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Changes in hematological parameters during different stages of lactation in Surti buffaloes

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Abstract

The present study was conducted to investigate changes in hematological parameters during different stages of lactation in Surti buffaloes. 10 healthy lactating Surti buffaloes were selected for the study. Whole blood containing anticoagulant was collected at early (30±5 days), mid (100±5 days) and late lactation (200±5 days) and used for analysis of hematological parameters. Haemoglobin, total erythrocyte concentration, packed cell volume and lymphocytes increased significantly ($p \leq 0.05$) whereas total leukocyte count, neutrophils, eosinophils, basophils and monocytes decreased significantly ($p \leq 0.05$) from early to late lactation. Mean corpuscular volume and mean corpuscular hemoglobin did not differ significantly. Mean corpuscular hemoglobin concentration was significantly ($p \leq 0.05$) highest in late stage of lactation than early and mid stage of lactation. It was concluded that hemoglobin, total erythrocyte concentration, packed cell volume and lymphocytes increased whereas total leukocyte count, neutrophils, eosinophils, basophils and monocytes decreased from early to late lactation in Surti buffaloes. Thus, it is important to monitor hematological parameters during different stages of lactation in Surti buffaloes.

Keywords: Hematological parameters, stages of lactation, Surti buffaloes

Introduction

The Animal Husbandry Statistics (AHS) released by the Department of Animal Husbandry & Dairying (DAHD) on March 15, 2023, revealed significant growth in India's milk production. Total milk production rose by 5.29% annually, reaching 221.06 million tonnes in 2021-22 from 209.96 million tonnes in 2020-21. Per capita milk availability surged by 33.33%, from 333 gm/day in 2015-16 to 444 gm/day in 2021-22. Gross value addition from milk increased by 184.33% from 2011-12 to 2020-21. The number of milch animals also rose by 8.47% from 2012 to 2019 (Singh, 2022) [15]. These statistics underscore the growing demand for milk production and emphasize the need for optimizing dairy livestock health. Buffaloes are vital species that contribute significantly to milk production in India.

Determining haematological profile at different lactation stages in buffaloes is crucial. Hematological parameters aids in monitoring risk of anemia, reflecting increased nutrient demands during lactation etc (Coffie, 2020) [2]. It assesses immune function, detecting changes that may increase susceptibility to infections. Stress levels can also be monitored through hematological profiling. It aids in identifying reproductive issues such as uterine infections, optimizing fertility. Regular haematological profiling ensures overall health assessment, early detection of abnormalities, allows timely intervention and maximizes productivity throughout the lactation cycle, emphasizing its importance in maintaining the well-being of dairy animals (Zhelavskiy *et al.*, 2024) [19]. Gazing the increased demands of milk production, importance of buffaloes' contribution in it and usefulness of haematological profiling during lactation stages the present study was performed to investigate changes in hematological parameters during different stages of lactation in Surti buffaloes.

Materials and Methods

Animal selection

Total 10 healthy lactating postpartum Surti buffaloes were selected for the study and these animals were maintained at Livestock Research Station, Navsari Agricultural University campus, Kamdhenu University, Navsari.

Sample collection and laboratory analysis

Blood samples were collected at early (30±5 days), mid (100±5 days) and late lactation (200±5 days) from 10 healthy postpartum Surti buffaloes. Approximately 10 ml of whole blood from animals were collected aseptically from jugular vein in K₃EDTA vacutainers and were used for analysis of hematological parameters. Hematological parameters such as hemoglobin, total erythrocyte count, total leukocyte count, packed cell volume, mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration were estimated by fully automated hematology cell counter machine while differential leukocyte count was performed manually.

Statistical analysis

Mean±SE values for hematological parameters at different stages of lactation in Surti buffaloes were calculated using descriptive statistics. Means were compared statistically by one way ANOVA using DMRT to interpret effect of different stages of lactation on the hematological parameters. DMRT was further used for assessing significant difference of mean at 5% level (Snedecor and Cochran, 1994)^[17].

Results

The result of changes in hematological parameters (Mean±SE) during different stages of lactation in Surti buffaloes are presented in table 1.

