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Influence of frequency of supplementation and protein concentration in supplements on digestion characteristics of beef steers offered wheat straw

Abstract

Eight ruminally cannulated steers were used to determine digestion characteristics of soybean meal/sorghum grain supplements containing 12%, 20%, 30%, or 39% crude protein (CP) fed either daily (7X) or three times weekly (3X). The basal forage was wheat straw. Weekly supplement intake was the same per week (30.5 lb) for both frequency groups. The effect of feeding supplements differing in protein concentration on wheat straw intake and dry matter digestibility (DMD) did not depend on frequency of supplementation. Increased frequency of supplementation resulted in greater intake of straw, although DMD was slightly depressed. Increasing protein concentration in the supplements was associated with increases in both straw intake and DMD.

Keywords

Cattlemen's Day, 1993; Kansas Agricultural Experiment Station contribution; no. 93-318-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 678; Beef; Frequency; Protein; Supplementation; Digestion characteristics

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Authors

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**INFLUENCE OF FREQUENCY OF SUPPLEMENTATION
AND PROTEIN CONCENTRATION IN SUPPLEMENTS ON
DIGESTION CHARACTERISTICS OF BEEF STEERS
OFFERED WHEAT STRAW¹**

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Summary

Eight ruminally cannulated steers were used to determine digestion characteristics of soybean meal/sorghum grain supplements containing 12%, 20%, 30%, or 39% crude protein (CP) fed either daily (7X) or three times weekly (3X). The basal forage was wheat straw. Weekly supplement intake was the same per week (30.5 lb) for both frequency groups. The effect of feeding supplements differing in protein concentration on wheat straw intake and dry matter digestibility (DMD) did not depend on frequency of supplementation. Increased frequency of supplementation resulted in greater intake of straw, although DMD was slightly depressed. Increasing protein concentration in the supplements was associated with increases in both straw intake and DMD.

(Key Words: Frequency, Protein, Supplementation, Digestion Characteristics.)

Introduction

Less frequent winter supplementation on range may serve to reduce labor costs and thereby enhance profit. Little research has compared digestion characteristics of supplements with different protein concentrations fed at different frequencies. Our objective was to determine the digestion characteristics of animals consuming wheat straw when supplemented with soybean meal/sorghum grain

mixtures containing different crude protein concentrations at two different frequencies.

Experimental Procedures

Eight ruminally cannulated steers were blocked by weight and assigned to two, concurrent, 4 × 4 Latin squares. The trial consisted of four periods in which the supplements were randomly rotated through each Latin square. Each period consisted of a 13-day adaptation, a 7-day forage intake period, a 7-day period for determining digestibility via total fecal collection, and a 2-day fermentation profile. Steers in one square were supplemented daily (4.3 lb DM basis), and steers in the other square, three times weekly (10.2 lb DM on Monday, Wednesday, and Friday). Animals in both Latin squares received the same amount of supplement per week (30.5 lb). Supplements contained 12%, 20%, 30%, or 39% crude protein (CP) and consisted of combinations of rolled sorghum grain and soybean meal. Trace mineral blocks were offered free choice. Wheat straw (3.1% CP, 82.0% NDF) was offered at 150% of the average daily intake for the previous week. Fermentation profiles were obtained both on days when all steers were supplemented and when only the 7X group was supplemented.

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Results and Discussion

With the exception of fiber digestion, response to altering frequency of protein supplementation did not depend on protein concentration in the supplements. Supplementing 3X lowered ($P < .01$) wheat straw and total intake compared with 7X supplementation (Table 1). Wheat straw and total intake increased as the supplement CP concentration increased and reached a maximum at 30%, but tended to decline thereafter (quadratic, $P = .07$). These observations agree with previously reported effects of protein supplementation on the consumption of bluestem-range forage. The dry matter digestibility of the total diet (straw and supplement) increased ($P \leq .01$) with increasing CP in the supplement and with less frequent supplementation. Digestible dry matter intake increased (cubic, $P = .08$) with increased supplement CP concentration, reached a maximum at 30% CP concentration, and then tended to decrease.

