Ruminant Nutrition: Beef: By-Products and Dietary Modifications

717 Effect of dietary fat concentration from corn coproducts, during the growing phase, on beef cattle performance, carcass traits, digestibility, and ruminal metabolism. J. R. Segers*, T. L. Felix, and D. W. Shike, *University of Illinois at Urbana-Champaign, Urbana.*

The objective of this research was to study the effect of fat concentration from corn coproducts, fed during the growing phase on DMI, gain, carcass traits, digestibility, and rumen metabolism of steers. Exp. 1: 40 steers (age = 140d; BW = 185 ± 11 kg) were randomly allotted to 1 of 5 dietary treatments: (1) corn-based control (CNT), (2) 0% corn distillers solubles (CDS), (3) 10% CDS, (4) 19% CDS, or (5) 27% CDS. Diets 2–5 included coproducts (corn gluten feed and soybean hulls) and were formulated to achieve fat concentrations of 3, 5, 7, and 9%, respectively. Diets were fed once daily for 106 d (growing phase, GP). All steers were fed a corn-based diet from d107 to 196 (finishing phase, FP). Contrasts were used to examine a) the difference between CNT and 10% CDS; b) linear and quadratic effects of CDS inclusion. During the GP, steers fed CNT had increased ($P \leq 0.03$) BW, G:F and ADG compared with those fed 10% CDS. Increasing CDS inclusion increased (linear; $P = 0.01$) ADG and G:F. At the conclusion of the GP, back fat thickness (BF) determined via ultrasound increased ($P = 0.05$) in CNT-fed calves compared with 10% CDS. There were no treatment differences ($P \geq 0.14$) in FP ADG, DMI, or G:F. Steers fed CNT had increased($P = 0.02$) overall ADG compared with steers fed 10% CDS, and increasing CDS inclusion increased (linear; $P = 0.05$) overall ADG. Final BW, and overall DMI and G:F were not different ($P \geq 0.06$). There were no effects ($P \geq 0.10$) of treatment on carcass traits. Exp. 2: steers (n = 5; BW = 345 ± 22 kg) were fed Exp.1 diets for ad libitum intakes in a 5x5 Latin square design. Apparent dry matter digestibility (DMD) increased (linear; $P = 0.02$) with increasing dietary CDS inclusion. Steers fed CNT had increased ($P = 0.01$) DMD compared with those fed 10% CDS. Fat digestibility increased (linear; $P < 0.01$) as CDS inclusion increased, but NDF digestibility was unaffected ($P \geq 0.17$). In conclusion, feeding a coproduct diet with 10% CDS during the GP decreased overall ADG compared with feeding corn; however, increasing CDS inclusion improved DM and fat digestibility as well as overall ADG.

Key Words: condensed distillers solubles, dietary fat, digestibility

718 Effects of partially replacing supplemental N with condensed distillers solubles on feedlot cattle performance and carcass characteristics. J. Simroth-Rodriguez*[1], M. S. Brown[1], J. Kawas[2], R. Butler[1], B. Coufal[1], H. Hughes[1], K. Kraich[1], B. Mendonca[1], and J. Wallace[1], [1]*West Texas A&M University, Canyon,* [2]*Universidad Autónoma de Nuevo León, Monterrey, Nuevo Leon, Mexico.*