During early, mid and late stages of lactation in Surti buffaloes, hemoglobin concentration (g/dl) were 9.15±0.14, 9.91±0.22 and 11.21±0.17; total erythrocyte count (10⁶/μl) were 6.24±0.16, 7.00±0.14 and 7.44±0.10 and packed cell volume (%) were 28.30±0.46, 31.07±0.59 and 33.54±0.40 respectively. Among erythrocytic indices, during early, mid and late stage of lactation in Surti buffaloes mean corpuscular volume (MCV) (fl) were 45.70±1.59, 44.69±1.67 and 45.15±0.77; mean corpuscular haemoglobin (MCH) (pg) were 14.77±0.50, 14.25±0.56 and 15.10±0.32; mean corpuscular hemoglobin concentration (MCHC) (g/dl) were 32.33±0.28, 31.89±0.25 and 33.40±0.25 respectively. All the erythrocytic parameters differed significantly ($p\leq 0.05$) between different stages of lactation. Significantly ($p\leq 0.05$) low values of hemoglobin, total erythrocyte count and packed cell volume were observed at early stage of lactation. Hemoglobin, total erythrocyte count and packed cell volume were significantly ($p\leq 0.05$) high during late and intermediate lactation stages. Mean corpuscular volume and mean corpuscular hemoglobin did not differ significantly. Highest value of mean corpuscular hemoglobin was observed at late stage of lactation followed by early stage and mid stage of lactation. Mean corpuscular hemoglobin concentration was significantly ($p\leq 0.05$) high in late stage of lactation than early and mid stage of lactation. Mean corpuscular hemoglobin concentration in early and mid lactation did not show significant difference between them but numerically it was higher in early stage than mid stage of lactation.

Table 1: Changes in hematological parameters (Mean±SE) during different stages of lactation in Surti buffaloes

Parameters	Early lactation (30±5 days) (n=10)	Mid lactation (100±5 days) (n=10)	Late lactation (200±5 days) (n=10)
Hb (g/dl)	9.15 ^c ±0.14	9.91 ^b ±0.22	11.21 ^a ±0.17
TEC (10 ⁶ /μl)	6.24 ^c ±0.16	7.00 ^b ±0.14	7.44 ^a ±0.10
PCV (%)	28.30 ^c ±0.46	31.07 ^b ±0.59	33.54 ^a ±0.40
MCV (fl)	45.70±1.59	44.69±1.67	45.15±0.77
MCH (pg)	14.77±0.50	14.25±0.56	15.10±0.32
MCHC (g/dl)	32.33 ^b ±0.28	31.89 ^b ±0.25	33.40 ^a ±0.25
TLC (10 ³ /μl)	10.07 ^a ±0.19	8.79 ^b ±0.19	7.71 ^c ±0.18
Neutrophils (%)	37.60 ^a ±0.45	30.80 ^b ±0.65	30.20 ^b ±0.94
Eosinophils (%)	2.00 ^a ±0.26	2.00 ^a ±0.15	1.20 ^b ±0.13
Basophils (%)	1.90 ^a ±0.28	1.50 ^{ab} ±0.17	1.00 ^b ±0.00
Lymphocytes (%)	52.93 ^c ±0.90	61.61 ^b ±0.57	63.75 ^a ±0.48
Monocytes (%)	5.57 ^a ±0.07	4.09 ^b ±0.13	2.46 ^c ±0.09

Means bearing different superscripts across rows differ significantly ($p\leq 0.05$) between different stages of lactation in Surti buffaloes

Among leukocytic parameters, during early, mid and late stage of lactation in Surti buffaloes total leukocyte count (10³/μl) was 10.07±0.19, 8.79±0.19 and 7.71±0.18; neutrophils (%) were 37.60±0.45, 30.80±0.65 and 30.20±0.94; eosinophils (%) were 2.00±0.26, 2.00±0.15 and 1.20±0.13; basophils (%) were 1.90±0.28, 1.50±0.17 and 1.00±0.00; lymphocytes (%) were 52.93±0.90, 61.61±0.57 and 63.75±0.48 and monocytes (%) were 5.57±0.07, 4.09±0.13 and 2.46±0.09 respectively.

All the leukocytic parameters differed significantly between different stages of lactation. Significantly ($p\leq 0.05$) highest values of total leukocyte count, neutrophils, eosinophils, basophils and monocytes were observed at early stage of lactation. Significantly ($p\leq 0.05$) lowest values of total leukocyte count, neutrophils, eosinophils, basophils and monocytes were observed at late stage of lactation followed by mid stage of lactation. Lymphocytes were significantly ($p\leq 0.05$) highest at late stage of lactation as compared to early and mid lactation stages.

