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Utilization of corn gluten meal by heifers as a self-fed supplement

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ABSTRACT: Utilization of a self-fed supplement that is effective at small amounts can minimize costs. Studies from NMSU have shown that it is possible to formulate and deliver a small supplement fed at 113.4 g/d to replace use of a cottonseed meal supplement fed at 454 g/d in gestating beef cows on winter range with minimal weight loss. Sixty-eight yearling heifers (303 ± 1.4 kg) were used in a completely randomized design with treatments in a 2X2 factorial arrangements to evaluate consumption of a self-fed corn gluten meal (**CGM**) formulated small supplement in comparison to an animal protein (**AP**) based small supplement. The duration of this study was 4 months beginning in July and terminating in November. The study was replicated across 4 pastures of which 2 had been aerially treated with tebuthiuron and 2 were not treated. Heifers were allowed supplements ad libitum while grazing piñon-juniper/blue grama rangelands. During the study CP content (OMB) declined ($P<0.01$) in hand plucked samples (11.1, 9.1, and 6.7 ± 0.9 % for 12-July, 16-Aug, 3-Oct, respectively). Supplement CP and estimated UIP content ($P<0.01$) on an as fed basis for CGM and AP were 27.6 ± 1.5 and 16.4 ± 0.6, 37.2 ± 1.5 and 21.4 ± 0.6, respectively. The calculated bypass protein value for each supplement was 59.4 and 57.5% of CP for the CGM and AP mix respectively. Supplements were formulated by weight with 50% protein source and 50% mineral. Supplement disappearance from feed tubs was recorded each week to calculate consumption per head. Cow body weights were recorded at initiation of treatments and at 28-d intervals. Daily consumption was not different ($P=0.13$) between the CGM and the AP (150.3 and 175.8 ± 3.8 g $head^{-1} \cdot d^{-1}$, respectively). No differences ($P=0.16$) were found in total body weight gain. The pasture treatments did not influence consumption of either small supplement formula ($P>0.5$). Results from this initial study show that CGM small supplement mix can be used in place of an AP mix.

Key Words: Beef Cows, Protein Supplementation, Corn Gluten Meal, Animal Protein

Introduction

Previous studies conducted at NMSU have shown that low amounts of high undegradeable intake protein (UDP) fed in a small package may enhance utilization of nitrogen (Sawyer et al., 1998, Stalker et al., 2002; Sawyer et al., 2005). Thus, protein supplementation in a small quantity may have the potential to decrease production costs. Sawyer et al., (2005) found that feeding an animal protein (AP) mix as part of a small range supplement decreased feed cost by 53% compared to hand feeding a 36% CP range cube. Consequently, supplement costs can be minimized by reducing the amount of supplement required per animal. This can be accomplished by utilizing more concentrated protein sources that are used efficiently in potent formulas at smaller amounts. If providing small amounts of a self-fed effective supplement reduces the number of trips required and the amount of feed fed then, the costs of supplementation should be reduced with no change in animal productivity. Although previous studies have demonstrated that animal protein sources were effective in reducing delivery and feed costs while maintaining cow body condition objectives there are concerns about animal protein sources due to potential involvement with Bovine Spongiform Encephalopathy (mad cow disease). Therefore concentrated plant based sources of UDP maybe more acceptable to the industry. The objectives of this study were to determine consumption of a self-fed supplement formulated with corn gluten meal protein mixed with salt and mineral and a self-fed supplement formulated with animal proteins mixed with salt and mineral with a secondary objective to determine the as fed crude protein content of the supplements (out of the feed tub and in the field) and estimate the potential ruminal protein bypass characteristics of the small supplements.

Materials and Methods

This study was conducted over a 17 week period from July to November at New Mexico State University's Corona Range and Livestock Research Center, Corona, NM. The ranch's elevation is 1900 m with an average annual precipitation of 400 mm. Rangeland at this study site is characterized as piñon-juniper woodland that is moderate to high density. Primary grass species are blue grama (*Bouteloua gracilis*) and wolftail (*Lycurus phleoides*) with minor components of sideoats grama (*Bouteloua curtipendula*), perennial threeawn (*Aristida spp.*), and galletagrass (*Hilaria jamesii*) (Knox et al., 1998).

