OPTIMIZING THE USE OF DISTILLER GRAIN FOR DAIRY-BEEF PRODUCTION

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SUMMARY

Optimizing the use of distiller grain (**DG**) is becoming increasingly important as ethanol production increases. Dairy-beef production is a system that has the potential to use large amounts of DG. Three-hundred and twenty Holstein steers (420.7 ± 71.5 lbs initial wt.) were fed finishing diets at the University of Illinois Beef Research Unit. Forty pens were each randomly assigned to ten treatments with eight calves per pen. Ten dietary treatments of various DG levels were randomly assigned to 4 different pens. The calves were fed ad libitum and the cattle were weighed in 28-day intervals. After 112 days, both treatments 7 and 8 along with 9 and 10 were switched to represent the change from 20% to 37.5% and from 37.5% to 20% for both wet distiller grain (**WDG**) and dry distiller grain (**DDG**) (DM basis). Implants were administered twice during the course of the trial. Fecal samples were collected on a per pen basis, sub sampled, and then analyzed for nitrogen (**N**), phosphorus (**P**), and sulfur (**S**). Cattle were then weighed at 270 d and sent to Packerland (Green Bay, WI) to be harvested. Effects of dietary treatment were analyzed using the GLM procedure of SAS. Orthogonal contrasts were used for the control versus DG diets, DDG versus WDG, and diet change from 20 to 37.5% DG versus 37.5 to 20% DG (represented in treatments 7 through 10). Linear and quadratic contrasts were also used for the level of DDG and WDG.

Performance values for average daily gain (**ADG**), dry matter intake (**DMI**), and feed efficiency expressed in feed:gain (**F:G**) were evaluated for the growing period (112 d) and for the entire trial (270 d). Steers fed all treatments performed well and the use of DG showed the potential to improve profitability. Steers had a significant linear decrease in ADG with an increasing level of WDG diets (P=.0202) and steers which shifted from high DG to (37.5%) low DG (20%) had significantly lower ADG than steers switched from low DG (20%) to high DG (37.5%) (P=.0035). There was a significant quadratic effect on DMI with increasing WDG (P<.0001). Steers fed 25% WDG ate more DM than those fed 0% or 50% WDG. There was a linear increase in F:G as the level of DDG increased (P=.0266). Steers had a quadratic response in F:G with WDG levels (P=.0296). Steers fed 50% WDG were the most efficient (5.68 F:G). WDG diets were significantly more efficient when contrasted against DDG diets (P=.0009). There was a linear increase in both P and S levels in the feces with increasing DDG (P<.0001, <.0001) and a quadratic effect for WDG treatments (P=.0403, 0356). When harvested, steers fed DG had a higher dressing percent (**DP**) than control (P=.03). The most profitable diets were determined by the relative price of corn and DG. When DDG was priced at $110/ton and WDG $100 with $2.50/bushel corn, low levels (12.5-25%) tended to be most profitable. When DDG were priced at $90/ton and WDG at $80/ton with $2.50/bushel corn, the 25-37.5% diets tended to be most profitable.

INTRODUCTION

Corn distiller grain (**DG**) is a by-product of ethanol production. During alcohol production, starch is removed from the grain and converted to alcohol and carbon dioxide. As a result of the starch removal, the remaining nutrients in the grain is concentrated approximately threefold (Spiehs et al. 2002).

The demand for ethanol is increasing. This trend will result in an abundance of byproducts, like DG that are potential alternatives to corn (Lodge et al. 1997). Many are projecting a threefold increase of DG production within the next decade. Maximizing the value of DG will benefit both the ethanol industry and cattle producers alike. Dairy-beef producers have a plethora of protein and energy sources available to incorporate in their diets, and DG should be a competitive nutrient source.

There has been extensive research completed at the University of Illinois on the nutritional value of wet (**WDG**) and dry (**DDG**) distillers grains (Firkins et al. 1984 and Firkins et al. 1985) and on the nutritional requirements of dairy-beef steers (Hussein and Berger, 1995). Feeding DG in dairy-beef production can be valuable because of the higher protein requirement of the light calves. Research trials conducted at Illinois (Firkins et al. 1984), Nebraska (DeHaan et al. 1982), and Iowa State (Trenkel et al. 1981) demonstrated that DG protein has more than twice the bypass value (undegraded intake protein) compared to soybean meal (**SBM**).

The treatments, as shown in Table 1, were based on previous research with beef steers. Treatments 1 through 4 were selected based on a 1985 study by Firkins and co-workers where finishing steers fed 25 or 50% WDG gained faster and more efficiently than control steers receiving an 87% concentrate diet. When the energy value was expressed relative to corn, the 25 and 50% WDG had values of 103 and 122%, respectively. In addition, a 1986 Nebraska summary (Aines et al. 1986) of five different trials demonstrated that DG average 109% the energy of corn for finishing beef steers. By feeding a combination of DG and urea (Treatment 2), the diet should be equal to SBM by meeting the protein requirements of the growing dairy-beef steer. This combination of urea and DG will be much cheaper per unit of crude protein (**CP**) compared to SBM.

Depending on the protein concentration of the basal ingredients, the 25% DDG diet (Treatment 3) will meet and slightly exceed the protein requirements of growing steers. The high-energy value of the distillers, however, may cause the economics to favor feeding extra protein. This level of distillers may also reduce the risk of subclinical acidosis without reducing intake, which is especially important for dairy-beef steers that are often on high-energy diets for around 300 days.

The 50% DDG diet (Treatment 4) was selected since it serves as both a protein and energy source for dairy-beef steers. In a study conducted by Farlin (1981), diets as high as 64% WDG on a dry-matter (**DM**) basis were fed to finishing beef steers. Even though the dry matter intakes (**DMI**) were reduced by 11%, gains were similar and feed efficiency, expressed in feed:gain ratio (**F:G**) was improved 10% compared to control diet. University of Illinois research with early-weaned beef steers entering the feedlot at 300-350 lbs suggest that energy intake early in the feeding program can have a great effect on the marbling level at slaughter. Increasing the energy density of the diet by feeding high levels of DDG may stimulate marbling deposition earlier in the feeding period resulting in a higher quality grade (**QG**) (Wertz et al. 2001).

