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Haematological variations during different lactation stages in Pantja goats under field and farm conditions

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Abstract

A study was conducted to study hematological parameters on 13 lactating Pantja goats under field and farm conditions, a native indigenous breed from Uttarakhand, India. The experiment compared animals maintained under two distinct management systems: seven goats under a semi-stall-fed farm condition at the Department of Livestock Production Management, GBPUAT, Pantnagar, and six goats under field conditions by a local farmer in Shantipuri. Goats of varying parity were categorized into three lactation stages for the study: S1 (0-30 days), S2 (31-60 days), and S3 (>61 days). Farm goats were housed in a loose housing system with access to cultivated fodders and grazing, while field goats utilized a mixed housing and feeding system with forest land grazing and locally available foliage. Haematological parameters of Hb concentration, PCV, MCV, MCH, MCHC were higher levels with the beginning of lactation stage but TEC of field Pantja goats and TLC of farm Pantja goats were increased at late lactation stage. Farm conditions provided a more stable physiological environment, with several parameters like Hemoglobin (Hb) and Total Erythrocyte Count (TEC) showing no significant variation across lactation stages. Field conditions induced greater variability and physiological stress. Goats in the field exhibited a significant drop in (Hb) during mid-lactation and marked changes in Packed Cell Volume (PCV), (TEC), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC) throughout the lactation cycle.

Keywords: Haematological profile, Pantja goats, lactation period

Introduction

Lactation is a very critical period for an animal where nutritional needs increase to supply more energy, protein and minerals for milk synthesis and in due process it may also lead to certain metabolic disorders. Since milk components are drawn directly and indirectly synthesized from blood (Rawat *et al.*, 2021) [1]. Hematological parameters serve as a true reflection of the health status of animals and vary during different physiological stages. All of the parameters that were analyzed during this research are related to a group whose blood levels can be used as a diagnostic tool to evaluate the cellular function of the animal during the stage of lactation. The research was conducted to assess the hematological parameters impacted by the lactation in Pantja Goats under field and farm conditions.

Materials and Methods

Experimental Material

For the study of planed work, 13 lactating Pantja goats under field and farm conditions, a native indigenous breed from Uttarakhand, India. The experiment compared animals maintained under two distinct management systems: seven goats under a semi-stall-fed farm condition and six goats under field conditions by a local farmer in Shantipuri. Goats of varying parity were categorized into three lactation stages for the study: S1 (0-30 days), S2 (31-60 days), and S3 (>61 days). Farm goats were housed in a loose housing system with access to cultivated fodders and grazing, while field goats utilized a mixed housing and feeding system with forest land grazing and locally available foliage. To active the aim of research, blood samples were collected in clean and dried test tubes with K₂EDTA for hematological analysis.

Experimental design

A total of 13 goats were selected randomly maintain at the farm and field conditions. Farm goats about seven (07) in numbers maintain at the animal shed by the Department of Livestock Production Management, while the remaining six goats maintain at the field condition by a local farmer at the Shantipuri, in Tarai region of Udham Singh Nagar district in Uttarakhand. These goats of different parity and in lactation period, where their lactation stages was consider for this particular study. Lactation stages as given below:

- Lactation stage first (S1): 0 to 30 days (1month)
- Lactation stage second (S2): 31 to 60 days (2months)
- Lactation stage third (S3): above 61 days (>2months)

Methodologies of analysis used for evaluating the haematological indices

1. Hemoglobin (Hb)

The hemoglobin concentration was estimated by Sahli's hemoglobin meter using acid hematin method Oser (1979) [2]. The hemoglobin value will be expressed in (g/dl) of blood.

2. Packed cell volume (PCV)

The packed cell volume was estimated by capillary method or microhematocrit method Dacie and Lewis (1975) [3]. Fresh anticoagulated blood was drawn into microhematocrit capillaries and sealed with moulding clay. The capillaries were then centrifuged at 10,000 rpm for 5 minutes. The microhematocrit value was recorded in percentage (%).

