EFFECT OF PROCESSING FLAX IN FEEDLOT DIETS ON BEEF HEIFER PERFORMANCE, CARCASS COMPOSITION, AND TRAINED SENSORY PANEL EVALUATIONS

Travis Maddock[1], Vern Anderson[2], Rob Maddock[3], Marc Bauer[1] and Greg Lardy1

[1] NDSU; [2]Carrington Research Extension Center;

[3]SDSU

This study was designed to investigate if processing flax would affect how cattle responded to flax inclusion in the diet. These data suggest flax addition increases gain and feed efficiency, and that processing flax is necessary to optimize feedlot performance.

A randomized complete block design was used to evaluate the effects of processing flax in beef feedlot diets. One-hundred twenty eight beef heifers (792.8 ± 31.0 lbs initial BW) were blocked by weight and assigned randomly to 16 pens (8 heifers/pen). Pens were then assigned to one of four diets. Heifers were fed a growing diet for the first 56 days after which they were stepped up to a finishing ration. The control growing diet consisted of corn, corn silage, alfalfa, barley malt pellets and linseed meal, and the finishing diet consisted of corn, corn silage, alfalfa, and linseed meal. Flax diets added whole, rolled, or ground flax to rations at eight percent of DM, replacing linseed meal and partially replacing corn. Supplements were formulated to provide 0.5 mg MGA, 2000 IU vitamin E, and 232 mg monensin daily. Heifers were harvested by block on days 96, 97, and 124 (two blocks) with carcass data and m. *longissimus lumborum* samples for shear force and sensory panel analysis collected. Dry matter intake (25.2 ± 0.4 lbs./d) was not affected ($P = 0.79$) by treatment. Flax addition increased ($P \leq 0.01$) ADG (lbs/d), feed efficiency (feed:gain), and hot carcass weight (lb; **HCW**), and increased KPH fat percent, and calculated yield grade. Processing (grinding or rolling) increased ($P \leq 0.001$) ADG, feed efficiency, and HCW. No treatment effects ($P \geq 0.23$) were noted for dressing percent, external fat, or ribeye area. Marbling score tended to increase with flax addition ($P = 0.14$). Steaks from cattle fed flax were less juicy ($P = 0.06$) than those from control diets, and steaks from cattle fed rolled flax were juicier ($P = 0.09$) than those fed ground flax. Treatment did not affect ($P \geq 0.16$) sensory tenderness or flavor ratings. Warner-Bratzler shear force tenderness was affected ($P = 0.06$) by treatment, with steaks from cattle fed flax rated more tender ($P = 0.04$) than the control cattle, and steaks from cattle fed processed flax were more tender ($P = 0.05$) than steaks from cattle fed whole flax. These data indicate including flax at eight percent of diet DM improves growth and efficiency of feedlot heifers, but may increase internal fat deposition and negatively affect yield grade. Additionally, processing flax is necessary to optimize these effects. Feeding flax reduced sensory panel ratings of beef juiciness, however flax did increase mechanical measurements of tenderness in the resultant beef.

Introduction

Many factors exist that affect the feedlot profitability of beef cattle including feed efficiency, average daily gain, and carcass quality. Increasing feed efficiency can significantly reduce feed costs and cattle with higher average daily gains can reduce yardage expenses. Historically, higher quality grades result in premiums for beef carcasses. This “spread” can be as much as $15/cwt between choice and select carcasses, and the prime vs. choice spread may exceed $5/cwt depending on seasonal price cycles. Depending on marketing strategy, cattle with greater marbling can be worth significantly more than those with lower quality grades regardless of overall beef demand.

Drouillard et al. (2002) reported that including flax at 10 percent of dry matter of receiving diets increased DMI, feedlot performance, and the percentage of USDA choice and prime cattle by greater than 10 percent. However, Maddock et al. (2003) reported no differences in marbling scores or quality grades in cattle fed six percent (DM) flax for the last 56 days prior to harvest. That study also reported that steers fed flax had lower trained sensory panel ratings for juiciness than cattle fed corn. Additionally, no data has been reported on the effect of processing flax on feedlot performance or carcass quality. Therefore, this trial was designed to investigate how processing flax included in feedlot diet at eight percent of dry matter would affect performance, carcass composition, and sensory panel evaluations of beef.

