Effects of feeding strategy on market cow performance, carcass quality and economics*

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The objective of this study was to investigate the effects of feeding strategy on cow feedlot performance, carcass traits and economics. Despite cows consuming less feed and lower labor costs, cows on self-fed diets had the highest feed cost of gain. Although self-fed diets can improve market cow quality, other low-cost alternatives require further investigation.

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Summary

Forty-eight cull (market) cows were blocked by weight and body condition to investigate the effects of feeding strategy on feedlot performance, carcass traits and economics. Diets evaluated were (1) corn-mixed hay (HAY), (2) barley-barley silage (SILAGE) and (3) a self-fed ground diet using a controlled intake system (LIMIT). All diets were formulated to provide 60 megacalories per pound (Mcals/lb) of net energy for gain (NE_g) and 11.5 percent crude protein (CP) using mixed hay, barley silage and a commercial supplement containing soy hulls as roughage sources for HAY, SILAGE and LIMIT, respectively.

After a 104-day feeding period, 14 cows were sold at auction locally to evaluate market prices for fattened cull cows. The remaining cows were harvested at Dakota Premium Foods LLC, South St. Paul, Minn., with individual carcass data collected. HAY and SILAGE cows gained faster ($P < 0.01$) because LIMIT cows acclimated slowly to their diet the first 46 days of study, resulting in lower dry-matter intake (DMI), average daily gain (ADG) and gain efficiencies (G:F) for LIMIT cows ($P < 0.02$). LIMIT cows had higher feed costs than HAY and SILAGE cows ($P = 0.02$). Despite similar final body condition scores ($P = 0.19$), LIMIT cows gained the least ($P = 0.04$). Carcass traits and total cow value were similar across treatments for harvested cows ($P = 0.10$). HAY cows had the lowest breakeven and greatest return for harvested cows ($P \leq 0.02$); however, breakevens and returns for sold cows did not differ across treatment ($P = 0.15$). Although self-fed diets can improve market cow quality, other low-cost alternatives require further investigation.

Introduction

The sale of market cows (cull cows) can contribute a considerable portion of income (15 percent to 30 percent) to the annual receipts of cow-calf producers (Feuz, 2006). Six million to 8 million market cows are slaughtered annually, providing a sizeable supply of muscle cuts to the packing industry (Stalcup, 2008). Generally, spring calving market cows are sold in the fall (following weaning and pregnancy checking) at a time when the cow supply is large and economic returns are low. Often, cow-calf producers give little forethought to adding value to market cows before culling. One method of enhancing market cow value is to feed the cows for a short time (60 to 100 days) and then sell the cows when market prices are seasonally higher (Strohbehn et al., 2004; Strohbehn and Sellers, 2002). As well as increasing market value, a feeding period enables cow-calf producers to improve cow carcass quality (Wright, 2005).

Moreover, little research has examined the use of self-feeding protocols as a system of adding value to market cows. As volatility continues in the

feed ingredient markets and fuel and other production input expenses increase, re-evaluation of market cow feeding strategies and economic profitability is crucial (Niemela et. al., 2008). Our study objective was to investigate the effects of feeding strategy on cow feedlot performance, carcass characteristics and economics. Our hypothesis was that the three feeding strategies would have similar performance and carcass quality, but the self-fed system would have lower feed and labor costs associated with it as compared with the other two systems.

