

THE EFFECT OF COAT COLOUR AND SEX ON SOME HAEMATOLOGICAL INDICES OF RABBITS RAISED IN THE TROPICS

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ABSTRACT

20 rabbits (10 males and 10 females) were grouped into five using their coat colours (white -WHT, brown -BR, brown/white female-BRN/WHTF, black-BLK and grey -GRY) and body weight (1.1kg and 2.6kg) were used to investigate the effect of coat colour, sex and weight on the Haematological parameters including Packed cell volume-PCV, Haemoglobin-Hb, Twbc, Mcv, MCH, Neutrophils, lymphocytes, monocytes, eosinophils, Nrbcs, basophils, and blood glucose. Blood analyses results showed that coat colour had significant effects ($p < 0.05$) on PCV (%), MCHC, Neutrophils, Lymphocytes and eosinophils. Brown female rabbits had the highest value of 36.6 (%), brown and white female had the highest neutrophil values ($71.00 \pm 8.50\%$), Grey female rabbits recorded highest lymphocytes ($58.0 \pm 8.68\%$), Grey male recorded the highest McHc values (37.00 ± 1.068), and white female rabbit recorded highest eosinophils ($4.00 \pm 0.474\%$). Sex had no significant ($p > 0.05$) effect on the Haematological parameters. Females recorded higher values

Introduction

A modest projection by the United nations have suggested that the global population will increase by 50% from 6.082 billion in the year 2000 to 9.2 billion by 2050, 11.2 billion by 2100 with Africa contributing more than 50% (UNDESA, 2015). This will mean more demand for food and animal protein especially in the developing countries including Nigeria where the current rate of population growth far outweighs food production even though enormous amount of money has been spent on production of conventional protein sources such as beef, chicken, pork, chevron and mutton. This could be due in part to the deliberate refusal to explore the potentials of non-conventional protein sources by stake holders in Nigeria (Orheruata and Ekhoegbe, 2008).

in PCV ($31.8 \pm 1.045\%$), Twbc ($3650 \pm 422.9 \times 10^3/\mu\text{l}$), MCV ($67.2 \pm 1.067\text{fl}$), Lymphocytes ($41.2 \pm 4.26\%$), monocytes ($1.6 \pm 0.221\%$) and eosinophils ($2.70 \pm 0.237\%$) than male rabbits. Males recorded higher values in Hb ($10.92 \pm 0.362\text{g/dl}$), MCH ($23.03 \pm 0.466\text{g/dl}$), Rbcs ($4.807 \pm 0.198 \times 10^6/\mu\text{l}$), platelet ($362.8 \pm 39.2 \times 10^3/\mu\text{l}$), Neutrophils ($60.5 \pm 4.26\%$) and basophils ($0.200 \pm 0.0943\%$) and McHc ($35.41 \pm 0.471\text{g/dl}$) than the female values. Coat colour and sex had no significant effect on the blood glucose level. BRM recorded the highest level of blood glucose with a mean value of $128.9 \pm 18.98\text{g/dl}$ compared to other coat colours. Bucks recorded higher blood glucose level ($111.1 \pm 7.11\text{g/dl}$) than females. The weight of the animals had no significant ($p > 0.05$) effect on the blood parameters. The study concluded that Haematological parameters shows the physiological status of an animal.

Key words: Coat Colour, Sex, Weight, Heamatology, Rabbits.

Thus, the race to search for alternative sources of protein from non-conventional sources such as rabbits to meet up with this ever-increasing population challenges and bridge the gap between population growth and available protein intake is a race against time. In spite of its breeding potentials, rabbit farming in Nigeria and other developing countries in the tropics is faced with myriad of problems (including poorly documented production and management techniques) which have contributed to the underdevelopment of this livestock in most developing countries (McMichael et al., 2007).

