THE EFFECT OF DIETARY SUPPLEMENTATION WITH MOLASSES AND CHRISTMAS IS. PHOSPHATE ON MILK YIELD OF COWS GRAZING TROPICAL PASTURES.

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SUMMARY

Milk yield responses to two dietary levels of molasses (3.5 and 0.5 kg/cow/d) and Christmas Is. phosphate (96 and 0 g/cow/d) were determined in a 2 x 2 factorial experiment. Thirty-two Friesian cows grazed tropical grass-legume pastures at 1.3 cows/ha and were supplemented for 280 days. Milk yield averaged 4150 and 3598 kg/cow ($P < 0.01$) for the high and low molasses groups and 4034 and 3714 kg/cow ($P = 0.053$) for groups with and without phosphorus supplement, respectively. Rib bone biopsies showed that phosphorus and calcium levels declined ($P < 0.01$) from days 50 to 260 of lactation in cows not supplemented with Christmas Is. phosphate.

(Key Words: Lactating cows, phosphorus, molasses, tropical pastures)

INTRODUCTION

Phosphorus levels in tropical pastures on the Atherton Tablelands are below that recommended for high levels of milk production (NRC 1978). Molasses, which is also low in phosphorus, is used as the major energy supplement to lactating cows on the Tablelands. It is likely that cows grazing tropical pastures and receiving molasses will have insufficient phosphorus in their diet to meet the requirement for high production.

As no quantitative data were available, this experiment aimed to determine whether milk production would respond to phosphorus supplementation. It also aimed to determine whether this response could be dependent on the level of molasses fed. Christmas Is. phosphate was used because it contained no nitrogen and was a commonly used phosphorus supplement.

MATERIALS AND METHODS

Location and pasture

The experiment was conducted between January and December 1981 at Kairi Research Station on the Atherton Tablelands (17° 14'S, 145° 34'E; altitude 700m). Rainfall in 1981 totalled 1794mm with 1334mm falling from January to May. The experimental area was a well established pasture on a fertile kraznozem soil consisting of Tinaroo glycine (Neonotonia wightii cv. Tinaroo), green panic (Panicum maximum var. trichoglume), guinea grass (Panicum maximum) and kikuyu (Pennisetum clandestinum). Soil pH averaged 6.6 over the experimental site while soil phosphorus (bicarbonate extraction) ranged from 40-60ppm.

Treatments, design and analysis

The experiment was a factorial design with treatments of high (3.5 kg/cow/d;HM) and low (0.5 kg/cow/d;LM) levels of molasses each at nil (NP) or 96 g/cow/d (HP) of Christmas Is. phosphate (CIP). Thirty-two multiparous Friesian cows calving from January to early March were blocked into eight groups on the basis of previous milk yield and calving date. One cow from each block was randomly allocated to each treatment group. All cows were fed 2.0 kg molasses/d in a 14 day covariate period at the start of lactation. Treatment feeding started on day 15 of lactation. Cows were removed from the experiment at day 280 of lactation.

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Animal data were analysed by analysis of variance to isolate the effects of molasses, phosphorus and their interaction. The error term was estimated from animal to animal variation after an allowance was made for treatments and blocks.

Management and measurements

Cows were milked and fed between 0700 and 0900 h and milked between 1500 and 1600 h each day. Cows in all treatments grazed as one group with water and shade available in all paddocks and a salt (NaCl) supplement available at the dairy. The grazing system comprised three day paddocks of 3 ha each and six night paddocks of 2.5 ha each to give a stocking rate of 1.3 cows/ha. Cows grazed only one day or night in each paddock before moving to the next paddock.

The milk yields were recorded daily and a composite sample of afternoon and morning milk was taken once each week and analysed for solids-not-fat (hydrometric), butterfat, protein and lactose content (Milkotester MkIII-Foss Electric). The phosphorus and calcium content of milk was determined in April and June on a composite sample from cows in each treatment (AOAC 1975). Live weight of the cows was recorded pre and post calving and subsequently once each fortnight after morning milking. Biopsies of the twelfth rib cortex (left-hand side) were taken from half the cows, in each treatment, at approximately 50 and 260 days post-calving (Little 1972). The same cows were sampled on both occasions. After specific gravity was determined, samples were analysed for calcium and phosphorus content.

Cows were fed individually and rejected feed was weighed out each day. An equivalent weight of reject material was fed the following day. Samples of molasses and CIP were taken each two months for chemical analysis. Average values for molasses were (% DM) 8.6% crude protein, 0.07% phosphorus, 1.1% calcium, 0.6% magnesium, 4.6% potassium and 0.35% sulphur, while average values for Christmas Is. phosphate were (% DM) 15.6% phosphorus and 28.0% calcium.

