Impact of Feeding New Fractionated Distillers Grains (Fiber plus Syrup) on Feedlot Cattle Performance and Carcass Characteristics

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Summary with Implications

Fractionation processes are being explored to supply higher protein distillers grains for premium markets. Resulting distillers grains after a fraction is isolated will still be marketed as a cattle feed so knowing the impact on performance is important. This study evaluated feeding wet or dry conventional distillers grains with wet and dry fractionated distillers (fiber plus syrup) fed at 0, 20, or 40% of diet DM. When compared to the corn control, intake and gain increased for each of the four distillers types were fed, but feed conversion was poorer (i.e., increased) for dry distillers grains and dry fiber plus syrup whereas feed conversion was equal across 0, 20, or 40% inclusion for wet distillers grains and wet fiber plus syrup. Fractionation process did impact feed conversion by decreasing 3% when fed at 20 or 40% compared to conventional distillers grains plus solubles and as expected, dry byproducts perform poorer than wet byproducts.

Introduction

Changes in production in the ethanol industry to produce differentiated feeds and improve ethanol production efficiency have resulted in new distillers grains type feeds available for use in cattle feeding. Partial grain fractionation technology consists of separating the corn kernel into germ, endosperm, and bran. The germ is used for oil extraction, the bran for cattle feed, and the endosperm after fermentation will result in a high-protein, lower-fat product called high-protein DDGS. The remaining syrup plus fiber can be dry or wet and can also be used for cattle feeding but there are not many studies investigating the effects of these by-products on the performance of feedlot cattle. The hypothesis was that feeding steers with fiber plus syrup (F+S) would not negatively affect cattle performance. The objective of this study was to evaluate the energy value of dry and wet fiber plus syrup compared to traditional wet and dry distillers grains plus solubles using cattle finishing performance.

Procedure

The experiment was conducted at the Eastern Nebraska Research, Extension, and Education Center near Mead, NE. Six hundred crossbred steers (initial BW= 660 lb; SD = 45 lb) were fed for an average of 182 days. The steers were allocated in 40 pens with 15 steers per pen, the treatments were randomly allocated to pens with the control treatment having 8 pens (120 steers) and each treatment (20 and 40% inclusion of four different distillers byproducts) containing byproducts having 4 pens (60 steers) each. The experiment was conducted in a randomized block design, with three BW blocks: heavy, medium, and light, where initial BW was used as a blocking factor. The initial live weight was determined using the average weights from two consecutive days. Before weighing, the steers were limit-fed at 2% of body weight for 5 days, during which time the diet was comprised of 50% alfalfa hay and 50% Sweet Bran (DM basis) to equalize gut fill. Pen was considered the experimental unit and the treatments were assigned randomly to pens. On day 1, the steers received a Revalor-IS implant (80 mg trenbolone acetate and 16 mg of estradiol; Merck Animal Health) and were re-implanted on days d 52 or 55 with Revalor-200 implant (200 mg trenbolone acetate and 20 mg of estradiol; Merck Animal Health). Cattle were supplemented with 300 mg ractopamine/steer daily (Optaflexx; Elanco Animal Health) for the last 28 days of the feeding period.

The treatment design was a 4×2+1 factorial, with one factor being four distillers grains types and other factor was the inclusion at 20% or 40%, along with a corn control. Byproduct types were dry distillers grains plus solubles (DDGS; NDF= 36.8%; CP= 30.22; Ether extract= 9.5%), wet distillers grains plus solubles (WDGS; NDF= 45%; CP= 31.7%; Ether extract= 9.3%), dry fiber plus solubles (Dry F+S; NDF= 41.1%; CP= 21.84%; Ether extract= 8.4%),), and wet fiber plus solubles (Wet F+S; NDF= 49.7%; CP= 22.67%; Ether extract= 8.5%),). All distillers were produced at one plant (ICM, St. Joseph, MO). The fractionated products were produced using the prefractionation process utilized by ICM whereby high protein distillers grains is produced resulting in a feed product labeled fiber plus syrup. In that process, distillers grains are produced that are lower in protein and greater in fiber, but also allows for more solubles to be applied to the isolated fiber product. Due to the production process, not all of the solubles could be added to Wet F+S, so those diets included distillers solubles (syrup) at the ratio needed to match Dry F+S. All materials were received from the same plant, twice over the feeding period and stored. Wet products (WDGS and Wet F+S) were stored in silo bags and dry products stored in a commodity shed under roof. Diets also contained a blend of high-moisture corn and dry-rolled corn along with roughage and supplement (Table 1).