Treatments 3 through 6 compared the relative value of WDG and DDG at 25 or 50% of the diet for dairy-beef steers which are important for two reasons. First, it is cheaper and more energy efficient to produce WDG than DDG. Alcohol producers can then sell WDG for slightly less than DDG on an equal DM basis and still generate the same net revenue from the byproduct stream. At the same time, WDG diets may reduce DMI in cattle if the total moisture level is too high. Farlin (1981) demonstrated that including 64% WDG (DM basis) reduced DMI 11%. With young calves the DM level in the diet may have greater effects on intake than with the yearling steers in the Farlin trial. By including the WDG and DDG at two levels, we can answer the question whether DDG is more valuable then WDG at higher inclusion rates. Previous research shows that both WDG and DDG have similar nutritional value when fed at low levels in the diet (Firkins et al. 1984). Additionally, these comparisons are important in that transporting the water in WDG is expensive. For some plants having both DDG and WDG available is the best alternative. WDG could be used by local beef and dairy producers, while those further from the source may find the DDG to be more economical.

MATERIALS AND METHODS

Three-hundred and fifty Holstein steer calves were purchased and sent to the Beef Research Unit at the University of Illinois in August 2002. The steers were immediately put on a pelleted grain mix and long-hay diet, ear-tagged, dewormed, and vaccinated according to their available records. The steers were gradually adjusted to an 85% concentrate-15% corn silage diet by replacing the corn silage with whole corn. The diets were balanced to meet or exceed the 1996 NRC Nutrient Requirements of Beef Cattle. The calves were vaccinated against infectious bovine rhinotracheitis (**IBR**), parainfluenza, clostridia, malignant edema, Haemophilus somnus, and Pasterurella. The steers were weighed on September 4, 2002 preliminarily and checked for illnesses. Those suffering from shipping fever or pinkeye were treated accordingly.

The steers were weighed on September 18 and 19th on two consecutive days. The two initial weights were averaged to use as a starting weight (420.7 ± 71.5 lbs). Electronic Identification (E-IDs) tags were inserted in all steers. Thirty calves were culled based on health, performance, and weight to create the most uniform set to start the trial. Forty pens were randomly assigned to ten treatments with eight calves per pen. The building has an open front, south exposure, with concrete fenceline feed bunks and the pens (12 X 40 feet) were bedded with wood chips. Electric-heated waters were available in each pen and the area was cleaned on a regular basis. The management and health procedures were approved by the University of Illinois Department of Animal Resources.

Ten dietary treatments that were randomly assigned to 40 different pens. The treatments are based on University of Illinois research and are as described in Table 1. Three different supplements (Table 2) were formulated to proved mineral vitamins and feed additives.

The WDG and DDG grains were provided by Archer Daniels Midland (**ADM**) from their Peoria, Illinois plant. A sample of each dietary treatment along with both the WDG and DDG were sent to a commercial laboratory for analysis.

The cattle were weighed at 28-day intervals. At 56 days, the cattle had their horns blunted with a Barnes dehorner and were implanted with Component E-S Steer Implants from VetLife with Tylan (progesterone USP 200mg and estradiol benzoate 20mg with 29mg tylosin tartate for a local antibacterial). Cattle health was monitored on a daily basis and animals were treated accordingly. Three steers were removed from trial due to injury or chronic pneumonia. Also, orts were weighed back on a regular basis and subtracted from the amount fed.

After 112 days, both treatments 7 and 8 along with 9 and 10 were switched according to protocol at approximately 750 lbs. This diet change represents the change from 20% to 37.5% and from 37.5% to 20% for both WDG and DDG. In March, the steers received Ralgro-Magnum® implants (Schering-Plough Animal Health located in Union, NJ; dosage is72mg).

In April, pens were allowed to accumulate manure for 19 to 24 d. Fecal samples were collected on a per pen basis and sub sampled. Chemical analysis was completed at a commercial laboratory for nitrogen (**N**), phosphorus (**P**), and sulfur (**S**).

Cattle were weighed at 270 d and subsequently sent to Packerland (Green Bay, WI) to be harvested. The carcass data collected included hot carcass weight (**HCW**), ribeye area (**REA**) between the 12th and 13th rib via chromatography paper, backfat (**BF**) measured opposite of the loin, marbling scores (**MS**), and liver abscess scores (**LA**) were noted.

Statistical Analysis. Effects of dietary treatment were analyzed using the general linear model (**GLM**) procedure of SAS (1996, SAS Inst., Inc., Cary, NC) for a randomized complete block design. Pen was used as the experimental unit for performance parameters. Individual animal was used as the experimental unit for carcass data. Orthogonal contrasts were used for the control versus DG diets, DDG versus WDG, and diet change from 20 to 37.5% DG versus 37.5 to 20% DG (Treatments 7 through 10). Linear and quadratic contrasts were also used for the level of DDG and WDG.

RESULTS

Performance values for ADG, DMI, and F:G for steers during the growing period (112 d) are given in Table 3. There was a significant linear decrease (P=.0021) in ADG among the diets with increasing WDG in the diet (Treatments 5, 6, and 9). There were several significant differences found in DMI. A linear increase in DMI occurred with increasing DDG (P=.0106). Likewise, a linear decrease was observed with increasing WDG (P=.0254). Finally, the contrast of WDG vs. DDG diets was found to be significant (P=.0002); steers consuming DDG having higher DMI. Additionally, there was a linear increase in F:G among increasing DDG level in the diets (Treatments 1, 2, 3, 4, and 7) (P=.0096). F:G was significantly more efficient for WDG diets when contrasted to DDG diets (P=.0369).

Feedlot performance figures for the entire trial (270 d) based on carcass weight are given in Table 4. There was a significant linear decrease in ADG with increasing WDG levels (P=.0202). Steers that were switched from high DG (37.5%) to low DG (20%) (Treatments 7 and 9) versus treatments that change from low DG (20%) to high DG (37.5%) (Treatments 8 and 10) had significantly lower ADG (P=.0035). There was a significant quadratic effect on DMI with increasing WDG (P<.0001) caused by an increase between control and 25% WDG and decrease at 50% WDG (Figure 1). F:G increased linearly as DDG increased in the diets (P=.0266). There was a significant quadratic effect of WDG levels on F:G (P=.0296), shown in Figure 2, with no change in F:G from control to 25% WDG

(Treatment 5) and increase in efficiency (decrease in F:G) with 50% WDG (Treatment 6). WDG diets were significantly more efficient when contrasted against DDG diets (P=.0009).

