RESEARCH ARTICLE

Effect of Photoperiod on Haematological Parameters of Surti Does and Kids

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Abstract

Effect of artificial long-day photoperiod under tropical climate was limited and no such reports were available for Surti goats and kids. Therefore, the present study was undertaken to know the effect of photoperiod on monthly haematological parameters of 24 parturient does and their kids for 5 months. The animals were divided into four groups after their parturition/ birth and were subjected to photoperiodic treatment. Control (n=6 does and kids, natural photoperiod, 11.5 h light : 12.5 h darkness) group, T_1 (n=6 does and kids, 14 h light : 10 h darkness) group, T_2 (n=6 does and kids, 16 h light : 08 h darkness) group and T_3 (n=6 does and kids, 08 h light : 16 h darkness) group. Blood samples were collected at monthly interval during entire experimental period. Positive effect of long-day photoperiod treatment was observed on haemoglobin and total erythrocyte count. However, the PCV % and total leukocyte count was significantly higher in short day photoperiod.

Keywords: Haematological parameter, Photoperiod, Surti doe and kid.

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Introduction

Photoperiod is a ratio of light to dark period within 24 hours (Wankhade *et al.,* 2019). A long day photoperiod represents a light exposure period of 16-18 hours and 6-8 hours of darkness; whereas a short-day photoperiod is characterized by a light exposure period of 8 hours and darkness of 16 hours. Haematological values are indicator of physiological status of animals. These values are important to know the stress level in different physiological stages of animals like, lactation, pregnancy and parturition (Manat *et al.,* 2016). Haematological analyses in farm animals have been extensively discussed as an essential part of clinical examination often pointing to a specific differential diagnosis or suggesting a prognosis (Braun *et al.,* 2010; Polizopoulou, 2010). It is well recognized that haematological parameters in healthy goats show variations in relation to breed (Okonkwo *et al.,* 2011; Zumbo *et al.,* 2011), age (Piccione *et al.,* 2010, 2014), reproductive status, housing, starvation, environmental factors, stress and transportation (Watson *et al.,* 1994; Waziri *et al.,* 2010). The literature on effect of artificial photoperiod on haematology of goats is scarce. Hence, the objective of this study was to assess the effect of different light treatment on haematological parameters of parturient Surti does and their kids.

Materials and Methods

The experiment was carried out on 24 goats and their kids of identical age from December, 2018 to May, 2019 at Livestock Research Station, NAU, Navsari, Gujarat. Experiment was approved by the Institutional Animal Ethics Committee. The animals were divided into four groups after their parturition/birth and were subjected to different photoperiodic treatment. Control animals received natural photoperiod (L11.5:D12.5), whereas the light : darkness ratio in experimental groups was; T_1: L14:D10, T_2: L16:D08 and T_3: L08:D16. Electronic timer was installed to strengthen long photoperiod. 100 Watt compact fluorescent light bulbs were used to provide extra supplemental light and a light intensity of approx. 400 lux was maintained. An opaque curtain was made to restrict the light in experimental shed. One week

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acclimatization period was given to experimental does and kids before actual start of the experiment.

Blood samples were collected at 30 days interval till 150th day of the study. Haematological parameters such as haemoglobin, packed cell volume, total erythrocyte count and total leukocyte count were estimated by using MEDONIC CA 620/530 VET fully automated haematology cell counter (Boule Medical AB, Sweden). One kid died in group T_1 at 1st month and one in T_3 at 3rd months of age, hence the data of rest 5 kids were taken into consideration for periods thereafter in these groups. Statistical analysis was carried out by One-way ANOVA using SAS 9.3 software. Duncan's multiple range test was used at 5% level of significance for mean separation.

Results and Discussion

Haemoglobin (Hb, g/dl)

Significantly higher ($p < 0.05$) haemoglobin (g/dl) concentration was observed in control (6.37 ± 0.18) group than T_1 (5.93 ± 0.03) group of does at 3rd month of the study. Conversely, at 4th and 5th months, the haemoglobin (g/dl) concentration was significantly higher ($p < 0.05$) in T_2 (7.27 ± 0.24 and 6.97 ± 0.21) group than control (6.35 ± 0.19) and T_1 (6.20 ± 0.13) group, respectively (Table 1). There were non-significant differences in haemoglobin concentration of kid among all the groups at all the stages, but the treatment groups had higher haemoglobin concentration compared to control group at 1st, 2nd, 3rd and 4th months of study (Table 1). Higher haemoglobin concentration means there was a more supply of oxygen from the lungs to the body tissues. Haemoglobin also plays an important role in maintaining the shape of the red blood cells. In present study haemoglobin (g/dl) concentration was found at par in long-day as well as short-day photoperiod. The reported values were lower than the normal range of haemoglobin in both the groups (Weiss and Wardrop, 2011).

