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Organic farming research project report submitted to the Organic Farming Research Foundation:

Project Title:

Feeding beef cattle to produce healthier and highly acceptable beef

FINAL PROJECT REPORT

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Summary

An on-farm study was conducted to compare the finishing performance of cattle that were fed to choice grade either on pasture or in the drylot. A corn-soybean concentrate mixture was fed at 0.5 to 1.0% of body weight to pasture-fed cattle and at 2.0% of body weight to drylot-finished cattle. Average daily gain was significantly faster for the drylot-fed cattle. However, sensory evaluation and tenderness tests of ribeye steaks from pasture-fed cattle were similar to those from the drylot-fed cattle. Conjugated linoleic acid concentrations of ribeye steaks, trim, and adipose tissue from pasture-finished cattle were more than twice the concentration in the same parts from the drylot group. Economic analysis shows that drylot-finished cattle have higher values than pasture-fed cattle. However, total cost of the pasture system was much less; hence, greater profit per head of pasture-fed cattle was realized.

Introduction

The typical ration for finishing beef cattle today is composed of about 70-90% grain, with the upper limit of the range practiced towards the last month before harvest of the animal. Large amounts of grain are fed to attain a choice carcass grade and the grain-fed taste that many customers seem to prefer. Our system of finishing beef cattle is similar to many other producers, although the percentage of grain may not be as high.

As an organic beef producer, pasture grazing is an integral part of our beef cattle production. Previous research including reports from a SARE-funded project, of which we are a participant, has shown that beef from pasture-based cattle fed lesser grain supplementation have higher conjugated linoleic acid (CLA) concentration than those fed diets with high concentrates. This study was conducted for two reasons. The first reason is to produce leaner beef with higher concentrations of potentially healthful fatty acids such as CLA. Second, the pasture feeding system should decrease the amount of organic corn to be fed to animals; hence, more will be available for sale for other uses and generate greater farm income. Having set these two premises, we conducted this research to determine if we can produce beef that is potentially healthier and highly acceptable to consumers by feeding cattle on pasture with less amount of grains during the finishing phase.

Objectives

1. Determine the differences in CLA content of organic beef produced by cattle that are grass-finished with minimal grain to that from cattle that are conventionally grain-finished.
2. Determine the time required for cattle to grade at least low choice when finished by the two finishing systems.
3. Determine the economic differences between the two finishing systems.
4. Determine the profitability of marketing grass-finished cattle through Organic Valley-CROPP.
5. Determine eating quality of beef produced by the two finishing systems.

Methodology

This study was conducted at the Rosmann Family Farms owned by Ron and Maria Rosmann of Harlan, IA, which was started on April 30, 2002. Thirty yearling Red Angus cross steers and heifers were selected and fed to choice grade either on pasture or drylot. The cattle on the pasture treatment grazed forages consisting primarily of cool-season endophyte-free tall fescue with some orchardgrass and alfalfa. The drylot group of cattle were fed with ground alfalfa-orchardgrass hay as the forage source. Two mortalities from the pasture group were incurred on June 17, 2002 and were caused by acute acidosis resulting from accidental excessive availability of ground corn released from a grain bin installed in the pasture. In addition to the basal forages, both groups of cattle were fed a concentrate mixture composed of 86.60% ground yellow and white corn, 12.08% ground raw soybeans, and 1.32% minerals on a DM basis. Toward late summer (beginning in September), the percentage of soybeans in the concentrate mixture was increased to 14.51% (DM basis) but the proportion of minerals was maintained. Pasture-fed cattle were targeted to receive the concentrate mixture at about 0.5% of body weight in early summer, which then was increased to 1.0% of body weight beginning in July. The percentage of concentrates in the drylot system was increased gradually to about 2.0% of body weight and was maintained at this level for the last 90 to 120 days of the finishing period, which is the typical diet for finishing cattle in the Rosmann Family Farms. In addition to the concentrate mixture, all animals were allowed free access to salt and minerals.

The cattle were harvested upon reaching choice grade, which was based on visual examination of fat cover across the loin and rump area and on each side of the tail. The animals were transported to two different packing plants. Nine cattle from the pasture group and 8 from the drylot group were slaughtered and processed at Amend Packing, Des Moines, IA. The rest of the animals were slaughtered and processed at Lorentz Meats, Cannon Falls, MN. All carcasses were graded by a USDA federal beef grader.

