Haematological and Serum biochemical profiles of four Sheep breeds in Nigeria

Kareem-Ibrahim, K. O., Abanikannda. O. T. F., Adeagbo, A. J. and Nzekwe, C. C.
Department of Animal Science, School of Agriculture, Lagos State University, Epe – Lagos
Corresponding author: otfabanikannda@hotmail.com; +234 802 312 8376

Abstract

Examination of blood profile provides opportunity to clinically investigate the presence of several metabolites and other constituents in the body, which constitute important indicators in the diagnosis, prognosis and treatment of livestock diseases. This study was aimed at investigating blood parameters as influenced by breed of sheep. Blood samples of four sheep breeds were analysed. Six animals aged 2 years each comprising Balami, Ouda, Yankasa and West African Dwarf were selected across the four breeds totaling twenty-four samples that were subjected to laboratory analyses for evaluation of eleven haematological and eight serum biochemical parameters. Descriptive statistics of the laboratory data was conducted, and a one-way analysis of variance (ANOVA) to investigate effect of breed on both haematological and serum biochemical parameters using Minitab® Statistical Software was done, with a post hoc test after significant ANOVA, using the Tukey's Honestly Significant Difference for mean separation. The within breed and between breed values obtained in the study lies within the previously reported normal range of values for all the parameters investigated. Breed of sheep was only significant (P<0.05) on two haematological parameters (PCV 38.28% and Neutrophil 30.96%) and two serum biochemical parameters (Total Protein 60.74% and Urea 42.91%), accounting for total variation in the parameters.. The Yankasa breed had higher values than the West African Dwarf on all parameters but was not statistically (P>0.05) different from the Balami and Ouda breeds. The study further corroborated differences in both haematological and serum biochemical parameters as a consequence of differences in breeds of sheep, thereby providing a platform for further comparative studies.

Keywords: *Haematology*, Serum Biochemistry, Nigeria Sheep breeds
Running title: Blood profile differences in four Nigerian breeds of sheep

Profils hématologiques et biochimiques sériques de quatre races ovines au Nigéria

Résumé

L'analyse du profil sanguin offre une possibilité d'investigation clinique de la présence de nombreux métabolites et autres constituants corporels. Ces analyses constituent des indicateurs précieux pour le diagnostic, le pronostic et le traitement des maladies du bétail. La présente étude visait à évaluer l'influence de la race ovine sur les paramètres sanguins. Des échantillons sanguins de quatre races ovines nigérianes (Balami, Ouda, Yankasa et West African Dwarf) ont été analysés. Vingt-quatre animaux âgés de 2 ans chacun ont été sélectionnés (six par race). Ces échantillons ont fait l'objet d'analyses de laboratoire pour l'évaluation de onze paramètres hématologiques et de huit paramètres biochimiques sériques. Une analyse descriptive des données de laboratoire a été réalisée. De plus, une analyse de variance à un facteur (ANOVA) a été effectuée à l'aide du logiciel statistique Minitab® afin d'étudier l'effet de la race sur les paramètres hématologiques et biochimiques sériques. Un test post-hoc avec correction de Tukey a ensuite été appliqué pour comparer les moyennes en cas d'ANOVA significative. Les valeurs intra et interraciales observées dans l'étude se situent dans la plage de valeurs normales précédemment rapportées pour tous les paramètres analysés. L'effet de la race ovine n'était significatif (p<0,05) que pour deux paramètres hématologiques (hématocrite et neutrophiles) et deux paramètres biochimiques sériques (protéines totales et urée). La race Yankasa présentait des valeurs supérieures à la race Naine d'Afrique de l'Ouest pour tous les paramètres, sans toutefois présenter de différence statistiquement significative (p>0,05) par rapport aux races Balami et Ouda. Cette étude

corrobore l'existence de différences dans les paramètres hématologiques et biochimiques sériques en fonction de la race ovine, ouvrant ainsi la voie à des études comparatives ultérieures.

Mots-clés : Hématologie, Biochimie sérique, Races ovines nigérianes

Introduction

Hematological parameters are related to the blood and blood forming organs and are good indicators of the physiological status of animals (Amakiri *et al.*, 2009; Etim *et al.,* 2013; Bezerra *et al.,* 2017). Examination of blood provides opportunity to clinically investigate the presence of several metabolites and other constituents in the body. It therefore plays a vital role in the assessment of physiological, nutritional and pathological status of the animal, and also helps to distinguish animals from normal state or state of stress.

Serum biochemistry is the chemical analysis of serum, which contained many substances including proteins, enzymes, lipids, hormones, etc. Values obtained should be within the acceptable range and deviation from these range of values could indicate potential for disease in the animal. Further evaluation of the test results may offer clues about which organ system is affected, and also the nature and severity of the disorder.