Packed Cell Volume (PCV %)

The PCV % was significantly higher ($p < 0.05$) in T_3 (19.33 ± 1.02) group than control (17.20 ± 0.33), T_1 (16.18 ± 0.44) and T_2 (17.30 ± 0.63) group of does at 2nd month of the study. Furthermore, at 3rd month of the study the value was significantly higher ($p < 0.05$) in T_1 (20.08 ± 1.32) and T_3 (19.35 ± 0.62) groups than control (16.10 ± 0.31) and T_2 (16.90 ± 0.56) groups. Whereas at 5th month significantly higher ($p < 0.05$) PCV % was found in T_3 (19.52 ± 0.96) group than T_1 (17.00 ± 0.43) group of does (Table 2).

There was a non-significant difference in PCV % in kids among all the groups at all the stages of the study. However, the T_3 group of kids had lower PCV % than all other groups from 0 day to 3rd month of the study. Although at 4th and 5th months of the study the T_1 group showed lower PCV % than all other group of kids (Table 2). Present experiment shows the higher PCV (%) in short-day photoperiod treated group than long-day photoperiod treated group. Increased PCV % in does under short-day photoperiod indicated that the animals were under dehydration stage or there was an abnormal increase in red blood cell production. However, the present values were lower than the normal range of PCV % in both groups of doe and kid (Weiss and Wardrop, 2011).

Total Erythrocyte Count (TEC, 10^6/mm^3)

There were non-significant differences among TEC values of all the groups of does at all the stages. The lower TEC value

Table 1: Least squares' means and standard error (LSM ± SE) of haemoglobin (g/dl) of Surti does and kids at monthly interval under different photoperiods

	Groups and Haemoglobin (g/dl) in Does			
Months post-partum/birth	*C (n=6)*	*T_1 (n=6)*	*T_2 (n=6)*	*T_3 (n=6)*
0 Day	6.83 ± 0.20	6.82 ± 0.17	7.02 ± 0.32	7.02 ± 0.39
1 Month	6.87 ± 0.18	6.45 ± 0.23	6.62 ± 0.25	6.67 ± 0.33
2 Month	6.53 ± 0.20	6.28 ± 0.12	6.33 ± 0.16	6.53 ± 0.12
3 Month	6.37^{a} ± 0.18	5.93^{b} ± 0.03	6.13^{ab} ± 0.05	6.10^{ab} ± 0.07
4 Month	6.35^{b} ± 0.19	6.65^{ab} ± 0.14	7.27^{a} ± 0.24	6.88^{ab} ± 0.24
5 Month	6.43^{ab} ± 0.19	6.20^{b} ± 0.13	6.97^{a} ± 0.21	6.55^{ab} ± 0.34
Groups and Haemoglobin (g/dl) in Kids				
0 Day	7.07 ± 0.27	6.88 ± 0.40	6.70 ± 0.18	6.83 ± 0.23
1 Month	6.58 ± 0.16	6.84 ± 0.37	6.50 ± 0.14	6.50 ± 0.17
2 Month	6.40 ± 0.14	6.68 ± 0.19	6.57 ± 0.15	6.60 ± 0.24
3 Month	6.33 ± 0.22	6.66 ± 0.33	6.52 ± 0.26	6.60 ± 0.09
4 Month	6.78 ± 0.20	6.80 ± 0.38	6.95 ± 0.18	6.82 ± 0.23
5 Month	7.00 ± 0.33	6.78 ± 0.36	6.68 ± 0.12	6.56 ± 0.37

Figures in parentheses are the numbers of animals used to derive LSM
LSM showing different superscripts in lower case letters in a row differ significantly at $p < 0.05$

Table 2: Least squares' means and standard error (LSM ± SE) of PCV (%) of Surti does and kids at monthly interval under different photoperiods