Three steaks from the 12^{th}-13^{th} rib of the carcasses from animals that were slaughtered and processed at Amend Packing were removed and transported to Iowa State University. For beef quality measurements, one steak was used for sensory evaluation and a second steak was tested for tenderness by the Warner-Bratzler method. The third steak was assayed for total lipid content and fatty acid composition. In addition to ribeye steaks, a sample of trim (85% lean, to represent hamburger patties material) and subcutaneous adipose tissue from the rump area were obtained from each carcass.

Sensory evaluation of steaks was undertaken by a standing panel in the sensory evaluation unit of the Center for Designing Foods to Improve Nutrition (CDFIN), Iowa State University. Each member of the standing panel, composed of 4 well-trained subjects, was given the opportunity to taste and score the steaks on several sensory attributes.

The steaks were thawed for 48 h at 4 ^{0}C and broiled to an internal temperature of 71 ^{0}C in a grill (George Foreman Grilling Machine, Mt Prospect IL, Model GR36TMR). About 1.27-cm cube of the cooked steak was served to each panelist. On a scale of 1 to 10, each panelist scored the cooked meat for juiciness, tenderness, chewiness, flavor, and off-flavor attributes.

In addition to determination of tenderness by sensory evaluation, this beef quality attribute was further tested by the Warner-Bratzler method. Three1.27-cm diameter cores were cut parallel to the muscle fibers of each steak. Then, the cores were cut perpendicular to the muscle fibers with a Warner Bratzler shear attached to an Instron universal testing machine (Instron Universal Testing Machine, Instron Corporation, Canton, MA, Model 4502) equipped with a 10 kilo Newton load cell and at a crosshead speed of 200mm/min. Beef tenderness was determined by measuring the force required to shear the core. The mean shear force of triplicate determination was used for statistical analysis.

The steak, trim, and adipose tissue samples were assayed for content of dry matter (DM) and total lipids and for fatty acid composition. Dry matter content was determined by drying about 1 g of ground sample at 105 ^{0}C for 24 h. Total lipids were extracted by the modified Folch method using chloroform and methanol. The extracted lipids then were stored at –20 ^{0}C, and about 9 to 10 mg was butylated eventually with butanol and acetyl chloride. The butyl esters of fatty acids were separated by gas chromatography and identified by comparing their retention times with individual standard fatty acids. Concentration of each fatty acid including the major isomers of CLA were determined. Atherogenic index (AI), which is an index of healthfulness, was calculated for each beef part.

A monthly farm visit was done to collect samples of hay, pasture and concentrate mix. At the end of the experimental period, the feed samples were composited, subsampled and dried in a forced-draft oven at 55 ^{0}C for 72 h. The dried forages then were ground in a Willey mill and the concentrate mix was ground in a Retsch ultra centrifugal mill (Glen Mills Inc., Clifton, NJ). Both grinders were equipped with a 2-mm size screen. The feed samples then were analyzed for fatty acids as described earlier.

Results

The performance data of cattle finished on pasture or drylot are presented in Table 1. The average starting weight of the pasture-fed cattle was slightly lighter than those in the drylot system. As all cattle were fed to choice grade, pastured cattle fed lesser grain supplementation had 55 days longer feeding time than did those fed in the drylot. The average final weight of the pasture-fed cattle was about 12 kg heavier than that of the drylot-finished cattle. Average daily gain (ADG) of the pasture-fed cattle was significantly slower than that of cattle fed a higher percentage of concentrates in the ration. In the absence of an accurate estimate of pasture DM consumption, only the concentrates consumption was included in the calculation of feed to gain ratio (F:G) for pasture-fed cattle. However, both ADG and F:G are considered low compared with current beef cattle industry standards. Feedyard performance of cattle in December 2003 from 25 feedlots showed ADG of 1.52 kg and 1.36 kg for steers and heifers, respectively (Feedstuffs, January 19, 2004). In the same report, feed to gain ratios were 5.92 and 5.98 for steers and heifers, respectively (Feedstuffs, January 19, 2004). The lower performance of cattle from this study could be attributed partially to the non-use of hormones and ionophores, being an organic farming system. Hormones are known to improve weight gains, whereas ionophores will improve feed efficiency.

