

Forages and Pastures - Livestock and Poultry: Harvesting, Ensiling, and Forage Quality

586 Fall growth potential of cereal-grain forages. J. L. Gunsaulis¹, W. K. Coblenz*², R. K. Bacon³, R. K. Ogden³, K. P. Coffey³, D. S. Hubbell, III⁴, J. V. Skinner, Jr.³, and J. D. Caldwell³, ¹Arkansas Cooperative Extension Service, Fayetteville, ²US Dairy Forage Research Center, Marshfield, WI, ³University of Arkansas, Fayetteville, ⁴Livestock and Forestry Branch Station, Batesville, AR.

In Arkansas, producers utilizing cereal grains as fall forage for weaned calves usually do not produce a grain crop the following summer. Our objectives were to evaluate eight diverse varieties of wheat (*Triticum aestivum* L.), oat (*Avena sativa* L.), rye (*Secale cereale* L.), and triticale (*X Triticosecale* Wittmack) specifically for their potential to accumulate forage DM during the fall. All varieties were drilled into prepared seedbeds at Fayetteville and Batesville during early September of 2004 and 2005. Beginning in mid-October, plots were harvested for DM yield at 2-wk intervals that continued through December. Variety × harvest date interactions or tendencies for interaction ($P \leq 0.069$) were observed for all combinations of site and year. For Fayetteville 2004, triticale and oat varieties accumulated DM in a cubic ($P \leq 0.040$) pattern, most likely because growing tillers exhibited stem elongation, and then were susceptible to freeze damage in late December. Generally, wheat and rye varieties accumulated DM in less complex patterns over harvest dates, but the maximum numerical yield for any wheat variety was 2,554 kg/ha compared to 4,661 kg/ha for oat. For Batesville 2004 and Fayetteville 2005, DM yields for varieties ranked similarly, but respective overall mean yields (490 and 988 kg/ha) were only 25 and 50% of those for Fayetteville 2004 (1,960 kg/ha) due to drought. For Batesville 2005, favorable growing conditions coupled with a sharp mid-November freeze (-7°C), created yield responses that were unique relative to other site-years. Yield of DM increased quadratically ($P \leq 0.002$) for wheat, rye, and triticale varieties throughout the sampling period, accumulating a mean maximum yield of 4,148 kg/ha on the final harvest date. In contrast, oat varieties were especially sensitive to freezing temperatures in November, and averaged only 2,484 kg/ha on the same date. Producers requiring high-quality forage in the fall and winter can usually improve fall production by using oat or other species that exhibit stem elongation; however, this trait will likely increase susceptibility to freezing temperatures, thereby making continued growth into the winter or winter survival problematic.

Key Words: Cereal Grains, Yield

587 Increasing non structural carbohydrates in alfalfa improves in vitro microbial N synthesis. R. Berthiaume*¹, C. Benchaar¹, A. V. Chaves³, G. F. Tremblay², Y. Castonguay², A. Bertrand², G. Bélanger², R. Michaud², C. Lafrenière¹, and A.F. Brito¹, ¹Agriculture & Agri-Food Canada, Sherbrooke, QC, ²Agriculture & Agri-Food Canada, Québec, QC, ³Agriculture & Agri-Food Canada, Lethbridge, AB.

Insufficient readily fermentable energy in alfalfa reduces forage N use efficiency by ruminants. Our objective was to compare the effect of contrasting levels of non structural carbohydrates (NSC; sugars + starch) in alfalfa on rumen microbial fermentation. More than 500 genotypes from the alfalfa cultivar AC Caribou grown near Québec City were individually harvested at the late flowering stage. Harvested genotypes were transferred to a draft oven, dried at 55°C , and

ground (1-mm). Samples were analyzed for soluble carbohydrates by HPLC and for starch using a colorimetric method. Genotypes having respectively the highest and lowest NSC concentrations (around 20 genotypes in each group) were pooled to constitute two contrasted 1-kg forage samples. Samples of high (170 mg/g DM) or low (66 mg/g DM) NSC were respectively allocated to separate dual flow fermenters (1300 mL) in a completely randomized design with 3 replications. Rumen inoculum was obtained from 4 ruminally fistulated cows fed a 50:50 forage to concentrate early lactation TMR (16.7% CP, 34.4% NDF). A 10-d incubation period was used with the first 6 d for adaptation followed by 4 d of sampling. Alfalfa digestibility (DM, OM, NDF, ADF and N), fermentation end-products (VFA, $\text{NH}_3\text{-N}$), pH and microbial protein synthesis (using ^{15}N as a microbial marker) were determined and results were analysed as repeated measures using the MIXED procedure of SAS. Increasing NSC concentration in alfalfa had no effect on digestibility but decreased ruminal pH (6.85 vs. 7.08; $P = 0.02$) and $\text{NH}_3\text{-N}$ concentration (316 vs. 409 mg/L; $P = 0.04$), and increased the molar proportion of butyrate (11.6 vs. 9.0%; $P = 0.04$). More importantly, microbial N flow was higher with high than with low NSC alfalfa (0.306 vs. 0.270 g/d; $P = 0.03$). These results suggest that increasing the concentration of NSC in alfalfa enhances microbial N synthesis in the rumen.

