M292 Effect of palm kernel meal plus urea on finishing of Brown Swiss young bulls. J. H. Avellaneda-Cevallos*[1], T. A. Cedeño-Cedeño[1], A. Suárez-Chiquito[1], O. Montañez-Valdez[2], C. D. Cepeda-Cantos[1], R. Luna-Murillo[1], I. Espinoza-Guerra[1], J. Quintana-Zamora[1], and L. Casanova-Ferrín[1], [1]*Facultad de Ciencias Pecuarias, Unidad de Investigación Científica y Tecnológica, Universidad Técnica Estatal de Quevedo*, *Quevedo, Los Rios, Ecuador*, [2]*División de Bienetar y Desarrollo Regional, Departamento de Desarrollo Regional, Universidad de Guadalajara*, *Ciudad Guzmán, Jalisco, México*.

The supplementation of the palm kernel meal (PKM) was evaluated plus urea (U) in 16 castrated cross breed Brown Swiss young bulls with initial average weight 283.75 kg, fed with grass Saboya (Panicum maximum Jacq). The research lasted 90 days. The daily gain of weight (DGW) and total gain (TGW) was evaluated, as was consumption of grass (CG), palm kernel meal (CPKM), total dry matter (TDMC: PKM+CG+U), and the nutritious conversion (NC). A completely random design was used with four treatments and four replications. The treatments were: T0 (control): shepherding; T1: T0+ 1.5 kg DM PKM + 50 g urea/animal; T2: T0 + 2.5 kg DM PKM + 50 g urea/animal; T3: T0 + 3.5 kg DM PKM + 50 g urea/animal. The DGW and TGW, didn't show differences ($p>0.05$) between the animals supplemented, but there were differences between these and T0 ($p<0.05$). The DGW improved when adding PKM+U to the diet, obtaining the best value with T3. The CG didn't present differences ($p>0.05$) between the treatments. The TDMC presented differences ($p<0.05$), the T3 had the most consumption. The NC between the supplemented treatments (T1, T2, and T3) didn't present differences ($p>0.05$), but it was differences were observed ($p<0.05$) when comparing them with the T0.

Table 1.

	T0	T1	T2	T3	SEM	p<
Initial weight, kg	284.25[a]	279.75[a]	290.50[a]	280.75[a]	3.08	0.68
Final weight, kg	316.75[b]	341.50[ab]	348.50[a]	351.75[a]	0.02	0.01
DGW, kg	0.36[b]	0.70[a]	0.65[a]	0.79[a]	0.02	<0.01
TGW, kg	32.50[b]	63.25[a]	58.25[a]	71.00[a]	1.99	<0.01
CPKM, kg/d	-	1.39[c]	2.10[b]	3.11[a]	0.02	<0.01
CG, kg/d	6.41[a]	6.63[a]	6.80[a]	6.76[a]	0.06	0.19
TDMC, kg/d	6.41[d]	8.03[c]	8.90[b]	9.86[a]	0.07	<0.01
NC,d	17.68[a]	11.45[b]	13.67[b]	12.80[b]	0.38	<0.01

Value within each row with common superscripts no differ (Tukey: $P<0.05$)

Key Words: Palm Kernel Meal, Supplementation, Gain of Weight

M293 Effect of heat processing on ruminal and post-ruminal disappearance of individual amino acids of Iranian whole soybeans. M. H. Fathi Nasri*[1] and M. Danesh Mesgaran[2], [1]*University of Birjand*, *Birjand, Iran*, [2]*University of Mashad*, *Mashad, Iran*.

The effect of heat processing (roasting and steep-roasting) on ruminal degradability and intestinal digestibility of individual amino acids (AA) in two Iranian whole soybean cultivars (Sahar and Williams) was determined using the mobile nylon bag technique. The seeds were roasted at 140 to 145ºC using a drum roaster (for 1.5-2 min). A fraction of the seeds were cooled immediately and the rest were held in isolated barrels for 45 minutes (steeping). The ruminal degradability of all AA of heat processed soybeans was reduced significantly ($P<0.001$) compared to raw seeds, however, among the individual AA there was variation in ruminal degradation, so that, in both raw and heat processed seeds Arg, Lys, Glu, Asp were degraded to a relatively high degree, whereas Leu, Ile, Met, Phe, Tyr, Thr, and to some extent, Val, Ala were degraded to a relatively low degree. Roasting increased the intestinal digestibility of total and individual AA in residues after rumen incubation, significantly ($P<0.001$), and steeping intensified it, showing beneficial effects of steeping beyond roasting (12.3 % and 18.5 % for total AA, respectively), however, variations in digestibility of the individual AA were found. Total tract disappearance of total AA was higher for raw than roasted seeds, due to higher AA degradability of raw seeds. Among individual AA, some had the higher total tract disappearance in raw seeds and some in heated seeds. There was no significant difference between the two soybean cultivars in respect to AA ruminal degradability, intestinal digestibility and total tract disappearance. The interaction between cultivar and heat processing was not significantly different either. Roasting and steep-roasting were effective methods of changing the site of digestion from rumen to small intestine and therefore the amount of digestible undegraded AA in small intestine was increased.

Key Words: Whole Soybean, Amino Acid, Mobile Nylon Bag

M294 *In situ* ruminal degradability of dry matter and crude protein of cottonseed meal containing different fat concentrations. M. Danesh Mesgaran*, A. Heravi Moussavi, and S. Danesh Mesgaran, *Department of Animal Science (Excellence Center for Animal Science), Ferdowsi University of Mashhad*, *Mashhad, Iran*.

The objective of this study was to determine *in situ* ruminal degradability of DM and CP of 3 cottonseed meals containing different fat concentrations [low (CSl), medium (CSm) and high (CSh); 5, 30 and 60 g/kg, respectively) produced in various Iranian oil industries. Cottonseed CP levels ranged from 288 (CSh) to 395 (CSl) g/kg DM. Four ruminally fistulated steers (400±20 kg, body weight) were used. Bags (12×19 cm, pore size of 48 tμm) containing 5 g DM of each sample was incubated in the rumen (4 replicates per each animal) for 0.0, 2, 4, 8, 16, 24, 48 and 72 h. Ruminal DM and CP disappearance rates was analyzed using a negative exponential model. Relative to the other cottonseed meals, CSl had the highest *in situ* quickly degradable (a) DM fraction (0.39). No difference in (a) fraction of DM was observed between CSm (0.33) and CSh (0.30). In situ (a) fraction of CP ranged from 0.33 for CSh to 0.41 for CSl. Slowly degradable (b) fraction of DM and CP was not similar among the cottonseed meals (CSl= 0.39 and 0.42, CSm= 0.34 and 0.31, CSh= 0.31 and 0.34, respectively). CSh had a lower rate of degradation (c) of DM and CP (0.04 and 0.05, respectively) compared with CSl (0.06 and 0.08, respectively). It was concluded that differences in ruminal degradable parameters exist between cottonseed meals with different fat levels, with more variations observed for ruminal CP than for DM degradability.

Key Words: Cottonseed Meal, Degradability, Crude Protein

M295 The effect of fat content on ruminal and post-ruminal protein disappearance of cottonseed meal using *in situ* mobile bag and alternative enzymatic procedures. M. Danesh Mesgaran*, M. Vatandoost, H. Jahani Azizabadi, and A. Heravi Moussavi, *Department of Animal Science (Excellence Center for Animal Science), Ferdowsi University of Mashhad*, *Mashhad, Iran*.

Ruminal, post-ruminal and total tract crude protein (CP) disappearance from various cottonseed meals [low (CSl), medium (CSm) and high (CSh) fat; 5, 30 and 60 g/kg, respectively) were evaluated using the in situ mobile nylon bag technique, an *in vitro* enzyme procedure and a three-step *in situ/in vitro* enzyme procedure. Results from the current study using different procedures showed relatively lower ruminal and post-ruminal digestibility values for CSh and CSm compared with CSl. Mean ruminal CP disappearance of CSl (0.68) was higher (P < 0.05) than CSm and CSh (0.59 and 0.57, SEM=0.03, respectively). There was a significant effect (P < 0.05) of fat content of cottonseed meal on post-ruminal CP disappearance (CSl= 0.94, CSm= 0.88, CSh= 0.76, SEM= 0.03). Total tract CP disappearance of CSl (0.96) was also significantly higher (P < 0.05) than CSm and CSh (0.88 and 0.79, SEM= 0.04, respectively). Ruminal, post-ruminal and total tract protein disappearance of various cottonseed meals followed non significant patterns with the different procedures used in this study. The coefficient of determination (r2) for the relationship of total tract CP disappearance between the mobile nylon bag technique and *in vitro* and three-step procedures was 0.67 and 0.69, respectively. It may be concluded that the different ruminal and post-ruminal diappearance of CP of cottonseed meal, using different procedures, might be due to the fat content of the samples evaluated in the present study.

Key Words: Protein Disappearance, Three-Step Procedure, In Vitro

M296 A comparison of synchrotron and globar Fourier transform infra-red microspectroscopy (FTIRM) use in predicting cereal grain rumen degradation characteristics. A. M. Walker*, C. R. Christensen, D. A. Christensen, P. Yu, H. C. Block, and J. J. McKinnon, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

The DM, CP, and starch degradation characteristics of one corn and four barley grain varieties were evaluated in two *in situ* nylon bag trials. Trial 1 was a 2 × 2 factorial comparing ground or rolled Harrington barley and Pioneer 39P78 corn. Trial 2 was a 2 × 4 factorial comparing ground or rolled CDC Bold, CDC Dolly, Harrington, and Valier barley. Spectra from reflectance mode globar-based FTIRM were collected on five seeds from each grain using the mid-IR end station at CLS (Saskatoon, SK). Spectra from transmission mode synchrotron-based FTIRM were collected on five seeds from Harrington and Valier barley and Pioneer 39P78 corn grain using the U2B beam line at NSLS-BNL (Upton, NY). Carbohydrate (CHO):amide I spectra peak area ratios were compared to in situ results to determine if FTIRM spectra related to degradation rate differences, and if globar and synchrotron based FTIRM differed. Trial 1 had grain x processing interactions (P<0.01) with Harrington barley degradation rates increasing more (P<0.05) with grinding. Trial 2 had barley variety x processing interactions (P<0.05) with the greatest (P<0.05) degradation rate differences occurring with ground CDC Bold and CDC Dolly vs. Harrington and Valier barley. Both globar- and synchrotron-based FTIRM found CHO:Amide I peak area ratios were greater (P<0.05) for corn than Harrington barley. This suggests high CHO:Amide I peak area ratios indicate reduced degradation rates. However, this relationship reversed when comparing barley varieties with globar FTIRM where varieties with higher (P<0.05) CHO:Amide I peak area ratios generally had higher (P<0.05) degradation rates. Synchrotron FTIRM comparison of Harrington and Valier barley failed (P=0.41) to identify differences in CHO:Amide I peak areas. These results suggest FTIRM spectral features may relate to cereal grain degradation characteristics, but additional research is required to characterize these relationships and compare spectra collection methods.

Key Words: Synchrotron, Infra-Red Spectra, Rumen Degradation

M297 *In situ* ruminal disappearance of acid detergent insoluble nitrogen (ADIN) of various feeds. H. Jahani-Azizabadi, M. Danesh Mesgaran*, R. Valizadeh, and H. Nasirimoghadam, *Ferdowsi University of Mashhad*, *Mashhad, Iran*.

In situ ruminal disappearance of acid detergent insoluble nitrogen (ADIN) of alfalfa hay, alfalfa silage, corn silage, corn grain, barley grain, cottonseed meal and canola meal was determined. Two rumen fistulated Holstein steers (450±50 kg, body weight) were used. Steers were fed 5.1 kg of alfalfa hay, 1.2 kg of corn silage and 2.7 kg of concentrate (150 g CP/kg of DM). Approximately, 6 g of each sample (DM) was placed in each bag [polyester nylon bag (9×17 cm, pore size of 52 µm) and incubated in the rumen for 0.0, 12, 24, 48 and 96 h. After removal of the bags from the rumen, they were washed using cold water and dried in a forced air oven (60 0C, 48 h), weighed to determination DM disappearance, and ADIN of the samples determined. Data in each time were statistically analyzed using a completely randomized design. ADIN value for alfalfa hay, alfalfa silage, corn silage, corn grain, barley grain, cottonseed meal and canola meal was 1.6, 3.4, 1.03, 2.25, 0.8, 2.8 and 4.5 g per kg of DM, respectively. Ruminal ADIN disappearance of alfalfa hay, alfalfa silage, corn silage, corn grain, barley grain, cottonseed meal and canola meal after 24 and 96 hours incubation was 0.3 & 0.4, 0.4 & 0.5, 0.3 & 0.5, 0.6 & 0.9, 0.6 & 0.7, 0.3 & 0.5, 0.2 & 0.3 (SEM= 0.02 & 0.02), respectively. The ruminal ADIN disappearance of the corn and barley grains was significantly higher compared with the other feed samples (P <0.05). Results of the present experiment indicated that a part of the ADIN of the feed samples analyzed in the present experiment disappeared in the rumen and the relative disappearance increased when incubation time was increased.

Key Words: ADIN, Disappearance, Rumen

M298 Feed intake and digestibility response of ram lambs fed olive cake ensiled with different feed supplements. F. T. Sleiman*[1], R. E. Issa[1], S. H. Ibrahim[2], M. G. Uwayjan[1], S. K. Hamadeh[1], I. Toufeili[1], and M. T. Farran[1], [1]*American University of Beirut*, *Beirut, Lebanon*, [2]*University of Dohuk*, *Dohuk, Kurdistan, Iraq*.

Previous research (J. Dairy Sci. 89. Suppl.1,P-371) has shown that ensiling high levels (≥ 72%) of olive cake (OC) with different levels of ground yellow corn (GYC), wheat bran (WB), molasses (M) and urea (U) improved apparent digestibility of fiber fractions and silage (S) DMI when fed to goat kids. In this study lower levels of OC were ensiled with the above feed ingredients in order to evaluate feed DMI, apparent digestibility and performance of ram lambs. The experiment utilized 12 lambs in a completely randomized design and consisted of a 4-wk trial including a 1-wk collection period using the following silage treatments: I) 58.55% OC + 21.3% GYC + 10.0% M + 10.0%

water + 0.15% U; II) 65.3% OC + 10.6% GYC + 6.0% WB+ 10.0% M + 8.0% water + 0.1 U; and III) 46.3% OC + 10.6%GYC + 6.0% WB +20% M+ 17.0% water +0.1% U. Each lamb received 0.5 kg/d concentrate (14% CP on DM basis) in addition to ad libitum feeding of the experimental silages. Means were separated using Duncan Multiple Range test. S DMI was not significantly different (P>0.05) among treatments and averaged 261, 220 and 308g/h/d for treatments I, II, and III, respectively. Change in BW was not significantly different (P>0.05) and averaged 112, 105 and 137 g/h/d for the respective treatments. Apparent digestibility of DM, NFE and NDF of treatment I was significantly higher (P<0.05) than that of treatment III (74.0 Vs 58.7%; 88.4 Vs 77.3%; 50.1 Vs 12.9%, respectively). CP, EE, CF and ADF digestibility was not significantly different (P>0.05) among the silage treatments, with treatment I having the highest digestibility coefficients of these fractions (72.0, 59.5, 36.5 and 40.5%, respectively). Results of this study indicated that ensiling OC with the used levels of feed supplements resulted in acceptable DMI, digestibility and animal performance.

Key Words: Ram Lambs, Olive Cake, Apparent Digestibility

M299 Effects of microwave irradiation on protein degradation of safflower meal in the rumen. P. Shawrang*[1] and A. A. Sadeghi[2], [1]*Animal Science Research Section, Research Center for Agriculture and Medicine, Atomic Energy Organization of Iran*, *Karaj, Iran*, [2]*Department of Animal Science, Faculty of Agriculture, Science and Research Branch, Islamic Azad University*, *Tehran, Iran*.

This study was completed to evaluate effects of 1000 W microwave irradiation for 1, 2 and 3 min on protein degradability and intestinal digestibility of safflower meal (SM) by using nylon bags and SDS-PAGE techniques. Duplicate nylon bags of untreated and microwave irradiated SM were suspended into the rumen of four non-lactating Holstein cows from 0, 2, 4, 6, 8, 12, 16, 24 and 48 h, and data was fitted to exponential model to calculate degradation parameters of CP. Increasing irradiation time decreased (P<0.05) the water soluble fraction and increased (P<0.05) the potentially degradable fraction of CP. The degradation rate of the b fraction decreased (P<0.05) with increases in irradiation time. The effective CP degradability of 1, 2 and 3 min microwave irradiated SM at a rumen outflow rate of 0.05/h decreased (P<0.05) by 10, 17 and 20 %, respectively, compared to untreated SM. SDS-PAGE analysis revealed that SM proteins were composed of two major components A and B, accounting for approximately 34 and 51 percent of the total meal protein, respectively. Both proteins were multi-subunits. The molecular weights of 31.9, 26.0, 21.4, 19.5 kDa for A subunits and 8.0, 9.6 kDa for B subunits were observed in this study. Electrophoretic and densitometric analysis of untreated SM protein residues revealed that B subunits were degraded completely within 4-h, whereas the four subunits of A were not degraded after 12-h of incubation. In microwave irradiated SM, B subunits were resistant until 12-h incubation and four subunits of A were not degraded until 24-h of incubation. Mobile bag CP digestibility linearly (P<0.001) increased as irradiation time increased. Intestinal CP digestibility of untreated, 1, 2 and 3 min microwave irradiated SM at 16-h of ruminal incubation period were 807, 838, 855 and 876 g/kg, respectively. Irradiation at this dose for 4 min induced burning of SM. In conclusion, microwave irradiation of SM at power of 1000 W for 3 min appeared to be an effective means of increasing digestible rumen undegradable protein content.

Key Words: Safflower Meal, Microwave Irradiation, SDS-PAGE

M300 Optigen® is a sustained release source of non-protein nitrogen in the rumen. R. Garcia-Gonzalez*[1], J. M. Tricarico[1], G. A. Harrison[1], M. D. Meyer[1], K. R. McLeod[2], D. L. Harmon[2], and K. A. Dawson[1], [1]*Alltech Inc.*, *Nicholasville, KY*, [2]*University of Kentucky*, *Lexington*.

A trial was conducted to study the N release characteristics of Optigen® (Alltech Inc.) in the rumen. Four ruminally-cannulated steers (277 kg average BW) were fed a 60% corn silage, 30% high moisture corn, and 10% supplement diet at 2% of BW in two daily meals. Steers were assigned to urea (0.11 g/kg BW) or Optigen® (0.12 g/kg BW) in cross-over design. Supplements were top-dressed at feeding. Each period consisted of a 21-d adaptation period and a 3-d sample collection period. On day 22, jugular blood and ruminal samples were collected for up to 8 h post-feeding. Ruminal fluid was analyzed for ammonia, pH and VFA content and blood plasma for ammonia, urea and glucose content. On day 23, disappearance of Optigen® NPN in the rumen was studied *in situ*. Bags with residue were not washed after *in situ* incubation but were placed in acidified water, sonicated, and analyzed for residual urea. On day 24, ruminal and blood samples were collected after intra-ruminal administration of Optigen® or urea prior to the morning feeding. Non-linear modeling of *in situ* NPN disappearance resulted in 7% NPN available at time 0h and a disappearance rate of 0.237 h^{-1} for the NPN fraction released over time. No differences in ruminal pH, VFA, or blood glucose concentrations were observed after urea or Optigen® administration. Ruminal ammonia concentrations were lower in steers fed Optigen® vs. urea (5.3 vs. 6.6 mg/dL, $P<0.05$) on day 22. Differences were greater when Optigen® or urea were administered intra-ruminally on day 24, possibly due to differential eating behavior between steers on day 22. Ruminal ammonia concentrations (mg/dL) were lower ($P<0.05$) in steers receiving Optigen® vs. urea at 2 (16.3 vs. 28.4) and 4 h (1.9 vs. 9.3). Jugular plasma ammonia concentrations peaked at 2 h post-administration of urea (0.216 mM) while they remained constant (0.069 mM average) throughout the same 8-h period in steers receiving Optigen®. Jugular blood plasma urea concentrations were lower ($P<0.05$) in steers receiving Optigen® vs. urea at 4 (4.00 vs. 4.82 mM) and 6 h (3.24 vs. 4.26 mM). This study suggests that Optigen® is a protected source of NPN with sustained release characteristics in the rumen.

Key Words: NPN, Urea, Ammonia

M301 Effects of Optigen® on fermentation, digestion, and N partitioning in rumen-simulating fermenters. G. A. Harrison*, J. M. Tricarico, M. D. Meyer, and K. A. Dawson, *Alltech Biotechnology*, *Nicholasville, KY*.

The effects Optigen® (blended, controlled-release urea) on ruminal fermentation, digestion, and N flow were investigated in single-flow rumen-simulating fermenter cultures. Data from 10 experiments were included in this meta-analysis (all-natural protein: 52 cultures; Optigen: 52 cultures). Cultures were fed diets with a forage base of corn silage and alfalfa hay, 45 to 50% forage (DM basis) and NPN from Optigen at 0.44 to 0.66% dietary DM. NPN from Optigen replaced 6.0 to 9.8% of dietary N. Cultures were fed 12.5 g as fed of experimental diets twice daily for six days. Target dilution rate with McDougall's artificial saliva solution diluted 70:30 with tap water was 0.045 h^{-1}. Samples were collected from all cultures immediately prior to morning feeding during the last 3 days of experiments for fermentation analysis. Effluent weights were recorded each day and a composite sample

for each fermenter was used for DM, OM, and NDF disappearance determination. Nitrogen flow measures were estimated by using purine to N ratios for effluent DM and bacteria. Data were analyzed using the PROC MIXED Model of SAS. Culture fluid pH was not affected by diet (6.42 vs. 6.45; $P>0.10$). Cultures fed all-natural protein diets had higher total VFA concentrations (75.5 vs. 69.1 mM, $P<0.05$) than Optigen-fed cultures. Ammonia (prior to morning feeding) was similar between culture diets (4.24 vs. 4.43 mg/dl, $P>0.10$). Apparent and true DM digestion were not affected by culture diet ($P>0.10$). Cultures receiving Optigen had higher protein degradability (63.5 vs. 65.3% of CP, $P<0.05$) and less undegraded feed N (0.239 vs. 0.228 g/d, $P<0.05$) than all-natural protein cultures. Bacterial N yields (0.323 vs. 0.324 g, $P>0.10$) and efficiency (23.3 vs. 23.3 g bacterial N/kg DM truly digested, $P>0.10$) were not altered by culture diet. We conclude that Optigen can replace up to 9.8% of dietary N in rumen-simulating fermenter cultures without negative effects on fermentation, digestion, or N partitioning.

Key Words: Non-Protein Nitrogen, Optigen, Ruminal Metabolism

M302 The effect of fat content of sodium hydroxide treated sunflower meal on *in situ* dry matter and crude protein degradation parameters. T. Mohammadabadi, M. Danesh Mesgaran*, A. R. Heravi Moussavi, H. Nasiri Moghadam, and M. Chaji, *Ferdowsi University*, *Mashhad, Iran*.