Table 1. Performance of cattle finished on pasture or drylot.		
	Finishing system	
Item	Pasture	Drylot
Number of animals	13	15
Starting weight, kg	394 ± 54	398 ± 46
Ending weight, kg	584 ± 64	578 ± 63
Average days fed	278	183
Average daily gain, kg[1]	0.68 ± 0.09[b]	0.98 ± 0.13[a]
Feed:gain	8.71[2]	14.18
[1]Means within a row with unlike superscripts differ ($p \leq 0.05$).		
[2] DM intake calculation does not include pasture consumption.		

The data on sensory evaluation and pH of the ribeye steaks are presented in Table 2. The differences in sensory evaluation attributes and pH of ribeye steaks were not significant ($p>0.05$) between the two treatments. The results indicate that the amount of concentrates fed to the pasture-finished cattle was still adequate to produce a similar quality of beef as those fed with higher amounts of concentrates.

Table 2. Sensory evaluation and pH of ribeye steaks from cattle finished on pasture or drylot.			
	Finishing system		
Attribute[1]	Pasture	Drylot	p-value
Juiciness	5.83 ± 0.68	5.43 ± 1.24	0.418
Tenderness	6.61 ± 1.41	7.00 ± 1.06	0.555
Chewiness	3.14 ± 0.99	2.43 ± 0.51	0.109
Flavor	2.08 ± 0.50	2.43 ± 0.31	0.134
Off-flavor	3.61 ± 1.68	2.39 ± 0.92	0.107
pH	5.56 ± 0.09	5.55 ± 0.11	0.833
	n=9	n=7	
[1]On a scale of 1-10, higher scores are better for juiciness, tenderness, and flavor and lower scores are better for chewiness and off-flavor.			

The tenderness of steaks was tested further by the Warner-Bratzler shear test method. Figure 1 shows the Warner-Bratzler shear force of the steaks from pasture- and drylot-finished cattle. Steaks from cattle in both feeding systems are considered to be tender, and the difference in shear force required to cut the muscle fibers of steaks between the two treatments was not significant ($p>0.05$). This result supports the sensory evaluation data in that steaks from pasture-fed cattle were just as tender as those from cattle fed higher amount of grains.

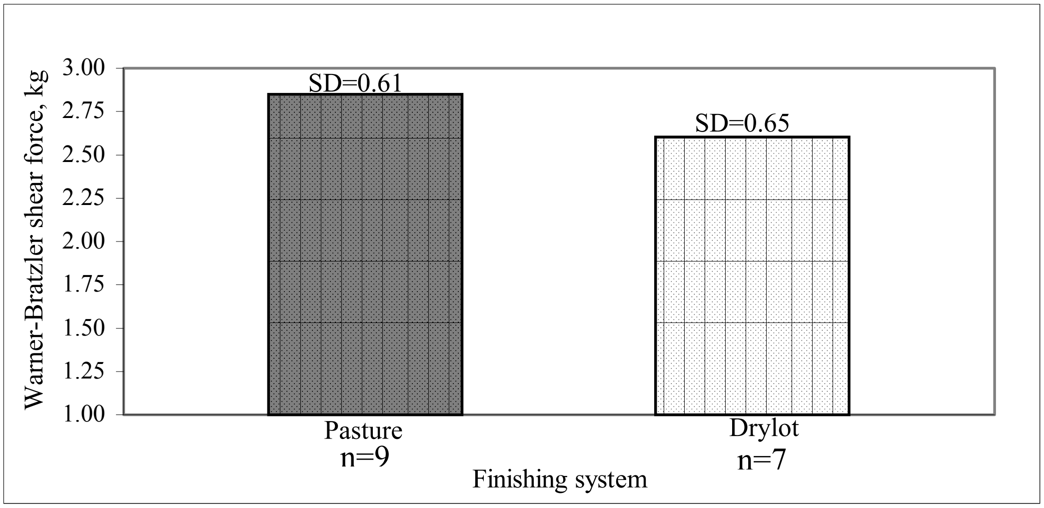

Figure 1. Test of ribeye steak tenderness by Warner-Bratzler shear method.

The dry matter and total lipid content of the different beef parts are presented in Table 3. The adipose tissue had the highest DM and total lipid contents, whereas the ribeye steak had the lowest values. Within a beef part, DM content did not differ significantly between pasture and drylot systems. Although total lipids of ribeye steak and adipose tissue from pasture-fed cattle were numerically higher, the differences were not significant ($p>0.05$). Only the trim lipid content was affected significantly by the finishing system of cattle where trim from drylot group had more than twice the concentration in trim from the pasture treatment.

