

75 % included acetyl CoA Carboxylase (-79 %), ATP citrate lyase (-75 %), insulin receptor induced protein (-77 %), IGFI (-30 to 50%), and IGFBP3 (-55 %). Leptin expression (Genbank: NM\_173928.1) was reduced 57 %. In a separate study, we fed 10 mg/d of chromium from 21 d prepartum through 35 DIM. There were 223 genes that were increased 2-fold or more at d -7 versus controls, and 1150 were decreased 50% or more compared to control. There were 3517 genes lower in supplemented cows in which at least one of the signals had an expression of 50 or more on the Affymetrix chip. There were 24 genes that increased and 347 that decreased in CrP supplemented animals

at both days. The primary functional cluster of genes that were up regulated in supplemented animals included those functioning in cell synthesis and in the immune system, such as myosin heavy chain and immunoglobulin A receptor. Genes decreased at both times to chromium were NADH dehydrogenase, t-cell receptor, and prostaglandin PGH2. Leptin expression was decreased by KT at d 28, as was growth hormone receptor mRNA. We have integrated a preliminary gene expression map with a mechanistic model of metabolism in dairy cattle.

**Key Words:** Adipose, Gene Array, Lactation Model

## Ruminant Nutrition: Corn Milling Co-Products - Beef

**521 Environmental concerns with feeding corn milling co-products in feedlot diets.** T. J. Klopfenstein\* and G. E. Erickson, *University of Nebraska, Lincoln.*

The grain to ethanol industry is rapidly expanding which creates challenges and opportunities for the cattle feedlot industry. This expansion creates competition for grain; however, byproducts may offer opportunities to reduce costs of production. Meta analysis indicates that wet distillers grains have 25 to 45% more feed value than corn and wet corn gluten feed has equal to or 9.4% more energy than corn depending on the plant processes. Priced at or below the price of grain, byproducts are economically advantageous to the feedlot industry. Ethanol is produced from the starch in grain so by removing the starch, nutrients are concentrated in the byproducts (three times in distillers grains). The two nutrients of concern, from an environmental standpoint, are N & P. Nitrogen is a concern primarily because it is volatilized from the surface of open feedlot pens. Alternatively, P is not volatilized...what the cattle excrete is what must be managed in the manure. A diet containing 40% distillers grains on a dry basis has about 18% CP which is about 50% above the animal's requirement. All of the excess N is excreted. A diet with 40% gluten feed is near the animal's requirement for CP. Byproduct diets are less digestible than corn based diets and the additional OM in the manure helps retain some of the excess N. Frequent cleaning is also beneficial. There is still a net loss of N as ammonia. A diet with 40% byproduct has about 0.5% P which is about three times the requirement. This essentially doubles the land necessary to utilize the manure compared to a corn-based diet. For a 25,000 hd feedlot that may add \$2 to \$3 per animal to distribute the manure. However, because of the value of the P as fertilizer there is actually a net benefit of \$3 to \$5 per animal fed. Phosphorus is a distribution issue with byproduct feeding, not a negative economic issue. While ammonia loss from open feedlots is not currently regulated, it may be in the future. Methods of maintaining the N in the manure to capture its value as fertilizer need to be researched for both diets with and without byproducts.

**Key Words:** Cattle Feeding, Nitrogen, Phosphorus

**522 Effect of modified wet distillers grains level on feedlot cattle performance and nitrogen mass balance.** M. K. Luebbe\*, G. E. Erickson, T. J. Klopfenstein, and M. A. Greenquist, *University of Nebraska, Lincoln.*

