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**PJBS**

ISSN 1028-8880

**Pakistan  
Journal of Biological Sciences**

**ANSI***net*

Asian Network for Scientific Information  
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

## Haematological Parameters in Rabbit Breeds and Crosses in Humid Tropics

<sup>1</sup>C.A. Chineke, <sup>1</sup>A.G. Ologun and <sup>2</sup>C.O.N. Ikeobi

<sup>1</sup>Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria

<sup>2</sup>Department of Animal Breeding and Genetics, University of Agriculture, Abeokuta, Nigeria

**Abstract:** Blood samples collected on 206 rabbits from breeding experiment conducted at rabbit unit of Teaching and Research, Federal University of Technology, Akure were analysed to study the effects of genotype, sex and age on some haematological values namely Packed Cell Volume (PCV), hemoglobin concentration (HBC), Red Blood Cells (RBC), White Blood Cells (WBC), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC), Mean Corpuscular Volume (MCV) and Erythrocyte Sedimentation Rate (ESR). The 206 rabbits, 59 males and 147 females used in the study comprised 7 genetic groups viz 54 New Zealand white×New Zealand white (NZW×NZW), 65 Chinchilla×Chinchilla (CHA×CHA), 17 Chinchilla×New Zealand white Dutch belted (CHA×NZWDBD), 28 New Zealand white Dutch belted×New Zealand white Dutch belted (NZWDBD×NZWDBD), 14 New Zealand white×New Zealand white Dutch belted (NZW×NZWDBD), 7 New Zealand white Croel×New Zealand white Croel (NZWCRL×NZWCRL) and 11 New Zealand white×Chinchilla (NZW×CHA), were aged 3-4, 5-6, 7-8, 9-10 and 11-12 months and above. The least squares model included main effects of genotype, sex and age as factors among others that contribute to variations in haematological values in rabbits. There was genotype differences ( $p < 0.05$ ) in PCV, WBC, MCH and ESR. Genotype NZW×CHA recorded highest mean values in PCV, HBC and RBC. The haematological variables by sex were not different ( $p > 0.05$ ) except in ESR where females recorded higher significant ( $p < 0.05$ ) mean value than the males. Age effect were obtained ( $p < 0.001$ ) for WBC and ESR and for ( $p < 0.05$ ) HBC, MCH and MCHC. The haematological values reported in this study could be useful for reference in health management of rabbits of different genotypes, sexes and ages in the humid tropics.

**Key words:** Haematology, rabbit, breeds, crosses, tropics

### INTRODUCTION

The life of all flesh is the blood and its usefulness for atonement for human soul (James, 2004), for assessing the health status, clinical evaluation for survey, physiological/pathological conditions and diagnostic and prognostic evaluation of various types of diseases in animals (Taiwo and Anosa, 1995; Awah and Nottidge, 1997, 1998; Nottidge *et al.*, 1999; Kral and Suchy, 2000; Padilla *et al.*, 2000; Tambuwal *et al.*, 2002; Singh *et al.*, 2002; Obasoyo *et al.*, 2005; Alade *et al.*, 2005; Amel *et al.*, 2006) have been reported. The genetic and non-genetic factors affecting biochemical and haematological parameters of animals have also been observed (Kleinbeck and McGlone, 1999; Agaie and Uko, 1998; Svoboda *et al.*, 2005).

The examination of blood provides the opportunity to clinically investigate the presence of several metabolites and other constituents in the body of animals and it plays a vital role in the physiological, nutritional and pathological status of an organism (Aderemi, 2004;

Doyle, 2006). It also helps in distinguishing normal state from state of stress, which can be nutritional, environmental or physical (Aderemi, 2004). Schalm *et al.* (1975) reported that blood pictures of animal might be influenced by certain factors such as nutrition, management, breeds of animals, sex, age, diseases and stress factors. Besides, physiological and environmental factors that might affect blood values as: age of the animal such as estrus cycle, pregnancy and parturition, genetics, method of breeding, breeds of animal, housing, feeding, fasting, extreme climatic conditions, stress, exercise, transport, castration and diseases had been identified (Carlson, 1996; Johnston and Morris, 1996).

