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RANGE VS FEEDLOT FINISHING. I. PERFORMANCE AND CARCASS QUALITY OF FALL-BORN STEERS FINISHED ON FORAGE WITH LIMITED GRAIN[1,2]

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Summary

Two levels of winter gain for fall-born steers followed by two levels of energy supplementation for finishing on range were compared in trials over two successive years. Steers were wintered on alfalfa hay *ad libitum* with two levels of barley supplementation. Daily supplementation of steers with 1.4 kg rolled barley increased (P<.01) winter gains in trial 1 by .17 kg but gains were similar in trial 2. The difference in winter treatment response between trials was attributed to differences in pre-trial nutrition, initial trial weights and hay intake.

The range finishing treatments consisted of sagebrush-bunchgrass range in trial 1 and crested wheatgrass range in trial 2 supplemented with either .9 or 2.3 kg barley. Gains were similar during both trials with the higher level of supplementation increasing (P<.10) ADG by .13 and .14 kg for trials 1 and 2, respectively. Previous winter treatment had no effect on range finishing gains in trial 2. However, in trial 1, steers from the previous low energy winter treatment had increased (P<.01) ADG on range of .38 kg.

No differences (P>.10) in carcass characteristics were found due to range finishing treatments for either trial. However, steers in trial 1 from the previous low energy winter treatment had lower (P<.10) dressing percents and less (P<.05) backfat than steers from the previous high energy winter treatment.

Electrical stimulation of range finished beef increased (P<.10) taste panel scores for juiciness in trial 1 and increased (P<.05) tenderness in trial 2. Electrical stimulation tended to increase taste panel scores for aroma, flavor and overall desirability.

Introduction

Worldwide energy consciousness has led to a reevaluation of our current systems for production of slaughter beef. Competition from man for direct consumption and increasing world prices have limited the availability of grain supplies for finishing beef. These facts have created interest in maximizing the use of forage and minimizing the use of grain in production of slaughter beef.

Increasing the use of forage for production of slaughter beef would have the additional advantages of producing leaner, higher yielding carcasses and lower the cost of production. Concerns with obesity and excess fat consumption by consumers in the United States should strengthen the market position of trimmer, lower grading beef that has been discounted in the past. Consumers prefer beef of the USDA good grade and would buy more of it compared to choice and prime beef if it were available (Brady, 1957).

Various forage finishing regimes compared to feedlot finishing have shown feedlot finishing produces faster gains, higher dressing percents, higher grading beef (Turner and Raleigh, 1977) and more tender and overall desirable beef (Bowling *et al.* 1977, and Ringkob *et al.* 1978). Recent research has evaluated several methods of increasing the palatability and consumer acceptability of lower grading beef. Postmortem electrical stimulation has been shown to accelerate carcass pH decline, hasten rigor development and reduce shear force test resulting in improved taste panel tenderness ratings (Savell *et al.* 1978 and Schroeder *et al.* 1978). Other researchers have shown pelvic suspension (Smith *et al.* 1979), high temperature chilling (Bowling *et al.* 1977) and carcass insulation (Ray *et al.* 1978) either alone or in combination with other treatments to have a positive effect on beef tenderness.

The current trials were conducted to compare two levels of winter energy supplementation of fall-born yearlings followed by two levels of energy supplementation for finishing on range. Carcass characteristics and taste panel evaluations compared range finishing treatments with and without postmortem electrical stimulation.

Experimental Procedure

Eighteen steers in trial 1 and 20 steers in trial 2 of Hereford-Angus breeding were allotted by weight to one of two levels of winter energy supplementation following a 98 and 99 day postweaning growth period. Both winter treatment groups received 2.3 kg bluegrass straw (7.6% crude protein) per head daily and alfalfa hay (IRN 1-00-063) *ad libitum*. Energy supplements consisted of 0 or 1.4 kg rolled barley (IRN 4-07-939) per head daily. Winter trials terminated after 161 days in trial 1 and 166 days in trial 2 depending on the availability of range forage in the spring.

Following the winter study, steers were allotted by weight and previous treatment to two levels of energy supplementation on range. Steers grazed native sagebrush-bunchgrass range in trial 1 and crested wheatgrass *(Agropyron desertorum)* in trial 2. Supplemental treatments consisted of either .9 or

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2.3 kg rolled barley per head daily. Steers were slaughtered off range after a 62-day finishing period and information gathered to assess carcass quality.

Immediately following slaughter the right side of each range finished steer was subjected to electrical stimulation (600 volts, 7 amps, 60 cycles/sec) for 60 seconds with the electrodes placed in the neck and *semitendinosus* muscle. Samples of *longissimus* muscle from the eleventh to thirteenth rib of all steers were frozen and stored (-34 C) for subsequent taste panel evaluations. Frozen steaks were cooked in matching gas ovens for 10 minutes on each side on broiler pans 18 cm from the flame. After 20 minutes, thermocouples were inserted into the center of the steak which was then cooked to a final internal temperature of 70 C. Ten-member trained sensory panels then evaluated steaks for aroma, tenderness, juiciness, flavor and overall desirability on an 8-point hedonic scale with 8 being the most desirable and 1 the least.

