Field Peas As An Ingredient In Fiber-Based Calf Weaning Transition Diets

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Summary

Transitioning calves from grazing to a feedlot environment is the subject of a long-term investigation. The objective of this project is to determine ruminal digestibility of field peas in medium concentrate diets, to evaluate the replacement value of field peas in calf weaning supplements and to measure the potential effect that short-term pea feeding, during the transition period following weaning, may have on subsequent carcass quality.

The evaluation of ruminal digestibility and microbial protein flow has been reported by Soto-Navarro et al. (2003).

Calves involved in the study were weaned in 2000, 2001 and 2002 and following a short 38.3 day weaning transitioning period the calves were sent to a commercial feedlot for finishing and subsequent carcass evaluation.

Combining three years, four hundred five crossbred heifer and steer calves have been weaned from fall pasture the first week of November each year and assigned to one of six weaning supplement treatments. Treatments consisted of chopped mixed hay that was replaced with six different pelleted complete weaning supplements. One supplement, SBM/Corn, consisted of 15.6% soybean meal and 77.8% corn. A second supplement, Pea/Corn, consisted of 62.0% peas and 31.4% corn. These two diverse starch-based supplements were compared to fiber-based supplements in which field peas replaced 0, 10, 20, and 30% of fiber ingredients. The fiber-based control diet was formulated to contain 39.4% soyhulls, 24.6% wheat midds, 20.0% barley malt sprouts and 10% corn. Soybean hulls, barley malt sprouts and wheat midds are highly digestible fiber co-products derived from North Dakota's soybean, malting and flour milling industries.

During the transitioning period, favorable growth response was observed up to 20% pea replacement (P=.0001). Response to the SBM/corn weaning supplement was comparable to that observed when up to 20% pea replaced fiber-based ingredients (P=.0001). Feed efficiency did not differ between treatments (P=.39). Replacing fiber-based ingredients with 30% pea reduced growth performance (P=.0001) but feed efficiency did not differ (=.39).

Steers within each treatment were sent to Decatur County Feed Yard, Oberlin, Kansas, for final finishing and carcass evaluation. Steers were on feed an average 134 days. Carcass measurements for days on feed (P= .40), hot carcass weight (P= .97), rib eye area (P= .33), marbling score (P= .14), yield grade (P= .72) and quality grade (P= .77) did not differ among any of the treatments tested. Across treatments 54.5% of steers graded choice compared to 68% among steers receiving a 20% pea replacement diet during 38.3d postweaning period. The 13.5% increase in the number of carcasses grading USDA Choice or better was not significantly greater (P= .77), however.

Net return to the cow/calf enterprise was estimated for each weaning transition supplement. Production expenses associated with weaned calf production (annual cow cost), short-term weaning transition cost and expenses associated with finishing were deducted from carcass income. Highest estimated returns to the cow/calf enterprise were $246.52, $234.90 and $240.16, respectively, for the soybean/corn, and the 20% and 30% field pea replacement diets.

Introduction

Weaning protocols that minimize weaning growth lag and help calves transition from grazing to a feedlot environment will reduce weaning stress. Calves that are weaned and on feed for an average of five to six weeks before shipment are less affected by changes in feeding environment and are better prepared to enter various marketing and production channels. Utilization of weaning feeds by producers during the transitioning period prior to movement to a commercial feedlot is part of a sound weaning management program. Current commercial feed formulations utilize a variety of highly digestible fiber-based ingredients (soyhulls, wheat midds, barley malt sprouts, beet pulp, etc.) to prepare weaning feeds. Although North Dakota research with field peas has shown field peas to be an excellent feedstuff in creep feeds for grazing calves, and as a source of protein and energy in backgrounding and finishing diets, field peas have received limited

attention as an ingredient in weaning transition supplements.

Peas contain more than 50% starch. The starch content of pea grain is of concern when peas are to be used as an ingredient in weaning supplements, since starch, when introduced in forage-based diets, has been shown to decrease forage intake and (or) digestibility resulting in reduced performance (Chase and Hibberd, 1987; Sanson and Clanton, 1989). Limited Canadian research with dairy cattle suggests that the degradability rate of pea starch is slower than that of conventional cereal grains such as barley, wheat and oats, and are similar to corn (Robinson and McQueen, 1989).

