COMPARATIVE BLOOD PROFILE OF HIGH AND LOW YIELDING KARAN FRIES COWS DURING EARLY LACTATION

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ABSTRACT

Hematological parameters associated with immunity and general health were estimated in high (EPA >5000kg/305d, n=8) and low yielding (EPA <3500kg/305d, n=8) Karan Fries (KF) (Holstein Friesian x Tharparkar) cows during their early lactation. Blood samples were collected once in a week during early lactation period i.e. from 1st to 14th week postpartum. Hematological parameters included under study are Hemoglobin, Packed cell volume (PCV), Total erythrocyte count (TEC), Total leucocyte count (TLC), Differential leucocyte count (DLC), blood indices and phagocytic activity (PA) of blood neutrophils. Hemoglobin concentration, Eosinophil count, TEC and PA of blood neutrophils were significantly (P<0.01) higher in low yielding cows when compared to high yielding cows. These values also differed significantly (P<0.01) during different weeks postpartum. Whereas, Mean corpuscular volume (MCV) values were significantly (P<0.01) higher for high yielding cows as compared with low yielding cows. No significant difference were found for other parameters under study i.e. PCV, TLC, blood DLC (except eosinophils), Mean corpuscular hemoglobin (MCH) and Mean corpuscular hemoglobin concentration (MCHC). Comparatively lower PA in high yielding cows could be one of the possible explanation for increased occurrence of udder infections i.e. mastitis in high yielder cows.

Key words: Crossbred cows, Hematological, Early lactation, Neutrophils, Phagocytic activity.

INTRODUCTION

During early lactation, dairy cows are under great physical and metabolic stress for production of colostrum, attaining peak milk yield and to sustain it. Continuous selection of dairy cows for superior milk production traits has resulted in a steady increase in the incidence of clinical mastitis (Hamon, 1994). Physiological equilibrium is maintained mainly by the blood in the body (Geneser, 1986) but many physiological conditions may alter this equilibrium. Hence, the hematological values during different physiological situations should be known for the diagnosis of various pathological and metabolic disorders, which can adversely affect the productive and reproductive performance of cows, leading to heavy economic losses (Dutta et al., 1988). With the development of automated laboratory instrumentation, the use of certain blood parameters as indicators of the physiological, nutritional, metabolic and clinical status of farm animals is gaining a wider application. For the evaluation of clinical tests in veterinary laboratories a reference basis of normal values of clinically healthy farm animals is essential. Here blood parameters of early lactation period in high and low yielding cows have been presented in order to find out difference, if any exists.

MATERIALS AND METHODS

Sixteen Karan Fries (KF) crossbred (Holstein Friesian x Tharparkar) cows were selected from the herd of N.D.R.I. Karnal. They were divided into two groups (high and low yielding) based on their expected production ability (EPA). High yielding animals (n=8) had production potential of ≥5000 liters per lactation, whereas, low yielding animals (n=8) had production potential ≤3500 liters per lactation as per their previous lactation. All the cows selected were of 2nd or 3rd parity and were managed

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under similar conditions as per standards followed in institute.

Blood (12 ml/animal) collected from all the experimental animals at weekly interval from week 1st to week 14th postpartum using ethylene diamine tetra acetic acid (EDTA) (1 mg/ml of blood) as anticoagulant. A part of blood sample was used for estimation of the hematological parameters. The remaining blood was utilized for neutrophil separation followed by their culture in vitro for studying phagocytic activity (PA). Hemoglobin (Hb) in blood was estimated by Sahl’s Acid Hematin Method. Packed cell volume (PCV) was estimated by standard procedure using Wintrobe Hematocrit (10cm x 3mm) tubes. Total erythrocyte count (TEC) was estimated by using Neubauer’s counting chamber. Erythrocyte indices were calculated using the values of hemoglobin, PCV and TEC by applying the standard formulas. The total leukocyte count (TLC) was estimated by the hemocytometer method as described by Schalm (1961). Differential leukocyte count (DLC) was estimated after staining the slides with Leishman’s stain. Identification of different types of the cell was done by observing the slide under 100X magnifications under oil immersion by counting 100 fields. Isolation of PMN from peripheral blood was performed using hypertonic lysis of erythrocytes as described by Mehrzad et al. (2004) within 2 hours of sample collection. The isolation procedure of PMN from blood yielded 90% neutrophils, as determined by counting the cells in smear stained with Leishman’s stain (Dang et al., 2007). For estimating the in vitro PA, one million viable cells from each group were taken in each well and their in vitro PA was determined by the procedure of Chai et al. (2005). All analysis was done using SYSTAT software package. Data from different experiments are presented as mean ± SEM. Analysis of variance of the data was done using RBD factorial design.

