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Effect of Milk Urea Nitrogen of Dairy Cows in Relation to Breed

Research Article

M.R. Islam[1], M.N. Uddin[2], M.R. Akanda[3], M.M.H. Khan[4], M.A. Baset[2] and S.A. Belal[5*]

[1] Deputy Manager, ACI Godraj Ltd, Bangladesh
[2] Department of Livestock Production and Management, Sylhet Agricultural University, Sylhet, Bangladesh
[3] Department of Pharmacology and Toxicology, Sylhet Agricultural University, Sylhet, Bangladesh
[4] Department of Chemistry and Biochemistry, Sylhet Agricultural University, Sylhet, Bangladesh
[5] Department of Poultry Science, Sylhet Agricultural University, Sylhet, Bangladesh

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*Correspondence E-mail: belalsa.dps@sau.ac.bd

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ABSTRACT

Milk urea nitrogen (MUN) of dairy cows was determined in relation to breed. A total of forty (40) Pabna and red Chittagong dairy cattle each of twenty (20) were selected to know the milk composition, nutritional status and milk urea nitrogen. Live weight of Pabna Cattle (187±14 kg) was higher than that of red Chittagong cattle (174±4 kg). In Pabna cattle milk yield (4.94 kg), minerals (0.15%) and lactose (5.38%) is more than red Chittagong cattle milk yield (3.62 kg), minerals (0.12%) and lactose (5.37%) but fat (5.04%), protein (3.7%) and solid not fat (SNF) content (9.92%) was more in red Chittagong cattle than Pabna cattle fat (4.03%), protein (3.64%) and SNF (9.87%). The metabolic energy 74.93 MJ/day, dry matter 9.47 kg, crude protein 0.84 kg , ash 1.24 kg, crude fiber 2.18 kg and true digestible nutrient 5.43 kg was required for Pabna cattle and in red Chittagong cattle metabolic energy 72.60 MJ/day, dry matter 9.14 kg, crude protein 0.660kg , ash 1.16 kg, crude fiber 1.93 kg and true digestible nutrient 5.19 kg was required. Milk urea nitrogen (MUN) concentration was higher under in Pabna cattle (38.15 mg/dL) than red Chittagong cattle (RCC) (29.30 mg/dL). Milk urea nitrogen (MUN) differ Pabna cows and red Chittagong cows.

KEY WORDS dairy cows, milk, urea nitrogen.

INTRODUCTION

Milk is one of the physiological products of cows. It varies in composition depending on plane of nutrition of cows, any relation between the composition of milk and the diets fed to cows may produce some options to develop feeding guides for milking cows. Milk urea nitrogen (MUN), a fraction of milk protein that is derived from blood urea nitrogen (BUN), may be one the useful tools (Peterson *et al.* 2004; Garcia *et al.* 1985; Oltner and Wiktorsson, 1983) that may help monitoring of any change required in the feeding and management of a herd. The MUN has been used as a non-invasive measurement of monitor the animal's protein status and the efficiency of N utilization (Eicher *et al.* 1999; Jonker *et al.* 1998; Broderick and Clayton, 1997; Moore and Verga, 1986). Milk Urea nitrogen is a by-product of dairy cattle protein metabolism. Ammonia, which is toxic to the animal, is generated from dietary protein fermentation in the rumen and from body tissue protein catabolism, and is released into blood stream.

The blood stream carries ammonia to the liver to be detoxified by converting it to urea. Urea is released back into blood stream and excreted proportionally from the body by the kidney through urine. Urea can easily diffuse from blood to milk; therefore MUN is highly correlated with blood urea nitrogen and plasma nitrogen (Jonker *et al.* 1998; Broderick and Clayton, 1997). Milk urea nitrogen is a normal component of milk and comprises about 20% to

75% of the milk non-protein nitrogen. Milk urea nitrogen (MUN) concentration for individual cow ranges from 8 to 25 mg/dL while optimum concentration for a herd ranges from 12 to 17 mg/dL (Hwang *et al*. 2000; Baker *et al*. 1995; Roseler *et al.* 1993).

