Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(3): 465-469

Received: 24-03-2019
Accepted: 28-04-2019

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Haematological assessment of healthy Gir cattle on an established farm

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Abstract
The normal haematological reference values were determined at various ages in both male (1 wk to 12 m) and female (1 wk to 36 m) and at different physiological stages (lactating and non-lactating) of Gir cattle maintained at the Cattle Breeding Farm, Junagadh Agricultural University, Junagadh, India. Blood was collected aseptically from all the animals and subjected to haematological analysis viz. Total Erythrocyte Count, Haemoglobin, Packed Cell Volume, Erythrocytic indices and Total Leukocyte Count. The values were statistically analysed and set as reference values. The reported haematological values could serve as baseline information for comparison and diagnosis of conditions at different ages, sex and physiological stages in Gir cattle in India.

Keywords: Age, cattle, gir, haematology, lactation, sex

1. Introduction
The 'Gir' breed of cattle has proved to be highly adaptable to harsh climatic conditions and resistant to common diseases prevalent in India. As per the livestock census of 2007, Gir cattle constitute 13.99 lakh of the total 79.75 lakh cattle of Gujarat [1]. Gir cattle originally belongs to Saurashtra region and is resistant to hot temperatures and tropical diseases and good animals produce around 12-25 litres milk per day. Haematological analysis is not only relevant for diagnosing disorders of the hematologic system but also helpful in the diagnosis of many organ and systemic diseases. Although, the diagnosis of a disease can seldom be based solely on a complete blood cell count (CBC), the haemogram contributes valuable information in the diagnosis, surveillance and formulation of a prognosis regarding the future progression of a disease in an individual [2]. Further the age, sex, breed, season and physiological stages like pregnancy, lactation, nutrition and health status of the animal affects the haemogram. Studies have been conducted on Hallikar breed of cattle in males and females from 1 – 6 years of age [3], Haryana cattle heifers aged around 1 year [4] and in male and female crossbred (HF X Sahiwal X Local) calves aged below 3 months [5]. It was opined by [6] that the geographical location affected the results obtained from different breeds and hence cannot be considered as a norm for related animal breeds of the same species in different geographical locality. Keeping this in mind, the authors attempted to assess the haematological profile of Gir cattle across age, sex and lactation stages.

2. Materials and Methods
The study was carried out on male (1 wk to 12 m) and female (1 wk to 36 m) Gir cattle of varied ages and physiological stages (1, 2 and 3 month of lactation; Non lactating pregnant and non-pregnant) maintained under isolateral management conditions at the Cattle Breeding Farm, Junagadh Agricultural University, Junagadh (Gujarat). Junagadh is geographically located at 21º31' North Latitude and 72º28' East Longitude at an elevation of 107 meter above mean sea level and has a subtropical climate. At each stage 8 females and 6 males were used for blood collection. The animals were separated from the herd only for the duration of blood collection. The project was approved by the Institutional Animal Ethics Committee (IAEC). The haematological evaluation was carried out at the Department of Physiology and Biochemistry, College of Veterinary Science and Animal Husbandry, Junagadh. Fresh whole blood (2 ml) collected aseptically from the jugular vein of Gir cattle in Lithium Heparin vacuettes, was immediately subjected to haematological analyses for TEC, Hb, PCV, MCV, MCH, MCHC and TLC values using Auto Hemato Analyzer (Model: BC – 2800 Vet, Mindray) and data was analysed as per [7].

3. Results and Discussion

The haematology of male and female Gir cattle at various ages is presented in Table 1 and the haematology of lactating and non-lactating Gir cattle is presented in Table 2.

3.1 Total erythrocyte count (TEC)

In Gir cows, the total erythrocyte count (TEC – 10^6/cmm) ranged from 6.58 ± 0.36 (24 m age) to 10.25 ± 0.86 (1 wk age) among all the ages studied. The count decreased significantly ($P < 0.05$) from 1 wk age to 1 m age. The levels decreased constantly till 24 m age and the counts at 12 m and 24 m were significantly ($P < 0.05$) lower than that at 1 m age. A non-significant rise was observed at 36 m from the levels at 24 m age. The count of total erythrocytes (10^6/cmm) in Gir males at all ages and physiological stages ranged from 6.67 ± 0.19 (12 m age) to 7.12 ± 0.22 (1 wk age). The count decreased non-significantly from 1 wk age upto 12 m age. Values of TEC for male and female Gir cattle are presented in Table-1. In lactating Gir cows, first month lactation shows significant ($P<0.05$) lower values than other two months but between pregnant and non-pregnant Gir cow groups shows non-significance difference.