Fecal samples were analyzed so that N, P, and S collected on a lbs/hd per d basis could be calculated (Table 5). There were no significant differences among the diets for N composition. However, there was a linear increase in P level with increasing DDG (P<.0001). In addition, there was a quadratic affect with P level among increasing WDG in diets (P=.0403) with a decrease from 25% WDG to 37.5% WDG and then increase in P level with 50% WDG diet (Figure 3). Manure P levels, were significantly lower for steers fed WDG than DDG diets (P=.0008). Manure S levels were increased by feeding DG (Treatments 1 vs. 2-10) (P=.0026). Additionally, there was a linear increase in S level due to increasing DDG level (P<.0001).

In general, carcass composition was not affected by diet (Table 6). There were significant increases in dressing percent (**DP**) with increasing levels of DG (P=.03). A quadratic effect on DP with DDG level (P=.0079) was found with an increase from control to 12.5% and decrease in DP at the 50% DDG level. There was a similar quadratic WDG response (P=.0031), with the highest DP at 37.5% WDG and decrease at 50% WDG. The quadratic contrasts for DP are shown in Figure 4. Also, with HCW, there was a significant quadratic affect with increasing WDG level (P=.0095) with a decrease at 50% WDG. There were no significant differences among MS, LEA, or YG (P>.05). Here again, there was a quadratic affect on BF due to increasing levels of WDG (P=.0360), with a linear increase from 25-37.5% WDG and decrease to 50% WDG (Figure 5).

As part of the economic evaluation, profits per head were calculated at four different price intervals: $110/ton DDG and $100/ton WDG; $90/ton DDG and $80/ton WDG at either $2.50 or $2.00 per bushel corn. These values are reported in Table 7 and 8, respectfully. As shown in Figure 6 ($110/ton DDG and $100/ton WDG with $2.50/bushel corn), there were quadratic effects with both DDG and WDG level in profits per head with a linear increase from 25-37.5% DG and then decrease with 50% DDG and WDG, respectfully (P=.0216, .0206). When the profits were calculated at $90/ton DDG and $80/ton WDG there were more significant differences (Table 7). First, there was a significant increase in net profit per head with the DG diets vs. control (P=.0084). Second, there was a significant quadratic affect on profit with increasing DDG level (P=.0336) and a decrease at 50% DDG as shown in Figure 7. Additionally for the $90/ton DDG and $80/ton WDG cost analysis, diets consisting of WDG were significantly more profitable than DDG diets (P=.0336). There were no statistically significant differences in profitability with diets switching from 37.5-20% DG or 20-37.5% at 750 lbs (Treatments 7 through 10).

Profits calculated with similar DDG and WDG prices but with $2.00/bushel corn had similar results (Table 8). When figured with $110/ton DDG and $100/ton WDG, there was a significant linear decrease in profit with increasing DDG level in the diet (P=.0093). As shown in Figure 8 ($110/ton DDG and $100/ton WDG with $2.00/bushel corn), there were quadratic effects with both DDG and WDG level in profits per head with a linear increase from 25-37.5% DG and then decrease with 50% DDG and WDG, respectfully (P=.0262, .0446). When the profits were calculated at $90/ton DDG and $80/ton WDG, there were similar quadratic effects as shown in Figure 9 (P=.0134, .0134).

DISCUSSION

There was a quadratic effect of WDG (P=.0017) on DMI which dropped at the 50% WDG level (Treatment 6). Significant differences in DMI among the DDG and WDG diets are as shown in Table 4. The DDG diets possess higher means indicating that perhaps the WDG were less palatable due to the high moisture level in diet. Next, there is a linear increase in ADG with increasing WDG (Treatments 1, 5, and 6) as shown in Table 4 (P=.0202). Additionally, cattle fed lower levels of protein during the growing phase and then switched at 750 lbs. to higher levels (20-37.5% vs. 37.5-20%) had slightly higher ADG (P=.0035). This may result from reduce sub-clinical acidosis. There was also a linear increase in F:G with increasing level of DDG in diets (P=.0266). This is in contrast to previous trials where DDG had more energy than corn. There was quadratic affect on F:G in WDG diets indicating that there was an increase from control to 25% WDG and then decrease in F:G when evaluated at 50% (Figure 2). Feed efficiency was poorer for steers fed the DDG compared to the WDG. This has been reported in previous studies and probably results from the drying process slowing fiber digestion.

During the finishing period, fecal samples were evaluated for their nutrient profile (Table 5). There were no significant differences among N level (P >.05). When comparing the control diet to the DG diets (Treatments 2-10), there was a significantly higher level of S. Among increasing DDG diets, there was a linear increase in both P and S excretion (P<.0001) on a lbs/ d per head basis. In contrast, the WDG diets had a quadratic affect (Figure 4) in that the 50% WDG diet had decreased P and S concentrations in the feces compared to feces from steers on the 25% WDG diet. There is no clear explanation for this difference. Also, with P only, there were higher fecal levels with DDG diets than WDG (P=.0008). Cattle feeders need to adjust their manure application rates to reflect the high P concentration in the feces from steers fed high levels of DG.

There were few statistically significant differences among the carcass composition characteristics demonstrated in Table 6. These data are important because cattle feeders selling on a grid can be assured that DG additions will not affect carcass values.

In studying the profitability on a dollars/head basis, values were calculated with both $2.00 and $2.50/bushel corn for DG purchase prices of $110 DDG and $100 WDG; $90 DDG and $80 WDG . Profits were calculated with corn priced at $2.50 per bushel as that represented our average corn price delivered to the bunk during this trial. With the more expensive DG price, the least profitable diet on a net per head basis was Treatment 4 (50% DDG) with $8.13 as shown on Table 7. There was a quadratic affect with both DDG and WDG (P=.0216, 0206) and demonstrated in Figure 6. This indicates that there was a decrease in net profit with 50% DDG and WDG. With the $90 DDG, this quadratic affect was also noted for both DDG and WDG (P=.0336, .0153). Currently DG are available at cheaper prices than these in some localities, which would favor feeding the DG at the higher levels, There were no differences in profitability for high to low DG level (37.5-20%) vs. low to high DG level (20-37.5%).

Similar calculations were performed for corn at $2.00 per bushel. With both price intervals, the least profitable diet on a net per head basis was also Treatment 4 (50% DDG) with profits of $24.29 and $49.95, respectfully as shown on Table 8. When DG was purchased at $110/ton DDG and $100/ton WDG, there was a linear decrease with increasing levels of DDG and WDG (P=.0093, .0402). Again with the more expensive DG, there were also a significant quadratic effect among increasing levels of DDG and WDG with a decrease at 50% DG (P=.0262, .0446) and exhibited in Figure 8. Here again, this indicates that there was a decrease in net profit with 50% DDG and WDG. With the $90/ton DDG and $80/ton WDG, this quadratic effect was also significant for both DDG and WDG (P=.0134, .0134) and is shown in Figure 9. These data suggest that the 50% DG diets would be the most profitable only when DG are available at a price lower than corn on a dollars per ton basis.