A summer feedlot trial was conducted to evaluate the impact of modified wet distillers grains plus solubles (52% DM, WDGS) level on steer performance, manure N removed, and N lost via volatilization. Ninety-six yearlings (373 ± 24 kg) were stratified by BW and assigned randomly to 12 pens. Steers were fed for 133 d from June to October. Treatments consisted of 0, 15, and 30% dietary inclusion of WDGS (DM basis) replacing corn (CON, 15WDGS, 30WDGS, respectively). Basal diets consisted of high-moisture and dry-rolled corn fed at a 1:1 ratio, 7.5% alfalfa hay, 5% molasses, and 5% supplement (DM basis). The CON and 15WDGS diets were balanced for MP using the 1996 NRC, and 30WDGS was in excess of requirements. Nitrogen excretion was determined by the difference between N intake and individual steer N retention. Total N lost was calculated by subtracting manure and runoff N from excreted N. Dry matter intake tended (P=0.09) to increase linearly with WDGS level. Average daily gain was lower (P=0.05) for CON compared with 15 and 30 WDGS (1.80, 1.94, and 1.91 kg, respectively). Carcass measurements, G:F, and final BW were not influenced (P>0.10) by WDGS level. Manure OM linearly increased (P=0.02) with WDGS level. Nitrogen intake was greatest (P<0.01) for 30WDGS, intermediate for 15WDGS, and least for CON (42.9, 35.5, and 28.9 kg•steer<sup>-1</sup>over 133 d, respectively). Nitrogen retention did not differ (P=0.16) among WDGS level. Excretion of N was greatest (P<0.01) for 30WDGS, intermediate for 15WDGS, and least for CON (38.0, 30.5, and 24.3 kg, respectively). Manure N was greater (P<0.01) for 30WDGS (10.2 kg) compared with 15WDGS (6.5 kg) and CON (5.8 kg). Runoff N was not different (P=0.54) among WDGS level. Amount of N lost was greatest (P<0.01) for 30WDGS, intermediate for 15WDGS, and least for CON (26.5, 20.0, and 14.1 kg, respectively) but percent loss (percent of excreted N) was not different (P=0.32) among treatments. In this study feeding WDGS balanced for MP or in excess of requirements resulted in improved ADG and more N in the manure for 30WDGS. However, the amount of N lost was increased when WDGS was fed.

**Key Words:** Cattle, Nitrogen, Waste Management

**523 Effect of wet distillers grains level on phosphorus balance in beef feedlots.** M. K. Luebbe\*, G. E. Erickson, T. J. Klopfenstein, and M. A. Greenquist, *University of Nebraska, Lincoln.*

The effect of wet distillers grains plus solubles (WDGS) level on P mass balance was evaluated in two experiments. Calves were fed 167 d from November to May (WINTER) and yearlings were fed 133 d

from June to October (SUMMER). Treatments consisted of 0, 15, and 30% dietary inclusion of WDGS (DM basis) replacing corn (CON, 15WDGS, 30WDGS, respectively). Modified WDGS was fed in the SUMMER experiment. Basal diets for both experiments consisted of high-moisture and dry-rolled corn fed at a 1:1 ratio, 7.5% alfalfa hay, 5% molasses, and 5% supplement (DM basis). Mass balance of P was evaluated by measuring P in diets, manure, soil on the pen surface, and runoff. Dietary treatments were fed in the same pens for both experiments. Diet P composition (DM basis) averaged 0.34, 0.39, and 0.47% in both experiments for CON, 15WDGS, and 30WDGS, respectively. When WDGS was fed, P intake linearly increased ( $P < 0.05$ ) for both experiments. Retention of P linearly increased ( $P < 0.05$ ) with WDGS level in the WINTER trial due to ADG response but was not different ( $P = 0.16$ ) among WDGS levels for the SUMMER trial. Excretion of P linearly increased ( $P < 0.01$ ) in both experiments with 3.88, 5.13, and 6.37 kg •steer<sup>-1</sup> in the WINTER and 3.77, 4.62, and 5.76 kg •steer<sup>-1</sup> excreted in the SUMMER for CON, 15WDGS and 30WDGS, respectively. Similarly, manure P linearly increased ( $P < 0.01$ ) with 2.77, 3.82, and 4.49 kg •steer<sup>-1</sup> in the WINTER and 2.05, 2.57, 4.32 kg •steer<sup>-1</sup> in the SUMMER for CON, 15WDGS and 30WDGS, respectively. Correcting manure for soil P accounts for 98, 79, and 102% of excreted P in the WINTER and 87, 62, and 57% of excreted P in the SUMMER for CON, 15WDGS, and 30WDGS, respectively. Runoff P was not different ( $P > 0.10$ ) among WDGS level and averaged 3.8, and 9.5% of excreted P for WINTER and SUMMER, respectively. These results suggest that increasing dietary P will increase manure P and the amount of land needed for manure application when WDGS are used by feedlot cattle.

