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# PERFORMANCE OF STEERS FINISHED ON PASTURE AND FOUR LEVELS OF GRAIN SUPPLEMENTATION

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Abstract

One hundred twenty-eight steer calves were weaned in October 1994, and wintered as two uniformly treated groups. Steers were randomly allocated to four pasture-fed finishing treatments and one feedlot treatment April 20, 1995. Replicated treatments were different levels of grain for supplying a percentage 0%, 25%, 50% and 75% of total dietary energy and other nutrients from grain, with remaining nutrients from management-intensive grazed pastures. Feedlot treatment was 90% grain plus 10% hammer-milled hay fed in self-feeders. Feedlot cattle were slaughtered September 29 and pasture treatments were slaughtered November 4. Pasture-finished cattle had smaller carcasses, lower dressing percents, and less fat than feedlot-finished steers. Conventional quality grades were lower for pasture-finished than feedlot-finished steers. Yellow-colored fat was not a problem in any of the comparisons. Pasture-finished carcasses were discounted heavily. Preliminary uncontrolled acceptability comparisons indicate that pasture- finished prime rib was equally as acceptable as feedlot-finished prime rib.

Introduction: Because of concerns about profitability of beef production systems and concerns about the environmental effect of feedlot systems, there is renewed interest in pasture-based finishing of cattle. Changes in consumer preferences toward more lean cuts of beef, coupled with demands for high quality meat products, add to the interest in beef finished on pasture.

Numerous studies have been conducted to measure gain performance of cattle on pasture. Results have been variable, from responses of near maintenance to gains nearly equivalent to feedlot gains, depending on the level of supplementation used (Seidman et al., 1985). We believe that the variability of response from pasture is a direct result of the variability in pasture availability and quality. The research involved three-paddock rotational pastures that were stocked to obtain uniform utilization of high quality available pasture and supplemented with grain at different levels from 0 to 18.7 lb daily. The results in respective gains ranged from 1 to 2.9 lb ADG (Perry et al. 1972). Cattle from these trials were subsequently finished in dry lot.

There are few studies comparing cattle finished with management-intensive grazing treatments with varying levels of grain. Pasture-finished beef has been criticized for having yellow fat, dark colored lean, unsaturated lipids, lower dressing percent (Seidman et al., 1985) and "grassy" off-flavors. These flavor compounds have been described and are thought to decrease to undetectable levels with grain feeding periods of 50-100 days (Larick, et al., 1987; Larick and Turner, 1989; and Larick and Turner, 1990). No trials have been found where attempts were made to dilute out these flavors by feeding different grain levels on pasture. The objective of this study was to measure animal gains, carcass quality, and beef flavor of cattle finished directly off pasture with varying grain levels.

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Materials and Methods: This study used 128 home-raised steers (88 on pasture and 40 in feedlot) that were either Hereford X Gelbvieh (HG), HG X Angus, or > 3/4 Angus. Spring born calves were weaned October 20, grazed fescue stockpile until January 1 (70 days), then wintered on large bales of mixed grass-legume hay and 5 lb daily of a grain mix (1/3 corn gluten feed and 2/3 cracked corn) until turnout on April 20 (110 days). Steers gained 1.03 lb daily during winter and went to pasture weighing 735 lb.

Pasture treatments were grain-feeding levels for supplying the equivalent of 0%, 25%, 50%, and 75% of the steer's nutrient needs with the remaining nutrients coming from pasture. A fifth treatment consisted of steers assigned to a conventional feedlot finishing program. Each treatment had two replicates. Number of steers per pasture replication was 8, 10, 12, 14 with approximately 8 acres per replication. Number of steers used per treatment was varied because as grain supplement increased, pasture consumed would decrease; hence, a higher stocking rate was necessary to utilize the available pasture on the higher grain feeding treatments. Base stocking rate in the zero grain system was consistent with previous experience on similar pastures at the Forage Systems Research Center.

Pastures were mixed cool-season diverse grass-legume species with about 20% legume in most pastures. Some pastures were predominantly tall fescue with an endophyte infection level >90%. Steers were moved to new pasture every 1 to 3 days depending on the season and need of the system. Each pasture treatment group was assigned to a grazing cell with 6 permanent paddocks. Steers were allocated about 1/3 of a paddock each day during Phase 1 and 1/6 paddock during Phase 2. Steers were allowed to back-graze for up to 6 days for water access. Nutrient content of pasture and the amount of pasture intake were measured and is reported in these proceedings.

