Journal of Animal and Veterinary Advances 5 (2) : 156-160, 2006

Effect of Including Flax in Beef Creep Feed on Performance and Subsequent Carcass Characteristics

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Abstract: Ninety-six cow-calf pairs with steers (663±9 kg initial cow BW; 168±1 kg initial calf BW) were stratified by cow age and steer weight and allotted randomly to one of 12 pastures. Pastures were assigned randomly to four treatments: 1) no creep feed (CON); 2) 0% flax (55% wheat middlings, 39.5% soy hulls; CRP; DM basis); 3) low flax (12.5% flax, 26.0% wheat middlings, 56.0% soy hulls; LOW; DM basis); or 4) high flax (25.0% flax, 69.5% soy hulls; HIGH; DM basis). All supplemented calves were offered CRP ad libitum for 21 d to acclimate calves to feed. Diets were offered ad libitum for 37 d prior to weaning. Calves were then co-mingled and fed a growing diet for 98 d after which they were fed a finishing diet for 143 d. Following finishing, cattle were transported to an abattoir, harvested, carcasses chilled for 24 h and carcass data and loin samples were collected. Creep-fed calves had greater pre-weaning ADG (p=0.05) than CON calves. Growing period ADG was not affected (p=0.34) by creep feed; however, creep-fed calves tended (p=0.11) to have greater finishing ADG. Flax addition had no effect on growing or finishing ADG (p=0.36 and 0.71, respectively) compared to CRP-fed calves. Creep-fed calves had greater HCW (p=0.05) and lower marbling scores (p=0.08) than CON. Calves fed flax had lower marbling scores (p=0.06) than those fed CRP; however, calves fed HIGH had greater marbling scores (p=0.08) than those fed LOW. Including flax in nursing steer creep feed for the last 37 d prior to weaning did not affect nursing calf or post-weaning performance, but may decrease marbling scores.

Key words: Beef steers, carcass composition, creep feed, flax, grazing

INTRODUCTION

Previous research has indicated that supplemental feed fed to nursing calves will increase weaning weights[1,2] and in many production scenarios, weaning weight is directly correlated to a producer's gross income[3]. Research on how creep feeding affects subsequent feedlot performance and carcass characteristics is not clear. Faulkner *et al.*[2] noted that creep feeding calves for 84 d reduced feedlot gain efficiency when placed on finishing diets, but that creep fed calves had a greater percentage of carcasses grade USDA choice compared to calves not offered creep feed. However, Tarr *et al.*[4] noted no differences in feedlot performance or carcass composition when creep feed was offered ad libitum.

Flax (*Linum usitatissimum*) is an oilseed that has a proximate analysis of 41% fat and 20% CP[5] and is very energy dense (2.82 Mcal/kg NE_m, 1.96 Mcal/kg NE_g[6]. Recent research has suggested that using flax in finishing diets can increase gain efficiency[7] and, when included at 5% in receiving diets and may increase the percentage of carcasses that grade USDA choice[8]. The objective of this trial was to determine if including flax in creep feed would affect nursing calf performance, subsequent post-weaning performance and resulting carcass composition.

MATERIALS AND METHODS

Animals and diets: All animal care and use procedures were approved by North Dakota State University's Institutional Animal Care and Use Committee prior to initiation of the study. Ninety-six cow-steer calf pairs (663±9 kg initial cow BW; 168±1 kg initial calf BW) were stratified by cow age and calf weight and assigned to one of 12 pastures (eight pairs per pasture). Pastures were assigned randomly to treatment (3 pastures/treatment).

