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Evaluation of Nutritional Regime in Small-Scale Dairy Farms in Khartoum State, Sudan

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Abstract: The objective of this study was to determine whether owners of small-scale dairy farm in Khartoum State feed their animals the required energy and protein. Calculated Crude Protein (CP) and Net Energy for lactation (NE_L) requirements of dairy cows in fifty small-scale dairy farms located in Khartoum, Omdurman and Khartoum North were compared with the actual CP and NE_L intake during the period of September to November 2006. The experimental design was completely randomized with 3×3 factorial arrangement of treatments. The cows of each locality (Khartoum, Omdurman and Khartoum North) were divided into three groups according to milk yield (low: 0-6 kg day^{-1}; medium: 6-12 kg day^{-1}; high: 12 kg day^{-1} and more). The average Crude Protein (CP) content of rations was 29.5, 24.66 and 24.05% for Omdurman, Khartoum North and Khartoum, respectively. Both the locality and milk yield had a significant effect ($p<0.05$) on protein oversupply which was lower for Khartoum (108.4%) than for Omdurman (180%) or Khartoum (141.9%). However, the least protein oversupply was 101.8% for high milk yielding cows. Producers in Omdurman, Khartoum North and Khartoum exceeded the total energy required for lactation by 81.4, 69.7 and 45.1%, respectively. The excess energy reached 100% of the total energy requirement for low milk yielding cows. In conclusion, all producers in small-scale dairy farms in Khartoum State feed their herds excess amounts of CP and energy. Therefore, guidelines need to be developed for optimal production efficiency.

Key words: Sudan small-scale dairy, required energy and protein

INTRODUCTION

There are two major systems of milk production in Sudan, modern and small-scale dairy farms around cities and urban centers, where irrigated forages (forage sorghum, maize, alfalfa and Rhodes grass) and concentrates are used (Habeeb Allah, 1996).

Small-scale dairy farms, where cattle are kept in a courtyard or fenced site and fed purchased fodder plus concentrate, are growing rapidly providing urban centers with most of their needs for milk. Owners of these farms feed their animals undetermined proportions of sorghum grains, wheat bran and oil-seed cakes as main ingredients in group-feeding irrespective of cow productivity.

Productivity of ruminants is influenced primarily by feed intake which in turn is determined by feed digestibility and the capacity of the diet to supply the correct balance of nutrients required by animals in different productive stages (Van Soest, 1994). Therefore, the two major variables that need to be considered are the amounts and balance of nutrients required and the quantitative availability of nutrients from the diet. Feeding crude protein in excess amounts increases energy requirement for the synthesis and excretion of urea from the body and the deficiencies of crude protein reduces digestibility

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of the diet (Cheek, 2005). Accurate supply of nutrients to cattle can have several positive outcomes. Providing the required nutrients can increase the production potential, reduce feed cost, improve nutrient utilization and reduce nutrient waste and decrease environmental concerns (Kaku *et al*., 2004). The hypothesis is that the problem behind the weak performance of small-scale dairy farms might be due to the feeding regime adopted in these farms. Therefore, the objective of this study is to quantify feeding practices among small-scale dairy farmers toward using the nutrient requirements.

MATERIALS AND METHODS

Data Collection and Experimental Design

Fifty small-scale dairy farms located in Khartoum (n = 15), Omdurman (n = 17) and Khartoum North (n = 18) with eight cows each, were studied during the period of September to November 2006. Data were collected on each cow by a producer questionnaire: Body weight, parity, milk production, feed consumption, weeks of pregnancy and housing. Diets and milk samples were collected for routine analysis.

The experimental design was completely randomized with 3×3 factorial arrangement of treatments. The cows of each locality (Khartoum, Omdurman and Khartoum North) were divided into three groups according to milk yield (low: 0-6 kg day^{-1} (n = 140); medium: 6-12 kg day^{-1} (n = 132); high: 12 kg day^{-1} and more (n = 128)).

Chemical Analysis

Milk samples were analyzed for milk fat, total protein and urea-N. For feed samples, proximate analysis was carried out according to AOAC (1990).

Metabolizable Energy (ME) for each diet was estimated from the chemical composition according to the following equation:

$$ME\ (MJ\ kg^{-1}) = 0.12CP\% + 0.31EE\% + 0.05CF\% + 0.14\ NFE\%\ (MAFF, 1975)$$

The efficiency of ME used for maintenance and lactation is 0.62 and 0.64, respectively, (Moe and Tyrrell, 1972).

Calculation of Protein and Energy Requirements

NRC (1989, 2001) was used for the prediction of the protein and net energy of lactation (NE_L) requirement of dairy cows based upon measurable, or observable, characteristics of dairy cows on test farms.