Procedures

One-hundred twenty-eight yearling beef heifers (792.8 ± 31.0 lbs.) were stratified by weight and assigned randomly to one of four treatment diets in a randomized complete block design. Heifers were sorted into 16 pens by weight, with eight heifers assigned to each pen. The four treatments (Table 1) were a non-flax control diet that consisted of corn, corn silage, alfalfa, and linseed meal as a protein supplement, and either whole, rolled, or ground flax replacing all linseed meal and partially replacing corn at eight percent of dry matter. Heifers were fed a growing diet for the first 56 days on feed, and then were stepped up to a finishing ration until blocks were harvested on days 96, 97, and two groups on day 124. Supplements were formulated to provide 0.5 mg melengestrol acetate, 2000 IU vitamin E, and 232 mg monensin daily. Cattle were harvested at Tyson/IBP Fresh Meats in Dakota City, NE. Carcass data and meat samples were collected and transported to the meats laboratory at North Dakota State University for further analysis. Warner-Bratzler shear force procedures were performed as a determination of tenderness and trained panelists were used for sensory evaluations of tenderness, juiciness, and flavor.

Table 1. Diet composition of control and flax diets

	Growing Diets[a]		Finishing Diets[a]	
Ingredient	Control	Flax	Control	Flax
		--100% DM Basis--		
Flax	--	8.00	--	8.00
Corn	31.00	27.00	79.00	75.75
Corn Silage	30.00	30.00	7.00	7.00
Alfalfa	14.00	14.00	7.00	7.00
Barley Malt Pellets	18.00	18.00	--	--
Linseed Meal	4.00	--	4.75	--
Supplement[b]	3.00	3.00	2.25	2.25

[a] Composition of flax diets was the same regardless of degree of processing.
[b] Supplements were formulated to provide 0.5 mg melengesterol acetate (MGA), 2000 IU vitamin E, and 232 mg monensin daily.

Results

The effect of treatments on feedlot performance and carcass traits are shown in Table 2. Treatment effects ($P \leq 0.01$) were noted for ADG and feed efficiency. Cattle fed flax had greater average daily gains ($P = 0.008$) than heifers fed the control ration and were more feed efficient ($P = 0.001$). Additionally, when compared to heifers in the whole flax treatment group, heifers fed processed (rolled or ground) flax had greater ($P \leq 0.01$) ADG and feed efficiency. There were also treatment effects ($P \leq 0.07$) for hot carcass weight (**HCW**), KPH fat percent, and yield grade, with flax fed heifers having heavier carcass weights, more KPH fat, and higher calculated yield grades than heifers fed the control diet. Processing flax also increased HCW ($P = 0.008$) when compared to those heifers consuming the whole flax diet. Marbling tended ($P = 0.14$) to be increased by flax addition to the diet. Table 3 summarizes treatment effects on sensory panel evaluations of palatability and Warner-Bratzler shear force determination of tenderness. Treatment did not affect ($P \geq 0.16$) sensory panel analysis of tenderness or flavor. There was a dietary effect ($P = 0.02$) on juiciness, with steaks from those heifers on flax diets having lower juiciness scores ($P = 0.06$) than steaks collected from heifers on the control diet. Steaks from the rolled flax diet were rated more juicy ($P = 0.09$) than steaks from heifers fed ground flax. Steaks from cattle fed flax had lower ($P = 0.04$) Warner-Bratzler shear force values than steaks from heifers fed the control ration and heifers fed processed flax produced steaks with lower values ($P = 0.05$) than those on the whole flax diet.

