

## Ruminant Nutrition: Co-Products

**W264 In vitro intestinal amino acid digestibility of distillers grains varies with grain source and milling process.** C. Li<sup>1,2</sup>, J. Q. Li<sup>1</sup>, K. A. Beauchemin<sup>2</sup>, and W. Z. Yang<sup>\*2</sup>, <sup>1</sup>College of Animal Science, Inner Mongolia Agricultural University, Hohhot, Inner Mongolia, China, <sup>2</sup>Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada.

A study was conducted to evaluate the in vitro intestinal digestibility of amino acids (AA) in dried distillers grains with solubles (DDGS) originating from different grain sources (corn vs. wheat) and milling processes (conventional vs. fractional). The experimental feeds were: wheat grain, wheat DDGS (wDDGS), corn grain, corn DDGS (cDDGS) and corn fractional DDGS (fDDGS). Ruminant residues were produced by incubating the feeds in polyester bags for 16 h in the rumen of 3 ruminally cannulated beef heifers fed a diet containing 60% barley silage and 40% barley-based concentrate (DM basis). In vitro intestinal digestibilities of the rumen undegradable protein (RUP) and AA were determined on the residues using a modified 3-step method. In vitro intestinal digestibilities of individual AA were similar for wheat and wDDGS, except for His ( $P < 0.05$ ; 65 vs. 83%) and Glu ( $P < 0.05$ ; 95 vs. 90%). The digestibilities of most AA, especially the individual essential AA (EAA), were lower ( $P < 0.05$ ) for cDDGS than for corn, and as a result, the digestibility of CP, total AA and EAA were lower ( $P < 0.05$ ) for cDDGS (86, 86 and 87%, respectively) than for corn (92, 92 and 91%, respectively). Digestibilities of 3 EAA (His, Met and Thr) were lower ( $P < 0.05$ ) for cDDGS (68, 81 and 83%, respectively) compared with wDDGS (83, 87 and 87%, respectively) with no differences in the digestibility of CP, total AA, and EAA. For fDDGS, 6 individual AA (4 EAA and 2 non EAA), total AA, non EAA and CP had lower ( $P < 0.05$ ) digestibilities compared with cDDGS. The results suggest that the AA availability of DDGS varies with the grain source used to produce ethanol and with the milling process before ethanol fermentation. Information on the intestinal digestibility of individual AA can be used to improve accuracy of diet formulation.

**Key Words:** AA digestibility, DDGS, in vitro

**W265 In vivo determination of undegradable intake protein (UIP) of dried distillers grains with solubles (DDGS) and comparing DAPA and DNA as bacterial markers.** E. Castillo-Lopez,\* T. J. Klopfenstein, and P. J. Kononoff, University of Nebraska-Lincoln, Lincoln.

The objectives of this trial were to determine the undegradable intake protein (UIP) of dried distillers grains with solubles (DDGS) and to compare the estimates of duodenal bacterial crude protein (BCP) flow using either DAPA or DNA as bacterial markers. Three crossbred steers fitted with ruminal and double L-shaped duodenal cannulas (average BW 780 ± 137 kg) were used in a 3 treatment, 6 period crossover design. Animals were housed in individual free stalls and fed twice daily at 0700 and 1900. Diets (DM basis) were 1) CONTROL, 0% DDGS, but with 19.5% corn bran, 20% sorghum silage, 60% brome hay, 0.5% trace minerals and 0.25% urea; 2) LOW DDGS, inclusion of 9.75% DDGS replacing equal percentage of corn bran; 3) HIGH DDGS, inclusion of 19.5% DDGS completely replacing corn bran. On d 16 to 19 of each period, 200 mL of duodenal digesta were collected every 4 h from each animal, then composited by day, by animal within period, lyophilized and analyzed for CP. Duodenal BCP flow was estimated by 2 methods, using DAPA and DNA as bacterial markers. DNA marker was part of the 16S rRNA gene. The UIP of DDGS was determined by difference of residual duodenal CP flow between HIGH DDGS treatment and CONTROL. Data were analyzed using the MIXED

procedure of SAS. Average DMI was 10.5kg/d across treatments. The average value of DDGS UIP as a percent of CP was determined to be 63.0 ± 0.64%. Average duodenal BCP flow across treatments was unaffected ( $P = 0.71$ ) by marker type and were 404 and 417 ± 83 g/d for DAPA and DNA markers, respectively. Overall, the value of DDGS UIP determined in this study will contribute to better understand the effect of this byproduct in ruminant nutrition. Duodenal BCP flow tended to decrease with DDGS inclusion, but was not affected by marker type.

**Key Words:** dried distillers grains with solubles, duodenal bacterial crude protein flow, undegradable intake protein

**W266 Urea treatment of different levels of pistachio hull and its relation to gas production in vitro.** A. Rahimi<sup>1</sup>, A. A. Naserian<sup>1</sup>, R. Valizadeh<sup>1</sup>, A. Tahmasbi<sup>1</sup>, A. R. Shahdadi<sup>2</sup>, and B. Saremi<sup>\*3</sup>, <sup>1</sup>Ferdowsi University of Mashhad, Mashhad, Khorasan Razavi, Iran, <sup>2</sup>Agricultural Sciences & Natural Resources, University of Gorgan, Gorgan, Golestan, Iran, <sup>3</sup>Bonn University, Bonn, Germany.

Tannins can inhibit enzymatic and microbial activity therefore affecting gas production. There is very limited information about effects of urea treatment on gas parameters in dietary of tannin. The objective of this study was to evaluate effects of processing of different levels of pistachio hull by urea on gas production in vitro. Experimental treatments were included: Control with 30% alfalfa, 20% straw and 50% concentration (0.42% tannin), T1) 15% alfalfa, 15% PH, 20% straw and 50% concentration (1.06% tannin) and T2) 30% PH, 20% straw and 50% concentration (1.83% tannin). The treatments were incubated with 0.5 and 1 percentage of urea. Gas production was measured (Theodorou et al., 1994; McDonald, 1979). The gas pressure and volume was recorded before incubation (0) and 2, 4, 6, 8, 12, 24, 36, 48, 72, 96 and 120 h after incubation. Gas production kinetics were estimated using the equation described by Ørskov and McDonald (1979),  $y = a + b(1 - \exp(-ct))$ . Statistical analysis was performed using the 3 × 2 factorial procedure of SAS ( $P < 0.05$ ). Our data exhibited that extent of gas production in treatments incubated with 0.5% urea in T2 was significantly higher vs. T1 and control. Extent of gas production in treatments incubated with 1% urea was significantly affected i.e., the value of gas production in T1 + 1% urea was lower than T2 + 1% urea and control + 1% urea. Indeed, T2 + 1% urea was significantly higher than control + 1% urea. Rate of gas production was not affected when co-incubation was done by 0.5% urea in different treatments while by incubation with 1% urea, the rate of gas production was significantly higher in T1 than control and T2. The treatments were incubated with 0.5 vs. 1% of urea led to increase of extent and reduction of rate of gas production with the exception of T2 which extent and rate of gas production were stable. It seems that urea supplementation can eliminate the negative effects of tannins on gas production.

**Table 1.** Effect of urea treatment of different levels of pistachio hull gas production parameter

Gas production parameters	Alfalfa		15% PH		30% PH		SEM	P-value
	0.5% urea	1% urea	0.5% urea	1% urea	0.5% urea	1% urea		
Extent (ml/gDM)	199.194 <sup>d</sup>	204.128 <sup>bc</sup>	199.937 <sup>cd</sup>	196.598 <sup>d</sup>	205.317 <sup>ab</sup>	208.798 <sup>a</sup>	0.6182	0.0005
Rate (ml/h/g)	0.071 <sup>ab</sup>	0.056 <sup>c</sup>	0.078 <sup>a</sup>	0.079 <sup>a</sup>	0.072 <sup>ab</sup>	0.069 <sup>b</sup>	0.0011	0.0006

<sup>a-d</sup>Means within same row with different superscripts differ ( $P < 0.01$ ).

**Key Words:** urea, tannin, gas production

**W267 Effect of different levels of pistachio hull on in vitro gas production.** A. Rahimi<sup>1</sup>, A. A. Naserian<sup>1</sup>, R. Valizadeh<sup>1</sup>, A. Tahmasbi<sup>1</sup>, A. R. Shahdadi<sup>2</sup>, and B. Saremi<sup>\*3</sup>, <sup>1</sup>Ferdowsi University of Mashhad, Mashhad, Khorasan Razavi, Iran, <sup>2</sup>Agricultural Sciences & Natural Resources University of Gorgan, Gorgan, Golestan, Iran, <sup>3</sup>Bonn University, Bonn, Germany.

Tannins are a heterogeneous group of phenolic polymers of the plant origin that can be detrimental when consumed by herbivores. Pistachio hull (PH) is a by product that has a high tannin content. Tannins can also inhibit enzymatic and microbial activity and together with inhibition of gas production. The aim of this study was to evaluate effects of different levels of Pistachio Hull on in vitro extent and rate of gas production. The rumen fluid was obtained from 4 fistulated sheep which were fed twice daily with a diet containing alfalfa hay (60%) and concentrate (40%). Experimental treatments were included: Control consisted of 30% alfalfa, 20% straw and 50% concentrate (0.42% tannin), T1) 15% alfalfa, 15% PH, 20% straw and 50% concentrate (1.06% tannin) and T2) 30% PH, 20% straw and 50% concentrate (1.83% tannin). Gas production was measured on procedure (Theodorou et al., 1994; McDonald, 1979). The pressure and volume of gas was recorded before incubation (0) and 2, 4, 6, 8, 12, 24, 36, 48, 72, 96 and 120 h after incubation. The linear regression equation between reading pressure and volume for determination of corrected volume of gas was estimated. Cumulative gas production data were fitted to the model of Ørskov and McDonald (1979),  $y = a + b(1 - \exp(-ct))$ . Statistical analysis was performed using the MIXED procedure of SAS (2000) using a completely randomized design. Extent of gas production decreased as the amount of tannin in the diet increased, but this decrease was significantly in treatment 2 (1.83% tannin) relative to T1 (1.06% tannin) and control (0.42% tannin;  $P < 0.01$ ). Rate of gas production was not affected by the amount of tannin in experimental treatments. It seems that tannins could be inhibiting for microbial activity and thus reduced the amount of gas production.

**Table 1.**

Gas production parameters	Alfalfa	15% PH	30% PH	SEM	P-value
Extent (mL/g o DM)	212.754 <sup>a</sup>	204.799 <sup>a</sup>	196.334 <sup>b</sup>	0.692	0.003
Rate (mL/h/g)	0.086	0.082	0.084	0.0006	0.129

<sup>a,b</sup>Means within same row with different superscripts differ ( $P < 0.01$ ).

