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Characterization of Blood cells and Comparative Analyses of Hematological Profile of Different Breeds of Dairy Cows in Odisha

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Abstract

The pathophysiological conditions of organisms can be revealed by the study of haematological profile. Three breeds of dairy cows of 02-07 years age groups namely, non-descriptive(ND), Red Sindhi (RS) and crossbred Jersey (CBJ) cows, were used in this study. From each breed nine cows were taken. The aim of the present study was to investigate comparative analyses of haematological profile of different breeds of dairy cows of Odisha which is useful to provide a baseline data for comparison with other breeds of cows. For Hb and PCV highly significant difference ($p<0.01$) was there among the three breeds of cows. For TRBC, MCV and MCH no significant difference was there among three breeds. For MCHC highly significant difference ($p<0.01$) is there between ND and CBJ cows and between RS and CBJ cows. For WBC significant difference ($p<0.05$) was there between ND and RS cows. For lymphocyte, neutrophil and basophil no significant difference is there among the different breeds of cows. For monocyte highly significant difference ($p<0.01$) is there among the three breeds of cows. For eosinophil highly significant difference ($p<0.01$) was there between ND and CBJ cows and between RS and CBJ cows.

Keywords: ND, RS, CBJ, cows

INTRODUCTION

Cows belong to the sub-family Bovinae of the family Bovidae. They are raised for milk, cheese, other dairy products, also for meat such as beef and veal and materials such as leather hide. Red Sindhi cattle are the most popular of all Zebu dairy breeds and originated in the Sindh province of Pakistan, they are widely kept for milk production across Pakistan, India, Bangladesh, Sri Lanka, and other countries. They have been used for crossbreeding with temperate (European) origin dairy breed in many countries to combine their tropical adaptations (heat tolerance, tick resistance, disease resistance, fertility at higher temperature etc.) with the higher milk production found in temperate regions. It has been crossed with Jerseys in many places, including India, the United States, Australia, Sri Lanka, etc. Jersey was bred on the British Channel Island of Jersey and adapts well to various climatic conditions. The cows are calm and docile in nature; bulls may be aggressive. With

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the advent of artificial insemination crossbreeding of cattle with European donor breeds are done for improvement of milk production.[1] Physiological equilibrium is maintained mainly by the blood in the body.[2] The haematological values during different physiological situations are essential 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.[3]

Three breeds of dairy cows of 02-07 years age groups namely, non-descriptive (ND), Red Sindhi (RS) and crossbred Jersey (CBJ) cows, were used in this study. The aim of the present study was to investigate comparative analyses of haematological profile of different breeds of dairy cows in Odisha which is useful to provide a baseline data for comparison with other breeds of cows.

MATERIALS AND METHODS

Hematological Method

After disinfecting of the sampling area, blood samples were taken from the jugular vein[4,5] of each individual cow by a skilled veterinary expert for routine haematological examination. Dry and sterilized needles and dry syringes were used for collection of blood.[4] Since EDTA is an excellent anticoagulant[6], the needle of syringe was inserted through the purple cap of EDTA vial for each sample (K3 EDTA, 2ml * 13×75mm, Mfg By: HXS Tech Co., Ltd. PRC. For: Peerless Biotech Pvt. Ltd., Chennai, Tamilnadu, India), were kept within an ice box and were taken to the laboratory for haematological examination. After that the sample blood were smeared on grease free microscopic slides.[7] After air drying, the smears were treated with methanol for 1-5 minutes.[5] Estimation of hemoglobin was done by Sahli's acid hematin method[8] with Sahli's haemometer (HiMedia GW 191-1NO, Plane haemometer (Square Type), HiMedia Laboratories Pvt. Ltd., Mumbai, Maharashtra, India). PCV was done by centrifugation of sample blood at 3,500 rpm for 15 minutes.

