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Short Communication

Milk urea nitrogen as a monitoring tool for assessing protein nutritional status of lactating dairy cows in Khartoum North, Sudan

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Abstract

The objective of this study was to determine whether milk urea nitrogen concentration could be used as an easy monitoring tool for assessing protein nutritional status of dairy cows. Data collected from five farms (A, B, C, D and E) located in Khartoum north were used in this study. Feed samples were collected from each farm and proximate analysis was carried out. Milk samples were collected separately from eighteen crossbred cows from each farm and milk urea nitrogen concentration was measured. The lowest CP content (19.9%) was reported for farm C, while the highest value (24.5%) was reported for farm A. The mean MUN concentrations of 35.6 mg/dl was recorded in farm A compared to 20.1, 17.0, 13.1 and 11.4 mg/dl for farm D, E, B, and C, respectively Differences in MUN concentration were observed within and between farms and a positive correlation (r: 0.81) was found between CP and MUN. It is concluded that measurement of MUN could be used to assess the adequacy of protein feeding in dairy cows and the efficiency of N utilization for milk production.

Keywords: Protein, Milk urea nitrogen, Dairy cows

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1. Introduction

Protein is a critical and most expensive nutrient for dairy cattle. Protein brakes down into smaller compounds such as peptides, amino acid and ammonia in the rumen. Rumen microbes can use ammonia for their growth and microbial protein synthesis (Van Soest, 1994), if dietary protein is fed above the level needed by the microbes, the excess ammonia will be converted to urea in the liver and excreted in the urine and increasing ammonia emission (Duinkerken *et al.,* 2011).

A key to efficient feed utilization is to formulate a ration that optimizes microbial protein synthesis and supply amount of rumen undegradable or bypass protein that provides additional protein to meet milk production requirement. The balance is associated with baseline concentration of urea in the plasma and milk (Roy *et al.,* 2005). Urea concentration can be tested from samples of either blood or milk. The concentration of blood urea may be estimated by measuring milk urea nitrogen (MUN) because milk is an easy fluid to collect and is done at least twice a day on most farms, milk urea will be slightly less volatile than a blood sample which is an invasive and time-consuming procedure. If milk is sample from an evacuated gland, urea concentration is very close to blood concentration at that time and all the factors which influence blood urea will influence milk urea (Broderick and Clayton, 1997). The mean MUN for the cows would be expected to fall within predictable range, if the MUN was outside this range it would suggest problems in protein supply (Schepers and Meijer, 1998). The urea concentration in milk may provide an opportunity to look at problems with the feeding program and system within our farm.

However in Sudan, there is an urgent need for on-farm diagnostic tool to monitor the adequacy of protein feeding offering the opportunity to optimize the efficiency of N utilization (Fadel Elseed *et al.,* 2008). Therefore, the objective of this study was to use the concentration of urea in milk (MUN) to evaluate the protein status in feeds of dairy cows.

2. Materials and methods

2.1. Collection of samples

Random milk samples were collected from eighteen cross bred cows Friesian × local breed) in five dairy farms (A, B, C, D and E) located in Khartoum North to determine the urea concentration. The samples were collected separately from each cow in a capped plastic bottle and immediately stored in freezer at (- 4ºC) until analysis. Sample of concentrate rations offered have been collected for analysis from the five farms. Diets consisted mainly of fresh sorghum and alfalfa forages offered ad libitium and concentrate. Almost all farms investigated adopt group feeding system and not according to production levels. Data were also collected on energy and protein balance. Energy and protein balance were calculated according to the NRC NE_L system (NRC, 1989; 2001).

2.2. Chemical analysis

Feed samples were analyzed for DM, OM, CF and N according to AOAC (1990). Milk urea nitrogen (MUN) was determined according to a modified Conway method (Voigt and Steger, 1967).

2.3. Statistical analysis

Data were subjected to analysis of variance according to Steel and Torrie (1980). A simple correlation was used to establish the relationship between MUN and crude protein. The comparison among means was analyzed by the least significant difference using LSD procedure of the Statisticx (Analytical Software, 2000).