This study was conducted to evaluate *in situ* dry matter (DM) and crude protein (CP) degradation parameters of sunflower meals (containing 25 (SFM25) or 150 (SFM150) g fat/kg DM). Samples were untreated (SFM25U or SFM150U) or sodium hydroxide (40g/kg DM) treated (SFM25T or SFM150T, respectively). CP content of sunflower meals ranged from 232 (SFM150T) to 338 (SFM25U) g/kg DM. Four ruminally fistulated Holstein steers (400±12 Kg, body weight) were used. Approximately, 5 g DM of each sample were placed into bags (12x19 cm), made of polyester cloth with 52 µm pore size (4 replicates per each treatment). Bags were incubated in the rumen for 0.0, 2, 4, 6, 8, 16, 24, 48, 72 and 96 h. The degradable parameters of DM and CP were determined using the equation of P=a + b (1 - e^-ct). SFM150T had the highest rapidly degradable fraction (a) of DM (0.43) compared with the other samples. There was no difference in (a) fraction of DM between SFM150U (0.39), SFM25T (0.32) and SFM25U (0.33). In situ (a) fraction of CP of SFM150U was the lowest, but there was no difference in (a) fraction CP between SFM150T (0.39) and SFM25T (0.38). Slowly degradable fraction (b) of DM of SFM25T was the highest (0.42) and SFM150T was the lowest (0.31) compared with the other samples and (b) fraction of CP ranged from 0.32 for SFM25U to 0.63 for SFM150U. No difference in (b) fraction of CP of SFM150T (0.59) and SFM25T (0.57) was observed. SFM150T had the lowest of fractional degradation rate (c) of DM (0.05) and CP (0.04) and SFM25U had the highest of (c) fraction of DM (0.16) and CP (0.11) compared with the others. It was concluded that the potential degradation of SFM might be affected by the fat content and sodium hydroxide treatment.

Key Words: In Situ, Sunflower Meal, Sodium Hydroxide

M303 Pistachio hull tannin affected digestibility of soybean meal and alfalfa during *in vitro* digestion. A. Bohluli and A. A. Naserian*, *Ferdowsi University*, *Mashhad, Iran*.

Due to binding tannin with protein and cellulose, it was hypothesized that pistachio hull tannin can decrease the digestibility of soybean meal (47% CP and 19% NDF) and alfalfa (18% CP and 34% NDF). Pistachio Hull (PH) is the main pistachio by-product produced from the pistachio dehulling process. PH consisted of 12.7, 5.7, 16.6, 25, and 20% ash, EE, CP, NDF, and ADF, respectively; also it contained a 9.6% total phenolic component and 4.5% tannin determined using Folin-Ciocalteu reagent with a calorimetric method. Poly Ethylene Glycol (PEG) was used as a tannin binder for its ability to counteract the action of PHT on digestibility of SBM and alfalfa. The SBM and alfalfa were incubated separately, with PH in 50:50 ratios or by adding PEG into the mixtures. Dry Matter and Organic Matter Digestibility (IVDMD and IVOMD) of the treatments were determined using a in vitro 2-step digestion technique (48h incubation in a rumen microbial culture and 48h digestion after HCl-pepsin solution addition). PEG enhanced dry matter and organic matter digestibility of the PH+SBM and the PH+alfalfa mixture ($P<0.05$) and its effect was higher for the PH+alfalfa ($P<0.01$). These results suggest pistachio hull tannin prevented digestion of high protein and structural carbohydrate feed sources. In this study, PHT inhibited fiber more than protein digestion. It is maybe because of the addition of HCl-pepsin solution in the second step of in vitro digestion, which may have eased the tannin-protein complex and improved protein digestion in the second step of digestion by pepsin; whereas the structural carbohydrate can only be digested in the first step.

Table 1.

Item	SBM	Alfalfa	PH	SEM
IVDMD	89.0	70.1	62.5	
IVOMD	89.7	71.0	67.4	
	SBM+PH	SBM+PH+PEG		
IVDMD	78.8	82.0		0.43
IVOMD	82.4	85.8		0.47
	Alfalfa+PH	Al+PH+PEG		
IVDMD	68.0	70.7		0.26
IVOMD	70.2	74.7		0.27

Key Words: Pistachio Hull, Tannin, Poly Ethylene Glychol

M304 Comparison of ruminal *in situ* crude protein degradability of selected feedstuffs in growing goats. Y. Hu*[1], Z. L. Tan[1], S. X. Tang[1], Z. H. Sun[1], M. Wang[1], and G. O. Tayo[1,2], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, P.R. China*, [2]*Babcock University*, *Ikeja Lagos, Nigeria*.

The objective of this study was to update the feed database on ruminal crude protein (CP) degradability in China. Ruminal in situ CP degradability of three classes of feedstuffs, namely cereal grain (barley, buckwheat, rice and millet), legume (horse bean, pea, mung bean and jequirity), and tuber (potato, sweat potato and cassava) were determined using the *in situ* nylon bag technique. All feed samples were collected from the main production regions in China. Three wether goats (20±1 kg) were used and fed a diet consisting of 500 g kg^{-1} concentrate and 500 g kg^{-1} forage containing DE (3.15 Mcal/kg DM)

and CP (140 g/kg DM). Ruminal CP degradability of each feedstuff was measured at 0, 2, 4, 8, 12, 24 and 36h in duplicate for each goat. The in situ CP disappearance data were fitted to the equation p=a+b (1-e^{-ct}). For cereal grain feedstuffs, the rapidly soluble fraction (a), potentially degradable fraction (b), and degradation constant rate (c) of fraction b was highest for barley, rice, and barley or buck wheat, respectively. For legume feedstuffs, Pea had the highest value of 'a', while 'b' and 'c' values were highest for soybean and horse bean. For tuber feedstuffs, potato had the highest values of 'a' and 'c', and the lowest value of 'b'. Results indicated that ruminal in situ CP degradability of these classes of feedstuffs varied widely. These data could be practically applied in formulating total mixed rations for ruminant production in China.

Acknowledgements: The work was partially funded by CAS (KSCX2-YW-N-49).

Table 1.

Feedstuff		a	b	c
Cereal grain	Barley	548^{a}	291^{b}	0.13^{a}
	Rice	309^{cd}	571^{a}	0.02^{c}
	Buckwheat	386^{b}	348^{b}	0.13^{a}
	Millet	68^{f}	373^{b}	0.06^{b}
Legume	Horsebean	555^{bc}	141^{b}	0.07^{a}
	Jequirity	530^{c}	219^{a}	0.04^{bc}
	Mung bean	623^{b}	178^{ab}	0.03^{c}
	Pea	723^{a}	110^{b}	0.05^{b}
Tuber	Sweat potato	593^{b}	121^{b}	0.12^{a}
	Cassava	553^{c}	286^{a}	0.05^{b}
	Potato	842^{a}	61^{c}	0.12^{a}

Key Words: Feedstuffs, Ruminal In Situ Degradability, Crude Protein

M305 Effect of replacing soybean meal with *Mucuna pruriens* on growth performance, carcass characteristics and meat safety. S. K. Chikagwa-Malunga*[1], A. T. Adesogan[1], M. Huisden[1], S. C. Kim[1], S. C. Phatak[2], N. J. Szabo[1], and R. C. Littell[1], [1]*University of Florida*, *Gainesville*, [2]*University of Georgia*, *Tifton*.

The harmful effects of the L-dopa in *Mucuna pruriens* (M, Velvet bean) seeds have limited its use as a protein supplement for monogastrics and humans. This study determined how replacing soybean meal (SB) with M affects the performance of lambs and meat safety. Twenty-seven Rambouillet lambs (RM; initial BW = 33.8 ± 5.4 kg) and twelve Florida Native (FN; initial BW = 24.9 ± 8.6 kg) lambs were assigned to four treatments and fed a basal diet of coastal bermudagrass hay, corn, and molasses for 42 (FN) or 49 d (RM) and then harvested. Dietary supplements were formulated by substituting 0 (SB), 33 (Lo), 67 (Med) or 100 (Hi) % of SB with rolled M seeds. Body weight was measured weekly and carcass characteristics and concentrations of L-dopa and its metabolites in rumen fluid, blood and the longisimuss dorsi muscle were measured at harvest. Lambs fed SB had greater ($P < 0.05$) ADG than those fed M (0.20 vs. 0.15 kg/d for RM; 0.18 vs. 0.13 kg/d for FN), and FN lambs had greater ($P < 0.01$) final BW (33.9 vs. 30.3 kg) and hot carcass weights (16.2 vs. 15.1 kg; ($P < 0.10$, tendency) than those fed M. However, supplementary protein source did not affect ($P > 0.05$) dressing percent and concentrations of BUN, blood glucose, cerruloplasmin, and haptoglobin, or concentrations of L-dopa and its metabolites in rumen fluid, blood and muscle. Therefore although SB is a better protein supplement than M, acceptable growth rates and carcass characteristics can be achieved with M supplementation in lambs. Mucuna L-dopa was extensively metabolized in lambs and did not elicit an inflammatory stress response or accumulate in muscle tissue. Therefore, feeding mucuna to lambs as described does not affect meat safety.

Key Words: *Mucuna pruriens* L-dopa, Soybean, Weight Gain

M306 Urea-nitrogen recycling in growing lambs fed diets differing in rumen degradable protein and carbohydrate. D. Kiran* and T. Mutsvangwa, *University of Saskatchewan*, *Saskatchewan, Canada*.

The objective of this study was to determine the interactions between dietary ruminally-degradable protein (RDP) level and ruminally-fermentable carbohydrate on urea kinetics and nitrogen efficiency in rapidly growing lambs fed high N diets. Four Suffolk ram lambs (34.8 ± 0.5 kg BW) were used in a 4 × 4 latin square design with 21-d periods and a 2 × 2 factorial arrangement of dietary treatments. The dietary factors studied were: 1) dry-rolled vs pelleted barley as the principal source of ruminally-fermentable carbohydrate; and 2) dietary levels of RDP of 60 vs 70%. All diets contained 28.8 g N/kg DM. Nitrogen balance was measured from d 15 to d 20, while urea-N kinetics were measured from d 15 to d 19 using intra-jugular infusions of [^{15}N^{15}N]urea. Nitrogen intake ($P = 0.001$), and fecal ($P = 0.002$) and urinary ($P = 0.034$) N excretion increased as the dietary RDP level increased; however, barley processing had no effect. Feeding dry-rolled barley compared to pelleted barley ($P = 0.04$), and feeding 60% RDP compared to 70% RDP ($P = 0.04$) resulted in higher N digestibility. Endogenous production of urea-N and its recycling to the gastrointestinal tract (GIT) did not differ among dietary treatments; however, endogenous production of urea-N was high (45.8 to 50.9 g/d), exceeding N intake (42.3 to 47.9 g/d) across dietary treatments. Similarly, across dietary treatments, 30.6 to 38.5 g/d of urea-N was recycled to the GIT, representing 66.9 to 74.2% of endogenous urea-N production; however, 63.6 to 75.6% of urea-N recycled to the GIT was returned to the ornithine cycle. In summary, although dietary treatment did not alter urea-N kinetics, substantial amounts of hepatic urea-N output were recycled to the GIT under the dietary conditions employed in this study, and additional research is required to determine how this recycled urea-N can be efficiently captured by bacteria within the GIT.

Key Words: Urea Recycling, Sheep, Degradable Protein

M307 Ruminal and intestinal protein and amino acid digestibility of feather meal and feather meal with blood products. K. W. Cotanch*[1], R. J. Grant[1], J. Darrah[1], M. E. VanAmburgh[2], D. A. Ross[2], and J. Haid[3], [1]*William H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*Cornell University*, *Ithaca, NY*, [3]*U.S. Poultry & Egg Association*, *Tucker, GA*.

Ruminal and intestinal protein and amino acid digestibility of feather meal (FM) with and without blood was determined using the 3-step in vitro procedure of Calsamiglia and Stern (1995) as modified by Gargallo et al. (1996). Thirteen samples of FM were selected for analysis: 6 without blood, 4 with blood added pre-hydrolyzation and 3 with blood added post-hydrolyzation. Hydrolyzation parameters varied

in time, (5 to 150 min), temperature (88 to 163°C) and pressure (30 to 75 psi). Samples were subjected to 12 and 18 h in situ (IS) incubation and 18 h in vitro (IV) incubation with rumen fluid buffer (Goering and Van Soest, 1970) comparing the 3 ruminal incubation methods. Ruminal residues were subjected to in vitro intestinal digestion with 0.1 N HCl and pepsin for 1 h, and then buffered pancreatin for 24 h. Residues were analyzed for total nitrogen (N) and essential amino acid (EAA). The GLM procedure of SAS was used to perform the ANOVA of the EAA content of the whole, buffer insoluble residue and undigested residues. Three soy products, a solvent-extracted soybean meal and two processed soy products were analyzed as controls with the FM through all procedures. Soy product N digestion was similar between products (98.2 to 99.3%) and among the IV intestinal digestion of the IS and IV ruminal residues. These values are consistent with previous data for these feeds and methods. Feather meal in vitro total N digestion did not significantly differ by product (P>0.05). Average total N digestibility for product without blood, with blood added pre-hydrolyzation and blood added post-hydrolyzation, were 57.6%, 64.1% and 66.6% respectively. These results support the 3-step methodology for protein and amino acid digestion as a viable means of estimating ruminal and intestinal digestion of FM product.

Key Words: Feather Meal, Digestibility, Protein

M308 Milk production, milk composition, digestion, and feed intake of cows fed different concentrations of flaxseed meal. H. V. Petit*[1] and P. S. Mir[2], [1]*Agriculture and Agri-Food Canada*, *Sherbrooke, QC, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*.

Thirty-two lactating multiparous Holstein cows averaging 620 kg of BW were used from week 33 to 37 of lactation to determine the effects of different concentrations of flaxseed meal in the diet on milk production, milk composition, digestion, and feed intake. Cows were blocked for similar DIM. Cows within groups were assigned randomly to one of four treatments. The four TMR consisted of a control diet (CON) with no fat supplement or diets containing either 5, 10 or 15 % flaxseed meal (FM) on a DM basis. Diets were designed to yield similar CP and NEL concentrations. Diets were fed twice daily for 10% orts. Feed consumption and milk yield were recorded daily. Milk samples were obtained from each cow for two consecutive milkings on the fifth week of the experiment and they were analyzed separately to determine milk composition. Total collection of feces and urine was carried out on the fifth week of the experiment. Milk production averaged 22.0 kg/d and was similar among treatments. Milk concentrations of protein and fat, and yields of protein, lactose, and fat were not affected by diet. Intake of DM averaged 17.3 kg/d and was similar among treatments. Digestibilities of DM, ADF, NDF, and N were similar among treatments. Dietary concentrations of flaxseed meal had little effect on milk concentrations of fatty acids (FA). However, feeding FM increased milk concentrations of C18:3n3 and decreased the omega 6 to omega 3 FA ratio in milk fat. These results suggest that flaxseed meal is a good protein source for late lactating dairy cows and that it is possible to feed as much as 15% of the DM in the total diet with little effect on feed intake, milk yield and milk composition.

Key Words: Dairy Cow, Flaxseed, Fatty Acid

M309 Interactions between oilseed supplementation and barley grain processing on urea-nitrogen recycling and nitrogen metabolism in dairy cows. G. N. Gozho*, M. Hobin, and T. Mutsvangwa, *University of Saskatchewan*, *Saskatchewan, Canada*.

The objective of this study was to determine how interactions between oilseed supplementation and barley grain processing alter urea-N transfer to the gastrointestinal tract (GIT) and the utilization of this recycled urea-N in lactating dairy cows. Four Holstein cows (656.3 kg BW; 79.8 days-in-milk) were used in a 4 × 4 Latin square design with 21-d periods and a 2 × 2 factorial arrangement of dietary treatments. The dietary factors studied were: 1) dry-rolled or pelleted barley as the principal source of ruminally-fermentable carbohydrate; and 2) whole canola or whole flaxseed as supplemental fat sources, such that experimental diets contained 6% total fat. Nitrogen balance was measured from d 15 to d 19, while urea-N kinetics were measured from d 15 to d 19 using continuous intra-jugular infusions of [$^{15}N^{15}N$]urea. Nitrogen retention was unaffected (P > 0.05) by diet; however, fecal N excretion was higher (P < 0.001) in cows fed dry-rolled barley compared to those fed pelleted barley. Source of supplemental fat did not affect (P > 0.05) urea-N kinetics. Urea-N production (468.7 vs 371.4 g/d; P = 0.03) was higher, and urea-N entering the GIT (299.4 vs 239.9 g/d; P = 0.07) and the amount of GIT urea-N entry that was returned to the ornithine cycle (230.3 vs 189.6 g/d; P = 0.06) tended to be higher in cows fed dry rolled barley compared to those fed pelleted barley. Despite differences between cows fed dry-rolled barley or pelleted barley in the amounts of urea-N entering the GIT, the amounts of recycled urea-N that were used for anabolic purposes were similar (60.0 vs 42.8 g/d; P = 0.39). The proportion of endogenous urea-N production that was transferred to the GIT, and the proportion of urea-N GIT entry that was used for anabolic purposes, or was lost in the urine or feces were unaffected (P > 0.05) by diet. In consequence, even if barley grain processing altered endogenous urea-N production and urea-N entry into the GIT, this did not result in increased utilization of recycled urea-N for microbial production as the additional urea-N which entered the GIT was returned to ureagenesis.

Key Words: Dairy Cow, Urea Kinetics, Nitrogen Metabolism

M310 Influence of carbohydrate source on nitrogen metabolism and microbial protein synthesis in dairy cows. G. N. Gozho* and T. Mutsvangwa, *University of Saskatchewan*, *Saskatchewan, Canada*.

Nitrogen balance and microbial protein synthesis were examined in four ruminally-fistulated dairy cows (676.3 kg BW; 120.5 DIM). The experiment was a 4 × 4 Latin square design with 21-d periods during which TMR containing barley, corn, oats or wheat as the major carbohydrate source were fed. In western Canada, dairy cow diets typically contain barley, corn, wheat or oats as the principal source of energy, and these cereal grains differ in their starch content and in their ruminal starch degradation. Our hypothesis was that these cereal grains would differ in their ability to support ruminal microbial protein production. Dry matter intake was unaffected by diet; however, cows fed wheat tended (P = 0.08) to consume less DM compared to those fed barley, corn or oats. Milk yield was unaffected by diet; however, 3.5% fat-corrected milk yield for cows fed wheat was lower (P = 0.02) compared to cows fed barley, corn or oats. Total N intake, urinary N output, urinary urea-N output and N retention were all unaffected (P > 0.05) by diet. Cows fed oats tended (P = 0.09) to have a lower fecal N output compared to those fed wheat, barley or corn. Cows fed barley or

corn had higher N output in milk ($P = 0.03$) compared with those fed wheat or oats; however, when expressed as a percentage of N intake, milk N output averaged 25% and was unaffected by diet. Overall, N balance was not affected ($P = 0.10$) by diet. Urinary uric acid excretion was unaffected by diet, but urinary allantoin excretion tended ($P = 0.08$) to be higher in cows fed barley or corn compared to those fed wheat or oats. Urinary excretion of purine derivatives (PD; uric acid + allantoin) were higher ($P = 0.04$) in cows fed barley (436 mmol/d) or corn (427 mmol/d) compared to those fed wheat (397 mmol/d) or oats (379 mmol /d). Microbial protein synthesis, calculated from PD excretion, was higher ($P = 04$) for cows fed barley (324 g N/d) compared to those fed wheat (291 g N/d) or oats (275 g N/d). These data suggest that commonly-fed carbohydrate sources differ in their ability to support ruminal microbial protein production.

Key Words: Dairy Cow, Nitrogen Metabolism, Microbial Protein Synthesis

M311 Supplementation of lactating cows receiving high citrus pulp diets with heated soybeans. G. S. Dias Júnior[1], A. van Vugt[2], G. Warringa[2], C. A. Mello, Jr.[3], and M. N. Pereira*[1], [1]*Universidade Federal de Lavras*, *Brazil*, [2]*Wageningen University*, *Holland*, [3]*Nutron Alimentos*, *Brazil*.

Total or partial replacement of corn by citrus pulp has decreased milk protein production. We tried two strategies to avoid such a depression: Increasing diet RUP content by replacing raw soybeans by heated soybeans, and decreasing diet forage content by replacement of corn silage by pellets of citrus pulp. Twenty-one Holsteins were assigned to a sequence of three treatments in seven 3x3 Latin Squares with 21-day periods. All diets contained 10.7% of DM of mature and finely ground flint corn, 13.0% of soybean meal and 11.0% of whole soybeans. Diet corn silage content was 46.9% for the high forage treatments with heated (HFHS) or raw (HFRS) soybeans. The low forage diet contained 34.2% of corn silage and raw soybeans (LFRS). Two single degree of freedom orthogonal contrasts were tested: LFRS *vs.* HFRS and HFRS *vs*. HFHS. Nutrient composition of the consumed diets were: 16.4% CP, 33.1% NDF, 19.3% forage NDF, and 5.1% EE for LFRS; 15.9% CP, 36.4% NDF, 26.6% forage NDF, and 5.1% EE for HFRS; and 16.6% CP, 37.3% NDF, 26.4% forage NDF, and 5.3% EE for HFHS. Intake was 17.6 ($P<0.01$), 19.1 and 19.5 ($P=0.51$) kg/d for LFRS, HFRS and HFHS. Milk yield was increased from 29.1 kg/d to 30.2 when heated soybeans replaced raw soybeans ($P=0.06$), while the replacement of forage with byproduct was not so effective (29.8, $P=0.18$). Lactose secretion were (kg/d): 1.364 for LFRS ($P=0.09$), 1.330 for HFRS, and 1.391 for HFHS ($P=0.03$). Plasma glucose were: 52.5 ($P=0.08$), 54.8 and 51.4 ($P=0.01$) mg/dl for LFRS, HFRS and HFHS. Diets that increased lactose secretion, decreased plasma glucose. Dietary manipulation did not affect the daily secretion or the content of fat and protein in milk ($P>0.22$). Diet LFRS had greater secretion of milk energy per unit of digestible organic matter intake than diet HFRS (1.53 vs. 1.49 Mcal/kg, $P=0.06$). Chewing time was decreased by the low forage diet ($P<0.01$), but plasma lactate did not change ($P>0.20$). Substitution of raw by heat treated soybeans increased milk yield and had no effect on milk composition, the mechanism may have involved a larger drive of plasma glucose to milk lactose synthesis.

Funded by Nutron/Provimi

Key Words: Lactose, Glucose, Milk Solids

M312 Comparison of protein disappearance of alfalfa hay and barley grain by *in vivo*, mobile bag and 3-step methods. H. Jahani-Azizabadi, M. Danesh Mesgaran*, R. Valizadeh, and H. Nasirimoghadam, *Ferdowsi University of Mashhad*, *Mashhad, Iran*.

Ruminal, post-ruminal and total tract crude protein (CP) disappearance of alfalfa hay and barley grain were measured using in vivo, mobile bag and three-step *in situ* / *in vitro* enzyme procedures. For in vivo, eight Baluchi lambs (49.4 ± 3.5 kg, body weight) were used. Experimental diets were made of two alfalfa hay:barley grain ratios (DM basis) as 1.0:0.0 and 0.50:0.50. Diets were fed to animals for 28 d, with 7 d of feces collection. For the mobile nylon bag technique, two Holstein steers (450 ± 50 kg, body weight) fitted with ruminal fistulae and T-shaped intestinal cannulae were used. Steers fed 5.1 kg of alfalfa hay, 1.2 kg of corn silage and 2.7 kg of concentrate (150 CP/kg of DM). Three-step procedure was followed by rumen incubation of samples for 12 h and enzymatic incubation of ruminal-undegradable samples. Data were analyzed using completely block randomized design. In vivo total tract CP disappearance of alfalfa hay and barley grain (0.74 and 0.69, respectively) was significantly ($P< 0.01$) lower than in situ mobile nylon bag (0.89 and 0.96, respectively) and three-step procedure (0.81 and 0.89, respectively). Total tract CP disappearance from mobile nylon bag was significantly ($P< 0.01$) higher than three-step technique. Post-ruminal disappearance of ruminal undegradable CP from alfalfa and barley grain in the mobile nylon bag method (0.69 and 0.86, respectively) was significantly ($P< 0.01$) higher than the three-step enzymatic method (0.49 and 0.56, respectively). Results of the present study showed that there is significant difference between in vivo, mobile bag and the 3-step method when total tract CP disappearance of barley grain and alfalfa hay is evaluated.

