**Introduction**

The horse (Equus caballus) is a long domesticated ungulate mammal belonging to the Equidae family, comprising of asses, horses and zebras. In Nigeria, horses are prestigious animals used for diverse functions such as draft, humans and luggage transport, agricultural, sports, exhibitions, research, recreation, security, parades, crowd control, food (meat and milk), source of variety of products and medicine as well as for ceremonies and festivals (Ihedioha & Agina, 2014; Zettl, 2007).

In Oyo State, horses racing competitions (Polo game) have great economic importance, where millions of naira exchanges hands and other valuables may be worn as prizes and thereby serve as internally generated revenue for the state. The importance of hematological and biochemical indices as diagnostic and prognostic tools in prevention and control of animal diseases has been elucidated (Olaogun and Adedeji, 2018)

Haematological and serum biochemical values are valuable guides and biomarkers in health and ill health for diagnosis, assessing disease prognosis, and monitoring therapy progress as well as for better understanding of the disease process in animals and humans (Gupta *et al.,* 2002, Burlikowska *et al.,* 2015). Because blood serves as the major transport channel for the body as well as the input and output substances for almost all of its metabolic activities, any variation from normal range values could suggest underlying disease problems (Stockham and Scott, 2008). Since evaluation of the hemogram and plasma biochemistry analytes can provide insights into oxygen transport, organ function, and fluid, electrolyte and acid–base balance, it is not surprising that such tests currently rank among the most frequent diagnostic techniques employed during investigation of suboptimal performance or disease in equine athletes. Reference standards for athletic horses bred and kept in tropical climates, however, have not been determined. Hematological and serum biochemistry profile of horses have been extensively documented in the literature especially in different countries and region of the world. Therefore, because reference hematological and serum biochemistry values in horses (and other animals) vary from one geographical location to the other, each clinic in a given area must develop reference values for the horse population in that area (Grondin and Dewitt 2010). Few studies on hematological and biochemical baseline data of apparently healthy horses have been reported in some states in Nigeria (Egbe-Nwiyi *et, al.,* 2012, Ihedioha and Agina, 2013). But this has not been carried out in polo horses in Oyo state, southwestern Nigeria, even where it has been done most of these studies were conducted on less than twenty horses; therefore, this investigation was carried out on a larger number to measure the hematology and some of the biochemical values including, electrolytes, serum glucose and lipid profile parameters which have not been previously measured in apparently healthy racing horses in Nigeria. Therefore, this study aims to establish demography, determine the hematological and serum biochemical parameters and possible variation amongst breed, sex and ages of apparently healthy Polo horses in Ibadan, Oyo state, Nigeria.

**Materials and Methods**

**Study Area**

This study was carried out in Ibadan located in South-Western Nigeria in the Southeastern part of Oyo state, at latitude 7° 23′ 47″ North and longitude 3° 55′ 0″ East.

**Study Animals**

Twenty (20) apparently healthy Horses of both sexes comprising Sudanese and Cross bred belonging to Ibadan Polo club was used for this study. These 20 horses were sampled randomly and they are representative of the larger population. Major horses’ selection criteria for this study were owners’ consent, cooperation of the animals, breed, sex and age of the animals. Sampling was done usually very early in the morning before exercise during dry season months of February and March 2021. Animals were housed in stables made of concrete floor, cement block wall, wood shavings as beddings, asbestos roof and well ventilated. The horses were provided with fresh pasture, wheat bran, sorghum and hay. Drinking water was given *ad libitum*.

Field records for breeds, sex and age were assessed and recorded appropriately as previously done by (Olaogun and Jeremiah, 2018). Breeds were established by their morphological features. Age was estimated using birth record as provided by the groom and sexes morphologically determined. Two millilitres of blood was taken from the jugular vein into sample bottles containing anticoagulant 2 mg of ethylene diamine tetra-acetic acid (EDTA) to prevent clotting for hematology. And five millilitres of blood was taken into sample bottles without anticoagulant for biochemistry analysis. The samples were immediately transported to the General laboratory of the Department of Veterinary Medicine, University of Ibadan, Nigeria on ice packs. Hematological analysis was performed immediately. Samples without anticoagulant were centrifuged and stored at -20ºC for biochemistry analysis

**Hematological examination:**

The hematological indices of the samples were analyzed using standard methods. The packed cell volume (PCV) was determined by the micro-haematocrit method (Thrall and Weiser, 2002). The haemoglobin concentration (Hb) was determined by the cyanomethaemoglobin method (Higgins et al., 2008). 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 manual differential leukocyte count and stained were made following the Leishman technique and enumerated by the meander counting method with appropriate stains to calculate the absolute lymphocyte count (Lymph), absolute eosinophil count (Eos), absolute neutrophil count (Neut), and absolute monocyte count (Mono) according to the procedure adopted by (Olaogun and Oyetoyinbo, 2020). The platelet count (PC) was done following the Rees and Ecker direct counting method as adopted by (Ihedioha and Agina, 2014).

