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EVALUATION OF MILK UREA NITROGEN OF DAIRY COWS REARED UNDER DIFFERENT FEED BASES IN THE DIFFERENT SEASONS

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ABSTRACT

Ten cows, each of native (local cow) and crossbred (local × crossbred) origins differing in lactation yield were used in 2×2×2×2 factorial experiment using RBD to evaluate existing milk urea nitrogen (MUN) of cows considering regions and seasons. The live weight and BCS of cows under good feed base management condition was higher than of the poor feed base management condition. Feed intake of cows under good and feed base management condition was significantly ($P<0.01$) higher than of the intake of cows under poor feed base condition. Daily dry matter intake (DMI) of cows under good and poor feed base condition was 8.53 and 5.40 kg, respectively. Daily ME intake of cows under good and poor feed base management condition were 70.23 and 40.20 MJ, respectively. The requirements of ME (ARC, 1994) were 83.3 and 51.7 MJ, respectively. The intake of CP, RDP and UDP were 839.0, 488.5 and 350.9 g/d, respectively in good feed base and 386.0, 166.0 and 220.0 g/d, respectively in poor feed base region. 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). The daily RDP intake were significantly ($P<0.01$) lower than the requirement (ARC, 1994). Daily milk yield and 4% FCM of cows under good feed base condition were 6.76 and 6.49 kg, respectively and under poor feed base condition were 3.67 and 3.31 kg, respectively, which differed significantly ($P<0.01$). The milk protein, lactose, SNF, minerals and total solids under good feed base condition were 3.79, 5.49, 10.09, 0.63 and 14.06%, respectively and under poor feed base condition were 3.63, 5.29, 9.80, 0.61 and 13.52, respectively, which were significantly ($P<0.01$) influenced by feed base. MUN and BUN under good feed base condition were found 38.86 and 40.98 mg/dl, respectively and under poor feed base condition 28.55 and 33.13 mg/dl, respectively, and this difference between the two areas were statistically significant ($P<0.01$). The live weight of cow was 284.0 kg in the dry season and in the winter season 282.3 kg which did not differ significantly ($P>0.05$). Intake of CP and RDP in dry season was found 664 and 358.5 g/d, respectively and in the wet season it was 561 and 296 g/d, respectively, which differed significantly ($P<0.01$). BUN and MUN in dry season were 37.35 and 36.79 mg/dl, respectively and in wet season 36.75 and 36.87 mg/dl, respectively. The live weight and BCS of crossbred cows was higher than that of the local cows. The live weight and BCS of crossbred cow were 318.8 kg & 2.85, respectively and of local cow were 247.5 kg & 2.34, respectively, which was significantly ($P<0.01$) higher than local cow. The daily DMI of local cow was 5.75 kg and crossbred cow was 8.17 kg, which differed significantly ($P<0.01$). Daily ME intake of crossbred cow (64.82 MJ) was significantly ($P<0.01$) higher than local cow (45.60 MJ), which were lowered compared to the requirement as per ARC (1994). Daily CP, RDP and UDP intake of crossbred cow were 708, 378 and 330 g, respectively and of local cow were 517, 276 and 240 g, respectively; which differed significantly ($P<0.01$). Daily milk yield and 4%FCM of local cows

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were 3.26 and 3.28 kg, respectively and of crossbred cows were 7.18 and 6.52 kg, respectively, which differed significantly (P<0.01). The milk protein of local cow was 3.73 % and of crossbred was 3.70 %, which differed significantly (P<0.01). The MUN and BUN of the local cow were 31.97 and 34.94 mg/dl, respectively and of crossbred cows were 35.44 and 39.17 mg/dl, respectively, which were statistically significant (P<0.01). It may be concluded that the MUN depends on plane of nutrition of cows, seasons and their genotypes but stages of lactation may not be affect its level in milk.

