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COMPARISON OF METHODS OF PRODUCING SLAUGHTER WEIGHT STEERS USING MAXIMUM QUANTITIES OF FORAGE AND MINIMUM QUANTITIES OF GRAIN

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Introduction

The probability of high grain prices and/or a shortage of grain for livestock feeding due to human competition has created a need for reevaluation of finishing cattle with a minimum use of grain. By necessity, cattle feeding may become more dependent upon range and pasture forage. Therefore, rangelands may again be looked to as a source of slaughter cattle.

The majority of the semi-arid and arid rangelands of the west have no alternate use for food production other than through grazing. It is important that our ranges and meadowlands be utilized to the fullest extent for meat production which will conserve feedstuffs that can be consumed directly by man. Production of a slaughter weight animal, which is acceptable to the consumer, utilizing a maximum quantity of forage and a minimal quantity of grain is needed to insure that beef will continue to be an economical protein source for the consumer.

The objectives of this study were to compare performance and slaughter characteristics of various production systems by which slaughter steers can be produced in the high desert rangeland of eastern Oregon, which is very similar to the semi-arid rangelands of western South Dakota. Economic analysis and taste panel evaluations are also included.

Materials and Methods

Trial 1. Sixty Hereford steers, with an equal number from each of four winter treatments, were assigned to a growing and finishing study on May 11, 1976. Steers were stratified by previous winter treatment and randomly allotted to one of three growing phase treatments. Thirty-six steers were assigned to a crested wheatgrass range and 24 split between alfalfa-fescue and clover-fescue irrigated pastures.

Steers on the range treatment, during the growing phase, were moved to a fresh pasture when they had utilized about 35% of the available forage as determined by visual observation. A supplemental feeding program for yearlings on crested wheat developed over a period of years on the Squaw Butte Station was used as a base (Raleigh, 1970). Table 1 shows the daily supplemental nutrient intake of the steers on range. Energy and nitrogen were supplied by barley and biuret, respectively. Careful attention was given to hand feeding the supplement at the same time each morning in order to maintain maximum grazing time and performance. Steers on irrigated pasture were alternated between two pastures, approximately 2 acres in size. Steers were moved every two weeks to allow for irrigation and regrowth. These animals received 3.2 pounds of barley per head through July 28 at which time barley was gradually increased to 5 pounds by August 3.

The finishing phase began August 3 at which time 10 steers from the range treatment and five from each irrigated pasture treatment were assigned to the feedlot. One-half of the steers placed in the feedlot received a 40% roughage (38% rye grass straw, 2% alfalfa) based ration with cottonseed meal (CSM) as the source of protein. The other half received basically the same ration with dried poultry waste (DPW) and feathermeal as the protein source. These rations are shown in table 2. Steers were slaughtered when back fat reached .3 inches as measured by ultrasonic means and carcass data were collected.

TABLE 1. DAILY SUPPLEMENT INTAKE ON RANGE

Period	Biuret (lb.)	Barley (lb.)
5/11-6/15	.0	1
6/16-6/17	.03	1
6/18-6/19	.04	1
6/20-6/26	.05	1
6/27-7/3	.09	1
7/4-7/10	.10	1.3
7/11-7/17	.12	1.6
7/18-7/24	.14	1.8
7/25-8/3	.14	2.5

TABLE 2. FEEDLOT RATIONS FOR STEERS, TRIALS 1 AND 3

Ingredient	CSM (lb.)[b]	DPW (lb.)[b]
Straw, rye grass	750	750
Alfalfa	50	50
Molasses	150	150
Tallow	50	50
Rolled barley	764	773
Cottonseed meal	225	---
Dried poultry waste	---	185
Feather meal	---	40
Limestone	9	---
Antibiotic	1	1
Vitamin A premix[a]	1	1
Total	2000	2000

[a] 2 million IU/lb.

[b] CSM and DPW are cottonseed meal and dried poultry waste rations, respectively.