**Serum biochemistry Analysis**

 From the serum, total protein and albumin concentrations were determined by spectrophotometric methods using the Sigma Diagnostic Kits Serum total cholesterol was determined by the enzymatic colorimetric method using reagent kit, glucose was determined by the Trinder reaction method using the reagent kit, serum total protein was determined by the direct Biuret method using reagent kit, albumin was determined by the bromocresol green method using a reagent kit, urea was determined by the modified Berthelot-Searcy. The concentrations of blood urea nitrogen, creatinine, total and conjugated bilirubin, sodium, potassium, chloride, Bicarbonate, and glucose were determined by spectrophotometry using RANDOX® laboratory reagent kits. Serum cholesterol and triglyceride levels were determined using Ecoline CHOD-PAP and Ecoline 25 GPO-PAP assay kits method using reagent kit. All the reagents used were obtained from RANDOX Laboratories Ltd., Ardmore, United Kingdom manufactured by FORTRESS Diagnostics Limited, based in the United Kingdom. Kits were used according to manufacturer’s directions. All procedures were adopted and followed according to (Olaogun and Onwuzuruike, 2018)

**Statistical analysis:**

Descriptive statistic was used to established frequency and percentage. The data obtained were summarized as means ± standard deviations. Breeds and sexes results were analyzed by students’ t -test and that of Age were subjected to one-way analysis of variance (ANOVA) for comparism of means, followed by pair-wise comparisons using the Duncan tests. Difference was considered significant when P < 0.05. The computer software, SPSS version 2007 Microsoft excel for windows was used for analysis (SAS, 1996)

**Results**

Of the total 20(100%) horses sampled, 14 (70%) were found to be Sudanese breed while 6 (30%) were Cross bred horses. Sex distribution revealed as follows; 18 (90%) were female (mare) and 2 (10%)were male (stallion), while age distribution showed as follows; 4-6years being 4(20%) followed by those of 7-9years being 8(40%) and horses within age bracket of 10-13years being 8(40%) (Table 1, 2 and 3).

The Mean± S.D of all erythrocytic and leucocytic parameters were within the normal range of reference values with their indices as follows; Packed Cell Volume(PCV)% was 44.25 ± 2.10, Hemoglobin (Hb) Concentration(g/dl) was 15.09 ± 1.03, Red blood cell (RBC) count (x 106/µL) was 9.61 ± 0.79, White Blood Cell Count (WBC (x 103/µL) was 8.33 ± 1.09, Platelet count (/cubic mm) was 467350 ± 132609.7, Neutrophils count (%) was 64.10 ± 5.11, Lymphocytes count (%) was 35.00 ± 4.59, Monocytes count (%) was 0.55 ± 0.76, Eosinophils count (%) was 0.3 ± 0.66 and Basophils count (%) was 0.05 ± 0.22 (Table 4).

The Mean± S.D of all biochemical parameters analyzed were within the normal indices referenced for horses except for the values of Total cholesterol(mg/dL) and Triglyceride (mg/dL) with relatively higher values in comparism with the reference values. The value of Total cholesterol(mg/dL) was 146.20 ± 12.98 with the reference value being 71-142, while the value of Triglyceride (mg/dL) was 61.55 ± 10.30 with the reference value being 11-59. All other values for electrolytes, proteins and glucose were within the reference range. Though we have the values for High density lipoprotein (mg/dl) and Low density lipoprotein (mg/dl) as 57.92±0.03 and 35±1.54 respectively, we are unable to get their reference values for comparism (Table 5).

Erythocytic indices according to breed revealed a relatively better and higher Mean± S.D values in Cross bred horses with the following parameters; 44.67±1.21, 15.3±0.81 and 9.68±0.98 for PCV, Hb and RBC respectively. While Sudanese breed had parameters as follows; 44.07±2.4, 15.0±1.13 and 9.59±0.81 for PCV, Hb and RBC respectively. No significant differences (P< 0.05) were observed for all erythrocytic indices among breeds. Also better and lower leucocytic indices were observed in Sudanese breed when compared with the parameters seen in Cross bred horses, no significant differences (P< 0.05) were observed in all leucocytic parameters in the two breeds of horses sampled (Table 6).

