Usefulness of milk urea concentration to monitor herd reproductive performances in crossbred Karan-Fries cows

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Abstract

Validity of milk urea (MU) concentration was investigated as an index of reproductive performances in crossbred Karan-Fries cow herd. MU was analysed in noon milk samples (1200 to 1300 hr) to interrelate with parturition to first service interval, number of insemination per conception, first service conception rate and service period. Milk progesterone (P4) and MU concentration were analysed in noon milk samples on day 1, 10, 20, 30 and 60 post insemination to study the relationship between MU concentrations and early embryonic mortality. The interval between parturition to first insemination was found significantly ($p<0.01$) higher (77.2 ± 5.5 days) when MU concentration was ≥ 63.4 mg/ dl. MU concentration (mg/ dl) was found 42.5 ± 2.5, 47.9 ± 1.5 and 50.9 ±3.0, respectively in the animals conceived at 1st, 2nd and 3rd insemination. First insemination conception rate (68.7%) was found significantly ($p<0.01$) higher when MU concentration was ≤ 32.4 mg/ dl. Service period was also increased (125.4 ± 8.8 days) significantly ($p<0.05$) when MU concentration was ≥ 45.1 mg/ dl. Milk P4 level indicated that the cows, those were detected as non-pregnant on day 60 post insemination were actually pregnant till day 30 post insemination and pregnancy was terminated between day 30 to day 60 post insemination. MU level was found significantly ($p<0.01$) higher in the non-pregnant cows.

Keywords: Milk urea, Milk progesterone, Conception rate, Service period, Cows

Introduction

Fertility is often associated with the protein nutrition. In dairy cows excess dietary protein increases blood urea, alters uterine fluid composition, decreases uterine pH and reduces conception rate (Jordon et al., 1983; Elrod and Butler, 1993; Elrod et al., 1993). Plasma

progesterone (P4) concentration has been found low in cows fed high dietary protein (Elrod and Butler, 1993; Elrod et al., 1993). It was found that heifers fed high protein diet exhibited extended luteal phase and inter-estrus interval that indicated the embryonic death, which occurred after day 15 to 16 post breeding (Elrod and Butler, 1993). Excess feeding of easily degradable protein results in an accumulation of ammonia in rumen, which in turn increases formation of urea in liver (Ropstad and Refsdal, 1987). The protein intake particularly the ratio of dietary protein to energy affect urea level in blood and milk (Oltner et al., 1983). Measurement of milk urea (MU) provides a useful index for studying the association between dietary protein metabolism and reproductive efficacy in dairy cows (Butler, 1998). The present study was undertaken to interrelate the MU concentration with different reproductive parameters in crossbred Karan-Fries cows to validate its utility as an index of reproductive performances under farm condition.

Materials and Methods

The study was conducted on healthy breedable crossbred Karan-Fries (Holstein Friesian × Tharparkar) cows maintained at Institute dairy farm, National Dairy Research Institute, Karnal, Haryana, India. Animals were maintained under loose house system. Estrus detection was carried out in open paddock by visual observation and vasectomised bull parading twice daily. Cows were not bred before 40 days postpartum and checked for pregnancy on day 60 post insemination per rectal by herd veterinarian. Animals were fed farm grown green fodder ad libitum twice daily at morning (0900 to 0930 hr) and afternoon (1500 to 1530 hr). Cows were provided a let down ration of 0.5 kg concentrate and an additional amount of 1.0 kg concentrate was fed for every 2.5 kg milk produced above 5.0 kg daily yield. The daily concentrate requirement was divided into three equal parts and fed during each milking at morning (0500 to 0600 hr), noon (1200 to 1300 hr) and evening (1800 to 1900 hr).

Noon (1200 to 1300 hr) milk samples were collected from the cows on 1st and 3rd day of each insemination to study the relationship between MU concentration and conception rate at different insemination. Average MU values on 1st and 3rd day of each insemination for individual animals were used for interpretation. For freshly calved cows noon milk samples were collected on the day of parturition followed by at 7 day interval till first

service to study the relationship between MU concentration and interval between parturition to first insemination. For P4 and urea analysis noon milk samples of inseminated cows were collected on day 1, 10, 20 and 30 post insemination. The animals, which came back to estrus before day 30 post insemination were ignored. The date of calving, interval between parturition to first insemination, service period, and number of insemination per conception of experimental animals were collected from farm record. To study the diurnal pattern of MU concentration milk samples of all the experimental animals were analysed once from morning (0500 to 0600 hr), noon (1200 to 1300 hr) and evening (0600 to 0700 hr) milking.