Serum biochemical indices, haematological indices and blood electrolytes are critical physiological indices which have health implications on the diagnosis, prognosis and treatment of livestock diseases especially in animals bred under different management systems (Onasanya *et al.,* 2015). The blood is considered an ideal sample to examine the genetic potential and metabolic status of animals (Babeker and Elmansoury, 2013). Serum biochemical and haematological indices constitute important panels in the diagnosis, prognosis and treatment of livestock diseases via the investigations of myriads of parameters influencing these blood and serum biochemical indices and have been reported to be influenced by age groups of different breeds of sheep (Braun *et al,* 2010; Polizopoulou, 2010; Arfuso *et al.,* 2016). Thus, this study was aimed to evaluate the physiological and health status of the four common different breeds [Balami, Ouda, West African Dwarf (WAD) and Yankasa] of sheep using serum and hematological parameters, and also compare genetic differences in measured parameters among the four breeds.

Materials and Methods

Sampling Sites*:* Blood samples were collected from Epe, Badagry and Ijebu Ode all along latitude 6.35'34.7ºN and Longitude 3.59'55.5ºE, latitude 6.41502ºN and longitude 2.88132ºE and latitude 6.83ºN and longitude 3.9165ºE, respectively.

Experimental Animals: Sheep breeds comprising Yankasa, Ouda, Balami and West African Dwarf were sourced from the three different locations within the humid tropics of Southwest Nigeria. Six age matched animals of same sex were sampled for each of the four breeds investigated.

Experimental Design*:* The study was a balanced Completely Randomized Design (CRD) with breed been the only factor investigated, and equal number of animals per breed.

Sample Collection

Blood samples of 5mL were obtained from the sheep's jugular vein using a 5-mL syringe, following proper restraint and with minimal excitement. The insertion site was sheared using a blade and then swabbed with cotton wool soaked with disinfectant.

As soon as the blood was collected, pressure from the vein was removed and the needle was taken out. Thereafter, 2.5mL of the blood was stored in a universal bottle (without anti-coagulants) and the remaining 2.5ml was stored in an EDTA bottle for serum and biochemical analysis and hematological analysis respectively. The universal bottles were slanted to enable blood coagulation leading to separation of the serum. The blood samples were transported to the laboratory by storing in a cooler filled with ice. There were twenty-four

samples each for serum biochemical and hematological analyses. Each of the bottle was appropriately labelled with the breed and ID of the animals for ease of identification.

Laboratory Analysis

All laboratory analyses for both serum biochemical and haematological analyses followed standard procedures as described by Reece (2009), K**ü**tting *et al.* (2017) and Nafisat *et al*., (2021). Hematological parameters investigated included; Packed Cell Volume (PCV), Haemoglobin (Hb), Red Blood Cell (RBC), White Blood cells (WBC), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC), White Blood Cells (WBC), Lymphocytes, Neutrophils, Basophils, Eosinophils and Monocytes.

Serum biochemical parameters investigated included; Glucose, Total Protein, Urea, Albumin, Globulin, Creatinine, Serum Glutamic Oxaloacetic Transaminase (SGOT) and Serum Glutamic Pyruvic Transaminase (SGPT).

Statistical Analysis

Values obtained from the laboratory analyses were entered on a Microsoft Excel worksheet for further statistical analyses. After an initial data validation and verification, preliminary exploratory plot was conducted to test for normality of the parameters studied using box plot and normal curve. Descriptive statistics was also computed to evaluate the mean and spread of the data within and between breeds. All statistical analyses were conducted using Minitab® (17) Statistical Software.

A one-way analysis of variance using breed as the discriminating factor was conducted on each of the measured variables for both serum biochemistry and haematology. The statistical model describing the ANOVA is given as $Y_{ij} = \mu + \alpha_i + e_{ij}$ where Y_{ij} is the record of the j^{th} sheep of the i^{th} breed (Balami, Yankasa, Ouda or WAD, μ is the common mean; α_i is the effect of the i^{th} breed and e_{ij} is the uncontrolled environmental and genetic deviations attributable to the individual sheep. All effects are random, normal, and independent with expectations equal to zero. Further mean separation was done after a significant ANOVA using the Tukey's honestly significant difference test to separate the means at probability less than 0.05.

Results and Discussion

Comparison of haematological values of Nigerian breeds with reference values

The range for both haematological and serum biochemical values obtained in the study along with the reference (normal) values are presented in Table 1.

For all the parameters investigated, it was observed that values obtained in the study are well within the range of values for normal healthy sheep as presented by Reece (2009). This is an indication that despite differences in age, size, breed, prevailing environment and management procedure adopted in rearing the animals, the values obtained from the four indigenous breeds still indicate that they are within the normal range and thus, can be classified as physiologically fit and normal.

