LNE94-042

ORCHARDGRASS UTILIZATION BY DAIRY CATTLE

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Abstract

Grasses (Poaceae) are perceived as inferior forages to alfalfa (*Medicago sativa* L.) for lactating dairy cattle. Effects of forage fiber source on intake, apparent digestibility, and milk production were studied for three dry hay forages: early bloom alfalfa, early bloom orchardgrass (*Dactylis glomerata)*, and late bloom orchardgrass. Twelve multiparous mid-lactation Holstein cows were used in a 3 X 3 Latin square design replicated four times for the production trial and replicated three times (9 cows) for *in vivo* digestibility. Cows were fed one of three rations formulated to contain .95 % NDF per lb BW from forage. Rations were balanced to be isonitrogenous (16.96 CP %) and isocaloric (.75 Mcal/lb of Net Energy for Lactation). Cows consumed similar quantities of NDF (1.47 $\pm$ 0.08 % BW) regardless of diet treatment. Animals selected from the total mixed ration (TMR) diets higher in NDF (38.03 $\pm$ 1.61 %) and lower in CP (15.39 $\pm$ 0.32 %) than anticipated. Cows consuming the early bloom alfalfa, early bloom orchardgrass, and late bloom orchardgrass diets produced 64.0, 66.2, and 71.5 lb/d of milk. Both NDF and overall DM apparent digestibility were higher for the orchardgrass rations than the alfalfa diet.

Introduction: Alfalfa has been referred to as the "Queen" of dairy forages (Barnes and Sheaffer, 1995). Intensively managed alfalfa often has higher quality than grasses due to poor grass management. On land suitable for alfalfa growth, alfalfa can have both high yield and quality. This makes growing alfalfa as the primary forage source for dairy cattle advantageous on some farms. However, many dairy farms have land that is poorly suited to alfalfa production because of low pH soils which are poorly drained. For this land, grass forage systems may be advantageous. Orchardgrass is of particular interest because of its relative high yield and persistence on poor soils. Alfalfa has a greater concentration of total protein and cell solubles, and lower concentrations of neutral detergent fiber with a higher proportion of the NDF as lignin than orchardgrass (Van Soest, 1994).

The number of studies with direct comparison of milk production between alfalfa and orchardgrass used in typical dairy rations are few with inconsistent results. Several studies (Weiss and Shockey, 1991; Beauchemin et al., 1994; Weiss, 1995; and Mertens, 1996) reported similar milk production for dairy cows fed either alfalfa- or orchardgrass-based diets. Holden et al. (1994) reported cows fed an alfalfa diet produced 30% more milk than cows fed an orchardgrass diet, but production data was limited to two observations per

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group. Diets studied by Weiss (1995) differed in NDF content, NDF from hay forage, and contained corn silage. Diets in another study (Weiss and Shockey, 1991) differed in NDF content and NDF from forage. Beauchemin et al. (1994) utilized diets which contained similar NDF contents from forage, but were supplemented with barley which is high in NDF relative to most concentrates. Mertens (1996) formulated diets to contain similar NDF from forage, but ration CP contents were variable.

The objectives for this study were: 1) to compare milk production and composition with cows fed equal percentages of NDF on a BW basis from orchardgrass or alfalfa in an isonitrogenous balanced dairy ration, 2) to determine whether source of forage NDF has an effect on milk production and composition, and 3) to compare apparent digestibilities of NDF for orchardgrass and alfalfa.

Materials and Methods: Twelve multiparous Holstein cows in mid-lactation were randomly assigned to three dietary treatments in a 3 X 3 Latin square with four replicates. Three replicates (9 cows) were randomly chosen for the apparent digestibility study. Treatments consisted of three different dry hay forages: early bloom alfalfa, early bloom orchardgrass, or late bloom orchardgrass. Forage nutrient composition is displayed in Table 1. All diets were formulated (Table 1) to provide NDF equal to .95 percent of body weight from forage and were balanced (as similar as possible) for Net Energy for Lactation (.75 Mcal/lb) and crude protein (16.96%) with cornmeal and soybean meal. Forage to concentrate ratio was 57:43, 46:54, and 37:63 for the early bloom alfalfa, early bloom orchardgrass, and late bloom orchardgrass based diets respectively. Diets were fed as TMR's *ad libitum.*

