EFFECT OF STAGE OF MATURITY OF WHEAT PASTURE AND LASALOCID SUPPLEMENTATION ON INTAKE, SITE AND EXTENT OF NUTRIENT DIGESTION BY STEERS

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Story in Brief

Effects of stage of maturity of wheat forage (immature and mature) and lasalocid supplementation (0 vs 300 mg/h*d) on site and extent of digestion of nutrients were studied with eight steers fitted with rumen and duodenal cannulae. Increasing forage maturity and lasalocid supplementation shifted the site of digestion of consumed organic matter and nitrogen toward the post-ruminal tract. Lasalocid increased the post-ruminal utilization organic matter and nitrogen reaching the duodenum by 32 and 11 percent, respectively ($P<.01$).

Key Words: Wheat Pasture, Maturity, Lasalocid, Intake, Site of Digestion, Steers.

Introduction

Efficient utilization of grazed forage is dependent on an understanding of the agronomic and animal processes involved and their interaction. Very little of the available information on grazing wheat pasture deals with the process of digestion of wheat forage within the gastrointestinal tract of ruminant livestock. This data is essential for improving the utilization of nutrients of grazed wheat pasture and for identification of sound supplementation strategies.

The ionophore, lasalocid, has been found to increase daily gains of stocker cattle grazing wheat pasture (Horn et al., 1984). Additional data relative to its mode of action are needed.

Materials and Methods

Experimental animals, treatments and conditions under which measurements were obtained have been described elsewhere in this research report (Vogel et al, 1985; Andersen et al., 1985). Measurements of fecal output by total collection during four consecutive days were obtained from steers grazing immature (March 7-27) and mature (April 22-May 14) wheat forage, which corresponded to approximately 20 and 67 days after initiation of lasalocid supplementation. Forage samples for in vitro dry matter digestibility (IVDMD), organic matter (OM) and total and soluble nitrogen (TN and SN, respectively) determinations were obtained by hand clipping wheat forage of each stage of maturity. Forage samples were freeze-dried for later analyses.

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Intake of forage dry matter (DM) was calculated as follows:

$$\text{Forage DM intake} = \frac{\text{Fecal output}}{1 - \text{IVDMD}}$$

Daily intake of OM and TN were calculated from forage composition and forage DM intake. Total tract apparent digestibility of OM and TN (OMD and TND, respectively) was calculated by the following expression:

$$\text{Total Tract Apparent digestibility of nutrient} = \frac{\text{Nutrient intake - nutrient in feces}}{\text{Nutrient intake}}$$

Estimates of digesta flow to the duodenum were obtained using ytterbium labeled wheat forage (Yb-WF) as a single marker.

Results and Discussion

Chemical composition, IVDMD and amounts of available forage during the grazing of immature and mature wheat forage is shown in Table 1. A reduction of 54 percent in the total N concentration of mature wheat forage was accompanied by an unexpected increase of 26 percent in the proportion of soluble nitrogen. No explanation for this observation is apparent at this time. With increasing forage maturity, more nitrogen would be expected to be part of the insoluble true protein and cell wall fractions. More detailed chemical analysis of the nitrogen fractions of wheat forage at different stages of maturity together with composition of structural and soluble carbohydrates is pending analysis.

Table 1. Chemical composition of wheat forage (var. TAM-105) during the immature (March 7 to March 27) and mature (April 22 to May 14) stage of growth (percent).

Nutrient	Stage of maturity	
	Immature	Mature
Observations	3	4
Dry matter	24.3	22.7
Organic matter	92.5	93.7
Nitrogen (N)		
Total	4.39	2.03
Soluble	1.184	.691
Nonprotein	.438	.201
Ratios		
Soluble N/total N	27.0	34.0
NPN/total N	10.0	9.9
In vitro dry matter digestibility, %	75.6	66.4
Forage available, (lb/acre)	1642	1565

Because of differences in forage intake, comparisons among treatments for the extent of nutrient disappearance in the rumen and flow of nutrients to the duodenum have been expressed as a percentage of total

nutrient intake. Extent of disappearance of nutrients postruminally were calculated as the difference between duodenal flow and fecal output and have also been expressed as a percentage of nutrient flow to the duodenum.

Significant interactions ($P<.10$) between the two main effects (stage of maturity and lasalocid supplementation) were observed for total tract apparent digestibility of OM and N, the percentage of OM and N intake truly digested in the rumen, percentage of N intake reaching the duodenum and the postruminal digestion of OM and N (Table 2).

Daily intakes of OM and N by steers decreased ($P<.01$), respectively with increasing stage of wheat forage maturity from 17.2 to 14.7 and from .818 to .388 lb. Lasalocid supplementation decreased ($P<.08$) OM and N intakes, respectively, from 16.8 to 15.1 and from .629 to .577 lb/day.

Apparent digestibility of OM and N was decreased by 12 percent ($P<.05$) with increasing maturity of wheat forage. Lasalocid supplementation did not affect apparent digestibility of OM and N of immature wheat forage, but decreased ($P<.05$) apparent digestibility of both nutrients of mature wheat forage by 5 percent.