Steers remaining on crested wheatgrass range and irrigated pasture received increasing amounts of grain at the rate of .5 pound every two days until they reached a full feed of grain, using the pastures and range as a roughage source. When the level of grain reached 8 pounds daily per head, the steers were fed half their daily allowance morning and evening. Composition of rations for the finishing phase are shown in table 3. It was necessary to feed grass hay to steers on irrigated pasture the last 31 days after frost stopped growth. The steers were slaughtered beginning November 6, prior to the onset of cold weather which reduces feed efficiency. The ten heaviest range steers were slaughtered at this time. The ten heaviest steers from irrigated pasture treatments were slaughtered November 13 and the next ten heaviest animals on range were slaughtered November 20. Carcass data were collected on each of these animals.

TABLE 3. FINISHING RATIONS FOR STEERS ON IRRIGATED PASTURE AND RANGE, TRIALS 1 AND 2

Ingredient	Irrigated Pasture (lb.)	Range (lb.)
Rolled barley	1961	1937
Biuret	8	25
Salt	20	16
Limestone	10	21
Vitamin A premix[a]	1	1
Total	2000	2000

[a] 2 million IU/lb.

Sensory panel evaluations were made on the longissimus muscle from the 9-10-11-12th rib section of five randomly chosen carcasses from each treatment. The cuts were placed in plastic bags, the air evacuated, over wrapped with freezer paper and frozen whole. Just prior to cooking and sensory evaluations, the frozen cuts were removed from the freezer. As thin a full cut as possible was taken from the small end and then three one-and-one-quarter inch steaks were cut. The steaks were cooked in the frozen form by broiling ten minutes on each side at which time thermocouples were inserted into the middle of the steak and broiling continued with turning every five minutes until an internal temperature of 71 C was reached. Warm samples (two per cut) were served to individual panelists on a ten member trained taste panel. Tenderness, flavor, aroma, juiciness and overall desirability were determined.

Trial 2. Thirty-nine Hereford and Hereford X Angus steers were assigned to a growing and finishing study on May 17, 1977. Eighteen head were allotted to crested wheatgrass range, 10 head to alfalfa-fescue irrigated pasture and 11 head to alfalfa orchardgrass irrigated pasture. Steers were managed and fed as in trial 1, except the steers on irrigated pasture received 2.5 pounds of barley daily per head.

The finishing phase began August 3 at which time nine steers from range, five from alfalfa-fescue and six from alfalfa orchardgrass irrigated pasture were allotted to one of four feedlot treatments. Each of the feedlot treatments was a 40% roughage based ration of either 5% alfalfa hay plus 35% annual rye grass straw (ARS), 35% perennial rye grass straw (PRS), 35% wheat straw (WS), or 35% grass hay (GH) (table 4).

The nine steers remaining on crested wheatgrass range were managed and fed as in trial 1. The 10 steers remaining on irrigated pasture were placed in drylot and fed long meadow hay ad libitum with the grain ration fed as in trial 1. Composition of steer rations for range and irrigated pasture were the same as fed in trial 1 (table 3). The steers from the irrigated pasture study were removed for slaughter on November 6. The crested wheatgrass steers were removed on November 20. Sensory panel evaluations were conducted as previously described.

Trial 3. Thirty Hereford and Angus X Hereford steers born in the fall of 1975 were assigned to various growing and finishing treatments at weaning time, July 28, 1976. Ten steers were assigned to go to the feedlot immediately, five of which were placed on the CSM ration and five on the DPW ration (table 2). The remaining steers were allotted to irrigated pasture until October 12. At this time ten went to the feedlot where half were placed on the CSM ration, the rest on the DPW ration. These treatments will be referred to as IP-CSM and IP-DPW.

TABLE 4. FEEDLOT RATIONS FOR STEERS, TRIAL 2

Ingredient	ARS(lb.)	PRS(lb.)	WS(lb.)	GH(lb.)
Annual rye grass straw	350			
Perennial rye grass straw		350		
Wheat straw			350	
Grass hay				350
Alfalfa	50	50	50	50
Rolled barley	683	683	683	683
Feather meal	25	25	25	25
Cottonseed meal	25	25	25	25
Tallow	50	50	50	50
Molasses	150	150	150	150
Limestone	14	14	14	14
Tricophos	1	1	1	1
Rumensin premix[a]	1	1	1	1
Vitamin A premix[b]	1	1	1	1
Total	1000	1000	1000	1000

[a] 20 g/lb.

