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Effect of frequency of supplementation of a soyhulls and corn gluten feed blend on hay intake and performance of growing steers

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ABSTRACT

Feeding supplements less frequently can reduce labor costs and increase profitability. However reducing the frequency of delivery of grain based supplements can negatively affect fiber digestion in the rumen because more grain must be fed per feeding potentially causing decreased ruminal pH and/or an insufficiency of ruminal nitrogen. Using supplements that have a moderate crude protein (CP) level, and that are low in starch, might alleviate negative effects on fiber digestion and therefore decrease negative effects associated with supplementing energy supplements less frequently. Corn gluten feed and soybean hulls are high in metabolizable energy but low in fat and starch, and corn gluten feed is also a good source of ruminally degradable CP. The objective of this study was to determine effects of reducing supplementation frequency during a weekly cycle on steer performance when supplementing medium quality hay with a blend of soybean hulls and corn gluten feed (SH/CGF). The 86 d feeding experiment was replicated over 4 years. Each year, 40 steers (BW = 263 ± 2.5, 281 ± 2.5, 271 ± 2.9, 229 ± 2.9 kg for years 1–4, respectively) were stratified by body weight and assigned to 8 groups which were randomly assigned to treatment. During years 1 and 2, treatments consisted of *ad libitum* medium quality fescue hay (70–100 g/kg CP and 340–410 g/kg acid detergent fiber) that was either not supplemented (HAY), supplemented daily (7X) with 2.73 kg/hd, or supplemented on Monday, Wednesday and Friday (3X) with 6.36 kg/hd. During years 3 and 4, an additional treatment was added in which steers were supplemented on Monday and Thursday with 9.55 kg/hd of SH/CGF (2X). Average daily gain was higher ($P<0.01$) in supplemented steers compared to non-supplemented steers, but did not differ due to supplementation frequency. Hay intake was reduced ($P<0.01$) by supplementation and was higher ($P<0.05$) for 7X compared to both 3X and 2X, but hay intake did not differ between 3X and 2X. The gain to feed ratio was increased by supplementation ($P<0.01$) and was further increased by less frequent supplementation ($P \leq 0.02$). Results suggest that when supplementing medium quality hay with a blend of soyhulls and corn gluten feed, steers can be supplemented as little as twice a week without reducing performance.

Abbreviations: ADG, average daily gain; BW, body weight; CGF, corn gluten feed; CP, crude protein; DIP, degradable intake CP; HAY, *ad libitum* hay only; ME, metabolizable energy; NSC, non-structural carbohydrates; SH, soybean hulls; 2X, supplementation twice a week; 3X, supplementation 3 times a week; 7X, daily supplementation.

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1. Introduction

There has been a considerable amount of research studying effects of reduced frequency of protein supplement feeding to ruminants consuming low quality forage. Many of these studies have shown little or no effect of reducing frequency of protein supplementation (Krehbiel et al., 1998; Huston et al., 1999). However, when high energy supplements, containing high levels of rapidly fermentable non-structural carbohydrates (NSC), were fed less frequently to cattle consuming low quality forages, body weight (BW) gain was reduced (Kartchner and Adams, 1982; Beaty et al., 1994). Results of less frequent supplementation of energy supplements, containing high levels of rapidly fermentable NSC to growing cattle consuming medium or high quality hay have been variable (La Manna, 2002; Loy et al., 2008). Responses to less frequent supplementation of high energy supplements may depend on the characteristics of the supplement and the forage and/or the forage–supplement interaction.

Feeding grain based energy supplements less frequently requires feeding of more grain per offering, thereby potentially exacerbating negative effects of NSC fermentation on forage digestion in the rumen. Feeding large amounts of high energy supplements can potentially result in a decreased ruminal pH and/or an asynchrony of available energy and N in the rumen, thus making microbial digestion less efficient (Hoover, 1986). We hypothesized that using a supplement that has a balanced energy and protein profile and that is low in NSC may decrease the negative effects associated with supplementing high energy supplements less frequently.