The total erythrocyte count in Gir males was lower than that in Gir females at all ages with the difference at 1 wk and 3 m age being significant. Significant ($P < 0.05$) age effect seen in Gir females and males and at all ages and physiological stages in our study agreed with the findings of [8] in Holstein and Brown Swiss cattle and their crosses. The range of mean TEC in our study was lower than that reported by [9] in Gaolao calves. The finding in the present study that TEC decreased as age increased was not in line with the findings of [10] in Friesian X Hariana cattle. Increase in erythrocyte count as lactation advanced was in agreement with the findings of [11]. Higher TEC observed during pregnancy over that of lactation and non-pregnant cows was not in agreement with the findings of [12, 13] in Holstein Friesian cattle. The TEC values were the highest at 1 wk age. Significant haematological changes seen in Gir cattle as age advanced may be due to increased destruction of erythrocytes, maturational changes of lymphoid organs and environment induced adaptative changes with increasing age [14]. Further, [15] opined that glucocorticoids promote the differentiation of embryonic stem cells to hematopoietic cells and prolong the proliferation of erythroid progenitor cells but reduce the rate of spontaneous differentiation and terminal maturation of erythroid cells. Further, thyroid hormone (T_3) promotes differentiation and maturation of erythroid cells toward enucleated Red Blood Cells. Thyroid hormone also promotes synthesis of erythropoietin in kidney [16].

3.2 Haemoglobin (Hb)

Haemoglobin (Hb – g/dl) levels at all ages and physiological stages ranged from 10.16 ± 0.52 (24 m age) to 13.91 ± 0.66 (1 m age) in Gir females. The values at 1 wk and 1 m age were statistically at par with each other. The haemoglobin concentration showed progressive and significant ($P < 0.05$) decrease from 1 m age to 24 m age. A significant ($P <0.05$) increase was found in the levels at 36 m age over that of 24 m age. In lactating Gir cows, a non-significant decrease was found in the values from 1 m to 3 m lactation stage. Non-significant difference was noted between non-lactating pregnant and non-pregnant Gir cows. It was reported by [17] that Hb levels in normal cycling crossbred cows to be 12.05 ± 0.42 g/dl. In Gir males, haemoglobin concentration (g/dl) ranged from 10.28 ± 0.65 (1 m age) to 11.70 ± 0.25 (6 m age) at all ages and physiological stages studied. The values decreased non-significantly at 1 m from that at 1 wk age and then rose non-significantly upto 6 m age before decreasing again at 12 m age. Comparing the haemoglobin levels of females and males of Gir breed it was noted that significantly ($P < 0.05$) higher levels existed in Gir females at 1 wk, 1 m and 3 m age, whereas the levels at 6 m and 12 m age were non-significantly higher in Gir males as compared to Gir females.

The significant ($P < 0.05$) effect of falling haemoglobin levels as age advanced seen in the present study in Gir females and males tallies with the results of [18, 19] in crossbred calves, and with findings of [20, 8] but did not agree with the findings of [13] in Holstein Friesian cattle. Significant ($P < 0.05$) differences found in the present study between male and female agreed with the reports of [8] in Holstein and Brown-Swiss cattle and their crosses. However, [21] found no sexual dimorphism in the Sokoto Gudali cattle. Blood Hb concentration could be used as an indicator of adaptability to the environment and the animal with higher Hb concentration have been found to be more adaptable than with lower Hb levels [22]. The changes in haematological values could also be dependent on the nutritional status of the animal.

