

treatment for similar levels of ADG for 35 weeks. Body weights and structural measurements were taken twice weekly and gains were computed as the linear regression of the measured value of interest against the days on trial. Initial (142 kg  $\pm$  5) and final BW (343 kg  $\pm$  5) were not different between treatments ( $P>0.20$ ) and ADG were similar between treatments (822 HC vs. 830 HF g/d  $\pm$  10;  $P>0.20$ ). Less DM was consumed by the heifers fed HC than for HF (5.41 HC vs. 5.95 HF kg/d  $\pm$  0.11;  $P<0.01$ ) at similar ADG leading to significantly

improved feed efficiency for the heifers receiving HC ( $P<0.01$ ). Daily gains of skeletal measurements were not different between treatments. Reproduction and first lactation data are also being monitored. From these results we conclude that feeding a HC ration leads to similar growth performance when the level of intake is restricted to achieve a controlled ADG.

**Key Words:** Dairy heifers, Forage:concentrate, Growth

## Ruminant Nutrition: Feedstuff Digestibility & Nutritive Value

**W212 Prediction of the nutritive value of maize stover using near infrared reflectance spectroscopy.** S. Fernandez-Rivera\*, G. Gebremariam, J. Hanson, and D. Negassa, *International Livestock Research Institute, Addis Ababa, Ethiopia*.

Our objective was to develop equations to calibrate near infrared reflectance spectroscopy (NIRS) instruments for predicting the nutritive value of maize stover. Two maize cultivars were grown in three replicates in one location in 2001, two cultivars in 12 farms in four locations in 2001 and eight cultivars in three replicates in one location in 2003. Stem, blade, husk and husk-less stover samples were taken at silk, dent and mature stages and analyzed for DM, OM, CP, NDF, ADF, ADL, true in vitro OM (TIVOMD) and NDF (NDFD) disappearance. They were scanned in a FOSS NIR System Model 5000 and absorbance was determined from 1100 to 2498 nm at intervals of 2 nm. Calibration results from principal component analyses using a mathematical treatment 1, 4, 4, 1 are presented in Table 1. Prediction equations were validated using an independent set of samples with n=232, 232, 231, 112, 48, 186 and 186 for OM, CP, NDF, ADF, ADL, TIVOMD and NDFD, respectively. Validation R<sup>2</sup> and SE of predictions were 0.98 and 0.61 for OM, 0.98 and 0.29 for CP, 0.89 and 3.93 for NDF, 0.94 and 1.78 for ADF, 0.87 and 0.62 for ADL, 0.86 and 3.10 for TIVOMD and 0.85 and 4.35 for NDFD. The NIRS equations developed can be used to predict the nutritive value of maize stover with acceptable levels of precision, but the precision is lower for NDF and NDFD than for OM, CP, ADF, ADL and TIVOMD.

**Table 1.**

Parameter	OM	CP	NDF	ADF	ADL	TIVOMD	NDFD
n	447	454	453	223	94	349	351
SEC	0.49	0.29	3.15	1.54	0.46	2.60	4.31
R <sup>2</sup>	0.99	0.99	0.93	0.98	0.94	0.90	0.86
SECV	0.56	0.33	3.51	1.92	0.53	0.88	4.75

SEC=SE of calibration, SECV=SE of cross-validation

**Key Words:** Crop residues, Maize, NIRS

**W213 Estimation of the nutritive value of cereals and wheat by products with or without oregano and rosemary supplementation.** A. Caputi Jambrenghi<sup>1</sup>, F. Giannico\*<sup>1</sup>, M. A. Colonna<sup>1</sup>, C. A. Marano<sup>1</sup>, L. Marvulli<sup>1</sup>, G. Cappiello<sup>2</sup>, and G. Vonghia<sup>1</sup>, <sup>1</sup>University of Bari, Bari, Italy, <sup>2</sup>Breeder Association of Taranto, Taranto, Italy.

Durum wheat is mainly imported in South Italy despite its production in the Apulian region. The new EU Common Agricultural Policy provides the same subsidy for any crop which respects good economic

and environmental conditions; hence the identification of crop systems which give a better yield and the choice to grow soft wheat and barley. Herbs and natural extracts typical of the Mediterranean area like oregano and rosemary act as antimicrobials, antioxidants and immunostimulators but their effects on rumen fermentation have been little investigated. The aim of the study was to evaluate the effect of sun dried oregano (OR) and rosemary (RO) (10 g/kg feed) on the nutritive value of local cereals (soft and durum wheat, barley, triticale) and derivatives from flour-milling (wheat middlings and bran). In vitro gas production was assessed by the Menke and Steingass (1988) technique, checked until 72 h and expressed as ml/g DM. The metabolizable energy (ME; MJ/kg DM) was calculated as: 1.06 + 0.157GP + 0.084CP + 0.22CF - 0.081CA, where GP is 24 h net gas production (ml/g DM), CP, CF and CA are crude protein, fat and ash (% DM), respectively. Data were processed by ANOVA according to a 6 (n. of feeds tested) x 3 (control, OR or RO supplementation) experimental model. Student's t test was used to compare differences between means. OR increased soft wheat ( $P<0.01$ ) and wheat middlings ( $P<0.05$ ) GP. The GP of barley was significantly depressed by OR and RO ( $P<0.01$ ). The ME values showed the same trend: OR improved the ME of soft wheat ( $P<0.01$ ) and of wheat middlings ( $P<0.05$ ), while OR and RO markedly decreased the ME of barley ( $P<0.01$ ). Durum wheat, triticale and wheat bran were not influenced by the herb supplementation. In conclusion, OR and RO affect rumen fermentation, but their effect on the activity of cellulolytic and amylolytic bacteria needs further study.

