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**HAEMATOLOGICAL PROFILE OF NIGERIAN HORSES IN OBOLLO-AFOR, ENUGU STATE**

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**ABSTRACT**

*This study assessed the haematological profile of 61 apparently healthy Nigerian horses and evaluated the influence of age, sex and season on the haematological parameters during a six-month period [three months of dry season (February – April) and three months of rainy season (June – August)] at Obollor Afor, Enugu State, Nigeria. The horses were bled by jugular venipuncture and all the haematological parameters were assessed following standard procedures. Results showed that the overall mean  $\pm$  SE for the haematological parameters were: packed cell volume (PCV) –  $43.21 \pm 0.77$  %, red blood cell (RBC) count –  $8.69 \pm 0.16$  ( $10^6/\mu\text{l}$ ), haemoglobin concentration –  $15.11 \pm 0.29$  g/dl, mean corpuscular volume –  $50.04 \pm 0.55$  fl, mean corpuscular haemoglobin –  $17.71 \pm 0.38$  pg, mean corpuscular haemoglobin concentration  $35.30 \pm 0.72$  g/dl, total leukocyte count –  $9.53 \pm 0.31$  ( $10^3/\mu\text{l}$ ), band neutrophils –  $0.28 \pm 0.04$  ( $10^3/\mu\text{l}$ ), segmented neutrophils –  $4.77 \pm 0.23$  ( $10^3/\mu\text{l}$ ), lymphocytes –  $4.19 \pm 0.19$  ( $10^3/\mu\text{l}$ ), monocytes –  $0.03 \pm 0.01$  ( $10^3/\mu\text{l}$ ), eosinophils –  $0.25 \pm 0.03$  ( $10^3/\mu\text{l}$ ), basophils –  $0.01 \pm 0.01$  ( $10^3/\mu\text{l}$ ), platelet count –  $326.94 \pm 16.30$  ( $10^3/\mu\text{l}$ ) and erythrocyte sedimentation rate (ESR) –  $28.19 \pm 3.57$  mm/20mins. The PCV (%) and RBC counts ( $10^6/\mu\text{l}$ ) of the male horses (PCV –  $45.07 \pm 0.85$ ; RBC –  $9.01 \pm 0.20$ ) were significantly ( $p < 0.05$ ) higher than that of the females (PCV –  $39.39 \pm 1.12$ ; RBC –  $8.04 \pm 0.19$ ), while the ESR (mm/20 mins) of the females ( $33.81 \pm 3.30$ ) were significantly ( $p < 0.05$ ) higher than that of the males ( $22.58 \pm 1.57$ ). No significant ( $p > 0.05$ ) age-related variations were recorded for all the haematological parameters. The overall mean platelet counts ( $10^3/\mu\text{l}$ ) for the horses were significantly ( $p < 0.05$ ) higher during the rainy season ( $368.70 \pm 29.16$ ) when compared with the dry season ( $292.64 \pm 15.19$ ).*

**Keywords:** Haematology, Apparently healthy, Nigerian horses.

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**INTRODUCTION**

The horse, *Equus caballus*, is a domesticated mammal belonging to the family *Equidae* and order *Perissodactyla* [1]. Horses are used for draft, transport, sports, ceremonial exhibitions, research purposes,

warfare, crowd control and as food (meat) and source of variety of products and medicines [2, 3, 4]. Nigerian horses are a mix of local Arewa breeds and their crosses with Arabian, Dongola/Barb and Sudanese breeds [5, 6].

The evaluation of the haematological profile is of utmost importance in the clinical assessment of animals and humans because the blood is the major transport system of the body, and both the input and output substances of almost all the body's metabolic processes and any deviations from normal caused by the invasion of the body by pathogens, other forms of injury, deprivation and/or stress are commonly reflected by changes in the blood picture [7, 8, 9, 10]. Haematological evaluations are therefore helpful to clinicians in making a diagnosis, assessing the efficacy of therapy and the toxicity of drugs and chemical substances [7, 8, 11]. Specifically in horses, haematological assessments are used as an aid to the clinical diagnosis of a variety of diseases, in monitoring recovery during treatment and to assess the health status of a single animal or an entire herd [12, 13, 14].

