated by each protocol were analyzed using the MIXED procedure of SAS to determine least

squares means (LSM), standard errors, and the variance components associated with each sampling method. The LSM of microbial N for the 4 dietary treatments estimated from SP1 and SP2 were 544, 558, 508, and 553 (SE = 19), and 476, 465, 445, and 476 g/d (SE = 18), respectively. The residual variance as a proportion of total variance for SP1 and SP2 was 28 and 37%, respectively. The residual variance is the proportion of the variance associated with day-to-day variation and measurement errors within cows. Based on differences in LSM and variance components with the 2 sampling protocols, standardization of urine sampling protocols when utilizing urinary excretion of PD to estimate microbial protein production in ruminants is needed.

Key Words: microbial protein production, urinary purine derivatives, sampling protocols

T431 Determining the difference in the supply of metabolizable methionine to dairy cows fed four methionine supplements using concentrations of selenium in milk. J. E. Plank*, W. P. Weiss, and N. R. St-Pierre, *The Ohio State University*, *Columbus*.

Accurately quantifying the amount of metabolizable methionine (Met) supplied by Met supplements can be economically beneficial to dairy producers. A previously developed method to estimate the supply of metabolizable Met, based on changes in the concentration of Se in milk when Met sources are fed, was used to compare metabolizable Met supplied from 4 Met supplements: DL-Met, Smartamine, 2-hydroxy-4-(methylthio)-butanoic acid (HMB) and the isopropyl ester of HMB (HMBi). Twenty Holstein cows were fed a diet containing 32% corn silage, 17% corn, 14% legume hay, 13% distillers grains and 13% wheat middlings as a percent of dietary dry matter (DM), as well as 0.3 mg of Se from Se-yeast/kg of dietary DM. Then, in a truncated Latin square experiment (2 blocks, 2 14 d periods), a methionine or control supplement was added to their diet. Methionine supplements were mixed with soyhulls and were fed twice daily as a 500g/day topdressing to provide 18g of Met/day, while control cows were fed 500g/day of soyhulls. Cows were allowed 11 d for adjustment followed by milk sampling on d 12–14 of each period. The specific activity (SA) of milk (the ratio of Se concentration to milk N concentration) was calculated for each treatment. Supplementing Met reduced the SA of milk for cows treated with HMBi (11.0 μg Se/mg N) and Smartamine (11.1 μg Se/mg N) relative to control (12.1 μg Se/mg N, $P < 0.05$), but SA of milk from other treatments did not differ from control. The SA in milk from treatment cows was divided by SA in milk from control cows to determine the change in supply of metabolizable Met. The digestible met flow for control cows, calculated using the Dairy NRC model, was 44 g/day. The calculated flow of metabolizable Met for cows supplemented with DL-Met, Smartamine, HMB and HMBi was 44.4, 48.3, 45.7 and 45.2 g/day respectively. DM intake was different only for cows supplemented with HMBi (21.1 kg/day vs. 19.7 kg/day for control, $P < 0.01$) and the data were adjusted accordingly. The average milk production was 30.3 kg/day and was not affected by the treatments.

Key Words: methionine, milk protein, selenium

T432 The relationship between milk urea nitrogen concentrations, diet, and milk production on Northeast dairy farms. K. M. Kouri*, *Poulin Grain*, *Newport, VT*.

Previous research has shown that concentrations of milk urea nitrogen (MUN) can be measured to monitor the efficiency of dietary protein utilization, and to decrease costs associated with feeding excess protein. The objective of this study was to determine the relationship between MUN concentrations, time of year, milk production, and diet on Northeast dairy farms. Data from 18 dairy farms (approximately 9300 cows) in Vermont and New York were collected and analyzed to identify associations with and possible predictors of MUN concentrations. Monthly milk production and composition for each farm was collected by local milk cooperatives. A subset of 8 farms was used to determine the relationship between MUN concentrations and nutritional measures. Across all farms, MUN levels averaged 11.3 ± 1.2 mg/dl and milk production was 33.8 ± 2.6 kg/d. Concentrations of MUN were affected by time of year ($P < 0.01$), being highest in the summer and lowest in the late winter. There was a positive relationship between MUN and milk yield ($r = 0.70$; $P < 0.08$), and a negative relationship between MUN and both fat ($r = -0.50$; $P < 0.03$) and protein ($r = -0.70$; $P < 0.002$) percentages. In contrast, there was a positive relationship between MUN and percent other solids ($r = 0.80$; $P < 0.04$). There was a modest negative relationship between MUN and forage:concentrate ratio ($r = -0.50$; $P < 0.17$). Somatic cell count, crude protein, rumen degradable protein, rumen undegradable protein, and soluble protein were not correlated with MUN levels in milk ($P > 0.05$). In conclusion, MUN concentrations changed throughout the year and this should be considered when making nutritional management decisions based on MUN. In addition, the positive relationship between MUN and milk production performance of farms in the current study indicates that dietary protein was not being fed in excess.

Key Words: milk urea nitrogen, Northeast dairy farm, production

T433 A critique of dose-response plots that relate changes in content and yield of milk protein to predicted concentrations of lysine in metabolizable protein by the NRC (2001), CPM-Dairy (v.3.0.10), and AMTS.Cattle (v.2.1.31) models. N. Whitehouse*[1], C. Schwab[1], D. Luchini[2], and B. Sloan[2], [1]*University of New Hampshire*, *Durham,* [2]*Adisseo, Atlanta, GA.*

