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Effect of Age, Sex and Management System on Some Haematological Parameters of Intensively and Semi-Intensively Kept Chicken in Mubi, Adamawa State, Nigeria

Research Article

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ABSTRACT

The study was designed to investigate the haematological parameters of intensively and semi-intensively kept chicken. 60 males and 60 females chickens were randomly selected from farmers in the area of study. Age of birds were ascertained from farmers and blood samples (one including anticoagulant; one whole blood) collected through wing venepuncture. Significant (P<0.001) age group effect was observed on packed cell volume (PCV), red blood cell (RBC) and white blood cell (WBC). The 150 d age group recorded the highest (P<0.001) PCV value (28.74±1.07%). Higher (P<0.001) RBC value (273.70±214 mm) was observed for age group 90 d. For WBC, the 90 d age group had the highest (P<0.001) effect (245.40±5.21 mm^3) and 150 d (229.16±7.40 mm^3) respectively while 60 d (155.30±5.21 mm^3) and 104 d (154.90±5.21 mm^3) had the least (P<0.001) respectively. A significant (P<0.001) sex effect was observed with males having higher (P<0.001) values on PCV (27.05±0.44%) and RBC (271.12±1.24 mm), and females recording higher (P<0.001) (214.20±3.01 mm^3) values on WBC. There was a significant (P<0.01) effect related to the management system evident for PCV indicating a higher (P<0.01) (25.14±0.57%) effect on semi-intensively kept chicken. A significant (P<0.001) age group effect was also observed for mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular volume (MCV). Significant (P<0.001) sex effect was evident with females having highest (P<0.001) value on MCHC (17.84±0.26 g/dL) while males had higher (P<0.001) MCV (0.10±1.31 x 10^{15} fl). A significant (P<0.01) management system effect was also observed on MCHC indicating higher (P<0.01) value (17.52±0.30 g/dL) on intensively kept chicken. A similar significant (P<0.001) management system effect was observed for MCV (0.10±1.63 x 10^{15} fl) for semi-intensively kept chicken recording higher values. A significant (P<0.01) age effect was evident for power of hydrogen (P^H) with the highest value recorded for 150 d (7.91±0.12) and 60 d had least value (7.31±0.09). A significant (P<0.001) sex effect was observed on P^H with males having higher (P<0.01) value (7.72±0.05) and on haemoglobin concentration (Hbc) (42.40±0.60 g/dL) respectively. Generally, blood parameter values increase with age in birds while males had higher values than females.

KEY WORDS age, chicken, haematology, intensively, semi-intensively, sex.

INTRODUCTION

Haematological parameters have been reported to provide valuable information on the immune status of the animal (Kral and Sachy, 2000). Blood profiles can be used as a diagnostic tool to assess the health status of an individual and / or a flock (Tras *et al.* 2000). Haematological changes are routinely used to determine various influences of envi-

ronmental, nutritional and / or pathological factors (Garacyk *et al.* 2003). Avian blood differs in cell characteristics from their mammalian counterparts (Smith *et al.* 2000).

Several factors including physiological (Alodan and Mashaly, 1999), environmental condition (Vecerek *et al.* 2002; Garacyk *et al.* 2003), dietary contents (Odunsi *et al.* 1999; Yeong 1999; Kurtoglu *et al.* 2005; Iheukwumere and Herbert, 2002), fasting (Lamosova *et al.* 2004), age (Forlan *et al.* 1999; Seiser *et al.* 2000), administration of drugs (Khan *et al.* 1994), anti-aflatoxin treatment (Oguz *et al.* 2002) and continuous supplementation of vitamins (Tras *et al.* 2000) affect the blood profile of healthy birds. Swenson (1970) also observed that factors such as age, nutrition, health of animal, degree of physical activity, sex and environmental factors affect blood values of animals. To combat disease of clinical and sub-clinical forms of poultry, accurate and differential diagnosis of the disease at early stages of infection is necessary (Mushi *et al.* 1999).