[b] 2 millionIU/lb.

The other ten steers were assigned to be fed approximately two-thirds alfalfa hay and one-third meadow hay through the winter period in drylot. They also received 1 pound of barley per head each day the last 90 days in the lot. On May 18, 1977, they were placed on crested wheatgrass range until July 17, at which time they were removed for slaughter. While on crested wheat they received 2 pounds of barley daily per head plus biuret as prescribed by the supplement schedule of table 1. This treatment is referred to as IP-SB-CW. Carcass data were collected for all five treatments.

Results and Discussion

Trial 1. Performance and economic analysis of steers during the 84-day growing phase are shown in table 5. Steers grazing the crested wheatgrass range gained faster ($P<.05$) than either group on irrigated pasture on approximately one-third the grain. It is possible that increased gains could have been obtained by feeding more concentrate (Perry et al., 1972). However, successive increments of grain usually return less gain per additional unit as shown by Denham (1977).

TABLE 5. GAIN AND CONSUMPTION DATA FOR 84-DAY GROWING PHASE OF TRIAL 1

Item	Irrigated Pasture		Range
	Alfalfa-fescue	Clover-fescue	Crested wheat
No. of steers	12	12	36
Initial wt., lb.	440	442	436
Daily gain, lb.	2.4	2.4	3.3*
Daily gain intake, lb.	3.3	3.3	1.3
Grain/gain ratio	1.4	1.4	.4
Economic Analysis			
Receipts			
Feeder steers, $[a]	205.22	204.59	225.05
Expenses			
Growing steers, $[b]	176.00	176.88	174.24
Feed cost, $[c]	36.34	36.34	26.99
Total expense, $	212.34	213.22	201.23
Returns to capital, land, labor and management, $	-7.12	-8.63	23.82

*Significant ($P<.05$).

[a]Valued at 32¢/lb.

[b]Valued at 40¢/lb.

[c]Barley at 5.5¢/lb. Forage at $7.50 per steer month.

Returns to capital, land, labor and management were greatest for the range steers. Fewer management problems were encountered with range steers than those on irrigated pasture due to fewer parasite and health problems.

Steers finished on irrigated pasture gained faster than those finished in the feedlot (table 6). Daily feed intake, which did not include grass for the range or irrigated pasture treatments, was nearly twice as much in the feedlot. The additional 11 pounds of feed required per head per day in the feedlot illustrates the contribution of the pastures for finishing the range and irrigated pasture steers. Utley and McCormick (1976) reported that the use of pasture decreased grain consumption by 39% as compared to the drylot. By finishing steers on range and irrigated pasture, a savings of 190 pounds of grain was made as compared to finishing under this type of a feedlot program. The actual savings is somewhat greater as 17 days of feed are not accounted for in the feedlot treatments. This period was allowed for steers to recover from transport and get back on feed. This illustrated another advantage of finishing on range as the range cattle do not go through a period of being off feed.

Weather conditions dictate the length of time cattle can remain on pasture, thus, restricting the feeding period and body weights attainable. This is illustrated in the heavier carcass weights of the feedlot animals which received an additional 27 days of feed as recorded plus the 17 days prior to the finishing phase beginning. Carcass grades were also higher from the feedlot which may also be due to the additional days on feed and not the type of feed. Fat color of the carcasses from irrigated pasture were more yellow than those from the range or feedlot. Rib eye areas were not significantly different among treatments. Beef from the feedlot group was more desirable in all factors of the taste panel evaluation except in aroma where no differences occurred. The overall desirability of cattle in the DPW feedlot treatment was greater than the CSM treatment.

