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Effect of concentrate supplementation on plasma minerals and performance of smallholder dairy cattle

A.A. Gimbi[1], A.E. Kimambo[1], N.L. Kanuya[2], L.A. Mtenga[1], G.H. Laswai[1] and J. Madsen[3]

[1]Department of Animal Science and Production, Sokoine University of Agriculture P.O. Box 3004, Morogoro, Tanzania
[2]Department of Veterinary Surgery and Theriogenology, Sokoine University of Agriculture P.O. Box 3020, Morogoro, Tanzania
[3]Department of Animal Science and Health, The Royal Veterinary and Agricultural University Grønnegaardsvej 2, DK-1870, Frederiksberg C, Denmark

ABSTRACT

An assessment of calf birth weight (CBWT), milk yield (MY) and plasma calcium (Ca), phosphorus (P) and copper (Cu) was done in supplemented (S) and control (C) cattle groups grazing tropical pastures . The supplemented group had compared to the control group higher P (5.1 vs 4.7±0.1 mg/dl; $P<0.05$), Cu (0.5 vs 0.4±0.02 µg/ml; $P<0.001$), MY (10.13 vs 7.63± 0.07 l/day; $P<0.001$) and CBWT (26.01 vs 23.4±0.68 kg; $P<0.05$). The control group showed P and Cu deficiency and the production effect of supplementation with an appropriate mixture were was more than 0.5 kg milk per kg mixture and 10% heavier calves at birth.

KEY WORDS: concentrate supplement, plasma minerals, productive performance

INTRODUCTION

Energy is often the first limiting nutrient for milk yield (MY) in the smallholder sector in the tropics because of low energy content in tropical forages (Larry and Joe, 1994) and tissue mineral concentrations and functional forms must be maintained within limits for optimum productive performance (McDonald et al., 1997). Deficiencies of Ca and P in plasma of dairy cattle have been reported in Tanzania (Phiri et al., 1997). Gimbi et al. (2002) found out that steaming up of animals was not normally done and mineral supplementation was not regular in

[3] Corresponding author: e-mail: jom@kvl.dk

Rungwe. The objective of the present study was to demonstrate with farmers the response of plasma mineral concentration and productive performance of dairy cattle to concentrate supplementation.

MATERIAL AND METHODS

Research design and treatments

A longitudinal study with multistage, purposive sampling was set where 3 divisions and in each 3 wards were selected. Two villages and 4 farmers per village were selected from each selected ward. A sample of 72 animals, mainly Friesian × Zebu crossbreds about 7 months pregnant was selected from the farmers and randomly allocated into control and supplemented treatments.

Feeding and management of experimental animals

Animals were managed under farmers' conditions, e.g., mainly only grazing tropical pastures, except for the S where concentrate was given in addition. Nutrients available and deficits from basal diet were estimated (Mussa, 1998) and supplement made to cover the deficits and enable the animals approximately meet daily allowances for ME, CP and minerals (McDonald et al., 1997) for 500 kg pregnant and lactating animals producing milk of 38 g fat and 34 g protein/kg. The supplement was made from hominy meal, sunflower seed cake and minerals (Super Maclick®, Coopers Kenya Ltd.) to contain 13.4 MJ ME, 138.1 g CP, 2.3 g Ca, 1.3 g P and 19 mg Cu per kg feed DM and was fed daily at a rate of 7 g/kg Bwt for 2 months pre and post calving.

Samples, parameters, laboratory and statistical analyses

Blood samples were collected monthly starting about 60 days prepartum to 90 days postpartum. Plasma Ca, P and Cu levels were determined by spectrophotometric techniques (Kessler and Wolfman, 1964; Paynter, 1987). A weigh band was used to estimate CBWTs. Daily MY was measured and recorded by farmers. General linear model (SAS System, Release 6.08) consisting of Ca, P, Cu, MY and CBWT as dependent variables and treatment as an independent effect was used for statistical analysis.

