

University of Wisconsin Beef Research Update

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Feedlot Nutrition and Management

Effects of forage type and inclusion level of dried distillers grains plus solubles on feedlot cattle performance and carcass characteristics.

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Feeding ethanol co-products in feedlots is commonly used to minimize feed costs. Products such as dried distillers grains plus solubles (DDGS) are cost effective sources of energy but must be fed within certain limits to maximize feedlot performance and efficiency (Leuppe et al. 2009). Formation of hydrogen sulfide is increased at a lower pH and in diets high in sulfur this can result in increased risk of S-induced polioencephalomalacia (PEM). Therefore management strategies to reduce the risk of acidosis may also be useful in reducing risk of S toxicity, but may also improve performance with higher inclusion of DDGS in beef cattle finishing diets. Crossbred beef steers (n = 72; 760 lbs initial weight) were used to evaluate the effects of forage type and inclusion level of dried distillers grains plus solubles (DDGS) on feedlot performance and carcass characteristics. The experimental design was a 2 x 2 factorial arrangement of treatments. Factors were inclusion level of DDGS (20% vs. 40%) and type of forage (corn silage = CS vs. hay = HAY) in beef cattle finishing diets. Experimental diets (on DM basis) were 20% DDGS plus 7.5 % chopped hay (20HAY); 20% DDGS plus 15%

CS (20CS); 40% DDGS plus 7.5% chopped hay (40HAY); and 40% DDGS plus 15% CS (40CS) and the remainder of the diets consisted of cracked corn and 15% vitamin-mineral supplement. Cattle were slaughtered at an average 12th rib fat thickness (1.0 cm) and carcass data collected.

Conclusions:

- 40% inclusion of DDGS improved feed efficiency.
- Feedlot cattle performance was improved when HAY was forage source vs. CS.
- Inclusion level of DDGS and forage type interaction was detected, whereas 40HAY had higher marbling scores than 20HAY and 40CS, but not different than 20CS.
- Carcass measurements impacting USDA Yield Grade were not affected by inclusion level of DDGS or forage type.
- Inclusion level of DDGS resulted in greater proportion of carcasses grading in upper 2/3 of USDA Choice and Yield Grade 1 with 40% vs. 20% inclusion of DDGS.

Implications: In order to reduce feed costs, nutritionists are seeking to increase inclusion level of distillers grains without detrimental impacts on feed efficiency and carcass traits. Results from this trial suggest up to 40% inclusion of DDGS on DM basis may replace corn while improving G:F. Furthermore, chopped hay vs. corn silage improves feedlot cattle performance regardless of inclusion level of DDGS and additional research is warranted to determine the effects of forage type at higher inclusion levels of DDGS.

	DDGS ¹ Inclusion		Forage ² Type		SEM
	20%	40%	CS	HAY	
Final BW, lbs	1367	1369	1365	1373	18.5
ADG, lbs/d	3.46	3.48	3.46	3.48	0.08
DMI, lbs	21.6	21.1	22.6 ^a	20.2 ^b	0.6
F:G	6.24 ^a	6.06 ^b	6.53 ^a	5.80 ^b	0.07
Hot carcass wt, lbs	803	802	797	808	18.6
Backfat, in.	0.56	0.47	0.47	0.50	0.01
Ribeye area, in ²	13.4	13.3	13.3	13.4	0.25
USDA yield grade	3.02	2.97	2.95	3.04	0.12
Marbling Score ³	404	416	404	416	10.5

^{ab} Means within treatment are significantly different $P < 0.05$
¹DDGS = dried distillers grains inclusion level 20 vs. 40%.
²Forage type: CS = corn silage and HAY = chopped bromegrass hay
³Small = 400 - 499, Modest = 500 - 599, Moderate = 600 - 699

Randomized field trial to evaluate the effect of chitosan at reducing STEC O157, non-O157, and Salmonella spp in cattle.

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To determine the impact of chitosan as a feed supplement in finishing beef cattle to reduce shedding human pathogenic bacteria, more specifically shiga toxin-producing *E. coli* (STEC) and *Salmonella* in cattle. Essentially, all *Salmonella* are capable of causing disease in animals and humans. Meat is most commonly implicated in outbreaks and cases of foodborne salmonellosis. Outbreaks of illness caused by STEC have been epidemiologically related to contact with animals and consumption of meat and fresh produce. *E. coli* O157:H7 is the most notorious of the STEC strains causing approximately 73,000 cases of illness annually according to the CDC. In order to minimize human infections with STEC O157 and non-O157 STEC, it is necessary to understand which serotypes are most virulent and prevalent and how they are propagated through cattle reservoirs associated with human infections. In addition, investigation of intervention strategies to reduced shedding by cattle of these pathogenic bacteria in beef cattle is beneficial to human health. The aim of the study is to reduce STEC-O157, non-O157, and *Salmonella* shedding in beef cattle by means of an FDA approved feed additive chitosan fed prior to slaughter. Beef steers and heifers ($n = 72$) will be used for the study. These cattle will be housed at the Arlington Beef Unit. Cattle will be fecal sampled to determine shedding of STEC O157 and *Salmonella* at approximately 6 weeks prior to slaughter. The study was conducted in summer 2011 and results are currently being analyzed.

