Vitamin and Mineral Supplementation for a Self-fed Soybean Hull Growing Diet

D.L. Lalman, D. E. Williams and J.D. Steele

Story in Brief

Twenty-five fall-born yearling South Devon x Angus and Angus x Hereford heifers (569 ± 47 lbs) were used in an 84-d growing experiment. Two pens of cattle received a blend of 80% soybean hull pellets, 20% sunflower seed pellets (**Control)** and two pens received a blend of 75% soybean hull pellets, 20% sunflower seed pellets and 5% supplement pellet (**Supplement**). The supplement was formulated to balance vitamin and mineral supply with estimated NRC (1996) requirements for growing cattle. Average daily gain substantially declined while feed intake continued to increase during the latter stages of the experiment. Heifers receiving the Supplement diet sustained ADG beyond 2 lbs per day through d-56, whereas performance of Control heifers declined earlier in the experiment. Cumulative daily weight gain was improved by 26% and feed conversion was improved by 14.6% with the inclusion of a vitamin/mineral supplement. Cumulative dry matter intake was not significantly altered by the supplement. However, average daily feed intake was greater for the Supplement group in six out of 12 wk, while average daily hay intake was greater for the Control group in five out of 12 wk. The vitamin/mineral supplement substantially improved animal performance, although poor feed conversion after d 56 requires additional investigation.

Key Words: Soybean hulls, self-feeding, growing, feed intake, performance

Introduction

Forage production is seasonal and subject to tremendous year-to-year variation. As a consequence, complimentary and cost effective growing programs are needed in the Oklahoma cattle industry to fill gaps when high quality forage is not available or the availability is limited. Compared to grazing high quality forage, growing programs based on feed grains require more labor, equipment, and management skill and increased feed costs due to ingredient blending and processing. During the spring of 1998, our group began to experiment with the idea of self-feeding soybean hulls as a major component in a growing diet for cattle. One of the primary objectives of these projects is to develop a growing program that requires minimal management, labor and additional equipment, while remaining economically viable. Initial studies (Shriver et al., 2000) pointed out that soybean hulls alone do not provide adequate effective fiber to maintain animal performance and rumen health and that free-choice access to an ionophore-containing mineral supplement improves performance and feed efficiency (Steele et al., 2001). Soybean hulls contain marginal or deficient calcium, phosphorus, manganese and vitamin A concentrations compared to the requirements of growing cattle (NRC, 1996). Therefore, the objective of this experiment was to determine the effects of supplying a commercial vitamin/mineral supplement to cattle receiving self-fed soybean hulls and hay.

Materials and Methods

Twenty-five fall-born yearling South Devon x Angus and Angus x Hereford heifers (569 ± 47 lbs) were used in an 84-d growing experiment. The study was conducted at the Range Cow Research Center, located West of Stillwater, Oklahoma. Four dry-lot pens were used with 6 or 7 heifers per pen. Two pens of cattle received a blend of 80% soybean hull pellets, 20% sunflower seed pellets (**Control)** and two pens received a blend of 75% soybean hull pellets, 20% sunflower seed pellets and 5% supplement pellet (**Supplement**). The supplement was formulated to balance vitamin and mineral supply with estimated NRC (1996) requirements for growing cattle (Table 1).

Table 1. Supplement composition.

Nutrient	Concentration
Vitamin A, IU per lb.	66,000
Vitamin E, IU per lb.	125
Vitamin D, IU per lb.	50
Selenium, ppm	2.9
Salt, %	1.25
Calcium, %	8.75
Phosphorus, %	.26

The experimental period began on August 23 and continued through November 16 for a total of 85 d. Feed, prairie hay and salt were provided free choice at all times. Hay was fed in round bale rings and feed was provided in self-feeders. Feed and hay were weighed and recorded prior to being placed in the feeders. Each Thursday morning, feed and hay remaining in the feeders from the previous week was weighed and discarded. Fresh feed and hay was provided at this time. The cattle were weighed at 8 a.m., after a 16-hr removal from access to feed and water, on August 23 and again on November 16. The cattle were weighed (without shrink) at 8 a.m. on September 20 and October 18 and at 4 p.m. on November 15. The purpose of the November 15 weight was to determine the amount of shrink occurring during the overnight stand without access to feed or water.

Each week, representative hay and feed samples were collected in paper bags. At the end of the experiment, hay and feed samples were thoroughly mixed and composited into one sample for each feed source. All hay and feed samples were ground with a Wiley mill using a 2 mm screen. Subsequently, samples were analyzed for dry matter, ash, and nitrogen, using AOAC accepted wet chemistry procedures. Crude protein concentration was determined by multiplying nitrogen concentration by 6.25. Acid detergent fiber (ADF) and neutral detergent fiber (NDF) concentrations were determined using an Ankom Fiber Analyzer.

Data were analyzed using least squares analysis of variance and effects in the model included treatment, pen and the treatment x pen interaction. Least squares means were separated using a multiple range test.

Results and Discussion

Chemical composition of the hay and feed blends are shown in Table 2. Both experimental diets exceeded the protein concentration recommended by NRC (1996). Soybean hulls are high in neutral detergent fiber (NDF), although a large proportion of this fiber is highly and rapidly

fermented, which can lead to acidosis and bloat in the absence of adequate effective fiber (Shriver et al., 2000).

Table 2. Chemical composition of hay and feed.