The indigenous chicken (*Gallus domesticus)* is a domesticated fowl and globally spread with a world wide population of more than 24 billion in 2003). Humans keep chickens primarily as a source of food, consuming both their meat and eggs (Perrins *et al.* 2003). Approximately 80 percent of poultry in Africa are raised in rural areas where they contribute substantially to egg and meat production (Sonaiya, 1997). Indigenous chickens' worldwide take a long time to attain maturity and lay fewer clutches of eggs per year compared to modern breeds (Safalaoh, 1997).

Genetic development for rapid growth together with intensive husbandry condition may be linked to increased numbers of outbreaks of avian diseases (Suchy, 2000). A number of major genes or gene complexes have been identified in the genome of the Nigeria local chicken population (Peters *et al.* 2002) which might likely be associated to various characteristics as described by Hernandez *et al.* (2002), among the genes are the feather distribution (naked neck), feather structure (frizzle), short shank (dwarf) and normal shank, which are to ameliorate tropical heat stress and enhance the performance of individual possessing the genes. There is limited information concerning the normal blood profiles of different indigenous chickens of varying age and for husbandry regimens in Nigeria (Mushi *et al.* 1999). Such information apart from being useful for diagnostic and management purposes could equally be incorporated into breeding programmes for genetic improvement of indigenous chickens (Kral and Sachy, 2000).

MATERIALS AND METHODS

One hundred and twenty chickens (60 males and 60 females) of different age groups were randomly selected from intensively and semi-intensively management systems in Mubi (Latitude 10˚ 15'N and Longitude 13˚ 16'E of Greenwich Meridian of Adamawa State of Nigeria) as described by Adebayo and Tukur, (1999).

Blood collection

Blood was collected aseptically with a sterile syringe and needle (23 gauge) from the wing vein of different groups of birds depending on age randomly. Before blood collection, the intensively kept chickens were fasted overnight for 12 hours and were bled the next morning to avoid excessive bleeding and severe stress. Two millilitres of blood was collected through the wing vein from each bird, and was dispensed into clean bijou bottles containing anticoagulant EDTA (ethylene diamine tetracetic acid). The anticoagulated blood was used to determine: red blood cell (RBC), white blood cell (WBC) count, packet cell volume (PVC), haemoglobin (Hb) concentration and power of hydrogen (pH) out of which values, mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were calculated.

Experimental procedures

Red and white blood cells were counted using the neubauer counting chamber (Brown, 1976), PCV by the microhaematocrit (Coles, 1974), Hb concentration by the haemometer sahlin method and pH by the pH meter (Janway Model). The values of MCV, MCH and MCHC were determined as described by Swenson (1970).

Statistical analysis

Collected data were subjected to analysis of variance (ANOVA) as described by Steel and Torries (1990). Duncan multiple range test was used to separate means. Differences between treatments were declared at $P<0.05$.

RESULTS AND DISCUSSION

Table 1 shows the means ±SEM (standard error of the mean) of PCV, RBC and WBC in relation to age, sex and management system of chicken. Significant ($P<0.001$) age group effects were observed for PCV where 150 days had the highest value (28.74±1.07%) followed by 120 days (26.60±0.62%) then 90 days (25.50±0.76%). Days 74 and 104 age groups had similar values (22.30±0.76%) and (21.20±0.76%) respectively while 60 days had the least value (18.60±0.76%). A significant ($P<0.001$) sex effect was observed for PCV with males having the higher value (27.05±0.44%) than the females (20.57±0.44%). Significant ($P<0.01$) effects were observed for the management system on PCV, with semi-intensively kept chickens recording

higher values (25.14±0.57%) than the intensively kept chickens (22.12±0.57%).

Significant (P<0.001) age effects were observed for RBC with 90 day chickens producing the highest value (273.70±2.14 mm) followed by similar values for age groups 150 day (262.20±3.03 mm) and 74 days (258.90±2.14 mm) and 150 days with similar records and respectively then 60 (249.90±2.14 mm) and 120 days (250.80±1.75 mm) with 104 days reporting the lowest value (220.50±2.14 mm).

