

The possible effect of gender and age on haematological and some biochemical parameters in donkey foals (*Equus asinus*) in Zaria, Nigeria

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ABSTRACT

In spite of the socioeconomic role played by donkeys in Nigeria, they are neglected in terms of veterinary care and veterinary research. Research on donkeys has been lagging far behind other domestic species of animals despite their prominent role in both rural and urban societies. This study was carried out to establish baseline haematological and serum biochemical parameters of apparently healthy donkey foals (*Equus asinus*) at the National Animal Production Research Institute Zaria, Nigeria. A total of 97 donkey foals between the ages of 4 and 9 months were used, comprising 34 males and 63 females. In general, a non-significant difference was observed in all parameters with the exception of red blood cell count ($P < 0.05$). Packed cell volume, total white blood cell count, urea, creatinine, total protein, calcium, phosphorus, aspartate amino transferase, alanine amino transferase and alkaline phosphatase were higher in female donkey foals. Data from this study and additional studies with other breeds in other locations will enhance our understanding of the haematological and biochemical parameters in this species, and also serve as reference values for Equine clinicians.

Key words: baseline; haematology; serum biochemistry; donkey; foals; age; Zaria

Introduction

Donkeys are part of the ancient domesticated livestock. In developing countries, donkeys are valued in particular for their ability to survive under harsh conditions (BLENCH et al., 1990; SWAI and BWANGA, 2008), yet they are often regarded as animals of low social status and neglected by research and development organizations (STARKEY, 1995). There are 41.5 million donkeys worldwide (DESALEGNE et al., 2011). Nigeria is one of the countries with a relatively large (800,000) donkey population (MABAYOJE

and ADEMILUYU, 2004). In Nigeria, donkeys are concentrated mainly in the northern states because of the savannah type of vegetation and fewer disease vectors such as tsetse flies (RIM, 1992). In south-eastern Nigeria, donkeys are used as meat animals and about 16,000 donkeys are transported annually from the northern states for this purpose (ATNESA, 1997; BLENCH, 2004). In Nigeria, donkeys help to transport people, carry water from deep wells and rivers, and serve Fulani herdsman during seasonal migration throughout

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Nigeria. In urban areas, donkeys provide small-scale services, such as transportation of building materials and grain, particularly in the northern part of the country. However, donkeys are not promoted by any governmental agency (HASSAN et al., 2013). In spite of the socioeconomic role played by donkeys, they are neglected in terms of veterinary care and veterinary research. Moreover, donkeys suffer from many parasitic and infectious diseases (KABORET, 1984; KARANGWA, 1998) and especially mistreatment by their owners.

To interpret data correctly, results obtained in a laboratory must be compared with values corresponding to the reference values of clinically healthy animals, which serve as a guide to the clinician in evaluating parameters (YOKUS et al., 2006). Haematological and biochemical examination of blood is routinely used in preventive medicine, diagnosis of disease and verification of treatment in all kind of animals (SEDLINSKA et al., 2017). Scientific reports have shown that a large number of factors can affect blood haematological and biochemical indices, even within a particular species, such as changes in environmental and geographical location, nutritional status or the effect of management practices (JORDANA et al., 1998; MUSHI et al., 1999; SOW et al., 2012; SEDLINSKA et al., 2016). Research on donkeys has been lagging behind other domestic species of animals, despite their prominent role in both rural and urban societies (ETANA et al., 2011). Despite the increase in modern transport throughout the world, donkeys are still used as 'beasts of burden' playing an important role in transport of people and goods in arid and semi-arid areas, where roads are poor or non-existent (PEARSON et al., 1995). In addition, donkey meat is highly accepted as a source of protein in the south-eastern part of Nigeria, and it is recommended that livestock farmers should contribute to their rearing (OGBA, 2014). There have been studies on the haematological and biochemical values of donkey, but little or no work has been carried out on donkey foals. Also, values obtained abroad may not be fully applicable to our conditions, because they are influenced by breed, and environmental and management differences (RICKETTS, 1987). For the reasons mentioned,

the purpose of this study was to determine reference haematological and some serum biochemical values for Nigerian donkey foals, to form a basis for clinical interpretation.

Materials and methods

The research was carried out at the National Animal Production and Research Institute (NAPRI) Shika, Kaduna State, located in the Northern Guinea Savannah zone of Nigeria, at latitude 11°11'N and longitude 07°73'E and 2112 ft above sea level.

