Dried Distillers Grains and(or) Soybean Hulls to Background Beef Calves Fed Bahiagrass Forage

Jacqueline Wahrmund
Matt Hersom[1]

Co-products dried distillers grains or soybean hulls can be utilized as supplements for growing beef cattle. Combinations of the two ingredients resulted in the best growth performance compared to the individual ingredients. The price of each co-product should determine the most economic proportion of the co-products fed.

Summary
The objective of this study was to determine the effects of supplementing dried distillers grains soybean hulls, or combinations of the two to growing beef steers consuming bahiagrass hay. Angus steers were randomly allotted to one of four supplement treatments. Treatments included: 1) dried distillers grains; 2) dried distillers grains/soybean hulls; 3) soybean hulls/distillers grains; 4) soybean hulls. 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. Supplement treatment had no effect on final bodyweight. From d 0 to 14, average daily gain (ADG) of dried distillers grains supplemented steers was 0.59 lb/d less compared to any treatments containing soybean hulls. Across all 42 d, ADG of soybean hull supplemented steers was less than the combinations of dried distillers grains and soybean hulls, but was not different than steers supplemented with dried distillers grains only. Plasma glucose concentrations were not different between supplement treatments. On d 0, plasma urea nitrogen concentration did not differ between treatments. However, on d 14, 28, and 42 the plasma urea nitrogen concentrations of steers offered supplements containing dried distillers grains were greater compared to steers offered supplements containing soybean hulls. Supplementing steers consuming bahiagrass hay with a combination of co-products resulted in improved ADG gain and nitrogen metabolism. The combination of 2.11 lb of dried distillers grains and 4.52 lb of soybean hulls optimized calf performance.

Introduction
Bahiagrass is the most common type of forage utilized in Florida (Chambliss and Sollenberger, 1991); however, cattle are not able to consume enough bahiagrass to meet their nutrient requirements at certain points of the production cycle. Therefore, supplementation programs must be developed to optimize beef cattle performance. Bahiagrass in Florida generally does not contain enough protein to meet growing beef cattle requirements.

Low-quality tropical and subtropical grass forages are often deficient in crude protein (CP) relative to the protein requirements of many classes of cattle. Therefore, cattle with greater protein requirements, such as growing cattle, will require additional protein supplementation to meet the nutritional demands associated with growth when maintained on a high-forage diet. Dried distillers grains (DDG) are a co-product of the corn-derived ethanol fuel industry. As ethanol fuel production continues to increase in the United States, DDG will become more available to cattle producers for animal consumption. Soybean hulls (SBH) are another readily available co-product. The price of the feedstuffs, as well as the nutrient needs of the cattle, will generally dictate the most economically desirable supplementation program to optimize herd performance. Combinations of DDG and SBH were fed to determine practical feeding applications of these two co-products.

Materials and Methods

Animals and Diets

Fifty-six Angus steers were blocked by bodyweight (BW) and randomly assigned to one of four treatments and one of seven pens. Treatments included: 1) DDG (6.17 lb of DM); 2) DDG/SBH (4.25 lb DDG, 2.16 lb SBH); 3) SBH/DDG (2.11 lb DDG, 4.52 lb SBH); 4) SBH (6.87 lb of DM). All steers were fed approximately 5.95 lb of SBH for five d prior to the initiation of the trial. Supplement treatments began on d 0 after sampling. Bahiagrass hay was offered to each pen, ad libitum, as large round bales. Fresh bales were offered each wk, and each bale was weighed and core-sampled for analysis of chemical composition. Steers were individually supplemented at approximately 0700 via a Calan gate system.

Sampling and Analysis

Steers were fed for 42 d, unshrunk BW were taken on two consecutive d at the initiation (d -1, 0) and termination of the trial (d 42, 43). Interim BW were obtained on d 14 and 28. The two-d mean of BW was utilized to determine initial and final BW and ADG. Blood samples were collect for analysis of plasma urea nitrogen (PUN) and glucose concentrations. Bodyweight measurements and blood samples were obtained prior to supplements being offered.