The objective of this study was to critique the Lys dose-response plots for the NRC, CPM and AMTS models (Whitehouse et al., 2009) with an expanded database. To help ensure that Met was not limiting production responses to supplemental Lys, regression analysis for NRC was limited to data where Met was greater than 2.16% of MP; the Met constraint used previously was 2.07%. The resulting data set for NRC contained 59 observations; the data sets for CPM and AMTS contained 48 and 37 observations, respectively. Observations were less for CPM and AMTS because the models, particularly AMTS, predicted lower concentrations of Lys in MP for the high corn-based basal diets without Lys supplementation than NRC. This created ranges of Lys in MP for more studies than with NRC where the highest predicted concentration of Lys in MP did not overlap with the ranges of Lys in MP for the rest of the studies. This precluded being able to identify a fixed reference concentration of Lys in MP that was intermediate to the lowest and highest values in as many of the Lys studies; a fixed reference concentration is needed to calculate the production responses (plus and minus values) for the y-axis of the dose-response plots. The resulting breakpoint estimates for the required concentrations of Lys in MP for maximal content and yield of milk protein were 6.89 and 6.95% for NRC, 7.23 and 7.36% for CPM, and 6.84 and 6.74% for AMTS. Using this expanded database pinpointed that diets rich in corn protein have very low predicted concentrations of Lys in MP when evaluated through AMTS and CPM, due primarily to the low Lys concentrations in RUP as estimated by the insoluble protein method. This not only precluded the use of certain data, but had consequences on the slopes (0.141 vs. 0.128 vs. 0.105) for NRC, CPM and AMTS and the breakpoints determined. It is suggested that an assessment be undertaken of what database is used for AA profiles of ingredients before updating present formulation guidelines.

Key Words: lactating cows, lysine, methionine

T434 Fatty acid supplementation to periparturient dairy cows fed diets containing low basal concentrations of fatty acids. L. F. Greco*, M. Garcia, M. G. Favoretto, R. S. Marsola, L. T. Martins, R. S. Bisinotto, E. S. Ribeiro, F. S. Lima, W. W. Thatcher, C. R. Staples, and J. E. P. Santos, *University of Florida*, *Gainesville*.

Objectives were to evaluate the impacts of supplementing diets containing low amounts of long chain fatty acids (FA, < 1.8%) with either mostly saturated free FA (SFA) or with Ca salts enriched with polyunsaturated FA (PUFA, 27% C18:2n6 and 3.5% C18:3n3 of the total FA) on performance of Holstein cows. Prepartum cows were allocated randomly to 1 of 3 dietary treatments from 60 d before expected calving date until 90 d postpartum. Supplementation with FA (% dietary DM) consisted of 0% (CTL, n = 26), 1.7% SFA (n = 25), and 1.7% as Ca salts of PUFA (EFA, n = 25). The DMI was recorded daily from 30 d pre- to 90 d postpartum. Body weight and BCS were measured at 60 and 30 d prepartum, at calving and then weekly postpartum. Milk production was measured daily and composition was evaluated weekly. Blood samples were collected weekly before calving and then thrice weekly postpartum for 40 d. Prepartum DMI was lower for cows fed EFA (11.3, 11.4 and 10.2 kg/d, respectively for CTL, SFA and EFA). Feeding EFA reduced postpartum DMI in multiparous but not in primiparous cows. Milk and protein yields were greater for primiparous cows fed EFA, however, fat yield did not differ. Postpartum BW, BW change, and BCS were not different among treatments. Feed efficiency was better and mean concentrations of plasma BHBA were greater for multiparous cows receiving supplemental EFA. Mean concentrations of plasma NEFA were lower for primiparous cows not fed supplemental fat. Cows supplemented with EFA had improved efficiency of converting feed into milk, and increased concentrations of BHBA despite similar BW and BW changes.

Table 1.

	CTL		SFA		EFA		P[1]		
	P[2]	M[3]	P	M	P	M	TRT* Parity	Fat	FA
DMI, kg/d	15.1	21.0	16.5	22.1	17.5	18.6	0.01	0.42	0.12
BW, kg	495	641	502	671	515	629	0.37	0.55	0.45
Milk, kg/d	28.1	35.3	25.8	37.8	30.7	37.5	0.07	0.27	0.06
Milk fat, kg/d	1.0	1.3	0.8	1.3	1.0	1.3	0.17	0.10	0.24
Milk protein, kg/d	0.8	1.0	0.7	1.0	0.9	1.0	0.08	0.40	0.05
Milk/DMI, kg/kg	1.9	1.7	1.6	1.8	1.8	2.1	0.03	0.94	0.01
BHBA, mg/100 mL	6.4	8.4	5.6	7.6	5.8	12.3	0.01	0.45	0.01
NEFA, mEq/L	432	468	317	464	341	522	0.04	0.13	0.11

[1]TRT = treatment; Fat = CTL vs. EFA+SFA; FA = EFA vs.SFA.

[2]Primiparous.

[3]Multiparous.

Key Words: dairy cow, fatty acids, linoleic acid

T435 Intake, digestibility and productive performance of dairy cows fed with sunflower meal. A. S. de Oliveira*[1], J. M. S. Campos[2], E. P. Viana[2], D. S. Caixeta[2], S. C. Valadares Filho[2], A. M. F. Santiago[2], J. P. do Carmo[2], A. C. S. Souza[2], G. H. Soares[2], J. P. Giordani[2], and L. F. do Lago[2], [1]*Universidade Federal de Mato Grosso*, *Sinop, MT, Brazil*, [2]*Universidade Federal de Viçosa*, *Viçosa, MG, Brazil*.