Haematology refers to the study of the numbers and morphology of the cellular elements of the blood. According to (James, 2004), blood is a very critical element in the life of all flesh and it is a very useful tool for health assessment, clinical evaluation for survey and diagnostic and prognostic evaluation of various types of diseases in animals (Amel et al., 2006). Haematological studies are of ecological and physical interest in helping to understand the relationship between blood characteristics and the environment (Ovuru and Ekweozo, 2004), and so could be useful in the selection of animals that are genetically resistant to certain diseases and environmental conditions (Mmereole, 2008; Isaac et al., 2013). As reported by Isaac et al. (2013) animals with good blood composition are likely to show good performance. Haematological parameters are those parameters that are related to blood and blood formation (Bamishaiye et al., 2009). Blood parameters including erythrocyte (red blood cells), leucocytes (white blood cells), platelets,

packed cell volume (PCV), mean corpuscular volume (MCV), haemoglobin (HB), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC) change in relation to the physiological status of the animal. The genetic and non-genetic factors affecting the Haematological and biochemical parameters have also been observed (Svoboda *et al.*, 2005). Laboratory tests on blood are vital tools that help detect any deviation from normal in the animal or human body (Moore *et al.*, 2010; Chmurska-Gasowska *et al.*, 2021). In spite of the clinical significance, correct Haematological interpretation and analysis are sometimes difficult because of the many factors that affect blood parameters. The factors that affect the Haematological values/parameters could be as a result of environmental or physical including sex, age, diet, physical activity, management, extreme climatic conditions, genotype, body weight, etc, which may bring about a significant reduction in the average performance of an animal. A lot of work have been carried out on the effect of genetic and non-genetic factors on blood parameters of various livestock such as cattle, goat, chicken by most researchers (Ahamefule *et al.*, 2006; Chineke *et al.*, 2006), only few researches have been carried out on rabbits, making it difficult to easily evaluate the physiological status of the animal for diagnoses of diseases, selection of improved species and criteria of adaptability in order to improve production, hence the study was carried out to determine factors affecting changes in some of the haematological parameters in rabbits.

MATERIALS AND METHODS

Experimental site, animals and design

The experiment was conducted at the Rabbit Unit of the University of Benin Teaching and Research Farm, Benin City, Nigeria (6.3931° N, 5.6195° E). Twenty (20) adult rabbits (5 months old; 10 males and 10 females) were used to carry out the study. Handling and housing of the animals were done in accordance to procedures stated in Orheruata and Ekhoegbe, (2008). The animals were selected based on their body weight, sex, and coat colour. Five coat colours (white, black, brown, brown/white and grey) were used during the selection. The animal's body weight was recorded prior to blood collection.

Data Collection and Analysis

5ml of blood was carefully drawn from the marginal ear veins of the 20 rabbits. This was done using a sterile disposable 5ml needles of 21 gauge and syringes.

3ml of blood was emptied gently into labelled tubes containing K3 EDTA (tripotassium ethylene di-amine tetra-acetic acid) which act as an anti-coagulant for the determination of haematological parameters and genotype testing. The remaining 2ml of the blood sample was emptied gently in the fluoride-oxalate bottle to test for glucose. After collection, the blood samples were immediately sent to the lab for analysis.

Haematological and Biochemical analysis

The Haematological parameters were determined using the Haematology analyzer (EMAC-automatic machine). Packed cell volume (PCV) and Hbc-Haemoglobin concentration was determined using micro-hematocrit centrifuge. The Haemoglobin (Hb) genotype was done using tris-buffer. The tris-buffer has three content (trise- salt, EDTA salt and Boric acid) which was prepared and the cellulose acetate electrophoresis machine was used to determine the genotype of the animals. Glucose was determined or estimated using the method of glucose oxidase (peroxidase, chromogen, glucose oxidase). The reagents were prepared commercially by Randox-company.

Statistical Analysis:

Data collected from the study was analyzed using the GENSTAT procedure for repeated measurement analysis of variance (ANOVA) using software program of Genstat 12th edition (2016). Statistical means of body weights and coat colours were compared using Duncan multiple range test (DMRT), while Least significance difference (LSD) was used for the sex.

