ISSN 2319 – 5703 EISSN 2319 – 5711

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A Comparison of the haematological and biochemical indices of broiler and red jungle (Hamburgh) fowl (Gallus gallus domesticus)

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Received 21 August; accepted 18 September; published online 01 October; printed 16 October 2012

ABSTRACT

The haematological and biochemical parameters of some domestic fowl (Gallus gallus domesticus) of 300-500g body weight and aged between 16-20 weeks old were investigated in 10 broilers and 10 Hamburgh (red jungle fowl) breed respectively using both their whole blood and serum samples. The blood group of both breeds had (A^+, B^+, and O^-) as those in man. The Hb genotype (HbAA, HbAS) also showed similarities to that of man. The mean and standard deviation values of the packed cell volume (PCV), white blood cell (WBC) count and platelets of the two breeds (broilers and jungle fowls) respectively are; (30.4 ± 2.8% and 30.6 ± 1.43%), (25.88×10^9 ± 3.4µL and 17.42×10^9 ± 0.6µL), (43.8×10^9 ± 4.6µL and 34.5×10^9 ± 3.80µL). Mean ± S.D values from serum for sodium, potassium, bicarbonate, chlorine, urea, creatinine, calcium, total protein and albumin were; (139.57 ± 2.40mmol/L and 137.46 ± 2.0mmol/L), (1.84 ± 0.97mmol/L and 3.39 ± 1.05mmol/L), (27.0 ± 2.45mmol/L and 25.8 ± 1.54mmol/L), (110.34 ± 11.1mmol/L and 93.96 ± 4.9mmol/L), (8.45 ± 2.07mmol/L and 5.43 ± 0.93mmol/L), (73.6 ± 12.2mmol/L and 70.54 ± 13.2mmol/L), (3.7 ± 0.73mmol/L and 4.17 ± 0.93mmol/L), (64.7 ± 13.0g/L and 68.07 ± 12.65g/L) and (30.79 ± 7.1g/L and 34.26 ± 9.60g/L) respectively. The research indicates that the haematological and serum biochemical values could serve as baseline information for comparing conditions of nutrient deficiency, physiological and health information of both the broilers and Hamburgh (red jungle fowl) breed.

Keywords: Fowl, Blood, haemoglobin, genotype, platelet, sodium, potassium, bicarbonate, chlorine, urea, creatinine, calcium, protein, albumin.

Abbreviations: Hb - Haemoglobin, HCO_3 - Biocarbonate, K - Potassium, Na - Sodium, Ca - Calcium, Cl - Chlorine, WBC - White Blood Cell, PCV - Packed Cell Volume.

Haemoglobin:
It is the oxygen-carrying pigment that is present in red blood cells. Haemoglobin molecules, which are produced by bone marrow, are made up of 4 protein chains (2 alpha- and 2 beta-globin) and 4 haem (a red pigment that contains iron).

Blood:
It is the red fluid that circulates in the body's veins, arteries, and capillaries of humans and animals. Almost half of the volume of blood consists of blood cells; these include red blood cells (erythrocytes); white blood cells (leucocytes); and platelets (thrombocytes). The remainder of the blood volume is a watery, straw colored fluid called plasma.

1. INTRODUCTION

Determining the haematological indices of domestic fowl/chicken is indeed necessary; hence the need to find out and observe the change/variation of the different analytical parameters in the broiler and red jungle fowl (Hamburgh) breeds of chicken. Such distinction in their various haematological and biochemical parameters thereby creates the adequacy for the creation of adequate physiological baseline value for the different chicken breeds in Nigeria, which help in the nutrition, diagnosis of pathological conditions and for the general management of the different fowl breeds (Kruchten, 2002).

1.1. Fowl

Fowl (Chicken) can be best described as a domesticated animal, a broiler and a subspecies of the red jungle fowl. They fall under one of the most common and widespread domestic animal. Fowl are omnivores; they feed on seeds, insects etc and can survive for five to ten years depending on the breed. They live in flocks together (Christopher et al., 2003). In Nigeria, the two major breeds are the broiler and jungle fowl, locally refereed to as agricultural and native fowls respectively. Both of them differ in weight, size, characteristic features, life span, nutritive and physiological demands (Obi, 2000).

2. SCOPE OF STUDY

This research targets at obtaining the baseline data on haematological and biochemical values of the chicken (both broiler and jungle fowl) that were raised in Nigeria. The relevance of the data obtained is for the diagnosis of disease, finding out the nutritional need of a particular breed and sourcing ways of fortifying their diet's with those nutrients needed, so as to boost their immune system to be able to resist some of the pathological conditions which they may be faced with.

3. MATERIALS AND METHODS

Twenty fowl samples were used for this purpose comprising of 10 broilers and 10 red jungle fowl.
Spectrophotometer (serial No: 001233, Labo med. Inc. U.S.A), Light Microscope (model XSZ107BN, B. BRAN SCI. COY. England), Microhaematocrit centrifuge – (Sorvall Instruments, GLC-4, USA), Refrigerator – (Daewoo, Refrigerator FR-142, Korea), Electrophoresis machine (model MSW 496).