Least squares analysis of variance for factorial designs and one-way classifications were conducted on the data with differences in treatment means tested by the Student's t or by using Least Significance Difference as described by Steel and Torrie (1960).

Results and Discussion

Results of the winter study are shown in table 1. Daily supplementation of steers with 1.4 kg barley increased (P<.01) winter average daily gains (ADG) by .17 kg. However, no difference was found between low and high energy levels for trial 2 and gains were higher for both treatment groups than in trial 1. Difference between trials in treatment response and ADG is probably partly due to differences in hay intake. Steers in trial 2 consumed 2.3 kg more hay per day which would more than account for differences in steer weights between trials. Apparently, efforts to reduce hay wastage in trial 1 resulted in not allowing sufficient weighback to maintain maximal hay intake. Hay was of equal quality for both trials and if intake was restricted in trial 1 as indicated by the lower gains, then the 1.4 kg of supplemental barley in the high energy treatment would be expected to have a more beneficial affect. Another contributing factor would be the differences in pre-trial planes of nutrition. Steers in trial 1 grazed alfalfa-grass irrigated pastures postweaning for 64 days and then were moved to a dry lot and fed alfalfa hay *ad libitum*. Steer gains were very poor for the first 30 days on irrigated pasture and the move to dry lot further depressed gains. Steers in trial 2 received meadow hay *ad libitum* plus a daily supplement of 1.4 kg rolled barley throughout the 99-day postweaning period. This resulted in increased postweaning ADG of .54 kg and 40 kg heavier steers at the start of the wintering period for trial 2. This information strengthens the possibility that hay intake was restricted during the wintering period of trial 1 as these steers would have been expected to compensate for the restricted postweaning gains.

Results of the range finishing treatments are shown in table 2. Although steers entered the finishing phase 78 kg heavier in trial 2, the finishing treatment responses were similar between trial 1 and 2. The high level of energy supplementation increased (P<.10) ADG by .13 and .14 kg for trials 1 and 2, respectively. The increased ADG resulted in a supplement conversion ratio of 10.8 and 10.0 kg barley per kg gain for the higher level of supplementation in trials 1 and 2, respectively.

Previous winter treatments had a significant effect on range finishing gains in trial 1. Steers from the previous low energy winter treatment compensated for their restricted winter gains resulting in an increased (P<.01) finishing ADG of .38 kg over steers from the previous high energy winter treatment. This resulted in equal slaughter weights for steers from both previous winter treatments. No differences were found between winter treatments in trial 2 and therefore no effects would be expected to carry over to the finishing phase. These results agree with a report by Castle *et al.* (1961) which found that rate of winter gain together with length of wintering period has a significant negative effect on subsequent summer gains. However, calves restricted to limited winter gains were considerably lighter at the end of the summer grazing period. Although the work by Castle *et al.* (1961) was with spring-born calves, a similar relationship would be expected with fall-born yearlings. Generally with fall-born yearlings to be finished on range following the wintering period, higher rates of winter gains would be more economical as the steers would be heavier entering the finishing phase and would require less time to reach slaughter weight. The importance of a constant rate of growth is shown by the difference in gains from weaning to slaughter between trials 1 and 2. Steers in trial 2 were slaughtered at 79 kg heavier weights at a similar age.

No differences (P>.10) were found between range finishing treatments for carcass quality grade, maturity, dressing percent, chilled carcass weight, marbling score, adjusted backfat, fat color or ribeye area for either trial (table 3). However, steers from the previous low energy winter treatment in trial 1 had lower (P<.01) dressing percents and less (P<.05) backfat than steers from the previous high energy winter treatment.

Differences in carcass characteristics between trials are probably the result of the heavier slaughter weights for trial 2. Steers in trial 2 produced heavier carcasses, higher dressing percent, more backfat and larger ribeyes. This resulted in 70% of the steers in trial 2 grading low good or better compared to 50% for trial 1. These results again demonstrate the importance of maintaining a constant rate of growth from weaning to slaughter. Steers in trial 2 reached a desirable slaughter weight (475 kg) by mid-July whereas steers in trial 1 were 79 kg lighter. Increased levels of supplementation would be required to maintain satisfactory gains after mid-July as the forage is rapidly decreasing in quality.

No differences (P>.10) in taste panel evaluations were found between previous winter or range finishing treatments. However, electrical stimulation resulted in an increased (P<.10) taste panel score for juiciness in trial 1 and an increase (P<.05) in tenderness score for trial 2 (table 4). Although not significantly different (P>.10), electrical stimulation also tended to increase taste panel ratings for aroma, flavor and overall desirability.

