

## Forages and Pastures: Improving Forage Conservation and Quality

**W90 Dry matter yield and silage nutritive value of winter cereals in the southern High Plains.** F. E. Contreras-Govea<sup>\*1</sup>, H. Gonzalez Garcia<sup>2</sup>, D. M. VanLeeuwen<sup>3</sup>, and J. Idowu<sup>4</sup>, <sup>1</sup>New Mexico State University, Plant and Environmental Sciences Department, Artesia, <sup>2</sup>Universidad Autonoma de Ciudad Juarez, Departamento de Ciencias Veterinarias, Ciudad Juarez, Chihuahua, Mexico, <sup>3</sup>New Mexico State University, Agricultural Biometrics Service, Las Cruces, <sup>4</sup>New Mexico State University, Extension Plant Sciences Department, Las Cruces.

This study was conducted to assess DM yield and silage nutritive value of 3 winter cereals harvested at different dates in Southern High Plains. Triticale ( $\times$  Triticosecale Wittm. Ex A. Camus), wheat (*Triticum aestivum* L.), and barley (*Hordeum vulgare* L.) were sown on 15 October 2009 in a split plot randomized block design with harvest date (HD) as whole plot and cereal as subplot. Cereals were harvested on 20 April, 4 May, and 10 May, 2010. Maturity at harvest ranged from boot to early milk, anthesis to early dough, and caryopsis water ripe to soft dough respectively. Triticale was the most immature and barley the most mature cereal with wheat intermediate. At harvest, 10 kg of each cereal from each plot was chopped to a theoretical length of cut (TLC) of 25 mm. Chopped cereal (500 g) was placed in a plastic bag, vacuum sealed, and stored at room temperature (20°C) for fermentation for 30 d. Pre-ensiled and ensiled cereals were analyzed for nutritive value and fermentation characteristics for the ensiled cereals. Data analysis were conducted using the MIXED procedure of SAS, with HD, cereal, and HD\*cereal interaction as fixed effect and replicate as random effect. There was no HD by cereal interaction among variables ( $P > 0.05$ ). Harvesting in April, DM yield was lower (13.2 Mg/ha) than in 4 May (16.5 Mg/ha) or 10 May (16.3 Mg/ha) ( $P < 0.05$ ), but nutritive value was higher. In vitro digestibility and NDF digestibility were greater ( $P < 0.05$ ) in April (862 g/kg and 761 g/kg) than in 4 May (827 g/kg and 713 g/kg) or 10 May (813 g/kg and 688 g/kg). Among cereals, barley had greater ( $P < 0.05$ ) nutritive value, followed by wheat, and triticale. All 3 cereals fermented well, but pH values were high in all 3; barley 5.84, wheat 5.93, and triticale 6.05. Lactic and acetic acid concentration did not differ ( $P > 0.05$ ) among cereals. Harvesting in May increased DM yield by 23%, but decreased nutritive value. Fermentation was similar across cereals, but the high pH may be was an indicator of unstable fermentation.

**Key words:** winter cereals, silage fermentation, dry matter yield

**W91 The effects of substituting corn silage and alfalfa hay with Master Graze on feed intake, milk yield and milk composition.** A. Salamone<sup>\*1</sup>, A. A. AbuGhazaleh<sup>1</sup>, C. Stuemke<sup>1</sup>, R. Atkinson<sup>1</sup>, and B. Dodd<sup>2</sup>, <sup>1</sup>Southern Illinois University, Carbondale, <sup>2</sup>Masterschoice, Anna, IL.

The objective of this study was to evaluate the effect of using Master Graze (Master's Choice, IL) as a forage source for dairy cows. Sixteen Holstein cows in early-mid lactation (90 $\pm$ 19 DIM) were divided into four treatment groups (4 cows/treatment) and fed treatment diets for 4 consecutive periods with each period consisted of 21 days. Cows on the control group (T1) were fed a 60:40 forage:concentrate diet (DM basis) with corn silage and alfalfa hay as forage source (1:1; DM basis). For treatment groups, the Master Graze silage substituted the forage mix at 16% (T2), 33% (T3) and 50% (T4) on DM basis. All diets were formulated to be isonitrogenous. Cows were fed treatment diets as TMR once daily for ad libitum consumption and amounts fed and refused were recorded daily. Substituting the corn silage-alfalfa

hay mix with the Master Graze at the three tested levels had no effects ( $P > 0.05$ ) on feed intake (19.4, 19.2, 19.7, and 19.2 kg/d for T1 to T4, respectively) or milk production (23.1, 22.7, 22.7, and 22.9 kg/d). Milk fat percentages (3.91, 3.82, 3.85, and 3.9) and yields (0.89, 0.85, 0.86, and 0.88 kg/d), and milk protein percentages (3.04, 3.06, 3.04, and 3.03) and yields (0.70, 0.68, 0.69, and 0.69 kg/d) were all similar ( $P > 0.05$ ) among treatment diets. Treatment diets had also no effects ( $P > 0.05$ ) on milk urea nitrogen, milk SCC, and cows body weight and body condition score. In conclusion, results from this study show that the Master Graze may replace 50% of dietary corn silage-alfalfa hay mix in dairy cows ration without any adverse effects on feed intake, milk production or milk composition.

**Key words:** Master Graze, forage, dairy

**W92 Ruminal degradability of *Albizia lebbbeck* silage.** T. Clavero<sup>\*</sup>, R. Razz, and O. Araujo-Febres, Centro de Transferencia de Tecnologia en Pastos y Forrajes. Universidad del Zulia, Maracaibo, Estado Zulia, Venezuela.

An experiment was carried out at the tropical western region of Venezuela in order to evaluate *in sacco* dry matter degradability of four levels of supplementation of *Albizia lebbbeck* silage. The rations used were: 100% *Brachiaria humidicola* hay (HBH); 75% HBH + 25% silage *Albizia lebbbeck* (ALS); 50% HBH + 50% ALS; and 25% HBH + 75% ALS. Samples (10g) milled to pass a 3 mm screen were weighed into 9 x 18 nylon bags, which were incubated for 0, 6, 12, 24, 48, 72 and 96 hours in rumen-fistulated steers. Residues were washed and dried at 65°C to estimate *in sacco* DM degradation. The animals were fed a diet consisting of *Echinochloa polystachia* ad libitum and 2 kg of a corn-soybean meal based concentrate. Digestion parameters were obtained by means of non linear regression, a randomized model with three replications was analyzed and treatments means separated by the Tukey test. The results showed significant effects ( $P < 0.05$ ) of diets on *in sacco* degradability kinetics of DM. For ruminal degradation, the lowest soluble fractions (23.42  $\pm$  1.4%) and degradation rate (0.005h<sup>-1</sup>) were observed in HBH. However, positive effects were observed with the other diets, presenting the highest values in maximum degradation (56.39  $\pm$  2.7%), degradation rate (0.015h<sup>-1</sup>) and potential degradation (85.18  $\pm$  3.1%) when 25% HBH + 75% ALS was offered ( $P < 0.05$ ). It can be concluded that *Albizia lebbbeck* silage diets had high DM rumen degradability and indicate that these diets could be used as ruminant feed supplements to enhance forage digestibility.

**Key words:** *Albizia lebbbeck*, silages, rumen degradability

**W93 Characterization and identification of *Lactobacilli* stains from tropical grasses.** J. P. S. Rigueira<sup>1</sup>, O. G. Pereira<sup>\*1</sup>, K. G. Ribeiro<sup>2</sup>, A. S. Cezário<sup>1</sup>, and W. F. Souza<sup>1</sup>, <sup>1</sup>Federal University of Viçosa, Viçosa, Minas Gerais, Brazil, <sup>2</sup>Universidade Federal dos Vales do Jequitinhonha e Mucuri, Diamantina, Minas Gerais, Brazil.

The grasses of *Brachiaria* and *Panicum* genera have constituted one of the most important forage for pasture in Brazil. There has been recent interest in using these forages for the silage production. In this work, we characterize and identify lactobacilli strains isolated from grasses *Panicum maximum* 'Mombaça' and *Brachiaria decumbens*. The isolation of predominant lactic acid bacteria (LAB) in forage before ensiling was carried out on Rogosa SL Agar (Difco), at 37°C, for 48 h.

Forage samples were randomly collected from the pasture after 70 d of regrowth. For the 10<sup>1</sup> dilution, 25 g of forage was mixed with 225 mL of sterile phosphate buffer solution and homogenized in a blender for 1 minute. Decimal dilutions were made ranging from 10<sup>1</sup> to 10<sup>6</sup> and plated on sterile Petri dishes. We carried out the Gram stain test reaction to catalase, growth at different pH and temperatures beyond the morphology of the isolated stains. Isolate identification was obtained using the API 50 CH carbohydrate fermentation test kit (bioMérieux, Inc., France). All isolated strains showed negative reaction to catalase and were Gram stain positive. They grew at pH 7.2 and were inhibited at pH 9.6. All the stains showed growth at temperature from 15°C to 45°C. The morphology of the bacillus stains was identified as *Pedio-coccus pentosaceus* and *Leuconostoc mesenteroides* and showed the coccus form. Table 1 shows the isolated species in tropical grasses. *Lactobacillus fermentum* and *Lactobacillus plantarum* the predominant species in both forages. Financial support by CNPq and FAPEMIG.

**Table 1. Species identified by API 50 CH test in *Brachiaria* (B) and *Panicum maximum* (M) forages and the respective percentage abundance (ID)**

Code	Species	%ID	Code	Species	%ID
B3	<i>Leuconostoc mesenteroides</i>	88.9	M2	<i>Lactobacillus lactis</i> ssp. <i>lactis</i>	83.8
B4	<i>Lactobacillus fermentum</i>	99.5	M4	<i>Lactobacillus fermentum</i>	93.7
B5	<i>Lactobacillus brevis</i>	70.7	M16	<i>Lactobacillus paracasei</i>	80.8
B6	<i>Lactobacillus fermentum</i>	96.2	M21	<i>Lactobacillus plantarum</i>	94.9
M1	<i>Pedio-coccus pentosaceus</i>	93.5	M17	<i>Lactobacillus paracasei</i>	80.8

**Key words:** lactic acid bacteria, tropical grass, silage

**W94 Milk production response to feeding alfalfa silage inoculated with *Lactobacillus plantarum*.** R. E. Muck\*<sup>1</sup>, G. A. Broderick<sup>1</sup>, A. P. Faciola<sup>2</sup>, and U. C. Hymes-Fecht<sup>1</sup>, <sup>1</sup>USDA, ARS, US Dairy Forage Research Center, Madison, WI, <sup>2</sup>University of Wisconsin-Madison, Madison.

In mini-silo trials, silages treated with a *Lactobacillus plantarum* inoculant (Ecosyl, Yorkshire, UK) had increased in vitro rumen microbial biomass production. Our objective was to determine if alfalfa silage treated with this inoculant could produce a milk production response commensurate with the in vitro responses. Alfalfa (240 g CP/kg DM, 300 g NDF/kg DM, 500 g DM/kg) was ensiled with (LP) and without (C) Ecosyl inoculant. Twenty-eight multiparous Holstein cows in early lactation were blocked by DIM and randomly assigned to 2 diets (C or LP-treated silage) in a double crossover design with 4 28-d periods. Diets were formulated to contain 162 g CP and 280 g NDF/kg DM, and the diets fed consisted of (g/kg DM): alfalfa silage (509), corn silage (206), high moisture corn (214), soy hulls (47) and vitamin/mineral mix (25). Milk production and DMI were recorded for the last 14 d of each period. Milk samples were collected from each cow at both milkings on d 20, 21, 27 and 28 for analysis of milk composition. Means for LP were compared against means for C before and after LP using a paired *t*-test in Proc MIXED of SAS. The LP diet increased milk production but did not affect DMI or milk/DMI. Milk composition and production of milk components were largely unaffected by diet except as noted in the table. The increased milk production and reduced MUN

in the current study support the hypothesis that the inoculated silage is producing more rumen microbial biomass.

