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Effects of Feeding High Levels of Byproducts in Different Combinations to Finishing Steers

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Summary

A finishing experiment was conducted to determine the effects of feeding wet distillers grains plus solubles (WDGS) and wet corn gluten feed (WCGF) with or without corn on feedlot performance and economics. Six treatment diets were evaluated: 1) 83% corn; 2) 44% WDGS and 44% corn; 3) 33% WDGS, 33% WCGF and corn; 4) 33% WDGS, 33% WCGF and soyhulls; 5) 44% WDGS and 44% WCGF; and 6) 66% WDGS and grass hay. The highest average daily gain (ADG) and lowest feed-to-gain ratio (F:G) were observed with cattle fed 44% WDGS and corn. The poorest ADG and F:G were observed with cattle fed WDGS, WCGF and soyhulls. All other diets were intermediate in performance. Largest profit was from steers fed 44% WDGS and corn.

Introduction

Wet distillers grains plus solubles (WDGS) and wet corn gluten feed (WCGF) can replace corn in feedlot diets and will generally improve performance when fed up to 30% to 40% of the diet (*2008 Nebraska Beef Report*, pp. 35-36; *2008 Nebraska Beef Report*, pp. 33-34; *2007 Nebraska Beef Report*, pp. 25-26; *2007 Nebraska Beef Report*, pp. 27-28), and are often cheaper than corn. The objective of the current study was to evaluate performance, carcass characteristics and economics when finishing cattle on diets containing WDGS or combinations of WDGS and WCGF at inclusions much greater than those studied in previous research.

Procedure

Finishing Performance

A finishing trial was conducted at the University of Nebraska Research Feedlot near Mead, Neb., using 288 yearling crossbred steers (BW = 823 ± 27 lb). Prior to initiation, steers were limit fed for five days to minimize gut fill differences. On day 0 and day 1, individual steer initial BW data were collected. Steers were blocked by BW, stratified within block and assigned randomly to pen. With eight steers per pen, pen was assigned randomly to one of six diet treatments. A total of 36 pens were utilized to provide six replications per treatment.

The six treatments included: 1) control (CORN) of 82.5% dry-rolled corn (DRC) and 5.0% molasses; 2) 43.8% WDGS and 43.8% DRC (WDGS:corn); 3) low blend with 32.8% WDGS, 32.8% WCGF and 21.9% DRC (LowBlend:corn); 4) soyhulls blend with 32.8% WDGS, 32.8% WCGF and 21.9% soyhulls (LowBlend:hulls); 5) high blend with 43.8% WDGS and 43.8% WCGF (HighBlend); and 6) 65.6% WDGS and 21.9% grass hay (WDGS:hay) all on a DM basis (Table 1). All diets contained 5.0% supplement and 7.5% alfalfa hay. WDGS was purchased at a commercial corn dry-milling plant (Abengoa Bioenergy, York, Neb.) and contained 32% dry matter (DM), 31.6% crude protein (CP), 13.8% fat and 0.75% sulfur. WCGF (SweetBran®, Cargill, Blair, Neb.) contained 26.7% protein, 4.7% fat and 0.56% sulfur. The supplement used for CORN was formulated to have a diet CP of at least 13.0% and included 1.10% urea. Supplement for the byproduct diets was calculated to keep the Ca:P ratio at 1.2 to 1. Supplements also were formulated to provide Rumensin® (Elanco Animal Health) at 320 mg/steer/day, Tylan® (Elanco Animal Health) at 90 mg/steer/day, and thiamine at 130 mg/steer/day.

Steers were adapted to diets for 21 days and received a delayed implant of Revalor-S (Intervet, Millsboro, Del.) 28 days after trial initiation. Steers were fed for 141 days and were slaughtered at a commercial abattoir (Greater Omaha, Omaha, Neb.). Hot carcass weights (HCW) and liver scores were collected on the day of slaughter. After a 48-hour chill, LM area, 12th rib fat thickness and USDA marbling scores were recorded. USDA yield grade (YG) was calculated from HCW, fat depth, LM area and an assumed 2.5% kidney, pelvic and heart fat (KPH). A common dressing percentage (63%) was used to calculate the carcass adjusted performance of final BW, ADG and feed efficiency. Feed efficiency was analyzed as G:F and presented here as F:G.

Lab Analysis

Weekly feed samples were taken and DM tested using a 60^{o} forced air oven for 48 hours. Composite samples for each ingredient over the feeding period were analyzed for CP, fat and

Table 1. Diet composition of six dietary treatments fed to finishing yearlings (all values on % of diet DM).

