W91 The influence of wilting on the quality of *Acacia mangium* silage. T. Clavero* and R. Razz, *Centro de Transferencia de Tecnologia en Pastos y Forrajes. Universidad del Zulia*, *Maracaibo, Zulia, Venezuela*.

An experiment was conducted in the dryland farming area of northwest Venezuela to evaluate the ensiling properties of *Acacia mangium* using microsilo techniques. Factors studied were wilting for 0 and 3 h and ensiling time of 0, 5, 8 and 16 days. A 1:2 (w:v) ratio of legume:molasses was mixed and stored at 25°C. Data were analyzed as a randomized design with a 2X4 factorial of wilting time and ensiling time, respectively. Means were compared by Tukey test. Response variables were: dry matter (DM), cellulose (C), pH, total nitogen (TN), ammonia (NH3) and NH3/TN. Increasing ensiling time of high moisture *Acacia* resulted in losses of DM and C in the silage. Ensiling *Acacia mangium* from 0 to 16 d resulted in decreased (P≤0.05) DM and C content of 12 and 10%, respectively for high moisture silage in contrast to 8.5 and 6% for wilted. This could have been due to the cumulative activity of plant cell respiration, enzymes cellulose and some facultative bacteria in the fresh ensiled forage. The pH increased (P≤0.05) while CP, NH3 and NH3/TN decreased (P≤0.05) with reduced moisture content of ensiled *Acacia* . The concentrations of fermentation end-product decreased with wilting, showing that low moisture restricted fermentation. Therefore, pH increased in wilted silage. The reduction in CP content in wilted silage was expected due to breakdown of true protein during sun-drying and ensiling process. Wilting resulted in a decrease (P≤0.05) in NH3 and NH3/TN when compared to high moisture silage. The concentrations of NH3 and NH3/TN in high moisture silage were 38 and 25.9% greater, respectively, than wilted silage. However, the levels of NH3 were still within acceptable limits, with values less than 80-100 g/kg TN which is commonly used to represent well fermented silage. Although fermentation patterns were different (P≤ 0.05), all silages in the current experiment achieved satisfactory preservation.

Key Words: *Acacia mangium*, Silage, Wilting

W92 Mulberry (*Morus alba*) fodder response to increasing levels of organic nitrogen. J. A. Elizondo-Salazar* and C. Boschini-Figueroa, *Estación Experimental Alfredo Volio Mata. Facultad de Ciencias Agroalimentarias*, *Universidad de Costa Rica, Costa Rica.*

In some areas of Costa Rica and many other countries, the available grazing is sometimes not sufficient to meet the nutrient requirements of animals, at least for part of the year. Thus, the use of fodder from trees and shrubs is widely utilized as dietary supplements for ruminants. However, high fodder yields and adequate CP levels require application of large doses of chemical N, increasing production costs and pollution risk. In order to reduce cost, producers utilized organic fertilizers without knowledge of the right amounts to use in order to obtain high yields. For this reason, a study was conducted to evaluate the application of increasing levels of N from organic fertilizer consisting of green waste composted material. A 12-yr-old mulberry plantation planted at spacings 0.9 × 0.40 m (27,777 plants/ha) was utilized in a randomized block design with 4 treatments: 150, 300, and 450 kg of N/ha/yr, and a control (no fertilizer). All plots were uniformly pruned at 0.6 m from the ground at the beginning of the trial. Organic fertilizer was applied in 2 doses during the rainy season. For a 365-d period, plants were pruned consecutively every 90 d. Leaves and stems were separated and analyzed for DM and CP content. On average, 475 kg of N/ha/yr were removed. There was no significant difference in dry matter yield; suggesting that the amount of N mineralized from the organic fertilizer was low during the duration of the study. However, CP content was greater for the higher N applications, indicating that greater N quantities were available for uptake. In order to replenish the N being removed, at least 450 kg of N/ha/yr should be applied.

Table 1.

	Treatment kg N/ha/yr					
Variable	0	150	300	450	SEM	*P*
Dry matter, %						
Leaves	22.28	22.16	21.12	21.51	0.44	NS
Stalk	23.47	23.80	22.70	23.03	0.43	NS
Total	22.67[a]	22.63[a]	21.63[b]	21.60[b]	0.33	0.09
Dry matter, kg/ha/yr						
Leaves	14,492.0	14,091.4	15,740.3	15,740.3	892.5	NS
Stalk	9,353.2	9,176.1	10,704.9	10,951.3	712.8	NS
Total	23,845.2	23,267.5	26,098.9	26,691.6	1,538.9	NS
Crude protein, %						
Leaves	15.23[b]	15.79[ab]	16.35[a]	16.43[a]	0.31	0.03
Stalk	5.36	5.48	5.52	5.82	0.16	NS
Total	11.50[b]	11.78[ab]	12.05[ab]	12.21[a]	0.20	0.07

Key Words: *Morus alba*, Nitrogen, Organic Fertilizer

W93 Effects of one-seed juniper on intake, rumen fermentation, and plasma amino acids in sheep and goats fed supplemental protein. S. A. Utsumi[1], A. F. Cibils[1], R. E. Estell*[2], S. Soto-Navarro[1], and D. M. Hallford[1], [1]*New Mexico State University*, *Las Cruces*, [2]*USDA/ARS Jornada Experimental Range*, *Las Cruces, NM.*

We tested the effect of feeding one-seed juniper (*Juniperus monosperma*) on total intake, VFA profile, and plasma AA of 12 does and 12 ewes fed sudangrass (*Sorghum vulgare*) and a basal diet with no protein supplement (Control; 5% CP) or rumen degradable (SBM; RDP 15% CP) or undegradable (FM; RUP 15% CP) protein supplements. After 15 d of adaptation to sudangrass and basal diets (period 1), animals were individually fed one-seed juniper leaves in addition to the sudangrass and basal diets during a second 15-d period (period 2). Each food was fed separately during 3-h periods at 110% of previous day intake. Blood and ruminal fluid samples were collected on the last 2 d of each period to determine plasma AA, VFA, and rumen pH. Analyses followed a split-plot design with periods with or without juniper as a sub-plot factor. Juniper intake did not vary between species ($P = 0.54$) or supplement treatments ($P = 0.93$; 4.7 g/kg$^{0.75}$). Total intake (TI), basal diet intake (BDI), and sudangrass intake (SGI) were not affected by supplements ($P > 0.05$), were higher for sheep than goats ($P < 0.01$), and decreased with juniper feeding in period 2 ($P < 0.01$). Total intake, BDI, and SGI for periods 1 and 2 were 54.9 vs. 47.6, 36.7 vs. 31.5, and 18.2 vs. 11.5 g/kg$^{0.75}$, respectively. Total VFA, acetate (Ac), and propionate (Pr) increased with juniper in period 2 ($P < 0.01$; period 1 vs. 2, VFA:

63.9 vs. 79.4; Ac: 47.5 vs. 60.5; Pr: 9.3 vs. 11.7 mM). Rumen pH averaged 6.4 and did not differ between supplements, species, or periods. Total AA and some individual AA differed between supplements (RUP≥RDP>Control), species (goats>sheep), and decreased with the feeding of juniper in period 2 ($P < 0.05$). Juniper intake in period 2 was associated with decreases in plasma ALA, GLY, THR, SER, ASP, MET, GLU, PHE, CYST, TYR, and TRP. These data suggest one-seed juniper in sheep and goat diets depresses intake, but may increase VFA and requirements for certain amino acids.