	Groups and PCV (%) in Does			
Months post-partum/birth	*C (n=6)*	*T_1 (n=6)*	*T_2 (n=6)*	*T_3 (n=6)*
0 Day	18.38 ± 0.57	17.42 ± 0.57	18.07 ± 1.00	18.78 ± 1.32
1 Month	17.53 ± 0.99	16.72 ± 0.45	18.22 ± 0.89	18.67 ± 1.06
2 Month	17.20^{b} ± 0.33	16.18^{b} ± 0.44	17.30^{b} ± 0.63	19.33^{a} ± 1.02
3 Month	16.10^{b} ± 0.31	20.08^{a} ± 1.32	16.90^{b} ± 0.56	19.35^{a} ± 0.62
4 Month	18.10 ± 1.50	19.11 ± 1.01	18.15 ± 0.59	19.18 ± 0.80
5 Month	17.62^{ab} ± 0.86	17.00^{b} ± 0.43	18.02^{ab} ± 0.57	19.52^{a} ± 0.96
Groups and PCV (%) in Kids				
0 Day	19.50 ± 1.08	20.06 ± 1.01	18.88 ± 0.75	17.62 ± 0.97
1 Month	20.25 ± 0.88	19.30 ± 1.26	18.13 ± 0.84	18.06 ± 0.75
2 Month	20.27 ± 0.70	19.78 ± 1.02	18.32 ± 0.95	18.00 ± 0.56
3 Month	17.97 ± 1.31	19.68 ± 1.49	19.42 ± 1.08	19.20 ± 0.99
4 Month	18.88 ± 0.93	17.38 ± 0.70	18.33 ± 0.95	17.44 ± 0.60
5 Month	18.92 ± 1.02	17.54 ± 0.84	19.93 ± 1.08	18.28 ± 1.50

Figures in parentheses are the numbers of animals used to derive LSM
LSM showing different superscripts in lower case letters in a row differ significantly at $p < 0.05$

Table 3: Least squares' means and standard error (LSM ± SE) of TEC (10^6/mm^3) of Surti does and kids at monthly interval under different photoperiods

	Groups and TEC (10^6/mm^3) in Does			
Months post-partum/birth	*C (n=6)*	*T_1 (n=6)*	*T_2 (n=6)*	*T_3 (n=6)*
0 Day	11.68 ± 0.67	09.92 ± 1.02	10.25 ± 1.19	09.48 ± 1.66
1 Month	10.53 ± 0.97	11.00 ± 0.99	11.35 ± 1.09	10.90 ± 1.36
2 Month	11.42 ± 0.74	11.30 ± 1.09	11.81 ± 1.10	11.26 ± 0.79
3 Month	11.10 ± 0.59	10.45 ± 0.92	11.03 ± 0.98	10.93 ± 0.67
4 Month	10.16 ± 0.70	10.91 ± 0.68	10.19 ± 1.04	09.98 ± 1.33
5 Month	09.81 ± 1.30	09.15 ± 0.57	10.20 ± 0.93	09.03 ± 0.83
Groups and TEC (10^6/mm^3) in Kids				
0 Day	09.34 ± 0.60	09.86 ± 0.71	09.35 ± 0.42	09.20 ± 0.58
1 Month	09.70^{b} ± 0.67	12.37^{a} ± 0.49	11.18^{ab} ± 0.56	09.84^{b} ± 0.57
2 Month	09.72^{b} ± 0.57	12.55^{a} ± 0.58	10.32^{b} ± 0.53	09.64^{b} ± 0.59
3 Month	12.03^{ab} ± 0.79	13.46^{a} ± 0.70	10.53^{bc} ± 0.75	09.20^{c} ± 0.33
4 Month	09.53 ± 0.64	09.32 ± 0.38	09.18 ± 0.58	08.41 ± 0.29
5 Month	09.49 ± 0.58	09.48 ± 0.68	10.19 ± 0.48	09.19 ± 0.67

Figures in parentheses are the numbers of animals used to derive LSM
LSM showing different superscripts in lower case letters in a row differ significantly at $p < 0.05$

was found in T_3 group of doe compared to other groups of animals at 0 day, 2nd, 4th and 5th month of trial. Moreover, the TEC values were lower in control and T_1 group at 1st and 3rd months of study (Table 3).

Significantly higher ($p < 0.05$) TEC (10^6/mm^3) value was observed in T_1 (12.37 ± 0.49) group than control (9.70 ± 0.67) and T_3 (9.84 ± 0.57) group of kids at 1st month of the study. As well as at 2nd month the T_1 (12.55 ± 0.58) group showed significantly higher ($p < 0.05$) difference between control (9.72 ± 0.57), T_2 (10.32 ± 0.53) and T_3 (9.64 ± 0.59) groups. Likewise, significantly higher ($p < 0.05$) TEC (10^6/mm^3) value was observed in T_1 (13.46 ± 0.70) group than T_2 (10.53 ± 0.75) and T_3 (9.20 ± 0.33) group of kids at 3rd month of the study (Table 3).

Total erythrocyte count increased with increase in photoperiod from natural light to extended photoperiod. It indicated that there was a positive effect of long-day photoperiod on total erythrocyte count in kids. RBCs contain haemoglobin, which carries oxygen to body tissues, which means there is higher supply of oxygen in long-day photoperiod treated group than short-day photoperiod treated group. The present values were in normal range of total erythrocyte count in both the groups (Weiss and Wardrop, 2011).