True ruminal digestion of dietary OM and N was decreased ($P<.05$) by 19 and 25 percent, respectively, with increasing maturity of wheat forage. Lasalocid supplementation of steers grazing immature wheat forage did not affect true ruminal digestibility of OM and N, but decreased ($P<.05$) true ruminal digestibility of OM and N by 14.4 and 30 percent, respectively, during grazing of mature wheat forage. With regard to the amount and nature of the nitrogen flowing to the duodenum, the main effects observed were on the quantity and proportion of microbial nitrogen to total N flow. Both measurements increased ($P<.05$) during the grazing of mature wheat forage. The proportion of forage N that was undegraded in the rumen, expressed as a percentage of total N flowing to the duodenum, was decreased ($P<.05$) by 13.6 percent with increasing forage maturity. The percentage of consumed wheat forage N that reached the duodenum was increased by 82 percent ($P<.05$) during grazing of mature wheat forage. Lasalocid supplementation increased by 9 percent ($P<.05$) the actual amount of wheat forage N bypassing the rumen at both stages of forage maturity. When this dietary bypass N was expressed as a percentage of wheat forage N intake, lasalocid increased ($P<.05$) the ratio by 52 percent only during the grazing of mature wheat forage.

The amount of microbial N flowing to the duodenum as a proportion of the quantity of dietary OM truly digested in the rumen (microbial efficiency) was increased by 81 percent ($P<.05$) during the grazing of mature wheat forage. Lasalocid increased microbial efficiency by 35.5 percent only during grazing of mature forage. Stage of maturity had no effect on the relative postruminal digestion of OM and N, while lasalocid supplementation increased ($P<.05$) both measurements by 63 and 17 percent, respectively during the mature stage only.

These estimates of daily intake of digestible organic matter per kg of body weight for immature wheat forage (13-14 g DOMI/kg BW) are similar to values reported by Losada et al. (1982) for cattle grazing ryegrass (13-18 g DOMI/kg BW). In contrast, the flows of nonammonia N (NAN) to the duodenum/kg DOMI for immature wheat forage of this study are much lower than values reported for ryegrass (13-14 vs 27-41 g NAN/kg DOMI, respectively). Differences in type of animals, forage and methodology among experiments may have influenced these comparisons. Nevertheless, these data suggest a possible shortage of the amount of nonammonia N available for absorption from the small intestine, and perhaps some limitations in the total intake of OM (energy) for high

Table 2. Effect of stage of maturity and lasalocid supplementation on site of digestion and flow of nutrients in steers grazing wheat pasture. (Least square means, n=4).

	Stage of maturity					Level of Significance	
	Immature		Mature				
Lasalocid, mg/h·d	0	300	0	300	SE	Maturity	Lasalocid
Intakes, lb/d							
Organic matter	17.6[b1]	16.8[b]	16.0[b]	13.4[a]	.64	.01	.04
Nitrogen	.836[b]	.800[b]	.422[a]	.354[a]	.02	.01	.08
Total tract apparent digestibility (%)							
Organic matter	82.6[c]	81.9[c]	73.1[b]	69.5[a]	.35	IA[2]	IA
Nitrogen	82.1[c]	82.3[c]	72.9[b]	69.3[a]	.60	IA	IA
True rumen digestion/intake (%)							
Organic matter	79.7[c]	78.2[c]	64.6[b]	55.3[a]	1.5	IA	IA
Nitrogen	73.8[c]	70.6[c]	52.2[b]	36.6[a]	2.1	IA	IA
Duodenal flow of nitrogen							
Total, g/d	152.8	161.6	162.6	170.8	7.2	NS	NS
Nonammonia, g/d	89.4	90.6	106.3	101.9	9.5	NS	NS
NAN/total, %	58.7	56.3	65.2	60.3	4.2	NS	NS
Microbial, g/d	53.2[a]	54.8[ab]	70.8[b]	68.7[ab]	6.3	.05	NS
Microbial/total, %	34.7[a]	33.9[a]	43.6[b]	39.8[ab]	2.6	.03	NS
Dietary, g/d	99.6[ab]	106.8[b]	91.8[a]	102.1[b]	3.4	NS	.05
Dietary/total, %	65.3[b]	66.1[b]	56.4[a]	60.2[ab]	2.6	.03	NS
Dietary/intake, %	26.2[a]	29.4[a]	47.8[b]	63.4[c]	2.1	IA	IA
Microbial efficiency[3]	8.4[a]	9.2[a]	15.2[b]	20.6[c]	1.8	.01	NS
Postruminal digestion/duodenal flow, %							
Organic matter	41.1[ab]	47.7[b]	31.2[a]	50.8[b]	4.7	IA	IA
Nitrogen	62.4[a]	65.7[a]	63.6[a]	74.2[b]	2.8	IA	IA

[1]Means in the same row with different superscripts differ (P<.10).
[2]Significant stage of maturity by lasalocid supplementation interaction (P<.10).
[3]Microbial efficiency in g microbial N per kg of OM truly digested in the rumen.

levels of performance of growing cattle grazing wheat forage, particularly during the immature stage of forage growth.

Literature Cited

Andersen, M.A. et al. 1985. Effect of lasalocid and stage of maturity of wheat forage on ruminal fermentation of steers grazing wheat pasture. Okla. Agr. Exp. Sta. Res. Rep. MP-117:

Horn, G.W. et al. 1984. Effect of lasalocid on performance of stocker cattle on wheat pasture. Okla. Agr. Exp. Sta. Res. Rep. MP-116:154.

Losada, H. R. et al. 1982. The effect of forage species and stocking rate on protein supply to the duodenum of cattle. In: Forage protein in ruminant animal production. British Society of Animal Production. Occasional Publication No. 6:144.

Vogel, G.J. et al. 1985. Comparison of external markers for estimating fecal output of cattle grazing wheat pasture. Okla. Agr. Exp. Sta. Res. Rep. MP-117: