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# Milk and plasma urea concentration in crossbred Karan-Fries cows fed on berseem based diet

A DHALI[1], R K MEHLA[2] and S K SIROHI[3]

*National Dairy Research Institute, Karnal, Haryana 132 001 India*

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ABSTRACT

The study was conducted in 6 crossbred Karan-Fries cows to investigate the urea concentration in milk and plasma. The average body weight (kg ± SE), milk yield/day (kg ± SE), milk fat (% ± SE) and days in milk were 405 ± 17.3, 8.6 ± 0.3, 4.4 ± 0.1 and 90.2 ± 16.2 respectively. Animals were fed the experimental diet individually. The 21-day adaptation period was given to the animals for the diet followed by a 7-day digestion trial. The experimental diet contained berseem, wheat straw and concentrate mixture. During digestibility trial the intake of DM (kg/day), CP (kg/day) and DCP (kg/day) were 8.52 ± 0.30, 1.09 ± 0.04 and 0.70 ± 0.03 respectively. The average milk and plasma urea concentrations (mg/dl) were found 30.8 ± 1.1, and 32.0 ± 1.5 respectively. The milk urea concentrations (mg/dl) were found within the range of 22.4 – 30.6, 22.6 – 46.5 and 22.3 – 42.5, respectively, in morning, noon and evening milk samples. The average urea concentration was found lower in morning samples than noon or evening samples. It may be concluded from the study that when cows are being maintained on berseem based diet, the milk urea concentration (mg/day) within the range of 22.0– 47.0 is indicative of feeding adequacy. Any value beyond this range indicates the protein or energy imbalance in diet and that need to be checked.

**Key words**: Berseem, Dairy cows, Milk, Plasma, Urea

In ruminant the protein utilization is maximized when the nitrogen (N) requirement of rumen microbes and ruminant tissues matches with the dietary N supply. This balance is associated with a base line concentration of urea in milk and plasma (Baker *et al.* 1995). Excess N supplied to the rumen or post ruminal tissues or energy deficiency increases the urea level in milk and plasma (Baker *et al.* 1995). However, the main factor influencing urea concentration in milk and plasma is not the amount of protein ingested in relation to the requirement, but the relationship between protein and fermentable energy in the ration (Oltner and Wiktorsson 1983). The urea concentrations in milk and plasma are closely correlated (Oltner *et al.* 1985). Hence, any of them can be used as a supplementary indicator of N utilization and feeding adequacy in ruminant (Baker *et al.* 1995, Jonker *et al.* 2002).

To the best of our knowledge no Indian standard for milk urea level is available for the dairy farmers. At this backdrop study was designed to investigate the level of urea in milk and plasma of crossbred dairy cows fed on berseem based diet.

Present address: [1]Scientist, NRC on Mithun, Jharnapani, Medziphema, Nagaland 797 106.
[2]Senior Scientist, Dairy Cattle Breeding, [3]Senior Scientist, Dairy Cattle Nutrition.

## MATERIALS AND METHODS

Six crossbred Karan-Fries (Holstein Friesian×Tharparkar) cows were used for the experiment. The animals were in 2–4 parity. The average body weight (kg ± SE), milk yield (kg ± SE), milk fat (% ± SE) and days in milk (day ± SE) were 405 ± 17.3, 8.6 ± 0.3, 4.4 ± 0.1 and 90.2 ± 16.2 respectively. The animals were maintained in individual tie stall and machine milked thrice daily, at morning (06.30), noon (12.30) and evening (06.30). The animals were fed as per the NRC (1989) standard. The diet contained berseem, wheat straw and concentrate mixture. The ingredient composition of the concentrate mixture was maize grain 40 parts, wheat bran 30 parts, mustard oil-cake 27 parts, mineral mixture 2 parts and salt 1 part. For individual animal, the daily roughage requirements were divided into 2 parts and were offered at morning 09.00 and afternoon 3.00. Whereas, the daily concentrate requirement of the individual animal was divided into 3 parts and offered during each milking. The animals were given a 21-day adaptation period during experiment, followed by a 7-day digestibility trial.