Twelve multiparous Holstein cows (128 ± 38 DIM and 627 ± 48 kg BW) were distributed in three 4 × 4 Latin squares by DIM, with 4 periods of 21 d (7 d of mensurations) to evaluate the effect of sunflower meal (SFM; 37.5% of CP) in diet (0, 7, 14 and 21% of DM) on intake, total tract apparent digestibility and productive performance. Diets TMR were isonitrogen (16.2% of CP), containing 55% of corn silage (DM basis). The SFM replaced mixture (37.5% of CP) containing 53.57% of soybean meal and 47.37% of wheat middlings. Fecal samples were directly collected once daily at 1600, 1400, 1200, 1000 e 800 h, of 15 to 19 d of each period. Indigestible ADF (after 264 h of ruminal incubation) was used to estimate fecal output. Milk samples were collected on 18 and 19 d of each period at am and pm milking. Data were analyzed using model mixed (PROC MIXED, SAS Inst. Inc., Cary, NC). Was applied Williams test to comparison of means for quantitative data. The SFM inclusion increased RDP (10.6, 10.7, 10.9 and 11.1% of DM), NDF (39.9, 40.8, 4. and 42.6), lignin sulfuric acid (2.3, 2.5, 2.8 and 3.1% of DM) and indigestible ADF (8.6, 9.6, 10.6 and 11.6 of DM) of diets. DM (21.6 kg/d), CP (3.75 kg/d) and NFC (7.8 kg/d) intakes were not affected by SFM ($P > 0.05$), but NDF intake (7.9, 7.9, 8.0 and 8.6 kg/d) was greater ($P < 0.05$) to 21% of SFM. DM digestibility (65.1, 64.1, 64.3 amd 62.1%), total carbohydrate digestibility (60.9, 59.2, 59.2 and 57.2%) and TDN (63.8, 62.7, 62.7 and 60.5%) of diets were not affected ($P > 0.05$) until 14% of SFM, but were reduced ($P < 0.05$) with 21% of SFM. Milk yield (29.8, 28.8, 28.7 and 27.4 kg/d) and milk lactose yield (1.32, 1.28, 1.30 and 1.23 kg/d) were not reduced ($P > 0.05$) until 14% of SFM, but were reduced ($P < 0.05$) with 21% of SFM. Milk crude protein (3.22, 3.18, 3.09 and 3.11%) was reduced ($P < 0.05$) from 7% of SFM. Milk efficiency (1.33 kg of milk/ kg of DM intake), milk fat (3.61%), milk lactose (4.47%) and milk solids non-fat (8.63%) were not affected ($P > 0.05$) by SFM. The SFM can be included in up to 14% in DM diets for dairy cows with production of 30 kg/d without affecting intake, digestibility and productive performance.

Key Words: milk

T436 Metabolism of nitrogen compounds in dairy cows fed with sunflower meal. A. S. Oliveira*[1], J. M. S. Campos[2], D. S. Caixeta[2], E. P. Viana[2], S. C. Valadares Filho[2], L. F. do Lago[2], A. M. F. Santiago[2], J. P. Giordani[2], G. H. Soares[2], J. P. do Carmo[2], and A. C. S. Souza[2], [1]*Universidade Federal de Mato Grosso*, *Sinop, MT, Brazil*, [2]*Universidade Federal de Viçosa*, *Viçosa, MG, Brazil*.

Twelve multiparous Holstein cows (28.7 ± 4 kg/day of yield milk, 128 ± 38 DIM and 627 ± 48 kg BW) were distributed in three 4 × 4 Latin squares by DIM, with 4 periods of 21 d to evaluate the effect of sunflower meal (SFM; 37.5% of CP) in diet (0, 7, 14 and 21% of DM) on metabolism of nitrogen compounds (N) and efficiency of N utilization for milk production. Diets TMR were isonitrogen (16.2% of CP), containing 55% of corn silage (DM basis). The SFM replaced mixture (37.5% of CP) containing 53.57% of soybean meal and 47.37% of wheat middlings. Milk samples were collected on 18 and 19 d of each period at am and pm milking. Spot urine samples were obtained approximately 0, 3 and 6 h postfeeding on 17 d of each period. Urine volume was estimated using creatinine concentration as a marker and assuming creatinine excretion of 24.05 mg/kg of BW/d. Data were analyzed using model mixed (PROC MIXED, SAS Inst. Inc., Cary, NC). Was applied Williams test to comparison of means for quantitative data. The SFM inclusion increased RDP (10.6, 10.7, 10.9 and 11.1% of DM). Rumen microbial crude protein synthesis (MPS, estimated by the derivatives in purine urinary excretion and secretion of milk; 2.10, 2.01, 2.03 and 1.77 kg/d) was not affected ($P > 0.05$) until 14% of SFM, but was reduced ($P < 0.05$) with 21% of SFM. The g of MPS/kg TDN intake (152.6) was not affected ($P > 0.05$) by SFM, but the efficiency of RDP intake used for MPS (0.90, 0.88, 0.88, 0.73 kg de MPS/kg of RDP intake) was reduced ($P < 0.05$) with 21% of SFM. Milk urea-N (17.60 mg/dL), blood urea-N (17.80 mg/dL), urinary N-urea (195.7 g/d), urinary N (240 g/d; 40% of N intake), feces N (185.2 g/d; 30.9% of N intake) and balance N (32.6

g/d; 5.5% of N intake) were not affected ($P > 0.05$) by SFM. However, because of lower efficiency RDP intake for MPS, the milk N/intake N (24.9, 24.2, 23.5 and 22.0%) was reduced ($P < 0.05$) from 14% of SBM. The SFM can be included in up to 7% in DM diets of dairy cows without affecting metabolism of nitrogen compounds (N) and efficiency of N utilization for milk production.

Key Words: blood urea-N, microbial crude protein synthesis, n efficiency

T437 A critique of dose-response plots that relate changes in content and yield of milk protein to predicted concentrations of methionine in metabolizable protein by the NRC (2001), CPM-Dairy (v.3.0.10), and AMTS.Cattle (v.2.1.31) Models. N. Whitehouse*[1], C. Schwab[1], D. Luchini[2], and B. Sloan[2], [1]*University of New Hampshire*, *Durham,* [2]*Adisseo, Atlanta, GA.*

The objective of this study was to critique the Met dose-response plots for the NRC, CPM and AMTS models (Whitehouse et al., 2009) with an expanded database. To help ensure that Lys was not limiting production responses to supplemental Met, regression analysis for NRC was limited to data where Lys was greater than 6.45% of metabolizable protein (MP); the Lys constraint used previously was 6.16%. The resulting data set for NRC and CPM contained 91 observations; the data set for AMTS contained 82 observations. Observations were less for AMTS because the model predicted lower concentrations of Met in MP than CPM for several of the basal diets without Met supplementation. This created ranges of Met in MP where the highest predicted concentrations of Met in MP in some studies did not overlap with the lowest concentrations of Met in MP for the rest of the studies. This precluded being able to identify a fixed reference concentration of Met in MP that was intermediate to the lowest and highest values in all studies; a requisite for calculating the production responses (plus and minus values) for the y-axis of the dose-response plots. The resulting breakpoint estimates for the required concentrations of Met in MP for maximal content and yield of milk protein were 2.23 and 2.38% for NRC and 2.40 and 2.44% for CPM. These compare favorably to the respective breakpoint estimates of 2.23 and 2.38 for NRC and 2.40 and 2.44 for CPM by Whitehouse et al. (2009). For AMTS, the relationship between changes in content and yield of milk protein to predicted concentrations of Met in MP was linear, a result of the more restricted database and differences between AMTS and CPM in predicted concentrations of Met in MP. It is suggested that an assessment be undertaken of what database is used for AA profiles of ingredients before updating present formulation guidelines for Met in MP for the models evaluated

