

1529 The effect of antioxidants on solubility of trace minerals in infant formula. C. R. Smith*, M. R. Guo, and R. S. Tyzbir, *University of Vermont, Burlington VT 05405.*

In infant formula, the solubility and availability of essential trace elements, especially iron (Fe) and zinc (Zn), may be affected by the forms of added mineral salts as well as the oxidation state of the mineral. Solubility and bioavailability of Fe may also be related to the oxidation state, being more soluble in a reduced state. To maintain a reduced environment in formula, we used high levels (200-300% RDA) of the naturally occurring antioxidant nutrients ascorbic acid (vitamin C) and vitamin E, both of which can be used at up to 10,000% of the RDA with little or no side effects. Ten 2.0 kg paired batches of milk-based, whey-protein dominated liquid infant formula (40:60 casein to whey protein ratio) were processed in our university laboratory, with either organic salts, i.e., gluconate, (OF) or inorganic salts, i.e., sulfate, (IF) of Fe and Zn; and 100% (control), 200%, or 300% the RDA of vitamin C or vitamin E. Mineral distribution was determined by measuring contents of the minerals in the fat, serum, and pellet fractions obtained on centrifuging the formula at 45,000 X g for 2 hours at 4°C. Mineral levels were evaluated by inductively coupled plasma atomic emission spectroscopy. There were no significant improvements on the solubility of iron and zinc in OF and IF by either ascorbic acid or vitamin E at all levels (200 & 300%). According to these results, the antioxidants used may have no effect on the solubility of trace minerals in infant formula. Further research is needed to elucidate and verify methods to increase trace mineral solubility and availability in infant formula.

Key Words: Infant formula, mineral solubility, antioxidant

1530 Carbonation of frozen soft-serve confections. L.V. Ogden*, L.K. Jefferies, and A. Ellsworth, ¹*Brigham Young University, Provo UT.*

A Taylor model 8756 soft-serve freezer was modified to pump carbon dioxide, instead of overrun air into the pressurized freezing chamber as the mix was freezing. Non-fat Yogurt soft-serve mix containing 12% MSNF was frozen while injecting carbon dioxide. The amount of carbon dioxide injected was adjusted the maximum that could be uniformly incorporated in the product. Soft frozen product at -7 °C had an overrun of 60 % and contained 1.3 volumes of dissolved carbon dioxide. The product had a distinct and pleasant carbonation flavor. Hard freezing the product resulted large carbon dioxide containing voids as gas was excluded from the freezing matrix.

Key Words: Frozen, Confection, Carbonation

1531 Effect of homogenization pressure on rheological properties and microstructures of heat-set whey protein emulsion gels. R. Suhareli*, G. Perez-Hernandez, and R. Richter, *Texas A&M University, College Station, TX.*

The objective of this experiment was to determine the effect of homogenization pressure on heat-set, whey protein emulsion gels. Whey protein

concentrates from acid and sweet whey were used. Gels contained 10 % protein and 20 % milkfat. Samples were heated to 65 C for homogenization at 20 and 90 MPa. The Dvs and viscosity of the emulsions were analyzed before the emulsions were heated at 90 C for 30 minutes. Stress-relaxation parameters were determined for the gels. Gels microstructure was observed by using ESEM.

The particle size distribution was affected by protein source and homogenization pressure. The Dvs of emulsions prepared with acid whey increased when the homogenization pressure was increased from 20 to 90 MPa. However, the Dvs of emulsions prepared with sweet whey decreased as the homogenization pressure was increased from 20 to 90 MPa. The consistency coefficient of the emulsion increased when the homogenization pressure was increased for emulsions from both sweet and acid whey. Emulsions prepared with acid whey had a higher consistency value compare to gels made with sweet whey.

The emulsions prepared with acid whey exhibited shear-thinning ($n < 1$). Emulsions prepared with sweet whey had Newtonian behavior after homogenization at 20 MPa but were susceptible to shear-thinning when the emulsions were homogenized at 90 MPa. Gels prepared from acid whey were stiffer after homogenization of the emulsions at 90 MPa than gels made from emulsions homogenized at 20 MPa. The micrographs showed that acid gels had a textured surface compare to sweet whey that had smoother surfaces.

Key Words: Homogenization, Whey Protein, Emulsion Gels

1532 Folic acid fortified fat free sugar free plain set yogurt. Kayanush Aryana*, *Louisiana State University.*

Folic acid is used in preventing birth defects of the spine and brain, hardening of arteries and colon cancer. Yogurt is not a good source of folic acid. Fortifying yogurt with folic acid may or may not alter its characteristics. Objective was to elucidate the effect of folic acid on the texture of yogurt. Texture was studied using a Brookfield DV II + viscometer fitted with a T-C spindle which operated at 30 rpm. Folic acid was added at either of the two stages, during mix preparation or after culture addition. Folic acid was also added at either of the two levels, a quarter or half the recommended daily allowance of 300 micrograms. Means were separated using the least significant difference test and the differences were determined at 5 percent level of significance. Addition of folic acid prior to heat treatment increased the viscosity significantly from 130.56 dyn.s/cm² in control to 140.73 dyn.s/cm². Doubling the concentration of folic acid significantly decreased the viscosity of yogurt from 128.39 dyn.s/cm² to 106.02 dyn.s/cm². Folic acid impacted the texture of yogurt.

Key Words: supplement, health

Forages and Pastures Silages, Small Grains, and Fertilization

1533 Effects of molasses-based preservative on fermentation and nutritive value of Albizia lebeck silage. T. Clavero* and R. Razz, *La Universidad del Zulia.*

A trial was carried out in Venezuela in order to evaluate fermentation characteristics and silage quality of Albizia lebeck with different levels of molasses. Chopped fresh plant materials of about 1 cm length were ensiled into a laboratory silo and stored at 25C. Treatments were applied according to a 3x3 factorial arrangements in a completely randomized design. Factors studied were three rates of legumes: molasses, 1:2, 1:4, 1:8 (w/v) and three storage times (1, 2 and 3 months). After opening the silos, pH, total nitrogen content (TN), rumen soluble nitrogen (SN), NFAD, nitrogen fixed to the cell wall of the total nitrogen (NFND/NT) and in vitro DM digestibility (IVDMD) were determined. Addition of molasses significantly ($P < 0.01$) decreased pH values but increased NT. The lowest pH values (5.1) and the highest TN values (2.44) were obtained with the relation 1:8. No significant differences ($P > 0.05$) in SN, NFAD, NFND/NT and IVDMD were found between levels of

molasses. The time of storage significantly affected ($P < 0.01$) the loss of TN, SN, NFAD and NFND/NT. IVDMD was reduced significantly by the ensiling process, from 71.76% after 1 month to 70.1 after 3 months of ensiling. This study concluded that Albizia lebeck fodder can be preserved successfully by ensiling with the addition of molasses.

Key Words: Albizia lebeck, Silage quality, Molasses

1534 Effects of molasses-formic acid silage preservatives on fermentation of Leucaena leucocephala silage. M. Betancourt*¹, T. Clavero², R. Razz², S. Pietrosemoli², and O. Araujo², ¹*INIA*, ²*La Universidad del Zulia.*

A trial conducted at tropical very dry forest located in the western part of Venezuela in order to evaluate the effect of molasses, formic acid and fermentation time on the pH and temperature of microsilos of Leucaena leucocephala. A factorial arrangement (3x3x8) with two replications was used, three levels molasses (0, 2.5 and 5%, three levels of formic acid (0,

0.25 and 0.5%) and eight fermentation time (10, 21, 27, 34, 41, 48, 55 and 62 days). There were significant differences ($P < 0.05$) for the interaction molasses x fermentation time, acid x fermentation time and acid x molasses on pH and temperature. The lowest values of pH (4.3, 4.4 and 4.36) were observed with 5% of molasses and 27 days; 0.5% formic acid x 27 days and 2.5% molasses x 0.25% formic acid, respectively. The lowest values of temperature (26.27, 26.22 and 28C) were obtained with 0% molasses x 21 days; 0.5% acid x 21 days and 2.5% molasses x 0.5% formic acid. Addition of molasses and formic acid were positive in all treatments. The temperature values showed in the microsilos were in an optimum range (20-30C). In all the treatments, pH values were consistent between 27 and 41 days. According to the results, it is concluded that *L. leucocephala* could be used in silage procedures with the use of conservants.

