

## Age and Strain Effect on Some Hematological Characteristics of Broiler Cocks Reared in a Derived Savanna Environment in Nigeria

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**Abstract:** The study evaluated some hematological characteristics of three strains of broiler cocks Anak 2000 (AN); Arbor Acre (AC) and Starbroshaller (ST) reared in a derived savanna environment in Nigeria at pre-pubertal (12 weeks) and at mature (36 weeks) stages of life in a Complete Randomized Block Design experiment. Sixty broiler cocks (20 of each strain) randomly selected from a stock of 120 broilers (40 of each strain) reared from day old on Ladoke Akintola University of Technology (LAUTECH) Teaching and Research (T&R) Farm were weighed and bled for hematological studies at 12 weeks and again at 36 weeks of age. The cocks were reared on commercial broiler starter ration from day old to 4 weeks and on commercial broiler finisher ration from 4 weeks to 12 weeks. They were offered 130.0 g of commercial growers mash per day from 12 up to 36 weeks, with water ad libitum from day old. Hematological studies revealed that all parameters were within the normal range recommended for cocks. However while no strain effect was observed at 12 weeks, all hematological parameters, except neutrophil and lymphocyte differential counts were affected by strain at 36 weeks of age. when Packed Cell Volume (PCV), Total Leucocyte Count (TLC) and Mean Corpuscular Volume (MCV) were significantly ( $p < 0.05$ ) higher in AN than both AC and ST, which did not significantly ( $p > 0.05$ ) differ from each other in PCV and MCV values. TLC was however significantly higher in ST than AC. Rectal temperature at 36 weeks was significantly ( $p < 0.05$ ) higher in AC than ST but not AN, which was equal to ST. Packed Cell Volume PCV was significantly ( $p < 0.05$ ) higher at 36 weeks than at 12 weeks while neutrophil and lymphocyte differential counts were significantly ( $p < 0.05$ ) higher at 12 weeks. Body weight was significantly ( $p < 0.05$ ) higher at 36 than 12 weeks of age. It was concluded that any of the three strains could be selected when preparing a broiler production programme if there is no genuine requirement or available facility for the choice of only one strain.

**Key words:** Age · strain · hematological characteristics · broiler cocks · derived savanna

### INTRODUCTION

Hematological evaluation in poultry represents a valuable aid in the diagnosis of many diseases and determination of the extent to which blood cells have been damaged [1]. Hematological studies become important when dealing with life as the various constituents of blood would change in direct relation to the physiological conditions of health, well being and age of the individual. Hematological parameters are important for monitoring stress responses [2] due to a significant increase in neutrophil proportion relative to lymphocyte, which

attend temporary stress conditions in farm animals [3]. The proportion returns to normal a few hours after, following relaxation or removal of the stress.

Strain and age have been implicated as factors that affect hematological parameters of a given specie [4-6]. According to Ayeni [7] hematological values of the domestic chickens have provided veterinary clinicians with the diagnostic basis for routine management of even the guinea fowl.

According to Jain [8] and Gupta *et al.* [6] Packed Cell Volume (PCV) decreased with age unlike Total Leucocyte Count (TLC), which increased with age.

Fathi *et al.* [9] reported that feed intake and conversion were negatively correlated with rectal temperature, while Galil [10] observed increased sperm motility and general semen improvement by the use of anti-heat stress compounds to lower rectal temperature in chickens.

The bulk of information on hematological values from the temperate countries has been adapted for birds reared in Nigeria, where different commercial poultry strains are regularly imported. However only these hematological figures are available for use in assessing their status. Commercial broilers are generally not reared past the age of 12 weeks on most farms in Nigeria. A new trend in production is now becoming fashionable with a generally increasing awareness in the local farmers, who rear indigenous poultry breeds. They have started to upgrade their local cocks stock. Fast growth trait of broiler breeds are introduced by the use of mature and heavy broiler cocks, as those involved in this study, to mate with their local hens, with the expectation of resultant heavier offspring. The commercial broiler breeding farms, where boiler breeders are reared to mate and produce fertile eggs for hatching, normally keep their birds through the breeding lifespan of not less than one-year laying period. These farms do not generally engage in any hematological studies of these birds at any age. This study was therefore designed to establish some hematological indices for three of the most commonly stocked commercial broiler strains in Nigeria as a means of assessing their health status at such a mature age (36 weeks) compared with their pre-pubertal hematological status (12 weeks). The information would be of use to farmers who need to upgrade local stock for natural brooding and hatching procedure as well as the commercial poultry breeding farms, with commercial incubation and hatching procedures.