3.1. Blood collection

On slaughtering the 10 broilers and 10 jungle fowls, blood sample for each fowl was collected into three (3) different sample bottles. One of the sample bottles contains no anticoagulant, while the others contained a very small amount of the anticoagulant (EDTA). The blood samples were sent to the laboratory immediately after collection for analysis which include the determination of haematological and biochemical parameters.

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HAEMATOLOGY

It is the study of blood and its function, as well as the investigation and treatment of disorders that affect the blood and the bone marrow.

BIOCHEMICAL INDICES

It is the chemical composition of living organisms. It includes the chemical processes involved in the maintenance and reproduction of body cells and the chemical reactions carried out inside cells that make up the metabolism of the body.

Genotype:
It is the genetic makeup of a cell, an organism, or an individual (i.e. the specific allele makeup of the individual or organism) usually with reference to a specific character under consideration.

3.2. Experimental procedure

3.2.1. Blood group Test

Blood grouping was done using Antisera A(sky blue), Antisera B (yellow), Antisera D (colorless), blood sample, white tile, rubber pipette and sample stirrer to ascertain the blood group of each sample.

3.2.1.1. Method

Using a rubber pipette, introduce a drop of each individual blood sample on 3 different portions of the white tile. To each of the 3 drops of blood sample on the tile, add a drop of the 3 different antisera's (A, B and D). Mix each portion properly using a stirrer and swirl tile till a visible agglutination is noticed. Take visual reading based on the areas of agglutination observed.

3.2.2. Hb genotype test

The test is used to determine the genetic constituent of a patient.

3.2.2.1. Method

A drop of each blood sample (both the control and test samples) was placed on different portions of the tile using a rubber pipette. Add a drop of water each to them to lyse and then mix properly (in order to degrade weak forces existing in blood sample so that its genotypic characteristics can be made known). Pour 100ml of the buffer solution into each of the outer sections of the electrophoretic chamber. Using a sample applicator, apply test samples and control sample at the centre of the paper (cellulose acetate paper) then place the paper in the electrophoretic chamber with the cellulose acetate side down, then allow for 10mins. After the chamber has been connected to power supply, take separation reading of the tests and control sample. Separation is due to variations in the net charge. Substances with similar charges have their separation based on the difference in their charge to mass ratio due to their molecular weight difference.

3.2.3. Packed cell volume (PCV) test

This test is used to ascertain the volume of red cells expressed as percentage of the volume of the whole blood in the sample.

3.2.3.1. Method

Place the open end of the capillary tube in the blood sample, allow blood move into the tube via capillary action until 2/3 of the tube is filled, then seal one end of the tube with a plastic. Allow tube to spin in the micro-haematocrit centrifuge for 3-5mins. Immediately after centrifuging, read PCV (%) from scale or micro-haematocrit reader.

3.2.4. White blood cell (WBC) count

It is the estimation of the total number of white blood cells in a cubic millimeter of blood. Both the total and differential WBC count can be determined.

3.2.4.1. Method

Measure 0.38ml of stock solution into a test tube; add 20µL of blood sample, then shake the mixture to obtain a homogeneous solution. Using the rubber pipette, make a drop of the homogeneous solution on a haemocytometer, cover with a slide cover and view under the microscope using the 10× objective. Values obtained are calculated and expressed in × 10^9µL.

3.2.5. Platelet count

Platelet count is used as a pointer to screen abnormalities in the skin and mucosal bleeding which occurs when platelet count is very low.

3.2.5.1. Method

Measure 0.38ml of filtered ammonium oxalate diluting fluid and dispense into a test tube. Add 20µL (0.02ml) of well mixed anticoagulated blood sample (serum) and mix. Assemble the counting chamber and fill with well-mixed sample, leave the chamber for 20mins. To prevent drying of the fluid, place the chamber in a petridish on a blotting paper and cover with a lid. Dry the underside of the chamber and place it on the microscope stage. Using the 10× objective, focus the rulings of the grid and bring the central square of the chamber into view. Change to the 40× objective and focus on the small platelets. Count the platelets and multiply actual number counted by × 10^9.

3.2.6. Sodium test (Colorimetric method)

To determine the sodium content of the serum sample colorimetrically.

3.2.6.1. Method

The method/procedure and calculation of results obtained is as described on the user manual of the Teco diagnostics sodium test kit used for the analysis.

3.2.7. Potassium test (Colorimetric method)

For the determination of serum potassium level.

3.2.7.1. Method

The method/procedure and calculation of results obtained is as described on the user manual of the Teco diagnostics potassium test kit used for the analysis.

3.2.8. Biocarbonate test (Colorimetric method)

For the quantitative determination of carbondioxide content of serum.

3.2.8.1. Method

The method/procedure and calculation of results obtained is as described on the user manual of the Teco diagnostics biocarbonate test kit used for the analysis.

3.2.9. Chloride test (Colorimetric method)

Measures chloride ion concentration in a serum sample.

3.2.9.1. Method

The method/procedure and calculation of results obtained is as described on the user manual of the Atlas medical chloride test kit used for the analysis.