Haematological Parameters

Heamatological parameters are indicators of the animal physiological state and nutritional state. The range of values obtained in this study was within normal range reported earlier in literature which is indicative of the fact that the animals sampled are healthy (Etim *et al.,* 2013; Gorkhali *et al.*, 2017; Nafisat *et al.*, 2021).

Breed alone exerted significant ($P<0.05$) influence on only two [Packed Cell Volume (PCV) and Neutrophils] of the eleven parameters investigated (Table 2), accounting for 38.28 percent and 30.96 percent of the total variation, respectively.

The PCV ranged between 28.70% and 33.60% with a mean of 31.02% (Table 2). The Yankasa had the highest PCV value while the West African Dwarf had the least PCV value. The West African Dwarf breed had significantly ($P<0.05$) lower values compared to the other three breeds (Table 2). It is worthy of note that dispersion of the PCV values within the breeds

varied, with the highest within-breed variation recorded in the Yankasa breed (SD = 1.43) and the least was recorded in Ouda breed (SD = 0.83).

The values obtained on Neutrophil ranged between 32.60 percent and 36.40 percent with a mean of 34.70 percent. The Yankasa breed had the highest value which was significantly ($P<0.05$) different from that of West African Dwarf breed that had the least (Table 3). However, Yankasa had the lowest within-breed variation (SD = 0.75), whereas the highest values were obtained within the Ouda breed (SD = 1.13) for Neutrophil.

Table 1: Range of hematological and serum biochemical parameters of Nigerian sheep against the reference values*

Haematological Parameters	Unit	Balami	Ouda	WAD	Yankasa	Overall	Normal Range*
PCV	(%)	28.7 - 31.7	30.2 - 32.5	28.9 - 31.4	30.2 - 33.6	28.7 - 33.6	27-45
Hb	(g/dL)	9.8 - 12.3	10.3 - 11.8	9.5 - 11.3	10.2 - 12.1	9.5 - 12.3	9-15
RBC	($X10^{12}$/L)	12.4 - 14.9	12.7 - 15.2	12.1 - 14.2	12.7 - 14.2	12.1 - 15.2	9-15
MCHC	(g/dL)	32.7 - 36.2	32.8 - 34.9	31.8 - 34.6	32.6 - 35.8	31.8 - 36.2	31-34
MCH	(*pg*)	7.2 - 9.3	8.3 - 9.7	7.9 - 9.4	7.9 - 9.4	7.2 - 9.7	8-12
WBC	($X10^{9}$/L)	8.3 - 10.4	8.7 - 11.2	8.1 - 10.8	8.1 - 11.4	8.1 - 11.4	4-12
Lymphocyte	(%)	59.7 - 62.9	59.3 - 62.4	58.5 - 62.3	60.3 - 63.9	59.5 - 63.9	40-75
Neutrophil	(%)	33.3 - 35.7	33.4 - 36.3	32.6 - 35.3	34.5 - 36.7	32.6 - 36.4	10-50
Basophil	(%)	0.00 - 0.07	0.00 - 0.03	0.00 - 0.04	0.00 - 0.06	0.00 - 0.07	0-3
Eosinophil	(%)	3.2 - 4.7	3.2 - 4.7	2.9 - 4.6	3.5 - 4.9	2.9 - 4.9	0-10
Monocytes	(%)	1.3 - 3.2	1.3 - 2.7	1.1 - 2.7	1.1 - 3.1	1.1 - 3.2	0-6
Serum Biochemical Parameters							
Glucose	(mg/dL)	49.8 - 53.2	50.5 - 53.4	48.7 - 52.4	50.2 - 53.6	48.7 - 53.6	40-80
Total protein	(g/L)	62.6 - 65.4	61.9 - 64.7	61.6 - 63.7	64.7 - 66.6	61.6 - 66.6	60-75
Urea	(mg/dL)	13.8 - 17.1	13.5 - 15.1	12.7 - 15.3	14.2 - 16.7	12.7 - 17.1	8-20
Albumin	(g/L)	29.4 - 34.2	29.5 - 33.5	28.3 - 34.1	30.4 - 35.3	28.3 - 35.3	32-41
Globulin	(g/L)	32.5 - 35.6	32.3 - 34.8	31.2 - 34.3	31.7 - 34.9	31.2 - 35.6	26-42
Creatinine	(mg/dL)	0.9 - 1.7	0.8 - 1.3	0.7 - 1.4	1.0 - 1.8	0.7 - 1.8	1-2
SGOT	(IU/I)	69.5 - 71.7	69.4 - 72.7	68.2 - 71.7	70.3 - 73.4	68.2 - 73.4	60-280
SGPT	(IU/I)	37.1 - 41.7	38.6 - 41.7	36.5 - 40.5	39.1 - 42.3	36.5 - 42.3	22-48