Milk samples were analysed for urea content using a colorimetric p-dimethylaminobenzaldehyde (DMAB) procedure (Dhali et al., 2005). Whole milk P4 was estimated by direct radioimmunoassay as per the method described by Gupta and Prakash (1993). The sensitivity of the assay was 1.25 ng/ ml. The intra- and inter-assay CVs were 8.3% and 12.6 %, respectively.

The effect of MU concentration on interval between parturition to first insemination, number of insemination per conception and service period were analysed by ANOVA using GLM procedure (SPSS 10.0.1., 1999). The variations in milk P4 and MU concentrations on different post insemination days in pregnant and non-pregnant animals were analysed by ANOVA using GLM procedure (SPSS 10.0.1., 1999). Duncan multiple range test was used to separate means if found significant (SPSS 10.0.1., 1999). The statistical significance of conception rate at different insemination was analysed by χ^2 test (Snedecor and Cochran, 1963).

Results

A positive relationship was found between MU concentration and interval between parturition to first service. The interval increased with increasing MU concentration and was found significantly ($p<0.01$) higher (77.2 ± 5.5 days) when milk urea concentration was ≥ 63.4 mg/ dl (Table 1). A significant ($p<0.01$) positive relationship was found between MU concentration and number of required insemination for conception (Figure 1). First insemination conception rate was found significantly ($p<0.01$) higher (68.7%) when MU level was ≤ 32.4 mg/ dl (Table 2). The conception rate was found significantly

($p<0.05$) poor at 1st and 2nd insemination when MU level was ≥ 45.1 mg/ dl (Table 2). Service period was also found significantly ($p<0.05$) higher (125.4 ± 8.8 days), when milk urea level was ≥ 45.1 mg/ dl (Table 3). Milk P4 level (ng/ ml) post insemination days did not vary significantly in pregnant and non-pregnant cows (Figure 2). The P4 level indicates that the cows, which were detected non-pregnant on day 60 post insemination were actually pregnant initially but the pregnancy was terminated during some time between day 30 to 60 post insemination. But the MU level was found significantly ($p<0.01$) higher in non-pregnant cows (Figure 2). A clear diurnal pattern in MU concentration was observed during study. It was found significantly ($p<0.05$) higher in noon samples than morning or evening samples (Figure 3).

Discussion

The current study was conducted to assess the usefulness of MU concentration to monitor reproductive performances in dairy cows under farm condition. A positive relationship between MU concentration and interval between parturition to first service was observed. It is reported earlier in dairy cows that interval between parturition to first service increases with increasing urea concentration in blood and milk (Figuera et al. 1992; Gustafsson and Carlsson 1993). It has been found that ionic concentration in uterine secretion (Jordon et al., 1983) and uterine pH (Elrod and Butler, 1993) changed in animals maintained on high protein diet or diet with excess degradable protein than cows on normal diet. The increased interval between parturition to first service in experimental animals was probably due to altered uterine environment in these animals, which delayed the postpartum uterine involution process and subsequent estrus. First insemination conception rate was found significantly higher when MU concentration was ≤ 32.4 mg/ dl. Earlier reports also indicate a similar trend (Elrod and Butler, 1993; Westwood et al., 1998). During current study MU was found to be associated negatively with service period and conception rate, which were in agreement with the previous findings (Elrod and Butler, 1993; Ferguson et al., 1993). Wenninger and Distl (1994) reported that reproductive traits were found optimum when MU concentration was between 15 and 25 mg/ dl. In contrast conception rate was found poor when milk urea concentration was > 32.4 mg/ dl in our study. This difference may be due to the fact that noon values were

used for interpretations, which were found comparatively higher than morning or evening values.

In current study milk P4 level did not vary significantly among pregnant and non-pregnant cows till day 30 post insemination. But MU concentration was found significantly lower in pregnant cows. The results indicated that in non-pregnant cows embryonic death occurs some time in between day 30 to day 60 post insemination. Earlier studies indicate that increased urea concentration in plasma or milk causes impairment of fertilisation and embryo development (Jordon et al., 1983). Weibold (1988) reported that embryonic mortality was associated with a uterine environment that was significantly different form those of cows with normal embryo and most of the embryonic death occurred before 5 days during cleavage. Elrod and Butler (1993) have proposed that excess degradable protein acts through some undefined mechanism to decrease uterine pH during luteal phase, which may play a role in the observed fertility. Heifers that fed high protein diet exhibited extended luteal phase and inter estrous interval of 26 to 36 days. This prolonged phase indicates that embryonic death occurred some time after the critical period i.e. day 15 to 16 post breeding. In contrast our result indicated that embryonic death occur some time after day 30 post breeding. However, a similar P4 profile in both pregnant and non-pregnant animals indicated that embryonic death probably did not occur due to sub optimal P4 level. Rather it was probably due to altered uterine environment in animals with high MU concentration.