Total erythrocyte count (TEC) and total leukocyte count (TLC) were done by using the conventional method[5] by using Neubauer's counting chamber. Erythrocyte indices like, MCH, MCV and MCHC were studied according to the methods described by earlier worker.[4] Differential leukocyte counts (DLC) (Sastry, 1983) were assessed by staining the smeared slides with Giemsa stain prepared from Giemsa powder [Qualigens CAS No. 51811-82-6 Product No. 39382, scientific India Pvt. Ltd., Mumbai, Maharashtra, India] following the standard hematological procedure[9] under 40X objective of light microscope and photomicrography of blood cells were done by CC130-1.3 mega pixel microscopic camera (Mfg. by Catalyst Biotech, Maharastra, India) connected to microscope under 40X objective.

STATISTICAL ANALYSES

Mean ± SE were calculated for each parameter by using Microsoft Office Excel 2007. For comparison of means, statistical analyses were done by Paleontological statistics (PAST) version 2.17 [Natural History Museum, University of Oslo] for One-Way Analysis of variance (ANOVA) followed by Turkey's pair wise comparison tests. Differences were classified as significant at $p<0.05$ and highly significant at $p<0.01$.

Photomicrography

Photomicrography of blood cells were done by CC130-1.3 mega pixel microscopic camera (Mfg. by Catalyst Biotech, Maharastra, India) connected to microscope under 40X objective.

RESULTS

Small erythrocytes (microcytes) and large erythrocytes (macrocytes) were observed (Fig. 1).

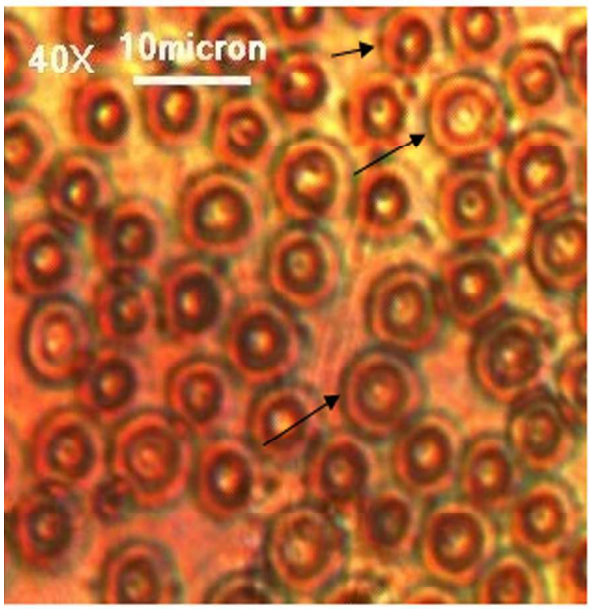

Fig. 1: RBCs (Red blood cells) Microcyte (small arrow), macrocytes (large arrows)

Small lymphocyte (Fig. 2), large lymphocyte (Fig. 3), monocyte (Fig. 4), neutrophil (Fig. 5), eosinophil (Fig. 6) and basophil (Fig. 7) were observed in the blood smears of this study.