**Key Words:** Cereals and wheat by products, Nutraceuticals, In vitro gas production

**W214 Nutritive evaluation of different types of frost damaged wheat for ruminants: I. Chemical characterization, II. energy values, III. protein and carbohydrate subfractions, IV. rumen degradation kinetics, and V. modeling nutrient supply.** P. Yu\*, V. Racz, L. White, J. J. McKinnon, and D. A. Christensen, *University of Saskatchewan, Saskatoon, SK, Canada*.

In 2004, more than 50% of wheat was frost damaged (frozen) in Canada resulting in millions of tons of frozen wheat. There is an urgent need to fully evaluate the nutritive value of frozen wheat for ruminants. The objectives were to compare chemical characterization, rumen digestive behavior, and potential nutrient supply to ruminant animals between normal wheat and different types of frozen grain wheat. Results showed that the frozen wheat was lower in starch, non-structural CHO, NPN and higher in crude fat, ADF and NDF, lignin, ADIN and NDIN. The frozen wheat was lower TDN and energy values (DE3X, ME3X, NEL3X for dairy; ME, NEM, and NEg beef cattle). Partitioning protein and carbohydrate (CHO) fractions showed that the frozen wheat

was lower in extremely rapidly degradable CP (PA) and intermediately degradable CP (PB2) and higher in fast degradable CP (PB1), and unavailable CP (PC). The frozen wheat had lower intermediately degradable CHO (CB1), higher slowly degradable CHO (CB2) and unavailable CHO (CC). The *in situ* results showed that the frozen wheat had a different pattern ( $P < 0.05$ ) in rumen degradation kinetics of DM, CP and starch. The nutrient modeling results showed that total truly digested protein value (DVE) in the small intestine in the frozen wheat tend to be lower ( $P = 0.10$ ) (89 vs. 110 g kg<sup>-1</sup> DM) using the DVE/OEB system and total metabolizable protein (MP) (95 vs. 108 g/kg DM) in the frozen wheat was significantly lower ( $P < 0.05$ ) using the NRC (2001) model. The degraded protein balance was all negative [-6.1 vs. -0.4 (DVE/OEB); -18.6 vs. -15.5 g kg<sup>-1</sup> DM (NRC, 2001) for the normal and frozen wheat]. In conclusion, the frozen wheat differed in chemical characterization, energy values, protein and carbohydrate fractions, *in situ* degradation behavior and potential nutrient supply from the normal wheat. The cold weather caused wheat to significantly reduce nutrient contents and availability and thus reduce nutrient supply to ruminants.

**Key Words:** Frozen wheat, Protein and energy evaluation, Modeling nutrient supply to ruminants

**W215 In vitro digestibility of wet sorghum distillers grain.** C. R. Richardson<sup>1</sup>, J. H. Mikus<sup>1</sup>, D. W. Boyles<sup>2</sup>, A. T. Moore\*<sup>1</sup>, J. E. Vander Dussen<sup>3</sup>, H. P. Hagaman<sup>1</sup>, and B. S. May<sup>1</sup>, <sup>1</sup>Texas Tech University, Lubbock, <sup>2</sup>LDJ Nutrition, Lubbock, TX, <sup>3</sup>Rajen Dairy, Clovis, NM.

Two experiments were conducted to determine the *in vitro* dry matter digestibility (IVDMD) of wet sorghum distillers grain (WSDG) in a 90% concentrate diet, using established rumen fluid incubation procedures. In experiment 1, triplicate samples were used to evaluate WSDG at inclusion levels of 0, 5, 10 and 15%. The WSDG substrates were incubated in an artificially buffered rumen fluid solution for 12, 24, and 48 h. Treatments were all run in triplicate. Linear contrasts were different for times of 12 ( $P = 0.022$ ) and 48h ( $P = 0.007$ ). At 12h, the control diet had a slightly higher IVDMD than the incubation diets containing 5 or 10% WSDG (55.55, 53.76 and 53.14, respectively). When WSDG was added at 15% of the diet, IVDMD increased to 58.32%. Contrasts were not different for the 24h incubation time. At 48h, similar values for IVDMD were found for the control, 5 and 10% treatments (80.46, 78.12 and 79.12%, respectively). An increase in IVDMD was found at the 15% level of WSDG (81.88%). A second IVDMD experiment was conducted to further evaluate the digestibility of WSDG at the 24h incubation time. Five replications per treatment were used in this experiment. Other procedures were the same as used in the first experiment. Quadratic ( $P < 0.0001$ ) contrasts were different. Results were similar to those found in experiment 1 at the 24h incubation time (61.92, 58.76 and 61.76%) for the control, 5 and 10% levels. An increase in IVDMD was again found at the 15% inclusion level with WSDG (69.10%). Results from these IVDMD evaluations indicate that the WSDG can be used in 90% concentrate diets with little change in IVDMD at levels at 5 and 10%, but with possible improvement in digestibility when added at the level of 15%.

**Key Words:** Sorghum, Distillers grain, Digestibility

**W216 Monitoring the fate of gamma irradiated soybean meal proteins in the rumen.** P. Shawrang<sup>1</sup>, A. Nikkhab\*<sup>1</sup>, A. A. Sadeghi<sup>2</sup>, and G. Raisali<sup>3</sup>, <sup>1</sup>Tehran University, Karaj, Iran., <sup>2</sup>Islamic Azad University, Tehran, Iran., <sup>3</sup>Nuclear Research Center for Agriculture and Medicine, Iranian Atomic Energy Organization, Karaj, Iran.