There are extensive reports in available literature on the effects of physiological factors such as age, sex, breed, exercise and environment/geographical location on the haematological profile of horses [7, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24]. Due to the variability from one geographical location to the other in the reference haematological values in horses (as with other animals), every laboratory or clinic in an area need to establish reference values for the horse population in its environment [8, 11, 12, 25].

There are published reference haematological values determined by laboratories, clinics and research institutes in European, Asian and North American countries for horses [7, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25]. However, there are only preliminary reports on the haematological profile of Nigerian horses [26, 27]. There is thus paucity of information on the comprehensive haematological profile of Nigeria horses, yet these horses are bought, kept and used in all parts of Nigeria. The objectives of this study were to evaluate the haematological profile of apparently healthy Nigerian horses and determine the influence of age, sex and season on the haematological parameters.

## **MATERIALS AND METHODS**

Nigerian horses brought from Northern Nigeria for sale at the Obollor Afor Horse market, Southeastern Nigeria were used for the study. The Obollor Afor Horse Market is located at the border between Northern and South-Eastern Nigeria, at latitude 6°54'56" north and longitude 7°30'55" east.

Research visits to the Obollor Afor Horse Market were made once a week during the six month study period, made up of three months of dry season (February to April, 2012) and three months of rainy season (June to August, 2012). All horses sold on the days of research visit were subjected to physical and clinical examination. Out of 207 horses examined during the study period, 61 were considered clinically healthy and included in the study. The remaining 146 horses that had diseases, disorders and other forms of abnormalities were excluded. The ages of the 61 horses were determined based on tooth eruption and wear, and they were categorised as foals (0 – 11 months), young (1 – 4 years), adult (5 – 12 years), and old (> 12 years) [28, 29]. Details of the age, sex and season of sampling were documented for each of the 61 horses. The horses were handled humanely during the study.

Two millilitres of blood was collected for haematology from each of the horses by jugular venipuncture. The blood was dispensed into a sample bottle containing 2 mg of ethylene diamine tetra-acetic acid (EDTA) to prevent clotting. The haematological determinations followed standard procedures. The packed cell volume (PCV) was determined by the micro-haematocrit method [30]. The haemoglobin concentration (Hb) was determined by the cyanomethaemoglobin method [31]. The red blood cell (RBC) and total leukocyte counts (TLC) were done by the haemocytometer method, while thin blood smear made on clean grease-free glass slides for differential leukocyte count were stained following the Leishman technique and enumerated by the meander counting method [30]. The mean corpuscular values – mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular

haemoglobin concentration (MCHC) were calculated using the standard formulae [11, 30]. The erythrocyte sedimentation rate (ESR) was determined by the microhaematocrit Wintrobe method [8]. The platelet count (PC) was done following the Rees and Ecker direct counting method [32].

The SPSS statistical package was used to analyse data generated from the study. The haematological parameters of the male and female horses and the influence of the seasons (dry and rainy) were compared using student's t - test. Age-related variations in the haematological parameters were subjected to one way analysis of variance, and variant means were separated by the least significant difference method. Significance was accepted at  $p < 0.05$ .

## RESULTS

The overall mean PCV, RBC count and Hb of the horses were  $43.21 \pm 0.77$  %,  $8.69 \pm 0.16$  ( $10^6/\mu\text{l}$ ) and  $15.11 \pm 0.29$  g/dl, respectively (Table 1). The mean PCV and RBC counts of the males were significantly ( $p < 0.05$ ) higher than that of the females, but there was no significant ( $p > 0.05$ ) difference between the Hb of the males and females (Table 2). There were no significant ( $p > 0.05$ ) age-related variations and seasonal differences in the PCV, RBC count and Hb of the horses (Table 3). The overalls of the mean erythrocytic corpuscular values were as follows: MCV –  $50.04 \pm 0.55$  fl, MCH –  $17.71 \pm 0.38$  pg and MCHC –  $35.30 \pm 0.72$  g/dl (Table 1). There were no significant ( $p > 0.05$ ) sex and seasonal differences or age-related variations in the MCV, MCH and MCHC of the horses. The overall mean ESR was  $28.19 \pm 3.57$  mm/20 mins (Table 1). The mean ESR of the female horses was significantly ( $p < 0.05$ ) higher than that of the males (Table 2), but there were no significant ( $p > 0.05$ ) age-related variations or seasonal differences in the ESR of the horses (Table 3 and 4).