A significant (P<0.001) sex effect was observed for RBC with males recording higher value (271.12±1.24 mm) than females (234.20±1.24 mm). Again a significant (P<0.001) management system effect for RBC was observed indicating intensively kept chickens present with higher values (260.82±2.13 mm) than semi-intensively kept chickens (242.60±2.13 mm). Significant (P<0.001) age effects for WBC were observed within 90 day (245.40±5.21 mm^3) and 150 day (229.16±7.40 mm^3) groups produced the highest similar records followed by similar records at 120 days (211.70±4.40 mm^3) and 74 days (201.40±5.21 mm^3) while 60 days (155.30±5.21 mm^3) and 104 days (154.90±5.21 mm^3) also recorded similar values. A significant (P<0.001) sex effect was observed for WBC with females reporting a higher value (214.20±3.01 mm^3) than the males (185.10±3.01 mm^3). No significant management system effect was found for WBC. Table 2 shows the means ±SEM of MCH, MCHC and MCV in relation to age, sex and management system of chicken. No significant differences were observed for age, sex and management system of MCH of chicken studied. A significant (P<0.001) age effect was observed for MCHC within the 60 day group producing the highest value (19.14±0.45 g/dL), followed by days 74 and 104 (17.24±0.45 *g*/dL) and (17.38±0.45 g/dL) respectively then 90 days (16.17±0.45 g/dL) followed by 120 days (15.39±0.37 g/dL) and 150 days recording the lowest value (14.00±0.64 g/dL). Significant (P<0.001) sex effects were observed for MCHC with females producing higher values (17.84±0.26 g/dL) than the males (15.27±0.26 g/dL). A significant (P<0.01) effect was observed for the management system of MCHC identifying that intensively kept chickens produced higher values (17.52±0.30 g/dL) than the semi - intensively kept chickens (15.82±0.30 g/dL).

Significant (P<0.001) age effects were evident for MCV with the 150 day group producing the highest values (0.11±3.22x10^{15} f1) followed by days 120 (0.10±1.90x10^{15} fl) then 90 days (0.09±2.30x10^{15} f1) and 104 days (0.09±2.30 10^{15} f1) having the same value each, followed by 74 days (0.08±2.30x10^{15} f1) and 60 days reporting the least value of (0.07±2.30x10^{15} f1).

A significant (P<0.001) sex effect was observed for MCV with males producing higher (0.10±1.31x10^{15} f1) values than females (0.80±1.31x10^{15} f1). Again a significant (P<0.001) management system effect was observed for MCV with semi-intensively kept chickens recording higher values (0.10±1.63x10^{15} fl) than the intensively kept chickens (0.08±1.63x10^{15} f1).

Table 3 reports the means ±SEM of pH and Hbc in relation to age, sex and management system of chicken. Significant (P<0.0l) age effects were observed onfor pH where the 150 day group (7.91±0.12) had the highest value, followed by 90 days (7.82±0.09), and 120 days (7.73±0.07), 74 days (7.62±0.09) and 104 days (7.61±0.09) had similar records and 60 days (7.31±0.09) recorded the lowest value. A significant (P<0.001) sex effect was observed for pH with males having higher value (7.72±0.05) than the females (7.46±0.05). No significant management system effects were observed on pH for the chickens studied.

Significant (P<0.001) age effects were observed for Hbc within the 150 day chickens (43.24±0.40 g/dL) recording the highest value, 120 days (41.70±0.81 g/dL) and 90 days (41.10±0.10 g/dL) having similar records and followed by 74 days (38.10±0.10 g/dL), 60 days (36.10±0.10 g/dL) having similar records and 104 days (34.20±0.10 g/dL) with the least values. A significant (P<0.001) sex effect was observed with males reporting higher values (42.40±0.60 g/dL) than the females (35.71±0.60 g/dL). The management system produced no significant difference in relation to Hbc.