Materials and Methods

The NDSU Animal Care and Use Committee approved all protocols. Sixty-eight Angus cross and Hereford market cows were purchased locally during a two-week period (Oct. 22 and 29, 2007). After purchase, cows were delivered to the NDSU Hettinger Research Extension Center. On day 0 and 1, purchased cows were weighed, had their body condition scored on a scale of 1 to 9 (body condition score [BCS], Herd and Sprott, 1986); and were evaluated for pregnancy status, temperament and overall health. From this group, 48 nonpregnant cows were selected as study subjects. Cows were vaccinated for respiratory and clostridial diseases, dewormed and implanted (Finaplex H, Intervet, Millsboro, Del.) on day 1. Cows were stratified by weight (body weight [BW] =1,313 ± 14.7 pounds) and BCS (5.71 ± 0.07) and allotted to one of 12 pens (four cows/pen). Pens were assigned randomly to one of three treatments: corn-mixed hay (HAY), barley-barley silage (SILAGE) and a self-fed ground diet using a controlled intake system (LIMIT). Diets were formulated to provide 60 Mcals/lb NE_g and 11.5 percent CP using ground mixed hay, barley silage and a commercial supplement containing soy hulls as roughage sources for HAY, SILAGE and LIMIT respectively (Table 1). Alfalfa haylage and soybean meal (47.5 percent CP) were included in the HAY diet to prevent ration separation and increase CP level. Ground hay was added to the SILAGE diet to increase ration dry matter (DM). Four rations of increasing energy density (data not reported) were fed to HAY and SILAGE cows during the first 40 days to acclimate cows to high-grain finishing diets. Fence line feed bunks were read daily at 7 a.m. and slick bunk management was used to determine individual pen daily feed allotment. HAY and SILAGE cows were fed once daily at 9 a.m. Purina Mills developed the feeding protocol used for the LIMIT cows. Creep feeders (self-feeders) were means of diet delivery for LIMIT cows. LIMIT cows had continual access to self-feeders containing respective diets (Table 1); LIMIT cows were fed small amounts of baled grass hay daily (6.4 pounds/cow; as fed). LIMIT diets were ground and feeders filled on day 0, 8, 22, 36, 42, 45, 47, 53, 63 and 74. All cows had free access to water in ice-free automatic fence line water fountains and white salt blocks. To prevent estrus, MGA pellets were added to all diets.

Due to deteriorating pen conditions because of inclement weather, all cows were removed from feedlot pens on day 76, commingled into one group and placed into a larger pen. From day 76 to 103, cows were fed a mixed ration at 2.6 percent BW (based on day 75 BW) containing 25 percent barley silage, 25 percent ground mixed hay, 22.5 percent whole barley, 22.6 percent cracked corn, 1.9 percent finishing supplement, 2.5 percent MGA pellets and 1.9 percent calcium carbonate (DM basis, 13.7 percent CP, 52 Mcal/lb NE_g) for the last 28 days prior to

Table 1. Dietary ingredient and nutrient concentration of HAY, SILAGE and LIMIT diets.

			Limit		
			Accuration[a]		Impact[b]
Item	Hay	Silage	d 0-21	d 22-46	d 47-75
Ingredient , % DM					
Alfalfa haylage	8.5	-	-	-	-
Barley silage	-	16.1	-	-	-
Calcium carbonate	0.7	0.7	-	-	-
Whole barley	-	67.2	-	-	-
Cracked corn	71.4	-	34.8	60.8	78.5
Finish supplement[c]	2.0	1.8	-	-	-
Purina supplement	-	-	52.1	26.1	8.7
MGA pellets[d]	2.6	2.4	2.8	2.8	2.8
Ground mixed hay[e]	12.7	11.8	-	-	-
Soybean meal (47.5% CP)	2.1	-	-	-	-
Grass hay	-	-	10.0	10.0	10.0
12:12 mineral	-	-	0.3	0.3	-
Nutrient concentration[f]					
% DM	76.92	69.22	88.19	87.52	85.2
CP, % DM	11.7	14.5	23.7	22.9	14.8
NE_m, Mcal/lb. DM	0.82	0.80	0.92	0.93	0.87
NE_g, Mcal/lb. DM	0.55	0.54	0.61	0.62	0.58
Ca:P	2.76	2.81	1.56	1.50	1.62

[a] Purina supplement contained 65 mg/lb. Monensin sodium.
[b] Purina supplement contained 113.5 mg/lb. Monensin sodium and 45 mg/lb. Tylosin phosphate.
[c] Supplement contained 500 mg/lb. Monensin sodium.
[d] Supplement contained 0.00011% Melengestrol Acetate.
[e] Mixed hay composed of equal parts barley and alfalfa-grass hays.
[f] Analytical results are from composited samples.

harvest. The roughage-based diet was fed because of concerns about possible cow lameness and cows going down during the long transport to harvest.

