INTAKE OF HIGH PRODUCING HOLSTEIN COWS GRAZING PASTURE OR FED A TOTAL MIXED RATION

E.S. Kolver and L. D. Muller

Department of Dairy and Animal Science, Pennsylvania State University, University Park, PA 16802, USA

ABSTRACT

The ability of a pasture diet to support a high dry matter intake without supplementary feed was determined using 16 high producing Holstein cows. Cows (n=8) were adapted to an all-pasture diet by incrementally reducing the amount of total mixed ration (TMR) fed over four weeks. A control group of cows (n=8) remained in confinement and were fed a TMR. Performance of grazing cows differed significantly ($P < 0.001$) from TMR fed cows by intake (19.0 vs. 23.4 kg DM/d), milk production (29.6 vs. 44.1 kg/d), milk protein content (2.61 vs. 2.80%), liveweight (562.1 vs. 597.3 kg), and condition score (2.02 vs. 2.50). Results indicate that intake of good quality pasture is higher than previously estimated for high producing Holstein cows in the USA, but that milk production is 15 kg/d less than when cows are fed a TMR.

KEYWORDS

Intake, pasture, balanced ration, dairy cow, milk production

INTRODUCTION

Dairy cows grazing intensively managed pasture in the northeastern USA are commonly fed supplemental energy, and in some cases protein, with the aim of increasing dry matter intake (DMI) and providing the animal with a balanced diet (Muller et al., 1995). However, because the comparative DMI and productive advantage of a balanced diet versus a diet of only high quality pasture has not been demonstrated for high producing dairy cows, the economic benefits of supplementing intensively managed pasture are difficult to determine.

Estimates of pasture DMI for Holstein dairy cows of high liveweight are limited, and all studies include some type of supplemental feed. Holden et al. (1994a) using chromic oxide, calculated a monthly pasture DMI during the grazing season which ranged from 11.6-15.1 kg DM/day for Holstein cows producing 22.7-30.1 kg milk/day. In addition, cows received 7.3-9.0 kg DM of concentrate DM/day (total DMI 20.6-22.4 kg/day). To provide an estimate of pasture intake without supplementation, this study compared intake of high producing Holstein cows grazing pasture with cows fed a nutritionally balanced total mixed ration (TMR) in confinement.

MATERIALS AND METHODS

Sixteen multiparous Holstein cows were paired by milk production (46.3, SE 2.1 kg/d), liveweight (602.6, SE 18.4 kg) and day of lactation (59.2, SE 6.8 days), and randomly assigned to either an all-pasture, or a confined-fed TMR feeding regime. The cows grazed pastures for four weeks from May 12 until June 9, 1995. During week 1 and 2, cows in the pasture treatment were adapted from a confined TMR feeding system to an all-pasture diet by incrementally decreasing the amount of TMR offered. In week 1, cows were offered TMR at 50% of required intake, with 25% of required intake offered in week 2. The TMR fed to the grazing cows during this transition, and to the confined cows was based on corn and legume silages, and included high moisture shelled corn, whole cottonseeds, corn gluten meal, wheat midds, soybean meal, animal protein, and appropriate minerals and vitamins. During weeks 3 and 4, the cows in the pasture treatment grazed predominantly ryegrass (*Lolium perenne* L.) and white clover (*Trifolium repens* L.) pastures, and did not receive supplementary feed (trace mineral salt blocks and fresh water were available).

Milk production and composition, liveweight and body condition score were measured at 3 times during the experiment; pretrial, during the transition (week 2), and while cows were grazing all-pasture (week 4). Intake was estimated in week 4 by dosing twice daily with 5 g Cr_2O_3 for 10 days. Fecal samples were collected twice daily on days 7 to 11 of Cr_2O_3 dosing, with pre-grazing pasture being sampled on days 6-10 of dosing. Fecal output, calculated from fecal chromium concentrations, and *in vitro* digestibility (IVDMD) were used to calculate intake (Parker et al. 1989). The intake of cows fed TMR in confinement was measured by weighing feed offered and refused on 5 days. Nutrient composition of pasture and TMR was determined according to AOAC procedures. Data were analyzed using the general linear models procedure of SAS (1990), with a pre-trial covariate and the repeated measures procedure applied to data collected across transition and production periods.

RESULTS

Pastures were of high quality (25.1 % CP; 25.0% soluble CP (%CP); 43.2% NDF; 22.8% ADF; 20.9% non structural carbohydrate, 77.0% IVDMD, 1.65 Mcal/kg NEL). The TMR contained 19.1% CP, 33% soluble CP (%CP), 30.7% NDF, 19.0% ADF, 39.0% non structural carbohydrate, 76.0% IVDMD, and 1.63 Mcal/kg NEL, and is according to NRC (1989) recommendations for high producing dairy cows.

Cows grazing a sole pasture diet consumed 19% less DM and NEL than cows fed TMR in confinement, although CP intake was maintained while grazing (Table 1). An all pasture diet resulted in cows producing 33% less milk with a protein content that was 0.19 percentage units lower ($P < .001$) than cows fed TMR (Table 2). No significant difference was detected in milk fat content of cows fed pasture or TMR, but the differences in milk yield and protein content resulted in a significantly lower milk solids yield ($P < .005$).