Key Words: Alfalfa, Carbohydrates, In Vitro Fermentation

588 Effect of a biological silage inoculant on the quality parameters under laboratory and field conditions. Y. Acosta Aragón*, G. Boeck, A. Klimitsch, and G. Schatzmayr, *Biomim GmbH, Austria, Herzogenburg, Lower Austria, Austria.*

The silage quality (laboratory and field trials) and the silage quality and cost effectiveness (field trials) using a biological silage inoculant (BSI) were determined. Three silage laboratory trials with three different raw materials were performed using a BSI (blend of hetero- and homofermentative bacteria). Grass, luzerne and whole plant corn (WPC) were ensiled in buckets (dry matter DM of 33-36, 52-56 and 29-33 %, respectively). The BSI was applied at a rate of 2×10^5 CFU/g of raw material and compared with other biological and chemical inoculants. The silos were opened after 2 or 3, 7, 14 and 50 days of ensiling. pH value, sugar and organic acids were analysed, as well as the aerobic stability. The control group produced less lactic and acetic acid (in all tested substrates) and more butyric acid (grass silage) than the group with the inoculant. BSI silages showed a better aerobic stability (7 days), low DM losses and no negative points compared to the control group. For the WPC silages, pH values in all treatments were low but the silage with BSI showed highest amount of acetic acid (31.4 g/kg DM) which results in good aerobic stability (7 days) without dry matter losses and no negative points. For field trials, the silages (grass, alfalfa and WPC) with very variable DM contents (from about 20 to more than 45 %) shown to have good parameters as low pH value (3.8-4.5), high lactic and acetic acid (about 60-70 and 10-30 g/kg DM respectively) and lower butyric acid content (< 3 g/kg DM), increasing the Net Energy for Lactation (NEL) content in about 0.05-0.18 MJ/kg DM. To estimate the profit in use of the silage inoculants, the parameter NEL with or without the use of BSI was selected over the other silage quality parameters. The calculation of the profit estimation included the price of the used product (1.8 euros/

treated ton), the net energy and corresponding milk production plus. The profit per ton can reach up to 5.21 euros/ treated ton.

Key Words: Silage, Inoculant, Aerobic Stability

589 Molasses effects on Kochia scoparia characteristics as an Iranian native forage in the form of silage. B. Saremi*, A. R. Shahdadi, and H. Zaher Farimani, *Education center of Jihad-e Agriculture, Khorasan razavi, Mashhad, Iran.*

The objective of this study was to introduce Kochia scoparia as native forage in Iran and to investigate characteristics of its ensiling with different amounts of molasses (0, 5 and 10 percent) via a factorial experiment based on a completely randomized design. Kochia scoparia was harvested from desserts around Sabzevar city in northeast of Iran (Khorasan-razavi) using Sabzaver Jihad-e agriculture branch facilities. This study was done at the education center of Jihad-e agriculture in Mashhad city. Kochia was chopped at 8±1.25 cm and completely mixed with different amounts of molasses (According to as fed weight), then ensiled in experimental silos (polymer buckets, 40 cm height and 30 cm diameter). 24 experimental silos were divided between treatments (0, 5 and 10 percent molasses) and opened 1, 2, 3 and 21 days after ensiling. Samples were taken and pH was determined immediately using on farm pH meter (Greisinger electronics, GPHR 1400 A). Fresh samples were mixed with distilled water (1:1), and then pH was determined. Another sample was frozen for future chemical analysis. DM, OM, ADF, Ca and P were determined using standard methods. Data was analyzed using SAS 9.1 and means were compared using Duncan test (P<0.05). Results showed that silage pH decreased with increasing molasses levels (P<0.0001). Also pH was decreased with a low rate up to 21 days after ensiling in comparison with corn silage that received 4.5% molasses after 2 days. DM content increased with molasses addition but reduced with days after ensiling (P<0.0001). OM increased with addition of molasses (P<0.0061) but reduced with days after ensiling (P<0.0015). This was because molasses has a higher DM content with respect to Kochia and nutrients usage by silage micro flora increased with molasses addition. Ca content of silage was not affected by day or treatments.