RESULTS AND DISCUSSION

The results pertaining to the Hb concentration in high and low yielding crossbred cows during different weeks of postpartum have been presented in Table 1. Comparison of the two experimental groups for Hb concentration revealed that values were significantly (P<0.01) higher in low yielding cows that substantiate the already existing reports of Stevens et al. (1980). The mean value of Hb concentration for high and low yielding group was 10.738 ± 0.0767 g% and 11.015 ± 0.0718 g% respectively. The exact mechanism of action of the changes in hemoglobin concentration of dairy cows with change in stage of lactation is not well understood, although the available evidence associates these changes with protein balance (Eppard et al., 1996) in the body of the animal. During the early and peak lactation the energy and protein demand of the animals often lags behind the milk production level, which is especially the case with high yielder animals and such animals are in negative energy and protein balance during that period which in turn may be responsible for the lower levels of Hb in blood. Week wise, Hb concentration was highest during first week postpartum, which declined steadily up to tenth week postpartum in both the groups and stabilized and recovered slightly at that level thereafter till week 14th. Rowlands (1980) also reported that Hematocrit and Hb concentrations are normally decreased postpartum until the 3rd or 4th months of lactation and then are increased again.

PCV values for high yielding animals ranged between 34.09 - 41.39 ± 0.719 % and for low yielding group range was 34.71 - 41.95 ± 0.673 % (Table 1) which falls under normal range as described by Jain et al. (1991). Mean PCV value for high and low yielding group was 37.278 ± 0.192 % and 37.597 ± 0.180 % respectively, which is higher for low yielding cows but difference is not significant. However, Whitlock et al. (1974) reported that cows with higher milk yield tend to have lower hematocrit than do cows with lower milk yield. PCV values were found to be highest during first week postpartum and later it declined steadily up to tenth week postpartum in both the groups and then increased non significantly later up to fourteen weeks. Rowlands (1980) also found that PCV are normally decreased postpartum until the 3rd or 4th month of lactation.

TLC values obtained for both the groups were within the normal range as reported by Jain, (1986) and the mean value for high and low yielding groups were 8.585 ± 0.0795 x10⁶ and 8.356 ± 0.0744 x10⁶ cells/μl respectively, which doesn’t differ significantly. The TLC in this study was found to be highest during first week postpartum and it declined rapidly up to
**TABLE 1:** Hematological parameters including DLC of high (HY) and low yielding (LY) KF cows during early lactation.

<table>
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<th>1</th>
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<td>LY</td>
<td>HY</td>
<td>LY</td>
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<td>HY</td>
<td>LY</td>
<td>HY</td>
<td>LY</td>
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<td>11.29(3)</td>
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<td>11.06(3)</td>
<td>11(3)</td>
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<td>9.67(3)</td>
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<td>39.14(3)</td>
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<td>8.46(3)</td>
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<td>8.04(3)</td>
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<td>7.91(3)</td>
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<td>7.96(3)</td>
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<td>8.07(3)</td>
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<td>8.41(3)</td>
<td>8.6(3)</td>
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<td>8.52(3)</td>
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<td>65.13(3)</td>
<td>67.75(3)</td>
<td>65.63(3)</td>
<td>68.5(3)</td>
<td>68.38(3)</td>
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Values are expressed as Mean with SEM and the values within a row bearing different letters as superscript are significantly different (P<0.01)
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<td>60.61ac</td>
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<td>63.88ac</td>
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<td>18.23</td>
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<td>0.24bc</td>
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<td>0.286c</td>
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Values are expressed as Mean with SEM and the values within a row bearing different letters as superscript are significantly (P<0.01) different.
fourth week in both the groups, later it increased slightly and remained fluctuating non significantly up to fourteen weeks (Table 1). Several studies have indicated that peak TLC values are observed at parturition, but levels decline shortly after and reach basal conditions within 2 week postpartum (Detilleux et al., 1995; Kimura et al., 1999). The increase in TLC around parturition was due to increasing neutrophil numbers (Kulberg et al., 2002).

Comparison of DLC values has been presented in Table 1. Mean DLC values (%) in high yielding group were: lymphocytes- 64.959 ± 0.308; neutrophils- 24.980 ± 0.287; monocytes- 5.061 ± 0.115; eosinophils- 4.439 ± 0.121 and basophils- 0.367 ± 0.0496, whereas, these values for low yielding group were: lymphocytes- 65.554 ± 0.289; neutrophils- 24.000 ± 0.269; monocytes- 5.259 ± 0.107; eosinophils- 4.893 ± 0.114 and basophils- 0.393 ± 0.0464. When the two groups were compared with respect to DLC values no significant difference was found between high and low yielding groups except for eosinophils which were significantly (P<0.01) higher in low yielding cows. Whereas, week wise significant difference (P<0.01) was reported for all types of cells except basophils which were almost consistent throughout early lactation. Among different cells of blood most significant (P<0.01) changes were reported for lymphocyte and neutrophil count. During first week postpartum lymphocyte count was lowest whereas neutrophil count was highest which significantly (P<0.01) changed in opposite direction up to second week and later changes were found to be non significant. Several studies (Detilleux et al., 1995; Kimura et al., 1999) indicated that peak neutrophil numbers are observed at parturition, but levels decline shortly thereafter and reach basal conditions within 2 week postpartum as reflected in our study also. Physiologically high periparturient blood concentrations of glucocorticoids have been suggested as an explanation for the increased neutrophil count around parturition (Lee and Kehrl, 1998; Kehrl et al., 1999).

