BEEF CATTLE RESEARCH UPDATE

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Relationship between Fat Content and Energy Content of Ethanol Feed By-Products

Wet distillers grains plus solubles (WDGS) is produced by combining the distillers grains and distillers solubles fractions of ethanol production. The amount of these components in WDGS can vary from plant to plant, changing the fat content of the final product. Distillers solubles are higher in fat content (15 to 24%) than distiller's grains (9 to 12%).[1] In addition, the fat content of WDGS can also be reduced as ethanol plants evaluate methods to recover oil as a separate by-product from the overall process. Recent studies have evaluated how the changing fat content of ethanol feed by-products impacts dietary net energy (NE) levels and feedlot performance.

South Dakota State University research evaluated the use of three ethanol feed by-products with varying crude fat content fed to yearling steers for 130 days.[2] The by-products included a commercially available corn gluten feed distillers blend (CGD), wet corn distillers grains without solubles (WDG), and WDGS. The finishing diets were formulated to contain 8.5% roughage and a 1:1 ratio of dry-rolled corn and high-moisture corn (dry matter, DM basis). By-products were included at 40% of the diet, replacing corn and a protein supplement in the control diet. The assayed fat content of the by-products (DM basis) were 8.2, 8.9, and 12.2% for CGD, WDG, and WDGS, respectively. The average dietary fat content for the control, CGD, WDG, and WDGS diets were 2.91, 4.95, 5.34 and 6.58%, respectively.

These researchers reported that increasing dietary fat content caused linear improvements (Table 1, P < .01) in final weight, average daily gain (ADG), DM intake (DMI), and feed efficiency (F:G). Most of this response was due to the WDGS treatment. Generally, carcass differences were small and consistent with increased DMI and growth rate (Table 1). Dressing percentage and hot carcass weight (HCW) increased linearly (P < 0.01) with increasing dietary fat.

Table 1. Effect of corn gluten feed distillers grain blend (CGD), wet distillers grains (WDG), and wet distillers grains plus solubles (WDGS) on feedlot performance and carcass characteristics.

Item	Control	CDG	WDG	WDGS	P-value Linear
Dietary fat, %	2.91	4.95	5.34	6.58	
Performance:					
Initial weight, lb	851	851	852	854	
Final weight, lb[a]	1333	1343	1347	1394	0.001
ADG, lb	3.71	3.79	3.82	4.16	0.002
DMI, lb	23.36	24.14	23.49	24.38	0.005
F:G	6.30	6.39	6.16	5.87	0.019
Carcass Characteristics:					
Dressing percentage	62.25	62.42	62.56	62.75	0.010
HCW, lb	833	839	843	871	0.001
12th rib fat, in.	0.50	0.52	0.54	0.55	0.125
Rib eye area, in^2	12.74	12.48	12.47	12.90	NS
Marbling[b]	569	578	533	572	0.1101

[a]Calculated from hot carcass weight, adjusted to 62.5% yield.
[b]Marbling: 400 = slight; 500 = small.
Source: Pritchard et al., 2012.

Dietary NE values were calculated based on actual steer performance (Table 2). The NE values increased linearly across diets. The CGD diet contained 2% more fat than the control diet and only 0.4% less fat than the WDG diet, but had a net energy for growth value (NEg) that ranked numerically lower than the control diet. In contrast, the NEg value of the WDG diet was intermediate to the values for the control and WDGS diets. The authors suggested that this indicates that the NE contents of the CGD diet were driven by feed components other than fat.

Table 2. Performance based calculations of diet and by-product NE values.

Item	Control	CDG	WDG	WDGS	P-value Linear
Diet					
NEm, Mcal/cwt	90.42	89.13	91.78	94.88	0.017
NEg, Mcal/cwt	60.56	59.65	61.99	64.56	0.014
By-product NEg, Mcal/cwt[a]		65.77	71.54	78.07	

[a]Assumed corn NEg = 68 Mcal/cwt. Example: [(Test NEg – Control NEg)/% by-product] + 68.
Source: Pritchard et al., 2012.

The researchers calculated NEg values for the by-products assuming that the substituted corn grain had a NEg content of 68 Mcal/cwt. Based on this assumption, the derived NEg values for the three by-products were 65.8, 71.5 and 78.1 Mcal/cwt for the CGD, WDG and WDGS diets, respectively. Regression of diet fat content against NEg content indicated that fat represented 2.02 times the NE content of non-fat diet components ($P < 0.02$; $r^2 = 0.26$) suggesting that for each 1% increase in dietary fat content that dietary NEg increases by 1.02 Mcal/cwt.

