Finishing Calves on North Dakota Protein Coproducts: The Effects of Canola Meal, Dried Distillers Grains, and Soybean Meal on Growth Performance and Carcass Characteristics

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In 2020, North Dakota was the #1 producer of canola (80% of U.S.), # 9 of soybean (4.6% of U.S.), and #13 of corn (1.75% of U.S.) (USDA-NASS). With the current development of additional oilseed crushing plants across North Dakota, demonstrating the usage of coproducts produced as a result of alternative energy production will benefit livestock producers and grain farmers. North Dakota currently sits as one of the few states having ethanol, soy oil, and other vegetable oil production, which creates a local market for area livestock producers to lower feed input costs. The utilization of coproducts locally may help reduce seasonal demand variability, ensuring a more stable market.

To optimize growth, growing and finishing steers require supplemental protein when fed diets containing corn or barley (McKinnon et al., 1993; Cecava and Hancook, 1994). Protein coproducts produced in North Dakota predominantly used in beef cattle diets include canola meal, distillers' grains (dry, modified, and wet), and soybean meal. Average crude protein levels are 40%, 30%, and 46% for canola meal (CM), dried distillers' grains (DDGS), and soybean meal (SBM), respectively (NASEM, 2016). Additionally, the ruminally undegradable protein levels in CM, DDGS, and SBM are approximately 42%, 68%, and 44%, respectively.

The focus of this project was to determine the effectiveness of incorporating three different North Dakota-produced protein coproducts (CM, DDGS, and SBM) in finishing steer diets on growth performance and carcass characteristics. We hypothesize that steers fed distillers’ grains would have improved performance over the oilseed treatments.

Materials and Methods

North Dakota State University Institutional Animal Care and Use Committee approved all procedures involving the use of animals in this experiment. The experiment was conducted at the North Dakota State University Carrington Research Extension Center (CREC) located near Carrington, ND. Coproducts were sourced from around North Dakota with CM, DDGS, and SBM coming from Velva, Spiritwood, and Spiritwood, respectively.

Experimental Design and Treatments

Three treatments were used in a generalized randomized block design to evaluate animal performance and carcass characteristics. The three finishing diets were balanced for net energy and crude protein. The final diets fed are presented in Table 1.

Table 1. Diet formulations.

Item	Dietary Treatment		
	DDGS	CM	SBM
Ingredient composition, %			
Dry rolled corn	57.8	63.4	64.9
Barley	9.4	10.2	11.3
Dried distillers' grains (DDGS)	20		
Canola meal (CM)		13.5	
Soybean meal (SBM)			10.7
Barley hay	6.8	6.9	7
Corn silage	3	3	3
Limestone and mineral supplement	3	3	3.1
Nutrient Composition			
NEm, Mcal/lb	1.00	1.01	0.99
Neg, Mcal/lb	0.60	0.59	0.60
CP, %	13.5	13.5	13.5

Animals, Initial Processing, Study Initiation

Two hundred and fifty-one cross bred steer calves (758 ± 19 lbs, initial body weight [BW]) from various ranches were used in the experiment. Steers were blocked by source from various producers across North Dakota (95 cross-bred steers from the Dakota Feeder Calf Show [block 1], 96 red-angus steers from producer 2 [block 2], 30 red angus home-raised steers from CREC [block 3], and 30 black angus steers from producer 4 [block 4]).

Upon arrival, cattle were processed for backgrounding. They were given a unique identification tag and vaccinated with Pyramid 5 + Presponse SQ, Inforce 3, Bar-Vac 7/Somnus, pour-on Cydectin, given a broad-spectrum antibiotic, and implanted with Synovex S. The steers were fed a high forage backgrounding ration for approximately 80 days.

Steers were individually weighed on two consecutive days prior to initiation day of the study. The initial body weight was used for pen allotment on the second weigh day. Steers were randomly assigned to one of 24 pens, then randomly assigned to one of three rations incorporating different coproducts - dried distillers grains with solubles (DDGS), soybean meal (SBM), or canola meal (CM) (Table 1). Steers were fed in 24 pens (n = 24; 10-11 steers/pen), resulting in eight replications per treatment with approximately 83 steers per treatment. Each pen had 3.25 ft concrete bunk space, 11.5 ft concrete feed apron, and 420 ft² of pen space per steer.

The experiment was initiated for blocks 1-3 on December 29, 2023, with a 23-d step-up adaptation period and 133-d finishing period (harvested May 31, 2024). Due to late arrival and low BW, steers within block 4 were delayed until January 16, 2024 (harvested July 5, 2024). Block 4 steers were fed a similar step-up adaptation ration for 23 days and 147-d finishing period. Synovex Choice was administered to cattle in blocks 1-3 and block 4 on February 15 and March 12, 2024, respectively. Steers consumed their respective coproducts on day one of the adaptation diet.

