Effect of Field Pea Level in Feedlot Finishing Diets on Animal Performance, Carcass Traits, Tenderness, and Taste Panel Response

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ABSTRACT
Yearling heifers (N = 118) were allotted by weight (initial wt = 926 ± 26.3 lbs.) in a randomized complete block design and sorted into 16 identical pens (four pens per treatment). Treatments were 0, 10, 20, and 30% dry-rolled field peas (DM basis) replacing dry-rolled corn and canola meal in corn-based finishing diets (62 Mcal NEg/cwt). Diets met or exceeded NRC requirements for protein. Heifers were fed for 74 days on treatment diets and shipped to a commercial abattoir. Ribeye area, fat thickness over the 12th rib, KPH, and HCW were measured to calculate USDA yield grade and quality grades were recorded. A 3-inch portion of the shortloin was secured from each carcass, aged for 14 days at 39°F and cut into two steaks. One was used for Warner-Bratzler shear force (WBSF) evaluation and the other for sensory analysis of tenderness, juiciness, off-flavor, and flavor intensity. Dry matter intake was greater (<.01) for control treatment vs. any of the pea treatments. Gains were not different (>.38) resulting in improved feed efficiency (P<.01) for the pea treatments. Carcass traits were not different except for fat thickness (P<.08) which was greatest for the 20% pea treatment. Increasing level of dietary field peas quadratically decreased (P = 0.001) WBSF (9.48 ± 0.33 lb.; 8.00 ± 0.33 lb.; 8.11 ± 0.35 lb.; 8.18 ± 0.33 lb. for 0, 10, 20, 30%, respectively). Sensory panel analysis indicated a linear increase in tenderness (P = 0.002) with addition of peas (4.56 ± 0.18; 5.14 ± 0.17; 5.28 ± 0.18; 5.34 ± 0.18 for 0, 10, 20, 30%, respectively). Sensory panel ratings indicated a tendency for increased juiciness (P = 0.14) and no differences in flavor (P = 0.21) or off flavor (P = 0.32) noted. The improved tenderness observed in this study has implications for improving beef acceptability and may provide consumers with a more consistently tender beef product.

Key words: field pea, tenderness, juiciness, beef, feedlot

Introduction
Field pea acreage is generally increasing throughout the Northern Plains states and Canadian provinces resulting in more field pea grain available for feed. Beef cattle are the largest potential year-round market for field pea grain. Past research with field pea grain has proven that it is a highly palatable and nutrient dense feed that improves animal performance in creep feeds and in beef cattle receiving diets. Feedlot research trials report equal or positive animal performance from field pea grain in growing and finishing feedlot diets. An NDSU Extension publication AS-1301 “Field pea grain for beef cattle” (Anderson and Lardy, 2005) is a review of beef feeding research. Anecdotal reports indicate that field pea grain in feedlot diets improves eating satisfaction for beef. There have been no taste panel comparisons, however. This trial was designed to study the effects of field pea grain in finishing rations on animal performance, carcass traits, tenderness, and taste panel response.

Materials and Methods
Feedlot
One hundred-eighteen yearling feeder heifers were weighed and blocked by weight and randomly allotted within block to one of four ration treatments. There were four pens or replicates for each treatment utilizing 16 pens. The four treatments were field peas included in the ration at 0, 10, 20, and 30% of the diet DM in corn-based rations. The alternate protein source was canola meal. Diet formulations are presented in Table 1. Corn and field peas were dry rolled. The finishing diets contained 62 Mcal per lb. (85% concentrate) and were fed for 74 days. The totally-mixed diets also included chopped straw, condensed separator by-product (a liquid co-product from the sugar beet processing industry) and a supplement that included an ionophore (Rumensin®; Elanco Animal Health,

Greenfield, IN), melangesterol acetate (MGA™; Pfizer Animal Health, Exton, PA), a vitamin premix, and a high calcium feedlot finishing mineral mix. Calves were fed once daily to appetite based on morning bunk readings, with feed recorded daily and summarized for each weigh period. Diets were assembled and mixed by treatment batch and distributed to respective pens in a three-auger, truck-mounted Knight LA-9 mixer wagon equipped with a digital scale. Pens were equipped with fenceline automatic water fountains and fenceline concrete bunks with a minimum of two feet per head. All heifers were marketed at the same time when visual appraisal of the animals suggested .4 inches of backfat and at least half would grade USDA Choice. Heifers were transported to a commercial abattoir (Tyson Fresh Meats, Dakota City, NE) for harvest. Carcasses were evaluated after a 48-hour chill.