3.3 Packed cell volume (PCV)

The mean Packed Cell Volume (PCV - %) in Gir cows ranged from 32.70 ± 1.88 (24 m age) to 41.75 ± 0.79 (3 m age) at all ages and physiological stages studied. The values from 1 wk of age to 12 m age were non-significantly different. The value at 24 m age was significantly ($P < 0.05$) lower than that at 12 m age. The value increased significantly ($P < 0.05$) at 36 m from the level at 24 m age, but was at par with the levels observed at earlier ages. A definite trend was not found in the values over different ages. No significant difference was observed between different lactation stages in lactating cows. Similarly, no significant difference was noted among the non-lactating stages of pregnant and non-pregnant cows. In male Gir cattle the packed cell volume (%) at different ages and physiological stages varied from 37.00 ± 1.84 (12 m age) to 40.17 ± 1.60 (1 wk age). The levels decreased non-significantly from 1 wk of age to 36 m age. No significant differences were found at different ages between Gir females and males.

Significant effect of age and decreasing value of PCV as age progressed was also reported by [8, 19, 20]. Haematocrit (PCV) values reported by [11] in lactating Gir, by [23] in pregnant Ongole cows was slightly lower whereas that reported by [12] in post-partum cows were higher than that found at the same stages in the current study. The higher value at pregnancy as compared to the early lactation observed in our study was contrary to the findings of [24] in two breeds of cattle. The decreasing trend of PCV seen in both the sexes of Gir cattle up to 24 m age in females and 12 m age in males corresponded to the declining trend of TEC seen at these ages. The increase in values at 36 m in the females of both the species again was in response to the increase in TEC values at this age. Packed cell volume is a representation of the amount of erythrocytes that are present in fixed volume of blood. Hence, the variation in the levels of PCV was in direct consonance to that of total erythrocyte count in most of the ages and stages studied.

3.4 Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC)

The MCV, MCH and MCHC values for Gir females and males are presented in Table 1. In Gir females, the MCV (fl) and MCH (pg) values showed significant ($P < 0.05$) increase at 36 m from its values at 1 wk of age. MCHC (%) value at 36 m was at par with that at 1 wk age. MCV and MCH values at 1 m lactation were significantly ($P < 0.05$) higher and MCHC levels were non-significantly higher than that at 2 m and 3 m lactation. The MCV, MCH and MCHC levels in non-pregnant non-lactating cows were higher than that in pregnant cows with the MCH values being significantly ($P < 0.05$) different. In Gir males, non-significantly lower levels were observed for MCV, MCH and MCHC levels at 12 m as compared to 1 wk age. In Gir cattle, significant ($P < 0.05$) effect of sex was seen for MCV and MCH values while the effect of sex on MCHC values was noted at 1 wk of age only.

The MCV (fl), MCH (pg) and MCHC (%) values recorded in the current study in Gir cattle differed from the findings of [12, 21] in Sokoto Gudali cattle and [9] in Gaolao calves. The significant differences observed at various ages (for MCV, MCH and MCHC) and physiological stages (for MCH and MCHC) were in line with the findings of [8]. Non-significant effect of sex on MCV, MCH and MCHC values as reported by [21] was not in total agreement with the current findings as at some of the ages (at 1 wk for MCV; at 1 wk and 6 m for MCH and at 1 wk, 1 m, 6 m and 12 m for MCHC) sexual dimorphism was observed in Gir cattle. Higher value of MCHC observed in lactating over non-lactating cows by [25] was not in agreement with the present findings.

3.5 Total leucocyte count (TLC)

In Gir cows, the total leucocyte count (TLC – 10^3/cmm) ranged from 6.39 ± 0.19 (24 m age) to 7.98 ± 0.25 (1 wk age) among all the ages and physiological stages studied. The count decreased non-significantly from 1 wk to 3 m age and then rose non-significantly at 6 m age and subsequently dropped at 12 m and 24 m age. The value at 24 m age was significantly ($P < 0.05$) lesser than that observed from 1 wk to 6 m age and at 36 m age. Lactating Gir cows exhibited a non-significant increase in TLC from 1 m lactation to 3 m lactation stage. The levels in non-lactating pregnant cows were higher than that in non-lactating non-pregnant cows. The count of total leucocytes in Gir males at all ages and physiological stages ranged from 6.85 ± 0.11 (1 wk age) to 8.25 ± 0.17 (6 m age). The values increased significantly ($P < 0.05$) from 1 wk to 1 m age and continued to increase non-significantly up to 6 m age. The count at 12 m age was non-significantly lower than that at 1, 3 and 6 m age and was also non-significantly higher than that at 1 wk age. The TLC in Gir bulls was significantly ($P < 0.05$) higher than that in Gir castrated males. Significantly ($P < 0.05$) lower TLC was present in males as compared to females in Gir cattle at 1 wk age, while the counts at 6 and 12 m age in females was significantly lower than that that in males.