**Key Words:** Cattle, Phosphorus, Nutrient Management

**524 Evaluation of dried distillers grains or soybean hulls with and without Optigen II® to background beef calves.** J. L. Wahrmond\* and M. J. Hersom, *University of Florida, Gainesville.*

The objective of this study was to determine the effects of supplementing a controlled-release source of DIP (Optigen) when feeding dried distillers grains (DDG) or soybean hulls (SBH) to weaned beef calves. Fifty-six Angus steers (initial BW=236 ± 25 kg) were blocked by BW and randomly allotted to one of four supplement treatments. Treatments included: 1) 1.19 kg DDG (0.82 kg CP, 2.4 kg TDN); 2) 1.19 kg DDG, 45.5 g Optigen (1.11 kg CP, 2.4 kg TDN); 3) 2.63 kg SBH (0.83 kg CP, 4.7 kg TDN); 4) 2.63 kg SBH, 45.5 g Optigen (1.11 kg CP, 4.7 kg TDN). Amounts of DDG and SBH were formulated to supply equal CP. Optigen was included to determine the effect of a slow-release DIP source in these diets. All steers were allowed ad libitum access to bahiagrass hay and individually supplemented via a Calan Gate system for 42 d. On d 0, 14, 28, and 42 BW was recorded and a blood sample was collected for analysis of plasma urea nitrogen (PUN) and glucose concentration from all steers. Supplement treatment had no effect on final BW ( $P = 0.97$ , mean=273 kg). 42 d ADG did not differ ( $P = 0.17$ , mean=0.88 kg/d) among treatments. No differences in plasma glucose concentrations were observed ( $P = 0.54$ , mean=69.2 mg/dL) between supplement treatments. PUN concentrations exhibited a treatment x day interaction ( $P = 0.001$ ). On d 14, 28, and 42 steers consuming only DDG had greater ( $P < 0.05$ ) PUN concentrations than steers consuming only SBH (10.3 vs. 8.6 mg/dL). Additionally, on d 14, 28 and 42 steers consuming Optigen had increased ( $P < 0.05$ ) PUN concentrations compared to steers not offered Optigen (11.6 vs. 8.5 mg/dL). On d 14 and 42, PUN concentration did not differ ( $P = 0.45$ ,

0.77) between DDG and SBH+Optigen steers. The inclusion of a controlled-release DIP source did not affect steer performance. However, Optigen was effective at increasing PUN concentrations above 10 mg/dL, indicating adequate DIP for forage fermentation within the rumen.

**Key Words:** Steers, Supplementation, Protein

**525 Carcass and meat quality characteristics of distiller's co-product-supplemented pasture- and feedlot-finished beef steers.** R. C. Knock\*<sup>1</sup>, A. H. Trenkle<sup>1</sup>, E. J. Huff-Loneragan<sup>1</sup>, S. M. Lonergan<sup>1</sup>, J. R. Russell<sup>1</sup>, P. M. Dixon<sup>1</sup>, K. M. Carnagey<sup>2</sup>, and D. C. Beitz<sup>1</sup>, <sup>1</sup>Iowa State University, Ames, <sup>2</sup>Wake Forest University School of Medicine, Winston-Salem, NC.

