Forage and Pastures II

T92   Productive response of finishing young bulls to tannins supplementation. M. Velázquez-Martínez[1], O. Hernández-Mendo[1], S. Pérez-Elizalde[1], E. López-Pérez[2], and G. Aranda-Osorio*[2], [1]*Colegio de Postgraduados, Montecillos, Texcoco, México,* [2]*Universidad Autónoma Chapingo, Chapingo, Texcoco, México.*

The aim of this study was to evaluate the productive performance of finishing bullocks when adding tannins into their diet. Twenty-seven crossbred (*B. taurus × B. indicus*) bullocks, with initial liveweight of 412.3 ± 22.19 kg, were used. They were allocated into 3 groups of 9 animals each, and then distributed, at random, to one of following treatments: T1) control (experimental diet), T2) control + 2,500 IU of vitamin E/animal/day, and T3) control + 4% (kg of DM) of condensed tannins. Quebracho extract (*Schinopsis balansae*, Indunor S.A.C.F.I.F.), was used as source of tannins. Dry matter intake (DMI), average daily gain (ADG), feed conversion (FC), feed efficiency (FE) and hot carcass yield (HCY), were evaluated. Animals were slaughtered at 518.65 ± 33.51 kg of liveweight on average. The variables were analyzed in a completely randomized design with Proc GLM of SAS/STAT. There were no differences ($P \geq 0.05$) among treatments, with averages for DMI, ADG, FC, FE, and HCY, of 10.85 kg, 1.98 kg, 5.60 kg, 183.6 g/kg DM and 57.74%, respectively, which agrees with those results reported by other authors. This study provides evidence that 4% of condensed tannins from Quebracho tree in diets for finishing bullocks did not affect animal performance. However, future studies should take into consideration its effect on ruminal variables, anti-gastrointestinal parasites, and antioxidant effect on meat quality, before its use under commercial conditions.

Key Words: beef cattle, tannins, performance

T93   Pelibuey sheep productive response to different sources of tannins from forage trees. M. Velázquez-Martínez[1], O. Hernández-Mendo[1], S. Pérez-Elizalde[1], E. López-Pérez[2], and G. Aranda-Osorio*[2], [1]*Colegio de Postgraduados, Montecillos, Texcoco, México,* [2]*Universidad Autónoma Chapingo, Chapingo, Texcoco, México.*

The objective of this study was to evaluate the effect of supplementing tannins from different forage tree species on growth performance and carcass yield of Pelibuey sheep. Thirty-six Pelibuey male sheep were used, with initial liveweight of 23.74 ± 4.57 kg and 5–6 mo of age, on average. The animals were distributed homogeneously into 4 groups of 3 each, with 3 replicates per group, and then randomly assigned to each of the following treatments: T1) control (experimental diet), T2) *Gliricidia sepium* (GS) diet, T3) *Guazuma ulmifolia* (GU) diet, and T4) Quebracho extract (*Schinopsis balansae*, Indunor S.A.C.F.I.F.) diet (QE). All diets were formulated to fulfill the animal requirements (15.4% CP, 33.8% NDF, 2.8 Mcal of ME, 0.92 Ca and 0.32 P, on average). The variables evaluated were dry matter intake (DMI), average daily gain (ADG), feed conversion (FC), feed efficiency (FE), hot carcass yield (HCY) and cold carcass yield (CCY). Animals were slaughtered with an average liveweight of 40.23 ± 4.24 kg. The data were analyzed by using the Proc Mixed from SAS/STAT, and a means comparison with *t*-test (PDIFF). The T3GU had the lowest ($P \leq 0.05$) DMI (1.18 kg) compared with the other treatments, which averaged 1.27 kg. The ADG was not different ($P \geq 0.05$) among treatments (268 g on average). The FC was higher ($P \leq 0.05$) for T2GS (5.22 kg) compared with the other treatments, which averaged 4.60 kg. The T2GS had the lowest ($P \leq 0.05$) FE (195 g/kg) compared with the other treatments, which averaged 220.6

g/kg. The HCY and CCY was higher ($P \leq 0.05$) for T3GU with 52.61 and 50.86% respectively. The results suggest that the use of fodder tree is an alternative for feeding Pelibuey sheep because they do not alter finishing performance and, at the same time, their use may decrease feeding costs. It is important to explore their effects on meat quality.

Key Words: sheep, tannins, performance

T94   Effects of tannin deactivation by alkaline chemicals on in vitro dry matter and organic matter digestibility in sainfoin (*Onobrychis vicifolia*). H. Khalilvandi-Behroozyar*[1,2], M. Dehghan-Banadaky[1], and K. Rezayazdi[1], [1]*Department of Animal Science, University of Tehran, Karaj, Tehran, Iran,* [2]*Department of Animal Science, University of Urmia, Urmia, West Azerbaijan, Iran.*

Nutritive value of forages for ruminant animals is inherently variable and depends on many factors including antinutritional factors. Sainfoin is a temperate legume forage, with medium to high concentrations of condensed tannins (CT). The objective of present study was to examine the effectiveness of tannin deactivation on nutrient availability from sainfoin. Second cut forage was shade dried and chopped (3 –5 cm length). Forage samples (1 kg, in 3 replicates) were exposed to $KMnO_4$ (0.03 M) and NaOH (0.05 M) solutions and water with forage to reagent ratio of 1:4 (wt/vol). The pH of solutions were determined (12.28 and 12.04 for NaOH and $KMnO_4$, respectively). All of the treatments were carried out in triplicate, in 25°C temperature, for 20 min, with hand shaking. Treated forages were then exposed to 40°C temperature in a forced air oven, for 48 h. All forage samples were ground to pass 0.5 mm screen size (ball mill) for determination of CT concentration using Butanol-HCl reagent. Also grinding with 1 mm laboratory mill was done for in vitro digestibility trial. The in vitro digestion technique used was that of Tilley and Terry (1963) as modified by Wilkins (1966) in triplicates. Rumen liquor was withdrawn from 2 rumen-fistulated Holstein cows fed a balanced diet, exceeded maintenance requirements (CNCPS) in 2 equal meals. Rumen fluids were mixed and then squeezed through 4 layers of cheesecloth. Completely randomized design, GLM PROC of SAS and Duncan's test were used for data analysis ($P \leq 0.05$). Untreated forage have CT concentration of 21.3+0.4 g/kg dry matter, but both the chemicals and water reduced CT levels more than 90 percent. In contrast, treatments were failed to significantly affecting dry matter and organic matter digestibility. It seems that in vitro digestibility (Tilley and Terry) overestimates OM digestibility of untreated tanniferous forages. This effect was explained by rapid passing of phenols through filter paper that entered the digestible fraction. In vitro gas production technique may be a suitable substitute.

Table 1. Effect of treatments on CT content and in vitro digestibility of DM and OM (means ± SD, g/100 g)

Treatment	CT	DMD	OMD
Control	2.13[a] ± 0.041	75.6 ± 0.83	68.9 ± 1.24
NaOH	0.13[c] ± 0.001	75.7 ± 2.43	69.8 ± 1.53
$KMnO_4$	0.16[b] ± 0.011	75.2 ± 2.06	69.9 ± 2.02
Water	0.17[b] ± 0.012	76.7 ± 1.98	69.8 ± 2.74

[a–c]Means within each column with different superscript letters are statistically different (P ≤ 0.05).

Key Words: sainfoin, tannin, digestibility

T95   Different rumen environments can cause different degradation profile of dry matter from tanniferous forages. H. Khalilvandi-Behroozyar*[1,2], M. Dehghan-Banadaky[1], and K. Rezayazdi[1], [1]*Department of Animal Science, University of Tehran, Karaj, Tehran, Iran,* [2]*Department of Animal Science, University of Urmia, Urmia, West Azerbaijan, Iran.*

Conventional in situ degradability methods have some problems in the case of tanniferous feeds because of small sample weight in nylon bags and dilution of antinutrients in rumen fluid. Thus we use another method to assess tannin effects on DM degradability in sainfoin. Second-cut sainfoin was dried and chopped (3–5cm length). Polyethylene glycol (PEG) solution in distilled water [6000 MW, 5% (wt/vol), volume to forage weight ratio of 1:1] and distilled water (volume to forage weight ratio of 4:1) were used to treat forage samples. Treatments were carried out at an ambient temperature for 20 min with hand shaking for water and overnight for PEG. Extractable condensed tannin content was determined using butanol-HCl reagent. An in situ experiment was done in 3×3 change-over design. Three ruminally fistulated Holstein cows (multiparous, 680 ± 20kg of BW) were used with 10 d for adaptation and 7 d for nylon bag incubation, each period. Forages were fed as sole diet (equals at 0800 and 1600) along with mineral/vitamins to meet 110% of the animal's maintenance requirements. CT content of untrated forage was 21.3, which water and PEG decreased it to 1.7 and 0.3 g/kg DM, respectively. Untreated Forage samples were ground to pass 2 mm screen (Wiley mill) and sieved to remove particles <50 μm. Five gram of samples weighed into nylon bags (10×20cm, 50 μm pore size) with sample size:surface area of 12.5 mg/cm^2. Duplicates were incubated for 4, 8, 12, 24, 48, 72 and 96h in ventral rumen. Degradation profiles were calculated by the nonlinear model of Ørskov and McDonald (1979). The effective degradability (ED) was calculated using NEWAY package. PROC MIXED of SAS 9.1 (2002) was used to statistical analysis at 0.05 probability level. Degradation rate increased from 0.0626[b] (control) to 0.0751[b] and 0.0961[a] h^{-1} and lag time decreased from 2.4[a] h (control) to 1.33[b] and 0.8[b] h for water and PEG, respectively ([a] and [b] indicate statistical differences between treatments). PEG significantly increased ED from 52.43 to 55.9 and from 47.93 to 51.60 in outflow rates of 0.05 and 0.08 respectively (relative to control). We concluded that PEG and water treatments diminished phenolic compound effects on rumen environment and can increase nutrient availability in situ due to increased microbial activity and nutrient availability.