The summer pasture season was divided into two phases because the gains were not as good as expected early in the grazing period (Table 1). During spring and early summer there was only .25 lb ADG difference between treatment 0% and 75% grain supplementation (Table 1). We would expect a difference of about 1 lb ADG or more. Therefore, we changed some management practices being used:

1) The grain supplement was reformulated from 100% cracked corn to a mixture of 70% cracked corn/30% corn gluten feed which added fiber to the ration to prevent acidosis and to promote appetite.

2) The steers were given a fresh paddock of pasture daily to enhance pasture intake. These changes seemed to be successful because the steers appeared to have improved appetites in Phase II and the ADGs were improved (Table 1).

Results and Discussion: Steers from the feedlot treatment were slaughtered Sept. 29, 1995, and cattle from the pasture treatments were slaughtered Nov. 4, 1995 (Table 1). The target finish goal for all cattle was .3 to.4 in. of backfat, but the pasture-based cattle were out of pasture, so they were harvested before they reached target backfat thickness. The major reason for slaughter directly off pasture was to be able to clearly evaluate the flavor of the resulting meat. Meat flavor and fat color are the most frequent criticisms of pasture-finished beef. The hypothesis for this study is that feeding grain supplement on pasture will dilute any off-flavor due to the pasture and the resulting meat will be comparable to grain-finished beef. We wanted to harvest cattle directly off pasture and chose not to use a fall-stockpiled pasture or a short feedlot- finishing period to reach our target finish. In another 3-year project we finished steers which had been forward-grazed on a comparable pasture system with no grain feeding. Those steers entered the feedlot weighing 792 lb, gained 4.13 ADG, were fed 115 days and finished at 1233 lb. Quality grades were 8% standard, 32% select, 43% choice and

17% prime. We are confident that we can finish steers off-pasture with a relatively short feeding period.

Values for total grain intake, finished live weight and carcass weight are presented in Table 1. The 0-grain group averaged about 130 lb lighter than the feedlot group and thus were not as finished. The feedlot group averaged .32 in. of backfat, which was in our target range. Feed conversion from pasture treatment ranged from 10 to 13 lb per lb of gain. Usually feedlot feed conversions will range from 8 to 10. Our low feed conversions for feedlot and pasture treating resulted from lower than expected ADGs which were possibly due to very hot weather and the lower energy density of the pasture ration.

Dressing percentage and carcass quality measures are presented in Table 2. As the carcass increased in weight, dressing percentage increased. It is well known that more finished cattle have higher dressing percentages than lean cattle. In general, all conventional carcass quality measures increased as grain level increased. Slightly over 50% of the carcasses in the feedlot group graded choice, whereas all but two carcasses in each replication in the 0-grain group graded standard. In the market, these carcasses were discounted severely so that their value was $220 less than the feedlot steers. With as little as 45 days (3.3 lb ADG, 150 lb total gain) in the feedlot, these cattle would have probably graded similar to the feedlot group and the carcass value would have also been similar. The cost of gain for the 0-grain supplemented group was $39/cwt, compared to $67/cwt for the feedlot group.

Fat color was also evaluated by giving each carcass a subjective visual score as it hung in the cooler. Pasture-finished cattle are thought to have yellow, undesirable fat. The fat of the pastured cattle from this study had fat color comparable to feedlot cattle (Table 2).

We have retained some cuts of meat from the carcasses for formal taste evaluation. We have some other cuts which we have had a total of 62 people taste (Table 3). These cuts were not cooked in any special way. Most people agreed that all meats were acceptable, and the data collected indicate that the meats from 0-grain pastured cattle could not be detected from feedlot cattle or cattle fed 75% grain on pasture (Table 3).