Pastures and Forages

Stocker growth response when grazing fertilized monocultures or mixed legume fescue pastures

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In the spring of 2009 four pasture treatments were established (5.6 acres) with either meadow fescue (MF) or tall fescue (TF), with (C) or without (NC) white clover, and each treatment was replicated three times. During the first year of establishment, all pastures were cut and harvested twice over the growing season. After the establishment year, pastures were managed under a rotational grazing management system with eight equally sized paddocks per pasture. Monoculture pastures were fertilized with 170 or 120 lbs N per acre (yr 1 and yr 2, respectively). The final application of N was not applied in year 2 because unusually dry weather resulted in an abbreviated grazing season. Each year (2010 and 2011) nine tester animals were allotted to pasture treatments and were allowed to graze until pasture growth could not sustain five hd/pasture, which resulted in 188 or 137 grazing days (yr 1 and yr 2, respectively). Excess pasture production was utilized

by the addition of put and take animals throughout the grazing season. Internal parasite control was accomplished with various anthelmintics and confirmed via fecal sample observations over the grazing season. All animals had access to clean, fresh water and free choice mineral with added insect growth regulator for fly control and were moved into a new paddock every 2-4 days.

Starting and ending animal weights were the average of 2 consecutive non-fasted day weights, while interim weights were taken approximately every 6 weeks using a single day weight. The 12 pastures were maintained to allow similar forage allowances across treatments. Forage samples were taken weekly until 7 July and then once every 2 weeks for the duration of the trial. In year 2, steers were treated once for a period of 5 d with Corid in their water. During each sampling date, four 4-sq. ft. quadrats were randomly placed per paddock and clipped to ground level. Samples were analyzed for content of NDF, in vitro true digestibility (IVTD), CP, and clover proportion, and also forage available. The objective of this study was to determine total animal gain per acre while monitoring forage quality and availability over the grazing season.

Results from this study show that grass type and inclusion of white clover in the sward had an effect on overall ADG ($P < 0.05$), 2.24, 2.02, 1.86, 1.55 (MF-C, MF, TF-C, TF, respectively). Mineral intake was greater for grass pastures, and greater for tall fescue than for meadow fescue ($P < 0.05$). Pounds of dry matter available was greater for tall fescue than for meadow fescue (2640 vs. 2380, $P < 0.05$) and decreased with the inclusion of white clover (2610 vs. 2410, $P < 0.05$). Animal gain per acre was increased by the inclusion of white clover (759 vs. 638, $P < 0.05$). Carrying capacity was greater for tall fescue than meadow fescue (1720 vs. 1490, $P < 0.05$). Adding clover to the pasture sward increased percent CP, IVTD, Ca, Mg and decreased NDF in the available forage ($P < 0.05$). These data show that the inclusion of white clover with either tall fescue or meadow fescue increased animal gain per acre by increasing animal growth rate during the grazing season, even though forage DM available was reduced by inclusion of clover.

Comparison of Supplemental Energy Sources for Grazing Yearling Beef Heifers

A. E. Crooks, A. R. Radunz and D. M. Schaefer

Energy is the first-limiting nutrient for growth by grazed cattle in Wisconsin. Supplementation of yearling steers with an energy source while they are grazing pastures populated with cool-season grasses and legumes has always resulted in a growth response. Prior research at the Lancaster Agricultural Research Station suggested that grazed yearling beef cattle expressed a preference for soyhulls, as opposed to ground corn, as an energy supplement during the early grazing season. However, the simultaneous comparison of these and other energy supplemental feeds has not been conducted.

Yearling beef heifers were used to compare corn, barley, soyhulls, and corn distillers' grains, along with a control treatment of no feed supplement. All supplements were fed in coarse-ground or meal forms. Nine commercial Angus heifers were assigned to each of the five treatments during May 25 to July 20, 2011. All heifers were managed in a rotational grazing system based on cool season grass and legume species, with free choice access to salt, trace minerals and water. Supplemental energy sources were provided daily in Calan feed bunks in an amount equivalent to 1 percent of heifer body weight. The average weight and age of the heifers was 766 lbs and 14-15 months at the initiation of the trial. Results are shown in Table 1.

