the number of observations and help to determine if the trends noted in this report are consistent over years.

Literature Cited

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Adaptation of Stocker Calves to NPN as the Result of Consuming Wheat Forage

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Story in Brief

Twenty-four heifer calves were divided into two groups. A control group was fed wheat straw, soybean meal and corn, and another group was fed wheat forage. Consumption of wheat forage resulted in significantly higher ruminal ammonia and nonprotein nitrogen (NPN) concentrations than found in the control group. A change in the ruminal metabolism of the forage nitrogen was noted 30 days after consumption of forage began. Concentrations of ammonia and NPN in the rumen decreased, and plasma protein concentration increased. Although the wheat forage group appeared to be going through an adaptation phase to NPN while grazing, the utilization of a urea supplement fed to both groups following the grazing phase was not different from that of the unadapted control group. The consumption of wheat forage during March and April did not increase the utilization of urea following the grazing period, but there may be another form of NPN to which adaptation had occurred.

Introduction

Wheat pasture has been used extensively in the southern plains area as a high quality forage for young ruminants from November to March and even as late as May if a grain crop is not harvested. The protein content of wheat forage will vary within the grazing period and between different years. The protein content as a percentage of the dry matter has been reported to range from 25 to 32 percent,

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and the nonprotein/nitrogen (NPN) content can represent 12 to 28 percent of the total protein content (Johnson et al., 1973). NPN sources are not efficiently utilized by the ruminant immediately upon addition to the diet, and an adaptation period of 20 to 40 days is required before they can be effective as nitrogen sources for growth of young ruminants. Once adaptation has been achieved, it is not permanent and can be lost with removal of the NPN from the diet for a few days. Thus, another period of adaptation is required when NPN is again reintroduced in the diet. It would appear that young ruminants, such as stocker calves, should be adapted to NPN after 40 days of grazing winter wheat pasture. This information would facilitate the formulation of protein-efficient rations for feeding calves prior to grazing wheat pasture, during periods of no wheat forage availability and during the subsequent finishing period. The objective of this experiment was to determine if ruminants are adapted to NPN after grazing winter wheat pasture.

Materials and Methods

Hereford-Angus crossbred heifer calves weighing an average of 455 lb were assigned to two groups of 12 heifers each. During Phase I of the experiment, group 1 grazed wheat pasture for 45 days from March 3 to April 16, 1980, and the other 12 heifers were confined in drylot and fed 6.8 lb of a 15 percent plant protein supplement (Table 1). The combination of supplement and straw fed to heifers of group 2 was calculated to promote the same rate of gain as heifers of group 1.

At the end of phase 1, all heifers were confined in a drylot and individually fed 8.1 lb per head per day of the supplement which contained urea (phase 2); see Table 1. Each heifer was individually fed the supplement in two equal portions at 0830 and 1530 each day. Approximately 30 minutes were needed at each feeding for all heifers to consume the supplement. When not in individual stalls, the heifers were maintained as a group in drylot. Wheat straw was fed once each day after the afternoon feeding of the supplement.

Rumen and blood samples were collected at 15-day intervals during phase 1 and at 10-day intervals during phase 2. Rumen samples were collected 2 hours after feeding and blood samples 6 hours after feeding during both phases. Rumen ammonia concentration was determined by an ion specific electrode; NPN concentration was determined by extracting the soluble nitrogen with buffer and precipitating the protein with tungstic acid. Plasma protein was determined by biuret reaction. The data were analyzed within each phase as a one-way classification over time.

Results

The changes in the concentration of ammonia in the rumen fluid during phase 1 for the two experimental groups are shown in Table 1. The initial concentration of ammonia (day 0) was equal for the two groups because both groups had been receiving the same diet, indicating that there was no built-in bias. Group 1 had a significant increase in the rumen ammonia concentration from the initial value of 18.5 mg/100 ml to 75.4 mg/100 ml after grazing wheat forage for 15 days. This increase was due to an increase in the dietary nitrogen level. On day 30 the ammonia concentration declined to 57.3 mg/100 ml and did not significantly change for the remainder of phase 1. The crude protein content of the wheat forage initially and at the subsequent three 15-day intervals was 24, 28, 25 and 23 percent of forage dry matter. Thus, the decline in rumen ammonia concentration at day 30 was not due to a drastic drop in forage crude protein content. The decline was probably due to either a change to a more efficient utilization of the forage protein by the animal in terms of assimilating more of the ammonia into microbial protein or a change in the composition of the protein fractions in the forage. As anticipated, the rumen ammonia concentration of group 2 was lower than group 1 and remained lower throughout phase 1. The combination of supplement and straw was adequate for a moderate rate of gain (.6 lb/day) but did not contain the excess protein level that was found in wheat forage.

The pattern of change in ruminal NPN concentration for the two experimental groups was the same as noted for ruminal ammonia concentration. Consumption of the wheat forage resulted in an elevation of the NPN concentration at day 15, but that concentration significantly declined at day 30. No differences were noted between day 30 and day 45. Group 2 had a lower ruminal NPN concentration than group 1. Since ruminal ammonia is a large part of the ruminal NPN fraction, the factors which were previously discussed as affecting ruminal ammonia concentration would also have an influence on ruminal NPN. Previous research in the area of NPN adaptation has indicated that NPN concentration in the rumen decreased as adaptation occurred over a 30 to 40-day period of time (Ludwick et at., 1972). Thus, it would appear that group 1 was utilizing the protein in the wheat forage more efficiently with time.