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Table 1. Grain intake, ADG, and finished weight for steers finished on pasture with different grain supplementation levels or in the feedlot.

| Treatment[a] | Grain intake Phase 1 | Grain intake Phase 2[b] | Total Grain Fed (lb) | Phase 1 ADG (lb) | Phase 2 ADG (lb) | Live Wt (lb) | Carcass Weight (lb) |
|---|---|---|---|---|---|---|---|
| 0 | 0.00 | 0.00 | 0 | 1.34 | 1.93 | 1066 | 563 |
| 25 | 3.75 | 7.00 | 968 | 1.27 | 1.86 | 1050 | 574 |
| 50 | 8.00 | 12.00 | 1852 | 1.47 | 2.29 | 1097 | 608 |
| 75 | 15.00 | 18.00 | 3126 | 1.59 | 2.33 | 1109 | 621 |
| Feedlot | 33.85 | 29.60 | 5253 | 2.73 | 2.70 | 1195 | 700 |

[a] Treatment was approximate % of energy from grain supplement based on 2.3% BW, DM intake. Feedlot treatment was concentrate fed free choice from self-feeder in drylot.

[b] Phase 1, April 20 to Aug. 15. Phase 2, Aug. 15 to Nov. 1.

Table 2. Dressing percent, carcass quality measures, and fat color for cattle finished on pasture supplemented with varying grain levels or in the feedlot.

| Treatment[a] | Dress % | Average Marbling Score[b] | Average Quality Score[c] | Backfat Thickness (in) | Rib Eye Area ($in^2$) | Yield Grade[d] | Fat Color Score[e] |
|---|---|---|---|---|---|---|---|
| 0 | 55 | 3.70 | 1.29 | 0.07 | 10.30 | 1.86 | 1.40 |
| 25 | 57 | 3.77 | 1.60 | 0.11 | 10.00 | 1.94 | 1.60 |
| 50 | 58 | 4.05 | 1.86 | 0.12 | 11.10 | 1.95 | 1.80 |
| 75 | 58 | 4.20 | 2.49 | 0.19 | 11.20 | 2.24 | 1.70 |
| Feedlot | 61 | 5.17 | 4.76 | 0.32 | 11.90 | 2.54 | 1.00 |

[a] Treatment was approximate % of energy from grain supplement based on 2.3% BW, DM intake. Feedlot treatment was concentrate fed free choice from self-feeder in drylot.

[b] Range for marbling score = 1.0 to 10.9, with 1 being devoid and 10.0 to 10.9 being abundant.

[c] Range for quality score = 1 to 10, with 1 standard grade and 10 prime plus grade.

[d] Range for yield grade = 1 to 5, with 1 high and 5 low yield.

[e] Range for fat color = 1 to 5, with 1 being very white and 5 very yellow.

Table 3. Preliminary taste comparisons of meat from cattle finished on pasture or with grain feeding.

| Treatment[a] | Quality Grade | Cut | Seasoned | # of Persons in Taste Test | Average Ranking[b] |
|---|---|---|---|---|---|
| Test I | | | | | |
| 0 | Standard | Sirloin | No | 11 | 1.45 |
| 75% | Select | Sirloin | No | 11 | 1.54 |
| Test II | | | | | |
| 0 | Standard | Prime Rib | Yes | 51 | 1.9 |
| 75% | Select | Prime Rib | Yes | 51 | 2.0 |
| Feedlot | Choice | Prime Rib | Yes | 51 | 2.1 |

[a] Treatment was approximate % of energy from grain supplement based on 2.3% BW, DM intake. Feedlot treatment was concentrated feed free choice from self-feeder in drylot.

[b] Ranking is from 1 = most preferred to 3 = least preferred.

# SWARD CHARACTERISTICS OF BEEF FINISHING PASTURES

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**Abstract**

For cattle to successfully finish on pasture, abundant high-quality forage must be available to the grazing animals. Eighty-eight steers were finished on pasture with grain supplementation ranging from 0 to 75 % of the dietary energy supplied by grain. Pastures were intensively managed, cool-season, grass-legume pastures. Forage dry matter availability increased throughout the grazing season. The quality of the pastures also improved through the season, with crude protein (CP) content increasing and acid detergent fiber (ADF) content decreasing. Forage intake decreased at an average rate of 1 lb for each lb of grain fed. Observed average daily gains (ADG) were consistent with predicted ADG based on forage plus grain intake levels.

Introduction: To successfully finish cattle on pasture, forage quality must be high and forage availability maintained at adequate levels to ensure optimal intake. Blaser et al. (1977) suggest that energy intake will limit performance of ruminants grazing cool-season forages before protein or other nutrients. Energy content of perennial cool-season forages is most affected by maturity of the plant. Management of high energy potential pastures must focus on maintaining plants in a high quality, vegetative state. In this research we examined trends in forage availability, pasture quality, and voluntary forage intake.

