

M88 80% whey (WPC) and serum protein (SPC) concentrate and 95% serum protein (SP) reduced micellar casein concentrate (MCC): Production and composition. J. Zulewska*², D. M. Barbano¹, M. Newbold¹, M. Drake³, E. A. Foegeding³, and C. Moraru¹, ¹Cornell University, Ithaca, NY, ²University of Warmia and Mazury, Olsztyn, Poland, ³North Carolina State University, Raleigh.

The research objective was to compare the production characteristics and composition of 80% WPC and 80% SPC. Raw whole milk (ca 1900 kg) was split into 2 portions: one was pasteurized (72C, 15s) and made into Cheddar cheese and whey and the other was cold separated into skim milk (SM) and cream. The SM was pasteurized (72C, 15 s), microfiltered (MF) to 3X (0.1 µm ceramic uniform transmembrane pressure) and diafiltered (DF) to 3X twice by adding reverse osmosis (RO) water back to the original SM weight to produce 95% SP reduced MCC. Separated whey (640 kg) and MF permeate (705 kg) from the first stage of MF of skim milk were ultrafiltered (UF) and DF using a spiral-wound 10 kDa polyethersulfone membrane to produce liquid 80% WPC and SPC. Whey and MF permeate were UF 5.2 and 5.5 X,

respectively. Protein content [measured by infrared spectrophotometer (IR)] was 47 and 41% of protein plus lactose in the retentate for whey and MF permeate after UF, respectively. Next, UF retentates from whey and MF permeate were diluted to their original weight with RO water and DF until the retentate protein content measured by IR was close to 90% of protein plus lactose. The DF retentates (ca 55 kg) were kept frozen (-40C) prior to spray drying (200C and 95C at inlet and outlet, respectively). All processing was replicated 3 times. Mean UF and DF flux was higher for WPC than SPC, but flux decreased more per hour for WPC than SPC over a 135 min run. Over a longer run, the WPC flux may be lower. Liquid SPC was clear while WPC was opaque; L-value was 18.5 vs. 52.5 for liquid SPC and WPC, respectively. Liquid SPC pH was higher than WPC (6.9 vs. 6.5, respectively). Spray dried (SD) 80% WPC contained more fat on a dry basis (db) than SPC, 0.5 vs. 8% and this may cause sensory differences between products. WPC contained more glycomacropeptide than SPC (about 4.9 vs. 0% of protein) and this may cause differences in functionality. The SD 95% SP reduced MCC contained 2.7% fat and 84.6% protein on db.

Key Words: whey protein, serum protein, micellar casein

Forages and Pastures: Forage Composition, Analysis and Utilization

M89 Utilizing near infrared (NIR) spectroscopy to predict carbohydrates (sugars) in forages. J. Horst*^{1,2} and G. Ayangbile^{1,2}, ¹Agri-King Inc., Fulton, IL, ²Analab, Fulton, IL.

The objective of this study was to determine if Near Infrared (NIR) can define the concentrations of carbohydrates in the cell contents of forages better than past methodologies. Total water soluble carbohydrates (WSC) and other acidic methods have been instituted in the past to quantify sugar contents. These methods are plagued with reproducibility problems, trying to determine a proper reference standard and numerous matrix interferences. NIR calibrations can be developed to assess carbohydrate concentration of mono and disaccharides in forages. The ability to rapidly predict Xylose, Fructose, Glucose and Sucrose in both fermented and non-fermented forages can provide useful nutritional information for optimizing animal performance. NIR also can provide accurate mannitol (sugar polyol) predictions on fermented silages, indicating undesirable heterofermentation. Calibrations were derived from reproducible wet chemistry techniques with extractions subjected to High Pressure Liquid Chromatography (HPLC) for analysis. The quantification of cell contents in feedstuffs including hay, haylage, corn silage, small grain silages and grain sources can potentially reduce incidents of laminitis in horses while improving feed efficiency in dairy, swine and poultry rations. NIR has achieved strong statistical correlations exceeding ≥ 90 1-VR (validation R-squared) on most analytes and forage matrices.

Key Words: carbohydrates, sugars, NIR Calibrations

M90 Investigation into the use of NIR predicted 12 and 30 hr IVNDFD as a measure of corn silage quality. R. T. Ward¹ and R. A. Patton*², ¹Cumberland Valley Analytical Service, Maugansville, MD, ²Nittany Dairy Nutrition, Inc., Mifflinburg, PA.

NDF digestibility in corn silage is important in determining the amount of nutrients provided in high producing dairy cattle with low rumen residence times. There is poor understanding of how to utilize available NIR predicted in vitro NDF digestibility (IVNDFD) evaluations to infer

differences in digestibility rates at rumen appropriate time points. This study characterized relationships between common nutrients in corn silage and IVNDFD at 12 hrs and 30 hrs measured by NIR to determine if the use of an earlier IVNDFD time point (12 hrs) allows for better characterization of rates of NDF digestibility. This study involved 14,576 samples of corn silage, including both normal and BMR types, for which both 12 and 30 hr NIR measured IVNDFD were reported for 3 crop years. Samples were analyzed for DM%, and CP%, soluble protein%, lignin%, ADF% and NDF% of DM. All nutrients were measured with NIR. The equations for 12 hr and 30 hr IVNDFD had R² of .883 and .853 for samples run by rumen incubation with digestibility of 36.7±1.57% and 60.9±2.41% respectively. Data were analyzed using proc mixed and proc reg of SAS. Fixed effects were crop year, geographic area (Northeast, Southeast, Midwest and Far West) and DM group. Dependent variables were IVNDFD at 12 and 30 hrs, the hourly rate of digestion for the first 12 hr and the last 18 hr. The Far West had lower 12 hr IVNDFD compared to other regions. Means for 12 hr and 30 hr IVNDFD were 38.7% and 58.3% respectively. Regression of 12 hr IVNDFD on 30 hr had R²=.51. Regression of rate of 12 hr IVNDFD with the final 18 hr yielded an R² of .18; thus speed of 12 hr digestibility was unrelated to speed of the last 18 hrs. Using all items analyzed, the maximum R² was .55 for 12 hr IVNDFD and .60 for 30 hr. We conclude 12 hr NIR predicted IVNDFD has the potential to be more appropriate than 30 hr NIR IVNDFD for characterizing NDF digestibility differences in corn silage. There appears to be a consistent geographical and DM% effect on NIR predicted 12 hr IVNDFD.

Key Words: NIR, IVNDFD, geographic effects

M91 Ethanol or amylase pretreatments affect estimates of in vitro NDF digestibility. A. L. Miller, J. P. Goeser, and D. K. Combs*, *University of Wisconsin, Madison.*

Our objective was to determine if pre-treating feed samples with ethanol or amylase affects estimates of NDF or in vitro NDF digestibility (iv NDFD). We also tested whether pre-rinsing Ankom F-57 fiber bags with

acetone affects estimates of NDF and ivNDFD. An alfalfa and a mixture of 70% alfalfa and 30% corn grain were dried (60 C), ground (1mm), and weighed (0.5 g) into Ankom F57 fiber bags. Half the bags were pre-rinsed in acetone and dried at 100 C prior to adding sample. Both sets of bags were sealed and pretreated as follows: untreated (control), bags with feed sample were rinsed in 70% ethanol prior to NDF and iv NDFD analysis (ETOH), bags and feed were hot water-rinsed with amylase prior to NDF iv NDFD analysis (AMYLASE), or samples were sequentially rinsed with ethanol and amylase prior to NDF and iv NDFD analysis (ETOH-AMYLASE). In vitro NDF digestibility (24 h) was calculated as: $\text{ivNDFD (\% of NDF)} = 100 \times [(\text{NDF0h} - \text{NDF residue 24 h}) / (\text{NDF0h})]$. NDF concentration of alfalfa (43.1% of DM) or the alfalfa and corn mix (35.7% of DM) was not affected by acetone, or ETOH, AMYLASE, or ETOH-AMYLASE pretreatments. Estimates of in vitro NDF digestibility (% of NDF) were higher from samples that had been pretreated with acetone (alfalfa; 28.6 v 30.9, $P < 0.1$, alfalfa-corn mix; 21.1 v 26.8, $P < 0.05$) than control. The 24 h ivNDFD for alfalfa (control: 29.7% of NDF) increased ($P < 0.01$) when feeds were pretreated with ETOH, AMYLASE, or ETOH-AMYLASE (36.8, 36.3, 38.9% of NDF, respectively). The iv NDFD values of bags containing the alfalfa-corn control (23.9% of NDF) were lower than from samples that had been pretreated with ETOH, AMYLASE or ETOH-AMYLASE (35.6, 38.5, 37.6% of NDF, respectively). Acetone pretreatment of Ankom F57 forage bags had little effect on estimates of NDF, but did influence the estimate of 24h iv NDFD. Pre-treatment of the alfalfa or the alfalfa-corn mix with ethanol, amylase or a sequential treatment of ethanol and amylase did not affect estimates of NDF. Estimates of iv NDFD were higher when samples were pretreated with amylase, ethanol or the sequential combination of ethanol and amylase.

