

NORMAL HEMATOLOGICAL VALUES OF NATIVE IRANIAN CATTLE AS INFLUENCED BY AGE, BREED AND SEX

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(Received: March 18, 1996)

ABSTRACT

Variations in hematological parameters of 500 native Iranian cattle were determined at <6 months to about 6 years of age of both sexes belonging to Sarabi, Golpayegani and Sistani breeds. Age had a significant effect on the blood parameters of native Iranian cattle as with the increase in age of animals, there was an increase in hemoglobin (Hb) concentration ($r=0.193$), packed cell volume (PCV) value ($r=0.343$), mean corpuscular volume (MCV) ($r=0.809$) and mean corpuscular hemoglobin (MCH) ($r=0.671$) whereas the number of erythrocytes ($r=-0.330$) and mean corpuscular hemoglobin concentration (MCHC) ($r=-0.393$) were decreased. Breed had a significant effect on the values of red blood cell (RBC) counts, Hb concentration, PCV, MCV, MCH, white blood cell (WBC) counts and the percent of band neutrophils ($P<0.05$). The mean of RBC counts, Hb concentration and PCV were higher in Sistani breed as compared with other breeds. The mean of RBC counts, Hb concentration, PCV, MCHC, platelet counts, leukocyte counts, absolute number of neutrophils and lymphocytes and percentage and absolute number of monocytes were higher in males as compared with females ($P<0.05$). In contrast, the

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mean of MCV, MCH and percent of eosinophils were higher in female animals as compared to males ($P < 0.05$).

تحقیقات کشاورزی ایران

۱۳۷۵ (۱۸۶-۱۷۵): ۱۵

ارزش های خون شناسی بهنجار گاوهای بومی ایران در ارتباط با

سن، نژاد و جنس

سعید نظیفی حبیب آبادی و علی مجابی

به ترتیب استادیار آسیب شناسی بالینی دانشکده دامپزشکی دانشگاه شیراز، شیراز، ایران و دانشیار بخش بیوشیمی دانشکده دامپزشکی دانشگاه تهران، تهران، ایران.

چکیده

تغییرات پارامترهای هماتولوژیک ۵۰۰ راس گاو بومی ایران در سنین کمتر از ۶ ماه تا ۶ سال در دو جنس نر و ماده از نژادهای سرابی، گلپایگانی و سیستانی اندازه گیری شد. سن اثر معنی داری بر پارامترهای خونی گاوهای بومی ایران داشت. به طوری که با افزایش سن، غلظت هموگلوبین ($r = 0/19$)، میزان هماتوکریت ($r = 0/34$)، MCV ($r = 0/81$) و MCH ($r = 0/67$) افزایش و تعداد گلبول های قرمز ($r = 0/33$) و MCHC ($r = 1/393$) کاهش یافتند. نژاد نیز اثر معنی داری بر تعداد گلبول های قرمز، غلظت هموگلوبین، PCV، MCV، MCH، تعداد گلبول های سفید و درصد باند نوتروفیل ها داشت ($P < 0/05$). میانگین تعداد گلبول های قرمز، غلظت هموگلوبین و PCV در گاوهای سیستانی در مقایسه با دو نژاد دیگر بیشتر بود. میانگین تعداد گلبول های قرمز، غلظت هموگلوبین، PCV، MCHC، تعداد پلاکت ها، تعداد گلبول های سفید، تعداد مطلق نوتروفیل ها

و لنفوسیت ها و درصد و تعداد مطلق مونوسیت ها در نرها بیشتر از ماده ها بود ($P < 0/05$). بر عکس ، میانگین MCH, MCV و درصد اتوزینوفیل ها در ماده ها بیشتر از نرها بود ($P < 0/05$).

