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Effects of seasons on haematologic and serum biochemical profiles of indigenous chickens in Shendam, Plateau State, Nigeria

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Target Audience: Extension Officers, Researchers, Climatologists

Abstract

The study was conducted at the Shendam Outstation of the National Veterinary Research Institute to investigate the influence of seasons on haematologic and serum biochemical profiles of indigenous chickens in Shendam, Plateau State, Nigeria. Four males and forty females formed the base populations. For haematologic parameters, season had significant effect only on haemoglobin, PCV (P<0.001), MCV, MCHC (P<0.05) and monocytes (P<0.001). Haemoglobin was highest (14.58±2.52g/dl) during the late rainy season and lowest (12.41±2.99; 12.33±3.14g/dl) during the late and early rainy seasons respectively. The PCV had highest value (35.98± 1.19%) during late rainy season and lowest (31.18± 1.20%) during the early rains. On the other hand, monocytes were highest (3.21±0.13%) during the early rains and lowest (1.01±0.20%) during the early dry season. For biochemical parameters on the other hand, season had significant effect only on glucose, albumin (P<0.001), total protein (P<0.01), cholesterol (P<0.001) and calcium (P<0.05). For these serum biochemical parameters, highest versus lowest values on season bases were: glucose (early higher than late rainy season), albumin (late than early rainy season), total proteins (early than late rainy season), cholesterol (late rains than late dry season), cholesterol (late rains than late dry season) and calcium (late rains than late dry season) respectively. On the higher haematologic values during the late rains might have been because of favourable environment. There were also variations in biochemical parameters with season but there was no trend to indicate that they were in response to environmental changes. Deliberate efforts should be made to ameliorate the effects posed by these changes.

***Keywords**:* Effect, Seasons, erythrogram, biochemical, profile, indigenous chickens

Description of Problem

There is scanty information on the influence of seasons on the haematological and serum biochemical parameters of indigenous chickens. Meteorological elements constitute a complex system, which acts upon the body of indigenous chickens (1). The interaction of these elements has tremendous effects on the productivity and wellbeing of these birds. These elements express themselves with varying intensity on a daily, weekly, monthly and yearly basis. In extreme conditions, they exert stress on the bird and the body reacts in diverse ways to balance the different physiological processes taking place.

Haematological and serum biochemical profiles provide reliable information on the health status of animals (2; 3). Haematological tests have been widely used for the diagnosis of various livestock and poultry diseases (3; 4).

The information obtained from blood parameters substantiates physical examination and coupled with medical history, provide excellent basis for diagnosis of diseases (4). Packed Cell Volume is a reliable indicator of the value of haemoglobin and circulating erythrocytes (RBCs), while changes in plasma globulins reflect the severity of a disease in birds and, thus, serve as the basis for prognosis (5). It also helps in distinguishing the normal state from the state of stress which can be nutritional, environmental or physical (6). Several factors including seasons (5) affect cellular and plasma haemodynamics.

The Nigerian indigenous chickens are dual-purpose birds that are used both for meat and egg production in the rural and peri-urban areas (7). They are found in small flocks, distributed across the different agro-ecological zones of the country under a traditional family based scavenging management system (8). Often, they are fed on household refuse, homestead pickings, crop residues, herbage, seeds, green grasses, earthworms, insects and small amount of supplemented feeds offered by the flock owner. They are well adapted to the adverse climatic conditions of the tropical environment and low management inputs (7). They contain a highly conserved genetic system with high levels of heterozygosity (9).

Indigenous chickens have diverse uses and benefits to different families. Their use varies from region to region and from one community to the other (10). Despite their small body size, slow growth, small egg size, low egg production and late maturity (11; 12), they possess certain inherent advantages. These include general hardiness, ability to adapt to harsh environments, capable of surviving on little or no inputs in terms of irregular supply of feed and water, minimum Veterinary healthcare and shelter (13). They are however ideal mothers and good sitters (14), excellent foragers, hardy and possess natural immunity against common local prevailing diseases (15).

