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NITROGEN FLOW TO DUODENUM OF STEERS GRAZING ON ORCHARDGRASS AND MEADOWFESCUE PASTURES

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Abstract

This experiment was conducted to evaluate nitrogen flow to the duodenum of steers grazing on orchardgrass (*Dactylis glomerata* L., OG) or meadowfescue (*Festuca elatior* L., MF) pasture. Holstein steers fitted with cannulas in the rumen and duodenum were used. Nitrogen content and *in vitro* dry matter digestibility of herbage did not differ between OG and MF pastures. Herbage nitrogen intake of steers grazing on OG and MF pastures averaged 229 and 271 g/day, respectively. Nitrogen flows to the duodenum of steers grazing on orchardgrass and meadowfescue pastures averaged 187 and 195g/d, respectively. Microbial nitrogen flow to the duodenum also did not differ between OG and MF pastures. Efficiencies of nitrogen utilization for microbial protein synthesis per kg organic matter apparently digested in the rumen of steers grazing on OG and MF pastures averaged 31.4 and 29.0g, respectively. There was no significant difference in nitrogen absorption from the intestine between steers grazing on OG and MF pastures. In both pastures, steers were supplied with more than 3.5 times metabolizable protein as much as required for maintenance without supplements.

Keywords: Steer, Grazing, Orchardgrass, Meadowfescue, Duodenum, Nitrogen digestion, Microbial synthesis

Introduction

Nitrogen content of herbage consumed by cattle grazing on well-managed temperate pasture is generally higher than that observed on mature forage harvested as silage or hay. However, it has been said that much of this nitrogen never reaches the small intestine because of high losses of ruminal degraded nitrogen (Poppi and McLennan, 1995). Nitrogen supply to small intestine of high producing cattle grazed on temperate pasture may be not enough to meet its high nitrogen requirement. The interest in grazing system among dairy farmers in the northern part of Japan has risen, because pasture can reduce the cost of milk production and improve the negative environmental effects of intensive dairy farming practices. OG and MF are commonly used in grazing systems in the northern part of Japan. However, there is little useful information about nitrogen supply to the small intestine and its utilization by cattle grazing on these pastures. The objective of this experiment was to evaluate nitrogen flow to the duodenum of steers grazing on OG and MF pastures.

Material and Methods

OG and MF pastures located at the Obihiro University farm in northern Japan were grazed rotationally. In 1998, two Holstein steers (mean BW = 382kg) fitted with cannulas in the rumen and the proximal duodenum were allowed to graze over three periods in each pasture. The experimental periods, in OG pasture, were from May 27 to June 18, from July 12 to August 3, and from August 27 to September 18, and those in MF pasture were from June 19 to July 11, from August 4 to August 26, and from September 19 to October 11. In 1999, four Holstein steers (mean BW = 302kg) fitted with cannulas in the rumen and the proximal duodenum were allowed to graze over three periods in each pasture. The experimental periods in OG pasture were from May 26 to June 17, from July 11 to August 2,

and from August 26 to September 17, and that in MF pasture were from June 18 to July 10, from August 3 to August 25, and from September 18 to October 10. Each experimental period consisted of 14 days for adaptation and 8 days for sampling. In both years, the steers were offered herbage as the sole feed in a system of rotational grazing in which the steers were rotated to a new paddock every day. Chromic dioxide was used to estimate duodenal flow and faecal output of steers. A gelatin bag containing 3.0g of chromic dioxide was inserted into the rumen at 0800 and 1700 during experimental period. Herbage samples were collected during sampling period by sampling the grass to the approximate height to which the steers were grazing. Faecal samples were obtained every four-hour on d 15, 16, 17 and 18. Duodenal samples were obtained every four-hour on d 19 and 20. Ruminant fluid samples and blood samples were obtained at 1000 on d 21. To isolate bacterial fractions, rumen fluid samples were also obtained at 1200 on d 22. Herbage dry matter intake (DM) was estimated by dividing fecal DM output by DM indigestibility of herbage. Duodenal DM flows were estimated by chromic dioxide content. Microbial nitrogen flows were estimated by purine content in duodenal digesta (Zinn and Owens, 1986). Metabolizable protein entered into small intestine was estimated using the calculation described by AFRC (1993).