Key Words: sainfoin, degradability, tannin

T96   Comparisons of metabolizable energy estimates for sainfoin (*Onobrychis viciifolia*) from different in vitro and in vivo methods. H. Khalilvandi-Behroozyar*[1,2], K. Rezayazdi[1], and M. Dehghan-Banadaki[1], [1]*Department of Animal Science, University of Tehran, Karaj, Tehran, Iran,* [2]*Department of Animal Science, University of Urmia, Urmia, West Azerbaijan, Iran.*

Sainfoin (*Onobrychis viciifolia* is a non-bloating member of the Fabaceae family. Limitations in nutrient availability data, limited the inclusion of sainfoin in balanced rations. The aim of the present study was to determine and compare the ME content of sainfoin with different methods. Forages were taken from farms (6 farms, 4 samples from each) in Isfahan, Iran. Shade dried, baled and representative samples were obtained and cut into 30–50mm lengths. Chemical analysis were done according to AOAC standard methods. Condensed tannin content was determined by butanol-HCl reagent (21.3 g/kg DM). Hay samples were milled through 2 and 1mm sieves for gas production and Tilley and Terry, respectively. Forages were incubated with rumen fluid in glass syringes following the procedures of Menke et al. Twenty-four hour gas

value ($34.9 \pm 1\cdot03$ mL) was used for ME determination using equation 1, ME = $2.2 + 0.1357$ GP$_{24}$ + 0.0057 CP (g/kg DM) + 0.0002859 EE^2(g/kg DM) ; equation 2, ME = $2.2 + 0.136$ GP$_{24}$ + 0.057 CP (g/100 g DM) + 0.0029 CP^2 (g/100 g DM) and indirectly by equations 3, OMD = $14.88 + 0.8893$ GP$_{24}$ + 0.448 CP (g/100 g DM) + 0.0651ash (g/100 g DM) and 4,ME = $0.0157 \times$ DOMD. The in vitro digestion technique used was that of Tilley and Terry (1963) as modified by Wilkins (1966) in triplicates. Three ruminally fistulated Holstein cows (multiparous, 680 ± 20 kg) were used in in vivo trial with 10 d for adaptation and 7 d for sample collection. Forages were used as the sole diet along with mineral/vitamins to achieve 10% more than maintenance energy requirements (NRC, 2001). Total fecal collection, acid insoluble ash (AIA) and chromium oxide were used for determination of OM digestibility. A comparison of means were undertaken using GLM procedure of SAS using a CRD design ($P \le 0.05$). Organic matter digestibility was 59.23, 59.36, 60.41 and 68.90 for total fecal, Cr2O3, AIA and Tilley and Terry, respectively. The content of digestible organic matter (DOM) was 643.7 g/kg DM, and estimated ME, from Tilley and Terry trial was 10.11 MJ/kg DM. Gas production gave mean estimates of 7.19 MJ/kg DM and the mean of in vivo measurements was 8.75 MJ/kg DM (table1). The OM digestibility in Tilley and Terry method was higher than values determined by in vivo and gas production profiles. Higher OM digestibilities determined by a filtration-based method such as Tilley and Terry for high tanniferous materials, was explained by rapid passing of phenols through filter paper that entered the digestible fraction. Low sample size especially in tanniferous plants can affect gas production results. It seems that in vivo methods are the best for ME estimation in the case of forages with antinutrients.

Table 1. Organic matter digestibility and metabolizable energy estimates of sainfoin with different in vitro and in vivo methods

	Gas production			Tilley and Terry	Total fecal collection	Chromium oxide	AIA	SEM	Error df
	(Eq. 1)	(Eq. 2)	(Eq. 3 & 4)						
ME (MJ/kg DM)	7.87[c]	8.04[c]	7.59[c]	10.11[a]	8.69[b]	8.71[b]	8.86[b]	0.222	12

[a–c]Means with different superscript letters are statistically different (P < 0.05).

Key Words: sainfoin, metabolizable energy, gas test

T97   Deactivation of tannins by chemical materials affect ruminal degradability kinetics and metabolizable protein profiles of sainfoin (*Onobrychis vicifolia*). H. Khalilvandi-Behroozyar*[1,2], M. Dehghan-Banadaky[1], and K. Rezayazdi[1], [1]*Department of Animal Science, University of Tehran, Karaj, Tehran, Iran,* [2]*Department of Animal Science, University of Urmia, Urmia, West Azerbaijan, Iran.*

Sainfoin (*Onobrychis viciifolia* Scop.) is tanniferous legume forage. There are few reports about effects of tannin destructive or binding matter on metabolizable protein profile of sainfoin. Second cut forage was shade dried and chopped (3 –5 cm length), and then exposed to solutions of KMnO$_4$ (0.03 M, pH 12.04), NaOH (0.05 M, pH 12.28) and water with forage to reagent volume ratio of 1:4 (wt/vol). All of above treatments were carried out in triplicates, in 25°C temperature, for 20 min, with hand shaking. Treated forages were then exposed to 40°C temperature in a forced air oven, for 48 h. All forage samples were ground to pass 0.5 mm screen size (ball mill) for determinations of condensed (CT) concentrations using Butanol-HCl reagent. Also grinding with 2 mm laboratory mill was done for in situ trial. Crude protein degradability was determined using 3 ruminally fistulated Holstein cows. Samples (5 g) were weighed into nylon bags and duplicates were incubated for

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4,8,12,24,48,72 and 96 in the ventral rumen. Effective degradability (ED) was calculated with NEWAY package. Degradation parameters then used to calculate QDP, SDP, RDP, ERDP, DUP, UDP and MP according to formula were presented by AFRC. GLM PROC of SAS and Duncan's Test were used for statistical analysis ($P \leq 0.05$). Control forage had CT concentration of 21.3+0.4 g/kg DM. Sodium hydroxide, $KMnO4$ and water decreased it by 93.79, 92.41, and 92.06%, respectively. Treatments increased degradability of sainfoin in all of the rumen incubation times (data not shown). Rapid degradable fraction increased with all of treatments. Slowly degradable fraction was not affected by treatments, but rate of degradation of this fraction significantly increased by water and NaOH. Also, treatments significantly improved effective degradability in different rumen outflow rates. All of the treatments improved protein metabolizability of sainfoin. Also, DUP (Digestible undegradable protein) /UDP (undegradable protein) ratio improved by water and $KMnO_4$. Despite that NaOH significantly reduced condensed tannins and improved degradability profiles, cannot increase metabolizable protein. This can be attributed to post ruminal behavior of NaOH treated proteins that reduced digestibility of undegraded protein content. Water as farm available material with no environmental hazard, greatly improved protein metabolism characteristics of sainfoin.

Table 1. Effects of tannin deactivation on MP fractions of sainfoin (g/100 g CP)

	QDP	SDP	RDP	ERDP	UDP	DUP	MP	DUP/ UDP (%)
Control	17.06[d]	21.15[b]	38.21[c]	34.80[c]	61.79[a]	27.78[b]	49.97[b]	44.96[b]
NaOH	40.04[a]	25.26[a]	65.30[a]	56.97[a]	34.70[c]	12.39[d]	48.90[b]	35.77[c]
Water	39.53[b]	26.53[a]	66.39[a]	58.16[a]	33.61[c]	21.42[c]	58.49[a]	63.04[a]
$KMnO_4$	31.78[c]	16.72[c]	48.49[b]	42.14[b]	51.51[b]	32.66[a]	59.51[a]	63.33[a]
SEM		1.44	1.49	1.43	1.46	1.29	0.38	1.29

[a–d]Means within each column with different superscript letters are statistically different ($P \leq 0.05$).

T98   Correlations between condensed tannins and CNCPS protein fractions of sainfoin.
H. Khalilvandi-Behroozyar*[1,2], K. Rezayazdi[1], and M. Dehghan-Banadaki[1], [1]Department of Animal Science, University of Tehran, Karaj, Tehran, Iran, [2]Department of Animal Science, University of Urmia, Urmia, West Azerbaijan, Iran.

