OPTIMIZING USE OF WET SORGHUM DISTILLER'S GRAINS WITH SOLUBLES IN FLAKED-CORN FINISHING DIETS

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Summary

A finishing trial was conducted using 637 heifers (initially 849 lb) to determine the optimal amount of wet sorghum distiller's grains with solubles (WDGS) in finishing diets containing steam-flaked corn. Dietary treatments consisted of six concentrations of WDGS (0, 8, 16, 24, 32, and 40%; dry basis). Heifers were placed into dirt-surfaced feedlot pens (25 to 30 heifers/pen; 4 pens/treatment) and fed for 58 days. Daily gain responded in a quadratic manner ($P<0.01$), peaking with 8% WDGS in the finishing diet. Average daily gains during the 58-day finishing period were 2.79, 3.11, 3.05, 2.89, 2.70, and 2.55 lb/day for cattle fed 0, 8, 16, 24, 32, and 40% WDGS, respectively. Dry matter intake decreased linearly ($P<0.01$) as content of WDGS increased. Feed efficiency was optimized with 16% WDGS (6.81, 6.49, 6.19, 6.64, 6.96, and 7.18 lb dry feed per lb gain for cattle fed 0, 8, 16, 24, 32, and 40% WDGS, respectively). Animal performance data were used to compute net energy gain (NEg) values of each diet, yielding estimates of 69.9, 71.7, 75.8, 71.2, 68.9, and 67.6 Mcal/cwt for diets containing 0, 8, 16, 24, 32, and 40% WDGS, respectively (quadratic effect, $P<0.03$). Ribeye area decreased linearly ($P<0.02$) as concentration of WDGS increased in the diet. The percentage of USDA Yield Grade 1 carcasses decreased linearly ($P<0.05$), and the percentage of USDA Yield Grade 3 carcasses increased linearly ($P=0.05$) as the content of WDGS was increased. Average USDA Yield Grade increased linearly ($P<0.02$) as content of WDGS was increased. Grid-based carcass values were not significantly different across dietary treatments. Regression analysis of efficiency data indicates that the optimum amount of sorghum WDGS in steam-flaked corn diets is approximately 15%. Diets containing as much as 24% WDGS yielded efficiencies equal or superior to diets containing no WDGS.

Introduction

Continued expansion of the fuel ethanol industry will increase availability of distillery byproducts, which are well suited for use as animal feed. The predominant byproduct from the fermentation of grains for fuel ethanol production is distiller's grains with solubles. Distiller's grains with solubles commonly contain the protein fraction of the grain as well as the bran, which is high in fiber, and the germ, which is high in fat. As a consequence, wet distiller's grains are valuable both as a source of protein and energy. Addition of wet distiller's grains in finishing diets based on dry-rolled grains can improve feed efficiency and increase average daily gain. Because we recognize that flaked grains are superior to dry rolled grains in supplying energy, this study was designed to identify the optimal amount of wet sorghum distiller's grains in finishing diets based on steam-flaked corn.

Procedures

In October 2003, 637 yearling, crossbred heifers (initially weighing 849 lb) were used in a 58-day finishing trial. Pens were ranked from heaviest to lightest average body weight,

and were randomly allotted, within strata, to each of the six dietary treatments (Table 1). Cattle were fed in dirt-surfaced pens of 25 to 30 animals each, with a total of four pens per treatment. Pens provided approximately 200 square feet surface area per heifer. Cattle were vaccinated, implanted with Revalor® 200, and treated for internal and external parasites. Feed was delivered once daily for ad libitum intake. Cattle in each pen were weighed before being transported to a commercial abattoir in Emporia, Kansas. Hot carcass weight and incidence of liver abscesses were recorded at time of slaughter. Yield grade, quality grade, marbling, incidence of dark cutters, 12th-rib fat thickness, ribeye area, and percentage of kidney, pelvic, and heart fat were recorded after a 72-hour chill.

Results and Discussion

Heifer performance is reported in Table 2. Replacing steam-flaked corn with WDGS yielded a quadratic effect ($P<0.02$) on daily gain. The maximal rate of growth was achieved when the amount of WDGS was 8% of the diet dry matter, and decreased as the proportion of inclusion increased. Feed intake was also maximized with 8% WDGS, and decreased linearly ($P<0.02$) as the proportion of WDGS in the diet increased. A quadratic effect ($P<0.02$) was observed for feed efficiency. Efficiency was optimized at 16% WDGS and decreased at amounts beyond 16%.