Key Words: *Leucaena leucocephala*, Silage

1535 The effects of height of cutting, hybrid, and stage of maturity at harvest on the nutritive value of corn silage for lactating dairy cows. J. M. Neylon^{*1}, T. L. Ebling¹, C. C. Taylor¹, M. P. Lynch¹, M. A. Reddish¹, M. I. Endres², and L. Kung, Jr.¹, ¹University of Delaware, Newark, Delaware, ²Mycogen Seeds, Egan, MN.

We studied the effect of increasing the cutting height of whole-plant corn at the time of harvest from 12.7 (NC) to 45.7 (HC) cm on yield and nutritive value of silage for dairy cows. Three leafy corn silage hybrids (TMF 100, 108, and 2404, Mycogen Seeds) were harvested at NC and HC at 1/2 millkline (E) and black layer (L) and ensiled in laboratory silos. Increasing the height of cutting lowered yields of harvested DM/ha by approximately 10%. The concentration of DM was higher (38.6 vs. 36.6%) and starch (34.4 vs. 32.4%) were higher ($P < 0.05$) but the concentrations of CP (8.29 vs. 8.43%), and ADF (23.4 vs. 25.3%) were lower ($P < 0.05$) in HC than in NC. The concentrations of NDF and lactic acid tended to be lower ($P < 0.10$) in the HC (41.3 and 4.23%) than the NC (42.9 and 4.41%), respectively. The concentration of acid detergent lignin was also lower ($P < 0.05$) in HC (2.42 vs. 3.27%), but only in corn harvested at E. In vitro digestion (30 h) of NDF was greater ($P < 0.05$) in HC (50.7%) than NC (48.3%). Calculated yield of milk per tonne of forage DM was greater for HC than for NC at E but not at L. Increasing the height of cutting of another leafy corn silage hybrid, TMF 29400, in general also resulted in similar changes in nutrient composition as just described. When fed to lactating dairy cows, HC corn silage resulted in tendencies ($P < 0.12$) for greater NDF digestion in the total tract (34.3 vs. 31.8%), higher milk production (+1.5 kg/d) and improved feed efficiency. Results from this study suggest that increasing the cutting height of whole plant corn at harvest can improve nutritive value of corn silage for lactating dairy cows.

Key Words: Cut Height, Corn Silage

1536 Comparison of physical and chemical characteristics of mechanically processed brown midrib, unprocessed brown midrib, or processed normal corn silage. T. L. Ebling^{*}, J. M. Neylon, D. H. Kleinschmit, J. M. Ladd, C. C. Taylor, and L. Kung, Jr., University of Delaware, Newark, DE.

We compared the physical and chemical compositions of processed brown midrib (PBMR), unprocessed brown midrib (UBMR) (Cargill 867, 118 d), and processed normal (P7511) (Cargill 7511FQ, 115 d) corn silage. All forages had a theoretical length cut of 19 mm and processed forage went through rollers with a clearance of 3 mm. Fresh forage was harvested at 1/2 millkline and ensiled in bag silos for 7 mo. Silage composites were collected three times per wk during a 5-wk period in a lactation trial (companion abstract). During the collection period, P7511 silage had a lower concentration of CP (6.19 vs. 8.21, 8.37%) compared to PBMR and UBMR. The concentration of NDF (41.5%) and ADF (24.2%) were similar for all silages. However, lignin was higher for P7511 (2.24 vs. 1.03, 0.87%) than PBMR and UBMR. Thirty hour in vitro NDF digestion was higher for the UBMR and PBMR than P7511 silage (54.0, 51.0 vs. 39.9%). The UBMR had more particles >1.91 cm than PBMR and P7511 (13.7 vs. 8.1, 3.28%) and more whole kernels (39.4 vs. 6.8, 8.6). Dry matter disappearance after 3 h of a macro in situ incubation was greater for the PBMR and P7511 silage than the UBMR (45.6, 46.0 vs. 40.8%). After 12 h, PBMR and P7511 had a greater DM disappearance than UBMR (52.8, 52.7 vs. 47.5%). By 30 h, DM disappearance was similar for all silages (65.2%). These data

showed that mechanical processing decreased particle size and whole kernels and increased DM digestion in normal and brown midrib corn silages.

Key Words: Processed, Brown midrib, Silage

1537 Effect of feeding mechanically processed brown midrib (PBMR), unprocessed brown midrib (UBMR), or processed normal corn silage (P7511) in diets for dairy cows on DM intake, milk production and digestion. T. L. Ebling^{*}, J. M. Neylon, D. H. Kleinschmit, J. M. Ladd, C. C. Taylor, and L. Kung, Jr., University of Delaware, Newark, DE.

Thirty Holstein cows producing 46 kg of milk/d (143 ± 32 DIM) were blocked and assigned randomly to one of three treatments to investigate the effects of feeding PBMR, UBMR, or P7511 corn silage on DM intake, milk production, and digestion. All forage had a theoretical length cut of 19 mm and processed forage passed through a roller width of 3 mm. Fresh forage was harvested at 1/2 millkline and ensiled in bag silos for 7 mo. Diets were fed as TMR and consisted of 42% PBMR, UBMR, or P7511 corn silage, 10% alfalfa silage, 8% chopped alfalfa hay, and 40% (DMB) concentrate. The first wk of the 6-wk study was a preliminary period where cows were offered a combination of the corn silages. Data collected during this period were used as covariate in statistical analysis of production data collected during wk 2 to 6. Cows fed a TMR with P7511 produced more ($P < 0.05$) milk protein content (%) than cows fed PBMR and UBMR. However, cows fed PBMR had a higher ($P < 0.05$) milk fat yield (1.48 vs. 1.31, 1.25 kg/d) and produced more 3.5 % fat corrected milk (43.3 vs. 40.3, 39.3 kg/d) than P7511 and UBMR. Dry matter intake (24.0 kg/d) and milk yield (44.2 kg/d) were similar among treatments. Cows fed the processed corn silages had greater ($P < 0.05$) total tract digestibility of OM (65.1 vs. 56.5%), CP (65.0 vs. 58.2%), and starch (98.9 vs. 88.5%) compared to UBMR. Total tract digestibility of ADF and NDF was greater ($P < 0.05$) for PBMR (39.6%, 42.1%) than P7511 and UBMR (32.8, 32.1%; 34.1, 30.0%). Cows fed the TMR containing unprocessed corn silages had more particles >1.91 cm remaining in the bunk after a 24-h period than cows fed processed corn silage. These data show that processing results in corn silage with fewer large particles and whole kernels, improves total tract digestibility, and reduces sorting when fed to dairy cows. Mechanical processing can improve the nutritive composition of brown midrib corn silage.

Key Words: Processed, Brown midrib, Silage

1538 The effect of adding *Lactobacillus buchneri* 40788 (LB), enzymes (ENZ), or ENZ and LB on the fermentation and aerobic stability of high moisture corn in lab silos. T. L. Ebling^{*}, J. M. Neylon, C. C. Taylor, M. A. Reddish, M. P. Lynch, and L. Kung, Jr., University of Delaware, Newark, DE.

We investigated the effects of adding a heterofermentative lactobacilli, *L. buchneri* 40788, alone or in combination with enzymes on the fermentation and aerobic stability of high moisture corn (HMC). High moisture corn (29% moisture) was ensiled in laboratory silos (27 × 36 cm) at a wet packing density of approximately 806 kg/m³. Treatments were applied by liquid application. Treatments were: 1) no additive (C), 2) ENZ (β -glucanase [5250 IU/g], α -amylase [2625 IU/g], xylanase [2850 IU/g], galactomannase [480 IU/g]), 3) LB to achieve 1×10^6 cfu/g, and 4) LB + ENZ (Biotal, Inc., Eden Prairie, MN). After 90 d of ensiling, HMC treated with LB (treatments 3 and 4) had the greatest ($P < 0.05$) concentrations of acetic acid (0.70 vs. 0.28%, DM basis), but highest ($P < 0.05$) pH (4.24 vs. 4.02) when compared to other treatments. The concentration of lactic acid was also numerically lowest in HMC treated with LB (0.56 vs. 0.77%, DM basis). Aerobic stability (number of h prior to a 2°C rise in temperature after exposure to air) was markedly ($P < 0.05$) improved with the addition of LB (> 210 h) in comparison to other treatments (< 50 h). Treatment with LB alone or in combination with ENZ had no effects on the concentrations of ADF, NDF, or CP. Addition of ENZ alone had no effect on the fermentation or aerobic stability of HMC. *Lactobacillus buchneri* 40788 is an effective biological control agent that anaerobically converts lactic acid to acetic acid and improves the aerobic stability of HMC, but combining it with enzymes did not enhance its effectiveness.

Key Words: *Lactobacillus buchneri*, Aerobic stability, High moisture corn

1539 Effect of fresh and ensiled alfalfa and red clover on the microbial protein synthesis in the rumen of sheep. J.M.J. Gosselink* and C. Poncet, *Institut National de la Recherche Agronomique, Theix, France.*

Six wethers of approximately 55 kg BW were fitted with ruminal and duodenal cannulas to study the effect of alfalfa and red clover (fresh vs ensiled) on the microbial protein (MP) synthesis in the rumen. In four periods the animals received in sequence fresh alfalfa (AF), alfalfa silage (AS), fresh red clover (RCF) or red clover silage (RCS) at sub ad libitum level. The forages were cut at the button stage and either fed directly or ensiled with formic acid (80 %). Three markers, Cr-EDTA (Cr), R-phenanthroline (Ru) and ¹⁵N, were continuously infused intraruminally to measure the digesta flow (Cr and Ru) and MP (¹⁵N) in the duodenum. After the infusing was stopped the passage rates (Kp) of Cr and Ru in the rumen were measured. OM apparently digested in the rumen (OMADR) differed between the forage species and between fresh and ensiled. The efficiency of MP synthesis (MP/OMADR) was the highest for AF. However the yield of MP per kg of DMI was similar between AF and RCF and was similar between AS and RCS. Kp of Cr and Ru were higher when feeding AF and lower when feeding RCS compared with other forages. The results imply that in comparison with RCF and RCS, the MP synthesis in the rumen with AF and AS was more affected by their passage rates and less affected by their ruminal OM digestion.

	AF	AS	RCF	RCS
NDF, % of DM	49.8	43.8	41.2	51.0
CP, % of DM	19.8	16.6	16.8	16.6
OMADR, % of OM intake	32.9 ^a	41.0 ^b	51.8 ^c	45.8 ^d
MP, g/kg of OMADR	432 ^a	265 ^b	266 ^b	228 ^b
MP, g/kg of DMI	124 ^a	98 ^b	123 ^a	94 ^b
Kp of Ru, %/h	8.6 ^a	6.8 ^b	6.3 ^b	4.6 ^c
Kp of Cr, %/h	12.0 ^a	9.6 ^b	8.8 ^b	7.2 ^c

^{a,b,c,d} Means with different superscripts within the same row are significantly different ($P < 0.05$).

Key Words: Microbial Protein, Alfalfa, Red Clover

1540 Influence of glyphosate tolerant (trait NK603) corn silage and grain on feed consumption and milk production in Holstein dairy cattle. R.J. Grant¹, D. Kleinschmit¹, A.L. Sparks*¹, E.P. Stanisiewski², and G.F. Hartnell², ¹University of Nebraska, Lincoln, ²Monsanto Company, St. Louis, MO.

The objective of this experiment was to evaluate the effect of a glyphosate tolerant (trait NK603) corn hybrid on feed intake and milk production of dairy cows compared with the non-transgenic hybrid and two reference hybrids. Sixteen multiparous Holstein dairy cows (95 DIM) were assigned to one of four treatments in a replicated 4 x 4 Latin square with 28-d periods (14 d adaptation and 14 d collection). The diets contained 40% (DM basis) of either glyphosate tolerant corn silage (Roundup Ready[®], RR), control corn silage (CON), or two non-transgenic reference hybrids which are commercially available (REF1 and REF2). Each diet also contained 23% corn grain (DM basis) from the same hybrid that supplied the silage. Hybrids were harvested for silage at the same physiological maturity, and chemical composition was similar among the four hybrids, except for DM. The RR silage was harvested last, and rapid drying conditions resulted in the RR silage being drier (average 42.5% DM) and undergoing a less extensive fermentation than the CON, REF1, and REF2 silages (average 35.5% DM). Consequently, DMI and milk production were reduced ($P < 0.05$) by 14 and 12%, respectively, for cows fed the RR diet compared with the other diets. However, there was no effect of the RR diet on efficiency of 4% FCM production (FCM/DMI) which averaged 1.43 kg/kg for all diets. The content of fat (3.91%), true protein (3.07%), lactose (4.66%), SNF (8.61%), SCC (114.8/ml), and milk urea nitrogen (20.8 mg/dl) was not influenced by diet. Under the conditions of this experiment, the RR diet resulted in similar milk composition and efficiency of FCM production compared with the non-transgenic control and two commercial corn hybrids.

Key Words: Glyphosate tolerant, Corn silage, Dairy cows

1541 Effect of feeding brown midrib-3 corn silage or conventional corn silage cut at either 23 or 71 cm on milk yield and milk composition. D.D. Dominguez*², V.R. Moreira², and L.D. Satter^{1,2}, ¹U.S. Dairy Forage Research Center, USDA-ARS,, ²Dairy Science Department, University of Wisconsin, Madison.

The objective was to measure milk yield when brown midrib-3 corn silage (bm3) cut at 23 cm or conventional corn silage cut at either 23 or 71 cm was fed to lactating dairy cows. Thirty lactating Holstein cows averaging 113 DIM (± 27) and 37.3 kg milk daily (± 4.7) were randomly assigned to one of six trts in a 6x6 Latin Square design. Trts were two levels of dietary NDF (low-27.6 to 29.2% and high-32 to 33.5%), and three corn silage sources: bm3 (bag silo), normal cut (23 cm, NC) and high cut (71 cm, HC), both ensiled in tower silos. The bm3 corn silage was Cargill 657, and NC and HC were Dekalb 520 RR. The corn silage sources were chopped at 0.95 cm theoretical length of cut. Diets with low NDF had 60.5, 63.5 and 62% of forage for NC, HC and bm3 and diets with high NDF had 77, 80.5 and 75.5%. Corn silage supplied 67% of forage DM. The length of each of four experimental periods was three wk. Statistical analysis was done as an unbalanced and incomplete 6x4 Latin square in SAS. HC corn silage had higher DM content than NC corn silage (40.9 vs 38.4%), while NDF content was decreased (33.9 and 38.6%). DMI was increased for bm3 trts (2.9 kg/d). Milk yield tended to be higher for bm3 (1.1 kg/d) and was higher for the low NDF trts. HC and NC trts supported the same milk yield. Fat percentage was decreased by low NDF trts. Feed efficiency was higher for the low NDF trts, and was reduced with the bm3 trts.