Key Words: Essential Oils, *Juniperus monosperma*, Protein Supplementation

W94 Effects of one-seed juniper and polyethylene glycol on intake, rumen fermentation, and plasma amino acids in sheep and goats fed supplemental protein and tannins. S. A. Utsumi[1], A. F. Cibils[1], R. E. Estell*[2], S. Soto-Navarro[1], and D. M. Hallford[1], [1]*New Mexico State University*, *Las Cruces*, [2]*USDA/ARS Jornada Experimental Range*, *Las Cruces, NM*.

We tested the effect of polyethylene glycol (PEG) on juniper (*Juniperus monosperma*) and total intake, rumen fermentation, and plasma AA of 12 does and 12 ewes fed sudangrass (*Sorghum vulgare*) and basal diets containing 10% quebracho (*Aspidosperma quebracho*) tannins with no protein supplement (Control; 5% CP) or high rumen degradable (RDP 15% CP) or undegradable (RUP 15% CP) protein supplement. After 15 days of exposure to non-restrictive amounts of juniper leaves, sudangrass, and basal diets (period 1), animals received an additional 50 g of PEG for a second 15-d period (period 2). Blood and ruminal fluid samples were collected on the last 2 d of each period to determine AA and VFA. Analyses followed a split-plot design with periods with or without PEG treated as sub-plot factor. Juniper intake did not differ between species ($P > 0.05$) or supplements ($P > 0.05$), but increased with addition of PEG in period 2 (Period 1 vs. 2: 4.3 vs. 10.8 g/kg$^{0.75}$; $P < 0.01$). Total intake and intake of sudangrass and basal diets were higher for sheep than goats ($P < 0.01$) and differed between supplements and periods (supplement x period, $P < 0.05$). Polyethylene glycol stimulated higher intakes of basal diet for Control and RDP, and of sudangrass for RUP. Total VFA was higher for sheep than goats ($P < 0.05$) and decreased from period 1 to period 2 with supplemental PEG in sheep (70.6 vs. 62.1 mM; species x period, $P < 0.05$) and with RDP (67.3 vs. 58.6 mM; supplement x period, $P < 0.05$). Acetate and propionate differed between periods with or without PEG in the same manner as total VFA. Total AA and some individual AA differed between species (sheep > goats), supplements (RUP ≥ RDP > Control), and periods ($P < 0.05$). Increased juniper intake with PEG in period 2 was associated with lower plasma GLY, THR, SER, ASP, MET, GLU, PHE, CYST, GLN, ORN, LYS, HIS, and TRP. Polyethylene glycol increased juniper intake and decreased several plasma AA when tannin-rich foods with varying CP were fed.

Key Words: Essential Oils, *Juniperus monosperma*, Condensed Tannins

W95 Effect of essential oils on in vitro NDF digestion. M. D. Tassoul*, J. P. Goeser, R. D. Shaver, and D. K. Combs, *University of Wisconsin*, *Madison*.

Our objective was to determine the effect of essential oils on in vitro NDF digestibility (ivNDFD). Corn (35.6% NDF) and alfalfa (41.8% NDF) silage samples were dried, ground (1 mm), and treated in one of two ways; left unsupplemented (Control, C) or mixed with an essential oil blend (CRINA®, EO) at a rate similar to supplementing EO at 1.2 g/cow/d and weighed (0.5 g) into Ankom F57 forage fiber bags. Samples were digested with Goering and Van Soest in vitro media in duplicate using a modified ivNDFD assay for 0, 7, 10, 14, 21, 24, 30, 36, 46, 54, 72, or 96 h. Rumen fluid was collected and pooled from two cannulated donor cows. Strained rumen fluid was mixed with buffer, reducing solution and primed with a mixture of carbohydrates and nitrogen, and allowed to produce 0.3 ml gas/ml of rumen fluid inoculum prior to inoculating feed samples. In vitro NDF digestibility was calculated as: ivNDFD (% of NDF) =100 X [(NDF0h – NDFresidue)/(NDF0h)]. Results were analyzed with SAS Proc Mixed. The model included fixed effects of: feed, EO, time, and two way interactions between each. Means were compared with the lsmeans statement. Corn silage NDF was more digestible than alfalfa silage NDF (32.1 vs. 31.1% ivNDFD, $P = 0.04$). There was a tendency for a feed by EO interaction ($P = 0.08$), Corn silage mean ivNDFD was greater with EO compared to C (32.9 vs. 31.3%, $P < 0.05$), while alfalfa silage did not differ. A significant time effect and a time by feed interaction were both observed ($P < 0.05$). There was a trend for an EO by time interaction ($P = 0.13$). Mean 24 h ivNDFD was greater for EO than C (24.51 vs. 20.57%, $P < 0.05$). The increased ivNDFD for both feeds at 24 h with EO, and improved corn silage ivNDFD with EO observed in this research agrees with previous in vitro experiments, but the feed by EO interaction merits further study.

Key Words: Essential Oils, In Vitro, NDF

W96 Nutritive evaluation of three browse tree foliages during rain and dry seasons: Total tannins and in situ digestibility in cattle and goats. R. Rojo*[1], D. López[1], F. Vázquez[1], O. Vazquez[1], B. Albarrán[1], S. Rebollar[1], J. Hernández[1], D. Cardoso[1], F. González[1], E. Dorantes[1], F. Avilés[1], A. García[1], and C. Narciso[2], [1]*Universidad Autónoma del Estado de México*, *Temascaltepec, Estado de México, México*, [2]*Colegio de Postgraduados*, *Córdoba, Veracruz, México*.

Foliages from three browse spp. (*Lysiloma acapulcencis*, *Quercus laeta* and *Pithecellobium dulce*), native to the southern subtropical region of the state of México, México, was harvested during the rain (2006) and dry (2007) seasons to evaluate chemical composition (CP, NDF, ADF), total tannin (TT) and *in situ* digestibility of DM (DMD), fiber fractions (NDFD, ADFD), and crude protein (CPD), using three different ruminal inoculums (bovine, BOV; goat unadapted, GUA; goat adapted, GA). Animals were equipped with ruminal cannula and received forage:concentrate (80:20) diets; where forage for BOV and GUA was a mixture of: alfalfa hay (30 %), corn silage (30 %) and corn straw (20 %), for GA the forage was alfalfa hay (24 %) and browse species (56 %). Browse foliages, season, and ruminal inoculums were arranged in a 3 X 2 X 3 factorial design. The incubations period was

48 h. Crude protein and fiber fractions were affected (P<0.01) by species and season. Total tannin content varied among species (P<0.01) (*L. acapulcencis* rain: 187.77[a] vs dry:160.24[a]; *Q. laeta* rain:89.9[bc] vs dry:108.99[b]; *P. dulce* rain:62.55[c] vs dry:94.11[bc] g kg^{-1} DM. Inoculum and season affected (P<0.01) DMD, NDFD, and CPD. During the dry season, DMD was highest for *P. dulce* (P<0.01) and lowest for *L. acapulcencis* (P<0.01). In the dry season, DMD was higher for goats than cattle (rainy: BOV:54.43[c], GUA:54.78[c], GA:51.46[d] vs dry: BOV:59.69[b], GUA:66.89[a], GA:65.28[a]). NDFD was higher for goats in the dry season (P>0.01) and was higher for *P. dulce* (rain: BOV:30.86[bc], GUA:33.24[ab], GA:27.38[c] vs dry: BOV:21.47[d], GUA:36.62[a], GA:33.62[a]). A similar effect was observed for CPD (P<0.01). Goats had more capacity to use browse species with tannins. *P. dulce* could be a forage specie with potential of use as protein source in small ruminants.