Results and Discussion

The average effects of the various factors under investigation on the haematological parameters of rabbits are presented in Tables 1 – 3.

PARA-METERS	WHTF	WHTM	BRF	BRM	BR/WHTF	BR/WHTM	BLCKF	BLCKM	GRYF	GRYM	SEM
PCV%	31.60 _a	30.25 _a	36.60 _b	34.55 _a	29.70 _a	31.35 _a	30.25 _a	31.85 _a	31.20 _a	30.40 _a	±2.37
Hb g/dl	10.40 _a	10.30 _a	12.25 _a	12.20 _a	9.95 _a	10.45 _a	9.95 _a	11.00 _a	10.70 _a	10.65 _a	±0.77
Twbc×10 ⁹ /μl	3450 _a	2800 _a	3850 _a	2600 _a	3550 _a	3700 _a	4850 _a	3050 _a	2550 _a	2350 _a	±109
Mcv	67.60 _a	65.20 _a	65.30 _a	61.10 _a	66.70 _a	64.40 _a	69.25 _a	66.25 _a	67.05 _a	68.30 _a	±2.57
McH	22.15 _a	22.35 _a	21.80 _a	22.40 _a	22.30 _a	22.40 _a	22.85 _a	22.75 _a	23.00 _a	25.35 _a	±1.082

McHc g/dl	33.00abc	34.00abc	33.40ab	36.70bc	33.40abc	34.90abc	32.85a	34.45ab	34.25abc	37.00c	±1.07
Rbcs×10 ⁶ /μl	4.65a	4.63a	5.62a	5.45a	4.45a	4.88a	4.37a	4.81 a	4.65a	4.26a	±0.420
PLT×10 ³ /μl	197.0a	218.0a	204.0a	325.0a	230.0a	368.0a	261.0a	484.0a	208.0a	419.0a	±97.7
Neutrophil	51.0ab	67.0ab	50.0ab	60.5ab	71.0b	54.5ab	62.5ab	70.0b	38.0a	50.5ab	±8.50
Lymphocytes	43.0ab	31.5ab	46.5ab	35.5ab	25.0a	42.0ab	33.5ab	27.0a	58.0b	46.5ab	±8.64
Monocytes	2.00a	1.50a	1.00a	1.50a	1.50a	0.50a	2.00a	1.50a	1.50a	1.00a	±0.59
Eosinophils	4.00b	2.50abc	2.50ab	2.00a	2.50ab	2.00a	2.00a	1.50a	2.50ab	2.00a	±0.47
Basophils	0.00a	0.50a	0.00a	0.50a	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a	±0.22
BLSg/dl	94.5ab	94.4ab	65.4a	128.9b	127.6 b	111.7ab	97.2ab	110.9ab	103.4ab	109.5ab	±14.08

Table 1: Effect of coat Colour on the Haematological parameters in rabbit

PCV= Packed cell volume; Hb= Haemoglobin; TWBCs= Total white blood cells; MCV= Mean corpuscular volume; McHc= Mean corpuscular haemoglobin concentration; RBCs= Red blood cell, BLS=Blood Sugar

WHTF = White female; WHTM = White male; BRF: Brown female; BRM: Brown male; BR/WHTF: Brown and White female; BR/WHTM: Brown and White male; BLCKF: Black female; BLCKM: Black male; GRYF: Grey female; GRYM: Grey Male; SEM: Standard error of means

Table 2: Effect of sex on the Haematological Parameters in the Experimental rabbit