Biochemical parameters of the two breeds of horses indicated a better and higher values in many of the analytes in Sudanese breed when compared with the analytes values observed in Cross bred horses. Significant differences (P >0.05) were observed in the values of glucoseand high density lipoprotein among the two breeds with significantly higher values of 83.29±4.1 and 45.43±4.65 for glucoseand high density lipoprotein respectively in Sudanese breed. Whereas the values of glucoseand high density lipoprotein were significantly lower with 79.83±3.19 and 39.67±6.62 respectively in Cross bred horses, though all were within the reference range of values, except for high density lipoprotein and low density lipoprotein without their reference range values (Table 7).

Erythocytic parameters as revealed by this study showed a higher and better values in male (stallion) when compared to the values observed in female (mare). The values of PCV, Hb and RBC in stallion were 45.0±2.83, 9.98±0.18 and 8.75±0.21 respectively compared to 44.17±2.09, 9.58±0.87 and 8.28±1.2 respectively seen in mare. Though no significant difference was observed in all of these analytes among stallion and mare. Lower and better values were observed in leucocytic parameters in mares compared to stallion but with no significant difference observed. The values of WBC, platelet, neutrophils, lymphocytes, monocytes and eosinophils were 15.06±1.05, 45.26±13.32, 63.56±5.1, 35.5±4.57, 0.56±0.78 and 0.33±0.69 respectively in mares. While the parameters were 15.4±1.13, 63.0±2.83, 69.0±0.0, 30.5±0.71, 0.5±0.71 and 0.0±0.0 respectively in stallion (Table 8).

Biochemical parameters among stallion and mares as revealed by this present study showed that most analytes appeared better in mares than in stallion. Though all were within the normal reference range of values, no statistical significant differences were observed in all biochemical analytes among male and female horses (Table 9).

The erythrocytic parameters in a older horse appeared better and higher with the following values; The values of PCV, Hb and RBC in 4-6yrs category were 44.0±1.15, 9.9±0.69 and 8.15±1.21 respectively compared to 45.38±2.62, 9.64±1.05 and 9.64±1.05 respectively seen in much older animals 10-13yrs. Though all were within the normal reference range. Most of the leucocytic parameters were lower especially the differentials in younger animals’ category (4-6yrs). The values of platelets, lymphocytes, monocytes and eosinophils were lower as follows; 15.08±0.85, 33.25±5.68, 0.25±0.5 and 0.0±0.0 respectively in 4-6yrs age group of horses when compared with the values of 15.68±1.16, 34.62±4.81, 0.75±0.89 and 0.12±0.35 respectively in 10-13yrs age group of horses. There were no significant differences observed in all parameters amongst all age groups of horses (Table 10).

Biochemical indices regarding age groups indicate increased in the values of all parameters with increased in age. Though all parameters analyzed were within the normal reference range of values, but, we observed significant difference (P<0.05) in the value of glucose. Glucose was significantly higher with Mean± S.D value of 84.5±2.56 in 10-13yrs age group of horses compared to 79.38±2.92 being Mean± S.D value in 7-9yrs age group of horses (Table 11).

**Table1: Breed distribution of Horses and their frequency**

|  |  |  |  |
| --- | --- | --- | --- |
| S/N | BREED | FREQUENCY | PERCENTAGE(%) |
| 1 | Cross | 6 | 30.00 |
| 2 | Sudanese | 14 | 70.00 |
| 3 | Total | 20 | 100.00 |

**Table2: Sex distribution of Horses and their frequency**

|  |  |  |  |
| --- | --- | --- | --- |
| S/N | SEX | FREQUENCY | PERCENTAGE(%) |
| 1 | Male | 2 | 10.00 |
| 2 | Female | 18 | 90.00 |
| 3 | Total | 20 | 100.00 |

**Table3: Age distribution of Horses and their frequency**

|  |  |  |  |
| --- | --- | --- | --- |
| S/N | AGE-GROUP | FREQUENCY | PERCENTAGE(%) |
| 1 | 4-6 | 4 | 20.00 |
| 2 | 7-9 | 8 | 40.00 |
| 3 | 10-13 | 8 | 40.00 |
| 4 | Total | 20 | 100.00 |

