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Soybean hulls in roughage-free diets for limit-fed growing cattle

Abstract

Three hundred heifers (573 lb initial body weight) were used in a growing study to compare growth performance of cattle fed roughage-free diets comprised mainly of soybean hulls with that of cattle receiving roughage- and corn-based diets and to determine if cattle fed soybean hull-based diets would respond to supplemental methionine hydroxy analogue (MHA; a source of methionine), ruminally protected betaine, or concentrated separator by-product (CSB; a source of betaine). Treatments included 1) a roughage-based diet fed at 2.75% of body weight (ROUGH), 2) a corn-based diet fed at 1.5% of body weight (CORN1.5), 3) a corn- based diet fed at 2.25% of body weight (CORN2.25), 4) a soybean hull-based diet fed at 1.5% of body weight (SH1.5), 5) a soybean hull-based diet fed at 2.25% of body weight (SH2.25), 6) SH1.5 top-dressed with 11.4 g/head daily MHA, 7) SH2.25 top-dressed with 11.4 g/head daily MHA, 8) SH2.25 top-dressed with 7 g/head daily rumenprotected betaine, and 9) SH2.25 top- dressed with 250 g/head daily CSB. Supplemental MHA, betaine, and CSB did not change feed intakes, gains, or feed efficiencies for cattle fed soybean hulls. Heifers fed soyhulls at 2.25% of body weight gained 27% slower (P<.01) than heifers fed the corn-based diet at similar intakes and were 25% less efficient (P<.01). Similar results were observed for cattle fed soybean hulls and corn at 1.5% of body weight. Cattle fed soybean hulls at 2.25% of body weight had gains similar to those of cattle receiving the roughage-based diet at 2.75% of body weight, but feed efficiencies tended to be better (P=0.11) for the cattle receiving soybean hulls because less feed was consumed. The roughage-fed cattle gained 23% less (P<.01) than cattle fed corn at 2.25% of body weight and were 34% less efficient.

Keywords

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SOYBEAN HULLS IN ROUGHAGE-FREE DIETS FOR LIMIT-FED GROWING CATTLE

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Summary

Three hundred heifers (573 lb initial body weight) were used in a growing study to compare growth performance of cattle fed roughage-free diets comprised mainly of soybean hulls with that of cattle receiving roughage- and corn-based diets and to determine if cattle fed soybean hull-based diets would respond to supplemental methionine hydroxy analogue (MHA; a source of methionine), ruminally protected betaine, or concentrated separator by-product (CSB; a source of betaine). Treatments included 1) a roughage-based diet fed at 2.75% of body weight (ROUGH), 2) a corn-based diet fed at 1.5% of body weight (CORN1.5), 3) a corn-based diet fed at 2.25% of body weight (CORN2.25), 4) a soybean hull-based diet fed at 1.5% of body weight (SH1.5), 5) a soybean hull-based diet fed at 2.25% of body weight (SH2.25), 6) SH1.5 top-dressed with 11.4 g/head daily MHA, 7) SH2.25 top-dressed with 11.4 g/head daily MHA, 8) SH2.25 top-dressed with 7 g/head daily rumen protected betaine, and 9) SH2.25 top-dressed with 250 g/head daily CSB. Supplemental MHA, betaine, and CSB did not change feed intakes, gains, or feed efficiencies for cattle fed soybean hulls. Heifers fed soyhulls at 2.25% of body weight gained 27% slower (P<.01) than heifers fed the corn-based diet at similar intakes and were 25% less efficient (P<.01). Similar results were observed for cattle fed soybean hulls and corn at 1.5% of body weight. Cattle fed soybean hulls at 2.25% of body weight had gains similar to those of cattle receiving the roughage-based diet at 2.75% of body weight, but feed efficiencies tended to be better (P=0.11) for the cattle receiving soybean hulls because less feed was consumed. The roughage-fed cattle gained 23% less (P<.01) than cattle fed corn at 2.25% of body weight and were 34% less efficient.

(Key Words: Soybean Hulls, Heifers, Performance, Feedlot.)

Introduction

Although soybean hulls have been evaluated as additions to a number of different diet types, they have not been studied extensively as the primary ingredient in high concentrate diets for cattle. Soybean hulls appear to be an excellent candidate as the predominant energy source in feedlot diets for limit-fed, growing cattle because 1) they are nearly as easy to transport and handle as grain; 2) they are highly digestible, reducing manure production when compared to forage-based diets; and 3) they have a fairly stable fermentation pattern when compared to grain. Because of the stable fermentation, it also should be possible to remove all roughage from soybean hull-based diets without compromising ruminal health.

Because soybean hulls have little rumen escape protein, and microbial protein synthesis may be low because of restricted feed intake, the metabolizable protein supply of such diets may be inadequate. Based on estimates of amino acid supply, methionine is implicated as the first-limiting amino acid for

growing cattle fed restricted amounts of soybean hull-based diets. Because one of the important roles that methionine plays is methyl group donation, in situations where diets are deficient in methyl groups, cattle may respond to alternative methyl donors, such as betaine.

Our objectives were 1) to compare growth performance of cattle fed roughage-free diets comprised predominantly of soybean hulls with that of cattle receiving roughage- and corn-based diets and 2) to determine if cattle fed soybean hull-based diets respond to supplementation with methionine hydroxy analogue (MHA; a source of methionine), ruminally protected betaine, or concentrated separator by-product (CSB; a source of betaine).