3. Total erythrocyte count (TEC)

The TEC was estimated by hematocytometer method (Jain, 1986) [4] using improved Neubauer's counting chamber. The blood sample was diluted with Haem's fluid (NaCl 1.0 g, Na₂SO₄ 5.0 g, HgCl₂ 0.5 g with DW 200 ml) and TEC values were expressed in (10⁶/μl) of blood.

4. Total leucocyte count (TLC)

The TLC was estimated by Hemocytometer method (Jain, 1986) [4] using Thomas diluting fluid (Glacial acetic acid-2 ml, Gentian violet 1%-1 ml, DW-97 ml). TLC values were expressed in (10³/μl) of blood.

5. Mean corpuscular volume (MCV)

The mean corpuscular volume was be calculated by using the formula given below and expressed in femtoliter (fl).

$$\text{MCV (fl)} = \frac{\text{Packed cell volume (\%)}}{\text{Total erythrocyte count (10}^6\text{/}\mu\text{l)}} \times 100$$

6. Mean corpuscular hemoglobin (MCH)

The mean corpuscular hemoglobin was calculated by using following formula and expressed in picogram (pg).

$$\text{MCH (pg)} = \frac{\text{Hemoglobin (g/dl)}}{\text{Total erythrocyte count (10}^6\text{/}\mu\text{l)}} \times 100$$

7. Mean corpuscular hemoglobin concentration (MCHC)

The mean corpuscular hemoglobin concentration was calculated by using following formula and expressed in (%).

$$\text{MCHC (\%)} = \frac{\text{Hemoglobin (g/dl)}}{\text{Packed cell volume (\%)}} \times 100$$

Statistical analysis

The statistical analysis was done with help of one-way ANOVA (for more than two groups of data) using IBM SPSS software package version 22.0. The significant mean difference were separated by Tukey post-hoc analysis with significance level defined at ($p < 0.05$).

Ethical considerations

Proper care was taken to minimize stress and ensure animal welfare throughout the study. All the sampling was done as per ethical guidelines, obtaining prior permission from The Institutional Animal Ethical Committee (IAEC) (IAEC/CVAsc/VPB/517).

Results and Discussion

Hematological variations during different lactation stages were observed in lactating Pantja goats under field and farm conditions.

The mean values of hemoglobin (g/dl) during early, mid and late lactation stages were 7.63 ± 0.47 , 4.43 ± 0.20 and 6.62 ± 0.12 , respectively in field and 6.49 ± 0.30 , 6.27 ± 0.25 and 5.90 ± 0.41 , respectively in farm conditions. Hb concentration was found significantly ($p < 0.05$) different during different lactation stages in field but non-significant difference between during different stages of lactation in farm was observed but the mean values of PCV (%) during early, mid and late lactation stages were 32.2 ± 1.30 , 26.27 ± 0.83 and 36.83 ± 1.56 , respectively in field and 31.14 ± 2.33 , 26.0 ± 1.46 and 29.00 ± 1.00 , respectively in farm. PCV was found significantly ($p < 0.05$) different during different lactation stages in field and farm. The field Pantja goats Hb and PCV results are in accordance with Rawat *et al.* (2021) [1], Gupta *et al.* (2008) [5] who reported similar significance ($p < 0.05$) difference between during different stages of lactation. This change in Hb and PCV might due to stress during parturition (Sarma *et al.*, 2022) [6].