Key Words: lactating cows, methionine, lysine

T438 In situ ruminal degradability of crambe, sunflower and soybean grains, and its by-products. R. H. de Tonissi e Buschinelli de Goes*, K. A. de Souza, R. A. Patussi, K. A. G. Nogueira, D. de Faria Pereira, T. da Cunha Cornélio, K. C. da Silva Brabes, and E. R. de Oliveira, *Universidade Federal da Grande Dourados*, *Dourados, MS, Brasil*.

The ruminal degradation of dry matter (DM) and crude protein (CP) of crambe (*C. abyssinica*), sunflower, soybean grains and its by-products (crushed seeds), were evaluated by the in situ technique, using 3 rumen fistulated sheeps. The feeds were grounded though a 2mm screen and incubated directly in rumen for 72, 48, 24, 12, 6, 3, and 0 h. Potential degradation, were adjusted by a no linear regression by Gauss-Newton's method, PD = A+B*(1-exp-ct), being A = soluble fraction, B = potentially degradable fraction, c = degradation rate of the fraction B, and *t* = time of incubation. Effective degradability (ED = a+(b*c)/(c+k)), where k = passage rate of 5%/h. DM and CP for crambe, sunflower and soybean was 93.5, 93.6, 89.4% and 27, 22.3, 50.3%; for its by-products was 70, 87.4, 90.5%, and 52.8, 30.3, 46.8%. The Crambe soluble fraction (23.5%) and potentially degradable fraction (74.1%), provided more ED (75.4%) for DM. Crambe crushed, showed lower degradability (60.4%) and soluble fraction (20.1%) and higher rate of degradation (14.7%). The soybean and sunflower had the lowest effective degradability (47.6 and 39.7%), possibly related to low soluble fraction (4.8 and 11.7%), while its by-products had the highest ED (75.6 and 84.5%), with soluble fraction of 23.2 and 22.9%, and potentially degradable fractions of 70.3 and 73.7%. For the CP, the crushed soybean presented a higher effective degradability and potentially degradable fraction (70.9 and 89,1%), while the grain presented 38.7 and 55.6%. The sunflower, crambe and its by-products presents ED and potentially degradable fraction of 30.7, 44.0, 45.0, and 35.5% and 41.3, 38.1, 34.6, 22.0%. The soluble fractions were 8.7, 9.8, 18.3, 7.7, 13.7, and 19.3, for soybean, sunflower, crambe and its by-products. The low degradation presented by crambe and sunflower by-products can be associated with the processing of grain for oil extraction, and undegradable fraction (58.7 and 51.7%). The grains of crambe, sunflower and soybean and its by-products had a medium degradability for the dry matter and low degradability for crude protein, except soybean by-product, that showed high degradability.

Key Words: nylon bags, chemical composition, oil seeds

T439 Effects of supplemented high linoleic or linolenic oil in the diet on lipid metabolism by rumen microbes in sheep. S. H. Choi*[1], G. W. Jin[2], H. G. Lee[3], C. W. Choi[4], S. S. Chang[4], S. B. Smith[1], and M. K. Song[2], [1]*Department of Animal Science, Texas A&M University*, *College Station,* [2]*Department of Animal Science, ChungBuk National University, Cheong Ju, Chungbuk, Korea,* [3]*Department of Animal Science, Pusan National University, Miryang, Gyongnam, Korea,* [4]*National Institute of Animal Science, RDA, Suwon, Gyunggi, Korea.*

A metabolic trial with 3 ruminally cannulated sheep (60 ± 6 kg) was conducted in a 3 × 3 Latin square design to investigate the effects of high linoleic (18:2 *n*-6; soybean oil) or α-linolenic oil (18:3 *n*-3, perilla oil) on the ruminal fermentation, formation of conjugated linoleic acid (CLA) in the rumen and apparent digestibilities of nutrients. Sheep were fed 1.3 kg of diet (DM basis) consisting of 60% concentrate and 40% chopped alfalfa hay. Oils were supplemented to concentrate at 5% level of the total diet (DM basis). Rumen pH was not influenced by the oil supplementation. But ammonia-N concentration significantly decrease ($P = 0.05$) by the feeding the oil supplemented diets. Molar proportion of each VFA in rumen fluid and whole tract digestibilities of DM, CP, EE, NDF and OM were not affected by oil supplementation. The compositions of *trans*-10, *cis*-12 CLA (from 0.56% to 1.43%) in the rumen fluid were slightly higher than that of *cis*-9, *trans*-11 CLA (from 0.27% to 1.47%). Oil supplementation resulted in decreased plasma oleic acid (18:1 *n*-9) proportion ($P < 0.03$) but increased linoleic acid proportion ($P < 0.04$) at 1 h before feeding. At 1 h post-feeding, oil supplementation resulted in a decreased stearic acid (18:0) proportion ($P < 0.02$) but increased palmitoleic acid (16:1*n*-7) proportion ($P < 0.01$) in plasma. The proportions of *cis*-9, *trans*-11 CLA in plasma was slightly (from 0.18% to 0.62% ; $P = 0.37$) increased with oil supplementation at 1 h post-feeding.