Cornell Net Carbohydrate and Protein System (CNCPS) is a growing feed evaluation and ration balancing system in the world but there are few reports about sainfoin. In this study we examine the effects of chemical tannin deactivation methods on CNCPS protein fractions of sainfoin. Also, correlations between condensed tannin (CT) content, acid detergent insoluble nitrogen, neutral detergent insoluble nitrogen, crude protein content, etc. were calculated. Samples of forage were chopped 3–5 cm length, and then treated with solutions of $KMnO_4$ (0.03 M), NaOH (0.05 M), sodium bicarbonate (0.1 M), wood ash (180 g/L) and water with forage to reagent volume ratio of 1:4 (wt/vol). Five percent solution of PEG (6000 MW) was sprayed to forage with 1:1 ratio. Treatment with urea (20 g/100 mL/1 kg of DM) was done using adhesive rubber to create anaerobic conditions for 1 week. All forage samples were ground to pass 0.5 mm screen size. Determinations of CT content of treated and control forages were done using butanol-HCl reagent. The CNCPS protein fractions of sainfoin, determined according to standardized procedure where the A fraction (non-protein N) was determined using TCA solution. Results are presented as percentage of CP. Data was analyzed by SAS using GLM procedure for a completely randomized design ($P \leq 0.05$). In untreated forage a large portion of crude protein was in the C fraction, which is unavailable for animal. This can be due to condensed tannin- protein complexes. Treatments were improved nutritional availability of protein by decreasing the C and increasing the A and B3 fractions. Reduction of antinutritional factors greatly changed protein fractions of sainfoin. For exampleb treatment with water was resulted in 34.2, 1.3, 37.2, 17.1 and 10.2 percentage for A, B_1, B_2, B_3 and C sections, respectively. These values for untreated and PEG treated forage were 16.8, 9.7, 28.6, 13.9, 30.9 and 16.6, 6.7, 52.4, 13.6, 10.6, respectively (other data not shown). Protein content of C fraction had highly positive correlation with CT, ADIN, and NDIN. Conversely, A fraction had negative correlation with this fractions. Correlation coefficients in Table 1 showed that we can attribute increasing in A fraction and reduction of C fraction in treated forages to reduction of CT.

Table 1. Correlation coefficients between CNCPS protein fractions and antinutritional factors in sainfoin

	A	B1	B2	B3	C
CT	−0.261[NS]	0.262 [NS]	−0.367 [NS]	−0.153 [NS]	0.785***
CP	0.252 [NS]	0.359 [NS]	0.145 [NS]	- 0.309[NS]	0.059[NS]
NDF	0.417*	−0.072[NS]	−0.093 [NS]	0.477*	0.064[NS]
ADF	0.254[NS]	0.152[NS]	0.093 [NS]	0.225[NS]	0.368[NS]
NDIN	−0.361[NS]	0.535**	−0.359[NS]	0.310*	0.855***
ADIN	−0.503**	0.778***	−0.227[NS]	−0.269[NS]	0.952***

NS = nonsignificant; *$P \leq 0.05$; **$P \leq 0.01$; ***$P \leq 0.001$.

T99   Local equations to predict relative feed value for alfalfa in northern Mexico.
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Knowing the chemical makeup of alfalfa in the field allows dairy producers to pick up the best time to harvest and determine the price of the crop. The use of wet chemistry is time-consuming, so alternative methods such as the predictive equations of alfalfa quality (PEAQ) have been used. Using samples of alfalfa of 15 farms located in the region of Delicias, Chihuahua, Mexico, planted with either one of 2 varieties of alfalfa (excellent or multileaf excellent), local equations (LE) were developed, on the assumption that such equations should reflect more accurately the relationship of ADF and NDF composition to stem length and phenologic stage than equations from PEAQ. Sampling was conducted during one year of alfalfa production on 113 locations, starting at the end of February and ending in late October. Those equations were calculated for each variety and for the whole group (Table 1). Relative feed values (RFV) were calculated with ADF and NDF values obtained with laboratory analyses (LV), LE equations (both varieties and whole group) and PEAQ equations. No additional advantage in terms of accuracy ($P < 0.05$) was obtained when comparing values from equations for separate varieties or the whole group. Calculated values for both ADF and NDF using those obtained with LE were more accurate than those of PEAQ as compared with the laboratory values (LV), but RFV was better estimated with PEAQ than with LE (203, 196 and 198 for LV, LE and PEAQ respectively). Such contradictory response is due to the fact that LE equations rendered lower values for ADF than LV values (21.92 vs 22.03) whereas PEAQ rendered higher values than ¨true¨ values (LV) (24.58 vs 22.03). A general conclusion is that the use of LE does not have advantage over PEAQ

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Table 1. Local predictive equations of alfalfa quality

	Whole Group	R^2
ADF	Y =7.095+(0.23*SL)+(0.843*PS)	0.4783
NDF	Y = 11.887+(.276*SL)+(3.290 *PS)	0.5369
	Excellent Variety	
ADF	Y = 7.84+(O.217*SL)+(0.851*PS)	0.4597
NDF	Y = 12.908+(0.268*SL)+(3.081*PS)	0.4947
	Multileaf Excellent Variety	
ADF	Y = 2.162+(0.315*SL)+(0.264*PS)	0.6226
NDF	Y = 5.653+(0.353*SL)+(3.841*PS)	0.8235

SL = stem length in cm; PS = phenologic stage.

Key Words: alfalfa, local equations, RFV

T100   A simplified procedure for measuring NDF within in situ Dacron bags for corn plant components ground to 6 mm. L. J. Nuzback, W. M. Rutherford, and F. N. Owens,* *Pioneer Hi-Bred International, a DuPont Company, Johnston, IA.*

Direct assays of NDF within in situ bags could simplify measurement of in situ NDF disappearance by avoiding re-grinding, compositing, and repackaging of in situ residues for NDF analysis. We compared estimates of NDF using samples ground to 6 mm in 50 micron bags (ONDF) with measured aNDF (samples ground at 1 mm in F-57 bags) using 2 sample sets — 288 samples (whole corn plants plus plant parts) and 90 whole plant corn samples (11 hybrids harvested between 22 and 50% DM). For ONDF analysis, 4 replicate 0.5 g samples of each feedstuff ground to 6 mm in 50 micron Dacron bags (5 by 5 cm) were extracted using automated aNDF procedures (Ankom Technology, Macedon, NY). Residue weights were compared with aNDF values from a lab certified by the NFTA. For the first sample set, ONDF closely matched aNDF (ONDF = 1.089 ± 0.19 × aNDF − 5.77 ± 1.17; R^2 = 0.92; root MSE 4.0) but deviations from regression ($P < 0.05$) were detected in 2 cases. For corn cobs, ONDF exceeded aNDF by 4.4%, presumably reflecting wash loss of finely ground particles. For whole plant samples, ONDF exceeded aNDF by 3.6 and 4.2% in the 2 sample sets. This difference was negatively ($P < 0.001$) related to hemicellulose content of samples and may reflect either particle loss from finely ground samples or incomplete NDF extraction from coarsely ground samples. Though the absolute values differed slightly, correlations between ONDF and aNDF values were sufficiently high ($R^2 > 0.91$) to reliably rank samples and detect differences in NDF content of samples. Direct comparison of 48 h ruminal disappearance with 4 corn silage samples (54 to 68% in situ NDF disappearance) revealed similar means (56.7% in situ ONDF versus 56.4 in situ aNDF) and a high correlation ($R^2 = 0.87$). Through avoiding the needs for sample transfer, compiling multiple residues, and grinding, this modified procedure can simplify measurement of in situ NDF disappearance.

Key Words: NDF, in situ, digestibility

T101   Digestibility and fecal output prediction using acid-detergent lignin, alkaline-peroxide lignin, and acid-detergent insoluble ash in cattle offered bermudagrass hays of varying quality. J. Kanani*[1], D. Philipp[1], K. P. Coffey[1], E. B. Kegley[1], C. P. West[1], S. Gadberry[2], J. Jennings[2], A. Young[1], and R. Rhein[1], *[1]University of Arkansas, Division of Agriculture, Fayetteville, [2]University of Arkansas, Division of Agriculture, Little Rock.*

The potential of acid-detergent insoluble ash (ADIA), alkaline-peroxide lignin (APL), and ADL to predict DM digestibility (DMD) and fecal output (FO) by cattle offered bermudagrass [*Cynodon dactylon* (L.) Pers.] hay of different qualities was evaluated. Eight ruminally cannulated cows (594 ± 100.3 kg) were allocated randomly to 4 bermudagrass hay diets categorized by their low (L), medium low (ML), medium high (MH), or high (H) CP concentrations (7.9, 11.0, 13.0, and 16.4% DM, respectively). Diets were offered in 3 periods to provide 2 replicates per diet per period (n = 24). Cows were individually offered hay at a total of 2% of BW in equal feedings at 0800 and 1700 for a 10-d adaptation followed by a 5-d total fecal collection (TC) each period. Hay, orts, and feces were analyzed for ADL, APL, and ADIA concentrations. Actual DMI, DMD, and FO were determined based on hay offered, orts, and feces excreted. Recovery of APL, ADL, and ADIA were expressed as the ratio of the quantity of marker excreted per unit of marker consumed on percentage basis. Data for in vivo DMI, DMD, and FO were analyzed as a replicated 4 × 4 Latin square with one period missing using PROC GLM of SAS, with effects of cow, diet, and period in the model. Data for ADL, APL, and ADIA recovery and marker-based estimates of DMD and FO were analyzed using PROC GLM of SAS, where diet, marker, and the diet by marker interaction were included in the model. Diet affected actual DMI ($P = 0.02$), but not FO ($P = 0.16$), or apparent DMD ($P = 0.23$). Average ADL recovery differed from 100% ($P < 0.05$), and that of APL tended to differ ($P = 0.08$) from 100%, but ADIA recovery was not different from 100% ($P = 0.41$). Estimates of DMD and FO derived using APL and ADIA were not different ($P \geq 0.32$) from TC while those using ADL differed ($P < 0.05$) from that of TC. Therefore, ADIA and APL are potential internal markers to predict DMD and FO of bermudagrass of various qualities fed to cattle.