Conclusions

In conclusion during present study the increased number of insemination for conception, longer service period and embryonic death in animals having high MU concentrations were might be due to altered uterine environment. It was probably not due to sub optimal P4 level, which in turn impairs the normal fertilisation process and embryo development. The study indicates that MU values may be used as a valuable index of reproductive performances in dairy cows under farm condition when individual animals are not being monitored for nutritional status. Altered MU values may be utilised as ready reference to rectify the protein and energy nutrition for achieving better reproductive performances in herd.

Table 1. Relationship between milk urea concentration and interval between parturition to first insemination; [a,b] Indicates values within column differ at p<0.01; Total number of experimental animal was 52

Milk urea level (mg/ dl)	Interval (days) between parturition to first insemination	SE
≤ 38.4	64.1[a]	7.3
38.5 – 50.8	64.7[a]	3.3
50.9 – 63.3	66.0[a]	8.9
≥ 63.4	77.2[b]	5.5

Table 2. Conception rate at different insemination in different levels of milk urea concentration; * Indicates values within column differ (p<0.05) by χ^2 test of association; Total number of experimental animal was 79

Milk urea level (mg/ dl)	Conception rate at different insemination (%)			
	Insemination 1	Insemination 2	Insemination 3	Non pregnant
≤ 32.4	68.7*	6.2*	6.2	18.9
32.5 – 45.0	37.5*	50.0*	-	12.5
≥ 45.1	39.6*	29.2*	14.6	16.6

Table 3. Interrelation between milk urea concentration and service period; [a,b] Indicates values within column differ at p<0.05; Total number of experimental animal was 69

Milk urea level (mg/ dl)	Service period	SE
≤ 32.4	89.9[a]	10.2
32.5 – 45.0	107.7[b]	15.6
≥ 45.1	125.4[c]	8.8

Figure 1. Milk urea (mg/ dl) concentration and conception rate (%) of experimental animals by number of insemination required for conception; Total number of experimental animal was 79

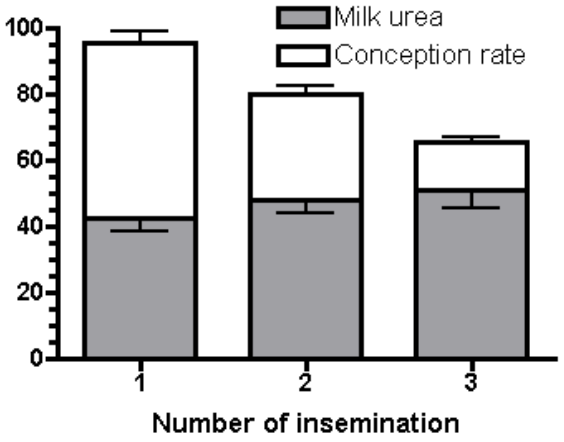


Figure 2. Milk progesterone (ng/ ml) and milk urea (mg/ dl) concentrations on different days post insemination in pregnant and non-pregnant cows; Total number of experimental animal was 58

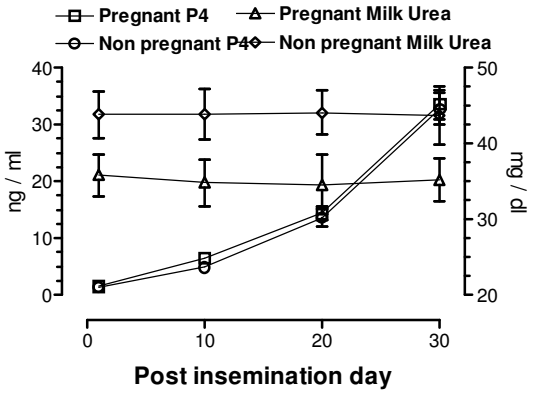
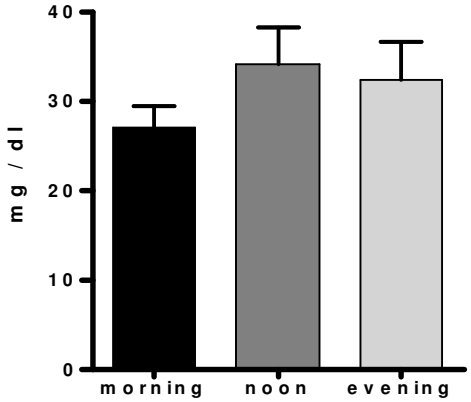


Figure 3. Diurnal variation of milk urea concentration in experimental animals



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