3. Result and discussion

The proximate composition of the rations from the 5 farms is presented in Table 1. Ether extract (EE) and crude fiber (CF) contents were relatively similar to the recommended levels suggested by NRC (1989). However, the lowest CP content (19.9%) was reported for farm C, while the highest value (24.5%) was reported for farm A. These values were higher than 15-17% CP levels that optimize the feed intake and milk production of dairy cattle (Krober *et al*., 1999; Nielsen *et al*., 2003). Feeding excess protein in relation to requirements increase environmental N emissions (Castillo *et al*., 2000; Duinkerken *et al.,* 2011), impairs reproductive performance (Shingfield *et al*., 1999), reduced energy availability and cause economical losses (Ferguson and Chalupa, 1989: Biswajit *et al*., 2011).

The mean MUN concentrations of 35.6 mg/dl was recorded in farm A compared to 20.1, 17.0, 13.1 and 11.4 mg/dl for farm D, E, B, and C, respectively (Table 2). Since the urea concentration in cow milk is influenced by the amount of CP in the diet (Carlsson and Bergstrom, 1994), higher concentration of urea were obtained in this study for Farm A, D and E. However, the variation in MU concentration within the farm ranged from 29.6 to 45.5 mg/dl in farm A, 7.0 to 21.0 mg/dl in farm B, 7.0 to 14.0 mg/dl in farm C, 10.5 to 31.5 mg/dl in farm D and 7.0 to 35.0 mg/dl in farm E (Table 2). The variation in MUN concentration between and within the farms may results from the individual cow variability, feed intake, health status of the cows, milk production, and the age of the cows (Erbersdobler, *et al*., 1990; Carlsson, *et al*., 1995; Schepers and Meijer, 1998).

The result shows significant ($P<0.05$) and positive correlation ($r^2 = 0.81$) between CP and MUN in consistent with other literature (Jonker *et al*., 2002; Nousiainen *et al*., 2004). Therefore, measurement of MUN could be used to assess the adequacy of protein feeding in dairy cows and the efficiency of N utilization for milk production (Broderick and Clayton, 1997; Jonker *et al*., 1998; 2002; Kohn *et al*., 2002). Normal MUN values are somewhere between 10 and 16 mg/dl. Values in excess of 16 or 17 would be considered high and may indicate over feeding of protein or underfeeding carbohydrates. However, MUN values below 10 may indicate protein rations could be increased to increase milk production without stressing the cows (Jonker *et al*., 1998).

4. Implication

Since milk is easily collected and can be determined accurately for urea, MUN could be used to predict CP concentrations of diets fed on-farm. Because of the large variation among and within cows in MUN, monitoring the protein nutrition of an individual dairy cow should never be interpreted without evaluating overall feeding management.

Table 1. Chemical composition (%) and estimated metabolizable energy of concentrated rations offered in five dairy farms in Khartoum North, Sudan.

Farm	DM	CP	EE	CF	Ash	NFE	EME (Mcal/kg)
A	93.12	24.47	4.97	10.42	7.76	52.38	2.95
B	93.16	21.45	5.57	9.63	6.02	57.33	3.06
C	94.57	19.09	4.43	14.1	14.16	47.41	2.65
D	86.05	22.32	4.92	10.11	5.71	56.94	3.03
E	91.82	21.56	4.94	8.40	7.01	58.09	3.03

CP: Crude protein; EE: Ether extract; CF: Crude fiber; NEF: Nitrogen free extract; EME: Estimated metabolizable energy

Table 2. Milk urea nitrogen (mg / dl) concentration of in five dairy farms in Khartoum North, Sudan

Farm	MUN mg/dl			SE
	Mean	Minimum	Maximum	
A*	35.61[a]	29.75	45.50	2.11
B	13.13[c]	7.00	21.00	2.11
C	11.38[c]	7.00	14.00	2.11
D	20.13[b]	10.50	31.50	2.11
E	17.00[bc]	7.00	35.00	2.25

SE: Standard error

**Milk of eighteen cows from each farm was analyzed for milk urea nitrogen (MUN)*

[a-c] *Means with different superscript in the same row differ significantly (P<0.05)*

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