Animal Science Research Report 2024

Effects of partial or total replacement of dried distillers plus solubles with soybean meal on growth performance, carcass characteristics, and dietary net energy utilization in finishing beef steers

Cassidy Ross, Warren Rusche, Zachary Smith

Rationale and Approach

The average inclusion of distillers in American feedlot diets is 19.9% dietary DM (Asem-Hiablie et al., 2016) with 86.7% of nutritionists choosing to use wet distillers grains with solubles (WDGS) or dried distillers grains with solubles (DDGS) as their primary grain by-product (Samuelson et al., 2016). Recent expansion in oilseed crush capacity should increase supplies of soybean meal (SBM) with potentially lower prices. The objective of this study was to determine if partial or complete substitution of DDGS with SBM influences growth performance, efficiency, or carcass characteristics in finishing beef steers.

Continental × British crossbred steers (*n* = 189; 7 or 8 steers/pen; 8 pens per treatment) were utilized in a 139-d finishing experiment at the South Dakota State University Ruminant Nutrition Center (RNC) in Brookings, SD using three treatments (Table 1): DDGS fed at 20% DM (15.4% CP, 8% RDP, and 1.90% NPN; DDGS), SBM replacing 50% of DDGS (16.4% CP, 9% RDP, and 0.96% NPN; SBM50), and SBM replacing 100% of DDGS (17.4% CP, 10% RDP, and 0.05% NPN; SBM100).

Findings

In the first 35 d of the study, ADG linearly increased with greater inclusions of SBM (Table 2; $P = 0.01$), but treatment did not affect DMI ($P = 0.39$). Feeding SBM as a replacement of DDGS linearly increased G:F in the first 35 d ($P = 0.01$). For the entire feeding period, steers fed SBM had greater final body weight ($P = 0.03$), ADG ($P = 0.05$), and G:F ($P = 0.01$). Dry matter intake was unaffected by soybean meal substitution ($P = 0.60$). Dietary treatment did not influence carcass-adjusted final BW ($P = 0.32$), ADG ($P = 0.77$), or DMI ($P = 0.38$). We noted a tendency for improved G:F (Quadratic; $P = 0.10$) for SBM50.

Feeding SBM in replacement of DDGS linearly decreased dressing percentage ($P = 0.03$), but linearly increased ribeye area ($P = 0.02$). Treatment did not affect hot carcass weight, ribfat, marbling score, or USDA Yield or Quality grade distribution ($P \geq 0.22$). Replacing DDGS with SBM altered the distribution of liver scores ($P = 0.05$). Steers from SBM100 had fewer livers classified as normal and a greater proportion of severely abscessed livers. However, steers fed SBM50 had the fewest severe abscesses and greatest proportion of normal livers.

Feeding SBM quadratically increased apparent dietary net energy values ($P = 0.03$) and the ratio of observed to expected dietary energy ($P \leq 0.04$). The total and partial substitution NEg values for SBM were 17.0 and 27.5% greater than DDGS respectively.

Implications

The use of SBM as a partial or complete replacement of DDGS resulted in greater daily gain and gain efficiency compared to DDGS when measured on a live basis. Feeding soybean meal altered the distribution of liver scores, increased REA, and decreased DP, with no other differences observed in carcass characteristics.

Acknowledgements

The authors wish to thank the Minnesota Soybean Research and Promotion Council for providing financial support for this study.

References

Asem-Hiablie, S., Rotz, C. A., Stout, R., Stackhouse-Lawson, K. 2016. Management characteristics of beef cattle production in the Northern Plains and Midwest regions of the United States. The Professional Animal Scientist, 32(6): 736–749. doi: 10.15232/pas.2016-01539

Samuelson, K. L., Hubbert, M. E., Galyean, M. L., Löest, C. A. 2016. Nutritional recommendations of feedlot consulting nutritionists: The 2015 New Mexico State and Texas Tech University survey. Journal of Animal Science, 94(6), 2648–2663. doi: 10.2527/jas.2016-0282

Table 1. Diet Composition (DM basis)[a].

