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Abstract

Six medium-framed steers, fitted with ruminal cannulae were used in a 6 x 6 Latin square design and fed the following six high concentrat e (90%) rations: control; 5, 10, or 15% pelleted wheat middlings (WM) replacing the concentrate (dry rolled corn); and 5 or 10% pelleted WM replacing the roughage (chopped alfalfa hay). Dry matter (DM), organic matter (OM), and starch digestibilities decreased linearly when increasing levels of WM replaced the concentrate , but replacing the roughage increased DM and OM digestibilities linearly. WM could replace only up to 5 % of the concentrate without reducing nutrient digestibilities, but complete (10% WM) replacement of the roughage increased nutrient digestibilities.

Keywords

Cattlemen's Day, 1995; Kansas Agricultural Experiment Station contribution; no. 95-357-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 727; Beef; Wheat middlings; Beef cattle; Feedlot; Digestibility

WHEAT MIDDLINGS IN HIGH CONCENTRATE RATIONS: DIGESTIBILITY AND RUMINAL METABOLISM [1]

B. S. Dalke [2], K. K. Bolsen, R. N. Sonon, Jr. [3], and M. A. Young

Summary

Six medium-framed steers, fitted with ruminal cannulae were used in a 6 × 6 Latin square design and fed the following six high concentrate (90%) rations: control; 5, 10, or 15% pelleted wheat middlings (WM) replacing the concentrate (dry rolled corn); and 5 or 10% pelleted WM replacing the roughage (chopped alfalfa hay). Dry matter (DM), organic matter (OM), and starch digestibilities decreased linearly when increasing levels of WM replaced the concentrate, but replacing the roughage increased DM and OM digestibilities linearly. WM could replace only up to 5% of the concentrate without reducing nutrient digestibilities, but complete (10% WM) replacement of the roughage increased nutrient digestibilities.

(Key Words: Wheat Middlings, Beef Cattle, Feedlot, Digestibility.)

Introduction

Wheat middlings (WM) are byproducts of flour milling and comprise a mixture of small particles of bran, germ, and the aleurone layer of the wheat kernel. The nutrient content of WM can be highly variable, but NRC publications indicate that they contain (dry basis) approximately .73 Mcal of NE_m/lb, .45 Mcal of NE_g/lb, 18.0% crude protein (CP), and high levels of rapidly degradable fiber.

Although WM commonly are used as a feed ingredient, little information is available concerning their nutritive value in high concentrate rations. Cattle performance results indicate that pelleted WM were more effective as a replacement of roughage than of concentrate in feedlot rations (page 19, this report).

Our objectives were to determine the effects of WM fed as a replacement for either the concentrate or roughage components in finishing rations on nutrient digestibilities and ruminal metabolism in feedlot steers.

Experimental Procedures

Six medium-framed steers, averaging 1,060 lb, were fitted with ruminal cannulae and utilized in a 6 × 6 Latin square design. They were fed the following six high concentrate rations (81.5% dry rolled corn, 10% chopped alfalfa, 6% supplement, and 2.5% molasses on a DM basis): control (0); 5, 10, or 15% pelleted (.25 inch) WM replacing the dry rolled corn; and 5 or 10% pelleted WM replacing the roughage. The rations were formulated to be isonitrogenous, supplied equal amounts monensin and tylosin, and were fed ad libitum, twice daily (8:00 AM and 3:30 PM) for the duration of the experimental periods. On day 1 of each period, the steers were allocated randomly to one of the six rations. The experimental periods were 14 days and consisted of a 9-day adaptation, a 4-day total fecal collection, and a 1-day rumen sampling. Ruminal digesta samples were collected before the first feeding (0 hour) and at 2, 4, 6, and 10

[1]The pelleted wheat middlings were provided by ADM Milling Co., Shawnee Mission, Kansas.
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hours after the first feeding. The samples consisted of subsamples from the dorsal blind sac, mid-dorsal region, mid-ventral region, and the reticulum.

Data were analyzed using the SAS GLM procedure. Fermentation profiles were analyzed as a split-plot in time 6 × 6 Latin square design using contrasts (linear, quadratic, and cubic) for treatment comparisons. Terms in the fixed effects model included the main effects of ration, period, steer, ration × period × steer, time, and time × ration. Digestibility data were analyzed as a 6 × 6 Latin square design using contrasts (linear, quadratic, and cubic) for specific treatment comparisons. Terms in the fixed effects model included ration, period, and steer.

