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The Response of Yearling Cattle on Crested Wheatgrass Pasture to Energy, Protein and Sodium Supplementation[1]

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The sale of yearling feeder cattle represents a considerable share of ranch income in the western range area. In an effort to maximize profits derived from the sale of such animals, progressive stockmen are continually striving for more efficient utilization of basic winter and summer feed resources. Increasing efficiency of feed utilization through supplementation under western range conditions is usually centered around feeding a minimum amount of selected concentrates to supply essential nutrients that are deficient in the hay or range forage.

Winter supplementation has become a common practice in many ranch operations. Numerous workers have shown beneficial effects of feeding various supplements with winter roughages (Brouse, 1955; Bohman and Torell, 1956; Embry, *et al.* 1958). Other workers have described conditions under which supplementation may be profitable on winter ranges (Rowden, *et al.* 1961; Anderson, *et al.* 1957; Bohman, *et al.* 1955; Guilbert and Hart, 1946). Under winter hay feeding conditions or where cattle are wintered on the range the problem of devising an effective supplement can be relatively simple. This is true because the basic roughage (hay or mature range forage) is generally stable with respect to availability and nutrient content.

Feeding of young cattle on summer range may be considered where additional gain is sufficient to offset the costs of supplements and extra labor involved. The first and primary step in establishing a range supplementation program is to properly evaluate nutrients made available by range forage at various stages of maturity in terms of animal requirements. Growing plants are continually changing in chemical composition and this generally causes a decrease in nutrient quality as the grazing season advances.

The primary objective of the work reported in this paper was to determine the rate of gain made by yearling cattle grazing crested wheatgrass pasture supplemented with energy (barley), protein (cottonseed meal), and sodium (salt) alone or in various combinations. The basic reason for including sodium in this experiment was to study the effect of an adjustment in the sodium-potassium ratio in the diet which may be attained by increased salt intake. A secondary objective was to relate chemical composition and *in vitro* cellulose digestibility of crested wheatgrass herbage collected at various intervals to animal performance.

Experimental Procedure

Experimental studies summarized in this paper were conducted at the Squaw Butte Experiment Station during the grazing seasons of 1958 and 1959. Crop-year precipitation during 1958 and 1959 was 143 and 54 percent of the median precipitation about 11.3 inches for the area, respectively (Sneva and Hyder, 1962). Experimental periods extended from May 15 to September 3 in 1958 and from May 12 to August 4 in 1959. The study was terminated on August 4 in 1959 because of a shortage of range forage resulting from the relatively limited amount of moisture that year.

At the beginning of the experimental period each year, 48 uniform Hereford yearlings were randomly alloted to 8 experimental treatment groups of 6 animals each. During 1958 year-

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ling steers were used and in 1959 half of the animals were steers and half were heifers. The animals grazed together on crested wheatgrass pasture during the entire study each year. They were gathered each morning and sorted into their respective pens where the proper supplements were made available to them. The animals remained in the pens for a 2-hour period each day before being turned back on the pasture. A representative group of yearlings used in the 1958 study is shown in Figure 1.