The aim of this study was to evaluate effects of gamma irradiation on ruminal DM, CP and true protein degradability and intestinal CP digestibility of soybean meal (SBM). Gamma irradiation (g-irradiation) was carried out in a cobalt-60 irradiator. Three SBM samples (25% moisture content) were irradiated in a gamma cell at doses of 25, 50 and 75 kGy. Duplicate nylon bags of untreated or g-irradiated SBM were suspended in the rumen of four Holstein cows for up to 48 h. Intestinal CP digestibility was measured using mobile nylon bag technique. Proteins of untreated and treated bag residues were fractionated by sodium dodecyl sulphate-polyacrylamide gel electrophoresis. Fitting *in sacco* data to non-linear degradation model showed that the water soluble fractions decreased linearly ( $P < 0.001$ ) and the potentially degradable fractions of DM and CP increased linearly ( $P < 0.001$ ) by g-irradiation. Effective degradability of DM and CP decreased linearly ( $P < 0.001$ ) with increases in irradiation dose. Gamma irradiation at doses of 25, 50 and 75 kGy decreased effective degradability of CP at a ruminal outflow rate of 0.05/h by 18, 31 and 42% units, respectively. Gamma irradiation increased linearly ( $P < 0.001$ ) intestinal mobile bag digestibility of ruminally undegraded CP. At doses of 25, 50 and 75 kGy, CP digestibility increased by 4, 13 and 19% units, respectively. Electrophoretic analyses of untreated, 25, 50 and 75 kGy g-irradiated SBM protein residues revealed that three of subunits of  $\beta$ -conglycinin were degraded completely after 2, 4, 8 and 12 h, respectively. In untreated SBM, the acidic and basic subunits of glycinin were degraded in the middle of the incubation period, but in g-irradiated SBM were not degraded even after 48 h of incubation. In conclusion, SBM proteins appeared to be effectively protected from ruminal degradation by g-irradiation at doses higher than 25 kGy.

**Key Words:** Soybean meal, Gamma irradiation, Protein degradation

**W217 Monitoring the fate of gamma irradiated canola meal proteins in the rumen.** P. Shawrang<sup>1</sup>, A. Nikkhab\*<sup>1</sup>, A. A. Sadeghi<sup>2</sup>, A. Zareh<sup>1</sup>, and G. Raisali<sup>3</sup>, <sup>1</sup>University of Tehran, Karaj, Iran, <sup>2</sup>Islamic Azad University, Tehran, Iran, <sup>3</sup>Nuclear Research Center for Agriculture and Medicine, Iranian Atomic Energy Organization, Karaj, Iran.

This study was completed to evaluate effects of gamma irradiation on ruminal DM and CP degradation parameters of canola meal (CM). The DM of CM was determined by freeze drying a 1 g sample in duplicate. Based upon this value, sufficient water was added to increase the moisture content of CM to 200 g/kg. Gamma irradiation was carried out in a cobalt-60 irradiator. Three samples were irradiated in a gamma cell at doses of 25, 50 and 75 kGy in the presence of air. Duplicate nylon bags of untreated or irradiated CM (2-mm particle size) were suspended in the rumen of four dry Holstein cows for up to 48 h and resulting data were fitted to non-linear degradation model to calculate effective rumen degradation (ERD). Intestinal CP digestibility was measured using mobile nylon bag technique. Proteins of untreated and treated bag residues were fractionated by gel electrophoresis. The ERD of DM and CP decreased linearly ( $P < 0.001$ ) with increases in irradiation dose. There was a linear decrease in the water soluble fraction and a linear increase in the potentially degradable fraction

of CP ( $P < 0.001$ ). Gamma irradiation at doses of 25, 50 and 75 kGy decreased ERD of CP at rumen outflow rate of 0.05/h by 19, 27 and 32 % units, respectively. Gamma irradiation increased linearly ( $P < 0.001$ ) intestinal mobile bag digestibility of ruminally undegraded CP. At doses of 25, 50 and 75 kGy, CP digestibility increased by 5, 7 and 9%, respectively. Electrophoresis results of untreated, 25, 50 and 75 kGy g-irradiated CM protein residues showed that napin subunits of untreated CM disappeared completely within the shortest, whereas cruciferin subunits were degraded in the middle of incubation period. In gamma irradiated CM, napin subunits were degraded in the middle of incubation and cruciferin subunits were degraded in the longest incubation period. In conclusion, CM proteins appeared to be effectively protected from ruminal degradation by gamma irradiation at doses higher than 25 kGy.

**Key Words:** Canola meal, Gamma irradiation, Protein degradation

**W218 Effect of microwave irradiation on ruminal starch and protein degradation characteristics of barley grain.** A. Nikkha<sup>\*1</sup>, A. A. Sadeghi<sup>2</sup>, and P. Shawrang<sup>1</sup>, <sup>1</sup>Tehran University, Karadj, Iran, <sup>2</sup>Islamic Azad University, Tehran, Iran.

The present study was designed to evaluate the effects of 800 W microwave irradiation for 2, 4 and 6 min on ruminal crude protein (CP) and starch degradation characteristics of barley grain (BG). Duplicate nylon bags of untreated and microwave treated BG were suspended into the rumen of three Holstein steers from 0, 2, 4, 6, 8, 12, 16, 24 and 48 h, and data was fitted to exponential model to calculate degradation parameters of CP and starch. Intestinal CP digestibility was measured using mobile nylon bag technique. Proteins of untreated and treated bag residues were fractionated by gel electrophoresis. There were significant differences ( $P < 0.05$ ) between CP degradation characteristics of untreated, 2, 4 and 6 min microwave treated BG. Microwave treatments decreased wash-out fraction and increased potentially degradable fraction of CP. The degradation rate of the latter fraction decreased as processing time increased. As a consequence, the effective CP degradability of 2, 4 and 6 min microwave treated barley at an outflow rate of 0.05/h decreased by 18, 19 and 23% units compared to untreated BG, respectively. Wash out fraction, potentially degradable fraction and degradation rate of starch was affected with microwave irradiation. Effective rumen degradability of starch decreased ( $P < 0.05$ ) as microwave processing time increased. Microwave irradiation increased ( $P < 0.05$ ) intestinal mobile bag digestibility of ruminally undegraded CP of BG. From electrophoretic analysis, two major Hordein fractions contain B-Hordein and C-Hordein was observed. In untreated BG, all of Hordein fractions were disappeared after 6 h of incubation, but in microwave treated BG, C-Hordein were not degraded until 12 h of incubation in the rumen.