Cattle were harvested at a commercial abattoir located in Omaha, NE. On the day of slaughter, hot carcass weight (HCW) and liver score data were collected whereas 12th rib fat, LM area, and USDA marbling score were collected 46 hours after slaughter. Data were analyzed using the MIXED procedure of SAS with pen as experimental unit. Orthogonal contrast statements were used to separate linear and quadratic effects of distillers grains type inclusion in the diet.

Table 1 Diets fed to finishing steers to evaluate energy of new fiber plus syrup distillers fed wet or dry compared to dry distillers grains plus solubles (DDGS) or wet distillers grains plus solubles (WDGS).

		Treatments[1]							
		DDGS		Dry F+S		WDGS		Wet F+S	
Ingredient, % DM[2]	Control	20%	40%	20%	40%	20%	40%	20%	40%
HMC	39	30	20	29.5	20	30	20	29.5	20
DRC	39	30	20	29.5	20	30	20	29.5	20
Corn silage	15	15	15	15	15	15	15	15	15
DDGS	-	20	40	-	-	-	-	-	-
Dry FS	-	-	-	20	40	-	-	-	-
WDGS	-	-	-	-	-	20	40	-	-
Wet FS	-	-	-	-	-	-	-	17	34
Syrup	-	-	-	-	-	-	-	3	6
Empyreal	2	-	-	1	-	-	-	1	-
Supplement 1[3]	5	1.67	-	2.5	-	1.67	-	2.5	-
Supplement 2[3]	-	3.33	5	2.5	5	3.33	5	2.5	5
Analyzed composition									
CP	12.00	13.15	16.73	12.69	13.38	13.44	17.33	13.72	15.44
NDF	14.57	19.94	25.22	20.75	26.94	21.58	28.50	20.98	27.39
Ether extract	3.51	4.81	5.99	3.47	3.93	4.77	5.91	4.53	5.55
S	0.13	0.23	0.34	0.24	0.35	0.22	0.33	0.25	0.38

[1] Treatments were due to byproduct type and inclusion in the diet; Control= control diet with no DDGS, WDGS, dry FS or wet FS inclusion; DDGS 20% = inclusion of 20% dry distillers grain solubles; DDGS 40% = inclusion of 40% dry distillers grain solubles; Dry F+S 20% = inclusion of 20% dry fiber plus syrup; Dry F+S 40% = inclusion of 40% dry fiber plus syrup; Wet F+S 20% = inclusion of 20% wet fiber plus syrup; Wet F+S 40% = inclusion of 40% wet fiber plus syrup; WDGS 20% = inclusion of 20% wet distillers grain solubles; WDGS 40% = inclusion of 40% wet distillers grain solubles (DM basis).

[2]HMC=high-moisture corn, DRC=dry-rolled corn, dry FS = dry fiber plus syrup, wet FS = wet fiber plus syrup, Empyreal is branded corn gluten meal to provide rumen undegradable protein (Cargill milling), DDGS= dry distillers grain solubles, WDGS= wet distillers grain solubles.

[3]Supplement 1 contained 1.2% urea and 1.63% fine ground corn in the diet. Supplement 2 contained no urea and 2.83% fine ground corn. Both supplements provided Rumensin (30 g/ton of DM), Tylan (8.8 g/ton of DM), tallow, minerals, vitamins, salt, and limestone.

Table 2. Effect of new fiber plus syrup fed compared to wet or dry distillers inclusion on performance and carcass characteristics of finishing steers.