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Table 1: Composition and analysis of creep feeds (% DM basis)

Item	Control	Low flax	High flax
Flax	--	12.5	25.0
Wheat middlings	55.0	26.0	--
Soybean Hulls	39.5	56.0	69.5
Molasses	4.2	4.2	4.2
Limestone	1.3	1.3	--
Dicalcium phosphorus	--	--	1.3
Analysis			
CP, %	16.6	15.6	14.8
ADF, %	24.5	26.7	34.3
NDF, %	44.9	43.2	48.7
Crude fat, %	2.3	5.9	12.2

Treatments (Table 1) were 1) no creep feed (CON), 2) creep feed containing 0% flax (CRP; DM basis); 3) creep feed containing 12.5% flax (LOW; DM basis) and 4) creep feed containing 25% flax (HIGH; DM basis). All creep feeds were pelleted, offered ad libitum and contained 4.2% (DM) molasses. Limestone was added to CRP and LOW and dicalcium phosphate was added to HIGH to maintain a Ca:P ratio of 2:1. In order to acclimate calves to feed and feeders, CRP was offered for the first 21 d of the trial after which treatment creep feeds were offered. Feed was weighed back once weekly to determine creep feed DM intake. Steers were implanted with 10 mg of estradiol benzoate and 100 mg of progesterone (Fort Dodge Animal Health, Overland Park, KS) at approximately 60 d of age and were not reimplanted prior to harvest. Treatment diets were offered for 37 d. Calves were weaned following the conclusion of the creep feeding period. After weaning they were fed a common growing diet (corn, corn silage and alfalfa hay) in a common pen for 98 d. Following growing period, they were transported (120 km) to the Carrington Research Extension Center, Carrington, ND feedlot. The steers were fed a diet based on corn and wet corn distiller's grains in a common pen for 143 d. Diets were offered once daily as a totally mixed ration. Diets were formulated to provide 232 mg monensin (Elanco Animal Health, Indianapolis, IN) daily and to meet the minimum daily requirements of minerals and vitamins[9].

Data and Sample collection and sample analysis: At the conclusion of the finishing period, steers were transported to Tyson Fresh Meats, Dakota City, NE (approximately 750 km), harvested and hot carcass weights were recorded. Carcasses were chilled for 24 h, after which 12th rib fat thickness and 12th rib longissimus area were measured and recorded. Marbling score, kidney, pelvic and heart fat percent, (KPH) and USDA quality grade were determined by trained North Dakota State University personnel and recorded. Longissimus muscle sections, caudal to the 12th rib and approximately 6 to 8 cm thick, were removed from the left side of each carcass, tagged to preserve individual animal identity and transported in coolers (< 4°C) to the meats laboratory at South Dakota State University where they were trimmed, vacuum packaged and aged at 4° C for 14 d. Following the aging period, one 2.54 cm-thick steak was removed and frozen at -20°C until they were evaluated for Warner-Bratzler shear force determination[10].

Statistical design and analysis: Data were analyzed using the GLM procedure of SAS (SAS Inst., Cary, NC) as a completely randomized design. Pasture was the experimental unit. Preplanned orthogonal contrasts were used to compare the CON to the average of the creep feeds (CRP, LOW and HIGH), CRP to the average of the flax containing creep feeds (LOW and HIGH) and LOW to HIGH.

RESULTS AND DISCUSSION

Performance: Intake and performance data are presented in Table 2. Creep intake was not affected by flax addition (p=0.26) or flax level (p=0.14). Intakes in this trial were consistent with other trials that offered creep feed ad libitum[4]. Creep fed calves gained more (p=0.05) while nursing compared to CON, but there were no differences found due to flax addition (p=0.85) or flax level (p=0.76). Creep fed calves had greater (p=0.04) weaning weights than CON. Gain efficiency was calculated by dividing the additional gain over the CON calves by the creep feed intake; however, no differences were noted for flax addition (p=0.98) or level of flax (p=0.44). The additional gain noted in creep fed calves is consistent with other literature[2,11,12] that offered nursing calves supplemental feed. Stricker *et al.*[13] reported that spring-born, creep fed calves were 32.2 kg heavier at weaning than non-creep fed calves. To our knowledge, no literature exists relative to addition of oilseeds to creep feed. Drouillard *et al.*[14] added flax to receiving diets at increasing levels and reported that 20% flax decreased DMI when compared to diets containing 10% flax; however, Maddock *et al.*[7] reported no differences in DMI when feedlot heifers had 8% flax added to the diet. Additionally, most literature relative to the addition of fat in beef cattle diets results in lower DMI[15,16]. Gibb *et al.*[17] reported increased DMI with increasing levels of sunflower seeds, but the authors attributed this to additional NDF found in the fibrous hull of the sunflower.