Table 1. Chemical composition of ensiled Kochia scoparia with different amounts of molasses in various days

Items	% Molasses			SEM	
	0	5	10		
pH	6.46 ^a	4.98 ^b	4.70 ^c	0.024	
DM (%)	38.85	40.11	43.57	0.248	
OM (%)	87.14 ^b	87.53 ^b	88.1 ^a	0.155	
Ca (mg/ml)	0.757	0.753	0.825	0.052	
		Days			
	1	2	3	21	
pH	6.22 ^a	5.52 ^b	5.21 ^c	4.57 ^d	0.027
DM (%)	39.53 ^b	38.4 ^c	38.12 ^c	37.08 ^c	0.286
OM (%)	88.04 ^a	87.81 ^a	86.92 ^b		0.155
Ca (mg/ml)	0.732	0.745	0.858		0.052

Means with different letters have significant difference in each row (P<0.05)

Key Words: Kochia scoparia, Molasses Treatment, Silage

590 Feeding value of silage made from Panicum maximum with or without Leuceana leucocephala or Gliricidia sepium as supplementary feeds for weaned rabbits. A. M. Raji*^{1,2}, A. T. Adesogan¹, J. A. A. Sansi², and R. A. Salako², ¹Department Animal Sciences, University of Florida, Gainesville, ²Federal College of Animal Health and Production Technology, IART, Ibadan, Oyo, Nigeria.

Ensilage is one of the methods that have been employed to conserve or preserve excess forages for use during the period of scarcity in term of quality and quantity in most tropical countries. Three different silage products were prepared using the mixture of Panicum maximum and Gliricidia sepium (A), Panicum maximum and Leucaena leucocephala (B); and panicum maximum alone (C), which served as the control experiment. The silages were opened after 4 months of ensilage and fed to weaned rabbits as supplements. The treatment diets were grouped in A, B and C. The feeding trial lasted for 12 weeks. The daily feed intake, refusal, and weekly weight gain of the experimental animals was measured. Significant (P<0.05) variations were noted among the treatment diets for nutrient composition, silage properties, feed intake and weight gained by the rabbits. The ADF of the silage produced ranged from 16.7% for treatment diet C to 35.6% for B, while the NDF ranged from 21.3% for treatment A to 40.5% for treatment C. The CP content of the silage prepared ranged from 6.5% for treatment C to 14.4% for treatment B. pH was raised with the inclusion of the browse plants. It ranged from 4.09 for C to 4.20 for A. Feed intake (g/DM) varied widely, it ranged from 62.6 for A to 99.4 for B while the weight gained/day/animal was highest for rabbits on treatment diet B (7.8g), while rabbits on A (2.4g) gained least. The raised pH value from grass alone versus grass/legume mixture is an indication of the influence of lactic acid production during fermentation of the product. This is an added advantage for effective preservation. The reduced feed intake of diet A is, however, unexpected and could be a result of mimosine breakdown during fermentation that resulted in unpalatable end product. These subsequently reduce the acceptability of the silage by the animals thus leading to reduced feed intake, eventually resulting in weight loss. The study revealed an improved performance of rabbits in terms of weight gain and quality of silage produced when G. sepium and P. maximum were combined.

Key Words: Silage, Panicum Maximum, Rabbit

591 Water soluble carbohydrates relative to protein in fresh forages: Impact on efficiency of nitrogen utilization in lactating dairy cows. D. Pacheco*¹, G. A. Lane¹, J. L. Burke², and G. P. Cosgrove¹, ¹AgResearch Grasslands, Palmerston North, New Zealand, ²Massey University, Palmerston North, New Zealand.