**Table 1. Milk production and composition from diets containing alfalfa silage made with (LP) and without (C) inoculant**

Item	C	LP	SE	<i>P</i> -value
Milk, kg/d	39.6	40.4	0.26	0.03
Milk Protein, %	2.81	2.78	0.009	0.05
Milk Lactose, %	4.82	4.89	0.013	<0.01
Milk Urea N, mg/dL	12.7	11.6	0.17	<0.01

**Key words:** silage inoculant, milk production, alfalfa

**W95 Biomin BioStabil Plus enhances the fermentation characteristics, aerobic stability, and intake by rams of native tropical grass silage.** C. Rosario<sup>1</sup>, A. A. Rodriguez\*<sup>1</sup>, and Y. Acosta-Aragon<sup>2</sup>, <sup>1</sup>University of Puerto Rico, Mayaguez, PR, <sup>2</sup>Biomin Holding GmbH2, Herzogenburg, Austria.

The effect of Biomin BioStabil Plus (BSP, blend of homo and heterofermentative lactic acid bacteria) on the ensiling characteristics, aerobic stability, and intake by rams of native tropical grasses (NTG) silage was determined. Forage (mix of *Panicum maximum*, *Sorghum halapense*, and *Digitaria decumbens*; 6-week regrowth) was chopped and treated with or without BSP. Treatments were applied to weighed portions of forage, manually mixed and packed into PVC micro-silos. Fresh forage and samples of 3 silos for each treatment opened at 4, 7, 14, 21, 28 and 35 d were analyzed for pH and fermentation products. Statistical analysis was performed as a Completely Randomized Design (CRD) with a 2 (treatments) by 7 (d) factorial arrangement. Aerobic stability was determined on 3 silages from each treatment exposed to air. The pH and temperature were measured after 0, 24, 72 and 96 d, and 0, 6, 12, 24, 30, 48, 72, 96 and 120 h of aerobic exposure, respectively. Statistical analysis of pH and temperature data was performed as a CRD with a 2 (treatments) by 4 (d) or 2 by 10 (h) factorial arrangement, respectively. To determine the effects of NTG fermented with BSP on DMI, chopped NTG were ensiled with or without the inoculant in 208-L capacity plastic bags for a minimum of 35 d. Six rams were used in a CRD trial with 3 replicates per treatment. Diets containing 50% grass hay and 50% NTG treated with or without BSP, were offered daily at 3% of ram BW/dry matter basis. Rams were allowed a 6-d diet adaptation, prior to a 5-d data collection period. Forage fermented with BSP had lower ( $P < 0.05$ ) pH and higher ( $P < 0.05$ ) lactic acid content than untreated silage. Vegetative material treated with BSP and exposed to air for 5 d had lower ( $P < 0.05$ ) pH than control, but no effect on temperature was observed. Silage intake as proportion of total DM offered and as percentage of total DMI was improved ( $P < 0.05$ ) by 8.13% and 4.42% when rams were fed with the inoculated silage. The ensiling of NTG with BSP enhanced the fermentation characteristics and improved forage consumption by rams.

**Key words:** tropical grasses, silage, BioStabil Plus

**W96 Fermentation characteristics and aerobic stability of tropical corn ensiled with additives containing homo-fermentative or hetero-fermentative bacterial strains.** V. Rivera<sup>1</sup>, L. Solorzano<sup>2</sup>, and A. Rodriguez\*<sup>1</sup>, <sup>1</sup>University of Puerto Rico, Mayaguez, PR, <sup>2</sup>Chr. Hansen, Fitchburg, WI.

The fermentation characteristics and aerobic stability were determined on tropical corn (TC; *Zea mays*) ensiled with additives containing homo-fermentative (*L. plantarum*) or a blend of homo and hetero-fermentative (*L. buchneri*, *E. faecium* and *L. plantarum*) lactic acid-producing bacteria (LAPB). Corn (38% DM) was chopped (2.5 cm), untreated or treated with both products to weighed portions of forage, manually mixed, and packed into PVC microsilos (1.5 kg) to ferment for 0, 15, 30, and 58 d. Three samples of fresh forage and silage for each treatment (trt) and ensiling d were analyzed to determine pH and fermentation products. Statistical analysis was performed as a Completely Randomized Design (CRD) with a 3 (trt) by 4 (d) factorial arrangement. For aerobic stability, 3 samples from each trt and ensiling d were exposed to air for 120 h. The pH and temperature were measured after 0, 1, 3 and 5 d, and 0, 6, 12, 18, 24, 48, 72, 96 and 120 h of aerobic exposure, respectively. Statistical analysis of pH and temperature data was performed as a CRD with a 3 (trt) by 3 (length of fermentation) by 4 (d) or 3 by 3 by 9 (h) factorial arrangement, respectively. Corn fermented with homo-fermentative LAPB tended to have lower ( $P < 0.09$ ) pH and higher ( $P < 0.07$ ) lactic acid content than untreated silage or TC fermented with hetero-fermentative LAPB. After 24 h of aerobic exposure TC fermented with both products had lower ( $P < 0.01$ ) pH than the control. The pH was also higher ( $P < 0.01$ ) in untreated silage than TC treated with additives after 15 and 30 d of ensiling, but similar when fermented for 58 d. Forage fermented with both products resulted in silage with lower ( $P < 0.05$ ) temperature after 1 d of aerobic exposure. Inoculation prevented the start of the temperature rise by 18 and 24 h in TC treated with homo or hetero-fermentative strains, respectively. In summary, homo-fermentative strains improved the fermentation characteristic and delayed the deterioration of TC silage, but a greater response of the product containing hetero-fermentative bacteria on aerobic stability was observed.

**Key words:** tropical corn, silage, additives

**W97 The aerobic stability and dry matter losses of high moisture corn ensiled as whole or ground grain using *Lactobacillus buchneri* alone or in association with *Lactobacillus plantarum*.** R. Coudure<sup>1</sup>, J. G. Cazaux<sup>1</sup>, F. Skiba<sup>1</sup>, E. Chevaux<sup>\*2</sup>, V. Demey<sup>2</sup>, and J. Sindou<sup>2</sup>, <sup>1</sup>Arvalis - Institut du végétal, Montardon, France, <sup>2</sup>Lallemand SAS, Bagnac, France.

The goal of this trial was to study the effect of addition of a single additive or a combination of silage additives on the fermentation, aerobic stability and nutritional value of High Moisture Corn (HMC). The trial was designed as a  $3 \times 2 \times 2$  factorial with the following factors: (i) no additive (C) vs *Lactobacillus buchneri* NCIMB 40788 (LB) (300000 cfu/g HMC) vs *L. buchneri*+ *Lactobacillus plantarum* MA18/5U (LBLP) (LB 150000 cfu/g HMC + LP 100000 cfu/g HMC), (ii) whole grain (WG) vs ground(G) (2 mm) and (iii) 36% vs 32% moisture (of the corn). Each experimental group had 6 replicates (microsilos). The anaerobic and aerobic phases lasted 144 and 13 days respectively. Dry matter (DM) losses were determined by weighing all silos individually at the start and end of each phase. Samples were taken for DM, pH and chemical composition determinations at d 11 and 20 of the anaerobic phase, at opening of silos and 13 days after opening. In the case of 36% moisture HMC, lower DM losses were seen with the combination LBLP. For GHMC as well as WGHMC, a higher fraction of the total DM was conserved at the end of the aerobic phase, compared to C (i.e. +5.3% vs. +2.4% resp.,  $P < 0.01$ ). The use of LB alone conserved 2.6% more DM in GHMC at the end of the aerobic phase. For WGHMC, little differences were seen in DM losses between C and LB alone. In terms of variations in pH, the values for LB and LBLP treated GHMC

were higher ( $P < 0.01$ ) than C at the end of the anaerobic phase ( $4.5 \pm 0.03$  and  $4.2 \pm 0.10$  vs.  $4.0 \pm 0.03$  resp.). However at opening, the pH of LB and LBLP treated silos stayed stable, whereas the pH of the C increased ( $P < 0.05$ ) rapidly ( $4.6 \pm 0.05$  and  $4.3 \pm 0.06$  vs.  $5.5 \pm 0.37$ ). In WGHMC the pH measured at opening was 4.5 for all experimental groups and rose by 0.5 units during the aerobic phase. The chemical composition of HMC was not affected by the silage additives when compared to C. Similar trends were observed for the parameters tested for the 32% moisture HMC, however differences observed seemed less pronounced compared to the 36% moisture HMC.

**Key words:** high moisture corn, *L. buchneri*, *L. plantarum*

**W98 Effect of dry matter density on fermentation and nutrient preservation in brown mid-rib (BMR) corn silage within bunker silos.** K. Griswold<sup>1</sup>, P. Craig<sup>2</sup>, J. Graybill<sup>1</sup>, and R. Ward<sup>\*3</sup>, <sup>1</sup>Penn State Cooperative Extension, Lancaster, <sup>2</sup>Penn State Cooperative Extension, Dauphin, <sup>3</sup>Cumberland Valley Analytical Services, Maugansville, MD.

The objective was to determine the relationship of dry matter (DM) density to fermentation and nutrient preservation in BMR corn silage within bunker silos. Poly-weave nylon bags (36 per silo) containing chopped BMR corn were buried in 3 bunker silos during filling on the same farm in 2 successive years. Bags were blocked by depth from bunk end, 10.6 m (Front), 27.8 m (Center), and 44.9 m (Back), level from silo floor, 0.6 m (Low), 1.5 m (Middle), and 2.2 m (High), and within level, location from the east wall, 0.9 m (I), 4.7 m (II), 8.4 m (III), and 12.2 m (IV). At feed-out, all bags at a specific depth were retrieved, and silage cores for DM density at each bag position were collected with a 5.08 cm diameter stainless-steel coring tube. Corn and silage subsamples were analyzed for nutrient content and fermentation profile by NIR and wet chemistry. Data were analyzed by PROC MIXED and REG within SAS. The model included fixed effects of depth, level, location, all interactions, and random effects of silo and year. Significance was set at  $P < 0.05$ , and trends at  $0.05 \leq P \leq 0.10$ . There were no significant interactions. Density was affected ( $P < 0.0001$ ) by depth, level, and location. Density was 221, 274, and 273 kg DM/m<sup>3</sup> for front, center, and back, respectively. Density was 282, 265, and 221 kg DM/m<sup>3</sup> for low, middle, and high, respectively. Density was 238 and 231 kg DM/m<sup>3</sup> for I and IV compared with 279 and 275 kg DM/m<sup>3</sup> for II and III, respectively. Fermentation was affected ( $P < 0.05$ ) by depth and level but not location. Total VFA were 9.7, 10.8, and 10.4% of DM for front, center, and back, and 11.2, 10.3 and 9.5% of DM for low, middle and high, respectively. There was a trend ( $P = 0.059$ ) for NDF content to be affected by level with 37.8, 38.6, and 40.4% of DM for low, middle, and high, respectively. Regression analysis showed a weak linear inverse relationship ( $R^2 = 0.05$ ) between DM density and NDF content. Starch content was unaffected ( $P > 0.10$ ) by DM density across all positions. These results suggest that DM density of BMR corn silage may affect fermentation, but likely does not affect starch and NDF content.

**Key words:** corn silage, density, fermentation

**W99 Effects of the levels of silage additives on the fermentation quality and in situ digestibility of reed (*Phragmites australis* Cav.) silage harvested at different maturity stages.** B. W. Kim<sup>\*</sup>, K. I. Sung, and J. S. Shin, College of Animal Life Sciences, Kangwon National University, Chuncheon, Kangwon-Do, South Korea.