British breed beef steers (n = 48; 370 kg) were assigned to pasture or feedlot diets and one of two concentrations of 25-hydroxyvitamin D<sub>3</sub> (VITD; 0 or 500 mg) to evaluate VITD and distiller's co-product supplementation effects on performance, carcass traits, and fatty acid composition. Pasture-finished cattle received 6.8 kg/hd per day of pelleted distiller's grains, wheat midds, and soy hulls. The feedlot diet contained 10% wet distiller's grains. Steers were harvested after 112, 133, or 154 d on feed (DOF) to minimize 12th rib fat differences. Steers (n = 24) received 25-hydroxyvitamin D<sub>3</sub> boluses orally 7 d prior to assigned harvest date. At harvest, carcass data and longissimus (LM), semimembranosus (SM), and gracilis (GR) muscles were collected for analysis. At harvest, feedlot steers were heavier ( $P = 0.0370$ ; 584 kg; 132 DOF) than pasture-fed steers (563 kg; 130 DOF) and had greater ADG ( $P < 0.0001$ ; 1.74 vs. 1.51 kg/d). Pasture-fed steers had less ( $P < 0.0001$ ) 12th rib fat and ( $P = 0.0108$ ) kidney, pelvic, and heart fat as well as lower ( $P = 0.0141$ ) marbling scores than did feedlot steers (Slight<sup>45</sup> vs. Slight<sup>90</sup>). Lipid percentage differed by muscle ( $P < 0.0001$ ) as GR had the least lipid followed by SM and LM (1.54, 1.94, and 2.54% of tissue, respectively). Pasture-fed steers had greater LM C18:2 cis-9, trans-11 (CLA) and C18:3n3 concentrations ( $P < 0.0001$ ) than did feedlot steers (0.95 and 0.63 vs. 0.19 and 0.26 mg/100 mg lipid, respectively). Feedlot steers generally had greater monounsaturated fatty acid percentages, except for C18:1 trans-9 and trans-11 isomers. VITD did not affect performance or carcass traits. Data indicate it is possible to finish steers on pasture by supplementing with distiller's co-products without substantially increasing time needed to reach market weight and still maintain increased CLA compared with feedlot-finished steers.

**Key Words:** Beef, Distiller's Grains, Pasture-Finished

**526 Evaluation of dried distillers grains or soybean hulls to background beef calves.** J. L. Wahrmond\* and M. J. Hersom, *University of Florida, Gainesville.*

The objective of this study was to determine the effects of supplementing dried distillers grains (DDG), soybean hulls (SBH), or combinations of the two to beef steers consuming low quality hay. Fifty-six Angus steers (initial BW=275 ± 27 kg) were blocked by BW and randomly allotted to one of four supplement treatments. Treatments included: 1) DDG (2.8 kg); 2) DDG/SBH (1.93 kg DDG, 0.98 kg SBH); 3) SBH/DDG (0.96 kg DDG, 2.05 kg SBH); 4) SBH (3.12 kg).

Supplements were formulated to be isoenergetic, and steers were individually supplemented via a Calan Gate system for 42 d. All steers were allowed ad libitum access to bahiagrass hay. On d 0, 14, 28, and 42 BW was recorded and a blood sample was collected for analysis of plasma urea nitrogen (PUN) and glucose concentration from all steers. Supplement treatment had no effect ( $P=0.79$ ) on final BW (mean=306 kg). From d 0 to 14, ADG of DDG steers was 0.27 kg/d less ( $P<0.05$ ) compared to treatments containing SBH (mean=0.60 kg/d). Across all 42 d, ADG of SBH steers was less than DDG/SBH ( $P=0.06$ , 0.80 kg/d) or SBH/DDG ( $P=0.03$ , 0.83 kg/d), but was not different ( $P=0.45$ ) than DDG steers (0.72 kg/d). Plasma glucose concentrations were not different ( $P=0.85$ , mean=77.98 mg/dL) between supplement treatments. PUN concentrations exhibited a treatment  $\times$  day interaction ( $P=0.01$ ). On d 0, PUN concentration did not differ ( $P=0.65$ , mean=6.4 mg/dL) between treatments. However, on d 14, 28, and 42 PUN concentrations of DDG and DDG/SBH steers (15.87, 13.98, 12.51 and 11.47, 11.67, 12.79) were greater ( $P<0.05$ ) compared to SBH/DDG or SBH steers (9.49, 8.45, 9.57 and 5.25, 5.46, 5.91). Supplementing steers consuming low-quality forage with a combination of co-products resulted in improved BW gain and nitrogen metabolism. The combination of 0.9 kg DDG and 2.05 kg SBH optimized calf performance.