Nitrogen utilization efficiency for milk production (NUE_m: g milk N per g of N intake) in systems based on grazing of temperate forages is lower than in systems based on concentrates and conserved forages. Forages with higher content of water soluble carbohydrates (WSC) have been proposed as a solution to increase the efficiency of conversion of dietary nitrogen into milk with concomitant reduction on the environmental impact of excreta nitrogen. We have conducted a series of experiments over 2 years to study the role of WSC for pasture-fed cows in New Zealand. In our experiments, NUE_m estimated at different times of the year has failed to show consistent, significant differences among grasses with differing concentrations of WSC (diploid perennial [*L. perenne*] and tetraploid annual ryegrasses [*L. multiflorum*] with

"high" WSC, compared with a diploid perennial ryegrass control). Meta-data (n=129, each one the mean of an experimental group of animals) from our experiments to-date has been examined to find possible explanations for the lack of consistent responses to the WSC. A regression tree analysis was performed (partition 70:30 in the data for training and validation), to predict NUEm from the values of chemical composition of the forage on offer at times of milk sampling (CP, fat, ADF, NDF, WSC, and ash % of DM; from NIRS). Splitting of nodes was constrained to $P < 0.10$, resulting in 2 rules for classification ($r^2 = 0.56$, validation data set). CP values higher than 23.2 % DM resulted in mean NUE of 0.20, while CP values below 23.2 % DM resulted in mean NUEm of 0.25. In the latter group, a mean NUEm of 0.23 was obtained from the subset with WSC lower than 21% DM; while WSC content higher than 21% resulted in a mean NUEm of 0.27. The analysis suggests that benefits of high WSC concentrations on NUEm are more likely to occur below a CP content threshold in fresh forages, regardless of the cultivar.

Key Words: Nitrogen Utilization, Fresh Forages, Water Soluble Carbohydrates

592 Contribution of plant mediated proteolysis to total protein degradation of fresh forages in the rumen of dairy cows. D. Pacheco*, W. C. McNabb, H. S. Easton, and B. Barrett, *AgResearch Grasslands, Palmerston North, New Zealand.*

Ruminal degradation of proteins in grazed forage is caused by intrinsic and extrinsic proteolytic processes mediated by plant and ruminal microorganism enzymes, respectively. The objective of this experiment was to measure the contribution of intrinsic proteolysis to the total crude protein (Nx6.25) degradation in tall fescue (FS: *F. arundinacea*), red clover (RC: *T. pratense*), perennial ryegrass (RG: *L. perenne*), and white clover (WC: *T. repens*) leaves. Representative leaf samples were harvested from field grown plots over four consecutive summer days, for use in *in sacco* incubations in a balanced design with 2 cows. Grass leaves were chopped into 1 cm segments, legume leaves were picked and left undamaged. Samples were sealed in permeable (Dacron 50 micron pore size) and impermeable (polyethylene) bags and incubated for 0, 1, 2, 3, 4, 6, 8, 12, 18 and 24 h. Protein degradation was measured by analysis of the residues in retrieved bags. For each forage, samples exhibited higher protein degradation levels ($P < 0.01$) in the permeable treatment than in the impermeable one. Plant-mediated protein degradation in the impermeable treatment was confirmed by the recovery of amino acids (170 (SE 15.7); 110 (SE 18.3); 177 (SE 9.2) and 251 (SE 66.6) mg total amino acids/g CP) at 24 h for FS, RC, RG and WC, respectively. Protein degradation measured in the permeable treatment bags was higher ($P < 0.05$) than the impermeable one after 6, 12, 8 and 6 h for FS, RC, RG and WC, respectively. Plant-mediated proteolysis estimated from asymptotic values of the degradation curves reached 0.26 (FS: SE 0.028); 0.14 (RC: SE 0.075); 0.33 (RG: SE 0.07) and 0.35 (WC: SE 0.029) of the initial amount of protein incubated. These values accounted for 0.34, 0.16, 0.41 and 0.42 of the asymptotic value for protein degradation measured from the permeable treatment, respectively. Variation in plant-mediated proteolysis deserves further exploration as a tool for improving nitrogen usage in the fresh-forage fed ruminants.

Key Words: Protein Degradation, Forages, Dairy Cows

593 Relationships between silage fermentation characteristics and feed intake by dairy cows. I. Eisner¹, K.-H. Suedekum^{*2}, and S. Kirchhof¹, ¹University of Kiel, Kiel, Germany, ²University of Bonn, Bonn, Germany.