Average MUN values may range from 10 to 14 mg/dL (Moore and Verga, 1986; Carlsson and Pehrson, 1994). Body weight or metabolic body weights have been reported to be negatively associated with MUN concentration by Oltner *et al*. (1985) and Jonker *et al*. (1998). The weight of blood of an animal is proportional to the animal's body weight. Therefore, given same amount of urea in the blood, a large animal should have more diluted MUN concentration than a smaller animal (Oltner *et al*. 1985). Thus, the study was conducted to estimate the status of milk urea nitrogen of Pabna cattle and red Chittagong cattle, to know the milk composition and nutritional status of Pabna cattle and red Chittagong cattle (RCC).

MATERIALS AND METHODS

Study placement and duration

The study was conducted in Bangladesh Livestock Research Institute (BLRI)**,** Savar, Dhaka, Bangladesh. It was conducted from 25th September to 24th October, 2012.

Selection of experimental animal

A total of forty dairy cows were randomly selected from Bangladesh Livestock Research Institute (BLRI)**,** Savar, Dhaka, Bangladesh. Among them, 20 cows were Pabna cattle and 20 are red Chittagong cattle (RCC). The average body weights of Pabna cattle was from 187 ± 14 kg and red Chittagong cattle was from 174 ± 4 kg. Age ranges from 2 years 6 months to 4 years 3 months.

Data collection

The data on management and feeding systems of cows were collected from 25th September to 24th October, 2012 from Bangladesh Livestock Research Institute (BLRI). Feed and milk samples were collected from selected cows and prepare for laboratory analysis.

Live weight of experimental cows

Live weight of experimental cows were taken before feeding every morning and expressed in kilogram (kg). Live weight of each cow was measured using a calibrated electronic digital scale (Baset, 2012).

Measurement of feed intake and chemical composition

The roughage and concentrate feeds were supplied 2 times daily by the respective workers to the selected cows, in morning and evening. The concentrate feeds were given before and roughage feeds were supplied after each milking. Cows consumed all the concentrates but sometime refused green grasses. For measuring feed intake, green grasses were weighed before supplying to the cow; next morning left over green grasses were weighed. Feed intake and refusals were recorded.

The samples of feeds and refusals were analyzed for nutrient composition using the method described by AOAC (1990).

Energy values were adopted from some studies. Fresh water was ensured twice a day (morning at 5.45 a.m. and evening at 4.45 p.m.) during the data collection, but the amount of water was not measured. Milking was done manually twice a day; first in the morning at 6.00 a.m. and again in the evening at 5.00 p.m. Cows were housed in individual stall on a concrete floor in a face-out-stanchion barn throughout the period of data collection.

Preparation of milk sample

Milk samples were warmed at room temperature (30 ˚C) and mixed well. Then 10 mL of milk was deproteinised with 12% TCA solution (10 mL) in a test tube and allowed to stand for one hour and filtered through a Whatman Paper NO.1 and centrifuged at 3000 rpm for 30 minutes. Then clear supernatant (2 mL) was mixed with 2 mL of DMAB reagent (1.6 g DMAB+90 mL ethanol + 10 mL concentrate HCL) in a cubate and spectrophotometer reading was taken at 425 nm and recorded.

Milk yield and milk composition

The daily milk yield of individual cow was recorded and milk samples were collected in every day. Samples were preserved at -20 ˚C and carried out and analyzed for fat, protein, lactose, solid not fat (SNF) and minerals in Dairy Science Laboratory of Animal Production Research Division (APRD), Bangladesh Livestock Research Institution (BLRI), Savar, Dhaka using a Milk Analyzer (LactoStar, Funke Gerber).

Determination of milk urea nitrogen (MUN)

Samples were analyzed for 'milk urea nitrogen (MUN) content of milk using a colorimetric di-methyl amino benzaldehyde (DMAB) method as described by some studies. Spectrophotometer absorbance is taken at 425 nm.

