OBSERVATIONS ON THE DRY SEASON PERFORMANCE OF PERI-URBAN SMALLHOLDER DAIRY CATTLE SUPPLEMENTED WITH UREA-MOLASSES-MINERAL- BLOCKS AND FARM FORMULATED CONCENTRATE

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SUMMARY

Two trials were carried out to investigate the suitability of two supplements, formulated concentrate (FC) and urea-molasses-mineral-blocks (UMMB) for incorporation in dry season dairy cattle feeding in smallholder farms of peri-urban Morogoro. Thirty eight smallholder farms, keeping a total of 103 milking cows were randomly selected and allocated to Treatments and Control groups. In Trial 1, 37 cows were supplemented with 0.8 kg FC per litre of milk produced and 28 cows in control whereas in Trial 2, 18 cows were supplemented with 2 kg UMMB per day and 20 cows in control. The concentrate and blocks were taken to the farms after successful on-station trial for acceptability and performance by dairy cows. In both trials control animals received on average 0.6 kg maize bran (MB) per litre of milk produced. Experimental supplements were fed in postpartum for 90 days. Animals were (as far as possible) balanced for previous lactation yields (4-12 L d^{-1}), number of previous parturitions (2-4), and condition scores (2-3.5). Farmers were appealed to feed their animals at the established rate for easy management and simplicity. The perfomance of the cows was evaluated for milk yield, body weight, body condition score (BCS). Reproductive performance was evaluated by rectal palpation and milk progesterone concentrations. Proximate analyses of the major feeds were carried out. Supplementation with FC increased milk yield by 1.6 L/d/cow, improved reproductive efficiency and BCS. The difference between treatment and control groups on these parameters was not significant ($P > 0.05$). Supplementation with UMMB significantly increased daily milk yield by 1.5 L/d and average weight of cows by 0.23 kg/d ($P < 0.05$). The increase in milk yield due to the provision of the supplements was mainly explained by an increased intake of energy and nitrogen. Taking the production costs into account, on-farm supplementation with the FC and UMMB is cost effective if milk yields increase respectively by 1.0 and 0.7 L/d (break even increases) during the dry season.

INTRODUCTION

Dairy production is an enterprise for many smallholder farms of peri-urban Tanzania. These farm units keep few dairy cows in the back yard compound mostly zero grazed. The smallholder dairy sector is important in that it contributes substantially to national economy, improve child nutrition, and well-being of women

who mostly look after the animals (Mdoe, 1993; Holden and Coppock, 1992).

A major constraint on the production of dairy cows on smallholder farms throughout the tropics, especially during the dry season, is that the roughage feeds provided are of poor quality, lignified, and their digestibility is low (Preston and Leng, 1987). This limits feed intake, rumen fermentation, and productivity. The use of poor quality forages can be improved by satisfying the requirements of the rumen micro-organisms to ensure efficient fermentation of fibre resulting in an increased production of fermentative outputs (Garg and Gupta, 1992). This can be achieved by providing a supplement of fermentable carbohydrate, nitrogen and minerals combined with a small amount of nutrients that bypass the rumen (Sansoucy et al. 1992). Commercial or farm made concentrates and mixtures of molasses, a nitrogen source, e.g. chicken litter, urea or urine, and minerals can be used as supplements. Such supplements can increase the intake of the poor quality forages (Badurdeen et al. 1994).

Commercial and farm made concentrates have been shown to improve smallholder dairy cattle performance (Jingura and Sibanda, 1998). However farmers rarely supplement their animals with protein concentrates in the dry season most probably because of expense. They mostly use only maize bran at milking times. To enhance the stability and sustainability of smallholder dairy cattle dry season feeding, it is necessary to develop low cost feed sources which are typical to the environment, compounded from available crop by-products.

UMMB have advantages in that they are easy to handle and use, and that urea can be well mixed and incorporated, thus avoiding toxicity problems. In addition, they are palatable due to the taste and smell of molasses (Sansoucy et al. 1992). Supplementation of UMMB to cows and buffaloes fed a base feed of cereal straw, lignified grass and/or maize stover increased milk yields and reduced feed costs of cows and buffaloes in India (Srinivas and Gupta, 1997), Indonesia (Hendratno et al. 1991), Pakistan (Habbib et al. 1991), and Bangladesh (Saadulah, 1991). If good quality forages can be provided, then the increase due to the provision of UMMB is limited (Sansoucy et al. 1992; Hendratno et al. 1991). UMMB have been used in Tanzania, but this is not well documented on smallholder dairy farms. In the Tanga region the use of these blocks resulted in non-significant increase in milk production of between 0.2 and 1.1 L per cow per day (Msangi, 1995). The use of FC and UMMB during the dry season could increase the milk production at smallholder farms in Morogoro.

The objectives of this study were i) to introduce and investigate the effect of supplementation with FC and UMMB during the dry season on productivity of dairy cows on peri-urban smallholder farms and

ii) to conduct a cost/benefit analysis of the supplementation.