IMPLICATIONS

Using recent prices, additions of DDG or WDG at moderate levels (12.5%-37.5%), can improve profitability for a dairy-beef operation. Feeding up to 50% DG, can decrease performance but may be profitable if DG is purchased at a low enough price. There were no differences between switching at 750 lbs from 20 to 37.5% or from 37.5 to 20%. WDG vs. DDG are less palatable, particularly when fed at the high level of 50%. At harvest, there are little differences in overall carcass composition when corn is replaced with DG. This is critical to producers selling cattle on a grid. Additionally, as the level of DG increased so did the level of P and S in the feces. This should be considered in dealing with environmental regulations and manure application rate. Dairy-beef steers should be fed DG at 12.5-37.5% of the diet for optimum performance, carcass composition and profit margins without having high levels of P and S in the feces.

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Table 1. Dietary treatments fed to dairy-beef steers

Trmt	Diet
1	Whole corn-corn silage diet with a soybean meal based supplement to 14% CP
2	Whole corn-corn silage diet with 12.5% dry distillers and urea to 14% CP
3	Whole corn-corn silage diet with 25% dry distillers (14-15% CP)
4	Whole corn-corn silage diet with 50% dry distillers
5	Whole corn-corn silage diet with 25% wet distillers
6	Whole corn-corn silage diet with 50% wet distillers
7	Whole corn-corn silage diet with 37.5% dry distillers to 750 lbs then 20% to harvest
8	Whole corn-corn silage diet with 20% dry distiller to 750 lbs then 37.5% to harvest
9	Whole corn-corn silage diet with 37.5% wet distillers to 750 lbs then 20% to harvest
10	Whole corn-corn silage diet with 20% wet distillers to 750 lbs then 37.5% to harvest

Table 2. Composition of Supplements used in diets 1-10.

Ingredient	Supp. A[a]	Supp. B[b]	Supp. C[c]
SBM	77.960	0.000	0.000
Ground Corn	0.000	77.840	79.910
Urea	6.550	6.670	3.300
Dical	0.810	0.000	0.000
Limestone	10.300	11.380	11.300
TM Salt & Se	2.000	2.000	2.000
Liq. Fat	2.000	2.000	2.000
ADE	0.100	0.100	0.100
Copper sulfate	0.050	0.050	0.050
Zinc Methione	0.150	0.150	0.150
Rumensin	0.125	0.125	0.125
Tylan	0.065	0.065	0.065

[a] Used in diet 1

[b] Used in diet 2

[c] Used in diet 3-10

Table 3. Feedlot performance during for the growing phase for dairy-beef steers fed various levels of distiller grains (DG).

Trmt	ADG	DMI	F:G
1	3.65	16.26	4.46
2	3.74	16.44	4.40
3	3.61	16.60	4.60
4	3.53	17.34	4.92
5	3.66	16.50	4.51
6	3.29	15.19	4.62
7	3.72	17.69	4.77
8	3.57	16.72	4.69
9	3.48	15.91	4.58
10	3.67	15.94	4.36

Contrast	ADG	DMI	F:G
Control vs. DG (1 vs. average 2-10)	0.4524	0.5958	0.3590
Linear DDG (1,2,3,4,7)	0.3181	0.0106	0.0096
Quadratic DDG (1,2,3,4,7)	0.2808	0.9214	0.4796
Linear WDG (5,6,9)	0.0021	0.0254	0.6160
Quadratic WDG (5,6,9)	0.9585	0.8842	0.9339
WDG vs. DDG (average WDG vs. average DDG)	0.1359	0.0002	0.0369

Table 4. Feedlot performance for dairy-beef steers fed various levels of distiller grains.

Trmt	ADG	DMI	F:G
1	3.09	17.75	5.93
2	3.20	18.85	6.08
3	3.14	19.47	6.21
4	3.06	19.01	6.21
5	3.15	18.70	5.94
6	2.95	16.76	5.68
7	3.24	19.82	6.13
8	3.07	19.32	6.30
9	3.06	17.82	5.83
10	3.15	18.22	5.80

Contrast	ADG	DMI	F:G
Control vs. DG (1 vs. average 2-10)	0.7955	0.1430	0.1728
Linear DDG (1, 3, 4)	0.3649	0.0923	0.0266
Quadratic DDG (1,3,4)	1.0000	0.1709	0.1706
Linear WDG (1, 5, 6)	0.0202	0.0583	0.6178
Quadratic WDG (1, 5, 6)	0.0554	0.0017	0.0296
WDG vs. DDG (average WDG vs. average DDG)	0.1281	<.0001	0.0009
20-37.5% vs. 37.5-20% (average 7 & 9 vs. average 8 & 10)	0.0035	0.2365	0.4640

Figure 1. Quadratic effect on wet distillers grain (WDG) level on dry matter intake (DMI)

