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EFFECTS OF HERD, SEASON AND DAYS IN MILK ON MILK UREA NITROGEN OF CROSSBRED DAIRY COWS IN SYLHET

Nusrat Zahan Shoshe[1] , Md. Abdul Baset[1], Md. Tariqul Islam[2], Shiekh MA Matin[3] and Md. Abdullah-Al-Mahmud[3]

[1]Department of Livestock Production and Management, Sylhet Agricultural University, Sylhet; [2]Additional Director, Department of National Security Intelligence, Sylhet; and [3]Veterinary Surgeon/Additional Veterinary Surgeon, Upazila Livestock Office, Ullapara, Sirajganj

***Corresponding author:** Md. Abdullah-Al-Mahmud, E-mail: dr.mahmud04@gmail.com

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ABSTRACT

The study included 724 crossbred cows (Local × Holstein Friesian) from 9 dairy farms of Sylhet district from July 2013 to June 2014 to determine the effect of herd, season, and days in milk in milk urea nitrogen and the effect of milk production and composition on milk urea nitrogen. According to the season, milk samples were divided into two groups: wet season (June - October) and dry season (November - February). Days in milk (DIM) were grouped into two lactation stages: Lactation 1 (<100 days in milk) and Lactation 2 (>100 days in milk). Milk urea nitrogen was grouped into five categories by increments of 5 mg/dl, started with those less than 10 mg/dl and finishing with concentration greater than 25 mg/dl. The daily milk yield was 6.78 kg ranged from 2.00 to 18.00 kg. The mean of milk urea nitrogen (MUN) concentration was 14.58 mg/dl. Mean values for milk fat and protein contents were 3.74 % and 3.72 %. Among the 9 herds, the highest content of milk urea (MU) was 16.37 mg/dl which was found in herd 2 and the second highest estimation of MU content were in herd 1, 3, 6 and 9 (15.58, 15.51, 15.12 and 14.45 mg/dl, respectively). In the district of Sylhet, the lowest MU content was estimated in herd 4, 5, 7 and 8 (13.59, 13.48, 13.16 and 13.60 mg/dl, respectively). Difference of MUN concentration was not significant between the dry and wet season. The MUN concentrations were 14.82 mg/dl and 14.90 mg/dl in dry and wet season respectively. The concentration of MUN in Lactation 1 was 13.61 mg/dl and in Lactation 2 was 16.26 mg/dl. Milk fat (%) were 3.56, 3.77, 3.64, 4.15 and 3.66 when MUN concentration were ≤10.00, 10.01-15.00, 15.01-20.00, 20.01-25.00 and ≥24.01 mg/dl respectively. Daily milk yield did not increase with the increase of MUN concentration. Milk yield were 6.37, 7.21, 6.23, 7.31 and 7.00 Kg/d while MUN concentration were ≤10.00, 10.01-15.00, 15.01-20.00, 20.01-25.00 and ≥25.01 mg/dl. It may be concluded that herd category and lactation stage influence the milk urea nitrogen concentration of crossbred dairy cows in the Sylhet district.

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INTRODUCTION

Milk urea nitrogen (MUN), a fraction of milk protein that is derived from blood urea nitrogen (BUN), may be one of the useful tools (Zhai et al., 2006; Dhali et al., 2005 and Peterson et al., 2004) that may help monitoring of any change required in the feeding and management of a herd. The MUN has been used as a noninvasive measurement to monitor the animal's protein status and the efficiency of N (nitrogen) utilization (Brodrick and Clayton, 1997; Jonker et al., 1998; Eicher et al., 1999). Normal value of BUN in cows is 15 mg/dl (Roseler et al., 1993) and 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 (Baker et al., 1995; Hwang et al., 2000). Imaizumi et al. (2010) and Moore and Verga (1986) reported average MUN values may range from 10 to 14 mg/dl. The liver convert ammonia to urea to be excreted or recycled and it diffuses freely across the cell membranes, and, therefore, MUN concentrations represent BUN. If, BUN values are elevated the MUN will be elevated. If MUN values are high, a herd may experience wasting of feed protein along with excess excretion of nitrogen into the environment causing pollution. If MUN values are too low, the rumen microbial protein yield may be reduced thereby limiting milk production and milk protein yield (Brodrick and Clayton, 1997).