Cows grazing pasture lost more liveweight and body condition than cows fed TMR ($P < 0.001$; Table 2). The difference in liveweight was apparent by the end of the transition period, with a trend for reduced body condition also evident during the transition. At the time when intake measurements were being made, cows grazing pasture weighed 35.2 kg less than TMR fed cows.

DISCUSSION

The intake difference between TMR and pasture fed dairy cows in this study indicates the potential DMI of high producing Holstein cows, and the extent that intake is constrained by a grazing system based on good quality pasture. The pasture intake of 19 kg DM/d is considerably higher than previously reported for Holstein cows grazing in northeastern USA. Summarizing four grazing studies, Muller et al. (1995) reported a range of pasture intake from 11.4 kg DM/d to 15 kg DM/d for high liveweight cows producing 30.5 to 39.2 kg milk/d, and receiving 7.3 to 8.6 kg grain DM/d. While these studies have shown that the total DMI of supplemented grazing dairy cows is comparable to the DMI expected with non grazing dairy cows, the present study suggests that the unsupplemented grazing Holstein is unable to achieve the intake of Holstein cows fed TMR.

When the differences in liveweight are accounted for, cows fed TMR consumed DM at 3.9% of liveweight, while grazing cows consumed 3.4% of liveweight. This difference could be a result of several factors. The IVDMD and NEL of pasture and TMR were similar, but pasture had a higher NDF content. Although NDF is commonly used as a predictor of intake with TMR diets, the high apparent digestibility of pasture NDF obtained in this experiment (74.8, SE 1.29%) suggests that fiber present in high quality pasture and TMR diets may be functionally different. The pre- and post-grazing pasture mass of 3080 and 1597 kg DM/ha measured in this study indicates that herbage availability was not limiting intake (Holmes, 1987). This relationship between DMI and herbage availability was developed using animals with considerably lower intake requirements than those of Holstein cows producing more than 30 kg milk/d. It is possible that the ability of grazing cows to match the intake of TMR fed cows may be constrained by the time and biting rate required to prehend the required amount of fresh pasture.

Although this was a short term study, the mobilization of body reserves by grazing cows to support milk production indicates that milk yields greater than 30 kg/d may be unlikely without supplementation of energy. The difference in DMI, rather than energy content of pasture versus TMR, appears the major factor reducing energy supplied by a high quality pasture diet. In addition, energy required for maintenance is likely increased by physical activity and metabolic cost involved in excreting nitrogen. Despite maintaining a similar CP intake, the milk protein content of grazing cows was lower than TMR fed cows. Given the negative energy balance of the pasture fed cows, amino acids may have been partitioned towards gluconeogenesis. An alternative explanation may be drawn from the data of Holden et al. (1994b) which indicated low utilization of ingested nitrogen by dairy cows grazing high quality pasture.

CONCLUSIONS

Holstein cows grazing good quality pasture ad lib without supplementation are able to consume DM at 3.4% of liveweight. Although this intake is higher than previously estimated, and despite calculated energy values of pasture and TMR being similar, the significant loss of body condition required to maintain a milk production greater than 30 kg/d necessitates supplemental energy to achieve these levels of production.

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Table 1

Intake of dry matter (DM), net energy for lactation (NE_L), and crude protein (CP) by cows fed a total mixed ration (TMR) in confinement and by cows grazing pasture without supplements.

	TMR	Pasture	*P < F*
DM intake, kg/d[a]	23.4	19.0	0.001
NE_L intake, Mcal/d	40.2	32.4	0.024
CP intake, kg/d	4.71	4.91	NS

a DM intake of TMR calculated by weighing feed offered and refused. Pasture DM intake was estimated using a Cr_2O_3 marker.

Table 2

Milk yield, fat corrected milk yield (FCM) and milk composition, liveweight and condition score (CS) of cows fed a total mixed ration (TMR) in confinement, and of cows grazing pasture without supplements during the pre-trial, transition and intake periods.

	Pre-trial	Transition period		Intake period		*P < F*	
	(all cows)	TMR	Pasture	TMR	Pasture	Transition	Intake
Milk production							
Milk, kg/d	46.3	45.4	35.4	44.1	29.6	0.001	0.001
4% FCM, kg/d	42.9	42.4	34.3	40.5	28.3	0.005	0.001
Milk fat, %	3.54	3.54	3.77	3.48	3.72	NS	NS
Milk protein, %	2.72	2.75	2.84	2.80	2.61	0.017	0.001
Milk solids, kg/d[a]	2.87	2.85	2.34	2.75	1.86	0.005	0.001
Liveweight and CS							
Liveweight, kg	602.6	609.0	572.5	597.3	562.1	0.001	0.001
CS[b]	2.52	2.57	2.27	2.50	2.02	0.100	0.001

a Milk fat and protein yield

b Five-point body condition scale (1 = thin to 5 = fat)