Key words: milk urea nitrogen, feed base, dairy cow

INTRODUCTION

Milk, one of the physiological products of cows, 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 of the useful tools (Peterson *et al.*, 2004; Garcia *et al.*, 1997; Hof *et al.*, 1997) 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 utilization (Broderick 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 (Roseler *et al*., 1993; Baker *et al.*, 1995; Hwang *et al.*, 2000). Carlsson and Pehrson (1994) & Moore and Verga (1996) reported average MUN values may range from 10 to 14 mg/dl. It is concluded that when BUN and MUN concentrations are lower than normal values, then more rumen degradable protein (**RDP**) may be needed to meet the microbial N requirement for protein synthesis. The liver converts ammonia to urea to be excreted or recycled and it diffuses freely across the cell membranes into blood and, therefore, MUN concentrations represent BUN (Gustafsson and Palmquist, 1993). Jonker *et al.* (1998) reported that MUN and BUN are highly correlated. Roseler *et al*. (1993) and Olmer *et al.* (1985) reported 0.84 and 0.91 correlation between MUN and BUN, respectively. Similarly, high correlation between MUN and BUN was reported by Broderick and Clayton (1997). 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 (Broderick and Clayton, 1997). 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 during collection time of milk may give a good indication on the protein availability of cows from the plane of nutrition that varies on seasons and cropping systems.

MUN provides an accurate reflection of how much nitrogen is absorbed by the cow, but not used for growth or milk protein synthesis. Most of these nitrogens are absorbed from feed. MUN assay may be a guide for identifying diets that's provide too little or too much protein. Dhali *et al.* (2005) studied the effect of urea supplemented and urea treated straw based diet on milk urea concentration in crossbred Karan-Fries cows and reported that MUN is a dietary monitor for dairy cows. Some other researchers (Garcia *et al*., 1997; Gustafsson *et al*., 1993; Hof *et al*., 1997and Roseler *et al*., 1993) also supported this finding.

Feeding standard, ration formulation, software use are the tools for feeding according to requirement, but their use by farmers, especially in developing countries is limited. Determination of milk protein and MUN may, in one hand, be used as an indicator if milk quality and, on the other hand, as a guiding tool for feeding dairy cows. Determination of MUN values may save feed cost, and improve production.

In Bangladesh, in fact, no work has been done, so far, on determining the concentration of MUN in dairy cows. Therefore, determination of optimum level of MUN concentration is worthwhile for economic milk production. Thus, the present work was undertaken with the following objectives.

i) to determine the on-farm plane of nutrition of cows and
ii) to determine the existing status of MUN in relation to region, season, and genotype.

MATERIALS AND METHODS

Animal and site selection: Ten cows, each of native (local cow) and crossbred (Local × Holstein-Friesian) origins (genotypes) differing in lactation yield were selected in Baghabari (Sirajgonj), a good feed base and Burirhat (Rangpur), a poor feed base region of the country in dry (November to February) and wet (June to October) seasons in 2009. A “good and/or poor feed base” region was classified based on the availability of quantity and quality roughages throughout the year. The villages were purposively selected with the help of Milkvita (Bangladesh Milk Producer’s Cooperative Union Ltd., Bangladesh) officials in each region.

Animal weighing and body condition score (BCS): The live weight of each cow was measured using a calibrated digital animal weighing balance (Baset *et al.*, 2010). BCS was assessed by palpating individual body parts and an average score was recorded on a 5-point scale, where 1 was emaciated and 5 was obese (Wildman *et al.*, 1982).

Measurement of feed intake and chemical composition: The roughage and concentrate feeds were supplied 2/2.5 times daily by the respective farmers to the selected cows, in the morning and evening. The concentrate feeds were given before and roughage feeds after each milking. Cows consumed all the concentrates but sometimes refused rice straw and green grasses. For measuring feed intake, rice straw and green grasses were weighed every day before supplying to the cow; next morning left over of straw and green grasses were weighed. Data on feeds and refusals were recorded and analyzed for nutrient composition according to AOAC (2004) in the laboratory of Animal Production Research Division (**APRD**) of Bangladesh Livestock Research Institute (**BLRI**).

Milk yield and milk composition: The daily milk yield of individual cow was recorded and milk samples were collected in a fixed day in each week from milk collection bucket from morning and afternoon milking by through mixing the milk container. Samples were preserved at -20°C and carried out at BLRI through ice box and were analyzed for fat, protein, lactose, Solids-Not-Fat (**SNF**) and minerals in Dairy Science Laboratory of APRD, BLRI using a Milk Analyzer (LactoStar, Funke Gerber).