TEC and TLC were also found significantly ($p < 0.05$) different during different lactation stages in field but TEC was no significant while TLC was significantly ($p < 0.05$) difference in farm. The mean values of TEC (10⁶/μl) during early, mid and late lactation stages were 8.68 ± 0.24 , 12.2 ± 0.37 and 13.74 ± 0.31 , respectively in field and 9.57 ± 1.14 , 10.07 ± 0.47 and 10.47 ± 0.41 , respectively in farm. The mean values of TLC (10³/μl) during early, mid and late lactation stages were 11.41 ± 1.26 , 10.90 ± 0.34 and 9.93 ± 0.64 , respectively in field and 9.33 ± 0.64 , 10.95 ± 1.03 and 12.60 ± 0.29 , respectively in farm. TLC was found no significant difference between during different stages of lactation in field and farm conditions. These TEC and TLC results are in accordance with Muthuramalingam *et al.* (2021) [7], Rawat *et al.* (2021) [1] who documented similar significance ($p < 0.05$) difference between during different stages of lactation. The marginal increase in the TEC might be due to the recovery of the body condition after kidding, which leads to more production of the red blood corpuscles (RBC) Masoni (1985) [8]. TLC might be attributed, to the increase in the immunity of the animal which might be indicated by the increased synthesis of leucocyte in the body for better phagocytosis and to increase resistance against environmental pathogens.

MCV (fl) was found significantly ($p < 0.05$) different, MCH (pg) and MCHC were found significantly ($p < 0.05$) higher during early lactation stage as compared to mid and late lactation stages in field Pantja goats. Mean $\pm$ SE values of

MCV (fl) during early, mid and late lactation stages were 37.21 ± 1.82 , 20.28 ± 1.95 , 27.36 ± 1.38 , respectively in field and 36.56 ± 1.96 , 26.10 ± 1.85 and 28.02 ± 1.64 , respectively in farm Pantja goats.

MCV and MCH were found significantly ($p < 0.05$) higher during early lactation stage as compared to mid and late lactation stages in farm but MCHC was significant ($p < 0.05$) higher during mid-lactation stage as compared to late lactation stage but non-significant was observed early lactation stage of farm Pantja goats. Mean $\pm$ SE values of MCH (pg) during early, mid and late lactation stages were 8.85 ± 0.69 , 3.65 ± 0.19 and 4.91 ± 0.17 , respectively in field and 7.13 ± 0.44 , 6.21 ± 0.39 and 5.65 ± 0.38 , respectively in farm. Mean $\pm$ SE values of MCHC (%) during early, mid and late lactation stages were 23.79 ± 1.29 , 18.67 ± 1.30 and 18.05 ± 0.43 , respectively in field and 22.68 ± 1.58 , 23.98 ± 0.92 and 20.24 ± 0.94 ,

respectively in farm Pantja goats.

The field and farm Pantja goats results erythrocytic indices (MCV, MCH, MCHC) are in accordance with Mbassa and Poulsen (1991) [9]; Azab *et al.*, 1999 [10], Sarma *et al.* (2022) [6], Rawat *et al.* (2021) [11] who documented similar significance ($p < 0.05$) difference between during different stages of lactation. These changes in erythrocytic indices might be due to stress during parturition.

The Mean $\pm$ SE values of hematological studies are presented according to lactation stage in lactating Pantja goats under field and farm conditions are depicted in Table 1, Variation in haematological parameters during different lactation stages in field Figure 1, in farm Figure 2 and erythrocytic indices (MCV, MCH and MCHC) during different lactation stages in field Figure 3, in farm Figure 4 in Pantja goats.

Table 1: Mean $\pm$ SE values of hematological parameters during different lactation stages in field and farm Pantja goats