Key Words: forage fiber, NDF digestibility, neutral detergent fiber

M92 Condensed tannins from purple prairie clover inhibit growth of *Escherichia coli* O157:H7. Y. Wang^{*1}, T. A. McAllister¹, S. N. Acharya¹, and A. D. Iwaasa², ¹*Agriculture & Agri-Food Canada Research Centre, Lethbridge, Alberta, Canada*, ²*Agriculture & Agri-Food Canada, Semiarid Prairie Agricultural Research Centre, Swift Current, Saskatchewan, Canada*.

The capacity of purple prairie clover (*Petalostemon purpureum*) condensed tannins (PCT) to inhibit growth of *Escherichia coli* O157:H7 was assessed in vitro. PCT were obtained from whole plant, full bloom forage by methanol extraction followed by Sephadex LH20 purification. One strain (25922) of generic *E. coli* and eight strains of *E. coli* O157:H7 of different origins and possessing different antibiotic resistance traits (strains 3081, E318N, E319N, H4420, H4420nal, R508N, R508N2006 and EDL933) were cultured individually in M9 medium in 70-mL Kimax glass tubes, with PCT included at 0, 25, 50, 100 or 200 µg/mL ($n = 4$). Bacterial growth was assessed by measuring the optical density of the cultures at 600 nm (OD_{600}) after 4, 6, 8, 12 and 24 h of incubation. Including PCT in M9 medium at levels as low as 25 µg/mL reduced ($P < 0.01$) growth of all nine strains of bacteria examined, demonstrating a broad range of activity of the tannins. Inhibition of all bacterial strains increased linearly ($P < 0.01$) with PCT concentrations from 0 to 200 µg/mL. In all of the cultures, inhibition by PCT was greater during rapid growth (at 4 to 8 h; up to 97%) than during the stationary phase (at 24 h; up to 50%). Among the strains tested, EDL933, R508N2006 and H4420nal were most susceptible to PCT, and 3081 and E319N were least inhibited. By 24 h, optical densities of 0.6 were achieved in all PCT cultures (compared with OD_{600} of 0.85 to 1.15 in control cultures), indicating that the anti-*E. coli* O157:H7 activity of PCT at levels up to

200 µg/mL was bacteriostatic, rather than bactericidal. Dietary incorporation of condensed tannins from purple prairie clover could be a potential tool for mitigating *E. coli* O157:H7 in beef cattle.

Key Words: *E. coli* O157:H7, purple prairie clover, condensed tannins

M93 Evaluation of tannins from forages for their capacity to inhibit growth of *Escherichia coli* O157:H7. Y. Wang^{*1}, T. A. McAllister¹, K. H. Ominski², D. O. Krause², and K. M. Wittenberg², ¹*Agriculture & Agri-Food Canada Research Centre, Lethbridge, Alberta, Canada*, ²*University of Manitoba, Winnipeg, Manitoba, Canada*.

Antimicrobial activity of plant tannins against rumen bacteria is well documented, but their potential for mitigating *E. coli* O157:H7 in beef cattle production is not known. Tannins from 10 forages growing on the western Canadian prairie, two commercially available products, and a brown seaweed (*Ascophyllum nodosum*; positive control) were extracted and purified, and their inhibitory effects on *E. coli* O157:H7 were determined. The bovine isolate, *E. coli* O157:H7 strain 3081 kan^R amp^R (resistant to kanamycin and ampicillin, each at 100 µg/mL), was cultured in 150-mL serum vials in M9 medium supplemented with each tannin type ($n = 3$). The tannins were added to medium individually at 400 µg/mL, except those from brown seaweed (50 µg/mL). Bacterial growth at 39°C was assessed throughout a 24-h incubation by measuring optical density at 600 nm (OD_{600}) after 0, 2, 4, 6, 8, 10, 12 and 24 h of incubation. Tannin from seaweed exhibited stronger anti-*E. coli* O157:H7 activity than did any of the other 12 tannins, inhibiting growth completely over the 24-h incubation. Among the terrestrial forages, purple prairie clover tannins showed the greatest activity against *E. coli* O157:H7 (i.e., lowest OD_{600}). Bacterial growth in cultures supplemented with tannins from three cultivars of sainfoin (Metrose, Erryr and Nova) and from Oxley cicer milkvetch was similar ($P > 0.05$) to that observed in the control (no added tannins). In the presence of tannins from Aurora Alsike clover, white clover and birdsfoot trefoil, growth was reduced ($P < 0.05$) only at 10 and 12 h, compared with control, whereas tannins extracted from cicer milkvetch and trefoil languile inhibited ($P < 0.05$) growth at 8, 10, 12 and 24 h of incubation. Commercially available tannic acid and Quebracho tannins inhibited ($P < 0.05$) bacterial growth at 10, 12 and 24 h. Anti-*E. coli* O157:H7 activity of plant tannins varied greatly among the species examined, depending on their origin. Only tannins from purple prairie clover and brown seaweed possessed significant activity against *E. coli* O157:H7 and warrant further evaluation.

Key Words: tannins, *E. coli* O157:H7, forage

M94 Comparing mathematical models to estimate *in vitro* gas production parameters of hydroponic forage. E. Herrera-Torres, A. Cerrillo-Soto, M. Murillo-Ortiz, O. Reyes-Estrada, and A. S. Juarez-Reyes^{*}, *Universidad Juarez del Estado de Durango, Durango, Dgo. Mexico*.

The goodness-of-fit test of four mathematical models: Gompertz, Richards, Logistic, and Ørskov and McDonald to describe the kinetic parameters of *in vitro* gas production from wheat hydroponic forage harvested at 12 days was evaluated. Samples were incubated in 100 ml glass syringes. Gas production was registered at 0, 3, 6, 12, 24, 48, 72, and 96h. The residual mean square (RMS) and the coefficient of determination (R^2) were used as selection criteria. Gas production data were obtained by the non linear regression procedure using the NCSS 2000

program. Gas parameters from models were analyzed using ANOVA. Tukey's test was used to compare means. The Gompertz model had the best goodness-of-fit according to values of 0.99 for R^2 and 4.28 for RMS. Highest gas production was obtained using Ørskov and McDonald model and was different among models ($P < 0.05$). Similarly, the constant rate of gas production varied among models ($P < 0.05$). Utilization of different models to evaluate *in vitro* gas production might avoid possible bias due to under or overestimation of *In vitro* gas production parameters.

Table 1. Statistical criteria for fitting of the models to evaluate *in vitro* gas production in hydroponic forage

Model	RMS	R^2
Logistic	14.56	0.98
Gompertz	4.28	0.99
Richards	11.78	0.99
Ørskov and McDonald	18.39	0.98

Key Words: mathematica models, *in vitro* gas production, hydroponic forage

M95 Effect of citrate synthase genes transformed into alfalfa on aluminum tolerance of its cells. F. F. Fan*, J. J. L. Li, Y. M. W. Wu, and J. X. L. Liu, Zhejiang University, Hangzhou, China.