Discussion

At various stages of an animal's life, hematological markers are frequently utilized to assess an animal's health, nutritional state, and metabolism. Early lactation is a stressful condition for animals because at this stage animals undergo many physiological changes to meet the energy demand for milk production as well as to maintain overall health and metabolism. During negative energy balance there is reduced dry matter intake which generally reflects in sub-optimal nutritional status. This could well explain the lower levels of hemoglobin, TEC and PCV during early lactation. This can also be justified by decreased serum iron levels in the present study as has also been reported by Esiebo and Moore (1979)^[5] at early lactation stage. Hemoglobin and packed cell volume are also representatives of animal's immunity. During stressful condition, these parameters are adversely affected (Anderson *et al.*, 2010)^[11]. In accordance to present findings, similar trend of hemoglobin concentration has been reported by Hagawane

et al. (2009)^[6] wherein they found low level of hemoglobin during early lactation in buffaloes. Mohammed *et al.* (2021)^[10] reported low level of RBC count during early lactation period than mid and late lactating stage in dairy cows. During the early stage of lactation significantly lowest level of hemoglobin as well as mean total erythrocyte count as compared to mid and late stages of lactation in Deoni cows has also been reported by Sateesh *et al.* (2018)^[16]. Significantly low level of hematocrit and hemoglobin at 30 days postpartum in Holstein dairy cows was recorded by Paiano *et al.* (2020)^[12]. During transition period similar trend of hemoglobin, total erythrocyte count, total leukocyte count in buffaloes was recorded by Reddy and Sivajothi (2020)^[13]. However, significantly increased trend of PCV during transition period in Murrah buffaloes was recorded by Saikiran *et al.* (2020)^[14]. Tanmaie *et al.* (2022)^[18] found higher values of MCV, MCH and MCHC during early stage of lactation than mid and late stage of lactation in Murrah buffaloes.

Leukocytes are key players of immune responses in the body especially during stressful states such as transition and early lactation. This period is generally marked with the vulnerability and susceptibility of animals to clinical as well as sub-clinical infections. The higher leukocyte count is generally associated with the activation of neutrophils which are first line of defence against pathogens in the mammary gland. Relatively higher proportion of blood neutrophils indicates its activation during early lactation. The increase in blood neutrophil level is associated with the immune response and the need for cellular defence in the mammary gland during this period (Mohapatra and Dang, 2018)^[11]. These could be possible reasons for increase in total leukocyte count and neutrophil levels during early lactation. Immune activation of leukocytes could also explain the increase in WBCs other than neutrophils except lymphocytes. It has been observed cortisol hormone rise during stressful state leads to increase in circulating neutrophils but decreases lymphocyte concentration in blood. Higher cortisol level during early lactation could be the reason of its detrimental effect on lymphocytes leading to its relative decline. Increase in glucocorticoid levels during periods of stress brings marginated neutrophils to circulation (Jain *et al.*, 1993)^[7]. Lymphocytes have been reported to decrease in stress (Devaraj and Upadhyay, 2007; Dayal *et al.*, 2017)^[4, 3].

Mohapatra and Dang (2018)^[11] recorded highest concentration of TLC count in early lactating buffaloes than mid and late lactating buffaloes. Mohammed *et al.* (2021)^[10] found decreasing trend with significant variations in differential leukocyte count from early lactation to mid and late stage of lactation in crossbred dairy cows. Joshi *et al.* (2018)^[8] reported significantly increased neutrophil level in early stage of lactation than mid and late lactation in crossbred dairy cows. Tanmaie *et al.* (2022)^[18] had also found significantly higher values of total leukocyte count in early stage of lactation than mid and late stages of lactation in Murrah buffaloes. Kumar *et al.* (2015)^[9] recorded increased levels of neutrophils, eosinophils, basophils and monocytes at early lactation than mid and late lactation stages in buffaloes.

Conclusion

Hemoglobin, total erythrocyte concentration, packed cell volume and lymphocytes increased whereas total leukocyte

count, neutrophils, eosinophils, basophils and monocytes decreased from early to late lactation in Surti buffaloes. Thus, it is important to monitor hematological parameters during different stages of lactation in Surti buffaloes.

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