The significant sex effect on PCV recorded in this researchwas in agreement with the findings of Christie (1979) who observed that as photoperiod lengths increases sexually matured males have high PCV value compared to young chickens. A significant effect of sex on RBC was recorded in this research with males having higher value than females.

These results are consistent with the findings of Akunyiba and Orji (1987) who reported higher values in males than the females. This might be due to inherent sex differences and also associated with advancement of age. Reported lower erythrocyte counts at younger ages which increased in relation to the advancement of age up to 12 months.

There was a significant difference between sex in the mean value of WBC, with females having the higher value than the males which was in agreement with the findings of Okeke *et al.* (1987) who reported significant difference in total leucocytes count on the sex of birds with females showing higher values than the males which alone accounted for over 85% of the WBC and it increases with increase in age. According reported on the total number of WBC and lymphocytes together with absolute count monocytes, eosinophils and basophils where there was a significant increase with an increase in age.

Table 1 Mean±SEM by PCV, RBC and WBC on age, sex and management system of chicken

Source of variation	N	PCV (%)	RBC (mm)	WBC (mm^3)
Age (d)		***	***	****
60	20	18.60±0.76^{d}	249.90±2.14^{c}	155.30±5.21^{c}
74	20	22.30±0.76^{c}	258.90±2.14^{b}	201.40±5.21^{b}
90	20	25.50±0.76^{b}	273.70±2.14^{a}	245.40±5.21^{a}
104	20	21.20±0.76^{c}	220.50±2.14^{d}	154.90±5.21^{a}
120	30	26.60±0.62^{ab}	250.80±1.75^{c}	211.70±4.30^{b}
150	10	28.74±1.07^{a}	262.20±3.03^{b}	229.16±7.40^{a}
Sex:		***	***	***
Female	60	20.57±0.44^{b}	234.20±1.24^{b}	214.20±3.01^{a}
Male	60	27.05±0.44^{a}	271.12±1.24^{a}	185.10±3.01^{b}
Management system:		**	***	NS
Intensive	60	22.12±0.57^{b}	260.82±2.13^{a}	200.70±5.30^{a}
Semi-intensive	60	25.15±0.57^{a}	242.60±2.13^{b}	195.70±5.30^{a}

N: number of observation; PCV: pack cell volume; RBC: red blood cell; WBC: white blood cell; NS: non significant; SEM: standard error of the mean.
*: P<0.05; **: P<0.01; ***: P<0.001.
The means within the same row with at least one common letter, do not have significant difference.

Table 2 Mean±SEM by MCH, MCHC and MCV on age, sex and management system of chicken

Source of variation	N	MCH (pg)	MCHC (g/dL)	MCV x 10^{15}fl
Age (d)		NS	***	***
60	20	0.98±0.50^{a}	19.14±0.45^{a}	0.07±2.30^{e}
74	20	0.13±0.50^{a}	17.24±0.45^{b}	0.08±2.30^{d}
90	20	1.03±0.50^{a}	16.17±0.45^{bc}	0.09±2.30^{c}
104	20	0.15±0.50^{a}	17.38±0.45^{b}	0.09±2.30^{cd}
120	30	0.27±0.41^{a}	15.39±0.37^{cd}	0.10±1.90^{b}
150	10	0.16±0.71^{a}	14.00±0.64^{d}	0.11±3.22^{a}
Sex:		NS	***	***
Female	60	0.07±0.29^{a}	17.84±0.26^{a}	0.08±1.31^{b}
Male	60	0.08±0.29^{a}	15.27±0.26^{b}	0.10±1.31^{a}
Management system:		NS	**	***
Intensive	60	0.71±0.29^{a}	17.52±0.30^{a}	0.08±1.63^{b}
Semi-intensive	60	0.16±0.29^{a}	15.82 ±0.30^{b}	0.10±1.63^{a}

N: number of observation; MCH: mean corpuscular haemoglobin; MCHC: mean corpuscular haemoglobin concentration; MCV: mean corpuscular volume; NS: non significant; SEM: standard error of the mean.
*: P<0.05; **: P<0.01; ***: P<0.001.
The means within the same row with at least one common letter, do not have significant difference.

