Protein-energy supplements for beef heifers

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Only those heifers grazing on irrigated pastures and receiving both high protein and high energy supplementation achieved adequate body gains during the two growing seasons in this test.

Recent studies concerned with the growth and development of replacement beef heifers bred to calve as two-year-olds have shown that protein-energy supplementation for such heifers grazing irrigated pasture will enhance average daily gain over conventional energy supplementation.

In the system of fall calving (October-November) used in annual grassland range areas of California, seven- to eight-month weaning weights of heifer calves from predominantly English breeds range from 400 to 450 pounds. For heifers to reach an ideal breeding weight of 650 pounds or more by 14 to 15 months of age, the average daily gain required is more than 1.25 pounds per head per day.

To take advantage of the high productivity and low production cost of an irrigated pasture, the use of high-energy supplements (grain) and monensin sodium in the diet of grazing heifers is recommended. Even with their use, however, gain has not always been in the recommended range of 1.25 pounds per day or better. This variable performance on irrigated pasture led to our investigation of various levels of protein and energy supplementation as a means of increasing average daily gain to produce heifers of adequate breeding weight.

Grazing studies

We conducted the studies on irrigated summer pastures during two grazing seasons at the University of California Sierra Foothill Range Field Station, Browns Valley. Irrigated pastures at the start of these trials were approximately 10 percent perennial clover, 65 percent perennial grasses, and 25 percent other species.

Irrigation during the grazing season was by surface flow every seven to ten days. Each year the pastures were grazed in early spring to remove excess forage, and this production was not credited to the trial. Three weeks before the trials began, the pastures were clipped and fertilized with 150 pounds per acre ammonium sulfate (21 percent nitrogen) and not grazed until the experimental grazing season.

Each year Good to Choice weaner heifers (seven to eight months old), predominately Hereford, were used. Stocking rate was five heifers per acre (10 head per treatment per year) and was set so as not to be limited by pasture availability. In a two-field system of grazing management, cattle were rotated weekly. Since stocking rates were equal for all treatments, heifers were randomly assigned to fields each week, so that all grazed all fields within the grazing season. Experimental animals were weighed individually every 28 days.

Treatments consisted of supplementing heifers with ground barley and cottonseed meal combinations to provide differing levels of protein and energy supplementation. Treatments were: (1) low protein, low digestible energy (L-L) (82 percent ground barley, 18 percent cottonseed meal); (2) low protein, high digestible energy (L-H) (100 percent ground barley; (3) high protein, low digestible energy (H-L) (8 percent ground barley, 92 percent cottonseed meal); and (4) high protein, high digestible energy (H-H) (50 percent ground barley, 50 percent cottonseed meal). During the second year, two additional treatments included monensin sodium added to treatments 2 and 4, resulting in L-H+ (treatment 5) and H-H+ (treatment 6). Treatment comparisons were for equal energy and equal protein supplementation and the interaction of energy and protein.

Supplements were fed three times weekly to provide either 0.4 or 1.2

pounds crude protein per head daily for low or high protein and either 1.9 or 3.2 therms digestible for low or high energy. At the start, middle, and end of each grazing season, blood samples were taken for blood urea nitrogen determination. At this same time, two esophageal-fistulated steers were used to collect ingested forage samples for dry matter and organic matter digestibility determinations. Forage samples were analyzed for dry matter, organic matter, and crude protein.

In behavior studies during the first grazing season, observations were made for 24 hours. Each lot, in the same order, was checked every 15 minutes and a record made of the number of animals grazing, eating supplement, ruminating, and idling. Total time spent in a given behavior was calculated by assuming that the number of animals observed in a given behavior continued in that behavior until the next observation.

Effects of supplementation

Responses to the treatments were similar in both years, except for treatment 3 (see table). Increasing the level of energy supplementation at the low level of protein feeding (L-L vs. L-H), did not improve the heifers' average daily gain. At the high level of protein supplementation, increasing energy intake (H-L vs. H-H) significantly improved average daily gain in the first year from 0.92 to 1.25 pounds but not in the second, 1.21 compared with 1.23 pounds. The reason for this variation in response to energy addition to high protein is unclear.