Diet, refusals, and fecal samples were analyzed for CP as estimated by Kjeldahl N X 6.25. Minerals were analyzed by the NEDHIA Forage Testing Laboratory (wet chemistry; Ithaca, NY). Neutral detergent fiber, ADF, and permanganate lignin were analyzed for all samples (Van Soest et al., 1991). Neutral detergent insoluble nitrogen and ADIN were also measured (Licitra et al., 1996). Milk samples for each cow were analyzed for milkfat and protein percent, and milk urea nitrogen by the NEDHIA Check Mark Dairy Laboratory (Ithaca, NY). Data was analyzed using the general linear model procedure of SAS (SAS^R Users Guide, 1989).

Results and Discussion: During the study, cows did not statistically differ ($P > .05$) in body weight (1338 $\pm$ 16.5 lb), body condition score (2.93 $\pm$ .19; Scale 1-5; Wildman et al., 1982), or days in milk (163 $\pm$ 21 days). Dry matter intake was lower for cows fed the early bloom orchardgrass diet compared with those fed other diets (Table 2). Cows consumed similar quantities of NDF (1.47 % BW) across all diets, but had higher consumption than rations were originally balanced for (.95 % BW). Because of differences in DMI combined with similar NDF (% BW) consumption, CP (% DMI) and NDF (% DMI) were different among some of the diets (Table 2). In general, cows consuming the late bloom orchardgrass diet had higher CP (% DMI) and lower NDF (% DMI) compared to other diets (Table 2). The alfalfa diet had the highest lignin : NDF ratio (Table 2).

Dry diets allowed for more animal selection than would have been possible with silage based TMR's, resulting in differences in nutrient content of the diets consumed. Cows selected forage from the TMR with the orts containing a higher proportion of concentrate than the original diet. Forage fed was higher in NDF and generally lower in CP than concentrate fed (Table 1). Consumption of proportionally more forage generally resulted in consumption of less concentrate, increasing NDF (% DMI) and reducing CP (% DMI) for all diets as compared to original diet formulation (Table 2).

Apparent digestibility for DM was lower for the alfalfa diet compared to both other diets, but overall differences were small (Table 2). Orchardgrass rations had higher apparent NDF digestibility than the alfalfa ration (Table 2). Both Weiss and Shockey (1991) and Weiss (1995) observed the NDF fraction in orchardgrass to be more digestible than the NDF fraction in alfalfa. Overall, NDF and NDIN apparent digestibility was lowest for the early bloom alfalfa diet (Table 2). The pattern of NDIN digestibility following the pattern of NDF digestibility is due to the integral association of the NDIN protein fraction within the NDF fiber fraction.

The alfalfa diet was less digestible than other diets primarily because its NDF fraction was less digestible (Table 2). Neutral detergent fiber apparent digestibility was correlated with lignin content. Higher proportions of lignin in NDF (Table 2) reduced NDF apparent digestibility. Higher lignin content has been associated with lower digestibility in feeds (Van Soest, 1994). High lignin content in the alfalfa diet reduced NDF, NDIN, and overall DM digestibility.

Cows consuming orchardgrass-based diets had milk production similar to or greater than those consuming the alfalfa diet (Table 2), which was consistent with several other studies (Weiss and Shockey, 1991; Beauchemin et al., 1994; Weiss, 1995; and Mertens, 1996). Cows consuming the late bloom orchardgrass diet produced more milk than those consuming the early bloom orchardgrass diet because of higher DMI and higher concentrate intake. Higher DMI and greater consumption of concentrates has been associated with higher milk production among cows fed orchardgrass rations (Weiss and Shockey, 1991). Cows fed the late bloom orchardgrass diet had higher milk protein and milk urea nitrogen levels (Table 2) due to higher CP and DMI (Table 2). Milk fat content and quantity were similar among all diets and consistent with other studies (Weiss and Shockey, 1991; Weiss, 1995).