Table 3. Dry matter and total lipid contents of the different beef parts[1].

Beef part[2]	Finishing system	Dry matter, %	Total lipids, % (wet basis)
Ribeye steak	Pasture	26.40 ± 1.41	4.02 ± 1.02
	Drylot	26.07 ± 1.76	3.50 ± 1.61
Trim	Pasture	30.87 ± 5.39	6.62 ± 3.08[b]
	Drylot	31.13 ± 2.64	15.20 ± 4.81[a]
Adipose	Pasture	90.64 ± 5.56	80.72 ± 10.10
	Drylot	91.19 ± 10.80	83.05 ± 3.20

[1]Means within a column and within a beef part with unlike superscripts differ ($p \leq 0.05$).

[2]n=9 for parts from pasture-fed cattle, except for trim where n=8; n=7 for parts from drylot-fed cattle.

The fatty acid composition of the pooled samples of pasture grass, ground hay, and concentrate mixture are shown in Table 4. Linolenic acid (C18:3*n-3*) comprised the greatest percentage of the total fatty acids for pasture and hay forages, whereas linoleic acid (C18:2*n-6*) was the largest component among the fatty acids in the corn-based concentrate mix. Pasture forage had the highest ratio of omega-3 to omega-6 fatty acids, and this ratio was lowest for the concentrate mix. Atherogenic index was similar for pasture and hay forages, which were higher than that of the concentrate mix.

Table 4. Fatty acid composition of feeds.

	Pasture	Hay	Concentrate mix
Fatty acid	----------------g/100 g of fatty acids----------------		
C12:0	0.79	0.83	nd
C14:0	1.07	1.38	0.04
C14:1	0.10	0.27	nd
C15:0	0.20	0.40	nd
C16:0	19.27	18.99	11.61
C16:1	0.53	0.80	0.08
C17:0	0.21	0.35	0.08
C18:0	1.85	3.30	2.41
C18:1	4.97	6.64	25.59
C18:2*n-6*	25.45	27.06	55.95
C18:3*n-3*	43.88	36.75	3.71
C20:0	0.46	0.82	0.29
C20:1	0.12	0.14	0.01
C20:2	0.08	0.07	nd
C20:3*n-6*	0.20	0.22	nd
C20:4*n-6*	0.03	0.05	nd
C22:0	0.36	0.89	0.13
C23:0	0.13	0.40	0.01
C24:0	0.30	0.64	0.10
n-3/n-6[1]	1.95	1.62	0.07
AI[2]	0.32	0.35	0.14

[1]*n3/n6*=calculated as the sum of all omega-3 fatty acids divided by the sum of all omega-6 fatty acids.

[2]AI=atherogenic index calculated as the sum of C12:0+4*C14:0+C16:0 divided by the sum of all unsaturated fatty acids.

nd=not detected.

Presented in Table 5 is the fatty acid composition of the different beef parts. The monounsaturated oleic acid (C18:1) accounted for the greatest concentration of the fatty acids in all three beef parts. This fatty acid was followed by palmitic acid (C16:0) and stearic acid (18:0) in a descending order of percentage. Myristic acid (14:0), which is the most atherogenic of all fatty acids, was found to be highest in the adipose tissue. Consequently, AI of adipose tissue was observed to be higher than that of the steak and trim. Linoleic acid, an omega-6 fatty acid, was highest in the ribeye steaks and lowest in the adipose tissue. Docosapentaenoic acid (C22:5), an omega-3 fatty acid, was also highest in ribeye steaks and almost negligible in the adipose tissue. Within a beef part, most of the fatty acids did not differ significantly ($p>0.05$) between the two finishing systems. In all three beef parts, the omega-3 linolenic acid (C18:3) was significantly higher in parts from the pasture-finished cattle than in those from drylot-fed cattle. This result indicates that some of the C18:3*n-3* in the feed, which makes up about 44% of the total fatty acids of the pasture forage, was transferred effectively to animal tissues. On the other hand, C18:2*n-6* content of adipose tissue was significantly higher in parts from the drylot-finished cattle than in parts from pasture-fed cattle. A similar trend was observed for this fatty acid in the ribeye steak as the concentration of C18:2n-6 tended to be significantly greater ($p=0.053$) with drylot-finished cattle. The ratios of omega-3 to omega-6 fatty acids were significantly greater for pasture-fed cattle compared with ratios for drylot-finished cattle in all three beef parts.