This study was carried out to investigate the effect of bivalence citrate synthase genes transformed into alfalfa (*Medicago sativa* L.) on aluminum tolerance of its cells. Two different kinds of citrate synthase genes (CS) were cloned from *E. coli* (CSI, 1284bp) and *Oryza sativa* L (CSII, 1425bp), respectively, and then bivalence expression vector, containing CSI, CSII and the phosphomannose isomerase (PMI) gene isolated from *Escherichia coli* as the selectable marker gene, was constructed and transferred into *Agrobacterium tumefaciens* LBA4404 strain through electrotransformation method. The expression vector containing CSI alone was also constructed with the same method. Leaf disks of *Medicago sativa* L cultivar Youke were inoculated with *Agrobacterium tumefaciens* LBA4404 and selected on the mannose(30g/l). The callus were grown on the solid SH medium for 6 weeks in a chamber at 25°C, 75% relative humidity, and exposed to 14 h of light and 10 h darkness. Integration of the transgene was detected by PCR with genomic DNA of the callus as template. Transcription of the transgene was determined by cDNA dot blotting analysis. The callus tissues of transgene were cultured in the liquid SH medium under the shake at 150 r.p.m and 25°C for 2 days. The activity of the cells and their ATPase were detected when stressed under the different concentrations of Al^{3+} . The specific PCR products of expected size (1284bp and 1425bp) were found in the genomic DNA from all transformed callus but not occurred in the non-transformed callus, indicating that two CS genes were integrated into the transformed callus. The cDNA dot blotting of the transformed callus revealed that the interested genes were transcribed. The activity of both the cells and their ATPase was significantly ($P < 0.05$) higher in the transformed cells than that in the non-transformed cells, and with significantly ($P < 0.05$) higher activity in the transformed cells of CSI and CSII as compared with those of CSI. It is suggested that the expression of the CS gene in the transformed cells could improve the aluminum tolerance of alfalfa (*Medicago sativa* L.) cells.

Key Words: citrate synthase gene, aluminum tolerance, alfalfa (*Medicago sativa* L.)

M96 Total digestible nutrient and energy values of new crossed and winter-hardy proanthocyanidin-containing alfalfa populations transformed with the maize bHLH (Lc) regulatory gene in ruminants: Comparison with non-transgenic alfalfa. A. Jonker*¹, P. Yu¹, Y. Wang², and M. Gruber³, ¹University of Saskatchewan, Saskatoon, SK, Canada, ²Lethbridge Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada, ³Saskatoon Research Centre, Agriculture and Agri-Food Canada, Saskatoon, SK, Canada.

The objectives of this study were to determine digestible nutrients and energy values of three new crossed and winter-hardy proanthocyanidin-containing alfalfa populations transformed with the maize bHLH (Lc) regulatory gene in ruminants in a 3×2 factorial treatment design. Three new crossed Lc-transgenic alfalfa populations included 88-19×Rangelander, 88-09×Ramber, and 88-01×Beaver with two phenotypes of each (green, purple). The green phenotype contained no Lc-gene as non-transgenic control alfalfa (NT). The purple phenotype contained Lc-gene as Lc-transgenic alfalfa (LC). All samples were collected during two consecutive years (2007, 2008) in AAFC research field, Saskatoon, Canada. The items assessed include digestible nutrients (tdNFC, tdCP, tdFA, tdnNDF, TDN) and energy values (DE3X, ME3X, NEL3X for dairy; NEm and NEg beef). The results showed that there were no population effect ($P > 0.05$) and no population × phenotype interaction effect ($P > 0.05$). Averages of three population were 34.9, 23.4, 2.5, 7.2, and 64.2% of DM for tdNFC, tdCP, tdFA, tdnNDF and TDN respectively and 2.77, 2.35, 1.46, 1.58 and 0.98 for DE3X, ME3X, NEL3X, NEm and NEg, respectively. There were phenotype effects only on tdCP (NT vs. LC: 24.5 vs. 22.2% DM, $P = 0.014$) and tdnNDF (NT vs. LC: 6.4 vs. 8.1% DM, $P = 0.056 < 0.10$), but no phenotype effect on all energy values. In general, Lc-transformation did not affect on the energy values of the new crossed and winter-hardy proanthocyanidin-containing alfalfa.

Key Words: proanthocyanidin-containing alfalfa, TDN and energy values, beef and dairy

M97 Chemical profiles and protein and carbohydrate subfractions of new crossed and winter-hardy proanthocyanidin-containing alfalfa populations transformed with the maize bHLH (Lc) regulatory gene in ruminants: Comparison with non-transgenic alfalfa. A. Jonker*¹, P. Yu¹, Y. Wang², and M. Gruber³, ¹University of Saskatchewan, Saskatoon, SK, Canada, ²Lethbridge Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada, ³Saskatoon Research Centre, Agriculture and Agri-Food Canada, Saskatoon, SK, Canada.

The objectives of this study were to determine chemical profiles and protein and carbohydrate (CHO) subfractions of three newly developed winter-hardy proanthocyanidin-containing alfalfa populations transformed with the maize bHLH (Lc) regulatory gene, in comparison with non-transgenic alfalfa in ruminants in a 3×2 factorial treatment design. Three new crossed Lc-transgenic alfalfa populations included 88-19×Rangelander, 88-09×Ramber, and 88-01×Beaver with two phenotypes of each (green, purple). The green phenotype contained no Lc-gene as non-transgenic control alfalfa (NT). The purple phenotype contained Lc-gene as Lc-transgenic alfalfa (LC). All samples were collected during two consecutive years (2007, 2008) in AAFC research field, Saskatoon, Canada. The CP and CHO fractions were partitioned according to the CNCPS system and included PA, PB1, PB2, PB3 and PC for protein fractions, and CA, CB1, CB2 and CC for carbohydrate fractions. Each fraction has different degradation behaviour (degradation rate) which is highly related to component nutrient availability. In chemical profile study, the results showed no population effect ($P > 0.05$) and no population × phenotype interaction effect ($P > 0.05$), but significant phenotype

effect ($P < 0.05$) on chemical contents of anthocyanidin ($0 \mu\text{m/g DM}$ in the Green vs. $197.4 \mu\text{m/g DM}$ in the purple), CP, CHO, ADICP and NDSF. Anthocyanidin had negative correlation ($P < 0.10$) with CP, CHO, Hemicellulose, SCP, EIRCP and ratio of N to CHO. In CNCPS fraction study, there were no population effect ($P > 0.05$) and no population \times phenotype interaction effect ($P > 0.05$), but phenotype effect ($P < 0.05$) on carbohydrate CB2 and CB3 as well as ratio of PB to CB fraction. Anthocyanidin had negative correlation ($P < 0.10$) with PB1, PB2, CB2 and ratio of PA to CA fraction. In conclusion, Lc-gene transformation partially affected chemical profile and carbohydrate subfractions of the newly developed proanthocyanidin-containing alfalfa.

Key Words: proanthocyanidin-containing alfalfa, protein and carbohydrate fractions, forage quality

M98 Sugarcane stalk proportion effects on dairy cow performance.

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Previous *in situ* digestibility data has shown that among sugarcane clones there is a positive correlation between the stalk to leaf ratio and whole plant digestibility. Stalk proportion is a high heritability trait; however it has not been used to select clones for alcohol and sugar production. This trial evaluated if there would be gain in dairy cow performance by acting upon this trait. Treatments were: Whole sugarcane plant or plant with complete leaf removal to simulate a clone with extremely high stalk to leaf ratio. Removing leaves decreased sugarcane NDF content from 52.7 to 42.3% of DM and forage particle size. The TMR ingredient composition was (% of DM): Sugarcane 18.3, corn silage 37.6, soybean meal 21.9, urea 0.2, citrus pulp 9.7, hydrated and ensiled mature ground corn 9.3, and a buffer-mineral premix 2.9. Diets nutrient composition was (No Leaves and Whole, respectively): CP 17.3 and 16.6, NDF 32.9 and 34.7, NFC 37.7 and 36.3. Fourteen Holsteins (256 DIM) were paired blocked and randomly assigned to a sequence of the two treatments in a crossover design with 21-periods and 14 days of adaptation. Daily milk yield was 18.4 kg for No Leaves and 18.2 for Whole ($P = 0.65$) and DMI was 18.0 and 17.5, respectively ($P = 0.28$). Differences in milk solids content and production, MUN, milk energy secretion, and chewing activity were not detectable ($P > 0.40$). The removal of leaves tended to increase the intake of total tract digestible OM ($P = 0.10$) and the ratio of milk energy secretion to digestible OM intake ($P = 0.08$). The total tract DM digestibility was 75.1% for No Leaves and 71.4% of consumed for Whole ($P = 0.06$). Although a positive response in dairy cow performance was not observed at this dietary sugarcane inclusion, digestibility variables suggest that sugarcane leaf removal may be advantageous. Funded by Fapemig.