Table 4: Least squares' means and standard error (LSM ± SE) of TLC (10^3/mm^3) of Surti does and kids at monthly interval under different photoperiods

	Groups and TLC (10^3/mm^3) in Does			
Months post-partum/birth	*C (n=6)*	*T_1 (n=6)*	*T_2 (n=6)*	*T_3 (n=6)*
0 Day	$12.83^{a} \pm 0.58$	$08.88^{b} \pm 0.76$	$10.73^{ab} \pm 0.78$	$09.03^{b} \pm 0.77$
1 Month	11.55 ± 0.61	13.22 ± 0.87	10.83 ± 0.89	10.80 ± 0.93
2 Month	11.95 ± 0.75	13.13 ± 0.40	13.43 ± 0.64	12.77 ± 0.59
3 Month	11.52 ± 0.77	13.03 ± 0.62	12.80 ± 0.71	10.53 ± 0.18
4 Month	11.03 ± 0.78	10.58 ± 0.60	11.52 ± 0.67	10.63 ± 0.83
5 Month	$11.37^{ab} \pm 0.59$	$09.40^{b} \pm 0.37$	$10.00^{ab} \pm 0.63$	$12.45^{a} \pm 0.51$
Groups and TLC (10^3/mm^3) in Kids				
0 Day	5.25 ± 0.52	6.65 ± 1.40	7.18 ± 1.33	8.20 ± 1.27
1 Month	5.53 ± 0.26	6.82 ± 1.27	6.85 ± 0.97	7.30 ± 0.61
2 Month	$5.35^{b} \pm 0.17$	$5.66^{b} \pm 0.17$	$6.43^{ab} \pm 0.52$	$7.06^{a} \pm 0.38$
3 Month	5.70 ± 0.17	4.88 ± 0.42	5.40 ± 0.43	6.04 ± 0.42
4 Month	$6.01^{b} \pm 0.18$	$7.20^{ab} \pm 1.29$	$8.77^{ab} \pm 2.21$	$9.94^{a} \pm 0.97$
5 Month	$6.35^{b} \pm 0.63$	$9.16^{a} \pm 0.85$	$9.80^{a} \pm 0.81$	$8.96^{a} \pm 0.70$

Figures in parentheses are the numbers of animals used to derive LSM
LSM showing different superscripts in lower case letters in a row differ significantly at $p < 0.05$

Total Leukocyte Count (TLC, 10^3/mm^3)

TLC ($\times 10^3$/mm^3) count was significantly higher ($p < 0.05$) in control group (12.83 ± 0.58) than T_1 (8.88 ± 0.76) and T_3 group (9.03 ± 0.77) of does at 0 day of the study. On the contrary at the end of the experiment significantly higher ($p < 0.05$) TLC count was observed in T_3 (12.45 ± 0.51) group than T_1 (9.40 ± 0.37) group (Table 4). Significantly higher ($P < 0.05$) TLC ($\times 10^3$/mm^3) count was observed in T_3 (7.06 ± 0.38) group than control (5.35 ± 0.17) and T_1 group (5.66 ± 0.17) of kids at 2nd month of the study. Likewise, significantly higher ($p < 0.05$) TLC was observed in T_3 (9.94 ± 0.97) group at 4th month of the study with control (6.01 ± 0.18) group. However, the significantly lower ($p < 0.05$) value was noticed in control (6.35 ± 0.63) group than T_1 (9.16 ± 0.85), T_2 (9.80 ± 0.81) and T_3 (8.96 ± 0.70) groups of kids at 5th month of the study (Table 4).

In present study, TLC was higher in short-day photoperiod group than long-day photoperiod group of does. However, irrespective of long-day or short-day treatment, lower TLC was found in control group of kids. The higher TLC of blood denotes some infection or immune deficiencies due to stress of short photoperiodic treatment on does. The present values were in normal range of total leukocyte count in both the groups during the experiment (Weiss and Wardrop, 2011).

The influence of breed and age should be considered when evaluating goat's haematology (Addass *et al.,* 2010; Okonkwo *et al.,* 2011; Piccione *et al.,* 2014). Arfuso *et al.,* (2016) reported that the ambient temperature, THI and the other climatic conditions affect haematological parameters in goats. In the present study the other climatic factor was a photoperiodic treatment. Direct effect of long or short day photoperiod was found on haematological parameters of Surti does and kids. There was a negative effect of short day photoperiod on PCV% (does) and TLC (does and kids) count. This finding may indicate that the animals under short day photoperiod were under dehydrated phase or under immune stress.

Conclusion

Positive effect of long-day photoperiod was observed on haemoglobin and total erythrocyte count, however, the PCV % and total leukocyte count was significantly higher in short day photoperiod.

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