Further assessment of the feeding value of condensed distillers solubles (CDS) is needed. Crossbred steers (initial BW = 376 ± 11 kg) previously adapted to a finishing diet were blocked by BW and randomly assigned to treatments in a 2 × 2 + 1. Diets contained equal fat. The control diet was based on steam-flaked corn, with urea and cottonseed meal (CSM) providing supplemental N. In remaining diets, N from CDS replaced urea N or CSM N, with CDS included at either 10 or 20% of DM (11 pens/treatment). Composite samples for each diet were assayed and contained 13.45, 13.65, 13.90, 14,55, and 14.60% CP for the control, 10% CDS replacing urea N, 10% CDS replacing CSM N, 20% CDS replacing urea N, and 20% CDS replacing CSM N, respectively. The effects of CDS concentration and source of N replaced did not interact for growth performance or carcass measures ($P > 0.12$). Steer DMI was 3.8% lower ($P = 0.07$) for the control than when CDS N replaced a portion of urea N. Steer DMI was 3.4% higher and ADG was 3.7% greater ($P < 0.06$) when CDS N replaced urea N than when CSM N was replaced. Steer DMI and ADG were not altered by CDS concentration. Steer ADG and gain efficiency were not different between the control and when CDS N replaced a portion of urea N nor when CDS N replaced urea or CSM N. However, gain efficiency was decreased 3.0% ($P = 0.02$) when 20% CDS was fed compared with 10% CDS. Carcass measures were not different between the control and when CDS N replaced a portion of urea N ($P > 0.49$). Hot carcass weight was lighter and LMA was larger ($P < 0.08$) when CDS N replaced CSM N. Fat thickness, average yield grade, and calculated empty body fat were also lower ($P < 0.03$) when CDS N replaced CSM N, whereas 20% CDS increased marbling score compared with 10% CDS ($P = 0.03$). Results suggest that CDS N is a more effective replacement of urea N than cottonseed meal N. Replacing CSM N reduced ADG and carcass weight, and produced leaner carcasses, whereas carcass quality was slightly improved when more CDS was fed.

Key Words: condensed solubles, growth, nitrogen degradability

719 Performance and metabolism of Holstein dairy calves receiving concentrate starter containing citrus pulp as a replacement for corn. C. E. Oltramari[1,2], J. T. Silva*[1,2], M. R. Paula[1,2], G. G. O. Napoles[1,3], M. C. Soares[1,3], M. P. C. Gallo[1,3], and C. M. M. Bittar[1,2], [1]*ESALQ/USP, Piracicaba, Sao Paulo, Brazil,* [2]*CNPq, Brasilia, DF, Brazil,* [3]*Fapesp, Sao Paulo, Sao Paulo, Brazil.*

The aim of this study was to evaluate the effect of replacing ground corn grain (C) with dried citrus pulp (CP) in the concentrate starter on performance and metabolism of dairy calves. Twenty-four newborns Holstein calves were housed in individual shelters and distributed into three treatments, according to the birth date and weight: (1) starter containing 64% C (0CP), (2) starter containing 32% C and 32% CP (50CP), and (3) starter containing 64% CP (100CP). Animals were fed 4 L/d of milk replacer (20:15), in two meals. Starter intake was monitored daily and body weight weekly. Blood samples were collected weekly to determine plasma glucose and β-hydroxybutyrate (BHBA). Ruminal fluid samples were collected at the 4th, 6th and 8th weeks of age for short-chain fatty acids determination. At eight week of age, animals were slaughtered to evaluate development of the upper digestive tract and rumen papillae. Performance was not affected by the replacement of corn by citrus pulp (Table 1). However, there were some positive effects of CP inclusion (50CP or 100CP) in concentrate starter to the development of the upper digestive tract.
Supported by Fapesp.

Table 1. Least squares means of variables of dairy calves receiving 0% (0CP), 50% (50CP) or 100% (100PC) of CP replacing corn in the starter

	0CP	50CP	100CP	SEM	P <
Starter intake, g/d	353.7	467.1	384.0	114.5	0.72
Daily gain, g/d	322.4	370.2	411.3	81.4	0.77
Live weight at weaning, kg	53.3	57.0	56.4	1.36	0.51
Plasma glucose, mg/dL	85.9	95.1	92.5	5.98	0.35
Plasma βHBA, mmol/L	0.07	0.15	0.11	0.05	0.53
Rumen acetate, µmol/mL	53.2	60.2	57.9	2.38	0.18
Rumen propionate, µmol/mL	28.5	26.5	20.8	3.24	0.25
Rumen butyrate, µmol/mL	6.3[b]	10.9[a]	9.2[ab]	0.74	0.01
Total upper digestive tract, kg	1.07[b]	1.54[a]	1.41[a]	0.29	0.01
Rumen-reticulum, % total tract	55.4[b]	68.7[a]	70.3[a]	4.5	0.06
Omasum, % total tract	14.6	13.4	13.4	2.2	0.28
Abomasum, % total tract	30.0[a]	17.9[b]	16.3[b]	4.1	0.006
Papillae/cm^2	82.4	71.2	85.1	24.3	0.36
Papillae height, mm	1.28[b]	3.30[a]	1.97[b]	0.39	0.01
Papillae width, mm	0.97	1.29	1.10	0.32	0.33
Papillae area, mm^2	1.55[b]	3.93[a]	2.03[ab]	1.02	0.03

[a–c]Means with different superscripts differ ($P < 0.5$).