Key Words: sugarcane, feed efficiency, digestibility

M99 Sugarcane stalk proportion effects on heifer growth. J. R. M. Silva², S. Siécola Júnior¹, L. L. Bitencourt¹, G. S. Dias Júnior¹, N. M. Lopes¹, V. A. Silveira¹, I. R. Rios¹, and M. N. Pereira^{*1}, ¹Universidade Federal de Lavras, Lavras, MG, Brazil, ²Centro Federal de Educação Tecnológica, Januária, MG, Brazil.

Previous *in situ* digestibility data has shown that among sugarcane clones there is a positive correlation between the stalk to leaf ratio

and whole plant digestibility. Stalk proportion is a high heritability trait; however it has not been used to select clones for alcohol and sugar production. This trial evaluated if there would be gain in heifer growth by acting upon this trait. Thirty two Holstein-Zebu heifers were paired blocked and randomly assigned to a treatment for 42 days, following a 14-day standardization period used as covariate in the statistical model. Data obtained over time was analyzed using the repeated measures approach of the mixed procedure of SAS. Eight sugarcane clones were daily harvested in rotation from the same field. Treatments were: Whole plant or plant with complete leaf removal to simulate a clone with extremely high stalk to leaf ratio. Removing leaves decreased the NDF from 53.6 to 46.8% of DM, DM from 35.3 to 30.7% of fresh, and forage particle size. Diets composition was (No Leaves and Whole, respectively): Sugarcane 77.1 and 78.6, soybean meal 19.2 and 17.9, urea 1.0 and 0.9, CP 14.1 and 13.7, NDF 38.8 and 45.3, NFC 43.6 and 36.4 (% of DM). Body weight was 333 kg for No Leaves and 328 for Whole ($P = 0.14$). There was an interaction between body weight and experimental week ($P = 0.07$), the treatment effect got more pronounced with time. Daily body weight gain was 1.395 kg for No Leaves and 1.125 for Whole ($P = 0.05$). Daily DMI was 8.4 kg for No Leaves and 8.7 for Whole ($P = 0.30$), resulting in a ratio of daily gain to DMI of 0.158 and 0.122, respectively ($P = 0.05$). Removing leaves reduced the daily ingestion time ($P = 0.04$), had no effect on chewing time ($P = 0.96$), and tended to decrease rumen pH ($P = 0.07$). Intake of total tract digestible non-NDF OM was increased by leaf removal ($P = 0.03$). Acting upon the sugarcane stalk to leaf ratio, genetically or mechanically, seems to be a promising avenue to accelerate heifer growth. Funded by Fapemig.

Key Words: sugarcane, heifer, digestibility

M100 Early-lactation cows fed concentrate do not respond to high-total nonstructural carbohydrates alfalfa.

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In late-lactation cows fed only forage, we reported that high-total nonstructural carbohydrate (TNC) alfalfa increased milk yield and N efficiency. The current study examines the effects of feeding high-TNC alfalfa on performance of early-lactation cows fed a high-concentrate diet. Alfalfa was cut at sundown or at sunup and conserved as baleage (46% DM). Ten multiparous (MC) and 8 primiparous cows (PC) were blocked by milk yield and parity and randomly assigned to treatments in a crossover design. Cows were fed high- or low-TNC alfalfa (59% of diet DM) plus a common concentrate (41% of diet DM). Alfalfas were fed once daily and concentrate (13.5% CP) 3 times a day. High- and low-TNC alfalfa baleage contained (% DM): 19 vs. 20 CP and 6.53 vs. 3.52 TNC. DMI and milk yield did not differ across treatments. However, 4% FCM was lower in the high- vs. low-TNC treatment due to reduced milk fat concentration with the former diet. The decrease in milk fat concentration with the high-TNC treatment was greater in MC than in PC (-0.26 vs. -0.10 unit of %) as evidenced by the significant TNC \times parity interaction. MC fed low- vs. high-TNC diet possibly mobilized more body fat as shown by their lower BW gain, which might explain the increase in milk fat concentration. Reduced MUN with the high- vs. low-TNC treatment, particularly in PC, suggests better N utilization. Overall, high-TNC alfalfa had no effect on performance of early-lactation cows fed a high-concentrate diet.

Table 1.

Item	PC			MC				P	
	High-TNC	Low-TNC	SED	High-TNC	Low-TNC	SED	TNC	TNCx Parity	TNCx Parity
DMI, kg/d	18.9	20.1	0.70	23.6	23.9	0.59	0.13	<0.01	0.31
Milk yield, kg/d	25.0	26.1	0.81	34.4	33.9	0.68	0.58	<0.01	0.16
4% FCM, kg/d	22.9	24.3	0.85	31.2	32.1	0.71	0.05	<0.01	0.61
Fat, %	3.44	3.54	0.06	3.40	3.66	0.05	<0.01	0.76	0.05
Fat, kg/d	0.86	0.92	0.04	1.16	1.24	0.03	0.01	<0.01	0.91
Protein, %	2.74	2.83	0.05	2.71	2.74	0.04	0.07	0.42	0.37
Protein, kg/d	0.69	0.74	0.03	0.93	0.93	0.03	0.23	<0.01	0.23
MUN, mg/dL	11.6	13.5	0.40	9.92	10.0	0.33	<0.01	<0.01	<0.01
BW change, kg/d	0.21	0.82	0.30	0.34	0.05	0.29	0.46	0.25	0.05

Key Words: alfalfa, dairy cows, TNC

M101 Effects of variety and maturity at harvest time in the composition and *in vitro* kinetics of ruminal degradability of alfalfa hays. C. Arzola*¹, A. Muro², M. R. Murphy⁴, O. Ruiz¹, J. Salinas³, C. Rodriguez¹, Y. Castillo¹, and J.A. Payan⁵, ¹Universidad Autonoma de Chihuahua, Chihuahua, Chihuahua, Mexico, ²Universidad Autonoma de Zacatecas, Zacatecas, Zacatecas, Mexico, ³Universidad Autonoma de Tamaulipas, Cd. Victoria, Tamaulipas, Mexico, ⁴University of Illinois, Urbana, ⁵INIFAP, Delicias, Chihuahua, Mexico.

To determine the effect of variety and stage of maturity upon the nutritional value of alfalfa hay, two varieties of alfalfa harvested at three different stages of maturity (SM) were utilized, with a completely randomized design; being the dependent variables neutral detergent fiber (NDF), acid detergent fiber (ADF) and crude protein (CP), and two varieties and three SM the independent variables. An ANOVA was carried to determine differences among varieties and/or SM. Two alfalfa varieties were used, CUF-101 and Excellent (multileaf), harvested in one of three phenotypic stages (PS): bud, early flowering or flowering stage. The effect of composition of the alfalfas in terms of concentration of NDF, ADF and CP upon the parameters of *in vitro* fermentation (A, B and C parameters of Groot's mono phase model) was evaluated, using a STEPWISE multiple regression analysis. NDF of the different PS showed differences ($P \leq 0.05$), with values of 33.97% for the CUF-101 variety in bud PS, 34.12% in the multileaf variety at bud PS, 29.66% in the CUF-101 variety at early flowering PS, 27.11% in the multileaf variety in early flowering PS, 42.88% in the CUF-101 variety at flowering PS, and 43.26% in the multileaf variety at flowering PS. The varieties registered a similar behavior in ADF, 22.23% for the CUF-101 variety in EF bud PS, 20.83% in the multileaf variety bud PS, 18.87% in the CUF-101 variety at early flowering PS, 18.74% in multileaf at early flowering PS, 26.13% in the CUF-101 variety at flowering PS, and 27.27% in the multileaf variety at flowering PS ($P \leq 0.05$). CP had values of 21.67% for the CUF-101 variety at bud PS, 20.44% in the multileaf variety at bud PS, 23.44% in the CUF-101 variety at early flowering PS, 22.02% in multileaf variety at early flowering PS, 20.10% in the CUF-101 variety at flowering PS, and 19.46% in the multileaf variety at flowering PS, corresponding the highest value to the CUF-101 variety at early flowering PS ($P \leq 0.05$). NDF and CP correlated positively with the parameters A and B of ruminal fermentation ($P \leq 0.05$), whereas ADF, NDF and CP were negatively associated with parameter C ($P \leq 0.05$).