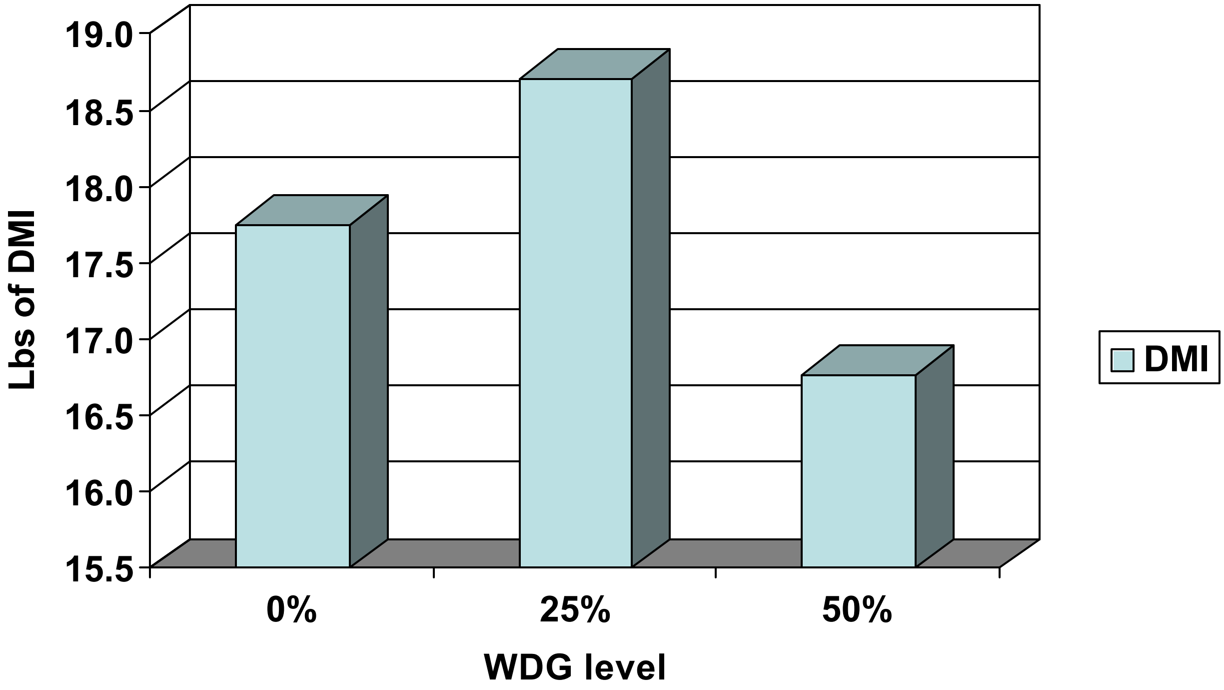

Figure 2. Quadratic effect on feed efficiency (feed:gain) due to increasing wet distiller grain (WDG) level

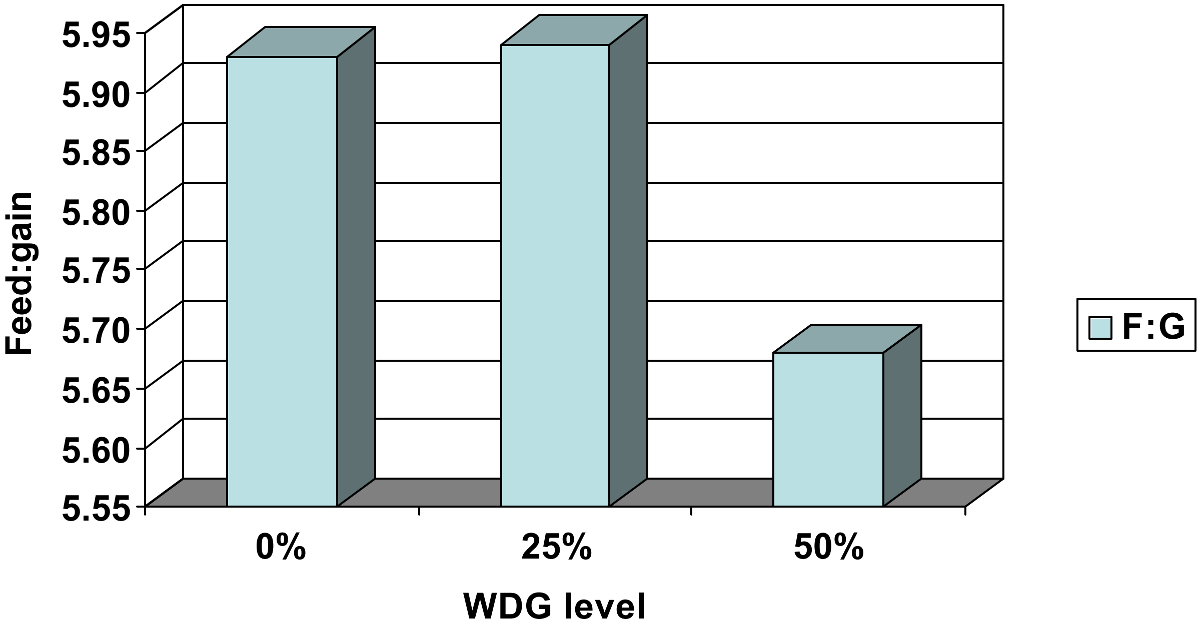

Table 5. Nutrient analysis of fecal samples for dairy-beef steers fed various levels of distiller grains.

Trmt[a]	N lbs/d[b]	P lbs/d[b]	S lbs/d[b]
1	0.1918	0.1304	0.0756
2	0.1747	0.1088	0.0813
3	0.2119	0.1511	0.1118
4	0.1971	0.1973	0.1655
5	0.2321	0.1473	0.1367
6	0.2481	0.1514	0.1591
7	0.1724	0.1238	0.0940
8	0.2190	0.1970	0.1664
9	0.1963	0.1102	0.0982
10	0.1938	0.1087	0.1108

[a] Fecal samples during finishing period
[b] Pounds per head per day basis

Contrast	N lbs/d	P lbs/d	S lbs/d
Control vs. Distillers (1 vs. 2-10)	0.5447	0.4259	0.0026
Linear Dry Distillers (1,2,3,4,7)	0.3712	<.0001	<.0001
Quadratic Dry Distillers (1,2,3,4,7)	0.5779	0.3936	0.8287
Linear Wet Distillers (5,6,9)	0.5326	0.8387	0.2119
Quadratic Wet Distillers (5,6,9)	0.0673	0.0403	0.0356
Wet vs. Dry Distillers (3,4,7,8 vs. 5,6,9,10)	0.1884	0.0008	0.3683

Figure 3. Quadratic effect on phosphorus (P) and sulfur (S) excretion for steers fed various wet distiller grain (WDG) levels