Key Words: Protein, Three-Step Procedure, Mobile Bag

M313 Evaluation of a rumen undegradable soybean product for lactating dairy cattle. S. S. Donkin*[1], S. L. Koser[1], E. M. Barnes[1], P. H. Doane[2], J. L. Dunn[2], and M. J. Cecava[2], [1]*Purdue University*, *West Lafayette, IN*, [2]*ADM Animal Nutrition Research*, *Decatur, IN*.

Increasing the bypass protein content of soybean meal can be accomplished by applying moist heat and additives in a controlled reaction process. The objective of this study was to determine the effects of feeding a specially-processed high bypass soybean meal on performance of dairy cows. Thirty-six multiparous Holstein cows from the Purdue University Dairy Cattle Research and Education Center were used in the study. Cows were 123 ± 4 days and produced 37.2 ± 1.1 kg/d of milk at study initiation. The base diet consisting of corn silage, legume haylage, legume hay, cottonseed hulls, soyhulls, soybean meal, corn gluten meal, high moisture corn, and a mineral/vitamin supplement was fed during a two-week covariate adjustment period. During the following six weeks, cows were fed the diets containing soybean meal (Negative control; NC), Aminoplus® to replace soybean meal and increase dietary RUP content (Positive control; PC), or the specially-processed bypass soybean meal as a replacement for soybean meal (RUPSBM). All diets contained equal amounts of protein and the PC and RUPSBM diets contained equal quantities of RUP. Cows were milked twice daily and weekly milk samples were analyzed for fat, protein, lactose, total solids, milk urea N, and somatic cells. Body weights and body condition scores were obtained at the beginning and the end of the study. Milk production was 37.4, 36.6, 37.8 ± 1.7 kg/d and feed intake was 25.6, 25.8, 26.3 ± 0.7 kg/d for NC, PC, and RUPSBM, respectively, and did not differ ($P > 0.05$). Milk composition

was not affected by treatment. When averaged across all treatments, DMI was 25.9 kg/d, or approximately 4.3% of body weight. The high DM and consequent high RUP intake likely diminished the ability to determine the value of bypass protein for lactating dairy cows. Both AminoPlus and RUPSBM were acceptable for lactating dairy cow diets based upon no observed detrimental effects on feed intake and milk yield or milk composition.

Key Words: Rumen Undegradable, Protein, Dairy

M314 The effects of controlled feeding a high concentrate or high forage diet at four nitrogen intakes on digestibility in dairy heifers. G. I. Zanton* and A. J. Heinrichs, *The Pennsylvania State University*, *University Park*.

The hypothesis of this experiment is that a high concentrate ration (**HC**) will be utilized with a greater efficiency than a high forage ration (**HF**) by postpubertal dairy heifers and that the response will be affected by level of N intake. To test this hypothesis, 8 Holstein heifers (beginning at 362 ± 7 kg and 12.3 ± 0.4 mo) were fed eight rations according to a split-plot, 4 x 4 Latin square design. Treatments were formulated to contain 75% or 25% forage (corn silage and chopped wheat straw) and 4 levels of N intake (0.94, 1.62, 2.30, 2.96 g N/kg $BW^{0.75}$ per d) and were fed to maintain equal ME intake. Feces were collected for 8 d/ 28 d period. Organic matter intake was greater for heifers fed HF, but, due to increased OM digestibility of HC (74.0 vs 67.6% ± 0.9; $P < 0.001$), digestible OMI was unaffected by forage level ($P > 0.40$). OM digestibility was affected by an interaction between forage level and N intake ($P < 0.013$); increasing to a plateau of 77.5% at 2.30 g N/kg BW0.75 for HC and 69.0% at 1.62 g N/kg $BW^{0.75}$ per d for HF fed heifers. Apparent N digestibility was greater for heifers fed HC and increased from 47.7% to 80.8% between 0.94 and 2.96 g N/kg $BW^{0.75}$ per d. Analysis of covariance revealed a strong linear relationship between apparently digested N and N intake, however the response differed between forage levels ($P < 0.05$). Predicted true digestibilities were 97.4 and 94.4% and non-dietary fecal N excretion was 0.45 and 0.47 g N/kg $BW^{0.75}$ per d for HC and HF fed heifers, respectively. Due to these relationships, less N appeared in the feces of heifers fed HC than HF (0.50 vs 0.57 g N/kg $BW^{0.75}$ per d). It is concluded that increasing N intake increases the digestibility of OM, the magnitude of which depends on the level of dietary forage provided. It is further concluded that the digestion of N by dairy heifers is high and nearly complete and that the majority of N appearing in the feces is not of dietary origin and may be differentially affected by the level of forage intake.

Key Words: Dairy Heifer, Forage:Concentrate, N Intake

M315 Evaluation of the fermentation dynamics of the soluble protein fraction of three protein sources in continuous culture fermenters. M. Ruiz Moreno*[1], A. Bach[2,3], M. Thrune[1], and M. D. Stern[1], [1]*University of Minnesota*, *Saint Paul*, [2]*ICREA*, *Barcelona, Spain*, [3]*IRTA-Unitat de Remugants*, *Barcelona, Spain*.

Six dual-flow continuous culture fermenters were used to assess differences in degradation pattern and ability to promote bacterial growth from the soluble CP fractions of canola meal (CM), soybean meal (SBM) and fish meal (FM) using a completely randomized design with two 9-d experimental periods. All fermenters received the same basal diet (58% ground corn, 40% canary grass hay, 0.4% vitamin-mineral premix, 1% CaCO3, 0.6% salt on a DM basis). During sampling on the last 3-d of each period, 90-mL doses containing soluble proteins were infused into fermenters 30 min after the beginning of the first and last feedings of the day at a rate of 3 mL/min, using a constant-infusion pump. These doses were prepared from samples of FM, SBM and CM that were ground and soaked in distilled water (1:4 wt/vol, 38C, 1h) under continuous stirring. The solutions were centrifuged and the supernatant vacuum-filtered through a N-free filter paper. Equal N concentrations were achieved by diluting filtrates with the higher N content to match the one with the lowest N content using distilled water. Normalized filtrates (1.8% CP as is) were frozen in 90-mL doses and were gently thawed prior to infusions into the fermenters. The total amount of soluble CP supplied by the infusions of FM, CM and SBM was 3.2 g/d, representing 27% of daily dietary CP intake. Each sampling day at 0, 0.5, 1, 3, and 6 h following the morning infusion of soluble CP fractions, a 10-mL aliquot from each fermenter flask was collected to determine NH_3-N concentrations. Infusion of FM resulted in the greatest ($P < 0.05$) NH_3-N concentrations (4.5±0.08 mg/dL) compared with the other treatments (0.42±0.08 mg/dL). Bacterial N flow (g/d) was also greatest ($P < 0.05$) with FM (1.47±0.07) compared with the other soluble CP fractions (1.09±0.07). Results indicate that microbial degradation of the soluble CP fraction of FM appears to be higher than the soluble CP fractions of CM or SBM.

Key Words: Soluble Protein, Rumen, Dual Flow Fermenters

M316 Supplementation of grazing dairy cows with high-fat dietary protein sources. R. Nyoka*, A. R. Hippen, and K. F. Kalscheur, *South Dakota State University*, *Brookings*.

The effect of supplementing cows on pasture with partial Total Mixed Rations (pTMR) containing different high-fat protein sources on milk yield and milk components was investigated. The objective of the experiment was to investigate the effect of using distiller's grains, soybean meal, and fishmeal as supplements to cows grazing an alfalfa/grass pasture on milk yields and milk components. Multiparious Holstein (n = 18) and Brown Swiss (n = 9) cows were blocked by milk yield and assigned to three dietary treatments in a complete randomized design for an 8 wk experimental period. The first 2 wk were a covariate period in which all 27 cows were fed a common diet. After the covariate period, nine cows in each dietary treatment were fed Soybean (SB), Fishmeal (FM), or Dry Distillers grain (DDG) in a partial TMR. The partial TMR was fed in the morning at a rate to provide 50% of estimated energy intake determined during the covariate period and cows grazed ad libitum on alfalfa pasture from the afternoon till the morning milking. Milk was sampled at all three milkings each day on the last 2 d of the covariate period, every third day during the first 9 d of the grazing period, and the last day of each week for 6 wk. There were no significant ($P > 0.05$) dietary effects observed in milk yield and milk components. Significant ($P < 0.05$) time differences were observed in milk yield and milk MUN content. Significant time*diet interactions ($P < 0.01$) were observed in milk yield with the decline in milk yield greatest in FM followed by DDG and the least in SB based TMR (40%, 34%, and 29% respectively). This research demonstrated that soybean-based supplement supports greater milk production in grazing cows than the lesser ruminally degradable protein sources distillers grains and fish meal.

Key Words: High Protein Diet, High Fat Diet, Grazing

M317 Effects of pure essential oil compounds on the digestion of nitrogen in dairy cows. V. Noirot[1] and C. Bayourthe*[2], [1]*Phodé, Albi, France*, [2]*Ecole Nationale Supérieure d'Agronomie de Toulouse, Castanet-Tolosan, France*.

An *in vivo* study was carried out to evaluate the effect of oral pure essential oil compounds (EOc) on nitrogen (N) digestion. Four non-lactating cows with ruminal, duodenal and ileal cannulas were used in a 4 × 4 Latin square design. EOc was given daily in two equal doses at feeding times with a total dose of either 1 g / head for carvacrol (Cv) and cinnamaldehyde (Cn) or 2 g / head for Cv + Cn (1:1). Each experimental period lasted 21 days, including 14 days of adjustment and 7 days of collection. There was a 3-day interval between two experimental periods during which all the cows received the control (C) diet to return them to the initial state. The markers Cr-EDTA, $YbCl_3$ and purines were used for liquid, particulate matter, and bacteria, respectively. Effects of treatments were determined (PROC MIXED, SPSS) and orthogonal contrasts were used: (C + Cn) *vs* (Cv + [Cv + Cn]). Significance was declared at $P \leq 0.05$ and tendency at $P \leq 0.10$. Compared with C and Cn, Cv and Cv + Cn increased significantly passage of non ammonia N (NAN) to the small intestine (159.8 *vs* 146.4 g / d) and duodenal N (percentage of NAN) of bacterial origin (64.3 *vs* 56.2 %). They also tended to slightly increase the apparent ruminal digestion of feed N ($P = 0.08$) compared with C and Cn. Bacterial synthesis efficiency was significantly improved by Cv treatments (16.6 *vs* 13.9 g N / kg of OM truly digested in the rumen).

Table 1.

	Treatment					P	
	C	Cn	Cv	Cv + Cn	SEM	Treatment	C+Cn *vs* Cv+ [Cv+Cn]
N Intake, g/d	163.0	164.9	166.7	165.2	2.1	0.80	-
Duodenal flow, g/d							
Total N	159.5	160.2	175.6	177.5	5.2	0.05	0.01
Nonammonia N	145.2	147.6	160.6	159.0	5.5	0.18	0.04
Bacterial N	79.7	84.9	101.7	103.8	4.4	< 0.001	< 0.001
Feed N apparent digestion, %	60.2	62.1	64.2	66.4	2.1	0.25	0.08
Microbial synthesis, g N / kg OMTDR	13.5	14.2	16.9	16.3	0.7	0.002	< 0.001

Key Words: Dairy Cow, Essential Oil Compound, Nitrogen

M318 Effects of garlic and juniper berry essential oils on site and extent of digestion by dairy cows. W. Z. Yang*[1], C. Benchaar[2], A. V. Chaves[1], M. L. He[1], and T. A. McAllister[1], [1]*Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada*, [2]*Dairy and Swine R&D Centre, Agriculture and Agri-Food Canada, Lennoxville, QC, Canada*.

An experiment was conducted to evaluate the effects of garlic (GAR) and juniper berry (JUN) essential oils (EO) and monensin (MO) on feed intake, site and extent of digestion, and microbial N synthesis in the rumen. Four mid-lactating Holstein cows with ruminal and duodenal cannulas were used in a 4 × 4 Latin square design (21-d periods) with four treatments: control (no additives), GAR (5 g/cow/d), JUN (2 g/cow/d) and MO (330 mg/cow/d). Cows were fed ad libitum a TMR consisting of 40% forage and 60% barley-based concentrate. Data were analyzed using the PROC MIXED procedure of SAS to account for effects of period, cow and treatments (feed additives). Feed intake averaged 20.4 kg/d and was not affected by the dietary additives. Digestibilities of DM and OM in the rumen were similar between GAR and JUN supplementation, and were increased by 13% ($P < 0.02$) compared to the control and MO. This increase was mainly attributed to the increase in ruminal CP ($P < 0.03$) and starch ($P < 0.15$) digestion. However, GAR and JUN supplementation had no effects ($P > 0.15$) on total-tract digestibilities of DM, OM, NDF, starch and CP. Supplementation of MO reduced ruminal digestibilities of CP (-11%; $P < 0.03$) and NDF (-16%; $P < 0.15$) compared with the control, but did not alter the total digestibility of other nutrients. Flow (g/d) of microbial N to the duodenum was similar ($P > 0.15$) among treatments, whereas the proportion of microbial N in the duodenum (% of intake) was higher ($P < 0.09$) for GAR and JUN (59.8%) than for the control (46.6%) or the MO (47.1%). These results suggest that at the doses evaluated, supplementing dairy cows with GAR and JUN had potential to improve feed digestibility in the rumen but not in the total tract.

Key Words: Essential Cil, Digestion, Dairy Cow

M319 Effect of vegetal extracts on rumen microbial fermentation in batch culture. M. Ruiz Moreno*[1], A. Bach[2,3], J. van Eys[4], and M. D. Stern[1], [1]*University of Minnesota, Saint Paul*, [2]*ICREA, Barcelona, Spain*, [3]*IRTA-Unitat de Remugants, Barcelona, Spain*, [4]*Global Animal Nutrition, Paris, France*.

An experiment using 24 h batch culture incubations was conducted in two consecutive periods to evaluate the effect of four different vegetal extracts on rumen microbial fermentation. Treatments consisted of 300 mg of *Acacia concinna* (AC), *Sapindus mukorossi* (SM), *Yucca schidigera* (YS) or *Sapindus rarak* (SR) extracts, added to 500 mL sealed bottles. An additional set of bottles without vegetal extract was utilized as a control (C) group. Each treatment was randomly assigned in triplicate to the incubation bottles. Three grams of DM (60% forage: 40% concentrate) were provided as substrate for microbial fermentation. Three hundred mL of a 1:4 rumen fluid + buffer mix were anaerobically transferred to each bottle and incubated in an agitation bath at 39 C. At each of the following incubation times, 0, 3, 6, 9, 12 and 24 h, gas pressure was monitored using a digital pressure meter, pH was recorded, and a 10 mL aliquot was anaerobically removed for ammonia and VFA analyses. Cumulative pressure throughout the experiment was calculated by adding individual pressures. Results were analyzed as repeated measures using mixed model by SAS. The control group had a higher pH ($P < 0.05$) than the rest of the treatments (C=6.63; vs SM=6.57; AC=6.58; SR=6.59; YS=6.6). There was a trend ($P < 0.1$) for pH with YS to be higher compared with SM. The SR and YS treatments attained lower ($P < 0.05$) ammonia concentrations (21.4 and 21.3 mg/100 mL, respectively) compared with C (22.6 mg/100 mL), AC (22.2 mg/100 mL) and SM (22.3 mg/100 mL) treatments. No differences in cumulative gas pressure were obtained between treatments ($P > 0.05$). Lower ammonia release after the addition of SR and YS extracts suggests a beneficial use of these extracts in altering ruminal protein degradability.

Key Words: Vegetal Extracts, Rumen, Batch Culture

M320 Adding rare earth elements to beef cattle diets improved in situ digestibility in the rumen and digestibility in the total tract. Q. Liu[1], W. Z. Yang*[2], C. Wang[1], Y. X. Huang[1], K. H. Dong[1], and H.

Wang[1], [1]*College of Animal Sciences and Veterinary Medicines, Shanxi Agricultural University*, *Taigu, Shanxi, China*, [2]*Research Centre, Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*.

Rare earth elements have been used as feed additives for many years in China and recently shown to improve growth performance of pig in Europe. A study was conducted to evaluate the effects of addition of Lanthanum (La) to beef cattle diet on in situ ruminal degradation and digestibility in the total tract. Eight ruminally cannulated steers were used in a replicated 4 × 4 Latin square experiment. Treatments were control, low, medium and high dose of La with 0, 450, 900 and 1800 mg/steer/day $LaCI_3$, respectively. Diets consisted of 60% corn straw and 40% concentrate (DM basis). Corn straw and soybean meal were ground (2-mm) and measured for in situ ruminal digestibility. The duplicated bags were suspended in the rumen of each steer for 0, 4, 8, 12, 24, 36, 48 and 72 h. Increasing the dose of La quadratically ($P < 0.02$) increased ruminal soluble (0.11, 0.19, 0.27 and 0.12) and potential degradable fractions (0.70, 0.72, 0.73 and 0.88), and effective degradability (ED; 39.9, 40.1, 42.1 and 30.3% for control, low, med and high dose of La, respectively) of DM for corn straw. The soluble fraction (0.44, 0.42, 0.42 and 0.38) and ED (58.3, 56.9, 55.0 and 51.3%) of DM were linearly ($P < 0.01$) decreased but the potential degradable fraction (0.52, 0.52, 0.56 and 0.60 for control, low, med and high dose of La, respectively) was linearly ($P < 0.04$) increased with increasing La supplementation for soybean meal,. Digestibilities of OM (72.1, 75.0, 77.9 and 74.5%), NDF (59.4, 62.6, 67.2 and 63.1%) and CP (72.1, 76.2, 77.3 and 75.4% for control, low, med and high dose of La, respectively) in the total tract were quadratically improved ($P < 0.05$). These results indicate that $LaCI_3$ supplementation potentially improved digestibility in the rumen and in the total tract of beef cattle with a dose-dependent manner.

Key Words: Rare Earth Elements, Digestibility, Beef Cattle

M321 Ethanolic extract of propolis in lactating cows. J. A. De Freitas*[1], J. C. De Souza[1], R. P. Lana[2], R. P. Antonangelo[1], A. A. De Freitas[2], and R. T. S. De Santana[1], [1]*Federal University of Parana*, *Palotina, PR, Brazil*, [2]*Federal University of Viçosa*, *Viçosa, MG, Brazil*.

Propolis is a natural product that contains several powerful substances like the flavonoids which have important therapeutic properties. Propolis also seems to have effects upon the rumen bacterial membrane and can be considered as ionophore agent. This study aimed to evaluated the effect of ethanolic extract of propolis (EEP) upon milk and 4% fat corrected milk (FCM) production, milk fat and milk protein in dairy cows. The research was conducted in Federal University of Parana - Brazil. Twenty Holstein cows with an average weight of 600 kg and production of 6000 kg of milk/year were used. The animals were fed ad libitum a diet formulated using the 2001 dairy NRC recommendations. The experiment was analyzed as completely randomized design and two treatments, with 10 animals per treatment, were used: T1 - control treatment - the animals were fed ad libitum a diet formulated to supply energy, protein, minerals and vitamins requirements plus 100 gr of finely ground corn; and T2 - T1 plus 50 mL of 30% EEP. The data were submitted to the analysis of variance and means of treatments were compared at 5% probability. The addition of EEP resulted in increased milk production but did not influence FCM (Table 1). Propolis probably acts upon the Gram-positive bacteria, reducing their growth and methane production, thereby reducing loss of energy in the rumen and increasing the total available energy for metabolism. Milk fat and protein were greater (3.14 vs 3.03 and 2.93 vs 2.80, respectively) in the treatment with EEP addition.

Table 1. Effect of propolis addition upon milk and 4% FCM production

Treatment	Milk (kg/cow/day)	Standard error	4% FCM (kg/cow/day)	Standard error
1 – Control	22.63a	1.30	19.48 ns	1.21
2 – EEP	25.92b	0.91	22.20 ns	0.85

ns – non significative ($p>0.05$).

Key Words: Animal Nutrition, Performance, Ruminal Fermentation

M322 Ruminal bacterial diversity in cattle grazing wheat and supplemented with condensed tannins. B. R. Min*[1], W. E. Pinchak[1], M. E. Hume[2], and R. C. Anderson[2], [1]*Texas Agricultural Research Center*, *Vernon, TX*, [2]*USDA/ARS, Food and Feed Safety Research Unit*, *College Station, TX*.

The objectives of this study were to 1) ascertain relative changes in ruminal bacterial diversity associated with transition from a Bermuda grass hay to a grazed wheat diet, 2) determine relative changes in diversity over 90 days of grazing winter wheat, and 3) bacterial populations response to supplementation with condensed tannin (CT) through the developmental stages of wheat associated peak bloat risk in stocker cattle. Eighteen rumen-cannulated steers were randomly allocated to CT treatments (0, 10, and 20 g CT/kg dry matter intake). Ruminal bacterial diversities were visualized by polymerization chain reaction (PCR)-denaturing gel gradient electrophoresis (DGGE). Dendograms were constructed based on similarity coefficients (% SC) among bands patterns. On day - 30, after steers had been fed Bermuda grass hay for 30 days, ruminal bacterial populations clustered ranging from 82 to 96% SC and exhibited animal to animal variation. Following 30 days (referred as to day 0) adaptation to grazing wheat, variability in bacterial populations within and among animals increased from 68 to 92%. After day 20 day CT supplementation and 50 days grazing wheat, ruminal bacterial similarity (83 to 98% SC) was comparable (82 to 92% SC) to day 0. In contrast, CT supplementation caused ruminal bacterial populations to become more dissimilar (56 to 84% SC). These results clearly document changes in ruminal bacterial populations associated with wheat grazing, animal to animal variation, and CT supplementation over time. The results of this study suggest that molecular-based DGGE facilitated rapid and cost effective visualization of diverse in vivo ruminal bacterial communities among animals, between diets and through time

Key Words: Bacterial Population, Plant Tannins, Wheat Forage

M323 *In vitro* manipulation of rumen fermentation by propolis flavonoids and monensin. S. M. J. Yaghoubi*[1], G. R. Ghorbani[1], H. R. Rahmani[1], and A. Nikkhah[2], [1]*Isfahan University of Technology*, *Isfahan, Iran*, [2]*University of Manitoba*, *Winnipeg, MB, Canada*.

Human health concerns as to the use of ionophore antibiotics in ruminant diets have promoted research on natural plant extracts. Flavonoids are plant pigments comprising polyphenolic compounds

with antimicrobial activity. The primary objective was to determine the effects of 1) the flavonoid extract from propolis (FE) and 2) monensin (MO) on batch culture rumen fermentation in three experiments. The three *in vitro* experiments determined fermentation properties of three diets with forage to concentrate ratios of 1) 100:0, 2) 50:50, or 3) 20:80. Rumen fluid was collected from two fistulated Naeini sheep fed for maintenance and adapted for 14-d to the same diet used as the substrate during the in vitro experiment. The FE doses of 17, 35, 70, and 140 µg/ml and a MO dose of 2.5 µg/ml were added to the three cultures (i.e., three forage to concentrate ratios). Within each forage to concentrate ratio, there was a control culture with no FE and MO. The increasing levels of FE linearly reduced ($P < 0.05$) in vitro 24-h dry matter disappearance in the 50% and 100% forage cultures but increased it in the 20% forage culture. The in vitro ADF disappearance, gas production, and ammonia concentrations were also decreased ($P < 0.05$) by the increasing levels of FE. Both FE and MO decreased pH with 20% but not with 50% dietary forage. With 20% and 50% forages, MO decreased ($P < 0.05$) ammonia and gas production. Also, MO reduced ($P < 0.05$) ADF digestibility with 20% and 100% forages but not with 50% forage culture. Monensin, however, increased ($P < 0.05$) 24-h dry matter digestibility with 20 and 50% but not with 100% dietary forage. The protozoa populations were decreased ($P < 0.05$) by MO and in a dose-dependent manner by FE with 50% and 20% forage diets. Results demonstrated that FE can manipulate the batch culture rumen fermentation. The effects of FE on rumen fermentation were reasonably comparable to that of MO. Therefore, findings offer the perspective that FE may be considered as an alternative for MO. Future in vitro and in vivo studies are essential before such a perspective could turn into an on-farm potential.

