

Performance of Finishing Steers Fed Low, Moderate and High Levels of Wet Distillers Grains

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Summary

Two experiments were conducted with yearling steers and heifers to evaluate feeding two forms of wet distillers grains (DGS) at 0, 20, 40 and 60% of diet DM. Modified (52% DM) wet distillers grains (DGS) was fed in the first experiment and wet DGS (32% DM) was fed in the second. In each experiment 4 pens of steers and 4 pens of heifers (6 head per pen) were fed each level of DGS with DGS replacing a portion of corn and protein supplement in a control diet containing dry rolled corn, corn silage, tub-ground grass hay and supplement. Steers and heifers were implanted at the beginning of each experiment with Component TE-S and Component TE-H, respectively. Feeding 20% or 40% of diet DM as modified or wet DGS did not affect performance or carcass measurements of steers or heifers. Steers and heifers fed 60% DGS consumed less feed, gained less and when fed modified DGS were less efficient. However when fed wet DGS both steers and heifers fed 60% DGS were more efficient than cattle not fed DGS. Numerical marbling scores declined with increasing levels of DGS, but were not statistically different from the control cattle. Carcass (\$/carcass) was less for cattle fed 60% DGS primarily because of reduced carcass weight. Economic analysis was done by comparing feed costs of gain at different prices for corn (\$2.00 to \$4.00/bu) and prices for DGS (1.0, 0.85 and 0.7 times the cost of corn on a dry basis). Feeding 20% or 40% modified or wet DGS reduced feed cost of gain compared with control cattle at all prices of corn and DGS. Feeding 60% modified DGS did not result in lower feed costs until price of DGS was 0.7 times the price of corn. Feed cost were less when feeding 60% wet DGS at all prices of corn and DGS. The results of these experiments indicate that steers and heifers respond similarly to feeding low to high levels of modified or wet DGS and that depending upon price, high levels of DGS can be economically fed to cattle.

Introduction

In several experiments, wet DGS was found to be an excellent feed to replace corn and protein supplement for finishing cattle. Wet DGS had the greatest economic value when fed at levels to satisfy the supplemental protein requirements of cattle, 20% or less of dry matter intake. At higher levels of inclusion the economic value of DGS was related to its energy content relative to corn grain and its effects on carcass value. With increased numbers of ethanol plants, production of ethanol has created an increased

demand for corn grain in competition with livestock. Though the value of DGS might decline when fed at high levels of inclusion, there is a price of DGS that would support feeding at high levels. The wet DGS fed in the early studies contained about 70% moisture. Since those experiments were conducted, several ethanol plants have changed processing of distillers grains by drying the wet grains and adding the condensed solubles with the dried grains to produce what is commonly termed modified wet DGS that contains about 50% moisture. Most of the experiments to evaluate DGS have been conducted with steers. In one study with heifers, the response to feeding wet DGS seemed to be similar to that reported with steers, but no experiments have been reported in which the response to wet DGS has been compared in steers and heifers. The objectives of this study were to evaluate feeding 20%, 40% and 60% of diet dry matter as wet DGS to steers and heifers. One experiment was done with modified wet DGS containing about 50% dry matter and a second experiment was conducted in which steers and heifers were fed wet DGS containing about 30% dry matter.

Materials and Methods

Yearling steers and heifers, predominantly Angus with a few red and Charolais cross cattle, weighing 830 and 730 lbs, respectively were purchased in September for the first experiment. Angus yearling steers and heifers weighing 810 and 710 lbs, respectively were purchased in May for the second experiment. After arrival at the research farm the cattle were placed in pens of six animals and fed a diet containing dry rolled corn, corn silage and chopped grass hay. About two weeks after arrival 96 steers and 96 heifers were allotted at random from outcome groups based on weight to 32 pens of six head for each experiment. Four pens of steers and four pens of heifers were assigned at random to each of the four dietary treatments (0, 20, 40 and 60% of diet DM as modified DGS for the first experiment and wet DGS for the second experiment). The starting and ending weight of each animal was the average of two weights taken early in the morning on two consecutive days prior to feeding but with access to water. The steers and heifers were implanted with Component TE-S and Component TE-H, respectively at the start of each experiment.