	Low NDF%			High NDF%			P value	Bm3 vs HC	Bm3 vs NC	HC vs NC
	28.8 NC	27.6 HC	29.2 Bm3	33.5 NC	32.0 HC	33.0 Bm3				
DMI (kg/d)	19.8 ^a	20.3 ^a	22.6 ^b	19.7 ^a	20.2 ^a	23.2 ^b	.64	$\leq .001$	$\leq .001$	.26
Milk Yield (kg/d)	34.1 ^a	34.4 ^a	35.0 ^a	30.9 ^b	31.5 ^b	32.6 ^b	$\leq .001$	.26	.09	.61
3.5% FMC	34.6 ^a	34.8 ^a	35.3 ^a	32.4 ^b	32.5 ^b	33.7 ^a	.003	.32	.22	.83
Fat (%)	3.61 ^a	3.60 ^a	3.57 ^a	3.81 ^b	3.69 ^b	3.73 ^b	.04	.96	.55	.52
Fat (kg)	1.22 ^a	1.23 ^a	1.24 ^a	1.17 ^a	1.15 ^b	1.21 ^a	.07	.36	.41	.91
Protein (%)	3.05 ^a	3.07 ^a	3.06 ^a	3.01 ^a	3.00 ^a	3.00 ^a	.04	.79	.97	.76
Protein (kg)	1.02 ^a	1.06 ^a	1.07 ^a	0.93 ^b	0.94 ^b	0.97 ^b	$\leq .001$	.46	.06	.25
SNF (%)	8.67 ^a	8.83 ^a	8.79 ^a	8.73 ^a	8.77 ^a	8.70 ^a	.56	.53	.71	.31
SNF (kg)	2.93 ^a	2.96 ^a	3.10 ^a	2.65 ^b	2.63 ^b	2.86 ^c	$\leq .001$	.04	.03	.96

Means in rows with different superscripts are different ($P \leq .05$)

Key Words: Corn silage, Brown midrib-3, Milk production

1542 Characteristics of silage prepared from alfalfa, sainfoin, and alfalfa:sainfoin mixtures. Y. Wang*, L.R. Barbieri, and T.A. McAllister, *Agriculture and Agri-Food Canada, Lethbridge, AB.*

To investigate the effects of including a forage containing condensed tannins on ensiling characteristics of alfalfa, whole first cut alfalfa (A) and sainfoin (S) were ensiled in ratios (% fresh weight) of 100:0, 75:25, 50:50, 25:75 and 0:100. The forages were swathed in mid-bloom, wilted for 2-4 h, chopped to a theoretical length of 1.0 cm, mixed manually (blends denoted A, A75, A50, A25 and S) and packed into 3-L laboratory-scale silos. Silage pH and concentrations of reducing sugars (RS), ammonia, soluble N, NPN and VFA, and microbial enumerations (d 20 only) were determined in triplicate silos opened after 1, 7, 20 and 72 d of storage at 22°C. The pH of all ensiled forages decreased rapidly in the first 7 d; all were below 4.5 at d 72. Over the 72 d, pH was consistently higher ($P < 0.001$) in A than in S, and the mixed silage pH values were intermediate to A and S, in the order A75 > A50 > A25. Concentrations of acetic acid and total VFA were consistently higher ($P < 0.05$) in A than in S, and a quadratic effect ($P < 0.05$) of sainfoin in the mixture was observed at d 72. At d 20, populations of lactobacilli were lower ($P < 0.05$) in silage S than in A or the blends, but there was no difference ($P > 0.05$) among A-S mixed silages. Total bacterial populations decreased linearly ($P < 0.05$) as the proportion of sainfoin increased; the differences attained significance with sainfoin at 75% ($P < 0.05$) and 100% ($P < 0.01$). Soluble N, NPN and ammonia N (as % of total N) also decreased

linearly ($P < 0.01$) as sainfoin increased, but the proportion of insoluble digestible N increased ($P < 0.01$) with sainfoin content during 72 d of ensiling. In all silages, N transformations occurred primarily during the first 7 d of ensiling. Over the first 20 d, rates of N transformation were lower ($P < 0.05$) in A25, A50, A75 and S than in A. Including sainfoin with alfalfa increased forage fermentability and reduced proteolysis during ensiling, and may be a practical means to preserve alfalfa protein during ensiling.

Key Words: Sainfoin, Alfalfa, N Transformation

1543 The effect of Tween 80 on kinetics of *in vitro* ruminal fermentation of silages. J. Baah^{*1}, J.A. Shelford², Y. Wang¹, T.A. McAllister¹, and K.-J. Cheng³, ¹*Agriculture and Agri-Food Canada, Lethbridge, AB*, ²*University of British Columbia, Vancouver*, ³*Academia Sinica, Taipei, Taiwan*.

Tween 80 (T80) has been shown to improve enzyme production and digestion of pure cellulose by mixed ruminal bacteria. This study was undertaken to examine the effects of T80 on *in vitro* fermentation of three cellulosic substrates: silages prepared from alfalfa (AS), corn (CS) and orchardgrass (OS). Each substrate (150 mg) was incubated for 24 h at 39°C with 15 mL of buffered ruminal fluid and 0 or 0.2% (w/w) T80. Three incubations, each in triplicate, were conducted. Gas production (GP) was measured at 10-min intervals via pressure transducers implanted in the flasks, and VFA profiles at 24 h were determined by gas chromatography. Effects of T80 on *in vitro* fermentations were substrate specific. With AS, T80 decreased ($P < 0.05$) the lag in GP (from 0.48 to 0.16 h) and specific rate of GP (to 0.058/h from 0.067/h), and increased ($P < 0.05$) the extent of GP (19.5 vs 18.1 mL/100 mg DM). With CS, T80 increased ($P < 0.05$) the lag and the specific rate of GP (from 0.77 h and 0.046/h to 0.88 h and 0.049/h, respectively), and decreased ($P < 0.05$) the extent of GP (25.9 vs 26.6 mL/100 mg). With OS, lag in GP was decreased by T80 (0.41 h vs 0.65 h; $P < 0.05$), specific rate of GP was increased (0.073 vs 0.070/h; $P < 0.05$), and extent of GP was decreased (13.8 vs 14.6 mL/100 mg; $P < 0.05$). Concentrations of total VFA at 24 h were increased ($P < 0.05$) by T80 in incubations of CS (by 17%) and OS (by 22%), but were reduced in AS incubations (by 10%, $P < 0.05$). Tween 80 reduced ($P < 0.05$) molar proportions of acetate and increased (by 150%; $P < 0.05$) isobutyrate and isovalerate in AS incubations; with OS, accumulation of these branched-chain FA was decreased ($P < 0.05$). These data suggest that T80 may be exerting its effects on specific microbial populations or enzymes; the overall substrate-specific effects on *in vitro* fermentation kinetics and products may be reflecting diet-specific rumen microbial species profiles.

Key Words: Tween 80, Silage, Ruminal Fermentation

1544 Performance of dairy cattle fed high moisture shelled corn inoculated with *Lactobacillus buchneri*. C. Kendall, D. K. Combs^{*}, and P. C. Hoffman, *University of Wisconsin, Madison*.

The objective of this study was to determine if intake and milk production of dairy cows is affected by inoculation of high moisture shelled corn (HMSC) with *Lactobacillus buchneri* (LB). Twenty lactating cows were fed total mixed rations (TMR) containing one of four sources of HMSC : 1) untreated HMSC removed from a silo immediately before feeding, (FC); 2) LB inoculated HMSC (5×10^5 CFU/g fresh corn) removed from a silo immediately before feeding, (FLBC); 3) untreated HMSC that was stored in a feed cart at ambient temperature for 48 h before feeding (TC); 4) LB inoculated HMSC that was stored in a feed cart at ambient temperature for 48 h before feeding (TLBC). Cows were randomly assigned to one of five 4 x 4 Latin squares. All cows were fed diets that contained 29% of DM as HMSC from one of the four treatments. Lactate levels in FC, FLBC were similar. Lactate levels of untreated HMSC declined when exposed to air but did not change in LB-inoculated HMSC. Acetate concentrations in FC and TC were lower than in FLBC and TLBC. Intake of TMR DM was not affected by either LB or exposure to air. Milk yield did not differ due to LB inoculation but was depressed when either corn was removed from the silo and stored for 48h. Although inoculation of HMSC with LB improved its aerobic stability, milk production was depressed when cows were fed TMR's containing either source of HMSC that had been exposed to air for 48h prior to feeding.