	d 1 to 16			d 17 to 21			d 22 to 103			d 104 to 139		
Item[b]	**DDGS**	**SBM50**	**SBM100**	**DDGS**	**SBM50**	**SBM100**	**DDGS**	**SBM50**	**SBM100**	**DDGS**	**SBM50**	**SBM100**
Ingredient Composition, %												
HMEC	65.40	65.51	65.61	74.90	74.88	74.85	14.47	14.48	14.49	13.93	13.95	13.97
LS 1[c]	4.96	2.48	0.00	5.08	2.54	0.00	4.80	2.40	0.00	4.80	2.40	0.00
LS 2[d]	0.00	2.48	4.97	0.00	2.54	5.07	0.00	2.40	4.81	0.00	2.40	4.81
SBM	0.00	9.77	19.57	0.00	10.04	20.08	0.00	9.55	19.12	0.00	9.64	19.31
DDGS	19.82	9.93	0.00	20.02	10.00	0.00	19.25	9.63	0.00	19.54	9.78	0.00
DRC	0.00	0.00	0.00	0.00	0.00	0.00	16.31	16.32	16.34	55.95	56.03	56.11
HMC	0.00	0.00	0.00	0.00	0.00	0.00	39.28	39.31	39.34	0.00	0.00	0.00
GH	9.81	9.83	9.85	0.00	0.00	0.00	5.88	5.89	5.89	5.79	5.79	5.80
Nutrient Composition[e]												
DM, %	74.52	74.40	74.28	71.01	71.04	71.07	79.90	79.83	79.77	84.35	84.23	84.11
CP, %	15.08	16.08	17.07	15.16	16.22	17.28	15.45	16.48	17.51	15.37	16.36	17.35
RDP, %	8.34	9.37	10.41	8.11	9.35	10.47	8.00	9.03	10.06	7.96	9.00	10.05
NDF, %	25.24	22.81	20.38	20.53	18.06	15.58	19.72	17.29	14.86	17.73	15.36	12.99
ADF, %	12.94	11.96	10.98	10.01	9.01	8.02	8.71	8.01	7.31	7.33	6.73	6.12
Ash, %	5.98	6.16	6.34	5.33	5.52	5.70	5.68	5.82	5.97	5.50	5.63	5.77
EE, %	4.15	3.57	2.98	4.22	3.63	3.04	3.77	3.22	2.68	3.82	3.25	2.69
NEm, Mcal/lbs[f]	1.97	1.90	1.89	1.97	1.96	1.96	2.07	2.06	2.06	2.06	2.05	2.04
NEg, Mcal/lbs[g]	1.26	1.25	1.24	1.34	1.33	1.32	1.40	1.39	1.38	1.38	1.37	1.36

[a] All values except dry matter are on a DM basis

[b] HMEC = high moisture ear corn; LS = molasses-based liquid supplement; SBM = soybean meal; DDGS = dried distillers grains plus solubles; DRC = dry rolled corn; HMC = high-moisture corn; GH = grass hay; DM = dry matter; CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; EE = ether extract; NEm = net energy for maintenance; NEg = net energy for gain.

[c] Liquid supplement 1 contained (DM basis): 44.46% CP, 38.78% non-protein nitrogen, 41 Mcal/cwt of NEm, 26 Mcal/cwt of NEg, 0.90% ether extract, 16.52% total sugars, 50.77% ash, 11.00% calcium, 0.38% P, 7.07% K, 0.13% Mg, 6.00% NaCl, 3.54% Na, 0.41% S, 4.30 ppm Co, 200.00 ppm Cu, 12.11 ppm I, 6.91 mg/lb EDDI, 525.35 ppm Fe, 404.93 ppm Mn, 2.93 ppm Se, 1,800 ppm Zn, 20,195.12 IU/lb Vitamin A, 201.95 IU/lb Vitamin E, and 585.37 g/ton monensin sodium.

[d] Liquid supplement 2 contained (DM basis): 7.32% CP, 1.03% non-protein nitrogen, 54 Mcal/cwt of NEm, 35 Mcal/cwt of NEg, 1.36% ether extract, 27.18% total sugars, 50.77% ash, 11.00% calcium, 0.38% P, 7.07% K, 0.12% Mg, 6.00% NaCl, 2.94% Na, 0.46% S, 4.38 ppm Co, 200.00 ppm Cu, 12.11 ppm I, 6.91 mg/lb EDDI, 436.14 ppm Fe, 409.87 ppm Mn, 2.93 ppm Se, 1,800 ppm Zn, 20,195.12 IU/lb Vitamin A, 201.95 IU/lb Vitamin E, and 585.37 g/ton monensin sodium

[e] Tabular NE from Preston (2016) and actual nutrient compositions

[f] Net energy for maintenance

[g] Net energy for gain

Table 2. Influence of dietary treatment on growth performance and carcass trait responses deads and removals excluded.