**Key Words:** gas production, pistachio hull, tannin

**W268 Increased dietary tannin by addition of pistachio hull and its relation to fermentation parameters and protozoa content of rumen in Balochi male lambs.** A. Rahimi<sup>1</sup>, A. A. Naserian<sup>1</sup>, R. Valizadeh<sup>1</sup>, A. Tahmasbi<sup>1</sup>, A. R. Shahdadi<sup>\*2</sup>, and B. Saremi<sup>3</sup>, <sup>1</sup>Ferdowsi University of Mashhad, Mashhad, Khorasan Razavi, Iran, <sup>2</sup>Agriculture Sciences and Natural Resources University of Gorgan, Gorgan, Iran, <sup>3</sup>Institute of Animal Science, Physiology & Hygiene Unit, University of Bonn, Germany.

Tannins could affect rumen parameters such as pH, NH<sub>3</sub>-N and microorganisms. The low rate and extent of protein degradation in the rumen by feeding tannin-rich feeds could lower rumen ammonia concentration. There are many reports indicating inhibitory effect of tannins on rumen protozoa. We aimed to determine the effects pistachio hull (PH) as a tannin source in the diet on rumen pH, N-NH<sub>3</sub> concentration, and protozoa content in Balochi male lambs. Three male lambs (35 ± 2 kg live weight) equipped with ruminal and abomasal cannula were randomly assigned into a changeover 3 × 3 design with 3 treatments: 1) control (alfalfa), 2) 15% alfalfa+15% PH and 3) 30% PH (DM basis).

Rumen fluid pH was measured immediately before and every 30 min up to 8 h after the a.m. feeding. Also, rumen fluid was collected from the anterior dorsal, anterior ventral, medium ventral and posterior dorsal and posterior ventral locations within the rumen at 0, 1, 2, 4, 6 and 8 h after the 0800 h feeding for determination of NH<sub>3</sub>-N concentration and protozoa count. Data were analyzed as a repeated measurement design using PROC MIXED of SAS ( $P < 0.05$ ), assuming the model included treatment, time, and time × treatment as fixed effects and animal as random effect. Rumen fluid pH was not affected by PH content of diet, although tended to increase as the amount of dietary PH increased. Dietary PH content resulted in a decrease in the rumen N-NH<sub>3</sub> concentration. Protozoa content of rumen was not affected by the amount of PH in the diets, although a tendency to decrease was observed when dietary PH amount increased.

**Table 1.** Substitution of alfalfa with different levels of pistachio hull (PH) and its contribution to rumen pH, NH<sub>3</sub>-N and Protozoa count

Rumen parameters	Alfalfa	15% PH	30% PH	SEM	P-value		
					Treat	Time	Treat × Time
pH	6.41	6.48	6.48	0.017	0.331	<0.0001	0.977
NH <sub>3</sub> -N (mg/dL)	15.42a	14.91 b	13.96 c	0.060	0.013	0.0003	0.055
Protozoa (Log10/mL)	3.06	3.00	2.99	0.062	0.935	<0.0001	0.540

<sup>a-c</sup>Means within same row with different letter are significantly different ( $P < 0.05$ ).

**Key Words:** pistachio hull, ammonia nitrogen, pH, protozoa

**W269 Effects using of pistachio hull and polyethylene glycol supplementation on feed intake and apparent digestibility of nutrients in Saanen dairy goats.** A. Rahimi<sup>1</sup>, A. A. Naserian<sup>1</sup>, R. Valizadeh<sup>1</sup>, A. Tahmasbi<sup>1</sup>, A. R. Shahdadi<sup>2</sup>, and B. Saremi<sup>\*3</sup>, <sup>1</sup>Ferdowsi University of Mashhad, Mashhad, Khorasan Razavi, Iran, <sup>2</sup>Agricultural Sciences & Natural Resources University of Gorgan, Gorgan, Golestan, Iran, <sup>3</sup>Institute of Animal Science, Physiology & Hygiene Unit, University of Bonn, Germany.

Tannins at low concentrations can confer nutritional advantages to ruminants by reducing protein degradation in the rumen and increasing the flow of protein and essential amino acids to the intestine. However, higher concentrations of condensed tannins have deleterious effects on animal performance, digestibility and voluntary intakes. Polyethylene glycol (PEG), react preferentially with condensed tannins and prevents the formation of tannin-protein complexes. The aim of this study was to evaluate the effects of feeding pistachio hull (PH, source of tannin) and PEG supplementation on feed intake and nutrients digestibility in Saanen dairy goats. Nine Saanen dairy goats were used in a 3 × 3 Latin square design with 21-d periods, including 14 d of adaptation followed by 7 d of sampling. Three treatments were formulated: T1) Control, without PH, T2) 30% PH (DM basis) that provided 18.1 g condense tannin per kg DM of diet and T3) 30% PH + 1% PEG (DM basis). In T2 and T3 PH was replaced with alfalfa hay. Statistical analysis was performed using the MIXED procedure of SAS ( $P < 0.05$ ). Dry matter intake (DMI), DMI per body and metabolically weight were not affected in the experimental diets. Organic matter intake (OMI), OMI per body and metabolically weight, ADF, NDF and crude protein intake were significantly decreased in 30% PH (T2) and with the addition of PEG in T3 were significantly increased. Fat intake in T2 (168.40 g/d) and T3 (175.13 g/d) in comparison to Control (150.14 g/d) were significantly increased. DM, ADF and NDF

apparent digestibility weren't significantly affected by the diets, but in T2 had a tendency to decrease and with the addition of PEG in T3 showed an increasing trend. OM and CP apparent digestibility were significantly decreased in T2 and with the addition of PEG in T3 were significantly increased. Fat apparent digestibility in T2 (84.95%) and T3 (85.98%) vs. Control (83.91%) was significantly increased. This study has shown that pistachio hull can replace alfalfa hay in diets for goats when PEG is given as a supplement.

**Key Words:** pistachio hull, feed intake, apparent digestibility

**W270 Effects of feeding pistachio hull and polyethylene glycol (PEG) supplementation on milk fatty acids composition in Saanen dairy goats.** A. Rahimi<sup>1</sup>, A. A. Naserian<sup>1</sup>, R. Valizadeh<sup>1</sup>, A. Tahmasbi<sup>1</sup>, A. R. Shahdadi<sup>2</sup>, and B. Saremi<sup>3</sup>, <sup>1</sup>Ferdowsi University of Mashhad, Mashhad, Khorasan Razavi, Iran, <sup>2</sup>Agricultural Sciences & Natural Resources University of Gorgan, Gorgan, Golestan, Iran, <sup>3</sup>Institute of Animal Science, Physiology & Hygiene Unit, University of Bonn, Germany.

Decreasing the level of saturated fatty acids (SFA) and increasing monounsaturated FA (MUFA) and polyunsaturated FA (PUFA) content in ruminant's milk would be beneficial for human health and would be of commercial interest. It is also recognized that tannins affect rumen biohydrogenation therefore increase the MUFA and PUFA content of milk and meat. We aimed to evaluate the effects of feeding pistachio hull (PH, source of tannin) and PEG supplementation on milk fatty acids composition in Saanen dairy goats. Nine Saanen dairy goats were used in a 3 × 3 Latin square design. Treatments were T1) Control, without PH, T2) 30% PH (DM basis) that provided 18.1 g tannin per kg DM of diet, and T3) 30% PH + 1% PEG (DM basis). In T2 and T3, PH replaced alfalfa hay. Milk fatty acids were analyzed on a Gas Chromatography with a flame-ionization detector and column. Statistical analysis was performed using the MIXED procedure of SAS ( $P < 0.05$ ). Concentration of UFA, MUFA, and PUFA in treatments including of tannin (with PH) were significantly higher than control (without PH). Conversely, concentration of SFA and medium-chain FA (MCFA) in T2 were significantly lower than the control and with addition of PEG in T3 were significantly increased relative to T2. Concentration of short-chain FA (SCFA) in T2 and T3 was significantly lower than the control. Long-chain FA (LCFA) in T2 was significantly higher than the control and with addition of PEG in T3 was significantly decreased relative to T2. In conclusion, tannin has the ability to reduce SFA and to increase UFA. PEG will reverse this effect but not to the control levels.

**Table 1.** Effect of PH and PEG on milk fatty acids composition

Milk FA composition	Alfalfa	30% PH	30% PH+PEG	SEM	P-value
SFA	67.056 <sup>a</sup>	54.642 <sup>c</sup>	63.077 <sup>b</sup>	1.840	0.0001
UFA	32.940 <sup>c</sup>	46.746 <sup>a</sup>	37.910 <sup>b</sup>	2.023	0.0003
MUFA	28.018 <sup>c</sup>	40.666 <sup>a</sup>	31.527 <sup>b</sup>	1.888	0.0006
PUFA	4.922 <sup>b</sup>	6.080 <sup>a</sup>	6.383 <sup>a</sup>	0.223	0.0059
SCFA	5.408 <sup>b</sup>	3.295 <sup>a</sup>	3.967 <sup>a</sup>	0.312	0.0027
MCFA	26.706 <sup>a</sup>	14.996 <sup>c</sup>	21.981 <sup>b</sup>	1.702	0.0011
LCFA	67.882 <sup>c</sup>	81.697 <sup>a</sup>	74.039 <sup>b</sup>	2.013	0.0061

<sup>a-c</sup>Means within the same row with different letters are significantly different ( $P < 0.01$ ).

**Key Words:** fatty acids composition, tannin, goat

**W271 Milk fatty acid profile of Saanen dairy goats fed diets containing pistachio hull tannin and polyethylene glycol supplementation.** A. Rahimi<sup>1</sup>, A. A. Naserian<sup>1</sup>, R. Valizadeh<sup>1</sup>, A. Tahmasbi<sup>1</sup>, B. Saremi<sup>2</sup>, and A. Reza Shahdadi<sup>3</sup>, <sup>1</sup>Ferdowsi University of Mashhad, Mashhad, Khorasan Razavi, Iran, <sup>2</sup>Institute of Animal Science, Physiology & Hygiene Unit, University of Bonn, Germany, <sup>3</sup>Agricultural Sciences & Natural Resources University of Gorgan, Gorgan, Golestan, Iran.