The cattle were fed the experimental diets shown in Table 1. The concentrate portion of the diet was prepared as a mix. The grain mixture, corn silage, tub-ground grass hay and wet DGS were weighed and mixed in a mixer wagon prior to delivery to the cattle. The cattle were fed twice per day and the amount of feed offered the cattle was gradually increased until their appetite was satisfied. Then they were

fed according to appetite. If the amount of feed consumed decreased, they were offered less feed and feed that accumulated in the bunks was removed and sampled for determination of dry matter. The mixed concentrate portion of the diet, corn silage and wet distillers grains were periodically sampled for chemical analysis. Average dry matter of the DGS was 52% and 32% in the first and second experiment, respectively. The cattle in the first experiment were started on feed in late September and those fed 0, 20 and 40% DGS were sold as a group after 120 days. The heifers and steers fed 60% DGS were fed an additional 49 days. The second experiment was started in early June and all the cattle were sold after feeding 140 days. Feed costs of gain were determined based on performance of the cattle and representative feed costs at the time the data were summarized (See footnote to Table 6.).

Daily gains of individual animals were calculated from beginning and ending weights and the average daily gain then calculated for each pen. Weights of hot carcasses were taken after slaughter, and measurements on the carcasses were obtained after a 24-hr postmortem chill. Trained personnel called marbling score, percentage of kidney, pelvic and heart fat (KPH), yield grade and measured ribeye area and fat thickness over the ribeye between the 12th and 13th ribs on the left side of each carcass. The value of each carcass was established by using a representative grid at the time the data were summarized (See footnote to Table 3).

Pen means were used as the experimental unit in the statistical analysis. Data were analyzed by analysis of variance. Main effects in the statistical analysis were diets. Differences were considered to be statistically significant at $P < .05$. Treatment means and probabilities of difference due to diet are presented.

Results and Discussion

The results of the first experiment are summarized in Tables 2 and 3. Gain of steers and heifers were not significantly affected by feeding 20 or 40% modified wet DGS. Both steers and heifers fed 60% DGS consumed less feed and therefore gained less. There were no differences in feed efficiency as the result of feeding 20 or 40% DGS compared with the control diet, but feeding 60% DGS resulted in poorer feed conversion. Feeding 20, 40 or 60% DGS (60% fed for an additional 49 days) had no effect on the carcass measurements made in this experiment or on final carcass value. The increase in carcass value of heifers fed 60% DGS was the result of more carcass weight. Carcass values, \$/lb, were: 1.571, 1.568, 1.565 & 1.459 for steers and 1.563, 1.558, 1.542 & 1.533 for heifers fed 0, 20, 40 and 60% modified DGS, respectively.

The results of the second experiment are summarized in Tables 4 and 5. Steers fed 60% wet DGS consumed less feed and tended to gain less, but were more efficient than steers fed 0 or 20% DGS. Heifers fed 40 or 60% DGS consumed less feed than heifers fed the control diet. Gain tended to be higher for heifers fed 20 or 40% DGS

compared with heifers fed 0 or 60% DGS. Heifers fed 60% DGS gained less than heifers fed 20% DGS. There were no significant differences in feed efficiency among the heifers fed the four diets. Carcass weights of steers and heifers fed 60% wet DGS were less than steers or heifers fed 0, 20 or 40% DGS. There were no differences among the diet groups in any of the carcass measurements. Carcass value was less for steers and heifers fed 60% DGS compared with steers or heifers fed 0, 20 or 40% DGS. The decrease in carcass value was primarily the result of less carcass weight. Carcass values, \$/lb, were: 1.546, 1.540, 1.539 & 1.522 for steers and 1.533, 1.538, 1.531 & 1.524 for heifers fed 0, 20, 40 and 60% wet DGS, respectively.

The economics of substituting wet DGS for corn and supplement relative to cost of corn and three prices for DGS were calculated for the cattle in these experiments. The results are summarized in Table 6 and Figures 1 and 2 for the first experiment in which modified DGS was fed and in Table 7 and Figure 3 and 4 for the second experiment in which wet DGS was fed. In the first experiment, total feed costs per animal were decreased by feeding 20 or 40% modified DGS compared with the control except when the DGS was priced equal to corn and when corn was priced at \$4.00/bu. Because the cattle fed 60% DGS were fed an additional 49 days, their feed costs were greater than the other groups at all price comparisons. Feed cost per lb gain was reduced by feeding 20 or 40% modified DGS at all prices of corn and DGS. Feed cost of gain of steers and heifers fed 60% was not less than the control unless DGS was priced at 0.70 times the cost of corn on a dry basis. In the second experiment total feed costs per animal were reduced by feeding all levels of wet DGS at all prices of corn and DGS for both steers and heifers. Also feed costs of gain were lower for both steers and heifers fed all levels and prices of wet DGS and prices of corn compared with the control diet without DGS.