PARAMETERS	Male	Female	±SEM
PCV%	31.87a	31.68a	1.045
Hb g/dl	10.65 ^a	10.92 ^a	0.362
Twbc×10 ³ /μl	3650a	2900a	±4220
Mcv (%)	67.2a	65.05a	±1.067
McHg/dl	22.440a	23.03a	±0.466
McHc g/dl	33.38ab	35.41ab	±0.471
Rbcs×10 ⁶ /μl	4.717a	4.807a	±0.198
PLT×10 ³ /μl	220ab	362.8ab	±39.2
Neutrophil	54.5a	60.5a	±4.26
Lymphocytes	41.2a	36.5a	±4.26
Monocytes	1.6a	1.4a	±0.221
Eosinophils	2.70a	2.00a	±0.237
Basophils	0.000a	0.200a	±0.0943
BLSg/dl	97.6a	111.1a	±7.11

PCV= Packed cell volume; Hb= Haemoglobin; TWBCs= Total white blood cells; MCV= Mean corpuscular volume; McHc= Mean corpuscular haemoglobin concentration; RBCs= Red blood cell, BLS =Blood Sugar

Table 3: Effects of different Body Weight Group on Haematological Parameters

PARAMETERS	WTG1	WTG2	WTG3	WTG4	WTG5	WTG6	WTG7	WTG8	WTG9	WTG10	WTG11	±SEM
PCV%	32.20	28.60	34.47	30.83	32.95	32.50	29.15	31.40	33.30	27.70	32.50	3.69
Hb g/dl	11.40	9.90	11.93	10.40	11.00	11.10	9.60	10.70	11.15	9.30	11.00	1.192
TWBC×10 ³ /μl	2300	2400	3533	2867	4100	3000	5350	3400	3150	1900	1700	141.5
Mcv	64.70	71.90	67.00	64.13	63.05	62.95	67.10	69.85	66.65	67.60	65.50	3.43
MCH	22.90	27.80	23.17	22.27	20.95	22.35	22.05	23.80	22.30	22.70	22.10	0.601
McHc g/dl	35.40	38.60	34.53	34.77	33.25	35.70	32.90	34.05	33.45	33.50	33.80	1.753
Rbcs×10 ⁶ /μl	4.97	3.46	5.16	4.81	5.2	4.97	4.34	4.49	4.99	4.08	4.96	0.621
PLT×10 ³ /μl	418.0	420.0	481.0	283.7	204.0	228.0	278.5	266.0	245.0	282.0	170.0	129.3
Neutrophil	47.0	54.0	61.7	45.7	52.0	56.5	63.0	52.0	73.5	56.0	77.0	14.03
Lymphocytes	51.00	42.00	34.33	50.67	44.00	38.50	35.50	44.00	24.50	37.00	19.00	14.16
Monocytes	0.00	2.00	1.67	1.00	1.50	2.00	2.00	1.50	0.50	2.00	1.00	0.680
Eosinophils	2.00	2.00	2.33	2.00	2.00	2.50	2.50	2.50	2.50	1.50	5.00	0.593
Basophils	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.236
BLSg/dl	113.30	105.67	115.67	109.22	116.93	106.91	96.72	99.82	70.84	118.44	92.73	26.70

WTG1 = 1.1-1.15kg; WTG 2 = 1.2 - 1.25kg; WTG 3 = 1.3 - 1.35kg WTG 4= 1.4 - 1.45kg; WTG 5= 1.5 - 1.55kg, WTG 6 = 2.0 - 2.25kg; WTG 7 = 2.3 - 2.35kg; WTG 8 = 2.4 - 2.45kg; WTG 9 = 2.45 - 2.5kg; W+ TG 10 = 2.55 - 2.6kg; WTG 11 >2.6 Kg

PCV= Packed cell volume; Hb= Haemoglobin; TWBCs= Total white blood cells; MCV= Mean corpuscular volume; McHc= Mean corpuscular haemoglobin concentration; RBCs= Red blood cell, BLS=Blood Sugar

Discussion

Coat Colours

Haematological parameters are good indicators of the physiological status of farm animals (Emit, 2010). Table 1 shows the haematological parameters of rabbits as influenced by their coat colours.