**Key Words:** Barley grain, Microwave irradiation, SDS-PAGE

**W219 Effect of ethanol treatments of soybean meal on rumen escape of soybean meal protein.** A. A. Sadeghi<sup>1</sup>, A. Nikkha<sup>\*2</sup>, and P. Shawrang<sup>2</sup>, <sup>1</sup>Islamic Azad University, Tehran, Iran, <sup>2</sup>Tehran University, Karaj, Iran.

Effects of ethanol treatment on the degradation kinetics of ruminal *in sacco* DM and CP of soybean meal (SBM) were determined. Soybean meal samples were soaked in 500, 600 or 700 mL/L ethanol solutions for 2 h. Duplicate nylon bags of untreated or treated SBM were

suspended in the rumen of four dry Holstein cows for up to 48 h, and resulting data were fitted to non-linear degradation model to calculate degradation parameters. Intestinal CP digestibility was measured using mobile nylon bag technique. Proteins of untreated and treated bag residues were fractionated by sodium dodecylsulfate-polyacrylamide gel electrophoresis. There were significant differences ( $P < 0.05$ ) for DM and CP degradation parameters between untreated and ethanol treated SBM. Regardless of the concentration, ethanol treatments applied to SBM decreased the water soluble fraction, the estimated rate of CP degradation, and effective degradable protein compared to untreated SBM. The lowest estimated rate of CP degradation and the calculated effective degradable protein were observed when SBM was treated with 600 mL/L ethanol solution. Extending the ethanol concentration over 600 mL/L to SBM was considered excessive. Ethanol treatment increased ( $P < 0.05$ ) intestinal mobile bag digestibility of ruminally undegraded CP. At concentration of 500, 600 and 700 mL/L, digestibility of CP increased by 4, 12 and 13% units, respectively. Electrophoretic analyses of untreated, 500, 600 and 700 mL/L ethanol treated SBM protein residues revealed that three of the subunits of  $\beta$ -conglycinin were degraded completely after 2, 6, 8 and 8 h, respectively. In untreated SBM, the acidic and basic subunits of glycinin were degraded in 8 and 12 h of incubation, but in treated SBM were not degraded even after 48 h of incubation. It was concluded that treatment of SBM with 600 mL/L ethanol solution had the greatest potential to increase rumen undegradable protein.

**Key Words:** Soybean meal, Ethanol treatment, Protein degradation

**W220 Nutritional value of tropical fruit processing by-products.** J. M. I. Sánchez<sup>\*1,2</sup> and C. Herrera<sup>1,3</sup>, <sup>1</sup>Universidad de Costa Rica, San José, Costa Rica, <sup>2</sup>Centro de Investigación en Nutrición Animal, San José, Costa Rica, <sup>3</sup>Escuela de Zootecnia, San José, Costa Rica.

Dairy cattle production systems under grazing conditions are usually energy deficient, mainly lacking non fiber carbohydrates (NFC). The production of tropical fruit juices and purees are important economic activities in extensive areas of the world. They provide substantial amounts of high moisture and energy by-products for dairy cattle feeding. To analyze the nutritional value of fresh green bananas, ripe banana peels, pineapple peels, whole cantaloupes and citrus pulp, a total of 40 samples was taken. Dry matter, CP, NDF, ADF, lignin, ether extract and ash were analyzed. Protein fractions were analyzed, while NFC and energy was estimated according to NRC (2001). Data was analyzed by a completely randomized experimental design. Means were compared using Scheffe's multiple range test. Green bananas, whole cantaloupes and citrus pulp had energy contents higher than 1.6 Mcal/ kg of DM of NE<sub>L</sub> 3X. More than 53% of the energy content in analyzed by-products was provided by sugars, pectin and starch. This can promote ruminal microbial growth and degradable protein utilization, increasing the feeding system efficiency. Non fiber carbohydrates levels for green bananas and citrus pulp were 79.6 and 72.4% of DM, respectively. Lush pastures usually have high levels of ruminal degradable protein; feeding proper amounts of NFC could improve the utilization of that protein. For by-products other than banana peels, lignin concentration was similar to what is found in common temperate and tropical pastures. Moreover, banana peels had one of the lowest energy contents and the highest proportion of protein fraction C.

**Table 1.**

By-product <sup>1</sup>	DM	CP	% of DM				NE <sub>L</sub> (3X)	NE <sub>M</sub>	NE <sub>G</sub>
			NDF	Lignin	NFC	NE <sub>L</sub> (3X)			
Green bananas	20.1 <sup>c</sup>	5.1 <sup>a</sup>	11.3 <sup>a</sup>	4.3 <sup>a</sup>	79.6 <sup>b</sup>	1.71 <sup>b</sup>	1.82 <sup>b</sup>	1.18 <sup>b</sup>	
Banana peels	11.3 <sup>b</sup>	8.2 <sup>a</sup>	34.1 <sup>c</sup>	14.5 <sup>c</sup>	45.9 <sup>a</sup>	1.22 <sup>a</sup>	1.31 <sup>a</sup>	0.68 <sup>a</sup>	
Pineapple peels	9.8 <sup>b</sup>	6.3 <sup>a</sup>	49.8 <sup>d</sup>	8.5 <sup>b</sup>	40.7 <sup>a</sup>	1.20 <sup>a</sup>	1.29 <sup>a</sup>	0.69 <sup>a</sup>	
Cantaloupes	6.3 <sup>a</sup>	17.6 <sup>b</sup>	23.0 <sup>b</sup>	3.8 <sup>a</sup>	46.0 <sup>a</sup>	1.81 <sup>b</sup>	1.92 <sup>b</sup>	1.24 <sup>b</sup>	
Citrus pulp	24.2 <sup>d</sup>	6.9 <sup>a</sup>	18.3 <sup>b</sup>	9.0 <sup>b</sup>	72.4 <sup>b</sup>	1.62 <sup>b</sup>	1.71 <sup>b</sup>	1.08 <sup>b</sup>	

a,b,c,d Means in a column with different superscripts are different ( $P \leq 0.05$ )<sup>1</sup> Average of eight samples

