EFFECT OF MEAT MEAL SUPPLEMENTATION OF WHEAT PASTURE STOCKER HEIFERS ON FORAGE INTAKE AND NITROGEN BALANCE

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Story in Brief

The effect of meat meal supplementation on forage intake and nitrogen balance of free-grazing growing heifers on wheat pasture was studied. Eight ruminally cannulated growing Hereford x Angus heifers were fed 2 lb/day (trial 1) and 3 lb/day (trial 2), of a corn-based, control supplement or a supplement containing 24% meat meal (as-fed basis). Forage intake and nitrogen balance were measured during three grazing periods. Intake of wheat forage organic matter, expressed as a percentage of body weight, was increased 39 and 18% by meat meal supplementation of heifers in these studies. Nitrogen retention of heifers was not influenced by meat meal supplementation. These results indicate that improved forage intake, possibly resulting from a correction in amino acid balance of non-ammonia nitrogen flowing to the small intestine, is a primary mechanism by which supplementing growing cattle on wheat pasture with protein supplements of low ruminal degradability, such as meat meal, has increased performance.

(Key Words: Wheat Pasture, Protein Supplementation, Nitrogen Balance.)

Introduction

The crude protein content of wheat forage is typically high (i.e., 20 to 30% of dry matter). However, supplementing wheat pasture stocker cattle with a "bypass" protein such as meat meal has been shown to increase daily weight gains (Horn et al., 1987 and Lee, 1985). This may partially be due to greater amounts of protein reaching the small intestine, compensating for the rapid ruminal degradation and loss of wheat forage nitrogen (Zorrilla-Rios et al., 1985) or a more balanced flow of amino acids to the small intestine. Including meat meal in supplements of steers grazing wheat pasture did not affect ruminal pH, ammonia concentration or molar proportions of volatile fatty acids (Andersen et al., 1987). This study was conducted to evaluate the effect of inclusion of meat meal in supplements of growing heifers grazing wheat pasture on forage intake and nitrogen balance.

Materials and Methods

Eight ruminally cannulated Hereford x Angus heifers grazed wheat pasture from February through March 1987 (trial 1) and from November through December, 1987 (trial 2). Heifers were randomly allotted to one of two treatments and received (2 lb/day in trial 1 and 3 lb/day in trial 2) either a corn-based, control supplement or a supplement containing meat meal. Supplements were administered to the heifers directly through the rumen cannulas. Ingredient composition of the

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supplements is shown in table 1. Yeast Culture was included in the supplements of trial 1 in an attempt to improve palatability and intake of the meat meal-containing supplement by cattle of a companion grazing and performance trial on wheat pasture. The supplement for trial 2 was formulated and fed at a level to provide the same amount of crude protein per kg of metabolic body weight as in trial 1. Within each trial, supplements were isocaloric and contained similar amounts of Ca, P and Mg. Forage intake and nitrogen balance measurements were made during 4 experimental periods. Each experimental period consisted of a supplement adaptation period of at least 2 weeks followed by periods of (1) one day for adaptation to catheterization and the fecal and urine collection harnesses and bags and (2) four days for collection of total feces and urine. Data of the second experimental period of trial 1 was deleted because it was extremely variable, which was attributed to the fact that the heifers were fairly light weight (i.e., about 400 lb) and the stress of the collection equipment. The remaining collection periods were March 7-13 in trial 1; and November 12-16 and December 2-6 in trial 2.

Total collection of feces and urine were made by the procedure of Stillwell et al. (1983). Feces were collected from bags every 24 h in trial 1, and every 12 h in trial 2. Total fecal contents were weighed, then mixed in a paddle mixer and subsampled. Subsamples were dried in a forced air oven at 55 C. Dry matter, organic matter (OM) and nitrogen (N) were determined on each subsample. Subsamples were composited by animal in proportion to the fecal dry matter output for the day corresponding to the subsample. Indigestible neutral detergent fiber was used as an internal indigestible marker to determine forage OM digestibility. In vitro digestibility of supplements was deter-

Table 1. Composition of supplements (% of DM).

Ingredient	Control	Meat meal
	--------- Trial 1 --------	
Corn	79.3	62.2
Meat meal	----	25.4
Cottonseed hulls	3.8	3.8
Calcium carbonate	2.7	----
Dicalcium phosphate	5.2	----
Magnesium oxide	.7	.2
Molasses	4.2	4.2
Diamond V Yeast Culture	3.0	3.0
Trace mineralized salt	.3	.3
Salt	.7	.7
Rumensin premix[a]	.14	.14
	-------- Trial 2[b] ------	
Meat meal	----	25.0
Corn	91.8	75.0
Calcium carbonate	2.7	----
Dicalcium phosphate	5.1	----
Magnesium oxide	.4	----

[a]Added to provide 75 mg monensin/lb of supplement.
[b]Monensin provided to all heifers in gelatin capsules at level of 231 mg/day.

mined, and daily fecal outputs were corrected for indigestibility of the supplements in calculating forage intake.