Key Words: Browse Species, Tannin, Digestibility

W97 Effect of fodder tree species, season, and inoculum source on in vitro gas production from foliage. L. M. Camacho*[1], R. Rojo[1], G. D. Mendoza[2], F. Avíles[1], D. López[1], D. Cardoso[1], S. Rebollar[1], and N. Pescador[1], [1]*Universidad Autónoma del Estado de México*, *Temascaltepec, Estado de México, México*, [2]*Universidad Autónoma Metropolitana*, *Distrito Federal, México*.

The *in vitro* gas production of *Lisyloma acapulcencis*, *Quercus laeta* and *Pithecellobium dulce* harvested during the rainy and dry seasons was measured, using three different ruminal inoculums bovine (BOV), unadapted goat (UAG), and adapted goat (AG). Animals were fitted with ruminal cannulae and received forage:concentrate (80:20) ratio diets, where forage for BOV and UAG was a mixture of alfalfa hay (40%), corn silage (40%) and corn stover (20%), and for AG the forage was alfalfa hay (24%) and browse species (56%). Browse foliages, season, and ruminal inoculums were arranged in a 3 X 2 X 3 factorial design. Chemical composition (CP, NDF) and total condensed tannin (TCT) were determined. The gas volume was recorded at 0,2,4,6,8,12,16,20,24,48,72 and 96 h and the data fitted to the model P=a+b(1-e-ct). *P. dulce* had the highest (P<0.05) CP content (186 and 167g kg^{-1} DM) in rainy and dry season, respectively. *L. acapulcencis* had the highest NDF (554 and 559 g kg^{-1} DM) in the rainy and dry season, respectively. The highest levels (P<0.05)of TCT were detected in *L. acapulcensis*, (188 and 160 g kg^{-1} DM), while the lowest were observed in *P.dulce* (63 and 94 g^{-1} kg) in rainy and dry season, respectively. Cumulative gas release at 96 h was 181-183 mL g^{-1} DM for *P.dulce* in dry season with inoculum from goats while *L. acapulcensis* produced 30-39 mL g^{-1} DM with inoculum from BOV in both seasons. The highest gas volume from the b pool was found with *P.dulce* (P<0.05; 182 and 179 mL g^{-1} DM) in rainy season with inoculum of AG and UAG, respectively. The least quantity from this fraction was produced in both seasons (46 and 43 mL g^{-1} DM) from *L. acapulcensis* with inoculum from BOV. The highest constant rate of gas production (c) was observed with *P.dulce* (5% h^{-1}) from the dry season using UAG and AG inoculum. The lowest constant rate (1 % h^{-1}) was observed with *Q.laeta* from the rainy season with BOV inoculum. *P.dulce* showed highest nutritional value and could be used for grazing goats in semi-arid regions.

Key Words: *In Vitro* Gas Production, Browse Species, Inoculums

W98 Ozone and nitrogen deposition effects on nutritive quality of a species-rich subalpine grassland. M. K. Cline*[1], J. C. Lin[1], K. Nadarajah[1], M. Volk[2], R. B. Muntifering[1], S. Bassin[2], and J. Fuhrer[2], [1]*Auburn University*, *Auburn, AL*, [2]*Swiss Federal Research Station for Agroecology and Agriculture*, *Zurich, Switzerland*.

Rising global levels of tropospheric ozone (O_3) and excessive rates of atmospheric N deposition represent major threats to productivity and sustainability of grasslands across the Northern Hemisphere. Effects of exposure to each of these on productivity and nutritive quality of intensively managed forages have been reported, but little is known about their combined effects or impacts on extensively managed grasslands. For these reasons, we conducted an experiment to determine effects of co-exposure to a range of current and projected levels of these air pollutants on productivity and nutritive quality of an extensively managed, species-rich (primarily *Festuca*, *Nardus* and *Carex*, numerous forb and few legume spp.) pasture located at Alp Flix, Switzerland. One hundred eighty plots (40 × 30 cm) representative of vegetation at the site were exposed during the April–October growing seasons in 2004–2006 to one of three levels of O_3 (1.0, 1.2 or 1.6 × ambient) in a free-air fumigation system that comprised 9 exposure rings (3 rings/O_3 level). Within each ring, 20 plots received biweekly applications of NH_4NO_3 solution that simulated five areal concentrations of atmospheric N deposition equivalent to 0, 5, 10, 25 or 50 kg/ha (4 plots/N concentration). Plots were harvested once each year in August by cutting forage at 2 cm above ground surface. Differences ($P < 0.0001$) were observed among years in forage concentrations of N, NDF, ADF and ADL, and in relative nutritive quality calculated from forage concentrations of NDF and ADF. Across all three growing seasons and levels of N input, there was no systematic effect of O_3 exposure level on grassland nutritive quality. However, there was an O_3 × N interaction ($P = 0.09$) such that positive responses in forage quality to N inputs of 25 and 50 kg/ha were ablated by increased deposition and lignification of cell-wall constituents associated with accelerated foliar senescence in the elevated-O_3 treatments. Results indicate that excessive rates of N deposition may increase plant sensitivity to elevated O_3, presumably from increased stomatal uptake, and further compound the phytotoxic effects of O_3 on forage quality.

Key Words: Ozone, Nitrogen, Forage Quality

W99 Forage quality of native pasture in an alpine area for the production of Bitto cheese. S. Colombini*, A. Tamburini, A. Sandrucci, and L. Rapetti, *University of Milan*, *Milan, Italy*.

Bitto is an Italian traditional cheese produced in Valtellina by grazing cows on alpine pasture with a maximum inclusion of 3 kg concentrate/day. The objective of this research was to characterize the nutrient composition and the feed value of native alpine pasture during rotational grazing. Grass samples were collected in two experimental study areas located in Valtellina (1500 m o.s.l.) in 2006. Triplicate samples were collected every 15 days during the grazing season (June-September) and chemically analyzed. NRC 2001 equations were used to predict the nutritive value of grass. NDF digestibility at 48 h was determined by Ankom Daisy Incubator [II]. Results were used to predict energy and protein metabolism of the cows with CPM-Dairy model and NRC Dairy

Cattle Program. Data were analyzed by GLM procedures of SAS, with 2 pasture levels and 8 sampling data.
DM content increased in both experimental sites during the grazing season (from 43.6 to 58.0% in site 1 - $P<0.05$, and from 34.9 to 43.9% in site 2 - $P<0.05$). Average NDF contents (67.6 and 62.9% on DM in site 1 and 2, respectively) were higher than those reported for north Italy alpine pastures. The energy value (Mcal NE_l/kg DM) was generally low and decreased from 1.11 to 0.78 in site 1 ($P<0.01$) and from 1.41 to 0.94 in site 2 ($P<0.10$). CP content decreased during the grazing season from 12.9 to 9.2% ($P<0.05$) and it was negatively correlated with the date of sampling ($y=-0.0484+1895.3$; $r^2= 0.86$). At the beginning of the season, in the diet there was low energy/nitrogen ratio due to herbage characteristics. Simulation of energy and protein requirements showed a negative balance for ME during the entire grazing season even with the daily integration of 1 kg soybean meal and 2 kg corn meal. Metabolizable protein balance was positive. The results showed an average low energy value of pasture, with significant differences between the two sites due to different botanical composition. The energy value decreased from June to September suggesting the importance of providing, during the grazing season, a proper supplementation in order to meet the energy and protein requirements of the cows.