Location and Climate

The research work was undertaken in Shendam Local Government Area of Plateau State, Nigeria. It is located between latitude $8^0$43’ and 10^0N, and longitude 9 ^{0}30’ and 10^0 E. It is at the altitude of 250 -300 meters above sea level. Generally, Shendam has two distinct seasons; dry and wet. The early dry season is from October to December, late dry, January to March; early wet, April to June and late rainy season, July to September. Annual rainfall ranges from 100-200cm. The average temperature in the dry season is 25^0C while that of the rainy season is 32^0C. The Relative Humidity in the dry season is between 40-50% and 50-75% in the rainy season (16).

Study Stock and Management

A total of forty-four, sexually matured indigenous chickens were used as foundation stock. These chickens consisted of forty hens and four cocks (n = 44). They were purchased from local markets in Shendam, Quan Pan, Mikang, Wase, Langtang North and Langtang South Local Government Areas. On arrival, these birds were dewormed using Levamisole orally and treated with Oxytetracycline long acting at the rate of one mililitre per bird against any bacterial infection. Kamorov vaccine, 0.5 mililitre was also administered on each bird to guard against Newcastle Disease outbreak a week after arrival.

The chickens were kept in a separate pen, and provided with nest boxes, watered and fed *ad libitum*. All chickens were fed commercially formulated feed. Chick mash was used to feed chicks during the brooding period to ten weeks of age. Grower mash was fed to the birds from 10 weeks to the point of lay and layers mash throughout the laying period from Grand Cereals and Oil Marketing Company, Jos, throughout the one-year study period.

Table 1: Means and Standard Errors of Haematologic Values of Local Chickens by Age and Seasons

	Variable	Haem. (g/dl)	RBC ($x10^6$)	PCV (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)	Heter. (%)	Lymp (%)	Monoc (%)	Eosino (%)	Basop (%)
Season		***	ns	***	*	ns	*	ns	ns	***	ns	ns
	Early dry	13.94 ±3.47^{b}	2.60±0.50	33.82±1.45	136.54±24.83^{bc}	54.86±12.10	38.16±5.03^{b}	49.48±1.51	46.43±1.39	1.01±0.29^{a}	2.14±0.41	1.31±0.22
	late dry	12.41 ±2.99^{a}	2.45±0.45	32.90±1.22	135.44±18.26^{ab}	53.29±29.54	37.24±3.400^{a}	46.09±1.49	47.51±1.41	1.46±0.31^{a}	1.60±0.48	1.09±0.16
	Early rainy	12.23±3.14^{a}	2.42±0.44	31.18±1.24	132.37±13.98^{a}	50.23±8.33	37.85±3.53^{a}	50.36±1.290	43.192±1.323	3.21±0.13^{b}	2.94±0.11	1.43±0.28
	Late rainy	14.58±2.52^{c}	2.59±0.44	35.98±1.19	140.66±11.16^{c}	56.17±3.87	40.01±2.02^{c}	48.85±1.43	44.93±1.45	1.97±0.57^{a}	1.93±0.51	1.11±0.19

Means in a column within a subset with different superscripts are significantly different. ns= not significant; * = Significant at $P< 0.05$; *** = Significant at $P< 0.001$. RBC= red blood cells, PCV= Packed cell volume, MCV= Mean corpuscular volume, MCH= Mean corpuscular haemoglobin, MCHC= Mean corpuscular haemoglobin concentration, Het.= heterophil, Lymp.=Lymphocytes, Monoc= Monocytes, Eosino=Eosinophil, Basop=Basophils

Blood Collection and Analyses

Blood samples were collected from the adult chickens purchased at the commencement of the study and monthly thereafter till the end of the one-year study period. Blood was equally taken from the progeny as from eight weeks of age. The right jugular vein was the site of blood collection because it is typically the larger of the two jugular veins in birds. The vein was stabilized before venipuncture. Following adequate restraint, the bird's head and neck were extended to allow the vein to fall into the jugular furrow along the lateral side of the neck (17). Jugular venipuncture was performed using a 23-guage needle and 5mililitre syringe.