Mean TEC values for high and low yielding group was 5.865 ± 0.044 x10^6 cells/µl and 5.908 ± 0.0414 x10^6 cells/µl respectively during early lactation. TEC values obtained for high and low yielding KF cows ranged between 5.5-6.66 ± 0.166 x10^6 cells/µl and 5.64-7.06 ± 0.155 x10^6 cells/µl, respectively (Table 1). Sattar and Mirza (2009) also reported TEC values in exotic HF and Jersey cows. TEC of low yielding cows was significantly higher (P<0.01) than high yielding cows. Stevens et al. (1980) also reported that cows with higher milk yield tend to have lower hematocrit and TEC than do cows with lower milk yield. One probable explanation for decreased RBC mass in high yielding animals may be malnutrition and other causes of negative energy balance as reported by (Eppard et al., 1996). TEC was highest during first week in both groups and it declined steadily up to fourth weeks postpartum and the difference was significant (P<0.01) between these periods but later changes were not significant. Rowlands (1980) reported highest TEC in non lactating cows, which decreased during postpartum up to 3rd or 4th months of lactation, and thereafter increased again. A judicious explanation for the mild decrease in TEC of dairy cows in early lactation could be that the negative energy and nitrogen balance may result in slightly modified production of RBC. As cows adapt to the metabolic demands of lactation and recover from the demands of late gestation, TEC slowly increases to steady-state values.

Mean values of MCV, MCH and MCHC for high and low yielding KF cows were as following: 63.822 ± 0.442 fl., 17.555 ± 0.176 pg, 28.799 ± 0.200 g/dl and 61.855 ± 0.413 fl., 18.170 ± 0.165 pg, 29.294 ± 0.187 g/dl respectively (Table 2). Range for MCV, MCH and MCHC values for high yielding group were: 59.78-67.98 ± 1.652 fl., 15.97-19.21 ± 0.66 pg and 27.66-30.05 ± 0.748 g/dl respectively while for low yielding animals it ranged between 58.43-66.32 ± 1.546 fl., 16.49-19.72 ± 0.617 pg and 28.32-30.81 ± 0.7 g/dl respectively. MCV values were higher (P<0.01) in high yielding group whereas values of MCH and MCHC were not significantly different between groups. Sattar and Mirza (2009) reported the highest MCV, MCH and MCHC in parturient cows and the lowest values were observed in pregnant lactating cows. The differences in erythrocyte indices in high and low yielding animals could not compared as no literature available in this context. In case of weeks, values were significantly (P<0.01) different for MCV and MCH while not for MCHC. Ahmad (1995) reported
MCV, MCH, MCHC in Sahiwal cows during last trimester of pregnancy (pregnant dry cows). These values are closely related to those of the present study. However, Kumar and Pachauri (2000) reported highest MCV and MCH, and lowest MCHC in non-pregnant dry cows compared to other groups.

Comparison of PA of blood neutrophils in high and low yielding crossbred cows during different weeks of postpartum period has been presented in Table 2. Significant (P<0.01) difference in PA was found between high and low yielding cows and it was higher in low yielding cows for most of the early postpartum period except in eleventh and thirteenth weeks. Mean PA value in high and low yielding KF cows was 0.266 ± 0.005 (OD) and 0.301 ± 0.005 (OD) respectively. Lower PA of blood neutrophils in high producing cows may be due to stress on the mammary gland to produce more milk. The ability of neutrophils to phagocytose foreign particles is important for protection of the mammary gland and in vitro analysis of neutrophil function provides a very effective tool for the study of normal mastitis resistance (MacDonald et al., 1994). In both the groups, PA was lowest in first week postpartum and increased continuously up to later stages of early lactation and then fluctuations in PA were seen during last few weeks of early lactation. Nonnecke et al. (2003) postulated that the metabolic demands associated with lactogenesis may impact negatively on the leukocyte function during the peri-parturient period. Blood PMN functions such as chemotaxis (Kremer et al., 1993) and diapedesis (Vandepitte-Van Messom et al., 1993; Shuster et al., 1996) were compromised during early lactation. The suppression in Polymorphonuclear chemiluminescence (PMNCL) has been found to be associated with the sudden changes in concentrations of ketone bodies (Suriyasathaporn et al., 1999), glucocorticoids (Guidry and Paape, 1976) and pregnancy and lactation-associated molecules (Dosogne et al., 1999; Hoeben et al., 2000). Kimura et al. (2002) isolated neutrophils from blood of cows with retained placenta which had significantly lower neutrophil function before calving, and this impaired function lasted for 1 to 2 week after parturition.

From this study it could be concluded that the period immediately after parturition is most stressful to the dairy cows as physiological changes were greatest at this time. PA was lower in high yielding cows as compared to low yielding cows and it could be reason for their higher vulnerability for mastitis during early lactation period.

**REFERENCES**