**Key Words:** Nutritional value, Energy sources, Tropical fruits

**W221 Intestinal digestibility of ADIN in grazed forages and agro-industrial by-products.** M. J. Marichal\*, A. I. Trujillo, and M. Carriquiry, *Facultad de Agronomía, Montevideo, Uruguay.*

Intestinal digestibility of ADIN (ID-ADIN) was determined in seven grazing forages (3 legumes and 4 grasses) collected in different harvest dates (HD), and 8 agro-industrial byproducts. Forages evaluated were alfalfa (AA, HD=7), birdsfoot trefoil (BT, HD=7), red clover (RC, HD=4), corn (CO, HD=2), oat (OA, HD=2), ryegrass (RG, HD=2) and sorghum (SG, HD=1). Byproducts were: wet and dried brewers' grains (WBG and DBG), malt sprouts (MS), dried sorghum distillers' grains (DSDG), raw and defatted rice bran (RRB and DRB), and raw and defatted hominy feed (RHF and DHF). Intestinal digestibility was estimated by the mobile bag technique (Incubations: rumen: 16h, acid pepsin-HCl solution: 2.5h, intestine: 24h) in two dry Holstein cows fed alfalfa hay. Data were analyzed in a completely randomized design. ADIN represented 5 to 15% of CP for forages, and 2 to 38% of CP for byproducts. In average, forages presented lower ( $P < 0.001$ ) ID-ADIN than byproducts (29.9 vs 51.0 ± 1.9%). There was an effect of family ( $P < 0.001$ ) and specie ( $P < 0.001$ ) of forage, and industrial procedure in byproducts ( $P < 0.001$ ). The ID-ADIN of forages ranged from 0 to 50% and was greater for grasses than for legumes (35.0 vs 22.8 ± 3.2%). For legumes, ID-ADIN was greater ( $P < 0.002$ ) for RC and BT than for AA and tended ( $P = 0.07$ ) to be greater for RC than for BT (36.8<sup>a</sup>, 24.9<sup>a</sup> and 6.6<sup>b</sup> ± 4.15 for RC, BT and AA, respectively). The ID-ADIN of grasses was similar ( $p > 0.65$ ) for the four species evaluated (34.0, 35.3, 32.8, and 38.0 ± 7.74% for CO, OA, SG and RG, respectively). For byproducts, ID-ADIN ranged from 0 (MS) to 99% (WBG). The DBG resulted in lower ( $P < 0.001$ ) ID-ADIN than WBG (71.6 vs 99.0 ± 1.0%) and fat extraction appear to reduce ( $P < 0.001$ ) ID-ADIN in rice bran (43.0 vs 30.0 ± 1.0% for RRB and DRF) and hominy feed (49.0 vs 41.0 ± 1.0% for RHF and DHM). The DSDG presented a similar ID-ADIN (74.5 ± 1.0%) than DBG. Results confirm ID - ADIN is highly variable. It would be advisable to continue to generate data on ID-ADIN to make adjustments when appropriate.

**Key Words:** ADIN, Intestinal digestibility, Ruminants

**W222 In situ ruminal degradation of the residue of the wine-producing industry and different agroindustrials by-products.** R. H. de T. Buschinelli de Goes\*, R. de C. M. Tramontini, S. T. Cardim, F. Morotti, G. D. Almeida, J. Ribeiro, L. A. Oliveira, and C. de L. Schecaira, *Universidade Estadual de Maringá-DZO, Umuarama, PR, Brazil.*

The ruminal degradation of the dry matter (DM) and the crude protein (CP) for the residue of the wine-producing industry, residue of the

industry of cookies, of the compress sunflower cake and of the soybean hulls, it was evaluated by the in situ technique, using three rumen fistulated zebu steers at pasture. The foods were grounded through 2mm screen and incubated directly in the rumen in nylon bags, in the times of 48, 36, 24, 18, 12, 06, 03, and 0 hours. The values about the potential degradation (PD) for the disappearance of DM, in the different incubation times were adjusted by a no-linear regression by Gauss-Newton's method, according to the equation  $PD = A + B * (1 - \exp(-ct))$ , being PD = potential degradability, A = soluble fraction, B = potentially degradable fraction, c = degradation rate of the fraction B, and t = time of incubation. The effective degradability was calculated by the formula:  $ED = a + (b.c)/(c+k)$ , where k = rate of passage of 5%/h. The soluble fraction of the wine-producing residue was from 21.61 and 19.84 % to DM and CP, with rate degradation of 4.2 and 7.67%/h, what resulted in effective degradabilities of 54.36 and 50.03 for DM and CP, respectively. The cookie residue presented main characteristic the high soluble fraction for the protein of 53.87%; the degradation rate relatively high for to DM and CP (8.7 and 14.6% for h) and the effective degradabilities arrived values of 79.87 and 37.73% for DM and CP, respectively. The potentially degradable fraction for compress sunflower cake, was of 26.17 and 40.15%, that it presented effective degradability by 50.97 and 38.65%, for to DM and CP. The compress sunflower cake presents high oil tenor (10%) what might have interfered in the degradation of this food. The main characteristic of soybean hulls was the high potentially degradable fraction for the protein (77.55%). Ruminal degradation of the studied nutrients foods presented medium values, with low soluble contents and of the extensive degradations of the insoluble fraction.