**Table 4: Mean±S.D of Haematological values of apparently healthy horses in Ibadan, Nigeria**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters (Units)** | **Mean ± SD** | **Range** | **Normal Reference Range (Schalm et al.,1975)** |
| Packed cell Volume(PCV)% | 44.25 ± 2.10 | 40-48 | **32 – 53** |
| Hemoglobin (Hb) Concentration(g/dl) | 15.09 ± 1.03 | 13.1-16.8 | **11.0 -19.0** |
| Red blood cell (RBC) count (x 106/µL) |  9.61 ± 0.79 | 7.80-10.8 | 6.8 -12.9 |
| White Blood Cell Count (WBC (x 103/µL) |  8.33 ± 1.09 | 6.55-11.3 | 5.4 -14.3 |
| Platelet counts(/cubic mm) | 467350 ± 132609.7 | 218,000-710,000 | 100,000-600,000 |
| Neutrophils count (%) |  64.10 ± 5.11 | 55-73 | **52– 70** |
| Lymphocytes counts (%) |  35.00 ± 4.59 | 27-43 | **21-42** |
| Monocytes count (%) |  0.55 ± 0.76 | 0-2 | **0-6** |
| Eosinophils count (%) |  0.3 ± 0.66 | 0-2 | **0 -7** |
| Basophils count (%) |  0.05 ± 0.22 | 0-1 | **0-2** |

**Table 5: Mean±S.D of serum biochemical values of apparently healthy horses in Ibadan, Nigeria**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters (Units)** | **Mean ± SD** | **Range** | **Normal reference Range (Schalm et al.,1975)** |
| Sodium (mmol/L) | 138.25 ± 2.85 | 131-142 | 128-142 |
| Potassium (mmol/L) | 3.78 ± 0.33 | 3.2-4.3 | 2.9-4.6 |
| Chloride (mmol/L) | 105.50 ±3.94 | 100-110 | 98-109 |
| Bicarbonate (mmol/L) | 23.45 ± 2.28 | 20-26 | 24-30 |
| Urea (mg/dL) | 24.60 ± 4.31 | 17-32 | 11-27 |
| Creatinine (mg/dl) | 0.64 ± 0.12 | 0.4-0.9 | 0.4-2.2 |
| Total protein (g/dL) | 6.81 ± 0.39 | 6.2-7.4 | 5.6-7.6 |
| Albumin **(g/dL)** | 3.72 ± 0.26 | 3.3-4.1 | 2.6-4.1 |
| Glucose (mg/dL) | 82.25 ± 4.10 | 75-90 | 62-134 |
| Total bilirubin (mg/dL) | 0.58 ± 0.23 | 0.3-1.0 | 0-3.2 |
| Total cholesterol (mg/dL) | 146.20 ± 12.98 | 120-169 | 71-142 |
| Triglyceride (mg/dL) | 61.55 ± 10.30 | 48-80 | 11-59 |
| High density lipoprotein (mg/dl) | 57.92±0.03 | 36-87 | **-** |
| Low density lipoprotein (mg/dl) | 35±1.54 | 4-82 | - |

**Table 6: Breed and their Mean±S.D of Hematological Parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **PARAMETERS** | **CROSS** | **SUDANESE** | **REFERENCE (Schalm et al.,1975)** |
|  | MEAN±SD | RANGE | MEAN±SD | RANGE |  |
| Packed cell Volume(PCV)% | 44.67±1.21 | 43.0-46.0 | 44.07±2.4 | 40.0-48.0 | **32 – 53** |
| Hemoglobin (Hb) Concentration(g/dl) | 15.3±0.81 | 14.0-16.0 | 15.0±1.13 | 13.1-16.8 | **11.0 -19.0** |
| Red blood cell (RBC) count (x 106/µL) | 9.68±0.98 | 8.65-10.85 | 9.59±0.81 | 7.8-10.61 | 6.8 -12.9 |
| White Blood Cell Count (WBC (x 103/µL) | 8.4±1.75 | 6.55-11.3 | 8.3±0.86 | 6.85-10.2 | 5.4 -14.3 |
| Platelet counts(/cubic mm) | 44.03±7.97 | 37.0-56.0 | 48.32±15.68 | 21.8-71.0 | 100,000-600,000 |
| Neutrophils count (%) | 64.5±4.59 | 57.0-71.0 | 63.93±5.47 | 55.0-73.0 | **52– 70** |
| Lymphocytes counts (%) | 34.83±3.66 | 29.0-40.0 | 35.07±5.06 | 27.0-43.0 | **21-42** |
| Monocytes count (%) | 0.17±0.41 | 0.0-1.0 | 0.71±0.83 | 0.0-2.0 | **0-6** |
| Eosinophils count (%) | 0.33±0.82 | 0.0-2.0 | 0.29±0.61 | 0.0-2.0 | **0 -7** |
| Basophils count (%) | 0.17±0.41 | 0.0-1.0 | 0.0±0.0 | 0.0-0.0 | **0-2** |