Key Words: Batch Culture, Flavonoid, Propolis

M324 Effects of zeolites and monensin on *in vitro* dry matter disappearance, pH change, and volatile fatty acid proportions. B. F. Domeniconi*[1,2], J. P. McMeniman[1], J. T. Vasconcelos[1], and M. L. Galyean[1], [1]*Texas Tech University*, *Lubbock*, [2]*FMVZ-UNESP*, *Botucatu, Brazil*.

Two experiments were conduced to determine the effects of 2 different zeolites and monensin on IVDMD and VFA proportions (Exp. 1) and in vitro pH changes over time measured with a reduced buffer fermentation (Exp. 2) of a 90% concentrate diet. Dietary treatments in both experiments were: 1) biolite (BIO); 2) maxibond (MAX); 3) monensin (MON); and 4) control (CON). All products were included in a 90% concentrate steam-flaked corn-based diet. The BIO and MAX additives were included at 2% of DM, and the MON and CON diets contained 2% (DM basis) of an inert substance (sand). Monensin was added to the cultures in 100 µL of ethanol to provide 4 µg/mL of culture, with an equal volume of ethanol added to other cultures. For Exp. 1, diet substrates (approximately 0.5 g in duplicate) were incubated with 35 mL of a 4:1 McDougall's buffer-to-ruminal fluid mixture for 0, 2, 4, 8, 24, and 36 h at 39°C, followed by a 48-h incubation in acidified pepsin solution. For Exp. 2, the same procedures were followed, except that the McDougall's buffer was diluted to 25% strength with 0.9% (wt/vol) saline, and culture pH was measured with a combination electrode at 0, 0.5, 2, 4, 8, 12, and 24 h. Ruminal fluid was obtained approximately 4 h after feeding from 2 ruminally cannulated steers fed a 75% concentrate diet. Both experiments were replicated in 2 separate runs. The IVDMD differed only at 8 h of incubation, being greater for MON than for BIO ($P = 0.03$) and MAX ($P = 0.02$). No differences ($P > 0.10$) in pH at the various incubation times were observed among treatments. For VFA in culture fluid after the 36-h incubation period of Exp. 1, MON increased propionate compared with MAX ($P = 0.01$) and BIO ($P = 0.03$), whereas proportions of acetate were greater for MAX ($P = 0.01$) and BIO ($P = 0.05$) than for MON. No differences in VFA proportions were observed between the 3 treatments and CON for either acetate ($P = 0.43$) or propionate ($P = 0.84$). Data suggest that adding 2% of these 2 zeolites to a high-concentrate diet did not markedly alter IVDMD or changes in pH compared with monensin, but both zeolites increased acetate relative to monensin.

Key Words: IVDMD, Monensin, Zeolites

M325 Preservation of enzymatic activities in a liquid extract obtained after *Agaricus bisporus* growth. M. Ayala–Martínez[1], S. S. González*[2], G. D. Mendoza–Martínez[3], C. Vázquez–González[1], M. Meneses–Mayo[2], O. Loera[4], and J. H. Avellaneda–Cevallos[5], [1]*UNAM*, *México D.F.*, [2]*Colegio de Postgraduados*, *Montecillo, Edo. México, México*, [3]*UAM Xochimilco*, *México D.F.*, [4]*UAM Iztapalapa*, *México D.F.*, [5]*Universidad Tecnica Estatal de Quevedo*, *Quevedo, Ecuador*.

The objective of this study was to evaluate lignocellulolytic enzymes and soluble protein in a crude extract from a compost after harvesting *Agaricus bisporus* body fruits at 50, 60 and 90 days culture times. Then crude extract was subjected to preservation treatments: refrigeration (R); R + benzoic acid (RB); freezing (F); F + B (FB); F + glycerol (FG); F + G + B (FGB); liophilization (L). Residual enzymatic activities were measured at 1, 7, 14, 28, 56 and 101 days after preservation. The experimental design was completely randomized, an ANOVA was performed and means were compared with Tukey test ($P \leq 0.01$). A difference ($P \leq 0.01$) was found according to culture times (50, 60 and 90 days) for xylanases (4361a, 3124b, 587c IU/g), cellulases (17b, 25a, 9c IU/g|), laccases (2502b, 3279ab, 4657a IU/g) and soluble protein (0.62a, 0.64a, 0.41b mg/g), with the highest values at 50 and 60 days. For conservation treatments the best results were for FB for xylanases (1323 IU/g), F for cellulases (9.09 IU/g), FG for laccases (3714 IU/g), and FB for soluble protein (0.75 mg/g).

Key Words: Fibrolytic Enzymes, Preservation Methods, *Agaricus Bisporus*

M326 Activity of fibrolytic enzymes by *Trametes sp.* EUM1, *Pleurotus ostreatus* IE8 and *Aspergillus niger* AD96.4 in solid-state fermentation. A. T. Márquez-Araque[1], G. D. Mendoza-Martínez[2], S. S. González*[3], S. E. Buntinx-Dios[4], and O. Loera[5], [1]*UNAM and UCLA*, *México D.F. and Caracas, Venezuela*, [2]*UAM Xochimilco*, *México D.F.*, [3]*Colegio de Postgraduados*, *Montecillo, Edo. México, México*, [4]*UNAM*, *México D.F.*, [5]*UAM Iztapalapa*, *México D.F.*

The objective of this study was to determine the activity of fibrolytic enzymes (xylanases, celullases and laccases) from the fungi *Trametes sp.* EUM1, *Pleurotus ostreatus* IE8, and *Aspergillus niger* AD96.4 at 14 and 19 d of fermentation on sugar cane bagasse. The fibrolytic activity was expressed as IU/g DM and as specific activity (IU/mg protein). The experimental design was completely randomized with four replicates per treatment, and means were compared with Tukey test ($P \leq 0.01$). *Trametes sp.* EUM1 showed higher activity ($P \leq 0.01$) of xylanases (141.77 IU/g DM and 1073.8 IU/mg protein) and celullases

(9.04 IU/g DM and 69.16 IU/mg protein) as compared to *P. ostreatus* IE8 and *A. niger* AD96.4. The higher (P≤0.01) laccases activity was expressed by *P. ostreatus* IE8 (15.54 IU/g DM and 128.75 IU/mg protein) at 14 and 19 d (11.75 IU/g DM and 102.88 IU/mg protein). For *Trametes sp*. EUM1 the laccases activity was similar at both fermentation times (3.45 and 2.03 IU/g DM) and lower (P≤0.01) than *P. ostreatus* IE8. For *A. niger* AD96.4 the laccases activity was significantly low. The activity of fibrolytic enzymes by *Trametes sp.* EUM1 suggests a potential for biotechnological applications in ruminant nutrition.

Key Words: Fungus, Fibrolytic Enzymes, Times of Fermentation

M327 Feed intake, nutrient digestibility and animal growth performance in sheep and goats fed wheat straw *ad lib*. in presence of ZADO as direct feed of anaerobic enzymes and bacteria. A.-F. Salem*[1], M. El-Adawy[1], H. Gado[2], and M. Khalil[3], [1]*Department of Animal Production*, *Faculty of Agriculture (El-Shatby), Alexandria University, Alexandria, Egypt*, [2]*Department of Animal Production*, *Faculty of Agriculture, Ain Shams University, Cairo, Egypt*, [3]*Animal Production Research Institute*, *Ministry of Agriculture, Dokki, Gizza, Egypt*.

Six crossbred sheep (32 kg BW) and six Baladi goats (18 kg BW) were used to evaluate the effect of ZADO (new probiotic, patent No. 22155) as feed direct microbials on feed intake, apparent digestibility and animal growth performance. Sheep and goats were randomly divided into two groups of three animals and fed wheat straw *ad lib*. as a basal diet and commercial concentrate with or without 10g/animal/d of ZADO. A growth performance trial of 65-days was ended by a digestibility trial of 21-days for each individual animal within each group. Feed intake was not affected (P>0.05) by ZADO addition neither in sheep nor goats but it improved the nutrients digestibility coefficients as well as total digestible nutrient of feed in sheep and goats. ZADO significantly increased (P<0.001) the neutral detergent fiber digestibility of diet. The improvement (P<0.001) was more in goats than sheep. Average daily gain and feed efficiency were improved (P<0.05) by addition of ZADO, and the improvement was more in goats than sheep. Calculated net energy required for one kg gain was decreased (P<0.05) by inclusion of ZADO in diets and the decease was more in goats than sheep. Improving the animal performance by addition of ZADO was as a consequence to the improvement in digestibility in sheep and goats. In conclusion, ZADO had improved the nutritive value of wheat straw, as a basal diet in sheep and goats and suggested that its useful roles in activating the ruminal fiber degrading enzymes.

Key Words: Feed Intake, Growth Performance, Sheep

M328 Performance of Holstein cows fed diets containing either alfalfa hay or Tifton 85 bermudagrass with or without a cellulase enzyme. J. K. Bernard*[1], J. W. West[1], and A. T. Adesogan[2], [1]*The University of Georgia*, *Tifton*, [2]*The University of Florida*, *Grainesville*.

Forty-four lactating Holstein cows were used in an 8-wk completely randomized trial with a 2 × 2 factorial arrangement of treatments to determine the effect of forage source and supplemental cellulase enzyme on performance. Diets were based on two forage combinations (corn silage plus 12.5 % DM from either alfalfa hay (**AH**) or Tifton 85 bermudagrass haylage (**T85**)) with (+) or without (-) a commercial cellulase enzyme (Promote N.E.T.-L, Agribrands Purina Canada, Inc., Woodstock, Ontario, Canada). Diets were formulated to provide similar concentrations of protein (16.5% of DM), energy (1.63 Mcal NE_L /kg of DM) and NDF (41.7 % of DM) and were fed once daily as a TMR behind Calan doors for ad libitum intake. The cellulase enzyme was applied at the rate of 4 gram hd^{-1} d^{-1} to the TMR and allowed to mix for 5 min before feeding. The cellulase enzyme provided 1,200 cellulase units of activity per gram. Before beginning the trial, all cows were trained to eat behind Calan doors and then fed the alfalfa hay based diet for 2 wk. Data collected during wk 2 were used as a covariant in the statistical analysis. At the beginning of the 6 wk experimental period, cows were assigned randomly to one of the four experimental diets. No interactions were observed among forage and enzyme for any measures. Daily DMI, milk yield, concentrations milk fat, true protein, lactose, and SNF, 3.5% FCM yield, and dairy efficiency were similar among treatments: 24.3, 41.3, 3.76, 2.81, 4.69, 8.41, 43.0 and 1.78; 24.2, 40.4, 3.70, 2.81, 4.66, 8.37, 41.8 and 1.73; 24.9, 42.1, 3.63, 2.75, 4.65, 8.32, 43.0 and 1.73; 24.6 kg/d, 41.6 kg/d, 3.68% , 2.81%, 4.68%, 8.41%, 42.8 kg/d and 1.74 for AH-, AH+, T85-, and T85+, respectively. These results indicate that Tifton 85 bermudagrass can replace alfalfa hay in rations fed to high producing lactating dairy cows when rations are balanced for NDF. Although cellulase enzymes have been shown to improve ration digestibility and animal performance, there were no advantages observed in the current trial.

Key Words: Tift 85 Bermudagrass, Alfalfa Hay, Milk Yield

M329 Effects of enzyme formulations on roasted grains and rations that contain them. K. F. Wilson*[1], G. V. Pollard[2], and C. R. Richardson[3], [1]*Animal Feed Technologies*, *Greeley, CO*, [2]*Texas State University*, *San Marcos*, [3]*Texas Tech University*, *Lubbock*.

The efficacy of enzymes for improving the nutritional valve over a broad spectrum of feedstuffs is evident and established. However, due to different feeding practices and processing methods, the affects of enzyme formulations are vague and constantly needing evaluation. Thus, an IVDMD study was conducted to determine and establish what effects Cattle-Ase™ C (corn specific) or Cattle-Ase™ S (sorghum specific) enzyme formulations could have on roasted grains and rations that contain them. Samples for corn and sorghum were collected at two different locations, however both feeding operations fed similar ration formulations with the exception of the grain source. The feedstuffs evaluated included roasted corn or roasted sorghum and subsequent rations formulated for starter and finishing cattle. Dry-matter disappearance was evaluated utilizing the Moore modification of the Tilley-Terry procedure at fermentation times of 24 h and 48 h. Results showed that at 24 h, Cattle-Ase treated samples had enhanced digestion. Yet, only the roasted corn, finished corn ration, and the roasted sorghum samples were improved (P = 0.0004, 0.020, and 0.018). At 48 h, the Cattle-Ase treatment still enhanced digestion, but only the roasted sorghum rations were improved (P = 0.007 and 0.005). On average, regardless of substrate and enzyme formulation, the Cattle-Ase treatments enhanced digestion by 17.8% at 24 h and 17.6% at 48 h. Moreover, the results appeared to show that Cattle-Ase C treated substrates responded best at 24 h vs. 48 h, and Cattle-Ase S treated substrates responded best at 48 h vs. 24 h. These responses most likely are attributed to the starch solubility of corn vs. sorghum.

Therefore, it is likely that Cattle-Ase has more of an affect on the rate vs. extent of digestion. As seen in other invitro studies, high-energy feedstuffs show their greatest response within the first 24 h, but tend to level off and show minimal returns to Cattle-Ase′s inclusion at longer periods.

Key Words: Enzyme, Roasted Grain, In Vitro

M330 Effects of monensin, virginiamycin and sodium bicarbonate on rumen fermentation of beef cattle fed medium concentrate. H. Y. Wei, J. Q. Wang*, C. H. Li, D. P. Bu, and L. Y. Zhou, *State Key Laboratory of Animal Nutrition,Institute of Animal Science,Chinese Academy of Agricultural Sciences*, *Beijing, China*.

To assess potential of preventing chronic acidosis in beef cattle fed medium concentrate, effects of monensin, virginiamycin and sodium bicarbonate on ruminal fermentation and fecal pH were studied in a 4×4 Latin-square trial over 64d with four ruminal cannulated steers. The basal diet (8.9 kg DM/hd/d) was fed for control(C), monensin (M; 180 mg/d), virginiamycin (V; 180 mg/d) or sodium bicarbonate (N; 120 mg/d) treatments. The basal diet included 40% Chinese wildrye hay and 60% concentrate. Ruminal pH at 0, 2, 4, 6, 9 and 12h after morning feeding was not different and when averaged was 6.44, 6.51, 6.49 and 6.50 for C, M, V and N, respectively. Also, ruminal total VFA at 0, 2, 4, 6, 9 and 12h after morning feeding were not different and averaged 88.29, 88.18, 95.38 and 92.79 mMol for C, M, V and N, respectively. Average acetate for C, M, V and N was 58.89, 55.63, 62.83 and 61.69 mMol, respectively and that of M was significantly less (p=0.03) than that of V. Average propionate for M (22.41mmol/L) was significantly higher (p=0.0002) than C, V and N (17.45, 17.87 and 18.45 mMol, respectively). Average L-lactic acid for C, M, V and N was 5.12, 4.63, 4.19 and 4.46 mMol (p=0.012) respectively. The potential for L-lactic acid accumulation in vitro was different (p=0.001) for C, M, V and N (6.56,5.98,5.33 and 6.35 mMol). Fecal pH for C, M, V and N was 6.39, 6.85, 6.84 and 6.58 (p=0.0001) respectively. For beef cattle fed medium concentrate, these results indicated that 1) supplementation of monensin and virginiamycin can inhibit lactic acid accumulation in rumen liquid, while virginiamycin tended to be more potent and sodium bicarbonate had little effect; 2) monensin and virginiamycin play a role not only in the rumen but in hind gut, whereas sodium bicarbonate mainly works in the rumen.

Key Words: Ionophores, Sodium Bicarbonate, Beef Cattle

M331 Effects of monensin and *Yucca schidigera* extract on metabolism by ruminal microbes in dual flow continuous culture fermenters. M. Ruiz Moreno* and M. D. Stern, *University of Minnesota*, *St. Paul*.

The effects of Monensin (M) and *Yucca schidigera* extract (YSE) on rumen fermentation were evaluated using a dual flow continuous culture system. Eight fermenters were inoculated with ruminal fluid from a dairy cow in early lactation on day 1 of two 10-d experimental periods. A 58:42 concentrate:forage diet (DM basis) was formulated with 0 (YS0) or 80 ppm (YS80) of YSE as substrate for fermentation. Two concentrations of Monensin, 0 (M0) and 5 ppm (M5), were continuously infused into the fermentation vessels via the artificial saliva. The YS0, YS80, M0 and M5 treatments were randomly assigned in a 2 × 2 factorial arrangement of treatments with two replicates per period. Apparent and true OMD were not affected ($P > 0.05$) by M (42.2 vs 39.6% and 56.1 vs 53.2% for M0 vs M5, respectively) or by YSE (39 vs 42.8% and 52.8 vs 56.6% for YS0 vs YS80, respectively). Maximum pH attained in fermenters was lower ($P < 0.05$) for YS80 than for YS0 (6.14 vs 6.32). Total VFA (140.9 vs 102.7 mM) and propionate concentrations (21.2 vs 36.9 mol/100 mol) were greater ($P < 0.05$) while acetate (63.4 vs 53.9 mol/100 mol), butyrate (10.3 vs 5.3 mol/100 mol), isovalerate (0.28 vs 0.13 mol/100 mol) and 2-methylbutyrate (1.19 vs 0.34 mol/100 mol) were lower ($P < 0.05$) for M5 vs M0 treatment. Total branched chain VFA were greater ($P < 0.05$) with M5 than M0 (1.8 vs 0.7 mol/100 mol), while the A:P ratio was greater ($P < 0.05$) with the M0 treatment (3.11 vs 1.48). Supplementation with YS80 increased ($P < 0.05$) isovalerate (0.29 vs 0.13 mol/100 mol), isobutyrate (0.36 vs 0.20 mol/100 mol) and decreased ($P < 0.01$) 2-methylbutyrate (0.16 vs 0.37 mol/100 mol) compared with YS0. Ammonia N concentration, bacterial N flow, efficiency of microbial protein synthesis and CP degradation were not affected ($P > 0.05$) by the addition of M or YSE. Monensin had substantial effects on total VFA concentration and VFA proportions, while YSE supplementation at 80 ppm only affected branched chain VFA concentrations and maximum pH.

Key Words: Rumen, Monensin, *Yucca Schidigera*

M332 Effects of Yea-Sacc1026 supplementation on rumen pH of loose-housed dairy cattle. A. Bach*[1] and S. Andrieu[2], [1]*Institut de Recerca i Tecnologia Agroalimentàries (IRTA)*, *Barcelona, Spain*, [2]*Alltech Biotechnology Centre*, *Dunboyne, Ireland*.

The aim of this study was to determine the effects on rumen pH of live yeast supplementation in loose-housed dairy cows. Four multiparous lactating rumen-cannulated cows were supplemented (YS) or not (C) with live yeast for 2 periods of 6 wk each, following a cross-over design. The live yeast was top-dressed on the TMR with a single dose of 10 g/d (equivalent to 5x10E10 CFU/d) of Saccharomyces cerevisiae strain 1026 (CBS 493.94, Alltech). The 4 cows were in a group of 50 cows in total, with access to 28 feeding places. During the last 8 d of each period, rumen pH was monitored every 15 min. pH was recorded with an automatic pH meter, placed inside a custom-made PVC pipe with 300 g of lead to ensure that the device remained in the ventral part of the rumen throughout experiment. The rumen was only accessed once every 2 days during samplings. The data were analyzed using a mixed model with repeated measures accounting for the random effect of each cow, and fixed effects of yeast, day of sampling, time since last TMR eating bout, time since previous concentrate consumption, and interaction of yeast with the remaining fixed effects. Yea-Sacc (YS) supplementation did not affect any of the studied feeding behaviors nor DMI. Rumen pH was numerically (P = 0.32) greater for YS than for Control (6.65 vs 6.48. respectively). The coefficient of variation (CV) was numerically lower for YS than for Control (4.91 vs 6.27%, respectively). The average minimum pH for YS (6.53) was numerically greater than the average minimum pH of Control (5.40). Conversely, and in line with the greater variation in rumen pH, the maximum average rumen pH of YS cows was 7.53, whereas the average maximum rumen pH for the C cows was 7.68. YS cows had only 11.1% of their rumen pH below the threshold of 6.2, whereas 26.2% of the rumen pH values were below 6.2 in the C cows. The area under the pH 6.2 for the Control was 0.76±0.09 pH x h/d, whereas the area under the pH 6.2 for YS was 0.67±0.09 pH x h/d (P < 0.05). The results indicate

that live yeasts may have a beneficial effect on rumen pH with cows kept in loose-house conditions receiving rations similar to the one of this study

Key Words: Ruminant, pH, Live Yeast

M333 Rumen fermentation patterns of dairy heifers fed restricted amounts of high, medium, and low concentrate diets and the addition of *Saccharomyces cerevisiae*. G. J. Lascano* and A. J. Heinrichs, *The Pennsylvania State University*, *University Park*.

The objective of this experiment was to investigate ruminal fermentation and *in situ* digestibility of 3 levels of forage:concentrate in diets fed at restricted levels. Three cannulated post-pubertal Holstein heifers (age 18 ± 1 mo; BW 450 ± 20 kg) were fed corn silage (CS)-based diets in a 3-period (35 d) Latin Square Design. Heifers were fed diets for 21 d with no yeast addition, followed by 14 d where yeast culture (YC) was added (1 g/kg as fed basis). A high concentrate (HC) TMR (40% CS, 60% grain; 12.6% CP, 25% NDF), a medium concentrate (MC) TMR (60% CS, 40% grain; 12.3% CP. 28% NDF), and a low concentrate (LC) TMR (80% CS, 20% grain; 12.4% CP, 35% NDF) were fed once/d on a restricted basis to provide 0.22 Mcal ME intake/kg $EBW^{0.75}$. Actual N intake was 165.99 HC, 181.69 MC, 175.21 LC ± 4.3 g ($P > 0.05$). Rumen fluid was sampled on d 18 and d 32 of each period; rumen contents were removed on d 21 and d 35. In situ digestibility was determined on d 15 to 17 and on d 30 to 32. MC diets were incubated with each diet as a control. HC rations had increased in situ rate of DM disappearance (DMD) compared to LC (4.8 vs. 3.4 ± 0.4%/h; $P < 0.06$), but no differences when compared to MC (4.8 vs. 4.0 ± 0.4%/h; $P > 0.1$). No differences were observed in MC in situ digestibility. Mean rumen pH was not different between treatments (6.32, 6.30, 6.30 ± 0.07; $P > 0.1$) and no YC effect was detected. Mean rumen NH3-N concentration was not different among treatments (4.5, 4.7, 4.5 ± 0.7 mg/dL; $P > 0.1$), but YC addition decreased NH3-N in all treatments ($P < 0.01$). Total wet and dry rumen contents, and DM turnover were different between all treatments ($P < 0.01$). From these results we conclude that feeding HC diets in restricted amounts increases DMD rate while having minimal effects on rumen fermentation patterns between different forage:concentrate diets. YC modified NH3-N utilization in the rumen in all 3 diets in this study.