Cows were weighed and had their body condition scored on day 0, 1, 28, 45, 46, 74, 75, 102 and 103. Initial and final weights were determined by averaging two-day unshrunk weights. HAY and SILAGE diet samples were collected on day 6, 22, 43, 60 and 74. LIMIT diet samples were collected on day 1, 6, 36, 60, 63 and 74. Diet samples from the commingled group were collected on day 80, 90 and 100. Diet samples were composited by treatment and analyzed by a commercial laboratory (Midwest Laboratories, Omaha, Neb.) for nutrient analysis. After the 104-day feeding period, 14 cows were sold at auction locally (n = 4 for SILAGE and n = 5 for HAY and LIMIT, respectively) to evaluate local market prices (Lemmon Livestock Inc., Lemmon, S.D., Feb. 13, 2008) for fattened cull cows. The remaining cows (n = 33) were harvested at Dakota Premium Foods LLC, South St. Paul, Minn., on day 104 and individual carcass data was collected following a 24-hour chill.

Economic values for feedstuffs and other service fees were obtained from purchased costs, local cash grain bids and the U.S. Department of Agriculture National Agricultural Statistics Service's North Dakota monthly commodity prices (www.nass.usda.gov/nd). Breakeven and closeout information was calculated using the NDSU Extension CalfWEB closeout analysis program (www.chaps2000.com/calfweb/closeout.asp). Cow performance, carcass traits and economic data were analyzed as a completely randomized design with the pen serving as the experimental unit. Carcass data was analyzed similarly, with missing data points from auctioned cows not included in the data set, but with the pen still serving as the experimental unit. Treatment means are separated by least square means following a protected F-test ($P < 0.05$).

Results and Discussion

Cow feedlot performance is shown in Table 2. One cow (HAY) was removed from the study because of founder (day 57). All performance data from the removed cow was deleted from subsequent performance analyses. Additionally, two cows were treated for foot rot (LIMIT and HAY, day 49 and 55, respectively). Veterinary medicine costs did not differ between treatments and averaged $12.15 ± 0.59 per cow ($P = 0.69$; Table 2). In general, dry-matter intakes for market cows are greater compared with calf-feds or yearling DMI.

Calf-fed DMI typically range from 20 to 24 pounds/day, yearlings from 23 to 28 pounds/day DMI and mature cows from 28 to 45 pounds/day DMI, depending on respective body weights. In this study, HAY and SILAGE cows gained faster ($P < 0.01$) because LIMIT cows acclimated slowly to their diet the first 46 days of study,

Table 2. Influence of market cow feeding strategy on feedlot performance and associated costs.