Tannins ability to modify the fatty acid composition of milk and meat has received great attention recently. There is limited information pertaining the effects of tannins on ruminal biohydrogenation process and content of C18:1, trans-11 (vaccenic acid) and C18:2, cis-9, trans-11 CLA (rumenic acid) in ruminants meat and milk. We aimed to evaluate the effects of feeding pistachio hull (PH, source of tannin) and polyethylene glycol (PEG) supplementation on milk fatty acid profile particularly vaccenic and rumenic acid in Saanen dairy goats. Nine Saanen dairy goats were used in a 3 × 3 Latin square design. Three treatments were formulated: T1) Control, without PH, T2) 30% PH (DM basis) that provided 18.1 g condense tannin per kg DM of diet and T3) 30% PH + 1% PEG (DM basis). In T2 and T3, PH replaced alfalfa hay. Statistical analysis was performed using the MIXED procedure of SAS ( $P < 0.05$ ). Percentage of C18:1, trans-9, C18:1, cis-9 and C18:1, trans-11 (vaccenic acid), and C18:2, cis-9, trans-11 CLA (rumenic acid) significantly increased with addition of PH in T2. Blocking of PH with PEG significantly reduced the fatty acids but not to the same level as control group. Percentage of C18:0, C18:2, trans-9, 12, C18:2, cis-9, 12, and C18:3, cis-9, 12, 15 with increasing PH in T2 significantly increased and addition of PEG in T3 could not reduce them back to levels of control group. In conclusion, addition of PH could increase the level of polyunsaturated acids content of goat milk and PEG supplementation will conserve it while blocking PH tannin content.

**Table 1.**

Milk FA profile (%)	Alfalfa	30% PH	30% PH+PEG	SEM
C18:0	9.901 <sup>b</sup>	12.454 <sup>a</sup>	11.566 <sup>a</sup>	0.381
C18:1, trans-9	4.040 <sup>c</sup>	9.950 <sup>a</sup>	7.232 <sup>b</sup>	0.854
C18:1, cis-9	21.620 <sup>c</sup>	26.837 <sup>a</sup>	21.965 <sup>b</sup>	0.869
C18:1, trans-11	3.825 <sup>c</sup>	5.511 <sup>a</sup>	4.214 <sup>b</sup>	0.255
C18:2, cis-9,trans-11CLA	1.286 <sup>b</sup>	2.156 <sup>a</sup>	1.817 <sup>c</sup>	0.126
C18:2, trans-9,12	2.187 <sup>b</sup>	2.882 <sup>a</sup>	2.788 <sup>a</sup>	0.110
C18:2, cis-9,12	2.216 <sup>b</sup>	2.64 <sup>a</sup>	2.944 <sup>a</sup>	0.108
C18:3, cis-9,12,15	0.519 <sup>b</sup>	0.558 <sup>a</sup>	0.651 <sup>a</sup>	0.022

<sup>a-c</sup>Means within the same row with different letters are significantly different ( $P < 0.05$ ).

**Key Words:** Saanen goat, tannin, milk fatty acids

**W272 Effects of pistachio hull and polyethylene glycol supplementation on milk yield and compositions in Saanen dairy goats.** A. Rahimi<sup>1</sup>, A. A. Naserian<sup>1</sup>, R. Valizadeh<sup>1</sup>, A. Tahmasbi<sup>1</sup>, A. R. Shahdadi<sup>2</sup>, and B. Saremi<sup>3</sup>, <sup>1</sup>Ferdowsi University of Mashhad, Mashhad, Khorasan Razavi, Iran, <sup>2</sup>Agricultural Sciences & Natural Resources University of Gorgan, Gorgan, Golestan, Iran, <sup>3</sup>Institute of Animal Science, Physiology & Hygiene Unit, University of Bonn, Germany.

Evaluation of dietary containing tannin for animal performance was very varied. We aimed to investigate the effects of pistachio hull (PH, source of tannin) and polyethylene glycol (PEG) supplementation on milk production and milk composition in early lactation Saanen goats. Nine Saanen dairy goats (average DIM, 71.5 ± 6.5 d; milk production, 1.5 ± 0.25 kg; and live body weight, 45 ± 1.75 kg) were used in a 3 × 3 Latin square design with 21-d periods, including 14 d of adaptation

followed by 7 d of sampling. Three treatments were formulated: T1) Control, without PH, T2) 30% PH (DM basis) that provided 18.1 g condense tannin per kg DM of diet and T3) 30% PH + 1% PEG (DM basis). In T2 and T3, PH replaced alfalfa hay. Goats were milked 2 times in day and milk yield was recorded. Milk samples were taken at the 3 last days of sampling. Statistical analysis was performed using the MIXED procedure of SAS ( $P < 0.05$ ). Treatment means were compared using Duncan's New Multiple Range test. The results showed that milk, fat corrected milk (FCM), and energy corrected milk (ECM) yields together with milk efficiency were not affected by experimental diets. Milk fat, lactose and solids not fat (SNF) percentage were not affected by addition of PH and PEG. Milk protein percentage in T2 in comparison to control was significantly decreased. Fat and protein yield (kg/d) were not affected by the experimental diets. In conclusion, use of tanniferous sources had no negative effects on milk production and composition of goats except protein percentage that can be compensated partly by addition of PEG. However, goats are able to consume large amounts of tannin-rich plant material in comparison to other ruminant species.

**Table 1.**

Milk production and composition	Alfalfa	30% PH	30% PH+PEG	SEM
Milk yield (kg/d)	1.453	1.438	1.546	0.088
FCM 4% (kg/d)	1.288	1.281	1.355	0.075
ECM (kg/d)	1.438	1.356	1.451	0.083
Milk efficiency	0.622	0.628	0.659	0.037
Fat%	3.252	3.295	3.258	0.062
Protein%	3.085 <sup>a</sup>	2.881 <sup>b</sup>	2.910 <sup>ab</sup>	0.041
Lactose%	4.251	4.334	4.347	0.046
SNF (%)	8.460	8.245	8.102	0.092
Fat (kg/d)	0.047	0.047	0.049	0.015
Protein (kg/d)	0.044	0.041	0.044	0.002

<sup>a,b</sup>Means within same row with different superscripts differ ( $P < 0.05$ ).

**Key Words:** Sannan goat, tannin, milk yield and composition

### W273 Liver enzymes and immune system response of Saanen dairy goats supplemented with pistachio hull and polyethylene glycol.

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High tannin diets may increase the clinical symptoms of intoxication in ruminants. Toxic effects are reflected by damage in the liver, kidneys and the epithelium of the digestive tract. Polyethylene glycol (PEG) can neutralize the toxic effects of tannins. The aim of this study was to evaluate the effects of feeding pistachio hull (PH, source of tannin) and PEG supplementation on the liver enzymes i.e., alanine aminotransferase (ALT) and aspartate aminotransferase (AST) and blood factors such as packed cell volume (PCV), mean corpuscular hemoglobin concentration (MCHC), total white blood cells (TWBC), neutrophils, eosinophils, lymphocytes, monocytes, and hemoglobin in Saanen dairy goats. Nine Saanen dairy goats were used in a 3 × 3 Latin square design. Three treatments were formulated: T1) Control, without PH, T2) 30% PH (DM basis) that provided 18.1 g condense tannin per kg DM of diet and T3) 30% PH + 1% PEG (DM basis). In T2 and T3, PH replaced alfalfa

hay. Statistical analysis was performed using the MIXED procedure of SAS ( $P < 0.05$ ). Immune factors and liver enzymes were not significantly affected by the experimental diets. But, plasma concentration of MCHC and hemoglobin and percentage of PCV in T2 had a tendency to decrease and was removed by PEG addition in T3 (with  $P = 0.534$ ,  $P = 0.735$  and  $P = 0.732$  for MCHC, hemoglobin and PCV, respectively). Conversely, concentration of ALT and AST and number of TWBC, neutrophil, eosinophil, lymphocyte, and monocyte in T2 had a tendency to increase and was removed by PEG addition in T3 (with  $P = 0.791$ ,  $P = 0.931$ ,  $P = 0.794$ ,  $P = 0.399$ ,  $P = 0.928$ ,  $P = 0.659$ ,  $P = 0.933$  and  $P = 0.368$  for ALT, AST, TWBC, neutrophil, eosinophil, lymphocyte and monocyte, respectively).

**Table 1.**

Immune plasma factors	Alfalfa	30% PH	30% PH+PEG	SEM
AST (U/L)	86.44	100.44	98.66	2.621
ALT (U/L)	57.66	62.05	60.50	2.284
PCV (%)	28.55	28.11	28.44	0.343
MCHC (g/dL)	31.44	30.44	30.77	0.495
Hemoglobin (g/dL)	8.90	8.57	8.74	0.149
TWBC (cells/UL)	9566.67	10256.00	9922.22	508.690
Neutrophil: adult (cells /UL)	4832.44	5474.67	5371.33	275.555
Eosinophil (cells /UL)	140.89	178.33	145.56	19.819
Lymphocyte (cells /UL)	4288.56	4433.33	4377.33	228.582
Monocyte(UL)	80.22	144.67	106.33	17.576

**Key Words:** tannin, immune system, goat

### W274 Effects of pistachio tannins on nitrogen metabolism in Balochi male lambs.

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The decreased rate and extent of protein degradation in the rumen as observed due to feeding of tannin-rich feeds could lower ammonia concentrations in the rumen and hence urea N excretion in urine. The tannins shift the site of N metabolism from rumen to the lower digestive tract and large intestine. Shifting excretion pattern of nitrogen from urine to feces and formation of tannin—protein complex are beneficial environmentally. We aimed to evaluate if tannin rich diets (pistachio hull (PH) as a tannin source) manipulate intake, digestion, excretion and retention of nitrogen in Balochi male lambs. Three male lambs (35 ± 2 kg live weight) equipped with ruminal cannula were randomly assigned into a changeover 3 × 3 design. Treatments were: 1) control (alfalfa), 2) 15% alfalfa+15% PH that provided 10.59 g/kgDM tannin, and 3) 30% PH that provided 18.28 g/kgDM tannin. Statistical analysis was performed using the MIXED procedure of SAS ( $P < 0.05$ ). As tannin was increased in the diets, the nitrogen intake linearly and quadratic was decreased, rumen N-NH<sub>3</sub> concentration linearly was decreased, and nitrogen excretion from urine and digested nitrogen linearly were decreased. Nitrogen excretion from fecal linearly and quadratic and retained nitrogen linearly were increased, by increased of dietary tannin. Thus, effects of tannins to reduce the degradation of protein in the rumen and nitrogen excretion from urine and to increase the nitrogen excretion from fecal and retained nitrogen due to N metabolism in the large intestine could have important role to improve nitrogen efficiency in lambs.

**Table 1.**

	Alfalfa	15% PH	30% PH	SEM	P-value	
					Linear	Quadratic
Nitrogen intake (g/d)	14.70 <sup>a</sup>	14.05 <sup>b</sup>	13.92 <sup>c</sup>	0.121	0.0005	0.003
Rumen NH <sub>3</sub> -N (mg/dL)	15.42 <sup>a</sup>	14.91 <sup>b</sup>	13.96 <sup>c</sup>	0.060	0.013	0.055
Nitrogen excretion from urine (g/d)	3.37 <sup>b</sup>	3.80 <sup>b</sup>	4.72 <sup>a</sup>	0.204	0.012	0.203
Nitrogen excretion from fecal (g/d)	7.12 <sup>a</sup>	4.25 <sup>b</sup>	2.15 <sup>c</sup>	0.720	0.0003	0.034
Digested nitrogen (g/d)	9.36 <sup>a</sup>	7.49 <sup>b</sup>	6.75 <sup>b</sup>	0.417	0.021	0.230
Retained nitrogen (g/d)	4.21 <sup>c</sup>	5.99 <sup>b</sup>	7.11 <sup>a</sup>	0.423	0.001	0.077

<sup>a-c</sup>Means within same row with different letters are significantly different ( $P < 0.05$ ).