Key Words: alfalfa hay, NDF, ADF

M102 Diurnal variation of non structural carbohydrate concentrations in alfalfa. C. Morin*^{1,2}, G. Bélanger², G. F. Tremblay², A. Bertrand², Y. Castonguay², R. Michaud², R. Berthiaume³, and G. Allard¹, ¹Université Laval, Québec, QC, Canada, ²Agriculture and Agri-Food Canada, Québec, QC, Canada, ³Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada.

Low concentrations of readily available energy combined with fast and intensive degradation of proteins in forages contribute to a low N use efficiency in dairy cows. Non structural carbohydrates (NSC) in forages are a major source of readily available energy for rumen bacteria. NSC are known to accumulate in forages during the day but few studies have established the time at which maximum NSC concentration is reached. Our objective was to study the diurnal variation of NSC in fresh alfalfa forage to determine the best harvest period to maximize NSC concentration. Field-grown alfalfa (cv. AC Caribou) in Lévis (QC, Canada, 46°48'N) was sampled every two hours between 6h00 and 20h00 on six different days around the recommended stage of development at harvest in each of the spring and summer growth cycles of 2007. A split-plot design with days as main plots and sampling times as sub-plots was used with three replications. All forage samples ($n = 288$) were scanned using near infrared reflectance spectroscopy and 75 samples were selected as calibration and validation sets and chemically analyzed for NSC [soluble carbohydrates (SC) + pinitol + starch]. Concentrations of NSC, SC, and starch in all samples were successfully predicted. Our results showed that they increased during the day in both growth cycles. In the spring growth period, NSC concentration averaged over the six days increased from 95 mg/g DM at 6h00 to a maximum value of 133 mg/g DM at 16h00 whereas, in the summer regrowth cycle, it increased from 74 at 6h00 to 129 mg/g DM at 18h00 ($P = 0.01$). This increase in NSC concentration was mainly due to an increase of 68% in starch concentration in spring and 156% in summer, and an increase of 24% in SC concentration in spring and 38% in summer. Our results confirm that NSC in alfalfa accumulate during the day under the Québec conditions and that the period when NSC concentration is maximum is between 16h00 and 18h00.

Key Words: sugars, *Medicago sativa*, legume forages

M103 Subjectivity of qualitative assessment of corn silage by dairy nutritionists. K. E. Griswold*¹, P. H. Craig¹, R. C. Goodling¹, and A. J. Heinrichs², ¹Penn State Cooperative Extension, University Park, ²Penn State University, University Park.

To evaluate the accuracy and variability of sensory evaluation of forages, nutritionists attending the Penn State Dairy Nutrition Workshop were asked to qualitatively assess corn silage (CS) using their visual and actual senses. In 2006, 34 nutritionists evaluated 12 samples, and in 2007, 21 nutritionists evaluated 8 samples. Nutritionists were allowed 2.5 min. to evaluate each sample for moisture content (MC) and particle size (PS). For MC, nutritionists could choose the descriptors, too wet, just right, or too dry. For PS, nutritionists were asked to evaluate PS for impact on fermentation and on rumen health with the descriptors, too fine, just right, or too coarse. Dry matter (DM) was determined by Koster Crop Tester, and PS distribution using a Penn State Particle Separator (PSPS). Data were analyzed using PROC MIXED and RSREG within SAS. The MC model included fixed effects of year and DM. The PS model included fixed effects of % of CS retained on each PSPS screen. Both models included the random effects of participant and sample. Assessment of MC was related ($P < 0.01$) to CS DM. Regression analysis showed an inverse linear relationship ($P < 0.01$, $R^2 = 0.67$) of the % of nutritionists labeling a sample as too wet compared to CS DM, and a

linear relationship ($P = 0.03$, $R^2 = 0.44$) of too dry classification to CS DM. The results showed nutritionists were better able to assess too wet CS compared to too dry CS. Evaluations of PS for both fermentation and rumen health were related ($P < 0.01$) only to the % of the CS retained on the PSPS top screen. For fermentation, the % CS retained was linearly ($P = 0.02$, $R^2 = 0.29$) related to the % of nutritionists ranking a sample as too coarse, but for rumen health, it was an inversely ($P = 0.04$, $R^2 = 0.22$) related to the % of nutritionists ranking a sample as too fine. These weak relationships indicate the reason for evaluating forage (e.g. effect on fermentation or on rumen health) will affect its assessment. The results indicate that nutritionists who routinely evaluate forage quality cannot adequately assess the value of CS without actual analysis.

Key Words: moisture, particle size, corn silage

M104 Use of *Pleurotus oestratus* to change the nutritional quality of wheat straw. O. D. Montañez Valdez*¹, J. H. Avellaneda-Cevallos², J. M. Tapia-Gonzalez², G. Rocha-Chavez², E. Guerra-Medina³, and E. O. Garcia-Flores³, ¹Centro Universitario del Sur de la Universidad de Guadalajara, Ciudad Guzmán, Jalisco, ²Universidad Técnica Estatal de Quevedo, Santo Domingo. Quevedo, Los Ríos, Ecuador, ³Centro Universitario de la Costa Sur de la Universidad de Guadalajara, Aullán, Jalisco.

A study was conducted to evaluate the effect of *Pleurotus oestratus* on chemical composition of wheat straw. Wheat straw treated and untreated with *Pleurotus oestratus*, were obtained from a commercial facility. Ten samples plastic bags of wheat straw used previously as substrate to culture edible fungus were collected at random. The negative control group consisted of the pasteurized wheat straw untreated with *Pleurotus oestratus*. All samples were analyzed to dry matter (DM), organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), cellulose and hemicellulose of each wheat straw. Data were analyzed by mean comparison using a T Student test. No differences ($P \geq 0.05$) between treatments were found for DM, CP and hemicellulose; however, treated straw ($P < 0.05$) showed higher percentages of OM, NDF, and ADF. *Pleurotus oestratus* increased OM, NDF and ADF and increased soluble carbohydrates content of the wheat straw. The growth of *Pleurotus oestratus* on wheat straw changes its chemical composition by increasing organic matter content and modifying cell wall components, this may improve the nutritional quality of agricultural byproducts. This process may allow using *Pleurotus oestratus*-treated straw for ruminant feeding.

Key Words: agricultural byproducts, *Pleurotus*, chemical composition

M105 Effects of wilting, molasses and inoculants on alfalfa silage nutritional properties. F. Hashemzadeh Sigari¹, M. Khorvash¹, G. R. Ghorbani¹, and A. Nikkhab², ¹Isfahan University of Technology, Isfahan, Iran, ²Zanjan University, Zanjan, Iran.

The objective was to determine the effects of wilting, molasses and inoculants on alfalfa silage nutritional characteristics. Fourth-cut, pre-bloom alfalfa crop with a DM of 20% was ensiled as either fresh or wilted to 37% DM. The fresh and wilted alfalfa were chopped into particles with a theoretical length of 2.5 cm and divided to three portions, added with 0, 5% and 10% molasses. Each portion was treated with either distilled water, or with Ecosyle containing *Lactobacillus plantarum* and *Propionibacterium*, or with Lalsil containing *Lactobacillus plantarum*

MTD1. The experiment had a $2 \times 3 \times 3$ factorial arrangement of wilting, molasses addition, and inoculants application. Each alfalfa treatment was ensiled in 3 replicates in 3-L PVC laboratory silos. After 90 days of preservation, silage was sampled for nutrient composition, in vitro digestion and gas production at 2, 4, 6, 8, 12, 16, 24, 36, and 48 h post-incubation as well as for 48-h in situ rumen degradation using fistulated sheep. Wilting alfalfa increased silage DM, tended to decrease CP and decreased silage NDF. Molasses increased silage DM linearly in fresh alfalfa and quadratically in wilted alfalfa. Silage NDF% increased with 5% but not 10% molasses. Molasses increased silage water soluble carbohydrates, and did not affect lactic acid content in wilted alfalfa while decreasing it in fresh alfalfa. Wilting reduced silage ammonia and acetate contents and increased silage pH. Adding 5% molasses to wilted but 10% to fresh alfalfa lowered silage pH. Lalsil in wilted alfalfa and both inoculants in fresh alfalfa reduced silage acetate. Inoculants did not affect silage ammonia in fresh alfalfa, but Lalsil decreased it in wilted alfalfa. Lalsil decreased silage pH in wilted alfalfa and increased it fresh alfalfa. Inoculants enhanced 48-h rumen degradation of silage OM. Adding 10% molasses to improved in vitro silage OM digestion at 6, 8, 36, and 48 h post-incubation. As incubation time progressed, gas production rose only in control and treated silos. Results suggest determining effects of wilting, molasses and inoculants on alfalfa silage nutritional properties.