There were no differences among feed supplements in heifer preference for consumption. On an as-fed basis, each supplement was consumed over the 55-day grazing period at the rate of 7.2 to 7.3 lbs/heifer daily. Heifers that received corn, barley, distillers grain or soyhulls had similar average daily gains, though heifers fed barley were not different in growth rate from the heifers that received no feed supplement. Feed conversion efficiencies were not different among the four supplemental feeds. Again, barley supplementation was not different from the unsupplemented, control treatment. To put the feed conversion efficiencies into more familiar terms of feed:gain, the conversion efficiencies for distillers grain, soyhulls, corn and barley were 12.7, 13.0, 13.4, and 28.1, respectively. It is possible that the barley treatment resulted in lower ruminal pH which was antagonistic to pasture fiber digestion. In conclusion, it appears that either corn, distillers or soyhulls should be used as a supplemental energy source and the choice would be based on the cost per unit of energy.

Table 1. Effect of feed supplementation on intake, weight gain and feed conversion efficiency.

Supplement	Intake, lbs as-fed/hd*d	Gain, lbs/d	Gain: Feed
None	0 ^b	1.28 ^b	0 ^b
Corn	398 ^a	1.82 ^a	0.074 ^a
Barley	399 ^a	1.55 ^{ab}	0.036 ^{ab}
Distillers grains	395 ^a	1.86 ^a	0.079 ^a
Soyhulls	402 ^a	1.84 ^a	0.077 ^a
P-value	<0.001	0.03	0.02
a,b Means within a column with unlike letters are different ($P < 0.05$).			

Genetics of Health and Reproduction in Cattle

Brian W. Kirkpatrick, Professor

Research work on genetics of health is focused on the study of John's disease (also called paratuberculosis), specifically susceptibility of cattle to infection by the causative organism, *Mycobacterium avium* subspecies paratuberculosis (MAP). The current USDA funded project is examining genetics of

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susceptibility to MAP infection in Jersey cattle and follows on previous work using Holstein cattle. In both cases animals from cooperating herds (~5,000 Jersey cows and ~10,000 Holstein cows) have been tested for evidence of infection and positive and matching negative animals (approximately 500 each per breed) have been genotyped with medium density genetic marker panels (ie. 50,000 SNP or single nucleotide polymorphism arrays). This data will be used to develop genetic tests that will be predictive of genetic susceptibility within the Jersey and Holstein breeds. One of the next steps in the research will be to conduct across breed (Jersey, Holstein) analyses to identify genetic markers that are useful not only within breed, but also across breeds. Markers of this type may have utility within beef breeds. Research work of this type is ongoing.

Research work on genetics of reproduction is currently focused on the study of a single gene with a large effect on ovulation rate. Over the past three years 116 daughters have been produced from a bull who was a triplet calf from a cow who had three times produced triplet births. These daughters have been examined for ovulation rate over four estrous cycles and genotyped with a low density (3,000 SNP) marker panel to map the gene. The gene's location has been narrowed to a "small" area of ~2 million bases of DNA, and additional work is ongoing to further narrow the likely location of the gene and to identify the causative mutation. The gene increases ovulation rate from the normal single egg to approximately two and a half eggs per cycle. Research is also ongoing to study the effects of the gene on hormone levels so that an understanding of how the gene works can be obtained. This is an exciting discovery with broad ramifications. The location of this gene does not correspond to any of the previously identified high litter size genes in sheep and will provide a possible explanation for some genetically unresolved high litter size breeds of sheep. Similarly, the location corresponds with one litter size gene mapping result in pigs and may lead to genetic markers useful in swine selection. While multiple births are typically not considered desirable by cattle producers, identification of this gene provides a tool that will be useful in facilitating future studies of uterine function, one of the stumbling blocks to acceptance of twinning in beef cattle.

Determination of appropriate delivery of PGF2α in the 5-day CO-Synch + CIDR protocol in lactating beef cows.

