

MILK PRODUCTION FROM A TROPICAL LEGUME-GRASS PASTURE

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Summary

One member of each of three pairs of monozygous twin dairy cows was fed freshly cut *Glycine javanica* and kikuyu-grass pasture *ad libitum* while the co-twins were fed lucerne hay *ad libitum* and a concentrate mixture.

The mean daily digestible organic matter and digestible crude protein intakes for the cows fed pasture were 7.0 kg and 1.35 kg, and for the cows fed hay and concentrates were 10.2 kg and 1.70 kg respectively.

Daily milk production was 8.2 kg and 18.1 kg, 4% fat corrected milk respectively.

It is suggested that differences in digestible energy intake largely accounted for the production differences measured and that the potential for milk production from a tropical legume-grass pasture is unlikely to match that from a legume-grass pasture in temperate areas.

I. INTRODUCTION

Many experiments have been made with lactating dairy cattle to determine the value of temperate zone pastures for milk production. There are, however, very few experimental results on the performance of lactating dairy cows fed pasture in the tropics and sub-tropics (Hardison 1966), where milk production is usually lower than in temperate areas. Poor husbandry and under-nutrition rather than the genetic merit of the cattle probably account for the poor performance (Mahadevan 1958).

Predictions of the likely performance of lactating dairy cattle in the tropics have been made based on the chemical composition of cut herbage. (Glover and Dougall 1961; Hardison 1966). The estimates suggest that levels of milk production will be much lower than can be achieved in the temperate zones.

The objects of the investigation reported here were to determine the voluntary intake of a tropical pasture by lactating cows, and to compare the milk production of these cows with that of cows fed a hay-concentrate diet. It was desired that cows fed the latter diet should, if possible, exhibit their genetic potential for milk production.

II. METHODS AND MATERIALS

The study was made at Wollongbar over a nine week period, January 26 to March 28, 1966.

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(a) Animals

Three sets of monozygous (grade Jersey) twin cows commencing their third, fifth and seventh lactations were housed in stalls where one member of each twin pair was offered tropical pasture and the other member received a hay-concentrate diet. The cows were accustomed to the stall conditions during a 'two week period in late pregnancy. Approximately four weeks after calving, the cows were again stalled for a one week preliminary period and for the nine week experimental period. The cows were milked twice daily with a 9 h interval between morning and evening milkings. Body weights were recorded once weekly after morning milking and before fresh feed was offered to the cows.

(b) Diets

The pasture given consisted of the legume *Glycine javanica* (var. Clarence) and kikuyu grass (*Pennisetum clandestinum*) with a small component of *Paspalum dilatatum*. The pasture, which was approximately six to eight weeks old (the period between cuts), was harvested twice daily using a Hayter "Silorator" and offered *ad libitum* to the cows. The quantities given and rejected were recorded. The hay-concentrate diet consisted of chaffed lucerne hay offered *ad libitum* and a mixture of eight parts crushed oat grain plus one part meatmeal given at a rate of 4 kg per 10 kg of 4 % fat corrected milk (FCM). Samples of the diets offered and of any rejected material were taken twice daily for dry matter (DM) determination.

(c) Determination of Apparent Digestibility Coefficients

The apparent digestibility coefficients of each diet were determined each week throughout the experimental period by giving each diet to two wether sheep in metabolism cages. The pasture and lucerne hay were offered *ad libitum* while the quantity of concentrate offered the appropriate sheep was restricted in an attempt to provide the same ratio of hay to concentrate as was consumed by the cows. It was assumed that the digestibility coefficients determined with the sheep were the same as for the cows.

(d) Milk Yields and Chemical Analysis

Milk production was recorded twice daily. Composite samples of one day's morning and evening milk were taken weekly for butterfat and solids-not-fat (SNF) determinations. The butterfat percentage was determined by the Babcock test while SNF percentage was determined by a milk hydrometer (British Standard Density Hydrometer No. 2).

Feed, rejected feed, and faecal samples were dried at 95°C for 24 h for DM determinations and then ignited at 600°C for 4 h for ash determinations. The nitrogen content of dried samples was determined by a semi-micro kjeldahl technique using samples of 0.2 to 0.3 g DM and selenium catalyst (White, Thompson and Brice 1948).