Net energy concentrations of diets are shown in Table 4. A quadratic effect was observed for dietary net energy available for gain ($P<0.03$), dietary net energy available for maintenance ($P<0.03$), and net energy available for gain of WDGS ($P<0.04$). Dietary concentrations of net energy for maintenance and net energy for gain peaked at 16% WDGS in the diet. Net energy for gain of WDGS peaked at 8%. Adding WDGS at 8, 16, or 24% yielded performance that was equal or superior to adding no WDGS. Exceeding 24% WDGS reduced performance of finishing feedlot cattle, suggesting that WDGS would need to be purchased at a discount relative to corn when fed at higher concentrations.

Carcass characteristics of heifers fed different amounts of WDGS are shown in Table 3. Replacing steam-flaked corn with WDGS in the diet resulted in a linear ($P<0.02$) decrease in ribeye area. There also was a linear effect ($P<0.06$) on the percentage of USDA Yield Grade 1 and USDA Yield Grade 3 carcasses, with cattle depositing more fat as the proportion of WDGS increased. Average USDA Yield Grades were 1.76, 2.06, 1.87, 2.15, 2.01, and 2.13 for heifers fed diets containing 0, 8, 16, 24, 32, and 40% WDGS, respectively (linear effect, $P<0.02$).

Grid-based carcass values of heifers fed different amounts of WDGS are shown in Table 5. Generally speaking, there were no clear effects of WDGS on carcass value when evaluated by using a marbling-based grid, or with a muscle-based grid at Choice-Select spreads of $2/cwt or greater. There was a tendency ($P=0.08$) for carcass value to decrease linearly as dietary inclusion of WDGS increased, based on the muscle grid with a Choice-Select spread of zero. The incidences of liver abscesses and percentage of dark cutters were not affected by addition of WDGS in the diet.

In summary, replacing steam-flaked corn in finishing diets with WDGS is a viable option for improving dry matter intake, daily gain, and feed efficiency of cattle. WDGS can be added at proportions as high as 24% without compromising performance during the last 2 months before slaughter. This experiment indicates that optimal efficiency is achieved when WDGS is added to flaked-corn finishing diets at approximately 15% of the diet dry matter.

Table 1. Composition of Diets Fed to Heifers During the Final 58 Days of Feedlot Finishing

	Wet Distiller's Grains with Solubles, % of Dry Matter					
Ingredient, % of dry matter	0	8	16	24	32	40
Flaked corn	83.6	76.9	70.3	63.6	56.1	48.1
Alfalfa hay	7.0	7.0	7.0	7.0	7.0	7.0
Wet distiller's grains w/solubles	---	8.0	16.0	24.0	32.0	40.0
Soybean meal	3.4	2.4	1.3	0.7	---	---
Rumensin/Tylan/MGA premix[a]	2.5	2.5	2.5	2.5	2.5	2.5
Limestone	1.5	1.5	1.5	1.5	1.5	1.5
Urea	1.20	0.84	0.48	0.12	---	---
KCl	0.47	0.49	0.52	0.54	0.55	0.55
Salt	0.31	0.31	0.32	0.32	0.33	0.33
Vitamin/mineral premix[b]	0.14	0.14	0.14	0.13	0.13	0.13

[a]Formulated to provide 300 mg/day Rumensin, 90 mg/day Tylan, and 0.5 mg/day MGA.
[b]Formulated to provide 0.1 ppm cobalt, 8 ppm copper, 0.5 ppm iodine, 48 ppm manganese, 0.25 pm selenium, 48 ppm zinc, and 1000 IU/lb vitamin A in the diet dry matter.

Table 2. Performance of Heifers Fed Flaked-Corn Diets with Increasing Percentages of Diet Dry Matter as Wet Sorghum Distiller's Grains with Solubles During the Final 58 Days of Feedlot Finishing

	Wet Distiller's Grains with Solubles, % of Dry Matter							P-Value	
Item	0	8	16	24	32	40	SEM	Linear	Quadratic
No. of heifers	99	93	92	98	102	99			
Initial weight, lb[a]	849	848	848	848	849	849	8.4	0.94	0.93
Final weight, lb	1049	1084	1073	1073	1057	1057	9.7	0.61	0.09
Carcass-adjusted final weight, lb	1011	1029	1025	1016	1006	997	11.5	0.14	0.20
Dry matter intake, lb/day	19.0	20.2	18.9	19.2	18.8	18.3	0.28	<0.01	0.37
Carcass-adjusted gain, lb/day	2.79	3.11	3.05	2.89	2.70	2.55	0.09	<0.01	<0.01
Carcass-adjusted efficiency[c]	6.81	6.49	6.19	6.64	6.96	7.18	0.18	0.04	<0.01

[a]Calculated using a 4% shrink.
[b]Average daily gain and efficiency were computed by using carcass-adjusted final weights. Final live weight = hot carcass weight / 63.5% dress.
[c]Statistics were performed as gain:feed, reported as feed:gain.