Availability of rumen degradable carbohydrate, a key factor that provides energy to the rumen microbes to convert ammonia into microbial protein often affects MUN values. Feeding too much dietary protein, and diets containing higher level of degradable and/or soluble protein, such as urea, may enhance MUN, even a diet contains a normal level of total crude protein (CP). Variation in lactation yield and genetic quality of cows fed diets containing similar level of nutrition, especially of protein, may also affect MUN contents. Evaluation of MUN content of milk during the collection time may give a good indication on protein availability to cows from the diets fed to them. Thus, determination of MUN values of cows available in different regions considering variations in plane of nutrition, feed availability, seasons, lactation stage and genotypes are important, this would provide database for developing relations between MUN content and dietary nutrition, and further, it would facilitate undertaking research works for MUN indicator development to monitor dairy cow feeding and nutrition. These MUN indicators may guide farmers for better feeding of their cows to increase productivity, and to bring more economic benefits and nutrition for their family. A little work has been done on milk urea nitrogen by Baset (2010) of his PhD research in Bangladesh. The objectives of this study were (i) to determine the effect of herd, season, and days in milk on milk urea nitrogen and (ii) to determine the effect of milk production and composition on milk urea nitrogen.

MATERIAL AND METHODS

The study included 724 crossbred cows (Local × Holstein Friesian) from 9 dairy farms of Sylhet district from July 2013 to June 2014. According to the season, milk samples were divided into two groups: wet season (June - October) and dry season (November - February). Days in milk (DIM) were grouped into two lactation stages: Lactation 1 (<100 days in milk) and Lactation 2 (>100 days in milk). Milk urea nitrogen was grouped into five categories by increments of 5 mg/dl, started with those less than 10 mg/dl and finishing with concentration greater than 25 mg/dl. All cows were milked twice daily, housed in free stalls and fed a total mixed ration (TMR) twice a day; no distinction was made for management style and feeding scheme.

Test day observations were combined into a data set that included herd code, date of test, milk yield, milk fat content, milk protein content, MU concentration, breeding date and days in milk (DIM). The daily milk yield of individual cow was recorded and milk samples were collected monthly. Samples were preserved at -20°C and carried out in the laboratory of the department of Livestock Production and Management, Sylhet Agricultural University, Sylhet and analyzed for fat, protein, lactose, SNF (Solid not fat) minerals using a Milk Analyzer (LactoStar, Funke Gerber, Germany) and following the method of Baset et al. (2009) for milk urea nitrogen. Statistical data analysis was carried out using SAS program (SAS, 2001). Descriptive statistics for milk yield, fat and protein content and milk urea nitrogen (MUN) were calculated. The relation between MUN concentration, herd, season, and lactation stage were analyzed using the PROC GLM of SAS (2001). Statistical significance among treatment means was determined by Duncan's multiple range tests.

RESULTS AND DISCUSSION

Milk yield, milk fat and protein and MUN of 724 dairy cows in Sylhet district of Bangladesh are presented in Table 1. In this data set, the daily milk yield was 6.78 kg ranged from 2.00 to 18.00 kg. Mean daily milk yield per cow was lower in comparison with studies of Jilek et al. (2006), Abdouli et al. (2008) and Konjačić et al. (2010).