RESULTS

Plasma mineral concentration, milk yield and calf birth weight

There was a small insignificant difference in mean Ca values between the S and C (Figure 1; Table 1). The mean P concentration for the S was significantly ($P<0.05$) higher than the C for most of the experimental period (Figure 1; Table 1). The S showed higher mean Cu concentration than C for most part of the experimental period (Figure 1). The overall mean Cu concentration of S was significantly (P<0.001) higher than the C. The S had significantly (P<0.001) higher mean MY and CBWT (P<0.01) than C (Table 1).

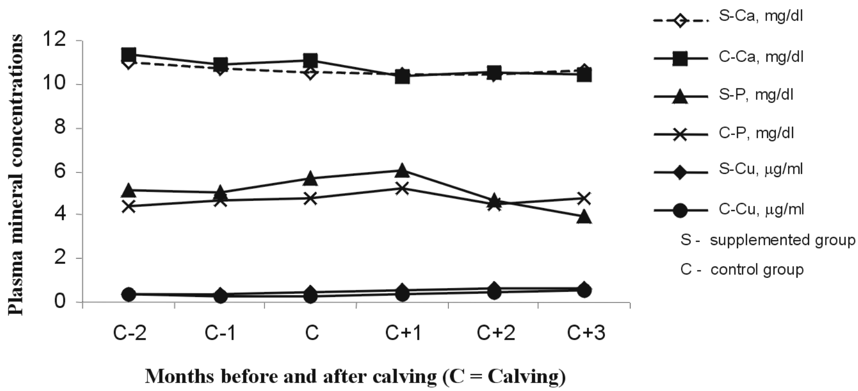

Figure 1. Plasma Ca, P and Cu concentrations trends between two months prepartum (C-2) and three months postpartum (C+3) for supplemented and control groups

Table 1. Least square means (LSMs ± Standard error) for selected minerals and production parameters

Parameter	Group		P-value SEM	
	control	supplemented		
Blood plasma Ca, mg/dl	10.8[a]	10.6[a]	0.1	NS
Blood plasma P, mg/dl	4.7[a]	5.1[b]	0.1	*
Blood plasma Cu, µg/ml	0.4[a]	0.5[b]	0.02	***
Milk production, L/day	7.63[a]	10.13[b]	0.08	***
Calf birth weight, kg	23.4[a]	26.01[b]	0.69	**

means with different superscript within each row are significantly different

DISCUSSION

The mean plasma P concentration for the C was within a band of marginal deficiency values, which is 3.1-4.7 mg/dl (Underwood and Suttle, 1999) while mean P concentration for S was above the values. The mean plasma Ca levels for both groups were within normal range of reference values, which is 9.6-12.3 mg/dl (Kaneko, 1989). The small variation in Ca values between the groups and the higher mean P values in S than C, could be due to the fact that Ca in serum is less responsive to dietary changes in intakes of the mineral than inorganic P (Betteridge, 1989) because of regulatory actions of parathyroid hormone, calcitonin and vitamin D, which in most species maintain the plasma concentration close to 10 mg/dl (Underwood and Suttle, 1999).

Although the mean plasma Cu concentration of the S was higher than the C, both groups showed mean values within a marginal deficiency band of values, which is 0.2-0.6 μg/ml (Underwood and Suttle, 1999). The present findings suggest that the level of supplementation was not enough to raise the plasma Cu concentration to the recommended level or the availability of Cu was low.

The low mean MY for the C could be due to low energy intake among other factors. Low energy intake during late pregnancy can result in slightly lowered CBWTs and lower MY in the coming lactation (Cornelia and Barry, 2000). Low protein intake could also contribute to low MY since it decreases feed consumption, feed passage rates and overall digestive efficiency (Cornelia and Barry, 2000). The P deficiency could have contributed to the lower MY C compared to S, since animals respond to dietary deficiency of P by reducing MY without affecting the P concentration in milk (Underwood and Suttle, 1999).

It is concluded that smallholder dairy cattle in Rungwe district suffer from P and Cu deficiencies and that the increase of more than 0.5 kg in MY per kg supplement and a 10% increase in CBWT most likely could pay for the supplementation.

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