Key Words: Forage:Concentrate, Rumen Fermentation, Yeast Culture

M334 Addition of three yeast cultures to diets for dairy cows in mid-lactation. K. E. Cowles*[1], M. R. Murphy[1], and J. W. Jones[2], [1]*University of Illinois*, *Urbana*, [2]*Western Yeast Co.*, *Chillicothe, IL*.

Our objective was to compare the effects of three concentrated yeast cultures fed with a totally mixed ration to dairy cows in mid-lactation. Eight multiparous Holstein cows (averaging 155 DIM at the start of the trial) were assigned to one of two 4 × 4 Latin squares, blocked by average daily milk yield for the previous week. Cows received a basal diet composed of corn silage, alfalfa silage, chopped alfalfa hay, ground corn, soybean meal, whole cottonseed, wet brewers grain, vitamin-mineral mix, and monensin. The four treatments included: control (14 g of cornmeal), 14 g of Western Yeast Cel-Con, 14 g of Western Yeast Cel-Con-5, or 14 g of Diamond V-XPC yeast. Dosages were according to tag instructions and treatments were topdressed daily at 1000 h. Experimental periods were 21-d long. Cows were milked twice daily at approximately 0600 and 1600 h. Milk composition was analyzed once weekly. Cows were administered Cr_2O_3 twice daily for the last 10 d of each period. Fecal grab-samples were collected twice daily for the last 5 d of each period, composited, and subsampled for Cr_2O_3 analysis. Data were analyzed using the MIXED procedure of SAS. One cow was removed after period 1 because of teat injury. Dry matter intake, 3.5% FCM yield, milk fat percentage and yield, milk protein percentage and yield, FCM:DMI, and apparent total-tract digestibility of DM were unaffected by treatment. Yeast cultures did not affect measured variables; however, stage of lactation and increased variation because of heat stress likely reduced experiment sensitivity.

Table 1.

	Treatment					
	Control	Cel-Con	Cel-Con5	DV-XPC	SE	*P*-value
DMI, kg/d	21.9	20.8	20.8	22.1	1.60	0.898
BW, kg	656	627	625	635	23.71	0.761
3.5% FCM, kg/d	31.3	29.5	29.9	31.1	2.20	0.915
Milk fat , %	2.88	2.89	2.86	2.91	0.11	0.992
Milk fat, kg/d	1.01	0.94	0.99	1.01	0.10	0.992
Milk protein, %	2.89	2.88	2.85	2.88	0.17	0.997
Milk protein, kg/d	0.89	0.86	0.88	0.90	0.07	0.975
FCM:DMI	1.37	1.39	1.51	1.45	0.08	0.561
DM digestibility, %	55.3	57.1	54.3	56.5	1.57	0.669

Key Words: Yeast Culture, Dairy Cow, Digestibility

M335 Effects of dietary yeast culture supplementation on milk production and somatic cell counts at a commercial dairy. C. R. Richardson*[1,3], D. W. Boyles[2], D. B. Wester[3], H. P. Hagaman[1,3], J. E. Vander Dussen[1,3], and G. V. Pollard[4], [1]*The Center for Feed Industry Research and Education*, *Lubbock*, [2]*LDJ Nutrition*, *Lubbock, TX*, [3]*Texas Tech University*, *Lubbock*, [4]*Texas State University*, *San Marcos*.

Sixteen pens of lactating Holstein cows were utilized in a 64 d yeast culture supplementation experiment to determine the effects of yeast source on milk production, somatic cell counts, feed intake, and health status. Treatments evaluated were: control, GRO-TEC, yeast, Diamond V yeast, and Western yeast. Upon initiation of the trial, 3,600 cows were utilized. As the daily cow husbandry protocol demanded, cow pen movements reduced the final number of cows used in the statistical evaluation of this experiment to 2,213 hd. Cows that did not remain in the same pen throughout the duration of the experiment were eliminated. Pen was the experimental unit for statistical comparison. Milk test days for variables being studied were: initial on August 7, month one of September 11, and month two on October 9. Means for variables were calculated by treatment for all cows in treatment pens (n=2,213) and also for those cows in mid-lactation (n=1,014). Mid-lactation cows were those over 60 d in milk or less than 230 d in milk. There were no differences among yeast sources across treatments for milk production (P=0.2656 for all cows and P=0.2180 for mid-lactation cows), or for somatic cell counts (P=0.1926 for all cows and P=0.4846 for mid-lactation cows). Milk production ranged from 32.1 kg/d to 34.8 kg/d, while somatic cell counts varied from

83,700 to 186,000.Milk production and somatic cell counts differed by month for all cows (P = 0.0001 and P = 0.008) and for mid-lactation cows P = 0.0001 and P = 0.080), respectfully. This study indicates possible benefits from yeast supplementation in high lactation Holstein cows and may be related to somatic cell counts.

Key Words: Lactation, Milk Production, Yeast Culture

M336 Blood metabolites in Holstein steers fed diets with different concentrate to alfalfa hay ratios. A. R. Vakili, M. Danesh Mesgaran*, A. Heravi Moussavi, and R. Valizadeh, *Ferdowsi University*, *Mashhad, Khorasan, Iran*.

In dry and semiarid regions, because of low pasture availability, ruminant diets are based on concentrates. The objective of the present experiment was to investigate the effect of diets providing different concentrate to alfalfa hay ratios on blood metabolites in Holstein steers. Four Holstein steers with initial body weight of 300±15 kg fitted with ruminal Fistulae were used in a 4×4 Latin square design (28 days of each period). Animals were fed 7 kg of DM of diets differing in concentrate [155 g CP kg-1 of DM; consisted of maize, barley, soybean meal, sugar beet pulp, wheat bran, cottonseed meal, CaCo3, mineral and vitamin premix, salt (30, 34, 8, 5, 10, 12, 0.3, 0.5, and 0.2 g/100g DM; respectively)] to alfalfa hay ratios as 60:40 (C_{60}:L_{40}), 70:30 (C_{70}:L_{30}), 80:20 (C_{80}:L_{20}) and 90:10 (C_{90}:L_{10}). Steers fed the experimental diets as total mixed ration twice daily at 0800 and 2000 h. At day 24 of the each experimental period, blood samples were taken from jugular vein before the morning feeding, 2, 4 and 6 h post feeding. Serum samples were measured for glucose and urea N by Spectrophotometer (CE 1021, England). Data were analyzed using the GLM procedure of SAS and the means compared by the Duncan test (P <0.05). Blood glucose was similar among diets but blood urea N was affected by treatments. The results of this study indicated that the blood glucose values were not significantly influenced by the concentrate to alfalfa hay ratios but urea N values were influenced significantly.

Table 1. Blood glucose and urea N (mg/dl) in Holstein steers fed diets differing in concentrate: alfalfa hay ratios

Item	Time (h)	Concentrate: alfalfa hay ratio[1]				
	Treatment effect					
	60:40	70:30	80:20	90:10	SEM[2]	P
Glucose	0.0	86.95	87.50	85.72	89.91	4.46	0.31
	2.0	84.50	87.82	86.10	93.37		
	4.0	89.42	91.78	95.27	84.74		
	6.0	93.20	93.40	90.60	92.78		
Blood Urea N	0.0	10.36	7.71	8.11	9.41	0.5	0.04
	2.0	11.42	9.72	11.46	9.90		
	4.0	11.10	9.50	10.82	8.80		
	6.0	10.62	10.22	10.03	9.13		

1: Values were reported as the mean of four sampling periods. 2: SEM= Standard Error of Mean

Key Words: Fistulae, Blood Metabolites, Alfalfa Hay

M337 Effects of corn and alfalfa particle size on ruminal fermentation, digestibility and chewing activity of dairy cows in midlactation. Z. J. Cao*, S. L. Li, M. Ma, and L. L. Wang, *China Agricultural University*, *Beijing, China*.

This study evaluated the effects of, and interactions between, corn particle size and alfalfa particle size on dry matter intake (DMI), milk production, milk composition, ruminal fermentation, microbial yield, chewing activity and nutrient digestibility in midlactating dairy cows. Four multiparous Holstein cows with ruminal cannulas, averaging 595 kg (SD =52) of body weight and 121 DIM (SD= 21) at the start of the experiment, were assigned randomly to a 4 × 4 Latin square design. Experimental periods were 21 d in length (14 d of treatment adaptation and 7 d of data collection). All diets were fed as TMR and were formulated to meet or exceed the requirements of a 600 kg multiparous cow producing 20 kg milk/ d with 4.0% fat. The ratio of concentrate to forage was 40:60 (DM basis). Treatments were arranged in a 2 × 2 factorial design; two levels of alfalfa particle size (2.54 cm and 6.22 cm) were combined with concentrates based on either ground corn (711 µm) or cracked corn (1755 µm). Corn and alfalfa particle size did not affect DMI, milk production and milk fat percentage. Milk protein percentage increased when corn particle size was decreased (P=0.04). Milk urea nitrogen was lower for cows fed ground corn compared to cracked corn (118 vs 134 mg/ l, P=0.05). Estimated microbial N supply increased 41.9 g/d for ground corn compared to cracked corn. Cows fed long alfalfa hay spent more time ruminating compared with cows fed short alfalfa hay ranging from 293 to 336 min/d (P<0.001). Total time spent on chewing by cows increased from 505 to 574 min/d (P=0.002) for short alfalfa and long alfalfa, respectively. Based on the results from this study, dairy cows can be fed diets that contain ground corn and short alfalfa hay without leading to negative effects on rumen pH or nutrient digestibility.

Key Words: Corn Particle Size, Alfalfa Particle Size, Ruminal Fermentation

M338 Effect of feeding pistachio by-product on milk yield, apparent nutrient digestibility and chewing activity of early lactation Holstein cows. A. Bohluli, A. A. Naserian*, R. Valizadeh, and F. Eftekharshahroodi, *Ferdowsi University*, *Mashhad, Iran*.

Eight multiparous Holstein cows in early lactation (57 ± DIM) were assigned into a replicated 4 × 4 Latin square design with 3-wk periods to study the effect of Pistachio By-product (PB) on their performance. Control diet consisted of 60% concentrate, 20% alfalfa, 5% cottonseed, and 15% corn silage. Pistachio by-product was substituted with corn silage at 0, 5, 10, and 15% in DM of control diet according to treat 1 to 4. DMI, daily milk yield and composition were not affected by treatments, although fat daily yield, Economically Corrected Milk (ECM) and 4% FCM were decreased linearly (P<0.1) and daily milk protein yield was increased quadratically (P<0.15) by increasing PB level in the diet. Milk urea nitrogen and Blood concentration of glucose, urea, and Hb were not affected by treatments. Urine pH was increased from 7.7 to 8.0 linearly (P<0.01) from T1 to T4. Crud protein digestibility was similar for all diets (P<0.15), but by increasing PB level in the diet, digestibility of DM, OM, NDF and ADF were decreased linearly (P<0.05). Daily rumination and chewing activity alone or per DM, NDF or ADF daily intake were linearly decreased when PB level increased in the diet (P<0.05). It seems the reduction in milk fat might be due to decrease in structural carbohydrate digestion and chewing activity by increasing PB in the lactating cow diet. The

results show the pistachio by-product can be used as a part of forage in the lactating cow diet; however it cannot be a perfect substituting for roughages in the diet.

Table 1.

Item	T1	T2	T3	T4	SEM
DMI, kg/d	30.4	30.6	31.5	30.6	0.29
Milk, kg/d	47.0	46.2	46.4	45.7	0.26
ECM, kg/d	46.0	45.8	46.4	43.0	0.3
FCM, kg/d	40.2	40.0	39.3	37.8	0.29
Fat, kg/d	1.43	1.44	1.38	1.30	0.07
Pro., kg/d	1.47	1.46	1.51	1.40	0.05
MUN, mg/dl	17.8	17.3	16.9	16.8	0.35
DDM, %	70.3	68.8	68.4	67.7	0.27
DOM, %	71.7	70.1	69.4	68.4	0.26
DCP, %	71.2	70.2	70.9	69.6	0.3
DNDF, %	55.3	53.2	50.9	51.0	0.35
DADF, %	54.1	49.6	48.6	47.0	0.43
Chew., h/d	14.5	13.1	12.8	10.5	0.25
Che/NDFI, min/kg/d	95.1	88.2	87.5	74.7	0.67

Key Words: Pistachio By-Product, Milk Yield, Apparent Digestibility

M339 Probiotics in growing pre-ruminant calves. J. B. Cannon*[1], D. L. Harmon[1], K. R. McLeod[1], and A. J. Gallegos[2], [1]*University of Kentucky*, *Lexington*, [2]*synBios*, *SA de CV Queretaro, Mexico*.

This study evaluated the addition of a Bacillus-based probiotic to milk replacer and starter for preruminant calves. Thirty-four dairy calves (1 to 4 d old) were housed individually and blocked by sex and birthdate with treatments assigned randomly within blocks. The treatments were probiotic (Bacillus subtilis + Bacillus licheniformis; 10^9 cfu/day) added to the milk replacer and starter or control (no additive). During the study, probiotic treated calves received a commercial starter containing 10^6 cfu/g starter while control calves were offered starter with no additive. All calves received a milk-based milk replacer containing their treatment during the initial 14 days on the experiment. On d 15, they were abruptly switched to a soy-based milk replacer. All calves remained on the soy-based milk replacer and their respective treatment until weaning. Weaning occurred when starter consumption exceeded 1% of body weight for three consecutive days. After 42 days on the study, unweaned calves were reduced to one feeding of milk replacer daily to promote increased starter intake. Weaned calves were maintained on their respective treatments through the total of 56 days on experiment. Dry matter intake (sum of the two food sources) was recorded daily and fecal output was scored (fecal scoring: fluidity, 1=normal, 2=soft, 3=runny, 4=watery; Consistency, 1=normal, 2=foamy, 3=mucus, 4=sticky, 5=constipated; Odor, 1=normal, 2=slightly offensive, 3=highly offensive). A scour day was recorded if fluidity=3 or 4, consistency=3, and odor=2 or 3. Calves were weighed weekly and measured for hip and wither height, hip width and heart girth. Blood samples were collected weekly for determination of hematocrit. Treatment did not affect days to weaning, however calves receiving the probiotic treatment had numerically greater ADG and BW gain (24.6 vs. 22.0 kg). There were no differences between treatments in feed efficiency, scour days per calf, hematocrit, hip and wither height or heart girth. Probiotic treated calves tended (P=0.07) to gain more in hip width. These results indicate that calves housed indoors in a temperature controlled environment with little added stressor may not benefit from probiotic feeding.

Key Words: Probiotic, Calf, Stress

M340 The performance of calves fed starter feeds containing distillers grains. A. B. Chestnut* and D. L. Carr, *Vigortone Ag Products*, *Hiawatha, IA*.

The value of dried distillers grains with solubles (DDGS) as an ingredient in calf starter feed was evaluated in two trials using Holstein bull calves that averaged 5 days of age (+/- 3 d) with a mean BW of 43.9 kg (Trial 1) or 41.6 kg (Trial 2). For each trial 106 calves were randomly assigned to treatments and weighed on d 1, 35, and 56 (Trial 1) or 60 (Trial 2). Each calf received 284 g commercial milk replacer twice daily from d 1 to 28 and once daily from d 29 to 35. Starter feeds were offered ad libitum beginning d 1. All starters were fortified with the same vitamin/mineral premix and formulated to contain 18% CP. The texturized control starter (CON) in both trials was composed of steam-flaked corn, oats, roasted soybeans, molasses, and a pellet containing soybean meal (SBM), fish meal, blood meal, corn gluten meal, and premix. Trial 1 compared CON with 3 pelleted starters composed of ground-corn, SBM, molasses, premix and DDGS. Treatments containing DDGS were: DG10 (10% DDGS), DG10L (10% DDGS + 0.1% L-lysine HCl), and DG20L (20% DDGS + 0.1% L-lysine HCl). From d 1 to 35 ADG was 475 g and did not differ among treatments (P>0.20). From d 35 to 56 ADG was 825, 765, 726, and 689 g for calves on treatments CON, DG20L, DG10L, and DG10, respectively. The CON supported more weight gain (P<0.05) than either DG10L or DG10. DG20L was not different (P>0.05) from either the CON or the DG10L and DG10 treatments. Trial 2 compared CON to a whole-corn/SBM/DDGS starter with 20% DDGS (DG) and a whole-corn/SBM starter (SB). All starters were formulated to 18% CP. The ADG from d 1 to 35 was 438, 427, and 343 g and from d 1 to 60 was 600, 565 and 501 g for CON, DG and SB treatments, respectively. The CON and DG treatments supported similar ADG. The SB treatment supported less (P<0.05) ADG than CON and DG treatments at d 35 and less (P<0.05) ADG than CON at d 60. In these trials starters with 20% DDGS supported ADG similar to a traditional texturized calf starter.

Key Words: Distillers Grains, Starter Feed, Calves

M341 Effect of feeding yeast culture on performance, health, and immunocompetence of dairy Calves. V. J. A. Magalhaes*[1], F. Susca[1], A. F. Branco[2], I. Yoon[3], and J. E. P. Santos[1], [1]*Veterinary Medicine Teaching and Research Center, University of California Davis*, *Tulare*, [2]*Univesidade Estadual de Maringa*, *Maringa, Brazil*, [3]*Diamond V Mills, Inc.*, *Cedar Rapids, IA*.

Objectives were to determine the effects feeding yeast culture (Diamond V XP, Diamond V Mills, Inc.) on performance, health and immunocompetence of calves from 2 to 70 d of age. Holstein calves (n = 512; 2±1 d of age) were randomly assigned to receive 0 (CON; 223 females and 34 males) or yeast culture at 2% of grain DM (YC, 218 females and 37 males). Calves were housed in individual hutches and received 3 feedings of 1.9 L of colostrum in the first 24 h, and pasteurized milk thereafter to 60 d of age. Grain intake was measured 5 d each week for each calf, while BW was measured on d 5, 30 and

68. Attitude and fecal consistency were scored daily. Incidence and duration of health disorders and treatments were recorded. Neutrophil phagocytic and killing activities and antibody response to immunization with ovalbumin were evaluated. Data were analyzed using the LOGISTIC, MIXED, and LIFETEST procedures of SAS. Grain intake did not differ (P = 0.54) between treatments and averaged 908 g/d. Body weight change was similar (P > 0.10) for YC and CON between d 5 and 30 (212 and 229 g/d) and d 30 and 68 (772 and 780 g/d). Glucose (76.1 vs. 71.9 mg/dL) and 3-hydroxybutyrate (0.343 vs. 0.344 mM) concentrations did not differ (P = 0.92) between YC and CON. Attitude scores were similar between treatments throughout the study, but calves fed YC had improved (P = 0.06) mean (1.44 vs. 1.47) and median (1.2 vs 1.3) fecal scores and fewer (P < 0.01) days with diarrhea (4.6 vs. 5.9%). Incidence of fever tended to be reduced (P = 0.08, 34.1 vs. 41.6%) and the risk of health disorders (cases/1000 calf days at risk) was reduced (P = 0.03, 40 vs. 49) with YC in the diet. Minor effects on neutrophil function were observed, and YC tended to improve (P < 0.10) killing of phagocytized bacteria. Yeast culture improved (P = 0.06) survival of calves (92.5 vs. 87.9%) because of a decline (P = 0.05) in mortality rate after 15 d of age. Incorporation of YC in the grain did not alter intake and weight gain, but improved health and survival of dairy calves.

Key Words: Calves, Yeast Culture, Health

M342 The effect of feeding different milk replacer programs on calf growth, health and serum glucose. T. J. Earleywine*[1], T. E. Johnson[1], B. J. Nonnecke[2], and B. L. Miller[1], [1]*Land O'Lakes, Inc.*, *Webster City, IA*, [2]*USDA, ARS, National Disease Center*, *Ames, IA*.

Twenty-six (26) Holstein bull calves (mean=45.6 kg) were employed in a 63 day trial to evaluate milk replacer (MR) feeding programs. Calves were allotted to treatment based upon weight and blood gamma globulin status. Calves were fed a conventional product (20% protein / 20% fat) to provide 227 g or an intensified product (28% protein / 20% fat) to provide 568 g of MR powder twice daily. Milk replacers contained all-milk protein and were medicated with neomycin and terramycin. The conventional and intensified products were fed through days 35 and 49, respectively. Calf starter (18% CP for conventional or 22% for intensified) was fed throughout this 63 day trial. Total gain, MR intake and F/G were improved (P<.05) for calves fed intensive product when compared with calves fed conventional product. Calves fed the conventional product had lower serum glucose levels than those fed the intensified product during the milk replacer feeding phase. After weaning, serum glucose levels of conventional product calves increased to that of intensified product fed calves.

Table 1. Serum Glucose, mg / dL

Diet	Day 14	Day 28	Day 35	Day 49	Day 61
Intensified	119.6	95.7	106.0	85.2	115.7
Conventional	71.7	60.1	72.0	73.2	120.8
P-value	.0003	.0041	.0011	.076	>.10

Key Words: Calf, Milk Replacer, Glucose

M343 First lactation milk yield and fertility of Holstein heifers reared using three milk replacer feeding regimes. P. C. Aikman*[1], M. Gould[2], and E. C. L. Bleach[3], [1]*University of Reading*, *UK*, [2]*Volac International Ltd*, *Royston, UK*, [3]*Writtle College*, *Chelmsford, UK*.

Holstein heifer calves previously used to study effect of pre-weaning feeding regime on calf growth rates were monitored until their second calving to assess effects on milk yield and reproductive performance. Calves were blocked according to birthweight and parity of dam then assigned 48 h after birth to warm ad libitum milk replacer (WA; n = 25), cold ad libitum milk replacer (CA; n = 25) or 4 l/d of warm milk replacer offered in 2 equal feeds (WR; n = 25). The same milk replacer (crude protein 260 g/kg, oil 160 g/kg, ash 70 g/kg; 100 g/l water) was used for each treatment. Ad libitum water, calf concentrate and barley straw were available pre-weaning. All animals were managed identically from weaning at six weeks of age until their second calving. WR animals tended to have lower daily liveweight gains from birth until 12 months of age and lower first parity pre-calving bodyweight. Age at first AI (420 ±7 d) and the number of services per conception as maiden heifers were similar. Age at first (720 ±13 d) and second (1108 ±28 d) calving, total first lactation milk yield (9146 ± 565 kg) and daily milk yield were not affected by treatment. Animals on the WA treatment tended to require less intervention for reproductive problems during the first lactation, hence calving interval and lactation length were numerically shorter. In conclusion, animals allocated to the WA treatment tended to have improved pre-breeding growth rate and reproductive performance in the first lactation, though the limited numbers of animals in the treatment groups prevented significant differences being detected.

Table 1.

	WR	CA	WA	SED	P
Liveweight gain, birth-12 months, kg/d[1]	0.909	0.943	0.958	0.020	0.067
First parity pre-calving bodyweight, kg[1]	634	652	659	14.1	0.200
Services/conception (maiden heifers)[1]	1.70	1.71	1.59	0.277	0.903
Milk yield, kg/d[1]	26.6	27.6	28.6	1.23	0.291
Lactation length, d[1]	344	342	310	15.4	0.069
Proportion of animals requiring reproductive intervention[2]	0.57	0.48	0.22	-	0.080
Calving interval, d[1]	405	394	376	27.6	0.606

[1]ANOVA [2]Chi-square

Key Words: Heifers, Rearing Period, Fertility

M344 Effects of early intensified nutrition on growth and metabolism of neonatal dairy calves. C. C. Williams*[1], D. T. Gantt[1], C. F. Hutchison[1], C. C. Stanley[1], and M. A. Froetschel[2], [1]*Louisiana State University Agricultural Center*, *Baton Rouge*, [2]*University of Georgia*, *Athens*.