Results and Discussion

OG pasture contained approximately 61% orchardgrass, 2% white clover and 21% dead material. MF pasture contained approximately 70% meadowfescue, 2% white clover and 24% dead material. Herbage allowances averaged 75.5gDM/kgBW in OG pasture and 84.0gDM/kgBW in MF pasture. Chemical composition and *in vitro* dry matter digestibility of herbage in OG and MF pastures are shown in table 1. Herbage nitrogen content did not differ between OG and MF pastures and ranged from 3.1 to 4.4% in OG pasture, and from 3.2 to 5.2% in MF pasture. The higher nitrogen content of herbage was determined under rotational

grazing system in orchardgrass/Kentucky bluegrass pasture (Hongerholt and Muller, 1998), and in tallfescue pasture (Elizalde et al., 1998).

Intake and digestion of nitrogen, and ruminal microbial nitrogen synthesis in steers grazing on OG and MF pastures are shown in table 2. Herbage nitrogen intake of steers grazing on OG and MF pasture averaged 229g and 271g, respectively. Although nitrogen intake of steers grazing on MF pasture was slightly higher than that on OG pasture, nitrogen flow to duodenum did not differ between steers grazing on OG and MF pastures. The proportion of duodenal nitrogen flow to nitrogen intake in OG and MF pasture averaged 0.82 and 0.72, respectively. Elizalde et al. (1998) reported that the proportion of duodenal nitrogen flow to nitrogen intake of steers grazing on tall fescue pasture without supplement was 0.72. Microbial nitrogen flow to duodenum did not differ between OG and MF pastures. Efficiencies of nitrogen utilization for microbial protein synthesis per kg organic matter apparently digested in the rumen of steers grazing on OG and MF pastures averaged 31.4 and 29.0g, respectively. These values were lower than the average of 40.4g reported by Elizalde et al. (1998) for steers grazing on tall fescue pasture without supplement. According to the increase of nitrogen intake, nitrogen disappearance from rumen increased. Ammonium nitrogen concentration in ruminal fluid of steers grazing on OG and MF pastures averaged 14.2 and 19.8mg/dl, respectively. There was a linear relationship between nitrogen disappearance from the rumen and ammonium nitrogen concentration in ruminal fluid.

The proportion of apparently absorbed nitrogen from the intestine to nitrogen flow to duodenum of steers grazing on OG and MF pastures averaged 0.67 and 0.65, respectively. Metabolizable protein flows to duodenum of steers grazing on OG and MF pastures averaged 678 and 654g/d, respectively. These values were greater than metabolizable protein requirement for maintenance of steers weighing 330kg (175g/day).

These results suggested that steer grazing on OG or MF pasture were able to supply

themselves with more than 3.5 times metabolizable protein, as much as required for maintenance without supplement, although some of consumed nitrogen was lost before reaching the duodenum.

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Table 1 - Chemical composition and <i>in vitro</i> dry matter digestibility of herbage in orchardgrass and meadowfescue pastures												
			1998			1999			1998.1999			
			OG	MF	s.e.d	OG	MF	s.e.d	OG	MF	s.e.d	
Chemical composition, % in DM												
	Organic matter		89,9	8,6	0,4	89,1	87,6	0,9	89,0	88,1	0,5	
	Nitrogen		4,0	3,9	0,3	3,6	4,1	0,7	3,8	4,0	0,3	
	Acid detergent fiber		28,3	27,0	2,5	27,2	24,3	1,5	27,7	25,7	1,4	
	<i>In vitro</i> dry matter digestibility, %		64,4	65,0	2,6	65,2	67,0	1,5	64,8	66,0	1,4	