Hematological Parameters	Farm condition (n = 7)				Field condition (n = 6)			
	Lactation stages			P Value	Lactation stages			P Value
	Early	Mid	Late		Early	Mid	Late	
Hb (g/dl)	6.49 ± 0.30	6.27 ± 0.25	5.90 ± 0.41	NS	$7.63^c \pm 0.47$	$4.43^a \pm 0.20$	$6.62^b \pm 0.12$	0.032
PCV (%)	$31.14^b \pm 2.33$	$26.0^a \pm 1.46$	$29.00^{ab} \pm 1.00$	0.045	$32.2^b \pm 1.30$	$26.27^a \pm 0.83$	$36.83^c \pm 1.56$	0.021
TEC ($10^6/\mu\text{l}$)	9.57 ± 1.14	10.07 ± 0.47	10.47 ± 0.41	NS	$8.68^a \pm 0.24$	$12.2^b \pm 0.37$	$13.74^c \pm 0.31$	0.003
TLC ($10^3/\mu\text{l}$)	$9.33^a \pm 0.64$	$10.95^{ab} \pm 1.03$	$12.60^b \pm 0.29$	0.017	11.41 ± 1.26	10.90 ± 0.34	9.93 ± 0.64	NS
MCV (fl)	$36.56^b \pm 1.96$	$26.10^a \pm 1.85$	$28.02^a \pm 1.64$	0.002	$37.21^c \pm 1.82$	$20.28^a \pm 1.95$	$27.36^b \pm 1.38$	0.011
MCH (pg)	$7.13^b \pm 0.44$	$6.21^{ab} \pm 0.39$	$5.65^a \pm 0.38$	0.019	$8.85^b \pm 0.69$	$3.65^a \pm 0.19$	$4.91^a \pm 0.17$	0.000
MCHC (%)	$22.68^{ab} \pm 1.58$	$23.98^b \pm 0.92$	$20.24^a \pm 0.94$	0.039	$23.79^b \pm 1.29$	$18.67^a \pm 1.30$	$18.05^a \pm 0.43$	0.005

*Mean values with different superscript along the row differ significantly ($p < 0.05$)

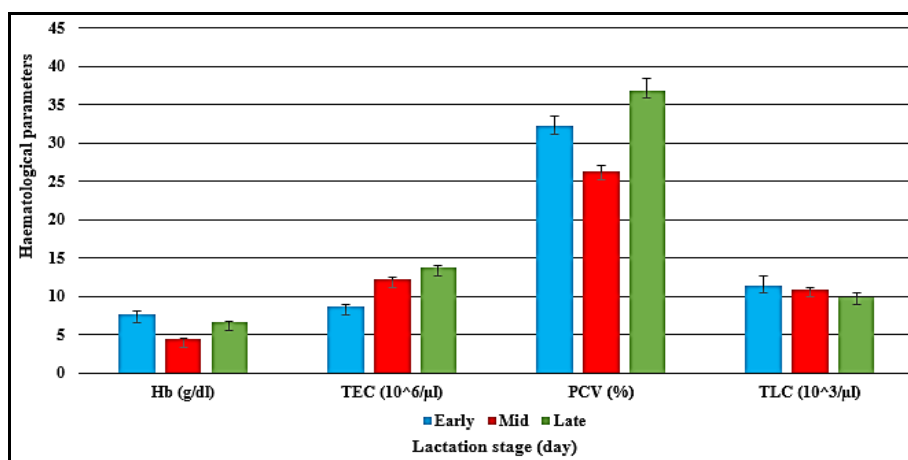


Fig 1: Variation in haematological parameters during different lactation stages in field Pantja goat

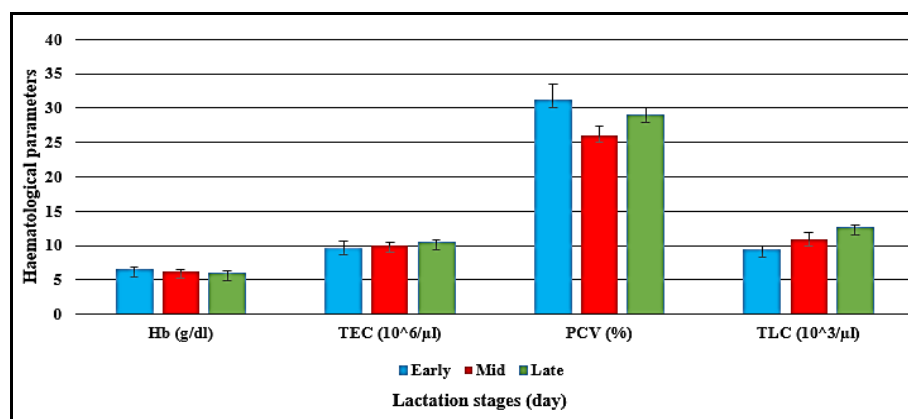


Fig 2: Variation in haematological parameters during different lactation stages in farm Pantja goats