**Key Words:** Steers, Supplementation, Co-Products

**527 Effect of wheat base distillers grains in a barley ration on the performance and carcass quality characteristics of feedlot steers.** R. M. Beliveau\*, J. J. McKinnon, and V. J. Racz, *University of Saskatchewan, Saskatoon, Saskatchewan, Canada.*

The objective of this experiment was to evaluate the effects of titrated levels of wheat-based dried distiller's grains with solubles (DDGS) on feedlot performance and carcass characteristics of growing cattle. Two hundred weaned calves (290 $\pm$ 5kg) were randomly assigned to one of 20 pens and fed one of 5 DDGS treatments. During backgrounding, the barley grain-based control diet was formulated to 12% CP, 28% RUCP, 1.52 and 0.93 Mcal / kg NE<sub>m</sub> and NE<sub>g</sub>, respectively. In treatments 2 through 5, DDGS replaced barley grain at levels of 8.1, 16.2, 24.2 and 32.1% of the ration dry matter. The finishing barley grain-based control diet was formulated to 12% CP, 27% RUCP, 1.90 and 1.26 Mcal / kg NE<sub>m</sub> and NE<sub>g</sub>, respectively. DDGS replaced barley grain in treatments 2 through 5 at levels of 5.9, 11.7, 17.5 and 23.3% of the ration dry matter. Crude protein and RUCP levels increased in a linear fashion as DDGS inclusion level increased. The backgrounding period lasted 85 d. The targeted end-point for finishing was a shrunk body weight of 600 kg. During the 85 d backgrounding period, ADG and DMI increased ( $P\leq 0.01$ ) quadratically as DDGS inclusion level increased. Feed efficiency was significantly improved ( $P\leq 0.05$ ) at the 2 highest levels of DDGS inclusion. During the first 56 d of finishing there was a linear increase ( $P\leq 0.05$ ) in ADG and a cubic increase in DMI as DDGS inclusion level increased, however over the entire trial there was no ( $P\geq 0.05$ ) ADG response to DDGS inclusion. Ultrasound backfat and ribeye area measurements were not ( $P\geq 0.05$ ) affected by treatment. Similarly, carcass weights and quality traits including dressing percentage, marbling, fat thickness and yield grade were not influenced ( $P\geq 0.05$ ) by treatment. The results of this trial indicate that for feedlot cattle, the energy value of wheat-based DDGS is at least equal to that of barley grain with no adverse effects observed on cattle performance or carcass quality.

**Key Words:** Wheat-Based Dried Distiller's Grains, Cattle, Barley

**528 Dry distiller's grains with solubles in steam-flaked or dry-rolled corn diets with reduced roughage levels.** M. L. May\*, M. L. Hands, M. J. Quinn, B. E. Depenbusch, J. O. Wallace, C. D. Reinhardt, and J. S. Drouillard, *Kansas State University, Manhattan.*

A study was conducted to evaluate the use of 25% dry corn distiller's grains with solubles (DG) as a partial replacement for dry-rolled corn or steam-flaked corn in finishing diets containing either high (15%) or low (5%) levels of corn silage (CS). Crossbred heifers ( $n=582$ ; BW 377  $\pm$  0.4 kg) were housed in 24 dirt surfaced pens with 21-25 heifers per pen and fed finishing diets once daily for 110 d. Experimental diets were: steam-flaked corn without DG and 15% CS (SFC), SFC with 25% DG and 15% CS (SFC<sub>High</sub>), SFC with 25% DG and 5% CS (SFC<sub>Low</sub>), dry-rolled corn with no DG and 15% CS (DRC), DRC with 25% DG and 15% CS (DRC<sub>High</sub>), and DRC with 25% DG and 5% CS (DRC<sub>Low</sub>). Within grain source, DMI were similar for cattle fed 0 and 25% DG. The 5% CS groups consumed less feed daily and also were more efficient. Yield grade and carcass quality were not affected by inclusion of DG. Results indicate that roughage levels can be reduced in feedlot diets containing DG with no adverse effects on efficiency, health, or carcass quality.