Key Words: Alpine Pasture, Energy Value

W100 Mineral profiles of selected grass and legume species as affected by liquid hog manure and inorganic fertilizer. G. N. Gozho[1], M. Undi*[2], J. Sletmoen[2], F. Stewart[3], J. C. Plaizier[2], and K. M. Wittenberg[2], [1]*University of Saskatchewan*, *Saskatoon, Saskatchewan, Canada*, [2]*University of Manitoba*, *Winnipeg, Manitoba, Canada*, [3]*Manitoba Agriculture, Food and Rural Initiatives*, *Beausejour, Manitoba, Canada*.

Mineral profiles of selected grass and legume forages grown on land receiving either liquid hog manure or inorganic urea fertilizer were determined. Two sources of N, liquid hog manure or urea, were used, with application rates of 112, 224 and 336 kg available N ha^{-1}. Urea-treated plots received 5.5 kg P_2O_5 ha^{-1} and 5.5 kg K_2O ha^{-1} each year. Manure ammonia-N was measured using a Nova meter (Agros Nova Nitrogen Meter, Kalby, Sweden) before application. Liquid hog manure in western Canada generally contains, DM basis, 74 to 146 g kg^{-1} N, 19 to 49 g kg^{-1} P and 99 to 117 g kg^{-1} K. A control that received no liquid hog manure or inorganic fertilizer was included. Three legume forages namely, alfalfa (Medicago sativa L.), red clover (Trifolium pratense L.), and birdsfoot trefoil (Lotus corniculatus L.) and three grass forages, tall fescue (Festuca arundinacea Schreb.), reed canarygrass (Phalaris arundinacea L.), and quackgrass (Elytrigia repens [L] Nevski) were evaluated. The two replicates were harvested on June 12 and 18 (cut 1) and on September 4 and 6, 2001 (cut 2). Urea application reduced ($P < 0.05$) the ash content of grass forages at first cut but not second cut relative to unfertilized and liquid hog manure treatments. Grasses harvested from the highest urea treatment had the highest Ca content, whereas those receiving the highest liquid hog manure application had the lowest Ca content, with other treatments being intermediate. A similar profile emerged for plant Mg response to fertility. Fertility reduced ($P < 0.05$) Ca content of legume forages but had no effect ($P > 0.05$) on P, Mg or S concentrations. Liquid hog manure application resulted in elevated ($P < 0.05$) K levels compared to urea treatment in all forages. The tetany ratio, K:(Ca + Mg), used to predict incidence of tetany in cattle, was highest in grass and legume forages for the highest liquid hog manure. Results of this study demonstrate that forage mineral profiles can be impacted differently when liquid hog manure is applied as opposed to conventional inorganic fertilizer sources.

Key Words: Liquid Hog Manure, Grass, Minerals

W101 Split application of nitrogen on perennial grasses compared to manure applications. D. J. R. Cherney*, J. H. Cherney, Q. Ketterings, and M. Davis, *Cornell University*, *Ithaca, NY*.

Timing of N applications and the form of the nutrients applied can impact forage yield and quality. Split application of nitrogen fertilizer on four field replications (3 × 6.1 m) of orchardgrass, tall fescue and reed canarygrass was compared with dairy manure applications. Nitrogen fertilizer was applied at 90.8 kg N/acre at spring greenup, or 45.4 kg N fertilizer/acre at spring greenup followed by 45.4 kg N fertilizer after first cut, or 45.4 kg N fertilizer/acre at spring greenup followed by 22.7 kg N/acre after first cut and 22.7 kg N/acre after second cut. Commercial N treatments were compared to two applications of 44.8 metric tons/ha of semi-solid dairy manure applied at spring greenup and after first harvest. A combination treatment of 89.6 metric tons/ha of manure split applied and 68 kg N fertilizer/ha split applied at spring greenup and after first and second cuts was also used. Plots were harvested with a forage harvester (Carter Mgf. Co., Brookston, IN). There was about a 5% yield increase due to a split N application and about an 8% yield increase using a three-way split application. Nitrogen fertilizer recovery decreased ($P<0.05$) with split application of N from 60% to 53%. The proportion of the total yield in the first two cuts decreased ($P<0.05$) from 80% to 71% with split N application. Manure application resulted in 20% lower yield ($P<0.05$) than commercial N application, while a combination of manure and N fertilizer increased yields 10% ($P<0.05$) over commercial N application alone. Grasses reacted similarly to treatments for yield and N recovery; yield of tall fescue was distributed more uniformly over the three cuts compared to the other species. Reed canarygrass was consistently 30-40 g/kg higher in CP and averaged 50 g/kg lower NDF than the other species over all three harvests. NDF averaged 530, 560, and 530 g/kg for the 3 cuts and NDF digestibility averaged 760, 690, and 640 g/kg for the three cuts. Treatments did not significantly impact NDFD. There was a small yield advantage for split application of N fertilizer on perennial grasses, and it will take more than four years of manure application at a 89.6 metric tons/ha rate to produce yields comparable with commercial N fertilization.

Key Words: Perennial Forage, Manure

W102 In vitro dry matter digestibilities of perennial peanut, annual peanut, alfalfa, and bermudagrass forages in horses. J. V. Eckert*, R. O. Myer, L. K. Warren, J. L. Foster, and J. H. Brendemuhl, *University of Florida*, *Gainesville*.

In vitro dry matter digestibilities (IVDMD) of perennial peanut (PP, *Arachis glabrata*, 'Florigraze'), annual peanut (AP; *Arachis hypogea*) hays (grown in Marianna, FL, 2005, 2006) as well as dried fresh forage samples taken from the same fields (2006), alfalfa hay (A; Iowa, 2006), Tifton 85 (T85) and Coastal (CB) bermudagrass hays (*Cynodon dactylon*, both from Suwannee county, FL, fertilized fields), and six variet-

ies of PP were compared (Marianna, FL, 2006). All hays had no rain damage. Seven yearling horses fed their normal diet (grass pasture and concentrate) were used as the source of feces. Samples were incubated in a closed fermentation apparatus (Daisy^{II} incubator). Freshly voided feces were collected from all horses, mixed with buffers, and placed in four incubation vessels. Twenty-one filter bags (each containing 0.5 g of sample) were placed in each vessel. Jars were heated and rotated for 48 h. Data were analyzed using PROC MIXED of SAS. Least square means of IVDMD (%±SE) from samples of dried fresh AP were 80 and 78% (% ±2). The IVDMD of AP hay (65% ±2) was lower than fresh AP ($P< 0.0001$). Dried fresh AP samples were greater than dried fresh PP ($P < 0.01$). Alfalfa hay (71% ±2) and PP hay (68% ±2) had similar IVDMD ($P> 0.2$). The IVDMD of A was greater than AP hay ($P< 0.01$) while PP and AP hays did not differ ($P> 0.2$). Perennial peanut, T85, and CB hays from a previous digestion trial (abstract 38 in 2007 meeting of the Southern Section of ASAS) showed a greater IVDMD for PP than T85 or CB ($P< 0.0001$; comparable to the in vivo DMD) and no differences ($P> 0.2$) between T85 and CB from the first two periods of that trial. During period 3 of that same trial, CB IVDMD tended to be greater than T85 ($P< 0.06$). Numerically, the IVDMD of the grasses was lower than their in vivo DMD. Of the six varieties of PP, the two with the highest IVDMD were Elite Line (75.7% ±2) and Ecoturf (73.8% ±2), even though all varieties were highly digestible. Results indicate that PP and AP are highly digestible, but PP may be better suited for horses.