**Key Words:** pistachio, nitrogen metabolism

### W275 Different levels of tannin by dietary addition of pistachio hull and plasma metabolic profile in Balochi male lambs.

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Pistachio hull (PH) is a byproduct that has high tannin concentration. Tannins can reduce the digestion of nutrients, especially proteins. We aimed to evaluate the effects of diets containing tannin on plasma metabolic profile of Balochi male lambs. Pistachio hull as a tannin source (with 6.68% tannin and 9.95% total phenol content) was used in diets of 3 male lambs (35 ± 2 kg live weight) which were randomly assigned into a changeover 3 × 3 design. Treatments were: 1) control (alfalfa), 2) 15% alfalfa+15% PH and 3) 30% PH (DM basis). Blood samples were taken from the jugular vein at 0, 2 and 4 h after the 0800 h feeding for measuring glucose, total protein, blood urea nitrogen (BUN), albumin, aspartate aminotransferase (AST), alanine aminotransferase (ALT), triglycerides and cholesterol. Data were analyzed as a repeated measurement design using PROC MIXED of SAS ( $P < 0.05$ ), assuming the model included treatment, time, time × treatment as fixed effects and animal as random effect. Blood metabolites glucose, albumin, BUN, AST and ALT were not affected by the experimental diets ( $P = 0.778$ ,  $P = 0.264$ ,  $P = 0.281$ ,  $P = 0.538$  and  $P = 0.899$  for glucose, albumin, BUN, AST and ALT, respectively). Total protein was decreased as the dietary PH content (Tannin source) increased ( $P = 0.003$ ). Plasma triglyceride concentration was significantly increased ( $P = 0.0008$ ). The fat metabolite i.e., cholesterol ( $P = 0.913$ ) was not influenced by PH content of diet.

**Table 1.** Effect of different levels of tannin by dietary addition of pistachio hull on plasma metabolic profile

Plasma metabolites	Alfalfa	15% PH	30% PH	SEM
Glucose (mg/dL)	57.22	58.44	57.33	0.947
Total protein (g/dL)	7.73 <sup>a</sup>	7.50 <sup>b</sup>	7.26 <sup>c</sup>	0.082
BUN (%)	10.95	10.64	10.01	0.161
Albumin (g/dL)	2.77	2.61	2.43	0.065
AST (U/L)	54.44	58.11	63.22	1.462
ALT (U/L)	28.11	29.44	30.21	1.053
Triglycerides (mg/dL)	3.89 <sup>c</sup>	4.27 <sup>b</sup>	5.36 <sup>a</sup>	0.126
Cholesterol (mol/L)	1.42	1.50	1.57	0.078

<sup>a-c</sup>Means within same row with different superscripts differ ( $P < 0.05$ ).

**Key Words:** metabolic profile, plasma, tannin

### W276 Replacing alfalfa with different levels of pistachio hull and its effects on feed intake and digestibility of nutrients in total tract, rumen and post-rumen in Balochi male lambs.

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Dietary tannins can exert either positive or negative effects on ruminants' nutrition and performance. Pistachio hull (PH) is a by-product containing high amount of tannin. Herein we determined the effects of replacing different levels of alfalfa with PH on feed intake and digestibility of nutrients in total tract, rumen and post-rumen in Balochi male lambs. Three male lambs (35 ± 2 kg live weight) equipped with ruminal and abomasal cannula were randomly assigned into a changeover 3 × 3 design and fed the experimental diets for 35 d, 20 d adaptation, 5 d collection and 10 d break time between the 3 periods. Treatments were: 1) control (alfalfa), 2) 15% alfalfa+15% PH and 3) 30% PH (DM basis). Statistical analysis was performed using the MIXED procedure of SAS. Least squares means were separated using the LSD. Total dry matter intake (DMI), organic matter intake (OMI), DMI and OMI per kg of body and metabolic weight, CP, ADF, NDF and fat intake were not different between treatments. Total tract and ruminal digestibility for DM, OM, ADF and NDF was not significantly affected by the diets, but CP in total tract and its ruminal digestibility were linearly decreased with 66.03, 60.11 and 55.50% for total tract ( $P = 0.011$  and SEM = 1.616) and 59.97, 53.67 and 49.17 for ruminal digestibility ( $P = 0.022$  and SEM = 1.718) for 0, 15 and 30% PH respectively. Total tract and ruminal digestibility of fat were linearly increased with 78.97, 80.37 and 82.43% for total tract ( $P = 0.025$  and SEM = 0.529) and 11.98, 17.47 and 21.98 for ruminal digestibility ( $P = 0.027$  and SEM = 1.558) as the amount of PH in the diet increased. Post-ruminal digestibility of OM, Fat, ADF and NDF was not significantly affected by the diets while DM decreased ( $P = 0.037$  and SEM = 0.419) from 29.03 to 28.64 and 27.31 and CP increased ( $P = 0.049$  and SEM = 0.642) from 7.90 to 10.52 and 12.21 for 0, 15 and 30% PH respectively.

**Key Words:** pistachio hull, feed intake, digestibility

### W277 Effect of increasing amounts of corn dried distillers grains with solubles in dairy cow diets on enteric methane emissions, digestibility, and milk production.

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Twelve lactating Holstein cows (DIM = 99 ± 18; BW = 645 ± 49kg) were used in a triplicated 4 × 4 Latin square (35-d periods, 14-d adaptation) to examine the effect of including increasing amounts (0, 10, 20 and 30%, DM basis) of corn dried distillers grains with solubles (DDGS) in the diet on enteric CH<sub>4</sub> emissions, digestibility, and milk production. Diets were isonitrogenous (CP = 16.9%) and isocaloric (NE<sub>L</sub> = 1.64 Mcal/kg) and fed for ad libitum intake. Production of CH<sub>4</sub> was measured (3 consecutive days) using respiration chambers. Digestibility and milk performance were determined over 6 consecutive days. Linear and quadratic contrasts (Proc MIXED; SAS) were used to determine effects of dietary DDGS levels on variable responses. Significance was declared at  $P \leq 0.05$ . Dry matter (DM) intake increased linearly as DDGS proportion increased in the diet (23.4, 24.4, 24.8 and 25.2 kg/d for 0 to 30% DDGS, respectively). Digestibility of DM (70.7, 70.2, 69.6,

and 68.1% for 0 to 30% DDGS, respectively), and energy (69.6, 69.2, 68.7, and 67.6% for 0 to 30% DDGS, respectively) declined linearly as DDGS level in the diet increased. Milk yield increased linearly (up to +4 kg/d) with increasing levels of DDGS in the diet. Milk fat (3.93 to 3.47% for 0 to 30% DDGS, respectively) and milk protein (3.49 to 3.31% for 0 to 30% DDGS, respectively) contents decreased linearly with the addition of DDGS in the diet. There was a tendency ( $P = 0.10$ ) for a quadratic increase in energy corrected milk (ECM) as the proportion of DDGS in the diet increased. Methane production decreased linearly with increasing levels of DDGS in the diet (495, 490, 477 and 475 g/d for 0 to 30% DDGS). When adjusted for gross energy intake,  $\text{CH}_4$  losses also decreased linearly as DDGS proportion increased in the diet (5.53, 5.30, 5.14, 4.76% for 0 to 30% DDGS, respectively). When expressed relative to ECM,  $\text{CH}_4$  production declined linearly as the amount of DDGS increased in the diet. Results from this study show that feeding DDGS to dairy cows can help to mitigate enteric  $\text{CH}_4$  emissions without negatively affecting intake and milk production.

**Key Words:** corn DDGS, methane, dairy cows

**W278 The effect of feeding canola meal on the performance of Chinese Holstein cows.** Z. G. Wang<sup>1</sup>, C. R. Wang<sup>1</sup>, G. L. Liu<sup>\*1,2</sup>, C. G. Zhang<sup>1</sup>, and G. Yang<sup>1</sup>, <sup>1</sup>State Key Laboratory of Dairy Biotechnology, Shanghai Bright Holstein Co. Ltd., Shanghai, China, <sup>2</sup>Shanghai Dairy Breeding Center Co. Ltd., Shanghai, China.

The objective of this study was to evaluate the effects of canola meal (CM) on the lactational performance of Chinese Holstein cows. One hundred multiparous Chinese Holstein cows average  $102 \pm 38.13$  d in milk were randomly assigned to one of 5 treatments. During the 8-wk periods, cows were fed total mixed diets containing 21.8% soybean meal (control), 16.4% soybean meal and 6.3% CM (CM1), 10.9% soybean meal and 12.6% CM (CM2), 5.5% soybean meal and 19% CM (CM3) or 25.3% CM (CM4) as the major protein source. All diets had a 60:40 forage-to-concentrate ratio, and were formulated to be isonitrogenous at 16.25% CP. Results showed that dry matter intake did not differ among control, CM1 and CM2 (17.54, 17.53 and 17.55 kg/d), but was lower for CM3 and CM4 (17.27 and 17.19 kg/d,  $P = 0.03$ ). Milk yield (26.3, 26.4, 26.5, 26.3 and 26.2 kg/d) was no different ( $P = 0.11$ ) when CM replaced soybean meal and corn except when the percentage of CM reached 25.3% DM. Milk SNF, TS, fat and protein percentages decreased for CM4 compared with other groups, but only the percentage of milk SNF and protein reached a significant level ( $P < 0.05$ ). Milk fat yield was higher for CM1 ( $P = 0.02$ ) and CM2 ( $P = 0.02$ ) compared with other groups. Milk protein yield was affected among CM1, CM2, CM3, CM4 and control (0.78, 0.74, 0.81, 0.71, 0.87 kg/d. for, CM1, CM2, CM3, CM4 and control respectively). The percentage of milk lactose was higher for control compared with the other four treatments, whereas the milk lactose yields of CM1 and CM2 were higher than control, CM3 and CM4. Results of this study showed that maximum economic payback could be obtained when the dairy ration was formulated to contain about 12.6% CM (DM basis).

**Key Words:** canola meal (CM), performance, Chinese Holstein cows

**W279 Effects of limit-feeding dried distillers grains to ewes during mid- to late-gestation on ram progeny post-weaning performance and carcass composition.** R. L. Burgett<sup>\*1</sup>, J. R. Luther<sup>2</sup>, D. L. Thomas<sup>1</sup>, D. M. Schaefer<sup>1</sup>, and A. E. Radunz<sup>1</sup>, <sup>1</sup>University of Wisconsin-Madison, Madison, <sup>2</sup>University of Wisconsin-River Falls, River Falls.