Weekly hay samples were collected from each pen and composited for analysis of chemical composition. Hay and supplement total digestible nutrients (TDN) concentrations were determined using the equation (Fike et al., 2002):

$$\%TDN = [(\%\ IVDMD * 0.59) + 32.2] * \text{organic matter concentration.}$$

Because hay was fed as large round bales within each pen, mean daily hay dry matter intake (DMI) was calculated using the NRC (2000) equation:

$$SBW = 13.91 * RE^{0.9116} * EQSBW^{-0.6837}$$

where:
SBW = shrunk body weight
RE = retained energy
EQSBW = equivalent shrunk body weight,
assuming a 4% shrink, and that RE is equal to net energy for gain (NE_g).

Statistical Analysis

The experiment was designed as a completely randomized design, with supplement treatment as the fixed effect (Littell et al., 2006), steer within treatment as the random effect, and individual steer was the experimental unit. Data were analyzed using the Mixed procedure of SAS v9.1 (2002, SAS Inst., Inc., Cary, NC). Means were calculated using least squares means, and means were separated using the P-diff option when the overall F-value was <0.10.

Results

Steer Performance and Intake

At the initiation of the trial, steer BW (mean 605 lb, Table 1) did not differ (P=0.99) among treatments. Between d 0 and 14, steers supplemented with DDG gained 55% less (P<0.05) than steers on all other treatments. Average daily gain from d 14 to 28 was not different (P=0.55) among treatments. At the completion of the study on d 42, final steer BW was not different (P=0.79, mean = 674 lb). From d 28 to 42, ADG did not differ (P=0.26) among treatments; however, there was a tendency (P=0.10) for treatment to affect overall ADG from d 0 to 42. Steers consuming SBH alone gained 0.37 lb/d less than steers consuming SBH/DDG, and 0.31 lb/d less than steers consuming DDG/SBH (P<0.05).

Supplement type affected (P=0.01) mean estimated hay DMI (Table 1); steers supplemented with only SBH consumed the greatest amount of hay across the 42-d experiment (8.48 lb/d), followed by steers offered the SBH/DDG and DDG treatments, which were not different (P>0.10). Differences were also observed (P<0.05) in estimated total DMI (Table 1), with steers offered SBH or SBH/DDG consuming 24% more DM compared to steers offered DDG or mostly DDG/SBH.

Gain:feed (Table 1) was calculated utilizing mean estimated daily hay DMI and the amount of supplement offered, with treatment affecting (P<0.001) gain efficiency. Steers consuming DDG/SBH were most efficient (P<0.05), followed by the DDG and SBH/DDG treatments, which were not different (P>0.10). Steers supplemented with SBH only were least efficient, with a gain efficiency of 0.03 less than steers supplemented with DDG and SBH/DDG, and 0.05 less than steers supplemented with DDG/SBH (P<0.05).

Steers consuming DDG or SBH/DDG averaged 0.018 fewer (P<0.05) lb of gain per lb of feed compared to steers consuming DDG/SBH.

Physiological Response

Prior to the initiation of the experiment, steers were supplemented with approximately 5.95 lb/d of SBH for five d. As a result, no treatment differences (P=0.68) were observed in PUN concentrations on d 0 (Table 2). However, on d 14, PUN concentration increased (P<0.01) as the amount of DDG offered in the supplement increased. Steers supplemented with only SBH had a mean PUN concentration of 5.31 mg/dL. Substituting a small amount of energy from SBH with DDG resulted in an 85% increase (P<0.05) in PUN concentrations of steers on the SBH/DDG treatment, whereas, steers supplemented with the DDG/SBH treatment had 24% greater (P<0.05) PUN concentrations compared to steers offered SBH/DDG. Steers supplemented with DDG had the greatest (P<0.05) PUN concentrations, with 36.9% greater concentrations compared to DDG/SBH-supplemented steers. Similar patterns were observed on d 28; PUN concentrations increased (P<0.001) with the amount of DDG in the diet. Treatment differences were observed (P<0.001) on d 42. Steers consuming DDG only had the greatest PUN concentrations; however, differences were not observed (P>0.10) between steers consuming the DDG and DDG/SBH treatments. Additionally, there were no differences (P>0.10) between steers on the DDG/SBH and SBH/DDG treatments. Steers supplemented with SBH had the lowest PUN concentration (P<0.05).

The effects of treatment on steer PUN were directly related to the amount of supplemental protein offered. Total dietary N intake was greatest (P<0.001; Table 1) for steers on the only DDG diet, and decreased with the amount of DDG offered, with steers offered only SBH consuming the least amount of N/d. The greater supply of dietary N resulted in greater amounts of N metabolized, which appeared in the blood as PUN. Hammond et al. (1993) suggested that PUN concentrations above 12 mg/dL indicate adequate dietary CP, and cattle may benefit from energy supplementation in this situation. Furthermore, PUN concentrations below 9 mg/dL indicate that dietary protein is inadequate, and protein supplements may enhance cattle performance. The steers offered only DDG consistently had PUN concentrations in excess of 12 mg/dL, and therefore, additional dietary energy may have improved performance. Additionally, steers offered only SBH never achieved PUN concentrations above 7 mg/dL, which indicates that protein was not sufficient to maximize steer performance. The steers that received a combination of co-products had PUN concentrations that ranged from 8.4 mg/dL to 12.1 mg/dL throughout the experiment after d 0. These results further illustrate the metabolic advantage of supplemental protein and energy, which tended to improve overall ADG above the SBH supplement, and increased gain efficiency in steers offered the DDG/SBH treatment.

There were no treatment differences (P≥0.78) in plasma glucose concentrations on d 0, 14, 28, and 42. Plasma glucose concentrations have been shown to be related to energy intake (Schmidt and Keith, 1983); however, differences in total TDN intake by steers in this trial (Table 1) did not affect plasma glucose.

Economic Analysis

A simple economic analysis was conducted to determine the most desirable supplement combination for producers (Table 3). The prices paid for the feedstuffs were as follows: hay, \$30/bale; DDG, \$182/T; SBH, \$155/T. Based on the prices paid for the supplements, the cost/lb of each supplement were as follows: DDG, \$0.091; DDG/SBH, \$0.086; SBH/DDG, \$0.082; SBH, \$0.077. The cost of BW gain was determined based on the cost of total feed.

Steers consuming the SBH treatment had the greatest (P<0.05) cost of BW gain at \$0.681/lb, compared to the other three treatments which ranged from \$0.499/lb to \$0.590/lb. The SBH were the least economically efficient as a result of their low BW gains and high hay intakes. These results may indicate that the combinations of co-products were more cost efficient compared to DDG or SBH alone. The price of each co-product should determine the most economically desirable proportions of DDG and SBH used to background steers.

The combination of mostly DDG was the most efficient and economical supplement. The other two supplements containing DDG also outperformed the SBH only diet. Therefore, the SBH treatment alone is not a desirable supplement to growing steers when fed at this level or in combination with this hay. Growing steers require more protein than they are able to consume from a diet of bahiagrass hay with SBH supplementation. The cost of the co-product supplements should dictate the most desirable combinations to feed to growing beef steers.

Literature Cited

Chambliss and Sollenberger. 1991. Pages 74-80 in Proc. 40th Florida Beef Cattle Short Course.

Fike et al. 2002. J. Dairy Sci. 85:866-878.

Hammond et al. 1993. In: Proc. XVII Int. Grassl. Congr. p 1989.

Littell et al. 2006. SAS System for Mixed Models. 2nd ed.

NRC. 2000. Nutrient requirements of beef cattle. 7th rev. ed.

[1] Jacqueline Wahrmund, Former Graduate Student, Matt Hersom, Assistant Professor, UF-IFAS, Department of Animal Sciences, Gainesville, FL.

Table 1. Effect of dried distillers grains (DDG) and/or soybean hulls (SBH) supplementation on steer bodyweight (BW), BW gain and intake.