The major determinant restraining production by lactating dairy cattle is dry matter intake and concentration of energy in the DMI. Waldo and Jorgesen (1981) reported that intake accounted for as much as 74% of the differences in digestible energy intake among forages which included legumes and grasses. The NDF-Energy Intake System suggests cows consuming dairy rations formulated to contain the same NDF concentration will have comparable intake and milk production (Mertens, 1996). Utilizing physical and physiological theories of intake regulation, NDF content associated with maximum DMI can be determined (Mertens, 1985). Mertens (1996) suggests an NDF intake of 1.1% to 1.2% of body weight per day, in a balanced ration, may yield optimum production and

minimize differences in forage quality by balancing for NDF. In the present study, NDF intake was similar among all diets studied (1.47 % BW), but dry matter intake and production potentially would not have been maximized at this level because of fill limitations according to the NDF-Energy Intake System.

Balanced orchardgrass dairy rations can be well utilized by lactating dairy cattle. Perceived inferiority of grass compared to alfalfa forage results from not properly managing grass harvest and diet formulation with grass based systems for lactating dairy cattle. Developing harvest management strategies to harvest grass at an early stage of growth is key to obtaining this nutritional quality for grass forage.

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Table 1. Forage and diet nutrient composition.

	Forage[a]			Diet[a]		
	Alfalfa	OG-EB	OG-LB	Alfalfa	OG-EB	OG-LB
DM %	94.4	95.1	94.7	91.70	91.50	90.80
CP(% DM)	20.9	15.7	9.9	16.75	16.85	16.65
ADIN(% CP)	5.7	5.1	7.1	--	--	--
NDIN(% CP)	10.5	25.5	24.2	--	--	--
SIP(% CP)	38.0	30.0	20.0	30.45	21.85	17.30
NE_L(Mcal/lb)	.61	.61	.51	1.58	1.63	1.61
ADF(% DM)	35.2	31.7	38.5	21.40	16.48	16.49
NDF(% DM)	43.3	54.3	66.5	28.48	29.80	30.14
NSC (% DM)	25.1	20.0	17.1	46.67	45.20	46.73
Lignin(% DM)	7.9	5.1	5.9	--	--	--
Lipid (% DM)	1.8	3.6	2.3	2.76	3.54	2.94
Ca (% DM)	1.28	.61	.40	.84	.78	.73
P (% DM)	.33	.29	.27	.44	.46	.47

[a]Alfalfa = early bloom alfalfa, OG-EB = early bloom orchardgrass, and OG-LB = late bloom orchardgrass for forage composition and diets based on respective forages.

Table 2. Nutrient intake, apparent digestibility, and milk production as influenced by diet.

	Early Bloom Alfalfa Diet	Early Bloom Orchardgrass Diet	Late Bloom Orchardgrass Diet
Intake, n	12	11	11
DMI, kg/d	23.8a[a]	21.9b	24.4a
CP, % of DMI	15.2a	15.1a	15.8b
NDF, % of DMI	38.2a	39.4a	36.2b
Lignin : NDF ratio	0.18a	0.11b	0.11b
Apparent Digestibility, n	9	9	9
DM, %	66.13a	67.81b	67.85b
CP, %	67.48a	64.87b	69.73c
NDF, %	54.06a	63.70b	58.05c
NDIN, %	61.72a	73.33b	64.35c
Milk Production, n	12	11	11
Milk, lb/d	64.0a	66.2a	71.5b
Milkfat, %	3.16a	3.12a	3.06a
Milk Protein, %	3.06a	3.05a	3.10b
Milk Urea Nitrogen, mg %	16.2a	15.0b	17.7c

[a]Data within rows with different letters (a, b, c) differ by P<.05.

1997 American Forage and Grassland Council Proceedings Volume 6

Kerney

1997 AMERICAN FORAGE AND GRASSLAND COUNCIL

PROCEEDINGS

April 13-15, 1997
Radisson Plaza Hotel - Fort Worth
Fort Worth, Texas

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