The effect of different protein concentrations in supplements on fiber (NDF) digestibility depended on the frequency of supplementation ($P = .05$). In the 7X group, NDF digestibility improved when supplement CP increased to 20% but was similar (quadratic, $P = .01$) with further increases in CP concentration. In contrast, no protein effect ($P > .10$) was evident in the 3X group. Ruminal pH values for the 3X group on days when they were not supplemented remained fairly constant and in a range that was optimal for fiber digestion (Figure 1). However, on days when both groups were supplemented, pH values were significantly lower in the 3X group than in the 7X group from 8 to 12 hours after feeding.

In conclusion, these data suggest that maximal stimulation of intake of low-quality forage use will occur when high protein supplements are fed on a daily basis. Although straw intake was depressed with less frequent supplementation, increased digestibility may have moderated potential impacts on performance.

Table 1. Influence of Frequency of Supplementation and Protein Concentration in Supplements on Digestion Characteristics of Beef Steers Offered Straw.^a

| Item | Protein concentration | | | | SE | L | P _≤ | | Frequency ^b | | SE | P _≤ |
|--|-----------------------|-------|-------|-------|------|-----|----------------|-----|------------------------|-------|-----|----------------|
| | 12% | 20% | 30% | 39% | | | Q | C | 7X | 3X | | |
| Straw DMI ^c , lb/d | 12.11 | 13.07 | 13.90 | 13.25 | .42 | .04 | .07 | .48 | 14.57 | 11.60 | .46 | .01 |
| Total DMI, lb/d | 16.47 | 17.43 | 18.26 | 17.61 | .42 | .04 | .07 | .48 | 18.93 | 15.96 | .46 | .01 |
| Straw DMI%BW ^d | 1.20 | 1.30 | 1.38 | 1.32 | .04 | .03 | .07 | .49 | 1.42 | 1.18 | .04 | .01 |
| Total DMI% BW | 1.64 | 1.73 | 1.82 | 1.76 | .04 | .03 | .07 | .49 | 1.85 | 1.63 | .04 | .01 |
| Total DDMI ^e , lb/d | 7.94 | 8.71 | 9.81 | 9.44 | .21 | .01 | .02 | .08 | 9.37 | 8.59 | .20 | .03 |
| Total DDMI%BW | .79 | .87 | .98 | .94 | .02 | .01 | .02 | .08 | .91 | .87 | .02 | .27 |
| DMD ^f % | 48.68 | 50.29 | 54.14 | 54.46 | .80 | .01 | .43 | .13 | 49.58 | 54.20 | .73 | .01 |
| NDF ^g Digestibility % ^h (dry matter basis) | | | | | | | | | | | | |
| 7X | 46.38 | 51.57 | 52.17 | 50.47 | .42 | .01 | .01 | .28 | | | | |
| 3X | 53.20 | 51.92 | 53.41 | 54.82 | 1.38 | .34 | .37 | .66 | | | | |

^aSE = standard error. L = linear. Q = quadratic. C = cubic. ^b7X = received supplement daily. 3X = received supplement three times weekly. ^cDMI = dry matter intake. ^dBW = body weight. ^eDDMI = digestible dry matter intake. ^fDMD % = dry matter digestibility percent. ^gNDF = neutral detergent fiber. ^hSignificant frequency × protein interaction ($P = .05$).