Table 3. Carcass Characteristics of Heifers Fed Flaked-Corn Diets with Increasing Percentages of Diet Dry Matter as Wet Sorghum Distiller's Grains with Solubles During the Final 58 Days of Feedlot Finishing

	Wet Distiller's Grains with Solubles, % of Dry Matter							P- Value	
Item	0	8	16	24	32	40	SEM	Linear	Quadratic
Hot carcass weight, lb	641	653	651	645	638	632	7.3	0.15	0.20
Dress, %	63.7	62.7	63.2	62.6	62.9	62.4			
Ribeye area, square inches	12.6	12.2	12.5	12.3	12.0	11.7	0.21	<0.01	0.15
12th-ib fat thickness, in	0.35	0.39	0.37	0.38	0.37	0.40	0.016	0.14	0.70
Kidney, pelvic, and heart fat, %	2.1	2.2	2.2	2.2	2.2	2.2	0.039	0.41	0.81
USDA Yield Grade									
1, %	32.8	15.5	33.2	11.8	25.8	13.4	4.8	0.04	0.99
2, %	57.8	63.0	46.7	63.2	47.4	61.6	4.5	0.77	0.38
3, %	9.2	21.4	19.9	22.7	26.7	23.7	5.4	0.06	0.55
4, %	0	0	0	2.17	0	0	1.0	0.36	0.47
USDA Yeld Grade, average	1.76	2.06	1.87	2.15	2.01	2.13	0.094	0.02	0.43
Marbling score[a]	486	507	482	524	500	509	9.1	0.08	0.64
USDA quality grade									
Prime, %	0	1.1	0	0	0	0	0.46	0.39	0.74
Choice, %	33.9	47.5	33.9	56.4	34.9	53.4	5.7	0.10	0.68
Select, %	57.7	46.2	63.7	38.4	59.4	44.2	5.1	0.23	0.95
Standard, %	5.2	4.0	2.2	3.0	4.7	1.1	2.2	0.34	0.68
Dark cutter, %	3.0	1.0	0	2.0	0.9	1.1	1.0	0.36	0.36
Liver abscess	1.9	3.2	2.2	2.0	2.0	2.2	1.6	0.85	0.96

[a]Marbling score: Slight = 400-499, Small = 500-599.

Table 4. Net Energy Values with Increasing Percentages Diet Dry Matter as Wet Sorghum Distiller's Grains with Solubles

	Wet Distiller's Grains with Solubles, % of Dry Matter							P-Value	
Item	0	8	16	24	32	40	SEM	Linear	Quadratic
Dietary NEg, Mcal/lb	0.699	0.717	0.758	0.712	0.689	0.676	0.019	0.14	0.03
Dietary NEm, Mcal/lb	1.007	1.030	1.075	1.021	0.998	0.984	0.021	0.15	0.03
NEg of WDGS, Mcal/lb[a]	---	1.243	1.216	0.848	0.748	0.717	0.137	0.09	0.04

[a]Based on NEg for steam-flaked corn of 0.767 Mcal/lb.

Table 5. Grid-based Carcass Values of Heifers Fed Flaked-Corn Diets with Increasing Percentages of Diet Dry Matter as Wet Sorghum Distiller's Grains with Solubles During the Final 58 days of Feedlot Finishing

	Wet Distiller's Grains with Solubles, % of Dry Matter							P- Value		
Choice-Select Spread, $	0%	8%	16%	24%	32%	40%	SEM	Linear	Quadratic	Control vs WDGS
Muscle-Based Grid[a]	Total Carcass Value, $									
0	843	855	856	840	835	826	10	0.08	0.18	0.98
4	826	842	839	829	818	814	10	0.13	0.18	0.81
8	809	829	822	818	802	803	11	0.21	0.19	0.62
12	792	816	805	807	785	791	11	0.32	0.20	0.47
16	775	802	787	796	768	779	12	0.47	0.22	0.36
20	758	789	770	785	752	768	12	0.64	0.25	0.28
Marbling-Based Grid[a]										
0	829	849	846	835	825	823	10	0.20	0.16	0.58
4	812	836	829	824	809	811	11	0.31	0.17	0.42
8	795	823	812	813	792	800	11	0.45	0.18	0.31
12	778	810	795	802	775	788	12	0.63	0.20	0.24
16	761	797	778	791	759	776	12	0.81	0.23	0.19
20	744	784	761	780	742	765	13	0.97	0.26	0.15

[a]Base carcass price = $130.00/cwt; Choice-Select spread in $4/cwt increments.