The commonly used haematological parameters are erythrocytes (Red Blood Cells, RBC), leucocytes (White Blood Cells, WBC), hemoglobin concentration (HBC), Packed Cell Volume (PCV) and values which include Mean Corpuscular Volume or cell (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) (Carlson, 1996). Specific causes of erythrocytic abnormalities, which might manifest in

chronic blood loss, include bloody diarrhoea, ulcers, bleeding, neoplasm and blood sucking parasites (Johnston and Morris, 1996).

A lot of work has been carried out on the blood parameters of various domestic animals and livestock (Solomon *et al.*, 1998; Kral and Suchy, 2000; Singh *et al.*, 2002; Svoboda *et al.*, 2005; Ahamefule *et al.*, 2006). But there is a dearth of information on the reference haematological values of rabbits in the humid tropics, confirming the fact that the rabbit has received little or no attention in the developing nations. This study was therefore designed to determine the effects of some factors such as genotype, sex and age on haematological parameters of rabbit breeds and crosses in the humid tropics of Nigeria.

## MATERIALS AND METHODS

**Location of study:** The study was conducted (between 1998 and 2001) in the rabbit unit of the Teaching and Research Farm of the Federal University of Technology, Akure, Nigeria. Akure is situated on 350.52 m above sea level at latitude 7°14'N and at longitude 5°14'E. The city falls within the rainforest zone of the humid tropics which is characterized by hot and humid climate. The mean annual rainfall is 1500 mm and the rains period is bimodal with a short break in August. The mean annual relative humidity is 75% and that of temperature is 20°C.

**Animal and their management:** A total of 206 rabbits obtained from a cross breeding experiment conducted at rabbit unit of Teaching and Research Farm, Federal University of Technology, Akure were used in the study. The rabbits, 59 males and 147 females were distributed into 7 genotypes as shown: 54 New Zealand white×New Zealand white (NZW×NZW), 65 Chinchilla×Chinchilla (CHA×CHA), 17 Chinchilla×New Zealand white Dutch belted (CHA×NZWDBD), 28 New Zealand white Dutch belted×New Zealand white Dutch belted (NZWDBD×NZWDBD), 14 New Zealand white×New Zealand white Dutch belted (NZW×NZWDBD), 7 New Zealand white Croel×New Zealand white Croel (NZWCRL×NZWCRL) and 11 New Zealand white×Chinchilla (NZW×CHA). The age range of the rabbits were recorded as 3-4, 5-6, 7-8, 9-10 and 11-12 months and above. The genotypes evolved from mating between 49 does (15 New Zealand white (NZW) and 13 Chinchilla (CHA) purebreds, 11 New Zealand white× Dutch belted (NZWDBD), 10 New Zealand white×Croel (NZWCRL) crossbreds) and 13 bucks (3 NZW and 5 CHA purebreds and 3 NZWDBD and 2 NZWCRL crossbreds). The does were randomly assigned to the bucks for mating early in the morning. The

kits were sexed at 21 days. Litters were weaned at 35 days when each kit was individually ear-tagged and weighed. Litter mates were kept together in the same cage to 56 days of age. Thereafter, the rabbits were separated into individual cages provided with feeding and watering troughs, which were made from tins.

The rabbits were given *ad libitum* access to commercial diet of 15% crude protein and 2300 kcal kg<sup>-1</sup> metabolizable energy in the morning, supplemented with sweet potato leaves and *Aspillia africana* in the evening.

The incidence of diarrhea was combated with antibiotics such as embassin forte<sup>®</sup>. To ensure absence of haemoparasites, internal and external parasites, the animals were treated with *IVOMECE*<sup>®</sup> injection.

**Collection of blood:** About 5 mL blood withdrawn from ear vein of each animal by means of 5 mL sterile needle and syringe was expelled gradually into labeled bijou bottle containing a speck of dried ethyldiamine tetracetic acid (EDTA) powder. The bottles were immediately capped and the contents mixed gently for about a minute by repeated inversion. Blood collected this way was used for the various haematological studies.