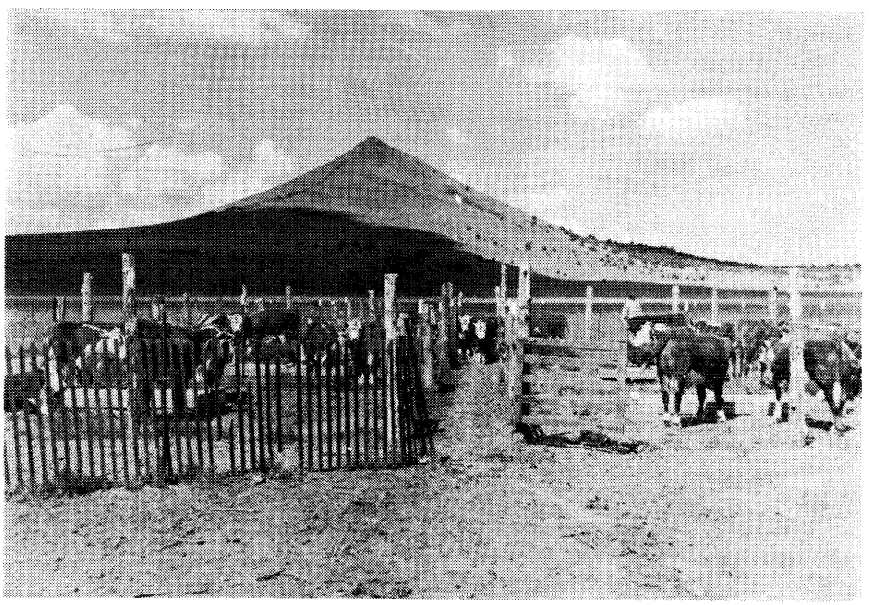

FIGURE 1. Yearlings in supplement pens during the 1958 trial. Alleyway was used to sort animals into their respective pens.

Experimental treatments were energy, protein and sodium supplements in a 2x2x2 factorial design. Energy was supplied as barley and was fed at the rate of 2 pounds per head daily throughout the entire trial each year. Cottonseed meal, used as the protein source, was gradually increased with advancing plant maturity each year in an effort to maintain at least 10 percent crude protein in the animal's diet. An estimation of forage intake and protein analyses of forage samples were used in establishing the level of cottonseed meal fed. During 1958 protein was available at the following rates; May 15-May 28, 0.25 pound; May 28-June 11, 0.50 pound; June 11-July 9, 0.75 pound; July 9-July 23, 1.0 pound; July 23-August 6, 2.5 pound; and August 19-September 3, 3.0 pounds per head daily. During the grazing season of 1959 protein supplementation was started at 0.25 pound per head daily on May 12 and was increased to 0.50, 1.0 and 2.0 pound on June 3, June 23 and July 22, respectively.

Sodium was provided as finely ground salt at the rate of 0.50 pound per head daily at the beginning of the 1958 trial and was later decreased to 0.25 pound on June 11 and finally to 0.10 pound on September 3. During the 1959 grazing season salt was provided at a constant rate of 0.25 pound per head per day throughout this study.

Chemical analyses were conducted on samples of crested wheatgrass herbage collected at various intervals during the study period each year. *In vitro* cellulose digestibility was determined on the forage samples according to the procedure described by Hubbert, *et al.* (1958a).

The animals were individually weighed at different intervals during the study periods. All weights were taken following overnight restriction from feed and water according to the procedure of Harris, *et al.* (1959).

Results And Discussion

Forage analyses and in vitro digestion data

Forage chemical analyses and *in vitro* cellulose digestion data are shown in Table 1. The difference between years in chemical composition data can possibly be attributed to the fact that 1958 was a year of relatively high precipitation while 1959 was rather dry. The dry matter content of the forage remained at a lower level in 1958 than 1959. Cellulose and lignin were higher during the 1958 season than on comparable dates and stages of growth in the 1959 grazing season. The crude protein decreased more rapidly in 1958 after mid-June than in 1959 during the same period. The sodium-potassium ratio was wider during the early part of the season than in late season for both years. Potassium values were higher during the early part of the 1958 season than for comparable dates in 1959.

In vitro cellulose digestibility values during the early part of the grazing season showed no real difference between years; however, the digestibility values declined more rapidly from mid-June to the end of the grazing season in 1958 than in 1959. The higher lignin content of the 1958 samples was probably associated, at least to some degree, with the somewhat reduced digestibility values found on these samples.

General trends of the chemical analyses and *in vitro* digestion data of this experiment are similar to those reported by Wallace, *et al.* (1961) in which similar analyses were conducted on crested wheatgrass and several native grass species.

Table 1. Chemical composition and in vitro cellulose digestibility of crested wheatgrass herbage.