	Treatments[1]							
	DDGS		Dry F+S		WDGS		Wet F+S	
Item	*Linear P-value*	*Quadratic P-value*	*Linear P-value*	*Quadratic P-value*	*Linear P-value*	*Quadratic P-value*	*Linear P-value*	*Quadratic P-value*
Performance								
Initial BW, lb	0.71	0.82	0.14	0.32	0.35	0.79	0.63	0.94
Final BW, lb[2]	0.03	0.29	0.11	0.13	0.08	0.22	0.01	0.50
DMI, lb/d	<0.01	0.64	<0.01	0.05	0.07	0.13	<0.01	0.07
ADG, lb	0.03	0.31	0.08	0.17	0.09	0.21	0.01	0.51
F:G[3]	0.10	0.34	<0.01	0.89	0.45	0.69	0.45	0.46
Carcass characteristics								
HCW, lb	0.03	0.29	0.11	0.13	0.08	0.22	<0.01	0.50
12th rib fat, in	0.36	0.48	0.33	0.41	0.33	0.90	0.96	0.93
LM area, in[4]	0.02	0.86	0.02	0.10	0.08	0.60	0.03	0.19
Marbling score	0.71	0.81	0.60	0.24	0.10	0.82	0.15	0.83
Yield Grade	0.70	0.54	0.25	0.54	0.25	0.84	0.70	0.84

[1] Treatments were due to byproduct type and inclusion in the diet; DDGS 20% = inclusion of 20% dry distiller's grain solubles; DDGS 40% = inclusion of 40% dry distiller's grain solubles; Dry F+S 20% = inclusion of 20% dry fiber plus syrup; Dry F+S 40% = inclusion of 40% dry fiber plus syrup; Wet F+S 20% = inclusion of 20% wet fiber plus syrup; Wet F+S 40% = inclusion of 40% wet fiber plus syrup; WDGS 20% = inclusion of 20% wet distiller's grain solubles; WDGS 40% = inclusion of 40% wet distiller's grain solubles (DM basis).

[2] Final BW calculated as HCW divided by a common dressing percentage of 63%.

[3]Analyzed as G:F, the reciprocal of F:G

[4] LM area = longissimus muscle (ribeye) area

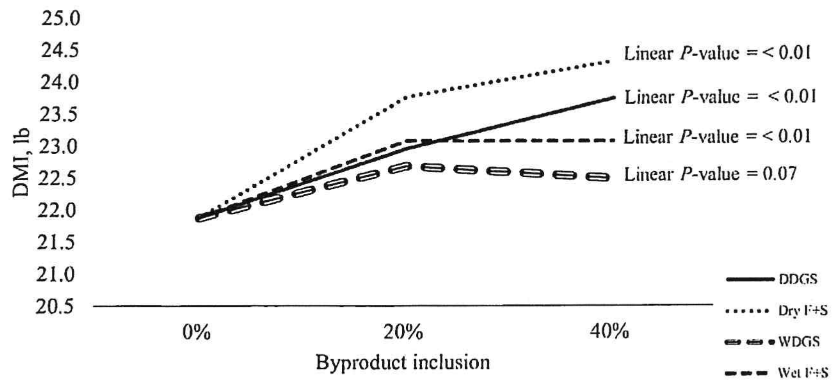

Fig. 1. Effect of byproduct type (DDGS, Dry F+S, WDGS and Wet F+S) and inclusion (0%, 20% or 40%) on DMI.

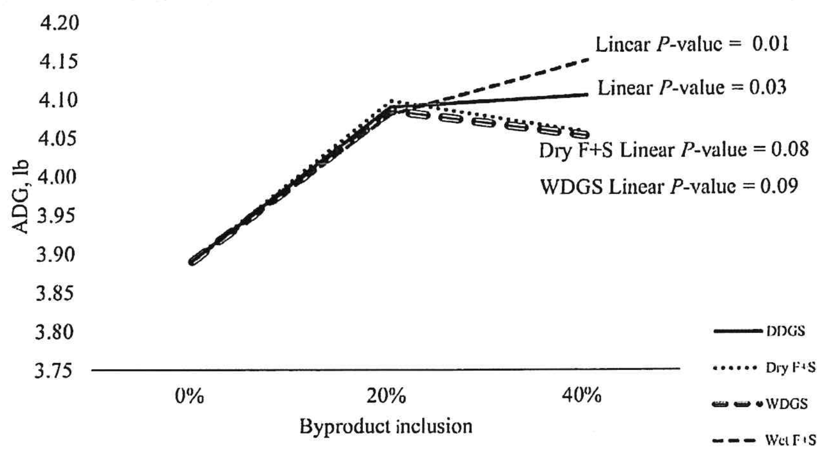

Fig. 2. Effect of byproduct type (DDGS, Dry F+S, WDGD and Wet F+S) and inclusion (0%, 20% or 40%) on ADG.