Hypothesis and Research Objectives:

Our research team hypothesized that replacing up to 30% of the digestible fiber co-products with field peas in weaning transition supplements, fed for six weeks prior to steer movement to a commercial feedlot, would result in comparable or improved animal performance and efficiency that may subsequently improve carcass quality. Additionally, the research sought to identify the effect of field pea replacement on diet intake, ruminal digestion, microbial efficiency, duodenal proein flow and total tract digestibility. The goal of these two investigations is to provide essential nutritional and feeding management information for producers that want to feed field peas after weaning and have elected to retain ownership of their calves to final harvest.

Project Objectives:

1. Using ruminally and duodenally cannulated steers, evaluate the effect of field pea inclusion on diet intake, ruminal digestion, microbial efficiency, duodenal protein flow and total tract digestibility.

2. Using freshly weaned, spring born calves, evaluate the replacement value of field peas for up to 30% of the fiber-based co-product feedstuffs in weaning transition supplements and evaluate subsequent effect on carcass characteristics.

3. Evaluate the economics of replacing fiber-based co-products with field peas under varying ingredient and calf prices, and beef price slides, when compared to conventional energy sources in a retained ownership program.

Procedure

Over three years, four hundred five crossbred heifer and steer calves have been weaned from fall pasture the first week of November each year and assigned to one of six weaning treatments. Calves were weaned and stratified across treatments based on sex and weaning weight. Supplement treatments evaluated were two grain-based supplements to include either soybean meal and corn or field peas and corn and four fiber-based supplements that containing 0, 10, 20 and 30% pea replacement for fiber-based ingredients (Table 1). The fiber-based control diet was formulated to contain 39.4% soyhulls, 24.6% wheat midds, 20.0% barley malt sprouts and 10% corn. Incremental pea inclusion replaced a proportional amount of soyhulls, wheat midds, and barley malt sprouts in each test supplement. Four pen replicates of six to eight calves per pen have been fed an average of 38.3 days prior to shipment to Decatur County Feed Yard, Inc., Oberlin, Kansas. Weaning feeds evaluated were prepared as complete feeds, medicated with decoquinate for coccidiosis control at the rate of 22.5 mg/100 lbs. body weight, and pelleted commercially. Five weeks before weaning all calves were vaccinated with One Shot Ultra® and Cattlemaster 4®. A booster vaccination of Cattlemaster 4® was administered at weaning. Calves assigned to the experiment were weaned over a four day period and received chopped grass hay ad libitum until all calves were in the drylot. Once all calves were weaned and delivered to the drylot pens, ground hay was gradually replaced with the experimental weaning supplements until calves in the grain-based groups were consuming from 11 to 14 pounds/hd/day and up to 21 pounds/hd/day among the calves receiving the fiber-based pea replacement supplements. The amount of supplement offered to calves receiving the SBM/Corn and Pea/Corn treatments were limited due to the high level of starch present in these two supplements.

Upon completion of the 38.3-day transition feeding period, heifer calves were retained and steer calves from each experimental treatment were shipped immediately to the Decatur County Feed Yard, Inc. Steers were fed to final harvest and individual feedlot performance was obtained using Decatur's Electronic Cattle Management (ECM) program. Steers were slaughtered at Excel Packing Company, Dodge City, Kansas.

Results

Combined years (00, 01, 02) weaning growth and efficiency are summarized in Table 2 and subsequent feedlot performance and carcass measurements are shown in Table 3. Using challenge feeding, calves receiving the experimental weaning diets, shown in Table 1, were worked up to predetermined intake levels during the first 10-14 days immediately after weaning. During the conversion, test supplements replaced ground mixed hay until the calves were consuming from 67% (starch-base) to 88% (fiber-base) of their daily intake from test supplements.

Growth performance was greatest among calves that received weaning supplements containing SBM/corn, and 0, 10, and 20% pea replacement diets (P=.0001). Average daily feed intake (ADFI) was greatest for calves that received from 0 to 20% pea replacement (P=.0001). Replacing 30% of the fiber-based ingredients with peas reduced gain and feed intake, and as expected, increased feed required per pound of gain. While some numerical differences were measured across treatments for feed efficiency, differences observed were not significant (P=.39). It is important for freshly weaned calves to begin eating as soon as possible after weaning. Average daily feed intake was highest for calves offered 0, 10 and 20% pea replacement diets. Intake among calves receiving the SBM/corn and 30% pea diets was intermediate. In calves receiving the Pea/Corn supplement, ADFI was reduced significantly (P=.0001).