This study was conducted to determine the optimum levels of silage additives on reed silage harvested at different maturity stages. Reed

plants harvested at early boot (23% DM), late boot (24% DM) and early heading stages (26% DM) were chopped to an average particle length of 1 cm and ensiled in 500 g mini silos, with and without additive treatment. The additives used were formic acid applied at 0.2, 0.4 and 0.6% of the fresh crop weight and molasses applied at 0.5, 1.0 and 2.0% of the fresh crop weight. Treatments were allocated in a randomized complete block design with three replicates. The silage pH, acid and  $\text{NH}_3\text{-N/TN}$  concentrations, and the *situ* DM disappearance at 0, 12, 24, 48 h of incubation in Korean beef cattle were examined. The silage fermentation quality and *in situ* digestibility were not affected by the different maturity stages. Silage treated with formic acid had the lower pH (4.5, 4.3 and 4.0 at 0.2, 0.4 and 0.6%, respectively) than the molasses (5.0, 4.8 and 4.4 at 0.5, 1.0 and 2.0%, respectively) and untreated (5.2). While the lactic acid concentrations increased with the higher levels of molasses, the higher levels of formic acid resulted in lower concentrations of lactic acid ( $P < 0.05$ ). The formic acid and molasses treatments were markedly effective for reducing the ammonia production which was similar at most addition levels (less than 10%  $\text{NH}_3\text{-N/TN}$  at all addition levels). Higher *in situ* digestibility resulted from adding additives, especially with formic acid treatment (about 10% at 0.2% level;  $P < 0.05$ ). No significant difference was found between the addition levels of both additives. It is concluded that formic acid or molasses applied at ensiling produced better fermented silage and enhanced silage digestibility compared with untreated reed silage. The highest quality of reed silage was observed at 0.2% of formic acid and 2.0% of molasses, which are considered as the optimum levels of addition in this study.

**Key words:** reed, silage, additive

**W100 Ruminal parameters of sheep fed corn silage inoculated with *Lactobacillus buchneri* and *L. buchneri* associated with *L. plantarum*.** F. C. Basso\*, P. A. R. Salvo, F. H. Kamada, J. P. R. Costas, W. L. da Silva, and R. A. Reis, *Animal Science Department, College Agricultural and Veterinary Sciences, São Paulo State University, Jaboticabal, São Paulo, Jaboticabal.*

Silages inoculated with certain heterofermentative bacteria show improvement in aerobic stability. Many studies are done on silages, however few studies are reported about the effect of microbial inoculants on ruminal parameters in sheep. Therefore, the aim was to evaluate the effect of microbial inoculants in corn silage on sheep ruminal parameters. Three stack silos containing 10 t of corn silage were prepared. The corn silages were treated with nothing (CS, 32% of DM); or with either *L. buchneri* NCIMB 40788 ( $1 \times 10^5$  cfu/g of forage; 35.5% of DM, CSB) or with *L. buchneri* ( $1 \times 10^5$  cfu/g; 31.7% of DM) plus *L. plantarum* MA18/5U ( $1 \times 10^5$  cfu/g, CSBP). Silage samples were collected during the experiment. The DM content, pH value, ammonia nitrogen content and yeast and mold counts (log cfu/g) were measured. Six castrated 10 mo-old, rumen cannulated male rams (40kg) were used. The animals were fed 80% of corn silage and 20% of commercial concentrate (57.5% soybean meal, 7% wheat bran, 5% cottonseed meal, 16% ground corn, 12.5% citrus pulp and 2% of mineral salt). The daily dry matter intake (DMI) was measured. Rumen fluid samples were collected 0, 3, 6, 9, 12 hours after feeding to measure pH values and ammonia levels. The experimental design was Latin square ( $3 \times 3$ ) repeated twice. Data was subjected to ANOVA and means compared by the Tukey test ( $P < 0.05$ ). The DM content was different ( $P < 0.05$ ) among treatments (CS: 31.68%; CSB: 33.42% and CSBP: 30.80%), probably because at ensiling, the DM content also was different among the forages. The pH value of CSB was lower (4.03) than CS (4.12) and CSBP (4.11) ( $P < 0.05$ ). Ammonia nitrogen content (CS: 12.94%,

CSB: 11.86% and CSBP: 14.51%) and yeast and mold counts ( $< 3.00$  log cfu/g of silage) were not different among treatments. Average DMI was 0.930; 0.962 and 0.881 kg/d, respectively for CS, CSB, and CSBP. The difference between CSBP and CSB was significant ( $P < 0.05$ ). Ruminal pH (6.06, 6.12 and 6.07, respectively) and ruminal ammonia (17.09, 13.87 and 15.11 mg/dL) were not affected by the microbial inoculants in silage. In conclusion, addition of microbial inoculant in corn silage did not affect the ruminal parameters evaluated.

**Key words:** ammonia, microbial additives, pH values

**W101 In vitro fermentation on cactus forage (*Opuntia* spp.) inoculated with *Kluyveromyces lactis* yeast.** C. Rodríguez-Muela\*, D. Díaz-Plascencia<sup>1</sup>, P. Mancillas-Flores<sup>1</sup>, O. Ruiz-Barrera<sup>1</sup>, F. Salvador-Torres<sup>1</sup>, G. Corral<sup>1</sup>, S. Mena<sup>2</sup>, R. Copado-García<sup>1</sup>, and L. Duran<sup>1</sup>, <sup>1</sup>Universidad Autónoma de Chihuahua, Chihuahua, México, <sup>2</sup>Universidad de Guadalajara, Jalisco, México.

In order to evaluate the effect of use of *Kluyveromyces lactis* yeast (K1) obtained from apple byproducts by solid state fermentation, on cactus forage (*Opuntia* spp), two treatments (Tr) were used: T1) 10 kg of paste of cactus forage (CF) and T2) 10 kg of CF + 100 ml of an inoculate of K1 ( $1.2 \times 10^9$  cells/mL). Each Tr was added with 20 g of urea, 2 g of ammonium sulfate, and 5 g of mineral supplement. There were six replications per Tr and samples were fermented in an aerator for 48h to support the growth of yeasts. Tr was mixed for 15 min every 12h, and samples were taken at 0, 12, 24 and 48h. The variables evaluated were: temperature (T), pH, ammonia (AM), lactic acid (LA), yeasts count (YC), soluble sugars (SS) and crude protein (CP). The statistical design used was a completely randomized design, considering the random effect of the aerator nested in Tr (plot). Data were analyzed with the Proc Mixed procedure of SAS. The results showed that T increased ( $P < 0.01$ ) from 0 to 12h, showing an inoculate\*time interaction, with values of 22.4°C and 24.1°C in T1, and 20.7°C and 24.6°C in T2. Values of pH in T1 decreased ( $P < 0.04$ ) from 4.9 to 4.6, and from 4.8 to 4.4 in T2 from 0 to 48h (respectively). Values of AM increased ( $P < 0.01$ ) from 0.31 to 0.44 mM/mL in T1, and from 0.29 to 0.38 mM/mL in T2 from 0 to 48h (respectively). Values of LA increased ( $P < 0.01$ ) from 2.30 to 2.63 mM/mL in T1, and they decreased from 1.55 to 0.91 mM/mL from 0 to 48h in T2. YC increased ( $P < 0.01$ ) from  $8.3 \times 10^6$  to  $1.8 \times 10^7$  cells/mL in T1 and from  $3.2 \times 10^7$  to  $4.9 \times 10^7$  cells/mL of 0h to 48h in T2. There was an effect of time ( $P < 0.01$ ) on SS, with a trend to decrease over fermentation time. An interaction was found for inoculate\*time on CP ( $P < 0.01$ ) with values in T1 of 9.4, 12.2 and 11.7% at 0h, 24h and 48h, and of 14.7, 19.4 and 18.0% at 0h, 12h and 48h, in T2, respectively. It can be concluded that the use of K1 on the *in vitro* fermentation of cactus forage increased significantly CP content and yeast counts with a marked reduction of SS and LA.

**Key words:** yeast, fermentation, cactus

**W102 Comparison of an inoculant and enzymes, separate and in combination, on the fermentation of alfalfa silage.** S. J. Z. Hansen\* and A. H. Smith, Danisco, Waukesha, WI.

Fermented feedstuffs are one of the key components of the dairy ration, where stability and digestibility are important characteristics. The objective of this study was to compare the use of inoculants and enzymes, separate and in combination, on alfalfa silage to determine whether a more stable, digestible forage was produced. Treatments tested in the mini-silos were untreated (Ctrl), Agmaster XV inoculant (XV) and 2 enzymes, Clampzyme 20 (C20) and Clampzyme HIGO100

(HG) (Genencor). Agmaster XV contains *Pediococcus pentosaceus* P751, *Lactobacillus plantarum* LP115 and *Lactobacillus brevis* LBR35 and was applied at 1.8 e 11 cfu/ton of haylage. Glucose oxidase and cellulase are the active ingredients of C20 (3500 carboxymethylcellulose (CMC) Units/g) and HG (3600 CMC Units/g) and these were applied at 0.91 g/ton of haylage. Mini-silos used were airtight 5-gallon buckets containing haylage at a density of 240 kg/cubic meter. Alfalfa was wilted for 24 h before it was chopped. The moisture of the alfalfa was 51.4%, within the ideal level for ensiling when packed. Three mini-silos from each treatment, at Day 1, 3, 7 and 14, were opened and homogenized, with samples taken for volatile fatty acid (VFA) analysis, pH, enumeration of lactic acid bacteria and spoilage organisms (coliforms, yeasts, molds), and ADF, aNDF, NDFD48 and CP. Statistics, using 2-way ANOVA analysis, established the inoculant and both enzyme treatments improved fermentation by decreasing pH and increasing lactate (Table 1), however a synergistic effect of the inoculants with enzymes was noted. All treatments decreased spoilage organisms, and the inoculant with enzymes increased digestibility, as measured by NDFD48, on d 7 when compared with the control ( $P < 0.001$ ). The use of inoculants and enzymes improved the fermentation of alfalfa silage, increasing the quality of the feed.

**Table 1.** Lactate (% DM) accumulation after ensiling

	Days of ensiling			
	1	3	7	14
Ctrl	0.5	1.9 <sup>a</sup>	3.9 <sup>a</sup>	3.6 <sup>a</sup>
XV	0.6	2.5 <sup>b</sup>	4.4 <sup>b</sup>	4.9 <sup>b</sup>
C20	0.5	2.5 <sup>b</sup>	4.3 <sup>b</sup>	4.7 <sup>b</sup>
HG	0.6	2.6 <sup>b</sup>	4.9 <sup>c</sup>	4.9 <sup>c</sup>
XV+C20	0.7	3.7 <sup>c</sup>	5.2 <sup>c</sup>	5.6 <sup>c</sup>
XV+HG	0.9	3.5 <sup>c</sup>	5.7 <sup>d</sup>	5.4 <sup>c</sup>

<sup>a,b,c</sup>Means within a column with unlike superscripts differ ( $P < 0.05$ ).

**Key words:** fermentation, enzymes, inoculant

**W103 Effects of sodium bisulfate on alfalfa silage preservation.** M. Terré<sup>1</sup>, D. Seale<sup>2</sup>, C. Knueven<sup>3</sup>, and A. Bach<sup>\*4,1</sup>, <sup>1</sup>*Institut de Recerca i Tecnologia Agroalimentàries, Caldes de Montbui, Barcelona, Spain*, <sup>2</sup>*DS AgriTech Ltd., Reading, Berkshire, UK*, <sup>3</sup>*Jones-Hamilton, Co, Walbridge, OH*, <sup>4</sup>*Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain*.