**Table 1. The haematological profile of Nigerian horses (n = 61).**

Haematology parameters	Means $\pm$ standard error	Minimum and maximum values
Packed cell volume (%)	$43.21 \pm 0.77$	31.50 – 53.50
Red blood cell count ( $10^6/\mu\text{l}$ )	$8.69 \pm 0.16$	6.46 – 11.16
Haemoglobin concentration (g/dl)	$15.11 \pm 0.29$	11.53 – 19.86
Mean corpuscular volume (fl)	$50.04 \pm 0.55$	38.37 – 60.96
Mean corpuscular haemoglobin (pg)	$17.71 \pm 0.38$	13.41 – 26.34
Mean corpuscular haemoglobin concentration (g/dl)	$35.30 \pm 0.72$	27.67 – 55.03
Erythrocyte sedimentation rate (mm/20 mins)	$28.19 \pm 3.57$	21.01 – 37.10
Total leukocyte count ( $10^3/\mu\text{l}$ )	$9.53 \pm 0.31$	5.40 – 13.90
Band neutrophils ( $10^3/\mu\text{l}$ )	$0.28 \pm 0.04$	0.00 – 0.97
Segmented neutrophils ( $10^3/\mu\text{l}$ )	$4.77 \pm 0.23$	2.05 – 8.83
Lymphocytes ( $10^3/\mu\text{l}$ )	$4.19 \pm 0.19$	1.54 – 6.79
Monocytes ( $10^3/\mu\text{l}$ )	$0.03 \pm 0.01$	0.00 – 0.15)
Eosinophils ( $10^3/\mu\text{l}$ )	$0.25 \pm 0.03$	0.00 – 0.85
Basophils ( $10^3/\mu\text{l}$ )	$0.01 \pm 0.01$	0.00 – 0.20
Platelet count ( $10^3/\mu\text{l}$ )	$326.94 \pm 16.30$	140 - 600

For the total and differential leukocyte counts ( $10^3/\mu\text{l}$ ), the overall means for the horses were as follows: TLC –  $9.53 \pm 0.31$ , band neutrophils –  $0.28 \pm 0.04$ , segmented neutrophils –  $4.77 \pm 0.23$ , lymphocytes –  $4.19 \pm 0.19$ , monocytes –  $0.03 \pm 0.01$ , eosinophils –  $0.25 \pm 0.03$  and basophils –  $0.01 \pm 0.01$  (Table 1). There were no significant ( $p > 0.05$ ) sex and seasonal differences or age-related variations in the TLC and differential leukocyte counts of the horses (Tables 2, 3 and 4).

The overall mean platelet count ( $10^3/\mu\text{l}$ ) was  $326.94 \pm 16.30$  (Table 1), and there were no significant ( $p > 0.05$ ) sex-related differences or age-related variations in the platelet counts of the horses (Tables 2 and 3). The platelet counts of the horses were however significantly ( $p < 0.05$ ) higher during the rainy season than during the dry season (Table 4).