**Key Words:** Sunflower cake, Cookies, Soybean hull

**W223 Effect of Grain Prep® surfactant on ruminal in situ degradability of flaked corn dry matter and starch.** A. N. Hristov\*<sup>1</sup>, S. Zaman<sup>1</sup>, K. Huber<sup>1</sup>, and D. Greer<sup>2</sup>, <sup>1</sup>University of Idaho, Moscow, <sup>2</sup>AgriChem, Inc., Ham Lake, MN.

The effect of Grain Prep® surfactant (GP) on ruminal in situ degradability of flaked corn DM and starch was studied in two trials at commercial feed preparation facilities. Incoming corn was automatically conditioned using the Grain Prep Auto Delivery System to average moisture contents of 24 (Trial 1) and 23% (Trial 2). The application rate of GP was 22 ppm (as is basis). Control corn was treated with water alone. In Trial 1, the flaked corn was stored in ice and transported to the laboratory. To evaluate the effect of ageing on flaked corn DM and starch degradability, processed corn in Trial 2 was incubated in insulated containers for 0, 4, 8, and 16 h, after which time the grain was cooled in ice and transported to the laboratory. The temperature (°C) of the aged flakes was: 86, 58, 41, and 30 (Control) and 82, 59, 43, and 27 (GP), respectively. Three replications per treatment were analyzed for in situ degradability. Three ruminally cannulated lactating dairy cows fed 60% forage:40% concentrate diet were used for the in situ trial. Flaked corn samples were incubated in the rumen for 0, 2, 4, 6, 16, and 24 h. Passage rate of 0.06/h was used to estimate effective degradability (ED). In Trial 1, GP increased, compared with the control, the soluble fraction and ED of DM ( $P = 0.05$  and  $P < 0.001$ ) by 17.2 and 8.6%, respectively. Effective degradability of cornstarch was increased ( $P < 0.001$ ) by 6.7%. In Trial 2, across flake ageing time, the concentration of soluble DM and starch were increased by GP by 15 and 24% compared with the control ( $P = 0.003$  and  $P < 0.001$ ). The ED of DM and starch were also increased ( $P < 0.001$  and  $P = 0.001$ ) by 3 and 4%, respectively. Flake ageing time decreased ( $P < 0.001$ ; quadratic effect) solubility and ED of corn DM

and starch. In conclusion, GP applied at 22 ppm increased flaked corn degradability in the rumen, primarily through increasing the soluble fractions of DM and starch.

**Key Words:** Corn grain, Surfactant, Ruminant degradability

**W224 Influence of corn hybrid on kernel traits.** F. W. Harrelson\*, G. E. Erickson, T. J. Klopfenstein, L. A. Nelson, and D. S. Jackson, *University of Nebraska, Lincoln.*

Extensive research has shown that processing corn can improve performance of feedlot cattle, however much less research has shown how effective using different corn hybrids can be on improving performance. Recent research, using 7 hybrids, suggests performance can be impacted by hybrid differences. A study was designed using 60 commercial hybrids, representing 22 different companies, previously used by the University of Nebraska for hybrid performance testing, to identify kernel traits that may be used as indicators of feeding value to cattle. Twelve separate physical and production traits, derived from three procedures, were measured on each hybrid. These traits were based on data gathered from growing the corn, weighing 1000 kernels, a Stenvert hardness test, and *in situ* digestibility. Since *in situ* digestion mimics ruminal digestion, any relationships between DM disappearance (DMD) and physical corn traits are of primary interest. Most corn production traits were negatively correlated or not correlated to physical traits making them less indicative of cattle performance compared to some lab techniques. Test weight (weight/volume) was negatively correlated ( $r = -0.53$ ) to DMD ( $P < 0.03$ ) indicating that a denser kernel is less digestible. This interaction complicates the relationship between farmers and feedyard managers when basing feed quality on this common measurement. The revolutions per minute (RPM) of the Stenvert machine, which indicates hardness based on grinding a corn sample, was also negatively correlated ( $r = -0.7$ ) to the DMD ( $P < 0.01$ ). This indicates that kernels requiring more force to grind are more digestible in the rumen, which is contradictory to previous research. A 10% change in DMD was observed between the most and least digestible hybrid. This trial indicates that many physical kernel traits can be helpful in determining feeding value of corn hybrids for cattle.

**Key Words:** Corn, Digestibility, Quality

**W225 Effect of replacing barley grain with cork oak acorn (*Quercus Suber L.*) on digestibility, nitrogen balance and growth of goat kids.** G. B. Aziza\*<sup>1</sup>, A. Hedi<sup>2</sup>, K. Hajer<sup>2</sup>, and M. Rabia<sup>2</sup>, <sup>1</sup>*Institut National Agronomique Tunis, Mahrajène Tunis, Tunisia,* <sup>2</sup>*Ecole Supérieure d'Agriculture Mateur, ESA Mateur, Tunisia.*

Oak acorn has been studied as an alternative energy source, replacing some grain in rabbit, broiler and sheep concentrate diets. However, the impact of oak acorn supplementation on diet utilisation by goats has not been studied. Such research would be useful in the Mediterranean mountainous areas because of the availability of oak acorn in bulk (October-January) and their use in the smallholder farming system goats. This study examined the effect of replacing barley grain with cork oak acorn (*Quercus Suber L.*) on apparent digestibility *in vivo*, nitrogen (N) balance and growth of goat kids. Voluntary intake of acorn was studied. Ten Boer kids (26.5 ± 0.5 kg) were individually housed in metabolism cages and were randomly divided into two equal groups. Kids in each group received individually 500 g oat hay and 600 g of concentrate containing barley grain (control diet) or oak acorn (experimental diet). The digestibility and growth experiment

lasted 60 days. In the following 3 weeks, voluntary intake of acorn containing concentrate was measured on kids receiving experimental diet. Digestibility coefficients of dietary constituents (DM, OM, and CP) were reduced ( $P < 0.001$ ) as a result of acorn substitution for barley. Nitrogen retention (g/day) was positive for acorn diet (4.94 g) but lower ( $P < 0.001$ ) than for control diet (8.74). No differences ( $P > 0.05$ ) in CF digestibility and daily gain were observed between the two groups of kids. Voluntary intake of acorn containing concentrate reached 1400 g/day without any observable toxicity sign. In conclusion, complete substitution of barley grain with cork oak acorn did not affect performance of growing kids. This alternative could decrease the cost of animal origin products.