INTRODUCTION

The knowledge of the normal hematological values of animals is essential in diagnosing various pathologic and metabolic disorders. Normal values for cattle have been reported by many investigators (1, 5, 7, 9, 11, 12, 13, 17, 18, 23). Disagreements in the values obtained by various workers relate mainly to physiologic differences such as animal excitement, muscular activity, time of sampling, ambient temperature and water balance, altitude, quality of nutrition, average age of the groups sampled and possibly breed and sex. This study was therefore conducted to estimate the normal hematological values of important breeds of native Iranian cattle, viz. Sarabi, Golpayegani and Sistani, with reference to different age groups, as no information is currently available in this regard.

MATERIALS AND METHODS

Blood samples were collected from jugular and caudal veins of 500 native Iranian cattle according to their age (<6, 6-18, 19-36, 37- 60 and > 60 months), breed (255 Sarabi, 148 Golpayegani and 97 Sistani) and sex. All animals appeared clinically healthy at the time of sampling. The herds were located around Tehran, Golpayegan and Delijan. The samples were taken in the morning in EDTA containing test tubes. Total erythrocyte counts, total leukocyte counts, hemoglobin concentration, hematocrit value, MCV, MCH, MCHC and platelet counts were determined with an automated blood cell counter (Baker 9000). For differential leukocyte counts, blood smears were

prepared and stained with Wright's stain (9). The results were subjected to regression analysis and mean separation was performed by the Duncan's test

RESULTS AND DISCUSSION

The values of hematological parameters in native Iranian cattle of different age groups, breeds, and sexes are presented in Tables 1, 2 and 3.

Values for RBC counts, Hb concentration, MCV, MCH, platelet counts, WBC counts, and percent of neutrophils, lymphocytes, monocytes, basophils and band neutrophils, were found to be similar to those reported earlier (4, 5, 6, 9, 11, 13, 16, 18). However, native Iranian cattle had lower values for PCV and consequently higher values for MCHC which are similar to findings of Duncan and Prasse (6), Junid and Krad (12), Meyer *et al.* (16) and Jain (10). Jain (10), Junid and Krad (12) and Meyer *et al.* (16) reported the normal range of PCV in cattle as 24.0-46.0%, 37.6±1.9% and 26-42%, respectively, and Duncan and Prasse (6), Meyer *et al.* (16) and Jain (10) reported that the normal range for MCHC in cattle were 30-36%, 26-36% and 30-36%, respectively.

The percent and absolute count of eosinophils in native Iranian cattle were lower than foreign breeds. Doxey (5), Coles (4) and Duncan and Prasse (6) reported the normal range of eosinophils in cattle as 0-20%, 2-15% and 2-20%, respectively.

Our results revealed that the RBC counts, Hb concentration, PCV, MCV, MCH, MCHC, platelet counts, WBC and the percent of neutrophils, lymphocytes, eosinophils, basophils and band neutrophils in different age groups were significantly different ($P < 0.05$). Age had a significant effect on the blood parameters of native Iranian cattle, as in advanced ages, Hb concentration ($r = 0.193$), hematocrit value ($r = 0.343$), MCV ($r = 0.809$) and MCH ($r = 0.671$) were higher, whereas the number of erythrocytes ($r = -0.330$) and MCHC ($r = -0.393$) were lower.

Table 1. Hematological values of Iranian native cattle as affected by age (Mean \pm SE).