Sodium bisulfate (SBS) is proposed as an acidifier to produce a rapid acid condition during the ensiling process by releasing the bisulphate ion  $\text{HSO}_4^-$ . The objective of this study was to evaluate the effects of SBS on pH, silage fermentation and aerobic stability of alfalfa silages. Third-cut alfalfa was harvested and chopped mid July 2010, wilted to 43.1% DM, and ensiled in 14 30-L capacity microsilos, and stored at ambient temperature (18–25°C). Half of them were treated with SBS at the dose of 8 g/kg of fresh alfalfa (Jones-Hamilton Co., OH) (SBS) and the other half was not treated with any preservative (C). On d 0, samples were analyzed for pH, DM, water-soluble carbohydrates (WSC), CP, NDF, ash and buffering capacity (BC). On d 3, 3 microsilos per treatment were opened to determine pH, BC, and ammonia-N. On d 100, 4 microsilos per treatment were opened to determine pH, DM, ammonia-N, WSC, lactic, acetic, propionic and butyric acid, ethanol, CP, and aerobic stability was monitored for 7 d. Lactate-assimilating yeasts and molds were enumerated on d 100 and 107. Data were analyzed with an ANOVA with silo treatment as main effect. The pH was lower ( $P < 0.05$ ) in SBS than in C silos on d 0 (4.80

vs.  $5.94 \pm 0.127$ , respectively), and this difference was maintained on d 100 ( $4.52$  vs.  $4.88 \pm 0.041$ , respectively,  $P < 0.001$ ). Buffering capacity was also modified with the addition of SBS, being lower ( $P < 0.05$ ) in SBS compared with C silos on d 0 ( $1208$  vs.  $1478 \pm 53.3$ , respectively) and 3 ( $1114$  vs.  $1347 \pm 77.5$ , respectively). All silages were well preserved and no differences in the NDF, WSC, CP and ashes content, the fermentation profile, in yeast and molds counts, in lactate-assimilating yeast counts, or in temperature changes during the aerobic stability measurements were observed between treatments. In conclusion, sodium bisulfate reduced silage pH (in agreement with an observation already made in grass silages) and lowers the buffering capacity of alfalfa silage, both of which could be expected to aid preservation under more difficult ensiling conditions than those encountered in this trial.

**Key words:** alfalfa, silage, sodium bisulfate

**W104 Nutritive value and fermentation parameters of ‘Tifton 85’ bermudagrass and ‘Mulato II’ brachiariagrass silage in Florida.** A. D. Aguiar<sup>\*1</sup>, J. M. B. Vendramini<sup>1</sup>, A. T. Adesogan<sup>2</sup>, L. E. Sollenberger<sup>2</sup>, L. Galzerano<sup>1</sup>, L. Custodio<sup>1</sup>, E. Alves<sup>1</sup>, and G. R. Manarim<sup>1</sup>, <sup>1</sup>*Range Cattle Research Education Center, Ona, FL*, <sup>2</sup>*University of Florida, Gainesville*.

The objective of this study was to investigate the nutritive value and fermentation parameters of Mulato II (*Brachiaria* sp.) and Tifton 85 bermudagrass (*Cynodon* sp.) silages treated with sugarcane (*Saccharum officinarum* L.) molasses [M; 1 kg molasses (DM)/50 kg forage (As fed)], inoculants [I; EcoSyl, MTD/1; 100 mg/50 Mg forage (As fed)] (I), molasses plus inoculants (MI), and control (C). The experiment was conducted in Florida and harvested in the summer (21 July) and fall (6 October) 2010. Tifton 85 plots were distributed in a randomized complete block design with 4 replicates, and Mulato II plots in a complete randomized design with 4 replicates. The data were analyzed using PROC MIXED with treatment as fixed effect, and block and replicates as random effects. Forage was harvested, wilted on the field for 4 h, packed into a mini-silo at a density of approximately 382 kg fresh forage/m<sup>3</sup>, and ensiled for 90 d. In the summer, there were no differences ( $P > 0.10$ ) among treatments for the parameters evaluated in Mulato II silage. In Tifton 85 silage, treatments C and I had greater concentrations of acetic acid than M ( $P = 0.05$ , 0.33 vs. 0.55%), however, the C treatment had greater NH<sub>3</sub>-N and lesser NDFD concentration than M and I ( $P = 0.03$ , 8.0 vs. 6.0% total N). During the fall, the I treatment had lesser lactic acid ( $P = 0.09$ , 1.8 vs. 3.9%), and NH<sub>3</sub>-N concentrations than the C ( $P = 0.03$ , 7.0 vs. 11.0% total N) in Mulato II silage. The M treatment had greater concentrations of water-soluble carbohydrates than C and I ( $P = 0.06$ , 9.9 vs. 6.7%) and the NDFD was greater ( $P = 0.09$ ) for MI (61%) than C, I, and M (Mean = 54%). Tifton 85 fall silage treated with molasses had greater water-soluble concentration than C and I ( $P = 0.04$ , 3.8 vs. 1.9%). The NH<sub>3</sub>-N concentration was greater for I than C ( $P = 0.04$ , 17 vs. 10% of total N) but there was no difference ( $P > 0.10$ ) between C and M, and M and I. The effects of molasses and inoculants were inconsistent in this study and further investigation is necessary to evaluate the benefits of those management practices on warm-season grasses silage.

**Key words:** warm-season grass, inoculants, silage

**W105 Effect of new mixtures of silage additives in grass and maize on fermentation quality and aerobic stability.** J. Jatkauskas<sup>1</sup>, V. Vrotniakienė<sup>1</sup>, C. Ohlsson<sup>2</sup>, and B. Lund<sup>\*2,1</sup>, <sup>1</sup>*Institute of Animal Sci-*

ence of Lithuanian University of Health Sciences, Baisogala, Lithuania, <sup>2</sup>Chr Hansen A/S, Hoersholm, Denmark.

The aim was to evaluate the effect of five new silage additives (A - E) containing lactic acid bacteria on fermentation characteristics and especially aerobic stability. The additives were compared to a positive and negative control in laboratory-scale experiments. The treatments were different combinations of inoculants containing *Lactobacillus plantarum* DSM16568 (B,C,D,E), *Enterococcus faecium* DSM 22502 (B,C,D,E), *Lactobacillus buchneri* DSM 22501 (A,B), *Lactococcus lactis* DSM 11037 (E) and NCIMB 30117 (B,C) at 150,000 cfu/g forage and one treatment was supplemented with sodium benzoate at 400 g/ton forage (C). The positive control was an inoculant of *Lactobacillus plantarum* at 100,000 cfu/g. The 3-liter mini-silos were filled with chopped ryegrass-timothy (DM 26.5%, WSC 2.7% of fresh matter (FM)) or whole-crop maize (DM 27.5%, WSC 2.7% of FM) with 5 replications per treatment and crop. Silos were stored at 20°C for 90 days before measuring the following parameters: pH, dry matter (DM) losses, fatty acids, ethanol, N-NH<sub>3</sub> and aerobic stability. Data were statistically analyzed as a randomized complete block by using the GLM procedure of SAS. In both grass and maize, additives A - E and the positive control resulted in significantly reduced ( $P < 0.05$ ) DM loss, pH, acetic acid, butyric acid, propionic acid, alcohols and/or N-NH<sub>3</sub> while lactic acid increased compared with untreated silage ( $P < 0.05$ ). Additives A, B and C designed for improved aerobic stability, had lower temperatures ( $P < 0.05$ ) at the end of the 7-day period of air exposure compared with the negative and positive controls in both silages. Untreated grass silages were stable for 4 days, the positive control 7 days, whereas additives A, B, C, D and E were stable for >13, 10, 7.5, 7 and 7 days, respectively. Untreated maize silage was stable for 2 days, the positive control 3 days, whereas A, B, C, D and E were stable for 6, 5.5, 6, 3 and 4 days, respectively. Additives A - E significantly improved fermentation quality and additives A, B and C significantly improved aerobic stability when compared to the positive control in both silages.

**Key words:** inoculant, silage additive, aerobic stability

**W106 Identification and characterization of spoilage yeasts from high moisture corn and corn silages.** M. C. Santos<sup>\*1</sup>, C. Golt<sup>1</sup>, R. D. Joerger<sup>1</sup>, G. D. Mechor<sup>2</sup>, and L. Kung<sup>1</sup>, <sup>1</sup>University of Delaware, Newark, <sup>2</sup>Elanco Animal Health, Greenfield, IN.

The objectives of this study were to identify and characterize yeasts associated with aerobic spoilage of high moisture corn (HMC) and corn silage (CS) and to compare 3 methods of yeast identification. Silages were sampled from 21 US dairy farms and shipped to the University of Delaware for analysis. Water extracts were prepared by homogenizing 25 g of silage with 225 mL of quarter-strength ringer's solution for 1 min. Silage pH was measured and yeasts were enumerated by pour plating in malt extract agar and incubated at 32°C for 48 h. Colonies were randomly picked from plates with the highest serial dilutions and taxonomically identified by fatty acid methyl ester (FAME) analysis (MIDI Inc., Newark, DE). An isolate of each species with the highest FAME similarity index was also characterized by DNA sequencing and biochemical tests (ID 32 C system, bioMerieux, Marcy l'Etoile, France). Average pH was 4.3 (ranging from 3.9 to 4.8) and 3.7 (ranging from 3.5 to 4.1) and average yeast counts were 6.3 log<sub>10</sub> cfu/g (ranging from 4.3 to 7.9) and 5.4 (ranging from 4.2 to 7.0) for HMC and CS, respectively. Of 266 colonies isolated, 87.3% were identified by FAME in 24 known species and 12.8% were unknown. *Candida valida* (33.1% of total isolates), *Saccharomyces cerevisiae* (10.2%),

*C. holmii* (7.1%), *Zygosaccharomyces bisporus* (7.1%) and *C. milleri* (4.1%) were the most prevalent species. The remaining 25.7% of isolates belonged to 19 other species. *C. valida* and *Z. bisporus* were lactate utilizers whereas *S. cerevisiae*, *C. holmii* and *C. milleri* were able to metabolize glucose and sucrose, but not lactate. *C. valida* was the most common species isolated from HMC and CS (35.1 and 30.5%, respectively). *S. cerevisiae* (12.8%) and *C. holmii* (13.6%) were the second most common isolates from HMC and CS, respectively. Yeast diversity was higher in HMC than in CS (21 species vs. 11 for CS) but the later had a higher percentage of unknown species (22.9% vs. 4.7%). Identification of yeasts using DNA analysis generally corresponded with identification using biochemical tests; however, FAME analysis did not generally agree with these 2 methods.

**Key words:** *Candida valida*, silage, spoilage

**W107 Ruminant parameters of cattle fed corn silage inoculated with microbial additive.** P. A. R. Salvo<sup>\*</sup>, F. C. Basso, F. H. Kamada, J. V. Yamaguchi, V. V. Naves, and R. A. Reis, *Animal Science Department, College Agricultural and Veterinary Sciences, São Paulo State University, Jaboticabal, São Paulo, Brazil.*

Microbial inoculants containing heterofermentative bacteria are used in corn silage to improve the aerobic stability, however few studies are reported about the effect of microbial inoculants on cattle ruminal parameters. The aim this study was to evaluate the effect of *Lactobacillus buchneri* and *Lactobacillus buchneri* associated with *Lactobacillus plantarum* in corn silage on ruminal parameters of cattle. Therefore, six rumen cannulated beef steers (470 kg) were used. The steers were fed with 80% of corn silage and 20% of commercial concentrate (8% of soybean meal, 87% of ground corn and 5% of mineral salt). The treatments were the corn silages inoculated with *L. buchneri* NCIMB 40788 ( $1 \times 10^5$  cfu/g of fresh forage, CSB); corn silage inoculated with *L. buchneri* NCIMB 40788 ( $1 \times 10^5$  cfu/g) in combination with *L. plantarum* MA18/5U ( $1 \times 10^5$  cfu/g, CSBP) and untreated corn silage (CS). Average daily dry matter intake (DMI) was measured. Rumen fluid samples were collected 0, 3, 6, 9, and 12 hours after feeding. The pH values were evaluated with a pH meter. Approximately 1mL of H<sub>2</sub>SO<sub>4</sub> (1:1) was added to the suspensions to stop the microbial activity. Samples were frozen and subsequently, ammonia concentrations were measured by the Kjeldahl method using KOH (2N). The experimental design was a Latin square (3 × 3) duplicated in time. Data were subjected to analysis of variance and means compared by the Tukey test at a significance level of 5%. Each experimental period consisted of 7 days of adaptation and 3 days of data collection. Average daily DMI, ruminal pH and ruminal ammonia were not affecting by the microbial inoculants in corn silage ( $P > 0.05$ ). Average DMI was 6.99, 6.92 and 6.78; ruminal values of pH were 6.12, 6.09 and 5.99 and the ruminal ammonia levels were 10.61; 9.91 and 9.73 mg/dL, respectively in the CS, CSB, and CSBP silages. Ruminal parameters evaluated were normal. In conclusion, the microbial inoculant treatment of corn silage did not affect the ruminal pH and ammonia concentrations of cattle.