Item	HAY[a]	SILAGE[b]	LIMIT[c]	SEM[d]	*P*-value[e]
No. head	16	15	16	-	-
No. pens	4	4	4	-	-
Initial BW, lb.	1324	1300	1315	14.74	0.55
Initial BCS	5.68	5.71	5.75	0.07	0.74
Period 1, day 0-46					
DMI, lb./d	38f	28g	25.6h	0.59	< 0.001
46-day gain, lb.	185.8f	153.5f	40.8g	27.2	0.01
ADG, lb./d	4.09f	3.54f	0.89g	0.60	0.01
G:F	0.11f	0.13f	0.03g	0.02	0.02
Feed cost/lb gain, $/lb.	0.79	0.83	2.21	1.44	0.74
Period 2, day 47-75					
DMI, lb./d	40	37.9	37.8	1.58	0.56
29-day gain, lb.	120.3	157.5	161.8	14.4	0.14
ADG, lb./d	4.14	5.42	5.58	0.50	0.14
G:F	0.10	0.14	0.15	0.01	0.09
Feed cost/lb. gain, $/lb.	0.82	0.71	0.70	0.08	0.52
Final, day 0-75					
DMI, lb./d	38.8f	33.5g	31g	1.06	0.002
75-day gain, lb.	308.3f	281f	195.3g	26.8	0.04
ADG, lb./d	4.11f	3.75f,g	2.61g	0.36	0.04
G:F	0.11	0.11	0.08	0.01	0.13
Feed cost/lb. gain, $/lb,	0.79g	0.80g	1.72f	0.15	0.002
Final BW, lb.	1629.3	1600.5	1517.5	27.8	0.047
Final BCS (1-9)	7.45	7.48	7.10	0.16	0.19
Commingled period, day 76-103					
28-day gain, lb.	98.8	124.8	155.5	-	-
ADG, lb./d	3.40	4.30	5.35	-	-
Yardage costs, $/cowh	36.75f	36.75f	29.15g	-	< 0.001
Veterinary medicine costs, $/cow	11.88	12.59	11.99	0.59	0.69

[a] HAY: Hay-based finishing diet consisted of ground mixed hay, cracked corn, alfalfa haylage, finish supplement, soybean meal, MGA pellets and calcium carbonate.
[b] SILAGE: Silage-based finishing diet consisted of barley silage, cracked barley, ground mixed hay, finish supplement, MGA pellets and calcium carbonate.
[c] LIMIT: Self-fed finishing diet, offered ad-libitum via self-feeders placed in pens.
[d] Standard error of mean; n = 4 observations per treatment.
[e] *P*-value for protected F test.
[f, g, h] Means with different subscripts differ ($P < 0.05$).

resulting in lower DMI, ADG and feed efficiencies (gain:feed ratios, G:F) for LIMIT cows ($P < 0.02$). LIMIT cows' DMI and ADG increased when the cows consumed the final self-fed diet during Period 2 (Table 2). At the end of 75 days, LIMIT and SILAGE cows had similar DMI, but differed from HAY cows ($P = 0.007$). Despite final G:F being similar across treatments ($P = 0.13$), LIMIT cows had the lowest DMI and ADG and the highest feed cost/lb. of gain ($P < 0.02$). Feed costs/lb. gained were similar for HAY and SILAGE cows ($P = 0.02$). Although final BCS were similar across treatments ($P = 0.19$), HAY cows were the heaviest, SILAGE cows intermediate and LIMIT cows the lightest before commingling ($P = 0.02$).

Yardage costs were 20 percent lower for LIMIT cows as compared with HAY and SILAGE cows ($P < 0.001$). Yardage charges were determined by surveying cattle feeders about yardage fees they charged their commercial feeding clients. Yardage fees were 25 cents per head per day for LIMIT cows and 35 cents per head per day for HAY and SILAGE cows. The use of self-feeders decreased labor and equipment needs during the 75-day period as compared with more traditional feeding methods (totally mixed rations fed by a feeder wagon).

Cow weight gain and ADG during the commingled period (day 76 to103) is reported in Table 2. Because of combining all pens into one large group, treatment effects could not be separated statistically during the commingled period. As a result, weight gain data from the commingled period is reported to illustrate the continued weight gain all cows experienced during the 28 days preceding harvest.

Carcass traits and total cow value were similar across treatments for harvested cows ($P = 0.10$; Table 3). This may be attributed to greater compensatory gain and DMI exhibited by LIMIT cows during the commingled period than is shown by the weight gain data before harvest (day 76 to 103, Table 2). Cows sent to the commercial abattoir received the same price at harvest ($1.08/pound of hot carcass weight). The effect of feeding strategy on auctioned cows and closeout returns is reported in Table 3. Initial average value for the cull cows used in this study was $0.455/pound or $596.70/head. Feeding these cows for an additional 104 days increased the average cow value to $1,009.31/head ± $16.26 for harvested cows, with no difference among treatments ($P = 0.14$). Additionally, cows sold at auction had increased value, averaging $958.18/head, with no difference between treatments ($P = 0.29$).