TABLE 6. PRODUCTION AND CARCASS CHARACTERISTICS FOR FINISHING PHASE IN TRIAL 1

Item	Irrigated Pasture		Range	Feedlot[f]	
	Alfalfa-fescue	Clover-fescue	Crested wheatgrass	CSM	DPW
No. of steers	6	6	25	10	10
Initial wt., lb.	662	664	706	726	724
Daily gain, lb.	3.0	3.0	2.5	2.0	2.2
Daily feed intake, lb.[a]	5.11	5.11	5.47	9.07	10.57
Feed/gain ratio	3.76	3.79	4.71	9.97	10.36
Days on feed	103	103	103	130	130
Carcass characteristics					
24 hr. carcass wt., lb.	519	524	557	607	625
Carcass grade[b]	7.6	8.2	9.2	10.3	10.1
Marbling score[c]	3.20	3.4	3.75	4.1	4.1
Rib eye area, in.	9.6	10.5	9.5	10.3	10.3
Fat color[d]	2.6	2.4	3.5	4.0	4.4
Taste panel evaluation[e]					
Aroma	4.62		4.58	4.37	4.37
Tenderness	3.95		4.47	5.63	6.35
Juiciness	4.69		4.83	5.45	5.94
Flavor	4.86		4.94	5.81	6.20
Overall desirability	4.31		4.70	5.61	6.31

[a]Intake does not include forage for irrigated pasture and range treatments.

[b]13 = medium choice, 10 = medium good, 7 = medium standard.

[c]4 = slight, 3 - traces.

[d]4 = slight yellow tinge, 3 = slightly yellow, 2 = moderately yellow;

[e]Scored on a scale of 1 to 8 with 8 being most desirable.

[f]CSM and DPW are cottonseed meal and dried poultry waste treatments respectively.

Trial 2. Performance characteristics and economic analysis of the growing phase are shown in table 7. The daily gains were much less than gains of steers in trial 1. Steers used in trial 2 were approximately 165 pounds heavier at the beginning, due to higher winter gains, than the animals of trial 1. The lighter animals of trial 1 exhibited compensatory growth which boosted their daily gains. The steers on the alfalfa-fescue irrigated pasture treatment gained the least as compared to the other two treatments. The steers on crested wheatgrass received approximately half the amount of supplement as those on irrigated pasture. Returns to capital, land, labor and management were again the highest for the range steers.

Production and carcass characteristics for the finishing phase are shown in table 8. Daily gain on crested wheatgrass was less than the other treatments. The irrigated pasture steers which were finished on meadow hay fed free choice in the lot had greater daily gains than those on range. Raleigh et al. (1967) reported that steers finished in drylot being fed meadow hay ad libitum gained more than the range-fed group. Days on feed for the feedlot treatments would have been 30 days longer except that the cattle went off feed and the trial was restarted at the point when they were back on feed again, thus the difference in initial weight. This inflated the daily gains of the feedlot steers, as the time the steers were recovering from shipment and getting back on feed was omitted. Daily feed and hay intake of the steers from irrigated pasture was greater than any of the 40% roughage rations in the feedlot. However, the steers from irrigated pasture consumed over half of their diet as roughage. A savings of 132 pounds of grain per head was possible by finishing steers in the feedlot as compared to range and irrigated pasture.

Carcass weights were again heavier from steers out of the feedlot. No significant difference was found in carcass grade or marbling score. The ARS and PRS carcasses had larger rib eye areas than either the alfalfa-orchardgrass or the crested wheatgrass treatments. Fat color was somewhat more desirable in the feedlot treatments. Overall desirability of the beef from the crested wheat treatment was lowest. This effect was due primarily to the range beef being less tender than the other treatments. Tenderness scores of this beef were considerably less (3.93 vs 4.47) than that of trial 1.