	Age (months)				
	<6	6-18	19-36	37-60	>60
No. of cattle	112	152	61	72	103
RBC ($\times 10^6/\mu\text{l}$)	7.40 ^{a†} \pm 0.11	6.65 ^b \pm 0.08	7.03 ^c \pm 0.14	6.67 ^b \pm 0.09	6.39 ^b \pm 0.08
Hb (g/dl)	11.70 ^a \pm 0.14	10.98 ^b \pm 0.13	12.49 ^c \pm 0.26	12.27 ^c \pm 0.18	12.56 ^c \pm 0.16
PCV (%)	30.94 ^a \pm 0.53	28.31 ^b \pm 0.42	34.34 ^c \pm 0.71	34.42 ^c \pm 0.55	35.52 ^c \pm 0.48
MCV (fl)	41.70 ^a \pm 0.25	42.41 ^a \pm 0.23	48.90 ^b \pm 0.54	51.64 ^c \pm 0.51	55.76 ^d \pm 0.56
MCH (pg)	15.99 ^a \pm 0.18	16.56 ^b \pm 0.08	17.77 ^c \pm 0.16	18.42 ^d \pm 0.14	19.72 ^e \pm 0.18
MCHC (%)	38.46 ^a \pm 0.48	39.20 ^a \pm 0.28	36.41 ^b \pm 0.21	35.75 ^b \pm 0.15	35.45 ^b \pm 0.21
Platelet ($\times 10^3/\mu\text{l}$)	367.95 ^a \pm 16.89	407.42 ^a \pm 20.43	363.11 ^a \pm 28.86	351.08 ^a \pm 19.96	289.91 ^b \pm 13.42
WBC ($\times 10^3/\mu\text{l}$)	10.91 ^a \pm 0.51	10.99 ^a \pm 0.23	10.37 ^a \pm 0.33	9.24 ^b \pm 0.22	9.33 ^b \pm 0.22
Neutrophils (%)	33.07 \pm 0.78	28.75 ^b \pm 0.70	28.90 ^b \pm 1.23	28.41 ^b \pm 1.11	29.09 ^b \pm 0.81
Lymphocytes (%)	62.19 ^a \pm 0.78	66.04 ^b \pm 0.77	66.24 ^b \pm 1.16	66.12 ^b \pm 1.17	65.29 ^b \pm 0.79
Monocytes (%)	3.06 ^a \pm 0.18	3.10 ^a \pm 0.16	2.67 ^a \pm 0.23	2.58 ^a \pm 0.17	2.81 ^a \pm 0.16
Eosinophils (%)	1.13 ^a \pm 0.14	1.81 ^b \pm 0.11	1.98 ^b \pm 0.26	2.51 ^c \pm 0.27	2.47 ^c \pm 0.18
Basophils (%)	0.04 ^a \pm 0.02	0.00 ^b \pm 0.00	0.00 ^b \pm 0.00	0.02 \pm 0.02	0.03 \pm 0.02
Band neutrophils (%)	0.49 ^a \pm 0.07	0.26 ^b \pm 0.05	0.19 ^b \pm 0.05	0.31 ^b \pm 0.06	0.28 ^b \pm 0.05

† In each row, means followed by same letter are not significantly different (P<0.05).

The influence of age had also been reported in several earlier studies (9, 10, 19, 25, 26, 28, 30). The general trend is that RBC, Hb and PCV values are high at birth and decline with age during the first 6 months to 1 or 2 years of life (30), although considerable differences are found in values reported by various investigators, and inconsistent or even no significant changes have been observed in these parameters, in particular with RBC and

Table 2. Hematological values in three breeds of Iranian naive cattle (Mean \pm SE).