Mature Polypay and Hampshire ewes ( $n = 48$ ;  $\text{BW} = 83.1 \pm 2.7$  kg) were used to evaluate the effects of maternal dietary energy source fed

during mid- to late-gestation on postnatal progeny performance. Ewes were blocked by breed ( $n = 2$ ) and BW ( $n = 3$ ), stratified by age, sire, and fetal number, and randomly assigned to pens ( $n = 12$ ). Pens were allocated to 1 of 2 treatments: ad libitum alfalfa hay (H) or limit-fed dried corn distillers grains plus solubles (D) as the primary dietary energy source from 63 to  $130 \pm 6$  d of gestation then removed from experimental treatments and managed as 1 group until weaning ( $66 \pm 9$  d). All ram lambs ( $n = 25$ ) were fed the same diet as 1 group: whole shelled corn (82.5%), commercial finishing pellet (12.5%, 150 g/t lasalocid), molasses (3.75%), calcium carbonate (0.75%) and ammonium chloride (0.5%) on DM basis. Rams were weighed bi-weekly until slaughter at  $114 \pm 9$  d post-weaning. At slaughter, KPH was removed before collecting HCW. Carcass measurements were collected 24 h after slaughter. Ram lambs from Hampshire ewes fed D during gestation tended ( $P = 0.08$ ) to be lighter at slaughter than lambs from Hampshire ewes fed H or Polypay ewes fed D or H, whereas ADG was similar ( $P = 0.34$ ) for rams between treatments from weaning to slaughter. Hampshire ram progeny from ewes fed H had greater ( $P = 0.05$ ) HCW than those from Hampshire ewes fed D and Polypay ewes fed H but not different than ram progeny from Polypay ewes fed D. Organ weights, KPH, and mesenteric fat as % HCW were similar ( $P \geq 0.17$ ) among treatments. No differences ( $P \geq 0.55$ ) were detected in 12th rib fat thickness, body wall thickness, intramuscular fat (% ether extract), or LM area, however, lambs from Hampshire ewes fed H had greater ( $P = 0.05$ ) percentage of boneless trimmed retail cuts than lambs from Polypay ewes fed H. Measurements for USDA quality grade (leg score and conformation) were also similar ( $P \geq 0.47$ ) among treatments. Feeding D versus H to ewes in mid to late gestation resulted in no difference in post-weaning growth performance but slight differences in ram progeny carcass weight.

**Key Words:** distillers grains, fetal programming, sheep

**W280 Effect of dried distillers grains with solubles (DDGS) on duodenal microbial crude protein (MCP) flow in steers as determined with DNA microbial markers.** E. Castillo-Lopez,<sup>\*</sup> T. J. Klopfenstein, and P. J. Kononoff, University of Nebraska-Lincoln, Lincoln.

The objectives of this trial were to evaluate the effect of dried distillers grains with solubles (DDGS) on duodenal flow of bacterial crude protein (BCP), protozoal crude protein (PCP) and yeast crude protein (YCP) in steers fed DDGS. Three crossbred steers fitted with ruminal and double L-shaped duodenal cannulas (average BW  $780 \pm 137$  kg) were used in a 3 treatment, 6 period crossover design. Animals were housed in individual free stalls and fed twice daily at 0700 and 1900. Diets (DM basis) were 1) CONTROL, 0% DDGS, but with 19.5% corn bran, 20% sorghum silage, 60% brome hay, 0.5% trace minerals and 0.25% urea; 2) LOW DDGS, inclusion of 9.75% DDGS replacing equal percentage of corn bran; 3) HIGH DDGS, inclusion of 19.5% DDGS completely replacing corn bran. On d 16 to 19 of each period, 200 mL of duodenal digesta were collected every 4 h from each animal, then composited by day, by animal within period. Duodenal microbial crude protein (MCP) was estimated using DNA as microbial markers. For bacteria, marker was part of the 16S rRNA gene. For protozoa, marker was part of the 18S rRNA gene. For yeast, marker was part of the II chromosome of *Saccharomyces cerevisiae*. Data were analyzed using the MIXED procedure of SAS. Average DMI was 10.5 kg/d across treatments. Duodenal BCP flow tended ( $P = 0.14$ ) to decrease with DDGS inclusion; estimates were 479, 397 and  $368 \pm 74$  g/d for CONTROL, LOW DDGS and HIGH DDGS, respectively. However, duodenal PCP flow was unaffected ( $P = 0.64$ ) and averaged  $80 \pm 12$  g/d. Duodenal YCP flow increased ( $P < 0.01$ ) with DDGS inclusion; estimates were 0.15, 1.94 and  $4.80 \pm 0.66$  g/d for CONTROL, LOW DDGS and HIGH DDGS, respectively. Overall,

when animals were fed DDGS, duodenal BCP flow tended to decrease, PCP flow was unaffected, YCP flow increased and total duodenal MCP flow tended to decrease.

**Key Words:** dried distillers grains with solubles, duodenal microbial crude protein flow

**W281 Effect of canola meal on growth performance, carcass quality and meat fatty acid profiles of feedlot cattle.** M. L. He<sup>\*1,2</sup>, T. A. McAllister<sup>1</sup>, D. Gibb<sup>3</sup>, and J. J. McKinnon<sup>2</sup>, <sup>1</sup>Lethbridge Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada, <sup>2</sup>University of Saskatchewan, Saskatoon, SK, Canada, <sup>3</sup>Viterra Feed Products, Lethbridge, AB, Canada.

This study investigated the effect of substituting canola meal (CM) for barley grain on growth performance, carcass quality and meat fatty acid (FA) profiles of feedlot cattle. Cross bred calves (n = 140; 285 ± 27 kg) were individually fed diets comprised of a barley grain based concentrate (including 5% supplements) and barley silage in dry matter (DM) basis at ratios of 45:55 and 92:8 during growing and finishing periods, respectively. Solvent extracted and pressed CM derived from *Brassica napus* or solvent extracted CM from *Brassica juncea* canola was compared. Pressed CM contained 11.4% residual oil. CM was substituted for 0 (control), 15, or 30% barley grain (DM basis) in the diet. There was no difference ( $P = 0.54$ ) in average daily gain among the treatments. The inclusion of 30% pressed CM increased ( $P < 0.05$ ) feed intake compared with the control and those 15% CM groups, but reduced ( $P < 0.05$ ) feed efficiency as compared with the control and 15% *Brassica juncea* or 15% pressed CM. Feed efficiency of cattle fed 15% CM did not differ from those fed the control diet. Carcass quality and incidence of liver abscesses were not affected ( $P > 0.05$ ) by inclusion of CM. Inclusion of 30% pressed CM resulted in higher ( $P < 0.05$ ) FA of total polyunsaturated, n-3, *trans*, non-conjugated dienes,  $\alpha$ -linolenic acid and rumenic acid, and a decrease ( $P < 0.05$ ) in n-6/n-3 ratio in the *pars costalis diaphragmatis* muscle as compared with the control diet. In conclusion, inclusion of 15% CM did not alter the growth performance or feed efficiency of beef cattle during the growing and finishing period. However, inclusion of 30% CM in the diet decreased feed efficiency, particularly during the finishing period. The inclusion of 15% or 30% solvent extracted CM did not alter carcass quality whereas that of 30% pressed CM increased functional fatty acids (i.e., n-3 and CLA) in beef.

**Key Words:** canola meal, beef cattle, growth performance

**W282 Effects of roughage concentration in steam-flaked corn-based diets containing wet distillers grains with solubles on nutrient digestibility by feedlot cattle.** J. S. Schutz,<sup>\*</sup> C. H. Ponce, D. R. Smith, and M. L. Galyean, Department of Animal and Food Sciences, Texas Tech University, Lubbock.

Effects of concentrations of alfalfa hay (AH) and wet distillers grains with solubles (WDGS) on apparent total-tract digestibility of nutrients were evaluated with 56 beef steers (initial BW = 395.3 ± 6.9 kg) in a randomized complete block design. Treatments were arranged in a 2 × 3 + 1 factorial and consisted of steam-flaked corn-based diets with (DM basis) 6 or 12% AH and 15, 30, or 45% WDGS plus a control diet without WDGS that contained 9% AH. Diets were fed for 28 d, and 0.15% (DM) of Cr<sub>2</sub>O<sub>3</sub> was included in the diet as an indigestible marker for measurement of nutrient digestibility from d 21 to 28. A WDGS × AH interaction (Linear and quadratic,  $P \leq 0.02$ ) was detected for intake of starch. Intakes of DM, OM, NDF, ADF, and CP were greater ( $P \leq 0.048$ ) for steers fed 12 vs. 6% AH. Increasing the dietary concentration

of WDGS increased NDF, ADF, and CP intakes (quadratic,  $P \leq 0.046$ ). Dry matter and OM digestibility were greater for the control steers vs. the average of the other treatments ( $P < 0.01$ ). A WDGS × AH interaction was noted for apparent total tract digestibility of DM, OM, and starch ( $P < 0.01$ ). Dry matter and OM digestibilities were decreased (AH × linear,  $P < 0.03$ ) and increased (AH × quadratic,  $P < 0.01$ ) with 6 and 12% AH; respectively, as WDGS increased in the diet, and starch digestibility increased (AH × quadratic  $P < 0.01$ ) at 12% AH. Increasing WDGS in the diet resulted in a linear increase of NDF and CP digestibilities ( $P < 0.01$ ). Results from this experiment suggest an interaction of WDGS and roughage concentrations in terms of total tract digestibility.

**Key Words:** alfalfa hay, digestibility, wet distillers grains with solubles

**W283 Effect of sarsaponin supplementation on digestive function of steers fed a high grain distillers grain-feedlot diet.** E. Valencia<sup>1</sup>, M. F. Montano<sup>\*1</sup>, J. Salinas<sup>2</sup>, V. M. Gonzalez<sup>1</sup>, O. M. Manriquez<sup>1</sup>, J. A. Valdez<sup>1</sup>, J. O. Chirino<sup>1</sup>, O. J. Castillo<sup>1</sup>, G. M. Carvajal<sup>1</sup>, and W. G. Caceres<sup>1</sup>, <sup>1</sup>Universidad Autónoma de Baja California, Mexicali, B.C. Mexico, <sup>2</sup>Universidad Autónoma de Tamaulipas, Ciudad Victoria, Tam. Mexico.