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The objective of this experiment was to determine if 2 doses of PGF2α (PG) administered at CIDR removal was an efficacious method for delivery of PG in the 5-d CO-Synch + CIDR protocol. Postpartum beef cows (n = 2465; 67 ± 0.4 dpp) from 13 herds in 8 states were enrolled in the 5-d CO-Synch + CIDR protocol and assigned to receive either 2 doses of PG (25 mg/dose) 8 h

apart with the initial injection given at CIDR removal (8hPG), 2 doses (25 mg/dose) of PG delivered in 2 injection sites with both administered at CIDR removal (CoPG), or a single 25-mg dose of PG at CIDR removal (1xPG). Cows were TAI 72 h after CIDR removal at second GnRH administration. Estrous cycling status (54% cyclic) was determined by evaluation of progesterone in 2 blood samples taken on d -10 and 0 relative to CIDR insertion. Determination of pregnancy was performed by transrectal ultrasonography 39 ± 0.1 d after TAI and after the conclusion of the breeding season. Data were analyzed with the Glimmix procedure of SAS, where herd was included as a random effect. Timed AI pregnancy rates were greater ($P < 0.05$) for the 8hPG (55%) than the 1xPG (48%) treatment, with the CoPG (51%) treatment intermediate and not different from the other treatments. Contrast analysis demonstrated that cows receiving 50 mg of PG (8hPG + CoPG) had greater ($P < 0.05$) TAI pregnancy rates than those receiving 25 mg (1xPG). Pregnancy rates to TAI were greater ($P < 0.05$) in cyclic (55%) than non-cyclic (47%) and greater ($P < 0.05$) in mature (≥ 3 y of age; 54%; $n = 1940$) than 2-y-old cows (40%; $n = 525$). Luteolysis following PGF treatment was assessed in a subset of cows ($n = 277$) and did not differ ($P = 0.13$) among the 8hPG (96%), CoPG (93%), and 1xPG (88%) treatments. Breeding season pregnancy rates (88%) did not differ among treatments. In summary, 50 mg of PG was required in the 5 d CO-Synch + CIDR protocol; however, TAI pregnancy rates did not differ when 50 mg of PG was administered simultaneously with CIDR removal or at 0 and 8 h following CIDR removal.

Meat Science Research Update

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Methods to Produce Safe, Natural, Organic Products

Developing Validated Time-Temperature Thermal Processing Guidelines for Ready-To-Eat Deli Meat and Poultry Products. This is a currently ongoing research project funded by the American Meat Institute Foundation where we are developing new thermal processing tools for cooking processed meat products. We are investigating novel thermal processing approaches for pathogenic strains of Salmonella, Listeria, and E.coli (including STEC strains) in roast beef, ham and turkey breast. The objectives of this research are to 1) validate the effect of thermal processing on the survival of Salmonella, Listeria, and E.coli 2) Use the data from objective 1 to develop easy-to-use time-temperature tables to assure pathogen destruction. This data will be used to validate regulatory compliance for Salmonella, Listeria, and E.coli destruction in ready-to-eat products.

Integrated Research & Extension to Improve the Safety of Natural and Organic Processed Meats by Increasing the Antimicrobial Impact of Sodium Nitrite. This currently ongoing study is investigating the antimicrobial impact that sodium nitrite has on Listeria in beef containing processed meats. Current experiments are being conducted to establish

a greater understanding of the impact sodium nitrite has on controlling Listeria Monocytogenes. Additional planned experiments will utilize these results develop to investigate and improve the safety of natural and organic processed meats typically containing lower nitrite levels. This work is support by the National Institute of Food and Agriculture, United States Department of Agriculture, WIS01523.

Meat Processing Validation

Validation of Pepperoni Process for Control of Shiga-Toxin

Table 3. Least squares means for Phase III consumer sensory analysis of emulsified frankfurters containing naturally brewed soy sauce (SS; TRTs 1-4) and a control frankfurter containing no SS (C).

TRT	Overall Liking	Salty Taste	Overall Taste Intensity	Bitterness	Texture	Internal Color	Meaty Taste
C	4.51 ^{cd}	4.57 ^{cd}	4.52 ^b	2.51 ^f	5.59 ^d	3.27 ^e	4.73 ^{de}
1	5.04 ^d	5.19 ^d	5.95 ^d	2.86 ^{def}	4.44 ^e	4.85 ^d	4.93 ^{de}
2	4.89 ^d	4.70 ^e	5.11 ^{cd}	2.67 ^{ef}	4.32 ^{ef}	4.59 ^d	4.80 ^{de}
3	4.87 ^{de}	4.74 ^e	5.41 ^c	2.89 ^{de}	4.17 ^{ef}	4.87 ^d	4.99 ^d
4	4.48 ^f	4.25 ^f	4.94 ^f	3.15 ^d	4.09 ^f	4.65 ^d	4.64 ^f
SEM	0.13	0.13	0.12	0.13	0.12	0.11	0.12

Treatments: C = 2.5% NaCl; 100% from flake salt; TRT 1 = 2.5% NaCl; 50% NaCl from SS, 50% salt from flake salt; TRT 2 = 20% reduction in Na; 50% NaCl from SS, 30% NaCl from flake salt, 20% KCl; TRT 3 = 35% reduction in Na; 50% NaCl from SS, 15% NaCl from flake salt, 35% KCl; TRT 4 = 50% reduction in Na; 50% NaCl from SS, 50% KCl

Means within the same column with different superscripts are different ($P < 0.05$).