Table 1. Rations fed to finishing heifers with increasing amounts of peas.

		Treatment			
Ingredient	Dry matter	0% Peas	10% Peas	20% Peas	30% Peas
		---------- Percent - Dry Matter basis ----------			
Dry-rolled corn	86	35.3	32.5	29.7	25.6
High moist corn	72	35.3	32.5	29.7	25.6
Field peas, rolled	89	0	10	20	30
Wheat straw, chopped	86	10	10	10	10
Cond separator by-product	60	5	5	5	5
Canola meal	89	10.6	6.2	1.9	0
MGA/Rumensin suppl	92	2.4	2.4	2.4	2.4
Calcium carbonate	95	1.4	1.4	1.4	1.4
Ration dry matter, %		80.3	80.9	81.5	82.3
Crude protein, %		13.43	13.45	13.51	14.37
Net Energy Gain (NEg) Mcal/cwt		62.01	62.34	62.66	62.75

A 3-inch (approximate) rib sample was procured from each carcass for sensory evaluation from the anterior end of the shortloins (NAMP #174; NAMP, 1997). Shortloin sections were aged in the vacuum packaged bags for 16 days postmortem at 39°F. After aging, shortloins were processed into 1-inch thick steaks. After steaks are exposed to air for approximately 15 min, a Minolta Chroma Meter CR-310 colorimeter (Minolta Corp., Ramsey, NJ) was used to record *longissimus* lean and subcutaneous fat L*, a*, and b* color space values. Steaks were weighed, individually vacuum packaged, and frozen at -40°F. Steaks were thawed at 39°F for 24 hours prior to cooking for tenderness and sensory panel analysis.

Warner-Bratzler Shear Force Determination

A mechanical tenderness test was conducted at the NDSU meats laboratory on cores from each steak along with color measurements of lean and fat.

One steak from each heifer was used for Warner-Bratzler shear force (WBS) evaluation (AMSA, 1995). Steaks were thawed for 24 hours at 36°F prior to cooking and thaw drip loss determined. Steaks were oven-broiled at 500°F until steaks reached an internal temperature of 160°F and then allowed to cool to room temperature and then weighed to determine cooking loss. Seven to ten .5 inch cores from each steak were obtained parallel to the muscle fiber. Each core was sheared once on a Warner-Bratzler shear machine (G-E Electric Manufacturing Co., Manhattan, KS). The mean of six cores was used in the statistical analysis.

Trained Sensory Panel
Sensory panelists were trained to evaluate initial tenderness, juiciness, sustained tenderness, and flavor intensity (Cross et al., 1978). Panelists scored samples by placing marks on 10-cm lines labeled at each end (0 = extremely tough, dry, and bland; and 10 = extremely tender, juicy, and intense beef flavor). A ruler was used to determine scores. Steaks were oven-broiled as previously described with the WBS evaluation. The sensory panel was conducted for 10 days with two sessions per day at 0900 and 1500 hrs. Five samples were given to each panelist per session and assigned randomly. Eight of 12 trained panelists were assigned to each session.

Statistical Analysis
Data were analyzed using SAS software with mixed-model procedures. Pen was the experimental unit. Significance, a term associated with a real vs. chance effects of the treatments tested, is reported at (P<.10) or when treatments effects have a 90% or greater chance of being real.