	Breed		
	Sarabi	Golpayegani	Sistani
No. of cattle	255	148	97
RBC ($\times 10^6/\mu\text{l}$)	6.49 ^a \pm 0.07	6.95 ^b \pm 0.07	7.46 ^c \pm 0.09
Hb (g/dl)	10.88 ^a \pm 0.08	12.49 ^b \pm 0.12	13.34 ^c \pm 0.15
PCV (%)	29.39 ^a \pm 0.33	33.84 ^b \pm 0.44	36.06 ^c \pm 0.51
MCV (fl)	45.46 ^a \pm 0.39	49.08 ^b \pm 0.67	48.51 ^b \pm 0.52
MCH (pg)	16.96 ^a \pm 0.12	18.12 ^b \pm 0.18	17.98 ^b \pm 0.15
MCHC (%)	37.59 ^a \pm 0.26	37.26 ^a \pm 0.25	37.25 ^a \pm 0.28
Platelet ($\times 10^3/\mu\text{l}$)	351.80 ^a \pm 11.53	371.02 ^a \pm 19.59	369.14 ^a \pm 20.59
WBC ($\times 10^3/\mu\text{l}$)	9.85 ^a \pm 0.24	10.84 ^b \pm 0.24	10.68 ^b \pm 0.25
Neutrophils (%)	30.41 ^a \pm 0.06	29.42 ^a \pm 0.72	28.54 ^a \pm 0.91
Lymphocytes (%)	64.41 ^a \pm 0.58	65.22 ^a \pm 0.70	66.51 ^a \pm 0.93
Monocytes (%)	2.90 ^a \pm 0.11	2.96 ^a \pm 0.15	2.81 ^a \pm 0.17
Eosinophils (%)	1.80 ^a \pm 0.11	2.12 ^a \pm 0.13	1.90 ^a \pm 0.15
Basophils (%)	0.03 ^a \pm 0.01	0.02 ^a \pm 0.01	0.00 ^a \pm 0.00
Band neutrophils (%)	0.40 ^a \pm 0.04	0.24 ^b \pm 0.04	0.21 ^b \pm 0.04

† In each row, means followed by same letter are not significantly different ($P < 0.05$).

**Table 3. Hematological values of Iranian native cattle as affected by sex
(Mean \pm SE)**

	Sex	
	Female	Male
No. of cattle	366	134
RBC ($\times 10^6/\mu\text{l}$)	6.70 ^a \pm 0.05	7.13 ^b \pm 0.09
Hb (g/dl)	11.29 ^a \pm 0.10	12.04 ^b \pm 0.09
PCV (%)	29.91 ^a \pm 0.40	32.77 ^b \pm 0.32
MCV (fl)	49.02 ^a \pm 0.36	41.93 ^b \pm 0.23
MCH (pg)	18.05 ^a \pm 0.09	16.00 ^b \pm 0.15
MCHC (%)	37.13 ^a \pm 0.16	38.24 ^b \pm 0.39
Platelet ($\times 10^3/\mu\text{l}$)	339.70 ^a \pm 9.15	418.63 ^b \pm 22.64
WBC ($\times 10^3/\mu\text{l}$)	9.86 ^a \pm 0.12	11.52 ^b \pm 0.43
Neutrophils (%)	29.42 ^a \pm 0.47	30.68 ^a \pm 0.74
Lymphocytes (%)	65.48 ^a \pm 0.47	63.90 ^a \pm 0.76
Monocytes (%)	2.71 ^a \pm 0.09	3.44 ^b \pm 0.16
Eosinophils (%)	2.02 ^a \pm 0.10	1.62 ^b \pm 0.13
Basophils (%)	0.02 ^a \pm 0.007	0.03 ^a \pm 0.01
Band neutrophils (%)	0.32 ^a \pm 0.03	0.31 ^a \pm 0.05

† In each row, means followed by same letter are not significantly different ($P < 0.05$).

Hb values in certain animals (26). By 2-4 years of age various RBC parameters tend to increase slightly and then stabilize. However, RBC counts may continue to decline for 5-6 years of age before becoming stabilized, while Hb and PCV may remain constant irrespective of age (25). A slight age-related decline in RBC, Hb and PCV values was observed in Holstein dairy cattle between 1 and 10 years of age (30) and in female Hereford cattle between 1.5 and 11 or 12 years of age (19), whereas these values were found to increase slightly in Friesian bulls between 2 and 8 years of age (21).

MCH and MCHC increased, while MCV changed inconsistently with age in Hereford cattle. Red blood cell counts may uncommonly decline with age to anemic levels in some high producing dairy cows (29). Amano *et al.* (2) reported that the PCV values decreased with increase in age. Vestweber *et al.* (28) reported that there was a statistically significant increase in MCV, MCH, and absolute neutrophil and eosinophil counts in advanced age.