The lower values observed at birth and the increase in the values as age progressed (in Gir males) could be because at birth the neonate attains its immunity from the colostrum that it sucks from the dam. However, as age increases the increase in TLC (10^3/cmm) values indicate the adaptability of the young one to its environment and also its increased immune ability. The counts of leucocyte at different periods of lactation and during pregnancy were comparatively higher than found at most of the ages in Gir cattle. The presence of higher leucocyte count during these stages could be due to stress. Significant ($P < 0.05$) effect of age seen in Gir females and males agreed with the findings of [10, 26]. It was reported by [21] that sex had no effect on TLC but in the present study the values at 1 wk of age were found to differ significantly ($P < 0.05$) between male and female Gir cattle. Higher count of leucocytes observed at pregnancy as compared to lactating stages in our study was similar to that reported by [12] and contrary to the findings of [27] in Frieswal cattle.

Table 1: Haematology at different ages in male and female Gir cattle (Mean ± S.E.)

Animal \ Age		Wk	Months					
		1	1	3	6	12	24	36
TEC (10^6/cmm)	F	$10.25^{cx} \pm 0.86$	$7.89^{b} \pm 0.41$	$7.26^{abx} \pm 0.05$	$7.05^{ab} \pm 0.09$	$6.64^{a} \pm 0.18$	$6.58^{a} \pm 0.36$	$7.40^{ab} \pm 0.23$
	M	$7.12^{ay} \pm 0.22$	$6.93^{a} \pm 0.41$	$6.74^{ay} \pm 0.19$	$6.79^{a} \pm 0.22$	$6.67^{a} \pm 0.19$	-	-
Hb (g/dl)	F	$13.59^{cx} \pm 0.71$	$13.91^{cx} \pm 0.66$	$12.18^{bx} \pm 0.17$	$11.35^{ab} \pm 0.19$	$10.38^{a} \pm 0.33$	$10.16^{a} \pm 0.52$	$13.80^{c} \pm 0.67$
	M	$11.46^{ay} \pm 0.44$	$10.28^{ay} \pm 0.65$	$11.20^{ay} \pm 0.31$	$11.70^{a} \pm 0.25$	$10.63^{a} \pm 0.34$	-	-
PCV (%)	F	$39.05^{b} \pm 1.19$	$38.88^{b} \pm 0.86$	$41.75^{b} \pm 0.79$	$41.00^{b} \pm 0.65$	$38.25^{b} \pm 1.58$	$32.70^{a} \pm 1.88$	$40.18^{b} \pm 1.36$
	M	$40.17^{ab} \pm 1.60$	$37.58^{a} \pm 1.25$	$39.50^{ab} \pm 1.99$	$38.83^{ab} \pm 1.22$	$37.00^{a} \pm 1.84$	-	-
MCV (fl)	F	$40.30^{ax} \pm 3.89$	$50.28^{b} \pm 2.83$	$57.96^{c} \pm 0.73$	$58.21^{c} \pm 0.99$	$57.56^{c} \pm 1.24$	$49.99^{b} \pm 3.41$	$54.41^{bc} \pm 1.31$
	M	$56.46^{y} \pm 1.58$	55.17 ± 3.54	58.42 ± 1.50	57.17 ± 0.52	55.35 ± 1.36	-	-
MCH (pg)	F	$13.59^{ax} \pm 0.68$	$17.73^{cdx} \pm 0.69$	$16.91^{c} \pm 0.18$	$16.13^{bcx} \pm 0.32$	$15.55^{b} \pm 0.15$	$15.48^{b} \pm 0.47$	$18.63^{d} \pm 0.64$
	M	$16.08^{by} \pm 0.23$	$14.80^{ay} \pm 0.36$	$16.63^{bc} \pm 0.45$	$17.27^{cy} \pm 0.29$	$15.95^{b} \pm 0.13$	-	-
MCHC (%)	F	$34.70^{cx} \pm 1.36$	$35.73^{cx} \pm 1.35$	$29.19^{ab} \pm 0.30$	$27.69^{abx} \pm 0.21$	$27.18^{ax} \pm 0.34$	$31.68^{b} \pm 1.45$	$34.36^{bc} \pm 1.30$
	M	$28.62^{aby} \pm 0.82$	$27.48^{ay} \pm 2.00$	$28.58^{ab} \pm 1.19$	$30.17^{aby} \pm 0.37$	$28.87^{aby} \pm 0.58$	-	-
TLC (10^3/cmm)	F	$7.98^{bx} \pm 0.25$	$7.71^{b} \pm 0.37$	$7.53^{b} \pm 0.18$	$8.13^{bx} \pm 0.14$	$6.94^{abx} \pm 0.31$	$6.39^{a} \pm 0.19$	$7.83^{b} \pm 0.45$
	M	$6.85^{ay} \pm 0.11$	$7.61^{b} \pm 0.42$	$7.86^{b} \pm 0.33$	$8.25^{by} \pm 0.17$	$7.08^{aby} \pm 0.15$	-	-