No significant difference between the mean values (p > 0.05), **\*** indicates significant difference (p < 0.05)

**Table 7: Breed and their Mean±S.D of Biochemical Parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **PARAMETERS** | **CROSS BRED** | **SUDANESE BREED** | **REFERENCE RANGE(Schalm et al.,1975)** |
| MEAN±SD | RANGE | MEAN±SD | RANGE |  |
| Sodium (mmol/L) | 138.0±2.0 | 136.0-141.0 | 138.36±3.2 | 131.0-142.0 | 128-142 |
| Potassium (mmol/L) | 3.7±0.28 | 3.4-4.1 | 3.81±0.35 | 3.2-4.3 | 2.9-4.6 |
| Chloride (mmol/L) | 105.0±4.47 | 100.0-110.0 | 105.21±4.0 | 100.0-110.0 | 98-109 |
| Bicarbonate (mmol/L) | 23.5±1.76 | 21.0-26.0 | 22.71±1.86 | 20.0-26.0 | 24-30 |
| Urea (mg/dL) | 24.0±3.74 | 20.0-29.0 | 24.86±4.64 | 17.0-32.0 | 11-27 |
| Creatinine (mg/dl) | 0.6±0.09 | 0.5-0.7 | 1.24±2.24 | 0.4-9.0 | 0.4-2.2 |
| Total protein (g/dL) | 6.68±0.33 | 6.3-7.1 | 6.86±0.41 | 6.2-7.4 | 5.6-7.6 |
| Albumin **(g/dL)** | 3.57±0.22 | 3.3-3.9 | 3.79±0.25 | 3.3-4.2 | 2.6-4.1 |
| Glucose**\*** (mg/dL) | 79.83±3.19 | 76.0-83.0 | 83.29±4.1**\*** | 75.0-90.0 | 62-134 |
| Total bilirubin (mg/dL) | 0.52±0.17 | 0.3-0.8 | 0.61±0.26 | 0.3-1.0 | 0-3.2 |
| Total cholesterol (mg/dL) | 139.33±15.31 | 120.0-162.0 | 149.14±11.2 | 130.0-169.0 | 71-142 |
| Triglyceride (mg/dL) | 57.0±10.35 | 48.0-76.0 | 63.5±10.01 | 49.0-80.0 | 11-59 |
| High density lipoprotein**\*** (mg/dl) | 39.67±6.62 | 33.0-51.0 | 45.43±4.65**\*** | 39.0-53.0 | **-** |
| Low density lipoprotein (mg/dl) | 80.83±15.66 | 69.0-110.0 | 88.07±15.82 | 60.0-115.0 | - |

No significant difference between the mean values (p > 0.05), **\*** indicates significant difference (p < 0.05).

**Table 8: Sex and their Mean±S.D of Hematological Parameters.**

|  |  |  |  |
| --- | --- | --- | --- |
| **PARAMETERS** | **Male** | **Female** | **REFERENCE****(Schalm et al.,1975)** |
|  | Mean ±SD | Range | Mean ±SD | Range |  |
| Packed cell Volume(PCV)% | 45.0±2.83 | 43.0-47.0 | 44.17±2.09 | 40.0-48.0 | **32 – 53** |
| Haemoglobin (Hb) Concentration(g/dl) | 9.98±0.18 | 9.85-10.1 | 9.58±0.87 | 7.8-10.85 | **11.0 -19.0** |
| Red blood cell (RBC) count (x 106/µL) | 8.75±0.21 | 8.6-8.9 | 8.28±1.2 | 6.55-11.3 | 6.8 -12.9 |
| White Blood Cell Count (WBC (x 103/µL) | 15.4±1.13 | 14.6-16.2 | 15.06±1.05 | 13.1-16.8 | 5.4 -14.3 |
| Platelet counts(/cubic mm) | 63.0±2.83 | 61.0-65.0 | 45.26±13.32 | 21.8-71.0 | 100,000-600,000 |
| Neutrophils count (%) | 69.0±0.0 | 69.0-69.0 | 63.56±5.1 | 55.0-73.0 | **52– 70** |
| Lymphocytes counts (%) | 30.5±0.71 | 30.0-31.0 | 35.5±4.57 | 27.0-43.0 | **21-42** |
| Monocytes count (%) | 0.5±0.71 | 0.0-1.0 | 0.56±0.78 | 0.0-2.0 | **0-6** |
| Eosinophils count (%) | 0.0±0.0 | 0.0-0.0 | 0.33±0.69 | 0.0-2.0 | **0 -7** |