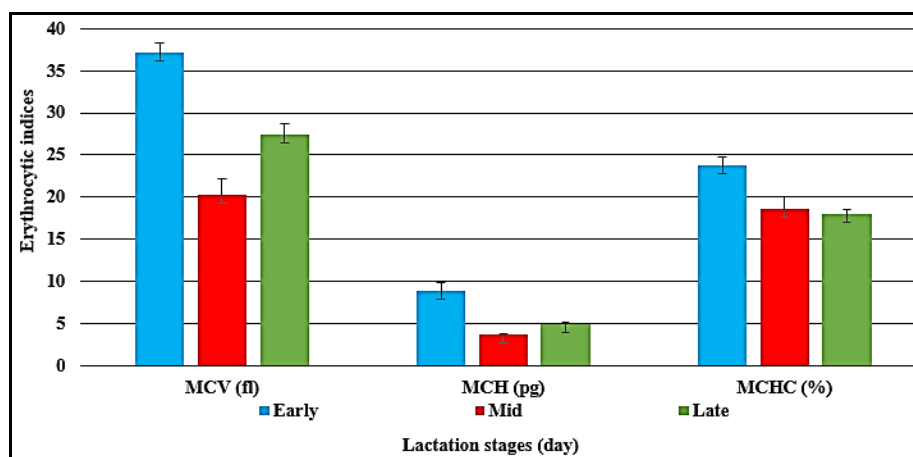


Fig 3: Variation in erythrocytic indices during different lactation stages in field Pantja goats

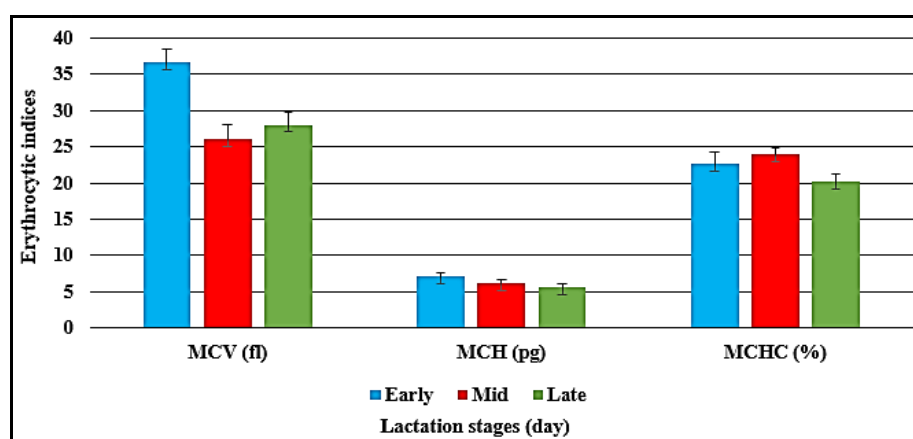


Fig 4: Variation in erythrocytic indices during different lactation stages in farm Pantja goats

Conclusion

The lactation cycle significantly influences the hematological profile of Pantja goats, with management conditions dictating the degree of physiological fluctuation. Goats in field conditions exhibited significant variations in hemoglobin (Hb) and total erythrocyte counts (TEC), likely due to the combined stresses of parturition and environmental exposure, whereas farm conditions provided greater stability for these parameters. While packed cell volume (PCV) and erythrocytic indices (MCV, MCH, MCHC) shifted significantly across all stages regardless of environment reflecting the universal metabolic demands of milk production. The total leukocyte count (TLC) remained statistically stable, suggesting a consistent immune baseline. Ultimately, while both groups adapt their blood chemistry to support lactation, farm management appears to buffer goats against the more drastic hematological shifts seen in field-reared animals. The findings of this study advance the knowledge of veterinary clinical physiology in the creation of disease diagnosis techniques in the field and farm.

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