Key Words: acid-detergent insoluble ash, alkaline-peroxide lignin, bermudagrass digestibility

T102   Diurnal variation in fecal concentrations of indigestible-acid detergent fiber, acid-detergent insoluble ash, and alkaline-peroxide lignin from cattle offered bermudagrass hays of varying quality. J. Kanani*[1], D. Philipp[1], K. P. Coffey[1], E. B. Kegley[1], C. P. West[1], S. Gadberry[2], J. Jennings[2], A. Young[1], and R. Rhein[1], *[1]University of Arkansas, Division of Agriculture, Fayetteville, [2]University of Arkansas, Division of Agriculture, Little Rock.*

The effect of time of fecal sampling on the accuracy of indigestible acid-detergent fiber (IADF), acid-detergent insoluble ash (ADIA), and alkaline-peroxide lignin (APL) for the prediction of fecal output (FO) in cattle fed bermudagrass was evaluated. Eight ruminally cannulated cows (594 ± 100.3 kg) were allocated randomly to 4 bermudagrass hay diets having a wide range of nutritional value (CP content of 7.9 to 16.4% DM) providing 2 replicates per diet for 3 periods (n = 24). Cows were individually fed their respective hay at a total of 2% of BW in equal feedings at 0800 and 1700 for a 10-d adaptation period followed by a 5-d total fecal collection (TC) period in 2.7 × 4.3-m pens fitted with rubber mats. Fecal grab samples were taken each day of the fecal collection period at 0600, 1200, 1800, and 2400 either directly from the rectum or from fresh feces, and were composited by cow and time. Duplicate samples of each hay, ort, and fecal sample were incubated for 144 h in the rumen of 2 cows for each period (n = 6 cows), followed by a sequential analysis of NDF and ADF to obtain IADF. Additionally, forage, ort, and fecal samples were analyzed for concentrations of APL and ADIA. Time of sampling affected the concentration of IADF ($P < 0.01$) while ADIA and APL concentrations in fecal grab samples were not different ($P \geq 0.24$) across sampling times or from that in total feces. Estimates of DMD by a representative sample from TC and that from all grab sampling times and their different combinations were not different ($P \geq 0.46$) from actual DMD regardless of which internal

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marker was used. Also, FO estimated by in vivo, samples from TC, or samples from different sampling times, and all different combinations of sampling time were not different ($P \geq 0.22$) across internal markers. Therefore, there is little variation in concentrations of ADIA and APL in daily fecal excretion and a minimum of 2 fecal grab samplings daily can be used in the prediction of DMD and FO.

Key Words: bermudagrass digestibility, fecal sampling time, internal markers

T103   Evaluating particle size of dry and wet forages using the Ro-Tap separator and Penn State Particle Size Separator method. A. D. Kmicikewycz,* D. D. Maulfair, and A. J. Heinrichs, *Pennsylvania State University, University Park.*

Adequate particle length of forages is an important part of a total ration feeding program and is necessary for proper rumen function. There has been considerable effort exerted to developing laboratory and field-based particle sizing techniques that accurately determine particle size (PS) distribution. The objective of this experiment was to compare 3 different methods used by various laboratories to analyze PS distributions of samples of corn silage (CS) and haylage (H). Method 1 involved utilizing the Ro-Tap separator (W. S. Tyler, Mentor, OH) in determining dry CS and H PS. Method 2 utilized the Penn State Particle Size Separator (PSPS; NASCO, Inc. Fort Atkinson, WI) in determining the PS of wet samples of CS and H. Lastly, method 3 utilized the PSPS in determining the PS of dry samples of CS and H. Three replicates were evaluated for each sample, and the log of the mean cumulative percentage for each sieve was analyzed using GLM procedure in SAS. The 3 methods produced different PS distributions for both CS and H ($P < 0.01$), evidenced by differences in the slope of the distributions. The percentage of particles ≥ 1.18 mm was determined to be 89.8%, 98%, and 92% for CS and 81.4%, 96.9%, and 89.9% for H for method 1, 2, and 3 respectively. Each system of particle sizing of forages yields a different distribution, and results from different methods are not interchangeable.

Key Words: particle size, forage, analysis

T104   In vitro evaluation of *Miscanthus sacchariflorus* var. as a roughage source for ruminants. S. J. Oh,* J. H. Yang, A. R. Lee, C. H. Ryu, J. H. Lim, S. B. Cho, and N. J. Choi, *Department of Animal Science, Chonbuk National University, Jeonju, Korea.*

This study was conducted to evaluate newly developed germtype *Miscanthus sacchariflorus* var. as a roughage for ruminants. *Miscanthus* has been regarded as an environment friend and carbon neutral plant because it does not require nitrogen fertilizer during its growth. *Miscanthus* has been extensively researched in various industry areas such as paper, energy, building materials, and geotextiles, but there are few studies concerning *Miscanthus* as feed for ruminants. In this study, *Miscanthus* from 2 stages of growth (mid and late) was evaluated using in vitro rumen fermentation and rice straw was used as a reference roughage. So, 3 different roughage sources were used to examine their effect on rumen fermentation. All of experiment was conducted in triplicates with same rumen fluid and in vitro fermentative condition, and the results were analyzed using general linear model with SPSS program In vitro rumen fermentation was prepared with rumen fluid from a Korean native steer equipped with cannula. Total gas production, volatile fatty acid production, pH and ammonia nitrogen concentration were investigated during fermentation until 72 h. In acetic acid production, *Miscanthus* in mid growth stages (MM) showed similar patterns with that of rice straw (RS) but *Miscanthus* in late growth stage (ML) was significantly

lower than RS ($P < 0.05$). The propionic acid production in RS was significantly higher than *Miscanthus* regardless of growth stages ($P < 0.05$). In butyric acid production, iso-butyrate production in MM was significantly higher than RS, particularly in 72 h of fermentation ($P < 0.05$). Valeric acid production patterns showed similar with butyric acid production across treatments. In pH profiles, MM showed significantly higher than RS ($P < 0.05$). No difference was found in ammonia nitrogen production between MM and RS but that of ML was significantly lower than MM and RS ($P < 0.05$). Total gas production from MM and RS showed same each other but total gas in ML was significantly low ($P < 0.05$). As a result, *Miscanthus* in mid growth stage could be replaced with RS as roughage for ruminants.

Key Words: *Miscanthus sacchariflorus*, roughage, ruminant

T105   Relationship between dynamic degradation and 48-hour degradation of alfalfa hay in Holstein heifers. Y. Tian*[1], Z. Cao[1], S. Li[1], and S. Yan[2], [1]*State Key Laboratory of Animal Nutrition, College of Animal Science and Technology, China Agricultural University, Beijing, China,* [2]*College of Animal Science, Inner Mongolia Agricultural University, Huhhot, China.*

The objective of this study was to determine the relationship between dynamic degradation and 48 h degradation of alfalfa hay in Holstein heifers. Four Chinese Holstein heifers of average weight 600 ± 30 kg fitted with ruminal cannula were selected. Alfalfa hay samples (n = 9) were incubated in the rumen for 4, 8, 16, 24, 36, 48 and 72h by in situ nylon bag technique. The diet was formulated at a 4:6 (DM basis) concentrate to forage ratio according to $1.3 \times$ maintenance nutrients level. Data were analyzed by ANOVA and Regression analysis procedures (SAS 9.0). The results showed that the Crude protein (CP) degradation rate after 16 h tended to be stable ($P = 0.08$), and degradation rate of DM ($P = 0.08$), NDF (Neutral Detergent Fiber, NDF) ($P = 0.06$) and ADF (Acid Detergent Fiber, NDF) ($P = 0.09$) after 24 h tended to be stable. There was significant correlation between nutrient effective degradation rate and the degradation rate at 48 h in Holstein heifers ($P < 0.001$) (Table 1). In summary, the degradation rate at 48 h for alfalfa hay can be used to predict effective degradation rate.

Table 1. Regression analysis between effective degradation and degradation at 48 h of alfalfa[1]

Index	Regression Equation	R[2]	*P*-value
DM	y = 0.804x+1.990	0.978	<0.001
CP	y = 0.898x-4.645	0.995	<0.001
NDF	y = 0.767x-1.964	0.927	<0.001
ADF	y = 1.050x-12.346	0.929	<0.001

[1]Where y = representative effective degradation rate, x = 48-h degradation rate, $P < 0.05$ showed significant difference.