No significant difference between the mean values (p > 0.05), **\*** indicates significant difference (p < 0.05).

**Table 9: Sex and their Mean±S.D of Biochemical Parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **PARAMETERS** | **Male** | **Female** | **REFERENCE RANGE (Schalm et al.,1975)** |
| MEAN±SD | RANGE | MEAN±SD | RANGE |  |
| Sodium (mmol/L) | 138.5±2.12 | 137.0-140.0 | 138.22±2.96 | 131.0-142.0 | 128-142 |
| Potassium (mmol/L) | 3.85±0.07 | 3.8-3.9 | 3.77±0.35 | 3.2-4.3 | 2.9-4.6 |
| Chloride (mmol/L) | 104.0±5.66 | 100.0-108.0 | 105.28±4.01 | 100.0-110.0 | 98-109 |
| Bicarbonate (mmol/L) | 23.5±0.71 | 23.0-24.0 | 22.89±1.91 | 20.0-26.0 | 24-30 |
| Urea (mg/dL) | 25.5±3.54 | 23.0-28.0 | 24.5±4.46 | 17.0-32.0 | 11-27 |
| Creatinine (mg/dl) | 0.65±0.07 | 0.6-0.7 | 1.09±1.98 | 0.4-9.0 | 0.4-2.2 |
| Total protein (g/dL) | 6.75±0.35 | 6.5-7.0 | 6.81±0.4 | 6.2-7.4 | 5.6-7.6 |
| Albumin **(g/dL)** | 3.85±0.35 | 3.6-4.1 | 3.71±0.26 | 3.3-4.2 | 2.6-4.1 |
| Glucose (mg/dL) | 80.5±0.71 | 80.0-81.0 | 82.44±4.29 | 75.0-90.0 | 62-134 |
| Total bilirubin (mg/dL) | 0.45±0.21 | 0.3-0.6 | 0.59±0.24 | 0.3-1.0 | 0-3.2 |
| Total cholesterol (mg/dL) | 142.5±3.54 | 140.0-145.0 | 146.61±13.64 | 120.0-169.0 | 71-142 |
| Triglyceride (mg/dL) | 63.0±11.31 | 55.0-71.0 | 61.39±10.52 | 48.0-80.0 | 11-59 |
| High density lipoprotein (mg/dl) | 42.5±4.95 | 39.0-46.0 | 43.83±6.0 | 33.0-53.0 | **-** |
| Low density lipoprotein (mg/dl) | 68.0±11.31 | 60.0-76.0 | 87.89±15.07 | 65.0-115.0 | - |

No significant difference between the mean values (p > 0.05), **\*** indicates significant difference (p < 0.05).

**Table 10: Age group and their Mean±S.D of Hematological Parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **PARAMETERS** | **4-6yrs** | **7-9yrs** | **10-13yrs** |
|  | MEAN±SD | RANGE | MEAN±SD | RANGE | MEAN±SD | RANGE |
| Packed cell Volume(PCV)% | 44.0±1.15 | 43.0-45.00 | 43.25±1.39 | 42.0-46.0 | 45.38±2.62 | 40.0-48.0 |
| Haemoglobin (Hb) Concentration(g/dl) | 9.9±0.69 | 8.91-10.50 | 9.45±0.71 | 8.71-10.85 | 9.64±1.05 | 7.8-10.75 |
| Red blood cell (RBC) count (x 106/µL) | 8.15±1.21 | 6.55-9.41 | 8.67±1.41 | 7.5-11.3 | 8.08±0.85 | 6.85-9.61 |
| White Blood Cell Count (WBC (x 103/µL) | 50.0±10.03 | 41.0-61.00 | 51.68±13.52 | 35.0-71.0 | 40.91±14.65 | 21.8-61.0 |
| Platelet counts(/cubic mm) | 15.08±0.85 | 14.0-16.00 | 14.51±0.69 | 13.9-15.9 | 15.68±1.16 | 13.1-16.8 |
| Neutrophils count (%) | 66.5±5.45 | 59.0-71.00 | 62.5±4.81 | 56.0-69.0 | 64.5±5.35 | 55.0-73.0 |
| Lymphocytes counts (%) | 33.25±5.68 | 29.0-41.00 | 36.25±4.06 | 31.0-43.0 | 34.62±4.81 | 27.0-43.0 |
| Monocytes count (%) | 0.25±0.5 | 0.0-1.00 | 0.5±0.76 | 0.0-2.0 | 0.75±0.89 | 0.0-2.0 |
| Eosinophils count (%) | 0.0±0.0 | 0.0-0.00 | 0.62±0.92 | 0.0-2.0 | 0.12±0.35 | 0.0-1.0 |