Key Words: butyrate, forestomach, pectin

720 Evaluation of nutrient composition and variability of wheat grain entering feedlots in western Canada using commercially available near-infrared reflectance spectroscopy. A. R. Harding*[1], C. F. O'Neill[1], M. L. May[2], L. O. Burciaga-Robles[2], and C. R. Krehbiel[1], [1]*Oklahoma State University, Stillwater,* [2]*Feedlot Health Management Services, Okotoks, AB, Canada.*

Near infrared reflectance spectroscopy (NIRS) has been used to accurately predict the nutrient composition of feedstuffs. Considerable variation is observed in nutrient profiles of wheat grain used as an energy source in beef cattle diets. The objective of this study was to investigate the accuracy of current commercially available NIRS prediction models for wheat and the variation in nutrient composition of wheat entering feedlots in western Canada. Wheat samples (n = 75) were selected from feedlots in western Canada from September, 2011 to April, 2012, representing a range in nutrient compositions as predicted by NIRS (InfraXact, FOSS North America, Eden Prairie, MN). Samples were selected for HIGH, MEDIUM, or LOW nutrient composition of CP, starch and DM. DM was determined by placing samples in a forced air oven at 55°C for 48 h and measuring moisture loss. CP and starch were determined using AOAC methods 992.23 and 996.11, respectively. Laboratory analysis of the samples was completed and lab values were correlated to the NIRS predictions for CP, starch and DM using PROC REG of SAS 9.3 (SAS Institute, Cary, N.C.). NIRS predictions and laboratory values for CP were correlated for all samples ($R^2 = 0.90$, $P < 0.05$) whereas there were poor correlations for lab values and NIRS predictions for starch and DM of all samples ($R^2 = 0.02$ and 0.17 respectively, $P < 0.05$). Regression analysis was conducted to evaluate NIRS predictions across the ranges (HIGH, MED or LOW) of each constituent, CP, starch and DM. Improved R^2 values for each parameter were observed [CP = 0.92 (n = 15, $P < 0.01$), starch = 0.27 (n = 15, $P \leq 0.05$), DM = 0.20, (n = 15, $P = 0.09$)] when samples only selected for that constituent from all ranges (HIGH, MED, LOW) were analyzed. NIRS technology is able to accurately predict CP of wheat samples in western Canada for a broad range of CP content. Current commercially available NIRS prediction models for wheat DM and starch require improvement.

Key Words: wheat, near infrared reflectance spectroscopy, nutrient

721 Effect of nutrient composition variability of barley grains on near infrared reflectance spectroscopy predictions using commercially available technology. C. F. O'Neill*[1], A. R. Harding[1], M. L. May[2], L. O. Burciaga-Robles[2], and C. R. Krehbiel[1], [1]*Department of Animal Science, Oklahoma State University, Stillwater,* [2]*Feedlot Health Management Services Ltd., Okotoks, AB, Canada.*