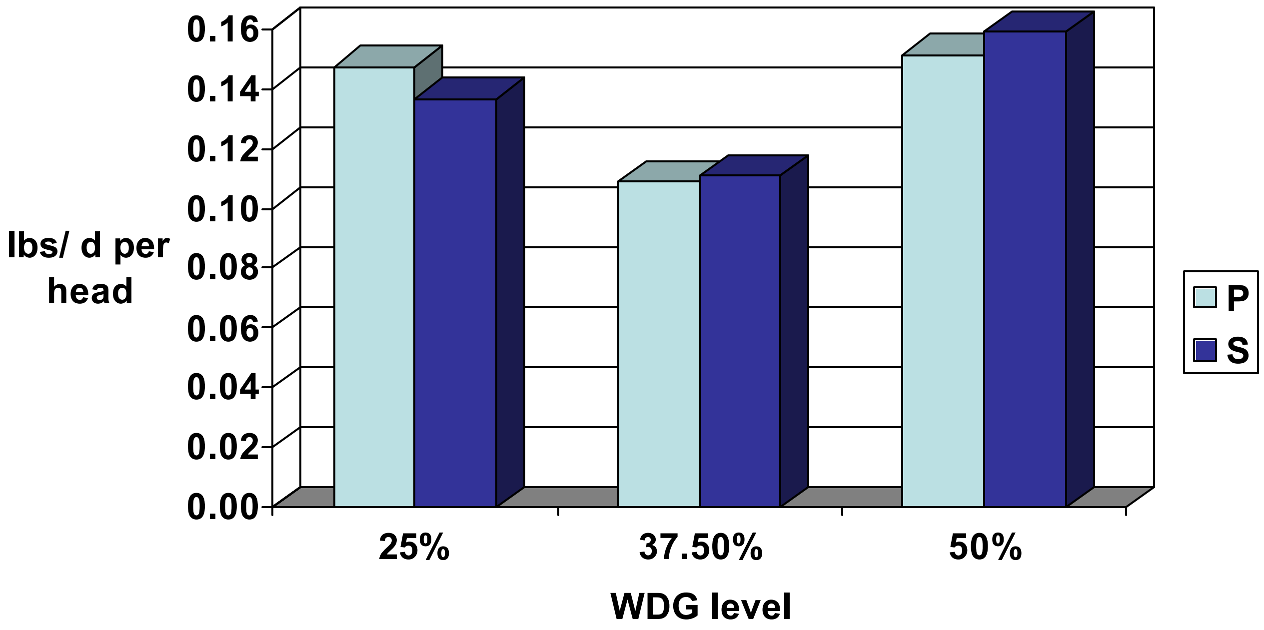

Table 6. Carcass composition for dairy-beef steers fed various levels of distiller grains.

Trmt	DP	HCW, lbs	MS[a]	LEA, sq. in	BF, in.	YG
1	60.20	725.59	559.69	11.26	0.23	2.62
2	61.32	759.29	557.74	12.00	0.27	2.61
3	61.09	745.65	565.41	11.39	0.22	2.63
4	59.75	715.63	525.31	11.05	0.19	2.56
5	61.53	751.27	560.63	11.47	0.25	2.72
6	60.43	706.52	520.65	11.18	0.19	2.51
7	61.14	758.48	542.50	11.23	0.26	2.82
8	60.82	728.47	559.06	11.54	0.21	2.50
9	60.67	725.91	523.13	11.73	0.19	2.38
10	61.95	752.84	531.94	11.66	0.23	2.61

[a] 400=Select 500=Low Choice 600=Average Choice

Contrast	DP	HCW	MS	LEA	BF	YG
Control vs. Distillers (1 vs. 2-10)	0.0300	0.2783	0.3201	0.3715	0.7401	0.7388
Linear Dry Distillers (1 vs. 3-4)	0.3333	0.5215	0.1279	0.5011	0.1323	0.6170
Quadratic Dry Distillers (1 vs. 3-4)	0.0079	0.0747	0.2460	0.4270	0.8336	0.7555
Linear Wet Distillers (1 vs. 5-6)	0.6296	0.2240	0.0864	0.7941	0.1323	0.3624
Quadratic Wet Distillers (1 vs. 5-6)	0.0031	0.0095	0.2962	0.3545	0.0360	0.1562
Wet vs. Dry Distillers (3,4,7,8 vs. 5,6,9,10)	0.0595	0.7204	0.2167	0.1806	0.9270	0.2481
20-37.5% vs. 37.5-20% (7,9 vs. 8,10)	0.1522	0.8895	0.4281	0.5818	0.9019	0.6000

Figure 4. Quadratic effect on dressing percent due to the dry (DDG) and wet (WDG) distiller grain level in the diet.

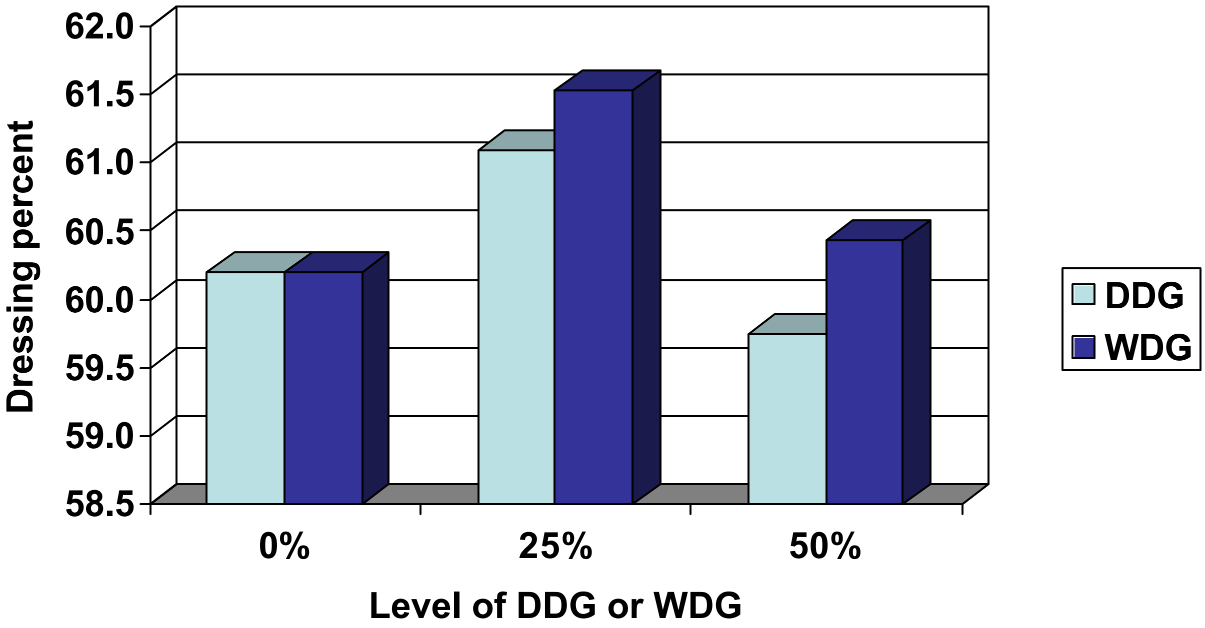

Figure 5. Quadratic effect on backfat (BF) die to level of wet distiller grain (WDG) in the diet