Statistical analysis

Data were analyzed in a 2 × 2 factorial experiment in a completely randomized block design (CRD) using a computer package GENSTAT. to determine the effects of breed on MUN and its relations with the quality of diets and milk.

RESULTS AND DISCUSSION

Management systems of Pabna cattle and red Chittagong cattle

Pabna cattle and red Chittagong cattle in Bangladesh Livestock Research Institute (BLRI) were reared face out system in bricked (floor), open sided and tin roofed shed. Milking was done by hand twice a day. Milking interval was 10 hours at morning (a.m.) to evening (p.m.) and 14 hours at evening (p.m.) to morning (a.m.). The culling rate (%/year) of Pabna cattle and red Chittagong cattle were 2 and 3, respectively in BLRI. The milk urea nitrogen may be affected by milking system, milking frequency, milking interval and length of lactation. These results are consistent with the findings of Baset (2012).

Effect of breed on nutrients intake of Pabna cattle and red Chittagong cattle

The effect of breed on nutrients intake of Pabna cattle and red Chittagong cattle are presented in Table 1 Pabna cattle are heavier than red Chittagong cattle.

Table 1 Effect of breed and nutrients intake on Pabna cattle and red Chittagong cattle

Parameter	Average value		LSD and level of significance
	Pabna cattle	Red Chittagong cattle	
Live weight, (kg)	187.6	174.7	7.12**
DM, (kg/d)	9.47	9.14	0.41ns
CP, (kg/d)	0.84	0.66	0.04**
Ash, (kg/d)	1.24	1.16	0.05**
CF, (kg/d)	2.18	1.92	0.09**
ME, (MJ/d)	74.93	72.60	3.61**
TDN, (kg/d)	5.43	5.19	0.23**

DM: dry matter; CP: crude protein; CF: crude fibre; ME: metabolizable energy and TDN: total digestible nutrients.
LSD: least significant difference.
NS: non significant.
** (P<0.01).

The live weight of Pabna cattle and red Chittagong cattle were 187.6 kg and 174.7 kg respectively, which was statistically significant (P<0.01). Genetically Pabna cattle are larger in size than red Chittagong cattle. Nutrients intakes of Pabna cattle were higher than the red Chittagong cattle though it was not significant. Daily dry matter (DM) intake of Pabna cattle was 9.47 kg/d and red Chittagong cattle was 9.14 kg/d. Crude protein (CP) intake of Pabna cattle and red Chittagong cattle were 0.84 kg/d and 0.66 kg/d, respectively, intake of Ash and crude fibre (CF) were 1.24 kg/d and 2.18 kg/d in Pabna cattle and 1.16 kg/d and 1.92 kg/d in red Chittagong cattle, respectively which were significant (P<0.01).

On the other hand daily metbolizable energy (ME) intake of Pabna cattle and red Chittagong cattle were 74.93 MJ and 72.60 MJ, respectively, which was also significant (P≤0.01).

Baset (2012) found that the effect of genotype (local and cross breed cows) on live weight of local cow was 247.5 kg and crossbred cow was 318.8 kg.

Daily dry matter intake of local cow 5.75 kg and crossed breed cow was 8.17 kg. Daily ME intake of local cow (45.60 MJ) and crossed cow (64.82 MJ), which were lowered compared to the requirement as per ARC (1994). Daily CP intake of crossbred cow was 708 g and local cow was 517 g.

Law *et al.* (2009) reported increase in DM intake when dietary CP (11.4%) and RDP (7.55%) where increased to 14.4% and 9.45 respectively. Reynal and Broderick (2005) and Kalscheur *et al.* (2006) did not report any increase on DM intake when cows fed diets deficient in RDP according to NRC (2001) (7.7 and 6.8% of DM, respectively) where supply with extra rumen degradable protein. The daily protein intake as live weight and milk production in good and poor feed base management condition were significantly (P<0.01) lower (-270.0 and -164.5 g, respectively) than the requirement (ARC, 1994).