Fig. 2: Small lymphocyte

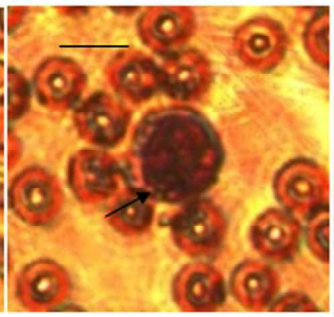

Fig. 3: Large lymphocyte

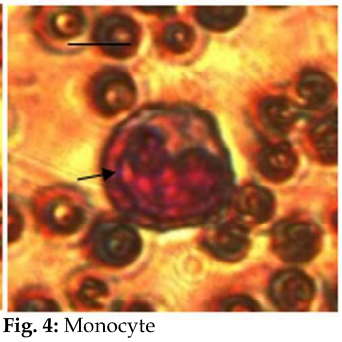

Fig. 4: Monocyte

Fig. 5: Neutrophil

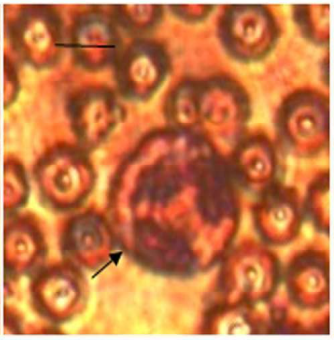

Fig. 6: Eosinophil

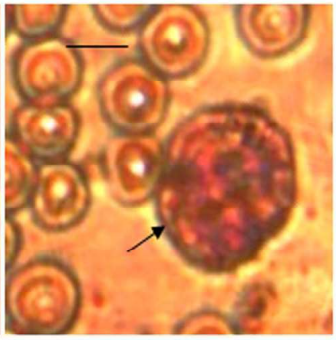

Fig. 7: Basophil

Erythrocyte parameters in different breeds of dairy cows of 02-07 years age are recorded (Table 1). Leukocyte parameters in different breeds of dairy cows of 02-07 years age are observed (Table 2).

Table 1: Erythrocyte parameters in different breeds of dairy cows of 02-07 years age.

Parameters	Breed		Breed		Breed		F-value
	Non descriptive (ND)		Red Sindhi (RS)		Crossbreed Jersey (CBJ)		
	Mean±S.E.	Range	Mean±S.E.	Range	Mean±S.E.	Range	
Hb(%)	10.47±0.50[a]	8.45-11.85	12.51±0.54[a]	10.32-13.95	14.03±0.16[a]	13.32-14.35	23.42**
TRBC (millions/mm3)	7.23±0.95	4.66-11.13	7.01±0.24	6.29-8.06	7.42±0.12	7.05-8.32	1.04NS
PCV(%)	33.07±1.67[a]	26.3-37.4	40.31±2.59[a]	31.00-47.00	46.67±1.16[a]	43.5-52.00	21.47**
MCV(fl)	50.62±5.62	34-76.18	59.81±5.09	39.39-71.86	62.93±1.11	59.18-68.60	2.29NS
MCH(pg)	16.02±1.75	10.69-23.81	18.17±1.29	12.9-21.15	18.44±0.24	17.22-19.57	0.89NS
MCHC(%)	31.69±0.12[a]	31.17-32.15	30.76±0.54[b]	29.20-33.29	29.32±0.40[a,b]	27.62-30.64	15.32**

Same lowercase superscript in the same row differs significantly at p<0.05 and p<0.01

** Means highly significant at p<0.01 and NS means not significant

Table 2: Leukocyte parameters in different breeds of dairy cows of 02-07 years age.

Parameters	Breed		Breed		Breed		F-value
	Non descriptive (ND)		Red Sindhi (RS)		Crossbreed Jersey (CBJ)		
	Mean±S.E.	Range	Mean±S.E.	Range	Mean±S.E.	Range	
WBC(thousands/mm3)	17.92±2.17[a]	10.95-26.5	12.06±0.95[a]	8.75-15.95	13.61±0.73	10.60-15.80	3.03*
Lymphocyte(%)	64.87±5.51	38-89	64.55±6.37	36-86	64.57±4.11	54-89	0.0010NS
Monocyte(%)	11.62±3.80 [a]	2-30	3.44±0.47[a]	2-6	2.42±0.64[a]	0-5	3.10**
Neutrophil(%)	15.87±3.27	5-31	23.66±5.97	2-49	17.00±2.10	11-24	0.64NS
Eosinophil(%)	3.62±0.88[a]	0-7	1.55±0.37[b]	0-4	9.42±1.95[a,b]	7-17	8.996**
Basophil(%)	1.62±0.37	1-4	2.22±0.46	0-5	0.85±0.45	0-3	2.09 NS

Same lowercase superscript in the same row differs significantly at p<0.05 and p<0.01

*Means significant at p<0.05, ** means highly significant at p<0.01 and NS means not significant

