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Kristina S. Mateo
South Dakota State University

Kent E. Tjardes
South Dakota State University

Cody L. Wright
South Dakota State University

Bradley D. Rops
South Dakota State University

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Kristina S. Mateo[1], Kent E. Tjardes[2], Cody L. Wright[2] and Bradley D. Rops[3, 4]
Department of Animal and Range Sciences

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Summary

A two-year study was conducted to determine the effect of feeding different protein sources on the performance of feeder cattle. During year 1 (Y1), 128 steers (506 ± 40 lb) were weighed and randomly allocated to 16 pens in a completely randomized design. Each pen was assigned to one of four treatment diets: 1) 20% soybean meal and corn (SBM); 2) 20% dried distillers grains with solubles (DDGS); 3) 20% wet distillers grains with solubles (WDGS); or 4) 20% blood meal, oil and corn (BM). In Y1, steers were fed a diet that consisted of 74% alfalfa/grass hay, 4% molasses and 2% supplement for the first 28 d and a diet that consisted of 50% alfalfa/grass hay, cracked corn, 4% molasses and 2% supplement for the remaining 56 d. During year 2 (Y2), 160 steers (535 ± 40 lb) were weighed and randomly allotted to 16 pens. Each pen was assigned to one of the four treatment diets used in Y1. The steers received the 50% alfalfa/grass hay based grower diet throughout the entire 57-d trial. Body weight was recorded prior to feeding at the start of the trial and every 28 d for both years. In Y1, ADG, DMI and G:F did not differ due to diet for the first 28 d and over the entire trial period. During the first 28 d of Y2, ADG, DMI and G:F was not affected by treatment; however, cumulative G:F of steers fed BM and WDGS were greater ($P < 0.05$) than steers fed SBM or DDGS. In conclusion, feeding BM and WDGS during the growing phase resulted in the most efficient gains when steers were started on a higher energy diet. In addition, distillers grains with solubles was an effective alternative to soybean meal in growing diets.

Introduction

Feed intake of newly arrived calves is often low during the first two weeks of the feedlot receiving period (Fluharty and Loerch, 1995). Reduced intake has implications on how receiving diets should be formulated, and therefore, shipped or stressed cattle should be provided with a diet they will readily accept. Since DMI is usually low during the initial weeks of the feedlot receiving period, higher concentrations of dietary CP would be required to offset the effects of low DMI (Fluharty and Loerch, 1995). Eck et al. (1988) reported that ruminal degradability of protein has shown to affect performance of calves after arrival at the feedlot. Results of their study showed that incoming feedlot cattle for the first 28 days should receive a diet containing at least 12.5% CP and that at least 60% of the total dietary protein should be high-quality rumen escape protein.

Distillers grains with solubles (DG), a product of the dry milling industry, are excellent feed sources for feedlot cattle. They are normally available for use in feedlot diets in two forms: dried distillers with solubles (DDGS) and wet distillers grains with solubles (WDGS). The chemical composition of WDGS and DDGS typically does not differ except for its DM content (WDGS, 25-45%; DDGS, 90-95%). Distillers grains contain 10-15% fat, 40-45% NDF, 30-35% CP and 5% ash (NRC, 1996). Reported values for undegradable intake protein (UIP) as percent of CP range from 47-57.

This study was designed to determine the effect of feeding different protein sources (soybean meal, blood meal, DDGS and WDGS) on the intake and performance of feeder cattle.

[1] Graduate Assistant
[2] Assistant Professor
[3] Research Assistant
[4] The authors thank the South Dakota Corn Utilization Council for their financial support of this research.

Materials and Methods

During Y1, 128 steers (507 ± 40 lb) were weighed and randomly allocated to 16 pens. Pens were randomly assigned to one of four treatment diets. Diets contained 1) 20% soybean meal and corn (SBM), 2) 20% dried distillers grains with solubles (DDGS), 3) 20% wet distillers grains with solubles (WDGS), or 4) 20% ring-dried blood meal, oil and corn (BM). Steers were fed a backgrounding diet that consisted of 74% alfalfa/grass hay, 4% molasses and 2% supplement for the first 28 d (Table 1) and a grower diet that consisted of 50% alfalfa/grass hay, 4% molasses, 2% supplement and cracked corn for the remaining 56 d (Table 2). The experimental period for Y1 lasted 84 days.
During Y2, 160 steers (536 ± 40 lb) were weighed and randomly allotted to 16 pens. Pens were randomly assigned to one of the four treatment groups used in Y1. In contrast to Y1, steers were fed the 50% hay grower diets throughout the 57-d experimental period (Table 2).

