cantly different from the Yellow-BR. The hybrid by location interaction was significant ($P < .05$), suggesting that both hybrid and location may affect the relative digestibility of these grain sorghums. Large differences between hybrids, however, may account for a major portion of this interaction.

These studies suggest that location as well as hybrid is important in determining the nutritive value of grain sorghum. This effect was especially pronounced for crude protein but was also observed to a lesser degree for IVDMD. The significant ($P < .05$) hybrid by location interactions indicate that both of these factors affect the nutritive characteristics of grain sorghum. Consequently, in order to predict the nutritive value of grain sorghum, these studies suggest that location, in addition to hybrid, must be considered.

Chemical Composition of Cattle Finished on Different Production Systems

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Story in Brief

Hereford x Angus crossbred steers were finished on a grazing system of small grain-interseeded bermudagrass (SG/B) pasture or a conventional 68.6 percent ground corn ration. Carcasses were examined for chemical composition of the intramuscular tissue. Following a stocker phase of predominantly wheat pasture, steers were randomly assigned to: 1) a grazing system of small grains-interseeded bermudagrass (SG/B) pasture for 180 days, or 2) a grazing system of SG/B pastures for 63 days in the spring prior to being finished on a conventional 68.6 percent ground corn ration (85 days). Live animal performance, carcass characteristics, crude protein, detailed lipid composition and fatty acid profile of the intramuscular tissue were examined. Final weights (897 and 1051 lb) and average daily gains (1.46 and 2.76 lb) were lower ($P<.05$) for the group on SG/B pastures than the feedlot group. Carcass characteristics were also lower for the steers finished on the SG/B pasture than the feedlot treatment. Crude protein content of the muscle tissue was slightly lower (21.7 *vs* 22.4 percent) while total lipid content was slightly higher (5.2 *vs* 4.7 percent) for the steers finished in drylot as compared to the SG/B finished group. Phospholipid content expressed in mg per 100 g of tissue was higher ($P<.05$) in the intramuscular fat tissue of feedlot finished cattle than SG/B finished steers. As for fatty acid profiles of the intramuscular fat tissue, linolenic acid ($P<.04$) and lauric acid ($P<.08$) were higher in steers grazed on SG/B pastures than cattle finished in the feedlot.

Introduction

It is accepted that carcasses of cattle finished on forage generally grade lower than those on grain. Carcasses of forage-finished cattle have been shown to possess less intramuscular fat (marbling) and have a greater degree of saturation among fatty acids than grain-finished cattle (Oltjen and Dinius, 1975). This has been attributed to higher percentages of stearic and lower percentages of oleic acids in the intramuscular fat of forage-finished steers as opposed to grain-finished animals (Rumsey *et al.*, 1972 and Williams *et al.*, 1979). The acceptability of the beef also appears to depend on the grain supplementation of forage-finished cattle (Skelly *et al.*, 1978).

Feeding a conventional 79 percent corn ration to cattle (avg. 935 lb) for 9 weeks increased quality grade, marbling at the 12th rib and ether extractable fat from the *longissimus* muscle as compared to forage-finished steers (Cross and Dinius, 1978). The intent of this research was to examine the effects of a short feeding period (85 days on grain) compared to an all-forage finishing system on the lipid and crude protein composition and detailed fatty acid profile of the muscle tissue.

Materials and Methods

Sixteen Hereford x Angus crossbred steer calves were placed on wheat pasture from November 9, 1977, to March 29, 1978. These steers were also supplemented with a mineral mix consisting of 2 parts dicalcium phosphate, 1 part trace-mineralized salt and 5 percent cottonseed meal free choice.

After the stocker phase, animals (avg. 639 lb) were randomly assigned to two groups of eight steers (four steers per pen): 1) one group of steers was grazed to heavier weights on SG/B pastures from March 29 to May 31, 1978 (63 days), before being fed *ad libitum* in drylot (85 days) on a finishing ration (Table 1); 2) the other group grazed small grains-interseeded bermudagrass (SG/B) pasture and allowed free choice to mineral mix utilized in the stocker phase. Details on the treatment of the SG/B pastures may be obtained from Mader *et al.*, 1979.