Table 6 shows the trans vaccenic acid (C18:*t11*) and CLA concentrations of the different beef parts. Among the four CLA isomers determined, *cis9 trans11* accounted for about 78% of the total CLA. Adipose tissue had the greatest amount of *cis9 trans11* CLA, which was followed in a decreasing order by the trim and ribeye steak. In all three beef parts, CLA concentrations were significantly greater from the pasture-finished cattle, having more than twice those from the drylot-finished cattle. These data are complemented by the higher concentration of trans vaccenic acid in parts from the pasture-fed cattle than in parts from the drylot-finished cattle; the differences were significant ($p\leq0.05$) for the ribeye steak and adipose tissue. Trans vaccenic acid is a precursor for CLA synthesis in animal tissues. Linolenic acid coming from pasture may have supplied the additional trans vaccenic acid produced during ruminal biodydrogenation.

Table 5. Fatty acid composition of the different beef parts[1].						
	Beef part					
	Ribeye steak		Trim		Adipose	
	Finishing system		Finishing system		Finishing system	
	Pasture	Drylot	Pasture	Drylot	Pasture	Drylot
Fatty acid	----------------------------g/100 g of fatty acids--------------------------					
C12:0	0.08	0.06	0.08	0.10	0.10	0.10
C14:0	2.95	2.61	3.12	3.16	4.27	4.22
C14:1	0.56	0.52	0.95	0.59	1.42	1.50
C15:0	0.41[a]	0.26[b]	0.52	0.46	0.59[a]	0.46[b]
C16:0	28.51	29.01	26.18	27.05	27.18	27.49
C16:1	3.56	3.34	4.48	3.33	5.64	5.17
C17:0	0.96[a]	0.78[b]	1.00	1.02	1.07	0.97
C18:0	15.96	14.94	15.28	18.65	13.52	12.96
C18:1	38.44	40.13	40.47	39.69	39.98	42.61
C18:2*n-6*	3.74	4.80	3.20	3.13	1.77[b]	2.26[a]
C18:3*n-3*	0.79[a]	0.61[b]	0.74[a]	0.54[b]	0.60[a]	0.46[b]
C20:0	0.09	0.08	0.09	0.11	0.09	0.09
C20:1	0.03	0.05	0.03	0.03	0.02	0.02
C20:2	0.03[b]	0.05[a]	0.04	0.04	0.02	0.02
C20:3*n-6*	0.29	0.40	0.22	0.18	0.07	0.08
C20:4*n-6*	0.87	1.20	0.65	0.36	0.06	0.05
C20:5*n-3*	nd	nd	nd	nd	0.03	nd
C22:5*n-3*	0.31	0.33	0.24	0.13	0.02	0.01
C24:0	0.15	0.15	0.11	0.03	nd	nd
n-3/n-6[2]	0.26[a]	0.15[b]	0.25[a]	0.19[b]	0.35[a]	0.19[b]
AI[3]	0.80	0.76	0.74	0.81	0.85	0.83
	n=9	n=7	n=8	n=7	n=9	n=7

[1]Means within a beef part and within a row with unlike superscripts differ ($p \leq .05$).

[2]*n3/n6*=calculated as the sum of all omega-3 fatty acids divided by the sum of all omega-6 fatty acids.

[3]AI=atherogenic index calculated as the sum of C12:0+4*C14:0+C16:0 divided by the sum of all unsaturated fatty acids.

nd=not detected.

Table 6. Trans vaccenic acid and conjugated linoleic acid concentrations of the different beef parts[1].

Beef part[2]	Finishing system	*c18:1t11*	C18:2 CLA isomers *c9, t11*	*t10, c12*	*c9, c11*	*t9, t11*	Total CLA
		------------------g/100 g of fatty acids------------------					
Ribeye steak	Pasture	1.70[a]	0.44[a]	0.02[a]	0.02	0.07[a]	0.56[a]
	Drylot	0.44[b]	0.17[b]	0.01[b]	nd	0.04[b]	0.22[b]
Trim	Pasture	1.68	0.61[a]	0.04[a]	0.03[a]	0.12[a]	0.81[a]
	Drylot	1.06	0.26[b]	0.02[b]	0.01[b]	0.07[b]	0.36[b]
Adipose	Pasture	2.39[a]	0.82[a]	0.05[a]	0.04[a]	0.16[a]	1.08[a]
	Drylot	1.09[b]	0.34[b]	0.02[b]	0.01[b]	0.07[b]	0.44[b]

[1]Means within a beef part within a column with unlike superscripts differ ($p \leq 0.05$).