Key Words: Perennial Peanut, In Vitro Digestibility, Horse

W103 Forage management affects bermudagrass Forage yield and nutritive value. A. E. Lee*[1], A. V. Riojas[1], B. D. Lambert[1,2], and J. P. Muir[2], [1]*Tarleton State University*, *Stephenville, TX*, [2]*Texas AgriLife Research*, *Stephenville, TX*.

Bermudagrass (*Cynodon dactylon*) cultivars are common forages in the southern USA. Coastal (CB) and Tifton 85 (T85) bermudagrass are widely cultivated in Texas. As fuel and labor costs rise, producers have opted to "stockpile" standing forages for winter grazing instead of using hay. Experiments compared the effects of stockpiling (Exp. 1) and hay cutting (Exp. 2) on CB and T85 forage yield and nutritive value. Sixteen 3 × 9 m plots were utilized, consisting of four plots of each species (CB or T85) per treatment. All plots received a single spring application of nitrogen (94 kg/ha). In Exp. 1, previously unharvested forage was sampled by hand clipping (1 m^2) to ground level every 14 days to determine the effect of maturity on forage stockpiling. In Exp. 2, forage was sampled by hand clipping to ground level (1 m^2) every 21 days and only regrowth was subsequently sampled, emulating well–managed hay production. Samples were analyzed for dry matter (DM), nitrogen (N), neutral detergent fiber (NDF), and acid detergent fiber (ADF) concentrations. Forage DM yield (kg ha^{-1} $year^{-1}$) was calculated. In Exp. 1, CB had greater yield (P=0.02) as well as greater N (P<0.0001), NDF (P<0.0001) and ADF (P=0.006) concentration. In Exp. 2, T85 had higher N (P=0.007) and lower NDF (P=0.01) concentrations than CB. Preliminary results indicate that CB is better suited for stockpiling than T85 while the reverse is the case for hay.

Key Words: Stockpiling, Coastal Bermudagrass, Tifiton 85 Bermudagrass

W104 Forage nutritive value of crown rust resistant and susceptible oat cultivars in Northern Mexico. H. Bernal-Barragán*[1], R. Quintero-Martínez[1], J. A. Hernández-Aguilar[1], M. A. Cerrillo-Soto[2], A. S. Juárez-Reyes[2], E. Gutiérrez-Ornelas[1], J. E. Treviño-Ramírez[1], and F. Zavala-García[1], [1]*Facultad de Agronomía UANL*, *Escobedo, N.L., México*, [2]*Facultad de Medicina Veterinaria y Zootecnia UJED*, *Durango, Dgo., México*.

Oat (*Avena sativa* L.) cultivated in Mexico is mainly utilized as green forage or hay for feeding ruminants in winter and early spring. Crown rust caused by *Puccinia coronata* is an important oat disease, especially when relative humidity is high during the growing season, and it can affect forage productivity and quality. This study was conducted with the aim to assess the nutritive value of four crown rust resistant oat cultivars (L-112, L-124, L-135 and L-164), which were released at the Facultad de Agronomía UANL in 2007, and two crown rust susceptible oat cultivars (Cocker and Cuauhtemoc). Crown rust was present during the experiment in 100% of the plots of susceptible cultivars, whereas resistant cultivars were not affected at all. Three random whole plant samples were collected from small plots at 92 and 103 days of growth, oven dried at 55º C, and ground to pass through 1 mm screen. Dry matter, ash, CP, NDF, ADF, and ADL, were determined and contents of cellulose, and hemicellulose were calculated. Further analyses were conducted using a Daisy^{II} Incubator and an adiabatic calorimeter to determine in vitro true digestibility of DM (IVTDMD) and digestible energy (DE) content, respectively. A 6 x 2 factorial arrangement (six oat cultivars x two cutting stages) was used in a complete randomized design, with three replicates per treatment. Ash contents were least ($P < 0.05$) for L-135 and greatest for Cuauhtemoc. Differences in CP, cellulose, hemicellulose, IVTDMD, and digestible energy content were found ($P < 0.05$) among oat cultivars (Table 1). There were no differences in ADL content. Ash and CP content of cultivars at 103 days were 16% less ($P < 0.05$) than at 92 days, whereas IVTDMD and digestible energy content were 5% less ($P < 0.05$) at 103 than at 92 days. In conclusion, the forage nutritive value of crown rust resistant cultivar L-112 was similar to those crown rust susceptible oat cultivars Cocker and Cuauhtemoc.

Table 1.- CP, fiber fractions, IVTDMD, and DE of oat cultivars (% or Mcal/kg DM)

Cultivar	CP	Cellulose	Hemicellulose	IVTDMD	DE
L-112	16.4^{a}	38.2^{a}	17.6^{c}	70.0^{b}	3.09^{abc}
L-124	14.4^{ab}	37.9^{a}	18.9^{bc}	65.1^{c}	2.81^{c}
L-135	12.0^{b}	35.6^{ab}	21.3^{ab}	62.2^{c}	2.86^{bc}
L-164	13.4^{ab}	38.0^{a}	19.4^{bc}	64.5^{c}	2.79^{c}
Cocker	15.9^{ab}	33.7^{b}	22.1^{a}	75.3^{a}	3.33^{ab}
Cuauhtemoc	16.6^{a}	38.0^{a}	21.5^{ab}	71.3^{b}	3.43^{a}
Mean	14.8	36.9	20.1	68.1	3.05
SEM	0.38	0.39	0.26	0.36	0.046

^{a,b,c} Means in a column with unlike superscripts are different ($P<0.05$)

Key Words: *Avena sativa*, Crown rust resistence, Nutritive value

W105 *In vitro* gas production characteristics and metabolizable energy content in crown rust (*Puccinia coronata*) resistant and susceptible oat (*Avena sativa* L.) cultivars. M. A. Cerrillo-Soto*[1], A. S. Juárez-Reyes[1], H. Bernal-Barragán[2], R. Quintero-Martínez[2], J. A.

Hernández-Aguilar[2], E. Gutiérrez-Ornelas[2], J. E. Treviño-Ramírez[2], and F. Zavala-García[2], [1]*Facultad de Medicina Veterinaria y Zootecnia UJED*, *Durango, Dgo, México*, [2]*Facultad de Agronomía UANL*, *Escobedo, N.L. México*.

This study was conducted to determine the kinetics of in vitro gas production and the metabolizable energy (ME) content of four crown rust resistant oat cultivars released in 2007 at the Facultad de Agronomía UANL, México (L-112, L-124, L-135, and L-164) and of two crown rust susceptible oat cultivars (Cocker and Cuauhtemoc). During the experiment crown rust affected 100 % of the plots of susceptible oat cultivars, but plots of resistant cultivars were not affected at all. Three random whole plant samples were collected from small plots at 92 days of growth. Samples were oven dried and ground through 1 mm screen. In vitro gas production in oat samples was performed by incubating in triplicate 200 mg DM in 100 ml calibrated glass syringes. A buffered solution was mixed with rumen fluid from three ruminal fistulated sheep fed alfalfa hay and commercial concentrate (75:25) in a ratio of 1:2 (v/v). Thirty ml of the mixture was added to the syringes and the gas production was recorded at 0, 3, 6, 9, 12, 24, 48, 72 and 96 h of incubation. The data were fitted to the exponential equation $p = a + b\ (1 - e^{-ct})$. The content of ME was calculated by: ME (Mcal kg^{-1} DM) = (2.20 + 0.136 Gas $Prod_{24h}$ + 0.057 Crude Protein + 0.0029 Crude Fat^2)/4.184. Data were analyzed using ANOVA for a completely randomized design. Data shown in Table 1 indicate that in vitro gas production allowed identification of a greater nutritional value for resistant crown rust oat cultivar L-112 compared to the crown rust susceptible cultivars.