Drylot steers were slaughtered when they reached a low choice slaughter grade (148 days-85 days in drylot) while the forage-fed group was slaughtered at the end of its normal production phase (180 days). Typical carcass characteristics were collected on these cattle after slaughtering at a commercial processing plant.

The right sides of the carcasses were bought from the commercial plant and samples taken for crude protein and detailed lipid and fatty acid analyses. Muscle tissue was taken from the following four locations on the carcass: [1] pectoral muscle (2 inches off midline at fourth sternebra); [2] *longissimus dorsi* muscle (2 inches off midline at sixth rib); [3] semi-membranosis muscle (first full-cut from round steak); [4] *longis-*

Table 1. Finishing ration fed to the drylot treatment.

Constituent	Quantity
	%
Ground corn	68.6
Cottonseed hulls	15
Soybean meal	11.4
Vitamin-mineral carrier supplement[a]	5

[a]Contained 8% crude protein on dry matter basis.

simus dorsi muscle (2 inches off midline at 13th rib). After the subcutaneous and intermuscular fat were separated from each muscle, the tissue was thoroughly ground and mixed in a hobart grinder and stored at −40°C for future analyses.

Crude protein was determined on the muscle tissue according to the Kjeldahl procedure (A.O.A.C. 1970). Total lipids were extracted from the muscle tissue with chloroform:methanol solution (2:1 v/v) according to Christie (1973). The lipid extract was analyzed for total lipids (A.O.A.C., 1970), triglycerides (Handel and Zilversmidt, 1957), phospholipids (Bartlett, 1959) and total cholesterol (Hycel, Inc., 1974). The lipid extract (20 mg) was also transesterified according to the procedure of Mason and Waller (1964) and analyzed for fatty acid methylesters.

Results and Discussion

Performance of steers finished on small grains-interseeded bermudagrass (SG/B) pasture as compared to those grazed on SG/B pasture for 63 days and finished on a conventional 68.6 percent ground corn ration is shown in Table 2. The lower performance of the steers finished on SG/B pasture is reflected by the lower final weights (897 *vs* 1051 lb) and ADG (1.46 *vs* 2.76 lb) than those finished on the conventional high grain ration.

As shown in Table 3, carcass characteristics were lower for steers grazed on SG/B pasture than those finished on a conventional corn ration. The forage-finished steers graded 13 percent choice, 75 percent good, 12 percent standard, while the conventional grain-finished group graded 63 percent choice and 37 percent good. Although carcass characteristics were lower, forage-finished steers had a respectable marbling score (high slight) and rib fat (.44 in) as noted by the percentage which graded good.

The crude protein and lipid composition of muscle tissue from steers are shown in Table 4. Crude protein, total lipid, triglyceride (measured in g per 100 g of tissue) and cholesterol (measured in mg per 100 g of tissue) were similar for steers finished on the widely diverse production systems. Phospholipid content (expressed in mg per 100 g of tissue) was higher ($P<.05$) in the intramuscular fat of grain-finished steers than forage-finished steers. Total lipid and triglyceride contents of intramuscular fat have been found to be higher ($P<.05$) in grain-finished than in forage-finished cross-bred steers (Williams *et al.*, 1979). The discrepancy in lipid composition between the two studies may be attributed to the tremendous differences in external rib fat (.20 *vs* .63 in) and marbling score (9 *vs* 14.8) for the forage-finished *vs* grain-finished steers. In the present study, the fact that the steers on the forage-feedlot treatment actually grazed SG/B pastures for 63 of the 148 days of the finishing phase only accounted for 10 percent greater amount of intramuscular fat (4.7 *vs* 5.2 g per 100 g of tissue) in the

Table 2. Performance of forage *vs* forage drylot fed Hereford x Angus crossbred cattle.

