Journal of Animal and Veterinary Advances 9 (16): 2123-2127, 2010
ISSN: 1680-5593

Comparative Study of Hematological Parameters According Strain, Age, Sex, Physiological Status and Season in Iranian Cattle

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Abstract: The aim of this study was comparison of hematological parameters according strain, physiological status, age, season and sex in cattle. Blood samples from 300 Holstein, Brown-swiss, Semental, Brown-swiss x Semental crossbreed and Brown-swiss x Holstein crossbreed cattle at different physiological status (dairy cows, dried cows, non pregnant cows, pregnant heifers, suckling and non suckling calf), age (0.5-3, 3.5-6, 6.5-9, 9.5-18, 18.5-36, 36.5-60 and >60 months) sex (male and female) and season (spring, summer, autumn and winter) were used. RBC mass, WBC mass, Hemoglobin concentrations (HB), PCV, MCV, MCHC, MCH, platelet mass, percent and concentration of lymphocyte, neutrophil, eosinophil and monocyte were determined with routine methods. Except for PCV, neutrophil, lymphocyte, eosinophil percents and neutrophil-lymphocyte ratio, there was not significant differences for other hematological parameters between strains. Except for Platelet concentration, monocyte percent and count, the other hematological parameters were significantly differ between various physiological status and ages of cattle. Except for Hb, PL, WBC and monocyte concentration, the other hematological parameters were significantly differ between sexes. Except for neutrophil concentration, monocyte percent and concentration, the other hematological parameters were significantly differ between seasons.

Key words: Cattle, hematological parameters, strain, age, sex, status, season

INTRODUCTION

Blood is a special type of connective tissue composed of formed elements in a fluid matrix. Plasma is the fluid portion called serum when depleted of fibrinogen. The formed elements include erythrocytes (red blood cells), leukocytes (white blood cells) and platelets (Bacha and Bacha, 2000). Physiological equilibrium is maintained mainly by the blood in the body but many physiological conditions may alter this equilibrium. Hence, the haematological values during different physiological situations should be known 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 (Sattar and Mirza, 2009).

Many of hematological parameters are influenced by many factors like breed, age, sex, seasonal variations, lactation, pregnancy, health and nutrition status (Aengwanich, 2002; Al-Shami, 2007; Mohammed *et al*., 2007). It is acknowledged that for comparisons between individuals and with reference data in a clinical diagnostic situation, it is necessary to consider normal variations due to age, sex and breed in order to increase diagnostic precision (Satue *et al*., 2009). It is recognized that normal values for the various blood cell parameters not only differ from species to species but can vary between the breeds within a species (Claxton and Ortiz, 1996). Red Blood Cells (RBCs) are small, disc-shaped, anucleate cells and the primary function of them is to transport hemoglobin wich carries oxygen and carbon dioxide to and from tissues, therefore red blood cells play an important role in pH regulation (Despopouols and Silbernagl, 2003). White Blood Cells (WBCs) are basic cellular components of the immune system and can be divided into neutrophilic, eosinophilic and basophilic granulocytes, monocytes and lymphocytes. Only a small percentage (0.5-3%) of the leukocytes of domestic mammals are basophils. Hence, they are not often found in blood smears. Platelets play an important role in hemostasis. (Bacha and Bacha, 2000; Despopouols and Silbernagl, 2003). Mean Corpuscular Volume (MCV) is more valuable than blood film examination in assessing the true size of erythrocytes. Using automated cell

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counting systems, a histogram or volume distribution curve of the erythrocyte population can be generated.

The aim of present study was comparison of hematological parameters according strain (Holstein, Brown-swiss and Semental), physiological status (dairy cows, dried cows, non pregnant cows, pregnant heifers, suckling and non suckling calf), age (0.5-3, 3.5-6, 6.5-9, 9.5-18, 18.5-36, 36.5-60 and >60 months), season (spring, summer, autumn and winter) and sex (male and female) in cattle.

MATERIALS AND METHODS

For this study, jugular vein blood samples from Holstein, Brown-swiss, Semental, Brown-swiss×Semental crossbreed and Brown-swiss×Holstein crossbreed cattle at different physiological status (dairy cows, dried cows, non pregnant cows, pregnant heifers, suckling and non suckling calf), age (0.5-3, 3.5-6, 6.5-9, 9.5-18, 18.5-36, 36.5-60 and >60 months), sex (male and female) and season (spring, summer, autumn and winter) were used. Blood letting was performed from apparently health cattle. Blood samples were collected in test tubes containing EDTA as an anticoagulant. These tubes were placed in an icebox and carried to the laboratory within 1 h of collection. In the laboratory, these samples were centrifuged at 3000 rpm for 10 min, the plasma was separated and stored at -4°C for further analysis. Red Blood Cell (RBC) mass, White Blood Cell (WBC) mass, Hemoglobin (HB) concentrations, Packed Cell Volume (PCV; i.e., hematocrit), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin Concentration (MCHC), MCH and platelet mass were determined with methods cell counter set (Coulter T 860, England) and methods that described by Thrall (2004). Statistical analysis was performed using the SPSS version 16.