As previously noted, there appeared to be a change in the ruminal metabolism of forage protein in wheat by day 30. A significant increase in total plasma protein concentration was also noted by day 30 in group 1 (Table 1).

Table 1. Composition of supplements[a]

	Group	
	1	2
Phase I		
Corn, ground	--	76.5
Soybean meal	--	17.1
Molasses	--	4.2
Dical	--	2.2
Phase II		
Corn, ground	88.2	88.2
Soybean meal	2.8	2.8
Urea	2.1	2.1
Molasses	5.0	5.0
Dical	1.9	1.9

[a]Percent of dry matter.

Although the heifers in group 1 appeared to be undergoing some metabolic changes which had the same characteristics as those experienced by ruminants adapting to NPN, the real test of adaptation was during phase 2 of this experiment. On day 45 both groups of heifers were individually fed a urea supplement. The subsequent changes in ruminal ammonia, NPN concentrations and plasma protein concentrations at 10-day intervals after initiation of phase 2 are shown in Table 2.

Ten days after introduction of the urea diet, the rumen ammonia concentration of group 2 had increased four-fold, but no change was noted in group 1. There was, however, a significant increase in NPN concentration in the rumen fluid for

Table 2. Concentration of ruminal and plasma nitrogen components during phase 1

Concentration of nitrogen components	Sampling period, days 0	15	30	45
Rumen ammonia, mg/100 ml				
Group 1	18.5[a]	75.4[b]	57.3[c]	52.4[c]
Group 2	18.3[a]	14.8[b]	12.8[b]	13.8[b]
1 vs 2[d]	NS	.01	.01	.01
Rumen non-protein nitrogen, mg/100 ml				
Group 1	32.6[a]	92.6[b]	73.3[c]	85.5[b,c]
Group 2	31.8[a]	28.4[a,b]	24.6[b]	22.3[b]
1 vs 2	NS	.01	.01	.01
Plasma protein g/100 ml				
Group 1	6.46[a]	6.60[a]	6.85[b]	6.82[a,b]
Group 2	6.61[a]	6.60[a]	6.49[a,b]	6.36[b]
1 vs 2	NS	NS	.05	.05

[a,b,c]Means in the same row with different superscripts are different (P<.01).
[d]Comparison of the two groups within each sampling period: NS = nonsignificant, .05 = P<.05, and .01 = P<.01.

both groups 1 and 2. For the remainder of the trial, significant differences were noted between groups 1 and 2 for any of the measurements except the NPN concentration at day 40. Ruminal ammonia and NPN concentrations decreased to significantly lower levels at day 20. Another significant decline was noted on day 40. Plasma protein concentration is inversely related to rumen ammonia and NPN concentration when nitrogen intake is held constant. When these two ruminal measurements increase, plasma protein concentration usually decreases because less nitrogen is being incorporated into microbial protein for later diges-

Table 3. Concentration of ruminal and plasma nitrogen components during phase 2

Concentration of nitrogen components	Sampling period, days 0	10	20	30	40	50
Rumen ammonia, mg/100 ml						
Group 1	52.4[a]	57.5[a]	28.5[b]	30.1[b]	21.4[c]	23.0[c]
Group 2	13.8[a]	51.6[b]	29.7[c]	29.7[c]	23.2[d]	22.5[d]
1 vs 2[e]	.01	NS	NS	NS	NS	NS
Rumen non-protein nitrogen, mg/100 ml						
Group 1	85.5[a]	124.4[b]	51.0[c]	40.4[c,d]	26.4[d]	30.2[c,d]
Group 2	22.3[a]	112.5[b]	61.3[c]	36.2[a]	30.4[a]	31.4[a]
1 vs 2	.01	NS	NS	NS	.05	NS
Plasma protein g/100 ml						
Group 1	6.82[a]	6.40[b]	6.96[a]	6.98[a]	6.85[a]	6.61[a,b]
Group 2	6.36[a]	6.34[a]	6.89[b]	6.89[b]	6.92[b]	6.73[b]
1 vs 2	.05	NS	NS	NS	NS	NS

[a,b,c,d]Means in the same row with different superscripts are different (P<.01).
[e]Comparison of the two groups within each sampling period: NS = nonsignificant, .05 = P<.05, and .01 = P<.01.

tion and absorption. As the ruminal metabolism of NPN improved with time, indicated by lower ammonia and NPN concentrations, plasma protein concentration also increased, with the exception of days 40 and 50. On day 40 another significant decrease in rumen ammonia and NPN concentration was observed although the plasma protein concentration was only slightly lower than on day 30.

The anticipated response of heifers in group 1 was not observed. Had these heifers been better prepared to utilize NPN in the form of urea as a result of consuming wheat forage, the changes in ruminal nitrogen components would have been lower in amplitude than they were in group 2, which were considered to be unadapted animals.

It is concluded that the consumption of wheat forage during March and April did not increase the utilization of a urea supplement following the grazing phase. The change in ruminal nitrogen metabolism during phase 1 for group 1 warrant further investigation. There may be another form of NPN to which the animals are adapting during the forage period.

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