Ingredient	CORN	WDGS: corn	Low Blend: corn	Low Blend: hulls	High Blend	WDGS: hay
Alfalfa	7.5	7.5	7.5	7.5	7.5	7.5
DRC[1]	82.5	43.8	21.9	—	—	—
WDGS[2]	—	43.8	32.8	32.8	43.8	65.6
WCGF[3]	—	—	32.8	32.8	43.8	—
Soyhulls	—	—	—	21.9	—	—
Grass hay	—	—	—	—	—	21.9
Molasses	5.0	—	—	—	—	—
Supplement	5.0	5.0	5.0	5.0	5.0	5.0
% diet CP	13.0	19.5	22.6	23.5	26.7	24.3
% diet fat	3.72	8.06	7.16	6.54	8.23	9.64
% diet sulfur	0.153	0.403	0.474	0.476	0.587	0.549

[1]Dry-rolled corn.
[2]Wet distillers grains plus solubles.
[3]Wet corn gluten feed.

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Table 2. Effect of byproduct finishing diets on performance and carcass characteristics.

Treatment[1]	CORN	WDGS: corn	Low Blend: corn	Low Blend: hulls	High Blend	WDGS: hay	SEM	P-value
Performance[2]								
IW, lb	823	823	822	824	824	821	1	0.12
FW, lb	1392[b]	1453[a]	1409[b]	1349[c]	1383[b]	1388[b]	17	< 0.01
DMI, lb/d	26.1[xy]	25.2[yz]	26.1[xy]	25.8[xyz]	24.8[z]	26.6[x]	0.6	0.06
ADG, lb	4.03[b]	4.47[a]	4.16[b]	3.73[c]	3.97[b]	4.03[b]	0.12	< 0.01
F:G	6.48[bc]	5.65[a]	6.28[b]	6.93[d]	6.26[b]	6.61[c]	0.13	< 0.01
Carcass Characteristics[3]								
HCW, lb	877[b]	916[a]	888[b]	850[c]	871[b]	875[b]	8	< 0.01
Marb	516[a]	513[a]	502[a]	460[b]	492[a]	491[a]	13	< 0.01
LM area, sq. in.	14.1	13.8	13.7	13.5	13.6	13.6	0.3	0.35
12th rib fat, in.	0.43[a]	0.52[bc]	0.55[c]	0.46[ab]	0.51[bc]	0.52[bc]	0.03	< 0.05
Yield grade	2.9[a]	3.4[b]	3.4[b]	3.1[ab]	3.2[b]	3.3[b]	0.1	< 0.05

[1]CORN = control diet of 82.5% DRC; WDGS:corn = 43.8% WDGS and 43.8% DRC; LowBlend:corn = 32.8% WDGS, 32.8% WCGF, 21.9% DRC; LowBlend:hulls = 32.8% WDGS, 32.8% WCGF, 21.9% soyhulls; HighBlend = 43.8% WDGS and 43.8% WCGF; WDGS:hay = 32.8% WDGS, 32.8% WCGF, 21.9% grass hay.
[2]IW = initial weight; FW = final weight; DMI = dry matter intake; ADG = average daily gain; F:G = lb of feed consumed per lb of weight gained.
[3]HCW = hot carcass weight; Marb = marbling score: 400 = slight 0, 500 = small 0, etc.; LM area = longissimus dorsi muscle area; Yield grade = calculated USDA yield grade (yield grade = 2.5 + (2.5*12th rib fat) + (0.2*KPH%) + (0.0038*HCW) – (0.32*ribeye area).
[a,b,c,d]Within a row, means without common superscript differ ($P < 0.05$).
[x,y,z]Row tends to differ ($P = 0.06$), means without common superscript differ ($P < 0.05$).

sulfur (S). The combustion method was used for CP analysis (AOAC 990.03). Fat was analyzed using a gravimetric fat procedure modified at the University of Nebraska. Samples were sent to a commercial laboratory for sulfur analysis. Diet CP, fat and sulfur are presented in Table 1.

Finishing Economics

Economic analysis was performed on all six diets using 2007 average prices from Livestock Market News, AMS-USDA. Initial steer price was calculated as average initial BW of pen multiplied by 2007 USDA Nebraska auction market price ($107.74/cwt). Final steer price was calculated similarly with average live final BW of pen multiplied by 2007 USDA Nebraska auction market price ($92.10/cwt). Average 2007 prices were used for DRC ($3.91/bu DM); WDGS ($133.24/ton DM; 95% corn price); WCGF ($126.00/ton DM; 90% corn price); soyhulls ($115.24/ton DM); grass hay ($80/ton DM); and alfalfa hay ($120/ton DM). Yardage was charged at $0.35 per steer daily with health and processing costs of $20 per steer and a death loss of 1.5%. Interest was estimated as 7.5% for feed costs and initial steer cost. Total production costs included total feed costs with interest; all health, processing and death loss costs; and initial steer cost with interest. Cost of gain (COG) was calculated by dividing total finishing cost by average gain per pen. Slaughter breakeven (BE) was calculated by dividing the total cost of production by the carcass-adjusted final BW. Profit or loss (P/L) was calculated by subtracting the total cost of production from the final steer value.

The effects of increasing corn price at $3.50, $4.50 and $5.50 /bu also were analyzed, with WDGS considered at three different percentages of corn price (65%, 75% and 85%). All other feed prices remained the same, and WCGF was priced at 90% the price of corn. Calf prices were adjusted for the control diet to break even on production.

Statistical Analysis

All data were analyzed using MIXED procedures of SAS as a randomized complete block design with pen as the experimental unit. The effects of treatment and block were included in the model. Treatment means were compared using a protected F-test and means separation when the F-test statistic was significant.

Results

Five steers were treated with thiamine for polioencephomalacia (polio) and recovered, but were removed from the study. Four of these steers were on the HighBlend diet and one was on the LowBlend:hulls diet. Four steers died, two due to causes unrelated to treatment and two due to polio; one was on the LowBlend:hulls diet (diet S of 0.48%) and the other was on the HighBlend diet (diet S of 0.59%). No steers were diagnosed with polio on the WDGS:hay diet, despite a dietary S of 0.55%.

Steers fed WDGS:hay had greater DMI (Table 2) than those fed WDGS:corn and HighBlend ($P < 0.01$). Intake for steers fed HighBlend was the lowest compared to all diets ($P < 0.01$). ADG was greatest for steers fed WDGS:corn and least for steers fed LowBlend:hulls. Steers fed WDGS:corn had lower F:G compared to all other diets ($P < 0.01$). Steers fed LowBlend:hulls had the highest F:G ($P < 0.01$). Interestingly, steers fed WDGS:hay and HighBlend and steers fed CORN had similar ADG and F:G. This analysis was performed with the animals remaining after eliminating from treatment those that died or were removed. The results would not be as favorable for steers fed HighBlend or steers fed LowBlend:hulls if the deads and removals had been included in the analysis.

Steers fed LowBlend:hulls had the lowest marbling scores and were statistically different ($P < 0.01$) from all other diets. Fat thickness was greatest for steers fed LowBlend:corn and lowest for those fed CORN. Steers fed CORN were also significantly different ($P < 0.05$) from all other diets for fat thickness and had the lowest calculated Yield Grade (YG). Only steers fed LowBlend:hulls were similar to CORN fed steers for calculated YG ($P > 0.05$).

(Continued on next page)

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Table 3. Effect of byproduct finishing diets on economics.

Treatment[1]	CORN	WDGS: corn	Low Blend: corn	Low Blend: hulls	High Blend	WDGS: hay	SEM	*P*-value
Deads out[2]								
BE, $/cwt[4]	91.91[cd]	87.41[a]	90.07[b]	93.24[d]	90.74[bc]	90.41[bc]	0.91	< 0.01
COG, $/cwt[5]	69.02[c]	60.69[a]	65.02[b]	70.52[c]	65.19[b]	65.02[b]	1.38	< 0.01
P/L, $/hd[6]	6.64[cd]	70.63[a]	30.43[b]	-14.69[d]	19.31[bc]	24.27[bc]	12.16	< 0.01
Deads in[3]								
BE, $/cwt[4]	91.49[ab]	86.99[a]	89.66[a]	96.82[b]	103.66[c]	89.99[ab]	3.40	< 0.01
COG, $/cwt[5]	67.55[a]	59.21[a]	63.55[a]	79.05[a]	103.88[b]	63.55[a]	10.54	< 0.01
P/L, $/hd[6]	10.76[ab]	74.74[a]	34.54[a]	-56.54[bc]	-126.73[c]	28.38[a]	37.09	< 0.01

[1]CORN = control diet of 82.5% DRC; WDGS:corn = 43.8% WDGS and 43.8% DRC; LowBlend:corn = 32.8% WDGS, 32.8% WCGF, 21.9% DRC; LowBlend:hulls = 32.8% WDGS, 32.8% WCGF, 21.9% soyhulls; HighBlend = 43.8% WDGS and 43.8% WCGF; WDGS:hay= 32.8% WDGS, 32.8% WCGF, 21.9% grass hay.
[2]Dead or removed cattle due to treatment (9 total) not included in performance analysis to calculate economic value of treatments.
[3]Dead or removed cattle due to treatment (9 total) included in performance analysis to calculate economic value of treatments.
[4]Breakeven = (initial steer cost ($107.74/cwt) + feed cost[7] + interest[8] + health&processing[9] + yardage[10] + death loss[11]) / FW.
[5]Cost of Gain = (feed cost[7] + interest[8] + health&processing[9] + yardage[10] + death loss[11]) / (FW-IW).
[6]Profit/Loss = final steer value ($92.10/cwt) – (initial steer cost ($107.74/cwt) + feed cost[7] + interest[8] + health&processing[9] + yardage[10] + death loss[11]).
[7]WDGS ($133.24/ton DM); WCGF ($126/ton DM); DRC ($3.91/bu); alfalfa ($120/ton DM); grass hay ($80/ton DM); soyhulls ($115.24/ton DM)
[8]7.5% interest applied to initial steer value (initial BW *107.74/cwt) and to feed costs.
[9]$20/steer applied.
[10]$0.35/steer/d applied.
[11]1.5% death loss applied.
[a,b,c,d]Within a row, means without common superscript differ ($P < 0.05$).

Due to cattle deaths and removals, economics were analyzed with these cattle not included (deads out) in performance calculations and with them included, as well (deads in).

As seen in Table 3, with deads out, WDGS:corn had the lowest breakeven price, along with the lowest cost of gain, and was statistically different ($P < 0.01$) from all other diets. LowBlend:hulls had the highest BE and highest COG ($P < 0.01$). Although economics were statistically similar to CORN, the performance of the steers fed LowBlend:hulls was much poorer. Another comparison of CORN to WDGS:hay was interesting as both sets of steers performed similarly in the feedlot, but the grass hay-fed steers had a higher profit due to the price of corn.

With deads and removals included in the analysis, cattle fed HighBlend and LowBlend:hulls showed much lower profit than all other treatments. Steers fed HighBlend initially showed a profit of $19.31/head, but inclusion of cattle that died or were removed from treatment turned profit to a loss of -$126.73/head. Steers fed LowBlend:hulls with deads out had a profit of -$14.69/steer, which decreased to -$56.54/head with deads in because of a death (and removal) rate of 12.5% and 4.2% for HighBlend and LowBlend:hulls, respectively.

Steers fed WDGS:corn had the greatest profit (Table 4) regardless of corn price. These steers were the most efficient and sold the most weight. Steers fed WDGS:hay performed similarly to steers fed CORN; however, their profitability was greater due to feeding a less expensive diet and selling the same amount of weight.

Table 4. Economic effects of increasing corn price in relationship to WDGS as a percent of corn price on profit or loss[1] per dietary treatment relative to steers fed corn.

Corn Price $/bu	WDGS Price[2]	CORN	WDGS: corn	Low Blend: corn	Low Blend: hulls	High Blend	WDGS: hay
3.50	65	—	87.23	30.98	-20.27	19.65	50.45
	75	—	75.73	22.04	-29.11	8.34	32.25
	85	—	64.24	13.10	-37.94	2.98	14.05
4.50	65	—	92.72	31.74	-4.32	24.60	71.52
	75	—	77.94	20.25	-15.68	10.05	48.12
	85	—	63.16	8.76	-27.03	-4.51	24.72
5.50	65	—	98.22	32.50	11.64	29.55	92.60
	75	—	80.15	18.46	-2.24	11.77	64.00
	85	—	62.09	4.42	-16.12	-6.02	35.40

[1]Profit/Loss = final steer value ($92.10/cwt) – (initial steer cost [price for CORN to breakeven] + feed cost + interest + health&processing + yardage + death loss).
[2]Price of WDGS as a % of corn price.

With the increasing price of corn, the WDGS:hay diet became increasingly competitive in relationship to the CORN and the WDGS:corn diets. With corn at $5.50/bu and WDGS at 65% the price of corn, the WDGS:hay diet had nearly the same profitability as the WDGS:corn diet. Also, the WDGS:hay diet was consistently more profitable compared to the CORN diet at all price levels and percentages of WDGS.

From this study, we can conclude it is possible to feed byproduct diets with no corn and not forfeit feedlot performance compared to feeding corn diets. The best performance and economic results were observed with steers fed 44% WDGS with corn or a blend of WDGS and WCGF with corn, like the byproduct and corn combinations typical for Nebraska. Knowing that roughage can be substituted on an equal NDF basis (Benton et al., *2007 Nebraska Beef Report*, pp. 29-32), grass hay, alfalfa hay or even cornstalks need to be included at higher levels in diets with very large inclusions of WDGS to manage dietary S as shown with the 66% WDGS and hay diet in this study. Even so, the optimum diet is dependent on prices of WDGS and WCGF relative to the price of corn.

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