Animal Care and Management
This project was approved by the NDSU Institutional Animal Care and Use Committee and all animals were managed according the Guidelines for the Care and Use of Agricultural Animals in Agriculture Research and Teaching (FASS, 1999).

Results and Conclusions
Feedlot Performance
Dry matter intake was greater for the control (26.86 lbs./hd/day) vs. the field pea treatments (P<.01) which averaged 25.26 lbs./hd/day (Table 2) over the length of the study. Only during period two was dry matter intake not different (P<.20). Intake was similar for all pea treatments in each period and overall. Daily gains were not different (P=.38) over the entire feeding period as control heifers gained 3.50 lbs. per day vs. 3.41, 3.72 and 3.54 for the 10, 20, and 30% pea grain diets, respectively. However, during period 3, greater gains (P<.01) were recorded for the 10 and 20% pea diets than the 30% and control diet (Table 2). Feed efficiency favored the pea treatments during period 1 (P=.03), and overall (P<.01) with the same pattern observed in the analysis of gain efficiency, which is a reciprocal value. Two heifers were removed from the study unrelated to diet treatment, one heifer calved and one died.

Table 2. Performance of feedlot heifers finished with increasing levels of field peas.

	Treatment						
	0% Peas	10% Peas	20% Peas	30% Peas	St Err	P-Value	Peas vs. No peas
Average weight/hd, lb.							
June 3, 2005	929.3	926.9	916.2	925.6	26.30	0.67	0.57
July 1, 2005	1032.8	1038.0	1033.5	1026.4	28.50	0.91	0.83
July 29, 2005	1124.1	1121.5	1120.0	1118.4	27.80	0.99	0.91
August 16, 2005	1188.2	1179.0	1191.8	1187.3	27.90	0.84	0.84
Dry matter intake, lb./hd/day							
Period 1	26.74	24.88	24.63	24.22	0.73	0.12	0.01
Period 2	26.39	25.27	25.56	25.29	0.97	0.83	0.20
Period 3	27.79	25.47	26.99	25.91	0.76	0.18	0.03
Overall	26.86	25.17	25.56	25.04	0.77	0.36	0.01
Average Daily Gain, lb./hd							
Period 1	3.70	3.97	4.19	3.60	0.23	0.16	0.25
Period 2	3.28	2.99	3.09	3.29	0.16	0.85	0.86
Period 3	3.55[ab]	3.19[a]	3.98[b]	3.82[b]	0.20	0.01	0.78
Overall	3.50	3.41	3.72	3.54	0.11	0.15	0.38
Feed efficiency, feed per lb. gain							
Period 1	7.59[a]	6.39[b]	5.91[b]	6.77[ab]	0.44	0.09	0.03
Period 2	8.33	8.78	8.42	7.99	0.84	0.91	0.95
Period 3	7.71[ab]	8.12[a]	6.71[b]	6.79[b]	0.42	0.03	0.21
Overall	7.85[a]	7.41[a]	6.85[b]	7.08[ab]	0.29	0.02	0.01

[a,b] values with different superscripts have less than a 5% chance of this being a random effect.

Carcass Traits

Carcass traits (Table 3) were not affected by treatment with the exception of fat thickness (P=.08) which was greatest for the 20% treatment (0.46 in.) vs. control (.38) and 30% peas (.38) with 10% peas intermediate (.42 in.).

Table 3. Carcass traits of feedlot heifers finished with increasing levels of field peas.

	Treatment					
	0% Peas	10% Peas	20% Peas	30% Peas	St Err	P Value
Hot carcass wt, lb	710.3	715.5	716.3	710.9	7.77	0.92
Dressing percent	62.41	62.99	62.48	62.43	0.27	0.39
Rib eye area, sq in	12.20	12.56	12.54	12.02	0.30	0.53
Fat thickness, in	0.38	0.42	0.46	0.38	0.03	0.08
KPH fat, %	2.33	2.43	2.32	2.38	0.07	0.66
Yield Grade*	2.43	2.44	2.53	2.39	0.12	0.86
USDA Marbling score**	372	399	372	382	10.65	0.25
Percent Choice	47	57	39	40	-	-