**Key words:** ammonia, *Lactobacillus buchneri*, *Lactobacillus plantarum*

**W108 Investigation of microbial additives on fermentation quality of alfalfa silage.** F. Kazemi, M. Dehghan-Banadaky<sup>\*</sup>, A. Zali, and K. Rezayazdi, *Animal Science Department, Campus of Agricul-*

tural and Natural Resources, University of Tehran, Karaj, Tehran, Iran.

The objective of present study was to investigate the effects of microbial additives on physical and chemical characteristics of alfalfa silages. In this experiment treatments included: 1-untreated corn silage (control), 2-treated with Ecosyl (EC) (0.125mg/kg), 3-Lacticil Maize (LM) (0.2 mg/kg), and 4- combination of both them Ecosyl (0.063 mg/kg), Lacticil Maize (0.1 mg/kg) were added to pilot silages. Silages were opened on days 10, 20, 30 and 40 after ensiling. Silage quality was assessed using pH, ammonia nitrogen and VFAs concentrations, Flieg point (ratio between dry matter concentration and pH), crude protein, dry matter, neutral detergent fiber and organic matter concentrations. Treatment 3 had the lowest pH and highest Flieg point compared with the others ( $P < 0.05$ ). While treatment 2 had the highest pH and lowest flieg point. Concentration of Ammonia nitrogen in treatment 4 was higher than the other treatments ( $P < 0.05$ ). Also treatment 2 had the lowest dry matter percentage. The results indicated that among those tested, Lacticil Maize is the preferred microbial additive for alfalfa silage due to improving fermentation quality.

**Key words:** microbial additives, alfalfa silage, fermentation quality

**W109 Volatile organic compounds emissions from different silages and cattle feed.** I. L. Malkina<sup>1</sup>, R. B. Franco\*<sup>1</sup>, A. Kumar<sup>2</sup>, P. G. Green<sup>3</sup>, and F. M. Mitloehner<sup>1</sup>, <sup>1</sup>Department of Animal Science, University of California-Davis, <sup>2</sup>Crocker Nuclear Laboratory, University of California-Davis, <sup>3</sup>Department of Civil and Environmental Engineering, University of California-Davis, Davis.

The San Joaquin Valley (SJV) in Central California exhibits high ground-level ozone pollution that may affect human, animal, and plant health. Silage and other feedstuffs were identified as one of the major sources of volatile organic compounds (VOCs), which in reaction with nitrogen oxides (NOx) contribute to ozone formation in this area. For reference, urban concentrations in the SJV represent 125 ppb of VOCs, while the rural concentrations in the SJV represent 62.5 ppb of VOCs. Detailed characterization of VOCs is relevant to ozone formation potential because the impact of different VOCs on ozone formation varies significantly. This study identified and quantified the VOCs emitted from silages and other feedstuffs in environmental chamber experiments conducted under controlled conditions. Approximately 80 VOCs were identified and quantified from corn (*Zea mays* L.), alfalfa (*Medicago sativa* L.), cereal (wheat [*Triticum aestivum* L.] and oat [*Avena sativa* L.] grains) silages, total mixed ration (TMR), almond (*Amygdalus communis* L.) shells and hulls using gas chromatography-mass spectrometry (GC/MS) and high performance liquid chromatography (HPLC). Four air samples of silages and TMR, and 2 air samples of almond hulls and almond shells were collected using 6-L SUMMA canisters and DNPH cartridges. High concentrations of emitted alcohols, predominantly ethanol ( $1615.5 \pm 188.6$  nL/L from cereal silage and  $1043.7 \pm 184.9$  nL/L from corn silage) and other oxygenated compounds were measured. Highly reactive alkenes and aldehydes, were also detected but in lower concentrations. Further studies in quantification and monitoring of these emissions are critical for assessment of and response to the specific needs of the air quality in the SJV.

**Key words:** volatile organic compounds, silage, ethanol emissions

**W110 Production and quality of corn silage cultivated on integrated crop-livestock-forest system in a Cerrado region of Minas Gerais, Brazil.** M. C. M. Viana\*<sup>1</sup>, W. Botelho<sup>1</sup>, P. A. Viana<sup>2</sup>, D. S.

Queiroz<sup>1</sup>, E. A. Silva<sup>1</sup>, M. S. Viana<sup>4</sup>, and C. G. Guimarães<sup>3</sup>, <sup>1</sup>EPAMIG - Minas Gerais Agricultural Research Corporation, Belo Horizonte, Minas Gerais, Brazil, <sup>2</sup>Embrapa Maize and Sorghum, Sete Lagoas, Minas Gerais, Brazil, <sup>3</sup>UFVJM University, Diamantina, Minas Gerais, Brazil, <sup>4</sup>FEAD University, Belo Horizonte, Minas Gerais, Brazil.

The trial was carried out at Santa Rita Experimental Farm (19°28' S, 45°15'W, 732 m) on *Brachiaria decumbens* degraded pasture to evaluate the interference of different eucalyptus structural arrangements and clones on the production and chemical composition of maize silage cultivated in an agroforestry system (iCLF). The experimental design was a randomized complete block in a split plot, with 3 replications. Eucalyptus arrangements: double rows ( $3 \times 2$ )  $\times$  20 m; ( $2 \times 2$ )  $\times$  9 m and single rows ( $9 \times 2$ m) were distributed in the main plots, with 20 and 9 m between rows and 2 m between tree spacing. Eucalyptus clones: VM 58, GG100 and I144 were tested in the subplots. The corn (hybrid BRS3060) was intercropped with eucalyptus clones. The maize cultivar used was BRS 3060. The maize silage yield, DM, ADF, NDF, lignin and cellulose contents were evaluated. Termites, white grub, wireworm, diplodes and corn rootworm larvae were the main soil pest observed in the experimental area. No difference was observed for maize productivity in relation to structural arrangements and eucalyptus clones in the first year of crop establishment. Also, the DM, ADF, NDF, lignin and cellulose were not influenced by the clones and the various structural arrangements of eucalyptus. The clones and the structural arrangements of eucalyptus did not influence the production and chemical composition of silage corn in the first year of crop establishment in the iCLF system in the Cerrado region of Minas Gerais State. (Research supported by FAPEMIG/CNPq)

**Table 1.** Dry matter (DM) yield (t/ha) and chemical composition of corn intercropped with eucalyptus in the first year of integrated crop-livestock-forest (iCLF) system

Arrangements	DM Yield (t/ha)	DM (%)	CP (%)	ADF (%)	NDF (%)	Lignin (%)	Cellulose (%)
(3 × 2) × 20 m	10.24 <sup>a</sup>	37.27 <sup>a</sup>	4.73 <sup>a</sup>	31.1 <sup>a</sup>	58.55 <sup>a</sup>	4.79 <sup>a</sup>	25.73 <sup>a</sup>
(2 × 2) × 9 m	6.03 <sup>a</sup>	36.03 <sup>a</sup>	4.86 <sup>a</sup>	31.26 <sup>a</sup>	59.07 <sup>a</sup>	4.86 <sup>a</sup>	25.72 <sup>a</sup>
(9 × 2) m	10.75 <sup>a</sup>	35.58 <sup>a</sup>	5.02 <sup>a</sup>	31.96 <sup>a</sup>	59.40 <sup>a</sup>	5.46 <sup>a</sup>	25.89 <sup>a</sup>

Same letters in the same column do not differ by Tukey test ( $P \geq 0.05$ ).

**Key words:** degraded pasture, nutritive value, agroforestry

**W111 Effect of molasses, starch and enzyme enrichment of sorghum and corn silage on chemical composition and rumen degradability.** M. Dehghan-Banadaky\*, M. Ghiasvand, and S. Sadeghi, *Animal Science Department, Campus of Agricultural and Natural Resources, University of Tehran, Karaj, Tehran, Iran.*

The present study investigated the effects of enzyme (1 g Natuzyme per kg DM) and carbohydrate (molasses and barley, 5 g per kg DM) enrichment in sorghum silage and comparison with corn silage. Sorghum and corn were harvested at maturity stage with 25% dry matter. Forage chopped to 3-5 cm length and ensiled. After 60 days, silages were opened and evaluated for odor, color, material tissue, the amount of mold and pH (5 replicates for each treatment). Chemical composition was measured including dry matter digestibility, dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), non fibrous carbohydrate (NFC), acid detergent fiber (ADF), and fermentation products such as ammonia nitrogen and volatile fatty acids. Three rumen fistulated Holstein cows were used for degradability experiment at 0, 6, 12, 24, 48, 72 and 96 h incubation. Corn silage dry matter was signifi-

cantly greater than sorghum silage (28 vs. 25,  $P < 0.05$ ). Silage with barley flour and molasses enrichment had more dry matter. NDF and ADF concentration in sorghum silage with barley flour and molasses additive were significantly lower than sorghum silage without additive and corn silage ( $P < 0.05$ ). Dry matter digestibility, digestible energy and total digestible nutrients in sorghum silage with barely flour and molasses significantly greater than other silages. Results of sensory evaluation showed that sorghum silage without additive had the lowest score and sorghum silage with molasses, barley flour and corn silage had very good quality. The in situ wash fraction was increased in sorghum silage with molasses and barley flour additive equal to corn silage. The potentially degradable fraction significantly increased in sorghum and corn silage with enzyme additives. The degradation rate and effective degradation at passage rates of 2, 5 and 8 percent per hour increased in corn and sorghum silage with barley flour and molasses. Sorghum silage enriched with molasses and barley flour in most parameters did not differ significantly with corn silage. We conclude that the quality of sorghum silage can be improved by adding molasses or barley flour.