There were no significant differences between steers and heifers in the response to feeding DGS. When fed 60% of diet DM as DGS, both steers and heifers consumed less feed, gained less and had reduced carcass value. However, if DGS was priced at 0.7 times the cost of corn on a dry basis both steers and heifers could be fed 60% of dry matter intake as modified or wet DGS. As expected across all diets, steers consumed more feed, gained more and were more efficient than heifers. In these two experiments in which steers and heifers were fed for the same number of days, steers had more marbling and a greater number of USDA Choice carcasses.

Implications

Up to 40% of the total feed intake of finishing steers or heifers can be derived from modified or wet distillers grains without affecting performance in the feedlot or carcass value. Feeding 60% of dry matter intake as modified or wet distillers grains reduces feed intake, rate of gain and carcass value. However if the distillers grains are priced at 0.7 times

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the cost of corn on a dry basis, feeding up to 60% distillers grains can be economically justified.

Acknowledgments

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Park, Kan.; and Vitamin A, DSM Nutritional Products, Inc., N.J. The assistance of Rod Berryman, research farm superintendent; Julie Roberts, Beef Center secretary; and the animal caretakers at the ISU Beef Nutrition and Management Research Center is appreciated.

Table 1. Formulated composition of diets (Dry basis).

Ingredient	Diets, % DGS			
	0	20	40	60
Dry rolled corn	80.31	63.88	44.09	24.01
Distillers grains ¹		20.00	40.00	60.00
Corn silage	10.00	10.00	10.00	10.00
Ground grass hay	4.00	4.00	4.00	4.00
Cane molasses	0.70	0.54	0.37	0.21
Soybean meal	2.00			
Urea	1.36	0.16		
Limestone	1.00	1.00	1.12	1.36
Sodium chloride	0.30	0.30	0.30	0.30
Vitamin A premix ²	0.08	0.08	0.08	0.08
Trace mineral premix	0.024	0.024	0.024	0.024
Rumensin premix ³	0.0195	0.0195	0.0195	0.0195

¹Modified wet distillers grains (52% DM) was fed in the first experiment and wet distillers grains (32% DM) in the second experiment.

²Provided 1,400 IU of vitamin A activity per pound of diet dry matter.

³Provided 15.6 mg sodium monensin per pound of dry matter.

Table 2. Performance of steers and heifers fed modified wet distillers grains (First experiment).

Item	Diet, % DGS				P ¹
	0	20.0	40.0	60.0	
Steers					
Beginning wt, lbs	833	833	832	836	0.669
Ending wt, lbs	1374 ^{ab}	1402 ^{ab}	1350 ^a	1440 ^b	0.023
Days fed	120	120	120	169	
Gain, lbs/d	4.51 ^a	4.74 ^a	4.32 ^a	3.57 ^b	0.001
Feed intake, lbs DM/d	24.3 ^{ab}	25.7 ^a	24.2 ^{ab}	23.2 ^b	0.029
Feed/gain	5.39 ^a	5.41 ^a	5.60 ^a	6.53 ^b	0.001
Heifers					
Beginning wt, lbs	727	726	725	725	0.850
Ending wt, lbs	1191 ^{ab}	1189 ^{ab}	1163 ^a	1230 ^b	0.026
Days fed	120	120	120	169	
Gain, lbs/d	3.87 ^a	3.86 ^a	3.65 ^a	2.99 ^b	0.001
Feed intake, lbs DM/d	22.6 ^{ab}	23.0 ^a	21.7 ^{ab}	20.5 ^b	0.003
Feed/gain	5.85 ^a	5.97 ^a	5.97 ^a	6.87 ^b	0.001

¹P is probability of a statistical difference.

^{ab}Differences between means that do not have a common superscript are statistically significant (P < .05).

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Table 3. Carcass measurements of steers and heifers fed modified wet distillers grains (First experiment).