* = Source: Reece, W.O. (2009)

PCV = Packed Cell Volume; Hb = haemoglobin; RBC = Red Blood Cell; MCH = Mean Corpuscular Haemoglobin; MCHC = Mean Corpuscular Haemoglobin Concentration; WBC = White Blood Cell; WAD = West African Dwarf; SGOT = Serum Glutamic Oxaloacetic Transaminase; SGPT = Serum Glutamic Pyruvic Transaminase

The statistical differences in PCV among the breeds is an indication of the differences in the genetic makeup of the animals. The 6.65 percent superiority of the Yankasa breed in PCV over the West African Dwarf breed indicated the improved physiological state of the Yankasa. It has been established that breed was a significant source of variation in packed cell volume and this study confirm such earlier reports (Gorkhali *et al*., 2017; Nafisat *et al.*, 2021; Atte and Opoola, 2022). Breed alone accounted for over one third of variation in PCV indicating that it is a strong source of influence on that haematological parameter. The progressive decrease in the PCV values from Yankasa to Ouda, Balami and West African Dwarf is concomitant with trend of the mature body weight of the different breeds, since PCV addresses the quality of blood and fitness of an animal by transporting energy, fluids, lymphocytes and other antibodies to the site of infection. It also reflects the adaptability of the Yankasa breed to the humid tropical zone of Nigeria, which is in consonance with submission of Al-Thuwaini (2021) who reported that there is useful information on the association of hematology parameters of sheep with adaptation and reproductive performance, indicating certain breed of sheep are more adapted to certain environments. The mean haematological parameter values obtained in this study agreed with previous reports of Tambuwal *et al*., 2002; Awodi *et al.,* 2005; Cheesbrough, 2005; Agbaye, *et al.,* 2021;) The increase in Hb concentration could be associated with greater ability to resist infection

and low level is an indication of infection and poor nutrition.

Breed of sheep accounted for almost a third (30.96 percent) of the variation in Neutrophil. The value obtained in this study is within the range earlier reported (Etim *et al.,* 2013) for sheep and falls within the normal range. Neutrophil plays a role in stimulating immunity, also in inflammatory processes which allows the animal recognize foreign material, and are involved in the response of the body against parasitic infections. The Yankasa have the highest value among the breeds, and was 5.82 percent higher than West African Dwarf breed, this implies that Yankasa disease resistance level is better than others.

Despite most researchers' (Onasanya *et al.*, 2015; Sarmin *et al.*, 2020; Nafisat *et al.*, 2021) reports of significant effect of breed on the other haematological parameters studied, the result obtained in this study deviated from what has been reported previously on the other nine parameters. However, the result in this study confirms the research of Ghorkhali *et al.*(2017) and Nafisat *et al.* (2021) who worked on Nepalese and Nigerian sheep breeds, respectively, and both groups reported that most of the haematological parameters were not significantly affected by breed. This observation may be adduced to the striking phenotypic similarities between the Nepalese and Nigerian sheep breeds (Ghorkhali *et al.,* 2017; Nafisat *et al.,* 2021).

There were absolute marginal differences in the values obtained from the other nine parameters and the values were not statistically (P>0.05) different due to breed alone (Table 2 and Table 3). Based on the eta-squared from the ANOVA (Table 2), the least impact of breed was recorded in the Monocyte (3.18 percent), while the PCV had the highest eta-squared value.

While the Yankasa breed recorded highest numerical values in PCV, Haemoglobin, Lymphocyte, Neutrophil and Eosinophil, the Ouda recorded highest values in Red Blood Cell (RBC), Mean Corpuscular Haemoglobin (MCH) and White Blood Cell (WBC). The West

African Dwarf breed had the least values in all haematological parameters except for Mean Corpuscular Haemoglobin (MCH), White Blood Cell (WBC), Eosinophil and Monocytes.

Table 2: Analysis of variance of haematological parameters

Source	Df	PCV (%)	Hb (g/dl)	RBC ($X10^{12}$/L)	MCHC (g/dl)	MCH (pg)	WBC ($X10^{9}$/L)	Lym (%)	Neu (%)	Bas (%)	Eos (%)	Mon (%)
Breed	3	4.93*	0.82^{ns}	1.25^{ns}	1.83^{ns}	0.49^{ns}	1.02^{ns}	2.27^{ns}	2.93*	0.00^{ns}	0.13^{ns}	0.09^{ns}
Error	20	1.19	0.57	0.65	1.30	0.38	0.91	1.62	0.98	0.00	0.31	0.41
R-Squared		38.28	17.78	22.46	17.36	16.24	14.37	17.40	30.96	16.38	6.22	3.18