MATERIALS AND METHODS

Study area and animals

This study was conducted at peri-urban farms in Morogoro, a semi-arid region of Eastern Tanzania, that experiences two dry seasons - from May to November and in January and February. A total of 103 zero grazed dairy cows belonging to 38 peri-urban smallholder farms were involved. The farms represented different wards of Morogoro municipality. Animals were crosses between dairy breeds (Friesian, Ayrshire, Jersey) with local indigenous Zebu or Boran cattle. The average live weight of the cows was 315 (± 9.1), body condition ranged between 2 and 3.5 on scale 1-5. The average milk yield prior to the introduction of FC and UMMB was 6.8 and 5.5 kg respectively. The major forage for the animals during the dry season was dried grass and/or maize stover.

Preparation of UMMB

The composition (% inclusion by weight) of the UMMB used are given in Table I. For the preparation of the UMMB a modified cold process described by Sansoucy *et al.* (1992) was used where the content of maize bran was increased and that of molasses was decreased in order to obtain sufficient hardness of the blocks. Fertiliser grade urea, limestone, salt, and bone meal were also included. Building cement was used as a binder to solidify the blocks. All solid components were mixed by hand. The salt was ground and mixed with water and added to the molasses. The liquid mixture was added to the solid mixture, and mixed thoroughly by hand. The resulting mixture was transferred into wooden moulds (0.25 m x 0.2 m x 0.2 m) and pounded (compressed) with wooden poles until satisfactory consistency was obtained. Following this, the blocks were removed from the moulds and air dried for at least two days.

Preparation of FC

FC was compounded, by thorough mixing, of CSC (28%), MB (70%), MM (Maclick®) 1% and NaCl 1% (Table I).

Trial 1.

Between September and November 1996 FC was provided to 14 farmers to feed 0.8 kg per litre of milk produced per day individually to all lactating cows (n = 37 cows), 10 farmers were control (n = 28 cows). Performance of the animals was monitored as described below.

Trial 2

The trial was conducted between July and September 1997, and included 38 cows kept on 14 peri-urban dairy farms around Morogoro. Farms were blocked by wards and randomly assigned to treatment (n = 18 cows) and control (n = 20 cows). Treatment included provision of UMMB which were provided to the farmers who were requested to feed a maximum of 2 kg of block per day (a quarter of block) individually to all lactating cows.

Table I: Composition of the supplements (% inclusion by weight)

Components	FC	UMMB
Cotton seed cake	28	0
Mineral mix	1	0
Maize bran	70	33.5
Salt (Nacl)	1	2.3
Molasses	0	28.0
Urea	0	9.3
Limestone	0	4.6
Cement	0	13.0
Bone meal	0	2.30
Water	0	7.0
Total	100	100

Both FC and UMMB were introduced into the smallholder farms following successful on-station trial for their acceptability and performance on dairy cows. Results of the test trial are reported elsewhere by Plaizier et al. (1999).

In both on-farm trials control animals received on average 0.6 kg MB per litre of milk produced. Farmers were appealed to feed their animals at the established rate for easy management and simplicity. Cows were milked twice daily. Milk yields for each cow at both milkings were recorded daily by the farmer or the farm assistant. Live weights were recorded biweekly using a weighing tape, also animals were condition scored using a 1-5 scale. Reproductive efficiency of the cows was monitored by monthly rectal palpation and by measuring progesterone concentrations using self-coating radioimmunoassay (RIA) in milk samples collected once weekly. Forage and supplement samples were collected biweekly from randomly selected farmers, one farmer per ward (chosen at random). All feed samples were analysed for dry matter (DM), crude protein (CP), acid detergent fibre (ADF) and neutral detergent fibre (NDF), and ash according to the method described by AOAC (1990). Minerals including Ca, P, Na, K, and Mg were analysed as described by AOAC (1990). Rumen degradability measurements of the grass, maize stover and the maize bran were made using the nylon bag techniques (Ørskov et al. 1980). Details of these techniques are briefly given by Plaizier et al. (1999). Farmers were visited at least weekly to monitor the implementation of the protocol and scrutinise the data recording.

Statistical analysis

Statistical analysis was conducted with collected data using the SAS General Linear Models procedure (SAS 1990), using the average milk yield before the introduction of the supplement as a covariate.

RESULTS

The chemical composition and rumen degradability characteristics of the feeds used in these trials are given in Table II. This table shows that the forage used in the farms in the dry season had high values for DM, and low CP content. The rumen degradability of the maize bran was high, while that of the forage was very low.