Key Words: conjugated linoleic acid, plant oil, sheep

T440 Effects of increasing amounts of high-linolenic perilla fatty acid infused into the duodenum on blood lipids metabolism and

their susceptibility to peroxidation in dairy cows. Q. S. Liu[1,2], J. Q. Wang*[1], D. P. Bu[1], E. Khas[1], G. Yang[1], L. Y. Zhou[1], P. Sun[1], and K. L. Liu[1], [1]*State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences*, *Beijing, China*, [2]*College of Animal Science and Technology, Yangzhou University*, *Yangzhou, China*.

Our objective was to determine the effects of increasing amounts of high-linolenic perilla fatty acid (HLPFA) emulsion (82.4% *cis-9*, *cis-12*, *cis-15* 18:3; 14.7% *cis-9*, *cis-12* 18:2; 2.8% *cis-9* 18:1 and 0.1% other fatty acids) infused into the duodenum of dairy cows on blood lipids metabolism and the susceptibility of blood to oxidation. Four primiparous Chinese Holstein cows (BW = 476 ± 6 kg, DIM = 100 ± 2 d) fitted with duodenal cannulas were administered 2 treatments in a crossover design. Treatments were homogenized aqueous mixtures of HLPFA emulsion (0, 100, 200, 300, 400 g/d) or control containing only the emulsifying ingredients. The control infusate consisted of 15 g/d of xanthan gum, 5 g/d sodium alginate, and 25 g/d of Tween 80 in 10 L of purified water. Each period lasted 5 wk, during period 1, 2 cows received each amount of HLPFA for 1 wk each, and the other 2 cows received only the carrier infusate. In period 2, the procedures were repeated, so that the other 2 cows received the HLPFA doses in sequentially increasing amounts and the cows that previously received HLPFA received the control infusate. Blood collection was made during the last day of each infusion amount. Data were analyzed statistically by using PROC MIXED of SAS. The concentration of high density lipoprotein cholesterol and total cholesterol were increased quadratically ($P = 0.0036$, 0.0013 respectively). The concentration of α-linolenic acid in blood increased linearly as infusion increased ($P = 0.0001$). The activity of total superoxide dismutase tended to decrease linearly ($P = 0.18$), and the total antioxidant capacity also tended to decrease quadratically ($P = 0.23$), but the thiobarbituric acid reactive substances tended to increase linearly ($P = 0.066$), and the content of vitamin E in serum tended to increase quadratically ($P = 0.096$) as the infusion increased. Infusion with increasing amounts of HLPFA into the duodenum altered the composition and distribution of blood lipids, but decreased the oxidative stability of the blood in dairy cows.

Key Words: high-linolenic perilla fatty acid, blood lipid, oxidation stability

T441 Effects of feeding ruminally protected lysine, with or without isoleucine, valine and histidine, to lactating dairy cows on productive performance and plasma amino acid profiles. P. H. Robinson[1], S. Juchem[1], N. Swanepoel*[2], and E. Evans[3], [1]*UC Davis*, *Davis, CA,* [2]*Meadow Feeds, Roodepoort, South Africa,* [3]*Essi Evans Technical Advisory Services, Bowmanville, ON, Canada.*

The literature on post-ruminal Lys supplementation to diets of lactating dairy cows shows small negative responses to supplemental intestinally absorbable Lys (IAL), and our recent survey of California dairy rations identified other amino acids (AA) that could become co-limiting if supplies of IAL were met. Objectives were to estimate the rumen escape of a ruminally protected (RP) Lys (RPL) product, and an RPL also containing Ile, Val and His (RPAA), to determine effects of their feeding on performance and plasma AA profiles of lactating dairy cows. Three pens of ~310 multiparous early lactation cows were used in a 3 × 3 Latin square design with 28-d experimental periods in which the basal total mixed ration (TMR) was the same for all groups except for the RP products that were added to the treatment pens at a level designed to deliver an equal amount of IAL to both groups. However rumen stability was slightly higher for the RPL vs. the RPAA, and RPL was calculated to deliver ~13.2 g/cow/d of IAL and the RPAA calculated to deliver ~10.6, 5.4, 2.2 and 1.6 g/cow/d of IAL, Ile, His and Val respectively. Only milk protein % was increased with RPL. Replacement of RPL with RPAA increased milk and milk lactose yields, while milk protein and energy outputs tended to increase. Plasma levels of both non-essential and essential AA, including Lys, were not impacted by feeding RPL or RPAA. Overall, feeding RPL alone caused generally reduced productive performance, which could be interpreted to suggest that Lys was not supplied in sufficient quantity or that it was not required. Addition of Ile, His and Val to the RPL increased performance overall, which supports an overall hypothesis that Lys alone resulted in an imbalance and/or deficiency of Ile, His and/or Val which was alleviated by their supplementation. Overall treatment differences, regardless of statistical significance, were small and of limited practical importance. Nevertheless, feeding a complex of RPAA was beneficial beyond supplementation of RP Lys alone.

Key Words: amino acids, imbalance, body condition

T442 Effect of extruded cotton seed and canola seed on the composition of unsaturated fatty acids in plasma, erythrocytes and liver of Mehraban male lambs. A. Akbarian[1], A. Golian*[1], A. Tahmasbi[1], M. H. Ghafari[1], and M. Mirzaee[2], [1]*Ferdowsi University of Mashhad*, *Mashhad, Khorasan Razavi, Iran*, [2]*Isfahan University of Technology*, *Isfahan, Iran*.

An experiment was conducted to study the effects of supplementary extruded cotton seed (ECOS) or canola seed (ECAS) on the composition of unsaturated fatty acids in plasma, erythrocytes and liver of Mehraban male lambs. The treatments included: (1) control (C); (2) diet C+6% ECAS, (3) diet C+6% ECOS, (4) diet C+12% ECAS, (5) diet C+12% ECOS, (6) diet C+6% ECAS+6% ECOS, (7) diet C+12% ECAS +6% ECOS, (8) diet C+6% ECAS +12% ECOS, (9) diet C+12% ECAS+12% ECOS, (10) diet C+18% ECAS+18% ECOS. A completely randomized design experiment was applied to feed the 10 dietary treatments to 60 individually pen housed lambs, to have 6 lambs per diet. The average weight of 5–6 mo lambs at the commence of study was 34.3 ± 2.12 kg. The experiment lasted for 90 d. The amount of oleic acid, linoleic acid and linolenic acid in plasma and oleic acid, and linolenic acid in erythrocytes lipids were higher in lambs fed diet contained either or a combination of supplemental extruded oil seeds compared with those fed control diet. The supplementation of 6% or 12% ECAS significantly increased linoleic acid in liver lipids compared with those fed diet containing ECOS. There was a linear ($P < 0.001$) correlation between the levels of dietary ECAS or ECOS with linoleic and linolenic acids content of liver.