TABLE 7. GAIN AND CONSUMPTION DATA FOR GROWING PHASE OF TRIAL 2

Item	Irrigated Pasture		Range
	Alfalfa-fescue	Alfalfa-orchardgrass	Crested wheat
No. of steers	10	11	18
Initial wt., lb.	618	596	620
Daily gain, lb.	1.5	2.0*	2.0*
Daily gain intake, lb.	2.5	2.5	1.3
Grain/gain ratio	1.6	1.2	.6
No. days	76	76	78
Economic Analysis			
Receipts			
Feeder steers, $[a]	233.94	237.72	247.77
Expenses			
Growing steers, $[b]	216.37	208.82	217.29
Feed cost, $[c]	29.47	29.47	25.26
Total expense, $	245.84	238.29	242.55
Returns to capital, land, labor and management, $	-11.90	-.57	5.22

*Significant ($P < .05$).

[a]Valued at 32¢/lb.

[b]Valued at 35¢/lb.

[c]Barley at 5.5¢/lb. Forage at $7.50 per steer month.

TABLE 8. PRODUCTION AND CARCASS CHARACTERISTICS FOR FINISHING PHASE, TRIAL 2

Item	Irrigated Pasture		Range	Feedlot			
	AF	AO	CW	ARS	PRS	WS	GH
No. of steers	5	5	9	5	5	5	5
Initial wt., lb.	741	750	781	838	845	851	865
Daily gain, lb.	2.9	2.9	1.8	2.6	2.3	2.2	2.3
Daily feed intake, lb.[a]	11.4	11.4	12.0	17.5	16.9	15.7	19.9
Daily hay intake, lb.	12.5	12.5					
Feed/gain ratio	8.1	8.2	6.4	6.6	7.2	7.1	8.8
Days on feed[b]	99	99	108	87	78	83	64
Carcass Characteristics							
24 hr. carcass wt., lb.	554	572	552	640	616	620	607
Carcass grade[c]	7.6	9.4	9.0	10.6	9.4	9.4	10.0
Marbling score[d]	3.0	3.8	3.8	4.2	3.8	3.8	4.0
Rib eye area, in.	10.5	9.8	9.7	11.3	11.7	10.8	10.7
Fat color[e]	3.0	3.0	3.0	3.4	3.6	3.4	4.0

[a]Feed intake only includes grain for the irrigated pasture and range treatments.

[b]Feedlot cattle went off feed for 30 days which is not accounted for.

[c]10 = medium good, 7 = medium standard.

[d]4 = slight, 3 = traces.

[e]4 = slight yellow tinge, 3 = slightly yellow.

[f]AF, AO, CW, ARS, PRS, WS and GH are alfalfa-fescue, alfalfa-orchardgrass, crested wheatgrass, annual rye grass straw, perrenial rye grass straw, wheat straw and grass hay treatments respectively.

TABLE 8. (continued)[f]

Item	Irrigated Pasture		Range	Feedlot			
	AF	AO	CW	ARS	PRS	WS	GH
Taste panel evaluation[g]							
Aroma	5.93		5.90	5.34	5.42	5.56	5.36
Tenderness	4.61		3.93	5.26	4.48	5.84	4.68
Juiciness	5.26		5.03	5.26	5.12	5.18	5.16
Flavor	5.68		5.53	5.64	5.44	5.60	5.34
Overall desirability	4.94		4.57	5.32	4.80	5.06	5.10

[f]AF, AO, CW, ARS, PRS, WS and GH are alfalfa-fescue, alfalfa orchardgrass, crested wheatgrass, annual rye grass straw, perrenial rye grass straw, wheat straw and grass hay treatments respectively.

[g]Scored on a scale of 1 to 8 with 8 being most desirable.

Trial 3. Production and carcass data for fall calves are shown in table 9. Daily gains of steers on the IP-SB-CW treatment were less than the other four treatments. Total days on feed were considerably longer as would be expected on an all forage diet. No significant differences were detected among treatments for carcass weight, grade or marbling score. Rib eye areas of the CSM and DPW treatments were largest. Fat color score of the IP-SB-CW treatment was less than the other treatments.

The steers on the IP-SB-CW treatment received less than .75 pounds of barley daily. The steers in the other treatments consumed 10 pounds or more of grain per day. Thus, the savings in grain alone amounted to 9.25 pounds per day or enough to have finished 10 more steers. By utilizing the irrigated pasture before going to the feedlot the IP-CSM and the IP-DPW treatments required 40 days less to finish than the CSM or DPW treatments, a savings of 436 pounds of grain.