Determination of BUN and MUN: Blood samples were collected directly from the jugular vein and serum was separated. Samples were preserved at -20°C and carried out at BLRI through ice box. Milk and blood serum were analyzed according to Baset *et al.* (2009).

Statistical analysis: Intakes of metabolizable energy (**ME**), crude protein (**CP**), RDP and rumen undegradable protein (**UDP**) of cows were calculated. Requirements of ME, CP, RDP and UDP of cows were calculated according to ARC (1994). Data were analyzed in a 2×2×2×2 factorial experiment and subjected to ANOVA following the principles of RCBD using computer package GENSTAT (Lawes Agricultural Trust, 1997) and SED or LSD differentiated treatment means. Pearson correlation and linear regression were done among the parameter where it was found appropriate.

RESULTS AND DISCUSSION

Effect of feed base (region) on milk urea nitrogen: Results of the effect of feed base (good and poor) on live weight, BCS and feed intake of dairy cows are presented in Table 1. The live weight and BCS of cows under good feed base management condition was higher than of the poor feed base management condition. The live weight and BCS were 350.9 kg and 3.13, respectively in good feed base and 215.5 kg and 2.07, respectively in poor feed base condition, which differed significantly (P<0.01). Feed intake of cows under good and feed base management condition was significantly (P<0.01) higher than of the intake of cows under poor feed base condition. Daily dry matter intake (**DMI**) of cows under good and poor feed base condition was 8.53 and 5.40 kg, respectively. The roughage/concentrate ratio was significantly (P<0.01) higher in poor feed base management condition (2.64 kg) compared to that of good feed base management condition (1.61 kg). Daily ME intake of cows under good and poor feed base management condition were 70.23 and 40.20 MJ, respectively. Where ME per kg dry matter (**M/D**) in good feed base management condition (8.24 MJ/KgDM) was significantly (P<0.01) higher than that of the poor feed base management condition (7.27MJ/kgDM). The requirements of ME (ARC, 1994) were 83.3 and 51.7 MJ, respectively. The daily intake of ash, organic matter (**OM**) and acid detergent fiber (**ADF**) were significantly (P<0.01) higher in good feed base than that of the poor feed base condition. The intake of CP, RDP and UDP were 839.0, 488.5 and 350.9 g/d, respectively in good feed base and 386.0, 166.0 and 220.0 g/d, respectively in poor feed base region. 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). The daily RDP intake were significantly (P<0.01) lower than the requirement (ARC, 1994).

The milk yield and 4% FCM (kg/d) of cows under the good feed base condition were higher than that of the poor feed base condition (Table 2). Daily milk yield and 4% FCM of cows under good feed base condition were 6.76 and 6.49 kg, respectively and under poor feed base condition were 3.67 and 3.31 kg, respectively, which differed significantly (P<0.01). Feed base did not affect on fat percentage of milk (3.96% & 3.73% for good and poor feed base respectively). The percentage of milk protein, lactose, SNF, minerals and total solids were influenced by feed base. The milk protein, lactose, SNF, minerals and total solids under good feed base condition were 3.79, 5.49, 10.09, 0.63 and 14.06%, respectively and under poor feed base condition were 3.63, 5.29, 9.80, 0.61 and 13.52, respectively, which were significantly (P<0.01) influenced by feed base. MUN and BUN were influenced by feed base. This was due to the intake of higher nutrition of cows under good feed base condition than that of poor base condition. However the intake of nutrients was below the requirement (ARC, 1994). MUN and BUN under good feed base condition were found 38.86 and 40.98 mg/dl, respectively and under poor feed base condition 28.55 and 33.13 mg/dl, respectively, and this difference between the two areas were statistically significant (P<0.01). This level of MUN concentration was 2 to 3 times higher than other works (Broderick 2003; Reynal & 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).