**Table 2. Comparison of the haematological profile of the male and female Nigerian horses.**

Haematology parameters	Means $\pm$ standard error	
	Males (n = 39)	Females (n = 22)
Packed cell volume (%)*	$45.07 \pm 0.85$	$39.39 \pm 1.12$
Red blood cell count ( $10^6/\mu\text{l}$ )*	$9.01 \pm 0.20$	$8.04 \pm 0.19$
Haemoglobin concentration (g/dl)	$15.50 \pm 0.29$	$14.32 \pm 0.60$
Mean corpuscular volume (fl)	$50.64 \pm 0.63$	$48.81 \pm 1.04$
Mean corpuscular haemoglobin (pg)	$17.63 \pm 0.43$	$17.89 \pm 0.79$
Mean corpuscular haemoglobin concentration (g/dl)	$34.58 \pm 0.60$	$36.78 \pm 1.81$
Erythrocyte sedimentation rate (mm/20mins)*	$22.58 \pm 1.57$	$33.81 \pm 3.30$
Total leukocyte count ( $10^3/\mu\text{l}$ )	$9.26 \pm 0.37$	$10.09 \pm 0.56$
Band neutrophils ( $10^3/\mu\text{l}$ )	$0.25 \pm 0.05$	$0.33 \pm 0.07$
Segmented neutrophils ( $10^3/\mu\text{l}$ )	$4.74 \pm 0.24$	$4.83 \pm 0.52$
Lymphocytes ( $10^3/\mu\text{l}$ )	$3.97 \pm 0.22$	$4.65 \pm 0.35$
Monocytes ( $10^3/\mu\text{l}$ )	$0.03 \pm 0.01$	$0.02 \pm 0.01$
Eosinophil ( $10^3/\mu\text{l}$ )	$0.26 \pm 0.04$	$0.23 \pm 0.05$
Basophil ( $10^3/\mu\text{l}$ )	$0.01 \pm 0.01$	$0.02 \pm 0.01$
Platelet counts ( $10^3/\mu\text{l}$ )	$340.60 \pm 19.99$	$276.06 \pm 27.48$

\* Asterisk superscripts on any parameter indicate significant difference between males and females,  $p < 0.05$

## DISCUSSION

The values recorded for the PCV, RBC count, Hb, erythrocyte corpuscular values and total and differential leukocyte counts in this study were comparable to and not different from those reported for horses in available literature [25, 27, 30, 33], but there were differences between some of the minimum and maximum values recorded in this study and that reported by the different cited literature. The mean values recorded in this present study for the PCV, RBC count and Hb were however slightly higher than that reported in a preliminary study on 21 adult horses in Maiduguri Northern Nigeria [27].

**Table 3. Comparison of the haematological profile of the Nigerian horses of different ages.**

Haematology parameters	Means $\pm$ standard error		
	Young (1 – 3 yrs) (n = 5)	Adult (4 – 10 yrs) (n = 45)	Old (> 11 yrs) (n = 11)
Packed cell volume (%)	44.17 $\pm$ 4.48	43.64 $\pm$ 0.82	40.50 $\pm$ 2.24
Red blood cell count ( $10^6/\mu\text{l}$ )	9.15 $\pm$ 0.67	8.70 $\pm$ 0.18	8.45 $\pm$ 0.34
Haemoglobin conc. (g/dl)	14.61 $\pm$ 1.56	15.20 $\pm$ 0.33	14.85 $\pm$ 0.50
Mean corpuscular volume (fl)	48.09 $\pm$ 2.05	50.58 $\pm$ 0.59	47.76 $\pm$ 1.66
Mean corpuscular haemoglobin (pg)	15.89 $\pm$ 0.51	17.85 $\pm$ 0.46	17.65 $\pm$ 0.52
Mean corpuscular haemoglobin conc. (g/dl)	33.10 $\pm$ 1.21	35.11 $\pm$ 0.86	37.15 $\pm$ 1.23
Erythrocyte sedimentation rate (mm/20 mins)	30.51 $\pm$ 6.01	27.42 $\pm$ 4.93	26.04 $\pm$ 2.14
Total leukocyte counts ( $10^3/\mu\text{l}$ )	11.98 $\pm$ 1.01	9.40 $\pm$ 0.36	9.33 $\pm$ 0.54
Band neutrophils ( $10^3/\mu\text{l}$ )	0.54 $\pm$ 0.21	0.26 $\pm$ 0.04	0.28 $\pm$ 0.14
Segmented neutrophils ( $10^3/\mu\text{l}$ )	6.38 $\pm$ 0.84	4.73 $\pm$ 0.27	4.40 $\pm$ 0.31
Lymphocytes ( $10^3/\mu\text{l}$ )	4.84 $\pm$ 0.79	4.11 $\pm$ 0.21	4.39 $\pm$ 0.56
Monocytes ( $10^3/\mu\text{l}$ )	0.01 $\pm$ 0.00	0.03 $\pm$ 0.01	0.03 $\pm$ 0.02
Eosinophils ( $10^3/\mu\text{l}$ )	0.19 $\pm$ 0.10	0.25 $\pm$ 0.04	0.24 $\pm$ 0.08
Basophils ( $10^3/\mu\text{l}$ )	0.03 $\pm$ 0.03	0.01 $\pm$ 0.01	0.00 $\pm$ 0.00
Platelet counts ( $10^3/\mu\text{l}$ )	333.33 $\pm$ 108.99	319.38 $\pm$ 18.04	376.67 $\pm$ 30.95

No significant age-related variations ( $p > 0.05$ ).