The three studies presented in this paper show that a substantial savings of grain can be made utilizing forage finishing systems, particularly when compared to conventional finishing systems feeding 80% grain rations. Livestock and Meat Situation[1] reports that typical Great Plains custom feeders feed 3300 pounds of grain to 600 pound steers for six months. The range and irrigated pasture systems reported in this study utilized 770 pounds of grain to finish 715 pound steers. This is a savings of 2530 pounds of grain over the conventional finishing system.

Daily gains were greater on crested wheatgrass range as compared to irrigated pastures for the growing stage. Returns to land, labor, management and capital were also greatest for the range treatment.

Carcass grades fell in the high standard to good grade for all treatments. Brady (1957) found that the public prefers beef of U.S.D.A. good grade and would buy more of it, as compared to choice or prime grades, if it were available. Kidwell et al. (1959) found that carcass grade does not have a great deal of influence on taste and acceptance of meat. Acord (1977) stated that consumers will need to learn how to appreciate the advantages of meat that carries relatively little fat and, therefore, grades "Good" instead of "Choice". Overall desirability of the beef from the feedlot treatments was greater than the range of irrigated pasture treatments but all were acceptable. Schupp et al. (1976) reviewed research results from state experiment stations evaluating the acceptability of forage-finished and limited grain-finished beef and found forage-finished beef to be acceptable in each case.

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[1] Livestock and Meat Situation, Economic Research Service, U.S. Department of Agriculture, LMS-217, October 1977.

TABLE 9. PRODUCTION AND CARCASS DATA FOR FALL CALVES, TRIAL 3

Item	Range[d]	Feedlot			
	IP-SB-CW	CSM	DPW	IP-CSM	IP-DPW
No. of steers	10	5	5	5	5
Initial wt., lb.	676	575	556	645	638
Daily gain, lb.	1.45*	2.2	2.0	2.0	1.9
Daily feed intake, lb.	18.6	16.6	17.7	18.0	19.3
Feed/gain ratio	12.8	7.6	8.5	9.0	10.3
Days on feed	252	191	199	133	148
Carcass Characteristics					
24 hr. carcass wt., lb.	561	594	579	545	550
Carcass grade[a]	9.7	8.4	10.2	9.4	10.0
Marbling score[b]	3.9	3.6	4.4	3.8	4.0
Rib eye area, in.	9.0	10.5	10.6	9.3	10.2
Fat color[c]	2.8	4.6	4.2	4.0	4.2

*Significant ($P<.05$).

[a]10 = good, 7 = standard.

[b]4 = slight, 3 = traces.

[c]4 = slightly yellow tinge, 3 = slightly yellow, 4 = moderately yellow.

[d]Includes time from when steers were removed from irrigated pasture until they were slaughtered. Forage is not included in intake for the 60 days on crested wheatgrass.

[e]Includes time in feedlot after steers started on treatment.

[f]IP-SB-CW, CSM, DPW, IP-CSM, IP-DPW are irrigated pasture to feedlot at Squaw Butte to crested wheatgrass pasture, cottonseed meal, dried poultry waste, irrigated pasture to cottonseed meal ration in feedlot and irrigated pasture to dried poultry waste ration in feedlot treatment management schemes respectively.

Conclusions

The steers in two trials gained faster on crested wheatgrass range than their counterparts on irrigated pasture during the growing period each year. The range steers continued to gain at a good rate going into the finishing period and through to slaughter. Considerable grain was saved by finishing on range as compared to the other treatments at the expense of reduced carcass quality and lowered taste preference.

Ranchers with good quality rangeland have the basic inputs to grow and finish cattle utilizing less grain than do commercial feeders. In short grain supply years, due to either human competition or low production, the range may be our best producer of beef.

Rangelands, such as those west of the Missouri River, can provide the quantities and quality of forage to produce a consistent supply of red meat using less grain.

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