Body weight was recorded prior to feeding at the start of the experiment and every 28 days until the end of the experimental period for Y1 and Y2. All steers were vaccinated (respiratory and clostridial) and dewormed on d 0 and implanted with Ralgro at d 28.

Feed ingredients and treatment diets were sampled weekly, frozen immediately and later analyzed for DM (AOAC, 1995), CP (Macro-Kjeldahl N; AOAC, 1995), NDF, ADF (Goering and Van Soest, 1970), ash (AOAC, 1995; Table 3) and gross energy. Fecal samples were collected on d 28 and 85 in Y1, and d 28 and 84 in Y2, frozen immediately and later analyzed for DM, N, NDF and gross energy. Apparent total tract digestibility of DM, N, NDF and energy was determined using acid insoluble ash (Van Keulen and Young, 1977) as the internal marker.

Data were analyzed for a completely randomized design using the GLM procedure of SAS with pen as the experimental unit. When the model was significant ($P < 0.05$), treatment means were separated using Fisher's LSD.

Results

In Y1, ADG, DMI and G:F was not affected by treatment ($P > 0.05$) during the first 28 d when steers were fed the lower energy diets (Table 4). After the percentage of corn in the diet was increased, ADG, DMI and G:F was still not different due to treatment from d 28 to 56, d 56 to 84, and over the entire feeding period.

In Y2 (Table 6), DMI, ADG and G:F ratio during the first 28 d were not affected by treatment. From d 28 to 57, steers fed WDGS had greater ($P < 0.05$) ADG compared to SBM fed steers. Steers fed WDGS were more efficient ($P < 0.05$) than steers fed the other diets. Over the entire feeding period in Y2, steers fed BM and WDGS had greater ($P < 0.05$) G:F compared to steers fed SBM, but did not differ from steers fed DDGS.

In Y1, apparent total tract digestibility of DM, OM, N and NDF of diets containing DDGS, WDGS and BM did not differ between treatments on d 28 and 84 (Table 5). Similar to Y1, no differences in the apparent total tract digestibility of DM, OM, N and NDF were found in steers fed SBM, DDGS, WDGS or BM on d 28 and 57 in Y2 (Table 7). During d 28 in Y1 (Table 5) and Y2 (Table 7), NE_m and NE_g of DDGS, WDGS and BM diets were greater ($P < 0.05$) than the SBM diet.

Implications

Results from this study show that feeding protein source over the entire feeding period that were higher in by-pass protein in growing diets did not consistently improve steer performance. However, distillers grains with solubles (wet or dry) was an effective alternative protein source to SBM in grower rations.

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Tables

Table 1. Composition of backgrounding diets that contained soybean meal (SBM), dried distillers grains with solubles (DDGS), wet distillers grains with solubles (WDGS) and blood meal (BM) fed to starter calves during the first 28 d in Y1

Item, %DM	SBM	DDGS	WDGS	BM
Alfalfa Hay	37.0	37.0	37.0	37.0
Grass Hay	37.0	37.0	37.0	37.0
DDGS	--	20.0	--	--
WDGS	--	--	20.0	--
Cracked Corn	10.0	--	--	13.8
SBM	10.0	--	--	--
Blood Meal	--	--	--	5.2
Wet Molasses	4.0	4.0	--	4.0
Dried Molasses	--	--	4.0	--
Soybean Oil	--	--	--	1.0
Supplement[a]	2.0	2.0	2.0	2.0

[a]Provides: ground corn, 1.118%; trace mineralized salt, 0.856%; Rumensin 80, 0.016%, Vitamin A, 0.002%; $CuSO_4$, 0.006%.