Table 3 Mean±SEM by pH and Hbc on age, sex and management system of chicken

Source of variation	N	pH	Hbc (g/dL)
Age (d)		**	***
60	20	7.31±0.09^{c}	36.10±0.10^{c}
74	20	7.62±0.09^{ab}	38.10±0.10^{b}
90	20	7.84±0.09^{ab}	41.10±0.10^{a}
104	20	7.61±0.09^{b}	34.20±0.10^{c}
120	30	7.73±0.07^{ab}	41.70±0.81^{a}
150	10	7.91±0.12^{a}	43.24±1.40^{a}
Sex:		***	***
Female	60	7.46±0.05^{b}	35.71±0.60^{b}
Male	60	7.72±0.05^{a}	42.40±0.60^{a}
Management system:		NS	NS
Intensive	60	7.60±0.05^{a}	38.41±0.70^{a}
Semi-intensive	60	7.72±0.05^{a}	39.43±0.70^{b}

N: number of observation; pH: power of hydrogen; Hbc: haemoglobin concentration; NS: non significant; SEM: standard error of the mean.
*: P<0.05; **: P<0.01; ***: P<0.001.
The means within the same row with at least one common letter, do not have significant difference.

In this study, management system effect on PCV was high on semi-intensively kept chickens and high value on RBC was observed on intensively kept chicken, while management system on WBC showed no significant variability among the chicken studied.

There was no significant difference between sex and age on the mean value of MCH which is similar to the findings of Awotwi (1990) who reported that MCH and MCHC values for adult female domestic chickens (32 weeks) were similar to those for (10 weeks) old birds. MCHC was found to be significantly associated with sex, with females having higher value than males and that this decreased when age increased, which is contrary to the findings of Awotwi (1990). Awotwi (1990) indicated that high MCV value (151.26 cell/mm^3) of the adult Ghanian domestic chickens was similar to that obtained by Oyewale (1987), for Nigerian domestic chickens (156.8 cell/mm^3) but was more than the value (127.8 cell/mm^3) reported by Assoku *et al.* (1970) for White Leghorn. This may be attributed to the differences in genotypes and possibly the environmental conditions under which the birds were reared.

The management system effect shows no significant difference in the mean value of MCH. The higher value of management effect was indicated on MCHC of intensively kept chicken while on MCV, semi-intensively kept chicken had the higher value. Sex shows significant difference in the mean value of Hbc with males reporting higher values than females. Tanaka and Rozengurt (1954) reported that Hbc values for male and female birds range between 13.9 to 14.l mg/100mL and 8.6 to 10.2 mg/100mL respectively and it increases when age is increased. In this study, sex also shows significant difference in the mean value of pH with males having higher value than females and it increases when age is increased. This could be due to the fact that males had higher red blood cells in circulation than females. Management system shows no significant effect on both pH and Hbc value of intensively and semi- intensively kept chicken. The non-significant effect could be due to similar conditions of husbandry system under which the bird were kept.

CONCLUSION

The study was designed to investigate the haematological values of intensively and semi - intensively kept chickens with regard to sex, age and management system. Significant age effects were observed for PCV (150 days), RBC (90 days), WBC (90 and 150 days), MCHC (60 days), MCV (150 days), pH (150 days) and Hbc (90, 120 and 150 days). Sex exerted a significant effect on the mean values of PCV, RBC, MCV, pH, Hbc with males recording the highest values whilst no significant differences existed for MCH. The mManagement systems investigated did demonstrate significantly different effects for RBC and MCHC with intensively kept chickens recording higher values, although no variance was found for WBC, MCH, pH and Hbc. This study concludes that the majority of haematological parameters for indigenous chickens increases with advancing age, males generally report higher values than females, whilst tintensively kept chickens record higher values for most haematological parameters than the semi-intensively kept chickens.

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