Table 1. In vitro gas production (mL/200 mg DM) and ME (Mcal/kg DM)

Cultivar	b	c	a+b	ME
L-112	64.5^{a}	0.049^{ab}	55.7^{a}	2.02^{a}
L-124	60.1^{b}	0.045^{b}	51.9^{c}	1.84^{b}
L-135	59.7^{b}	0.047^{b}	54.6^{ab}	1.90^{b}
L-164	57.5^{b}	0.053^{a}	50.9^{c}	1.93^{ab}
Cocker	59.2^{b}	0.047^{b}	52.3^{bc}	1.84^{b}
Cuauhtemoc	58.0^{b}	0.046^{b}	50.9^{c}	1.92^{b}
Mean	59.9	0.048	52.7	1.91
SEM	2.45	0.003	2.39	0.06

b= gas from slowly degraded fraction; c = constant rate of gas prod. (% h^{-1}); a+b = potential gas prod. ^{a,b,c} Means within columns with different superscript differ (P<0.05)

Key Words: *Avena sativa*, Crown Rust Resistance, Forage Nutritive Value

W106 Chemical composition, metabolizable energy content and *in vitro* gas production of grasses from North Mexico. E. Herrera-Torres, M. Murillo-Ortiz, M. A. Cerrillo-Soto*, O. Reyes-Estrada, and A. S. Juárez-Reyes, *Universidad Juárez del Estado de Durango*, *Durango, Dgo., Mexico*.

The objective of this study was to determine the chemical composition, in vitro gas production characteristics and metabolizable energy content of grasses commonly selected by grazing cattle in the semiarid region of North México. Samples of Plateado (1) (*Bothriochloa barbinodis*), Navajita (2) (*Bouteloua gracilis*), Banderita (3) (*Bouteloua curtipendula*), Pata de gallo (4) (*Chloris submutica*), Rhodes (5) (*Chloris gayana*) , Rosado (6) (*Rhynchelytrum roseum*) and Buffel (7) (*Cenchrus ciliaris*) were collected during the wet season in an open grassland in Durango, Mexico. The samples were dried and ground (1 mm). Chemical analyses for CP, NDF and ADF were performed. In addition, triplicate samples (200 mg DM) were incubated in calibrated 100 ml glass syringes, with 30 ml of a mixture of buffer:rumen fluid. The inocculum was collected from three sheep fed alfalfa hay and a commercial concentrate (75:25). Gas production was recorded at 0, 3, 6, 9, 12, 24, 48, 72 and 96h. Data were fitted to the equation: $p=a+b(1-e^{ct})$. The ME content (Mcal Kg^{-1}DM) of sample was calculated by: ME: $(2.20+0.136GP_{24h}+0.057CP+0.0029CF^2)/4.184$. Statistical analysis was performed using a completely randomized design. Differences (P<0.05) were observed for CP and NDF among grasses. The content of ME calculated from in vitro gas production as well as the gas produced from the insoluble but slowly degradable fraction of the feed ***b*** and the constant rate of gas production ***c*** were also different among grasses. Based on our results, *C. ciliaris* has potential to improve grazing for cattle in the semiarid region of North Mexico.

Table 1. Chemical composition, metabolizable energy and *in vitro* gas production of grasses from North Mexico

Grasses	CP	NDF	ME	***b***	***c***
1	3.3^{g}	81^{c}	1.0^{d}	60^{a}	2.2^{b}
2	5.4^{d}	83^{b}	1.4^{c}	61^{a}	2.9^{ab}
3	4.3^{f}	82^{b}	1.5^{b}	57^{a}	2.6^{b}
4	4.8^{e}	84^{a}	1.4^{c}	61^{a}	2.7^{ab}
5	7.3^{c}	65^{f}	1.4^{c}	46^{b}	3.1^{ab}
6	7.8^{b}	77^{d}	1.4^{c}	55^{a}	2.6^{b}
7	10.5^{a}	70^{e}	1.8^{a}	54^{a}	4.2^{a}
Mean	6.2	77.4	1.4	56	2.9
SD	0.09	0.28	0.01	2.8	0.005

^{abcdefg}Means within columns with different superscript differ (P<0.05). CP, NDF (%); ME(Mcal/kgDM); ***b***(ml/.2gDM); ***c***(% h^{-1})

Key Words: Grasses, In vitro Gas, Metabolizable Energy

W107 Evaluation of African star grass– pastures grazed under the leaf stage concept on commercial dairy farms in the humid tropics of Costa Rica. J.M. l. Sánchez*[1,2], S. Salazar[1,3], and A. Martínez[1,2], [1]*Universidad de Costa Rica*, *San José, Costa Rica*, [2]*Centro de Investigación en Nutrición Animal*, *San José, Costa Rica*, [3]*Escuela de Zootecnia*, *San José, Costa Rica*.

African star grass (*Cynodon nlemfuensis*) is used widely on dairy and beef farms in tropical countries. In Costa Rica it grows from sea level to 1200 m in altitude and it is the most important grass in the humid tropics, where annual average precipitation is 4500 mm and annual average temperature is 23°C (minimum of 10°C; maximum of 27 °C). This grass is characterized by a high DM yield and good nutritional value; however grazing intervals are critical because nutritional value declines rapidly with advancing maturity. Thus dairy farmers have had to apply plant phenological concepts such as the leaf stage concept, to determine when to graze this pasture. The aim of this study was to analyze the DM yield, utilization of the pasture on offer, botanical composition of African star grass-based pastures and nutritional value according with NRC (2001) proposed methodologies, on three dairy farms located in the humid tropics of Costa Rica. Farms were selected at random from a

group of farms where the pasture is intensively managed with fertilization, weed control and well-established grazing systems. Measurements and samples were taken every two mo for 1 yr period. Cows grazed the African star grass when it had an average number of 7.9 leaves. Botanical composition analysis showed that 86.7 % of the biomass was African star grass, 2.4% other grasses, 2.9% weeds and 7.8% senescent material. Average DM yield was 26.25 t/ha/year, which is similar to values reported in the literature when this grass is intensively managed. Pastures on the three farms were established more than 20 years ago, indicating farmers use management practices that sustain the grass. On average, pasture contained 20.3% CP, 72.8% NDF, 37.9% ADF, 8.7% ash, 7.7% NFC, 5.6% lignin and 1.2 Mcal/ kg NEL (3X). Agronomic and nutritional data strongly suggest African star grass should be grazed when it has 8 leaves. A grazing system based on the leaf stage concept is a good tool for managing African star grass in the humid tropics.

Table 1.

Farm N°	N° of leaves at grazing	Regrowth period, d	DM yield, kg/ha/cut	% of grass on offer utilized	C P DM%	NE_1 (3X) Mcal/kg DM
1[1]	8.50[a]	29	2570[a]	44	19.8	1.20
2	7.45[b]	30	1624[b]	38	20.8	1.21
3	7.77[b]	27	1864[b]	47	20.2	1.20

[a,b] Means in a column with different superscripts are different (p≤0.05)
[1]Average of 12 samples or measurements

Key Words: African Star Grass, Plant Phenology, Nutritional Value

W108 Production of *Brachiaria brizantha* and *Panicum maximum* forages according to period of intercropping with corn and nitrogen fertilization. R. S. Barducci[1], C. Costa[1], T. C. Putarov[1], L. M. N. Sarti[1], E. S. Ogawa[1], D. D. Millen[1], R. D. L. Pacheco*[1], J. P. S. T. Bastos[1], T. M. Mariani[1], T. C. B. da Silva[2], and S. R. Baldin[1], [1]*FMVZ/UNESP*, *Botucatu, São Paulo, Brazil*, [2]*Faculdade de Zootecnia/UNESP*, *Dracena, São Paulo, Brazil*.