Key Words: lamb, extruded cotton and canola seeds, fatty acids

T443 Effects of roasted and electron beam irradiation on ruminal and intestinal disappearance of whole soybean. A. Akbarian[1], M. Khorvash[1], G. Ghorbani[1], M. Dehghan-Banadaky*[2], P. Shawrang[3], and E. Ghasemi[1], [1]*Isfahan University of technology, Department of Animal Sci.*, *Isfahan, Iran*, [2]*University of Tehran, Department of Animal Sci.*, *Karaj, Tehran, Iran*, [3]*Nuclear Science and Technology Research Institute, Atomic Energy Organization of Iran*, *Tehran, Iran*.

The aim of this study was to evaluate the effects of roasting and electron bean irradiation on in situ ruminal and intestinal dry matter and crude protein degradability of whole soybean. Whole soybeans were roasted in a commercial roaster in 145°C for approximately 30 min. The TT200 Rhodotron accelerator was used for irradiation of whole soybean at dose of 63 kGy. Three rumen and duodenum fistulated non-lactating Holstein cows (620 ± 25 kg) were used for in situ study. Rumen degradability of

dry matter and crude protein were determined using the nylon bag technique and mobile nylon bag technique used for intestinal disappearance. Bags were incubated in the rumen for 2, 4, 8, 12, 24 and 48 h and bags washed without incubation in the rumen for 0 h. Rumen degradation (p) was estimated by the curves were fitted using the nonlinear procedure (PROC NLIN) of SAS, which yielded the equation parameters a, b, and c, each of which is defined as: $P = a + b\ (1\text{-}e^{-ct})$. The soluble fraction (a) and effective degradation (ED, K = 0.05 h-1) decreased and insoluble potentially degradable fraction (b) increased in roasted soybeans (Table 1) but irradiation increased fraction of a and ED and decreased the b fraction of DM and CP ($P < 0.05$). Roasting increased but e-beam irradiation decreased intestinal digestibility of DM and CP. Base on present results, roasting could improve ED and intestinal disappearance of soybean seed but e-beam in 63 kGy could not improve aggregation of soybean protein to increase by pass protein.

Table 1. Rumen degradability and intestinal digestibility of untreated, roasted and irradiated whole soybean

Parameters	Treatments			SEM
	Untreated	Roasted soybeans	Irradiated soybeans	
DM				
a	28.6[b]	20.9[c]	33.9[a]	2.05
b	71.3[b]	79[a]	64.9[c]	3.01
c(h-1)	8.1[b]	4.9[b]	12.9[a]	0.02
Effective degradability	69.5[b]	64.1[b]	80.04[a]	2.3
CP				
a	22.5[b]	13.7[c]	36.8[a]	2.09
b	77.4[b]	86.2[a]	62.8[c]	2.2
c(h-1)	8.4[b]	6.1[b]	14.3[a]	0.02
Effective degradability	70.7[b]	60.7[c]	83.1[a]	3.6
Intestinal crude protein digestibility	73.07[b]	81.9[a]	63.1[c]	0.06

[a,b,c] Means in the same row with different letters differ ($P < 0.05$).

Key Words: whole soybean, electron beam irradiation, roasted

T444 Meta-analysis for the prediction of net portal absorption (NPA) of amino acid-N (AAN) and ammonia (NH_3) in ruminants. C. Côrtes*[1], R. Martineau[1], D. Sauvant[2], D. R. Ouellet[1], J. Vernet[3], I. Ortigues-Marty[3], and H. Lapierre[1], [1]*Agriculture and Agri-Food Canada*, *Sherbrooke, Quebec, Canada*, [2]*AgroParisTech*, *Paris, France*, [3]*URH INRA*, *Theix, France*.

To improve the efficiency of N utilization in ruminants, the objective of this meta-analysis was to predict NPA of AAN and NH_3 from feed intake and composition. Composition of feed ingredients was estimated from INRA (1988) tables, except for N and NDF when reported. Selection of publications (FLORA, Vernet and Ortigues-Marty, 2006) was done on availability of NPA-AAN or NH_3, N intake (NI), BW, and feeding treatments. The final database included 68 publications, 90 experiments (sheep n = 44, cattle: beef and dairy breeds n = 29, dairy: lactating cows n = 17) for a total of 216 treatments: NI, NPA of AA-N and NH_3 averaged (SD): 0.48 (0.20), 0.21 (0.13) and 0.19 (0.12) g N/d per kg BW. In addition to NI, dietary interfering factors (IF) were tested on sub-groups with a sufficient variation of the IF: NDF, CP, ruminally (R) digestible starch (RdS), R-degradable protein (RDP), R-undegradable protein (RUP), R-fermented organic matter (RfOM), and RfOM minus RDP (RfOM-RDP) as %DM; RUP and RDP, as %CP; RdSi (g/d per kg BW), RDP:RfOM, RDP:RfOM-RDP and RdS:RfOM. Seven and 5 IF had a significant slope with the within-experiment residues of the model $Y = \alpha + \alpha i + \beta Ni + \varepsilon$, on NPA of AAN and NH_3, respectively. Each of the IF with an effect on the residues was included to generate a model: $Y = \alpha + \alpha i + \beta Ni + \gamma X + \zeta X^2 + \varepsilon$. Looking for a common IF, RDP:RfOM was selected as the best IF: NPA-AAN = -0.001^{NS} (0.02) + 0.59***(0.05) × NI - 0.60***(0.16) × RDP:RfOM, RMSE = 0.0373, R^2adj = 88.4%, with a species effect** on the intercept: Δ = 0.05, 0, −0.05 for sheep, cattle and dairy cows; NPA-NH_3 = −0.09*(0.04) + 0.15**(0.06) × NI + 2.05***(0.48) × RDP:RfOM - 3.77***(1.08) × RDP:$RfOM^2$, RMSE = 0.0309, R^2adj = 92.3%, species × NI interaction*: Δ = −0.13, 0.09, 0.04 for sheep, cattle and dairy cows. The ratio RDP:RfOM combining the availability of N and energy in the rumen and estimated from dietary characteristics is, in addition to NI, a useful predictor of NPA of AAN and NH_3.