The feeding value of silage is defined mainly by the contents of net energy for lactation, crude protein and cell wall components. In addition, the quality of silage is determined by fermentation products. A number of experiments have shown that the varying concentrations of these attributes affect feed intake. Unfortunately, the results are controversial. Therefore, this study had the objective to quantify the effects of fermentation end products on intake of grass, corn, and legume silages based on a meta-analysis of literature data. In addition, the accuracy of multiple regression models was tested by including silage fermentation characteristics into equations for feed intake prediction. The meta-analysis revealed that the concentration of acetic acid was closely and negatively correlated with silage intake when concentrate and forage were offered separately. These results supported previous studies in which acetic acid was supplemented directly into the silage before feeding. The effects of other short-chain fatty acids and of lactic acid and ammonia were unclear. Literature data were either controversial or effects were affected by collinearity between fermentation products. Protein quality appears to be an important factor for feed intake. Proteolysis during ensiling has increased the concentration of soluble nitrogen in silage and has consistently reduced silage intake. Amines have been suggested as being responsible for reduced silage intake but experimental evidence so far did not support this hypothesis. Total acid concentration was closely and negatively related to total feed intake in diets fed as total mixed rations (TMR). In the data set used for the meta-analysis of diets with forage and concentrate offered separately, inclusion of the acetic acid concentration in a model with animal-associated factors such as milk yield and body weight resulted in an improved accuracy of the prediction of total feed intake. The total acid concentration was the best factor that increased the fit of a model for feed intake prediction when diets were fed as TMR. In conclusion, current equations for feed intake prediction need and warrant further development.

Key Words: Silage, Intake, Fermentation

594 Alfalfa harvested in the afternoon increases performance of lactating dairy cows. A. F. Brito^{*1}, G. Tremblay², D. R. Ouellet¹, A. Bertrand², Y. Cantonguay², G. Belanger², R. Michaud², H. Lapierre¹, and R. Berthiaume¹, ¹Dairy and Swine R&D Centre, Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada, ²Soils and Crops R&D Centre, Agriculture and Agri-Food Canada, Ste-Foy-Normandin, QC, Canada.

Alfalfa (*Medicago sativa*) harvested in the afternoon has been shown to have greater concentration of total nonstructural carbohydrates (TNC) than that harvested in the morning. Our objective was to determine the effects of alfalfa cut either in the afternoon (PM, 1800) or in the morning (AM, 0600) on performance and ruminal metabolism of lactating dairy cows. Alfalfa was conserved as silage (50% DM) into individually wrapped large rectangular bales. Sixteen multiparous Holstein cows (8 ruminally cannulated), in mid to late lactation, were assigned in a crossover design (24-d periods) to one of two treatments: PM vs. AM silage. Cows were fed only silage that contained on average (g/kg DM) 211 vs. 214 CP and 126 vs. 99.3 TNC for PM vs. AM, respectively. Dry matter intake (DMI), and yields of milk, milk protein

and milk fat were greater with PM than with AM silage. Reduced milk urea nitrogen (MUN) with feeding PM compared to AM silage indicates improved N utilization. Ruminal pH tended to be lower on AM than on PM silage; this was probably associated to the increased ruminal acetate and total volatile fatty acids (VFA) on alfalfa cut in the morning. The greater ruminal acetate:propionate ratio observed with AM silage suggests that ruminal metabolism was shifted towards lipogenesis. Overall, increased alfalfa silage TNC content with afternoon harvest resulted in improved performance of dairy cows.

Table 1.

Item	AM silage	PM silage	SED	P
DMI, kg/d	18.8	20.0	0.22	<0.01
Milk yield, kg/d	19.2	20.1	0.18	<0.01
Milk protein, %	3.22	3.24	0.02	0.37
Milk protein, kg/d	0.61	0.65	0.01	<0.01
Milk fat, %	3.96	4.04	0.08	0.31
Milk fat, kg/d	0.75	0.82	0.02	<0.01
MUN, mg/dL	18.9	17.2	0.27	<0.01
Body weight gain, kg/d	0.55	0.23	0.08	<0.01
Ruminal pH	6.34	6.41	0.04	0.09
Ruminal acetate, mM	66.7	63.5	0.96	0.02
Ruminal propionate, mM	15.8	15.3	0.25	0.10
Ruminal butyrate, mM	6.36	6.14	0.13	0.13
Ruminal total VFA, mM	91.6	87.9	1.27	0.02
Ruminal acetate:propionate ratio	4.27	4.17	0.04	0.05

Key Words: Alfalfa Silage, Diurnal Harvest, Total Nonstructural Carbohydrates

Goat Species

595 *In vitro* larval activity and *in vivo* gastro-intestinal parasites infestation in goats grazing tropical legumes. K. A. H. Valentin^{*1}, B. R. Min², E. Valencia¹, A. Rodriguez¹, W. E. Pinchak², J. E. Miller³, and J. P. Muir⁴, ¹University of Puerto Rico, Mayaguez, Puerto Rico, ²Texas Agricultural Research Center, Vernon, ³Louisiana State University, Baton Rouge, ⁴Texas Agricultural Research Center, Stephenville.