Among the three breeds the highest (14.03±0.16g/dl) and the lowest (10.47±0.50g/dl) mean haemoglobin concentrations were observed in CBJ and ND cows respectively (Fig.8). The highest mean of total erythrocyte count was observed in CBJ cows (7.42±0.12x106) and lowest (7.01±0.24x 106) was observed in RS cows (Fig. 9). The highest average PCV value was observed in CBJ cows (46.67±1.16%) and lowest was observed in ND cows (33.07±1.67) (Fig. 10). The highest average MCV (62.93±1.11fl) and MCH (18.44±0.24pg)were recorded in CBJ cows whereas lowest average MCV (50.62±5.62fl) and MCH (16.02±1.75pg) were noted in ND cows (Fig. 11 & 12). The highest mean MCHC was there in ND cows (31.69±0.12%) and lowest was in CBJ cows (29.32±0.40%) (Fig. 13).The highest average leukocyte count (17.92±2.17x103) and lymphocytes (64.87±5.51%) were observed in ND cows and lowest average leukocyte count (12.06±0.95x103) and lymphocytes (64.55±6.37%) were observed in RS cows (Fig. 14 & 15). The highest average monocytes (11.62±3.80%) were found in ND cows and lowest (2.42±0.64%) were observed in CBJ cows (Fig. 16). The highest average neutrophils (23.66±5.97%) were noticed in RS cows and lowest (15.87±3.27) were observed in ND cows (Fig. 17). The highest average eosinophils (9.42±1.95%) were found in CBJ cows and lowest average eosinophils (1.55±0.37%) were observed in RS cows (Fig. 18). The highest average basophils (2.22±0.46%) were noticed in RS cows and lowest (0.85±0.45) were observed in CBJ cows (Fig. 19).

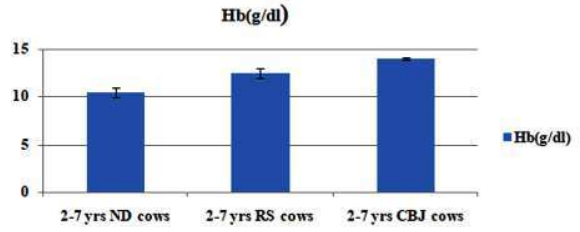

Fig. 8: Average haemoglobin in different breeds of cows.

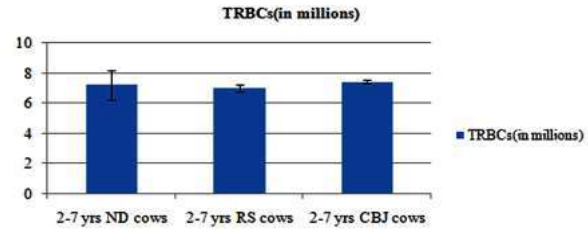

Fig. 9: Average red blood cell counts in different breeds of cows.

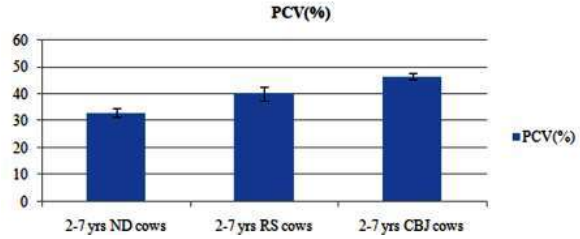

Fig. 10: Average packed cell volume (PCV) in different breeds of cows.

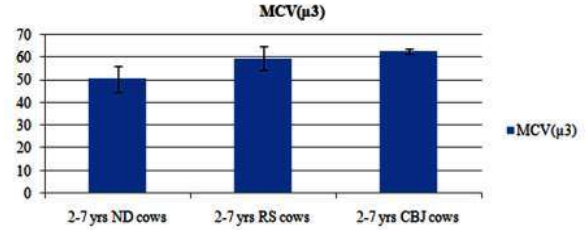

Fig. 11: Average mean corpuscular volume (MCV) in different breeds of cows.