Experimental Procedures

Three hundred heifers (573 lb initial body weight) were used in an randomized complete block design. Cattle were allotted to pens (4 to 6 heifers/pen, 6 pens/treatment) based on previous treatment. Treatments included 1) a roughage-based diet fed at 2.75% of body weight (ROUGH), 2) a corn-based diet fed at 1.5% of body weight (CORN1.5), 3) a corn-based diet fed at 2.25% of body weight (CORN2.25), 4) a soybean hull-based diet fed at 1.5% of body weight (SH1.5), 5) a soybean hull-based diet fed at 2.25% of body weight (SH2.25), 6) SH1.5 top-dressed with 11.4 g/head daily MHA, 7) SH2.25 top-dressed with 11.4 g/head daily MHA, 8) SH2.25 top-dressed with 7 g/head daily rumen protected betaine, and 9) SH2.25 top-dressed with 250 g/head daily CSB. The CSB supplied 15.5 g of betaine per day. Heifers were stepped up to final diets over a 13-day adaptation period and fed the final diets for 71 days. The cattle then were stepped up over 14 days to the corn-based diet, which all cattle were fed at 2.25% of body weight (CORN2.25).

Results and Discussion

Supplemental MHA, betaine, and CSB did not change feed intakes, gains, or feed efficiencies for cattle fed soybean hulls (Table 2). Heifers fed soybean hulls at 2.25% of body weight gained 27% slower ($P<.01$) than heifers fed the corn-based diet at similar intakes. As a result of their slower growth, the cattle receiving soybean hulls were also 25% less efficient ($P<.01$). Similar results were observed for cattle fed soybean hulls and corn at 1.5% of body weight. Cattle fed soybean hulls at 2.25% of body weight had gains similar to those of cattle receiving the roughage-based diet at 2.75% of body weight. Feed efficiencies, however, tended to be higher ($P=0.11$) for the cattle receiving soybean hulls because of 27% lower feed consumption. The roughage-fed cattle gained 23% less ($P<.01$) than cattle fed corn-based diets at 2.25% of body weight and were 34% less efficient.

Most of the heifers fed soybean hulls at 2.25% of body weight did not consume all their feed, resulting in intakes that averaged approximately 2.15% of body weight. During the study, three cattle receiving soybean hulls at 1.5% of body weight died, apparently because of overeating.

Gains of cattle fed soybean hull-based, roughage-free diets were 27% less than those of cattle fed similar amounts of a corn-based diet, but gains and efficiencies of heifers fed the soybean hull-based diet at 2.25% of body weight were roughly comparable to those of heifers fed a roughage-based diet at 2.75% of body weight. Soybean hulls can be used as the primary ingredient in roughage-free diets for growing cattle.

Table 1. Compositions of Diets

Item	Diet		
	Soybean Hull-Based	Corn-Based	Roughage-Based
	----------% of DM----------		
Soybean hulls, pelleted	91.6	0	0
Corn grain	0	76.6	29.3
Alfalfa hay	0	15.0	45.0
Prairie hay	0	0	20.0
Molasses (cane)	3.1	4.0	5.0
Vitamin/mineral mix[a]	0	0	.7
Vitamin/mineral mix[b]	0	3.0	0
Vitamin/mineral mix[c]	2.5	0	0
Soybean meal (47.5%)	0	1.4	0
Blood meal	.5	0	0
Urea	.4	0	0
Lignin sulfonate	1.9	0	0
Crude protein, calculated	13.6	14.0	12.0

[a]Formulated for the complete diet to contain .90% Ca, .30% P, 1.29% K, 1200 IU/lb added vitamin A, and 20 g/ton Rumensin® (DM basis).
[b]Formulated for the complete diet to contain .73% Ca, .34% P, .76% K, 1230 IU/lb added vitamin A, 30 g/ton Rumensin, and 10 g/ton Tylan® (DM basis).
[c]Formulated for the complete diet to contain 1.02% Ca, .51% P, 1.41% K, 3378 IU/lb added vitamin A, 34 g/ton Rumensin, and 11 g/ton Tylan (DM basis).

Table 2. Performance of Cattle Fed Roughage-, Corn-, and Soybean Hull-Based Diets

Treatment[a]	Day 0 to 98 Performance		
	Intake, lb/d	Daily Gain, lb/d	Gain:Feed
ROUGH	16.79[b]	1.80[c]	.107[cd]
CORN1.5	9.29[d]	1.13[d]	.122[c]
CORN2.25	14.36[c]	2.34[b]	.163[b]
SH1.5	9.07[d]	.84[de]	.092[d]
SH1.5 + MHA	9.10[d]	.78[e]	.085[d]
SH2.25	13.97[c]	1.71[c]	.122[c]
SH2.25 + MHA	13.45[c]	1.58[c]	.118[c]
SH2.25 + BET	13.94[c]	1.71[c]	.122[c]
SH2.25 + CSB	13.53[c]	1.61[c]	.119[c]
SEM	.25	.081	.0066

[a]ROUGH = roughage-based diet fed at 2.75% of BW, CORN1.5 = corn-based diet fed at 1.5% of BW, CORN2.25 = corn-based diet fed at 2.25% of BW, SH1.5 = soybean hull-based diets fed at 1.5% of BW, SH2.25 = soybean hull-based diets fed at 2.25% of BW, MHA = 11.4 g/d supplemental methionine hydroxy analogue, BET = 7 g/d supplemental rumen-protected betaine, CSB = 250 g/d supplemental concentrated separator by-product.
[b,c,d,e]Means within the same column differ (P<.01).