## MATERIALS AND METHODS

**Location:** The study was undertaken at the Ladoko Akintola University of Technology Teaching and Research Farm, Ogbomoso, Nigeria. Ogbomoso is located on latitude 8° 07'N and Longitude 4° 15' E with a mean rainfall of 1224.7 mm and relative humidity of between 75 and 95%. Mean annual temperature is 26.2°C [11].

**Experimental procedure:** Sixty broiler cocks, comprising twenty each of Anak 2000 (AN), Arbor Acre (AC) and Starbroshaller (ST) strains were randomly selected from an

initial stock of one hundred and twenty broilers, reared from day old on LAUTECH Farm. Routine poultry management practices including vaccinations were carried out during the rearing period. Feed, in terms of broiler starter mash from day old to 4weeks and broiler finisher mash from 4 to 12 weeks of age along with water were provided ad libitum. From 12 weeks onwards, the birds received 130.0 g of poultry growers mash daily with water ad libitum. The selected birds were each weighed and bled through the wing vein at the pre-pubertal age of 12 weeks and again at the mature age of 36 weeks. The 2 mL blood sample collected from each bird at each time was with a sterile syringe and emptied into a collecting tube containing Ethylene Diamine Tetra Acetic Acid (EDTA). Standard hematological assay procedures according to Dacie and Lewis [12] were employed to determine Packed Cell Volume (PCV), Total Leucocyte count (TLC) as well as neutrophil and lymphocyte differential counts. Additionally at 36 weeks, Red Blood Cell (RBC) count, employed in the estimation of Mean Corpuscular Volume (MCV), was estimated and the rectal temperature was recorded for each bird.

**Data analysis:** Data collected were subjected to analysis of variance (ANOVA) and means, where significant, were separated by Student's t-Test [13].

## RESULTS

Table 1 shows the body weight and hematological characteristics of the three strains of broiler cocks at both the mature age of 36 weeks and at the pre-pubertal age of 12 weeks. Body weight and all the hematological parameters did not differ significantly ( $p>0.05$ ) between the strains at 12 weeks of age. ST strain was significantly ( $p<0.05$ ) heavier than AC strain but not AN strain, which did not significantly ( $p>0.05$ ) differ from AC at 36 weeks of age.

PCV and TLC were significantly ( $p<0.05$ ) higher in AN than AC and ST. TLC but not PCV was significantly higher ( $p<0.05$ ) in ST than AC. The MCV, calculated only at 36weeks of age was significantly ( $p<0.05$ ) higher in AN strain than AC and ST, which did not significantly ( $p>0.05$ ) differ from each other. Rectal temperature was observed to be higher in AC than ST but not AN.

Body weight was significantly ( $p<0.05$ ) higher at 36 weeks than at 12 weeks in the three strains of broiler cocks just as the PCV and TLC values. The mean values observed for lymphocyte differential count and neutrophil /lymphocyte ratio were lower at 36 weeks in all the strains

Table1: Effect of Broiler cocks age and strain on liveweight and some hematological characteristics at 32 and 12 weeks of age