University of Nebraska research evaluated the feeding performance of yearling feedlot steers fed normal-fat WDGS (12.9% fat) or low-fat WDSG (6.7% fat).[3] The control diet (DM basis) was formulated to contain 10% sorghum silage, 5% protein supplement, and 85% corn (1:1 ratio of dry-rolled corn and high-moisture corn, DM basis). WDGS was added at 35% of the diet DM, replacing corn. The dietary fat content for the control, low-fat WDGS, and normal-fat WDSG diets were 3.64, 4.72, and 6.91%, respectively.

These researchers reported that final weights and average daily gain were significantly greater ($P < 0.05$) for steers fed the 12.9% fat WDGS compared to steers fed the corn control diet or the 6.7% fat WDGS (Table 3). In addition, feed efficiency tended be improved by 8.5% ($P = 0.12$) in cattle fed the normal-fat WDGS. Steers fed the corn control or the low-fat WDGS diets had identical feedlot performance. The only carcass characteristic that differed across treatments was HCW which was significantly greater ($P = 0.04$) for steers fed normal-fat WDGS (Table 3).

Table 3. Effect of low-fat WDGS and normal-fat WDGS on feedlot performance and carcass characteristics.

Item	Control	Low-Fat WDGS	Normal-Fat WDGS	P-value
Dietary fat, %	3.64	4.72	6.91	
Performance:				
Initial weight, lb	889	886	886	
Final weight, lb[a]	1295	1294	1331	0.04
ADG, lb	3.41	3.41	3.71	0.02
DMI, lb	24.4	24.4	24.4	0.99
F:G[b]	7.19	7.19	6.58	0.12
Carcass Characteristics:				
HCW, lb	816	815	839	0.04
12th rib fat, in.	0.47	0.52	0.53	0.25
Rib eye area, in^2	13.4	12.9	13.1	0.62
Marbling[c]	614	591	617	0.61

[a]Calculated from hot carcass weight, adjusted to 63% yield.
[b]Calcualed and analyzed from G:F, which is the reciprocal of F:G.
[c]Marbling: 400= slight; 500 = small; 600 = modest.
Source: Gigax et al., 2011.

Based on actual steer performance, I calculated dietary NE values for the three diets (Table 4). I then calculated NEg values for the low-fat WDGS, and normal-fat WDGS assuming that the substituted corn had a NEg content of 68 Mcal/cwt. Based on this assumption, the derived NEg values for low-fat WDGS and normal-fat WDGS were 68.0 and 78.3 Mcal/cwt, respectively. The calculated NEg content of the 12.9% fat WDGS is nearly identical to that calculated for the 12.2% fat WDGS in the South Dakota study (78.1 Mcal/cwt).

Table 4. Performance based calculations of diet and WDGS NE values.

Item	Control	Low-Fat WDGS	Normal-Fat WDGS
Diet			
NEm, Mcal/cwt	83.90	83.45	87.53
NEg, Mcal/cwt	54.88	54.88	58.50
WDGS NEg, Mcal/cwt[a]		68.00	78.34

[a]Assumed corn NEg = 68 Mcal/cwt. Example: [(Test NEg – Control NEg)/% by-product] + 68. Calculated from Gigax et al., 2011 performance data.

Both of these studies indicate that removing fat from ethanol feed by-products will lower the net energy contents of the feeds. The data suggests that the advantage of feeding WDGS with dry-rolled corn or high-moisture is derived from or associated with the high fat content of normal-fat WDGS. Thus, cattle feeders purchasing WDGS should periodically monitor product purchased for fat content and seek normal- or higher-fat product.

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[1] Loy, D. D. and W. Miller. 2008. Ethanol coproducts for cattle: The process and products. Iowa Beef Center IBC-18. Available: http://www.extension.iastate.edu/Publications/IBC18.pdf.
[2] Pritchard, R., E. Loe and T. Milton. 2012. Relationship between fat content and NE values for some ethanol byproducts. 2012 South Dakota Beef Report BEEF 2012-06:29-35.
[3] Gigax, J. A., B. L. Nuttelman, W. A. Griffin, G. Erickson and T. Klopfenstein. 2011. Performance and carcass characteristics of finishing steers fed low-fat and normal-fat wet distillers grains. Nebraska Beef Cattle Report MP94:44-45.