Table 1. Effect of feed base (good/poor) on live weight, body condition score (BCS) and feed intake of dairy cows

Parameter	Mean value		SED/(LSD) and level of significance
	Good Feed base	Poor Feed base	
Live weight, kg	350.9	215.5	(14.02)**
BCS	3.13	2.07	(0.24)**
Feed intake			
DM, kg/d	8.53	5.40	(0.45)**
ME, MJ/d	70.23	40.20	(3.86)**
CP, g/d	839	386	(50.0)**
RDP, g/d	488.5	166.0	(32.95)**
UDP, g/d	350.9	220.0	(19.79)**
Ash, kg/d	0.94	0.75	(0.06)**
OM, kg/d	7.62	4.63	(0.40)**
ADF, kg/d	2.92	1.25	(0.15)**
M/D, MJ/kgDM	8.24	7.27	(0.16)**
Roughage/concentrate	1.61	2.64	(0.35)**
Energy/protein	0.09	0.11	(0.003)**
Requirements (ARC, 1994)			
ME, MJ/d	83.3	51.7	(6.55)**
Protein deficit, g/d	-270.0	-164.5	(18.30)**
RDP, g/d	650.0	403.0	(51.1)**

**. Significant at the 0.01 level, *. Significant at the 0.05 level, NS. Not significant

Table 2. Effect of feed base on milk production, milk composition, milk urea nitrogen (MUN) and blood urea nitrogen (BUN) of dairy cows

Parameter	Mean value		SED/(LSD) and level of significance
	Good Feed base	Poor Feed base	
Milk production, kg/d			
Milk yield	6.76	3.67	(0.75)**
4%FCM	6.49	3.31	(0.73)**
Milk composition, %			
Fat	3.96	3.73	0.13NS
Protein	3.79	3.63	(0.08)**
Lactose	5.49	5.29	(0.12)**
SNF	10.09	9.80	(0.23)*
Minerals	0.63	0.61	(0.02)*
Total solids	14.06	13.52	(0.41)*
MUN, mg/dl	38.86	28.55	(2.39)**
Blood			
BUN, mg/dl	40.98	33.13	(2.65)**

**. Significant at the 0.01 level, *. Significant at the 0.05 level, NS. Not significant

Effect of season on milk urea nitrogen: Seasons did not influence the live weight of cows but, it influenced the BCS of the animals. Table 3 shows that the live weight of cow was 284.0 kg in the dry season and in the winter season 282.3 kg which did not differ significantly (P>0.05). But, the body condition score (BCS) between dry season and wet season (2.74 vs 2.46 kg) differed significantly (P<0.05). The CP and RDP intake of cows were higher in dry season compared to that of wet season. Intake of CP and RDP in dry season was found 664 and 358.5 g/d, respectively and in the wet season it was 561 and 296 g/d, respectively, which differed significantly (P<0.01). The daily protein and RDP intake as per body weight and production in both season were below the requirement (ARC, 1994).

Table 3. Effect of season (dry/wet) on live weight, body condition score (BCS) and feed intake of dairy cows

Parameter	Mean value		SED/(LSD) and level of significance
	Dry season	Wet season	
Live weight, kg	284.0	282.3	7.09NS
BCS	2.74	2.46	(0.24)*
Feed intake			
DM, kg/d	7.00	6.93	0.23NS
ME, MJ/d	54.69	55.73	1.95NS
CP, g/d	664	561	(50.0)**
RDP, g/d	358.5	296.0	(32.95)**
UDP, g/d	305.6	265.4	(19.79)**
Ash, kg/d	0.76	0.93	(0.06)**
OM, kg/d	6.27	5.98	0.20NS
ADF, kg/d	2.60	1.57	(0.15)**
M/D, MJ/kgDM	7.61	7.90	(0.16)**
Roughage/concentrate	2.15	2.10	0.18NS
Energy/protein	0.09	0.10	(0.003)**
Requirements (ARC, 1994)			
ME, MJ/d	66.1	68.9	3.32NS
Protein deficit, g/d	-237.3	-197.2	(18.30)**
RDP, g/d	515.0	538.0	25.9NS