Key Words: alfalfa, wilting, additive

M106 Effect of drying methods on chemical composition kinetics of ruminal fermentation and digestibility of *Leucaena leucocephala* in goats. R. Rojo-Rubio*¹, O. Vázquez-Mendoza¹, A. Z. M. Salem^{1,2}, D. López-Aguirre¹, D. Cardoso-Jiménez¹, B. Albarrán-Portillo¹, S. Rebollar-Rebollar¹, J. Hernández-Martínez¹, F. Vázquez-Armijo¹, and L. M. Camacho-Díaz¹, ¹Universidad Autónoma del Estado de México, Temascaltepec, Estado de México, México, ²Alexandria University, Alexandria, Egypt.

The aim of the study was to determine the effect of drying methods: shadow at 25°C (SH), oven dry at 45°C (OD) and lyophilized at -27°C (LP) on chemical composition and nutritive value of *Leucaena leucocephala* leaves collected during dry season (April, 2007). Free condensed tannins (FCT), tannins binding-fiber (CT-fibre), tannins binding-protein (CT-protein)]; and chemical composition were determined. In vitro gas production of leaves was recorded after 1, 2, 4, 6, 8, 10, 12, 15, 19, 24, 30, 36, 48, 72 and 96 h of incubation. Two goats fitted with ruminal cannula were used in a randomized complete block design. Overall, drying method did not affect crude protein, acid detergent lignin and FCT content. Drying method affected NDF, ADF, CT, CT-fibre, CT-protein content and gas production ($P > 0.05$). IVOMD and IVDMD were similar between drying methods ($P > 0.05$). Metabolizable energy increased with LP method ($P > 0.05$). Drying method affected chemical composition and nutritive value of *Leucaena leucocephala*.

Key Words: *Leucaena leucocephala*, drying method, tannins

M107 Timothy dietary cation-anion difference, grass tetany index, and mineral concentrations predicted by near infrared reflectance spectroscopy. G. F. Tremblay*¹, Z. Nie², G. Bélanger¹, S. Pelletier¹, and G. Allard³, ¹Agriculture and Agri-Food Canada, Québec, QC, Canada, ²China Agricultural University, Beijing, China, ³Université Laval, Québec, QC, Canada.

The mineral concentration of forage grasses is involved in two metabolic disorders in dairy cattle production, namely clinical hypocalcaemia (milk fever) and hypomagnesaemia (grass tetany). Risks of occurrence of these two metabolic disorders can be evaluated by determining the dietary cation-anion difference (DCAD) and the grass tetany (GT) index of forages and specific rations. The objective of this study was to evaluate the feasibility of predicting timothy (*Phleum pratense* L.) mineral concentrations (Na, K, Ca, Mg, Cl, S, and P), DCAD, and GT index using near infrared reflectance spectroscopy (NIRS). Timothy samples (n = 1018), from an experiment with N and Cl fertilizers conducted at four sites in eastern Canada, were scanned using NIRS and analyzed for their mineral concentrations. Calculations of the DCAD were made using three formulas [DCAD1 = (Na + K) - (Cl + S); DCAD2 = (Na + K + 0.15 Ca + 0.15 Mg) - (Cl + 0.6 S + 0.5 P); DCAD3 = (Na + K) - (Cl + 0.6 S)]. The GT index [K/(Ca + Mg)] was also calculated. Samples were divided into calibration (n = 240) and validation (n = 868) sets. The calibration, cross validation, and prediction for mineral concentrations, DCAD, and GT index were performed using modified partial least squares regressions. Concentrations of K, Ca, Mg, Cl, and P were successfully predicted with coefficients of determination for prediction (R^2_p) of 0.69 to 0.92 and coefficients of variation for prediction (CV_p) ranging from 6.6 to 11.4%. The prediction of Na and S concentrations failed with respective R^2_p of 0.58 and 0.53, and CV_p of 82.2 and 12.9%. The three calculated DCAD and the GT index were successfully predicted with $R^2_p > 0.90$ and $CV_p < 20\%$. Our results confirm the feasibility of using NIRS to predict K, Ca, Mg, Cl, and P concentrations, as well as DCAD and GT index, in timothy.

Key Words: near infrared reflectance spectroscopy, dietary cation-anion difference, mineral concentration

M108 The effect of maturity stage on in vitro digestibility and energy utilization of mesquite (*Prosopis laevigata*) pods in goats. R. Rojo-Rubio^{*1}, A. Z. M. Salem^{1,2}, L. M. Camacho-Díaz¹, D. Cardoso-Jiménez¹, and S. Rebollar- Rebollar¹, ¹Universidad Autónoma del Estado de México, Estado de México, México, ²Alexandria University, Alexandria, Egypt.

The aim of this study was to determine the in vitro digestibility, ruminal volatile fatty acids (VFA), in situ disappearance and energy utilization of Mesquite (*Prosopis laevigata*) pods at different stages of harvest using ruminal inoculums of two fistulated goats of Criollo × Nubia (40 ± 0.5 kg LW) fed on 40:60 ratio of forage (alfalfa) to concentrate (corn, soybean, mineral), respectively. Mesquite pods were harvested during the year 2008 at different maturity stages: young (YO, in May); and the semi-mature (SM- in August) and mature (MA- in October) pods, from the sub arid region in the Mezquital Valley, Hidalgo, México. DM and CP disappearance were determined after 24h of pods samples incubation, whereas the energy utilization of metabolizable and net energy (e.g. ME and NE) were estimated using a previous data recorded of ruminal gas production after 24h. VFA were increased ($P = 0.001$) in MA and SM than in YO pods, whereas IVDMD and ruminal disappearance of DM and CP, followed the opposite trend by increasing ($P = 0.001$) in YO than in MA or SM pods. Energy utilizations (ME or NE) were not affected by the maturity stage of pods, except the NE had tended ($P = 0.089$) to increase in MA and SM than in YO pods samples. On the basis of these results, it is assumed that, Mezquite pods of the semi-mature or mature stage have a higher nutritive value than young pods, which may be an important constraint for the use of these tree pods by ruminants browsing upland areas of Mexico where this tree species is predominant.

Key Words: mesquite, maturity stage, digestibility

M109 Nutritive value, in situ degradability and intake of forage soybean and Lablab by weanling goats. E. Valencia*, A. Rodríguez, and F. Rivera Melendez, *University of Puerto Rico, Mayaguez, Puerto Rico.*

Information is limited on nutritive value [crude protein (CP), neutral detergent fiber (NDF) and acid detergent fiber (ADF)] of forage soybean (FS; *Glycine max*) and lablab (LL; *Lablab purpureus*) when baled at approximately 20% DM. The objectives of this study were to determine their nutritive value, in situ DM and NDF degradability, and intake of FS and LL. Triplicate samples (500 g) from each forage were analyzed to determine CP and cell wall components (NDF, ADF, hemicellulose, and ADIN). Data were analyzed using the ANOVA procedure of SAS and mean separation was conducted with LSMEANS. The in situ degradability study was conducted in fistulae cows (2) maintained on grass diets utilizing the suspended nylon bags technique. Triplicate samples of each forage species were incubated after 0, 3, 6, 24 and 48 hrs and analyzed for rate of degradation and DM and NDF disappearance. Data were analyzed using the non-linear model; Degradation = $a+b*(1-\exp(-c*t))$, where; a = soluble fraction, b = degradable fraction, c = rate of degradation, and t = time. Forage intake was determined using eight weanling Boer goats (average 17 kg BW). Goats were fed with FS and LL (at 3% of animal daily LW), 5-d adaptation and 5-d collection period in a crossover design with four goats per treatment. Crude protein concentration was similar ($P > .05$) for both FS and LL (averaging 17%). However, NDF and ADF were lower ($P < .05$) in FS than in LL (35.7 and 16.0 vs. 46.6 and 32.4%), and hemicelluloses and ADIN values were higher ($P < .05$), (19.7 and .62 vs. 14.16 and .41%). Ruminal DM degradation rate (kd) was faster in FS (.03) than in LL (.05), but NDF kd values were similar for both FS and LL (.09). After 48h of incubation, in situ DM disappearance was higher in FS (73.21%) than in LL (59.2%). Hay intake (FS = 439.9 and LL = 428.9 g/d) and intake as % of animal live weight (FS = 2.49, LL = 2.42%) were similar ($P < .05$). Both FS and LL differ in nutritive value and in situ DM degradability rate and disappearance, but forage intake was similar.