Year and date of sampling	Air dry matter	Crude protein	P.	Ca.	Na.	K.	Cellulose	Lignin	*In vitro* cellulose Digestibility
					(Percent)				
1958									
5/16	29	16.5	.340	.20	.010	2.17	20.9	3.81	58.4
5/28	32	14.4	.244	.20	.008	2.47	28.5	4.70	57.2
6/18	44	9.4	.196	.17	.006	1.53	28.0	7.37	43.5
6/27	49	6.7	.187	.17	.004	1.13	32.3	8.51	38.2
7/23	60	4.2	.164	.17	.002	0.83	29.9	7.96	25.9
8/15	80	2.8	.062	.17	.002	0.70	29.6	8.24	23.0
1959									
4/30	36	16.9	.278	....	.016	1.70	21.8	4.78	65.8
5/18	59	11.5	.240	....	.005	1.33	24.6	4.34	53.4
6/2	78	10.0	.199	....	.002	1.10	23.6	4.69	52.8
6/16	93	10.4	.194	....	.006	1.53	25.5	6.53	51.1
7/1	92	8.2	.154	....	.004	1.13	25.9	6.60	41.3
7/15	92	6.2	.191	....	.003	0.97	28.2	6.90	36.7

Animal Performance Data

Animal gains decreased with advancing periods during the grazing season each year (Table 2). Similar trends were noted by Frischknecht, *et al.* (1953) in grazing trials conducted on crested wheatgrass. In general, gains were higher during 1958 than 1959. This was probably due to the abundance of forage during 1958 rather than to quality since forage quality remained at a higher level during the 1959 grazing season (Table 1).

Energy supplementation resulted in a significant increase in rate of gain during 1958 and a highly significant increase in the 1959 trial (Table 3). A greater response to energy supplementation was apparent during July of 1959 than was true for 1958. This was probably due to reduced forage intake brought about by drought conditions in 1959. The gain response obtained from energy supplementation during the 1959 trial would seem to indicate that energy intake from the forage was a limiting factor throughout the season. The early response from energy supplementation might be attributed to the relatively low dry matter content (Table 1) of the forage during the early season which would tend to limit dry matter consumption.

Protein supplementation resulted in a greater response in 1958 (especially during the latter part of the grazing season) as compared to 1959 (Table 3). This may be attributed to lower forage protein in 1958 and also to the length of the 1958 trial. The apparent depression of gain by protein supplementation during May and June of 1958 as shown by main effect comparisons was partially caused by the reduced gains made by animals receiving the salt-protein combination during this period (Table 2). As shown in Table 3, a significant protein x salt interaction was noted during the first, fourth

Table 2. Summary of Average Daily Gain by Treatment, Weigh Period and Year.

Year and weigh period	Treatment								
	control	salt[1]	CSM	barley	Salt + CSM	Salt + barley	CSM + barley	Salt + CSM + barley	Average (by periods)
					(Pounds)				
1958									
5/15-6/11	2.68	2.92	2.89	2.86	2.36	2.71	2.89	2.53	2.73
6/11-7/9	2.12	1.78	1.70	2.18	1.55	1.98	2.07	1.96	1.92
7/9 -8/6	1.41	1.41	1.58	1.26	1.59	1.55	1.55	1.81	1.52
8/6 -9/3	0.18	0.62	1.49	0.54	1.21	0.68	1.75	1.46	0.99
Average	1.64	1.73	1.96	1.76	1.72	1.78	2.20	1.99	1.85
1959									
5/12-6/5	1.52	1.88	1.52	1.53	2.01	2.15	1.95	2.02	1.82
6/5 -7/15	1.52	1.60	2.02	1.96	1.79	1.67	2.14	1.90	1.82
7/15-8/4	1.38	1.17	1.42	1.38	1.16	1.79	1.17	2.00	1.43
Average	1.49	1.58	1.74	1.70	1.71	1.83	1.86	1.96	1.73
Average (both yrs.)	1.56	1.66	1.85	1.73	1.72	1.80	2.03	1.98	

[1] Salt was mixed and fed with 0.50 lb. barley in 1958 and with 0.25 lb. CSM in 1959 in order to maintain desired sodium intake.