A study was conducted to determine if early intensified nutrition would improve performance of neonatal dairy calves in southeast Louisiana. Thirty-one calves (19 male; 12 female) were assigned to one of two dietary treatments. Treatments included an accelerated feeding program or the conventional feeding program in use at the LSU Dairy Farm. The accelerated feeding treatment (ACC) consisted of milk replacer (Cow's Match, Land O'Lakes, 28% CP, 20% fat) and

22% CP calf starter, and the conventional treatment (CON) consisted of milk replacer (20% CP, 20% fat, Land O′Lakes) and 18% CP calf starter. Both treatments were fed according to recommended procedures. On day 42 milk replacer was reduced by 50%, and on day 49 all calves were weaned. Body weights were measured at birth and weekly through weaning. Additionally, hip height, wither height, and body length were measured weekly. Feed intake and fecal scores were recorded daily. Beginning on day 7 and continuing weekly through weaning, blood samples were collected prior to morning feeding for analysis of IGF-I. On day 25 and again on days 56, 84, 112 rumen fluid was collected for analysis of pH and short chain VFA to evaluate possible differences in rumen development. Calves on the ACC treatment had greater ($P < 0.01$) body weight gain and fecal scores and decreased starter intake when compared to CON calves. There was a treatment by week interaction ($P < 0.01$) for ADG, with calves on ACC having higher ADG through week 5 and CON calves having higher ADG from weeks 6 through 8. Wither height, hip height, and body length were greater ($P < 0.05$) in ACC calves. There were no effects ($P > 0.05$) of treatment on pH, IGF-I or VFA concentrations. However, there were treatment by week interactions ($P < 0.05$) for rumen concentrations of acetate, propionate, and total VFA. There was an effect of week ($P < 0.01$) on IGF-I concentrations and on rumen pH. These data indicate that early intensified nutrition does improve growth in young dairy calves. However, rumen development may be affected due to decreased starter intake and the effects on rumen VFA concentrations.

Key Words: Calves, Early Intensified Nutrition, Growth

M345 Partial replacement of whole milk with soymilk stimulates early calf starter intake, saves milk, and reduces weaning age and costs. G. R. Ghorbani[1], R. Kowsarzar*[1], M. Alikhani[1], and A. Nikkhah[2], [1]*Isfahan University of Technology*, *Isfahan, Iran*, [2]*University of Manitoba*, *Manitoba, Canada*.

Evidence has been accumulating that cow's milk must not be considered undesirable for human health simply because of its cholesterol and saturated fatty acids. Milk, instead, contains bioactive substances that may reduce the risk of cancer and cardiovascular diseases. Partial replacement of whole milk with soymilk was hypothesized to stimulate starter intake, hasten rumen development, and reduce weaning age, thereby reducing feed costs and saving more milk. The primary objective of the current study was to determine the effects of partial replacement of whole milk with soymilk on pre-weaning calf performance and feed costs. Following 3-d of colostrum and transition milk feeding, twenty seven neonatal Holstein calves (41.6 ± 1.6 kg body weight; mean ± SE) were assigned in a completely randomized design to three treatments: 1) whole milk (M), 2) 75% M + 25% soymilk (S25), or 3) 50% M + 50% soymilk (S50), fed at 10% of body weight, on a wet basis. The weaning criterion was defined as the calf age at a daily intake of 900 g starter concentrate lasting for two weeks. During the first two weeks of the trial, treatments did not differ in starter intake and fecal score; however, the M- and S25-fed calves gained more weight ($P<0.05$) than did S50-fed calves. By 49 days of age, S25-fed but not S50-fed calves gained competitively similar body weight as M-fed calves. The S25- and S50-fed calves achieved a minimum daily starter intake of 900 g respectively about 10 and 12 d earlier than did M-fed peers ($P<0.01$). As a result, soymilk fed calves consumed about 20% less milk than M-fed calves to meet the weaning criterion ($P<0.05$). Because M was about 50% more expensive than both soymilk and starter concentrate, feed-related weaning costs dropped by about 35% when soymilk was fed ($P=0.06$). Saving more milk will have nutritional implications as to the increasing human demands for milk products.

Key Words: Calf, Soymilk, Weaning

M346 Evaluation of Jersey calves fed milk replacers and starter of varying protein and fat composition. E. H. Jaster*, J. L. Beckett, and D. G. Peterson, *California Polytechnic State University*, *San Luis Obispo*.

The objective of this study was to evaluate the growth and performance of Jersey calves fed milk replacer and starter with different amounts of protein and fat. Three day old Jersey calves (n=24) were assigned to one of three diets. From d 3 to 42, calves in treatment 1 were fed a standard MR (20% CP and 20 % fat) and an 18 % CP pelleted starter. Calves in treatment 1 were fed 236 g of milk replacer and fed at constant rate of 1.89 L of warm water per feeding with a nipple bottle. Milk replacer was fed twice daily in two equal feedings at 0600 and 1800 h. Treatment 2 calves were fed a MR (22 % CP and 22 % fat) and 18 % CP starter. Treatment two calves were fed the same amounts of milk replacer and schedule as treatment 1. Treatment 3 calves were fed a MR (30 % CP and 25 % fat) and 25 % CP starter. The CP content of each milk replacer was derived from all-milk sources and the fat content was choice white grease. During wk 7, calves in all treatments were fed half the daily amount offered during wk 2-6 and weaned at the end of wk 7. During the experiment, calves were offered ad libitum intake of a starter from wk one to ten; intake was measured weekly between wk 1 to 3 and daily from wk 4 to 10. Calves weights, fecal consistency scores, heart girth, height at withers and body length were measured weekly. A blood sample was drawn by jugular venipuncture wk 1 (start) and wk 2, 4, 6, 8, and 10. Samples were assayed for glucose and serum urea nitrogen. Increasing levels of dietary protein and fat resulted in greater overall body weight ($P<0.05$), though body weight was not different at week 10 between treatment 2 and 3 ($P>0.50$). Plasma glucose was similar across all groups with no effect of diet ($P>0.50$). Urea nitrogen was not different between treatments 1 and 2, but elevated in animals fed treatment 3.

Key Words: Dairy, Calves, Milk Replacer

M347 Pre- and post weaning performance and health of dairy heifer calves fed milk replacers supplemented with oligosaccharides. B. Ziegler*[1], R. Larson[1], S. Hayes[2], H. Chester-Jones[3], D. Ziegler[3], J. Linn[4], M. Raeth-Knight[4], and G. Golombeski[4], [1]*Hubbard Feeds*, *Mankato, MN*, [2]*Milk Products*, *Chilton, WI*, [3]*University of Minnesota Southern Research and Outreach Center*, *Waseca*, [4]*University of Minnesota*, *St. Paul*.

One-hundred one 2 to 4 day-old dairy heifer calves were randomly assigned to one of 4 non-medicated, all-milk protein (20% protein:20% fat) milk replacers (MR) with supplemental treatments to evaluate their effect on pre- and post weaning calf performance and health. Calves were housed from July to September in 2.29 x 1.17 m individual calf pens, within a frame-steel curtain side-wall, naturally ventilated barn. Initial BW averaged 40.4 kg ± 0.69 kg. Treatments were: 1) MR control; 2) MR with mannan oligosaccharides (Bio-mos®, fed at 2 g/calf daily); 3) MR with fructo-oligosaccharides (inulin, fed at 5.67

g/calf daily) and, 4) MR with a combination of Bio-mos® (2 g/calf daily) and inulin (5.67 g/calf daily). Milk replacers were fed at 0.284 kg (as-fed) in 1.99 L water 2× daily for the first 35 d, and then 1X daily from d 36 to weaning at 42 d. Calves were offered a 20.4% CP (DM basis) texturized calf starter (CS) and had access to fresh water at all times. Total DMI from MR for 42 d averaged 20.58 kg/calf. There were no pre- and post weaning performance differences by treatments (P > 0.05). Pre-weaning CS DMI, total DMI, total gain and feed/gain averaged 17.32, 37.90, 22.81 and 1.67 kg, respectively. Post weaning CS DMI, total gain, and feed/gain averaged 26.51, 12.75 and 2.08 kg, respectively. Overall 56-d daily gain and feed/gain averaged 0.64 and 1.79 kg, respectively. Pre-weaning fecal scores for the control MR calves tended (P = 0.07) to be lower than calves fed the other treatments. Health treatment costs/calf averaged $3.24, $3.17, $3.88 and $3.97 for calves fed treatments 1, 2, 3 and 4, respectively. Under the conditions of this study, feeding a MR supplemented with oligosaccharides did not affect pre- and immediate post weaning calf performance.

Key Words: Dairy Calves, Milk Replacer Supplements, Performance

M348 Pre- and post weaning performance and health of dairy heifer calves fed milk replacers with different protein sources. S. Hayes*[1], B. Ziegler[2], R. Larson[2], H. Chester-Jones[3], D. Ziegler[3], J. Linn[4], M. Raeth-Knight[4], and G. Golombeski[4], [1]*Milk Products*, *Chilton, WI*, [2]*Hubbard Feeds*, *Mankato, MN*, [3]*University of Minnesota Southern Research and Outreach Center*, *Waseca*, [4]*University of Minnesota*, *St. Paul*.

One-hundred twenty-four 2 to 4 d-old dairy heifer calves were randomly assigned to 1 of 5 medicated (20% CP:20% fat) milk replacers (MR) with 4 MR partially replacing milk protein with plant-based sources to measure pre- and post weaning performance and health. Calves were housed in 2.29 x 1.17 m individual calf pens within a frame-steel, curtain side-wall, naturally ventilated, barn. Initial BW averaged 40.9 ± 0.79 kg. Treatments were: 1) MR with all-milk protein (CON); 2) MR with hydrolyzed wheat gluten protein replacing 50% of the milk protein (50WG); 3) MR with soybean protein concentrate replacing 50% of the milk protein (50SPC); 4) MR with WG replacing 30% of the milk protein (30WG); and 5) MR with 25% WG and 25% SPC replacing milk protein (25SPCWG). Milk replacers were fed at 0.284 kg (as-fed) in 1.99 L water 2× daily for the first 35 d, and then 1X daily from d 36 to weaning at 42 d. Calves were offered a 20.2% CP calf starter (CS) and had access to fresh water. Total DMI from MR averaged 21.8 kg/calf. Calves fed CON had 4.09 kg greater (P < 0.05) pre-weaning gain compared to other groups. Overall ADG and feed/gain were 0.78, 1.80; 0.71, 1.85; .70, 1.98; 0.69, 1.88; 0.68 and 1.93 kg for calves fed CON, 50WG, 50SPC, 30WG and 25WGSPC, respectively. Health treatment costs/calf averaged $2.09. Under the conditions of this study, feeding an all-milk protein MR with CS resulted in excellent growth. The use of WG and SPC as a partial replacement for milk protein reduced calf performance due mainly to CS intake differences. Plant-based MR protein sources do have the potential to reduce feed costs to weaning.

Key Words: Dairy Calves, Milk Replacer Protein Sources, Performance

M349 Comparison of three analytical methods to assess urea nitrogen in colostrum. N. E. Lobos*[1], M. A. Wattiaux[1], and G. A. Broderick[1,2], [1]*University of Wisconsin*, *Madison*, [2]*US Dairy Forage Research Center*, *Madison, WI*.

Recent research has suggested that milk urea nitrogen is correlated with feed efficiency (FCM/DMI) and thus the cow's metabolic status in early lactation. Colostral urea nitrogen (UN) may provide useful information for early lactating cow management. Thus, we studied three methods to determine colostral UN. Starting 2 wks before calving, 27 Holstein cows were fed a 13.2% CP diet. Colostrum samples were collected and preserved frozen with bronopol until analysis. After thawing, three sub-samples were obtained. The first one was analyzed in a commercial laboratory by near infrared spectroscopy (NIR) using a Foss 6000 instrument calibrated for milk. The second sub-sample was centrifuged to remove fat and analyzed using a colorimetric urease-based assay with sodium nitroprusside as catalyst (Berthelot reaction (BR)). After deproteinization, the third sub-sample was analyzed by an automated colorimetric assay using the Diacetyl Monoxyme method (DAM) adapted to a flow-injection analyzer (Lachat QuikChem 8000). Data were analyzed using Proc REG of SAS. Linear models assumed no intercept. Average and (standard deviation) of colostral UN were 20.9 (14.8), 9.5 (4.5), and 11.1 (4.3) mg/dL for the NIR, BR, and DAM methods, respectively. Values ranged from 0.6 to 62.5, from 1.2 to 18.0 and from 4.2 to 23.3 mg/dL for the NIR, BR, and DAM methods, respectively. Regressions were as follow: NIR-UN = 1.69 (standard error (se) = 0.34) x BR-UN (r^2 = 0.49, root MSE = 18.6); NIR-UN = 1.66 (se = 0.27) x DAM-UN (r^2 = 0.60, root MSE = 16.5), and BR-UN = 0.84 (se = 0.06) x DAM-UN (r^2 = 0.89, root MSE = 3.5). For each regression, the slope differed from 1.0 (P<0.05). Because true colostral UN was not known, the most accurate technique could not be established, but the NIR-UN was the least precise. The NIR-UN was poorly correlated with BR-UN and DAM-UN, but the latter two methods were in close agreement. The wide variation in colostral UN most likely reflected metabolic differences among cows at parturition.

Key Words: Colostrum, Urea, Nitrogen

M350 Influence of fish/soybean oil supplementation on milk conjugated linoleic acid and mammary gland SCD gene expression in dairy cows. D. P. Bu[1], J. Q. Wang*[1], T. R. Dhiman[2], and S. J Liu[1], [1]*State Key Laboratory of Animal Nutrition,Institute of Animal Science,Chinese Academy of Agricultural Sciences*, *Beijing, China*, [2]*Department of Animal, Dairy and Veterinary Sciences, Utah State University*, *Logan*.

The objective of this study was to examine the effect of adding fish oil and soybean oil to dairy cows on milk fat C18:2 cis-9 trans-11 conjugated linoleic acid (CLA) and mammary gland SCD gene expression. Eighteen Chinese Holstein dairy cows (176 ± 16 DIM) in a randomized design were fed a basal diet (CTL), or basal diet supplemented with either 2% fish oil (FO) or a combination of 2% fish oil and 2% soybean oil (SBFO). The basal diet contained 40% forage and 60% concentrate mix. Oils were added by replacing the corn in the diet. Experimental duration was 9 wk. Diets contained an average 16.6 ± 0.3% CP and had 1.56, 1.64 and 1.72 Mcal NEL/kg DM in CTL, FO and SBFO, respectively. Milk yields were recorded daily and milk samples were collected weekly from 3 consecutive milkings and analyzed for composition and fatty acid (FA) profile. Within each treatment, 3 cows were used for mammary gland biopsy sampling.

Mammary gland tissues were taken from a rear quarter at the end of the treatment period. Relative gene expression data were calculated by $2^{-\Delta\Delta CT}$ method. β-actin was used as the reference gene. Analysis of variance for variables was conducted using the MIXED procedure of SAS. Significance was declared at $P < 0.05$. Feed DMI and milk yields were not different among treatments. Cows in FO and SBFO treatments had 2.50^{b} and 2.86^{b} % fat in milk, respectively compared to 3.63^{a} % in CTL. The proportions of vaccenic acid (VA) and cis-9 trans-11 CLA isomer were 0.75^{b} , 7.88^{a} , and 8.54^{a} , 0.56^{b} , 3.20^{a} and 4.15^{a} percent of total FA methyl esters in CTL, FO and SBFO, respectively. The proportions of unsaturated FA were increased in FO and SOFO treatments compared to CTL. The abundance of SCD mRNA in the mammary gland was reduced by 50% in FO and 57% SOFO compared to CTL. Feeding 2% fish oil (FO) or 2% fish oil plus 2% soybean oil (SBFO) to dairy cows increased the content of VA and CLA in milk by 560% and decreased the milk fat content by 26% compared to CTL without oil.

Key Words: Fish Oil, Conjugated Linoleic Acid, SCD

M351 Flow of fatty acids to the duodenum and fatty acid profile of milk from cows fed diets differing in forage fiber level. D. P. Bu[1], J. Q. Wang*[1], T. R. Dhiman[2], S. C. Li[1], and S. J. Liu[1], [1]*State Key Laboratory of Animal Nutrition,Institute of Animal Science,Chinese Academy of Agricultural Sciences*, *Beijing, China*, [2]*Department of Animal, Dairy and Veterinary Sciences, Utah State University*, *Logan*.

A study was conducted to evaluate the effects of diets differing in forage NDF (fNDF) on the flow of fatty acids (FA) to the duodenum and milk FA profile. Four Holstein cows (483±21kg BW; 175±6 DIM) fitted with permanent ruminal and simple T-shaped cannulae in the proximal duodenum were used in a 4×4 Latin square design experiment. Each period was 21 d. First 2 wk were considered as adaptation to the diets and measurements were made during the last week in each period. Diets in 4 treatments had fNDF content of 46.71(Trt-1), 37.01(Trt-2), 26.43 (Trt-3) and 18.50% (Trt-4) on dry matter basis. The different levels of fNDF in diets were achieved by varying the ratio of forage and concentrate and type of forage. The forages used to formulate diets were corn silage, Chinese wildrye or Alfalfa hay. The diets were formulated to be low-fat. The FA content of the diets was 0.86, 1.14, 1.46 and 1.71 in treatments 1 through 4, respectively. During the last week in each period samples of the rumen fluid and duodenal chyme were collected to study the flow of FA. Milk samples were analyzed for FA profiles. Ruminal fluid pH was 6.56^{a} , 6.55^{a} , 6.45^{a} and 6.26^{b} in treatments 1 through 4, respectively. Decreasing fNDF content of the diets tended to increase the flow of C18:1 trans-11 (VA; $P < 0.09$). The flow of C16:0, C18:0, C18:1 cis-9 and C18:2 to the duodenum increased significantly with decreasing fNDF in the treatment diets. The flow of C18:2 cis-9 trans-11 isomer of conjugated linoleic acid (CLA) was not affected by dietary treatments. Varying the fNDF in the present study had no influence on milk fatty acid profile including CLA content. The results suggest that varying forage NDF content from 46.7 to 18.5 % of diet DM in low fat diets (< 2% of diet) had little effect on milk fatty acid profile

Key Words: Forage, Fatty Acids, Dairy Cow

M352 Fatty acids composition of milk from cows fed oilseeds. S. J. Liu[1], J. Q. Wang*[1], D. P. Bu[1], and T. R. Dhiman[2], [1]*State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences*, *Beijing, China*, [2]*Department of Animal, Dairy and Veterinary Sciences, Utah State University*, *Logan*.

The objective of this study was to examine the influence of oilseeds supplementation on milk fatty acid (FA) profile and plasma parameters in dairy cows. Forty Holstein dairy cows (150 ± 25 DIM) were randomly assigned to four treatments. Cows in four treatments were fed a basal diet (CTL) or basal diet supplemented with either whole soybeans (FS), expanded soybeans (ES), or a mix of whole cottonseed, whole soybeans and expanded soybeans (MIX). Diets contained 1.57, 1.59, 1.60 and 1.64 NEL/kg DM in CTL, FS, ES and MIX treatments. All diets were iso-nitrogenous and contained an average 16.50% CP. Experimental duration was 6 week. Measurements were made during the last 3 weeks. Daily feed intake and milk yield were recorded. Weekly milk samples were analyzed for composition and fatty acid profile. Blood samples were taken from the coccygeal vein or artery at 3h post-feeding on the last day of experiment and analyzed for blood chemistry. Statistical analysis was conducted using the MIXED procedure of SAS for a completely randomized design with repeated measures. Yields of milk, fat and protein were not different among treatments. The proportions of short and medium chain (C4:0 – C12:0) were decreased and long chain FA increased in cows fed oil seeds compared with cows in CTL. Feeding expanded soybeans to cows in ES treatment increased the C18:2 cis-9 trans-11 isomer of CLA in milk by 84% compared with CTL treatment. The concentrations of CLA in milk were the same in CTL, FS and MIX treatments. Mean concentration of plasma cholesterol, lipoprotein cholesterol, NEFA, Leptin, glucose, triglyceride, insulin and β-hydroxybutyric acid was not different among treatments. Results suggest that feeding expanded soybeans to dairy cows enhances the C18:2 cis-9 trans-11 isomer of CLA without influencing feed intake, milk yield, milk composition and blood parameters.

Key Words: Oilseeds, Milk Fatty Acids, Hormones

M353 Please see abstract #282.

M354 Yields of fatty acids in milk of dairy cows fed a high- or low- forage diet supplemented with either flaxseed or flaxseed oil. C. Benchaar*[1], H. V. Petit[1], T. A. McAllister[2], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada*, *Dairy and Swine R&D Centre, Sherbrooke, QC, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*, [3]*Université Laval*, *Quebec, QC, Canada*.

The objective of this study was to examine the effect of whole flaxseed (FS) and flaxseed oil (FO) supplementation (10 and 3%, respectively; DM basis) on yields of fatty acids in milk of dairy cows fed high- (H) or low- (L) forage diets (70 and 30%, respectively; DM basis). Four lactating cows (BW = 647 kg; DIM = 96 d) used in a 4x4 Latin square design were fed: H+FS (HFS), H+FO (HFO), L+FS (LFS), and L+FO (LFO). Orthogonal contrasts (PROC MIXED, SAS) were used to test the effects of forage level (F), flaxseed source (FLA), and their interaction (F x FLA). Significance was declared at $P < 0.05$. Yields of C18:0 (147.3 vs. 190.8 g/d) and *cis*-9, *trans*-11, *cis*-15 C18:3 (CLNA; 0.78 vs. 1.16 g/d) were lower, and those of C10:0 (37.9 vs. 30.7 g/d), C12:0 (45.2 vs. 33.6 g/d), C14:0 (158.6 vs. 136.1 g/d), C14:1 (14.4 vs. 10.8 g/d), C15:0 (17.4 vs. 14.2 g/d), and *trans*-15 C18:1 (12.9 vs.

9.48 g/d) were higher in milk of cows fed L than in milk of cows fed H diets. Cows fed FS had higher yields of C6:0 (27.8 vs. 24.2 g/d), C8:0 (16.8 vs. 14.3 g/d), C10:0 (37.9 vs. 30.7 g/d), C12:0 (43.4 vs. 35.4 g/d), C16:0 (341.9 vs. 292.8 g/d), C18:0 (179.6 vs. 158.4 g/d), and *cis*-9, *cis*-12, *cis*-15 C18:3 (8.75 vs. 5.74 g/d), and lower yields of *cis*-15 C18:1 (4.67 vs. 7.84 g/d), *trans*-9 C18:1 (3.40 vs. 6.05 g/d), *trans*-11 C18:1 (16.5 vs. 37.7 g/d), *trans*-15 C18:1 (10.1 vs. 12.3 g/d), *cis*-9, *cis*-12 C18:2 (5.21 vs. 14.4 g/d), and *cis*-9, *trans*-11 C18:2 (CLA; 6.10 vs. 14.2 g/d) than cows fed FO. Yield of *trans*-10 C18:1 was 6.83, 3.83, 27.8, and 5.54 g/d for HFO, HFS, LFO, and LFS, respectively (F x FLA). Cows fed FS had higher transfer of *cis*-9, *cis*-12, *cis*-15 C18:3 from feed to milk than cows fed FO (1.63 vs. 1.24%). Feeding L diets modified the pathway of biohydrogenation, leading to higher production of *trans*-10 C18:1 in milk and this effect was of greater magnitude when FO was added in the diet as compared to FS. Feeding FS increased yield and transfer efficiency of *cis*-9, *cis*-12, *cis*-15 C18:3 and decreased the concentration of *trans* intermediates of ruminal biohydrogenation as compared with FO.