Item	Diet, % DGS				P ¹
	0	20	40	60.0	
Steers					
Carcass wt, lbs	824.8	851.5	830.1	872.6	0.071
Dressing %	60.3	61.1	61.8	60.5	0.059
Back fat, in	0.42	0.44	0.45	0.50	0.175
Ribeye area, sq in	12.6 ^a	12.7 ^a	12.8 ^a	13.7 ^b	0.002
KPH, %	2.1	2.3	2.2	2.3	0.080
Marbling score ²	546	553	531	528	0.473
Avg yield grade	2.38	2.29	2.25	2.56	0.401
Quality grades					
Choice	9	6	6	3	
Choice -	12	16	14	13	
Select	3	2	4	7	
% USDA Choice	87.5	91.7	83.3	70.8	0.380
% USDA Choice or > ³	37.5	25.0	25.0	12.5	0.365
Yield grades					
1			2	3	
2	17	17	14	7	
3	6	7	8	10	
4	1			3	
Carcass value ⁴ , \$	1295.63	1334.81	1299.28	1273.08	0.292
Heifers					
Carcass wt, lbs	723.9 ^{ab}	731.3 ^{ab}	714.0 ^a	750.4 ^b	0.044
Dressing %	61.0	61.8	61.9	61.0	0.260
Back fat, in	0.39 ^a	0.42 ^a	0.42 ^a	0.55 ^b	0.002
Ribeye area, sq in	12.7	12.6	12.6	12.8	0.803
KPH, %	2.2	2.3	2.3	2.4	0.077
Marbling score ²	525	538	522	542	0.456
Avg yield grade	2.08 ^a	2.33 ^{ab}	2.33 ^{ab}	2.83 ^b	0.008
Quality grades					
Choice	4	2	1	3	
Choice -	15	20	18	19	
Select	5	2	5	2	
% USDA Choice	79.2	91.7	79.2	91.7	0.449
% USDA Choice or > ³	16.7	8.3	4.2	12.5	0.533
Yield grades					
1	4	1			
2	14	14	17	9	
3	6	9	6	11	
4				4	
Carcass value ⁴ , \$	1131.75	1139.60	1100.80	1150.08	0.136

¹P is probability of a statistical difference.

²Marbling score, 400 = Slight⁰, 500 = Small⁰, 600 = Moderate⁰.

³Moderate marbling or greater.

⁴Grid: \$154/Cwt for USDA Choice- YG 3; quality grade: Prime +\$19, CAB +\$5.46, Select -\$5.80; and yield grade: YG 1 +\$6.5, YG 2 +\$2.5, YG 4 -\$15.

^{ab}Differences between means that do not have a common superscript are statistically significant (P < .05).

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Table 4. Performance of steers and heifers fed wet distillers grains (Second experiment).

Item	Diet, % DGS				P ¹
	0	20.0	40.0	60.0	
Steers					
Beginning wt, lbs	810	813	813	813	0.755
Ending wt, lbs	1270	1252	1270	1234	0.088
Days fed	140	140	140	140	
Gain, lbs/d	3.28	3.14	3.26	3.01	0.097
Feed intake, lbs DM/d	21.8 ^a	21.0 ^a	20.5 ^a	18.4 ^b	0.001
Feed/gain	6.66 ^a	6.70 ^a	6.30 ^{ab}	6.12 ^b	0.008
Heifers					
Beginning wt, lbs	712	707	714	714	0.345
Ending wt, lbs	1115 ^{ab}	1151 ^a	1135 ^{ab}	1101 ^b	0.044
Days fed	140	140	140	140	
Gain, lbs/d	2.88 ^{ab}	3.17 ^a	3.01 ^{ab}	2.77 ^b	0.044
Feed intake, lbs DM/d	19.8 ^{ab}	20.6 ^a	19.3 ^b	17.7 ^c	0.001
Feed/gain	6.87	6.52	6.44	6.40	0.407

¹P is probability of a statistical difference.

^{abc}Differences between means that do not have a common superscript are statistically significant (P < .05).

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Table 5. Carcass measurements of steers and heifers fed wet distillers grains (Second experiment).