Morning, noon and evening milk samples were collected from individual animal on days 1, 3 and 7 during the digestibility trial. Samples were collected from milk collection bucket after complete milking and thorough mixing. Milk samples were analysed for urea content using a colorimetric p-dimethylaminobenzaldehyde (DMAB) procedure (Bector *et al.* 1998), after little modification. Milk samples were warmed at room temperature (30°C) and mixed well. Milk (10 ml) was deproteinised with 12% cold TCA solution (10 ml), allowed to stand for 1 hr, centrifuged at 3 000 × g for 30 min and filtered. Clear supernatant (2 ml) was mixed with 2 ml DMAB reagent (1.6 g DMAB + 90 ml ethanol + 10 ml concentrated HCl). Spectrophotometric absorbance was 425 nm. Milk total protein (N × 6.25) was determined for individual animal from composite milk samples of morning, noon and evening. Blood samples were collected on the same day of milk sampling within 30 min after morning milking. Samples were collected in heparinised tube and placed on ice immediately, centrifuged at 3 000 × g for 25 min. Plasma was removed, frozen and stored at –20°C. Plasma samples were analysed for urea content using a colorimetric diacetylmonoxime procedure (Rahmtullah and Boyde 1980). During digestibility trial, samples of feed and residue were collected in morning and were composited. These samples were analysed for nutrient content according to the method of AOAC (1984). Metabolisable energy (ME M cal $kg^{-1}$ DM = –0.45 + 1.01 DE) and net energy for lactation ($NE_L$ M cal $kg^{-1}$ DM = 0.0245 × TDN (% of DM) –0.12) were calculated as per the NRC (1989) equations. The data are presented as means and standard errors. Variance was analysed using general linear model procedure of SPSS (SPSS 1999). To test the association between milk and plasma urea levels the correlation analysis was performed according to the procedure of SPSS (SPSS 1999).

## RESULTS AND DISCUSSION

The chemical composition of different feed ingredients in the experimental diet are in Table 1. The intake of DM (kg/day), CP (kg/day) and DCP (kg/day) were 8.52 ± 0.38, 1.09 ± 0.04 and 0.70 ± 0.03 respectively (Table 2). Whereas, the values for energy intake (M Cal/day) were 19.12 ± 0.86 and 11.60 ± 0.50, respectively, for ME and $NE_L$ (Table 2). During digestibility trial average milk yield (kg/day) of the animals was 8.81 ± 0.53 and the milk protein content (%) was 3.33 ± 0.07 (Table 2). Urea concentrations (mg/dl) in milk and plasma on 1, 3 and 7 days of digestibility trial were 33.4 ± 2.5, 28.7 ± 1.5, 30.5 ± 1.7 and 33.5 ± 2.3, 31.9 ± 2.4, 30.7 ± 2.1 respectively. The average milk and plasma urea concentrations (mg/dl) were found 30.8 ± 1.1 and 32.0 ± 1.5

Table 1. Chemical composition of the different feed ingredients in the experimental diet

| Ingredients | DM% | OM% | CP% | EE% | TCHO% |
|---|---|---|---|---|---|
| Concentrate mixture | 93.00 | 89.07 | 15.21 | 4.35 | 69.51 |
| Berseem | 19.89 | 82.55 | 12.95 | 1.67 | 67.93 |
| Wheat straw | 86.00 | 87.05 | 2.74 | 1.32 | 82.99 |

Table 2. Intake of different nutrients, milk yield and milk protein content during digestibility trial

| Particulars | Mean±SE |
|---|---|
| DM intake (kg/day) | 8.52±0.38 |
| CP intake (kg/day) | 1.09±0.04 |
| DCP intake (kg/day) | 0.70±0.03 |
| ME intake (M Cal/day) | 19.12±0.86 |
| $NE_L$ intake (M Cal/day) | 11.60±0.50 |
| Milk yield (kg/day) | 8.81±0.53 |
| Milk protein (%) | 3.33±0.07 |

respectively. The level of plasma urea was higher than the milk urea but the variation was nonsignificant. The variation in the level of milk and plasma urea on different days during digestibility trial was also nonsignificant. During experiment the milk urea (mg/dl) values were within the range of 22.4–30.5, 22.6–46.5 and 22.3–42.5, respectively, in morning, noon and evening samples. The urea concentration (mg/dl) in milk was lower in morning samples (29.0 ± 1.4) than that in noon (32.0 ± 1.5) or evening (31.2 ± 1.2) samples. However, the variation was non-significant.