Key Words: amino acid, ammonia, ruminants

T445 Effect of tannins in pistachio by-product and urea infusion into the rumen on rumen fermentation and blood metabolites in Iranian Balochi sheep. H. Gholizadeh, A. A. Naserian*, R. Valizadeh, and A. M. Tahmasebi, *Ferdowsi University of Mashhad*, *Mashhad, Iran*.

The objective of this study was to determine the effects of tannins in pistachio by-product (PB) on ammonia concentrations in rumen, abomasum and blood metabolites in Iranian Balochi sheep. Three rams with ruminal cannulas and T cannulas in the abomasums were used in a 3 × 3 change over design experiment. Rams were maintained in individual metabolism crates (1.3 m × 0.5 m) which access to water at all times. Treatments were including 3 levels of PB (T1 = 0, T2 = 20 and T3 = 40% of DM). Urea was continuously infused into the rumen via peristaltic pump (1 mL/ min). Daily intake was determined. Abomasum samples were taken simultaneously from all rams twice daily during a period of 4 successive days as follows: d 1, 0900 and 1500 h; d 2, 1000 and 1600 h; d 3, 1100 and 1700 h and d 4, 1200 and 2000 h. Ruminal samples were obtained from each ram on d 3 of the 5-d collection period before the morning meal and 1, 2, 3, 4, 6 and 8 h after feeding. Blood samples were collected from each rams at the end of experiment via jugular vein 2 h after morning feeding. Dry matter intake (DMI) decreased for sheep fed PB (0.75, 0.74 and 0.64 kg, respectively). This reduction was significant for T3 and no differences were observed between T1 and T2. The addition of PB in the diet reduced ammonia concentration in the rumen. In contrast, ammonia concentration in the abomasum increased (25.01, 26.09 and 31.90 mg/dL, respectively). Treatment effects on blood urea nitrogen (BUN) did not differ ($P > 0.05$), but tended to be greater for sheep fed the PB (14.66, 16.33 and 17.66 mg/dl, respectively). Blood glucose, triglyceride and cholesterol decreased for sheep fed T3 compared with control (57 vs. 64; 8 vs. 13 and 26 vs. 40 mg/dL, respectively) It was concluded that feeding PB at high levels (40% of DM) led to decreased DMI, glucose, cholesterol and triglyceride compared with control, but the addition of 20% had no affect.

Key Words: pistachio by-product, urea, Balochi sheep

T446 The protection of nano-encapsulated conjugated linoleic acid (CLA) from biohydrogenation by rumen bacteria. S. D. Cho*[1], H. G. Park[1], H. G. Ji[2], E. G. Kweon[3], and Y. J. Kim[1], [1]*Department of Food and Biotechnology, Korea University*, *Chungnam, Korea*, [2]*Pharmachem*, *Samjung-dong, Ohjung-gu, Bucheon-city, Kyounggi-do, Korea*, [3]*Hanwoo Experimental Station, National Livestock Research Institute*, *Gangwon, Korea*.

Conjugated linoleic acid (CLA) occurs mainly in dairy products because it is produced as an intermediate in the ruminal biohydrogenation process of linoleic acid, a characteristic biochemical process carried out by some rumen bacteria. Thus, dietary sources of CLA are not well protected from

biohydrogenation. In this study, nano-encapsulated CLA; nanosome complex with lecithin was tested as one of the ways to protect CLA from ruminal biohydrogenation. CLA was emulsified with saturated lecithin, capric-capric triglyceride, glycerin, and cholesterol ester using microfludizer. Free form of CLA (CLA-FFA), and triglyceride form of CLA (CLA-TG) were coated with nanosome about the size 100 nm in diameter. To test the protection effect, rumen bacteria were cultured in rumen fluid media in 500 mL continuous culture fermenter. Fresh media was supplied at 25 mL/h with 2% fat substrates with 4 different forms (CLA-FA, CLA-TG, CLA-FFA nanosome, and CLA-TG nanosome). The change in fatty acid profiles by rumen bacteria was monitored during the 48 h incubation. Gas chromatography was used to analyze fatty acid profiles in each group. In all tested groups, the biohydrogenations of CLA were observed during incubation. In CLA-TG and CLA-FFA nanosome groups, the protection effects were not significant compared with CLA-FFA group. In CLA-FFA group, most of CLA was hydrogenated to vaccenic acid (C18:1) or stearic acid. However, in CLA-TG nanosome group, the degree of conversion to vaccenic acid from CLA was the lowest in all tested groups ($P < 0.05$). These results showed that nanoemulsification is one of the ways to protect natural form of unsaturated fatty acids from the ruminal biohydrogenation and to increase the accumulation level of CLA in the tissue of ruminants.

Key Words: conjugated linoleic acid, rumen bacteria, biohydrogenation

T447 Study on the effect of flaxseed and vitamin E supplementation on rumen biohydrogenation by Rumen Simulation Technique (RUSITEC). H. Sultana*[1], M. L. He[1], M. E. R. Dugan[2], and T. A. McAllister[1], [1]*Agriculture and Agri-Food Research Centre*, *Lethbridge, AB, Canada*, [2]*Agriculture and Agri-Food Research Centre*, *Lacombe, AB, Canada*.