Near infrared reflectance spectroscopy (NIRS) has been used to accurately predict nutrient composition of feed commodities. Feeding feedlot cattle is challenged by large variation in nutrient composition of commodities entering operations. The objective of this study was to examine the variation in nutrient composition and calibration prediction accuracy of NIRS technology. Barley samples (n = 98) were selected from 5 feedlots in western Canada between April and August, 2012, representing a range in nutrient compositions as predicted by NIRS using commercially available NIRS prediction equations (InfraXact, FOSS North America, Eden Prairie, MN). Samples were selected for HIGH, MEDIUM, or LOW nutrient composition of starch, crude protein (CP) and dry matter (DM). Laboratory analysis was completed and correlated to the predicted NIRS values for starch, CP, and DM. Data were analyzed with PROC REG of SAS (SAS Institute, Cary, N.C.) to determine correlations between laboratory assayed and NIRS values. When comparing laboratory and NIRS predictions of DM and CP for all samples, there was a strong correlation ($R^2 = 0.61$ and 0.64, respectively, $P < 0.05$). Whereas for starch predictions, there was a poor correlation ($R^2 = 0.12$, $P < 0.05$) when comparing NIRS and starch analysis. Regression analysis was conducted to evaluate NIRS predictions across the range (HIGH, MED or LOW) of each constituent (starch, CP, and DM). Similar or improved R^2 values for all parameters were observed, [DM = 0.86 (n = 21), CP = 0.63 (n = 24), and starch = 0.17 (n = 23) ($P < 0.05$)] when predictions were tested across the range. The NIRS technology can adequately predict across a variable range of barley samples in western Canada for DM and CP. However, prediction accuracy decreases when variation exists in the population sampled. Accurate predictions can be obtained for DM and CP concentration of barley arriving to feedlots in western Canada using commercially available NIRS prediction equations; however, starch concentration is not accurately predicted with this current application.

Key Words: barley, near infrared reflectance spectroscopy, nutrients

722 Co-prilling flaxseed and dolomitic hydrate to decrease ruminal biohydrogenation of polyunsaturated fatty acids. C. Alvarado*[1], D. Sousa[1], K. Miller[1], C. van Bibber-Krueger[1], E. van Cleef[1], F. Scarpino[1], D. Klamfoth[2], and J. Drouillard[1], [1]*Kansas State University, Manhattan,* [2]*Lhoist North America, Fort Worth, TX.*

Two experiments were conducted to evaluate ruminal biohydrogenation of flaxseed embedded in matrices consisting of dolomitic lime hydrate or a blend of hydrate and dolomitic limestone. In Study 1, steers (n = 45, 252.5 ± 18.2 kg) were blocked by weight and randomly assigned to individual pens and dietary treatments (15 replicates). Steers were fed for 14 d with a basal diet consisting of 30% corn gluten feed, 25% wheat straw, 25% prairie hay, 12.8% steam-flaked corn, and 3% linseed meal with no flaxseed (C), with 2.79% ground flaxseed (F), or 8.13% of a flaxseed-dolomitic hydrate blend (H) to provide an amount of α-linolenic acid (ALA) equivalent to the F diet. Cattle were fed once daily ad libitum and DMI was determined each day. For study 2, heifers (n = 40, 274 ± 11 kg) were blocked by weight and allocated randomly to each of 4 diets (10 replicates). The basal diet consisted of 30% corn silage, 27% wet corn gluten feed, 22% steam-flaked corn, and 15% alfalfa hay with no flaxseed (C), 0.45 kg/d ground flaxseed (F), 0.45 kg/d of a 50:50 flaxseed:dolomitic hydrate blend; or 0.45 kg/d of a 50:25:25

flaxseed:dolomitic hydrate:dolomitic carbonate blend (HC). On d 0 and 14 of each study, whole blood was sample by jugular venipuncture, plasma was recovered by centrifugation, and concentrations of fatty acid methyl esters were determined by gas chromatography. Plasma ALA concentrations were not different among treatments on d 0 of either study, remained low in C after 14 d of feeding, but increased by d 14 for cattle fed all sources of flaxseed ($P < 0.01$). In study 1, plasma ALA was 2.9-fold greater for H than for F ($P < 0.01$) after 14 d (0, 30, and 87 µg/mL for C, F, and H, respectively). In study 2, embedding flaxseed in dolomitic hydrate-carbonate or dolomitic hydrate matrices resulted in 195 and 339% greater assimilation of ALA, respectively, compared with ground flaxseed (11, 93, 96, and 153 µg/mL for C, F, H, and HC, respectively; $P < 0.01$). These studies indicate that matrices consisting of dolomitic hydrate or dolomitic hydrate and carbonate are effective barriers to ruminal biohydrogenation of unsaturated fats.

Key Words: encapsulation, matrix, n-3 fatty acid