Key Words: legumes, in situ dry matter degradability, voluntary intake

M110 Inclusion of nopal (cactus) in diets for finishing lambs in Mexico. G. Aranda-Osorio*, M. Segundo-Espejel, C. A. Flores-Valdez, and F. M. Cruz-Miranda, *Universidad Autonoma Chapingo, Chapingo, Mexico, Mexico.*

The objective of this study was to evaluate the inclusion of nopal in diets of finishing lambs and its effect on animal performance and profitability. There were used 72 crossbred (Pelibuey × Damara × Rambouillet) lambs with initial live weight of 22.10 ± 2.96 kg. Three diets were used in which nopal constituted: T1=0, T2=15, and T3=25% of the dry matter (DM), fulfilling the requirements for a daily gain of 250 g (NRC 1985), with similar nutritional composition. The nopal (cladodes of Atlixco variety, one years old) was chopped (2×3 cm) and offered in a separate feedbunk from concentrate. The total feed was offered (50–50%) twice a day (07:00 and 14:00 h). Feed rejected was collected and weighed every day before morning feeding. Four lambs were assigned per pen (3×3 m), which constituted the experimental unit, each treatment had 6 replicates. Lambs were weighed every 14 days. The experiment lasted 84 d. Data was analyzed under a mixed model of completely random design for repeated measures of SAS. The response variables were: total liveweight gain (TLG), daily liveweight gain (DLG), dry matter intake (DMI), feed conversion (FC), hot carcass yield (HCY) and profitability. The TLG was different ($P \leq 0.05$) between T1=0% (21.34 kg) vs. T2=15%

(18.62 kg) and T3=25% (17.19 kg), but similar ($P \geq 0.05$) among T2 and T3. Similar to ADG (T1=0.254 vs. T2=0.218 and T3=0.219 kg lamb⁻¹ day⁻¹). The concentrate intake (DM) was different ($P \leq 0.05$) between treatment T1 (1.43 kg) vs. T2 (1.02) and T3 (0.90 kg) lamb⁻¹ day⁻¹, as well as for the nopal (DM) (T1=0, T2=0.123 and T3=0.201 kg lamb⁻¹ day⁻¹). The FC values were not different ($P \geq 0.05$) between T1 (5.74) and T2 (5.99), but different ($P \leq 0.05$) for T3 (5.29). There were no differences ($P \geq 0.05$) on HCY (48.1, 47.4 and 47.8% for T1, T2 and T3, respectively). The profitability (USD) was similar among treatments (T1=\$22.50, T2=\$22.02 and T3=\$20.38), as well as the cost: benefit ratio (T1=1.39, T2=1.43 and T3=1.40). Concluding that the inclusion of nopal in diets for finishing lambs in percentages between 15 to 25% (DM) could be an important alternative for producers in arid and semiarid lands.

Key Words: cactus pear, sheep, performance

M111 Nopal (cactus) fresh versus proteinically enriched in diets for finishing lambs in Mexico. G. Aranda-Osorio*, Y. Campos-Anzures, F. A. Salinas-García, C. A. Flores-Valdez, L. A. Miranda-Flores, and F. M. Cruz-Miranda, *Universidad Autónoma Chapingo, Chapingo, Mexico, Mexico.*

The objective of this study was to evaluate the productive performance and profitability of finishing lambs fed with a diet containing fresh chopped or protein enriched nopal. Crossbred (Pelibuey × Damara × Rambouillet) male lambs (n=72) with an initial live weight of 23.22 ± 1.20 kg were used. Three diets were formulated (isoenergetic and isoproteinic) to fulfill the requirements of lambs growing at 250 g day⁻¹ (NRC 1985), in which nopal was included (25% dry matter) in the following manner: T1=0, T2=fresh nopal and T3=enriched nopal. Cladodes of Atlixco variety one year old were used, chopped (2×3 cm) for the fresh manner or aerobically fermented for protein enrichment (addition of microorganisms such as fungus, yeast, and bacteria), which had a liquid consistency. Each treatment had 6 replicates and a pen (3×3 m) with 4 lambs constituted the experimental unit. The lambs were weighed every 14 days. The collected data was analyzed under a mixed model of completely random design of repeat measures by the statistical package of SAS. The analyzed variables were: total liveweight gain (TLG), average daily gain (ADG), dry matter intake (DMI), feed conversion (FC), and profitability. There were differences ($P \leq 0.05$) in TLG among treatments T1 (12.93 kg) and T3 (9.77 kg) but they were similar ($P \geq 0.05$) to T2 (10.33 kg). In ADG the T1 (238 g) was higher ($P \leq 0.05$) than T2 (174 g) and T3 (158 g), although T2 and T3 were similar ($P \geq 0.05$). The average DMI was higher ($P \leq 0.05$) for T3 (1,015 g) than for T1 (935 g), and they were similar ($P \geq 0.05$) to T2 (975 g). Treatments were different ($P \leq 0.05$) in FC (T1=4.08, T2=6.31 and T3=7.93). The profitability (USD) per lamb was higher for T1=\$21.17 than for T2=\$16.24 and T3=\$14.90. It is concluded that the inclusion of nopal to finishing diets at levels of 25% (DM) could decreased performance and profitability and protein enrichment process needs to be reviewed before it could be recommended to producers.

Key Words: cactus pear, proteinic enrichment, sheep

M112 Chemical composition, in vitro gas production kinetics of mesquite (*Prosopis laevigata*) pods at different stages of maturity in goats. A. Z. M. Salem^{1,2}, R. Rojo-Rubio^{*1}, O. Vazquez-Mendoza¹, D. Cardoso-Jiménez¹, and B. Albarrán-Portillo¹, *1Universidad Autónoma*

del Estado de México, Estado de México, México, 2Alexandria University, Alexandria, Egypt.

The effect of the maturity stage on chemical composition and in vitro gas production as well as the energy utilization of Mezquite (*Prosopis laevigata*) pods were evaluated using ruminal inoculums of two fistulated goats of Criollo × Nubia (40 ± 0.5 kg LW) fed on 40:60 ratio of forage (alfalfa) to concentrate (corn, soybean, mineral), respectively. Mezquite pods were harvested during the year 2008 at different maturity stages: young (YO, in May) and the semi-mature (SM- in August); and mature (MA- in October) pods from the sub arid region in the Mezquital Valley, Hidalgo, México. Chemical composition and tannins levels [extractable condensed tannins (CT), free condensed tannins (FCT) and tannins binding fiber (CT-fibre) and protein (CT-protein)] in pods were determined. Gas production of pods samples was recorded at 1, 2, 3, 4, 6, 8, 12 and 24 h after incubation. Crude protein content was significantly increased ($P = 0.001$) in YO pods than in SM or MA, while the NDF, ADF, OM as well as the EE contents were increased ($P < 0.05$) in MA and SM than in YO samples. The SM samples were recorded a high concentration ($P = 0.006$) of fiber free carbohydrate (FFC) than the other groups of pods. Tannins contents (e.g. CT, FCT, CT-fiber, and CT-protein) in pods, at the different harvest stages, were ranked in the order MA = SM > YO. Seasonal differences in tannin contents may have been related to the phenology of plant species and to the temperatures prevailing during the different stages of growth. Gas production kinetics (G24, b and c) were increased ($P < 0.05$) in SM and MA than in YO samples, while the lag time as well as the partitioning factor were increased ($P < 0.05$) in YO pods than SM or MA. These results may be due to the type and structure of tannins at different stages of harvest. Based upon the results presented herein, it is concluded that the Mezquite (*Prosopis laevigata*) pods of the semi-mature or mature stage may represent a high quality feeding resource for grazing ruminants in the rangelands of Mexico, particularly during dry seasons.

