EFFECTS OF WET CORN DISTILLER'S GRAINS WITH SOLUBLES (WCDGS) AND NON-PROTEIN NITROGEN ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF YEARLING STEERS

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Summary

Yearling steers (n = 525; initial weight = 822 lb) received dietary treatments involving WCDGS (15 or 30% of DM) and non-protein N (NPN; 0, 1.5, or 3.0% of DM) from urea; a control diet without WCDGS was fed that contained 3.0% NPN and cottonseed meal. Feed intake increased linearly ($P = 0.04$) as NPN increased, but was not altered by WCDGS. Overall ADG for steers fed 15% WCDGS was greater for 1.5 and 3.0% NPN than for 0% NPN ($P < 0.07$, quadratic); however, ADG was not influenced by NPN for 30% WCDGS. Overall ADG was not different between the control and 15% WCDGS, but ADG was lower ($P < 0.02$) for 30% than for 15% WCDGS. Overall gain efficiency among steers fed 15% WCDGS was greatest for 1.5% NPN and least for those fed 0% ($P < 0.07$, quadratic), whereas gain efficiency decreased linearly ($P < 0.09$) as NPN increased in 30% WCDGS diets. Dressing percent was greater ($P < 0.01$) for the control diet than for 15% or 30% WCDGS. Data suggest that optimum performance occurs between 1.5 and 3.0% NPN when diets contain 15% WCDGS, and with 1.5% NPN or less when diets contain 30% WCDGS.

Introduction

The growth of the ethanol industry in the recent past has led to more widespread availability of wet distiller's grains with solubles, most commonly made from corn grain. Wet corn distillers grains with solubles (WCDGS) can be fed at low levels to provide supplemental protein to feedlot cattle, but higher dietary levels may be cost effective if the price difference between corn and WCDGS is favorable. Thus, a range of dietary levels is expected to be utilized in the feedlot industry, depending on current ingredient prices.

As corn grain is replaced with WCDGS, dietary starch is replaced with readily fermentable fiber. This replacement may result in a reduced need for rapidly degraded nitrogen (e.g., feed grade urea) in the rumen to support optimum ruminal fermentation. Therefore, assessment of degradable nitrogen needs in diets containing WCDGS is needed to allow provide information on appropriate diet formulation adjustments to aid the cattle industry in managing feed costs.

Experimental Procedures

Crossbred yearling steers (549 head) were procured, processed on arrival, and adapted over at least 28 days to a 90% concentrate diet based on steam-flaked corn that did not contain grain milling byproducts. Cattle were then weighed before feeding to select study candidates. Scales were validated with certified weights before each use. Cattle were blocked and randomized to treatments based on this weight measurement. On the following day, cattle were weighed a second time, implanted with Revalor-IS, and were sorted into study pens as they exited the chute. Initial weight was the average of these body weight measurements on consecutive days. Treatments were arranged in a 2 x 3 + 1 factorial of WCDGS (15 or 30% of DM) and 0, 1.5, or 3% non-protein N derived from urea; a control diet was also fed that did not contain WCDGS in which 3.0% non-protein N and cottonseed meal were included (Table 1). Cattle assigned to 30% WCDGS diets with 0, 1.5, and 3.0% non-protein N were fed 15% WCDG diets with the appropriate non-protein N for three days before increasing WCDGS to 30% of DM. Feed was mixed and delivered twice daily throughout the study. Cattle were reimplanted with Revalor-S after an average of 55 days on feed and were slaughtered after an average of 129 days on feed.

Steam-flaked corn was prepared approximately 4 times/week. Corn was steamed for 35 minutes after tempering to 18% moisture overnight and was flaked to a bulk density of 27.5 lb/bu. The WCDGS was obtained three times/week from Quality Distiller's Grains in Hereford, TX and stored under shelter in an open-front commodity shed until fed. Shrink from the point of loading at the plant until entering the feed mixer averaged 6.2% over the entire study (April through August). Dry matter of steam-flaked corn and WCDGS were determined 5 days/week at 60°C for 48 hours. Dry matter of remaining ingredients were determined once/week at 60°C for 48 hours. Each week, ingredient DM was updated to determine diet DM. Actual diet DM composition during the study was calculated using the overall average DM of each ingredient.