**Haematological studies:** The haematological parameters were determined following the methods outlined in Lamb (1981). This is described here briefly. The Packed Cell Volume (PCV) was determined by spinning about 75 UL of each blood sample in heparinized capillary tubes in a hematocrit micro centrifuge for 5 min. The Red Blood Cell (RBC) count and White Blood Cell (WBC) count were estimated using normal saline as the diluting fluid. The hemoglobin concentration (HBC) was estimated using cyanomethemoglobin method while the Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) and the Mean Corpuscular Volume (MCV) were calculated by Lamb, (1981) procedure.

**Analytical procedures:** The effects of genotype, sex and age on the blood parameters were estimated from least-squares procedures of unequal subclass numbers according to the method of Harvey (1999). Where significant differences were observed, differences among means were tested using the Duncan's multiple range procedures outlined in the Harvey (1999).

## RESULTS

Genotype was an important source of variation ( $p < 0.05$ ) for PCV, WBC, MCH and ESR. Age strongly influenced ( $p < 0.001$ ) WBC and ESR. Also age effect ( $p < 0.05$ ) was observed for HBC, MCH and MCHC. The

**Table 1: Mean Squares (MS) for haematological indices**

Source of variation	Weight		Pcv		Hbc		Rbc		Wbc		Mch		Mchc		Mcv		Esr	
	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS	DF	MS	DF	MS
Genotype	6	13967.8	6	32.14*	6	0.25	6	0.17	6	5.15*	6	27.67*	6	46.33	6	131.21	6	5.60**
Age	9	3379413.6***	9	41.71	9	1.35*	9	1.03*	9	26.73***	9	83.35*	9	51.94*	9	214.72	9	6.49***
Sex	1	1337586.7	1	136.12	1	3.33	1	1.77	1	1.09	1	80.15	1	220.98	1	223.56	1	3.01*
Genotype×sex	6	138080.5	6	24.40	6	0.58	6	0.23	6	0.67	6	26.34	6	43.45	6	186.80	6	0.67
Error	183	118678.9	183	25.89	183	1.56	183	0.58	183	2.23	183	41.69	183	27.53	183	244.13	183	1.82