Six Holstein steers (132 ± 3 kg) with cannulas in rumen and duodenum were distributed in a 3 × 3 replicated Latin square design to evaluate the effect of supplementation of sarsaponin on a finishing diet with 40% of dried distillery grains plus soluble (DDGS) on the characteristics of digestion and rumen function. Treatments were a combination of an initial dose of SarStart (SarTec Corporation, Anoka, MN) via mouth on the d 1 of each experimental period plus a daily dose of SarStart DSC (SarTec Corporation) offered in the diet. Treatments were as follows: 1) 0cc of SarStart + 0 g/d of SarStart DSC; 2) SarStart 100cc + 2 g/d of SarStart DSC and 3) 200cc of SarStart + 4 g/d of SarStart DSC. Ruminant starch digestion was greater (79.6 vs 82.1%;  $P < 0.05$ ), as well as its amount reaching duodenum (160 vs. 125 g/d;  $P < 0.05$ ), in T2 compared with T3. There was no effect of treatment on ruminal, post-ruminal or total digestibility of the nitrogen components of diets, or microbial efficiency ( $P > 0.05$ ). The treatments did not affect ( $P > 0.05$ ) total volatile fatty acids, or its composition, or ruminal pH. It was concluded that the doses from sarsaponin used in this experiment did not significantly alter the digestive efficiency of the components of finishing diets with high levels of dried distillery grains plus soluble in cattle.

**Key Words:** distillery grains, sarsaponin, steers

**W284 Effect of tannins extract supplementation on feedlot performance and plasma urea nitrogen of yearling bulls fed dry-ground corn-based diets containing corn-DDG and cane molasses.** R. Barajas<sup>\*1</sup>, B. J. Cervantes<sup>2</sup>, M. A. Espino<sup>1,3</sup>, A. Camacho<sup>1</sup>, M. Verdugo<sup>1</sup>, L. R. Flores<sup>1</sup>, J. J. Lomeli<sup>1</sup>, and J. A. Romo<sup>1</sup>, <sup>1</sup>FMVZ-Universidad Autónoma de Sinaloa, Culiacán, Sinaloa, México, <sup>2</sup>Ganadera Los Migueles S.A. de C.V., Culiacán, Sinaloa, México, <sup>3</sup>Pronutrient Developers, León, Guanajuato, México.

Thirty *Bos Taurus* × *Bos indicus* yearling bulls 365 ± SE 1.10 kg, were used in a 84 d experiment to determine the effect of tannins extract supplementation on feedlot performance and plasma urea nitrogen of yearling bulls fed dry-ground corn-based diets containing corn-DDG and cane molasses. Prior to the experiment, bulls were placed in experimental pens and fed a 15.4% CP, 70% roughage diet for 90 d to homogenize previous nutritional plane. Day-1 bulls were weighed and blocked by initial weight, and in groups of 5 were placed in 6 ground floor pen (6 × 12 m). In agreement with a complete randomized block design, in each block, bulls were

randomly assigned to one of next treatments: 1) Feeding with a finishing diet containing ground corn 53.37%, corn dry distiller grain 13.51%, sugar-cane molasses 12.71%, tallow 2.35%, mineral premix 2.82%, and corn straw 14.23% (Control); or 2) Diet similar to Control, added with 0.3% (dry matter basis) of a tannins extract (TE). Tannins extract was supplied as ByPRO (Pronutrient Developers; Mexico), a premix that contains 72% of a condensed (Quebracho tree) and soluble (Chesnutt) tannins blend. Bulls were weighed in d 1 and 84. In d 1 and 28, blood samples were taken from jugular vein for plasma urea nitrogen (PUN) determination. Real mean daily tannins extract intake was 36 g by bull, equivalent to 0.33% of the dietary DMI. In d 28 TE decreased ( $P = 0.08$ ) PUN concentration in 18%. At end of the experiment TE-fed bulls were 2.9% heavier ( $P = 0.04$ ) than Control (498.25 vs. 512.98 kg, for Control and TE, respectively). TE supplementation increased ( $P = 0.02$ ) average daily gain by 11.8% with mean values of 1.580 vs. 1.767 for Control and TE treatments, respectively. DMI was not affected by treatments ( $P = 0.91$ ). TE improved ( $P = 0.06$ ) the Gain:DMI ratio by 12% (0.149 vs. 0.167 kg/kg, for Control and TE, respectively). It is concluded, that tannins extract supplementation improves feedlot performance of yearling bulls fed dry-ground corn based-diets containing corn-DDG and cane molasses.

**Key Words:** feedlot performance, tannins, yearling bulls

**W285 Inclusion of triticale dried distiller grains and flaxseed in feedlot cattle diets increases alpha-linolenic acid in beef without affecting carcass or meat quality traits.** M. L. He<sup>1,2</sup>, L. M. Hernandez-Calva<sup>1</sup>, T. A. McAllister<sup>1</sup>, J. L. Aalhus<sup>3</sup>, M. E. R. Dugan<sup>3</sup>, and J. J. McKinnon<sup>2</sup>, <sup>1</sup>Lethbridge Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada, <sup>2</sup>University of Saskatchewan, Saskatoon, SK, Canada, <sup>3</sup>Lacombe Research Centre, Agriculture and Agri-Food Canada, Lacombe, AB, Canada.

This study examined the effect of including triticale dried distillers grain (TDDG), with and without ground flaxseed (FS) or high oleic acid-sunflower seeds (SS), in feedlot finishing diets on carcass and meat quality and fatty acid profiles in beef. Steers ( $n = 90$ ;  $455 \pm 31$  kg) were housed in individual pens and fed either: 1) control (CON) consisting of (dry matter basis) 90% barley concentrate (including 5% supplements) - 10% barley silage, or the following diets with barley grain substituted for 2) 30% TDDG; 3) 10% FS; 4) 30% TDDG - 8.5% FS (FS+DDG); 5) 10% SS; and 6) 30% TDDG - 8.5% SS (SS+DDG) over a 15 wk finishing period. Major carcass traits including grade fat depth, rib eye area and marbling ( $n = 15$ ) as well as meat quality parameters including *longissimus thoracis* (LT) pH, temperature, drip loss, shear force, cook loss and meat color ( $n = 8$ ) were measured. Fatty acids in back fat, perirenal fat and LT muscle samples were analyzed ( $n = 8$ ). Including TDDG, in combination with either oilseed did not affect ( $P > 0.05$ ) carcass or meat quality except for: a higher ( $P < 0.05$ ) post-slaughter temperature at 45 min, an increase ( $P < 0.05$ ) in drip loss and chroma values after inclusion of TDDG; and a reduction ( $P < 0.05$ ) in cook loss after inclusion of FS. Inclusion of TDDG decreased ( $P < 0.05$ ) total *trans* fatty acids (excluding conjugated linoleic acids and vaccenic acid), whereas inclusion of FS increased ( $P < 0.05$ )  $\alpha$ -linolenic acid (ALA) as well as associated biohydrogenation products (non-conjugated dienes (NCD)) in meat and adipose tissues. Inclusion of TDDG together with FS further increased ( $P < 0.05$ ) ALA, but decreased ( $P < 0.05$ ) NCD in the meat and adipose samples. Compared with inclusion of FS alone, addition of DDG+FS in feedlot diets increased n-3 fatty acid while reducing levels of *trans* fatty acids in fat and meat, without adversely impacting carcass or meat quality.

**Key Words:** carcass, flaxseed, triticale dried distillers grain with solubles

**W286 Effects of increasing distillers grain and monensin on feed intake and ruminal fermentation in feedlot cattle diets.** L. Xu<sup>1,2</sup>, Y. Jin<sup>2</sup>, C. Li<sup>1,2</sup>, and W. Z. Yang<sup>\*1</sup>, <sup>1</sup>Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada, <sup>2</sup>College of Animal Science, Inner Mongolia Agricultural University, Hohhot, Inner Mongolia, China.

It has been reported that diets that contain corn distillers grain with solubles (DG) are less responsive to monensin (M) addition in feedlot cattle. A study was conducted to determine the effects of increasing M supplementation and inclusion rates of corn DG on DMI, sorting index and ruminal fermentation. Five ruminally and duodenally cannulated beef heifers were used in a  $5 \times 5$  Latin square design with  $2 \times 2+1$  factorial arrangement. Treatments were control (CON; 10% barley silage, 87% barley grain, 3% supplement, and 28 mg M/kg DM), and diets substituting 20% or 40% corn DG for grain combining with 28 or 48 mg M/kg diet DM, i.e., 20DG-28M, 20DG-48M, 40DG-28M and 40DG-48M. The CON is a standard feedlot diet in western Canada. Sorting index was calculated as the ratio of actual intake to expected intake for particles retained on 19- and 8-mm sieve of Penn State Particle Separator. DMI (kg/d) was lower ( $P < 0.05$ ) for CON (7.2) than for DG (8.3) diets. There was no interaction between DG and M on DMI, which was not affected by the level of DG (8.3 kg/d), whereas DMI was higher ( $P < 0.05$ ) with 28M (8.9) than with 48M (7.7). Sorting index was not affected by treatments but it was 109 for the particles retained on 19 mm sieve, indicating that animals were intentionally selected for the coarse particles. Total VFA concentrations (mM), molar proportions of acetate and propionate were not different between CON (128, 52 and 29, respectively) and DG (126, 50 and 32, respectively) diets. There was no interaction of DG with M on ruminal fermentation. Total VFA concentration was greater ( $P < 0.06$ ) for 20DG (130) than for 40DG (122) with no difference in molar proportions of acetate and propionate. Increasing the level of M increased ( $P < 0.04$ ) proportion of acetate from 48 to 51% but did not affect other fermentation variables. These results indicate that manipulating the levels of corn DG and M in feedlot diets can change DMI, whereas the effects on ruminal fermentation appear minimal.

**Key Words:** distillers grain, feedlot cattle, monensin

**W287 Modeling nutrient supply from combined feeds of corn with wheat dried distillers grains with solubles at different ratios in ruminants.** D. Damiran, M. Yari, L. Yang,\* X. Zhang, and P. Yu, Department of Animal and Poultry Science, University of Saskatchewan, Saskatoon, SK, Canada.

The objectives of this study were to use modeling approach to estimate nutrient supply from combined feeds of corn with wheat DDGS at 4 different ratios of corn to wheat dried distillers grains with solubles (DDGS): 100:0, 75:25, 50:50, 25:75. Each feed treatment had 2 different replicates using 2 different DDGS sources. The parameters for nutrient supply prediction that were accessed included: truly absorbed rumen synthesized microbial protein in the small intestine; truly absorbed rumen undegraded feed protein in the small intestine; endogenous protein in the digestive tract; total truly absorbed protein in the small intestine and degraded protein balance. Two dry Holstein Friesian cows, fitted with a flexible rumen cannula were used for measuring rumen degradation kinetics of the 4 combined feeds. Based on lab chemical analysis, in situ degradation and in vitro intestinal digestion data, the nutrient supply to dairy cattle was predicted. The data were analysis by Mixed procedure of SAS with a CRD model. The results showed that with increasing inclusion rate of wheat DDGS to corn, it did not change the truly absorbed rumen synthesized microbial protein in the



small intestine with an average of 54 g/kg DM and endogenous protein with an average of 7 g/kg DM, but changed the truly absorbed rumen undegraded feed protein in the small intestine from 50 to 108 g/kg DM, total truly absorbed protein in the small intestine from 95 to 154 g/kg DM and degraded protein balance from -54 to 102 g/kg DM. These results indicated that with the inclusion of bioethanol co-product, the nutrient supply from corn grain could be further improved.