Samples of ingredients and diets were collected each week and composited before laboratory analysis. Uncompacted ration density was determined by pouring a fresh ration sample into a 3-gallon bucket and removing excess feed with a straight edge. Compacted ration density was determined in a similar fashion except that feed was compacted by lifting the filled bucket 12 inches and dropping it 10 times. These ration densities were determined on 6 separate occasions during the study.

Growth performance data and continuous carcass data were analyzed using Mixed procedures of SAS. The distribution of carcass quality and yield grades were analyzed using Glimmix procedures of SAS. Means were separated using the contrasts of 0 vs 15% WCDG, 15 vs 30% WCDG, and linear and quadratic effects of non-protein N either within or across WCDG concentrations. Interactions were considered statistically significant at $P < 0.15$, whereas means were declared as different if $P < 0.10$.

Results and Discussion

Actual diet ingredient and chemical composition agreed well with formulation targets (Table 1) with the exception of calcium content of the control ration. This discrepancy is most likely related to sampling challenges because the same supplement was used for the three diets containing 3.0% non-protein N. The WCDGS fed contained 37.8% DM, 33.4% CP, and 12% crude fat (Table 2); the WCDGS was derived from a blend of milo and corn (10:90). Observed diet NEm and NEg based on cattle performance were 98% of expected for cattle fed the control diet; the NEm and NEg values used were 1.093 and 0.766 Mcal/lb for steam-flaked corn, 2.15 and 1.59 Mcal/lb for yellow grease, and 0.81 and 0.526 Mcal/lb for cottonseed meal. Through the process of substitution, the NEg that wet corn distiller's grains with solubles had to contain, assuming no associative effects, was 97% of steam-flaked corn for optimum performance with 15% WCDG (average of 1.5 and 3.0% non-protein N diets, WCDGS = 0.746 Mcal/lb) and 101% of steam-flaked corn for optimum performance with 30% WCDGS (0% non-protein N diet, WCDGS = 0.776 Mcal/lb).

From day 1 through reimplant (Table 3), dry matter intake increased linearly ($P < 0.05$) as dietary non-protein N increased in diets containing either 15 or 30% WCDGS. This response continued throughout the study such that overall dry matter intake increased linearly ($P < 0.05$) with increasing non-protein N. Feed efficiency through reimplant was not different ($P > 0.10$) between the control and diets containing 15% WCDGS, but feed efficiency was poorer for steers fed 30% WCDGS than for steers fed 15% WCDGS. Feed efficiency through reimplant became poorer ($P < 0.05$) as dietary non-protein N increased in diets with 30% WCDGS (WCDG x non-protein N, $P = 0.02$). Overall carcass-adjusted ADG was not different ($P > 0.10$) between steers fed the control and those fed 15% WCDGS, but steers fed 15% WCDGS had greater ADG than those fed 30% WCDGS ($P < 0.05$). Among steers fed 15% WCDGS, ADG was increased by adding 1.5% non-protein N ($P < 0.10$). Overall carcass-adjusted feed efficiency (WCDGS x non-protein N, $P = 0.14$) was not different ($P > 0.10$) between steers fed the control and those fed 15% WCDGS. However, feed efficiency became poorer ($P < 0.05$) when 30% WCDGS was fed than when 15% WCDGS was fed. In addition, feed efficiency was not affected by non-protein N in diets containing 15% WCDGS ($P > 0.10$), whereas increasing non-protein N in diets containing 30% WCDG resulted in poorer feed efficiency ($P < 0.10$).