In Exp. 1, eight naturally parasite-infected growing Boer goats were randomly allocated to two treatments. One treatment (n = 4; initial LW = 18.8 ± 0.5 kg) entailed grazing of Arachis (*Arachis pintoi*) from September to December 2006 with a second treatment of Calliandra (*Calliandra calothyrsus*) (n = 4; initial LW = 14.4 ± 0.5 kg) grazing up to 84 days. In Exp. 2, three purified tannins (Calliandra, lespedeza (*Lespedeza cuneata*), and Acacia (*Acacia angustissima* var. hirta) and commercially available tannin monomers (ellagettannin, gallotannin, and catechin) were used *in vitro* to determine the effect of legume forage tannins and monomers on the larval migration inhibition (LMI %) rates of infective third-stage larvae of *Haemonchus contortus* (*H. contortus*). For the *in vitro* study, Calliandra was chosen because of anthelmintic activity measured in Exp. 1, while, Lespedeza and Acacia tannins were included because of known anthelmintic activity. Exp. 1 mean fecal egg counts (5262 vs. 7644 eggs/g; P < 0.001) and FAMACHA score (2.5 vs. 2.9; P < 0.02) were lower for Calliandra than for Arachis. ADG (11.1 vs. -34.7; P < 0.02) and packed cell volume (22.3 vs. 20.5; P = 0.13) were greater for Calliandra than for Arachis, respectively. *In vitro* DM digestibility was lower (P < 0.001) for Calliandra but crude protein and condensed tannins were greater (P < 0.01) than for Arachis. In the presence of 2 and 4 mg purified tannin/ml (using a Sephadex LH-20), LMI rates of *H. contortus* increased with Lespedeza and Calliandra extracts. There was no dose response of Acacia extract on LMI. *H. contortus* exhibited dose dependent (P < 0.01) response to 1, 2, and 4 mg/ml of ellagettannin, gallotannin, catechin tannin monomers though differential inhibitory activity was observed: ellagettannin > gallotannin > catechin.

Key Words: Gastrointestinal Nematodes, Tannins, Tropical Legumes

596 Effects of hay inclusion on intake, total tract nutrient utilization and ruminal fermentation of goats fed spineless cactus (*Opuntia ficus-indica* Mill) based diets. E. L. Vieira¹, A. M. Batista¹, A. Guim¹, F. F. Carvalho¹, A. C. Nascimento¹, R. F. Araújo¹, and A. F. Mustafa^{*2}, ¹Universidade Federal Rural de Pernambuco, Pernambuco, Brazil, ²McGill University, QC, Canada.

A study was conducted to determine the effects of increasing levels of tifton bermudagrass hay in cactus-based diets on total tract nutrient utilization and ruminal fermentation parameters of goats. Five ruminally fistulated goats were used in a 5 × 5 Latin square experiment with 17-d periods. Experimental diets contained (g/kg) 765, 670, 572, 473 and 373 spineless cactus and 50, 150 250, 350, and 450 tifton bermudagrass hay, respectively. Results showed that that DMI increased quadratically (P<0.05) while intake of OM, CP and NDF increased linearly (P<0.05) as the level of hay in the diet increased. However, intake of non-fiber carbohydrates (NFC) decreased quadratically (P<0.05) as a result of hay inclusion. Total tract digestibility of DM (average 70.6%), OM (average 73.7%), CP (average 80.4%), NDF (average 55.3%), and NFC (average 90.4%) were not influenced by hay level in the diet. Nitrogen retention was similar for all dietary treatments, however, N supply to the small intestine increased quadratically (P<0.05) as the level of hay in the diet increased. Hay inclusion linearly increased (P<0.05) ruminal pH and NH₃-N concentration, and rumen content of DM and NDF. Rumen turnover of DM and NDF quadratically decreased (P<0.05) while rumen disappearance of DM and NDF increased quadratically (P<0.05) as the level of hay in the diet increased. It was concluded that inclusion of tifton bermudagrass hay in high cactus diets improved feed intake without adversely affecting total tract nutrient utilization or ruminal fermentation. A minimum of 150 g/kg of hay should be included in high cactus diets to avoid digestive disturbances and maximize feed intake.

Key Words: Goats, Nutrient Utilization, Spineless Cactus