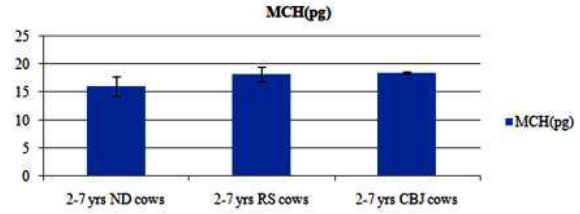

Fig. 12: Average mean corpuscular haemoglobin (MCH) in different breeds of cows.

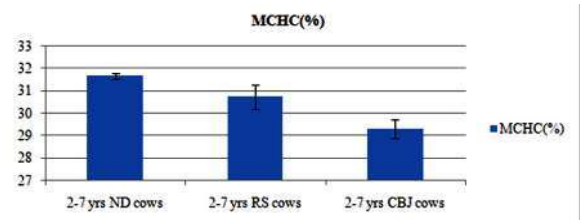

Fig. 13: Average mean corpuscular haemoglobin concentration (MCHC) in different breeds of cows.

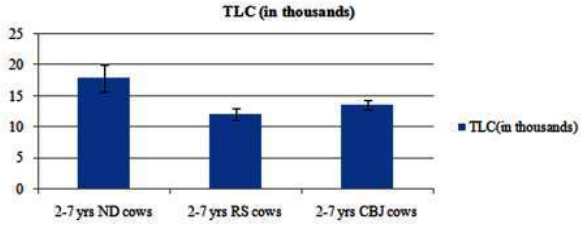

Fig. 14: Average total leucocyte count (TLC) in different breeds of cows.

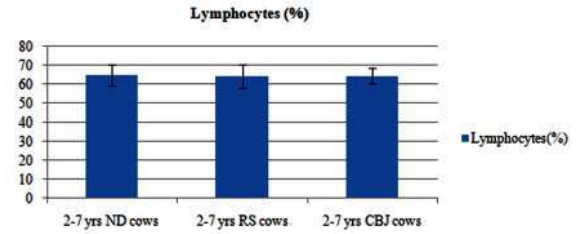

Fig. 15: Average mean lymphocytes in different breeds of cows.

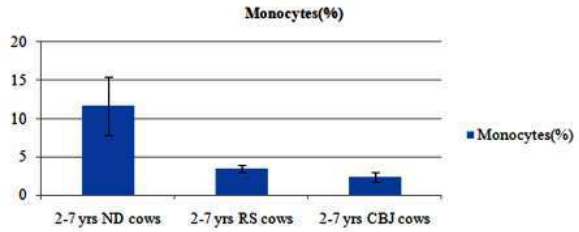

Fig. 16: Average mean monocytes in different breeds of cows.

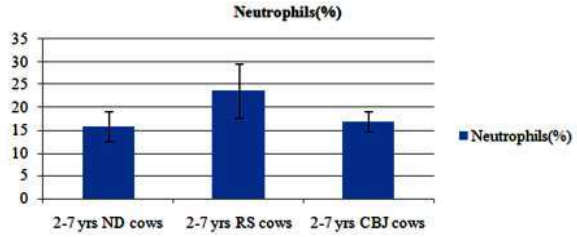

Fig. 17: Average mean neutrophils in different breeds of cows.

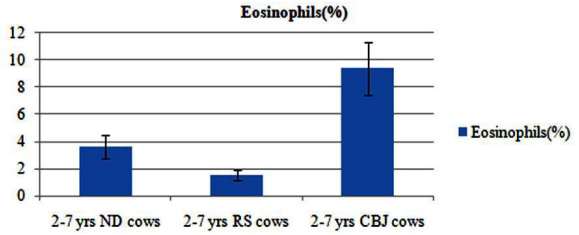

Fig. 18: Average mean eosinophils in different breeds of cows.

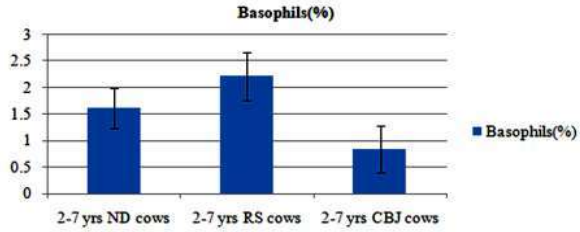

Fig. 19: Average mean basophils in different breeds of cows.