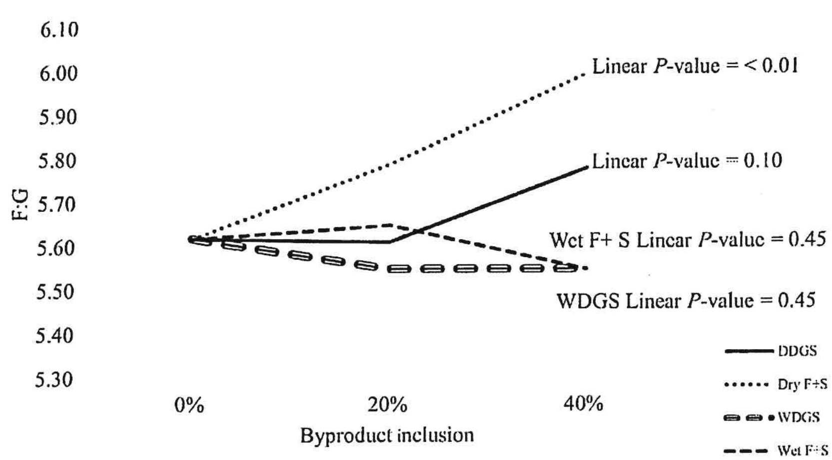

Fig. 3. Effect of byproduct type (DDGS, Dry F+S, WDGD and Wet F+S) and inclusion (0%, 20% or 40%) on feed to gain ratio. The linear interaction of byproduct type and inclusion was analyzed as Gain:Feed.

The factors included in the model were byproduct type (DDGS, Dry F+S, WDGD and Wet F+S) and inclusion (20% or 40%). Pen was considered the experimental unit and block treated as a fixed effect. To evaluate the interaction between processing method, moisture, and inclusion, a separate statistical analysis (ANOVA) was performed using the MIXED procedure (SAS Inst. Inc.). For this analysis, the control treatment was ignored, and the data were analyzed as a 2×2×2 factorial, where the factors were processing method (ICM or Traditional), moisture (dry and wet), and inclusion (20% or 40%).

Results

A quadratic effect was observed for DMI in the Dry F+S treatment ($P = 0.05$) where intake increased for 20% and 40% inclusion compared to control (Table 2). A linear increase in DMI was observed as DDGS ($P < 0.01$), Dry F+S ($P < 0.01$), and Wet F+S ($P < 0.01$) were added to diets and tended to increase linearly for WDGS ($P = 0.07$; Figure 1). Feeding DDGS ($P = 0.03$) and Wet F+S ($P = 0.01$) linearly increased ADG whereas feeding Dry F+S ($P = 0.08$) and WDGS ($P = 0.09$) tended to linearly increase ADG relative to the control (Figure 2). Despite increased ADG, F:G linearly increased as Dry F+ S ($P < 0.01$) replaced corn and tended to increase for DDGS ($P = 0.10$) as well (Figure 3). Due to proportional increases in DMI and ADG, no changes in F:G were observed for steers as Wet F+S ($P = 0.45$) or WDGS ($P = 0.45$) replaced corn at 20 to 40%. Based on F:G, WDGS and Wet F+S appear similar whereas both dry byproducts performed similar but worse than the corn they replaced. A linear effect was observed for HCW and LM area, where DDGS ($P = 0.03$) and Wet F+S ($P = 0.01$) treatments showed a linear increase in HCW with increasing inclusion of DDGS or Wet F+S, and tended to for inclusion of Dry F+S ($P = 0.11$) and WDGS ($P = 0.08$). A linear increase for LM area was observed as inclusion of DDGS ($P = 0.02$), Dry F+S ($P = 0.02$), and Wet F+S ($P = 0.01$) increased and tended to increase with inclusion of WDGS ($P = 0.08$). No linear or quadratic effects were observed for 12th rib fat, YG, and marbling score due to increasing inclusion of any of the distillers byprod-

Table 3. Interaction effect between moisture and inclusion of byproducts on performance and carcass characteristics of finishing steers.