Item	Diet, % DGS				P ¹
	0	20	40	60.0	
Steers					
Carcass wt, lbs	764 ^{ab}	767 ^{ab}	775 ^a	743 ^b	0.030
Dressing %	60.2	61.2	61.0	60.2	0.201
Back fat, in	0.48	0.53	0.53	0.48	0.276
Ribeye area, sq in	13.0	13.0	12.9	12.8	0.962
KPH, %	2.2	2.1	2.2	2.2	0.087
Marbling score ²	537	530	522	496	0.206
Avg yield grade	2.29	2.46	2.54	2.38	0.310
Quality grades					
Choice	2	4	1		
Choice -	15	10	18	12	
Select	7	10	4	10	
			1	2	
% USDA Choice	70.8	58.3	79.2	50.0	0.438
% USDA Choice or > ³	8.3	16.7	4.2		0.259
Yield grades					
1	4	2		1	
2	9	9	11	14	
3	11	13	13	8	
4				1	
Carcass value ⁴ , \$	1181.14 ^{ab}	1180.66 ^{ab}	1192.66 ^a	1130.43 ^b	0.021
Heifers					
Carcass wt, lbs	682 ^{ab}	700 ^a	697 ^{ab}	664 ^b	0.040
Dressing %	61.1	60.8	61.4	60.2	0.144
Back fat, in	0.43	0.44	0.42	0.44	0.895
Ribeye area, sq in	12.7	13.2	12.8	12.7	0.674
KPH, %	2.1	2.0	2.1	2.1	0.147
Marbling score ²	480	484	484	459	0.732
Avg yield grade	1.96	1.92	2.12	2.21	0.320
Quality grades					
Choice	1			1	
Choice -	8	10	10	8	
Select	13	12	11	13	
Standard	2	2	2	2	
% USDA Choice	37.5	41.7	43.5	37.5	0.980
% USDA Choice or > ³	4.2			4.2	0.588
Yield grades					
1	6	9	4	2	
2	13	8	12	15	
3	5	7	7	7	
4					
Carcass value ⁴ , \$	1045.58 ^{ab}	1076.32 ^a	1066.64 ^{ab}	1011.84 ^b	0.030

¹P is probability of a statistical difference.

²Marbling score, 400 = Slight⁰, 500 = Small⁰, 600 = Moderate⁰.

³Moderate marbling or greater.

⁴Grid: \$154/Cwt for USDA Choice- YG 3; quality grade: Prime +\$19, CAB +\$5.46, Select -\$5.80; and yield grade: YG 1 +\$6.5, YG 2 +\$2.5, YG 4 -\$15.

^{ab}Differences between means that do not have a common superscript are statistically significant (P < .05).

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Table 6. Feed costs in relation to cost of corn and pricing of modified wet grains (First experiment).

Corn, \$/bu	Price DGS ¹	Diet, % DGS			
		0	20	40	60
		Feed cost (Steers/Heifers) ² , \$/head			
2.50	1.0	163.15/151.62	158.88/142.55	149.06/133.99	202.68/179.24
3.00		188.41/175.09	186.65/167.46	175.25/157.54	238.10/210.56
3.50		213.67/198.56	214.42/192.38	201.45/181.10	273.52/241.88
4.00		238.93/222.04	242.19/217.29	227.65/204.65	308.94/273.21
2.50	0.85	163.15/151.62	154.19/138.34	140.23/126.06	184.77/163.40
3.00		188.41/175.09	181.02/162.42	164.66/148.03	216.61/191.55
3.50		213.67/198.56	207.86/186.49	189.10/169.99	248.44/219.71
4.00		238.93/222.04	234.69/210.56	213.53/191.96	280.28/247.86
2.50	0.70	163.15/151.62	149.50/134.13	131.41/118.13	166.86/147.56
3.00		188.41/175.09	175.40/157.37	154.08/138.51	195.11/172.54
3.50		213.67/198.56	201.30/180.60	176.74/158.88	223.37/197.53
4.00		238.93/222.04	227.19/203.83	199.41/179.26	251.62/222.52

¹Price of distillers grains on a dry basis expressed as 1.0, 0.85 or 0.70 times the cost of corn (12% moisture) on a dry basis. Prices for wet DGS (52% DM) were \$52.76, \$63.31, \$73.86 and \$84.42 with corn priced at \$2.50, \$3.00, \$3.50 and \$4.00/bu, respectively.

²Feed costs other than corn and DGS were as follows: corn silage, 8 x cost corn (\$/bu) + 5; tub-ground hay, \$70/ton; soybean meal, \$300/ton; urea, \$375/ton; molasses, \$175/ton; minerals and other supplemental ingredients, \$400/ton.

Table 7. Feed costs in relation to cost of corn and pricing of wet grains (Second experiment).