Table 3. Summary of influence of energy, protein and sodium (main effects) supplementation on average daily gain by periods and years.

Year and period	Main effects[1] Energy 0	Energy 1	Protein 0	Protein 1	Sodium 0	Sodium 1	C.V.
	(Pounds)						Percent
1958							
5/15-6/11[4]	2.71	2.75	2.79	2.67	2.83	2.63	14.0
6/11-7/9	1.79	2.05[2]	2.02	1.82	2.02	1.82	23.0
7/9 -8/6	1.50	1.54	1.41	1.63[2]	1.42	1.59	24.8
8/6 -9/3[4]	0.88	1.11	0.50	1.48[3]	0.99	0.99	25.9
5/15-9/3[4]	1.76	1.91[2]	1.73	1.94[3]	1.87	1.80	12.1
1959							
5/12-6/5	1.73	1.91	1.77	1.88	1.63	2.02[2]	33.6
6/5 -7/15	1.73	1.92	1.69	1.96	1.91	1.74	27.0
7/15-8/4	1.30	1.58	1.44	1.45	1.33	1.55	41.6
5/12-8/4	1.63	1.83[3]	1.65	1.81[2]	1.69	1.77	13.0

[1] The zero level of each treatment main effect received no supplementation while the one level received supplements in accordance with the experimental design as explained in the text under experimental procedure.

[2] Significantly higher than non-supplemented animals ($P < 0.05$).

[3] Significantly higher than non-supplemented animals ($P < 0.01$).

[4] Significant ($P < 0.05$) Protein x Salt interaction during these periods.

and over all period in 1958. The consumption of supplements containing salt was somewhat reduced during the early part of the 1958 trial because of the relatively high salt level fed.

The lack of consistent response to both protein and energy supplements during the first period of 1958 may, on the other hand, indicate the supplementation during this period is unnecessary and may be detrimental.

The 1958 data indicated that the high level of salt fed (0.5 pound per head daily) with cottonseed meal and barley decreased performance during the first month. The daily feeding of 0.25 pound salt per steer during 1959 appeared to increase the performance obtained from feeding cottonseed meal and barley alone (Table 2). The significant response resulting from salt supplementation during the first period of 1959 might be partially attributed to an adjustment of sodium: potassium ratio in the animal's diet. The work of Hubbert, *et al.* (1958b) suggested that a more suitable media was provided for rumen bacteria when the sodium: potassium ratio in the animal's diet was approximately 1 to 1.

Where salt was fed in combination with cottonseed meal there was an apparent depression in gain compared to cottonseed meal alone (Table 2). This was true during both years but was considerably more evident during the 1958 study. The restriction in performance resulting from high salt intake was possibly due to reduced forage intake brought about by increased water consumption. Crampton (1956) reported that forcing animals to consume an excess of water may limit their intake of nutrients because of the limited capacity of the digestive system. Results of this study suggest the need for a thorough evaluation of the influence of salt-protein mixtures as supplements for young cattle on range.

SUMMARY

Energy (barley), protein (cottonseed meal) and sodium (salt) supplements were fed alone and in all possible combinations to yearling cattle on crested wheatgrass pasture during two grazing seasons.

Both energy and protein supplementation resulted in significant increases in rate of gain each year. Energy supplementation appeared more favorable when forage was somewhat limited or when dry matter content of the forage was relatively low. The primary response to protein supplementation occurred during the latter part of the grazing season.

Supplementation of sodium (salt) resulted in a significant gain response during the early part of one year and appeared somewhat detrimental to performance during the other year. When salt was fed in combination with cottonseed meal, yearling gains were reduced compared with those from cottonseed meal alone.

Chemical analyses and *in vitro* cellulose digestibility values of crested wheatgrass samples collected each year during the grazing season were presented.

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