Effect of breed on live weight, milk yield, milk composition and milk urea nitrogen of Pabna cattle and red Chittagong cattle (RCC)

The effect of breed on live weight milk yield, milk composition and milk urea nitrogen of Pabna cattle and red Chittagong cattle is presented in Table 2. Daily milk yield of Pabna cattle was 1.5 times higher than red Chittagong cattle. Milk yield of Pabna cattle was 4.97 kg and red Chittagong cattle were 3.62 kg (Table 3).

Table 2 Effect of breed on live weight, milk yield, milk composition and milk urea nitrogen of Pabna cattle and red Chittagong cattle

Parameter	Average value		LSD and level of significance
	Pabna cattle	Red Chittagong cattle	
Live weight, (kg)	187.60	174.70	7.12**
Milk yield, (kg/d)	4.97	3.62	0.23**
Fat, %	4.03	5.04	0.24**
Protein, %	3.64	3.70	0.08ns
Lactose, %	5.38	5.37	0.09ns
SNF, %	9.87	9.92	0.11ns
FPP ˚C	-0.60	-0.61	0.01**
Minerals	0.15	0.12	0.03**
MUN (mg/dL)	38.15	29.30	0.05**

SNF: solid not fat and MUN: milk urea nitrogen.
LSD: least significant difference.
NS: non significant.
** (P<0.01).

Fat percentage (4.03%) was higher in red Chittagong cattle than Pabna cattle, (5.04%) and found significant. Protein percent was more or less similar in red Chittagong cattle and Pabna cattle and found not significant. Percentage of lactose in milk of Pabna cattle and red Chittagong cattle were 5.38% and 5.37% which are more or less similar and found not significant.

Minerals percent in Pabna cattle (0.15%) was also higher than red Chittagong cattle (0.12%) and differed significantly (P<0.01).

Solids-not-fat found 9.87 and 9.92 % in Pabna cattle and red Chittagong cattle, respectively.

Table 3 Effect of breed on milk yield, milk composition and milk urea nitrogen at morning

Parameter	Average value		LSD and level of significant
	Pabna cattle	Red Chittagong cattle	
Live weight (kg)	187.60	174.70	7.12**
Milk yield (kg/d)	3.25	2.45	0.38**
Milk composition			
Fat (%)	3.8	4.15	0.32**
Protein (%)	3.44	3.36	0.10ns
Lactose (%)	5.24	5.15	0.17ns
SNF (%)	9.59	9.86	0.19ns
Minerals (%)	0.14	0.13	0.04**
MUN (mg/dL)	38.75	29.33	0.47**

SNF: solid not fat and MUN: milk urea nitrogen.
LSD: least significant difference.
NS: non significant.
** (P<0.01).

MUN found 38.15 and 29.30 mg/dL in Pabna cattle and red Chittagong cattle, respectively and differed significantly (p<0.01). Baset (2012) found that milk yield of local cows were lower than crossbred cows. Daily milk yield and 4% FCM of local cows were 3.26 and 3.28 kg, respectively and crossbred cows were 7.18 and 6.52 kg, respectively. The milk protein of local cow was 3.73% and of crossbred was 3.70%. The MUN of local cow and crossbred cow were 31.97 mg/dL and 35.44 mg/dL, respectively, which were statistically significant (P<0.01). In some study reported variation like this study. Variation in lactation yield and genetic quality of cows fed diets containing similar levels of nutrition, especially of protein, may also affect MUN contents (Grande *et al.* 2009).