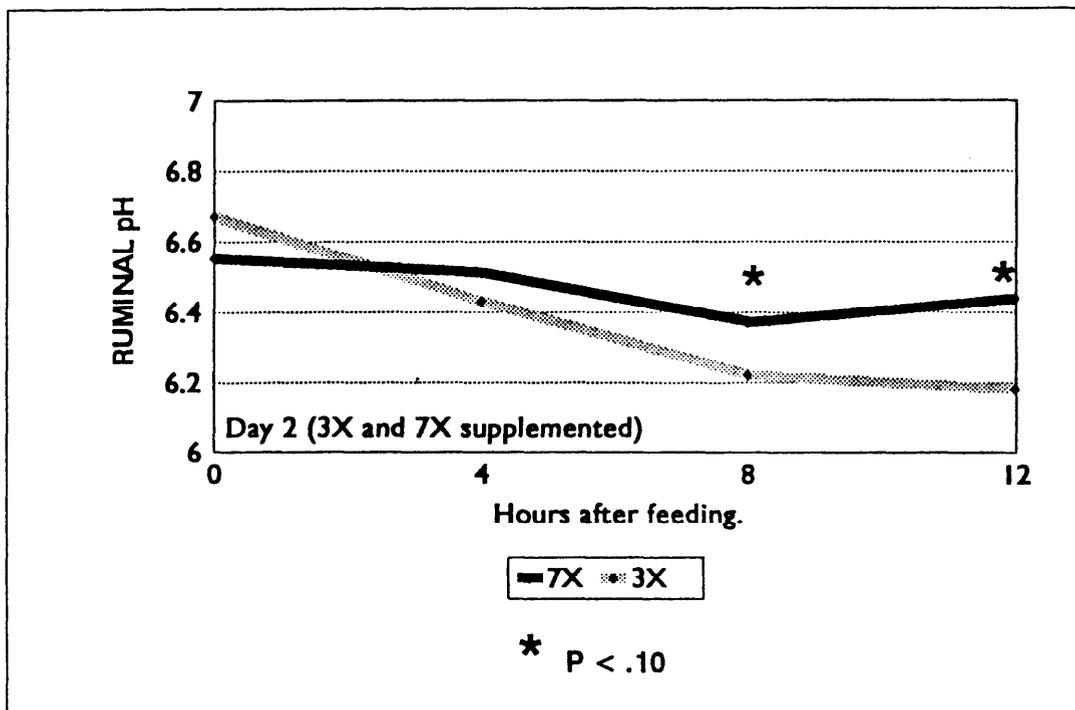
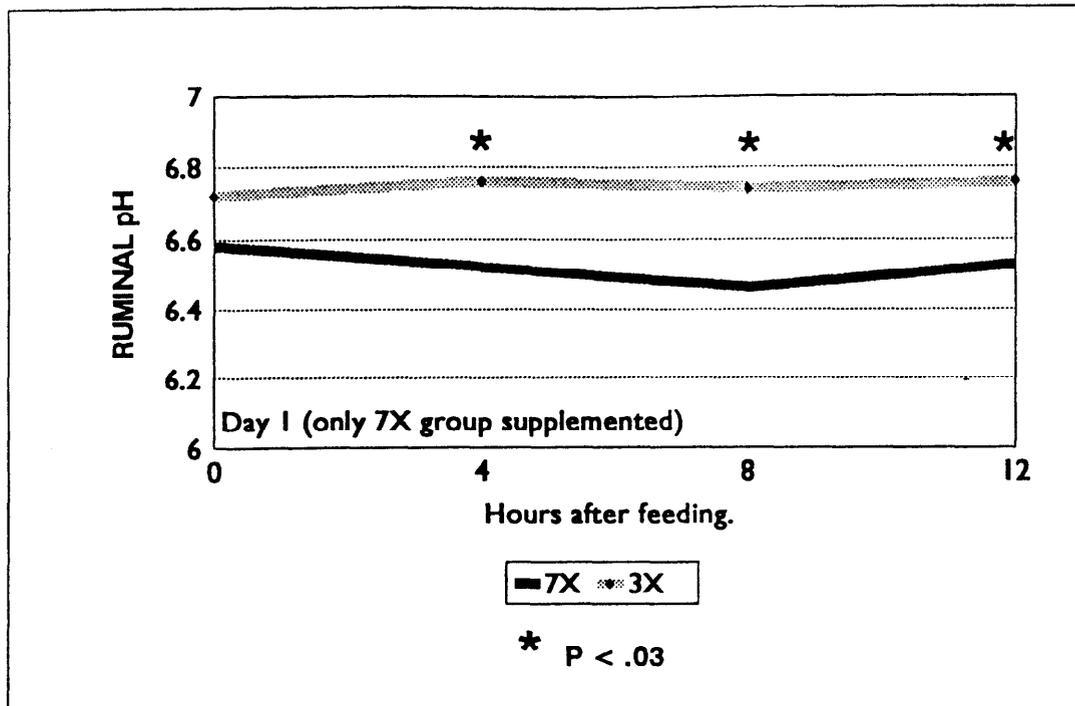


Figure 1. Ruminal pH in Steers Supplemented Daily (7X) or Three Times Weekly (3X)