There were no differences noted for cow weight change due to creep feed (p=0.42) or flax addition (p=0.42); however, there was a tendency (p=0.11) for cows nursing calves offered HIGH to lose more weight than those nursing calves offered LOW. Most literature

Table 2: Effects of creep feed supplementation and flax addition to creep feed on calf creep feed intake, performance and cow performance

	Treatment[a]					*P*–values[b]			
Item	CON	CRP	LOW	HIGH	SE	Trt	Creep	Flax	Level
Calf									
Intial BW, kg	167.6	168.0	168.9	168.6	0.5	0.32	0.17	0.23	0.70
Weaning BW, kg	245.9	252.4	252.4	253.1	2.4	0.19	0.04	0.91	0.85
Creep DMI, kg/d	--	2.85	2.81	2.50	0.13	<0.001	<0.001	0.26	0.14
ADG, kg									
Nursing	1.35	1.46	1.44	1.45	0.04	0.21	0.05	0.85	0.76
Backgrounding	1.30	1.32	1.36	1.37	0.04	0.59	0.34	0.36	0.81
Finishing	1.42	1.71	1.90	1.68	0.17	0.31	0.11	0.71	0.37
Creep G:F,[c] g/kg	--	36.1	31.3	41.4	8.8	0.04	0.007	0.98	0.44
Cow									
Initial BW, kg	664.4	675.9	647.7	663.0	8.9	0.24	0.84	0.10	0.26
Final BW, kg	637.0	654.2	626.8	633.5	10.4	0.35	0.92	0.10	0.66
ADG, kg	-0.47	-0.37	-0.36	-0.51	0.06	0.28	0.42	0.42	0.11

[a]CON = No creep feed offered, CRP = control creep contained 0% flax, LOW = low flax creep contained 12.5% flax (DM basis) and HIGH = high flax creep contained 25% flax (DM basis), [b] *P*–values associated with F-test for treatment and pre-planned contrasts (TRT = treatment, creep = no creep vs. all creep feed, flax = control creep vs. creep feeds that contained flax and level = low flax vs. high flax), [c] G:F = Additional gain above control that can be attributed to creep feed per unit of creep feed consumed.

Table 3: Effects of creep feed supplementation and flax addition to creep feed on carcass composition, cooking loss and Warner-Bratzler shear force

	Treatment[a]					*P*–values[b]			
Item[c]	CON	CRP	LOW	HIGH	SE	Trt	Creep	Flax	Level
HCW, kg	361	392	411	393	14	0.17	0.05	0.58	0.38
12th rib fat, cm	0.76	0.86	0.96	0.88	0.08	0.38	0.14	0.57	0.47
LMA, cm^2	82.1	84.2	82.4	83.2	0.7	0.24	0.22	0.13	0.45
KPH, %	1.87	1.87	1.73	1.83	0.09	0.63	0.53	0.43	0.44
Yield Grade	2.76	2.62	2.71	2.60	0.08	0.47	0.21	0.75	0.37
Marbling[d]	450	444	400	431	11	0.05	0.08	0.06	0.08
Maturity[e]	165	166	164	166	2	0.77	0.86	0.45	0.50
Cooking Loss,%	26.8	24.5	26.8	26.1	0.8	0.19	0.29	0.07	0.56
WBS, kg	3.42	3.46	3.41	3.59	0.17	0.88	0.75	0.86	0.48

