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A.M. Trater

C.A. Löest

B.D. Lambert

See next page for additional authors

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Soybean hulls and alfalfa for limit-fed cattle

Abstract

We evaluated the optimal level of alfalfa inclusion in limit-fed, soybean hull-based diets. Steers were fed soybean hull-based diets containing 0 to 30% alfalfa or alfalfa alone. Feed intakes were lower for alfalfa than for soybean hull-based diets. Digestibilities of dry matter and neutral detergent fiber were lower ($P < 0.05$) for alfalfa than for diets containing soybean hulls. Dry matter and neutral detergent fiber digestibilities were similar for different levels of alfalfa in diets containing soybean hulls, although there were positive associative effects between soybean hulls and alfalfa. Rates of liquid passage from the rumen were higher for alfalfa than for soybean hull-containing diets, and increased as alfalfa was added to the soybean hull diets. Solid passage rates also increased with increasing amounts of alfalfa in soybean hull-containing diets. Adding 30% alfalfa to primarily soybean hull diets led to positive associative effects on diet digestibility, but alfalfa additions increased liquid and solid passage rates, suggesting that the benefit was not a result of slower passage of soybean hulls from the rumen.

Keywords

Cattlemen's Day, 2001; Kansas Agricultural Experiment Station contribution; no. 01-318-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 873; Beef; Soybean hulls; Alfalfa; Steers; Digestion; Passage rate

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Authors

A.M. Trater, C.A. Löest, B.D. Lambert, and Evan C. Titgemeyer

SOYBEAN HULLS AND ALFALFA FOR LIMIT-FED CATTLE

*A. M. Trater, E. C. Tügemeyer,
C. A. Löest, and B. D. Lambert*

Summary

We evaluated the optimal level of alfalfa inclusion in limit-fed, soybean hull-based diets. Steers were fed soybean hull-based diets containing 0 to 30% alfalfa or alfalfa alone. Feed intakes were lower for alfalfa than for soybean hull-based diets. Digestibilities of dry matter and neutral detergent fiber were lower ($P < 0.05$) for alfalfa than for diets containing soybean hulls. Dry matter and neutral detergent fiber digestibilities were similar for different levels of alfalfa in diets containing soybean hulls, although there were positive associative effects between soybean hulls and alfalfa. Rates of liquid passage from the rumen were higher for alfalfa than for soybean hull-containing diets, and increased as alfalfa was added to the soybean hull diets. Solid passage rates also increased with increasing amounts of alfalfa in soybean hull-containing diets. Adding 30% alfalfa to primarily soybean hull diets led to positive associative effects on diet digestibility, but alfalfa additions increased liquid and solid passage rates, suggesting that the benefit was not a result of slower passage of soybean hulls from the rumen.

(Key Words: Soybean Hulls, Alfalfa, Steers, Digestion, Passage Rate.)

Introduction

Soybean hulls present an opportunity to the beef and dairy cattle industries because they contain a large amount of potentially digestible fiber. Consequently, they may be included in high-forage diets to increase energy content without decreasing fiber digestibility. However, they have a short

retention time in the rumen due to their small particle size and high specific gravity, which may limit their digestibility and subsequent animal performance. Previous research at Kansas State University indicated that restricting the intake of soybean hull-based diets to 1.5 or 2.25% of body weight (BW) in an attempt to slow passage did not change digestibility, and, therefore, probably did not change the passage rate of soyhulls from the rumen. An alternative method to decrease the rate of passage of feed from the rumen may be to include forage in the diet.

Our experiments were designed to investigate changes in digestibility and passage rate of soybean hull-based diets as graded levels of alfalfa were added.