The differences in taste panel scores between trials are difficult to explain. The steers in trial 2 produced heavier carcasses and had a higher percentage of beef grading good. However, their taste panel scores were lower than for trial 1 and were on the average below a consumer acceptable level of 5 on the hedonic scale. The difference in taste panel ratings between trials may be due to the fact that in trial 2 a direct comparison of range finished beef was made with higher grading feedlot finished beef. This comparison was not made in trial 1. Other researchers have shown that when range finished beef is fed to an acceptable slaughter weight (454 + kg), the beef is generally acceptable. Schupp *et al.* (1979) compared forage finished, limited grain finished and feedlot finished beef for consumer acceptance through trained taste panels, purchaser ratings and volunteer household panels. The trained taste panel was the most critical but found that when limited grain finished beef had been fed to slaughter weights of 454 to 476 kg, the beef was all in the favorable end of the rating scale.

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TABLE 1. GAIN AND INTAKE DATA OF STEERS WINTERED ON TWO ENERGY LEVELS

Item	Trial 1 Low energy	Trial 1 High energy	(SEM)	Trial 2 Low energy	Trial 2 High energy	(SEM)
Postweaning period ADG, kg	.44			.98		
Initial wt, kg	291.7	288.9		326.6	333.9	
May wt, kg	352.5	378.0	(15.19)	438.6	448.3	(11.64)
ADG, kg	.38[a]	.55[b]	(.02)	.67	.69	(.03)
Intake per head						
Barley, kg/hd	0	1.4		0	1.4	
Total barley intake, kg[c]	0	219.1		134.7	360.6	
Hay, kg/day	9.89	9.53		12.25	11.70	

[a,b]Means within trials in the same row with different superscripts differ significantly (P<.01).

[c]Includes barley intake during 99 day postweaning period for trial 2.

TABLE 2. GAIN AND INTAKE DATA OF STEERS FINISHED ON RANGE ON TWO ENERGY LEVELS

Item	Trial 1 Low energy	Trial 1 High energy	(SEM)	Trial 2 Low energy	Trial 2 High energy	(SEM)
Initial wt, kg	369.9	360.6	(14.33)	442.6	444.3	(12.32)
Final wt, kg	413.2	412.3	(12.79)	485.8	496.7	(12.12)
ADG, kg[c]	.70[a]	.83[b]	(.05)	.70[a]	.84[b]	(.06)
ADG, kg[d]	.55	.56	(.02)	.67[a]	.74[b]	(.03)
Barley intake, kg/hd/day	.9	2.3		.9	2.3	
Barley intake, kg/hd[e]	154	262		304	388	

[a,b]Means within trials in the same row with different superscripts differ significantly (P<.10).

[c]Average daily gain during 62 day finishing period.

[d]December to July ADG, trial 1 - 223 days and trial 2 - 228 days.

[e]Includes total barley intake per head from weaning to slaughter.

TABLE 3. CARCASS CHARACTERISTICS OF RANGE FINISHED STEERS

Item	Trial 1 Low energy	Trial 1 High energy	(SEM)	Trial 2 Low energy	Trial 2 High energy	(SEM)
Maturity	A-	A-		A-	A-	
Chilled wt, kg	223.7	226.5	(7.62)	288.3	290.3	(8.45)
Dressing, %	54.2	54.9	(.38)	57.7	57.6	(.71)
Marbling score[a]	3.9	3.4	(.38)	3.8	4.0	(.24)
Backfat, cm	.48	.60	(.06)	.76	.69	(.07)
Fat color[b]	3.0	3.0	(.0)	5.0	4.8	(.20)
Ribeye area, cm^2	64.4	61.0	(2.25)	71.7	73.0	(2.23)
Grade[c]	9.4	9.0	(.77)	9.4	9.9	(.61)

[a]3=traces, 4=slight, 5=small.

[b]3=slight yellow, 4=slightly yellow tinge, 5=white.

[c]13=average choice, 10=average good, 7=average standard.

TABLE 4. EFFECT OF ELECTRICAL STIMULATION ON TASTE PANEL EVALUATIONS

Item	Trial 1 Control	Trial 1 Electric	(SEM)	Trial 2 Control	Trial 2 Electric	(SEM)
Aroma	6.0	6.0	(.08)	5.2	5.3	(.07)
Tenderness	5.6	5.8	(.16)	4.2[a]	4.6[b]	(.14)
Juiciness	5.0[c]	5.4[d]	(.02)	4.7	4.9	(.15)
Flavor	5.7	5.9	(.10)	4.9	5.0	(.11)
Overall	5.4	5.6	(.12)	4.5	4.7	(.14)

[a,b]Means within trials, in the same row with different superscripts differ significantly ($P<.05$).

[c,d]Means within trials, in the same row with different superscripts differ significantly ($P<.10$).