[2]n=9 for parts from pasture-fed cattle, except for trim where n=8; n=7 for parts from drylot-fed cattle.

nd=not detected.

Economic analysis of finishing cattle with grain in drylot versus grain feeding on pasture.

An on-farm demonstration compared finishing cattle to choice grade by feeding cattle in a drylot with all the feed supplied by the ration versus supplementing cattle with grain while on pasture. The cattle on pasture received much of their nutrition from grass and as a result used much less total grain than did the drylot finished cattle. The motivation for the "non-conventional" finishing practices is that the producer can feed less organically grown grain that has a higher market value than conventional grain when sold on the organic market. If the producer can decrease the grain required to produce cattle to an acceptable degree of finish, the producer will have more organic grain to sell and thus increase farm income.

This demonstration involved 30 cattle--15 fed in a drylot and 15 pasture-fed. Table 7 shows that drylot diet consisted of 50% hay and the pasture consisted of 46% hay (these cattle consume grass pasture in addition to grain mix diet). Both diets are higher in roughage than is typical in the industry today. Most feedlot operations feed about 10-20% hay in the diet for cattle of this weight. The as-fed feed to gain ratio in the pasture-fed group is approximately 10% higher than that of conventional feedlots. The drylot feed to gain ratio is approximately twice the industry standard. Closeout data from over 2600 pens of cattle fed in the upper Midwest in 1999-2002 as part of the Land O' Lakes database indicated ADG of over 3 pounds per day and DM feed efficiency of approximately 7.20.

Table 7. Diets and feed to gain ratio (as-fed basis) for pasture- and drylot-fed cattle.				
	Pasture		Drylot	
Feed	% in the ration	Feed:gain	% in the ration	Feed:gain
Hay	46	4.11	50	7.85
Corn	45	4.07	43	6.79
Soybean	8	0.68	7	1.05
Total	100	8.95	100	15.78

Table 8 summarizes the revenue and costs for actual results of the demonstration in the columns labeled "Actual" and "General" results. The "General" columns standardize the analysis on equal selling weight and equal values where the actual values were not different. Values were different when actual results warrant differences. The pasture-fed cattle had a lower dressing percentage and a lower percentage of choice than did the drylot cattle but had a higher percentage of yield grade 1 and 2. Both the actual and general examples indicated that the drylot cattle produced slightly higher revenue with equal prices.

The drylot cattle had higher daily gain and fewer days on feed than did pasture-fed cattle, although, as mentioned earlier, both are less than the industry standard. However, costs for the pasture-fed group are lower than those for drylot cattle because less total dry feed was used. In the general analysis, total costs for drylot cattle are approximately $50 per head higher than those for pasture-fed cattle.

The pasture-fed system was more profitable in the demonstration and for the standardized prices and performance in the general analysis. Do the results hold under other conditions? Table 9 shows the results of a sensitivity analysis to determine how the profitability changes as the key variables change by 10%. The change in the variable was chosen to decrease the advantage of the pasture-fed system to illustrate what could make it less profitable than the drylot. For the changes considered, the pasture-fed system remains more profitable, but the results are most sensitive to pasture cost and corn price. A 10% decrease in corn price resulted in nearly a 20% reduction in the profit advantage. A 10% increase in pasture cost decreased the profit advantage by 22%.

The last column shows the pasture cost needed to equalize the returns between the two systems. If pasture cost were $72.75 higher, the drylot system would be more profitable. If pasture costs less than $72.75, the pasture-fed system would be more profitable. The cost of the pasture should reflect the direct costs for taxes, fencing, and weed control and also the opportunity cost for the land. The opportunity cost may be the market value in the rental market or the value of the land in another enterprise (e.g., corn, soybeans, hay, and cow-calf). One of the advantage to the pasture system is that, if there is a more profitable enterprise for the land in pasture or if the price of corn is low enough that drylot feeding is more profitable than the pasture feeding, the cattle can easily be confined to the drylot and the pasture can be used for the more profitable enterprise.