Table 2. Composition of grower diets that contained soybean meal (SBM), dried distillers grains with solubles (DDGS), wet distillers grains with solubles (WDGS) and blood meal (BM) fed to steers during Y1 (d 56-84) and Y2 (d 0-57d)

Item, %DM	SBM	DDGS	WDGS	BM
Alfalfa Hay	33.3	33.3	33.3	33.3
Grass Hay	16.7	16.7	16.7	16.7
DDGS	--	20.0	--	--
WDGS	--	--	20.0	--
Cracked Corn	34.0	24.0	24.0	38.0
SBM	10.0	--	--	--
Blood Meal	--	--	--	5.0
Wet Molasses	4.0	4.0	--	4.0
Dried Molasses	--	--	4.0	--
Soybean Oil	--	--	--	1.0
Supplement[a]	2.0	2.0	2.0	2.0

[a]Provides: ground corn, 1.118%; trace mineralized salt, 0.856%; Rumensin 80, 0.016%, Vitamin A, 0.002%; $CuSO_4$, 0.006%.

Table 3. Chemical composition of the diets that contained soybean meal (SBM), dried distillers grains with solubles (DDGS), wet distillers grains with solubles (WDGS) and blood meal (BM) fed to steers during the backgrounding and growing period

Item	SBM	DDGS	WDGS	BM
Backgrounding Diet, Y1				
DM, %	90.5	90.6	66.8	89.5
OM, %	90.6	90.9	91.3	91.1
CP, %	16.7	16.8	17.6	17.2
NDF, %	46.7	54.8	56.3	47.1
ADF, %	28.1	31.3	31.8	27.9
UIP, %CP*	33.3	45.4	38.2	45.6
Growing Diets, Y1				
DM, %	85.5	86.3	63.7	84.4
OM, %	91.2	91.4	92.1	91.9
CP, %	16.8	16.3	17.8	17.2
NDF, %	34.5	40.8	45.8	34.0
ADF, %	20.6	22.1	23.3	19.7
UIP, %CP*	34.4	47.6	39.3	47.4
Growing Diets, Y2				
DM, %	85.4	85.3	62.1	84.2
OM, %	91.7	92.2	92.3	92.5
CP, %	16.5	16.1	16.7	16.3
NDF, %	35.7	43.3	45.0	34.6
ADF, %	21.1	23.9	24.6	20.2
UIP, % CP*	34.7	45.6	39.4	45.7

*Calculated based on NRC (1996) values.

Table 4. Performance data of steers fed diets that contained soybean meal (SBM), dried distillers grains with solubles (DDGS), wet distillers grains with solubles (WDGS) and blood meal (BM) during the backgrounding and growing period (Y1)

Item	SBM	DDGS	WDGS	BM	SEM
Initial Weight, lb	502	505	508	509	7
day 0-28					
ADG, lb/d	1.91	2.06	2.03	2.08	0.11
DMI, lb/d	12.03	12.09	11.54	12.35	0.38
Gain:Feed	0.159	0.170	0.176	0.169	0.009
Feed:Gain	6.34	5.34	5.71	5.98	0.32
day 28-56					
ADG, lb/d	3.07	2.78	2.66	2.71	0.23
DMI, lb/d	16.67	16.8	15.89	17.39	0.68
Gain:Feed	0.183	0.165	0.168	0.156	0.011
Feed:Gain	5.53	6.27	5.98	6.43	0.42
day 56-84					
ADG, lb/d	2.98	2.65	2.85	3.09	0.20
DMI, lb/d	19.4	19.31	18.77	20.84	1.30
Gain:Feed	0.158	0.138	0.151	0.150	0.013
Feed:Gain	6.55	7.33	6.79	6.8	0.60
Final Weight, lb	721	712	717	727	10
Cummulative (d 0-84)					
ADG, lb/day	2.65	2.49	2.51	2.62	0.10
DMI, lb/day	15.99	16.03	15.36	16.81	0.73
Gain:Feed	0.166	0.156	0.163	0.157	0.005
Feed:Gain	6.03	6.42	6.14	6.42	0.21

Table 5. Apparent total tract digestibility and energy concentration of the diets that contained soybean meal (SBM), dried distillers grains with solubles (DDGS), wet distillers grains with solubles (WDGS) and blood meal (BM) fed to steers during the backgrounding and growing period (Y1)