Key Words: alfalfa hay, degradation

T106   In vitro organic matter and nitrogen disappearance of Kenyan browse using rumen from goats ingesting grass versus browse. A. McEwin*[1], C. Wambui[3], J. P. Muir[2], J. Githiori[4], and B. D. Lambert[1,2], [1]*Tarleton State University, Stephenville, TX,* [2]*Texas Agrilife Research, Stephenville,* [3]*Edgerton University, Kenya,* [4]*International Livestock Research Institute, Kenya.*

In vitro organic matter disappearances (IVOMD) of browse species are often thought to be artificially low because of the presence of secondary plant compounds such as condensed tannins (CT). This

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project investigated how the diet of the wether donating the rumen fluid affected (IVOMD) and in vitro nitrogen disappearance (IVND) results of 11 Kenyan browse species with CT concentrations ranging from 0.2 to 11.9%. The trial consisted of comparing IVOMD and IVND using rumen liquor donated from ruminally cannulated goats that were either fed a Bermudagrass hay diet (no CT) or were allowed to graze freely on natural Texas browse (high CT levels). For 7 of the species, leaf IVOMD was greater ($P < 0.05$) for samples incubated in rumen liquor of goats fed hay but there were no differences ($P > 0.05$) for 2 species without CT or 3 species with CT. Nitrogen in vitro disappearance (as a proportion of the original N) was greater ($P < 0.05$) for 3 species when hay was fed the donor animal, greater 4 species when browse was used, and made no difference ($P > 0.05$) in 4 species, including those without CT. No consistent pattern was discernible between CT concentration and proportion of N disappearing in vitro. These results suggest that when looking IVMD and IVND in browse species that contain secondary compounds, which may interfere with rumen microorganisms, the diet of the rumen fluid donors sometimes but not always make a difference. Further research in needed into determining what factors in the CT or additional factors beyond CT produce differences in IVOMD and IVND.

Key Words: condensed tannins, organic matter disappearances, ruminant

T107   Chemical composition and in vitro gas production of mulberry (*Morus alba* sp.) leaves during regrowth. R. A. Gomes[1], M. H. M. R. Fernandes*[1], I. A. M. A. Teixeira[1], K. T. Resende[1], R. A. Reis[1], F. S. B. Rey[2], and D. C. Soares[1], [1]*UNESP/Sao Paulo State University, Jaboticabal, Sao Paulo, Brazil*, [2]*Faculdade de Medicina Veterinaria e Zootecnia/USP, Pirassununga, Sao Paulo, Brazil.*

Mulberry (*Morus* spp.) is the traditional feed for the silk worm, but its leaves have been widely used as feed for herbivorous animals in several countries, from the temperate areas through the tropics. An experiment was carried out to evaluate in vitro ruminal degradation and to chemically characterize fractions of mulberry leaves harvested at 30, 60, 90, and 120 d of regrowth. Four CHO fractions (A = nonstarch nonfiber CHO, B1 = nonfiber CHO minus sugar; B2 = available fiber and C = indigestible fiber) and 4 CP fractions (A = nonprotein N, B1+B2 = true rapidly and intermediate degraded protein, B3 = slowly degraded protein and C = unavailable protein) were evaluated according to their fermentation characteristics. Incubations were conducted in gas-tight bottles, and the gases accumulated were measured by a pressure transducer. Gas production was recorded from 2 to 124 h, every 2 h. Data were fitted to a modified dual pool logistic equation with a single pool using NLIN procedure of SAS. Polynomial contrasts were used to determine days of regrowth effects. Mulberry leaves had high crude protein (201 ± 5g/kg DM) and high potential of gas production (255 ± 20mL/g DM). Leaves B2(108 to 146 g/kg DM) and C (90 to 108 g/kg DM) carbohydrate fractions increased linearly ($P < 0.05$), and CP (224 to 191 g/kg DM) and degradation rate of non-structural carbohydrates (17 to 8%) decreased linearly ($P < 0.05$) as days of regrowth increased from 30 to 120 d. There was no effect of days of regrowth on leaves CHO fractions A (148 ± 10 g/kg DM) and B1 (280 ± 15 g/kg DM), and protein fractions B1+B2 (49 ± 4 g/kg DM), B3 (48 ± 3 g/kg DM) and C (22 ± 2 g/kg DM), in vitro organic matter digestibility (65 ± 3%) and total gas production ($P > 0.05$). A high proportion of protein fractions A and B1+B2 (up to 62%) relative to the total CP was observed. We concluded that mulberry is a good quality forager, and could be recommended as a protein supplement in ruminant diets based on poor quality forages.

Key Words: carbohydrate, in vitro gas production, protein

T108   Methane-generating potential of *Lotus subbiflorus* 'El Rincón' (LR) and *Lotus uliginosus var. Maku* (LM) harvested in spring. M. de J. Marichal*[1], R. Crespi[1], G. Arias[1], S. Furtado[1], M. H. Guerra[1], and L. Piaggio[2], [1]*Facultad de Agronomía, Universidad de la República, Montevideo, Uruguay,* [2]*Secretariado Uruguayo de la Lana, Montevideo, Uruguay.*

The objective of this study was to evaluate the methane generating potential of forage of *Lotus subbiflorus* 'El Rincón' (LR) and *Lotus uliginosus var. Maku* (LM). Three replicate plots (2×2 m) of each Lotus were seeded in August at the Experimental Research Center of the Secretariado Uruguayo de la Lana (S 33° 52·, W 55° 34·). In October, forages were first harvested (plant heights 20 ± 5cm) at ground level using a manual scissor, dried at 60°C (48 h), ground (2 mm screen) and analyzed for NDF, ADF and H_2SO_4 soluble lignin (Lig_{sa}). An in vitro gas production procedure was followed using rumen contents of 2 fistulated whethers fed alfalfa hay (17 and 45% CP and NDF, respectively). Rumen contents were collected 2 h after morning feed (alfalfa hay, 1.6 kg DM w[1]d[1], twice daily), in preheated (39°C) bottles, pooled and blended (less than 1 min) and strained using 4 layers of gauze all maintained at 39°C under CO_2. Samples (500 mg, milled 2 mm) were weighed into 125 mL serum bottles, mixed with ruminal fluid (10mL), and buffer solution (40 mL) and reducing solution (2 mL) of Goering and Van Soest, at 39°C under CO_2. Three batches of 24 of bottles (in each batch 3 bottles by experimental forage and replicate, 3 with alfalfa as standard, and 3 blanks) were incubated (water bath, 39{oC, continuous stirring) for 24 h. Gas was collected at 8 h, and from 8 to 24 hs of incubation in separated bottles and methane in accumulated gas was measured by gas chromatography. Methane production at 8, 8 to 24 and overall 24 h and fiber fractions were analyzed in a complete randomized design (PROC GLM, SAS; Tukey test). Fiber fractions were similar ($P > 0.20$) for both species (47.8 and 44.4; 36.3 and 31.2, and 20.1 and 17.1% NDF, ADF and Lig_{sa}, respectively). In gas accumulated up to 8 h, methane production from LR was greater ($P = 0.01$) than for LM (9.2 and 7.6 mg CH4 g OM[1], respectively); however, no differences $P > 0.30$) were registered neither in gas accumulated from 8 to 24 h (10.8 and 10.9 mg CH4 g OM[1], respectively) nor in overall 24h (20.1 and 18.5 mg CH4 g OM[1], respectively) methane production. Both species seemed to be similar in their support of ruminal methane production.

Key Words: methane, *Lotus subbiflorus*, *Lotus uliginosus*

T109   Factors affecting in vitro undigested NDF as estimates of indigestible NDF. D. R. Mertens*[1], D. Taysom[2], and B. Steinlicht[2], [1]*Mertens Innovation & Research LLC, Belleville, WI,* [2]*Dairyland Laboratories Inc., Arcadia, WI.*

Objectives were to evaluate the effects of run (1 vs 2), time (120 vs 262h), single vs double inoculations, blank-correction (bc), ash-correction (om) and substrates on in vitro undigested NDF (uNDF) as estimates of indigestible NDF. Two sources of wheat straw (WS), corn silage (CS), alfalfa haylage (AH), grass hay (GH) and distiller's grains (DG) were fermented in flasks using the method of Goering and Van Soest (1970) with the modification that a composite inoculum containing strained ruminal fluid and blended ruminal solids from 3 steers was used. Donors were fed a TMR (12% CP, 43% aNDF and 18% starch - DM basis). The 262h fermentation was inoculated at 0h (262S), or 0 and 120h (262D), and the 120h fermentation was inoculated at 0h (120S). Two replicates (0.5g) were fermented in each of 2 in vitro runs that were 39d apart. Residues were extracted in neutral detergent with amylase and sulfite and were collected in crucibles with Whatman GF/C filters. Results were analyzed using mixed models with replicate-within-run as a random effect. Blanks were typically greater than zero, and differed by run,

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time and inoculation ($P < 0.01$). As a fraction of DM, uNDFbc at 262S varied from 0.034 for DG to 0.362 for WS. Blank corrections were large compared with the small uNDF residues of DG yielding erratic results. Results for WS, CS, AH and GH were pooled to evaluate factors affecting uNDF. All uNDF at 120h were larger than those measured at 262S or 262D ($P < 0.0002$). Both uNDF and uNDFom were larger for 262D compared with 262S ($P < 0.0001$). When blank-corrected, uNDFbc ($P = 0.34$) and uNDFombc ($P = 0.27$) were not different between 262D and 262S. Runs differed for all measures of uNDF ($P < 0.04$), while replicates within run did not ($P < 0.63$). Extending fermentation from 120 to 262h reduced uNDF by 5 to 15%; however double inoculation provided minimal reduction. The SEs of LSMeans were lower for 120S and for ash-corrected uNDF. We concluded that blank-correction was critical for the measurement of uNDF and that at least 3 blanks are needed per run. For robust results, uNDF should be replicated across rather than within runs.