**. Significant at the 0.01 level, *. Significant at the 0.05 level, NS. Not significant

Season did not affect milk yield and 4%FCM (Table 4) and it also did not affect milk quality except minerals (0.65% and 0.59%). BUN and MUN in dry season were 37.35 and 36.79 mg/dl, respectively and in wet season 36.75 and 36.87 mg/dl, respectively. This level of MUN concentration was 2 to 3 times higher compared to other works (Broderick 2003; Reynal & Broderick, 2005; Kalscheur *et al*., 2006). Wenninger and Distl (1994) found 15-25 mg/dl, Dhali *et al.* (2005) found 29.2 ± 2.6 to 45.3 ± 0.9 mg/dl and Shewy *et al.* (2010) found 24.57 to 28.00 mg/dl. The MUN was highest during the summer months reported by others (Carlsson *et al.*, 1995;; Godden *et al.*, 2001). Ferguson *et al. (*1997) reported that MUN (mg/dl) varied by seasons and the another reported 14.11 ± 0.20 mg/dl in winter, 15.09 ± 0.21 mg/dl in spring, 16.45 ± 0.24 mg/dl in summer, and 14.30 ± 0.26 as the fall.

Effect of genotype on milk urea nitrogen: The effect of genotypes (local and crossbred cow) on live weight, BCS and feed intake of dairy cows is presented in Table 5. The live weight and BCS of crossbred cows was higher than that of the local cows. The live weight and BCS of crossbred cow were 318.8 kg & 2.85, respectively and of local cow were 247.5 kg & 2.34, respectively, which was significantly (P<0.01) higher than local cow. Daily feed intake of crossbred cow was higher than the local cow due to its higher live weight and BCS. The daily DMI of local cow was 5.75 kg and crossbred cow was 8.17 kg, which differed significantly (P<0.01); but, the roughage/concentrate ratio of local cow (2.65) was significantly (P<0.01) higher than crossbred cow (1.60). Daily ME intake of crossbred cow (64.82 MJ) was significantly (P<0.01) higher than local cow (45.60 MJ), which were lowered compared to the requirement as per ARC (1994). The intake of crossbred cow was higher than of the local cow. Daily CP, RDP and UDP intake of crossbred cow were 708, 378 and 330 g, respectively and of local cow were 517, 276 and 240 g, respectively; which differed significantly (P<0.01), but, below the requirement (ARC, 1994). Energy/protein ratio in local cow (0.10) and crossbred cow (0.09) were not-significant.

Table 4. Effect season on milk production, milk composition, milk urea nitrogen (MUN) and blood urea nitrogen (BUN) of dairy cows

Parameter	Mean value		SED/(LSD) and level of significance
	Dry season	Wet season	
Milk production, kg/d			
Milk yield,	5.27	5.17	0.38NS
4%FCM,	4.90	4.90	0.37NS
Milk composition, %			
Fat	3.96	3.73	0.13NS
Protein	3.71	3.72	0.04NS
Lactose	5.37	5.40	0.06NS
SNF	9.97	9.92	0.11NS
Minerals	0.65	0.59	(0.02)**
Total solids	13.93	13.65	0.21NS
MUN, mg/dl	36.79	36.87	1.31NS
Blood			
BUN, mg/dl	37.35	36.75	1.34NS

**. Significant at the 0.01 level, *. Significant at the 0.05 level, NS. Not significant

Milk yield of local cows were lower than crossbred cows (Table 6). Daily milk yield and 4%FCM of local cows were 3.26 and 3.28 kg, respectively and of crossbred cows were 7.18 and 6.52 kg, respectively, which differed significantly (P<0.01). The percentage of milk protein of local cows was higher than the crossbred cows. The milk protein of local cow was 3.73 % and of crossbred was 3.70 %, which differed significantly (P<0.01). The MUN and BUN of local cow was lower than that of crossbred cow. The MUN and BUN of the local cow were 31.97 and 34.94 mg/dl, respectively and of crossbred cows were 35.44 and 39.17 mg/dl, respectively, which were statistically significant (P<0.01).