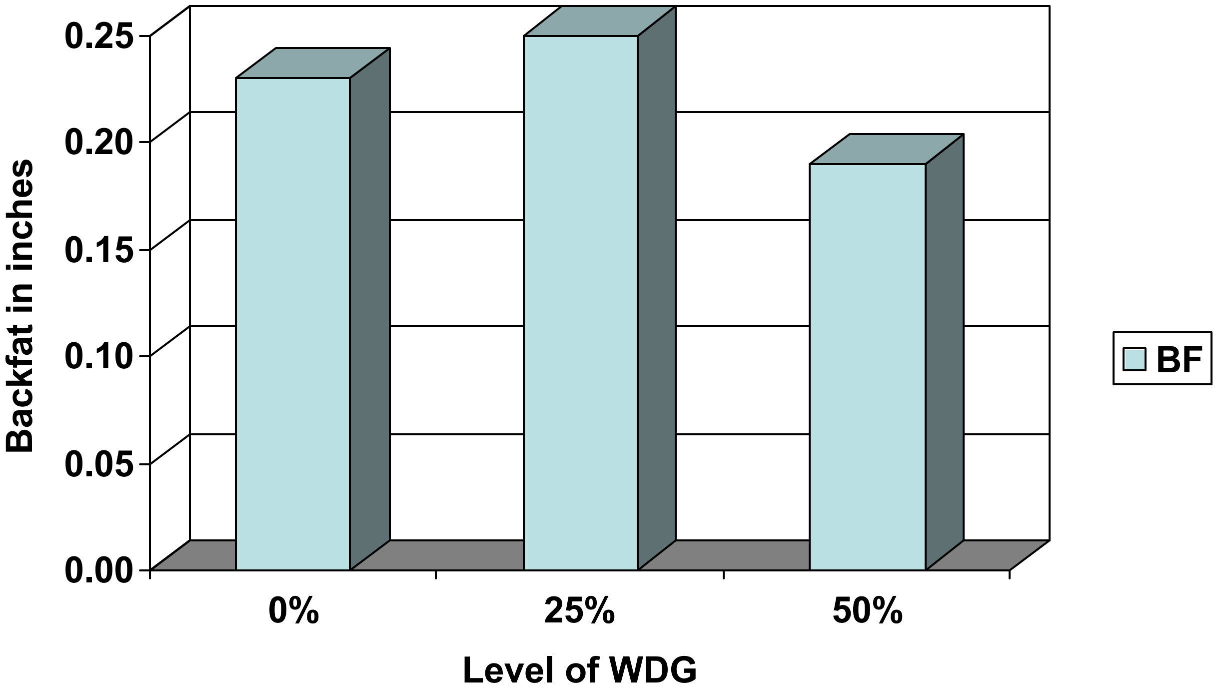

Table 7. Profit per head with purchase price of $110 and $90 per ton of dry distillers grain (DDG) and $100 and $80 per ton wet distillers grain (WDG), and corn at $2.50 per bushel.

	Net Profit	
Trmt	$110 DDG $100 WDG	$90 DDG $80 WDG
1	28.49	28.49
2	71.01	77.29
3	57.09	70.09
4	8.13	35.07
5	72.92	93.12
6	33.05	69.25
7	62.72	77.81
8	30.87	47.33
9	43.59	65.38
10	72.80	97.25

	Net Profit	
Contrasts	$110 DDG	$90 DDG
Control vs. Distillers (1 vs. 2-10)	0.1564	0.0084
Linear Dry Distillers (1 vs. 3-4)	0.3187	0.7428
Quadratic Dry Distillers (1 vs. 3-4)	0.0216	0.0336
Linear Wet Distillers (1 vs. 5-6)	0.8221	0.0489
Quadratic Wet Distillers (1 vs. 5-6)	0.0206	0.0153
Wet vs. Dry Distillers (3,4,7,8 vs. 5,6,9,10)	0.1251	0.0236
20-37.5% vs. 37.5-20% (7,9 vs. 8,10)	0.9264	0.9607

Figure 6. Quadratic effect of dry (DDG) and wet (WDG) distiller grain level on profitability per head with the cost of $110/ton DDG, $100/ton WDG, and $2.50 corn per bushel.

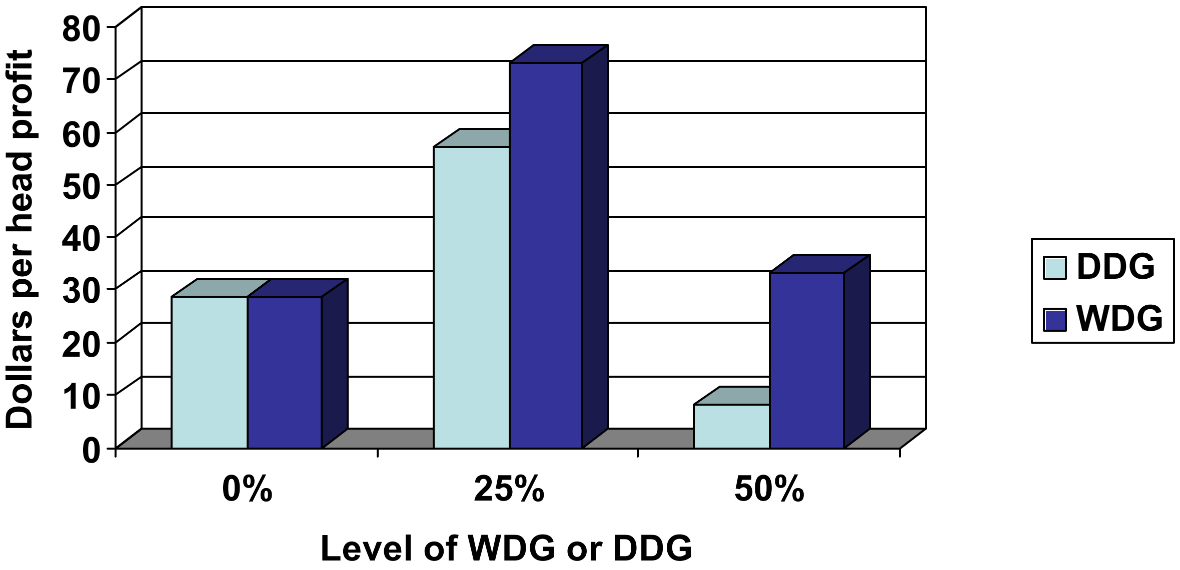

Figure 7. Quadratic effect of dry (DDG) and wet (WDG) distiller grain level on profit with $90/ton DDG, $80/ton WDG, and $2.50/bushel corn.