Key Words: indigestible NDF, fiber, forage evaluation

T110   Intensive milk production on marandugrass pasture during the rainy season. C. A. M. Gomide*[1], A. J. Anjos[2], K. G. Ribeiro[2], E. A. Salgado[1], M. J. F. Morenz[1], and D. S. C. Paciullo[1], *[1]Embrapa Dairy Cattle, Juiz de Fora, Minas Gerais, Brasil, [2]UFVJM, Diamantina, Minas Gerais, Brasil.*

The efficient exploitation of the potential forage production of tropical grasses can bring a great benefit to the producer. Besides the increase in production per area, it is possible to increase the area required to produce forage for the dry season. The objective of this study was to assess milk production, per cow and per hectare, in pasture of *Brachiaria brizantha* 'Marandu' managed under rotational stocking with a fixed rest period of 30 d or variable according to the light interception (LI) of 95% by the canopy. In both treatments, the grazing period was 3 d with 4 Holstein × Zebu cows per paddock. The average size of paddocks was 850 m[2]. Assessments were made in summer-autumn period of 2010–2011, considering 5 grazing cycles. The experimental design was randomized blocks with 2 repetitions of the area. To evaluate the milk production each cow was considered as a repeat. Data were analyzed as repeated measures (grazing cycles) using the Mixed Procedure of SAS. Means were estimated using the "LSMEANS" command and comparisons made with Student *t*-test with a 10% significance level. The average milk production per cow did not differ between treatments with values of 15.3 and 14.6 L/day, respectively, for fixed and variable (LI) management. The average daily production decreased in response to grazing periods, from 15.8 to 13.8 respectively for the first and fifth cycle. The average rest period observed was 25.2 and 30 d for the treatment based on light interception and fixed interval, respectively. Consequently, the estimate of the stocking rate shows values of 5.1 and 4.1 cow/ha, representing an increase of 24% in favor of the management based on LI. Thus, the daily milk production per hectare has increased from 63.4 to 73.6 L in response to management that is based on pasture growth and not on pre-defined intervals. These results could be even better considering that in this year there was a long period without rain (38 d). Evaluations of the first year of study (2009–2010) showed an average rest period of 21 d for the management based on canopy light interception. Just as the production per cow, daily production per hectare decreased from 72.3 to 63.0 L in response to the grazing cycles. This reduction is due, in part, to the advancement of the growing season and reduced pasture growth factors. Support: FAPEMIG and CNPq.

Key Words: grazing cycles, light interception, rest period

T111   Nutrient digestibility of annual winter forages using different indigestible markers and fecal collection schedules in growing beef heifers. C. A. Njombwa, D. D. Henry,* F. M. Ciriaco, V. R. G. Mercadante, K. M. Bischoff, G. H. L. Marquezini, M. Ruiz-Moreno, G. C. Lamb, and N. DiLorenzo, *University of Florida, North Florida Research and Education Center, Marianna.*

Twelve Angus and Angus-crossbred heifers ($364 ± 52$ kg of BW) were used to determine the effects of indigestible markers and fecal sample collection schedules on apparent total tract digestibility of nutrients in 3 annual winter forages. The study was conducted at the University of Florida Feed Efficiency Facility (FEF). Winter forages consisted of ryegrass, a blend of ryegrass and Trical 342 triticale, and a blend of oat and ryegrass planted in 0.7-Ha paddocks. On d 0 heifers were randomly assigned to their forage treatments and allowed to graze for 28 d. On d 29 heifers were moved to the FEF (2 heifers/pen) and from d 29 to 44 were offered daily fresh cuts of the same forages. Individual intake was monitored in the FEF using a GrowSafe system (GrowSafe Systems Ltd., Alberta, Canada). From d 29 to 44, heifers received 10 g/d of Cr_2O_3 and 10 g/d of TiO_2 via a gelatin capsule and a balling gun. Feed and fecal samples were collected from d 39 to 43 and 40 to 44, respectively. Fecal samples were collected by rectal grab at 0800, 1200 and 1600 h, and composited within heifer using 2 samples/d (2s; 0800 and 1600 h only) or 3 samples/d (3s; all samples). Data were analyzed as a split-split plot design with the whole plot testing forage treatment effect, the split plot testing the fecal collection schedule (2s vs. 3s) and the split-split plot testing the marker (Cr_2O_3 vs. TiO_2) using heifer as the experimental unit. No effect of treatment was found ($P > 0.05$) for DM, OM, NDF or ADF digestibility of winter forages. Across forage treatments, mean apparent nutrient digestibility in the total tract were 59 ± 5.9%, 62 ± 5.8%, 48 ± 9.9%, and 27 ± 14.7% for DM, OM, NDF, and ADF, respectively. No effect of marker, sampling schedule, or marker x sampling schedule interaction was found for nutrient digestibility ($P > 0.05$). In conclusion, collecting fecal samples at 0800 and 1600 h was sufficient for measuring digestibility in winter forages. Both Cr_2O_3 and TiO_2 may be used indistinctively to estimate digestibility of winter forages, however standard errors of the mean reported, especially for digestibility of fiber fractions may be of concern. The use of digestibility markers that associate more intimately with the forage (e.g., internal markers) should be tested in future studies.

Key Words: digestibility, winter forages, markers

T112   Estimating crude protein and fiber contents in Tifton-85 bermudagrass swards with a new portable chlorophyll meter. R. Silva[1], R. Rossiello[2], É. Junior[2], M. Morenz[2], and J. Costa Junior*[3], *[1]UFBA, Salvador, Bahia, Brazil, [2]UFRRJ, Seropédica, Rio de Janeiro, Brazil, [3]UFRGS, Rio Grande do Sul, Brazil.*

Traditional methods for determining the nutritional value are costly and time consuming, so several indirect methods are under study. This study aimed to evaluate the performance of a new model of portable chlorophyll meter as a fast and inexpensive procedure for the assessment of nutritional attributes of Tifton 85 bermudagrass (*Cynodon* spp. 'Tifton 85'). Data were obtained from a field trial where treatments consisted of 3 levels of soil N availability: low (native soil N); medium (75 kg N/ha/cutting), and high (150 kg N/ha/cutting). Measurements were performed in 2 successive regrowth periods, with duration of 28 and 29 d, respectively, in the rainy season. Chlorophyll meter readings (FCI values - Falker chlorophyll index) were taken in the uppermost fully expanded leaf. Correlation analysis showed significant relationships between FCI values and acetone 80% extractable–total chlorophyll ($r = 0.83$; $P < 0.0001$); crude protein (CP) contents that oscillated between

100.2 and 183.5 g/kg DM also showed significant relationships (r = 0.85; $P < 0.0001$); neutral detergent fiber (NDF) and acid detergent fiber (ADF) contents whereas lignin contents did not showed consistent associations. Crude protein contents were determined from N-Kjeldahl analysis, and the NDF, ADF and lignins by the method of Van Soest et al. (1991), in dried and ground samples. The results obtained were first subjected to standard normal distribution tests and after processed for variance analysis (F test, $P \leq 0,05$). The averages were compared through SNK test (a = 0,05) for the N variables and cut period, respectively. The programs used for data analysis were SAEG v.9.1 (UFV, 2007) and Graph Prism 5.0. Taken together, these preliminary results showed the feasibility of using this new chlorophyll meter to predict CP and ADF contents in Tifton 85 bermudagrass. However, there is need of more research to validate the use of a chlorophyll meter with other fibrous fractions.

Key Words: *Cynodon* spp., total chlorophyll, fibrous fractions

T113   Mixed silage of potato residue and corn straw affects growth performance and blood biochemical parameters in mutton sheep. D. Wang[1,2], J. Q. Wang*[1,2], D. P. Bu[2], Y. D. Zhang[2], P. Sun[2], and L. Y. Zhou[2], *[1]College of Animal Science and Technology, Heilongjiang Bayi Agricultural University, Daqing, Heilongjiang, China, [2]Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

This study was conducted to determine the effects of mixed silage with potato residue and corn straw on growth performance and blood biochemical parameters in mutton sheep. A total of 40 healthy White-Suffolk cross sheep within initial body weight (47.45 ± 6.38 kg) were randomly allocated into 4 treatments with 10 replicates per treatment and 1 sheep per replicate. The feeding trial lasted for 70 d. Four treatments included: 1) control group(Ctrl), 40% basal diet + 60% corn silage; 2) test group 1 (S25), 40% basal diet + 45% corn silage + 15% mixed silage; 3) test group 2 (S50), 40% basal diet + 30% corn silage + 30% mixed silage; 4) test group 3 (S75), 40% basal diet + 15% corn silage + 45% mixed silage. Data were analyzed using MIXED procedures of SAS (SAS Institute, 2001). The ADG of S75 group was increased by 14.29% compared with Ctrl group ($P < 0.05$). There was no difference in the dry matter intake (DMI) ($P > 0.05$). The ammonia-N content in S25, S50 and S75 groups was significantly lower than that in Ctrl group by 18.92% ($P < 0.01$), 30.17% ($P < 0.01$) and 33.03% ($P < 0.01$), respectively. No remarkable differences were observed in acetate content, propionate content, butyrate content, acetate percentage, propionate percentage, butyrate percentage, the ratio of acetate to propionate and the ratio of acetate to propionate and butyrate ($P > 0.05$). There was no significant difference in serum total protein ($P > 0.05$). On the sixtieth day of the trial, serum urea nitrogen content was greater in S25 and S75 groups than that in S50 and Ctrl group($P < 0.05$) and serum glucose contents of S75 group was improved compared with the other 3 groups ($P < 0.05$). In conclusion, the mixed silage with potato residue and corn straw can increase ADG, serum urea nitrogen content, serum glucose contents and decrease the ammonia-N content of mutton sheep. Therefore, the study suggests that the mixed silage with potato residue and corn straw can account for 75% of corn silage in the mutton sheep diet.