Urine bags were emptied every 12 h. Total urine volume was measured, then urine was diluted to an exact volume. Aliquots (i.e., 10% of the final volume) were acidified, composited and refrigerated until analyzed for N content at the end of each period.

Hand clipped forage samples were collected during each period to determine dry matter and OM of wheat forage. A second set of forage samples were collected by use of esophogeal cannulated steers, and were frozen and lyophilized for use in determining indigestible neutral detergent fiber content of forage. A third set of forage samples were hand clipped, and frozen immediately in liquid nitrogen. These samples were lyophilized, and subsequently analyzed for N, soluble N, non-protein nitrogen (NPN), and soluble carbohydrate concentrations. Nitrogen of wheat forage was determined by the Kjeldahl procedure, NPN content was determined by the difference between total N and protein N precipitated in a 10% H_2SO_4 and Na-tungstate solution. Soluble N was determined as N soluble in the mineral mixture (2% v/v; pH = 6.5) of the "Ohio" in vitro fermentation media (Johnson, 1969). Soluble carbohydrates were determined by the procedure of Balwani (1965).

Results and Discussion

Forage N components (table 2) appeared typical for wheat forage during this time of the year, with the exception that total N concentration was slightly lower than normal in trial 1. This may be related to the unusually large fluctuations in temperature and moisture during the 1987 wheat pasture year.

Effects of meat meal supplementation on forage intake and N balance during trial 1 are shown in table 3. Supplementation with meat meal increased ($P<.15$) forage OM intake from 1.5 to 2.1% of body weight (BW). Total N intake was greater ($P<.05$) in heifers fed meat meal supplements. This was due to greater forage intake and greater intake of supplemental N. Total N excretion was greater ($P<.06$) for heifers supplemented with meat meal, as both fecal and urinary excretion of N was increased ($P<.10$). Nitrogen retained (g/day) was greater ($P<.09$) in heifers supplemented with meat meal, however N retained expressed as

Table 2. Chemical composition (DM basis) of wheat forage.

Item	Trial 1	Trial 2	
		Period 1	Period 2
	--------- % of dry matter ---------		
Organic matter	87.05	97.6	98.6
Nitrogen	2.98	3.87	3.38
Soluble N, % of total N	24.42	47.79	48.67
NPN, % of N	12.76	20.96	23.67
Soluble carbohydrate, %	23.19	-----	-----
IVOMD[a], %	81.57	84.34	85.15

[a]In vitro organic matter digestibility of esophageal extrusa.

Table 3. Effect of meat meal supplementation on forage intake and nitrogen balance of heifers (Trial 1)[a].

Item	Control	Meat meal	SE[b]	OSL[c]
Observations	4	4		
Weight, kg	193	186	13.8	
Forage organic matter intake				
kg	2.90	3.96	.448	.20
g/kg of body weight	15.3	21.2	2.43	.14
Nitrogen intake, g/day	123	183	16.9	.05
Nitrogen excretion, g/day				
Total	55.9	76.6	6.02	.06
Fecal	20.0	27.0	2.07	.06
Urinary	35.9	49.6	4.67	.09
Nitrogen retention, g/day	67.3	106.7	12.90	.09
% of N intake	54.8	57.1	3.47	.66
% of absorbed N	65.5	67.1	3.61	.77

[a]Least-squares means.
[b]Standard error.
[c]Observed significance level.

a percentage of N intake or of absorbed N was not influenced by supplementation with meat meal.

Forage intake and N balance data of trial 2 are shown in table 4. Forage OM intake, expressed as a percent of body weight, was increased 18% ($P<.13$) by meat meal supplementation. As in trial 1, supplementation with meat meal did not affect N retention.

Intake of wheat forage OM, expressed as a percentage of body weight, was increased 39 and 18% by meat meal supplementation of

Table 4. Effect of meat meal supplementation on forage intake and nitrogen balance of heifers (Trial 2)[a].

Item	Control	Meat meal	SE[b]	OSL[c]
Observations	7[d]	8		
Weight, kg	309	324	19.8	
Forage organic matter intake				
kg	4.78	5.79	.584	.28
g/kg of body weight	15.1	17.8	1.07	.13
Nitrogen intake, g/day	213	279	22.6	.10
Nitrogen excretion, g/day				
Total	120	155	18.5	.24
Fecal	48	62	7.6	.35
Urinary	72	93	12.7	.24
Nitrogen retention, g/day	93	124	15.8	.24
% of N intake	44.3	43.0	4.76	.86
% of absorbed N	57.1	54.9	5.01	.69

[a]Least-squares mean.
[b]Standard error.
[c]Observed significance level.
[d]One heifer was deleted from analysis of data because of problems with her urinary catheter.

heifers in these studies. Nitrogen retention of heifers was not affected by meat meal supplementation. These results indicate that the improvement in forage intake, possibly resulting from a correction in the balance of amino acids flowing to the small intestine, is a primary mechanism by which supplementation of growing cattle on wheat pasture with protein supplements of low ruminal degradability, such as meat meal, has increased performance.

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