Table 1. Descriptive Statistics of analyzed variable (n = 724)

Parameter	Mean	SEM	Minimum	Maximum
Milk yield, kg/d	6.78	0.113	2.00	18.00
Fat, %	3.74	0.030	2.20	5.60
Protein, %	3.72	0.009	3.04	4.27
Lactose,	5.41	0.012	4.42	6.20
Solids-not-fat, %	9.79	0.022	7.80	12.00
Minerals, %	0.624	0.0019	0.520	0.780
Total Solids, %	13.28	0.046	11.00	16.00
Milk urea nitrogen, mg/dl	14.58	0.158	6.70	29.00

SEM= Standard Error Mean

The mean of MUN concentration was (14.58 mg/dl) higher than values reported in studies of Johnson and Young (2003), Rajala-Schultz and Saville (2003) and Yoon et al. (2004), but lower than values reported Jilek et al. (2006), Abdouli et al. (2008) and Konjačić et al. (2010). This finding suggests that cows are fed diets in high protein, insufficient energy supply or influenced by some non-nutritional factors. It is possible that the high MUN may be caused by high concentrate ration. However, until more is known about the factors which affect MU concentration, the results must be interpreted with caution and only after taking into consideration the variations in feeding practices and management systems in different countries. Thus, it is necessary to consider non-nutritional factors such as herd, season, genotype and lactation stage affecting milk production and MUN concentration. Mean values (±SE) for milk fat and protein contents were 3.74 (±0.030) % and 3.72 (±0.009) %. Means milk fat was lower and milk protein was higher than those reported by Rajala-Schultz and Saville (2003), Jilek et al. (2006), Abdouli et al. (2008) and Konjačić et al. (2010).

Means of milk urea nitrogen concentration by herd category

Herd means a group of cattle or other domestic animals of a single kind kept together for a specific purpose (The Free Dictionary). In this research work, 9 herds was selected on the basis of several factors such as feeding and nutrition status, milk production, stage of lactation, body weight, number of milking cows. From the result, the highest content of MU (16.37 mg/dl) was found in herd 2 (Table 2). It significantly differed ($P < 0.05$) from LSM (Least square means) in all other herds, similar to the second highest estimation of MU (Milk urea) content were in herd 1, 3, 6 and 9 (15.58, 15.51, 15.12 and 14.45 mg/dl, respectively). In the district of Sylhet, the lowest MU content were estimated in herd 4, 5, 7 and 8 (13.59, 13.48, 13.16 and 13.60 mg/dl, respectively), which may be due to variation in supply of protein concentrate and also other factors. The effect of herd on MUN content is related to the different ratio of energy and protein in the feeding dose, as was reported by Carlsson and Pehrson (1994).

Table 2. Means of milk urea nitrogen (MUN) concentration by herd categories

	Herd								
	1	2	3	4	5	6	7	8	9
N	77	91	64	70	71	76	71	84	120
MUN (mg/dl)	15.58^{ab}	16.37^{a}	15.51^{ab}	13.59^{c}	13.48^{c}	15.12^{ab}	13.16^{c}	13.60^{c}	14.45^{bc}
SE	0.46	0.583	0.460	0.476	0.440	0.434	0.509	0.439	0.343

Different letters of superscript mean significant difference at the level of p<0.01

Influence of season on milk urea nitrogen

Influence of season on milk urea nitrogen is shown in Table 3. Difference of MUN concentration was not significant between the dry and wet season. The MUN concentrations were 14.82 mg/dl and 14.90 mg/dl in dry and wet season respectively. Fatehi et al. (2012) reported that MUN concentration was lower in the December (13 mg/dl), and reached a maximum in July of 18.8 mg/dl. Carlsson et al. (1995), Godden et al. (2001), Rajala-Schultz and Saville (2003) reported higher MUN concentration in the summer. They also reported that effect of season was much less evident in the high producing herds that could be explained by lower dry meter and protein component intake in the summer.