For Hb and PCV highly significant difference ($p<0.01$) was there among the three breeds of cows. For RBC, MCV and MCH no significant difference was there among three breeds. For MCHC highly significant difference ($p<0.01$) is there between ND and CBJ cows and between RS and CBJ cows. For WBC significant difference ($p<0.05$) was there between ND and RS cows. For lymphocytes, neutrophils and basophils no significant difference is there among the different breeds of cows. For monocytes highly significant difference ($p<0.01$) is there among the three breeds of cows. For eosinophils highly significant difference ($p<0.01$) was there between ND and CBJ cows and between RS and CBJ cows.

DISCUSSION

In veterinary medicine, examinations of hematological parameters present an effective tool in monitoring the health and nutritional status of animal.[10] The haematological values provide valuable baseline information and help in realistic evaluation of managemental practices, nutritional and physiological status of animals and diagnosis of health condition.[11] The erythrocyte parameters and total and differential leucocyte counts are affected by various physiological determinants.[12] The typical RBCs shape for multiple veterinary species is the disc or biconcave disc (discoid) resulting in a high surface area to volume ratio making the red blood cells deformable. Central pallor can be observed to various degrees in these species on examination of a peripheral blood smear.[13-16,7]

Long et al. (1952)[17] were working with Shorthorn, Angus and Herefords and Rusoff et al. (1954)[18] working with Jerseys, Guernseys and Holsteins found no breed differences in haemoglobin content of blood, the present study disagrees with these; whereas Mac Donald et al. (1956)[19] found that Angus males were higher in haemoglobin than Hereford males. Earlier worker[20] reported a decrease in haemoglobin content when calves grew older but no marked difference was observed in total number of red blood cells. Cornelius (1956)[21] determined blood haemoglobin values for dwarf beef cattle and concluded that a mean value of 11.7±1.4g of haemoglobin per 100ml of blood was within the normal range for the bovine species. According to Mac Donald et al. (1956)[19] an average value of 12.0g of haemoglobin per 100ml of blood for Hereford and Angus beef calves on performance test at 500- and 800-pounds body weight. Late pregnancy and onset of lactation is a period when slight anaemia exits.[22] The Hb value of 117.4±2.42 and 106.3±2.21, the RBC value of 8.49±0.21 and 7.63±0.16, the haematocrit value of 36.15±0.75 and 32.10±0.64, the MCV value of 43.55±0.69, 42.79±0.61, the MCH value of 14.42±0.43, 14.03±017, MCHC value of 324.7±1.38 and 330.1±1.48 and WBC value of 11.88±0.36 and 10.57±0.29 were studied respectively by previous resercher[23] for Muturu and Bunaji breeds of cattle in Nigeria.

A range of 4.9 to 9.98 million red blood cells per cu. mm of blood has been reported for dairy cattle[24,25,26,20,18,27,28] and 4.5 to 9.8 million per cu.mm of blood for beef cattle.[17,29] Rusoff (1946)[31] explained the variable means for red blood counts on dairy cows