**Table 1. Performance of cattle fed steam-flaked or dry-rolled, reducing roughage levels, and with or without distiller's grains**

Item	DRC		DRC		SFC		Contrasts		
	DRC	High	Low	SFC	High	Low	1	2	3
DMI, kg	8.37	8.38	7.78	8.08	7.70	7.16	<0.01	<0.01	<0.01
F:G	0.138	0.141	0.151	0.156	0.155	0.166	<0.01	0.02	0.01
Choice, %	56.89	62.86	61.11	66.94	67.98	61.64	NS	NS	NS
Yield grade	2.59	2.65	2.66	2.54	2.42	2.54	0.02	NS	NS

Contrast 1: Dry-rolled vs. Steam-flaked; Contrast 2: 25% DDG with 15% CS vs. 25% DDG with 5% CS; Contrast 3: 0% DDG and 15% CS vs. 25% DDG and 5% CS

**Key Words:** Steam-Flaked Corn, Dry-Rolled Corn, Dry Distiller's Grain

**529 Use of distiller's dry grains in steam-flaked corn finishing diets with reduced roughage levels.** M. L. May\*, M. J. Quinn, B. E. Depenbusch, and J. S. Drouillard, *Kansas State University, Manhattan.*

A finishing study was conducted to evaluate the use of dry corn distiller's grains (DDG) in steam-flaked corn (SFC) diets, and to examine the potential for reducing the level of Corn Silage (CS) when DDG is substituted for a portion of SFC. Crossbred heifers ( $n=377$ ; BW 378 $\pm$ 1.4 kg) were fed diets consisting of 0% DDG with 15% CS (CON), 25% DDG with 15% CS (HIGH), or 25% DDG with 5% CS (LOW). Heifers were individually weighed and assigned randomly to feedlot pens containing 15 to 16 animals each, with eight pens per treatment. Heifers were fed twice daily ad libitum for 85 d. There were no differences among treatments with respect to ADG, G:F, final weight, carcass weight, subcutaneous fat thickness, carcass quality grade, or yield grade ( $P > 0.10$ ). Compared to cattle fed the CON diet, heifers fed LOW had decreased DMI (9.01 vs. 8.52 kg/d) and higher dressing percentage (63.23 vs 63.73%). Inclusion of DDG with 15%

CS reduced LMA when compared to CON (86.1 vs 82.5 cm<sup>2</sup>; P < 0.04). Partial replacement of SFC with DDG yields satisfactory performance and carcass characteristics in cattle fed diets with CS as the roughage source. Additionally, it is possible to remove a significant portion of dietary roughage in diets containing DDG without compromising performance.

**Table 1. Performance of heifers fed steam-flaked corn with dry distiller's grains with reducing roughage levels**

Item	CON	HIGH	LOW	SEM	Contrasts		
					1	2	3
DMI, kg	9.01	8.77	8.52	0.16	NS	0.05	NS
G:F	0.146	0.148	0.151	0.59	NS	NS	NS
HCW, kg	312	309	309	3.20	NS	NS	NS
Prime/Choice, %	55.89	62.24	61.93	4.11	NS	NS	NS
Yield grade, avg	2.62	2.74	2.66	0.07	NS	NS	NS
Yield grade 4 & 5, %	5.68	14.12	11.09	3.13	0.07	NS	NS

Contrast 1: 0% DDG and 15% CS vs. 25% DDG and 15% CS; Contrast 2: 0% DDG and 15% CS vs. 25% DDG and 5% CS; Contrast 3: 25% DDG and 15% CS vs. 25% DDG and 5% CS

**Key Words:** Steam-Flaked Corn, Finishing Cattle, Dry Distiller's Grains

**530 Effect of crude glycerin in finishing cattle diets.** N. A. Pyatt, P. H. Doane, and M. J. Cecava\*, *ADM Animal Nutrition Research, Decatur, IN.*

One hundred fifty-eight Angus-cross steers (387.4 ± 1.6 kg) were used in a 2 × 2 factorial to assess the effects of diet type (grain or co-product) and crude glycerin on feedlot performance. The grain diet consisted of (DM basis) 70% cracked corn, 15% corn silage, 10% DDGS, and 5% supplement; the co-product diet consisted of 35% cracked corn, 30% DDGS, 15% soyhulls, 15% corn silage, and 5% supplement. Glycerin replaced 0 or 10% corn in both diet types. Cattle were blocked by weight (4 pens per treatment), weighed at 28-d intervals, and processed at a constant backfat endpoint (116 to 153 d on feed). Period and cumulative (d 1-116 and 1-153) data were analyzed. No significant (P > 0.10) interactions were observed. Cumulative ADG was 11.4% greater in cattle fed grain diets with glycerin and 2.5% better for steers fed co-product diets with glycerin. Cattle fed co-product diets had 9.7% greater (P < 0.05) DMI relative to cattle fed grain diets (8.74 vs. 9.59 kg/d, respectively). Feeding glycerin resulted