Key Words: potato residue, fermentation quality, blood biochemical parameters

T114   Effect of different fat protected sources on milk yield and composition in goats fed on corn silage as based diet in dairy goats. C. Vázquez-Fontes*[1], R. Ayala[2], A. Z. M. Salem[2], N. Pescador-Salas[2], L. R. Bernal-Martínez[1], and M. Gonzalez Ronquillo[2], *[1]Universidad Autonoma del Estado de Mexico, Facultad de Ciencias Agrícolas, [2]Facultad de Medicina Veterinaria y Zootecnia, Toluca, Estado de Mexico, Mexico.*

High quality milk and dairy products are nutritious and healthy foods that are frequently consumed by people who desire healthy products. In ruminant, fats are the major source of CLA in the human food. Canola and Safflower oil has the highest source of polyunsaturated fatty acids (PUFA) than that found in any other type of vegetable oil (i.e., almost 79% PUFA). The available evidence suggested that increase the intake of 18:2n-6 in high-forage diets could be used as a nutritional strategy for enhancing the supply of *cis*-9,*trans*-11-CLA available for absorption. The objective of the present study was to determine the milk yield and milk composition in dairy goats, supplemented with different fat protected sources, Canola calcium soap (CS), Safflower calcium soap (SFS) or lactomilk (LM) rich in 16:0 fatty acid. Three lactating dairy French alpine goats (BW 54 ± 2 Kg) in 3 × 3 Latin square design were used. Goats were housed in an individual metabolic cages, and fed at 0800 and 1600 h, with free water access and milked daily at 0800 h. Diets (14% CP, 2.8 Mcal MEm) were formulated with corn maize silage ad libitum, supplemented with a concentrate based on corn grain (50%), barley hay (21%), soybean meal (20%) and minerals (3%) plus one fat protected source (6%). Each 20 d as experimental period consisted for 14 d for adaptation and ended with 6 d of samples collection. Individual intake and daily milk yield were recorded daily. Milk fat, true protein, SNF, was determined for infrared Milko-Scan 133B analyzer® (Foss Electric, Hillerød, Denmark). Data of each period was analyzed using proc GLM in SAS; LS means are reported in Table 1. Milk yield was higher ($P = 0.009$) in SFS versus with CS and LM, while fat content (g/d) was lower ($P = 0.001$) in CS versus SFS and LM; and true protein content (g/d) was also higher ($P = 0.003$) in SFS followed by LM and CS. Total solids and SNF (g/d) was higher ($P = 0.005$) in SFS compared with the other treatments. According to the present study SFS treatment increase milk yield and chemical composition versus CS and LM.

Table 1. Effect of different fat protected sources on milk yield (kg/d) and composition (g/d, %) in dairy goats

Item	CS	SFS	LM	SEM	P-value
Milk yield (kg/d)	0.949[a]	1.105[b]	0.883[a]	0.87	0.009
Fat (g/d)	32.3[a]	35.0[b]	34.3[b]	0.56	0.002
Fat (%)	3.5[b]	3.3[b]	4.1[a]	0.52	0.001
True protein (g/d)	29.8[a]	37.7[b]	34.6[c]	0.48	0.003
True protein (%)	3.3[b]	3.5[b]	4.1[a]	0.57	0.003
Total solids	111.3[a]	127.9[b]	113.6[a]	0.85	0.005
Total solids (%)	12.2[a]	12.0[b]	13.6[a]	1.75	0.049
SNF (g/d)	78.9[a]	100.5[b]	78.9[a]	0.96	0.002
SNF (%)	8.6[a]	9.5[a]	9.4[a]	0.91	0.002

Key Words: goats, safflower soap, sunflower soap

T115 Effect of oil palm (*Eleais guineensis*) effluent plus supplement in the feeding of pigs (Duroc x Pietrain) in the finishing phase during dry season. I. Espinoza,* R. Vivas, D. Zambrano, B. Montenegro, G. Muñoz, M. Romero, H. Medina, R. Soria, M. Medina, L. Godoy, and E. Torres, *Universidad Técnica Estatal de Quevedo, Quevedo, Los Ríos, Ecuador.*

This investigation was carried out at the "El Recuerdo" pig farm, located at one and a half mile at the Valencia - La Mana highway, province of Los Ríos, Ecuador. Its geographical location is 01° 6′ 20'' south latitude and 79° 29′ 23'' west longitude at 120 m above sea level and was conducted between August and October of 2010, lasting 56 d, including the period of adaptation. The effect of oil palm (*Eleaeis guineensis*) effluent (agro-industrial waste) plus supplement in the diet of pigs (Duroc × Pietrain) in the finishing stage during the dry season, along with the productivity indices (weight gain, feed intake, feed conversion, carcass yield and backfat) and cost/benefit ratio of the treatments under study were determined, assuming that with the implementation of one of the treatments under study production rates will be improved. Through an economic analysis of the treatments under study it was determined which of them improved the benefit / cost ratio. The treatments under study were 2 (T1: 2.5 kg of balanced feed plus 1 kg of oil palm effluent and T2: 2.5 kg of balanced feed plus 2 kg of oil palm effluent) compared with a control (2.5 kg of finishing phase balanced feed). A complete randomized block design was used in this study with 3 treatments and 6 replications. The highest feed intake in T2 ($P < 0.05$) and T1 in relation to the control, were because the pigs were influenced directly by the increased availability of food offered since the rations were larger in both cases. The total weight gains were similar ($P < 0.05$) in both treatments under study. However, there was a greater weight gain in the treatment supplemented with 1 kg of oil palm effluent surpassing the control with 3.67 kg. Besides a better feed conversion at 28 d in T1 ($P < 0.05$) was observed. In the variables carcass yield and backfat, no significant influences were observed when supplementing the diet of the pigs with oil palm effluent. The best cost / benefit ratio was achieved by T1 with 0.27.

Key Words: oil palm affluent, pig, supplement

T116 Planting date and crop harvest phenological stage effects on biomass and nutritive value of non-photosensitive forage soybean lines in Puerto Rico. A. Aponte, E. Valencia,* and J. Beaver, *University of Puerto Rico, Mayaguez, Mayaguez, PR.*

Forage soybean [*Glycine max* L. (Merr.)] has high potential for biomass production in the tropics, because, in a short period of time high quality hay can be produced for animal feed. However, in the tropics information on soybean for forage or grain is non-existent. Information of the effects of planting dates and crop harvest phenological stage (CHPS) on dry matter yield (DMY) of non-photosensitive soybeans are needed. This research assessed biomass production (Mg ha-1), crude protein (CP), neutral detergent fiber (NDF), and acid detergent fiber (ADF)] % of 10 non-photosensitive soybean lines at 2 CHPS and 2 planting dates on an Oxisol (Cotito series) at Isabela, Puerto Rico. The field design was a complete block with 4 replications in a split-plot arrangement of 10 forage soybean lines and 2 CHPS (R2 and R5.4); 100% flowering and 75% grain physiological filling, respectively. Planting dates were September 2010 and January 2011. For each planting date and CHPS, a 1.2 m^2 area was harvested from the main plot and fresh weight and a sub-sample (500g) taken. Subsamples were oven-air-dried to determine % dry matter (DM). Nitrogen % (Kjeldahl), NDF and ADF (Van Soest procedure) were determined in a commercial laboratory. The

data was analyzed using the Statistical Package, INFOSTAT. Unlike planting date, CHPS had a significant effect ($P < 0.05$) on the DMY. Soybean forage DM produced on average between 5.4 and 6.5 Mg/ha when harvested at the R2 (8 weeks) and R5.4 (12 weeks) stages of development, respectively. Maximum biomass was obtained at the R5.4 harvest with an increase in DM of 1.0 Mg/ha in 28 d. There was an interaction ($P < 0.05$) between the lines x CHPS for CP ranging from 29.6% to 33.6% for R2 harvest, while samples for the R5.4 harvest ranged from 23.0 to 26.7%. NDF in R2 stage ranged from 33.3 to 34.6, and increased in the R5.4 stage from 38.1% to 44.8%, while ADF for R2 ranged from 21.0% to 25.6%, whereas ADF increased from 26.2% to 33.2% for the R5.4 stage. These results indicate that biomass for soybean lines did not differ ($P > 0.05$) between planting date, but there was a marked effect of CHPS on DM yield. Forage soybeans harvested at the R5.4 versus the R2 stage of development had 60% more biomass, and higher nutritional value. Fiber values were similar to alfalfa and can satisfy the nutritional requirement of ruminants in the tropics.