The study assessed the haematological and biochemical blood profiles of 97 donkey foals between the ages of 4 and 9 months. The donkeys were all owned and cared for by the Equine and Camel Research Programme of the National Animal Production Research Institute, Shika. All donkey foals were considered apparently healthy at the time of blood sampling. They were sampled between January and June 2018. The study group comprised 34 males and 63 females. They were fed with straw and concentrate, and allowed to graze with adult donkeys in favourable conditions, while water was provided *ad libitum*. None of the donkeys in the institute were working (draft or riding).

Physical examination and blood sampling were done by equine specialist veterinarians. Foals were excluded from the study if any significant physical or clinical abnormalities were noticed. Blood samples were collected via the jugular vein into 5 mL plain and EDTA-containing collection tubes, for serum extraction and haematology respectively. Complete blood count was carried out within 24 hours of sampling, and biochemical profiles at the end of the study. Samples were allowed to coagulate at room temperature and then centrifuged at 2,054 g for 15 minutes; serum harvested was aspirated carefully by a pasture pipette, and transferred into dry, sterile, labelled cryo-tubes and stored at -20°C until required. Direct contact with blood was avoided by the use of gloves and laboratory coats.

Packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell (RBC), mean erythrocyte indices (mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentrations) and white blood cells (WBC) were determined using a Mindray

Auto Hematology Analyzer BC- 2800vet while differential leucocyte (lymphocytes, neutrophils, eosinophils, basophils and monocytes) counts were done using a light microscope (Olympus-XSZ-107BN) under high power magnification with oil immersion after staining the slides with Giemsa stain (ZINKL, 1986).

Once the serum samples were thawed, the concentrations of blood urea nitrogen, creatinine, total protein, albumin, calcium, phosphorus, aspartate amino transferase (AST), alanine amino transferase (ALT) and alkaline phosphatase (ALP)

were determined using an Audiocomb Serum Auto-analyser (Bayer Express Plus, Bayer Germany, Serial Number 15950) in the Chemical Pathology Laboratory of Ahmadu Bello University Teaching Hospital, Zaria, Nigeria.

Descriptive statistics were used to analyse all the data obtained. The Student t-test with Tukey's multiple comparison test was performed using GraphPad Prism Version 5.00 for Windows, GraphPad Software San Diego California USA, www.graphpad.com. Values of $P < 0.05$ were considered significant.

Results

Table 1. Mean (\pm SE) haematological and biochemical parameters of male and female donkey foals in NAPRI, Zaria, showing the influence of sex

Parameters	Male (n = 34)*	Female (n = 63)*
PCV (%)	24.1 \pm 2.86	27.25 \pm 0.97
Hb (g/dL)	8 \pm 0.96	9 \pm 0.33
RBC Count ($\times 10^{12}$ /L)	3.6 \pm 0.22*	4.9 \pm 0.39*
TWBC Count ($\times 10^9$ /L)	8.7 \pm 1.40	9.4 \pm 1.60
MCV (fL)	75 \pm 14	62 \pm 6.30
MCHC (g/dL)	33 \pm 0.06	33 \pm 0.03
MCH (pg)	25 \pm 4.60	21 \pm 2.10
Neutrophils ($\times 10^9$ /L)	3.3 \pm 1.50	3.6 \pm 1.50
Lymphocytes ($\times 10^9$ /L)	3.5 \pm 1.10	4.7 \pm 1.90
Monocytes ($\times 10^9$ /L)	0.51 \pm 0.26	0.3 \pm 0.11
Eosinophils ($\times 10^9$ /L)	0.37 \pm 0.09	0.71 \pm 0.43
Basophils ($\times 10^9$ /L)	0.00 \pm 0.00	0.00 \pm 0.00
Band Cells ($\times 10^9$ /L)	0.3 \pm 0.08	0.33 \pm 0.06
Urea (mg/dL)	4.28 \pm 0.10	5.04 \pm 0.29
Creatinine (mg/dL)	88.1 \pm 1.77	105.11 \pm 5.54
Total Protein (g/L)	61.2 \pm 0.79	66.4 \pm 1.35
Albumin (g/L)	32.2 \pm 0.81	37.3 \pm 1.47
Globulin (g/L)	29.0 \pm 0.65	29.1 \pm 0.92
Calcium (mg/dL)	1.54 \pm 0.19	1.66 \pm 0.23
Phosphorus (mg/dL)	0.73 \pm 0.21	0.88 \pm 0.24
AST (IU/L)	45.7 \pm 1.38	49.78 \pm 2.37
ALT (IU/L)	44.4 \pm 1.86	51.4 \pm 5.05
ALP (IU/L)	105.7 \pm 4.87	109.3 \pm 5.55