		Control	Supplement
Item	Hay	80:20	75:20:5
Dry matter	93.0	91.4	91.6
	----------% Dry Matter----------		
Ash	6.2	5.3	6.4
Crude protein	4.8	15.4	17.4
Acid detergent fiber	48.8	47.7	44.4
Neutral detergent fiber	74.6	61.9	59.3

Animal performance, feed intake and feed efficiency data are presented in Table 3. During the first 56 d of this experiment, weight gain, feed intake and feed conversion of heifers receiving the Supplement diet was very similar to values reported by Steele et al. (2001) when growing heifers were self-fed soybean hulls with free-choice access to hay. However, average daily gain substantially declined while feed intake continued to increase during the latter stages of the experiment. Heifers receiving the Supplement diet sustained ADG beyond 2 lbs per day through d-56, whereas performance of Control heifers declined earlier in the experiment. Reduced weight gain later in the experiment could be due to reduced performance generally associated with increased body fat composition (fleshiness) or it could be attributed to compromised rumen health. One heifer receiving the Control diet bloated on September 17, although the incident was not severe enough to warrant intervention. Throughout the experiment, no lameness, laminitis or any other health problems were noted.

Table 3. Performance of beef heifers fed free-choice soybean hull/sunflower seed diets with or without vitamin and mineral supplementation.

Item	Control	Supplement	SEM[a]
Number of heifers	13	12	
Initial weight, lbs	566	573	14
Aug. 23 to Sep. 20			
ADG	2.40	2.27	.18
DM Intake	17.10	17.40	.27
Feed:Gain	7.14	7.77	.68
Sep. 20 to Oct. 18			
ADG[b]	1.31	2.46	.24
DM Intake[c]	17.91	19.66	.41
Feed:Gain	14.59	8.02	2.40
Oct. 18 to Nov. 16			
ADG	.96	1.18	.16
DM Intake	20.53	22.68	.71
Feed:Gain	22.22	19.56	3.60

Cumulative, 85 days			
ADG[b]	1.55	1.96	.09
DM Intake	19.97	19.35	.41
Feed:Gain[b]	11.63	9.93	.34
[a]Standard error of the mean.			
[b]Treatment means differ, P < 0.07.			
[c]Treatment means differ, P < 0.1.			

Steele et al. (2001) found that a monensin-containing mineral supplement improved average daily gain and feed conversion of beef heifers when self-fed a soybean hull diet. However, due to the design of the experiment, it could not be determined if this response was due to the ionophore, supplemental vitamins and minerals or both. In the current experiment, cumulative daily weight gain was improved by 26% and feed conversion was improved by 14.6% with the inclusion of a vitamin/mineral supplement. Cumulative dry matter intake was not significantly altered by the supplement. However, average daily feed intake was greater for the Supplement group in six out of 12 wk, while average daily hay intake was greater for the Control group in five out of 12 wk (Figure 1). NRC (2001) indicates that soybean hulls are marginal to deficient in P, Na and Mn compared to the requirements of growing cattle. Furthermore, soybean hulls contain very low concentrations of vitamin A (NRC, 1996) and liver stores of vitamin A can be depleted in growing cattle in two months or less (NRC, 1996).

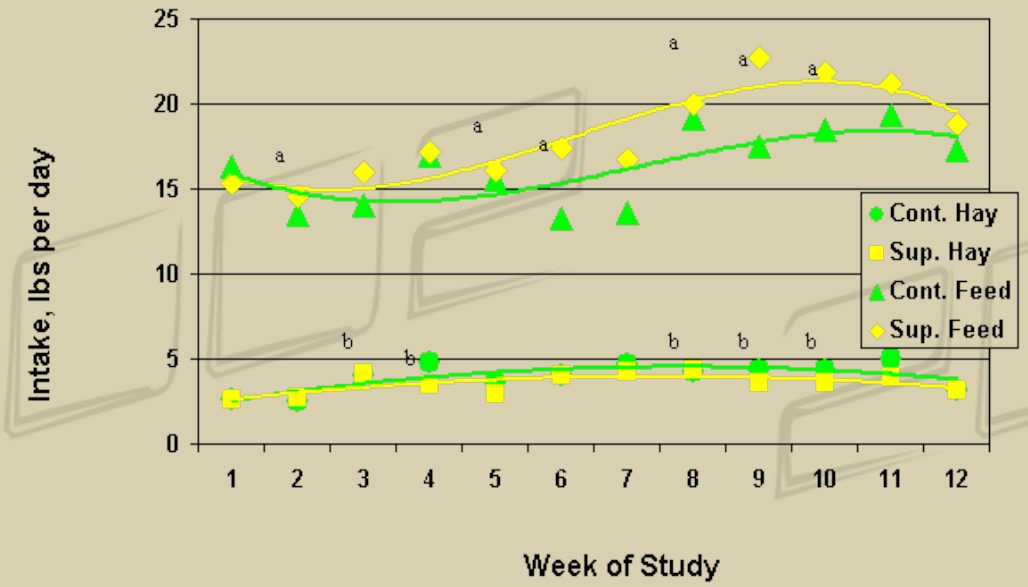

Figure 1. Average Daily Feed and Hay Intake.

[a]Treatment means for feed intake within a week differ (P<.1).

[b]Treatment means for hay intake within a week differ (P<.1).

Implications

The addition of a vitamin/mineral supplement to a soybean hull/sunflower seed diet substantially improved animal performance and the conversion of feed energy to animal weight gain. The decline in animal performance after 56 d on feed needs further investigation.

Literature Cited

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