Approximately 5 mililitres of blood was collected from each bird (at a time) into two sets of sample bottles; one set containing Ethylene-diamine-tetra-acetic acid (EDTA) as anticoagulant and the other without anticoagulant, was allowed to clot. Serum was collected after two hours and transferred to 2 mililitres cryovials. The samples were packed inside a cooler with ice and transported immediately to the Central Diagnostic Laboratory, National Veterinary Research Institute, N.V.R.I., Vom, which is about 150 km from Shendam for analyses using commercially available kits for serum Biochemistry. The sample with EDTA were used to determine blood components (haemoglobin, packed cell volume, red and white blood cells), while the other was used to determine serum glucose, albumin, total protein, cholesterol and calcium.

Haematologic analysis

The BC-3000 Plus auto-hematology analyzer (Shenzhen Mindray Bio-Medical Electronics Company Limited, China) which is a quantitative automated device was used to determine all the haematologic parameters in this study namely haemoglobin, red blood cells, packed cell volume and direct leucocyte counts (heterophils, lymphocytes, monocytes, eosinophils and basophils).

The whole blood samples collected into EDTA anticoagulant were used to determine the above parameters. The samples were presented to the probe and the key was pressed to aspirate 13µL of the sample into the analyzer.

After each analysis cycle, each element of the analyzer was washed. The sample probe washed internally and externally with diluent, WBC bath was washed in diluent and rinsed. Results were recorded on external printer. Mean cell volume (MCV), corpuscular haemoglobin (MCH) and corpuscular hemoglobin concentration (MCHC) were calculated using the following expressions (18):

MCV= (PCV/RBC)/ 10; MCH= (Hb/RBC) /10; MCHC= (Hb/PCV) /100.

Table2: Means and Standard Errors of Serum Biochemical Values of Local Chickens by Season

Parameter		Glucose	Albumin (mg/dl)	Total protein (g/dl)	Cholesterol (mg/dl)	Calcium (mg/dl)
Season		***	***	**	***	*
	Early dry	9.98 ± 0.38^{b}	3.72 ± 0.21^{b}	5.85 ± 0.25^{b}	3.96 ± 0.27^{b}	13.99 ± 0.84^{b}
	late dry	10.41 ± 0.33^{b}	3.45 ± 0.21^{ab}	4.81 ± 0.26^{a}	3.01 ± 0.15^{a}	10.56 ± 0.12^{a}
	Early rainy	11.60 ± 0.36^{c}	3.19 ± 0.15^{a}	6.50 ± 0.24^{b}	3.42 ± 0.17^{a}	10.70 ± 0.51^{a}
	Late rainy	8.70 ± 0.24^{a}	5.04 ± 0.18^{c}	4.60 ± 0.13^{a}	4.30 ± 0.16^{b}	11.23 ± 0.24^{a}

Means in a column within a subset with different superscripts are significantly different. ns= not significant; * = Significant at P< 0.05; ** = Significant at P< 0.01; *** = Significant at P< 0.001.

Biochemical analysis

The Sinnowa D-360 (Sinnowa Medical Science and Technology Company Limited China) is random access, high-speed fully automatic clinical Chemistry analyzer, with intelligent multitasking software, automatic calibration, bar coding, innovative cuvettes washing station; its photometric trough output is 300 tests per hour. It was used for the biochemical analysis. There is slight variation in procedure for each parameter.

Methods:

They differed slightly depending on the parameter to be determined. It is known as Glucose Oxidase for Glucose (19), Bromocresol Green for albumin, Biuret for albumin (20), Sodium hydroxide for protein (21; 22), Cholesterol Oxidase (23; 24) and O-Cresolpthalein for Calcium (20).