Effect of breed on milk yield, milk composition and milk urea nitrogen at morning and evening milk is presented in Table 3 and Table 4, respectively. Daily milk yield of Pabna cattle and red Chittagong cattle were higher at morning than evening but percentage of milk composition was lower at morning than evening. Milk yield in Pabna cattle and red Chittagong cattle found 3.25 and 2.45 kg/d, respectively at morning, and 1.72 and 1.17 kg/d, respectively at evening. Fat, protein, and SNF of Pabna cattle were 3.8, 3.44 and 9.59%, respectively at morning and 4.26, 3.84 and 10.15%, respectively at evening. Fat, protein, and SNF of red Chittagong cattle were 4.15, 3.84 and 9.86%, respectively at morning and 5.93, 4.06 and 9.98%, respectively at evening. MUN of Pabna cattle and red Chittagong cattle found higher at morning than at evening. MUN of Pabna cattle and red Chittagong cattle were 38.75 and 29.33 mg/dL, respectively at morning and 37.55 and 29.27 mg/dL, respectively at evening. MUN of Pabna cattle and red Chittagong cattle were statistically significant.

Table 4 Effect of breed on milk yield, milk composition and milk urea nitrogen at evening

Parameter	Average value		LSD and level of significant
	Pabna cattle	Red Chittagong cattle	
Live weight (kg)	187.60	174.70	7.12**
Milk yield (kg/d)	1.72	1.17	0.13**
Milk composition			
Fat (%)	4.26	5.93	0.40ns
Protein (%)	3.84	4.06	0.09ns
Lactose (%)	5.54	5.59	0.13**
SNF (%)	10.15	9.98	0.12ns
Minerals (%)	0.16	0.11	0.03**
MUN (mg/dL)	37.55	29.27	0.04**

SNF: solid not fat and MUN: milk urea nitrogen.
LSD: least significant difference.
NS: non significant.
** (P<0.01).

This level of MUN concentration was 2 to 3 times higher than others works (Broderick, 2003; Reynal and Broderick, 2005; Kalscheur *et al.* 2006) but it was consistent with 15-25 mg/dL reported by Wenninger and Distl (1994), 29.2 ± 2.6 to 45.3 ± 0.9 mg/dL reported by Dhali *et al.* (2005) and 24.57 to 28.00 mg/dL by Shewy *et al.* (2010) and 28.55 to 38.86 mg/dL by Baset (2012).

Effect of breed on milk urea nitrogen (MUN) of Pabna cattle and red Chittagong cattle (RCC)

Milk urea nitrogen (MUN) content of Pabna cattle and red Chittagong cattle (RCC) were found 38.75 mg/dL and 29.33 mg/dL in morning (a.m.) respectively, which was significant (P<0.01) (Table 5).

Table 5 Effect of breed on milk urea nitrogen (MUN) of Pabna cattle and red Chittagong cattle

Parameter	Average value		LSD and level of significance
	Pabna cattle	Red Chittagong cattle	
MUN (mg/dL) at morning	38.75	29.33	0.047**
MUN (mg/dL) at evening	37.55	29.27	0.043**
Average MUN (mg/dL)	38.15	29.30	0.05**

MUN: milk urea nitrogen.
LSD: least significant difference.
NS: non significant.
** (P<0.01).

In the evening time milk urea nitrogen (MUN) for Pabna cattle and red Chittagong cattle (RCC) were found 37.55 mg/dL and 29.27 mg/dL respectively, which was significant (P<0.01). Average of days milk urea nitrogen (MUN) for Pabna cattle and red Chittagong cattle (RCC) were found 38.15 mg/dL and 29.30 mg/dL respectively, which was significant (P<0.01). This level of MUN concentration was 2 to 3 times higher than others works (Broderick, 2003;

Reynal and Broderick, 2005; Kalscheur *et al*. 2006) but it was consistent with 15-25 mg/dL reported by Wenninger and Distl (1994), 29.2 ± 2.6 to 45.3 ± 0.9 mg/dL reported by Dhali *et al*. (2005), and 24.57 to 28.00 mg/dL Shewy *et al*. (2010) and 28.55 to 38.86 mg/dL Baset (2012).

CONCLUSION

Milk urea nitrogen is very important to know the nutritional status of animal. If milk urea nitrogen is more and body condition of animal is good then protein percentage should decrease in ration formulation. On the other hand if milk urea nitrogen is more and body condition of animal is bad then protein percentage should increases. Milk urea nitrogen concentration can help us to make ration formulation.

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