The objective was to evaluate forage dry matter production (FDMP) according to period of intercropping with corn and responses to nitrogen fertilization (NF) applied after harvesting of corn. This study, conducted at São Paulo State University (UNESP-Botucatu) farm, Brazil, was designed in a split plot 4x4 factorial arrangement: corn with *Brachiaria brizantha* intercropped in the sowing (BS), corn with *Brachiaria brizantha* intercropped in the coverage fertilization (BC), corn with *Panicum maximum* intercropped in the sowing (PS) and corn with *Panicum maximum* intercropped in the coverage fertilization (PC) and four rates of N (0, 30, 60, 120 kg/ha) and three periods of growth (1=07/20/2006, 2=09/29/2006, 3=11/09/2006). Corn hybrid 30F90 from Pionner was utilized to establish 55,000 plants/ha while 20kg of seed/ha of each forage was sown. Corn and BS and PS forages were sown on 12/20/2005, but BC and PC forages were sown on 01/14/2006 with coverage fertilization. Forage coverage fertilization was made on 05/24/2006. In period 1 FDMP increased (P<0.01) for BS as rates of N increased, but no effects were found (P>0.05) for BC, PS and PC. BC had greater (P<0.01) FDMP as rate of N increased in period 2. In period 3 as N rate increased, FDMP for BS, BC and PC increased (P<0.01). Summing the three periods, PS did not show a response (P>0.05) to rates of N. Thus, the system of cultivation, forage species, daylength and temperature are important factors to determine FDMP in tropical forages.

Table 1. F values of tropical forage dry matter productivity in response to doses of nitrogen fertilization

Item	Response	Period 1	Period 2	Period 3	Sum
PS	L	4.71	4.97	2.76	0.04
PS	Q	2.79	0.95	1.47	9.79
BC	L	10.08	0.37	23.97**	11.80**
BC	Q	0.004	21.77**	33.90**	39.25**
BS	L	111.30**	2.31	0.07	6.17**
BS	Q	63.81**	2.98	27.68**	46.14**
PC	L	2.19	2.87	81.83**	50.16**
PC	Q	17.70	0.69	83.34**	84.55**

** (P<0.01). L=linear, Q=quadratic.

Key Words: Fertilization, Forage, Intercropping

W109 Production of corn grain with *Brachiaria brizantha* and *Panicum maximum* forages according to period of intercropping. R. S. Barducci[1], C. Costa[1], T. C. Putarov[1], L. M. N. Sarti[1], E. S. Ogawa[1], D. D. Millen*[1], R. D. L. Pacheco[1], J. P. S. T. Bastos[1], T. M. Mariani[1], S. R. Baldin[1], and T. C. B. da Silva[2], [1]*FMVZ/UNESP*, *Botucatu, São Paulo, Brazil*, [2]*Faculdade de Zootecnia/UNESP*, *Dracena, São Paulo, Brazil*.

The study evaluated the production of corn grain intercropped with *Brachiaria brizantha* and *Panicum maximum* forages in no tillage systems. This study, conducted at São Paulo State University (UNESP-Botucatu) farm, Brazil, examined 5 treatment systems of corn cultivation with tropical grasses replicated four times and randomly blocked: single corn crop (MS), corn with *Brachiaria brizantha* intercropped in the sowing (BS), corn with *Brachiaria brizantha* intercropped in the coverage fertilization (BC), corn with *Panicum maximum* intercropped in the sowing (PS) and corn with *Panicum maximum* intercropped in the coverage fertilization (PC). Corn hybrid 30F90 from Pionner was utilized to establish 55,000 plants/ha and 20kg of seed/ha of each forage was used. T-tests were used to compare means at P<0.05. Corn and BS and PS forages were sowed on 12/20/2005, but BC and PC forages were sowed on 01/14/2006 with coverage fertilization. Corn grain was harvested on 05/18/2006 when more than 50% the grain grain was at black layer. Results are showed on a 100% DM basis. BS and PC produced more (P<0.05) corn grain compared to MS (MS= 0%, BS= 1.3%, BC= -7%, PS= -9.3%, PC= 11%). Corn production was greater (P<0.05) for PC than MS, BS, BC and PS (MS=10729, BS=10873, BC=10089, PS=9731, PC=11904 kg/ha). Less competition for nutrients may contributed increased production for PC. Thus, the system of cultivation may impair or enhance corn grain productivity, as observed for PS and PC, respectively. Other factors that affect corn grain productivity are related to forage species, as observed for BC and PC.

Key Words: Corn, Forage, Intercropping

W110 Use of a nutraceutic feed produced by solid state fermentation of apple pomace in lactating dairy cows diets. C. Rodríguez-Muela*, F. J. Gutiérrez-Piñ, M. A. Gallegos-Acevedo, H. Garcí-Nevarez, H. E. Rodríguez-Ramirez, O. Ruiz-Barrera, and J. Jiménez-Castro, *Universidad Autónoma de Chihuahua*, *Chihuahua, Mexico*.

Manzarina (MZ), a feed rich in phenol compounds and yeasts produced by Solid State Fermentation of apple pomace, was evaluated in lactating cow diets. Two groups of 11 mature lactating cows (93 days of lactation) were used in a 2X2 Latin Square with a switch back arrangement. Treatments were: a concentrate with 15% MZ (MT) and a concentrate without MZ (CT). Concentrates were offered in the parlor and hay (alfalfa and oat) was offered free choice in the bunk. A 12 d adaptation period was followed by a 12 d sample collection during the two periods of the Latin Square (P1 and P2). Milk production was measured and milk samples were collected from each cow daily at milking. Milk constituents were analyzed with a Milk Scan FT 120®. Two blood samples per cow were obtained at the beginning and the end of each period. The concentrate intakes were 11.77 kg cow^{-1} d^{-1} for CT and 13.25 kg cow^{-1} d^{-1} for MT; the forage intakes were 12.60 kg cow^{-1} d^{-1} for CT and 11.19 kg cow^{-1} d^{-1} for MT. Milk production was different ($P<0.05$) between treatments (CT= 22.06±0.23 kg cow^{-1} d^{-1}, MT= 22.84±0.23 kg cow^{-1} d^{-1}). Milk constituents were not different between treatments ($P>0.05$). A diet*period effect ($P<0.05$) occurred for somatic cell count (P1: MT= 6.44±0.20*10^3 cells ml^{-1}, CT= 7.13±0.21*10^3 cells ml^{-1}; P2: MT= 6.64±0.20*10^3 cells ml^{-1}, CT= 5.60±0.20*10^3 cells ml^{-1}). White blood cell count was higher for MT ($P<0.05$; MT= 7.12±0.75%, CT= 4.86±0.75%). Plasma antioxidant activity differed across periods ($P<0.05$; 18.65±0.53 mM Fe_2 in P1, 22.52±0.53 mM Fe_2 in P2). We conclude that MZ can be incorporated into lactating dairy cow diets during early lactation.