The significantly higher PCV and RBC counts recorded for the males in comparison with females in this present study could be attributed to the known ability of the male androgenic hormones to enhance erythropoiesis by stimulating erythropoietin production and release [34, 35], and is in agreement with the reports of Coles [8] and Grondin and Dewitt [25], but was in contrast with that of Altinsaat [23] who reported lower RBC numbers in male Arabian horses. The lack of age-related variations in all the haematological parameters evaluated in the study was in agreement with the reports of Grondin and Dewitt [25] and Ralston *et al.* [36] for horses one year and above, but was in contrast to the reports of Cebulj-Kadunc *et al.* [17] and Altinsaat [23] who documented significant age-related variations in some of the erythrocytic parameters of horses.

The ESR values recorded for the horses in this present study were higher than that reported for horses [7]. The platelet counts recorded in this study were comparable to that reported for horses by Thrall and Weiser [30], but the maximum value (upper limit) recorded in this present study was higher than that documented for horses by Krimer [33]. The lack of seasonal differences in the haematological parameters evaluated in this study (except the platelet counts) is worthy of note, as it implies that the differences in environmental conditions between the rainy and dry seasons did not directly impact on the haematological values (except the platelet counts).

Based on the results of the study, it was concluded that the most of the haematological values (except ESR) of the Nigerian horses studied were comparable to and not different from those reported for horses in available literature, but the upper and lower reference limits (minimum and maximum values) were different from those in available literature for most parameters.

**Table 4. Comparison of the haematological profile of Nigerian horses during the dry and rainy seasons.**

Haematology parameters	Means $\pm$ standard error	
	Dry season (n = 38)	Rainy season (n = 23)
Packed cell volume (%)	43.77 $\pm$ 1.01	42.44 $\pm$ 1.18
Red blood cell count ( $10^6/\mu\text{l}$ )	8.73 $\pm$ 0.22	8.64 $\pm$ 1.10
Haemoglobin concentration (g/dl)	15.61 $\pm$ 0.36	14.92 $\pm$ 0.43
Mean corpuscular volume (fl)	50.65 $\pm$ 0.81	49.18 $\pm$ 0.66
Mean corpuscular haemoglobin (pg)	18.39 $\pm$ 0.56	17.28 $\pm$ 2.03
Mean corpuscular haemoglobin concentration (g/dl)	36.14 $\pm$ 1.10	35.15 $\pm$ 0.75
Erythrocyte sedimentation rate (mm/20 mins)	26.82 $\pm$ 2.11	28.19 $\pm$ 3.57
Total leukocyte counts ( $10^3/\mu\text{l}$ )	9.60 $\pm$ 0.41	9.43 $\pm$ 0.49
Band neutrophils ( $10^3/\mu\text{l}$ )	0.26 $\pm$ 0.06	0.31 $\pm$ 0.06
Segmented neutrophils ( $10^3/\mu\text{l}$ )	4.98 $\pm$ 0.32	4.48 $\pm$ 0.32
Lymphocytes ( $10^3/\mu\text{l}$ )	4.06 $\pm$ 0.22	4.37 $\pm$ 0.33
Monocytes ( $10^3/\mu\text{l}$ )	0.03 $\pm$ 0.01	0.02 $\pm$ 0.01
Eosinophils ( $10^3/\mu\text{l}$ )	0.26 $\pm$ 0.04	0.24 $\pm$ 0.05
Basophil ( $10^3/\mu\text{l}$ )	0.02 $\pm$ 0.01	0.01 $\pm$ 0.01
Platelet ( $10^3/\mu\text{l}$ ) *	292.64 $\pm$ 15.19	368.70 $\pm$ 29.16

\* Asterisk superscripts on a parameter indicate significant differences between the seasons,  $p < 0.05$

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