Pasture on offer, botanical composition and chemical composition of pasture components were determined in April, June and August by sampling one day paddock and two night paddocks using the technique of Davison et al. (1985). The botanical and chemical composition of the diet was determined on the day after pasture sampling using four cows fitted with oesophageal fistulas (Davison et al. 1985). One subsample of extrusa was sorted into grass, legume and dead material and another subsample was dried at 45°C for 24h and analysed as for pasture samples (AOAC 1975).

RESULTS

Feeding the higher level of molasses increased ($P < 0.01$) the yields of milk, protein, solids-not-fat (SNF) and lactose (Table 1). Use of CIP increased the yields of milk ($P < 0.06$), protein and SNF ($P < 0.05$) and lactose ($P < 0.01$). There were no interactions ($P > 0.05$) between treatments in milk yield or composition. Live weight of all cows averaged 513 kg post-calving and 538 kg at day 280. Treatments did not influence live weight or liveweight change.

Phosphorus content of milk averaged across both samplings was .101, .091, .093 and .099% for HM, LM, HP and NP respectively. Phosphorus content decreased from April to June in all milk samples with values of -.009, -.003, -.008 and -.005% for HM, LM, HP and NP respectively. Calcium levels in milk also decreased from April to June but were not consistent across treatments. Mean values for calcium in April and June were .093, .091, .093 and .090% for HM, LM, HP and NP respectively.

Supplementation with CIP increased bone phosphorus and calcium content ($P < 0.01$) from day 50 to 260 of lactation (Table 1). The ratio of calcium to phosphorus was constant at 2.1:1 for all treatments at day 50 and 260.

Pasture on offer at the three samplings averaged 5196 kg DM/ha with a mean composition of 45% grass, 28% legume, 25% dead matter and 2% weed. Botanical composition of the diet averaged 54% grass, 37% legume and 9% dead matter. Legume content of the diet increased from April (27%) to August (42%), while grass content decreased from 67% to 46% in the same period. Mineral composition of the pasture and extrusa are shown in Table 2.

TABLE 1 Responses in milk yield and milk composition (kg/cow) over 280 days of lactation and changes in bone phosphorus and calcium content (mg/cc) with level of molasses and phosphorus supplement

Variable	Molasses		Phosphorus		LSD
	HM	LM	HP	NP	($P = 0.05$)
Milk yield	4150	3598	4034	3714	325
Fat yield	119	109	117	112	10.4
SNF yield	369	316	361	324	28.1
Protein yield	130	109	125	115	9.9
Lactose yield	210	182	208	184	15.8
Bone phosphorus					
day 50	218	218	216	221	17
day 260	245	200	258	187	55
Bone calcium					
day 50	463	458	457	464	42
day 260	514	424	541	397	105

TABLE 2 Mean mineral content (% DM) of pasture components and diet selected from pasture

	Nitrogen	Phosphorus	Calcium	Magnesium	Potassium
Pasture					
legume	2.5	0.29	1.36	0.28	2.78
grass	1.5	0.28	0.40	0.30	3.00
Diet	2.7	-	0.91	0.21	

DISCUSSION

The increase in milk production with the increased level of molasses feeding was indicative of the low available energy content of tropical pastures. The response of 0.7 kg milk/kg molasses is the same as that found in other studies with tropical pastures (Davison et al. 1982). This response is highly economic at current prices of 23c/kg milk and 7c/kg molasses.

We believe the response in milk production to supplementation with Christmas Is. phosphate was due primarily to the phosphorus component. It is possible some of the response was due to calcium. Tropical grasses are noted for their high oxalate levels which inhibit the utilisation of calcium from pasture (Gartner et al. 1980). In this study, calcium levels in the pasture, molasses and the diet selected from pasture indicated that calcium was supplied well above recommended levels (NRC 1978), which should have compensated for any high oxalate levels.

The levels of phosphorus in whole grass and legume were below that recommended for cows producing up to 17 l/d (NRC 1978). The similar response in milk yield to CIP at both levels of molasses, indicated there was inadequate phosphorus selected in the diet from pasture. The most likely mode of action of phosphorus supplementation, on extra milk production, was through increased intake of pasture (Wadsworth and Cohen 1976). The increased solids-not-fat yield from cows supplemented with CIP support the contention that these cows had a greater intake of digestible energy (Rook 1961).

The dietary data showed that cows were able to select a high quality diet, as a higher proportion of legume was present in the diet than in the whole pasture. The quantity of pasture on offer was high throughout the experiment, even in spring. This indicated that the quality of pasture and not the quantity of pasture on offer was limiting to milk production (Davison et al. 1982). While the provision of extra energy in the form of molasses, did not improve the utilisation of the phosphorus supplement, the provision of both extra molasses and phosphorus were shown to be necessary for high levels of milk production.

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