At the low energy level, increasing protein (L-L vs. H-L) did not increase average daily gain in the first year but did improve gain ($P<0.05$) during the second season. Increasing protein in the high-energy-based supplements (L-H vs. H-H) significantly improved animal performance during both grazing seasons. Feeding the high-protein, high-energy (H-H) supplement consistently resulted in the desired level of performance — an average daily gain of approximately 1.25 pounds. The response in animal performance to level of protein and energy supplementation is attributed to an interaction of both components involved in growth.

Monensin sodium in the diet significantly improved average daily gain in both treatments. When compared with comparable treatments without the additive, monensin sodium increased gain 0.15 pound per day in the low-protein, high-energy (L-H+) and 0.24 pound per day in high-protein, high-energy (H-H+) treatments — 15 and 20 percent increases in gain, respectively. These results are consistent with earlier findings at this station, where increases of up to 20 percent occurred when monensin sodium was added to all barley supplements on irrigated pasture.

In the present research, we intended to determine if blood urea nitrogen would reflect the nutritional status of heifers, as it had done in ewes under supplementation. Our results indicate that blood urea nitrogen is not a good indicator of nutritional status and is affected by other variables in addition to the protein and energy content of the supplement. Grazing conditions may limit its use as an indicator of protein nutrition because of the selection of plant species by animals and the difficulty of predicting intake. In addition, green herbage has more soluble protein than does the same material when dried and will therefore affect rumen ammonia and, subsequently, blood-urea-nitrogen levels.

In both grazing seasons, the average amount of crude protein consumed from supplements fed on a daily basis was 0.48, 0.40, 1.39, and 1.50 pounds, respectively, for L-L, L-H, H-L, and H-H treatments. Average crude protein of the pasture sward, based on hand-clipped samples, was 13.45 percent the first grazing season and 15.80 percent the second season. The National Research Council 1976 tables indicate that a 550-pound heifer gaining 1.25 pounds a day would require 1.36 pounds crude protein per day. It would take a daily intake of 6.6 pounds of forage plus the supplements fed to meet these daily crude protein requirements. We therefore feel that the dietary crude protein available, even in the low-protein treatments was adequate to support an average daily gain of 1.25 pounds. As previously stated, average daily gain in the high-protein treatments increased from 0.92 pound with low-energy supplementation to 1.25 pounds with high energy in the first year but was similar the second year — 1.21 to 1.23 pounds. The increase in crude protein of the grazed forage may relate to the increased gain during the second year for the high-protein, low-energy treatment.

Previous trials have shown that time spent grazing can be a reflection of forage quality. Although differences in gain occurred as a result of addition of protein to an energy supplement, supplementation did not affect grazing time. No behavioral differences were attributable to supplementation treatment, indicating that forage quality was the same for all treatments.

Adequate body gains during the two growing seasons were achieved only by heifers receiving high protein and high energy supplementation. Therefore, supplemental programs for irrigated pastures should consider both energy and protein. Addition of monensin sodium to supplements improved gains. The relationships between pasture forage and supplementation of protein and energy are still unclear.

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Influence of protein and energy supplements on heifer growth rates*

	#1 (L-L) 82% GB, 18% CSM Year:		#2 (L-H) 100% GB Year:		#3 (H-L) 8% GB, 92% CSM Year:		#4 (H-H) 50% GB, 50% CSM Year:		#5 (L-H+) #6 (H-H+) (plus monensin) Year:	
Item	1	2	1	2	1	2	1	2	2	2
Length of trial, days	140	141	140	141	140	141	140	141	141	141
No. of animals	10	10	10	10	10	10	10	10	10	10
Animals/acre	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Initial wt., lb	489	399	488	404	487	406	486	404	417	403
Final wt., lb	616	544	625	552	615	576	661	577	587	610
ADG, lb†	0.90 a	1.03 a	0.97 a	1.06 a	0.92 a	1.21 b	1.25 b	1.23 b	1.21 b	1.47 c
Supp. fed/hd/day, lb (planned)	2.73	2.73	4.44	4.44	3.10	3.10	4.82	4.82	4.25	4.82
Supp. cons./hd/day, lb (actual)	2.95	2.71	4.25	4.27	3.41	3.10	4.66	4.77	4.27	4.77
Total supp. cons./hd, lb	414	381	594	601	477	438	653	675	598	669

*Supplements ground barley (GB) and cottonseed meal (CSM) fed in various combinations to produce low or high protein and low or high digestible energy (see text).
†Treatment means followed by different letters are significantly different ($P<0.05$).