(F: n = 8; M: n = 6)

Means having the same superscript do not differ significantly from each other ($P<0.05$).

Superscripts: **a – d:** between different age in females and males

x – y: between male and female

Table 2: Haematology at different lactation stages in Gir cows (Mean ± S.E.)

Age / Animal	Lactation months			Non lactating	
	1	2	3	P	NP
TEC (10^6/cmm)	6.98^{h} ± 0.08	7.51^{i} ± 0.23	7.61^{i} ± 0.12	7.67 ± 0.19	7.30 ± 0.61
Hb (g/dl)	12.51 ± 0.49	11.90 ± 0.21	11.75 ± 0.23	12.70 ± 0.59	13.85 ± 1.04
PCV (%)	41.18 ± 1.07	40.00 ± 1.05	40.00 ± 1.00	40.64 ± 1.21	40.55 ± 1.97
MCV (fl)	59.15^{i} ± 1.19	53.33^{h} ± 0.76	52.56^{h} ± 1.06	52.91 ± 1.06	56.55 ± 1.84
MCH (pg)	17.98^{i} ± 0.70	15.88^{h} ± 0.31	15.43^{h} ± 0.24	16.53^{f} ± 0.66	19.19^{g} ± 0.57
MCHC (%)	30.54 ± 1.61	29.81 ± 0.35	29.44 ± 0.60	31.23 ± 0.94	33.88 ± 1.09
TLC (10^3/cmm)	8.68 ± 0.31	8.55 ± 0.05	8.80 ± 0.29	9.45^{f} ± 0.25	8.10^{g} ± 0.29

(P – Pregnant; NP – Non Pregnant)

Means having the same superscript do not differ significantly from each other (P<0.05).

Superscripts: **f – g:** between non lactating pregnant and non-pregnant

h – i: within lactating Gir

4. Conclusion

It was found that age and sex had significant (P<0.05) effect on various haematological parameters in Gir Cattle. TEC increased significantly (P<0.05) from 1st month to 3rd month of lactation. TLC was significantly (P<0.05) higher in pregnant non-lactating Gir than in non-pregnant non-lactating Gir cattle. The findings of this study may serve as reference values in which alterations due to metabolic, nutrient deficiency, physiological and health status can be compared for diagnostic and therapeutic purpose in different age and physiological states of Gir cattle breed, which are unique cattle breed adapted to existing climatic conditions.

5. Acknowledgements

Authors are thankful to the authorities (Directors of Research, Deans of the Veterinary Colleges) of Anand Agricultural University and Junagadh Agricultural University for the permission and facilities granted for conducting the research study.

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