	Treatments[a]					*P*-value	
Item	DDGS	SBM50	SBM100	SEM[c]	F-test	Linear	Quadratic
Pens, n	63	61	63				
Steers, n	8	8	8				
Initial BW[b], lbs	842	844	844	2.2	0.84	0.57	0.91
d 1 to d 35							
BW d35[b], lbs	983	992	1008	2.9	0.01	0.01	0.33
ADG, lbs	4.01	4.21	4.63	0.079	0.01	0.01	0.35
DMI, lbs	21.8	21.7	22.0	0.13	0.31	0.39	0.21
G:F	0.185	0.196	0.211	0.0033	0.01	0.01	0.61
F:G[c]	5.41	5.10	4.74	-	-	-	-
d 36 to d 77							
BW d77[b], lbs	1193	1197	1206	4.2	0.08	0.03	0.81
ADG, lbs	4.96	4.89	4.74	0.097	0.33	0.16	0.63
DMI, lbs	24.2	23.8	23.4	0.24	0.08	0.03	0.85
G:F	0.205	0.207	0.204	0.0032	0.77	0.69	0.55
F:G[c]	4.88	4.83	4.90	-	-	-	-
d 78 to d 105							
BW d105[b], lbs	1276	1283	1287	4.2	0.19	0.07	0.98
ADG, lbs	3.00	3.00	2.91	0.090	0.66	0.43	0.67
DMI, lbs	24.3	24.1	24.1	0.29	0.88	0.65	0.83
G:F	0.124	0.125	0.121	0.0038	0.71	0.58	0.55
F:G[c]	8.06	8.00	8.26	-	-	-	-
d 106 to d 139							
BW d139[b], lbs	1369	1391	1391	6.6	0.04	0.03	0.14
ADG, lbs	2.69	3.24	3.04	0.165	0.10	0.18	0.09
DMI, lbs	25.5	25.4	25.2	0.22	0.60	0.33	0.87
G:F	0.106	0.128	0.120	0.0059	0.05	0.10	0.06
F:G[c]	9.43	7.81	8.33	-	-	-	-
Cumulative (live-basis)							
ADG, lbs	3.77	3.95	3.92	0.051	0.06	0.05	0.15
DMI, lbs	23.9	23.7	23.6	0.17	0.38	0.18	0.72
G:F	0.158	0.167	0.167	0.0173	0.01	0.01	0.05
F:G[c]	6.33	5.99	5.99	-	-	-	-
Cumulative (HCW/0.625)							
Final BW, lbs	1413	1429	1420	6.6	0.32	0.60	0.16
ADG, lbs	4.10	4.21	4.12	0.053	0.42	0.77	0.21
G:F	0.172	0.178	0.175	0.0020	0.14	0.26	0.10
F:G[c]	5.81	5.62	5.71	-	-	-	-
Applied Energetics[e]							
NEm[f], Mcal/cwt	91.2	95.3	95.3	0.73	0.01	0.01	0.03

NEg[g], Mcal/cwt	61.2	64.9	64.9	0.64	0.01	0.01	0.03
O/E[h] NEm	0.98	1.03	1.03	0.008	0.01	0.01	0.03
O/E[h] NEg	0.99	1.04	1.04	0.011	0.01	0.01	0.04
Carcass Traits[i]							
HCW, lbs	884	893	886	4.2	0.32	0.60	0.16
DP[j], %	64.60	64.10	63.75	0.251	0.09	0.03	0.80
REA, in^2	14.0	14.3	14.4	0.12	0.05	0.02	0.54
RF, in	0.55	0.59	0.57	0.018	0.22	0.28	0.17
Marbling[k]	519	531	524	14.9	0.85	0.83	0.60
Calculated YG	3.25	3.30	3.19	0.078	0.63	0.60	0.42
EBF[j], %	31.02	31.61	31.23	0.349	0.49	0.68	0.27
AFBW[l], lbs	1279	1272	1276	11.9	0.91	0.87	0.69
Quality Grade Distribution, %							
Select	6.3	5.0	6.5	-	0.92		
Low Choice	39.7	40.7	38.7				
Average Choice	33.3	30.5	33.9				
High Choice	17.5	17.0	16.1				
Prime	3.2	6.8	4.8				
Yield Grade Distribution, %							
1	0.0	3.3	3.2	-	0.36		
2	41.2	30.1	46.0				
3	55.6	63.3	44.4				
4	3.2	3.3	4.8				
5	0.0	0.0	1.6				
Liver Abscess Prevalence, %							
Normal	74.6	81.7	63.5	-	0.05		
A-	4.8	8.3	9.5				
A	3.2	5.0	0.0				
A+ or greater	17.4	5.0	27.0				

[a] DDGS = 100% DDGS; SBM50 = 50 % DDGS, 50% SBM; SBM100 = 100% SBM
[b] A 4% pencil shrink was applied to BW measures to account for gastrointestinal tract fill.
[c] Calculated as; 1/G:F
[d] Pooled SEM
[e] Calculated from live BW shrunk 4%
[f] Net energy for maintenance
[g] Net energy for gain
[h] Observed to Expected ratio (calculated net energy value/tabular net energy estimate)
[i] HCW = hot carcass weight; DP = dressing percent; REA = ribeye area; RF = rib fat; EBF = empty body fat; AFBW = adjusted final body weight
[j] Calculated as: (HCW/Final BW shrunk 4%) × 100.
[k] Small00 = 400
[l] Calculated according to Guiroy et al. (2002).