^{ns} = Not significant (P>0.05); * = Significant (P<0.05); ** = Highly significant (P<0.01)

Table 3: Mean ± standard errors of haematological parameters

Haematological Parameters	Unit	Balami	Ouda	WAD	Yankasa	Overall Mean
PCV	(%)	30.47 ± 0.45^{ab}	31.40 ± 0.34^{ab}	30.10 ± 0.37^{b}	32.10 ± 0.58^{a}	31.02±0.26
Hb	(g/dL)	11.13 ± 0.37^{a}	11.00 ± 0.24^{a}	10.38 ± 0.28^{a}	11.18 ± 0.32^{a}	10.93±0.16
RBC	($X10^{12}$/L)	14.00 ± 0.37^{a}	14.23 ± 0.36^{a}	13.25 ± 0.32^{a}	13.47 ± 0.24^{a}	13.74±0.17
MCHC	(g/dL)	34.68 ± 0.59^{a}	33.98 ± 0.35^{a}	33.47 ± 0.42^{a}	34.52 ± 0.47^{a}	34.16±0.24
MCH	(*pg*)	8.28 ± 0.32^{a}	8.98 ± 0.22^{a}	8.67 ± 0.23^{a}	8.60 ± 0.24^{a}	8.63±0.13
WBC	($X10^{9}$/L)	9.41 ± 0.32^{a}	10.37 ± 0.36^{a}	9.78 ± 0.40^{a}	10.12 ± 0.47^{a}	9.92±0.20
Lymphocyte	(%)	61.48 ± 0.49^{a}	61.03 ± 0.43^{a}	60.93 ± 0.56^{a}	62.28 ± 0.59^{a}	61.43±0.27
Neutrophil	(%)	34.47 ± 0.40^{ab}	34.85 ± 0.46^{ab}	33.85 ± 0.43^{b}	35.52 ± 0.31^{a}	34.67±0.23
Basophil	(%)	0.03 ± 0.01^{a}	0.01 ± 0.01^{a}	$0.0\ 1\pm0.01^{a}$	0.02 ± 0.01^{a}	0.02±0.00
Eosinophil	(%)	3.95 ± 0.21^{a}	3.97 ± 0.22^{a}	3.90 ± 0.25^{a}	4.23 ± 0.21^{a}	4.01±0.11
Monocytes	(%)	2.23 ± 0.29^{a}	2.08 ± 0.22^{a}	1.93 ± 0.23^{a}	2.10 ± 0.29^{a}	2.09±0.12

Means with different superscripts within the same row are statistically different (P<0.05)

Serum biochemical parameters

The effect of breed was significant (P<0.05) only on Total Protein and Urea, while there was no significant (P>0.05) difference in the other six parameters (Table 4).

Total protein ranged between 61.60 g/L and 66.60g/L across the four breeds, with a mean of 64.09g/L (Table 5). Breed alone accounted for 60.74 percent of the total variation recorded in total protein, with the Yankasa having the highest total protein value, which was significantly (P<0.05) higher than values recorded by the Ouda and West African Dwarf breeds. The variation within breed for total protein was highest in the Ouda breed (SD = 1.17), while the Yankasa breed had the least within breed variation in total protein of 0.67.

Urea had values between 12.70 mg/dL and 17.10mg/dL across the four breeds, with an overall mean value of 15.00mg/dL (Table 5). The Yankasa breed had highest value for Urea which was only significantly (P<0.05) higher than the value obtained in West African Dwarf. The values for Urea was more homogenous in the Ouda breed with a dispersion of just 0.58 compared to the 1.20 recorded in the Balami breed.

Table 4: Analysis of variance of serum biochemical parameters

Source	Df	Glucose (mg/dL)	Total protein (g/l)	Urea (mg/dL)	Albumin (g/L)	Globumin (g/L)	Creatinine (mg/dL)	SGOT (IU/I)	SGPT (IU/I)
Breed	3	1.14^{ns}	9.71*	4.21*	2.77^{ns}	1.75^{ns}	0.17^{ns}	3.39^{ns}	3.29^{ns}
Error	20	1.54	0.94	0.84	3.24	1.33	0.07	1.22	1.97
R-Squared		10.01	60.74	42.91	11.38	16.48	27.07	29.42	20.06

^{ns} = Not significant (P>0.05); * = Significant (P<0.05); ** = Highly significant (P<0.01)
SGOT = Serum Glutamic Oxaloacetic Transaminase; SGPT = Serum Glutamic Pyruvic Transaminase

Despite the non significance (P>0.05) effect of breed on Glucose, Albumin, Globulin, Creatinine, Serum Glutamic Oxaloacetic Transaminase (SGOT) and Serum Glutamic Pyruvic Transaminase (SGPT), it was observed that Yankasa breed had marginally higher values in all except Globulin, where the Balami breed had the highest value. The West African Dwarf breed had the least values for all serum biochemical parameters except for Albumin where it surpassed the Ouda breed in value. Since monitoring the concentration of biochemical parameters as well as concentrations of hormones in the blood of sheep gives clearer picture of their nutritional status, health and welfare (Antunović *et al.*, 2011), assessment of these parameters in this study provides a platform for the assessment of the status of the different breeds studied.