Item	Treatment[a] DDG	DDG/SBH	SBH/DDG	SBH	SEM[b]	*P*-value
Initial BW, lb	604	608	606	600	16.0	0.99
BW gain, lb/d						
d 0 – 14	0.73[d]	1.19[de]	1.37[e]	1.39[e]	0.18	0.03
d 14 – 28	1.98	2.07	1.78	1.48	0.31	0.55
d 28 – 42	2.05	2.07	2.36	1.50	0.31	0.26
d 0 – 42	1.59[de]	1.76[d]	1.83[d]	1.45[e]	0.11	0.10
Mean hay DMI, lb/d	6.01[de]	5.64[d]	7.67[ef]	8.48[f]	0.64	0.01
Total DMI, lb/d	11.45[d]	11.32[d]	13.57[e]	14.60[e]	0.64	0.001
N Intake, g/d[c]	180.45[d]	154.67[e]	142.40[f]	122.15[g]	4.48	<0.001
TDN Intake, lb/d[c]	8.50[d]	8.79[d]	8.92[e]	7.73[f]	0.20	<0.001
Gain:Feed	0.12[d]	0.14[e]	0.12[d]	0.09[f]	0.01	<0.001

[a] Least square means; Treatment: DDG, 6.17 lb dried distillers grains; DDG/SBH, 4.25 lb DDG, 2.16 lb soybean hulls; SBH/DDG, 2.11 lb DDG, 4.52 lb SBH; SBH, 6.87 lb SBH.

[b] Standard error of the mean, n=56.

[c] Estimated total dietary intake (hay and supplement).

[d, e, f, g] Means with different superscripts within a row are different (P<0.05).

Table 2. Effect of dried distillers grains (DDG) and/or soybean hulls (SBH) supplementation on steer plasma glucose and urea nitrogen concentration.

Item	Treatment[a] DDG	DDG/SBH	SBH/DDG	SBH	SEM[b]	*P*-value
PUN[c], mg/dL						
d 0	6.75	6.17	6.13	6.44	0.41	0.68
d 14	16.57[d]	12.10[e]	9.80[f]	5.31[g]	0.81	<0.001
d 28	14.01[d]	11.55[e]	8.42[f]	5.64[g]	0.70	<0.001
d 42	12.53[d]	11.86[de]	10.24[e]	5.86[f]	0.83	<0.001
Glucose, mg/dL						
d 0	77.24	74.49	75.19	74.51	3.69	0.94
d 14	78.88	76.30	79.56	76.64	3.92	0.90
d 28	80.38	75.69	76.25	76.29	4.06	0.83
d 42	80.76	75.82	76.79	75.66	4.29	0.78

[a] Least square means; Treatment: DDG, 6.17 lb dried distillers grains; DDG/SBH, 4.25 lb DDG, 2.16 lb soybean hulls; SBH/DDG, 2.11 lb DDG, 4.52 lb SBH; SBH, 6.87 lb SBH.

[b] Standard error of the mean, n=56.

[c] Plasma urea nitrogen.

[d, e, f, g] Means with different superscripts within a row are different (P<0.05).

Table 3. Economics of supplementing dried distillers grains (DDG) or soybean hulls (SBH).

	Treatment[a]					
Item	DDG	DDG/SBH	SBH/DDG	SBH	SEM[b]	*P*-value
Supplement cost, \$/lb[c]	0.091	0.086	0.082	0.077	---	---
Feed cost, \$/steer/d[d]	0.89[ef]	0.92[e]	0.95[f]	0.87[f]	0.01	0.07
Total feed, \$/steer	37.43[ef]	38.83[e]	39.91[f]	36.53[f]	2.53	0.07
Cost of gain, \$/lb BW gain/steer	0.590[e]	0.499[f]	0.554[ef]	0.681[g]	0.03	0.003

[a] Least square means; Treatment: DDG, 6.17 lb dried distillers grains; DDG/SBH, 4.25 lb DDG, 2.16 lb soybean hulls; SBH/DDG, 2.11 lb DDG, 4.52 lb SBH; SBH, 6.87 lb SBH.

[b] Standard error of the mean, n=56.

[c] Cost of supplements: \$182/T DDG, \$155/T SBH.

[d] Cost of hay and supplement consumed per steer/d; hay cost, \$30/bale.

[e, f, g] Means with different superscripts within a row are different (P<0.05).