(e) Energy content of Diets and Milk

In the calculation of energetic efficiency the following assumptions or calculations were made :—

- (i) the mean gross energy content of the tropical pasture was 4.35 kcal/g DM (Minson and Milford 1966).

- (ii) the mean gross energy content of the lucerne hay-concentrate diet was 4.50 kcal/g DM (Montgomery and Baumgardt 1965).
- (iii) the gross energy content of milk was calculated from the prediction equation of Tyrrell and Reid (1965).

III. RESULTS

The voluntary dry matter intake (DMI) and digestible organic matter intake (DOMI) of the lucerne hay-concentrate fed cows were consistently greater than those of the cows fed pasture with a mean difference of 3.9 kg DMI/day and 3.2 kg DOMI/day, respectively (Table 1) . The DMI of both diets remained relatively constant during the experiment except in week 9 when cows fed pasture consumed 13.9 kg DM/day, a higher intake than that of the cows fed lucerne hay and concentrate when considered on a body weight (kg) basis (39.0 vs. 36.5 gDM/kg/day). This rise in intake appeared to be associated with increased DM digestibility of the pasture (71.7% as compared to the mean of 63.6%).

The mean daily intakes of digestible crude protein (DCP) were 1.35 kg and 1.70 kg for the pasture and hay-concentrate fed cows, respectively.

The lucerne hay-concentrate diet had higher and less variable apparent digestibility coefficients than the *Glycine*-grass pasture (Table 2). The relatively large variability in the pasture digestibility coefficients appeared to be associated with variations in botanical composition. Over the experimental period, the proportion of lucerne hay to concentrates on DM basis consumed by the sheep and cows was the same, and on average was 60% lucerne hay and 40% concentrates.

The milk production achieved by the cows fed lucerne hay-concentrate was approximately double that of the cows fed pasture (Table 1). Milk production of both groups declined with time but there was a definite rise from the cows fed pasture during the last week of the experiment. The SNF content of milk of the cows fed lucerne hay and concentrate was consistently higher than that of the cows fed pasture (Table 1).

There was a mean body weight difference of 20 kg between the two groups at the time of allocation to treatments. This difference had increased to 68 kg after calving and the end of the two preliminary periods. The continued increase in the difference over the nine week experimental period appeared to be accompanied by a greater rate of loss of body condition in the cows fed pasture.

IV. DISCUSSION

This study has shown that DMI by lactating dairy cows fed a tropical legume and grass species can approach that of temperate pasture species under stall feeding conditions. The intake by lactating dairy cows of about 340 kg liveweight fed a New Zealand pasture of higher digestibility than the tropical pasture was approximately 12.5 kg DM/day over a 15 week period (Hutton 1962). This

TABLE 1
Body weight, voluntary intake and milk production of dairy cows fed freshly cut *Glycine javanica* and kikuyu grass pasture and lucerne hay-concentrate diets.

Period (weeks)	<i>Glycine</i> -grass pasture					Lucerne hay-concentrate diet				
	Body Weight (kg)	Dry Matter Intake (kg/day)	Digestible Organic Matter Intake (kg/day)	F.C.M. (kg/day)	S.N.F. %	Body Weight (kg)	Dry Matter Intake (kg/day)	Digestible Organic Matter Intake (kg/day)	F.C.M. (kg/day)	S.N.F. %
1	369	10.4	6.2	11.6	8.72	437	15.8	10.5	19.6	9.25
2	368	11.7	7.3	9.9	8.58	434	15.6	10.0	19.7	9.14
3	362	10.1	6.4	9.1	8.52	432	15.7	10.3	18.8	9.11
4	360	11.9	6.7	7.9	8.61	433	15.1	9.9	18.8	9.10
5	368	11.8	6.3	6.9	8.75	427	15.6	10.4	18.3	9.04
6	367	11.9	7.1	7.0	8.83	426	15.8	10.2	17.5	9.00
7	362	10.7	6.2	6.3	8.86	428	15.2	9.9	17.9	9.07
8	356	11.9	7.8	6.7	8.79	428	15.5	10.2	16.4	9.04
9	355	13.9	9.4	8.1	8.78	428	15.7	10.3	16.1	9.09
Mean	363	11.6	7.0	8.2	8.71	430	15.5	10.2	18.1	9.09

TABLE 2

Mean apparent digestibility coefficients and nitrogen content of freshly cut *Glycine javanica* and kikuyu grass pasture and lucerne hay-concentrate diets.