The coat colours of rabbits did not significantly affect the majority of the haematological parameters except for the PCV which was lowest in the in female rabbits with Brown and white (29.70 %) and highest in Brown coloured females

(36.6%) with SEM of ± 2.365 . The values fall within the normal range of PCV in rabbits (30-50%). The McHc (g/dl) was significantly ($p < 0.05$) different between Grey females (37.00), Brown males (36.70) and Black females (32.85) from the other coat colours with SEM of ± 1.068 .

The Neutrophils (%) content was significantly ($p < 0.05$) different between Brown and white females (71.0) and Grey females (38.0) from other coat colours with SEM of ± 8.50 . Neutrophils help to defend the animals against stress and invading pathogens. The normal range of N is within (40-75%). The result revealed that Grey female rabbits have low neutrophils mean values which means they might be easily susceptible to pathogenic and nonpathogenic diseases.

The Lymphocytes (%) values for Grey females (58.0) and Brown and White females (25.0) were significantly ($p > 0.05$) different from the other coat colours of rabbits with SEM of ± 8.68 . Lymphocytes in the blood helps to release antibodies in the body to eliminate threats to the body. The normal range in rabbit is (30-85%). From the results Black males and Brown and White females has low lymphocytes values, which may be as result of the pathogenic infection.

The eosinophils (%) value recorded for White females (4.00) and Brown males (2.00), were significantly ($p < 0.05$) different from other coat colours with SEM of ± 0.474 . The normal range falls within (0-4%). Eosinophils helps to detect parasitic infections in animals. From the result it indicated that rabbits with White coat colours are more susceptible to parasitic infections which might be caused by ecto-parasites such as ticks, which causes mange.

Most of the values obtained from the result were within normal physiological range reported by Ozkan et al. (2012).

Sex

Table 2 shows the relationship between sex the Haematological parameters of rabbits. From the results, sex had no significant effect on the haematological parameters of the rabbit. However, platelets and McHc values were significantly higher in females than in males. These values fall within normal range but they were however higher than values reported by Chmurska-Gąsowska et al. (2021) for pregnant rabbits

Weight Groups

The results for the weight groups are presented in table 3. Weights of rabbits did not significantly ($p > 0.05$) affect the haematology of rabbits. A trend of inverse

relationship between weight and most of the parameters was observed. For example, values of 170 ($10^3/\mu\text{l}$) were observed for WTG11 ($>2.6\text{ Kg}$) and 420($10^3/\mu\text{l}$) for WTG 2 (1.2 - 1.25kg) for platelets and lymphocytes and values of 51 and 19 were obtained for WTG1 (WTG1 = 1.1-1.15kg) and WTG11($>2.6\text{ Kg}$) respectively. Observed values were within normal range reported by Moore et al. (2010), However, lymphocytes values for WTG11($>2.6\text{ Kg}$) (19) was a noticeable deviation from normal, this might indicate a compromise of the immune architecture of heavier rabbits, when other factors are equal.

Conclusion and Recommendation

The study revealed that coat colours significantly affected the haematological parameters of rabbits, which also influenced the physiological status of the animals and their performance. Brown and white female rabbits had better physiological status than rabbits of other coat colours. Blood parameters such as Neutrophils and Eosinophils were affected by coat colour. Sex had no significant effect on the haematological parameters of rabbits, but sex-related differences were recorded for the Hb, McHc, RBCs, platelet, neutrophils, and eosinophils which were higher in males than in females. This was similar in the report by Isaac et al (2013). In the study conducted, brown and white female rabbits provided more information about the physiological status of rabbits based on their Haematological parameters compared to other rabbit coat colours.

Recommendation

Haematological parameters have been proven to provide valuable information on the physiological and immune status of the animal. Since coat colour has been shown to significantly influence the haematology of rabbit, farmers should be encouraged to breed more of mixed coloured rabbits. The influence of coat colour in animals could determine the adaptability and survivability of the animal tropical environment.

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