The calculated protein and NE_L requirement is divided into the requirement for milk synthesis, maintenance and body tissue change. The calculated protein and NE_L requirements were compared with the actual protein and NE_L intake.

Statistical Analysis

Data were statistically analyzed as a 3×3 factorial arrangement in a completely randomized design. The factors were: locality (Khartoum, Omdurman, Khartoum North) and milk yield (low, medium, high). The least significant difference was used to separate the means (Analytical Software, 2000).

The interaction between locality and milk yield was not significant. Therefore, only the differences between the main effects were tested and discussed.

RESULTS AND DISCUSSION

The average crude protein content in the dry matter of the rations was 29.5, 24.66 and 24.05% for Omdurman, Khartoum North and Khartoum, respectively (Table 1). These values are above the critical level (19%) that has been shown to have negative effects on reproduction (Jordan *et al*., 1983; Elrod and Butler, 1993; Canfield *et al*., 1990).

Both the locality and milk yield had a significant effect ($p<0.05$) on protein oversupply (Table 2, 3). The protein oversupply was higher for Omdurman (180.9%) than for Khartoum North (141.9%) and Khartoum (108.4%). However, the protein oversupply was 101.8, 150.6 and 176.8% for high, medium and low milk yielding cows, respectively. Chase (2003) reported that when crude protein intake increases, about 37 to 50% of the N excreted by lactating dairy cows is in the urine. A high proportion of the urinary N is in the form of urea, which can be degraded to ammonia by the urease enzyme in the feces on the barn floor and thus is the primary source of N emissions from a dairy barn and has a negative impact on environment.

Moreover, producers in Omdurman, Khartoum North and Khartoum exceeded the total energy required for lactation by 81.4, 69.7 and 45.1%, respectively. The excess energy reached 100% of the total energy requirement for low milk yielding cows, 53.3% for medium milk yielding and 42.3% for high milk yielding cows. Proper nutritional status is critical for optimal production efficiency in the

Table 1: Chemical composition (%) and calculated ME (MJ kg^{-1} DM) of diets used in the evaluated small-scale dairy farms in Khartoum State

Parameters	Khartoum (n = 15)	Khartoum North (n = 18)	Umdorman (n = 17)
OM			
Mean	93.12	91.64	94.70
Min.	91.03	83.01	91.99
Max.	94.20	96.24	97.70
SD	1.01	3.45	1.37
CP			
Mean	24.66	24.05	29.50
Min.	12.25	13.30	20.65
Max.	35.53	42.35	54.25
SD	5.98	8.92	8.55
CF			
Mean	13.04	46.09	18.55
Min.	8.59	16.67	11.28
Max.	18.16	56.19	27.22
SD	2.77	9.20	5.82
ME			
Mean	12.09	8.87	11.72
Min.	11.60	7.20	11.05
Max.	12.97	11.13	12.68
SD	0.38	0.96	0.46

OM = Organic Matter, CP = Crude Protein, CF = Crude Fiber, ME = Metabolizable Energy, n = No. of Farms

Table 2: Effects of locality on protein and energy oversupply (%) in small-scale dairy farms in Khartoum State, Sudan

Parameters	Khartoum (n = 120)	Khartoum North (n = 144)	Umdorman (n = 136)
Protein oversupply	108.24±16.11^{b}	141.88±16.64^{ab}	180.94±16.17^{a}
Energy oversupply	45.11±10.22^{b}	69.69±10.63^{ab}	81.44±8.93^{a}

$^{a-b}$: Means with different superscript in the same row differ significantly ($p<0.05$), *: All values are means±SE, n = Number of cows

Table 3: Effects of milk yield on protein and energy oversupply (%) in small-scale dairy farms in Khartoum State, Sudan

Parameters	High (n = 128)	Medium (n = 132)	Low (n = 140)
Protein oversupply	101.79±2.76^{a}	150.56±1.92^{a}	176.83±3.15^{b}
Energy oversupply	42.28±12.28^{b}	53.32±7.37^{b}	100.64±13.02^{a}

$^{a-b}$: Means with different superscript in the same row differ significantly ($p<0.05$), *: All values are means±SE, n = Number of cows

dairy cow herd, therefore, the increases of CP and NE oversupply may lead to an increment in the diets cost with no benefits gained from this extra cost in addition to the negative impacts on reproduction and environment (Butler, 1998; McCormick *et al*., 1999; NRC, 2001).

In conclusion, producers in small-scale dairy farms in Khartoum State feed their herds' excess amounts of CP and energy following one size fits all approach leading to paying high tax in energy used for urea synthesis and excretion in urine which may have a negative impact on production cost, reproductive performance and environment. Therefore, guidelines need to be developed for better understanding of nutritional needs of the individuals within the cow's herd for the improvement of economic efficiency for the small-scale dairy farm sector.

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