	Moisture × Inclusion[1]					
	Dry		Wet			
Item	20%	40%	20%	40%	SEM	*P*-value
Performance						
Initial BW, lb	660	659	660	661	0.5	0.22
Final BW, lb[2]	1404	1400	1402	1406	9.2	0.63
DMI, lb/d	23.3[b]	24.0[c]	22.9[a]	22.8[a]	0.16	0.03
ADG, lb	4.09	4.08	4.08	4.10	0.050	0.75
F:G[3]	5.71[b]	5.88[c]	5.59[ab]	5.55[a]	-	0.04
Carcass characteristics						
HCW, lb	885	882	883	886	5.8	0.64
12th rib fat, in	0.56	0.56	0.56	0.55	0.013	0.85
LM area, in[4]	14.4	14.6	14.1	14.5	0.13	0.36
Marbling score	499	496	484	486	8.9	0.72
Yield Grade	3.41	3.39	3.39	3.37	0.036	0.86

[1] Byproducts moisture: dry or wet, Byproducts inclusion: 20% and 40%.

[2] Final BW calculated as HCW divided by a common dressing percentage of 63%.

[3] Analyzed as G:F, the reciprocal of F:G

[4] LM area = longissimus muscle (ribeye) area

Table 4. Main effects of ICM or traditional processing method on performance and carcass characteristics of finishing steers.

	Processing Method[1]			
Item	ICM	Traditional	SEM	*P*-value
Performance				
Initial BW, lb	660	660	0.4	0.62
Final BW, lb[2]	1404	1402	6.6	0.86
DMI, lb/d	23.5	22.9	0.12	<0.01
ADG, lb	4.09	4.08	0.036	0.79
F:G[3]	5.75	5.62	-	0.03
Carcass characteristics				
HCW, lb	884	883	4.1	0.86
12th rib fat, in	0.56	0.56	0.010	0.93
LM area, in[4]	14.4	14.4	0.09	0.67
Marbling score	504	478	6.4	0.01
Yield Grade	3.39	3.39	0.026	0.86

[1] Processing method of byproducts, ICM method= wet and dry F+S; traditional method= DDGS and WDGS

[2] Final BW calculated as HCW divided by a common dressing percentage of 63%.

[3] Analyzed as G:F, the reciprocal of F:G

[4] LM area = longissimus muscle (ribeye) area

ucts. Feeding WDGS tended to decrease marbling score linearly as WDGS inclusion increased ($P = 0.10$) with no impact due to other byproducts.

For the 2×2×2 factorial, there was an interaction between inclusion (20% or 40%) and moisture (dry or wet) for DMI ($P = 0.03$) and F:G ($P = 0.04$). When dry byproduct inclusion increased, DMI increased ($P < 0.01$) whereas no difference was observed due to increasing inclusion of wet byproducts ($P = 0.67$). Steers fed dry byproducts had an increase in F:G as a result of increasing inclusion ($P = 0.02$), but there was no difference in F:G from steers fed wet byproducts ($P = 0.45$; Table 3). No other interactions were observed between inclusion, moisture content, or ethanol production process (P > 0.62), but there were main effects due to production process.

Steers fed byproducts produced by the traditional method had lower DMI than steers fed byproducts produced using the ICM fractionation method ($P < 0.01$). As there was no difference in ADG ($P = 0.79$), this resulted in slightly improved F:G of animals fed byproducts produced by the traditional method ($P = 0.03$; Table 4), which averaged 2.78% improvement for an average inclusion of 30% (average of 20 and 40%).

Conclusion

When compared to corn, feeding both types of distillers grains as either wet or dry increased gain, but either intake increased more resulting in poorer feed conversions in the case of dry distillers or the new dry fiber plus solubles, or did not impact feed conversion for both types of wet feeds as inclusion increased from 0 to 40%. When evaluating only 20 and 40% inclusion, gain was not impacted but feed conversion was poorer for dry byproducts compared to wet byproducts. The traditional distillers grains were slightly (3%) better than fractionated fiber plus syrup distillers byproducts due to slightly greater intakes and similar gain.

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