Table 5. Effect of genotype (local/crossbred cow) on live weight, body condition score (BCS) and feed intake of dairy cows

Parameter	Mean value		SED/(LSD) and level of significance
	Local cow	Crossbred cow	
Live weight, kg	247.5	318.8	(14.02)**
BCS	2.34	2.85	(0.24)**
Feed intake			
DM, kg/d	5.75	8.17	(0.45)**
ME, MJ/d	45.60	64.82	(3.86)**
CP, g/d	517	708	(50.0)**
RDP, g/d	276.4	378.0	(32.95)**
UDP, g/d	240.6	330.4	(19.79)**
Ash, kg/d	0.71	0.98	(0.06)**
OM, kg/d	5.04	7.21	(0.40)**
ADF, kg/d	1.77	2.40	(0.15)**
M/D, MJ/kg DM	7.60	7.91	(0.16)**
Roughage/concentrate	2.65	1.60	(0.35)**
Energy/protein	0.10	0.09	(0.003)*
Requirements (ARC, 1994)			
ME, MJ/d	55.0	80.0	(6.55)**
Protein deficit, g/d	-179.4	-255.2	(18.30)**
RDP, g/d	429.0	624.0	(51.1)**

**. Significant at the 0.01 level, *. Significant at the 0.05 level, NS. Not significant

Table 6. Effect of genotype on milk production, milk composition, milk urea nitrogen (MUN) and blood urea nitrogen (BUN) of dairy cows

Parameter	Mean value		SED/(LSD) and level of significance
	Local cow	Crossbred cow	
Milk production, kg/d			
Milk yield	3.26	7.18	(0.75)**
4%FCM	3.28	6.52	(0.73)**
Milk composition, %			
Fat	3.95	3.73	0.13NS
Protein	3.73	3.70	(0.08)**
Lactose	5.40	5.38	0.06NS
SNF	9.40	9.89	0.11NS
Minerals	0.61	0.63	(0.02)**
Total solids	13.95	13.63	0.21NS
MUN, mg/dl	31.97	35.44	(2.39)**
Blood			
BUN, mg/dl	34.94	39.17	(2.65)**

**. Significant at the 0.01 level, *. Significant at the 0.05 level, NS. Not significant

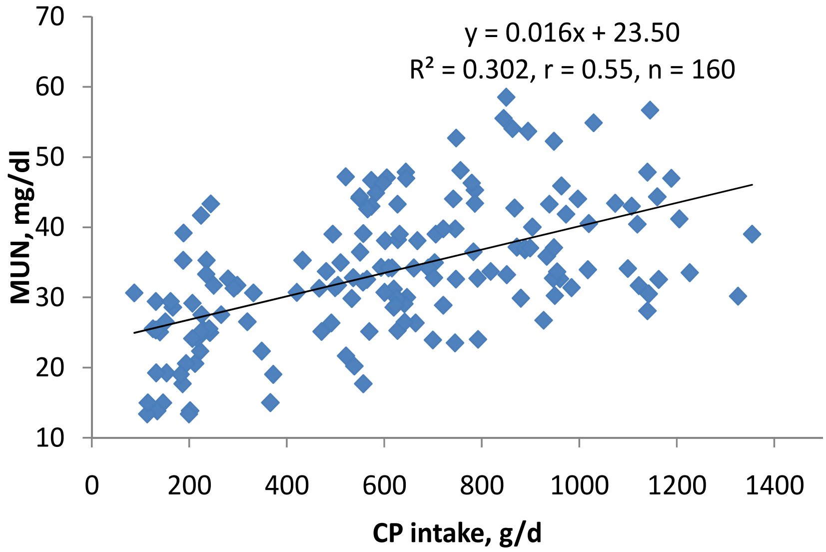

Figure 1. Linear relationship between CP intake and MUN

The following Figure 1 and 2 show that MUN values significantly correlated with CP intake (r = 0.55; P<0.01) and RDP intake (r = 0.54; P<0.01) of cow. MUN concentration also correlated with DMI (r = 0.51; P<0.01), ME intake (r = 0.54; P<0.01), ADF (r = 0.48; P<0.01) and UDP (r = 0.51; P<0.01) intake of cow (Appendix 3.21). MUN significantly (P<0.01) correlated with milk yield (r = 0.33) and the percentage of milk protein (r = 0.22).