Corn gluten feed (CGF) and soyhulls (SH) are two byproduct feeds that are highly digestible (12.09 MJ/kg of metabolizable energy (ME)) but are low (<300 g/kg) in NSC (NRC, 1996). Additionally, corn gluten feed is a good source of CP (230 g/kg DM) much of which is ruminally degradable (750 g/kg CP; NRC, 1996). These byproducts are widely available and are an affordable source of supplemental ME and CP. However, the labor and equipment costs of hand feeding supplements can be very high making the feeding of a supplement less frequently potentially profitable, provided that animal performance is not greatly affected. The objective of this study was to determine the effect of reducing supplementation frequency of a SH and CGF blend during a weekly cycle on steer performance when cattle were consuming medium quality hay *ad libitum*.

2. Materials and methods

Winter feeding experiments were conducted for four years to determine effects of supplementing hay with a mixture of SH/CGF daily, 3 times a week, or 2 times a week on steer performance. The protocol for this study was approved by the Institutional Animal Care and Use Committee at North Carolina State University.

2.1. Animal care

Prior to the initiation of the study, steers were treated for internal and external parasites using Dectomax pour-on (Pfizer Inc., New York, NY, USA) and implanted with Ralgro (Intervet, Millsboro, DE, USA). At the start of each experiment, access to hay and water was removed for 24 h and the Angus cross-bred steers were weighed to determine initial shrunk body weight (BW). Each year, 40 steers (BW = 263 ± 2.5, 281 ± 2.5, 271 ± 2.9, 229 ± 2.9 kg for year 1 through 4, respectively) were stratified by BW into 8 groups of 5, randomly assigned to treatment and fed for 84 d. During the first two years, dietary treatments consisted of *ad libitum* fescue hay which was supplemented daily (7X) with 2.73 kg/hd (as fed), supplemented 3 d a week (3X) with 6.36 kg/hd (as fed) or not supplemented (HAY). In years 1 and 2, three groups were assigned to each of the two supplemented treatments and two groups to HAY. During the last two years, an additional treatment was added in which steers were supplemented twice a week (2X) with 9.54 kg/hd (as fed). In years 3 and 4, there were two groups for each of the four treatments. Each week, 3X steers were supplemented on Monday, Wednesday and Friday, and 2X steers were supplemented on Monday and Thursday. The supplement contained (as fed) a loose mixture of 470 g/kg of SH pellets, 470 g/kg of CGF pellets, 20 g/kg of feed grade limestone, and 40 g/kg of spent beer liquid yeast (Samual Adams Brewery, Boston, MA, USA). Final shrunk BW was determined using the same protocol as initial shrunk BW. Each group was housed in a 92 m^2 pen that was partially covered by an open sided barn. Steers had access to a covered concrete bunk (61 cm bunk space per steer), a plastic feed bunk (97.5 cm of bunk space per steer) and 1 automatic water bowl per pen. Each week the groups were rotated among pens to balance any pen effect.

2.2. Feeding

In the morning prior to hay feeding, the supplement was fed in the plastic feed bunk under the cover of the barn. For the first 10 d, steers on the supplemented treatments were adapted to diets by gradually increasing the amount of supplement fed (Table 1). Throughout the experiment, the supplement offered was completely consumed by the steers. Therefore, supplemented groups consumed the same amount of supplement weekly (*i.e.*, 19.1 kg/hd each week). A weighed amount of square baled fescue hay was fed in the concrete bunk each morning in quantities sufficient to ensure *ad libitum* access. Prior to feeding hay, hay remaining from the previous day was collected and weighed. Hay intake per group was estimated as hay offered minus hay remaining. All groups were given free choice access to a mineral supplement (Beef Cow Special Mineral, Southern States Cooperative, Inc., Richmond, VA, USA) containing 255 g/kg Ca; 50 g/kg P; 240 g/kg salt; 4000 mg/kg