No interactions ($P > 0.15$) between WCDGS and non-protein N were evident for carcass characteristics. Dressing percent was greater for steers fed the control than for those fed 15 or 30% WCDGS ($P < 0.01$). Hot carcass weight was not different between the control and diets with 15% WCDGS ($P > 0.10$), but hot carcass weight was reduced by feeding 30% WCDGS compared to feeding 15% WCDGS ($P < 0.01$). More carcasses from steers fed 30% WCDGS were yield grade 1 ($P < 0.10$) than from steers fed the control or 15% WCDGS, and steers fed the control had more yield grade 3 carcasses ($P < 0.10$) than those fed 15 or 30% WCDGS.

Implications

Optimum performance by finishing yearling steers fed 15% WCDGS occurred when the diet contained between 1.5 and 3.0% non-protein N, but removing all non-protein N was necessary to optimize performance in diets containing 30% WCDGS.

Acknowledgements

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Table 1. Ingredient and analyzed chemical composition of experimental diets (DM basis)

Item	Control	Wet corn distiller's grains with solubles, % of DM					
		15%			30%		
		Dietary non-protein N, % of DM			Dietary non-protein N, % of DM		
		0	1.5	3.0	0	1.5	3.0
Steam-flaked corn	76.46	66.54	66.53	66.53	52.66	52.66	52.65
Cottonseed meal	3.85	-	-	-	-	-	-
Urea	1.06	-	0.52	1.06	-	0.52	1.06
Wet corn distiller's grains with solubles	-	14.75	14.76	14.75	29.58	29.57	29.57
Supplement	2.39	3.45	2.93	2.40	3.46	2.94	2.42
Steep liquor	4.12	4.13	4.13	4.12	4.13	4.14	4.14
Yellow grease	2.01	1.00	1.00	0.99	-	-	-
Alfalfa hay	10.11	10.14	10.13	10.14	10.17	10.16	10.16
CP, %	13.6	12.9	15.0	15.6	16.6	18.1	18.9
Non-protein N, %	3.25	0.6	1.8	3.3	0.6	1.7	3.1
ADF, %	8.0	9.9	9.9	9.4	11.7	12.4	11.2
NDF, %	13.8	15.4	18.4	17.4	20.0	22.5	20.3
Crude fat, %	4.8	5.0	4.8	4.8	4.6	4.8	4.5
Ca, %	0.98	0.88	0.87	0.86	0.92	0.89	0.80
P, %	0.33	0.36	0.36	0.35	0.42	0.42	0.40
K, %	0.78	0.81	0.83	0.82	0.90	0.90	0.86
Mg, %	0.19	0.20	0.21	0.19	0.22	0.23	0.20
S, %	0.17	0.23	0.24	0.23	0.31	0.32	0.29
Zn, mg/kg	81	84	87	79	90	91	85
Fe, mg/kg	214	342	240	260	259	278	230
Mn, mg/kg	53	49	46	44	50	53	45
Cu, mg/kg	20	18	18	21	19	19	19
Diet DM, %	82.70	69.79	69.82	69.86	60.61	60.64	60.66
Density of uncompacted diet, lb/ft^{3} [a]	25.7	28.4	29.0	28.4	29.8	30.0	29.9
Density of compacted diet, lb/ft^{3} [a]	32.8	36.6	37.8	36.5	38.9	39.6	39.9

[a]Control vs 15% distiller's grains and 15% vs 30% distiller's grains ($P < 0.01$).

Table 2. Chemical composition of wet corn distiller's grains with solubles[a]

Analyte	Concentration (DM basis)
DM, %	37.8
CP, %	33.4
Soluble CP, % of CP	13.5
NPN, % of CP	0.1
ADICP, %	5.2
NDICP, %	8.5
ADF, %	18.7
NDF, %	36.2
Lignin, %	6.1
Starch, %	4.8
Crude fat, %	12.2
Ash, %	5.7
Ca, %	0.07
P, %	0.64
K, %	0.71
Mg, %	0.22
Na, %	0.16
Cl, %	0.19
S, %	0.56
Cu, mg/kg	5
Fe, mg/kg	111
Mn, mg/kg	16
Mo, mg/kg	0.9
Zn, mg/kg	55
DCAD, mEq/100 g	-15

[a]Samples assayed were a composite of samples collected once/week throughout the study.