[a] CON = No creep feed offered, CRP = control creep contained 0% flax, LOW = low flax creep contained 12.5% flax (DM basis) and HIGH = high flax creep contained 25% flax (DM basis), [b] *P*–values associated with F-test for treatment and pre-planned contrasts (TRT = treatment, creep = no creep vs. all creep feed, flax = control creep vs. creep feeds that contained flax and level = low flax vs. high flax), [c] HCW = hot carcass weight, LMA = longissimus muscle area measured at the 12th rib, KPH = kidney, pelvic and heart fat and WBS = Warner-Bratzler shear force determination of tenderness, [d] 400 = small [0] and 500 = modest [0], [e] 100 = A and 200 = B.

suggests creep feeding has little affect on performance of the dam[1,4,18]. Subsequent calf gain during the growing period was not affected by creep feeding (p=0.34), flax addition (p=0.36), or level of flax (p=0.81). Lusby[19] reported that creep feed can be used as a preconditioning tool to acclimate calves to feed and to ease the transition from nursing to the feedlot; however, that was not found in this study. There was a tendency (p=0.11) for creep-fed calves to have greater ADG during the finishing period, however, no effect of flax addition (p=0.71) or flax level (p=0.37) was noted for finishing ADG. These results are in contrast with Faulkner *et al.*[2] who reported that calves offered creep feed were more efficient during the growing period but were less efficient during the finishing period. Additionally, Tarr *et al.*[4] noted decreased feedlot performance in calves that were creep fed compared to those that were not.

Carcass composition and shear force: Treatment effects on carcass composition, cooking loss and Warner-Bratzler shear force are reported in Table 3. Hot carcass weight was greater (p=0.05) for steers offered creep than CON; however, HCW was not affected by flax addition (p=0.58) or level of flax (p=0.14). Creep feed did not affect backfat (p=0.38); longissimus muscle area (p=0.22); or kidney, pelvic, heart fat percentage (p=0.53). Backfat and longissimus muscle area were not affected by flax addition (p=0.57 and 0.13, respectively) or flax level (p=0.47 and 0.45, respectively). Yield grade was not affected by creep feed (p=0.21), flax addition (p=0.75), or flax level (p=0.37). Creep feed calves had lower marbling scores (p=0.08) than CON calves and calves offered creep feed that contained flax had lower (p=0.06) marbling scores than those offered CRP. Calves fed HIGH had greater marbling scores (p=0.08) than those offered LOW. Steaks from steers fed flax had greater cooking losses (p=0.07) than those from CRP fed steers. There was no difference in cooking loss due to creep feed (p=0.29) or flax level (p=0.56). Warner-Bratzler shear force was not affected by creep feed (p=0.75), flax addition (p=0.86), or flax level (p=0.48).

The carcass results from this trial contradict previous literature relative to creep feeding. Morrow *et al*.[11], Tarr *et al*.[4] and Faulkner *et al*.[2] all reported increased fat thickness when comparing creep fed calves to non-creep fed controls. Additionally, Faulkner noted increased marbling scores in calves offered creep feed and correlated this to energy intake during the pre-weaning phase. Why these results are contrary to those discovered in this study are difficult to explain. One explanation may be the length of time calves were offered supplemental feed. In this trial it was 58 d (total of the acclimation and treatment feeding periods), whereas Faulkner *et al*.[2] and Tarr *et al*.[4] offered creep for 84 d prior to weaning, which might explain why creep feeding in this trial did not increase marbling, but did increase fat deposits in previous research, however it still leaves questions regarding why creep feed decreased marbling scores. Differences noted in cooking loss may be due to higher levels of unsaturated fatty acids previously reported in cattle which have been fed flax[8] which would have lower melting points and may result in greater fat loss during the cooking process.

CONCLUSIONS

Flax can be included in creep feed at up to 25% of the formulation without adversely affecting feed intake, but including flax in nursing calf creep feed does not improve cow or calf performance. However, creep-fed calves had greater preweaning ADG and finishing feedlot ADG when compared to calves not offered creep. Flax did not alter most carcass traits with the exception of marbling, which was lower in calves offered flax than those offered the control creep diet. Additionally, there was an effect of level noted for marbling, with 25% flax creep fed calves having greater marbling scores than those offered 12.5%.

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