Sale cow BW was similar at the local auction on sale day ($P = 0.08$). Although cow values were increased for both auctioned and harvested cows, these increased values do not reflect the added expense of feeding these cows for an additional 104 days. HAY cows had the lowest breakeven and greatest return for harvested cows ($P \leq 0.02$); however, the breakevens and economic returns for sold cows did not differ across treatments ($P = 0.15$). Cows sold at auction received similar market prices across treatments, with cows averaging $0.595/pound ($P = 0.34$).

Table 3. Influence of market cow feeding strategy on carcass traits and economics.

Item	HAY[a]	SILAGE[b]	LIMIT[c]	SEM[d]	*P*-value[e]
Harvested cows					
Hot carcass weight, lb.	961.5	925.3	917.3	15.1	0.14
Dressing %	54	53	54	0.78	0.88
Lean maturity[f]	448	453	445	19.61	0.96
Skeletal maturity[f]	441	477	446	16.09	0.29
Marbling score[g]	398	390	422	21.81	0.58
12th rib fat thickness, in.	0.56	0.74	0.59	0.05	0.10
Longissimus area, $in.^2$	13.7	12.5	12	0.7	0.25
Muscling score[h]	2.75	3.25	3.75	0.34	0.18
Fat color[i]	2.75	3.25	2.50	0.26	0.18
Lean color[j]	5.25	6.0	5.50	0.40	0.44
Total cow value, $	1,038.33	999.27	990.32	16.26	0.14
Auctioned cows					
Sale BW, lb.	1656.3	1776.3	1584.5	52.8	0.08
Sale price, $/lb.	0.595	0.603	0.588	0.64	0.34
Total cow value, $	962.74	1005.51	906.29	41.78	0.29
Breakevens					
Harvested cows, $/lb.	0.53[l]	0.54[k, l]	0.56[k]	0.007	0.03
Auctioned cows, $/lb.	0.52	0.50	0.56	0.02	0.11
Closeouts, profit or loss					
Harvested cows, $/head	155.34[k]	125.22[k, l]	94.92[l]	13.35	0.03
Auctioned cows, $/head	122.41	175.61	53.62	40.09	0.15

[a]HAY: Hay-based finishing diet consisted of ground mixed hay, cracked corn, alfalfa haylage, finish supplement, soybean meal, MGA pellets and calcium carbonate.
[b]SILAGE: Silage-based finishing diet consisted of barley silage, cracked barley, ground mixed hay, finish supplement, MGA pellets and calcium carbonate.
[c] LIMIT: Self-fed finishing diet, offered ad-libitum via self-feeders placed in pens.
[d]Standard error of mean; n = 4 observations per treatment.
[e]P-value for protected F test.
[f]A = 100 to199, B = 200 to 299, C = 300 to 399, D = 400 to 499 and E = 500 to 599.
[g]Slight = 300 to 399 and Small = 400 to 499.
[h]Thin = 1, Average = 3 and Thick = 5.
[i] Pure white = 1, Yellow = 5.
[j] Light red = 1, Cherry red = 4 and Very dark red = 8.
[k,l] Means with different subscripts differ ($P < 0.05$).

Implications

Feeding hay-based, silage-based or self-fed rations for a short time (during late fall-early winter) resulted in a net profit for feeding market cows. Despite the increased dietary adjustment time, LIMIT cows gained more efficiently when consuming their final self-fed diet. Although LIMIT cows consumed less feed and had lower labor costs, feed cost of gain was highest for this group. Potential economic returns by feeding market cows will be highly dependent on several factors: availability of local resources, initial cow body condition, feed costs and availability, days on feed and final carcass characteristics. Self-feeders are a viable alternative system of feeding and improving market cow value. Although self-fed diets can improve market cow quality, other low-cost alternatives require further investigation.

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