Results and Discussion

The WM were from a single source and had the following composition (DM basis): 19.0% crude protein, 44.3% NDF, 10.7% ADF, 23.2% starch, .14% calcium, 1.2% phosphorus, and 1.0% potassium.

The effects of replacing concentrate with WM on DM intake, intake of digestible DM (DDM), and nutrient digestibilities in the steers are presented in Table 1. Neither DM intake nor digestible DM intake were significantly influenced (P>.05) by replacing concentrate with WM. Dry matter, OM, and starch digestibilities decreased (P<.05) in a linear manner with increasing WM. Decreases of 5.7 and 5.3 percentage units in DM and starch digestibilities, respectively, were observed at the 15% level of WM addition.

The effect of replacing concentrate with WM on ruminal fermentation characteristics is summarized in Table 2. Ruminal pH increased (P<.05) linearly with increasing levels of WM. Acetate and butyrate proportions increased (P<.05) and propionate proportions decreased (P<.05) as WM increased, resulting in a quadratic increase (P<.05) in the acetate/propionate ratio. Total VFA concentrations decreased 25% at both the 10 and 15% levels of WM compared to the control.

The effects of replacing roughage with WM on DM intake, intake of DDM, and nutrient digestibilities in the steers are summarized in Table 1. Daily intakes of DM and DDM were not affected (P>.05) by WM replacement of roughage. However, DM and OM digestibilities increased in a linear manner with increasing levels of WM.

The effects of replacing roughage with WM on ruminal fermentation characteristics is summarized in Table 2. Total VFA and propionate concentration and pH were not influenced (P>.05) by WM replacement of roughage. Acetate proportions and acetate/propionate ratio were decreased and butyrate proportions were increased as WM replaced roughage.

In summary, WM could replace only 5% of the concentrate without reducing nutrient digestibilities, but complete (10%) replacement of the roughage increased nutrient digestibilities.

Table 1. Effects of Replacing either the Concentrate or Roughage Components with WM on Intake and Nutrient Digestibilities in Feedlot Steers [a]

		Middlings for Concentrate			Middlings for Roughage			Probability [b]	
Item	Control	5%	10%	15%	5%	10%	SE	C	R
DM intake, lb/day	28.6	30.4	28.0	33.1	28.9	26.2	1.70	NS	NS
Intake of DDM, lb/day	22.0	23.8	21.2	23.8	23.6	22.0	1.56	NS	NS
Digestibility, %									
DM	77.1	78.7	74.3	72.7	77.1	84.1	1.69	L	L
OM	79.4	80.8	77.7	75.2	79.4	86.7	1.47	L	L
Starch	95.5	93.1	92.9	90.4	95.5	96.6	1.24	L	NS

[a]Values are least square means, and SE is the pooled standard error of the mean.
[b]C = replac ement of concentrate, R = replacement of roughage, and L = linear effect of WM addition (P<.05). NS = not different.

Table 2. Effects of Replacing either the Concentrate or Roughage Components with WM on Ruminal Fermentation Characteristics in Feedlot Steers [a]

		Middlings for Concentrate			Middlings for Roughage			Probability [b]	
Item	Control	5%	10%	15%	5%	10%	SE	C	R
pH	5.3	5.6	5.7	5.8	5.3	5.3	.04	L	NS
VFA, mol/100 mol									
acetate	47.0	48.0	51.0	51.0	43.0	44.0	.64	C	Q
propionate	40.0	39.0	32.0	28.0	40.0	41.0	.61	C	NS
butyrate	9.0	10.0	13.0	16.0	12.0	10.0	.38	C	Q
Total VFA, mM	111	105	83	83	113	94	3.51	Q	NS
Acetate/ propionate	1.3	1.4	2.0	2.1	1.1	1.1	.06	Q	Q

[a]Values are least square means, and SE is the pooled standard error of the mean.
[b]C = replac ement of concentrate, R = replacement of roughage, and L = linear effect of WM addition (P<.05), Q = quadratic effect of WM addition (P<.05), and C = cubic effect of WM addition (P<.05). NS = not different.