At the end of the 38.3 day weaning transition period, steers within each treatment were sent to Decatur County Feed Yard, Oberlin, Kansas, for final finishing and carcass evaluation. Employing the electronic cattle management system in use at Decatur, steers were fed to attain 0.40 inch backfat as the endpoint target for slaughter. Steers were fed in the commercial yard for an average 134 days across treatments. Days on feed between treatments did not differ, however, steers that received a 20% field pea replacement diet during transitioning required numerically fewer days on feed (129 vs. 134). Measured carcass characteristics included hot carcass weight (P= .97), rib eye area (P= .33), marbling score (P= .14), yield grade (P= .72), quality grade (P= .77) and percent choice (P= .77). None of the carcass measurements differed significantly. In this data set, individual marketing according to predetermined specifications associated with the ECM system effectively removed outliers commonly associated with whole pen marketing systems. Across treatments 54.5% of steers graded choice compared to 68% among steers that received a 20% pea replacement during weaning transition. Although not significant, this is a 13.5% increase in the number of carcasses graded USDA Choice or better.

Enterprise analysis with respect to retained ownership has been summarized in Table 4. Income from finished carcasses and direct production expenses to include weaning transition feed, transition yardage, feedlot cost (yardage, feed, health treatment, ECM fee), freight and annual cow cost of production were used to estimate net return to the cow/calf enterprise. Highest return to the cow/calf enterprise of $246.52 was obtained with the soybean/corn weaning transition supplement followed by $240.90 for the 30% pea replacement supplement and $234.90 for the 20% pea replacement supplement. Lowest return to the cow/calf enterprise of $207.25 was documented when a field pea/corn transition supplement was fed after weaning. Replacing 0% and 10% of fiber-based ingredients with peas resulted in net returns per cow of $227.91 and $220.23, respectively.

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Acknowledgment:

This project was funded in part by grant #BAK792-01 received from the USDA/CSREES Cool Season Food Legume Program administered at the University of Idaho.

Table 1. Complete pelleted weaning transition feed formulation and nutrient analysis (% As Fed).

	SBM/ Corn	**Pea/ Corn**	**0% Pea**	**10% Pea**	**20% Pea**	**30% Pea**
Corn	77.801	31.365	10.0	10.0	10.0	10.0
Peas	0.0	62.046	0.0	10.0	20.0	30.0
SBM	15.601	0.0	0.0	0.0	0.0	0.0
Soyhulls	0.0	0.0	39.421	38.226	37.086	35.628
Wheat Midds	0.0	0.0	24.56	20.748	16.888	13.346
Barley Malt Sprouts	0.0	0.0	20.0	15.0	10.0	5.0
Molasses	5.0	5.0	5.0	5.0	5.0	5.0
Limestone	0.85	0.85	0.3	0.3	0.3	0.3
Dical	0.1	0.1	0.1	0.1	0.1	0.1
Salt	0.5	0.5	0.5	0.5	0.5	0.5
TM Premix	0.075	0.075	0.075	0.075	0.075	0.075
Vit A & D	0.025	0.025	0.025	0.025	0.025	0.025
Decoquinate	0.0489	0.0386	0.0269	0.0269	0.0269	0.0269
Total	100.0	100.0	100.0	100.0	100.0	100.0
Cal. As Fed Anal.						
CP, %	16.0	16.1	16.5	16.2	16.0	15.7
TDN, %	85.2	79.2	69.3	69.9	70.7	77.5
C. Fiber, %	2.8	5.0	18.0	17.9	17.9	17.7
Fat, %	3.6	2.2	2.4	2.4	2.3	2.2
Deg. CP, %	58.0	70.3	71.4	72.0	72.9	73.7
Ne_m, Mcal/lb	0.96	0.87	0.73	0.74	0.75	0.76
Ne_g, Mcal/lb	0.65	0.59	0.46	0.47	0.48	0.49

Table 2. Three year combined weaning transition diet growth and efficiency (00, 01, 02).

	SBM/ Corn	Pea/ Corn	0% Pea	10% Pea	20% Pea	30% Pea	P-Value
No. Calves	68	68	68	68	67	66	
Ave. Days Fed	38.3	38.3	38.3	38.3	38.3	38.3	
St. Wt.	607.20	614.89	610.60	608.93	630.26	603.91	.73
End Wt.	703.11	689.80	714.44	709.02	726.84	688.37	.28
Gain	95.91[a]	74.91[c]	103.82[a]	100.09[a]	96.58[a]	84.46[b]	.0001
ADG	2.54[a]	2.00[c]	2.75[a]	2.65[a]	2.57[a]	2.24[b]	.0001
ADFI, (As Fed)	16.74[c]	15.17[d]	19.36[a]	18.17[b]	18.66[a]	17.19[bc]	.0001
F:G	7.02	8.13	7.11	7.19	7.32	8.16	.39
Feed Cost/Hd, $	37.53	35.03	46.14	44.21	44.30	41.10	
Feed Cost:Gain, $	.387	.470	.438	.444	.448	.500	

[1]One calf died.