*Number of foals in parentheses

Table 2. Mean (\pm SE) haematological and biochemical parameters of donkey foals in NAPRI, Zaria, showing the influence of age

Parameters	4-6 months (n = 46)*	7-9 months (n = 51)*
PCV (%)	27 \pm 1.9	25 \pm 1.3
HB conc.	8.7 \pm 0.61	8.4 \pm 0.45
RBC count ($\times 10^{12}$ /L)	4.6 \pm 0.35	4.2 \pm 0.43
TWBC	9.5 \pm 0.73	8.8 \pm 0.80
MCV	66 \pm 6.2	71 \pm 11
MCHC	33 \pm 0.042	33 \pm 0.025
Neutrophils ($\times 10^9$ /L)	3.7 \pm 0.71	3.4 \pm 0.72
Lymphocytes ($\times 10^9$ /L)	4.8 \pm 0.64	4.31 \pm 1.0
Monocytes ($\times 10^9$ /L)	0.36 \pm 0.11	0.37 \pm 0.14
Eosinophils ($\times 10^9$ /L)	0.40 \pm 0.11	0.45 \pm 0.23
Band Cells ($\times 10^9$ /L)	0.24 \pm 0.063	0.27 \pm 0.081
Urea (mg/dL)	4.6 \pm 0.17	4.3 \pm 0.15
Creatinine (mg/dL)	95 \pm 3.3	95 \pm 2.3
Total Protein (g/L)	64 \pm 0.86	65 \pm 0.74
Albumin (g/L)	34 \pm 0.87	36 \pm 0.89
Globulin (g/L)	30 \pm 0.31	31 \pm 0.61
Calcium (mg/dL)	2.1 \pm 0.033*	2.2 \pm 0.022*
Phosphorus (mg/dL)	1.0 \pm 0.026	0.96 \pm 0.018
AST (IU/L)	46 \pm 1.6	43 \pm 1.2
ALT (IU/L)	49 \pm 1.5	47 \pm 1.0
ALP (IU/L)	94 \pm 2.8	92 \pm 2.7

*Number of foals in parentheses

A total of 97 blood samples of donkey foals within an age range from 4 to 9 months were examined for the study, comprising 34 males and 63 females. All foals used were considered to be apparently healthy. The results for haematological and biochemical profiling, showing the influence of sex and age, are listed in Tables 1 and 2 respectively.

Discussion

The haematological values reported in this article provide information that could be useful for clinical evaluation of donkey foals within the above age range. RBCs and PCV values in our study do not agree with the haematological reference values determined by previous studies for donkeys (GUL et al., 2007; GARBA et al., 2015; SEDLINSKA et al., 2017). This may be due to the much older donkeys (1 to 4 years) used in their studies. Other possible suggestions may be attributed to changes in body fluid balance (HUTTON and HASSAN, 2007) and the rapid development and growth of foals, resulting in haemodilution due to the rapid expansion of plasma volume and reduced total mass of RBCs (MUEGLER et al., 1979). The number of RBCs showed a significant difference ($P<0.05$) in relation to sex, with male foals having higher values, which is not in accordance with the results of GUL et al., (2007). The cause of the higher RBCs in male foals in this study is unknown, but one possibility may be attributed to the rapid growth of the male foals, with increased body size and plasma volume without a concomitant increase in erythropoiesis and red cell mass (ESIEVO et al., 1984). In addition, a non-significant difference was observed in TWBCs and differential leukocytes observed, which were within the reference intervals in agreement with work by GUL et al. (2007), GARBA et al. (2015) and BURDEN et al. (2016). In relation to age, a non-significant difference was obtained in all haematological parameters. However, higher erythrocytic (PCV, RBC and HB conc.) values were seen in 4-6 month old foals in comparison to those 7-9 months old. This finding agrees with ZAKARI et al. (2015), who observed higher erythrocyte values in foals (2-3 months) than in adults and yearling donkeys. The finding also is in agreement with the work of CEBULJ-KADUNC

There were no statistically significant differences ($P<0.05$) between any of the examined parameters, with the exception of red blood cell (RBC) count in relation to sex. A significant difference ($P<0.05$) was observed in serum calcium concentration in relation to the age of the foals.

et al. (2002), who observed that foals have higher RBC and PCV than stallions and mares of the same breed. Lower leukocyte, neutrophil and lymphocyte values observed in older foals may be a result of an age-related decrease in the immune system. This is in accordance with the reports by SATUE et al. (2009) and ZAKARI et al. (2015) in horses and donkeys, respectively.