Differences in mean percentages and concentrations of the variables between strains, physiological statuses, ages and seasons were analyzed by one-way analysis of variance and subsequent Duncan's multiple comparison test (post-hoc). Differences in mean percentages and concentrations of the variables between male and female animals were determined by Paired-Samples t-test (Petrie and Watson, 2006).

RESULTS AND DISCUSSION

The comparison of some normal hematological parameters according strain (Holstein, Brown-swiss, Semental, Brown-swiss x Semental crossbreed and Brown-swiss x Holstein crossbreed cattle) is shown in Table 1. The comparison of some normal hematological parameters according physiological status (dairy cows, dried cows, non pregnant cows, pregnant heifers, suckling and non suckling calf) is shown in Table 2. The comparison of some normal hematological parameters according age (0.5-3, 3.5-6, 6.5-9, 9.5-18, 18.5-36, 36.5-60 and >60 months) is shown in Table 3. The comparison of some normal hematological parameters according (male and female) is shown in Table 4. The comparison of some normal hematological parameters according season (spring, summer, autumn and winter) is shown in Table 5.

As shown in Table 1, except for PCV percent (in Holstein significantly lower than Brown-swiss and Semental cattle), there was not significant differences for other hematological parameters between strains ($p>0.05$).

Table 1: The comparison of some hematological parameters in Holstein, Brown-swiss and Semental cattle

Strain	No.	RBC ($\times10^6$ μL^{-1})	HB (g dL^{-1})	PCV (%)	MCV (fl)	MCH (pg)	MCHC (g dL^{-1})	PL ($\times10^3$ μL^{-1})	WBC ($\times10^3$ μL^{-1})
Holstein	205	5.40±0.94^a	10.10±1.46^a	24.28±3.25^a	51.89±4.17^a	18.89±3.10^a	36.49±5.070^a	325.76±180.25^a	9.80±3.75^a
Brown-swiss	96	5.36±0.89^a	9.8±1.380^a	28.32±4.84^b	52.87±3.86^a	18.56±2.48^a	35.20±4.550^a	371.17±125.70^a	8.89±4.26^a
Semental	89	5.36±0.97^a	10.9±1.620^a	28.45±4.66^b	51.83±4.25^a	19.15±2.34^a	36.90±4.580^a	297.44±156.42^a	10.18±4.13^a
Brown-swiss x Semental	8	5.67±0.85^a	10.77±1.85^a	30.50±3.85^{ab}	53.70±4.33^a	18.97±2.50^a	35.46±5.220^a	327.12±186.85^a	10.58±3.95^a
Holstein x Brown-swiss	5	5.35±0.92^a	10.08±0.97^a	29.66±4.12^{ab}	55.80±3.90^a	18.99±3.15^a	33.92±4.940^a	301.20±192.27^a	7.10±4.82^a

Means within a column with different superscripts differ significantly ($p<0.05$)

Table 2: The comparison of some normal hematological parameters according physiological status

Physiological status	No.	RBC ($\times10^6$ μL^{-1})	HB (g dL^{-1})	PCV (%)	MCV (fl)	MCH (pg)	MCHC (g dL^{-1})	PL ($\times10^3$ μL^{-1})	WBC ($\times10^3$ μL^{-1})
Dairy cow	134	5.09±0.23^{ab}	9.34±1.65^{ab}	27.42±4.25^b	53.73±6.04^b	18.44±2.15^{ab}	34.33±4.15^a	340.80±125.12^a	9.03±3.20^a
Dried cow	14	5.28±0.26^{abc}	10.38±1.86^{bd}	30.59±5.06^{bd}	56.51±6.18^b	19.18±2.24^{ab}	33.98±3.64^a	346.30±132.42^a	8.00±2.50^b
Non pregnant cow	22	5.37±0.31^{bc}	10.12±1.47^{bc}	29.27±4.12^b	54.75±5.85^b	18.91±3.04^{ab}	34.54±4.06^a	306.94±129.78^a	9.19±3.10^{ab}
Pregnant heifer	47	5.91±0.15^c	11.34±2.13^c	32.61±4.98^{cd}	54.77±5.32^b	19.13±2.93^{ab}	34.96±3.40^a	289.63±138.56^a	10.00±3.17^{ab}
Suckling calf	150	4.59±0.12^a	8.85±0.95^a	22.39±3.12^a	49.26±3.76^a	20.19±2.12^a	40.07±5.81^c	338.00±192.10^a	8.28±2.64^b
Non suckling calf	31	5.65±0.16^c	10.47±2.05^{cd}	28.79±4.35^b	49.86±4.14^a	18.87±3.17^{ab}	37.86±5.21^b	344.60±122.54^a	10.60±3.42