	Forage-drylot	Forage
Initial wt, lb	643	634
Final wt, lb	1051	897
Total days in finishing phase	148	180
ADG (live), lb	2.76	1.46

forage-feedlot group than the forage group. This may suggest that most of the fat was deposited externally to the muscle tissue as subcutaneous fat during the finishing phase on grain.

Fatty acid profiles for the lipids from muscle tissue are shown in Table 5. Higher percentages of lauric (C_{12}) and linolenic ($C_{18:3}$) acids in the forage-finished group were responsible for the only differences in fatty acids observed between the two groups of steers. Previous reports (Rumsey *et al.*, 1972, Williams *et al.*, 1979, and Brown *et al.*, 1979) have found higher percentages of oleic acid and lower percentages of stearic acid in the muscle tissue of grain-finished as compared to forage-finished steers. Failure to detect differences in this particular study may possibly be due to the similarity in total lipid content of intramuscular tissue. The higher percentage of linolenic acid in the intramuscular tissue has been observed by other researchers who have suggested that it may contribute to development of off flavors detected in forage-finished beef (Brown *et al.*, 1979).

Table 3. Carcass characteristics of the forage *vs* forage-drylot fed Hereford x Angus crossbred steers.

Carcass trait	Forage	Forage-drylot
Hot carcass wt, lb	493[a]	667[b]
Dressing percentage	54.9[a]	63.6[b]
Marbling score[a]	12.3[a]	14.1[b]
Quality grade[b]	8.5[a]	10.0[b]
Rib eye area, in^2	9.2[a]	11.7[b]
Fat thickness, in	.44[a]	.74[b]
YLDGRD	2.6[a]	3.6[b]
KHP,%	1.94[a]	2.31[b]

[a]17=average modest; 14=average small; 11=average slight.
[b]12=high choice; 10=low choice; 8=average good.
[ab]means in a row with different superscripts differ at P<.05.

Table 4. Protein and lipid composition of the muscle tissue from Hereford x Angus crossbred steers.

Production system	Crude protein	Total lipid[c]	Triglyceride[c]	Phospho-lipid[c]	Choles-terol[c]
	g/100g of Tissue			mg/100g of Tissue	
Forage	22.42	4.67	2.71 (56.7)	550.2[a] (14.4)	81.0 (1.89)
Forage-drylot	21.72	5.15	3.04 (58.8)	653.2[b] (13.2)	79.0 (1.64)

[ab]Means in the same column with different superscripts differ at P<.05. Values in parentheses are expressed as percent of total lipid.
[c]Lipid (intramuscular fat) extracted from the muscle tissue and analyzed for the individual lipid components.

Table 5. Fatty acid profile of the intramuscular tissue from forage *vs* forage-feedlot Hereford x Angus crossbred steers.

Constituent	Forage	Forage-drylot
	%	%
C_{12}	1.24[c]	.91[d]
C_{14}	2.72	2.72
$C_{14:1}$	1.39	1.14
C_{16}	24.38	24.16
$C_{16:1}$	5.71	5.45
C_u[e]	1.91	2.09
C_{17}	1.28	1.68
C_{18}	13.58	12.88
$C_{18:1}$	41.64	41.88
$C_{18:2}$	4.71	4.68
$C_{18:3}$	1.53[a]	1.04[b]
Unsaturated fatty acids, % of total	55.0	54.2

[ab]Means in the same row with different superscripts differ at P<.04.

[cd]Means in the same row with different superscripts differ at P<.08.

[e]Unknown fatty acid which was not identified.

In conclusion, steers finished on SG/B pasture as opposed to a conventional high grain ration performed less favorably and possessed lower carcass traits. Lipid and crude protein contents and fatty acid profiles of the muscle tissue did not reflect the tremendous differences in performance and carcass characteristics between steers finished on these two different production systems.

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