Producing E. coli (STEC). The Center for Disease Control identified serotypes of E.coli as potential contaminants in the food supply chain. This study validated commonly utilized low temperature thermal processing of pepperoni in the US for the additional serotypes. The original study was only conducted for E.coli O157:H7. This study included the 7 serotypes (026, 045, 103, 111, 121, 145, 157). We concluded that the original validated process for controlling O157:H7 was also sufficient for controlling the other 6 STECS.

The Development of Reference Standards for the Nutritional Labeling of Single Ingredient, Ground Meats Containing Varying Fat Percentages. This study was designed to address the nutritional labeling requirements of ground meat products, specifically ground beef, by developing reference fat percentage cards for various fat content-related raw materials. A visual reference guide was constructed for pork, beef, and lamb at different fat contents (95/5; 90/10; 85/15; 80/20; 75/25; and 70/30; Figure 1). Individuals were asked to evaluate a sample of the 2" grind (Control). The individuals then received the Visual Reference guide which contained pictures for all of the samples listed above and were again asked to evaluate fat percent in 5 samples (2 pork, 2 beef and 1 lamb; Visual Guide). The average assigned value for the samples was closer to the actual fat content when the Visual Reference Guide was available. Figure 2 is an example of the assigned values form an 18.89% fat beef sample. This research was supported by the American Association of Meat Processors.

Figure 1. Visual Reference Guide illustration (Beef 85/15)

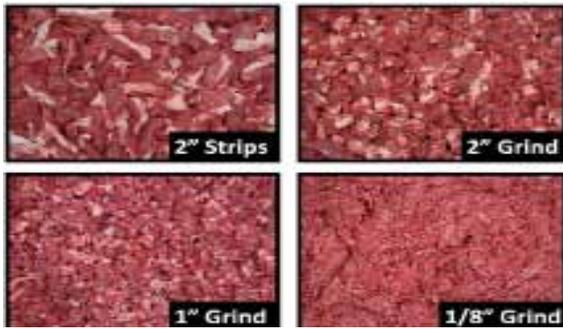
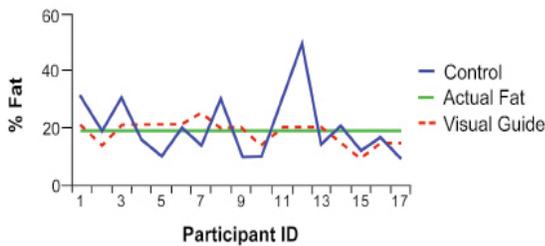


Figure 2. Visual Guide Impact on Assigned Value



Investigating the Efficacy of Reducing Sodium Levels in Processed Meats by Using Natural Flavor Enhancer (NFE) and Soy Sauce. Modified soy sauce was investigated as a potential sodium-reduction ingredient in beef/pork frankfurters by allowing the reduction of salt via replacement with salt-enhancing soy sauce. Several consumer taste tests were conducted with frankfurters produced with various levels of salt replace by modified soy sauce and the data is presented in Table 3. This research shows that sodium levels could be successfully reduced by up to 35% by replacing a portion of formulation salt with soy sauce.

Development of a Natural Curing Process for Beef Jerky. The objective of this study was to develop a natural curing process for whole muscle beef jerky utilizing vegetable juice powder high in naturally occurring nitrate and a starter culture containing *Staphylococcus carnosus*. The study successfully determined an effective process for the manufacture of natural/organic beef jerky. This research was supported by the Wisconsin Beef Council.

Controlling *Listeria monocytogenes* in natural, ready-to-eat meat and poultry products. The objective of this study was to identify ingredients that suppress growth of *Listeria monocytogenes* in ready-to-eat (RTE), deli-style, meat and poultry products that meet natural or organic requirements defined by USDA. The study successfully identified several natural antimicrobials that were effective in improving the safety of ham, turkey breast and roast beef. Figure 4 shows the results of three natural antimicrobials that effectively controlled the growth of *L. monocytogenes* in roast beef.