Key Words: Flaxseed Oil, Milk Fatty Acid Yield, Dairy Cows

M355 Abomasal infusion of butterfat increases milk fat in lactating dairy cows. A. K. G Kadegowda*, L. S. Piperova, and R. A. Erdman, *University of Maryland*, *College Park*.

Our objective was to compare the effects of abomasal infusion of short and medium chain FA (SCFA) with long chain fatty acids (LCFA) on milk fat synthesis. Eight rumen fistulated Holstein cows, beginning in early lactation (49±20 DIM) were used in a replicated 4x4 Latin square design. Treatments were: 1) Control (C) (no infusion); 2) abomasal infusion of 400g/d butterfat (B); 3) 245 g/d LCFA using a blend of 60% cocoa butter, 30% olive oil, and 10% palm oil that provided equivalent amounts of LCFA found in 400g of B; and 4) CLA (negative control). The CLA mixture provided equal proportions of c9t11 and t10c12 CLA (18% of total CLA; 7.5g/d of t10c12 CLA). Fat supplements were infused in equal portions 3 times daily at 0800, 1400, and 1800 h during the last 2 wks of each 3 wk experimental period. Milk samples for milk composition by infrared analysis were collected from 5 consecutive milkings at the end of wk 3. Daily dry matter intake (DMI) and milk production were unaffected by treatment. Butterfat infusion increased milk fat percentage by 14% ($P < 0.03$) to 4.26% and milk fat yield by 15% ($P < 0.07$) to 1351 g/day compared with Controls (3.74 % and 1175 g/day). CLA infusion decreased milk fat percentage and fat yield by 43% ($P< 0.001$). However, milk protein percentage was higher (3.70%; $P < 0.01$) in CLA infused cows than in Controls (3.30%), butterfat (3.28%) or LCFA (3.27%). While LCFA had no effect on fat synthesis, abomasal infusion of butterfat containing both LCFA and SCFA suggested that the availability of short and medium chain FA may be a limiting factor for milk fat synthesis.

Table 1.

	Treatments					Contrasts (*P*		
Item	C	CLA	B	LCFA	SED	CLA	B	LCFA
DMI, kg/d	23.7	24.1	24.2	25.7	1.10	0.750	0.66	0.09
Milk								
kg/d	31.0	29.9	32.1	33.4	2.28	0.640	0.62	0.30
Fat%	3.74	2.16	4.26	3.79	0.19	0.001	0.03	0.83
Fat yield, g/d	1175	661	1351	1299	102	0.001	0.07	0.19
Protein%	3.30	3.70	3.28	3.27	0.12	0.010	0.86	0.80

Key Words: Butterfat, Milk Fat, Lactating Cows

M356 Evaluation of LYSOFORTE™ PF brand biosurfactant toward enhancing digestion of supplemental dietary fat in animal diets. D. Sapienza[1], F. R. Valdez*[2], A. S. Suleman[2], and W. Rounds[2], [1]*Sapienza Analytica LLC*, *Slater, IA*, [2]*Kemin Industries, Inc.*, *Des Moines, IA*.

Emulsifiers as feed additives improve total-tract digestibility of dietary fats and are especially important in improving fat digestibility when dry distillers grains solubles (DDGS) are fed. An objective of this evaluation was to quantify the increase in the quantity of DDGS that could be digested with the synergistic effects of supplemental emulsifiers. Three different emulsifiers, namely LYSOFORTE™ brand PF (LPC) Biosurfactant, LYSOPRIN, and de-oiled lecithin were evaluated in an *in vitro* anaerobic system with proteases and a lipase. LPC is more effective than either de-oiled lecithin or LYSOPRIN as an aid to digestion of DDGS. The beneficial effects of LPC appear to be more consistent across dosages and levels of DDGS incubated than either de-oiled lecithin or LYSOPRIN. The data suggest that there may be limited benefit in adding an emulsifier when soy oil or tallow is the dietary source of fat but at certain dosages the production of free fatty acids (FFA) was increased when choice grease was incubated with LPC. The concentrations of DDGS ranged from the equivalent of 5 to 30% of the ration dry matter. At the inclusion rate of 5%, the data show that DDGS can be digested (%FATD) above 95% without the aid of an emulsifier. But at inclusion percentages above 14%, %FATD can decrease to 72.2% at the 30% rate. The comparisons of %FATD by dosage reveals that LPC at 250 g/T is significantly better ($P>0.1$) in the number of incidences in which %FATD is equal to or greater than 95%. In contrast, de-oiled lecithin at 250 g/T and LYSOPRIN at 250 g/T have significantly lower instances above 95% and their average %FATD are also significantly lower at 90.4% and 90.8%, respectively. LPC averages 95.7% across all three of its dosages. These data suggest that LPC may be a viable fat digestibility enhancer when DDGS are fed to animal diets greater than 14% of the diet compared to de-oiled lecithin and LYSOPRIN.

Key Words: Dry Distillers Grains Solubles, Fat Digestibility, Lysoforte

M357 Optimizing the levels of linseed oil in grazing cow diets to maximize conjugated linoleic acid in milk. G. D. Flowers*[1], A. A. AbuGhazaleh[1], and S. Ibrahim[2], [1]*Southern Illinois University Carbondale*, *Carbondale*, [2]*North Carolina Agricultural and Technical State University*, *Greensboro*.

In the recent past, there has been considerable interest in the potential health-promoting properties of conjugated linoleic acid (c9t11 CLA), a fatty acid produced naturally in ruminant animals. Previous studies have shown that milk c9t11 CLA increased when cows grazed or fed vegetable oils, however, feeding vegetable oils at higher level can be detrimental to cows. The primary objective of this study was to determine optimum dietary level of linseed oil to increase milk c9t11 CLA for grazing dairy cows. Twelve Holsteins cows in mid lactation were placed on alfalfa based pasture and assigned into four treatment groups using a 4 X4 Latin square design with 3 wk experimental periods. Treatment groups were: 1) control grain supplement; 2) control grain supplement containing 167g linseed oil; 3) control grain supplement containing 333g linseed oil and 4) control grain supplement containing 500g linseed oil. Grain supplements were offered at 7kg/d in two equal feedings after the a.m. and p.m. milking. Additional 100g/day of algae (high in C22:6n3, 40% of total fatty acids) were

added to treatment diets. Milk samples were collected during the last three days of each period and analyzed for composition and fatty acids profile. Treatment diets had no effect on milk production (19.9, 18.8, 19.3, and 20.3 kg/day for diets 1 to 4, respectively), milk fat percentages (3.23, 3.35, 3.36, and 3.31) and milk protein percentages (3.02, 3.1, 3.11, and 3.07). Milk c9t11CLA (1.10, 1.23, 1.43, and 1.65 g/100g fatty acids for diets 1 to 4, respectively), t11 C18:1 (3.28, 3.59, 4.30, and 4.79 g/100g), and C18:3n3 (0.59, 0.78, 1.02, and 1.03 g/100g) concentrations were linearly ($P < 0.05$) increased with linseed oil supplementations. In conclusion, adding linseed oil to grazing dairy cows diet at 500g/d can improve the nutritional value of milk by increasing the levels of milk c9t11 CLA and C18:3n3 without adversely affecting cows milk production or composition.

Key Words: CLA, Linseed Oil, Grazing

M358 Effect of ruminal infusion of sunflower oil (SO) or seeds (SS) combined or not with fish oil (FO) on conjugated linoleic acid (CLA) in milk. G. A. Gagliostro*[1], M. A. Rodriguez[2], P. Pellegrini[2], G. Muset[2], P. Gatti[2], D. A. Garciarena[1], H. H. Fernández[1], M. Oporto[1], A. Ferlay[3], and Y. Chilliard[3], [1]*Instituto Nacional de Tecnología Agropecuaria (INTA)*, *Balcarce, Argentina*, [2]*Instituto Nacional de Tecnología Industrial (INTI)*, *Buenos Aires, Argentina*, [3]*Institut National de la Recherche Agronomique (INRA)*, *Theix, France*.

Four rumen cannulated Holstein cows grazing a pasture (Avena sativa, L.) received according to a 4×4 Latin square design four corn silage-based diets supplemented with sunflower seeds (SS, 1.9 kg DM/cow/d); sunflower oil (SO, 0.8 kg/cow/d); SS plus fish oil (SS-FO, SS + 0.24 kg/cow/d FO) or SO-FO (SO + 0.24 kg/cow/d FO). Corn silage and corn grain were fed at 5.6 and 1.3 kg DM/cow/d. SO treatments were balanced for CP by adding 0.89 kg DM/cow of sunflower meal. Oils and seeds (coarsely ground) were introduced via ruminal cannulae. Statistical analysis included effects of cow, period, linoleic source, FO supply and the interaction. Duncan's Multiple Range Test was used to compare (SS + SS-FO) vs (SO + SO-FO) and (SS +SO) vs (SS-FO + SO-FO). Pasture, SO and FO represented 39, 5.6 and 1.6% of total DMI. . Interaction effects were not detected. Milk yield tended ($P<0.07$) to increase with SO (9.9 vs 8.7 kg/d). FCM (8.01 vs 6.37 kg/d) and milk fat (270 vs 191 g/d) yields increased ($P<0.04$) with SO. Content (40.5 vs 37.0 g/kg) and yield (397 vs 322 g/d) of milk protein were higher ($P<0.01$) in SO treatments. Parameters of pasture NDF degradation did not differ. Soluble CP fraction of pasture increased ($P<0.04$) from 31.3% up to 49.6 % when FO was fed. Ruminal pH was higher ($P<0.05$) in SS-FO (6.07) compared to SO-FO (5.77). SS or SO alone or combined with FO decreased concentrations (g/100g FA) of de novo synthesized saturated FA (-1.59 for C12:0, -4.79 for C14:0 and -8.29 for C16:0, vs pre-experimental period). C18:0 was 14.1 in SS and SO vs 6.42 g/100g FA in SS-FO and SO-FO ($P<0.002$). Trans-C18:1 was higher ($P<0.001$) in FO groups (30.7) compared to SS and SO (13.9) and particularly with SS-FO (33.5; $P<0.05$). Cis-9 C18:1 decreased (-12.6 g/100g FA) with FO ($P<.0001$). Increase of 9-cis 11-trans CLA over baseline averaged 2 g/100g FA across treatments. FO supply increased CLA content from 2.86 up to 3.92 g/100g FA ($P<0.04$) and increased the C18:3n-3 (+0.34 g/100g FA, $P<0.0003$). Unsaturated FA supply had a marked effect on milk FA profile. However the increase in trans-C18:1 isomers with FO and their implications on human health need to be determined.

Key Words: Conjugated Linoleic Acid, Sunflower, Fish Oil

M359 Effects of high oil corn grain supplementation on milk yield and composition and milk fatty acid profile in grazing dairy cows in early lactation. F. Luparia[1], D. A. Garciarena[1], C. A. Cangiano[1], P. Pellegrini[2], M.A. Rodriguez[2], H. H. Fernández[1], and G. A. Gagliostro*[1], [1]*Instituto Nacional de Tecnología Agropecuaria, INTA*, *Balcarce, Buenos Aires, Argentina*, [2]*Instituto Nacional de Tecnología Industrial, INTI*, *Buenos Aires, Argentina*.

The objective was to evaluate the effect of high oil corn grain (HOC, 6.6% ether extract) vs conventional corn (CC, 2.25 % ether extract) at two feeding levels (4 and 8 kg/cow/d) on yield, composition and fatty acid (FA) profile of milk in grazing dairy cows. Four ruminal cannulated Holstein cows in early lactation (30 days in milk) grazed a pasture in 4x4 Latin square design with a 2x2 factorial arrangement of treatments. Each experimental period lasted 14 days (d). The first 10 d were used for adaptation to diets with the last 4 d for data collection. Herbage allowance was fixed at 11 and 17 kg pasture DM/cow/d when 8 and 4 kg of grain were consumed. Cows received 2 kg/d of soybean meal and 0,15 kg/d of a mineral-vitamin premix. Milk yield (25.5 kg/cow/d), FCM (21.9 kg/cow/d), milk fat (30.8 g/kg) and milk protein contents (31.2 g/kg) did not differ between treatments. Concentration of C12:0 and C14:0 in milk-fat resulted lower ($P<0.01$) in HOC (2.70 and 24.51 g/100 g FA) than CC (3.15 and 25.85 g/100 g FA). A significative corn level x genotype interaction was detected for C16:0 concentration. It was lower in HOC groups (24.51 g/100 g FA) compared to CC (25.85 g/100 g FA) and particularly to HOC8 (24.04 g/100 g FA). Concentration of vaccenic acid (trans-11 C18:1) in milk-fat was higher with 4 kg (3.20 g/100 g FA) instead of 8 kg (2.81 g/ 100g FA) feeding level of corn grain without genotype effect. Content of 9c, 11t CLA resulted higher ($P<0.02$) in cows that ingested 4 kg (1.28 g/100 g FA) instead of 8 kg (1.08 g/ 100g FA) of corn grain. Neither the level nor the genotype of supplemental corn grain affected yield and composition of milk. Feeding HOC grain slightly reduced the concentration of C12, C14 and C16 FA in milk without effects on milk CLA content. Milk CLA concentration was decreased with the highest corn grain intake.

Key Words: High Oil Corn, Conjugated Linoleic Acid, Grazing Dairy Cows

M360 Evaluation of the effects of dietary fat supplement on conjugated linoleic acid (CLA) in milk fat of dairy cows: A meta-analysis approach. A. Nudda, C. Dimauro, A. Mereu, N. P. P. Macciotta*, and A. Cappio-Borlino, *Dipartimento di Scienze Zootecniche - University of Sassari*, *Sassari, Italy*.

Diet has been widely recognized as the most important factor influencing milk CLA content in ruminant milk. However results of experiments carried out the effects of dietary fat supplementation on milk CLA content in dairy cows are remarkably variable. In this work, a meta-analysis has been carried out to analyze the results from different studies designed to evaluate the effects of different fat sources and different amount of dietary fat on milk CLA content in dairy cows. Data were extracted from 51 feeding trials published in Pubmed, ScienceDirect and proceedings of scientific meetings, updated through January 2007. Data on milk CLA content were analyzed with a linear mixed model that included the content of fat supplemented in the diet, the type of fatty acid predominant in the fat source, the physical form of the supplemented fat, the forage/concentrate ratio as fixed effects. Moreover, the study has been included as a block random variable. Results highlighted a significant effect on milk CLA content of the

type of fatty acid predominant in the dietary fat source and of the physical form of the lipid supplement. In particular, the fish oil results in the highest CLA concentration in milk, whereas the saturated fatty acids (C18:0+C16:0) are the less efficient. As far as the physical form of supplement is concerned, the highest milk CLA content is observed when oil and mix of oil with other fat are used. Finally, the content of fat in the diet and the forage/concentrate ratio does not show significant effects on milk CLA content. In conclusion, results of the meta-analysis confirms the assessed knowledge about main nutritional factors that influence the milk CLA content but some points are raised on the usefulness of some nutritional strategies that have been recommended to obtain appreciable increases of milk CLA content.

Acknowledgements: *Research supported by the Ministry of University and Research (MIUR) with FISR project.*

Key Words: CLA, Dairy Cow, Meta-Analysis

M361 Milk conjugated linoleic acid response to fish oil and sunflower oil supplementation to dairy cows managed under two feeding systems. D. O. Felton* and A. A. AbuGhazaleh, *Southern Illinois University*, *Carbondale*.

Conjugated linoleic acid (CLA) is a generic term used to describe positional and geometric isomers of octadecadienoic fatty acids (FA) containing conjugated double bonds. CLA have been of keen interest since it was discovered that some have potential human health benefits. Earlier research has showed that cis-9, trans-11 CLA level in milk fat is highest when cows diets are supplemented with a blend of fish oil (FO) and linoleic acid-rich oil. The objective of this study was to determine the effect of FO and sunflower oil (SFO) supplementation to dairy cows fed fresh or conserved forage-based diets on milk cis-9, trans-11 CLA. Fourteen cows in midlactation were split into two treatment groups and fed the treatment diets for 3 wk. Cows in group one were fed corn silage-alfalfa hay mix ad libitum (L) while cows in group two grazed on alfalfa-grass pasture (P). Both groups were supplemented with 8kg grain supplement containing 640g of FO and SFO (1:3 w/w). Grain supplement was fed in two equal feedings after the AM and PM milkings. Milk samples were collected during the last 3 days. Compared with the L group, the P group saw a large decrease ($P < 0.05$) in milk production (25.8 and 16.8kg/d for L and P, respectively). Milk fat percentages (2.18 and 3.16) were lower ($P < 0.05$) in L compared with P treatment, however, milk fat yield (0.55 and 0.52kg/d) was similar ($P > 0.05$) for both treatments. Milk protein percentages were not affected ($P > 0.05$) by treatment diets (3.27 and 3.41) but protein yield (0.80 and 0.55kg/d) was lower ($P < 0.05$) for P compared with L treatment. Concentrations and yields of vaccenic acid (2.15 and 4.52g/100g of FA; 10.8 and 18.3g/d for L and P, respectively) and cis-9, trans-11 CLA (0.84 and 1.52g/100g FA; 4.0 and 6.1 g/d for L and P, respectively) in milk fat were higher ($P < 0.05$) with P compared with L treatment. Milk fat trans-10 C18:1 concentration (4.99 and 1.69g/100g FA) and yield (23.4 and 7.4g/d) were higher ($P < 0.05$) with L compared with P treatment. In conclusion, milk cis-9, trans-11 CLA content was higher when FO and SFO were supplemented with fresh forage-based diet.

Key Words: CLA, Oil, Forage

M362 Effects of feeding increasing amounts of a lipid-encapsulated conjugated linoleic acid (CLA) supplement on periparturient cows. J. W. Wheelock*[1], L. L. Hernandez[1], S. R. Sanders[1], M. J. de Veth[2], and L. H. Baumgard[1], [1]*University of Arizona*, [2]*BASF AG*, *Germany*.

Compared to established lactation, *trans*-10, *cis*-12 CLA is less effective at reducing milk fat synthesis during the first few weeks postpartum. Therefore, to induce milk fat depression and improve bioenergetic variables a much larger CLA dose is necessary. Objectives of this small preliminary trial were to evaluate the transfer of dietary *trans*-10, *cis*-12 CLA into milk fat and utilize those concentrations to predict effects on mammary lipid metabolism and production variables. Multiparous Holstein cows (n = 15) were randomly assigned to one of four supplemental CLA doses (0, 50, 250 and 500 g/d) with each dose providing either 0, 5, 25, or 50 g of *trans*-10, *cis*-12 CLA/d, respectively. *cis*-9, *trans*-11 was the only other CLA isomer in the supplement and was at a similar content as the *trans*-10, *cis*-12 CLA isomer. Each group received treatments (top-dressed) from -10 to 21 d relative to calving. Milk yield and feed intake were recorded daily, and milk samples obtained from each cow on 2, 4, 6, 8, 10, 15 and 20 DIM. Milk samples from 2, 8 and 20 DIM were analyzed for milk fatty acid composition. Results were analyzed as repeated measures using PROC MIXED of SAS. There were no overall differences in milk yield (35.6 kg/d), DMI (17.1 kg/d), protein% (3.61), lactose% (4.43), SNF (9.01) or SCC (355 x 1000). The 50 g/d dose did not significantly effect milk fat levels, but the two largest CLA doses decreased overall milk fat content by >17%. Milk fat *trans*-10, *cis*-12 CLA content averaged 0.13, 0.27, 0.76 and 1.42 mg/g fatty acids and milk *cis*-9, *trans*-11 followed a similar dose responsive ($P< 0.05$) pattern. Milk fat 18:1 *trans*-10 content averaged 3.35, 3.43, 3.48 and 4.57 mg/g, but treatment had no effect on other 18:1 trans-monoenes. Both CLA isomers and the 18:1 *trans*-10 milk fat content were temporally independent. Data from this small preliminary trial indicate a large dose of lipid-encapsulated CLA supplement delivers an amount of *trans*-10, *cis*-12 CLA necessary to reduce milk fat synthesis during the transition period.

Key Words: CLA, Transition Cows

M363 Effect of diets enriched with oleic, trans-octadecenoic, linoleic, or linolenic acids on gene expression of liver tissue from early postpartum lactating Holstein cows. B. C. do Amaral*, C. R. Staples, L. Badinga, S. A. Sennikov, and W. W. Thatcher, *University of Florida*, *Gainesville*.

The objective was to evaluate how dietary fat sources of oleic, trans-octadecenoic, linoleic, or linolenic acids affected gene expression of pyruvate carboxylase (PC), phosphoenolpyruvate carboxykinase (PEPCK), IGF–2, IGFBP–2, and IGFBP–3 in the liver of Holstein primiparous (n = 12) and multiparous (n = 20) cows during the summer season. Fat supplements were the following: 1) sunflower oil (SFO; Trisun, Humko Oil, 80% C18:1), 2) Ca salt of trans-octadecenoic acids (TRANS; EnerG TR, Virtus Nutrition, 57% trans 6–12 C18:1), 3) Ca salt of vegetable oils (CaVeg; Megalac–R, Church & Dwight Co, 29% C18:2), and 4) linseed oil (LSO; Archer Daniels Midland, 56% C18:3 and 16% C18:2). Supplemental fats were fed at 1.35% of dietary DM beginning at 30 ± 7 d prior to expected calving date. After calving, fat supplements were fed at 1.5% (oils) and 1.75% (Ca salts) of dietary DM for 15 wk. Liver samples were taken via biopsy on 2, 14 ± 1, and 28 ± 1 DIM. Abundance of PC mRNA decreased linearly whereas that

of PEPCK mRNA increased linearly over time across diets. Abundance of PC and PEPCK mRNA increased over time in livers of cows fed LSO but decreased in those of cows fed CaVeg. Primiparous cows had a greater abundance of IGF–2 and IGFBP–2 mRNA in the liver compared to multiparous cows. Hepatic content of IGF–2 mRNA did not change over DIM in cows fed LSO but was maximal at 14 DIM in cows fed CaVeg (LSO vs. CaVeg by DIM interaction). Expression of IGFBP–2 increased from 2 to 14 DIM but decreased at 28 DIM, with the decrease being greater for liver of cows fed the monounsaturated fats (MUFA) compared to the polyunsaturated fats (PUFA) (MUFA vs. PUFA by quadratic DIM interaction). Likewise, hepatic expression of IGFBP–3 was only different at 28 DIM with cows fed MUFA expressing less IGFBP–3 than those fed PUFA. Supplemental fat source influences hepatic gene expression of the gluconeogenic enzymes as well as the IGF system.

Key Words: Fat, Liver, Gene Expression

M364 Please see abstract #279.

M365 Effects of abomasal infusion of water linseed oil or tallow on responses to glucose and insulin challenges in feed restricted Holstein cows. J. A. A. Pires*, J. B. Pescara, N. Silva del Rio, A. P. Cunha, and R. R. Grummer, *University of Wisconsin*, *Madison*.