No significant difference between the mean values (p > 0.05), **\*** indicates significant difference (p < 0.05)

**Table 11: Age group and their Mean±S.D of Biochemical Parameters**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PARAMETERS** | **4-6yrs** | **7-9yrs** | **10-13yrs** |  |
| MEAN±SD | RANGE | MEAN±SD | RANGE | MEAN±SD | RANGE |
| Sodium (mmol/L) | 138.0±3.56 | 133.0-141.0 | 138.5±2.07 | 136.0-141.0 | 138.12±3.48 | 131.0-142.0 |
| Potassium (mmol/L) | 3.82±0.42 | 3.2-4.1 | 3.69±0.16 | 3.5-3.9 | 3.85±0.42 | 3.2-4.3 |
| Chloride (mmol/L) | 106.25±4.79 | 100.0-110.0 | 104.38±3.2 | 100.0-110.0 | 105.38±4.75 | 100.0-110.0 |
| Bicarbonate (mmol/L) | 22.5±1.29 | 21.0-24.0 | 23.5±1.77 | 20.0-26.0 | 22.62±2.13 | 20.0-26.0 |
| Urea (mg/dL) | 24.25±5.5 | 17.0-29.0 | 24.62±3.93 | 20.0-31.0 | 24.75±4.68 | 18.0-32.0 |
| Creatinine (mg/dl) | 0.62±0.1 | 0.5-0.7 | 1.66±2.97 | 0.5-9.0 | 0.64±0.14 | 0.4-0.8 |
| Total protein (g/dL) | 6.8±0.41 | 6.2-7.1 | 6.81±0.35 | 6.3-7.3 | 6.8±0.46 | 6.2-7.4 |
| Albumin **(g/dL)** | 3.68±0.17 | 3.5-3.9 | 3.78±0.27 | 3.3-4.1 | 3.69±0.3 | 3.3-4.2 |
| Glucose**\*** (mg/dL) | 83.5±5.8 | 76.0-90.0 | 79.38±2.92b | 75.0-84.0 | 84.5±2.56a | 81.0-89.0 |
| Total bilirubin (mg/dL) | 0.57±0.17 | 0.4-0.8 | 0.57±0.3 | 0.3-1.0 | 0.59±0.22 | 0.3-0.9 |
| Total cholesterol (mg/dL) | 134.25±12.97 | 120.0-151.0 | 146.0±11.01 | 128.0-159.0 | 152.38±11.81 | 140.0-169.0 |
| Triglyceride (mg/dL) | 54.25±6.13 | 48.0-60.0 | 60.25±7.76 | 50.0-71.0 | 66.5±12.29 | 49.0-80.0 |
| High density lipoprotein (mg/dl) | 39.0±3.74 | 34.0-43.0 | 42.88±5.36 | 33.0-48.0 | 46.88±5.64 | 38.0-53.0 |
| Low density lipoprotein (mg/dl) | 77.0±6.32 | 69.0-83.0 | 83.25±11.77 | 65.0-100.0 | 93.0±20.12 | 60.0-115.0 |

No significant difference between the mean values (p > 0.05), **\*** indicates significant difference (p < 0.05).