Table 3. Three year combined feedlot growth performance and carcass measurements (00, 01, 02).

	SBM/ Corn	Pea/ Corn	0% Pea	10% Pea	20% Pea	30% Pea	P-Value
Growth Performance:							
Receiving Wt.	732.2	724.3	733.3	736.1	749.1	725.9	0.79
Harvest Wt.	1173.6	1170.8	1169.7	1174.8	1165.9	1173.0	0.99
Days at Feedyard	134.6	140.9	131.1	134.9	129.0	135.7	0.40
ADG	3.27	3.19	3.32	3.29	3.24	3.31	0.75
Feed:Gain Efficiency	6.0	6.0	5.85	6.0	6.0	5.81	0.55
Carcass Measurements:							
Hot Carcass Wt.	739.7	730.6	740.6	738.1	731.7	734.1	0.97
Rib Eye Area	11.93	11.61	11.67	12.02	11.7	11.6	0.33
Marbling Score[1]	49.01	54.43	52.84	52.7	54.32	47.95	0.14
Yield Grade	3.15	3.21	3.27	3.11	3.21	3.14	0.72
Quality Grade[2]	2.46	2.44	2.53	2.46	2.36	2.48	0.77
Percent Choice, %	56.0	55.3	53.2	55.8	68	52.0	

[1] Marbling Score: First two years of study shown (00 and 01) - Marbling Score relationship to USDA Degrees of Marbling are as follows 10-19 Practically Devoid-Standard, 20-29 Traces-Standard, 30-39 Slight-Select, 40-49 Small-Choice, 50-59 Modest-Choice, 60-69 Moderate-Choice, 70-79 Slightly Abundant-Prime, 80-89 Moderately Abundant-Prime, 90-99 Abundant-Prime.
[2] Quality Grade: 1= Prime, 2= Choice, 3= Select, 4= Standard.

Table 4. Three year economic analysis for finishing and return to the North Dakota cow calf enterprise through retained ownership (00, 01, 02).

	SBM/ Corn	Pea/ Corn	0% Pea	10% Pea	20% Pea	30% Pea	P-Value
Feedlot Analysis:							
Income:							
Carcass Value, $	$885.99	$849.29	$871.04	$863.32	$871.08	$879.72	0.71
Expenses:							
Receiving Calf Cost, $ [1]	($632.56)	($624.25)	($631.96)	($634.17)	($643.54)	($630.05)	0.70
Feedlot Cost/Head, $ [2]	($236.46)	($241.68)	($231.24)	($233.24)	($226.14)	($232.99)	0.81
Net Return to Finishing, $	$16.97	($16.64)	$7.84	($4.09)	$1.40	$16.68	
Cow-Calf Enterprise Analysis:							
Income:							
Carcass Value, $	$885.99	$849.29	$871.04	$863.32	$871.08	$879.72	
Expenses:							
Transition Feed Cost, $ [3]	($37.53)	($35.03)	($46.14)	($44.21)	($44.30)	($41.10)	
Transition Yardage Cost, $	($8.25)	($8.25)	($8.25)	($8.25)	($8.25)	($8.25)	
Feedlot Cost/Hd, $ [2]	($236.46)	($241.68)	($231.24)	($233.24)	($226.14)	($232.99)	
Annual Cow Cost [4]	($341.03)	($341.03)	($341.03)	($341.03)	($341.03)	($341.03)	
Freight to Feedlot/Hd, $	($16.20)	($16.05)	($16.47)	($16.36)	($16.46)	($16.19)	
Net Return to ND Cow/Calf Enterprise with Retained Ownership, $ [5]	$246.52	$207.25	$227.91	$220.23	$234..90	$240.16	

[1] Receiving Calf Value established using price slide at Decatur County Feed Yard.
[2] Feedlot Cost/Head includes cost of processing, treatment, and electronic cattle management.
[3] Transition Feed Value from Table 2.
[4] Annual Cow Cost from Annual Report 2002, ND Farm and Ranch Business Management Education Program, Table 12-1.
[5] Net Return to Cow/Calf Enterprise with Retained Ownership calculation: gross carcass value less weaning transition cost, total finishing cost, shipping cost, and the Dickinson Research Extension Center's estimated annual cow cost of $341.03.