	FC	FLBC	TC	TLBC	SE	C vs LB ^a	F vs T ^b
Composition of HMSC							
pH	4.8	4.6	6.4	4.7	0.2	NS	P<0.01
Lactate, % DM	0.46	0.37	0.14	0.34	0.08	NS	P<0.05
Acetate, % DM	0.05	0.42	<0.01	0.11	0.06	P<0.01	P<0.05
Animal performance							
DMI, kg/d	19.6	19.8	19.3	19.7	0.31	NS	NS
Milk yield, kg/d	31.7	32.2	30.9	30.8	0.9	NS	P<0.05

^a Untreated corn vs LB-inoculated corn. ^b Corn as it was removed from the silo vs corn that was fed 48 h after it was removed from the silo.

Key Words: High moisture corn, *Lactobacillus buchneri*, Dairy

1545 Evaluation of small grain cultivars for forage in north Alabama. M. Lema^{*}, E. Cebert, and V. Sapra, *Alabama A & M University*.

Small grains can play an important role as emergency feed source for livestock in the fall and winter in North Alabama. Data regarding the comparative forage yield and quality of triticale (*X Triticosecale Wittmack*), wheat (*Triticum aestivum L.*) and rye (*Secale cereale L.*) cultivars for forage in North Alabama is scarce. Six triticale cultivars (TCL-105, TCL-111, TX-98D955, TX-96VT5019, Tritical 498 and Tritical 2700), two cultivars of each of wheat (Madison and Roberts) and rye (Maton and Oklon) were planted in four replicated 6-row plots 6.1 m long with rows 1.22 m apart in a randomized complete block design. Forage was harvested and dry matter (DM), crude protein (CP), extract (EE), gross energy (GE), acid-detergent fiber (ADF), neutral-detergent fiber (NDF), in-vitro dry matter digestibility (IVDMD), P, K, Ca, Mg, S, Na, Fe, Mn, Zn and Cu were determined. Dry matter and digestible DM (DDM) production of the rye cultivars Maton (4,112.2 and 3,915.74) and Oklon (3,321.22 and 3,134.56 kg/ha, respectively) were higher ($P < 0.05$) than that of the other wheat and triticale cultivars. TCL105 and TCL111 produced the lowest ($P < 0.05$) DM (1,541.61 and 1,526.57) and DDM (1,261.01 and 1,205.17 kg/ha, respectively). TCL105 had the lowest ($P < 0.05$) CP (17.45 %) and TCL111 the highest ($P < 0.05$) ADF (39.16 %) content than the other small grain cultivars. Maton (81.1%), Oklon (80.0%), TCL2700 (80.39 %), TCL498 (79.01 %), TX96VT5019 (81.07 %) and TX98D955 (81.24 %) had similar but higher ($P < 0.05$) IVDMD than TCL105 (76.19 %), TCL111 (76.52 %), Jackson (78.45 %) and Roberts (78.67 %). Similarly, significant differences were observed in P, Ca, Mg, K, S, Zn, Cu, and Fe contents among cultivars. Among small grain species, rye was higher ($P < 0.05$) in DM (4,007.84 kg/ha) and DDM (3,222.19 kg/ha) than triticale (2,268.99 and 1,846.69) and wheat (2,174.76 and 1,703.14 kg/ha, respectively). Significant differences ($P < 0.05$) were also observed among rye, triticale and wheat in P, Mg, K, S, Fe, and Cu contents.

Key words: Small grain forage, forage quality.

Key Words: Small grain forage, Forage yield, Forage quality

1546 Assessment of ruminal N disappearance kinetics for wheat forage as affected by harvest technique and sampling date. W. K. Coblenz^{*}, K. P. Coffey, J. E. Turner, D. A. Scarbrough, J. B. Humphry, J. V. Skinner, and D. W. Kellogg, *University of Arkansas*.

A trial was initiated in September of 1999 to assess the effects of harvest techniques and sampling dates on ruminal N disappearance kinetics and forage quality of wheat forage. #Delta King 9027' soft-red winter wheat was established at the Forage Research Area in Fayetteville. Wheat forage was grazed lightly throughout the fall to control growth. Forages were harvested on three dates in the spring, which corresponded to vegetative, mid-elongation, and boot stages of growth (6 March, 27 March, and 11 April, respectively). Sampling techniques evaluated on each date included three clipping techniques (whole plant, random pluck, and top half) and two evaluations of masticates (oven or freeze dried). Concentrations of total N, neutral detergent insoluble N (NDIN), and acid detergent insoluble N (ADIN) were affected by sampling technique, harvest date, and the associated interaction of these main effects ($P < 0.017$). Oven-dried masticate had greater ($P < 0.05$) concentrations of NDIN

than did freeze-dried masticate on all harvest dates. For ADIN, a similar relationship ($P < 0.05$) was observed for the 27 March and 11 April harvest dates, but not for 6 March ($P > 0.05$). When these wheat forages were evaluated by the situ technique in five confined steers (393 ± 54 kg), sampling technique, harvest date, and their associated interaction all affected ($P < 0.001$) disappearance rate, potential extent, and effective ruminal degradability of N. For each harvest date, disappearance rate was greater (by 56 to 104%; $P < 0.05$) for freeze-dried masticate than for oven-dried masticate. Similar ($P > 0.05$) estimates of disappearance rate and effective degradability were observed for freeze-dried masticate and the top-half clipping treatment on the first two harvest dates, but not ($P < 0.05$) on the final harvest date. The other clipping treatments were not effective in mimicking the diet selected by steers. Oven-drying masticate samples greatly affected characteristics of ruminal N disappearance relative to those that were freeze dried.

Key Words: wheat forage, N disappearance kinetics, forage quality

1547 Effects of sampling date and nitrogen fertilization on forage yield, quality and tetany hazard of soft red winter wheat. C. R. Bailey*, W. K. Coblenz, L. B. Daniels, E. B. Kegley, T. J. Wistuba, and L. J. McBeth, *Department of Animal Science, University of Arkansas, Fayetteville.*

A study was conducted from December 1999 through March 2000 using a completely randomized design to evaluate forage yield, quality, and tetany hazard in soft red winter wheat (*Triticum aestivum* L.) forage as influenced by nitrogen (N) fertilization rate and sampling date. Paddocks were randomly assigned to a control (0 kg N ha^{-1}), or one of two rates of ammonium nitrate fertilization (34-0-0) to supply 38 kg N ha^{-1} (Low), or 76 kg N ha^{-1} (High). Forage yield and IVOMD as well as DM, OM, ADF, NDF, CP, Mg, K, and Ca concentrations were evaluated. Forage yield was determined by clipping three 0.25-m^2 quadrats per $30.5 \times 3.1\text{-m}$ paddock. Nitrogen fertilization had no effect on forage yield, OM, ADF, NDF, IVOMD, Ca, or Mg. Forage dry matter ($P < 0.01$) concentrations decreased while CP ($P < 0.01$) and K ($P < 0.01$) increased linearly with increasing levels of N fertilization. Organic matter increased ($P < 0.05$) linearly with sampling date. Dry matter yield, NDF, and ADF increased ($P < 0.01$), while CP decreased ($P < 0.01$) quadratically with sampling date. Magnesium ($P < 0.05$), K ($P < 0.01$), Ca ($P < 0.01$), and IVOMD ($P < 0.01$) decreased in a cubic manner in respect to sampling date. Dry matter concentration reacted quadratically ($P < 0.01$) to sampling date peaking in February and declining through the end of March. Results indicate caution should be taken when grazing lactating cows on soft red winter wheat forage in the early spring as Mg and Ca concentrations fall below required levels and DM decreases. Nitrogen fertilization of soft red winter wheat increases tetany hazard as it increases CP and K and causes a decrease in DM concentrations. Although forage quality decreased in respect to calendar date, nutritive value of soft red winter wheat forage remains acceptable through the end of March if supplementary minerals are provided.