Corn, \$/bu	Price DGS ¹	Diet, % DGS			
		0	20	40	60
		Feed cost (Steers/Heifers) ² , \$/head			
2.50	1.0	169.41/153.58	150.56/147.42	146.84/138.53	131.91/126.89
3.00		195.63/177.36	176.88/173.19	172.66/162.88	154.96/149.06
3.50		221.86/201.14	203.20/198.96	198.47/187.23	178.01/171.24
4.00		248.09/224.91	229.51/224.73	224.28/211.58	201.06/193.41
2.50	0.85	169.41/153.58	146.12/143.07	138.15/130.33	120.25/115.67
3.00		195.63/177.36	171.55/167.97	162.22/153.04	140.97/135.61
3.50		221.86/201.14	196.98/192.87	186.29/175.75	161.69/155.54
4.00		248.09/224.91	222.40/217.77	210.37/198.45	182.41/175.47
2.50	0.70	169.41/153.58	141.68/138.72	129.46/122.13	108.59/104.46
3.00		195.63/177.36	166.22/162.75	151.79/143.20	126.98/122.15
3.50		221.86/201.14	190.76/186.78	174.12/164.26	145.37/139.84
4.00		248.09/224.91	215.30/210.81	196.46/185.33	163.76/157.53

¹Price of distillers grains on a dry basis expressed as 1.0, 0.85 or 0.70 times the cost of corn (12% moisture) on a dry basis. Prices for wet DGS (33% DM) were \$23.44, \$28.12, \$32.81 and \$37.50 with corn priced at \$2.50, \$3.00, \$3.50 and \$4.00/bu, respectively.

²Feed costs other than corn and DGS are given in the footnote to Table 6.

Figure 1. Feed cost of gain for steers fed 0, 20, 40 or 60% modified wet distillers grains (First experiment). A, B and C for heifers fed DGS priced at 1, 0.85 and 0.70 X price of corn, respectively. Costs of feed ingredients are given in Table 6.

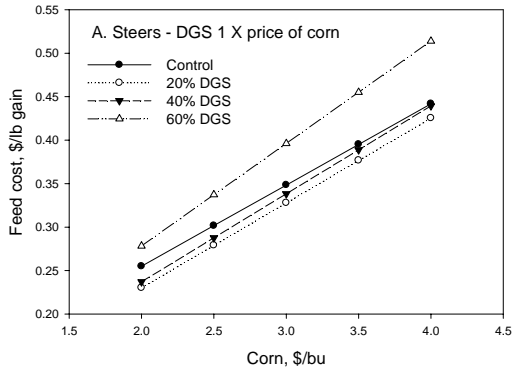


Figure 2. Feed cost of gain for heifers fed 0, 20, 40 or 60% modified wet distillers grains (First experiment). A, B and C for steers fed DGS priced at 1, 0.85 and 0.70 X price of corn, respectively. Costs of feed ingredients are given in Table 6.