Key Words: forage soybeans, phenological stages, nutritive value

T117 Nutritional characterization of pastures used in Colombian dairies with emphasis on fatty acid profile. E. A. De La Vega,* J. E. Parales, C. A. Mendoza, M. M. Knowles, G. J. Díaz, M. L. Pabón, and J. E. Carulla, *Universidad Nacional de Colombia, Bogotá, Cundinamarca, Colombia.*

Fatty acid profile of different pastures used in Colombian dairy farms and their relationship with grazing management strategies and altitude (meters over sea level; mosl) were examined. Forage samples of pastures were taken from 115 dairy farms in 5 dairy regions. Pasture type and management were characterized for each farm. Samples were oven-dried and analyzed for DM, NDF, ADF, CP, total fat and ash. Fatty acid profiles of the samples were determined using GC. The data were subjected to multivariate statistical analysis using the 2-stage cluster procedure. To define homogeneous clusters, we followed the Bayesian Information Criterion Schwarz including continuous and discrete variables. None of the variables measures related to grazing management were included as main grouping criteria. Five clusters were identified which main grouping criteria were the altitude and type of pasture. Cluster 1: lowland ($\mu \pm SD$; 442 ± 99 mosl) native pastures; cluster 2: medium altitude ($\mu \pm SD$; 874 ± 444 mosl) pastures composed mainly of *Brachiaria* spp.; cluster 3: upland pastures ($\mu \pm SD$; 2711 ± 144 mosl) composed mainly of *Lolium* spp. pastures and mixed pastures of *Pennisetum clandestinum* with *Trifolium pratense*; cluster 4: upland grasslands ($\mu \pm SD$; 2597 ± 88 mosl) consisting of monocultures of *Pennisetum clandestinum* and cluster 5: upland pastures ($\mu \pm SD$; 2605 ± 83 mosl) composed of mixtures of *Pennisetum clandestinum* and *Lolium* spp. Lipids of low land and medium altitude pastures had lower content of linolenic acid ($\mu \pm SD$; 20.1 ± 7.5 vs 35.6 ± 9.4 g/100 g FA) and higher in saturated fatty acids ($\mu \pm SD$; 59.8 ± 8.2 vs 45.4 ± 8.4 g/100 g FA) than upland pastures ($P < 0.05$). Most variable fatty acids in forage lipids were linolenic and palmitic acid. Degree of saturation was mainly explained by an increase in palmitic acid and a reduction in linolenic acid ($r^2 = 0.73$; $P \leq 0.001$). Low land and medium altitude pastures had higher levels of DM (17.5 vs. 24.7 g/100 g DM), NDF (56.8 vs 67.7 g/100 g DM), ADF (26.6 vs 36.6 g/100 g DM) than high altitude pastures ($P \leq 0.05$). Differing pasture species combinations at various altitudes resulted in variable nutritional quality and lipid profiles for dairy pastures in Colombia.

Key Words: fatty acids, forages, linolenic acid

T118   Effect of sowing density and planting date on the establishment of *Pennisetum purpureum* 'CT-115' in a semiarid region of northern Mexico. E. Gutierrez Ornelas*[1,3], J. J. Nava Cabello[1], R. Herrera[2,3], H. Bernal Barragan[1,3], E. Treviño Ramirez[1], and E. Olivares Saenz[1], [1]*Universidad Autónoma de Nuevo León, San Nicolás de los Garza, Nuevo León, México,* [2]*Instituto de Ciencia Animal, San José de Las Lajas, Habana, Cuba,* [3]*Red Internacional de Nutición y Alimentación en Rumiantes, México.*

The objective of the experiment was to evaluate the effect of 2 sowing densities ((D1 = 17,850 and D2 = 11,350 plants/ha) and 4 planting dates of King Grass, *Pennisetum purpureum* cv. CT-115 according to a completely random block design with a 4 × 2 factorial arrangement of treatments, where each planting date (July, August, September, and October 2009) was done under an area of 900 m[2], including 2 replications per density. Seven plants were randomly sampled in each of the 16 experimental units to estimate the interest variables. Basic climatic factors affecting establishment of non irrigated forages were registered. Forage establishment variables were measured during May 2010. On January 2010 lowest temperatures were recorded (−6°C) during 2 consecutive days without affecting viability of plants after re-growing conditions were present on April 2010. Sowing density only affected ($P \leq 0.05$) the proportion of senescence material (D1 = 15.8 vs. D2 = 11.4%) and dry matter production (D1 = 6.1 vs. D2 = 4.3 ton/ha). Dry matter percentage was affected ($P \leq 0.05$) by the planting time, having lower content than those plants planting on July and August. Leaf proportion was higher ($P \leq 0.05$) in July and August (57.7 and 58.5%, respectively) compared with September and October (44.6 and 43.7%, respectively). Leaf/stem ratio and the number of stems/plant were higher ($P \leq 0.05$) in the 2 first months of planting. It can be concluded that the better sowing density was D1. The lowest temperatures registered during January 2010 did not affect the establishment of *Pennisetum purpureum* 'CT-115' planted from July to October at the region of Marin Nuevo León, México.

Key Words: *Pennisetum purpureum*, cultivar CT-115, sowing density

T119   Effect of plant density over the productive performance of gliricidia. E. N. Muniz*[1], J. H. A. Rangel[1], D. O. Santos[1], C. O. Sá[1], and J. L. Sá[2], [1]*Embrapa Tabuleiros Costeiros, Aracaju, Sergipe, Brazil,* [2]*Embrapa Semi* Árido, *Petrolina, Pernambuco, Brazil.*

Gliricidia sepium (Jacq.) Walp. is a forage tree species very well adapted to water stress conditions, with high protein content in its leaves make it a low cost strategy for ruminant diets during drought periods. In northeast Brazil, gliricídia has been used as cattle and sheep food in silvopastoral systems, and also as silage or hay providing good dry matter productivity of high quality and good acceptance by animals. The present work aimed to evaluate the effect of different plant densities over the biomass and dry matter productivity of gliricídia. The trial was carried out without irrigation in a randomized block design with 4 replications in the Pedro Arle Experimental Station belonging to Embrapa Tabuleiros Costeiros at Frei Paulo County, Sergipe, Brazil. The densities of 10,000; 20,000; 30,000; and 40,000 plants/ha were tested. Fresh biomass and dry matter productivity of 6 harvests were evaluated for the growth period between 05/22/2009 and 03/22/2011. Cuts were done at 09/02/2009, 03/16/2010, 05/26/2010, 08/24/2010, 12/09/2010 and 03/22/2011. Mean values of cuts for total biomass, stem biomass, leaves biomass, leaves percentage and total dry matter per cut were presented in Table 1. Values of biomass productivity increased with the increase of plant density after the density of 20,000 plant/ha. Based on the results, it is recommended the density of 40,000 plants/ha of gliricidia for that condition.

Table 1. Means of biomass productivity of gliricidia at different plant densities

Treatment	Total biomass/ cut (t)	Stem biomass/ cut (t)	Leaves biomass/ cut (t)	Leaves (%)	Leaves DM/ cut(t)	Total leaves DM (t) 6 cuts
10000	21.54[b]	7.12[b]	14.41[b]	67.98[a]	3.02[b]	18.14[b]
20000	20.72[b]	6.56[b]	14.16[b]	68.49[a]	2.92[b]	17.53[b]
30000	25.19[ab]	8.05[ab]	17.15[ab]	69.05[a]	3.46[ab]	20.78[ab]
40000	27.28[a]	9.13[a]	18.15[a]	67.13[a]	3.75[a]	22.49[a]

[a,b]Means followed by the same letter in columns are not different by Tukey test ($P < 0.05$).

Key Words: dry matter, gliricidia

T120   Assessment of the socio-economic value of goods and services from Manitoba grasslands. S. Kulshreshtha[1], M. Undi*[2], J. Zhang[1], M. Ghorbani[1], K. M. Wittenberg[2], A. A. Stewart[3], E. Salvano[4], E. Kebreab[5], and K. H. Ominski[2], [1]*Dept of Bioresource Policy, Business and Economics, University of Saskatchewan, Saskatoon, SK, Canada,* [2]*Department of Animal Science & National Centre for Livestock and the Environment, University of Manitoba, Winnipeg, MB, Canada,* [3]*Shur-Gro Farm Services Ltd., Waskada, MB, Canada,* [4]*Manitoba Agriculture, Food, and Rural Initiatives, Winnipeg, MB, Canada,* [5]*Dept of Animal Science, University of California, Davis.*

Grasslands in Manitoba occupy 2.4 million ha and provide goods and services (G & S) that have direct and indirect monetary value. The objectives of this study were to a) provide a framework for comparing the value of G & S from grasslands by utilizing direct and indirect assessment, b) assess the value of Manitoba grasslands and the variables influencing value, and c) identify gaps in knowledge thereby improving estimates of grassland contribution to socio-economic well-being. Methods of valuation employed in the study were specific to the type of G & S examined. Market price was utilized to value grassland G & S where transactions occur in the marketplace while the benefit transfer method was used to infer non-market values of those G & S that are not typically sold through the marketplace. A total of 18 grassland G & S were identified for Manitoba grasslands, but only perennial forage production, carbon storage, nutrient cycling, water regulation, waste treatment, soil formation, erosion control, wildlife habitat, and recreation were included in the valuation. Genetic, medicinal, and ornamental resources, water supply (including filtration), nursery function, biological value, and many cultural services, while important, could not be assigned monetary value due to lack of data. The socio-economic value of grasslands in Manitoba was estimated to be $936 million yr^{-1} (equivalent to $390 ha^{-1} on average) with a range of $702 million to $2,518 million yr^{-1}. The 2 most highly valued G & S in Manitoba grasslands were carbon storage and forage production. More research will be required to further quantify carbon storage in Manitoba grasslands as well as assess the value of G & S not included in the above total value of grasslands.

Key Words: grassland, goods and services, socio-economic value

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