* Yield Grade is a calculated score based on the fat to lean ratio of a carcass

** Marbling scores: 300-399 = select; 400-499 = choice

Mechanical Tenderness and Taste Panel Response

Mechanical tenderness and taste panel assessment of tenderness both significantly (P<.01) favored the three pea treatments over the control (Table 4). The Warner-Bratzler shear test required 9.48 lbs. of force for the 0% pea treatment vs. 8.00, 7.81, and 8.18 lbs., respectively, for the 10, 20, and 30% pea treatments (Table 4) Taste panel tenderness scores agreed with the mechanical test. Higher scores indicate more tender meat in this scale. Taste panel tenderness scores for the control pea treatment averaged 4.56 vs. 5.14, 5.28, and 5.35 for the 10, 20, and 30% pea treatments, respectively, a linear improvement with increasing pea level. Juiciness also improved (P<.04) with pea treatment. The control treatment juiciness score was 4.78 and respective pea treatments were 5.05, 5.14, and 5.14. Flavor intensity was greater (P<.10) for the 20% pea treatment vs. 0% peas with 10 and 30% pea treatments intermediate. No off-flavors were detected in any of the samples (P>.80).

Table 4. Tenderness and taste panel response to ribeye steaks from heifers fed increasing levels of peas.

	Treatment					
Item	0% Peas	10% Peas	20% Peas	30% Peas	St Err	P Value
WB Shear test, lb†*	9.48 [a]	8.00 [b]	7.81 [b]	8.18 [b]	0.33	0.01
Taste Panel Responses**						
Tenderness	4.56 [a]	5.14 [b]	5.28 [b]	5.35 [b]	0.17	0.01
Juiciness	4.78 [a]	5.05 [a,b]	5.14 [b]	5.14 [b]	0.13	0.04
Flavor intensity	5.06 [a]	5.11 [a,b]	5.31 [b]	5.14 [a,b]	0.09	0.10
Off-flavor presence	3.89	3.86	3.81	3.84	0.03	0.81

† Warner Bratzler mechanical shear test, lower score indicates less force required (more tender);* Lower score is more desirable

[a, b] Values with different superscripts are significantly different.

** Higher score is more desirable

Discussion

Feeders who have included pea grain in their cattle diets see palatability and performance advantages. In some previous studies, feed intake improved, especially in younger or newly-weaned cattle (Anderson and Stoltenow, 2004; Anderson and Schoonmaker, 2004). In this study, which started with

heavier cattle, feed intake was numerically reduced with peas in the diet, which is in agreement with Flatt and Stanton (2000). Both studies give some indication of improvement in feed efficiency. This study was prompted by frequent and consistent anecdotal input that beef fed peas is exceptionally tender and juicy, which has been proven to be true in the circumstances of this experiment. Feeders using peas now have the ability to market a potentially higher value beef product to processors and consumers.

While this study produced confident statistical results showing improved eating qualities with pea-fed beef, additional research is warranted to validate this data with different breeds and sex of animals fed and managed at other locations during a different time of the year. It is important to define exactly what may be causing the juiciness and tenderness effects and if we can isolate that factor for future supplement considerations. It may be useful to study improving the eating satisfaction of beef from older animals as well, and cattle with a propensity for lean growth and lower marbling scores.

Preparing ribeyes from pea-fed beef for the CREC Advisory Board.

Implications

No dietary treatment, additive, or other feed has been observed to affect the taste-panel response as much as field pea grain did in this experiment. With tenderness as the single most important criteria for consumer satisfaction, field pea grain could make a huge contribution to the beef industry by literally insuring improved tenderness and possibly juiciness of meat. Additional research is warranted to further explore this result. With pea acres increasing rapidly, the supply of peas should support increased use of the grain legume in feedlot finishing diets. Progressive niche marketers or branded beef enterprises should be very interested in procuring animals that have been fed peas to provide a superior eating experience to their customers.

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