(Jerseys 6.55, Guernseys 7.49 and Holsteins 7.84 million per cu.mm). Long et al. (1952)[17] reported the composition of blood taken from Hereford, Angus and Shorthorn beef cattle. All the breeds had a normal variation from 4.5 to 6.0 million red blood cells per cu.mm. This seems low when compared with data on dairy cattle which is congruent with Dash et al., 2015.[28] The difference may be due to the indirect turbidity technique used in determining the red cell count. From complications of information of several investigators, Coffin (1953)[26] reported a red blood cell count ranging from 5.4 to9.0 million per cu.mm for cattle. In my study the range of RBCs count ranging from 8.45-11.85 million in ND cows, 10.32-13.95 million in RS cows and 13.32-14.35 million in CBJ cows. Ferguson (1954)[24] observed a mean of 6.33 million per cu. mm with a range of 5.64 to 7.44 million per cu.mm for dairy cattle. Dukes (1955)[28] noted an overall mean of 6.3 million per cu.mm and a range of 4.90 to 9.79 per cu.mm calculated from 144 samples on six dairy cows. Cornelius (1956)[21] found, from data on 38 Hereford and Angus dwarf cattle ranging in age from 6 days to 14 months, a mean red cell count of 9.8±1.6 million per cu.mm. Arthaud et al. (1959)[29] reported both an increase in haemoglobin and in total number of red blood cells as Hereford, Shorthorn and Angus calves grew from 7 months old to 9 months old. Age[30-32], sex[33], breed, exercise[34,35], pregnancy and lactation[36-38], emotional state are variables to be considered when establishing references values in domestic animals, altitude polyglobulia (increased RBCs count at high altitude) is well documented and extensively studied.[39,40]

The total leukocyte count of 8,580 per cu.mm of blood is reported by.[18] Greatorex (1954)[20] found the number of leukocytes per cu.mm of blood, in dairy calves from birth to a year of age, ranged between 4,500 and 15,000 with the majority ranging from 6,500 to 11,500 per cu.mm. Dash et al. (2015)[28] reported a mean value of 26.00±0.26 for 02 years ND cows, a mean value of 16.68±0.23 for 06 years ND cows and a mean value of 11.08±0.07 for 10 years ND cows, amean value of 11.73±0.27 for 02 years RS cows, a mean value of 8.93±0.10 for 06 years RS cows and a mean value of 15.51±0.21 for 10 years RS cows, a mean value of 14.33±0.14 for 02 years CBJ cows, a mean value of 10.78±0.11 for 06 years CBJ cows and mean value of 15.71±0.04 for 10 years CBJ cows. Other studies in fatty liver cows, without being downer reported decreased[41, 42] or increased WBC.[43] Previous researcher[44] also reported that there was an increase in the number of leukocytes during gestation.

Coffin (1953)[26] opined normal ranges and means for differential white cell counts of cattle. Neutrophils range from 1 to15, with a mean of 30%; eosinophils range from 1 to15, with a mean of 8%, basophils range from 0 to1, with a mean of 0.5%; lymphocytes range from 40 to70; with a mean of 52%; and monocytes range from 3 to15, with a mean of 9%. Dash et al. (2015)[28] reported a mean value of 72.33±3.17%, 74.50±14.50%, 51.00±7.00% lymphocytes for 02 years, 06 years and 10 years ND cows respectively, a mean value of 11.73±0.27%, 8.93±0.10%and 15.51±0.21% lymphocytes for 02 years, 06 years and 10 years Red Sindhi cows respectively, a mean value of 14.33±0.14%, 10.78±0.11%, 15.71±0.04% lymphocytes for 02 years, 06 years and 10 years Crossbred Jersey cows respectively.

The haematological parameters of cattle are influenced by many factors like breed, age, sex, seasonal variation, lactation, pregnancy, health and nutritional status of the animal.[45] Dash et al. (2015)[28] reported a mean value of 5.00±1.52%, 3.00±1.00%, 24.00±3.05% monocytes for 02 years, 06 years and 10 yearsnon-descriptive cows respectively, a mean value of 3.66±0.33%, 2.33±0.33%and 4.33±1.20% monocytes for 02 years, 06 years and 10 years Red Sindhi cows respectively, and a mean value of 3.50±0.50%, 2.66±1.20% and 1.00±1.00%monocytes for 02 years, 06 years and 10 years Crossbred Jersey cows respectively.

Dash et al. (2015)[28] reported a mean value of 14.00±2.501%, 16.00±11.00%, 17.66±6.88% neutrophils for 02 years, 06 years and 10 years non-descriptive cows respectively, a mean value of 8.00±4.16%, 46.33±1.45% and 16.66±2.33% of neutrophils for 02 years, 06 years and 10 years Red Sindhi cows respectively, and a mean value of 22.00±1.00%, 17.66±3.17% and 11.00±0.00% of neutrophilsfor 02 years, 06 years and 10 years Crossbred Jersey cows respectively.