Key Words: Forage Quality, Nitrogen Fertilization, Sampling Date

1548 Effect of soil type and fertilization level on mineral concentration of pasture: relationship to ruminant performance and health. K.J. Soder*, W.L. Stout, W.J. Gburek, and G.J. Folmar, *USDA-ARS, Pasture Systems and Watershed Management Research Unit, University Park, PA.*

A study was conducted to measure the effects of varying levels of dairy slurry application on mineral content of forages from three soils types. Slurry was applied to orchardgrass (*Dactylis glomerata* L., cv. Pennlate) using 60 cm diameter drainage lysimeters to measure the direct impact of four levels of slurry (urine and feces) N application (0, 168, 336, 672 kg N/ha/yr) on mineral content of the forage on three soil types (Hagerstown, Hartleton, and Rayne soil types). The results were then related to potential impacts on performance and health of grazing dairy cows. Forage P was not affected by slurry application (mean = 0.46% DM). Forage grown on the Hartleton soil had the highest P content (0.6% DM). Forage K increased with increased slurry (2.50, 2.85, 3.22, and 3.45% DM, respectively), and was lowest for forage grown on the Rayne soil (2.69% DM). Forage Ca decreased with increased slurry (0.59, 0.56, 0.50, and 0.49% DM, respectively) and was not affected by soil type. Forage Mg also decreased with increased slurry (0.25, 0.24, 0.24, and 0.23% DM, respectively), and was highest for the Hartleton soil (0.27% DM). The variable results in mineral content associated with

soil type may have, in part, been due to prior soil fertility. The P and Mg levels in all treatments were generally adequate for grazing dairy cows. The K levels were high in relation to NRC recommendations for prepartum dairy cows, which may predispose them to milk fever. The Ca levels were inadequate for lactating dairy cows. Comprehensive forage testing and ration balancing based on individual farm situations is the best strategy to ensure proper mineral nutrition of grazing animals.

Key Words: animal health, pasture, slurry fertilization

1549 Forage macro- and trace mineral concentrations from pastures fertilized with broiler litter. K. P. Coffey*¹, J. B. Humphry¹, T. J. Sauer², H. L. Goodwin¹, P. A. Moore, Jr.³, Z. B. Johnson¹, E. B. Kegley¹, L. J. McBeth¹, B. C. McGinley¹, and W. K. Coblenz¹, ¹University of Arkansas, Fayetteville, AR, ²USDA National Soil Tilth Lab, Ames, IA, ³USDA-ARS, Fayetteville, AR.

Repetitive application of broiler litter to pastures leads to accumulation of various nutrients in the soil that can be potentially taken up by forages. Four farms in NW Arkansas and NE Oklahoma that routinely applied broiler litter were monitored for nutrient cycling from April 2000 to February 2001 under a project supported by USDA/NRICGP Agricultural Systems Program grant number 99-35314-8655. The four farms had a forage base of bermudagrass and cool-season perennials or annuals, and initial soil test P (STP; Mehlich 3 extract) levels of 230, 282, 526, or 636 kg/ha. Random forage samples were gathered monthly during normal grazing periods and analyzed for macro- and trace elements, but were not gathered when pastures were being stockpiled for hay. Mineral concentrations within farm were averaged across sampling dates and compared with requirements for gestating and early lactating beef cattle using a t-test. The equivalent ratio of K to Ca plus Mg was calculated to indicate the potential for grass tetany. Mean forage Ca, P, S, Co, and Fe from each farm exceeded ($P < 0.05$) lactating cow requirements. Forage Mg from the farm with the highest STP exceeded ($P < 0.05$) Mg requirements for lactating cows, but the other three farms exceeded ($P < 0.05$) only Mg requirements for gestating cows. Only the two farms with the lowest STP levels had average grass tetany ratios below ($P < 0.05$) 2.2, but every farm had grass tetany ratios above 2.2 when sampled in the spring. The farm with the lowest STP had inadequate ($P < 0.05$) forage Cu, but forage Se and Zn did not differ ($P < 0.05$) from NRC requirements. The farms with the two highest STP levels exceeded ($P < 0.05$) Se requirements and farms with the three highest STP levels exceeded Zn requirements. Therefore, producers grazing broiler litter amended sites should be able to reduce Ca and P supplementation, but should provide adequate supplemental Mg in the spring.

Key Words: Manure Management, Phosphorus, Forage

1550 Chemical characterization and ruminal nutrient degradabilities of spineless cacti. A. Batista¹, A. Mustafa², and I. Adeleye*², ¹Bolsista da coordenacao de Aperfeicoamento de Pessoal de Nivel Superior, Brasilia, DF-Brazil, ²McGill University.

This study determined the chemical composition and in situ ruminal nutrient degradabilities of three cactus varieties grown in northeastern Brazil. These were Gigante, IPA-20 and Mida. Results of the chemical analysis showed no significant differences in ash (average 16.8%), ether extract (average 2.0%), CP (average 6.3%) and NDF (average 27.8%) between the three cactus varieties. However, ADF was highest for IPA-20 (19.4%), intermediate for Gigante, (17.6%) and lowest for Mida (16.5%). Fractionation of carbohydrate and true protein based on rates of ruminal degradation indicated that the main carbohydrate component was the rapidly degradable fraction while the main true protein component was the intermediately degradable fraction. No differences in these carbohydrate or protein fractions were observed between the cactus varieties. Results of the in situ experiment showed small differences in ruminal nutrient kinetic parameters between the three cactus varieties. The average effective ruminal degradability of DM, CP and NDF was 59.2, 59.9, and 39.5%, respectively. Our data indicate little or no differences in chemical composition or ruminal nutrient degradabilities between the three cactus varieties used in this study.

Key Words: Spineless cacti, Chemical characterization, Ruminal degradability

1551 Predicting the production of milk from forage on Quebec dairy farms using their ration characteristics. N. St-Pierre*¹, G. Allard¹, D. Lefebvre², A. Bregard¹, and D. Pellerin¹, ¹Université Laval, QC, Canada, ²PATLQ inc, Montréal, QC, Canada.

Chemical and physical characteristics of dairy cow rations affect their production of milk from forage (MF). Our objective was to determine which chemical and physical characteristics could be used to predict MF on farms. Across Quebec, Canada, 90 farms were studied: 22 used corn silage and 68 did not. Forage and concentrate contents in CP, ADF, NDF, NEL and RDP were determined. Grain and silages were also screened to determine their particle size. Cows from all farms were pooled in groups of early (DIM < 90 d), mid (DIM from 90 to 200 d) and late (DIM > 200 d) lactation. In order to select the best characteristics for predicting MF, we used the SAS procedure PROC REG with a stepwise approach and a linear model, a significant entrance threshold of 0.25 and a significant stay threshold of 0.10. In the farm group not using corn silage, regression equations predicted 39, 38 and 32 % of the variation in MF between cows for early (EL), mid (ML) and late (LL) lactation cows, respectively. For EL and ML cows, MF was improved by a higher RDP content in concentrates and finer grain milling. A shorter particle size for silage decreased MF for EL cows, but increased it with LL cows. Forages with better quality as determined by CP and ADF contents increased MF production for all cows. In the farm group using corn silage, regression equations predicted 43, 52 and 51 % of the variation in MF between cows for EL, ML and LL cows, respectively. As without corn silage, all cows produced more MF with increasing RDP in concentrates. However neither grain milling nor forage particle size or forage quality affected MF. Our results suggest that MF can be predicted based on some specific characteristics of cow rations as long as the DIM for each cow and the availability of corn silage are known. For almost all cows, an increase in RDP content in the concentrates is associated with higher MF. This suggests that an appropriate choice of concentrate adapted to the forage served lead to higher MF.