Table 3. Influence of season on milk urea nitrogen

	Dry season	Wet season	Level of significance
N	321	403	-
Milk urea nitrogen (mg/dl)	14.82	14.90	NS
SE	0.236	0.211	-

N: Number of animal, SE: Standard Error, Dry season: Nov–Feb. 2014 & wet season: Jun.–Oct. 2013
NS. Not significant at the 0.01 level

Influence of lactation stage on milk urea nitrogen

MUN of cows by lactation stage are shown in table 4. The concentration of MUN in Lactation stage 1 was 13.61 mg/dl and in Lactation stage 2 was 16.26 mg/dl. The concentration of MUN in Lactation 2 was significantly higher ($P<0.01$), that shows the same results with Carlsson et al. (1995); Eicher et al. (1999); Godden et al. (2001). A factor may be involved in the reduction of MUN concentration during the lactation stage-1 is the inability of cows to ingest insufficient feed early in the lactation, leading to relatively lower protein intake (Carlsson et al., 1995). Arunvipas et al. (2002) associated the lowest MUN level during the first month of lactation explained by low DM (Dry matter) intake during this stage of lactation and it reached to the peak at fourth month of lactation due to the increase in DM intake and decreased at the end of lactation as a result of the reduction in DM and protein consumption in this stage.

Table 4. Influence of lactation stage on milk urea nitrogen

	Lactation 1	Lactation 2	Level of significance
N	345	379	-
Milk urea nitrogen (mg/dl)	13.61	16.26	**
SE	0.221	0.210	-

Lactation 1: ≤ 100 days in milk & Lactation 2: ≥ 100 days in milk; **. Significant at the 0.01 level

Influence of milk yield, fat and protein percentage on milk urea nitrogen

Descriptive information about milk yield, fat and protein percentage stratified by MUN category, are summarized in Table 5. Association between MUN concentration and milk protein percentage was negative. The data suggest that milk protein percentage was highest when MUN values were lower than 10.00 mg/dl. Konjačić et al. (2010) reported a negative relationship between the MUN concentration and milk protein percentage. Similar relationship was reported by Johnson and Young (2003), width exception of protein percentage which was the highest (3.40%) when MUN values ranged from 6.01 to 8.00 mg/dl. Milk fat (%) were 3.56, 3.77, 3.64, 4.15 and 3.66 when MUN concentration were ≤10.00, 10.01-15.00, 15.01-20.00, 20.01-25.00 and ≥24.01 mg/dl respectively. Above data suggest that milk fat percentage did not decreased consequently with the increase of MUN concentration. An inverse relationship was reported by Konjačić et al. (2010). Daily milk yield did not increase with the increase of MUN concentration. Milk yield were 6.37, 7.21, 6.23, 7.31 and 7.00 Kg/d while MUN concentration were ≤10.00, 10.01-15.00, 15.01-20.00, 20.01-25.00 and ≥25.01 mg/dl. While Konjačić et al. (2010) reported that daily milk yield increased with increasing of MUN.

Table 5. Daily milk yield, fat and protein percentage by milk urea nitrogen (MUN) categories

MUN (mg/dl)	N (724)	Milk yield (kg/d)	Fat (%)	Protein (%)
≤10.00	105	6.37±0.294	3.56±0.077	3.77±0.023
10.01-15.00	292	7.21±0.176	3.77±0.046	3.73±0.014
15.01-20.00	234	6.23±0.197	3.64±0.052	3.69±0.015
20.01-25.00	85	7.31±0.327	4.15±0.085	3.74±0.025
≥25.01	8	7.00±1.066	3.66±0.279	3.68±0.083

Mean significant difference at the level of $p<0.01$

CONCLUSION

The research work was conducted to investigate the effects of herd, season and days in milk in milk urea nitrogen of crossbred dairy cows in Sylhet. The mean of milk urea nitrogen concentration of crossbred dairy cows in Sylhet was 14.58 mg/dl. Mean values for milk fat and protein contents were 3.74 % and 3.72 %. Difference of MUN concentration was not significant between the dry and wet season. In the district of Sylhet, MUN concentration was varied from herd to herd which may be due to variation on feeding and nutritional status especially protein rich feeds, herd size, milk yield, composition of milk, stage of lactation, genotype and overall management system of dairy cow. So, feeding, breeding, sanitation and management system is very important for dairy cattle.

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