Dash et al. (2015)[28] reported a mean value of 4.66±0.33%, 4.00±1.00% and 2.33±2.33% of eosinophilsfor 02 years, 06 years and 10 years non-descriptive cows respectively, a mean value of 1.66±1.20%, 2.00±0.00% and 1.00±0.00% of eosinophils for 02 years, 06 years and 10 years Red Sindhi cows respectively, anda mean value of 7.00±0.00%, 10.33±4.80% and 10.50±1.50% for 02 years, 06 years and 10 yearsCrossbred Jersey cows respectively.

Dash et al. (2015)[28] reported a mean value of 1.33±0.33%, 2.50±1.50% and 1.33±0.33% of basophils for 02 years, 06 years and 10 years non-descriptive cows respectively, a mean value of 3.00±1.15%, 2.00±1.00% and 1.66±0.88% of basophils for 02 years, 06 years and 10 years Red Sindhi cows respectively,

and a mean value of 1.00±1.00%, 1.00±1.00% and 0.50±0.50% for 02 years, 06 years and 10 years Crossbred Jersey cows respectively.

Greatorex (1954)[20] has reported a decrease in the number of lymphocytes as calves grew from birth to one year of age and observed the number of monocytes, neutrophils and eosinophils to be variable from age to age while basophils were absent. Cornelius (1956)[21] found that all haematological values appeared normal with the exception of the differential leukocyte count. Seasonal of some diseases may influence the levels of certain blood indices. In spring more inflammatory processes occurs which may stimulate the neutrophils.[46] Changes in white blood cell counts are observed around parturition, for example, an increase in the numbers of circulating neutrophils.[47,48] It is accepted that fatty liver usually induces low leukocyte counts in the peripheral blood[49,50]; one author[51] stated that in calves the most disadvantageous influences are high temperature and high humidity and, in these conditions, the greatest changes occur in the white blood system in bone marrow and in peripheral blood. Pereira et al. (1987)[44] reported that there was an increase in the number of leukocytes.

A range in average haematocrit values in dairy cattle from 28 to 50% has been reported[52, 53, 20] and in beef cattle from 31 to 48%.[29] The packed cell volume (PCV) is one of the most valuable techniques for determination of the percentage of cellular components of blood in the clinical laboratory.[54] As per previous study haematocrit value of Muturu cattle was 36.15±0.75[23] and 35.86 in West African cattle breeds as stated by Berthier et al. (2015)[55] and 29.23±0.42 reported by Mbanasor et al. (2003)[56] which is not in accordance of our study. Albritton (1952)[52] puts forth a range of 14.2 to 18.5 micro micrograms with a mean of 15.7 micro micrograms for corpuscular haemoglobin content of the blood of the adultcow. Normal ranges reported on cattle by[26] are 14.4 to 18.6 micro micrograms for mean corpuscular volume and 32% to 34% for mean corpuscular haemoglobin concentration. Mean corpuscular volume in dairy and beef cattle varied from 40.0 to 60.7 cubic microns [52, 26, 20]. Average of 32.0 and 37.2% for mean corpuscular haemoglobin were observed.[27] Greatorex (1954)[20] calculated the mean corpuscular volume on 233 dairy calves from birth to one year of age. The extreme values were 28 to112 cubic microns whereas the mode was from 40 to 60 microns and individual values were evenly distributed throughout the first 12 months of life. Despite the fact wide variation of normal ranges and the anisocytosis that usually appear[57] make the diagnostic value of MCHC for cows with fatty liver poor.

CONCLUSION

The haematological results obtained in this study vary according to different breeds. Differences in results are may be due to environmental, genetic, non-genetic factors, managemental practices, body weight, age groups and due to breed difference. These factors may be considered when establishing reference values and this study is helpful for interpretation of haematological values with other breeds.

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