**Key Words:** Oak acorn, Kids, Digestibility

**W226 Apparent digestibility, voluntary feed intake and performance of goat kids fed olive cake ensiled with different feedstuffs.** F. T. Sleiman\*<sup>1</sup>, R. E. Issa<sup>1</sup>, S. H. Ibrahim<sup>2</sup>, M. G. Uwayjan<sup>1</sup>, S. K. Hamadeh<sup>1</sup>, I. Toufeili<sup>1</sup>, and M. T. Farran<sup>1</sup>, <sup>1</sup>*American University of Beirut, Beirut, Lebanon,* <sup>2</sup>*University of Dohuk, Dohuk, Kurdistan, Iraq.*

Feed intake and apparent digestibility of olive cake (OC) ensiled with urea (U), molasses (M), wheat bran (WB) and yellow corn (YC) were studied using 18 goat kids (23.5 kg BW) in a completely randomized design. The study consisted of a 4-wk trial including a 1-wk collection period using the following treatments: I) 100% OC, II) 99.4% OC + 0.6% U, III) 87.5% OC + 10% M + 0.5% U + 2% water, IV) 82.9% OC + 12% WB + 0.1% U + 5% water, V) 71.5% OC + 21.3% YC + 0.2% U + 7% water, and VI) 72% OC + 12% WB + 10% M + 6% water. Each kid received 0.5 kg/d concentrate (14% CP on DM basis), in addition to ad libitum feeding of the experimental silages. Means were separated using Duncan Multiple Range test. Change in BW of kids was not significantly different ( $P > 0.05$ ) among experimental silages. The highest BW gain was recorded for treatment VI (35g/h/d). Silage (S) DMI was not significantly different ( $P > 0.05$ ) among treatments, averaging 105, 93, 72, 158, 154 and 219 g/h/d for treatments I, II, III, IV, V and VI, respectively. The apparent digestibility of DM, NFE, NDF, and ADF of treatment V was significantly higher ( $P < 0.05$ ) than that of treatment IV (83.2, 90.3, 61.5 and 64.4 vs 70.5, 82.5, 32.8 and 34.4%, respectively). The CP digestibility of treatment III was significantly higher ( $P < 0.05$ ) than that of VI (82.6 vs 74.4%). The CF and EE digestibilities of all silage treatments were not significantly different ( $P > 0.05$ ). Results of this study indicate that ensiling OC with the used levels of ground YC, WB and M improved apparent digestibility of fiber fractions, SDMI and animal performance.

**Key Words:** Apparent digestibility, Olive cake, Goat kids

**W227 Effect of *Pleurotus florida* on digestibility of wheat stubble and date palm leaf in sheep.** F. Kafilzadeh\*<sup>1</sup>, A. Kabirifard<sup>2</sup>, and H. Fazaeli<sup>3</sup>, <sup>1</sup>*Razi University, Kermanshah, Kermanshah, Iran,* <sup>2</sup>*Research Center of Agriculture and Natural Resources, Boushehr, Iran,* <sup>3</sup>*Research Center of Animal Science, Karaj, Iran.*

This study was conducted to investigate the effect of *Pleurotus florida* on the voluntary feed intake and digestibility of wheat stubble and date palm leaf. The experiment was carried out in a complete randomized design with eight Shall male sheep (four replicate for each treatment), 41.5 ± 1.5 kg initial live weight and 2 yr old. The treatments were: 1) Untreated wheat stubble (UTWS); 2) Mycelial treated wheat stubble (MTWS), 3) Fungal treated wheat stubble after the first harvesting of

mushroom (FTWS), 4) Untreated date palm leaf (UDPL), 5) Mycelial treated date palm leaf (MTDPL), and 6) Fungal treated date palm leaf after the first harvesting of mushroom (FTDPL). Total tract digestibility of DM and OM of the MTDPL (34.7 & 37.2% respectively) were significantly ( $P < 0.05$ ) increased in comparison with the UTDPL (27.8 & 31.8% respectively). The OM digestibility of the MTWS (38.8%) was also significantly ( $P < 0.05$ ) higher when compared to UTWS

(32.7%). The digestibility of DM and OM of the FTDPL (26.5 and 30.0% respectively) were lower ( $P < 0.05$ ) than those of MTDPL, but were not significantly ( $P > 0.05$ ) different from those found in the UTDPL. However no significant difference ( $p > 0.05$ ) in digestibility of OM and DM was observed when FTWS was compared with MTWS.

**Key Words:** Pleurotus Florida, Wheat stubble, Date palm leaf

## Ruminant Nutrition: Forage & Fiber

**W228 Ingestive behavior of dairy goats and feedlot lambs fed sugar cane silage.** C. Q. Mendes, I. Susin\*, A. V. Pires, L. G. Nussio, R. C. Araujo, L. V. Gerage, and M. F. Ribeiro, *Escola Superior de Agricultura Luiz de Queiroz (ESALQ)/University of São Paulo (USP), Piracicaba, São Paulo, Brazil.*