Key Words: Milk From Forage, Forage Particle Size, Grain Milling

1552 Effects of Tasco (a kelp extract) and heat stress on metabolism of wether lambs. J. H. Fike*¹, K. E. Saker², N. G. Marriott³, S. F. O'Keefe³, D. L. Ward², J. P. Fontenot⁴, and H. P. Veit², ¹Crop and Soil Environmental Sciences, ²VA-MD Regional College of Veterinary Medicine, ³Food Science and Technology, ⁴Animal and Poultry Sciences, Virginia Tech.

Wether lambs (n = 27, average BW = 40 kg) were used to test response to forage treated with Tasco-Forage (an extract of the brown kelp *Ascophyllum nodosum*) prior to conserving, or to direct feeding of Tasco-EX. Hays made from endophyte-infested tall fescue-based pasture received 0 or 3 kg of Tasco/ha prior to harvest. Lambs, blocked by weight, were randomly allotted to one of three diets: 1) control hay, 2) treated hay, and 3) #1 + Tasco-EX fed at 1% of the diet. Hays were low in CP (< 7%) so all lambs were fed soybean meal (12% of the diet) and trace mineralized salt. Diets were fed at 1.5% BW to prevent refusals. Total collections (7 d) were made during periods without or with applied heat stress. After each period, rumen contents were obtained to determine pH, NH₃ and VFA. Lambs were sacrificed post-trial. A subset was used to evaluate sensory traits and muscle fatty acids. Lambs were in negative N balance during the study and Tasco treatments did not affect N metabolism. Fecal N tended (P < 0.10) to increase with short duration heat stress causing a concomitant decrease (P < 0.05) in apparent N digestibility (58.6 vs. 56.1%; SE = 0.7). Urinary N loss decreased (P < 0.0001) with heat stress (8.0 vs. 5.9 g/d; SE = 0.2), resulting in increased (P < 0.0001) N retention (21.8 vs. 4.5%; SE = 2.8). Apparent OM digestibility was not affected by heat stress but increased (P < 0.05) with Tasco-EX treatment. Tasco diets decreased (P < 0.05) ruminal butyrate. Heat stress increased (P < 0.05) acetate and total VFA and decreased (P < 0.01) ruminal pH. A tendency (P < 0.11) of increased 14:1ω5 and decreased (P < 0.05) 18:0 fatty acids in muscle were observed with Tasco diets. Muscle color and flavor was unaffected by any Tasco treatment. The data suggest Tasco may alter rumen function but has no effect on N metabolism or meat quality of sheep fed restricted, low-quality diets.

Key Words: Tasco, Heat stress, Fescue

1553 Validation of the GrassGro decision support tool: steer methane emissions and intakes. R.D.H. Cohen*¹, J.P. Stevens¹, A.D. Moore², M. Freer², and J.R. Donnelly², ¹Department of Animal Science, University of Saskatchewan, Canada, ²CSIRO Division of Plant Industry, Canberra, Australia.

Predicted methane emissions and dry matter intakes (DMI) of steers using the GrassGro decision support tool were compared with field data from an experiment at Brandon, Manitoba in which steers grazed alfalfa/grass pastures at 1.1 or 2.2 steers/ha in continuous and rotation systems 1992-1994. Observed methane in 1994 (271.4±43.1) did not differ from predicted data (276.8±11.4). Observed (13.8±0.8) and predicted (11.6±0.6) DMI differed (P=0.02), perhaps due to incomplete recovery of fecal marker. Experimental steers required 33 d in a feedlot to reach Canada grade A at 620 kg. GrassGro predicted that supplementing barley at pasture would increase (P=0.000) final liveweight from 504±39 to 615±11 kg and body condition score (BCS) from 3.2±0.3 to 4.6±0.1 (scale 1-5). Neither trait differed between years, stocking rate or grazing systems but barley intake differed (P=0.002) between years (5.27, 2.25, 4.10 kg/d). GrassGro indicated lower (P=0.02) methane emissions for steers at 2.2/ha (275.8±11.8 g/d) compared with 1.1/ha (286.1±7.3 g/d) but no difference between rotation (282.5±10.8 g/d) and continuous (279.5±11.2 g/d) grazing. Methane emissions per unit liveweight gain (LWG) did not differ between stocking rates or grazing systems but were reduced (P=0.000) for supplemented steers (287.8±6.5 vs 274.1±10.1 g/kg LWG). Total methane emissions were reduced (P=0.0001) for steers finished at pasture (38.7±7.3 vs 54.4±4.0 kg). Neither stocking rate nor grazing system affected total metabolizable energy intake (MEI) or MEI/kg LWG. However, mean MEI/kg LWG of steers finished at pasture (68.28±6.73 MJ) was less (P=0.000) than feedlot finished steers (169.58±8.84 MJ). Similarly, methane emissions/kg LWG were reduced for pasture finished steers (133±22 vs 199±20 g/kg LWG; P=0.000). Finishing at pasture is energetically efficient and environmentally friendly.

Key Words: Methane, Intake, Steers

1554 Influence of nitrogen fertilization rate on content and in situ solubility of selected macrominerals from common bermudagrass harvested on two dates. N. W. Galdamez*¹, K. P. Coffey¹, W. K. Coblenz¹, J. L. Gunsaulis², D. A. Scarbrough¹, J. E. Turner¹, E. B. Kegley¹, K. A. Teague², and M. B. Daniels³, ¹University of Arkansas, Fayetteville, AR, ²Cooperative Extension Service, Fayetteville, AR, ³Cooperative Extension Service, Little Rock, AR.

Forage mineral concentrations may vary across the growing season due to several factors such as forage species and fertilization levels. Common bermudagrass [*Cynodon dactylon* (L)] growing on a layer manure-amended site was fertilized with ammonium nitrate at four rates (0, 56, 112, and 168 kg N/ha) at approximately one month before a first and third harvest on May 30 and August 18, 2000 to evaluate forage concentration and ruminal release of Ca, P, Mg, and K. Ruminally cannulated crossbred steers (n=5; 421.5 kg BW) were used to evaluate these forages in situ in a randomized complete block design with a 2 x 4 (harvest x N fertilization rate) factorial arrangement. Forage P content decreased (P<0.01) with increasing N fertilization on August 18, while forage Mg increased (P<0.01) and forage Ca content tended (P=0.08) to increase with increasing N fertilization on both harvest dates. Approximately 99% of plant K was immediately soluble compared with approximately 82%, 72%, and 48% of Mg, P, and Ca, respectively. The potentially degradable fraction and effective degradability for Ca, P, Mg, and Ca were affected by the linear or quadratic interactions between N fertilization and harvest date. Effective P degradation on August 18 decreased quadratically (P<0.01) and effective Mg degradation increased linearly (P<0.01) on both dates with N fertilization rate. The potential extent of P, Mg, and K degradation was greater (P<0.05) on May 30 than August 18, but the mean values for each date were > 86%. Rate of Mg disappearance responded quadratically (P<0.01) to N fertilization rate and was greater (P < 0.05) on August 18 compared with May 30. Therefore, N fertilization rates affected the concentration and ruminal solubility of macrominerals from bermudagrass, and the potential extent of mineral degradation was greater than 83% in all instances.