Table 2. Effects of processing flax on feedlot performance and carcass characteristics

Item	Diets[a]					P-values[b]			
	Control	Whole	Rolled	Ground	SE	Treatment	Control vs Flax	Whole vs Processed	Rolled vs Ground
DMI, lbs/d	25.6	25.0	25.1	25.1	0.4	0.79	0.34	0.90	0.96
ADG, lbs/d	3.08	3.18	3.42	3.41	0.08	0.01	0.008	0.01	0.64
Feed Efficiency	8.25	7.84	7.33	7.34	0.31	<0.001	0.001	0.008	0.68
HCW, lbs	702.2	716.2	729.5	726.8	5.4	0.001	<0.001	0.008	0.38
Dressing %	60.4	60.8	60.6	60.8	0.5	0.85	0.48	0.79	0.70
Backfat, in	0.49	0.52	0.55	0.53	0.03	0.33	0.14	0.42	0.45
REA. in^2	12.2	11.9	11.7	12.1	0.2	0.23	0.26	0.79	0.09
KPH, %	2.20	2.55	2.54	2.58	0.10	0.07	0.01	0.92	0.79
Yield Grade	2.93	3.20	3.40	3.21	0.09	0.03	0.01	0.38	0.17
Marbling[c]	431.6	477.5	469.8	456.2	13.1	0.14	0.04	0.39	0.48

[a] Control treatment was a basal, no-flax diet; whole, rolled, and ground treatments included flax in the diet at 8% of DM.

[b] P-values are associated with F-test for treatment and contrasts of control diets vs. diets that include flax, whole flax diet vs treatments where flax was processed, and the rolled flax diet vs the ground flax diet.

[c] Marbling scores are reported as 300 = slight 0 or low select, 400 = small 0 or low choice, and 500 = modest 0 or average choice.

Table 3. Effect of processing flax on sensory panel evaluations and Warner-Braetzler shear force determination of tenderness

Item	Diets[a]					P-values[b]			
	Control	Whole	Rolled	Ground	SE	Treatment	Control vs Flax	Whole vs Processed	Rolled vs Ground
Tenderness[c]	5.08	5.21	5.46	5.24	0.12	0.16	0.11	0.31	0.18
Juiciness[c]	5.54	5.19	5.50	5.27	0.10	0.02	0.06	0.09	0.09
Flavor[c]	5.29	5.23	5.44	5.41	0.09	0.30	0.54	0.07	0.82
Shear, lbs	8.15	7.91	7.01	7.29	0.33	0.06	0.04	0.05	0.49

[a] Control treatment was a basal, no-flax diet; whole, rolled, and ground treatments included flax in the diet at 8% of DM.

[b] P-values are associated with F-test for treatment and contrasts of control diets vs. diets that include flax, whole flax diet vs treatments where flax was processed, and the rolled flax diet vs the ground flax diet.

[c] Tenderness, juiciness, and flavor were evaluated on a scale of 1 to 8 with anchors of 1 = not at all tender, not at all juicy, no flavor at all and 8 = extremely tender, extremely juicy, and an extreme amount of flavor.

Discussion

Flax addition to feedlot diets increased ADG and feed efficiency. The performance data noted in this trial compares favorably to previous research (Drouillard et al., 2002; Farren et al., 2002), which found increases in performance, dry matter intake, and feed efficiency in receiving calves. Additionally, in this trial flax increased HCW and internal (KPH) fat measures without increasing muscularity (ribeye area), which resulted in higher numerical yield grades. There also was a tendency for flax addition to increase marbling scores. Again, these data are similar to those reported by Drouillard et al. (2002) which found that cattle fed flax at 10 percent DM had increased fat deposition and the percentage of cattle that graded choice or prime. However, Maddock et al. (2003) found no differences in measured carcass traits when flax was included in the diet at six percent of dry matter. This might suggest that eight percent flax may be necessary in order to see the full effects of adding flax to feedlot diets. It should be noted that the cattle in the Maddock et al. (2003) study were fed flax for only the last 56 days prior to harvest. Trained sensory panel observations in this trial are similar to Maddock et al. (2003), which found that flax fed cattle produced steaks that were rated less juicy than control diets. Panelists in this study also reported that flax fed cattle produced beef with lower juiciness scores, although steaks from the rolled treatment were rated similar to those from the control diet.

Implications

These results suggest that flax incorporated into the diet at eight percent of dry matter will increase average daily gain and feed efficiency and that processing of the flax is necessary to optimize these effects. Additionally, adding flax to feedlot diets can increase internal fat deposition and increase yield grades while tending to increase carcass quality grades. Palatability of beef may be affected by flax, as trained sensory panelists reported lower juiciness scores from flax-fed beef, however mechanical determination of beef tenderness indicated that feeding flax may increase tenderness.

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