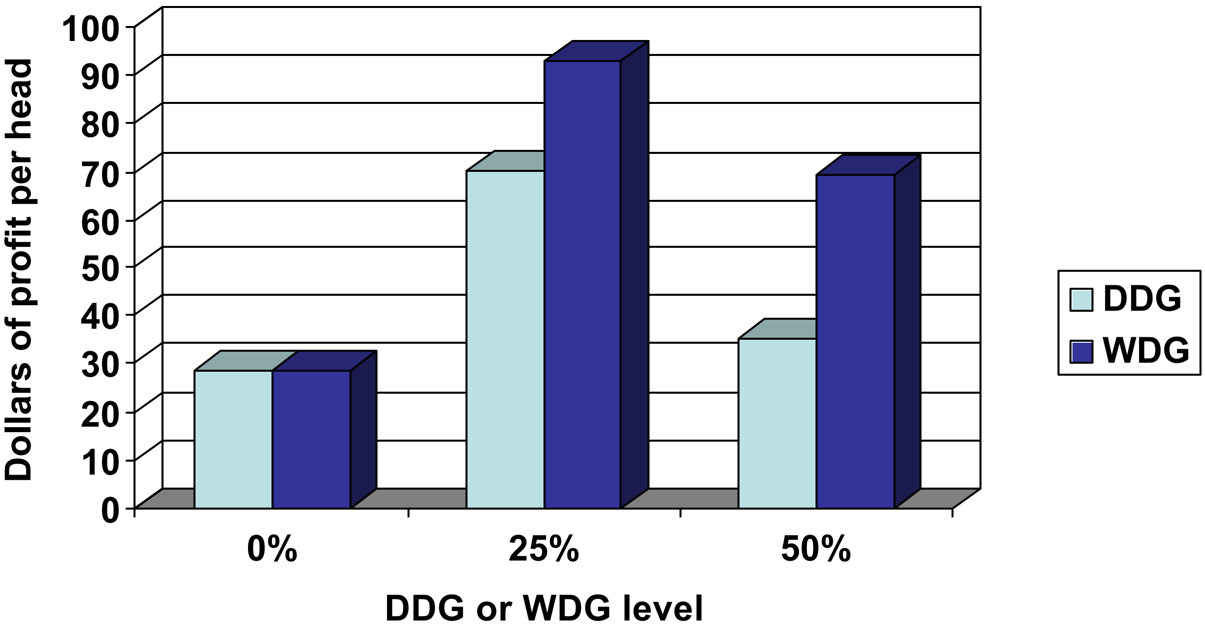

Table 8. Profits per head with purchase price of $110 and $90 per ton of dry distillers grain (DDG) and $100 and $80 per ton wet distillers grain (WDG), and corn at $2.00 per bushel.

	Profit	
Trmt	$110 DDG $100 WDG	$90 DDG $80 WDG
1	78.49	78.49
2	113.93	120.21
3	90.88	103.87
4	24.29	49.95
5	92.97	120.39
6	36.67	72.87
7	95.97	110.04
8	59.89	76.01
9	68.03	86.25
10	92.58	117.41

	Profit	
Contrasts	$110 DDG $100 WDG	$90 DDG $80 WDG
Control vs. Distillers (1 vs. average 2-10)	0.8136	0.2618
Linear Dry Distillers (1, 3, 4)	0.0093	0.1566
Quadratic Dry Distillers (1, 3, 4)	0.0262	0.0134
Linear Wet Distillers (1, 5, 6)	0.0402	0.7769
Quadratic Wet Distillers (1, 5, 6)	0.0446	0.0134
WDG vs. DDG(average WDG vs. average DDG)	0.6257	0.1568
20-37.5% vs. 37.5-20% (average 7 & 9 vs. average 8 &10)	0.6790	0.9182

Figure 8. Quadratic effect of dry (DDG) and wet (WDG) distiller grain level on profit per head with $110/ton DDG, $100 WDG, and $2.00/bushel corn.

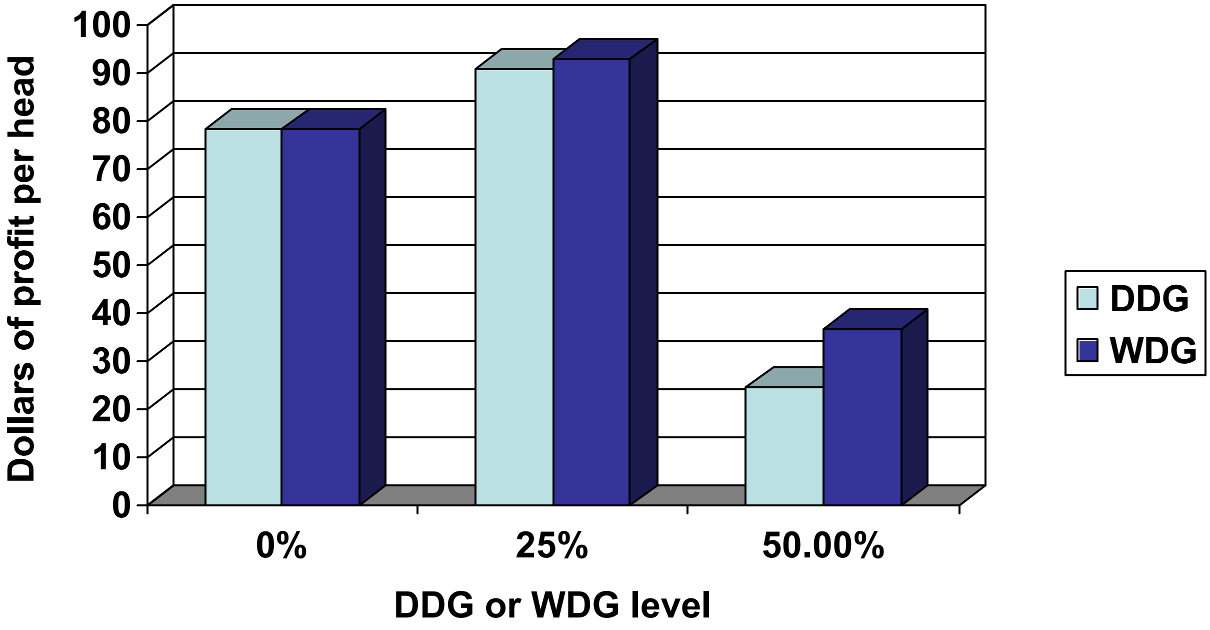

Figure 9. Quadratic effect of dry (DDG) and wet (WDG) distiller grain level on profit with $90/ton DDG, $80/ton WDG, and $2.00/bushel corn.