In the present study, total leukocyte counts ($r = -0.207$), absolute numbers of neutrophils ($r = -0.209$), lymphocytes ($r = -0.169$) and monocytes ($r = -0.188$) decreased and the percent and absolute numbers of eosinophils ($r = 0.280$ and $r = 0.186$) increased with the increase in the age of animals.

White blood cell counts are generally higher at birth and in calves and growing animals up to 1-2 years of age followed by a gradual reduction with the advancement of age (21). Neutrophils exceed lymphocytes at birth, but this is reversed within the first week and then persists for life as a species-specific characteristic (9). Higher and irregular leukocyte values observed in adult dairy cattle with peaks at 5-7 years of age (30), do not seem to be entirely age-dependent. Environmental and physiologic factors as well as udder health may also have some effect. An age-related decrease was observed for total leukocytes, neutrophils and lymphocytes in 849 Holstein-Friesian cows, 2-13 years of age, in 36 Minnesota herds (22). Age-related decreases were found for WBC counts and absolute lymphocyte numbers, but not for other leukocyte types, after the first year of life (27). Studies on cattle below and above 3 years of age belonging to several breeds in two herds in Australia showed that values for WBC counts and lymphocytes, neutrophils and monocytes decreased with age, while values for eosinophils

increased (8). Changes in absolute numbers of neutrophils were not age-dependent, whereas an age-dependent decrease in lymphocyte numbers was reported earlier (25).

A fairly steep increase in eosinophil numbers during the first 2-6 years of life, starting at very low numbers (70-400/ μ l) and leveling off at a plateau of about 680 (range 450-1000/ μ l) was reported by Straub (25). High eosinophil counts in lactating dairy cows might be in response to a phenomenon in which some cows become allergic to their own milk (3). Monocytes increase during the first weeks of life to about twice their value at birth, but thereafter show either a slight decline (25) or no change with advancing age. Basophils occur in too low a number to allow detection of any influence of age on them (9).

In this study, breed differences were found in RBC counts, Hb concentration, PCV, MCV, MCH, WBC counts and the percent of band neutrophils ($P < 0.05$). The means of RBC counts, Hb concentration and PCV were higher in Sistani cattle as compared with other breeds. The values of WBC counts ranged from 9.85 ± 0.24 ($\times 10^3$ / μ l) in Sarabi cattle to 10.84 ± 0.24 ($\times 10^3$ / μ l) in Golpayegani breed. Although statistically significant breed differences were found in cattle, the differences were not large enough to cause concern in the clinical interpretation of hemograms.

In general, Jersey, Guernsey, and Brown Swiss cattle have lower RBC count whereas Charolais have higher RBC, hemoglobin and PCV values than most other breeds (10). Erythrocyte values in Zebu and Scotch-Highland cattle have been compared (20). The Zebu animals are normally found in warm climate and the Scotch-Highland in cold climate. Zebu cattle have more erythrocytes, smaller MCV and PCV, and a lower hemoglobin level than the Scotch-Highland cattle. Higher WBC, neutrophils, and lymphocytes were found in Hereford and Charolais cattle, while lower values were observed in Jersey (24). Higher WBC and lymphocytes were seen in Jersey as compared to Holstein (15).

In this study, the mean of RBC counts, Hb concentration, PCV, MCHC, platelet counts, leukocyte counts, absolute number of neutrophils and lymphocytes and percent and absolute number of monocytes were higher in

males as compared with females ($P < 0.05$). In contrast, the means of MCV, MCH and percent of eosinophils were higher in females as compared with males ($P < 0.05$). Slightly higher mean values for hemoglobin concentration in males as compared with females were reported in dogs, cats, horses, cattle, pigs, and goats (10). Our findings are in agreement with those of Maach *et al.* (14) on Black Pied calves in Morocco. However, differences in blood values between the sexes seem to be of little practical importance (10).

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