Serum biochemical parameters showed a non-significant difference in relation to the sex and age of the foals, with the exception of calcium. The higher serum calcium concentration in older foals may be associated with an increase in bone metabolism with age. The mean serum concentrations of creatinine and urea fall within the range obtained by GARBA et al. (2015); BURDEN et al. (2016) and SEDLINSKA et al. (2017). Creatinine concentration depends upon the total body content of creatine, which in turn depends upon dietary intake and muscle mass (AL-BUSADAH and HOMEIDA, 2005). In most mammals, increases in creatinine and urea nitrogen usually parallel each other, and thus the same information can be gained from either value alone. In horses, creatinine tends to be more sensitive than urea nitrogen to glomerular filtration rate, probably because of urea excretion into the alimentary tract (STEVE and MICHEAL, 2008), but both generally help in assessing renal damage in animals and humans (RADOSTITS et al., 1994).

There was no significant difference ($P>0.05$) in the total protein, albumin and globulin concentrations between the foals examined. However, the values obtained for total protein, albumin and globulin were lower than those observed by GARBA et al. (2015) and BURDEN et al. (2016) where older donkeys were used, but they are relatively close to values in pregnant and nursing jennies found by HARVEY et

al. (1994). The possible increase in older donkeys may be due to increasing amounts of globulins (SEDLINSKA et al., 2017), while the decrease in pregnant and nursing donkeys may be due to physiological changes. Consequently, calcium and phosphorus concentrations were approximately half the levels reported by AL SHAFEL et al. (2015), BURDEN et al. (2016) and SELINSKA et al. (2017) even though no significant difference was observed. The low calcium and phosphorus concentrations are probably due to the smaller skeletal system in young animals, since 99% and 85% of calcium and phosphorus are located in the bone matrix (ROSOL and CAPEN, 1997). The AST and ALT concentrations reported were within the range reported for adult donkeys by GARBA et al. (2015) but there was a higher value of ALP, which disagrees with their report. This could probably be due to the known trend of a decrease in ALP activity with age, as reported by ZINKL et al., (1990).

In conclusion, there were no significant differences in serum biochemicals between the sexes in donkey foals. However, a significant difference was observed in RBC count. Data in this study and additional studies with other breeds in other locations will enhance our understanding of the haematological and biochemical parameters in this species, and also serve as reference values for Equine clinicians.

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SAŽETAK

Unatoč socioekonomskoj važnosti koju imaju magarci u Nigeriji, odgovarajuća veterinarska skrb te vrste još je uvijek nedostatna. Istraživanja ove vrste znatno zaostaju za istraživanjima drugih domaćih životinja bez obzira na njihovu istaknutu ulogu u ruralnim i urbanim sredinama. Ovaj je rad proveden kako bi se ustanovili osnovni hematološki i serumski biokemijski pokazatelji klinički zdrave magareće ždrebadi (*Equus asinus*) u Nacionalnom istraživačkom institutu za animalnu proizvodnju Zaria, Nigerija. U istraživanje je uključeno ukupno 97 magareće ždrebadi u dobi od 4 do 9 mjeseci, među kojima je bilo 34 mužjaka i 63 ženke. Uvažavajući spol jedinki, nije bilo znakovite razlike u krvnim pokazateljima osim broja crvenih krvnih stanica ($P < 0,05$). Vrijednosti hematokrita, ukupnih leukocita, ureje, kreatinina, ukupnih proteina, kalcija, fosfora, aspartat-aminotransferaze, alanin-aminotransferaze i alkalne fosfataze bile su veće u ženki. Rezultati ovoga istraživanja te istraživanja drugih pasmina s drugih lokacija omogućit će bolje razumijevanje hematoloških i biokemijskih pokazatelja u ovih vrsta te će također poslužiti kao referentne vrijednosti kliničarima koji se bave kopitarima.

Ključne riječi: osnovne vrijednosti; hematologija; serumska biokemija; magarci; ždrebac; dob; Zaria