A high concentration of ethanol, present in sugar cane silage, may reduce voluntary feed intake affecting animal performance. Two trials were performed to evaluate the ingestive behavior of dairy goats and feedlot lambs fed diets based on fresh sugar cane or sugar cane silage. Thirty-nine Saanen goats (Trial 1) and thirty Santa Ines ram lambs (Trial 2) were assigned to a complete randomized block design. Animals were fed 50:50 (concentrate:roughage ratio) TMR rations. Roughage source was fresh chopped sugar cane (FSC), sugar cane silage without additive (SCS) or sugar cane silage treated with *Lactobacillus buchneri* (SCS+Lb,  $5 \times 10^4$  cfu/g wet basis), corresponding to the experimental treatments FSC, SCS and SCS+Lb, respectively. During the feeding trial two sessions of 24 h were used to determine feeding behavior where eating and ruminating times were observed and recorded every 5 minutes. The parameters calculated were: dry matter intake (DMI, kg/day), NDF intake (kg/day), total time (min/day) and rate (min/g DM and min/g NDF) of eating, ruminating and chewing. In Trial 1, DMI was higher ( $P < 0.01$ ) for goats fed FSC diet (2.77 kg/d) when compared to silage diets (2.12 and 2.23 kg/d for SCS and SCS+Lb, respectively). There were no differences on eating, ruminating and chewing times. Eating and chewing rates were similar among diets. However, rumination rate (min/g DM) was higher ( $P < 0.05$ ) for goats fed silage diets (0.18, 0.25 and 0.25 min/g DM for FSC, SCS and SCS+Lb, respectively). In Trial 2, there was no difference on DMI among diets. Lambs spent similar time for ruminating and chewing activities. However, eating rate (min/g NDF) was lower for SCS and SCS+Lb diet when compared to FSC diet (0.43, 0.29 and 0.29 min/g DM for FSC, SCS and SCS+Lb, respectively). Sugar cane silages reduce DMI and increase rumination rate of dairy goats and decrease eating rate (min/g NDF) of feedlot lambs.

**Key Words:** Ethanol, Hair sheep, Silage additives

**W229 Effects of dietary fiber from forage of advanced maturity on performance of lactating goats.** R. H. Branco<sup>1</sup>, M. T. Rodrigues<sup>\*2</sup>, M. M. C. da Silva<sup>2</sup>, C. A. F. Rodrigues<sup>3</sup>, V. Viana<sup>2</sup>, F. D. O. Morbi<sup>2</sup>, R. da Silva Matos<sup>2</sup>, and M. de Souza Duarte<sup>2</sup>, <sup>1</sup>Instituto de Zootecnia, Sertãozinho, São Paulo, Brasil, <sup>2</sup>Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brasil, <sup>3</sup>Sadia, Concórdia, Santa Catarina, Brasil.

Although the term quality is ambiguous when applied to the forage in ruminant nutrition it is highly correlated with intake and digestibility. Both chemical and physical changes occur in forage as a result of plant maturity affecting, as a consequence, the dynamics of digestion and passage of rumen digesta, resulting in filling effects, reduction of feed

intake and decrease of milk production. The effect of the inclusion of neutral detergent fiber levels from forage (fNDF) with advanced maturity (86.24% NDF; 6.47% CP) was evaluated in goat diets. Feed intake, digestibility of dry matter and of nutrients, nitrogen balance, milk production, efficiency of use of metabolizable energy consumed (ME), and feeding behavior were used as dependent variables. Five dairy goats were assigned to a 5 x 5 Latin square design, using dietary fNDF levels of 20, 28, 35, 43 and 49% as independent variables. The intakes of dry matter (DMI), of nutrients, and of net energy (NEL) were reduced ( $p < 0.05$ ) as fiber was added to ration. Conversely, intake of NDF increased ( $p < 0.01$ ) suggesting ability for accommodation of fiber in the rumen despite the negative effect on intake. The fNDF level influenced ( $p < 0.05$ ) the digestibility coefficients of dry matter, organic matter, crude protein and nonfibrous carbohydrates. Intake of nitrogen (g/day) was influenced in a quadratic manner with no effect on retained nitrogen. Quadratic effects were observed for the nitrogen excreted in the feces and urine, and a linear effect on nitrogen produced in the milk. No influence of fNDF levels was observed for milk constituents (fat, protein and lactose). A quadratic effect of fiber in diet was observed for milk yield with higher values obtained at 28% of fNDF. The levels of forage fiber studied did not influence values of efficiency of use of ME consumed for milk production. A variation on feeding behavior was noticed by increased time of rumination and mastication with a reduction on idle time as fiber from forage increase in diets.

**Key Words:** Dairy goats, Energy, Intake

**W230 Influence of level of dietary forage fiber on intake and nutrient utilization of dairy goats.** R. H. Branco<sup>\*1</sup>, M. T. Rodrigues<sup>2</sup>, C. A. F. Rodrigues<sup>2</sup>, M. M. C. da Silva<sup>2</sup>, F. L. de Araújo<sup>2</sup>, V. Viana<sup>2</sup>, and V. R. Paiva<sup>2</sup>, <sup>1</sup>Instituto de Zootecnia, Sertãozinho, São Paulo, Brasil, <sup>2</sup>Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brasil.

Forage is a major constituent in most ruminant diets and exerts an economic impact on diet formulation due to the fact of contributing to reduce cost of available energy. Tropical forages are known for presenting both high concentration of fiber and to undergo the process of lignification at early stages of development. As a consequence it is observed a significant reduction on feed intake caused by variation on kinetics of degradation and passage in the rumen determining the available energy for microbial growth and efficiency, affecting the host performance. The present study evaluated the effect of increasing levels of dietary fiber from forage (fNDF) on lactating goats by using Tifton hay (*Cynodon* spp.) as the forage source, containing 78.54% NDF and 11.44% CP. Five goats were assigned to a 5x5 Latin square design using the levels of 19, 27, 35, 42 and 48 % of fNDF as the independent variables. Intake of dry matter (DM), of crude protein (CP), ether extract (EE), non-fiber carbohydrate (NFC), total digestible nutrients (TDN), and net energy of lactation (NEL) altered ( $p < 0.05$ ) by increasing levels of ration fNDF. Intake of NDF did not differ among