Table 3. Effects of wet corn distiller's grains with solubles and non-protein nitrogen on growth performance by yearling steers

Item	Control	Wet corn distiller's grains with solubles, % of DM						SE	DG*U
		15%			30%				
		Dietary non-protein N, % of DM			Dietary non-protein N, % of DM				
		0	1.5	3.0	0	1.5	3.0		
Pens	8	8	8	8	8	8	8	-	-
Animals	75	75	75	75	75	75	75	-	-
Initial weight, lb[a]	822	824	821	821	820	822	821	28	-
Reimplant weight, lb[a]	1071	1059	1067	1075	1052	1055	1054	33	-
Shrunk, final weight, lb	1322	1316	1346	1317	1297	1294	1297	26	0.31
Adjusted final weight, lb[b,d]	1322	1302	1322	1318	1292	1290	1292	20	0.47
Day 1 to reimplant									
Days on feed	55	55	55	55	55	55	55	-	-
DMI, lb/d[c]	20.6	19.7	20.1	20.7	19.4	19.6	20.4	0.6	0.97
ADG, lb/d[c,d]	4.50	4.21	4.45	4.59	4.21	4.22	4.23	0.15	0.20
DMI:ADG[d,f]	4.59	4.68	4.54	4.52	4.63	4.67	4.87	0.14	0.02
Day 1 to slaughter									
Days on feed	129	129	129	129	129	129	129	-	-
DMI, lb/d[c]	21.49	20.87	21.55	21.65	20.84	20.83	21.52	0.57	0.55
ADG, live basis[d,e]	3.77	3.69	3.92	3.85	3.70	3.66	3.69	0.09	0.12
ADG, lb/d, adjusted basis[d]	5.70	5.67	5.50	5.62	5.63	5.69	5.85	0.08	0.06
DMI:ADG, adjusted basis[d,f]	3.88	3.69	3.86	3.84	3.65	3.63	3.63	0.09	0.37

[a]A pencil shrink of 4% was applied to actual weight.
[b]Calculated as (hot carcass weight ÷ (overall average dressing percentage of 64.22/100)).
[c]Linear urea effect ($P < 0.05$).
[d]15 vs 30% DG ($P < 0.03$).
[e]Quadratic effect of non-protein N within 15% wet corn distiller's grains ($P < 0.10$).
[f]Linear effect of non-protein N within 30% wet corn distiller's grains ($P < 0.10$).
[g,h]Means differ within 15% wet corn distiller's grains ($P < 0.10$).

Table 4. Effects of wet corn distiller's grains with solubles and non-protein nitrogen on carcass characteristics of yearling steers

		Wet corn distiller's grains with solubles, % of DM							
		15%			30%				
		Dietary non-protein N, % of DM			Dietary non-protein N, % of DM				
Item	Control	0	1.5	3.0	0	1.5	3.0	SE	DG*U
Pens	8	8	8	8	8	8	8	-	-
Animals	75	75	75	75	75	75	75	-	-
Dressing percent[a]	65.1	64.3	64.0	64.3	63.9	64.0	63.9	0.3	0.60
Hot carcass weight, lb[b]	849	836	849	846	829	828	829	13	0.47
Ribeye are, in^2	14.3	14.1	13.9	14.2	14.4	14.2	14.4	0.2	0.87
Average yield grade	2.77	2.75	2.86	2.83	2.63	2.67	3.06	0.20	0.53
Fat thickness, in	0.49	0.48	0.49	0.51	0.48	0.47	0.49	0.03	0.86
Marbling score[c]	400	387	405	402	395	400	393	11	0.66

[a]Control vs 15% DG ($P < 0.01$).
[b]15 vs 30% DG ($P < 0.01$).
[c]Small = 400 to 499, etc.