^{a}Means within a column with different superscripts differ significantly ($p<0.05$)

Table 3: The comparison of some normal hematological parameters according age

Age (M)	No.	RBC ($\times10^6$ μL^{-1})	HB (g dL^{-1})	PCV (%)	MCV (fl)	MCH (pg)	MCHC (g dL^{-1})	PL ($\times10^3$ μL^{-1})	WBC ($\times10^3$ μL^{-1})
0.5-3	27	4.57±0.56^{a}	8.7±1.230^{e}	22.44±4.21^{a}	49.40±5.87^{ab}	20.08±3.27^{a}	40.30±7.69^{c}	538±15.75^{a}	7.86±2.85^{a}
3.5-6	23	5.32±0.42^{abc}	10.09±1.86^{ab}	25.73±3.86^{ab}	47.83±5.32^{a}	19.57±3.64^{a}	40.70±7.83^{c}	329±15.82^{a}	9.98±2.10^{a}
6.5-9	20	5.39±0.48^{bd}	10.27±1.97^{ad}	25.93±4.32^{ac}	48.24±6.03^{a}	19.24±3.17^{a}	39.96±8.62^{c}	379±16.10^{a}	11.41±3.17^{bc}
9.5-18	48	5.48±0.68^{be}	10.22±1.84^{ac}	28.30±5.84^{bcd}	48.39±5.39^{a}	19.20±3.58^{a}	38.74±8.24^{c}	351±15.70^{a}	11.24±3.24^{bc}
18.5-36	93	5.84±0.61^{cde}	10.79±2.03^{bcd}	30.55±4.63^{d}	51.79±4.69^{b}	18.60±3.44^{a}	25.92±6.53^{b}	327±15.47^{a}	10.16±3.49^{bc}
36.5-60	82	5.32±0.34^{b}	9.86±1.42^{a}	28.65±4.38^{bce}	53.56±6.68^{c}	18.56±4.05^{a}	34.69±5.32^{ab}	325±16.06^{a}	9.74±2.43^{ab}
>60	110	5.20±0.46^{b}	9.70±1.34^{a}	28.69±4.72^{bcd}	54.90±6.53^{c}	18.66±3.82^{a}	34.00±4.15^{a}	330±15.68^{a}	8.50±2.65^{a}

Means within a column with different superscripts differ significantly ($p<0.05$)

Table 4: Comparison of some normal hematological parameters according sex

Sex	No.	RBC ($\times10^6$ μL^{-1})	HB (g dL^{-1})	PCV (%)	MCV (fl)	MCH (pg)	MCHC (g dL^{-1})	PL ($\times10^3$ μL^{-1})	WBC ($\times10^3$ μL^{-1})
Male	34	4.99±0.83^{a}	9.79±1.04^{a}	24.34±2.13^{a}	47.89±3.27^{a}	20.18±2.86^{a}	41.97±4.21^{a}	244.00±124.72^{a}	10.37±1.76^{a}
Female	367	5.44±0.72^{b}	10.00±1.10^{a}	28.73±2.21^{b}	52.60±3.63^{b}	18.74±3.10^{b}	35.69±4.82^{b}	331.69±83.120^{a}	9.58±1.69^{a}

Means within a column with different superscripts differ significantly ($p<0.05$)

Table 5: The comparison of some normal hematological parameters according season

Age (M)	No.	RBC ($\times10^6$ μL^{-1})	HB (g dL^{-1})	PCV (%)	MCV (fl)	MCH (pg)	MCHC (g dL^{-1})	PL ($\times10^3$ L^{-1})	WBC ($\times10^3$ μL^{-1})
Spring	101	5.59±1.12^{a}	10.46±1.20^{a}	29.28±2.72^{a}	52.38±1.63^{b}	18.82±2.21^{b}	36.06±1.18^{a}	294.39±58.43^{b}	10.08±1.43^{a}
Summer	101	4.79±0.83^{b}	9.75±1.14^{b}	27.20±2.63^{b}	54.46±1.57^{c}	20.58±2.60^{c}	37.88±1.22^{b}	313.90±67.93^{ab}	8.67±1.10^{b}
Autumn	101	5.59±1.24^{a}	9.91±1.12^{b}	28.24±2.68^{ab}	50.48±1.60^{a}	17.97±1.42^{a}	35.74±1.42^{a}	374.72±63.17^{a}	10.34±1.21^{a}
Winter	100	5.57±1.15^{a}	10.05±1.16^{ab}	28.77±2.70^{ab}	51.45±1.45^{ab}	18.05±1.76^{ab}	35.17±1.53^{a}	339.23±66.86^{ab}	9.51±1.33^{ab}