**Key Words:** combined feeds, modeling, nutrient supply

**W288 Effects of biodiesel by-products on in vitro fermentation, digestion kinetics and methane production.** S. J. Meale<sup>\*1</sup>, S. M. Olivares-Palma<sup>1</sup>, L. G. R. Pereira<sup>2</sup>, F. S. Machado<sup>2</sup>, H. Carneiro<sup>2</sup>, F. C. F. Lopes<sup>2</sup>, and A. V. Chaves<sup>1</sup>, <sup>1</sup>Faculty of Veterinary Science, University of Sydney, Sydney, NSW, Australia, <sup>2</sup>Embrapa Dairy Cattle, Juiz de Fora, MG, Brazil.

Increasing interest in the biofuel industry has produced by-products which show promise as energy and protein feeds in the diets of ruminant livestock. The objective of this study was to determine the effects of biodiesel by-products, from a variety of oilseed sources on *in sacco* nutrient degradability, *in vitro* ruminal fermentation and CH<sub>4</sub> production. Beard grass (*Brachiaria brizantha*) was incubated alone (control) and in combination with 7 biodiesel by-products (i.e., moringa, castor, cotton, radish, palm kernel and sunflower press oil seeds and glycerine) at ratios of 900:100, 800:200 and 600:400 for each treatment, in a 48 h *in vitro* batch culture. Gas production (mL/g incubated DM) was measured at 6, 12, 24 and 48 h. Methane production (mg/g of DMD) was measured at 6 and 12 h. Data were analyzed using the MIXED procedure of SAS. After 48 h, culture pH and IVDMD were affected by level x supplement interaction ( $P < 0.05$ ). Supplement type affected gas production, total VFA, proportions of individual VFA and CH<sub>4</sub> production ( $P < 0.05$ ). Moringa produced the lowest amount of CH<sub>4</sub> (g/kg of DM) at 6 and 12 h of incubation, whereas glycerine had the highest CH<sub>4</sub> production ( $P < 0.05$ ). The *in sacco* experiment examined ruminal degradation of CP and DM in moringa, castor, cotton, radish, palm kernel and sunflower press oil seeds and soybean meal (control). Three nylon bags, containing 5 g of sample, were placed into the rumen of each of the 3 lactating Holstein-Friesian dairy cows. Corresponding bags were removed at 0, 3, 6, 12, 24, 48 and 96 h (i.e., 3 replicates per cow, 9 replicates per time point) for determination of CP and DM disappearance. Moringa press oils seeds exhibited the greatest effective degradability of DM. Similarly, moringa and sunflower press oil seeds exhibited rapid degradation rates of both CP and DM and showed the greatest effective degradability of CP compared with other feed sources ( $P < 0.05$ ). The findings suggest moringa press oils seeds may have the potential to be included in ruminant diets to reduce CH<sub>4</sub> production without adversely affecting nutrient degradability.

**Key Words:** methane, press oil seeds, ruminal fermentation

**W289 Effect of replacing barley grain with glycerol in feedlot diets on nutrient digestibility, methane emissions, growth, fatty acid profiles and carcass traits of lambs.** J. S. Avila<sup>1,3</sup>, S. J. Meale<sup>\*1,2</sup>, T. A. McAllister<sup>2</sup>, M. L. He<sup>2</sup>, O. M. Harstad<sup>4</sup>, K. A. Beauchemin<sup>2</sup>, S. M. McGinn<sup>2</sup>, and A. V. Chaves<sup>1</sup>, <sup>1</sup>Faculty of Veterinary Science, University of Sydney, Sydney, NSW, Australia, <sup>2</sup>Lethbridge Research Center, Agriculture and Agri-Food Canada, Lethbridge, Alberta, Canada, <sup>3</sup>Facultad de Ciencias Veterinarias, Universidad de Concepción, Chillan, Chile, <sup>4</sup>Norwegian University of Life Sciences (UMB), Ås, Norway.

The aim of the study was to assess the effects of replacing barley grain with increasing concentrations of glycerol on total tract nutrient

digestibility, methane (CH<sub>4</sub>) emissions, growth performance, and fatty acid (FA) profiles. The control diet (DM basis) contained 57% barley grain, 14.5% wheat dried distillers grain with solubles (WDDGS), 13% sunflower hulls, 6.5% beet pulp, 6.3% alfalfa and 3% mineral-vitamin mix. Increasing concentrations (7, 14 and 21% dietary DM) of glycerol in the diet DM were achieved by substituting it for barley grain. As glycerol was added alfalfa and WDDGS were increased to maintain similar concentrations of CP and NDF among diets. Nutrient digestibility and CH<sub>4</sub> emissions from 12 ram lambs were measured in a repeated 4 × 4 Latin square experiment. Additionally, 60 weaned lambs were blocked by weight and randomly assigned to one of the 4 dietary treatments and fed to slaughter weight. Data were analyzed using the mixed procedure of SAS. The model included the fixed effects of treatment (diet), day and treatment by day interactions and the random effects of period (n = 4), chamber (group) and lamb nested within treatment as random effects with day of sampling within each period treated as repeated measure. Nutrient intakes, digestibility and CH<sub>4</sub> emissions were not altered by inclusion of glycerol in the diets. In the growth trial, increasing glycerol in the diet linearly decreased DMI ( $P < 0.01$ ) and linearly decreased final bodyweight ( $P = 0.01$ ). The 7% glycerol group tended to have higher ADG ( $P = 0.06$ ) compared with all other treatments. Feed efficiency, carcass traits and total SFA or MUFA proportions of subcutaneous fat were not affected by inclusion of glycerol, but PUFA were linearly decreased ( $P < 0.01$ ). Proportions of 16:0, 10 $\alpha$ -18:1, linoleic acid 18:2 (n-6) and the n-6/n-3 ratio were linearly reduced ( $P < 0.01$ ) and those of 18:0 (stearic acid), 9 $\alpha$ -18:1 (oleic acid) were linearly increased ( $P < 0.01$ ) by glycerol inclusion in the diets. In conclusion, glycerol did not affect nutrient digestibility or CH<sub>4</sub> emissions of lambs fed barley-based finishing diets. Lamb growth performance was optimized at 7% glycerol inclusion in the diet and may improve back fat fatty acid profiles by increasing 18:0 and 9 $\alpha$ -18:1, while reducing 10 $\alpha$ -18:1 and the n-6/n-3 ratio.

**Key Words:** biofuel by-products, methane, *trans* fatty acids

**W290 Crude glycerin decreases fiber digestibility in finishing Nellore bulls.** E. H. C. B. van Cleef<sup>\*1</sup>, J. M. B. Ezequiel<sup>1</sup>, J. B. D. Sancañari<sup>1,2</sup>, A. P. D'Aurea<sup>1</sup>, V. R. Fávoro<sup>1</sup>, D. A. V. Silva<sup>1</sup>, J. W. Catellani<sup>1</sup>, and F. B. O. Scarpino<sup>1</sup>, <sup>1</sup>São Paulo State University, Jaboticabal, São Paulo, Brazil, <sup>2</sup>Uzinas Químicas Brasileiras S.A., Jaboticabal, São Paulo, Brazil.

Nellore bulls (n = 30, 277.7 ± 23.8 kg BW) were used to evaluate total tract digestibility when fed diets containing 0, 7.5, 15, 22.5, or 30% crude glycerin. Treatments (5 diets) consisted of a control diet containing 30% corn silage, 35% corn grain, 19.2% soybean hulls, 14.6% sunflower meal, and 1.2% supplement, and diets containing 7.5, 15, 22.5 or 30% glycerin (dry matter basis). In this study, glycerin replaced specifically corn grain. Bulls were vaccinated against common viral and clostridial diseases, stratified in a randomized block design, by initial BW, and assigned randomly to 30 individual feedlot pens (6/treatment). Over a period of 21 d, bulls were transitioned from diets containing 20% concentrate to their respective 70% concentrate finishing diets using 4 step-up diets that contained progressively greater proportions of concentrate. Final diets provided 12.2% CP and 2.5 Mcal ME/kg. Data were analyzed using the General Linear Model procedure of SAS, with animal considered as experimental unit. Indigestible acid detergent fiber was used as internal marker to determine nutrient apparent digestibility. Five Nellore rumen-cannulated steers (approximately 400 kg BW) were adapted to experimental diets and incubated *in situ* with diets, and fecal samples from the 30 finishing study animals for 264 h. Feeding glycerin caused linear ( $P \leq 0.01$ ) reductions in neutral detergent fiber

and hemicellulose apparent digestibility, while simultaneously increased crude protein apparent digestibility ( $P \leq 0.01$ ). Dry matter, ether extract and acid detergent fiber apparent digestibilities were unaffected ( $P > 0.05$ ) by adding glycerin. The negative effect in digestibility was not reflected in changes in DMI ( $P > 0.05$ ) nor ADG ( $P > 0.05$ ). The inclusion of crude glycerin in finishing Nelore cattle diets cause significant decrease in digestibility of neutral detergent fiber and hemicellulose, suggesting caution to the level and type of roughage used. Further studies are needed to elucidate the effect of crude glycerin on mechanisms of action of fibrolytic microorganisms as well as the processes involved in the adhesion of these to fiber particles. Supported by FAPESP and CNPq.

**Key Words:** biodiesel, co-product, beef cattle

**W291 Effect of replacing wheat offal with dried oil palm slurry on the performance and carcass traits of Ndama weaners.** M. K. Adewumi\* and J. A. Aderiye, *Department of Animal Science, University of Ibadan, Ibadan, Oyo State, Nigeria.*

The objective of this trial was to evaluate the effect of replacing wheat offal (WO) with dried oil palm slurry (DOPS) on performance and carcass traits of weanling Ndama calves. Sixteen calves weighing  $60.00 \pm 1.50$  kg were used in a complete randomized design. Control (T1) diet consisted of 53.0% wheat offal (WO), 30.0% dried brewers grains (DBG), 15.0% palm kernel cake (PKC) and 2.0% of a ruminant premix on dry basis. In the test diets, wheat offal was replaced with dried oil palm slurry at 18.9% (T2), 37.7% (T3) and 56.6% (T4) on dry matter basis. The supplements were fed at the rate of 3 kg/100 kg of body weight. Animals, also had access to fresh *Panicum maximum*. The trial lasted 180 d with a 14 d adaptation. All animals were weighed at the start of the trial and subsequently every 14 d to obtain average daily gain (ADG). At the end of 180 d, 3 animals were slaughtered per treatment after fasting for 16 h and hot carcass weight (HCW) determined. Dressing percentage (DP) and rib eye area (REA) were measured after cooling the carcass. Data were analyzed using ANOVA. Dry matter intake ( $2.58 \pm 0.04$  kg/d) was similar for T1, T2 and T3 but higher ( $P < 0.05$ ) than for T4 ( $2.17 \pm 0.01$  kg/d). Dry matter digestibility ( $69.88 \pm 3.18\%$ ) was not different among treatments. Hot carcass weight (kg) and dressing percentage (%) were higher ( $P < 0.05$ ) for T2 ( $74.20 \pm 1.80$  and  $49.19 \pm 0.76$ ) and T3 ( $78.07 \pm 1.76$  and  $50.99 \pm 0.68$ ) than T1 ( $52.00 \pm 1.68$  and  $40.86 \pm 0.74$ ) and T4 ( $59.17 \pm 1.80$  and  $43.45 \pm 0.72$ ) respectively. Rib eye area ( $\text{cm}^2$ ) was higher ( $P < 0.05$ ) for T3 ( $76.00 \pm 1.78$ ) than the average ( $52.33 \pm 3.18$ ) for the other 3 treatments respectively. Replacing wheat offal with not more than 37.7% dried oil palm slurry improved performance and carcass traits of Ndama weaners.