Supplementation with omega-3 fatty acid (FA)-rich flaxseed, is used to increase poly-unsaturated fatty acids (PUFA) in meat and milk. High levels of vitamin E (VE) are often included in such diets to reduce oxidation of PUFA in ruminant products. In this study, the RUSITEC was used to assess the effects of flaxseed and/or VE on rumen fermentation, DM disappearance, methane emission and FA profile. Inoculum was obtained from 3 ruminally cannulated non-lactating Holstein cows fed a 75:20:5 diet of barley grain:barley silage:mineral supplement. Fermenters were fed a barley silage (2 g DM) / barley- grain concentrate (8 g DM) diet daily. The experiment was a 2 × 2 factorial with ground flaxseed replacing concentrate at 0 or 15% of DM, along with VE at 0 or 100 IU/kg DM. Volume of effluent, pH and total gas were determined daily at feeding. After 8 d of adaptation, 48-h DM disappearance from silage and concentrate were determined on d 9, 10, 11, 15, 16, and 17. Methane in gas samples and FA accumulations in 24-h effluent were analyzed on d 12, 13, 14, 18, 19, and 20. Disappearance of DM from concentrate was unaffected ($P = 0.93$) by VE, but tended to be lower ($P = 0.07$) with flaxseed. There was no significant difference in total gas or methane production among treatments. As a percent of total FA, inclusion of flaxseed increased levels of saturated ($P = 0.03$), including C18:0 ($P = 0.001$) and decreased ($P = 0.03$) levels of PUFA. Inclusion of flaxseed tended to increase percentage of C18:1 t11 ($P = 0.08$) and the ratio of C18:1 t11/t10 FA ($P = 0.08$). Inclusion of VE did not appear to influence biohydrogenation or the fatty acid profile in effluent. In conclusion, this study indicates that alteration in FA profile arises from the inclusion of flaxseed in the diet with VE having no measurable influence.

Key Words: rumen fermentation, flaxseed, fatty acid

T448 Partial replacement of common bean by-products (*Phaseolus vulgaris*) with soybean meal impacts on feed intake and apparent digestibility in growing lambs. H. P. Mejia[1], A. Z. M. Salem*[1,2], E. J. D. Coronado[1], J. L. Tinoco[1], and F. Avilés[1], [1]*Universidad Autónoma del Estado de México*, *Centro Universitario UAEM-Temascaltepec, Estado de México, C.P. 51300, México*, [2]*University of Alexandria*, *Department of Animal Production, Faculty of Agriculture (El-Shatby), Egypt*.

Four total mixed rations (TMRs) were prepared with supplementary protein supplied by soybean meal (TMR1) being replaced by protein from either 50 (TMR2), 75 (TMR3) or 100% (TMR4) of the common bean by-products (*Phaseolus vulgaris*) as the only sources of protein. Six Pelibuey male lambs (29 ± 10kg BW) were allocated into each of the dietary treatments in a random complete design of 4 TMRs × 6 repetitions (animals) and were fed ad libitum. Nutrients and energy composition as well as daily DM intake (DMI) and in vivo apparent digestibility of the treatments were determined. The CP, and energy contents (i.e., NEm, NEg) content of the all TMRs were approximately 13.5%, 1.72 and 1.1 Mcal/kg DM, respectively, while CF was 21% in TMR1 and TMR2 and was approximately 18% in TMR3 and TMR4. No significant differences were observed among the 4 treatments in DMI with a tendency to increase in TMR1 (1.15 kg DM, $P = 0.590$) than others treatments. Digestibility of DM (DMD, $P = 0.838$) and CP (CPD, $P = 0.872$) also had tendency to improve from TMR1 to TMR4 (73, 74, 74 and 76% for the DMD, and 76, 76, 77 and 78% for the CPD, and for the 4 treatments, respectively. Digestibility of CF was not affected by the replacement of *P. vulgaris* with soybean meal in TMR and all TMRs were approximately the same (72%, $P = 0.872$). In conclusion, *P. vulgaris* could be used in a partial substitution of the soybean meal and it could be used as an alternative source of protein in Pelibuey lambs diets.

Key Words: *Phaseolus vulgaris*, digestibility, lambs

T449 The effect of partial replacement of soybean meal by *Phaseolus vulgaris* byproducts on growth performance in Pelibuey growing lambs fed finishing diets. H. P. Mejia[1], A. Z. M. Salem*1,2, J. L. Tinoco[1], R. S. Robollar[1], E. J. D. Coronado[1], and F. Avilés[1], [1]*Universidad Autónoma del Estado de México*, *Centro Universitario UAEM-Temascaltepec, Estado de México, C.P. 51300, México*, [2]*University of Alexandria*, *Department of Animal Production, Faculty of Agriculture (El-Shatby), Egypt*.

Twenty-four Pelibuey male lambs ((29 ± 10 kg BW) were used to evaluate the effect of replacing soybean meal with common bean by-products (PV- *Phaseolus vulgaris*) as the only sources of protein, on average daily gain (ADG), feed conversion (FC) and economic efficiency (EE). Lambs were fed finishing diets and assigned randomly to one of 4 dietary treatments. Treatment diets were prepared with supplementary protein supplied by soybean meal (CON, n = 6), being replaced by protein from either 50 (PV50, n = 6), 75 (PV75, n = 6) or 100% (PV100, n = 6) of the common bean by-products (*P. vulgaris*). Crud protein and energy contents (i.e., NEm, NEg) were approximately similar, while crude fiber was higher in CON and PV50 compared with PV75 or PV100. No differences ($P = 0.590$) were noticed in feed intake, final weight, total gain, and ADG among all treatment diets. FC ratio was numerically ($P = 0.940$) increased in PV50 lambs, than the CON or PV75 and PV100 diets. Cost of one kg gain (i.e., EE) was also numerically decreased in PV75 and PV100 lambs when compared with CON or PV50 groups. These data indicate that feeding fattening Pelibuey growing lambs diets containing 100% of CP diet from the *P. vulgaris* did not affect feed intake or growth performance parameters that could also supported to reduce the production costs in fattening sheep.

Key Words: Pelibuey lambs, *Phaseolus vulgaris*, growth performance