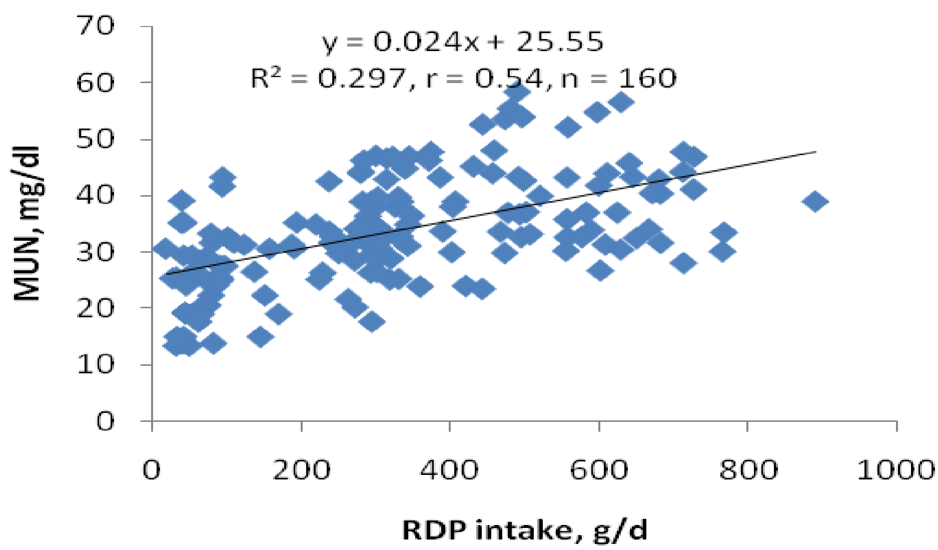

Figure 3.4 Linear relationship between RDP intake and MUN

The percentage of fat was not correlated with MUN; but, lactose was significantly (P<0.05) correlated (r = 0.20). Figure 3. shows that MUN is highly correlated (r = 0.82; P<0.01) with BUN. CP concentrations had a significant effect on milk, milk fat, and protein production, plasma urea N, MUN, and on N balance measurements (Kauffman and St-Pierre, 2001) but, crude protein levels had a low effect on milk yield and composition (Zhai *et al.*, 2006). The main factor influencing these concentrations is not the amount of protein ingested as per requirement, but the relationship between protein and fermentable carbohydrate in ration (Oltner and Wiktorsson, 1983; Roseler *et al.*, 1993; Lykos *et al.*, 1997). With adequate dietary energy, MUN indicates protein status and MUN concentration increased when different forms of protein were fed in excess of National Research Council recommendations with no difference in milk production (Roseler *et al.*, 1997) as well as conversely, feeding protein below recommendation reduced MUN concentration and milk production. High levels of readily degraded protein are reported to increase MUN concentrations (Baker *et al.*, 1995). Analysis of data from 35 conventional lactation trials found MUN was affected by protein to energy ratio; however, MUN was not affected by total energy intake (Mcal/d) and dietary concentration of energy (Mcal/kg) (Broderick and Clayton, 1997). Urea concentration in milk and plasma are closely related (Gustafsson and Plamquist, 1993). Several investigators have suggested the possibility of using either of them as a supplementary indicator of nitrogen utilization and feeding adequacy in dairy cows (Shepers and Meijer, 1998; Jonker *et al.*, 2002; Dhali *et al.*, 2005). Dhali *et al.* (2005) worked on the effect of urea supplemented and urea treated straw based diet on milk urea concentration in crossbred Karan-Fries cows, and the authors reported that MUN is a dietary monitor for dairy cows. Garcia *et al.* (1997); Gustafsson *et al.* (1993) and Hof *et al.* (1997) also supported it.