Means within a column with different superscripts differ significantly ($p<0.05$)

Unlike this study, Jain (1986) reported significantly higher RBCs count in Brown-swiss cattle than other strains. PCV percent in Angus was significantly lower than Sharuleh (Fisher *et al*., 1980). In this study, the comparison of hematological parameters according physiological status (dairy cows, dried cows, non pregnant cows, pregnant heifers, suckling and non suckling calf) indicated that except for Platelet concentration, the other hematological parameters were significantly differ between various physiological status of cattle ($p<0.05$) (Table 3). RBCs count and HB concentration in dairy cow were significantly lower than pregnant heifer and non suckling calf. Also, PCV percent in dairy cow was significantly lower than pregnant heifer ($p<0.05$) that was similar to results of Nonnan (1978). Rowlands *et al.* (1977) reported that values of HB and PCV reduced during lactation period.

Esievo and Moore (1979) reported a decrease in Hb concentration in non-pregnant lactating Holstein-Friesian cows during early lactation. In another study, The highest HB concentration was recorded in non-pregnant heifers while the lowest values were observed in non-pregnant lactating cows (Sattar and Mirza, 2009). Steinhardt *et al.* (1994) reported decrease in Hb with advancing lactation and pregnancy which increased at parturient stage. Unlike this study, Neelu *et al.* (1996) reported significantly higher MCHC in pregnant lactating cows than the other groups. Unlike the study, Kumar and Pachauri (2000) reported highest MCV and MCH and lowest MCHC in non-pregnant dry cows compared to other groups. Unlike the study in study of Sattar and Mirza (2009), the highest WBCs count was recorded in pregnant heifers. As shown in Table 5, the values of RBCs, HB and PCV from 0.5-36 months ages increased and then reduced. Unlike the study, Jain (1993) reported that RBC, HB and PCV was highest at birth time and then reduced sharply. Wingfield and Tumbleson (1973) reported gradually reducing of RBC, HB and PCV in dairy cattle from 1-10 year ages. In present study, MCV was low till 18 months age and increased significantly from 18 months age. This finding was according to Jain (1986) and Coles (1986). Unlike findings of Jain (1986) and Coles (1986) in this study there was no significant difference for MCH between various ages. In this study, MCHC concentration reduced significantly with increasing the age that was according to findings of Jain (1986).

The reason of this result can be because of increasing the MCV with aging of cattle. In this study, the difference of platelet between all the groups was statistically non significant. The study indicated that with increasing the age up to 36 months age the WBC count increased and then decreased. Unlike the study, Kelly (1974) reported that WBC was higher in calf. Weiss and Perman (1992) indicated that with increasing the age from 2-10 year of age in Holstein-freesian cattle, the WBC of blood reduced. In study by Aengwanich (2002) on Holstein Friesian crossbred, PCV, HB, MCV and WBC concentration differences between different ages were not significant. Aa shown in Table 4, the RBC concentration in female cattle was higher than bull. This finding is apposite the results of Maach. In the study, PCV and MCV in females were significantly higher than males. Contrariwise, MCH and MCHC in males were significantly higher than females. For HB, there was not significant difference

between male and female cattle. In another study, PCV in male and MCH in female were higher than other sex (Meyer and Harvey, 1992). In the study, there was not significant difference for platelet and WBC concentrations between male and female cattle. Unlike the study, Olayemi *et al.* (2006) on Gudali cattle, Awolaja *et al.* (1997) on Keteku cattle and (Olayemi *et al.*, 2006) on kuri cattle reported that there were no sex differences in the erythrocyte values. As shown in Table 5, RBC concentration in summer was significantly lower than other seasons in which can be because of increased water consumption during summer season (Fisher *et al.*, 1980).

Agree with Rowlands *et al.* (1977), HB concentration and PCV in summer were significantly lower than spring but their differences were not significant between spring and winter. According with Nonnan (1978), MCV in spring was significantly higher than autumn and in summer was significantly higher than spring.

CONCLUSION

In the study, MCH in spring was higher than autumn and in summer was higher than spring. MCHC in summer was significantly higher than other seasons. Platelet concentration in autumn was higher than spring but its difference was not significant with other seasons. This finding was not agrees with report of Nonnan (1978). Unlike Rusoff *et al.* (1954), the WBC was lower in summer than spring and autumn. It is concluded that hematological parameters of cattle can be affected with strain, age, sex, physiological status and season.

ACKNOWLEDGEMENT

The researchers a gratefully acknowledged the Ramin Agricultural and Natural Resources University for research funds.

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