**Key words:** sorghum silage, molasses, corn silage

**W112 Effect of processed and unprocessed canola straw on growth performance, feeding behavior and rumen metabolites in Holstein feedlot calves.** M. Ghiasvand, M. Dehghan-Banadaky\*, and K. Rezayazdi, *Animal Science Department, Campus of Agricultural and Natural Resources, University of Tehran, Karaj, Tehran, Iran.*

Studies on the nutritional value of canola straw are very limited, therefore this forage is unknown to farmers and often is not used in ruminant nutrition. This experiment used 24 Iranian Holstein male calves with  $266 \pm 64$  kg live weight. The study had a randomized complete design with three experimental diets with 25 to 75, forage: concentrate ratio. Diet 1 contained 10% corn silage and 15% alfalfa hay, diet 2 and 3, alfalfa was substituted with unprocessed and processed canola straw respectively. Energy density and protein content of the diets were similar. Canola straw was processed with NaOH (5% of dry matter). Calf live weight was recorded monthly. Calf feeding behavior was recorded for 24 h. Rumen fluid was collected 4 h after morning feeding at the end of experiment. Calves fed diet 2 had significantly less individual DMI than other groups. Final BW and average daily gain were not different between diets ( $p > 0.05$ ). Feed conversion ratio for calves fed diet 2 was significantly less than calves fed diet 1 (5.75 vs. 6.72,  $P < 0.05$ ). Digestibility of DM and OM in calves' fed diet 1 were significantly lower than diet 2 and 3. Protein and cell wall digestibility in diets 2 were more than diet 1 and there was no significant difference between diets 2 and 3. Ruminal pH in calves fed diet 3 was significantly greater than calves fed diet 1 and 2 (6.05, 5.90, and 6.27 for treatments 1-3 respectively). There was no significant difference among the calves fed different diets ( $P > 0.05$ ) in rumen total volatile fatty acids and  $\text{NH}_3\text{-N}$  concentration. Total ruminating time was greatest in calves fed diet 2. Ruminating time per kg of dry matter, per kilogram of NDF and per kilogram of forage NDF (fNDF) in calves fed diets containing unprocessed canola straw was significantly greater than calves fed diets 1 and 3. Results indicate that unprocessed canola straw can be used as a roughage source in feedlot calf diets.

**Key words:** canola straw, Holstein male calves, feeding behavior

**W113 Kinetics of solid-state fermentation of waste peach (*Prunus persica*) to be used as animal feed.** Y. Castillo<sup>1</sup>, O. Ruiz<sup>\*2</sup>,

J. C. Gomez<sup>1</sup>, E. Peru<sup>1</sup>, H. Gonzalez<sup>3</sup>, A. Orozco<sup>3</sup>, C. Angulo<sup>2</sup>, I. Ramos<sup>3</sup>, and M. R. Murphy<sup>4</sup>, <sup>1</sup>*División multidisciplinaria, UACJ, Nuevo Casas Grandes, Chihuahua, Mexico,* <sup>2</sup>*Facultad de Zootecnia y Ecología, UACH, Chihuahua, Chih., Mexico,* <sup>3</sup>*Instituto de Ciencia Biológicas, UACJ, Ciudad Juárez, Chihuahua, Mexico,* <sup>4</sup>*Animal Science Department, University of Illinois, Urbana.*

Feed produced by solid state fermentation (SSF) has been added to ruminant diets to improve the nutritional value, including the true protein content. The aim of the present study was to determine the effect of incubation duration on the fermentation profile and chemical content of fermented peach residues collected after processing in a mill. Peach waste was ground and mixed with 1.5% urea, 0.2% ammonium sulfate, 0.9% calcium carbonate, and 0.5% of a mineral salt mixture. These ingredients were mixed and then 200 g portions were distributed to separate sterile 250 ml flasks for solid-state fermentation (SSF). Each flask was plugged with cotton and incubated under static conditions at 32°C for 0, 24, 48, and 72 h. At each sampling time, four flasks were withdrawn from the incubator. A completely randomized design was used with 4 replications at each time of incubation and data was analyzed with the GLM procedure of the SAS. Results showed that pH decreased ( $P \leq 0.0001$ ) progressively over time (5.80, 4.81, 4.72 and 4.54 for 0, 24, 48 and 72 hours, respectively). Counts of yeast colonies (log cells/ml) increased ( $P \leq 0.0001$ ) over time. Dry matter (DM) was constant during the first 48 hours and then decreased ( $P \leq 0.03$ ). Neutral and acid detergent fiber (NDF and ADF) increased in the first 24 hours and decreased subsequently ( $P \leq 0.001$  and  $P \leq 0.003$ , respectively). Hemicellulose (HEM) developed in the same way ( $P \leq 0.0001$ ), but showed no changes after 24 h. Crude protein showed no statistical differences during incubation. True protein content did not improve in the first 24 h, but it increased at 48 h ( $P < 0.05$ ), with no changes subsequently (4.62, 5.04, 5.42 and 5.18% for 0, 24, 48 and 72 h, respectively). According to these results, it can be concluded that a fermentation time of 48 h is enough to accomplish an improvement of the nutritional value of residues of the peach industry.

**Key words:** fermentation, peach, chemical

**W114 Chemical additives on sugarcane ensilage: Fermentation parameters, digestibility and intake by sheep.** A. F. Pedrosa<sup>\*1</sup>, S. N. Esteves<sup>1</sup>, W. Barioni<sup>1</sup>, G. B. Souza<sup>1</sup>, C. Carbello<sup>2</sup>, and G. G. Chiquitin<sup>2</sup>, <sup>1</sup>*Brazilian Agricultural Research Corporation - Embrapa, São Carlos, SP, Brazil,* <sup>2</sup>*Fund. Educacional de Andradina, Andradina, SP, Brazil.*

The objective was to determine the apparent digestibility and intake by sheep of sugarcane silages produced with and without chemical additives, and to evaluate the effectiveness of additives at controlling alcoholic fermentation in the silages. Mature sugarcane (22 °Brix) was ensiled in 200 L metal drums without treatment (control) or treated with (fresh forage basis): urea (5 g/kg) + sodium benzoate (0.5 g/kg); sodium propionate (4 g/kg); calcium hydroxide (10 g/kg). Silos were opened 80 d after ensiling and silages were fed to 16 wethers (averaging 45 kg live body weight - LW) housed in metabolic cages. Animals were distributed among treatments (four diets based on the different silages) in a complete randomized design with four replicates. Soybean meal and a mineral supplement were used to respectively balance protein content and minerals in diets. Silage DM digestibility and intake were calculated by difference since soybean digestibility was known. All silages had adequate pH (<4.2; Table 1). All additives reduced alcoholic fermentation in the silages but calcium hydroxide had the greatest effect (83% less ethanol relative to control). Urea +



benzoate and calcium hydroxide improved silage digestibility similarly (18% higher) but did not affect silage intake (relative to LW) compared to the untreated silage. Treatment with sodium propionate had no effect on silage digestibility and intake compared to control.

**Table 1.** Fermentation parameters, apparent digestibility and intake by sheep of sugarcane silages produced with and without additives

Silage	pH	Ethanol (g/kg DM)	Digestibility (% DM)	DM Intake (% LW)
Control	3.55 <sup>c</sup>	96.6 <sup>a</sup>	37.2 <sup>b</sup>	1.8 <sup>ab</sup>
Urea + benzoate	3.77 <sup>b</sup>	67.3 <sup>b</sup>	43.7 <sup>a</sup>	1.7 <sup>ab</sup>
Sodium propionate	3.72 <sup>b</sup>	76.8 <sup>b</sup>	38.2 <sup>b</sup>	1.3 <sup>b</sup>
Calcium hydroxide	4.08 <sup>a</sup>	11.6 <sup>c</sup>	44.3 <sup>a</sup>	2.0 <sup>a</sup>
SE	0.045	6.94	3.03	0.37

<sup>abc</sup>Means in rows with unlike superscript differ by the *t* test ( $P < 0.05$ ); LW = live body weight.

**Key words:** alcoholic fermentation, calcium hydroxide, sodium propionate

**W115 Effects of the form of applying virgin lime and the treatments duration on the temperature and pH of sugarcane.** E. Z. Ramos\*, M. D. S. Oliveira, A. C. Rego, M. P. R. Sforcini, and V. B. Ferrari, *UNESP, Jaboticabal, São Paulo, Brazil.*

This study aimed to evaluate the effects of the form of applying virgin lime (powder or solution) and the treatment duration (0, 3 and 6 h) on hydrolysis of sugarcane with particle sizes of 4 or 10 mm. Control samples were untreated at time 0. Each treatment had four replications, and the treatment arrangement was a  $2 \times 2 \times 3$  factorial. Virgin lime was applied at the rate of 0.5% (fresh weight basis) to sugarcane. Treatment effects on the cell wall were monitored using Scanning Micrographs (SEM), and effects on temperature and pH were also recorded. The experimental data were analyzed using AgroEstat software and means were compared with the Tukey test at the 5% probability level. Table 1 shows that temperature increased with the treatment duration such that the lowest temperatures occurred at 0 h (24.1°C), and the highest values at 6 h (27.2°C). There was an interactions of treatment duration and temperature and of particle size and duration. Treatment with the powder resulted in higher temperatures (26.1°C) than the solution (25.7°C). Lime-treated samples had higher pH, regardless of the treatment duration, such that values were (5.7) for the control, and (10.3) and (9.8) after lime application for 3 and 6 h, respectively. In conclusion, the application of lime powder proved more efficient than in solution, but the particle size did not affect the results. Treatments duration increased sample temperature, but had no influence on pH values. The SEM images revealed that, regardless of other treatments, application of lime degraded the cell wall and potentially released cell contents that could be utilized by animals.

**Table 1.** Temperature and pH values

	Virgin lime		Particle size (mm)		Treatment duration (h)		
	Powder	Solution	4	10	0	3	6
Temperature (°C)	26.1 <sup>a</sup>	25.8 <sup>b</sup>	26.0 <sup>a</sup>	25.9 <sup>a</sup>	24.1 <sup>c</sup>	26.5 <sup>b</sup>	27.2 <sup>a</sup>
pH	8.7 <sup>a</sup>	8.6 <sup>a</sup>	8.5 <sup>a</sup>	8.7 <sup>a</sup>	5.7 <sup>b</sup>	10.3 <sup>a</sup>	9.8 <sup>a</sup>

**Key words:** sugarcane, hydrolysis, microscopy

**W116 Effect of calcium chloride fertilization on the dietary cation-anion difference of forage crops in northern New York.** E. O. Young<sup>1</sup>, C. S. Ballard\*<sup>1</sup>, and S. Mishra<sup>2</sup>, <sup>1</sup>William H. Miner Agricultural Research Institute, Chazy, NY, <sup>2</sup>TETRA Technologies, Inc., The Woodlands, TX.

Maintaining forage with an ideal dietary cation-anion difference (DCAD) for non-lactating cows can be challenging. The objective of this experiment was to determine if the application of liquid calcium chloride could increase chloride content and reduce DCAD of grass and mixed alfalfa-grass stands. In June 2010, three replicate plots were established on grass and alfalfa-grass fields at each of four sites at Miner Institute in Chazy, NY. Within plot, treatment was randomly assigned to subplot (with or without calcium chloride). Treatment subplots received 80 kg/ha of chloride as liquid calcium chloride applied one week after first cutting. Plots were harvested near the third week of June 2010 (second cut), and a second harvest was taken at the end of July (third cut). Analysis of variance was used to determine treatment effects on yield, DCAD, and forage nutrient content for each harvest. Results showed that calcium chloride application nearly doubled the chloride content of both forages at each harvest ( $P \leq 0.001$ ) and significantly reduced DCAD ( $P \leq 0.001$ ). For alfalfa-grass, calcium chloride fertilization reduced DCAD from 317 to 179 mEq/kg for the first harvest ( $P \leq 0.001$ ), and 432 to 326 mEq/kg for the second harvest ( $P \leq 0.05$ ). Grass DCAD was reduced from 115 to -108 mEq/kg with calcium chloride fertilization ( $P \leq 0.001$ ) for first harvest and 293 to 91 mEq/kg for second harvest ( $P \leq 0.001$ ). There was no impact on yield from chloride addition ( $P \geq 0.58$ ) and no apparent impacts on forage nutritive value ( $P \geq 0.15$ ) besides chloride content. Fertilizing alfalfa-grass or grass stands with liquid calcium chloride appears to be a viable approach to reduce DCAD in forages fed to non-lactating dairy cattle in Northern NY. Future work will compare the cost-effectiveness of chloride fertilization of forages versus addition of supplements to animal rations to reduce DCAD.