Table II: Composition of feeds on dry matter (DM) basis

Component	G	MB	UMMB	FC
DM(%)	88.3	90.9	93.0	94.3
N (CP/6.25,%)	0.8	1.8	6.0	2.6
ADF (%)	39.8	7.2	3.6	55.8
NDF(%)	73.4	30.1	9.4	48.6
Ca (%)	0.27	0.01	8.56	1.28
P (%)	0.18	0.63	0.92	0.22
K (%)	0.87	0.81	1.57	0.63
Mg (%)	0.15	0.29	0.34	0.37
Na (%)	0.02	0.01	1.02	1.0
DM degradability				
24 hr	32.6	75.8	*	*
48 hr	41.4	87.4	*	*

G - grass, * - not determined

Trial 1

The mean production and reproduction performance for the FC supplemented animals are shown in Table III. From the table it is evident that supplementation during the dry season substantially, but not significantly improved milk yield, body condition and reproductive efficiency in treatment group compared to control group, 8.4 L/d vs 6.8 L/d; 0.2 vs -0.1; days to first postpartum oestrus 71 vs 86, and conception rate 68 vs 50.7 respectively

Table III: Mean production and reproduction performance for FC supplemented cows (mean ± se)

Parameter	Supplemented (n=37)	Control (n=28)	Significance
Milk yield (kg/d)	8.4±0.12	6.8±0.12	n.s
BCS change	0.2±0.01	-0.1±0.01	n.s.
Weight change (kg)	0.6±0.1	0.2±0.1	n.s.
Postpartum interval			
To first oestrus (d)	71.2±5.3	86.3±6.6	n.s.
Conception (d)	80.4±4.7	102.4±5.1	n.s.
Conception rate	68.0±3.9	50.7±3.3	n.s.
insemination/ conception	1.3±0.01	1.9±0.1	n.s.

n.s. - not significant (P > 0.05)

Trial 2

Animals in the UMMB farms had an average milk yield of 7 L/d against 5.5 L/d in the control

farms; that is, on average a 1.5 L/d ($P<0.05$) higher milk production. Similarly the average weight increase of cows on UMMB farms (0.19 kg/d) was significantly ($P<0.05$) higher than that on control farms (-0.04 kg/d).

Financial considerations

The cost/benefit analyses for supplementation with FC and UMMB are given in Table IV. From the table it is evident that the cost of feeding FC is much higher than that of UMMB, while the cost of production is the same. Supplementation with FC and UMMB is cost-effective if the increase in milk production is higher than 1.0 and 0.7 L/d respectively.

Table IV. Cost-benefit analyses for UMMB and FC supplementations.

Source	FC	UMMB
Cost (Tsh/kg)	100	102
Feeding cost (Tsh)	256	163
Milk price (Tsh/L)	250	250
Break even milk increase (L/d)	1.0	0.7
Observed milk increase (L/d)	1.6	1.5

DISCUSSION .

Rumen degradability of the major forage (dry grass) was very low, lower than all the potential degradabilities for Tanzania forages reported by Shem et al. (1995), but in the range of the rumen DM degradabilities reported by FAO (1992), for straws. The low CP content of the forage combined with its very low rumen degradability highlight the importance of supplementation with nitrogen during the dry season. The production and reproduction performance values for FC supplemented cows were lower in the control than in treatment groups most probably because roughage fed alone can hardly provide all the nutrients and in adequate amounts as required by milking cows (Cheswoth, 1992). Provision of concentrates based on CSC and MB which contain high levels of nutrients gave non significant improvement in the measured parameters. Similar non significant improvements were observed by Jingura and Sibanda (1998). The non significant improvement was most probably due to farmers withdrawing other supplements in favour of the experimental supplement to reduce costs, although they were appealed to feed their animals at the established rate. This most likely happened because the experimental supplement was distributed at no cost, similarly control farms got some MB at no cost, also as an incentive for participating in the study.

Supplementation with UMMB also most likely alleviated the Ca and Na deficiency observed in the control animals that only received dried grass/maize stover and maize bran. On all farms, farmers provide some form of a supplement on top of the base feed. Supplements include mainly MB, brewer's spent grain, CSC, or rice polishing. The amount of supplement given depends on availability, price and preference of the farmer. The increase in milk production due to the provision of UMMB during the on-farm study was much lower (1.5 L/d) than that observed in the on-station study (4.5 L/d) (Plaizier et al. 1999), but close to that reported by Habbib et al. (1991), Hendratno et al. (1991), and Msangi, (1995) who reported increases of up to 1.6, 1.9, and 1.1 kg/d, respectively. Cows on-station had better nutrition and potential. Some cows on the small holder farms have very low milk yields, reaching as low as 2 L/d in the dry season.

Supplementation with UMMB significantly increased milk production by 1.5L/d which is much more than the break even milk increase of 0.7 L/d. However, such an increase was only observed when reduction of the quality and availability of the base feed due to the dry season had become evident. Supplementing outside the dry season when good quality forages are available or giving the blocks to cows with very low milk yield will not be cost effective (Sansoucy et al. 1992; Hendratno et al. 1991). Hence, if UMMB can be provided on a cost-recovery basis, then providing these blocks to cows during the dry season can be recommended.

Blocks should be provided on a cost recovery basis by farmers co-operative. Commercial company that needs to include a profit margin, will jeopardise the cost effectiveness of the UMMB by increasing the "break even" production increase to a level similar to the production increase observed on the smallholder farms.

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