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**Discussion**

The demography of horses that showed larger percentage being Sudanese breed and fewer cross bred horses in the study area does not agrees with the observation of (Mayaki, 2017) who reported more local breed of horse than the Sudanese breed. This difference in breed occurrence may be associated with difference in location of the two studies. Local breed may not be as suitable as Sudanese breed for polo game, as polo horses were sampled for this present study. Occurrence of more mare than stallion in this present study is not in tandem with the general observation of (Ihedioha and Agina, 2014) who reported to have recorded more stallion compared to mare in their work on Nigerian horses in Enugu Southeast Nigeria. The observed dissimilarity may be associated with location and purpose for which animals were being kept for. The earlier study was carried out in horses at the Obollor Afor Horse market, Southeastern Nigeria, more male animal may be presented for sale at the market place than female animal that may be essential for breeding at the polo stables. Greater percentage of the horses sampled were adult animal with few young ones, this correlates with the findings of (Turaki et al., 2014) who observed a similar trend of greater number of adult horses amongst local horses in Northeastern Nigeria.

The erythocytic and leucocytic values recorded in this present study are not different from the reference range of values reported for horses in countries worldwide by previous authors (Schalm *et al*., 1975; Howard and Kaser, 2022; Merck Veterinary Manual 2016). Which indicates good health, wellbeing and proper condition of the sampled animals as no clinical signs of any disease were observed in these animals.The values of erythrocytic indices in this present study is higher and leucocytic indices lower than what have been previously reported by (Ebge-Nwiyi et al., 2012) in their work on hematology and biochemistry parameters of apparently healthy adult horses in Maiduguri, Nigeria. But generally the leucocytic parameters were in agreement with earlier findings (Schalm et al., 1975). The erythrocytic values recorded in this present study is also similar to what have been previously reported by (Ihedioha and Agina, 2014), while the leucocytic parameters were generally higher than the values observed by (Ihedioha and Agina, 2014)

The serum biochemical values recorded in most of the analytes were within the normal reference range and slightly agrees with the earlier findings of (Ebge-Nwiyi et al., 2012) amongst apparently healthy adult horses in Maiduguri, Nigeria. But the values of Total cholesterol(mg/dL) and Triglyceride (mg/dL) with relatively higher when compared with the reference values as reported by (Schalm et al., 1975). The observation of high cholesterol and triglyceride than the reference range seems attributed to nutritional vis a vis dietary factors as the animals sampled were well kept and heavily fed. The improved care and management provided may also be due to importance horse owners attached to Polo horses. These variations could be attributed to climate or environmental factors, as it is essential to note that this study was conducted in a tropical climate, while Schalm et al., (1975) made their observations from animals in the temperate region. Zongping et al., (1995) reported that some biochemical values of domestic animals may vary according to geographic (altitude, latitude, climate) and dietary factors.

Egbe-Nwiyi et al (2007) has previously described influence of climate and season on the hematology and biochemical parameters of donkey in Northeastern Nigeria.

Relatively better and higher Erythocytic indices in Cross bred horses compared to Sudanese breed observed in this present study may be associated with improved trait known with cross bred especially as regard diseases resilient ability. Lack of significant difference detected within breeds is similar to the observation of (Hasso et al., 2012). Relatively better and higher biochemical indices observed in Sudanese breed compared to Cross bred recorded in this present study agrees with the earlier findings of (Hasso et al., 2012) who reported similar higher biochemical indices in Arabian horses compared to Cross bred horse as well. This difference could be attributed to Sudanese breed adaptation to tropical climate and genetic factor. Significant differences observed in the values of glucoseand high density lipoprotein among the two breeds with significant higher values in Sudanese breed compared to Cross bred may also be due to dietary intake, adaptation and could be genetic.

An improved hematological and biochemical indices of male horses compared to female horses seen in this present study, though with no significant difference. This correlates with the observation of (Hasso et al., 2012) who reported a similar improved parameters of serum glucose and lipid profile in racing horses in Iraq.

Improved and better hematological and biochemical indices in older horses observed in this present study is similar to variations in glucose and lipid indices as reported by (Hasso et al., 2012). Glucose was significantly higher in 10-13yrs age group of horses compared to 7-9yrs age group of horses. This similar increased in older horses has been previously reported especially in Total Cholesterol by (Nazifi et al., 2005). Age seems to only have significant influence on the level of glucose as significant higher value of glucose was recorded in 10-13yrs age group of horses.

In conclusion, the demography of polo horses in Ibadan shows predominantly more of Sudanese breed, Mares and Older animals especially from 7years and above. Sudanese breed, Stallion and older horses especially 10-13yrs age group seems to possessed the best hematological and biochemical indices amongst Nigerian Polo horses.

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