\*p<0.05, \*\*p<0.01, \*\*\*, p<0.001

**Table 2: Least square means for haematological indices**

Variables	No.	Wt (g)	Pcv (%)	Hbc g/100 mL	Rbc 10 <sup>6</sup> um <sup>-3</sup>	Wbc ×10 <sup>6</sup> m <sup>-3</sup>	Mch	Mchc	Mcv	Esr
<b>Genetic Group</b>										
NZW×NZW	54	1711.27±64.74	29.32±1.8 <sup>ab</sup>	8.57±0.43	3.47±0.27	6.76±0.64 <sup>bc</sup>	25.92±2.30 <sup>b</sup>	30.09±1.87	87.32±5.43	2.07±0.45 <sup>b</sup>
CHA×CHA	65	1646.74±68.33	29.69±0.66 <sup>b</sup>	8.78±0.16	3.48±0.11	7.43±0.24 <sup>b</sup>	26.52±0.85 <sup>b</sup>	30.41±0.69	87.11±2.00	2.81±0.17 <sup>b</sup>
CHA×NZWDBD	17	1938.47±118.99	27.82±1.94 <sup>b</sup>	8.75±0.47	3.51±0.18	7.51±0.69 <sup>b</sup>	29.52±2.49 <sup>a</sup>	31.91±2.02	92.21±5.86	3.12±0.47 <sup>b</sup>
NZWDBD×NZWDBD	28	1655.64±96.07	30.46±1.19 <sup>ab</sup>	8.56±0.29	3.24±0.29	7.24±0.42 <sup>bc</sup>	25.35±1.52 <sup>b</sup>	28.59±1.23	89.40±3.59	2.27±0.32 <sup>b</sup>
NZW×NZWDBD	14	1567.67±136.65	29.08±1.7 <sup>ab</sup>	8.47±0.42	3.58±0.26	8.01±0.61 <sup>a</sup>	23.79±2.20 <sup>b</sup>	29.67±1.79	81.87±5.19	2.88±0.42 <sup>b</sup>
NZWCR×NZWCR	17	1335.00±109.03	29.32±1.35 <sup>b</sup>	8.76±0.33	3.55±0.20	8.09±0.48 <sup>a</sup>	24.82±1.72 <sup>b</sup>	30.20±1.40	83.49±4.06	2.37±0.33 <sup>b</sup>
NZW×CHA	11	1344.87±214.79	32.27±1.75 <sup>b</sup>	9.05±0.42	3.69±0.26	6.33±0.62 <sup>c</sup>	24.92±2.34 <sup>b</sup>	28.47±1.80	88.09±5.27	1.18±0.69 <sup>c</sup>
Sex Male	59	1564.41±71.90	30.00±0.95	8.99±0.23	3.61±0.14	7.22±0.34	26.15±1.21	30.74±0.98	84.82±2.85	2.16±0.28 <sup>b</sup>
Female	147	1664.87±43.38	29.56±0.51	8.58±0.12	3.45±0.08	7.28±0.18	25.62±0.65	29.64±0.53	88.35±1.53	2.54±0.13 <sup>b</sup>
Age (months) 3-4	36	1213.03±58.44 <sup>d</sup>	29.19±1.05	9.16±0.25 <sup>a</sup>	3.48±0.15	5.06±0.26 <sup>b</sup>	27.24±1.34 <sup>a</sup>	31.75±1.12 <sup>a</sup>	85.20±3.17	2.86±0.36 <sup>b</sup>
5-6	45	1278.00±59.13 <sup>d</sup>	30.12±1.03	8.88±0.25 <sup>b</sup>	3.49±0.15	7.25±0.26 <sup>a</sup>	26.43±1.32 <sup>a</sup>	30.12±1.10 <sup>a</sup>	87.81±3.11	2.35±0.27 <sup>b</sup>
7-8	58	1596.17±54.86 <sup>c</sup>	30.01±0.93	8.70±0.22 <sup>b</sup>	3.63±0.14	8.05±0.23 <sup>a</sup>	24.46±1.18 <sup>b</sup>	29.58±0.98 <sup>a</sup>	84.26±2.78	2.53±0.22 <sup>b</sup>
9-10	37	2027.03±53.39 <sup>b</sup>	28.43±1.08	8.75±0.26 <sup>b</sup>	3.47±0.16	8.02±0.27 <sup>a</sup>	25.77±1.37 <sup>b</sup>	31.62±1.14 <sup>a</sup>	83.24±3.24	3.16±0.26 <sup>b</sup>
11-12 and above	30	2299.07±52.19 <sup>a</sup>	30.97±1.18	8.64±0.28 <sup>b</sup>	3.54±0.17	7.83±0.29 <sup>b</sup>	26.05±1.50 <sup>a</sup>	28.64±1.25 <sup>b</sup>	91.96±3.55	2.52±0.28 <sup>b</sup>
Overall	206	1639.46±37.22	29.61±0.61	8.69±0.15	3.49±0.09	7.27±0.22	26.05±0.78 <sup>a</sup>	30.04±0.63	87.31±1.83	2.44±0.17

Means with different superscripts in the same column are significantly different (p<0.05, p<0.01, p<0.001)

effect of sex was similar for all the variables except for ESR (p<0.05). The interaction between genotype x sex was not an important of variation (Table 1).

Genotypes differed in mean values for PCV, WBC, MCH and ESR but were similar in HB, RBC, MCHC and MCV. The highest PCV%, HBC and RBC values were recorded for NZW×CHA while the lowest values of the same parameters were observed for CHA×NZWDBD (27.82±1.94%), NZW×NZWDBD (8.47±0.42g/100 mL and CHA×NZWDBD (3.24±0.2910<sup>6</sup> μm<sup>-3</sup>). For MCH, MCHC, MCV and ESR, the highest means were observed for CHA×NZWDBD while the lowest values for the same parameters were obtained for NZW×CHA (28.47±1.80), NZW×NZWDBD (81.87±5.19) and NZW×CHA (1.18±0.69) (Table 2).