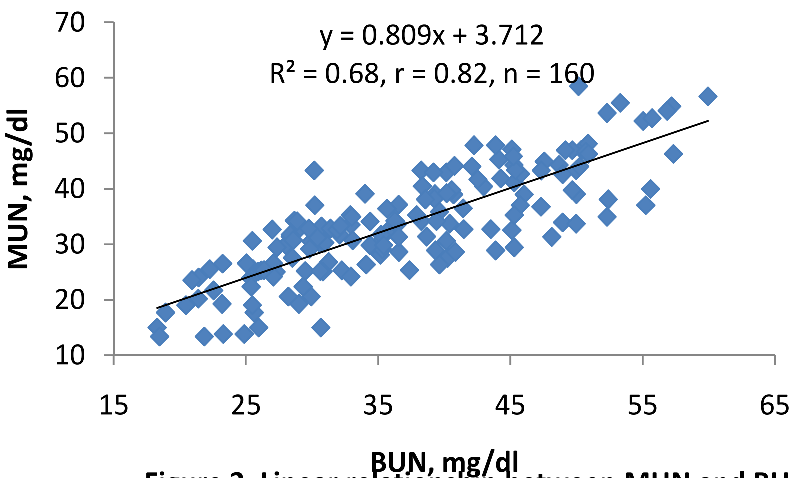

Figure 3. Linear relationship between MUN and BUN

Interaction of feed base regions and seasons on milk production, milk composition, MUN and BUN of dairy cows is presented in Table 7. Result showed that interaction of feed base regions and seasons significantly (P<0.01) influenced milk yield and the percentage of milk fat, and also significantly (P<0.05) influenced SNF % and BUN. Milk protein and MUN were not affected by interaction of feed base regions and seasons. MUN concentration was significantly (P<0.05) influenced by the interaction of feed base regions and genotypes (Table 8).

Table 7. Interaction of feed base regions and seasons on milk production, milk composition, milk urea nitrogen (MUN) and blood urea nitrogen (BUN) of dairy cows

Interaction	MY, kg/d	4%FCM, kg/d	Fat, %	Protein, %	Lactose, %	SNF, %	Minerals, %	Total solids, %	MUN, mg/dl	BUN, mg/dl
R1×S1	7.39	6.66	3.84	3.75	5.42	10.00	0.65	13.85	39.78	42.89
R1×S2	6.13	6.32	4.08	3.83	5.55	10.18	0.60	14.26	37.93	39.07
R2×S1	3.15	3.13	4.08	3.66	5.33	9.94	0.65	14.02	28.55	31.81
R2×S2	4.20	3.49	3.38	3.60	5.26	9.66	0.57	13.03	28.55	34.43
SED	-	0.52	-	0.06	0.08	-	-	-	1.71	-
LSD	1.06	-	0.36	-	-	0.32	0.02	0.57	-	3.75
Level of significance	**	NS	**	NS	NS	*	*	**	NS	*

**. Significant at the 0.01 level, *. Significant at the 0.05 level, NS. Not significant

Table 8. Interaction of feed base regions and genotypes on milk production, milk composition, milk urea nitrogen (MUN) and blood urea nitrogen (BUN) of dairy cows

Interaction	MY, kg/d	4%FCM, kg/d	Fat, %	Protein, %	Lactose, %	SNF, %	Minerals, %	Total solids, %	MUN, mg/dl	BUN, mg/dl
R1×G1	5.04	5.20	4.10	3.84	5.55	10.22	0.62	14.32	38.60	40.00
R1×G2	8.48	7.78	3.82	3.74	5.42	9.96	0.63	13.79	39.11	41.96
R2×G1	1.48	1.36	3.81	3.62	5.25	9.78	0.59	13.58	25.35	29.87
R2×G2	5.87	5.26	3.65	3.65	5.33	9.82	0.63	13.47	31.76	36.38
SED	0.53	0.52	0.18	0.06	0.08	0.16	-	0.29	-	1.90
LSD	-	-	-	-	-	-	0.02	-	3.38	-
Level of significance	NS	NS	NS	NS	NS	NS	*	NS	*	NS

**. Significant at the 0.01 level, *. Significant at the 0.05 level, NS. Not significant

CONCLUSION

MUN depends on genotype, stage of lactation and plane nutrition of cows, more specifically on dietary crude protein and rumen degradable protein. Dietary intake of nutrients was not fulfilled the requirement of cows, still then, level of MUN was found higher compared to other studies. In this study MUN concentration was found 28.55 to 38.86 mg/dl.

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