Milk and plasma urea levels of the present study are comparable with the other findings (Oltner and Wiktorsson 1983, Baker *et al.* 1995, Hof *et al.* 1997). In the current investigation plasma urea level showed a significant ($P < 0.01$) correlation ($r = 0.94$) with milk urea level. Our result is in agreement with the findings of (Oltner *et al.* (1985), and Baker *et al.* (1995). In our investigation the slightly higher level of plasma urea than milk urea level is comparable with the findings of Oltner *et al.* (1985) and Baker *et al.* (1995). During experiment the milk urea (mg/dl) values were within the range of 22.3 – 46.5, that covered all the samples of morning, noon and evening milking. The reference standard for milk urea levels can be used as a non invasive economical feeding guide to monitor the protein and energy intake balance. Hwang *et al.* (2000), reported the standard levels of 3.0% milk protein and 24.4–37.7 mg/dl milk urea can be used as reference value in cattle. The milk protein content below 3.0% indicates inadequate energy intake. Whereas, milk urea below or above the mentioned range is regarded as deficiency or surplus of dietary protein. However, to use milk or plasma urea concentration as an efficient monitoring tool, the time gap between feeding and sample collection should be considered carefully. Because these levels depend directly on rumen fermentation pattern. The rumen ammonia concentration attains peak within 1 hr of feeding (Gustafsson and Palmquist 1993). Whereas, peak milk urea concentration is observed 1.5–2 hr after the peak concentration of ammonia in the rumen and then decreased gradually (Gustafsson and Palmquist 1993). In our study the time gaps between major feeding event and sample collection were about 14 hr for the morning samples and about 4 hr for the noon or evening samples that covered the all possible variation in milk urea level.

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REFERENCES

AOAC. 1984. *Official Methods of Analysis.* 14th edn. Washington, DC.

Baker L D, Ferguson J D and Chalupa W. 1995. Responses in urea and true protein of milk to different protein feeding schemes for dairy cows. *Journal of Dairy Science* **78**: 2424–34.

Bector B S, Moti Ram and Singhal O P. 1998. Rapid platform test for the detection/determination of added urea in milk. *Indian Dairyman* **50**: 59–62.

Gustafsson A H and Palmquist D L. 1993. Diurnal variation of rumen ammonia, serum urea and milk urea in dairy cows at high and low yields. *Journal of Dairy Science* **76**: 475–84.

Hof G. Vervoorn M D, Lenaers P J and Tamminga S. 1997. Milk urea nitrogen as a tool to monitor the protein nutrition of dairy cows. *Journal of Dairy Science* **80**: 3333–40.

Hwang S Y, Lee M J and Chiou P W S. 2000. Monitoring nutritional status of dairy cows in Taiwan using milk protein and milk urea nitrogen. *Asian-Australian Journal of Animal Sciences* **13**: 1667–73.

Jonker J S. Kohn R A and Hight J. 2002. Use of milk urea nitrogen to improve dairy cow diets. *Journal of Dairy Science* **86**: 939–46.

NRC. 1989. *Nutrient Requirements of Dairy Cattle.* 6th edn. National Academy of Science, Washington, DC.

Oltner R and Wiktorsson H. 1983. Urea concentrations in milk and blood as influenced by feeding varying amounts of protein and energy to dairy cows. *Livestock Production Science* **10**: 457–67.

Oltner R, Emanuelson M and Wiktorsson H. 1985. Urea concentrations in milk in relation to milk yield, live weight, lactation number and amount and composition of feed given to dairy cows. *Livestock Production Science* **12**: 47–57.

Rahmatullah M and Boyde T R C. 1980. Improvement in the determination of urea diacetylmonoxime: Method with and without deproteinisation. *Clinica Chimica Acta* **107**: 3–9.

SPSS. 1999. *SPSS ® User's Guide, Release* 10.0.1 edn. SPSS Inc.