Key Words: mesquite, maturity stage, chemical composition

M113 Using in vitro gas production technique to calculate total digestible nutrients value of native forage in southern Texas. A. D. Aguiar^{*1}, L. O. Tedeschi¹, F. M. Rouquette², A. Ortega³, D. S. Delaney³, and S. Moore⁴, *1Texas A&M University, College Station, 2Texas AgriLife Research, Overton, TX, 3Texas A&M University, Kingsville, 4King Ranch, Kingsville, TX.*

A major challenge in grazing beef production is to maintain nutritive value and production of forages in the pasture at an adequate level to meet animal requirements throughout the year. Therefore, proper and rapid forage analyses are needed to accurately determine the availability of energy and nutrients of the forage. The in vitro fermentation (ivF) of forages obtained from native forage pastures of the King Ranch, Kingsville, TX for two consecutive years (2006-2007) was evaluated. The objectives of this study were (1) to study the relationships between ivF parameters of isolated NDF, feed chemical composition, intestinal digestibility of NDF (idNDF), and passage rate (kp) to calculate total digestible nutrients (TDN), (2) to study the variation of TDN throughout the year, and (3) to correlate TDN with climatic variables. Twenty one samples were fermented using the gas production technique. The pressure of the cumulated gas production was collected every 5 min for 48 h. A theoretical equation using fractional rate of fermentation (kd) of NDF and kp were used to estimate digestible NDF. A combination of kp (4, 6, and 8% h⁻¹) and idNDF (0, 10, and 20%) were used to compute TDN. This TDN was compared with a published empirical TDN equation, assuming 0.8 and 0.75 digestion coefficients for NDF (kdNDF).

The best combinations to calculate TDN were those assuming 0%, 6% h-1, and 0.75 ($r^2 = 0.48$, mean square error or prediction (MSEP) = 3.83%) and 10%, 8%, 0.75 ($r^2 = 0.48$, MSEP = 3.65) for IDNDF, kp, and kdNDF; respectively. Because a kp of 8% h-1 was assumed to be too fast to be effective for grazing cattle, the combination with kp of 6%/h was selected. A mixed model analysis indicated no differences among

months ($P = 0.08$) and seasons ($P = 0.39$; year as random). Temperature, relative humidity, and rain had weak correlation with TDN. The TDN distribution was lognormal with a 90% confidence interval between 40.7 and 55.5%. The lack of correlations was likely due to large variation and small sample size.

Key Words: evaluation, forage, fermentation

Graduate Student Paper Competition-CSAS Poster Competition: CSAS Graduate Student Competition 1

M114 Variation in antibody and cell-mediated immune responses between Canadian Holsteins and Norwegian-Red crossbred first calf heifers. S. Cartwright^{*1}, E. B. Burnside³, N. Karrow², L. Schaeffer², and B. A. Mallard¹, ¹University of Guelph Department of Pathobiology, Guelph, Ontario, Canada, ²Centre for Genetic Improvement of Livestock, Guelph, Ontario, Canada, ³Gencor Inc., Guelph, Ontario, Canada.

Inbreeding in the Holstein (HF) population has been steadily increasing and is thought to contribute to reduced fertility, decreased production and increased disease occurrence. The problems associated with inbreeding may be resolved by crossbreeding with more robust breeds. Previous research has shown superior udder health and reproductive efficiency of the Norwegian Red (NR) breed. The objective of this study was to evaluate antibody (AMIR) and cell-mediated immune response (CMIR) as well as production and differential cell count data on purebred and crossbred (HF, $n=50$; NR \times HF, $n=50$) first calf heifers. Therefore heifers were immunized 6-9 days post-calving using type-1 and type-2 test antigens. Sera were obtained on days 0 and 7 for antibody detection using ELISA. On day 7, background skin-fold measurements were taken of the tail-fold and intradermal injections of PBS (control) and test antigen were administered. Forty-eight hours later any increase in skin-fold measurements were taken to assess delayed type hypersensitivity (DTH) as an indicator of CMIR. Whole blood samples were taken on day 7 for differential cell count analysis. Data on production was obtained from Dairy Comp 305. A SAS general linear model that includes the effects of breed, month and herd will be used to determine any statistical significance in AMIR, CMIR, and production or cell counts between breeds. Preliminary results show crossbreds (least squares mean = 78.24%) had a significantly greater DTH response compared to purebreds (least squares mean = 50.56%) ($p = 0.0474$). However there was no significant difference between crossbreds (least squares mean = 1.10 OD) and purebred (least squares mean = 1.16 OD) for antibody response ($p = 0.7830$). These results suggest crossbreds have a greater cell-mediated immune response compared to purebreds and therefore enhanced defence against intra-cellular pathogens.

Key Words: immune response, purebred, crossbred

M115 Translation efficiency mediated by untranslated region of bovine beta casein mRNA. J. Kim^{*}, M. Bakovic, J. Li, J. Bag, and J. P. Cant, University of Guelph, Guelph, Ontario, Canada.

Regulation of protein translation in milk secretory cells of the mammary glands may influence milk protein production. It is generally accepted that untranslated regions (UTR) of mRNA play an active role in determining translational efficiency. Some of the characteristics of UTR involved in regulation of gene expression include secondary structure, length, and GC content. We hypothesized that the milk protein transla-

tion efficiency is influenced by characteristics of the 5' and 3' UTRs. The objectives were to test this hypothesis with *in vitro* translation assays, and to identify characteristics of 5' and 3' UTR of β -casein. Total RNA extracted from mammary gland of a Holstein dairy cow was first reverse transcribed to cDNA using oligo(dT), followed by 5' and 3' RACE-PCR to obtain the complete sequence of β -casein mRNA. Using different pairs of gene-specific primers, various recombinant transcripts spanning fragments of 5' and/or 3' UTR with the entire β -casein coding region were constructed. The amplified products were cloned into a pTZ19R vector to add a regulatory element sequence required for *in vitro* transcription and subsequent translation in rabbit reticulocyte lysate. Efficiency of translation was indexed as incorporation of biotinylated lysine residues into nascent β -casein which was detected by chemiluminescence. The quantity of extracted RNA from 100 mg of mammary gland was 884.7 ng/ μ l. The quality of RNA was illustrated by stained 28S and 18S ribosomal RNAs as well as the 260/280 and 260/230 ratios, both within the range of 2~2.05. The complete sequence of β -casein mRNA obtained by RACE-PCR was identified as 1095 bp in length where its 5' and 3' UTRs were 61 bp and 359 bp long respectively. Each of various recombinant transcripts incorporated in the pTZ19R vector were successfully transcribed and translated *in vitro* at optimal reaction times of 60 min and 40 min, respectively. The identification of sites on the UTR of mRNA of a milk protein that are responsible for translation efficiency improves our understanding of the mechanisms of translational control of milk protein.

Key Words: UTR, beta casein, translation efficiency

M116 Impact of an extended photoperiod in farrowing houses on sow and litter performances. M.-P. Lachance^{*1}, J.-P. Laforest², N. Devillers¹, A. Laperrière³, and C. Farmer¹, ¹Agriculture and Agri-Food Canada, Dairy and Swine R & D Centre, Sherbrooke, QC, Canada, ²Animal Science Dept., Laval University, Québec, QC, Canada, ³LTE, Hydro-Québec's Research Institute, Shawinigan, QC, Canada.

The current project studied the effect of an extended photoperiod around parturition and throughout lactation on the performance of sows and piglets. Fifty-four sows were assigned to two light regimens: 1) standard (CTL, $n = 28$) consisting of 8 h of light daily from d 112 of gestation until d 23 of lactation; 2) extended (TRT, $n = 26$) consisting of 23 h of light from d 112 of gestation to d 4 of lactation and 16 h thereafter. On d 4 and 21 of lactation, (between 1000 and 1115), milk samples were obtained for compositional analyses and blood samples were collected to measure prolactin and melatonin. Feed intakes were noted during lactation for sows and during the 35 d following weaning for piglets. Colostrum intake was estimated based on a 24 h piglet weight gain starting at the end of farrowing. Litter size was standardized to 10 ± 1 pigs. Piglets were weighed at birth and on d 2, 4, 7, 14, 21 (weaning), 35 and 56. Behavior of sows was recorded using scan sampling every