Item	SBM	DDGS	WDGS	BM	SEM
	---------- Day 28 ----------				
Apparent total tract digestibility					
DM, %	45.4	55.7	52.4	51.7	2.7
OM, %	46.4	57.0	53.7	53.0	2.7
N, %	47.1	61.0	61.4	56.1	3.6
NDF, %	47.3	57.9	54.5	53.4	2.6
Energy concentration of the diets					
NE_m, Mcal/lb DM	0.386[a]	0.490[b]	0.504[b]	0.522[b]	0.023
NE_g, Mcal/lb DM	0.141[a]	0.240[b]	0.250[b]	0.263[b]	0.023
	---------- Day 84 ----------				
Apparent total tract digestibility					
DM, %	69.5	68.5	66.3	74.5	2.3
OM, %	71.0	70.0	67.8	76.3	2.3
N, %	58.5	66.3	67.1	74.7	2.3
NDF, %	70.9	73.1	70.0	71.2	2.9
Energy concentration of the diets					
NE_m, Mcal/lb DM	0.671	0.653	0.522	0.721	0.023
NE_g, Mcal/lb DM	0.404	0.390	0.390	0.449	0.023

[a,b]Means within the same row with different subscripts differ ($P < 0.05$).

Table 6. Performance data of steers fed diets that contained soybean meal (SBM), dried distillers grains with solubles (DDGS), wet distillers grains with solubles (WDGS) and blood meal (BM) during Y2

Item	SBM	DDGS	WDGS	BM	SEM
Initial Weight, lb	537	536	531	538	7
day 0-28					
ADG, lb/d	2.24	2.31	2.51	2.69	0.19
DMI, lb/d	15.60	15.89	15.65	15.46	0.32
Gain:Feed	0.144	0.145	0.160	0.174	0.010
Feed:Gain	7.12	7.03	6.28	5.83	0.46
day 28-57					
ADG, lb/d	2.86[a]	3.07[ab]	3.30[b]	3.09[ab]	0.08
DMI, lb/d	19.68	19.36	17.84	18.74	0.48
Gain:Feed	0.146[a]	0.158[ab]	0.186[c]	0.165[b]	0.005
Feed:Gain	6.88	6.33[ab]	5.42[c]	6.08[b]	0.17
Final Weight, lb	682	689	696	703	9
Cummulative (day 0-57)					
ADG, lb/d	2.55	2.68	2.90	2.88	0.1
DMI, lb/d	17.53	17.54	16.69	17.02	0.34
Gain:Feed	0.145[a]	0.153[a]	0.174[b]	0.170[b]	0.005
Feed:Gain	6.93[a]	6.56[a]	5.77[b]	5.92[b]	0.22

[a,b,c]Means within the same row with different subscripts differ (P < 0.05).

Table 7. Apparent total tract digestibility of the diets that contained soybean meal (SBM), dried distillers grains with solubles (DDGS), wet distillers grains with solubles (WDGS) and blood meal (BM) fed to steers during the growing period (Y2)

Item	SBM	DDGS	WDGS	BM	SEM
	---------- Day 28 ----------				
Apparent total tract digestibility					
DM, %	72.2	69.8	68.8	73.7	2.5
OM, %	73.9	71.3	70.4	75.4	2.6
N, %	69.0	66.1	68.6	71.9	2.1
NDF, %	70.2	69.8	72.6	70.5	2.5
Energy concentration of the diets					
NE_m, Mcal/lb DM	0.685[a]	0.744[b]	0.776[b]	0.762[b]	0.014
NE_g, Mcal/lb DM	0.417[a]	0.467[b]	0.499[b]	0.485[b]	0.014
	---------- Day 57 ----------				
Apparent total tract digestibility					
DM, %	63.5	61.4	62.4	62.6	2.3
OM, %	64.6	62.6	63.8	63.7	2.4
N, %	61.7	54.4	63.5	61.8	1.9
NDF, %	60.7	63.3	67.8	60.3	2.5
Energy concentration of the diets					
NE_m, Mcal/lb DM	0.658	0.694	0.685	0.712	0.014
NE_g, Mcal/lb DM	0.395	0.422	0.417	0.440	0.014