**Key Words:** dried oil palm slurry, Ndama, performance

**W292 Glycerin from soybean biodiesel in diets with high levels of concentrate for sheep.** R. L. Galati,\* P. G. Paiva, L. S. Cabral, J. T. Zervoudakis, J. G. Abreu, R. S. Gomes, M. P. S. Fachin, and A. P. G. Baroni, *Universidade Federal do Mato Grosso, FAMEV/UFMT, Cuiabá, Brazil.*

The objectives of this study were to evaluate the effect of glycerin from soybean biodiesel in high-concentrate diets on intake, digestibility, rumen pH and glucose blood concentrations. Animals were housed in individual pens, randomly allocated in a 5x5 Latin square design, and the dietary treatments were: 0, 5, 10, 15 and 20% of glycerin on diet DM. The glycerin used was derived from soybean biodiesel (98% glycerol, 0.98% methanol, 0.18% ethanol, 101 mg KOH/g). Five male sheep, castrated and cannulated in the rumen, with initial body weight of 52.2

$\pm 5.5$  kg were used in this study, and fed isoproteic diets (11.2% CP), containing 25% cotton boll and 75% concentrate, on DM basis. Water, feed, refusal and total fecal output were collected on 8 d through 13 d of each period. Rumen fluid was collected on 14 d to measure the pH values up to 8 h after feeding. The glucose blood concentrations were measured with AccuChek on 17 d of each period until 4 h after feeding. Quadratic responses ( $P < 0.03$ ) were observed on DM (1631.16 g/d), OM (1515.69 g/d), CP (184.98 g/d), total digestible nutrients (TDN) intakes, with maximum inclusions of 12.95, 12.55, 13.01 and 15.75% glycerin, respectively. Linear response ( $P < 0.01$ ) from 32.21 to 93.41 g/d was observed for ether extract (EE) intake, while non-fiber carbohydrate (NFC) linearly decreased from 761.79 to 501.69 g/d. Water intake was about 2.3 L/kg DM without glycerin effect ( $P > 0.10$ ). For the most part of nutrients digestibility (DM, OM, CP, EE and NDF), a positive linear response ( $P < 0.08$ ), without any effect on fiber carbohydrate ( $P > 0.10$ ), were observed. Linear decreases ( $P < 0.07$ ) were observed in NFC digestibility, and to the TDN, a positive response ( $P < 0.01$ ) was obtained (71.55 to 75.24%). Quadratic response ( $P < 0.03$ ) were observed on rumen pH values by glycerin and collection times, with the maximum of 5.57 for 8.63% glycerin, and minimum of 5.39 about 4.78 h after feeding. The increase of glycerin did not affect ( $P > 0.11$ ) the blood glucose concentration (63.66 mg/dL). The dry matter intake was not affected by the inclusion of 13% soybean glycerin in high-concentrate diets, and the linear digestibility response could compensate low intake, so that, 15% glycerin could be adequate without compromising nutritional parameters.

**Key Words:** digestibility, glycerol, soybean

**W293 Nitrogen balance and microbial efficiency in sheep fed with diets containing glycerin.** R. L. Galati,\* P. G. Paiva, J. T. Zervoudakis, L. S. Cabral, J. G. Abreu, M. Zanchetin, L. R. Rebelo, and R. S. Fioravante Filho, *Universidade Federal do Mato Grosso, FAMEV/UFMT, Cuiabá, Brazil.*

The objective of this study was to evaluate the effect of glycerin inclusion in diets with high levels of concentrate on nitrogen balance (NB), excretion of purine derivatives, microbial production (Pmic) and efficiency (Efmic), and ruminal ammonia concentrations. The glycerin used was derived from soybean biodiesel production (98% glycerol, 19.2% fat, 0.98% methanol, 0.18% ethanol, 101 mg KOH/g). Five castrated male sheep, cannulated in the rumen, with initial body weight of  $52.2 \pm 5.5$  kg were used in this study. Animals were housed in individual pens and fed isoproteic diets (11.2% CP), containing 25% cotton boll and 75% concentrate, on DM basis. Animals were randomly allocated in a 5 x 5 Latin square design, and treatments were 0, 5, 10, 15 and 20% of glycerin on diet DM. The total fecal collection was performed during 3 d, and urine for 24 h to enable quantification of nitrogen (N) intake, in feces, urine, and therefore the balance of this nutrient. Estimates of Pmic and Efmic were obtained from the total excretion of purine derivatives in urine. The inclusion of glycerol increased quadratically ( $P < 0.08$ ) the intake, fecal, urinary and the uptake of nitrogen, with estimated values of 31.21, 11.71, 8.12 and 18.93 g/d for 14.22, 11.53, 11.86 and 15.52% glycerin, respectively. The nitrogen balance was not affected by glycerin ( $P > 0.10$ ) with values of 57.97%, on average. Ammonia concentrations linearly decrease ( $P = 0.01$ ) from 23.64 to 20.45, which corresponded to 0.16 mg/dL for each 1% of glycerin. The excretion of purine derivatives were not affected ( $P > 0.10$ ), except for xanthine + hypoxanthine which was linearly increased ( $P < 0.01$ ), but without influences on total excretion of purine (9.85 mmol/d), which result in Pmic 55.03 g/d, and Efmic of 48.35 g CP/kg TDN. It was concluded that up to 20% of glycerin could be utilized. The nitrogen intake and losses

could vary above 15% of glycerin, but without any damage in retention. Ammonia concentrations decreased with the inclusion of glycerin, but without disadvantage in microbial production and efficiency.

**Key Words:** ammonia concentration, glycerol, purine derivatives

**W294 Blood parameters of Nelore steers fed with glycerin.** V. R. Fávaro,\* J. M. B. Ezequiel, A. P. D'Áurea, J. B. D. Sancanari, E. H. C. B. van Cleef, A. C. Homem Junior, and V. C. Santos, *São Paulo State University, Jaboticabal, São Paulo, Brazil.*

Ruminants fed high concentrate diets frequently present metabolic disorders. Blood parameters have been used to assess the health status of animals. The viability of glycerin use in cattle diets may be indicated by the blood parameters of the animals. This study aimed to evaluate blood parameters indicators of metabolic disorders (glucose, triglycerides, cholesterol and urea). Five rumen cannulated Nelore steers ( $420 \pm 20$  kg BW) were used in a  $5 \times 5$  Latin square design. Orthogonal contrasts were used to determine the linear, quadratic, and cubic effects of glycerin. Experimental diets (DM basis) consisted of 40% corn silage and 60% concentrate (corn grain, soybean hulls, sunflower meal, glycerin) with the following levels of glycerin 0, 5, 10, 15 and 20% of DM. Blood samples were taken on 25d of each experimental period through coccygeal vein puncture, 4h after morning feeding, using Vacutainer tubes. The samples were analyzed using commercial kits. There was no effect ( $P > 0.05$ ) of treatment for serum triglycerides and urea. The average values (7.3 and 21.4 mg/dL, respectively) were in agreement with those suggested in the literature (0–14 mg/dL and 12–65 mg/dL). Diets promoted quadratic effect on plasma glucose concentration ( $P = 0.0001$ ) which presented as maximum point 73.1 mg/dL (10% of glycerin) and minimum, 50.9 mg/dL (0% of glycerin), and promoted cubic effect on serum cholesterol ( $P = 0.04$ ) which presented as maximum point 117.0 mg/dL (0% of glycerin) and minimum, 88.6 mg/dL (5% of glycerin). Although there was difference between treatments, these values were in according to those suggested in the literature (45–75 mg/

dL, and 80–120 mg/L, respectively for glucose and cholesterol). The inclusion of glycerin in cattle diet affect blood concentrations of glucose and cholesterol, however, the values for all parameters obtained in this study are in agreement with the suggested in the literature.

**Key Words:** beef cattle, biodiesel, blood

**W295 Levels of replacement of corn by glycerin in multiple supplements for Nelore steers grazing in dry season: Performance.** J. T. Zervoudakis,\* R. P. da Silva, L. C. R. P. Silva, A. J. Neto, J. F. W. Koscheck, R. G. F. da Silva, T. P. Trindade, A. O. Zanette, and E. R. Donida, *Federal University of Mato Grosso, Cuiabá, Mato Grosso, Brazil.*

The objective of this study was to evaluate the productive performance of Nelore steers in growing on *Brachiaria brizantha* cv. Marandu during dry season and receiving supplements with partial replacement of corn by glycerin. Forty Nelore steers with initial body weight of 203.  $12 \pm 20.10$  kg and average initial age of 12 months, divided into eight paddocks of 1.6 ha each, were used. The design was completely randomized with five replicates and eight supplements. The supplements were formulated with levels of partial replacement of corn by glycerin: 0% (G0), 10% (G10), 20% (G20), 30% (G30), 40% (G40), 50% (G50) and 60% (G60). The supplements were supplied to the animals in the level of 1 kg/animal/day. A group of animals was allotted to untreated control treatment (MM) and received exclusively mineral mix. Average daily gain (ADG) was higher ( $P < 0.10$ ) for animals receiving supplements G30 (0.568 kg/d), G 40 (0.548 kg/d) and G60 (0.570 kg/d) in relation to supplements G0 (0.510 kg/d), G10 (0.475 kg/d), G50 (0.523 kg/d) and MM (0.208 kg/d). Significant differences ( $P < 0.10$ ) in ADG were observed for supplemented animals as compared MM. It is concluded that supply of supplements using partial replacement for corn by glycerin in levels of 30, 40 and 60%, results in higher performance of cattle grazing in dry season.

**Key Words:** beef cattle, in growing, supplementation