	Apparent Digestibility Coefficients %			Nitrogen Content of Dry Matter consumed (%)
	Dry Matter	Organic Matter	Nitrogen	
Glycine-grass Pasture	63.6 (56.1 — 71.7) *	64.8 (57.0 — 72.1) *	71.5 (64.7 — 80.7) *	2.54 (1.99 — 3.72) *
Lucerne hay — concentrate diet	67.8 (66.9 — 68.7) *	70.4 (69.6 — 71.3) *	74.7 (71.2 — 78.4) *	2.35 (1.99 — 2.58) *

*Range in weekly values.

intake was approximately 10% higher than the mean DMI obtained in this study, but 30% higher than the mean DOMI.

The milk production of the cows fed tropical pasture appeared to reflect the low intakes of digestible energy since at no stage was the intake of DCP likely to have limited milk production (Reid, Moe and Tyrrell 1966). The consistent difference in SNF content of the milk produced is in agreement with many previous studies and probably also reflects differences in digestible energy intake (Huber and Boman 1966). In comparison with the New Zealand study, average yields were at least 50% lower from the tropical species.

Production achieved by the twins fed hay and concentrates indicated that the twins fed pasture were genetically capable of higher production. The difference can in fact be explained in terms of the differences in DOMI.

Wallace (1961) found that with stall fed cows, the utilization of feed consumed for maintenance and production could be described by the regression equation:

$$\text{DOMI} = 0.33 \text{ FCM} + 0.063 \text{ LW}^{0.73} + 2.0 \text{ LWI}$$

where:

$$\begin{aligned} \text{DOMI} &= \text{Digest. organic matter intake (lb) daily} \\ \text{FCM} &= \text{Average daily 4\% fat corrected milk (lb)} \\ \text{LW}^{0.73} &= \text{Liveweight (lb) raised to power 0.73} \\ \text{LWI} &= \text{Average daily liveweight increase (lb)} \end{aligned}$$

Substitution of the results obtained for the hay-concentrate cows in this equation gives a predicted average intake of 10.3 kg DOM/day which is virtually the same as the actual intake. However, with the cows fed pasture, predicted intake was 6.3 kg DOM/day or 10% lower than the actual intake. It appears that the DOM consumed by the cows receiving pasture was not used as efficiently for productive purposes as the DOM consumed by cows fed the hay and concentrate or by the New Zealand cows.

This conclusion is supported by calculations of the efficiency with which ingested energy was converted to milk energy. If milk energy is expressed as a

percentage of the gross energy and of the digestible energy consumed, then for the cows fed pasture the values obtained are 12.5% and 22.5% and for the cows fed hay-concentrate are 20.6% and 30.7% respectively. Hutton (1966) obtained values of 20% and 28 % , respectively, for cows fed temperate pasture.

If intake of digestible energy does limit production of dairy cows offered a diet of tropical grass-legume, as it may do under some circumstances with even high yielding temperate pasture (Hutton 1966), then energy supplements should allow greater production/cow. In a current study at this Station, an average daily intake of 2.0 kg crushed oats has raised production from 9.2 kg to 12.0 kg FCM daily in the first 200 days of lactation of cows grazing a *Glycine-kikuyu* grass pasture at a stocking rate of 0.75 cows/acre (1.8/ha) (Holder, Dale and Colman, unpublished data).

Hardison (1966) estimated, after an examination of available data on chemical composition of various tropical grass and legume species, that the total digestible nutrients available to dairy cows would allow an average production of only 5 kg FCM/day. This study indicates that productive levels well in excess of Hardison's estimate can be achieved at least with *Glycine javanica* and kikuyu grass.

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