Table 5. Effects of wet corn distiller's grains with solubles and non-protein nitrogen on carcass quality and yield grade distributions

Item	Control	Wet corn distiller's grains with solubles, % of DM						DG×U
		15%			30%			
		Dietary NPN, % of DM			Dietary NPN, % of DM			
		0	1.5	3.0	0	1.5	3.0	
Pens	8	8	8	8	8	8	8	-
Animals	75	75	75	75	75	75	75	-
Yield grade, %								
1[a]	15.6	13.9	11.4	14.1	26.4	15.2	22.8	0.84
2	41.2	53.6	47.4	47.0	43.1	50.8	44.5	0.66
3	38.9	21.0	34.4	31.4	22.2	31.5	23.7	0.59
4 and 5	4.3	11.5	6.8	7.5	8.3	2.5	9.0	0.36
Quality grade, %								
> Choice-	11.5	4.2	9.2	11.8	9.0	14.7	10.5	0.44
Choice-[b]	33.9	36.4	42.0	36.8	35.1	30.2	28.9	0.67
Prime and Choice, %	45.4	40.6	51.2	48.6	44.1	44.9	39.4	0.50
Select	54.6	58.0	48.8	48.2	53.8	51.1	57.6	0.51
Standard	0	1.4	0	3.2	2.1	4.0	3.0	-

[a]15 vs 30% DG ($P < 0.02$).
[b]15 vs 30% DG ($P < 0.09$).

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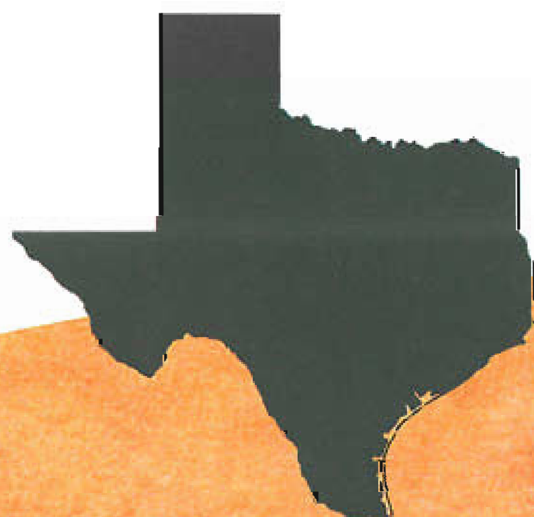

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Beef Cattle Research in Texas 2009-2010

The Texas beef cattle industry continues to remain strong and have a very important impact on the state economy and the lives of its citizens. As of January, 2010 there were 13.3 million cattle in Texas. There were approximately 145,000 Texas cattle producers accounting for 5.1 million beef cows and over 6 million stocker calves operating under widely varying environments and production systems across the state. There were close to 3 million cattle on feed in Texas feedlots on any given day, and packing plants in Texas with processing capacity of approximately 7 million cattle annually. Nationwide, Texas ranks first for numbers of total cattle and calves, beef cows, beef cattle operations, and fed cattle marketed. Texas produces approximately 30% of the beef consumed in the United States. Cash receipts for cattle and calves in Texas for 2010 were $7.4 billion.

Many state organizations such as Texas Department of Agriculture, Texas & Southwestern Cattle Raisers Association, Texas Cattle Feeders Association, Texas Farm Bureau, Texas Beef Council, Texas Animal Health Commission, and the Independent Cattlemen's Association of Texas are dedicated to helping Texas cattle producers deal with emerging production and policy issues, improve profitability and sustainability, and satisfy demands of beef consumers. We in academia as well as industry are fortunate and grateful for their support.

The publication highlights some of the recent projects conducted through Texas A&M AgriLife that can have direct impacts on the Texas beef cattle industry, and beyond. These efforts are due to many scientists, graduate students and staff that care deeply about the continued success and sustainability of the Texas and United States beef cattle industries.

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