Table 8. Cost and return budget for drylot- and pasture-fed cattle: Actual results and generalized variables for one head representing 2/3 steer and 1/3 heifer

	Actual		General	
Item	Drylot	Pasture	Drylot	Pasture
Revenue				
End weight, kg	577	582	578	578
Dressing percent, %	62.2	61.0	62.2	61.0
Carcass weight, kg	357	355	360	353
Choice, %	80	69	80	70
Yield Grade 1 and 2, %	62	100	60	100
Average price, $/kg	3.2123	3.2050	3.2187	3.2408
Value[1], $/head	1,145.28	1,138.33	1,157.78	1,143.66
[1]Cattle prices: choice $3.31/kg, select discount $0.33/kg, yield 3, 4 and 5 discount 0.11/kg.				
Costs				
Feeder steer/heifer				
Weight, kg	398	393	395	395
Price, $/kg	1.7637	1.7637	1.7637	1.7637
Cost, $/head	702.00	693.76	696.00	696.00
Feed cost				
Pasture, ha/head	0.00	0.607	0.00	0.607
Corn, kg	1211.39	768.90	1246.70	747.06
Hay, kg	1397.08	780.19	1442.44	752.97
Soybeans, kg	186.97	128.19	192.42	124.65
Vitamins and minerals, kg	16.57	16.90	17.05	16.42
Total feed cost[2], $/head	320.35	281.24	329.95	275.14
[2]Feed prices: pasture $123.55/ha, corn $0.1378/kg, hay $0.0551/kg, soybeans $0.3307/kg, minerals $0.8818/kg.				
Performance				
Average daily gain, kg/d	0.98	0.68	0.98	0.68
Days on feed	183	278	188	270
Interest on feeder at 7%, $	24.64	36.99	25.09	36.04
Interest on ½ the feed, $	5.62	7.49	5.95	7.12
Yardage ($/d/hd)	0.25	0.15	0.25	0.15
Yardage cost, $/head	45.75	41.70	47.00	40.50
Total cost, $/head	1,098.53	1,060.90	1,103.93	1,054.79
Profit per head, $	46.75	77.43	53.85	88.87

Table 9. Sensitivity analysis to 10% change in input prices and equal return pasture cost

Change in price of:	Base[1]	C-S spread[2]	Pasture[2]	Corn[2]	Soybeans[2]	Interest[2]	Equal return[3]
Choice-select (C-S)spread, $	-0.10	***-0.11***	-0.10	-0.10	-0.10	-0.10	-0.10
Pasture price, $	50.00	50.00	***55.00***	50.00	50.00	50.00	***72.75***
Corn price, $	3.50	3.50	3.50	***3.15***	3.50	3.50	3.50
Soybean price, $	9.00	9.00	9.00	9.00	***8.10***	9.00	9.00
Interest, %	7.0	7.0	7.0	7.0	7.0	***7.7***	7.0
Profit per head							
Drylot, $	53.85	52.27	53.85	71.34	60.34	50.75	53.85
Pasture-fed, $	88.87	86.54	81.18	99.43	93.09	84.55	53.86
Profit difference, $	35.02	34.27	27.32	28.09	32.76	33.80	0.01
Percent change, %		-2.1	-22.0	-19.8	-6.4	-3.5	

[1] Base input prices and returns.
[2] 10% change in listed variable and resulting impact on returns.
[3] The pasture price needed to equalize the return between drylot and pasture system.

Conclusions

Results from this study show that finishing cattle on pasture with limited grain supplementation is feasible and economically sound with reference to the usual practice on the farm where this study was conducted. Higher CLA and linolenic acid concentrations and omega-3 to omega-6 fatty acid ratio strongly suggest that potentially healthier beef can be produced by the pasture system with limited grain supplementation. Pasture finishing produced beef of similar quality as did the usual drylot system on the farm; the pasture system did not significantly diminish beef quality because of feeding lesser amounts of grain. Furthermore, if beef with higher contents of CLA and omega-3 fatty acids could be given a premium price, an even higher profit could be realized with the pasture-based finishing system of cattle.

Future Research Needs

Results of this study indicate that pasture-based finishing system of cattle produced beef with higher content of potentially healthful fatty acids. Can we increase further the concentrations of these beneficial fatty acids in beef by feeding pasture only without sacrificing quality and acceptability by consumers? Also, concentrations of CLA and omega-3 fatty acids in beef as cattle are moved from summer grazing to winter rations needs to be studied.