Materials and Methods: A pasture-based, beef finishing project was conducted at the University of Missouri - Forage Systems Research Center in north-central Missouri in 1995. Eighty-eight steers were assigned to four grain feeding levels on pasture with each treatment replicated twice. Grain feeding levels were expressed as the percent of their total dietary energy intake supplied by grain and were 0, 25, 50 and 75 % with the remaining nutrients supplied by pasture. The pasture with steers receiving no grain was stocked at 1.0 steer to the acre. The pasture with steers receiving 25 % of their energy from grain was stocked at 1.25 steers per acre. The pasture with steers receiving 50 % of their energy from grain was stocked at 1.5 steers per acre. The pasture with steers receiving 75 % of their energy from grain was stocked at 1.75 steers per acre (Table 1).

During the first phase of the experiment, April 22 to August 22, the supplement was cracked corn. During the second phase, August 23 to October 30, the supplement contained 70 % cracked corn and 30 % corn gluten feed.

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Each treatment consisted of 8 acres which were divided into six permanent paddocks (Fig 1). During the grazing season, these were further divided with temporary fences and animals were allowed to back graze the paddock in order to access the water supply. Each subdivision within a paddock provided the animals with 1 to 3 days of feed depending on the season. Rest periods ranged from 10 to 35 days depending upon season and subdivision within paddock. Pastures were clipped for seedhead control in early June after cool-season grasses had headed.

Table 1. Supplementation level, stocking rate, and number of steers per treatment group in pasture-based finishing study.

| Supplementation level | Stocking rate | Number of steers |
|---|---|---|
| % of diet | steers/acre | no. |
| 0 | 1.00 | 8 |
| 25 | 1.25 | 10 |
| 50 | 1.50 | 12 |
| 75 | 1.75 | 14 |

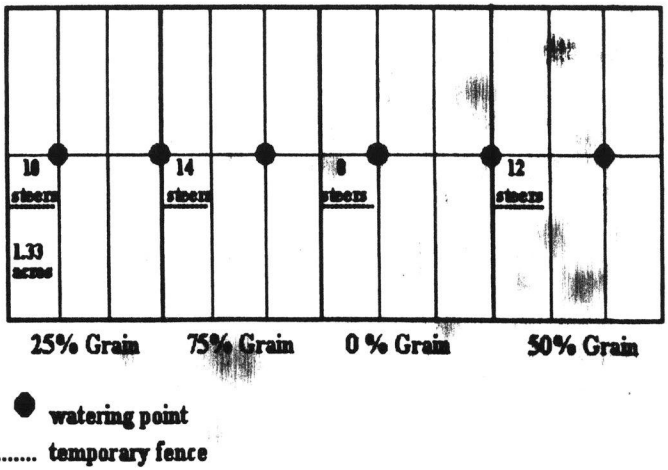


Figure 1. Schematic outline of one replication of beef-finishing pastures.

Within each treatment, individual paddocks were gridded into 900 $ft^2$ blocks for pasture sampling purposed. Prior to the allocation of a new grazing strip, one 2.7 $ft^2$ quadrat was cut from each grid block in that pasture allocation strip. Samples were oven dried and CP, ADF, and neutral detergent fiber (NDF) were determined using near infrared reflectance spectroscopy. Forage samples were collected from May 16 to October 18, 1995. Species composition data were collected from these paddocks as well. Forage dry matter intake (DMI) was calculated by the difference method using quadrats clipped prior to and immediately following grazing of an individual paddock.

Results and Discussion: Forage quality of these cool-season grass-legume pastures increased during the season, with CP increasing and ADF decreasing. Crude protein was not limiting for the animals at any time during the grazing season. Crude protein requirement for medium-framed 700-pound steers gaining 2.0 lb/day is approximately 10%, according to the National Research Council (1984). Crude protein levels of the forage exceeded this requirement throughout the season (Fig. 2). This result is in concurrence with the claims of Blaser et al. (1977) that protein would not limit performance on cool-season pastures. Linear regression was used to determine trend in forage quality through the season using day of year as the independent variable. For CP the relationship of CP to day of year was significant ($P=.05$) for the 0%- and the 75%-grain groups and a strong trend held true for the 25% and 50% groups ($P<.10$). For ADF the relationship to day of year was also significant ($P=.05$) for the 0%- and 75%- grain levels, and again the strong trend held true for the 25% and 50% groups. Cool-season pastures are often cited as being low quality during the summer months. Results of this research indicate that cool-season pastures managed to maintain vegetative forage are quite high quality even through the summer months.