**Key words:** forage quality, nonlactating cows, dietary cation-anion difference

**W117 In vitro ruminal fermentation of dairy cows diets with eight yeast strains isolated from apple byproducts.** D. Díaz-Plascencia\*<sup>1</sup>, C. Rodríguez-Muela<sup>1</sup>, P. Mancillas-Flores<sup>1</sup>, F. Salvador-Torres<sup>1</sup>, C. Arzola<sup>1</sup>, L. Durán<sup>1</sup>, J. Jiménez<sup>1</sup>, and S. Mena<sup>2</sup>, <sup>1</sup>Universidad Autónoma de Chihuahua, Chihuahua, México, <sup>2</sup>Universidad de Guadalajara, Jalisco, México.

In order to evaluate the effect of the inclusion of eight strains of yeasts isolated from apple byproducts on the in vitro fermentation of dairy cows diets samples, were developed eight yeast inoculums with the following strains (strains 2, 9, 11 and 13 of *Kluyveromyces lactis* (Kl), 3 and 8 of *Issatchenkia orientalis* (Io), 4 and 6 of *Saccharomyces cerevisiae* (Sc) to be assessed by the in vitro gas production technique. Exactly 0.2 g sample, 10 ml rumen fluid, 20 ml artificial saliva and 1 ml of yeast inoculum were evaluated in 72 glass bottles in triplicate for 12, 24, and 48 h at 39° C. Variables evaluated were ammonia nitrogen (AN), lactic acid (LA) and yeast count (YC). The data were evaluated with a completely random design with a split plot in time. Results of the LA variable are showed in Table 1. There were strain and fermentation time effect on AN, LA and YC ( $P < 0.01$ ). Lowest values of AN were obtained with Kl2 ( $P < 0.01$ ) and highest with Io3, Io8 and Sc6 (22.5, 24.8, 24.8 and 24.1 mM/L at 48h, respectively). Highest values of YC were obtained with Kl2, Kl9, Kl11, Kl13 and Sc6 with values of 1.9, 1.3, 1.2, 1.1 and 1.0E+07 cells/ml respectively at 48h ( $P < 0.01$ ).

We conclude that *K. lactis* yeast showed to be the most effective on the in vitro rumen fermentation, with better performance on yeast count and lactic acid reduction.

**Table 1.** Lactic acid values (mM/L) on the in vitro rumen fermentation of dairy cow diets with eight different strains of yeast

Strain	Time (h)		
	12	24	48
Kl 2	21.75 <sup>c</sup>	7.51 <sup>c</sup>	2.47 <sup>c</sup>
Kl 9	27.54 <sup>ed</sup>	10.11 <sup>c</sup>	2.82 <sup>c</sup>
Kl 11	34.77 <sup>a</sup>	10.47 <sup>c</sup>	2.37 <sup>c</sup>
Kl 13	28.14 <sup>cd</sup>	15.82 <sup>cd</sup>	2.39 <sup>c</sup>
Io 3	45.78 <sup>a</sup>	34.48 <sup>a</sup>	17.61 <sup>a</sup>
Io 8	32.80 <sup>ab</sup>	21.95 <sup>b</sup>	15.34 <sup>ab</sup>
Sc 4	26.35 <sup>bcd</sup>	17.72 <sup>bcd</sup>	8.81 <sup>cd</sup>
Sc 6	36.11 <sup>bc</sup>	18.27 <sup>bc</sup>	9.95 <sup>c</sup>

<sup>abcde</sup>Different letters within columns indicate statistical difference between strains ( $P < 0.01$ ). Rows standard error:  $\pm 0.31$ .

**Key words:** yeast, fermentation, lactic acid

**W118 Effect of exogenous fibrolytic enzymes on in vitro ruminal fermentation kinetics and energy utilization of three Mexican tree fodder species.** D. López<sup>1</sup>, R. Rojo\*<sup>1</sup>, A. Z. M. Salem<sup>1</sup>, J. Cedillo-Monroy<sup>1</sup>, B. Albarrán<sup>1</sup>, A. González<sup>2</sup>, J. L. Martínez-Benites<sup>1</sup>, J. Morales-Díaz<sup>1</sup>, and J. Tinoco-Jaramillo<sup>1</sup>, <sup>1</sup>Centro Universitario UAEM-Temascaltepec, Universidad Autónoma del Estado de México, Temascaltepec, Estado de México, México, <sup>2</sup>Universidad Autónoma de Tamaulipas, Cd. Victoria, Tamaulipas México.

A factorial experimental treatment structure (3 x 3) was used to evaluate the effect of exogenous fibrolytic enzymes (EFE) on in vitro ruminal fermentation kinetics and energy utilization of three browse tree foliages (*Pithecellobium dulce*, *Heliocarpus velutinus* and *Guazuma ulmifolia*). A commercial exogenous fibrolytic enzyme (EFE) mixture (Fibrozyme, Alltech Inc., Nicholasville, KY) was added to browse species leaves at three levels: 0 (control), 3.5 and 7.0 mg/g. Browsers species were harvested during dry season (April/May 2009) and incubated with goat ruminal inoculum. Chemical composition, plant secondary metabolites [total phenolics (TP), saponins (SAP), aqueous fraction (AF)] as well as in vitro ruminal gas production kinetics were determined using a general compartment model. Short chain fatty acids (SCFA) and metabolizable energy (ME) were estimated. Seven replicates of each treatment were used and data were analyzed using a randomized complete design. Differences among means were determined using a least squares means test. Addition of EFE improved the fermentation kinetics of the browse tree leaves. The CP content of *P. dulce* was higher ( $P < 0.05$ ) than those of the remaining tree species. The NDF and SAP concentration of *G. ulmifolia* was higher ( $P < 0.05$ ) than those of the other species. *P. dulce* and *G. ulmifolia* had high ( $P < 0.05$ ) contents of TP. Gas production at 24 (h) (GP24) of *P. dulce* at the high EFE level (i.e., 7 mg EFE /g DM) showed a higher ( $P < 0.01$ ) ruminal fermentation after 24 h of incubation than that of *G. ulmifolia*. The asymptotic gas production (b) (ml/g DM) and rate of gas production (c) (/h), were affected ( $P < 0.01$ ) by enzyme treatment while the lag phase was not affected. The lower ( $P < 0.01$ ) extent of gas production occurred in *G. ulmifolia* at 0 mg EFE /g DM as well as the c and b values. *P. dulce* with high levels of EFE (7.0 mg/g DM) showed the highest ( $P < 0.05$ ) values for ME and SCFA while the *G. ulmifolia*

without EFE showed the lowest values for ME and SCFA. Addition of EFE improved the fermentation kinetics of the browse tree leaves.

**Key words:** browse species, exogenous fibrolytic enzyme, plant secondary metabolites

**W119 Effects of pH and temperature on fibrolytic enzyme activities of various commercial exogenous enzyme preparations.** K. G. Arriola\*, J. J. Romero Gomez, and A. T. Adesogan, *Department of Animal Sciences, Institute of Food and Agricultural Sciences, University of Florida, Gainesville.*

The objective of this study was to evaluate how the enzyme activity of commercial fibrolytic enzymes differed with the prevailing pH and temperature. Eighteen commercial fibrolytic enzymes from 5 companies were assayed in triplicate for xylanase and endoglucanase activity at pH 4.0, 5.0, 6.0, 7.0 and 8.0 at 39°C (Experiment 1) and at 20, 30, 40, and 50°C at pH 6.0 (Experiment 2). Xylanase was assayed in a 15-mL test tube containing 1.0 mL of 1.0% (wt/vol) oat spelts xylan as substrate and 0.9 mL of citrate-phosphate buffer (pH 6.0). After preincubation for 10 min., 0.1 mL of diluted enzyme was added to initiate the reaction and the suspension was incubated for 5 min. The reaction was terminated by adding 3 mL of dinitrosalicylic acid reagent. Endoglucanase was assayed as described above using 1.0% (wt/vol) carboxymethyl cellulose as substrate. The unit of enzyme was the amount of enzyme required to release 1  $\mu$ mol of reducing sugars as xylose (xylanase) or glucose (endoglucanase) equivalents min<sup>-1</sup> mg<sup>-1</sup>. Treatments were arranged in an 18 (enzymes) x 5 (pH) or 4 (temperatures) factorial layout and data analyzed with a model including these terms and the interaction using Proc Mixed of SAS. Xylanase activity was optimal at 20, 30, 40 and 50°C for 0, 11, 6, and 83% of the enzymes; whereas endoglucanase activity was optimal for 11, 0, 11, and 78% of enzymes at the respective temperatures. Xylanase activity was optimal at pH 4, 5, 6, 7, and 8 for 17, 44, 17, 5, and 17% of the enzymes, whereas, endoglucanase activity was optimal for 44, 33, 17, 6 and 0% of the enzymes at the respective pH. Xylanase and endoglucanase activities of most enzymes were optimal at 50°C and at pH 4 - 5. Therefore, few (<25%) of the 18 enzymes exhibited optimal activity under ruminal conditions (pH 6–7, 39°C).

**Key words:** xylanase, endoglucanase, exogenous enzymes

**W120 Fiber digestibility of cool-season grasses.** T. W. Downing\*, *Oregon State University, Corvallis.*

Forage grass production is an important component of profitable dairy-farming along the Pacific Northwest coast. Neutral detergent fiber digestibility (NDFD) is increasingly being used in ration formulation and forage benchmarking. However, data on differences in NDFD between and within cool-season grass species is limited. The objective of this study was to determine if NDFD differs between species and varieties. Eighteen cool-season grass varieties were replicated 3 times each in 6-m<sup>2</sup> randomized field plots. Included were 6 varieties each of perennial ryegrass (*Lolium perenne*), orchardgrass (*Dactylis glomerata*), and tall fescue (*Lolium arundinaceum*). Plots were mechanically harvested six times at approximately 28 d intervals beginning in March each year and harvested over a two year period. Forty eight-hour in vitro neutral detergent fiber (NDF) digestibility was determined using 0.3 g of sample in F57 bags in a DaisyII Incubator (Ankom Technology, Fairport, NY). Neutral detergent fiber was less ( $P < 0.001$ ) for ryegrass (49.5 $\pm$ 1.58) compared to both orchardgrass (57.5 $\pm$ 3.64) or tall fescues (53.5 $\pm$ 1.4). Neutral detergent fiber digestibility was greater

for ryegrass compared to orchardgrass and tall fescue (79.4±1.3, 76.2±1.4, and 76.5±1.1% of NDF respectively;  $P < 0.01$ ). The fescues and orchard grasses were similar in NDF and NDFD. Neutral detergent fiber increased and NDFD decreased ( $P < 0.05$ ) as the growing season progressed. These results indicate ryegrasses when managed intensively were significantly different from orchard grass and fescues.

**Key words:** neutral detergent fiber digestibility, cool-season grass, in vitro digestibility

**W121 Comparison of chemical composition and digestibility among wheat straws treated with *Pleurotus djamur*.** O. D. Montañez-Valdez<sup>1</sup>, J. A. Reyes-Gutierrez<sup>1</sup>, J. A. Martínez-Ibarra<sup>1</sup>, G. Rocha-Chavez<sup>1</sup>, J. M. Tapia-Gonzalez<sup>1</sup>, C. E. Guerra-Medina<sup>2</sup>, J. J. Martínez-Tinajero<sup>3</sup>, and J. H. Avellaneda-Cevallos<sup>4</sup>, <sup>1</sup>Centro Universitario del Sur, Ciudad Guzmán, Jalisco, México, <sup>2</sup>Centro Universitario de la Costa Sur, Aulán de la Grana, Jalisco, México, <sup>3</sup>Facultad de Ciencias Agrícolas, Universidad Autónoma de Chiapas, México, <sup>4</sup>Universidad Técnica de Estatal de Quevedo, Quevedo, Los Rios, Ecuador.