Diets and Intake Management

Feed analysis was performed on all feed ingredients by Dairyland Laboratories, Inc. (Arcadia, WI) prior to and throughout the study to balance the rations. Dairyland Laboratories conducted wet chemistry analysis of ash, ether extract, neutral and acid detergent fiber, and crude protein.

Steers were fed once daily in the morning around 0800. Bunks were managed to be devoid of feed at 0700 the following day.

Animal performance was calculated on a pen basis for dry-matter intake, average daily gain, and the ratio of feed:gain for each interim weigh period. All cattle were marketed and harvested at a commercial abattoir when treatment backfat reached approximately 0.5 in. Carcass data including hot carcass weight, ribeye area, 12th rib fat, USDA marbling scores, USDA Quality Grade and USDA Yield Grade were obtained. Data were analyzed using pen as the experimental unit (n = 24) using a generalized randomized block design model. Tukey's studentized range test was used to separate means.

Results

There was a difference in the bodyweight gain between coproduct treatments ($P < 0.05$). Steers assigned to DDGS, CM, and SBM treatments had an overall body weight gain of 588 lbs, 605 lbs, and 569 lbs, respectively. Steers that consumed canola meal had increased bodyweight gain ($P < 0.05$) of approximately 35 lbs compared to steers that consumed soybean meal (Table 2).

Table 2. Effects of canola meal, dried distillers grains, and soybean meal on growth performance and carcass characteristics.

	Dietary Treatment					Mean Separation (P-value)		
	DDGS	CM	SBM	SEM	*P*-value	DDGS to CM	DDGS to SBM	CM to SBM
Bodyweight gain, lbs	589	605	570	8.1	**0.0156***	0.3	0.2	**0.01***
Average Daily Gain, lbs	3.7	3.8	3.6	0.023	**0.0162***	0.3	0.2	**0.01***
Dry Matter Intake, lbs	25.8	25.8	24.5	0.35	0.4	0.9	0.5	0.4
Gain:Feed, lbs	0.14	0.15	0.15	0.0036	0.7	0.8	0.8	0.9
Hot Carcass Weight, lbs	850	867	832	7.4	**0.0006***	**0.08**	**0.05**	**0.004***
Yield Grade	3.7	3.81	3.53	0.069	**0.0274***	0.4	0.2	**0.02***
Rib Eye Area, in^2	12.7	12.9	12.8	0.1	0.3	0.3	0.9	0.5
Marbling	550	546	525	17.2	0.5	0.9	0.5	0.6
Rib fat, in	0.66	0.71	0.63	0.02	**0.0058***	**0.06**	0.5	**0.005***
Dressing Percentage, %	63.07	63.78	62.59	0.002	**0.007***	0.1	0.3	**0.005***

There was a difference in the overall average daily gain (ADG) between treatments ($P < 0.05$). Calves in the DDGS, CM, and SBM had an ADG of 3.6 lbs., 3.7 lbs, and 3.5 lbs, respectively. Steers that consumed canola meal had increased ADG ($P < 0.05$) of approximately 0.2 lbs more than steers that consumed soybean meal (Table 2).

No differences in overall dry matter intake (DMI) were detected when feeding DDGS, CM, or SBM ($P > 0.05$). The calves consumed 25.8 lbs, 25.8 lbs, and 24.5 lbs, respectively (Table 2). No differences in overall G:F were detected due to different coproduct feeds ($P > 0.1$). Steers fed DDGS, CM, and SBM gained 0.14 lbs, 0.15 lbs, and 0.15 lbs, respectively (Table 2).

Differences in hot carcass weights of calves were detected ($P < 0.05$). Carcass weights for DDGS, CM, and SBM were 850 lbs., 867 lbs., and 832 lbs. Steers fed CM averaged 35 lb heavier carcasses than

SBM ($P < 0.05$) and tended to have heavier carcasses than those fed DDGS ($P < 0.10$). Additionally, those fed DDGS tended to have heavier carcasses than SBM ($P < 0.10$).

No differences in ribeye area (REA) or marbling were detected due to feeding different coproducts in the rations ($P > 0.1$). Animals fed DDGS, CM, and SBM had ribeye areas of 12.7 in², 12.9 in², and 12.8 in², respectively. Marbling scores were 550, 546, and 525.

Rib fat (RF) thickness differed between groups ($P = 0.006$). Steers fed DDGS, CM, and SBM had rib fat measuring 0.66 in., 0.71 in., and 0.63 in., respectively. Steers fed CM had deposited more rib fat than steers fed SBM ($P < 0.05$) and tended to have thicker rib fat than steers fed DDGS ($P < 0.10$).

Differences in dressing percent (DP) were detected in the study ($P = 0.007$). The dressing percentages of steers fed DDGS, CM, and SBM were 63.07%, 63.78%, and 62.59%. Steers fed CM dressed approximately 1.19% higher than those fed SBM ($P < 0.05$).

Steers being loaded for market, May, 2024.