Forage dry matter availability also increased during the season. Accurate forage sampling was hampered in the early part of the season due to extremely wet weather so forage availability data is presented for only Phase II. Forage intake by grazing animals during the Phase I period also appeared to be depressed due to heat stress and excessive rainfall. Rainfall during the Phase I period was 18 in. above normal for the research location. Phase II forage availability at turn-in and daily forage intake are in Table 1. The observed intake indicates that the steers in the 0 grain treatment were consuming adequate forage dry matter to maintain the expected ADG of 2.0 pounds per day.

A concern about feeding high levels of grain on pasture is the substitution of grain intake for forage intake. Based on the intake data in Table 2, it appears that the first increment of grain fed has the greatest negative impact on forage intake. The substitution coefficients for 25-, 50-, and 75%-grain feeding levels were 1.26, 1.00, and .74, respectively. Steer performance in this study as reported by Martz et al. (1996) indicates very little difference in ADG between the 0- and 25%-grain groups. The lacck of response to grain supplementation at the 25% level may be the result of decreased forage intake in the presence of added grain in a quantity that was high enough to affect rumen performance but not high enough to increase ADG. Average forage availability was very similar between the 0- and 25%-grain supplemented pastures, suggesting that forage availability was probably not limiting intake. Mean forage availability in the 50- and

75%-grain supplemented pastures was significantly lower than the 0 and 25% grain pastures. As the steers receiving higher levels of supplementation increased body weight, their forage consumption in terms of pounds of dry matter per head likely increased more rapidly than the steers growing at a slower rate. More forage was, therefore, consumed in each grazing cycle and the residual following grazing was reduced. The lower residual dry matter resulted in slower regrowth and lower dry matter yield at turn-in on each subsequent grazing cycle. The availability was low enough that forage intake may have been limited on these pastures explaining why steer performance on the 75%-grain pastures was not as high as what would have been predicted.

In summary, forage quality tended to increase throughout the grazing season on all treatments. Forage availability at the beginning of each rotation remained near constant or slightly increased for the 0- and 25%-grain groups while availability tended to decrease slightly through the season for the steers receiving 50 and 75% grain levels. It appears that forage availability was more likely to limit steer performance than would forage quality on these mixed cool-season grass-legume pastures.

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Table 2. Forage dry matter availability and voluntary dry matter intake of steers grazing pasture at four levels of grain supplementation.

| Grain supplementation level | Available dry matter at turn-in | Voluntary forage intake |
|---|---|---|
| % of diet | -- lb/A -- | - lb/hd/day - |
| 0 | 2659 | 21.5 |
| 25 | 2583 | 12.7 |
| 50 | 1983 | 9.6 |
| 75 | 2161 | 8.2 |

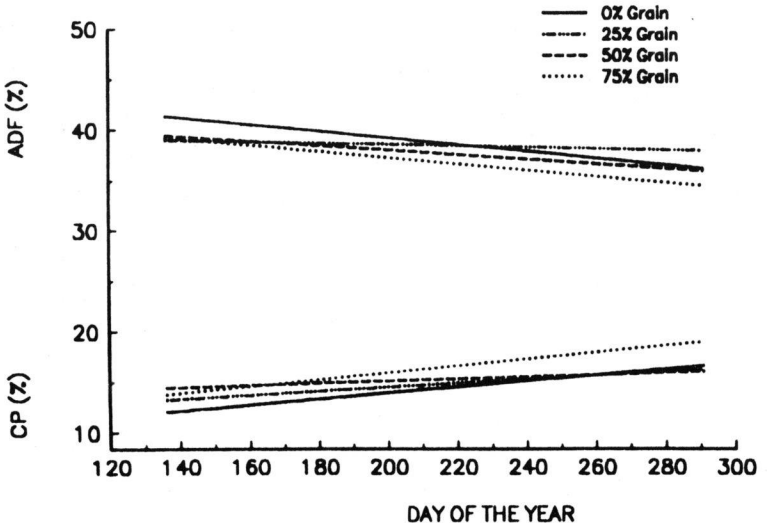


Figure 2. Trend in forage acid detergent fiber (ADF) and crude protein (CP) in cool-season, grass-legume pastures across the grazing season.