Key Words: *Cynodon dactylon*, Minerals, In Situ Degradation

1555 Effect of poultry litter applied as fertilizer on forage mineral concentrations. E. B. Rayburn, W. L. Shockey*, D. A. Seymour, B. D. Smith, T. J. Basden, and J. D. Lozier, *West Virginia University, Morgantown, WV.*

Mineral supplementation of grazing livestock is not precise because most pastures are not tested for mineral content, livestock are not fed individually, pasture fertilizer application varies, and pasture forage species are not constant. To improve the mineral supplementation for grazing livestock, an experiment was conducted at 4 locations to determine the effects of fertilizer treatment on pasture mineral content. Pastures received no fertilizer, commercial fertilizer applied at WV Soil Testing Laboratory recommendations, 4,480 kg poultry litter/ha, or 8,960 kg poultry litter/ha. Poultry litter increased ($P < .05$) P and K in grasses, legumes and broadleaf weeds; Ca and S in legumes; and Mo in grasses and legumes. Results suggest that phosphorus supplementation of cattle consuming forages fertilized with poultry litter could be reduced, but not eliminated. Copper concentration of forages fertilized with poultry litter did not increase ($P > .05$), even though poultry litter contained higher levels of Cu than standard commercial fertilizer. Increased concentrations of S and Mo indicate that Cu supplementation may be important for cattle that consume forage fertilized with poultry litter. Results show that poultry litter did not adversely affect forage mineral concentrations for grazing livestock and that mineral supplementation is a vital component of a pasture-based livestock production system.

Key Words: Pasture, Minerals, Livestock

1556 Forage pasture species selection and nitrogen fertilization rates. G. Cuomo, D.G. Johnson*, A. Singh, and M. Rudstrom, *University of Minnesota, Morris, MN.*

The objective was to identify forage species and dry urea nitrogen fertilization combinations for pastures to feed grazing dairy cows in the

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1557 Transport of preimplantation embryos in the genitalia of buffalo heifers superovulated with pFSH and variable doses of LH. A.M. Osman* and S.H. Shehata, ¹*Dept. Theriogenology, Fac. Vet. Medicine, Assiut Univ. Assiut, Egypt.*

Twelve buffalo heifers of similar age (21-25 month) and body weight (325-385 kg) were superovulated during mid luteal phase using pFSH (total 65 NIH unit Super-Ov divided into 6 equal dose, 1.4 ml each, for 3 consecutive days) and lutalyse (25mg injected with the 5th injection). To improve ovarian response variable doses of LH (0, 2, 4, 5, 7 and 10 thousands USP unit, Steris, Lab. Inc Phoenix, Arizona) were injected at the morning of the 4th day of the treatment in 6 trials ($n=2$). Fertile bulls were allowed to mount heifers frequently after 24hour (h) from onset of estrus. Heifers were classified into 3 equal groups (2 trials/each) which slaughtered at various time intervals from the onset of estrus: 72-89, 100-106 and 118-120 (h). After slaughter, the intact genitalia were dissected free and transported to the lab in a thermos container at 4C. The number of newly formed corpora lutea (CL) and unovulated, >1 cm, follicles (UF) in both ovaries were done. Flushings of the oviduct and uterine horn were performed separately using phosphate buffer saline to identify the numbers and locations of embryos. The duration of estrus (h), numbers of CL and UF were 41.5 11.2, 3.11.3 and 1.10.76 respectively. The overall ovulation and embryo recovery rates were 72.5 and 54% respectively. Group without LH gave low response (50 and 0% respectively). The higher ovulation rate (66-100%) were recorded for heifers supplemented with 4000 and more unit LH while the higher embryo recovery rates (50-100%) were associated with the doses of 4000-7000 unit LH. At 72-89h post-oestrus (48-65h post-insemination) 6 embryos were collected from the oviducts and one embryo from the uterus. Some non-motile spermatozoa were observed in the oviduct. At 100-106 and 118-120 h post-oestrus (76-82 and 94-96 h post-insemination) 7 and 6 embryos were recovered respectively from the uterus. The rate of embryo transport in the oviduct of superovulated buffalo heifers appeared to be 30 h and more faster than in buffalo or bovine cows.

Key Words: buffalo heifer, superovulation, embryo

Midwest. Five species-fertilizer combinations were studied in a randomized complete block experiment with three replicates over three years. Combinations were Bromegrass with no N (B0N), Bromegrass with 56 kg/ha early N + 56 kg/ha late N (B56-56N), Bromegrass with 112 kg/ha early N (B112-0N), Bromegrass with 112 kg/ha late N (B0-112N), and Bromegrass with Legume and no nitrogen fertilization (BL). Early fertilization was before the first grazing of the year and late fertilization was after the second grazing. The pasture was organized in species strips 21m by 164 m with fertilization plots 21m by 14 m. Pastures were initially prepared by a glyphosate spray for weed control, fall moldboard plowing, spring disking and planting into a prepared seedbed. Bromegrass (Bounty) seeding rate was 667 seeds/m². Bromegrass-legume seeding rate (seeds/m²) was Bromegrass (Bounty), 398; Alfalfa (Amerigraze421), 108; Birdsfoot trefoil (Noreen), 215; and Kura Clover (Endura), 215. Pastures were grazed by lactating dairy cows 4-5 times per year for a 24 hr grazing period at a density of approximately 67 Mg/ha. Utilization of BL was approximately 50%, whereas utilization of B ranged from 29-35%. Intake was determined by difference of quantity of forage by clipping before and after grazing. Annual total intake varied by year ($P = .02$), and forage-fertilizer combination ($P = .0001$). Grazing pressure was restricted the first year to increase the probability of maintaining stand. Annual intakes (Mg/ha) were B0N, 1.62; B56-56N, 2.02; B112-0N, 2.41; B0-112N, 2.29; and BL, 6.26. These results indicate that diverse mixes of legumes and bromegrass are more productive than bromegrass monoculture with or without supplemental nitrogen fertilization

Key Words: Pasture systems, Grass vs. legume pasture

1558 Factors affecting the reproductive performance of Bali cattle in Manokwari, Papua, Indonesia. O.R. Faidban¹, J.B. Gaughan^{*2}, and R.S. Copland², ¹*The Papua State University, Manokwari, Papua Province, Indonesia,* ²*The University of Queensland, Gatton, Australia.*

Poor reproductive performance of cattle is a problem in many developing countries. The major objective of this study was to characterize the reproductive performance of Bali cows ($n=336$) based upon nutritional management practices where the cattle were (i) grazing (G), (ii) were tethered in paddock during day, tethered at the farmers house at night with grass cut and carried at night (PZ), and (iii) had zero grazing, with all feed supplied to tethered animals via cut and carry (Z). A second objective was to determine the major factors which influence the reproductive performance of these animals. Cattle were identified using ear tags or neck collars (prior to the study most animals had no identification), aged (using their teeth) into groups (1.5 # 3 years of age; 3.5 # 5; 5.5 # 7; > 7 years of age), body condition scored (BCS; 1 # 5; 1 # emancipated, 2 # lean, 3 # medium, 4 # fat, 5 # very fat), and reproductive status assessed (lactating, pregnant or not pregnant, ovarian activity or no activity). The data were collected three times (March, July and October) over a 9-mo period. Data were analyzed using SAS. Over the period the mean pregnancy rate across all treatments was 57%. There were no measured seasonal effects on pregnancy rate. Cows that were over 7 years of age ($n=25$) had a higher ($P < .01$) pregnancy rate (74%) compared to those aged 1.5 # 3 years of age (37%) ($n=25$). The majority of cows had a BCS of either 2 ($n=162$) or 3 ($n=128$). Five cows had a BCS of 5 (very fat) and 10 cows had a BCS of 1 (emancipated). Pregnancy rates increased ($P < .05$) as BCS increased (37%, 50%, 64%, 73%, 63% respectively for BCS 1 # 5). Over the 9-mo period, 84% of the P cows, 92% of the PZ cows and 78% of the Z cows were either pregnant, lactating or cycling at one of the three data collections. However, the feeding system had a significant ($P < .05$) effect on pregnancy rate, with the Z cows averaging 30% pregnancy over the 9-mo period compared to 58% for the G group and 57% for the PZ cows.

Key Words: Beef cattle, Reproduction