Sixty-eight long yearling replacement heifers were used in a completely randomized design with treatments arranged in a 2x2 factorial to evaluate consumption of CGM added supplement (CGMS) compared to an AP added supplement (APS) and the influences of brush control

management on supplement intake. Heifers were randomly assigned to one of four pastures containing 130 ha. Two pastures were treated with tebuthiuron in 1997 and two pastures were untreated. Treatments were then randomly assigned within pasture treatment which resulted in 2 replications per treatment. Cow weights were collected prior to pasture assignment, at the initiation of treatment application and at 28-d intervals thereafter until termination of the trial. Body condition scores (BCS, 1 = emaciated, 9 = obese) were assigned at initiation and termination of trial.

Ingredients for both supplements were mixed and bagged at the Corona Range and Livestock Research center. The APS supplement was produced on site by combining 2 parts salt-mineral mix with 1 part each of hydrolyzed feather meal and dried blood meal. The CGMS was composed of 1 part corn gluten meal and 1 part salt and mineral mix (Table 1). A grab sample of mixed supplement was collected at the time of mixing, and chemical analyses were conducted on these samples. Supplements were provided ad libitum in each of the four pastures and were placed in tubs at water. Delivery amounts were recorded each week so that total inputs could be determined and consumption per head by week could be calculated. Feed remaining in the open tub feeder was weighed once a week and subtracted from the amount of feed delivered the previous week. Consumption was calculated as grams of supplement that disappeared from the tub each week and was reported as supplement consumed per heifer per day. If supplement remaining in tubs was wet from precipitation it was allowed to dry before it was weighed to record supplement remaining weight. Consumption of APS and CGMS were determined on a weekly basis. The initial composition of small supplement provided to tub feeders consisted of 2 parts mineral and 1 part protein mix to allow for a gradual change from salt and mineral. The ratio decreased as heifers accepted the protein mixture. Within 3 weeks they were consuming the final mixer. The final mix was 1 part mineral mix and 1 part protein mix. Heifers used in this study had experience consuming salt and mineral since birth. No other source of salt or mineral was provided.

Table 1. Composition of NMSU mineral

NaCl	38.7%
Calcium, maximum	11.5%
Phosphorus, minimum	8 %
Magnesium, minimum	2 %
Potassium	2 %
Copper	1000 ppm
Zinc	1000 ppm
Manganese	2500 ppm
Selenium	13 ppm
Vitamin A, units/lb	120,000

Forage quality was estimated from 1000 g of hand plucked samples at three different periods during the study in each of the four pastures. Samples were analyzed for DM, CP, ash (AOAC, 2000) and NDF (Van Soest et al., 1991). Samples of supplements were taken at the time of mixing and were analyzed for CP (AOAC, 2000) and CP solubility (Poos-Floyd et al., 1985) using a buffer and protease incubation. Each of the weekly supplement samples were composited into three samples that represented the following periods; July 12 to August 15, August 16 to October 2 and October 3 to November 3. Data were analyzed using GLM procedures of SAS using pasture as the experimental unit. A probability of less than 0.10 was considered significant.

Results and Discussion

Protein content of supplements The as fed crude protein content of CGMS was 27.6 $\pm$ 1.5% and the APS was 37.2 $\pm$ 1.5% ($P<0.01$). The in vitro protein solubility and protease degradability estimate of protein bypass was 16.4 $\pm$ 0.6 % as fed for the CGMS and 21.4 $\pm$ 0.6 % as fed for APS ($P<0.01$). The calculated protein bypass value for each mix was 59.4 and 57.5% for CGM and the AP mix respectively (Table 2).

Table 2. Crude protein and estimated undegradable intake protein analysis of small supplements.