Parameters	36 weeks strain						12 weeks strain						Normal Poultry Range
	AN	AC	ST	Mean	SED	P-value	AN	AC	ST	Mean	SED	P-value	
Live weight (kg)	3.78** (3.6-3.8)	3.50** (3.3-3.6)	3.93* (3.4-4.4)	3.74 <sup>a</sup>	0.16	0.058	2.62' (2.5-2.7)	2.61' (2.2-2.95)	2.60' (2.2-2.9)	2.61 <sup>a</sup>	1.15	0.99	
PCV (%)	44.20* (41-41)	38.00** (35-41)	37.60** (35-41)	39.93 <sup>a</sup>	1.86	0.007	34.40* (33-35)	32.80* (30-35)	34.60* (33-37)	33.93 <sup>a</sup>	1.02	0.20	24.9-45.2**
RBC	4.18 (3.55-4.81)	3.89 (3.26-4.82)	3.78 (3.48-4.81)	3.95	0.27	0.344	-	-	-	-	-	-	-
TLC (X10 <sup>3</sup> /mm <sup>3</sup> )	24.9** (23.6-26.2)	16.30** (14.4-18.1)	19.80 <sup>b</sup> (16.8-22.7)	20.32	1.94	0.001	20.40* (16.5-25.7)	20.4* (13-37.5)	21.4 (15-27)	20.72	2.55	0.88	9.2-31.0**
MCV (fl)	105.74 <sup>a</sup> (41.2-41.4)	97.69 <sup>b</sup>	99.47 <sup>b</sup>	-	-	-	-	-	-	-	-	-	90.140***
Neutrophil (%)	3.40* (2.9-3.8)	3.40* (2.8-3.8)	3.80* (3.3-4.2)	3.53 <sup>a</sup>	0.61	0.76	4.40* (3-5)	4.60* (4-5)	4.60 (4-5)	4.53 <sup>a</sup>	0.43	0.87	2.23-9.76**
Lymphocyte (%)	9.20 (8.4-9.6)	9.00 (8.3-9.2)	9.20 (8.6-9.3)	9.13 <sup>a</sup>	0.81	0.96	10.40 (10-11)	10.00 (9-11)	10.20 (10-11)	10.20 <sup>a</sup>	0.37	0.56	5.45-18.40*
Neutrophil/Lymphocyte	0.37 (0.33-0.4)	0.38 (0.36-0.41)	0.41 (0.38-0.44)	-	-	-	0.42	0.46	0.45	-	-	-	0.4****
Rectal Temperature (°C)	41.30 <sup>a</sup> (41.2-41.4)	41.50 <sup>a</sup> (41.1-41.2)	41.18**	41.33	0.1	0.03	-	-	-	-	-	-	-
N	20	20	20	-	-	-	20	20	20	-	-	-	-

\*\* Denote significant difference (p<0.05) among different strains in a particular parameter in each age  
 \* Indicates that a particular parameter differs significantly (p<0.05) in the same strain between the ages.  
 ( ) Data in parenthesis denotes the range of values for each parameter  
 n Denotes the number of cocks involved  
 Pq Denotes significant difference (p<0.05) between means of parameters between the ages.

Table 2: Effect of strain irrespective of age on liveweight and hematological characteristics of broilers cocks reared in Ogbomoso, Nigeria

Parameters	Overall mean	Strain			SED	P-value
		AN	AC	ST		
Live weight (kg)	3.17	3.20 <sup>b</sup>	3.06 <sup>b</sup>	3.27 <sup>a</sup>	0.16	0.001
PCV (mL %)	36.93	39.30 <sup>a</sup>	35.40 <sup>b</sup>	36.10 <sup>b</sup>	1.73	0.001
TLC (X10 <sup>3</sup> /mm <sup>3</sup> )	20518	22630 <sup>a</sup>	18315 <sup>a</sup>	20609 <sup>a</sup>	2.25	0.040
Neutrophil (%)	4.03	3.90	4.00	4.20	2.61	0.700
Lymphocyte (x10 <sup>3</sup> /mm <sup>3</sup> )	9.67	9.80	9.50	9.70	0.60	0.700
Rectal Temp. (°C)	41.33	41.30 <sup>b</sup>	41.50 <sup>a</sup>	41.18 <sup>b</sup>	0.10	0.030
RBC	3.95	4.18	105.74	3.89	97.69	3.780
MCV (fl)	-	99.47	0.27	0.30	-	-

<sup>b</sup> Mean elements on same row with different superscript differ significantly (p<0.05)

which also paraded significantly (p<0.05) lower neutrophil differential counts at this age than at 12 weeks.

Table 2 shows the effect of strain, irrespective of age on the body weight and hematological parameters studied. ST strain was significantly (p<0.05) heavier than AC but not AN, which did not significantly (p>0.05) differ from AC. PCV was significantly (p<0.05) higher in AN than AC and ST while AC has significantly (p<0.05) lower value in TLC than AN and ST.

Table 3 shows mean square effect of strain and age on live weight and some hematological characteristics in broiler cocks.

**DISCUSSION**

The significantly higher body weight of the three strains of broiler cocks at 36 weeks of age can be explained by the fact that the skeletal size, which is the most important factor controlling body weight [14] does not stop increasing until the epiphyseal cartilage, which provides for linear growth, is used up at the late adolescent period [15]. This period in the cock is much later than 12 weeks from hatching. There is also the effect of Testosterone from the leydig cells in the testis, which is stimulated by luteinizing hormone (the usual

Table 3: Mean squares effect of strain age and strain age on liveweight and some hematological characteristics of broiler cocks reared at Ogbomosho, Nigeria