The means of the indices by sex were not statistically (p>0.05) different. However, the males were higher in PCV%, HBC, RBC, MCH and MCHC than the females. Females were only higher than males in WBC, MCV and ESR.

The age differed significantly (p<0.05) in mean values for HBC, WBC, MCH, MCHC and ESR but was similar in PCV, RBC and MCV. The highest PCV% (30.97±1.18) was recorded at 11-12 above, HBC (9.16±0.25 g/100 mL) at 3-4 months, RBC (3.63±0.14 10<sup>6</sup> μm<sup>-3</sup>) at 7-8 months; MCH (27.24±1.34), MCHC (31.75±1.12) at 3-4 months; WBC (8.05±0.25 10<sup>6</sup> m<sup>-3</sup>) at 7-8 months; MCV (91.96±3.55) at 11-12 above and ESR (3.16±0.26) at 9-10 months ( Table 2 ).

## DISCUSSION

The range of haematological indices in the rabbits understudy agreed closely as reported elsewhere (Kral and Suchy, 2000; Padilla *et al.*, 2000; Tambuwal *et al.*, 2002; Singh *et al.*, 2002; Schalm *et al.*, 1975; Johnston and Morris, 1996; Solomon *et al.*, 1998). Genotype influence (p<0.05) on PCV, WBC, MCH and ESR was observed. Schalm *et al.* (1975) reported significant breed differences between haematological values of New Zealand White and wild jackrabbits. Generally, haematological studies of various farm animals showed either no significant or significant breed effects (Schalm *et al.*, 1975). The values obtained for PCV were higher than that reported by Solomon *et al.* (1998). Kopp and Hetesa, (2000) reported that high PCV haematocrit reading indicated either an increase in the number of circulating RBC or reduction in circulating plasma volume. Adejumo (2004) reported that haematological traits especial PCV and HB were correlated with the nutritional status of the animal. However, the primary functions of the erythrocyte are to serve as a carrier of hemoglobin. It is thus hemoglobin that reacts with oxygen carried in the blood to form oxyhemoglobin during respiration.

The HBC, RBC, MCHC and MCV values were identical in all the genotypes. This might point to the fact that all the blood samples collected and analysed had similar cellular hemoglobin content. However, MCHC is

very significant in the diagnosis of anaemia and also serves as a useful index of the capacity of bone marrow to produce red blood cells (Awodi *et al.*, 2005).

The non-significant sex effects on the haematological variables were obvious in this study except ESR. This agreed with the study of Schalm *et al.* (1975) which found no sex effect on rabbit and sheep haematology, but contrasted with the sex significant effect reported in dogs (Awah and Nottidge, 1997). Several haematological reports involving farm animals showed no sex effect (Nottidge *et al.*, 1999; Singh *et al.*, 2002).

Age had significant influences on HBC, WBC, MCHC and ESR. Similar age effects had been reported in various animal species (Schalm *et al.*, 1975). In the present study, the haematological variables with age did not follow any particular trend in their variation. In horses, the MCV, MCH and MCHC consistently increased with age but WBC was highest in the youngest group (Schalm *et al.*, 1975).

The ESR with regard to the blood physical properties was low. ESR was believed to be mostly determined by the frictional resistance of the surrounding plasma, which holds the cells in suspensions and the gravitational pull on the erythrocyte. The values obtained in the present study should not be a source of worry since they were very low. Similar sedimentation rates had been reported elsewhere (Fasuyi *et al.*, 2005).

Apart from these factors considered in the study, differences in haematological indices may be caused by nutritional, environmental and hormonal factors. However the results obtained in this study compared closely with reports in available literature. There is still the need to have more reference values of haematological parameters of domestic rabbit in the humid tropics.

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