in 10.1% lesser (P < 0.05) DMI (9.65 vs. 8.68 kg/d, respectively). Glycerin decreased DMI by 8.1% for the grain diet and 11.8% for the co-product diet. Feed efficiency was 11.0% greater (P < 0.05) for cattle fed grain diets versus co-product diets. Glycerin improved feed efficiency by 19.2% (P < 0.05). Feed efficiency improved by 21.9% and 16.4% when glycerin was fed in the grain and co-product diets, respectively. These data suggest that feeding crude glycerin can improve efficiency of cattle fed high-grain diets. Furthermore feeding crude glycerin in combination with co-products like DDGS and soyhulls may diminish feed intake but improve feed efficiency.

**Key Words:** Feedlot Cattle, Crude Glycerin, Co-Products

**531 The effect of forage allowance and stage of growth on average daily gain, frothy bloat, and rate of ruminal in vitro gas production in steers grazing wheat pasture.** W. E. Pinchak\*<sup>1</sup>, B. R. Min<sup>1</sup>, D. P. Malinowski<sup>1</sup>, J. W. Sij<sup>1</sup>, J. D. Fulford<sup>1</sup>, and R. Puchala<sup>2</sup>, <sup>1</sup>Texas Agricultural Research Center, Vernon, TX85, <sup>2</sup>E (Kika) dela garza American Institute for Goat Research Center, Langston, OK.

A combination of grazing and in vitro experiments were conducted over 3 yrs. to determine the effect of plant chemical composition, forage allowance and two stages of growth on the severity of bloat and ADG in steers grazing wheat forage. Concurrently, in vitro ruminal gas production was quantified at the same time of bloat measurement. Wheat forage protein dynamics, related with forage allowance and plant stage of growth, are presented. ADG was greater for high forage allowance than for low forage allowance during yr 2004 (P < 0.01) and 2005 (P < 0.001). Mean bloat score tended to differ with forage allowance during vegetative (P = 0.07) and reproductive (P = 0.16) stages of growth. Across the yrs, average percentage of bloated steers in the low forage allowance treatment was consistently less (21 vs. 45%; P < 0.001) than in animals grazing the high forage allowance treatment. Bloat frequency on wheat forage is temporally variable with most frothy bloat occurring during the vegetative stage of growth (32%) compared to the reproductive stage of growth (13%). Frothy bloat negatively effected (r = -0.37 to -0.54; P < 0.001) and linearly decreased (P < 0.001) ADG in steers grazing wheat forage. Average in vitro potential gas and methane production were greater (P < 0.001) for the reproductive stage of growth than for vegetative stage of growth. Wheat forage bloat is a complex disorder that varies across stage of plant growth, forage allowance and experimental yrs. Frothy bloat negatively impacts ADG and animal performance.

**Key Words:** Average Daily Gain, Frothy Bloat, Gas Production

## Teaching/Undergraduate & Graduate Education: Shaping Animal Sciences Curricula for 2020

**532 Animal sciences curricula: A historical perspective.** J. A. Sterle\*, *Texas A&M University, College Station.*

When the Land Grant University system was officially started at the time President Lincoln signed the Morrill Act in 1862, animal husbandry courses were already being taught at various colleges and universities across the country. Soon, individual courses began to develop into series, and series into an overall curriculum. Originally set

up to teach farmers' and ranchers' sons new technological advancements so they could return to the ranch, courses included nutrition, animal breeding and reproductive physiology. Curricula in animal science departments across the nation has developed, ebbed and flowed over time in response to a variety of factors. "Husbandry" became "science", and not in name only. New disciplines, from ethology to genomics, and new technology, from molecular biology techniques to artificial insemination brought about new courses and new requirements in