Mean glucose level obtained in this study across the four indigenous breeds is consistent with the 45.44 percent - 48.87 percent reported by Agbaye *et al.* (2021) who also worked on Nigerian indigenous sheep breeds, which implied that the animals sampled are healthy and their physiological status are normal.

Proteins function to control oncotic pressure, transport substances (hemoglobin, lipids, calcium), and promote inflammation and the complement cascade, whereby a low level of total protein below the normal range value may indicate a problem with the liver or kidney and it may be that protein is neither being absorbed nor well digested. The largest contribution of breed to serum biochemical parameters was recorded in total protein accounting for almost 61 percent of the variation. The Yankasa breed evidently and significantly had higher total protein values compare to the Ouda and West African Dwarf breeds. The 4.77 percent superiority of the Yankasa mean total protein level is indicative of the healthier status of the breed compared to the West African breed. Breed difference has been previously established as a major component accounting for differences in serum biochemical parameters (Gorkhali *et al.*, 2017; Agbaye *et al.,* 2021; Nafisat *et al.*, 2021;Atte and Opoola, 2022;). Values obtained in this study are within the range reported in literature on similar breeds of sheep.

Urea, the other significantly impacted parameter by breed was influenced by breed alone accounting for about 43 percent of the values obtained from the four breeds. It plays a role of counter reabsorption of nitrogen and

carries hormone, vitamins, and enzymes throughout the body it denotes the wellness of animal as related to feeding and nutrition. Pronounced difference in the values obtained further reiterate breed effect on urea. This result agreed with reports of Agbaye *et al.,* 2021 and Nafisat *et al.*, (2021).

Table 5: Mean ± standard errors of serum biochemical parameters

Serum Biochemical Parameters	Unit	Balami	Ouda	WAD	Yankasa	Overall Mean
Glucose	(mg/dL)	51.92±0.50^{a}	52.03±0.41^{a}	51.18±0.18^{a}	52.15±0.55^{a}	51.82±0.25
Total protein	(g/L)	64.37±0.45^{ab}	63.55±0.48^{bc}	62.73±0.35^{c}	65.72±0.28^{a}	64.09±0.30
Urea	(mg/dL)	15.78±0.49^{ab}	14.30±0.24^{ab}	14.25±0.38^{b}	15.73±0.34^{a}	15.00±0.23
Albumin	(g/L)	32.73±0.71^{a}	31.78±0.62^{a}	31.95±0.83^{a}	33.23±0.76^{a}	32.43±0.36
Globulin	(g/L)	34.27±0.46^{a}	33.68±0.42^{a}	32.95±0.50^{a}	33.57±0.50^{a}	33.62±0.24
Creatinine	(mg/dL)	1.27±0.12^{a}	1.05±0.08^{a}	1.03±0.12^{a}	1.38±0.12^{a}	1.18±0.06
SGOT	(IU/I)	70.88±0.33^{a}	71.45±0.49^{a}	70.35±0.51^{a}	72.10±0.45^{a}	71.20±0.25
SGPT	(IU/I)	40.18±0.68^{a}	40.55±0.45^{a}	39.10±0.60^{a}	40.77±0.54	40.15±0.30

Means with different superscripts within the same row are statistically different (P<0.05)
SGOT = Serum Glutamic Oxaloacetic Transaminase; SGPT = Serum Glutamic Pyruvic Transaminase

Though breed did not significantly affect albumin levels in the animals, however since albumin helps keep fluid from leaking out of the blood vessels into other tissues, and also carries hormones, vitamins, and enzymes throughout the body, the values obtained across the different breeds is indicative that the physiological state of the animals was normal. Without enough albumin, fluid could leak out of your blood and build up in your lungs, abdomen (belly), or other parts of your body (Agbaye *et al*., 2021). Despite the numerical differences in the breed mean values, the non significance may be explained by the fairly consistent dispersion of the values within each breed. This observation is in agreement with the report of Agbaye *et al*., (2021).