A study was conducted to evaluate the effect of *Pleurotus djamur*, on chemical composition of maize stover. Maize stover treated and untreated with *Pleurotus djamur*, were obtained from a commercial facility. Ten samples of maize stover used previously as substrate to culture edible fungus were collected randomly. The negative control group consisted of the pasteurized maize stover untreated with *Pleurotus djamur*. All samples were analyzed to determinate dry matter (DM), organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), cellulose (C), hemicellulose (HC) and lignin (L). Data were analyzed by mean comparison using a Student's *t*-test. No differences ( $P \geq 0.05$ ) between treatments were found for DM, OM, CP, C, and L; however, treated maize stover ( $P \leq 0.02$ ) showed higher percentages of ADF, as well as a lower NDF and HC value. We do not found change on in situ digestibility of DM ( $P \geq 0.05$ ; Table 1). The growth of *Pleurotus djamur*, on maize stover changes its chemical composition by decreasing hemicellulose content and modifying cell wall components, this did not improve the nutritional quality of agricultural byproducts. This suggests that *Pleurotus djamur*-treated maize stover is not an ideal forage for ruminants.

**Table 1.** Chemical composition and in situ digestibility of maize stover treated with and without *Pleurotus djamur* (%)

Component	NC <sup>1</sup>	TMS <sup>2</sup>
DM	92.03 <sup>a</sup>	92.56 <sup>a</sup>
OM	82.45 <sup>a</sup>	82.59 <sup>a</sup>
CP	4.78 <sup>a</sup>	4.42 <sup>a</sup>
ADF	22.67 <sup>b</sup>	27.20 <sup>a</sup>
NDF	55.91 <sup>a</sup>	47.56 <sup>b</sup>
C	33.70 <sup>a</sup>	32.40 <sup>a</sup>
HC	33.24 <sup>a</sup>	20.36 <sup>b</sup>
L	12.22 <sup>a</sup>	11.89 <sup>a</sup>
Coefficients of digestibility <i>in situ</i> of DM		
48	24.77 <sup>a</sup>	25.57 <sup>a</sup>
24	30.96 <sup>a</sup>	31.13 <sup>a</sup>
12	44.46 <sup>a</sup>	44.46 <sup>a</sup>

<sup>a,b</sup> Superscript letters indicating differences ( $P \leq 0.05$ ).

<sup>1</sup>Negative control.

<sup>2</sup>Treated maize stover.

**Key words:** byproducts, *Pleurotus djamur*, ruminant

**W122 Effect of crude protein content on intake and digestion of coastal bermudagrass hays by horses.** C. L. Spurgin, J. A. Coverdale, K. N. Winsco\*, and T. A. Wickersham, Texas A&M University, College Station.

Forage is an essential component of the equine diet; however, relatively little information is currently available regarding the effects of CP content of bermudagrass (*Cynodon dactylon*) hay on intake and digestion in horses. Therefore, this study was conducted to determine the effect of forage CP content on intake and digestion of bermudagrass hay by horses. Four cecally fistulated geldings (BW 548 ± 23 kg) were used in a 4 × 4 Latin square. Geldings were provided ad libitum access to bermudagrass hay of 4 CP levels (6.9, 9.8, 12.7, and 15.6% CP; L, ML, MH, and H, respectively). Hay was offered daily in 2 equal feedings at 0600 and 1800 each day. Experimental periods were 15 d long, with 9 d of adaptation to treatment. Forage intake was determined from d 10 through d 13 to correspond with total fecal collections from d 11 through d 14. On d 15 cecal fluid samples were collected before feeding (0 h) and 4, 8, and 12 h, after the 0600 feeding. Forage OM intake was not significantly ( $P > 0.21$ ) affected by CP content and was 8.97, 8.60, 9.53, and 10.98 kg/d for L, ML, MH, and H, respectively. In contrast, digestible OM intake increased linearly ( $P = 0.04$ ) with increasing CP content and ranged from 3.70 to 5.35 kg/d for L and H, accordingly. Digestion of OM increased quadratically ( $P = 0.03$ ). This response was largely driven by the increase between L and ML hays from 41.1 to 55.0%, followed by a leveling off at 48.8 and 48.5% for MH and H, respectively. Cecal pH responded in a cubic manner ( $P < 0.01$ ) to CP content of the hays; however, all values were in the acceptable range for promoting fiber digestion. Plasma glucose concentrations increased linearly ( $P = 0.04$ ) with increasing CP content and ranged from 68.8 for L to 73.7 mg/dL for H. Forage intake did not increase in response to increasing CP content; however, utilization, measured as the combination of intake and digestion, was sensitive to increasing CP content, suggesting nutritive value determinations of bermudagrass hay are justified when purchasing bermudagrass hay for horses.

**Key words:** horses, bermudagrass, intake

**W123 The effect of silage nutrient variations on milk prediction outcomes of the Cornell Net Carbohydrate and Protein System.** C. T. Hill\*<sup>1</sup>, M. J. Tetreault<sup>1</sup>, and H. M. Dann<sup>2</sup>, <sup>1</sup>Poulin Grain Inc., Newport, VT, <sup>2</sup>William H. Miner Agricultural Institute, Chazy, NY.

Variability in forages and forage samples is inevitable and measurable. The objective of this study was to determine the amount of variation of key nutrients in typical corn silage and haylage bunkers and how it may affect milk production. Samples were taken from 6 bunker silos [3 corn silage (CS) and 3 haylage (H)] on 24 of 28 consecutive days on 3 Vermont dairy farms. Samples were taken daily at 7, 30-cm intervals up to 2.1 m high, mixed, and sent for NIR analysis. Means were calculated for NIR results of nutrient parameters for each bunk and used to enter each forage into CNCPS (version 6.1.36). A base diet was created for each CS utilizing an alfalfa silage from the CNCPS library. The H base diets utilized a library CS. Forage ratios were 64.1% for the CS diets and 58.5% for the H diets. The ratio of CS to H was approximately 2:1 on a DM basis for all diets. Standard deviations were calculated (Microsoft Excel, 2007) within bunks for DM, CP, NDF, starch, and K<sub>d</sub>. Diets of plus or minus one SD for each nutrient were created

for comparison to the base diets. Mean nutrient values and SD for each bunk are shown in Table 1. Variations in DM resulted in a predicted AF difference up to 2.6 kg. There was a 1.2 kg and 1.7 kg increase in ME and MP milk respectively for plus one versus minus 1 SD for CS1 K<sub>d</sub>. Minus one SD resulted in approximately 1.0 kg of increased ME and MP milk for all CS NDF. All other variations resulted in less than 1.0 kg difference in ME and MP predicted milk. Although silages may appear uniform throughout a silo, frequent sampling may reduce variation in diets and improve the accuracy of model predictions.

**Table 1.** Silage mean nutrient values and standard deviations

Nutrient	Forage					
	CS1	CS2	CS3	H1	H2	H3
DM	36.8	36.4	36.4	36.1	43.0	33.5
DMSD	1.6	1.1	1.4	1.5	3.2	2.2
CP	7.0	7.3	7.6	15.7	19.4	18.3
CPSD	0.5	0.4	0.6	0.9	0.8	0.5
NDF	34.7	36.8	37.0	59.3	43.7	41.6
NDFSD	2.1	2.2	1.9	2.2	1.6	2.1
Starch	40.5	37.0	33.6	1.3	2.2	1.4
StarchSD	2.6	2.5	6.9	0.5	1.0	0.5
Kd	5.0	5.0	5.9	5.2	5.9	5.1
KdSD	0.2	1.0	0.4	0.3	0.4	0.2

**Key words:** silage variation, CNCPS, forage sampling

**W124 Partially replacing alfalfa and corn silages with fescue silages maintained fat corrected milk production.** W. D. Verbeten\*, D. K. Combs, and D. J. Undersander, *University of Wisconsin Madison, Madison.*

Meadow fescue or tall fescue silage was fed in combination with alfalfa and corn silage to evaluate the effects on milk production in early lactation dairy cows. Four treatment diets were fed to 52 early lactation (60.7 DIM ± 46.4 DIM) Holstein dairy cows (39 multiparous, 13 primiparous) producing 46.4 kg ± 11.7 kg of milk per day at the University of Wisconsin-Arlington research station. The feeding trial was a continuous lactation trial with a covariate period (2 weeks) before 6 treatment periods (2 weeks each). The cows were randomly assigned in pairs to electronic feeding gates, with 1 of the 4 treatment diets randomly assigned to each gate. Each gate was an experimental unit. The 4 diets varied in forage composition: the meadow fescue diet contained 4.6 kg DM of meadow fescue silage, 4.6 kg DM alfalfa silage, and 4.6 kg DM corn silage; the tall fescue diet contained 4.6 kg DM of tall fescue silage, 4.6 kg DM alfalfa silage, and 4.6 kg DM corn silage; the positive control diet contained 5.6 kg DM of alfalfa silage, 5.6 kg DM of corn silage, and 2.2 kg DM of wheat straw; the negative control diet contained 6.8 kg DM of corn silage and 6.8 kg

DM alfalfa silage. All diets contained between 11 and 12 kg DM of concentrate feeds. The meadow fescue, tall fescue, and positive control diets were formulated to 30% NDF, while the negative control diet was formulated to 27% NDF. Total covariate adjusted 84 d, 3.5% FCM yields were analyzed in a mixed effects model, where the gate was the random effect and the diet was the fixed effect. The milk yields for the meadow fescue, tall fescue, positive control, and negative control diets were not statistically different at  $P > 0.05$  (7219.94 kg/gate, 7110.19 kg/gate, 7352.60 kg/gate, and 7197.18 kg/gate, respectively). This data indicates that high quality meadow and tall fescue silages can be fed to high producing dairy cows without a decrease in fat corrected milk production.

**Key words:** meadow fescue, tall fescue, wheat straw

**W125 Processed and unprocessed canola straw in Holstein male calves diets changed blood parameters and carcass characteristics.** M. Ghiasvand, K. Rezayazdi, and M. Dehghan-Banadaky\*, *Animal Science Department, Campus of Agricultural and Natural Resources, University of Tehran, Karaj, Tehran, Iran.*

Canola has been vastly cultivated for edible oil production. After harvesting, the canola straw remains in the field and is burnt. This research used 24 Iranian Holstein male calves with 266 ± 64 kg live weight in an experiment with a completely randomized design with three diets. Diet 1, included 10% corn silage and 15% alfalfa hay and in diet 2 and 3, alfalfa substitute with unprocessed and processed canola straw. Energy value and protein content of the diets were similar. The animals were housed in individual concrete-floor tie stalls and individually fed. The experimental period lasted 90 days and at the end of experiment, four hours after the morning meal, blood samples were taken. After slaughter some carcass characteristics were measured and beef quality was evaluated by a sensory panel. Blood glucose level was significantly decreased in calves fed diet 2 ( $P < 0.05$ ) and cholesterol level was significantly lower in calves fed diets 2 and 3 ( $P < 0.05$ ). Effect of diet 3 on T3 (tri-iodothyronine) hormone was significant, calves fed this diet had higher levels of T3 ( $P < 0.05$ ) but values in calves fed diets 2 and 1 did not significantly differ. Hormone levels of T4 (thyroxine) and thyroid weight had no significant difference among calves. Hot carcass weight, visceral fat weight, back fat thickness, carcass length and muscle cross section were not affected by diets. But the effect of different diets on dressing % was significant ( $P < 0.05$ ). Calves fed diet 2 had the highest dressing % and calves fed diet 3 the lowest ( $P < 0.05$ ). The results indicated that chemical composition and sensory quality of meat did not differ among treatments. Canola straw can be used in the diet of male calves for fattening particularly under drought conditions and or when there is a shortage of other forage sources.

**Key words:** canola straw, Holstein male calves, carcass characteristics