Key Words: Nutraceutic Feed, Oxidative Stress, Phenol Compounds

W111 Use of feed produced by solid state fermentation of apple pomace (manzarina) in lambs feedlot diets. C. Hernández-Gómez*, C. Rodríguez-Muela, J. A. Ortega-Gutiérrez, H. E. Rodríguez-Ramírez, F. Salvador-Torres, A. Flores-Mariñelarena, and G. Corral-Flores, *Universidad Autónoma de Chihuahua*, *Chihuahua, México*.

The productive behavior and carcass characteristics of lambs fed with manzarina (MZ) were evaluated in 24 males and females (Charolais×Dorper and Katahdin) with an initial body weight (BW) of 25.5±3.3 kg. Lambs were assigned to two treatments: MT (with 5% MZ) or CT (without MZ); diets were isonitrogenous and isocaloric; diet ingredients were alfalfa, corn, soybean meal, animal fat, sugar cane molasses, mineral premix and MZ. Lambs were confined in individual stalls and received water and feed *ad libitum*. Feed intake (FI) was measured daily. The BW increase was evaluated by period (PWG) and by day (DWG). Periods were of 14 d each. Carcasses were evaluated 24 h after the slaughter in order to determine carcass yield (CY), rib eye area (RA) and back fat (BF). Productive variables were analyzed with a mixed statistical model with diet, sex and their interactions as fixed effects, replicate as random effect and initial BW as covariate. Carcass data were analyzed in SAS GLM procedure. There was a linear increase ($P<0.01$) on BW during the experiment. Males with MT diet had greater PWG (4.76±0.19 kg) and DWG (0.349±0.019 kg) than those with CT diet (3.96±0.19 and 0.309±0.018 kg), with a final body weight (FBW) of 44.58±0.77 and 41.97±0.71 kg respectively. Females with MT diet had less PWG (3.65±0.27 kg) and DWG (0.246±0.019 kg) than those with CT diet (4.05±0.27 and 0.290±0.019 kg), with a FBW of 38.94±0.76 and 41.46±0.72 kg respectively. There was a linear increase ($P<0.01$) on the FI throughout the trial; the increase was 2.68 g d^{-1} $lamb^{-1}$. There was a sex effect ($P<0.05$) for Feed:gain ratio (FG). Males had greater ($P<0.05$) FG than the females (5.4±0.21 and 4.5±0.21 respectively). There was a diet*sex effect ($P<0.06$) for CY. Males of MT had a CY value of 48.00±1.25% and the males of CT of 50.23±1.14%. Females of MT had a CY value of 51.52±1.23% and the females of CT of 48.96±1.15%. There was not effect ($P>0.05$) for RA. The BF was greater ($P<0.06$) on females (4.5±0.81 mm) compared with males (2.5±0.81 mm). We conclude that the use of manzarina is feasible in lambs feedlot diets.

Key Words: Apple Pomace, Manzarina, Lambs

W112 Fermentation of apple waste products added with bakery residues. Y. Castillo-Castillo[1], O. Ruiz-Barrera*[1], D. Cruz-Guillen[1], A. Elias-Iglesias[2], C. Rodriguez-Muela[1], J. Ortega-Gutierrez[1], O. La O-Leon[2], and C. Arzola-Alvarez[1], [1]*Facultad de Zootecnia, Universidad Autonoma de Chihuahua*, *Chihuahua, Chih, Mexico*, [2]*Instituto de Ciencia Animal*, *La Habana, Cuba*.

Solid state fermentation (SSF) is a tool to improve nutritive value of agroindustrial by-products. By promoting growth of epiphytic microorganisms, SSF is one of the most efficient methods to breakdown lignocellulosic compounds, increase the quantity and quality of protein and reduce enviromental impact. The study assessed the influence of adding bakery waste (0, 15, 30 and 45%) on an as-is basis to apple waste on changes of pH and yeast count across fermentation time. Bakery waste was a mix of salted and sweetened bread, cookies, dough, etc. We hypothesized that adding bakery waste would increase DM, reduce pH, and increase counts of useful microorganisms. A completely random design with 6 replications of treatments in a 4 x 3 factorial was used. The variables were four levels of bread inclusion and three incubation periods (0, 24 and 48 h). During fermentation, pH decreased linearly ($P<0.001$) across time for all four treatments. Only the pH at 48 h of the 45% inclusion level was higher than the control (4.6 vs 4.01; $P<0.001$). Yeast count (log 10) increased across time (quadratic effect; $P<0.001$) for all levels of bakery waste. Yeast count was higher ($P<0.001$) for the 30 and 45% treatments compared to the control and 15% treatments. As levels of bakery waste increased, texture of the mix was improved. Based on these results we conclude that 30% inclusion of bakery waste improves the SSF fermentative process of apple residues and enhances beneficial bacterial populations.

Key Words: Solid State Fermentation, Apple Waste, Bread

W113 Fiber degradation during solid state fermentation of apple pomace. H. E. Rodríguez-Ramírez*, C. Rodríguez-Muela, H. A. Castillo-Gonzalez, J. A. Ortega-Gutiérrez, O. Ruiz-Barrera, D. Villagran-Torres, C. Hernández-Gómez, S. Romero-Villalobos, and C. A. Arzola-Alvarez, *Universidad Autonoma de Chihuahua*, *Chihuahua, Mexico*.

This experiment was conducted to measure yeast growth (YG) and changes in the structural carbohydrates during solid state fermentation of apple pomace (AP). Treatments (T) were: T1 (n=36) 100%AP as substrate and T2 (n=36) mixture of 66.67%AP+33.33% non commercial apple as substrate to get different carbohydrates concentration. Both were amended with urea, ammonium sulfate and a mineral mixture (1.5, 0.4, 0.5%, wet basis); around 350 g of substrate were placed on plastic containers (n=72), stirred four times daily every 5 h at 30±1°C. Six samples of each T were taken on 0, 1, 2, 4, 8 and 16 days (D) during the experiment to determine YG (using malt extract agar cultures) and %DM

consumed during fermentation (DMc). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and lignin (L) were determined on d0 and d8 following ANKOM™ procedures. Colony forming units (CFU) were converted to their natural logarithm prior to statistical analysis. Data were analyzed with the MIXED procedure of SAS, using T, D and their interaction (T*D) as fixed effects, and sample as random effect. There was T*D effect ($P<0.05$). YG on d8 was different ($P<0.05$) between T1 and T2; YG of T1 increased from $2.14*10^9$ on d0 to $3.09*10^{10}$ CFU*g DM^{-1} on d8. YG of T2 increased from $1.99*10^9$ on d0 to $4.69*10^9$ CFU*g DM^{-1} on d8. DMc was lower ($P<0.05$) in T1 than T2 on d2 (+2.08 *vs*. -7.79%); DMc reached 40.73 and 49.92% on d8 and d16 respectively without T effect ($P>0.05$). NDF of T1 decreased ($P<0.05$) from 55.81 on d0 to 28.59% on d8 and NDF of T2 increased ($P<0.05$) from 45.07 on d0 to 61.45% on d8. ADF of T1 decreased ($P<0.05$) from 40.52 on d0 to 31.98% on d8. ADF of T2 increased from 31.98 on d0 to 48.82% on d8. L of T1 decreased ($P<0.05$) from 17.29 on d0 to 9.83 on d8. L of T2 increased ($P<0.05$) from 9.62 on d0 to 25.87% on d8. These results suggest that a higher yeasts concentration and species diversity on T1 can degrade structural carbohydrates more efficiently than in T2, probably due to higher rapidly fermentable carbohydrates content on T2. Therefore we recommend further work on microbial isolation and community characterization on apple pomace solid state fermentation.

Key Words: Apple Pomace, Solid State Fermentation, Yeast