Globulin, Creatinine, Serum Glutamic Oxaloacetic Transaminase (SGOT) and Serum Glutamic Pyruvic Transaminase (SGPT) were all not impacted by breed. However, the values obtained on each breed was within the normal range reported on indigenous sheep breeds and not too far from the values on other sheep globally (Borjesson, 2000; Jawasreh *et al*., 2009; Bhat *et al.,* 2014; Sitmo, 2014). Creatinine has been reported in sheep to be correlated with more intense muscular activity and muscular mass (Azimzadeh and Javadi, 2020), thus the marginal numerical superiority of both Yankasa and Balami breeds may be due to their body sizes, which portends that the animals are in good physiological state and healthy. The values obtained for SGPT are within the normal range, indicating a healthy status for the animals because it is an enzyme commonly found in cells in the heart and liver and emitted into the bloodstream when the heart and liver become injured.

Conclusions and Recommendations

This is a comparative study of the differences in the haematological and serum biochemical parameters among four Nigerian sheep breeds. The range of values obtained for each of the parameter was consistent with the range of values other researchers had earlier reported, which is indicative of the normal physiological and health status of the animals sampled in the study. There are eleven haematological indices and eight serum biochemical indices investigated, and only two of each of the parameters were significantly (P<0.05) different among the four breeds.

The following can be deduced from the study:

- That the four breeds investigated had values within the range reported for the specie globally, thus indicating the adaptability of the different breeds to the study areas, as a result of their normal health and physiological status.

- That the Yankasa breed significantly outperformed the West African Dwarf breed in packed cell volume and Neutrophil values for the haematological parameters and also for the total protein and urea for the serum biochemical parameters.
- That the indices for Yankasa was not statistically different from those obtained in Balami and Ouda except for total protein where the Balami breed had significantly lower total protein compared to the Yankasa.

Thus, it can be concluded that breed of sheep impacted their haematological and serum biochemical indices and can be further investigated to characterize the breeds.

Acknowledgements

We wish to appreciate Mr. O. O. Afolabi of the Institute of Agricultural Research and Training (IAR&T), Ibadan for his assistance and painstaking analyses of the samples sent to him. We also wish to acknowledge all Final Year Undergraduate Students of the Department of Animal Science, School of Agriculture, Lagos State University that were part of our research team for their diligence and support throughout the course of this work.

References

Agbaye, F. P., Sokunbi, A. O., Onigemo, M. A., Alaba, O., Anjola, O. A. J., Amao, E. A., Timothy, T. 2021. Blood profile of prevalent sheep breeds in Nigeria: A case study of Ikorodu Local Government Area of Lagos State, Nigeria. *Nigerian Journal of Animal Production*, 48(5), 293-299.

Al-Thuwaini, T. 2021. The relationship of hematological parameters with adaptation and reproduction in sheep; A review study. *Iraqi Journal of Veterinary Sciences*, 35 (3): 575-580.

Amakiri, A.O., Owen, O.J. and Jack, D.O. 2009. Effects of refined petroleum product (kerosene) flame and fumes on haematological characteristics of broiler chickens. *Proc of the34th Annual Conf of the Nig. Soc. for Anim Prod., Uyo;* 41-44.

Antunović, Z., Josip, N., Marcela, Š., Mensur, V., Valentina, P., Boro, M. and Mislav, D. 2011. Changes in biochemical and hematological parameters and metabolic hormones in Tsigai ewes blood in the first third of lactation. *Archiv fur Tierzucht*. 54. 10.5194/aab-54-535-2011.

Arfuso, F., Fazio, F., Rizzo, M., Marafioti, S., Zanghì, E., Piccione, G. 2016. Factors affecting the hematological parameters in different goat breeds from Italy. *Annals of Animal Science* 16: 743–757.

Atte, P. O. and Opoola, E. 2022. Seasonal Variation in Haematological and Oxidative Status of West African Dwarf Sheep. *Nigerian Journal of Animal Science and Technology (NJAST)*, 5(3), 80 - 85.

Awodi, S., Ayo, J. O., Atodo, A. D. and Dzende, T. 2005. Some haematological parameters and the erythrocyte osmotic fragility in the laughing dove (Streptopella senegalensis) and the village weaver bird (Ploceus cucullatus). In *Proceedings of the 10th Annual Conference of Animal Science Association of Nigeria* 384-387.

Azimzadeh, K. and Javadi, A. 2020. Serum Biochemistry and Haematology of Iranian Red Sheep (Ovis orientalis gmelini) in Sorkhabad Protected Area, Zanjan, Iran: Comparison with Age and Sex. *Iranian Journal of Veterinary Medicine*, 14(1):77-85.

Babeker, E.A. and Elmansoury, Y.H.A. 2013. Observations concerning haematological profile and certain biochemical in Sudanese desert goat. *Online Journal of Animal and Feed Research*, 3(1): 80 – 86.