Procedure:

Three test-tubes were mixed thoroughly

a. Glucose- The test tubes were incubated for 15minutes at 37^{o}C and absorbance read against blank at 546 nm.
b. For albumin and cholesterol- The test tubes were incubated for 10minutes at 37^{o}C and absorbance read as for glucose.
c. Protein- Incubation was for 30minutes at 20- 25^{o}C and absorbance of the sample and the standard were read against blank at 546 nm.
d. Calcium- Incubation was for 5minutes at 37^{o}C at 578 nm.

Calculation: = Absorbance of test/ absorbance of standard x concentration of standard.

Statistical Analysis

i). The data generated were analyzed using the General linear model (GLM) as contained in the Statistical Packages for Social Sciences, version 10.5 to determine differences in haematologic and biochemical parameters among the following:

a. Seasons: Early dry (October- December)
Late dry (January- March)
Early rainy (April- June)
Late rainy (July- September).

Significant means were separated using the Ryan-Einot-Gabriel-Welsch function.

Results and Discussion

There is paucity of information on the influence of season on the haematologic and serum biochemical parameters of indigenous chickens. Haematologic and serum biochemical parameters by seasons are presented in Tables 1 and 2 respectively.

For biochemical parameters on the other hand, season had significant effect only on glucose, albumin ($P<0.001$), total protein ($P<0.01$), cholesterol ($P<0.001$) and calcium ($P<0.05$). The finer division of season into months however resulted in significant ($P<0.001$) effect on all serum biochemical parameters.

For these serum biochemical parameters, highest versus lowest values on season bases were: Glucose (early higher than late rainy season), albumin (late than early rainy season), total proteins (early than late rainy season), Cholesterol (late rains than late dry season), Cholesterol (late rains than late dry season) and Calcium (late rains than late dry season) respectively.

Generally late rainy season (July-September), had the highest erythrogram values. This season is the period with almost an average ambient temperature and relative humidity, thus favouring high feed intake, therefore high erythrogram values. The hot-dry season is thermally stressful to animals (25; 26). High environmental temperatures are factors that alter (negatively) physiological (haematologic and serum biochemical) profiles of birds (27).

When a bird is exposed to stressful environmental conditions, the hypothalamo-pituitary-adrenal gland and parasympathetic nervous system are activated and this results in temperature increase (28) which has detrimental effect on the animal's welfare (29). A thermally stressful environment is also known to alter the homeostatic mechanisms of birds (30; 31), resulting in impairment of erythropoisis and protein synthesis (27). This can clearly be seen in this work where the erythrocytic values including PCV decline. High environmental temperature also increases oxygen intake, respiration and respiratory water loss of birds. The increased oxygen intake increases its partial pressure in the blood (32), and perhaps is one of the elements responsible for compromised erythropoiesis. Consequently, there was a reduction in circulating erythrocytes and hence, PCV and haemoglobin values (27). Haemodilution caused by heat stress is indicated by decreased haemoglobin concentration and PCV (33). This mechanism could be responsible for the low erythrogram and total protein values in birds of this study during the late dry and early rainy seasons and the high heterophil to lymphocytic ratio in the early rainy season.

Blood protein concentrations in chickens may vary due to breeding season, indicating that egg production is associated with changes in total protein concentrations induced by estrogens (34).

Conclusion and Application

1. Season have a great influence on poultry production in the study area.
2. In stressful conditions, birds normally take less feed and more water and this lowers their growth and productivity.
3. Appropriate measures should be instituted to ameliorate these negative effects. These include supplementary feeding of the indigenous chickens especially in harsh weather, improved Veterinary health care, provision of multivitamins especially vitamin C and adequate provision of water. Dietary supplementation of birds is desirable as this will improve performance as well as egg quality.

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