Experimental Procedures

Twenty Holstein steers (702 lb initial BW) were used in a randomized complete block design. They were housed in partially covered, individual pens, and had free access to water. Diets were fed once daily at 1.75% of body weight (dry matter basis). Treatments were a soybean hull mix (95.7% soybean hulls, 3% molasses, 0.5% urea, 0.8% mineral mix) fed with 0, 10.4, 20.7, and 30.9% coarsely chopped alfalfa hay (100:0, 90:10, 80:20, 70:30, respectively), or alfalfa alone (0:100). The experiment lasted 16 days, with total fecal collection (in bags) during the last 6 days. Fecal bags were emptied daily. Liquid and solid passage rates from the rumen were determined using fecal samples taken once daily, immediately prior to fecal bag emptying. These samples were analyzed for concentrations of liquid (chromium EDTA) and solid (ytterbium chloride) ingesta markers.

Results and Discussion

Intakes, digestibilities, and passage rates (liquid and solid) are presented in Table 1. Despite restriction of feed to 1.75% of BW, some steers refused part of their daily ration. This produced dry matter intakes that were lower ($P<0.05$) for alfalfa alone than for diets containing soybean hulls. The alfalfa we used contained appreciable dust, which may have contributed to the lower intakes for the 0:100 diet. Intakes for the 100:0, 90:10, 80:20, and 70:30 diets were similar.

Dry matter digestibility was lower for alfalfa alone ($P<0.05$) than for diets containing soybean hulls. Similar results have been found with other forage sources. There was no significant difference in dry matter digestibility among diets containing soybean hulls, although there were positive associative effects on dry matter and neutral detergent fiber digestibilities for combinations of soybean hulls and alfalfa. Our original hypothesis was that forage additions would slow passage from the rumen and thereby allow more time for digestion. However, solid passage rate actually increased with alfalfa additions to soybean hull-containing diets. Liquid passage rates were higher

($P<0.05$) for alfalfa alone than for diets containing soybean hulls. Further, liquid passage rate increased linearly ($P<0.05$) as alfalfa was added to the soybean hull mix. Because soybean hull particles are small and have a high specific gravity, they have the propensity to pass rapidly from the rumen. The increase in liquid passage rate with alfalfa addition may have hastened the passage of soybean hulls by carrying the small solid particles out of the rumen as part of the liquid phase. Although pH was not measured in this experiment, other research indicates that diets consisting primarily of soybean hulls can result in low ruminal pH. At a low rumen pH, fiber digestion can be inhibited. Thus, the positive associative effects for digestion with the addition of alfalfa might have resulted from an increase in rumination and salivary flow and, therefore, a higher rumen pH. Ruminal pH also may have been affected by alfalfa addition because alfalfa itself has a high buffering capacity. If rumen pH was sub-optimal for steers fed only soybean hulls, an increase in pH with alfalfa addition to the soybean hull-containing diets may have increased the rate of fiber digestion, and this may explain the observed associative effects.

Table 1. Intakes, Digestibilities, Passage Rates, and Associative Effects^a for Digestibilities and Passage Rates for Mixtures of Soybean Hulls and Alfalfa

Item	Soybean Hull Mix:Alfalfa					SEM
	100:0	90:10	80:20	70:30	0:100	
Dry matter						
Intake ^b , lb/day	11.9	11.2	12.1	12.5	9.9	0.70
Digestibility ^b , %	67.5	70.9 (6)	67.2 (3)	70.9 (10 ^e)	56.2	2.00
Neutral detergent fiber						
Intake ^b , lb/day	7.0	6.8	7.3	7.3	5.5	0.37
Digestibility ^b , %	66.1	70.5 (9)	65.4 (4)	68.6 (11 ^e)	47.4	2.30
Liquid passage ^{b,c} , %/hour	4.6	6.2 (22)	5.6 (7)	7.4 (24 ^e)	7.7	0.53
Solid passage ^{c,d} , %/hour	4.1	5.0 (18)	4.2 (4)	7.0 (42 ^e)	4.0	0.47

^aAssociative effects (% , in parentheses) calculated as (observed - expected)/expected, where expected was calculated as a weighted average based on the proportions of soybean hulls and alfalfa in the diet. ^bAlfalfa vs soybean hull-containing diets ($P<0.05$). ^cLinear effect of alfalfa within soybean hull-containing diets ($P<0.05$). ^dCubic effect of alfalfa within soybean hull-containing diets ($P<0.05$). ^eAssociative effect different from 0 ($P<0.05$).