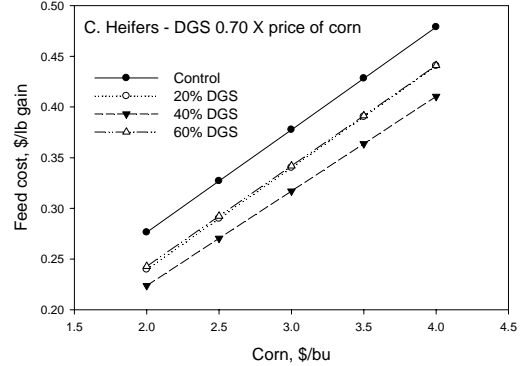
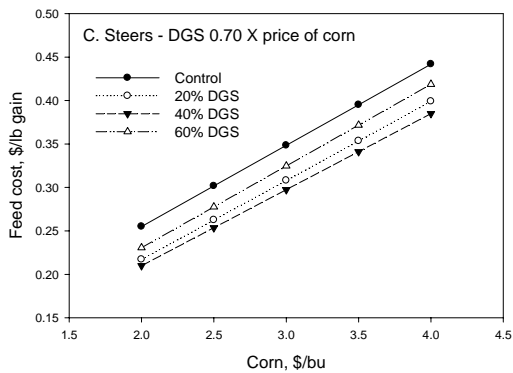
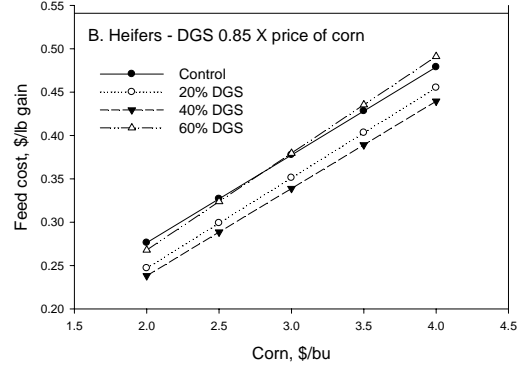
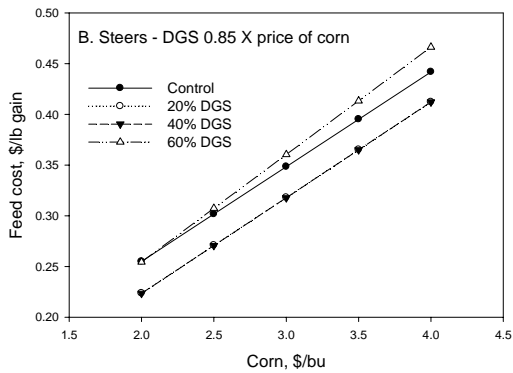
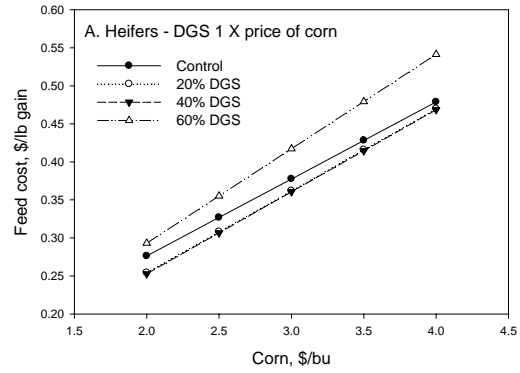


Figure 3. Feed cost of gain for steers fed 0, 20, 40 or 60% wet distillers grains (Second experiment). A, B and C for steers fed DGS priced at 1, 0.85 and 0.70 X price of corn, respectively. Costs of feed ingredients are given in Table 7.

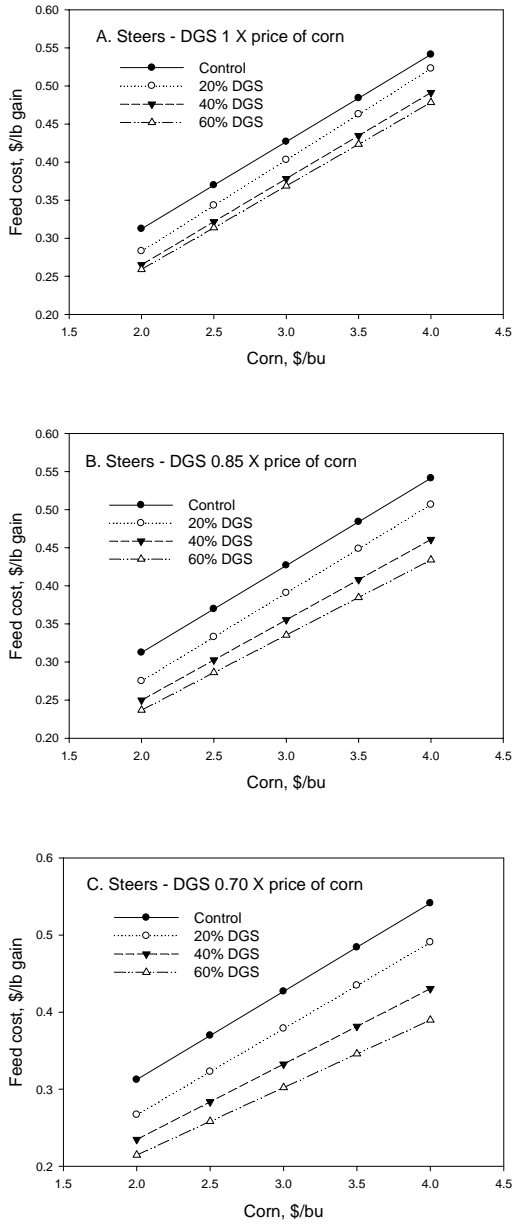


Figure 4. Feed cost of gain for heifers fed 0, 20, 40 or 60% wet distillers grains (Second experiment). A, B and C for steers fed DGS priced at 1, 0.85 and 0.70 X price of corn, respectively. Costs of feed ingredients are given in Table 7.