Parameters	Source of variation	Df	Mean square
Liveweight	Strain	2	0.11558333
	Age	1	9.52033333**
	Strain x Age	2	0.12308333
PCV	Strain	2	43.23333330*
	Age	1	270.00**
	Strain x Age	2	30.100*
Rectal Temp.	Strain	2	0.13066667
	Age	1	0.0
	Strain x Age	2	0.0
RBC	Strain	2	43.23333330*
	Age	0	0
	Strain x Age	0	0
WBC	Strain	2	46610170.00*
	Age	1	1176120.00
	Strain + Age	2	49629670.00*
Neutrophil	Strain	2	0.23333333
	Age	1	7.50*
	Strain + Age	2	0.10
Lymphocyte	Strain	2	0.23333333
	Age	1	8.53333333
	Strain + Age	2	0.03333333

\*\* Means on same row with different superscripts differ significantly ( $p < 0.05$ )

\* Significant at  $p < 0.05$ , \*\* Significant at  $p < 0.01$

measure of gonadotrophin secretion in poultry). Testosterone promotes protein anabolism, resulting in increased body size and it is responsible for an enormous burst of growth hormone, which leads to the growth spurt at puberty. As the bodyweight increases, the concentration of LH increases to a maximum after sexual maturity is attained in the male [15-17]. Since puberty is attained between 16 and 24 weeks in broiler breeders [18], body weight at 12 weeks is expected to be lower as this age is in the prepubertal phase of development of the birds. The significantly higher body weight observed in ST strain over AC and its marginally higher value over AN indicates the likelihood of its better response to the androgenic secretions as well as the efficiency of its bone development.

The significantly ( $p < 0.05$ ) higher PCV value observed in AN strain is higher than the standard mean value of 35.6 mL % although it falls within the standard range of 26.0-45.2 mL % [19], while the other strains have closer values to the standard mean. When this observation is viewed with the marginally higher value of RBC in AN strain, which is higher than the upper limit of the standard range over the other two strains, it would suggest a

more efficient erythropoiesis in the AN strain. The significant differences between the strains in PCV and TLC but not RBC agrees with the fact that hematological parameters, except RBC are affected by breed [4, 5]. The observations however run counter to the observations that there was no strain difference in hematological parameters of poultry layers [20].

That the significantly ( $p < 0.05$ ) higher TLC in AN strain, which though higher than the standard mean value for the normal cocks falls within the recommended range implies that the AN strain appears better poised to protect itself against any impending pathogens [19]. The non-significant difference between the strains in differential lymphocyte and neutrophil counts is an indication of the relatively similar ability of the three strains to provide defense in the event of attack from invading pathogens according to their TLC. The significantly ( $p < 0.05$ ) higher PCV observed in the cocks at 36 weeks than at 12 weeks of age is in line with the report of Jain [8]. Mitruka and Rawnsley [19] had reported that adult males have higher erythrocyte counts since PCV is a direct measure of RBC. This is logical as RBC contains the hemoglobin, which is responsible for the transportation of oxygen from the lungs to the body parts. Older birds generally undergo higher metabolic processes and hence the need for more oxygen by the birds at an older age as in this study. The significantly higher differential neutrophil and lymphocyte counts at 12 weeks of age in the cocks are contrary to the report of Awotwi [20] in layers, where the pattern of distribution did not differ by age. That the TLC was generally only marginally higher in the younger birds agree with the reports of Jain [8]; Diner and Houbenov [21] and Awotwi [20]. This can be explained by the greater need for protection and fortification against invasion by pathogens at the younger age than at mature age, when there would have been greater physiological and pathological adaptation to the environment. Neutrophils fight disease by migrating to the point of infection, engulfing the bacteria and destroying them while lymphocytes fight diseases by producing and releasing antibodies when infections occur [3]. The non significant difference between strain and between age in neutrophil/lymphocyte ratio and the fact the ratios were within the standard limit [22], both indicate the fact that the experimental birds were not under any stress condition, making the above findings to be credible and possibly repeatable. The significantly lower rectal temperature in the ST strain is an indication that the strain could be superior to the other two in feed conversion [9] and sperm production characteristics [10].

## CONCLUSIONS

The significantly higher bodyweight, the normal level of WBC, RBC and PCV as well as lower rectal temperature of ST strain are characteristics that make ST a likely preferable strain of choice followed by AN in the event of a genuine need and available facility for the choice of only one strain especially for broiler breeding programme. However, the fact that all the hematological parameters fall within the standard range recommended for cocks, lends credence to the conclusion that any of the three strains could be selected when preparing a commercial broiler rearing programme with the understanding of the result in this study.

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