Bezerra, L.R., Oliveira, W.D., Silva, T.P., Torreão, J.N., Marques, C.A., Araújo, M.J. and Oliveira, R.L. 2017. Comparative Hematological Analysis Of Morada Nova And Santa Inês ewes in all reproductive

stages. *Pesquisa Veterinária Brasileira*, 37(4):408 – 414.

Bhat, S.A., Mir, M.R., Reshi, A.A., Ahmad, S.B., Husain, I., Bashir, S., and Khan, H.M. 2014. Impact of age and gender on some blood biochemical parameters of apparently healthy small ruminants of sheep and goats in Kashmir valley India. *International Journal of Agricultural Science and Veterinary Medicine*, 2(1): 22-7.

Borjesson, D.L., Christopher, M.M. and Boyce, W.M. 2000 Biochemical and hematologic reference intervals for free-ranging desert bighorn sheep. *Journal of Wildlife Diseases*, 36(2): 294-300.

Braun, J.P., Trumel, C. and Bezille, P. 2010. Clinical biochemistry in sheep: a selected review. *Small Ruminant Research*, 92: 10–18.

Cheesbrough, M. 2005. District Laboratory in Tropical Countries, Part 1. 2nd Edition, *Cambridge University Press, Cambridge*. http://dx.doi.org/10.1017/CBO9780511581304

Etim, N.N., Enyenihi, G.E., Williams, M.E., Udo, M.D. and Offiong, E.E.A. 2013. Haematological parameters: indicator of the physiological status of farm animals. *British Journal of Science*, 10(1): 33-45.

Gorkhali, N.A., Khanal, S., Sapkota, S., Prajapati, M., Shrestha, Y.K. and Khanal, D.R. 2017. Effect of breed and gender on hematological parameters and some serum biochemical profiles of apparently healthy indigenous sheep of Nepal. *Nepalese Veterinary Journal*, 34: 85-94.

Jawasreh, K., Awadeh, F., Bani-lsmail, Z, Al-Rawashed, O. and Al-Majalli, A. 2009. Normal haematology and selected serum biochemical values in different genetic lines of Awassi Ewes in Jordan. *Interna Journal of Veterinary Medicine*, 7(2): 1 – 5.

Kütting, F., Schubert, J., Franklin, J., Bowe, A., Hoffmann, V., Demir, M., Pelc, A., Nierhoff, D., Töx, U. and Steffen, H.M., 2017. Insufficient evidence of benefit regarding mortality due to albumin substitution in HCC-free cirrhotic patients undergoing large volume paracentesis. *Journal of Gastroenterological Hepatology,* 32(2):327-338.

Minitab 17 Statistical Software 2010. [Computer software]. State College, PA: Minitab, Inc. (www.minitab.com)

Nafisat, A., Boyi1, B., Mbap, S. T., Elizabeth, T., Ibrahim, Y., Ja'afar, A. M. and Shuaibu, A. 2021. Effect of breed, sex, age and season on the haematological parameters of sheep in Bauchi State, Nigeria. *Nigerian Journal of Animal Science*, 23 (2): 28-37

Onasanya, G.O., Oke, F.O., Sanni, T.M. and Muhammad, A.I. 2015. Parameters influencing haematological, serum and bio-chemical references in livestock animals under different management systems. *Open Journal of Veterinary Medicine,* 5:181–189

Oramari, R.A.S., Bamerny, A.O. and Zebari, H.M.H. 2014. Factors affecting some hematology and serum biochemical parameters in three indigenous sheep breeds. *Advances in Life Science and Technology* 21:56–63

Polizopoulou, Z.S., 2010. Haematological tests in sheep health management. *Small Ruminant Research* 92: 88–91.

Reece, W.O. 2009. Functional Anatomy and Physiology of Domestic Animals. (4th Edition), *Wiley Blackwell Publishing*, Ames, Iowa, USA Pg 521.

Sarmin, S., Winarsih, S., Hana, A., Astuti, P. and Airin, C.M. 2021. Parameters of blood biochemistry in different physiological status of fat-tailed sheep. *AIP Conference Proceedings* 2353: 030070. https://doi.org/10.1063/5.0052634

Sitmo, M. S. 2014. Effect of gender on some plasma biochemical parameters of sheep from southern Al Jabal Al Akhdar in Libya. *The Journal of American Science*, 10(8), 74-77.

Tambuwal, F.M., Agale, B.M. and Bangana, A. 2002. Haematological and Biochemical

values of apparently healthy Red Sokoto goats. *Proceeding of 27th Annual Conference Nigerian Society of Animal Production (NSAP)*, March, 17-21, 2002, FUTA, Akure, Nigeria. pp. 50-53.

Date received: 13th July, 2023
Date accepted: 3rd July, 2024