The objective was to test the effects of abomasal infusion of water (**W**), linseed oil (**L**) or tallow (**T**) on responses to i.v. glucose tolerance tests (**IVGTT**; 0.25g dextrose i.v. bolus/kg BW) and insulin challenges (**IC**; 0.1 IU insulin i.v. bolus/kg BW) in feed restricted Holstein cows. Six non-lactating, non-gestating cows were assigned to a replicated 3 × 3 Latin square design, and infused with W, L or T at a rate of 0.54 g/d per kg BW, for 5.5 d. Cows were fed to meet maintenance requirements for the first 72 h of each period, and were feed restricted thereafter to stimulate body reserve mobilization. IVGTT were performed on d 5, 50 h after initiation of feed restriction, followed by IC 12 h later. Contrasts were: 1) W vs. fat; 2) L vs. T. Before IVGTT, plasma glucose was 58, 61 and 58 ± 1.3 mg/dL (L vs. T; $P = 0.09$), serum insulin was 12.3, 11.8 and 12.5 ± 1.3 µIU/mL, and plasma NEFA was 548, 612 and 508 ± 44 µEq/L (L vs. T; $P = 0.09$) for W, L and T respectively. There were no treatment differences in glucose or insulin response to IVGTT. NEFA clearance rate was 2.6, 2.8 and 2.5 ± 0.1 %/min (L vs. T; $P = 0.06$), time to reach half concentration was 27, 25 and 29 ± 1.3 min (L vs. T; $P = 0.04$), and NEFA response area under the curve (**AUC**) was -52187, -64150 and -46402 ± 5871 (\mu;Eq/L)*180 min (L vs. T; $P = 0.04$) for W, L and T, respectively. Before IC, plasma glucose was 59, 60 and 60 ± 1.5 mg/dL, serum insulin was 10.1, 8.7 and 9.6 ± 1.3 \mu;IU/mL, and plasma NEFA was 689, 764 and 664 ± 72 \mu;Eq/L for W, L and T respectively. There were no differences in glucose and insulin response after IC. NEFA AUC was -16338, -18275 and -13817 ± 5034 (µEq/L)*30 min (L vs. T; $P = 0.12$) for W, L and T respectively. Supplementation of L, rich in C18:3, may enhance insulin antilipolytic effects in adipose tissue of Holstein cows as compared to T. However, plasma NEFA immediately before IVGTT and IC was approximately 100 µEq/L greater for L than T for unknown reasons.

Key Words: Linseed Oil, NEFA, Insulin Resistance

M366 Effect of vitamin E or vitamin C on *in vitro* biohydrogenation of linolenic and linoleic acid in the presence of unesterified DHA. C. Boeckaert*[1], K. Ardvisson[2], N. Boon[1], and V. Fievez[1], [1]*Ghent University*, *Melle, Belgium*, [2]*Swedish University of Agricultural Sciences*, *Umeå, Sweden*.

Unesterified DHA was shown to inhibit the production of C18:0 in the rumen from dietary linolenic (C18:3 n-3) or linoleic (C18:2 n-6) acid. The current study investigated whether supplementation of vitamin E or C could prevent this inhibition. *In vitro* incubations with 50 ml buffered rumen fluid were performed to study the effect of unesterified DHA (21.5 mg) either or not supplemented with lipid soluble vitamin E or water soluble vitamin C on rumen biohydrogenation of C18:3 n-3 from grass silage (0.8 g) and C18:2 n-6 from sunflower oil (20 mg). Vitamin E was supplemented as DL-all-rac-α-tocopherol (5 mg) and vitamin C as ascorbic acid (5 mg). After 6 h of incubation, DHA supplemented flasks contained significantly ($P < 0.05$) higher amounts of C18:3 n-3, C18:2 t11c15, CLA c9t11 and C18:1 t11 whereas C18:3 c9t11c15 and C18:0 significantly decreased. No significant difference in C18:2 n-6, CLA t10c12 and C18:1 t10 concentrations were observed between control and DHA supplemented treatments. Vitamin addition did not prevent DHA to inhibit rumen biohydrogenation as the accumulation of hydrogenation intermediates did not significantly differ between DHA supplemented incubations either with or without vitamin addition. DHA also shifted rumen fermentation, significantly depressing acetate and CH_4 productions whereas propionate and butyrate productions significantly increased in comparison to the control treatment without DHA supplementation. The overall volatile fatty acid production was not affected by DHA. The relative CH_4 productions for incubations supplemented with vitamin E or vitamin C were intermediate ($P < 0.05$) between the control and the DHA treatments. This indicates that the inhibition of rumen methanogenesis induced by DHA can partially be prevented by both vitamins. In conclusion, vitamin E or vitamin C supplementation could not prevent the inhibitory effect of unesterified DHA on rumen biohydrogenation, which indicates that the latter effect is not provoked by oxidation of DHA.

Key Words: Biohydrogenation, DHA, Vitamin

M367 Effect of dietary polyunsaturated fatty acids on the expression of genes involved in prostaglandin biosynthesis in the bovine uterus. S. M. Waters[1], S. Childs[1,2], J. M. Sreenan[1], A. A. Hennessy[2], C. Stanton[2], and D. A. Kenny*[3], [1]*Teagasc, Animal Production Research Centre, Mellows Campus*, *Athenry, Co. Galway, Ireland*, [2]*Teagasc Dairy Products Research Centre*, *Fermoy, Co. Cork, Ireland*, [3]*School of Agriculture, Food Science & Veterinary Medicine, University College Dublin*, *Belfield, Dublin 4, Ireland*.

Nutrition plays a critical role in the regulation of cow fertility and there is emerging evidence that dietary omega-3 polyunsaturated fatty acids (ω-3 PUFA) may act as potent regulators of the reproductive process. *In-vitro* studies have demonstrated that the ω-3 PUFAs, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) play pivotal roles in the suppression of uterine derived prostaglandin F2α synthesis, a critical regulator of embryo survival, though the biochemical mechanisms involved are as yet unclear. The objective of this study was to determine the effect of dietary supplementation of ω-3 PUFA on mRNA expression of key uterine endometrial genes involved in PGF2α biosynthesis. Beef heifers were fed either a high or low ω-3 PUFA diet, generating, in turn, combined uterine endometrial

concentrations of EPA and DHA which were more than two-fold higher (P <0.05), and EPA concentrations alone that were more than fourfold higher (P < 0.01) in the high and low supplemented animals, respectively. Total RNA was isolated from endometrial tissue and real-time RT PCR was carried out to measure the relative expression of 10 genes known to be involved in the prostaglandin biosynthetic pathway. Expression of mRNA for prostaglandin E synthase (PGES) and the peroxisome proliferator-activated receptors, PPAR α and δ was increased in animals fed the high compared with low ω-3 PUFA diet (P<0.05). There was a tendency for the mRNA expression of phospholipase A2 (PLA2), to be down-regulated (P=0.08). In conclusion, bovine endometrial gene expression of PGES, PPAR α, PPAR δ and PLA2 is differentially regulated in response to long chain ω-3 PUFA supplementation, suggesting a possible mechanism by which PUFAs may influence uterine function and in turn embryo survival.

Key Words: ω-3 PUFA, Gene Expression, Bovine Endometrium

M368 Effect of electron beam irradiation on ruminal DM and NDF degradation characteristics of wheat and barley straws. A. A. Sadeghi*[1] and P. Shawrang[2], [1]*Department of Animal Science, Faculty of Agriculture, Science and Research Branch, Islamic Azad University*, *Tehran, Iran*, [2]*Animal Science Research Section, Research Center for Agriculture and Medicine, Atomic Energy Organization of Iran*, *Karaj, Iran*.

The present study was designed to evaluate the effects of electron beam irradiation at doses of 100, 200 and 300 kGy on ruminal DM and NDF degradation characteristics of wheat straw (WS) and barley straw (BS). Duplicate nylon bags of untreated and treated straws were suspended into the rumen of four non-lactating Holstein cows for 0, 8, 12, 24, 48, 72 and 96-h. Immediately after submersion of the 0 h bags of substrate into the ruminal fluid, all bags were removed and rinsed with an automatic washing machine. Bags were then freeze dried, weighed and analysed for chemical composition. Data were fitted to exponential model to calculate degradation parameters of DM and NDF. The degradability parameters for the nylon bags analyzed as a randomized complete block design, using cows as blocks. Data were analyzed with the general linear model of SAS (1996). Differences among treatments were separated using polynomial orthogonal contrasts to determine linear, quadratic, and cubic responses. Electron beam had no effect on CP, ash and ether extract contents, but decreased NDF and ADF contents of both straws as irradiation dose increased. There was a linear increase (P<0.001) in the wash-out fraction and a linear decrease (P<0.001) in the potentially degradable fraction of DM and NDF. The degradation rate of the latter fraction increased linearly (P<0.001) as irradiation dose increased. The effective DM and NDF degradability of 100, 200 and 300 kGy irradiated WS at an outflow rate of 0.05/h increased by 18 and 15; 31 and 27; and, 43 and 38%, compared to untreated WS, and for 100, 200 and 300 kGy irradiated BS increased by 21 and 19; 36 and 33; and, 48 and 43% compared to untreated BS, respectively.

Key Words: Electron Beam, Wheat and Barley Straws, Ruminal Degradability

M369 Delta 9 desaturase gene expression in muscle, adipose tissue and liver of beef heifers following supplementation of grass with a concentrate containing sunflower seed and fish oil. S. A. McGettrick*[1], A. P. Maloney[2], F. J. Monahan[1], T. Sweeney[1], and F. J. Mulligan[1], [1]*Veterinary Sciences Centre, School of Agriculture, Food Science and Veterinary Medicine*, *University College Dublin, Belfield, Dublin 4, Ireland*, [2]*Teagasc, Grange Research Centre*, *Dunsany, Co. Meath, Ireland*.

In ruminant tissues delta 9 desaturase is involved in the endogenous synthesis of conjugated Linoleic acid (CLA) from vaccenic acid (VA), formed during rumen microbial biohydrogenation of Linoleic and Linolenic acid. Previous experiments have shown that dietary sunflower and fish oil inclusion increase CLA levels in bovine tissue. The objective of this experiment was to examine the effects of grazed grass or concentrates either alone or supplemented with sunflower seed (SFS) and fish oil (FO) on the expression of the delta 9 desaturase gene in liver, adipose tissue and muscle of fattening beef heifers. Forty Charolais or Limousin crossbred heifers of similar nutritional history were assigned to two outdoor and two indoor groups (n=10). The outdoor animals were offered unsupplemented pasture (*Lolium Perenne*), or restricted pasture with 2.5kg of a supplement containing SFS (29%) and FO (6%). Indoor groups were fed a basal concentrate rich in linolenic acid (32% of total fatty acids) or restricted basal concentrate with 2.5kg of the SFS and FO based supplement. Animals were slaughtered after 150 days on experimental treatments. Samples of subcutaneous adipose, liver and muscle were collected within 45 minutes of slaughter and stored at -70°C before total RNA extraction using RNAeasy kits (Qiagen). RNA extracts were quantified spectrophotometerically and c-DNA was synthesized using Invitrogen Superscript III First-Strand Synthesis System for RT-PCR. Quantities of mRNA were determined relative to 18S-RNA using quantitative real time-RT PCR and analysed using the GLM procedure of SAS. Delta 9 desaturase mRNA levels were lower (P<0.05) in muscle and subcutaneous adipose of grass-fed animals compared to concentrate-fed animals but were unchanged in liver (P>0.05). Supplementation of the diet with SFS and FO had no effect on delta 9 desaturase gene expression in any tissue. These results show that grass-based diets result in lower delta 9 desaturase gene expression in muscle and adipose tissue of beef animals despite increasing overall CLA levels in the tissues.

Key Words: CLA, Delta 9 Desaturase, Beef

M370 Effect of level and duration of dietary ω-3 polyunsaturated fatty acid supplementation on Δ-9 desaturase gene expression in muscle of beef cattle. S. M. Waters[1], J. P. Kelly[2], P. O Boyle[1], A. P. Moloney[3], and D. A. Kenny*[2], [1]*Teagasc, Animal Production Research Centre, Mellows Campus*, *Athenry, Co. Galway, Ireland.*, [2]*School of Agriculture, Food Science & Veterinary Medicine, University College Dublin*, *Belfield, Dublin 4, Ireland*, [3]*Teagasc, Grange Beef Research Centre*, *Dunsany, Co. Meath, Ireland.*

Supplementation of cattle diets with a blend of oils rich in omega-3 polyunsaturated fatty acids (ω-3 PUFA) and linoleic acid has a synergistic effect on the accumulation of ruminal and tissue concentrations of vaccenic acid, the main substrate for tissue synthesis of the cis9, trans11 isomer of conjugated linoleic acid (CLA), via Δ-9 desaturase. However, concentrations of CLA in muscle of beef animals have not always been increased. The objective of this study was to investigate the effect of level and duration of feeding a high ω-3

fishoil (FO) supplement in combination with soyaoil (SO) on the gene expression of Δ-9 desaturase in muscle. Beef bulls (n=48) were assigned to one of four isolipid and isonitrogenous dietary treatments. Diets contained one of the following: (i) 6% SO (CON); (ii) 6% SO + 1% FO (FO1); (iii) 6% SO + 2% FO (FO2) or (iv) 8% palmitic acid for first 50 days and 6% SO + 2% FO for the latter 50 days (FO2(50)). Samples of *M. longissimus dorsi* were harvested. Concentrations of a range of fatty acids were measured. Total RNA was isolated and the relative expression of mRNA for Δ-9 desaturase was determined. Expression of mRNA for Δ-9 desaturase was decreased 2.6, 4.1 and 4.6 fold in FO1, FO2(50) and FO2 treatment groups compared with CON, respectively ($P<0.05$). Increasing the level of dietary FO from 1% to 2%, resulted in a further repression of Δ-9 desaturase mRNA expression ($P=0.09$). Extending the duration of supplementation by 50 days did not affect mRNA expression ($P=0.24$). Regression analysis displayed a negative relationship between tissue concentration of ω-3 PUFA and Δ-9 desaturase gene expression ($P<0.05$). Simultaneous enhancement of both CLA and ω-3 PUFA concentrations in bovine muscle may be hindered by negative interactions between dietary ω-3 PUFA supplementation and tissue Δ-9 desaturase gene expression.

Key Words: Δ-9 Desaturase, Gene Expression, Bovine Muscle

M371 Body condition score and day of lactation affect lipogenic mRNA abundance and transcription factors in adipose tissue of beef cows fed supplemental fat. C. M. Murrieta*, S. L. Lake, E. J. Scholljegerdes, B. W. Hess, and D. C. Rule, *University of Wyoming*, *Laramie*.

We hypothesized that BCS at parturition and postpartum dietary fat supplementation will alter transcription factors and mRNA abundance of adipose tissue lipogenic and lipolytic enzymes during lactation in beef cows. Our objective was to determine abundance of mRNA for acetyl-CoA carboxylase (ACC), hormone-sensitive lipase (HSL), and lipoprotein lipase (LPL), and transcription factor levels in adipose tissue of 3-yr old Angus × Gelbvieh beef cows nutritionally managed to achieve a BCS of 4 ± 0.07 (BW = 479 ± 36 kg; n = 18) or 6 ± 0.07 (BW = 579 ±53 kg; n = 18) at parturition. Beginning 3 d postpartum, cows within each BCS were assigned to isonitrogenous and isocaloric diets of hay plus low-fat control supplement, or supplements (5% of DMI as fat) with either cracked high-linoleate or cracked high-oleate safflower seeds until d 60 of lactation. At d 30 and d 60 of lactation, s.c. adipose tissue biopsies were collected for RNA extraction, quantitative RT-PCR determination of transcript abundance, and Western blot analysis for STAT-5 and PPAR-γ. Adipose tissue of BCS 4 cows had less mRNA for LPL ($P = 0.001$) and HSL ($P = 0.09$) compared with BCS 6 cows. Abundance of LPL mRNA was lower ($P = 0.002$) at d 30 postpartum compared with d 60; whereas, HSL mRNA was greater at d 30 ($P = 0.001$). Cow BCS did not affect ($P = 0.35$) ACC mRNA; however, it tended to be higher ($P = 0.13$) at d 60 compared to d 30 of lactation. Abundance of PPAR-γ tended ($P = 0.13$) to be lower in adipose tissue of BCS 4 cows compared with BCS 6 cows. Both STAT-5 ($P = 0.0001$) and PPAR-γ ($P = 0.05$) were higher at d 30 compared to d 60 postpartum. We conclude that abundance of adipose tissue mRNA for LPL and HSL are influenced by cow BCS, and changes in mRNA abundance during lactation indicates a shift in nutrient partitioning away from the mammary gland to s.c. adipose tissue. Furthermore, STAT-5 and PPAR-γ likely play a role in the transcription regulation of LPL and HSL in adipose tissue during lactation in beef cows.

Key Words: Adipose, mRNA, Lactation

M372 Modeling fatty acid kinetics in plasma and immune cells of neonatal calves in response to increasing levels of dietary fish oil. M. A. Ballou*, J. G. Fadel, and E. J. DePeters, *University of California*, *Davis*.

Mathematical descriptions of the changes in FA composition of immune cells and plasma were determined in calves fed a commercial milk replacer supplemented with additional lipid. 15 Jersey calves (6 ± 1 d old) were completely randomized to one of 3 treatment diets, which were altered by supplementing 2% of a milk replacer with FA from various sources. Treatments included a control (3:1 blend of corn and canola oils), a 1:1 mix of fish oil (FO) and the control blend, and FO only. On d 0, 7, 14, 21, and 42 blood was collected and plasma and peripheral blood mononuclear cells (PBMC) were fractionated for FA analyses of phospholipids. Parameter estimations, the rate of incorporation and the proportional change in the FA composition when a relative asymptote was reached, were determined for each calf using non-linear procedures of SAS. ANOVA of parameter estimates were performed and simple linear regression analyses were carried out to describe the dose response relationship to dietary FO. All data are reported from the PBMC pool as arachidonic acid (AA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). In control calves, AA, EPA, and DHA all decreased during the neonatal period. Concentrations at d 0 (19.4, 0.46, and 1.47 g / 100 g FA), the proportional decrease from d 0 to asymptote (19.3, 66.6, and 35.5 %), and the relative half lives (6.0, 3.2, and 4.0 d) are reported. Supplementing FO to neonatal calves increased EPA and DHA incorporation into PBMC; linear regression analyses of EPA ($r^2 = 0.825$) and DHA ($r^2 = 0.861$) revealed the linear relationship between concentration in diet and PBMC. Supplementing FO tended ($P < 0.08$) to linearly decrease AA. The relative half lives of AA, EPA, and DHA did not differ with level of dietary FO; however, across FO treatments the half lives were markedly different (6.2, 30.5, and 8.4 d). The impacts of decreased polyunsaturated FA composition of neonatal PBMC are unknown. These data demonstrate that dietary strategies to alter immune cell FA composition by supplementing FO require adaptation periods of weeks to months to reach a new steady state.

Key Words: Immune, Fatty Acid, Kinetic

M373 Effects of soybean oil plus additional forage and anabolic implant on performance, carcass quality, and meat CLA content in finished steers. V. Poulin*[1], A. Fournier[2], J. Jacob[3], C. Gariépy[4], C. Avezard[4], N. Durand[4], J. Fortin[4], and P. Y. Chouinard[1], [1]*Institut des nutraceutiques et des aliments fonctionnels, Université Laval*, *Québec, Qc, Canada*, [2]*MAPAQ*, *Nicolet, Qc, Canada*, [3]*MAPAQ*, *St-Narcisse, Qc, Canada*, [4]*CRDA, Agriculture and AgriFood Canada*, *St-Hyacinthe, Qc, Canada*.

One hundred twenty crossbred steers (9 mo of age; 336 kg BW) were allotted to six weight replicates. Within each replicate, steers were allotted to one of four pens in a randomized complete block design (5 head per pen, 24 total pens). Treatments were low forage control diets (LFC) or high forage diets supplemented with soybean oil (HFO), without (NI) or with anabolic implant (Revalor S) (I) in 2x2 factorial arrangement. Growing diets fed for 63 d were based (DM basis) on wet grass hay (22.9 and 33.7% for LFC and HFO, respectively) corn silage (19.3 and 27.9%), ground corn (52.7 and 28.5%), soybean meal (3.0 and 3.4%), and soybean oil (0 and 4.6%). Finishing diets fed from day 64 to slaughter (4-10 mm backfat, 600 kg BW) were based on wet grass hay (14.0 and 21.2%) corn silage (14.2 and 21.5%), ground corn

(66.9 and 47.3%), soybean meal (2.9 and 3.6%), and soybean oil (0 and 4.3%). Steers were implanted at the beginning of the growing and the finishing phases. The HFO diets resulted in 12.6% lower ADG, 2.2% lower carcass yield, and 19.4% lower s.c. fat thickness at slaughter (P<0.01). Implant increased ADG by 26%, feed efficiency by 16%, carcass yield by 2.1%, BW at slaughter by 5.4%, and carcass weight by 7.5% (P<0.01), but decreased s.c. fat thickness by 13% (P=0.02). Warner-Bratzler shear force of the longissimus dorsi (l.d.; 3 steers per pen) was 33% higher (P<0.01) for I than for NI, which was confirmed by a 23% higher firmness score for I than for NI (P<0.01) as rated by a trained sensory panel (8 steers per treatment). Total fatty acid (FA) content of l.d. (2 steers per pen) were lower (P<0.01) with HFO as compared to LFC (-21%), and with I as compared to NI (-41%). Conjugated linoleic acid (CLA) concentration (% by weight of total FA) in intramuscular fat was 140% greater in HFO than in LFC. The CLA content of l.d. was also higher for HFO than for LFC, but the increase was of higher magnitude for NI (11 vs. 5 mg/g meat) than for I (6 vs. 3 mg/g meat) (interaction, P=0.03). This trial shows several interactions between diet and anabolic implant on carcass quality and FA composition in finished steers.

Key Words: Beef, Implant, CLA

M374 Effects of flunixin meglumine on pyrexia, production, and bioenergetic variables in post-parturient dairy cows. G. Shwartz*[1], S. R. Hartman[1], J. D. Earnest[1], A. L. Debold[1], K. L. Hill[2], M. J. VanBaale[1], and L. H. Baumgard[1], [1]*The University of Arizona*, *Tucson*, [2]*Schering Plough Animal Health*, *Kenilworth, NJ*.

Multiparous cows (n=26) were randomly assigned to one of two treatments beginning at parturition. Treatments were flunixin meglumine (Banamine®, 50 mg/mL, Schering Plough Animal Health, Kenilworth, NJ) at a dose of 2cc/45.5 kg BW and control (saline) at 2cc/45.5 kg BW. All treatments were administrated I.V. via a jugular catheter daily for the first 3 DIM. Individual milk yield (MY) and DMI were recorded daily. Body temperature (BT) was measured daily at 0700 h and 1600 h for the first 7 DIM. Milk composition was determined on 2, 7, 14, 21, 28, and 35 DIM. Blood plasma was harvested on 1, 2, 3, 4, 7, 14, 21, 28, and 35 DIM. BW and BCS were determined on -7, 1, 7, 14, 21, 28, and 35 DIM. BT did not differ between treatments during the first 7 DIM (38.87°C), and there was no treatment differences in overall MY (35.2 kg/d), 3.5% FCM (37.6 kg/d), or ECM (37.7 kg/d). Compared to controls, flunixin meglumine had no effect on DMI (2.97% of BW), or overall energy balance (-2.32 Mcal/d). There were no treatment differences in milk fat (3.91%), milk protein (3.32%), milk lactose (4.57%), and milk SCC (532 × 1000/mL). Treatment had no effect on plasma glucose (66.5 mg/dL) or plasma NEFA (553 μEq/mL), but circulating PUN tended to be lower in flunixin meglumine treated cows (16.4 vs. 14.5 mg/dL). Irrespective of treatment, when separated into a BT hierarchy (warmest 50% vs. coolest 50%; 39.21 vs. 38.64°C) cows with a higher body temperature during the first 7 DIM had an overall lower PUN (13.8 vs. 16.6 mg/dL), higher plasma NEFA (642 vs. 493 μEq/mL), and tended to have a lower energy balance (-4.09 vs. -1.19 Mcal/d). Warmer cows also had increased milk SCC (955 vs. 200 × 1000/mL), but BT had little or no effect on other milk components and production parameters. Daily flunixin meglumine administration for the first 3 d after parturition had little or no effect on production or energetic variables, but tended to decrease PUN levels in transition dairy cows.

Key Words: Flunixin Meglumine, Transition Cow, Pyrexia