Supplement	Crude protein % (as fed)	Estimated Bypass protein % (as fed)	Bypass protein % of crude protein
Corn gluten meal	27.6 $\pm$ 1.5*	16.4 $\pm$ 0.6*	59.4
Animal protein	37.2 $\pm$ 1.5	21.4 $\pm$ 0.6	57.5

* $P<.01$

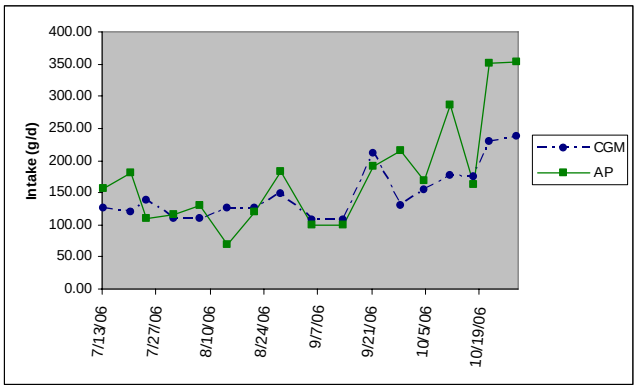
Small supplement consumption. The daily consumption of CGMS was 150.3 ± 3.8 g $head^{-1} \cdot d^{-1}$ which was not different from APS consumed at 175.8 ± 3.8 g $head^{-1} \cdot d^{-1}$ ($P=0.13$, Figure 1). However, heifers in both treatments consumed 32-55% over targeted intake of 113.4g.

Figure 1. Mean consumption of small supplement with Corn Gluten Meal or Animal Protein.*

N = 34. $P < 0.13$

Consumption of the self fed supplements varied ($P<.01$) by week. In general intake was greater in the latter weeks (Figure 2).

Figure 2. Weekly consumption of corn gluten meal and animal protein formulated small supplement



Brush control or non brush control pastures did not influence daily consumption (159.7 and 165 ± 3.7 g head^{-1}·d^{-1}, respectively) of either supplement treatment (P>0.5). The similarity in supplement intake between the bush and non brush control pastures suggests that forage availability did not influence supplement intake. Donart 1998 (personal communications) showed that the brush treated pastures produced 4 time the herbaceous forage as the untreated pastures. The forage quality did not differ (P=0.25) over the course of the study between the two CGMS treated pastures and the two APS treated pastures (9.0 and 7.6 ± 0.9 % crude protein respectively). Forage from brush control treated pastures and non-treated pastures also had similar (P > 0.98) crude protein concentration (8.3 ± 0.9 % and 8.3 ± 0.9 % for brush controlled and non brush controlled, respectively). Over the duration of the study crude protein content declined (P < 0.01) in the hand plucked samples (11.1 ± 0.9 %, 9.1 ± 0.9 % and 6.7 ± 0.9 % for 7/12 to 8/15, 8/16 to 10/2 and 10/3 to 11/4 respectively). Ash content of the forage increased and neutral detergent fiber content remained high as the study progressed. During the study CP content (OMB) declined (P<0.01) in hand plucked samples (11.1, 9.1, and 6.7 ± 0.9 % for 12-July, 16-Aug, 3-Oct, respectively). Neutral detergent fiber (NDF) contents in July, August, and October were 69.6, 71.1, and 71.5 % OM basis respectively.

Type of supplementation did not differentially influence (P <0.16) body weight or total weight gain (Table 3) of yearling heifers throughout the 17 week experimental period.

Table 3. Body weight and body condition responses of heifers to different supplementation strategies.

Item	CGMS	APS	SE[a]	P
Body Weight Responses				
July 10 BW, kg[b]	300	305	.98	0.98
August 8 BW, kg[c]	324	326	2.1	0.78
September 6 BW, kg	383	398	3.2	0.44
Final BW, kg[d]	398	408	1.9	0.16
Body Weight Changes				
August 8 BW, kg[c]	20.8.0	23.2.9	2.1	0.55
September 6 BW, kg[c]	60.2	63.2	5.3	0.44
October 23BW, kg	15.3	20.3	5.5	0.16
Total BW, kg[d]	96.3	106.7	--	--

[a]n = 15
[b]Cow weight at initiation
[c]Cow weight at 28 d intervals
[d]Cow weight change (Final – Initial)

Implications

CGMS had only a small insignificant decrease in consumption and weight gain compared to APS. Therefore, in this initial study CGMS was an effective substitute for APS in a self-fed, small package supplement for long yearling replacement heifers while grazing 130 ha pastures having unlimited availability of forage.

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