3.2.10. Urea test (Urease-Berthelot method)

For quantitative in vitro determination of urea in serum.

3.2.10.1. Method

The method/procedure and calculation of results obtained is as described on the user manual of the Randox urea test kit used for the analysis.

3.2.11. Creatinine test (Precipitation method)

For the quantitative in vitro determination of creatinine in serum.

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Discovery Nature, 2012, 1(1), 15-18,
http://www.discovery.org.in/dn.htm

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Table 1: Shows result of the various haematological tests

Sample	Platelet count (µL)	WBC (µL)	PCV (%)	Genotype	Blood group
Broiler 1	40	18,848	24	AA	A^+
Broiler 2	37	28,500	31	AA	B^+
Broiler 3	52	26,100	30	AA	A^+
Broiler 4	42	29,100	32	AS	O^-
Broiler 5	41	20,900	30	AA	O^+
Broiler 6	44	28,300	33	AA	A^+
Broiler 7	46	27,200	34	AA	A^+
Broiler 8	49	25,500	28	AA	O^-
Broiler 9	39	24,700	29	AS	B^+
Broiler 10	48	29,700	33	AA	A^+
Jungle fowl 1	30	17,800	30	AS	O^-
Jungle fowl 2	40	18,000	32	AA	O^+
Jungle fowl 3	36	16,700	31	AS	A^+
Jungle fowl 4	31	18,200	30	AS	A^+
Jungle fowl 5	30	17,000	31	AS	O^+
Jungle fowl 6	32	17,200	33	AS	O^+
Jungle fowl 7	34	16,500	30	AS	B^+
Jungle fowl 8	39	17,900	29	AS	O^-
Jungle fowl 9	40	18,100	32	AA	O^-
Jungle fowl 10	33	16,800	28	AS	O^-

Table 2: Shows the result of the various biochemical tests

Samples	Na	K	HCO_3	Cl	Urea	Creatine	Total protein	Albumin	Ca
Broiler 1	141.0	2.0	24.0	125.0	9.2	89.0	40.0	16.7	2.8
Broiler 2	141.8	1.0	26.0	93.1	5.0	57.0	76.0	16.7	3.0
Broiler 3	136.2	1.3	25.0	111.1	10.3	59.0	86.0	41.0	4.7
Broiler 4	139.4	4.0	28.0	104.1	5.2	89.0	68.0	26.7	3.2
Broiler 5	136.0	1.0	29.0	92.7	9.8	87.0	45.0	40.0	4.6
Broiler 6	142.1	1.2	23.0	96.2	10.0	59.0	69.0	28.6	2.9
Broiler 7	140.5	1.1	30.0	105.8	6.0	68.0	70.0	29.7	3.8
Broiler 8	137.8	1.3	31.0	124.2	8.9	77.0	68.0	32.0	4.7
Broiler 9	137.9	2.5	27.0	118.6	9.4	82.0	59.0	38.7	4.0
Broiler 10	143.0	3.0	27.0	120.2	10.7	69.0	66.0	28.8	3.3
Jungle fowl 1	140.2	2.4	24.0	91.7	3.1	58.9	96.0	37.3	4.6
Jungle fowl 2	135.1	2.0	27.0	88.0	5.8	89.0	66.0	27.0	4.6
Jungle fowl 3	135.0	5.0	25.0	97.2	6.0	59.6	54.0	21.9	4.7
Jungle fowl 4	138.0	3.0	28.0	104.2	5.8	89.0	54.0	20.6	2.8
Jungle fowl 5	135.1	3.0	24.0	89.0	6.7	59.0	80.0	46.3	4.7
Jungle fowl 6	139.2	2.0	24.0	92.0	5.0	58.9	72.0	41.1	5.0
Jungle fowl 7	136.1	4.0	25.0	93.0	5.3	87.0	78.9	47.8	2.8
Jungle fowl 8	140.3	5.0	27.0	89.5	6.1	66.9	69.8	36.7	3.2
Jungle fowl 9	137.1	3.5	28.0	95.0	4.9	79.8	86.8	23.9	3.7
Jungle fowl 10	138.5	4.0	26.0	100.0	5.6	57.9	77.2	40.0	5.6

Table 3: Shows the mean and standard deviation of the results

Parameters	Broilers	Jungle fowls
Haematological parameters		
Genotype	HbAA (80%) and HbAS (20%)	HbAA (20%) and HbAS (80%)
PCV (%)	30.4 ± 2.8	30.6 ± 1.43
Platelets (µl)	43.8 ± 4.6	34.5 ± 3.80
Total WBC ($\times 10^3$µl)	25.88 ± 3.4	17.42 ± 0.6
Biochemical parameters		
Na (mmol/l)	139.67 ± 2.40	137.46 ± 2.07
K (mmol/l)	1.84 ± 0.97	3.39 ± 1.05
HCO_3 (mmol/l)	27.0 ± 2.24	25.8 ± 1.54
Cl (mmol/l)	110.34 ± 11.1	93.96 ± 4.9
Urea (mmol/l)	8.45 ± 2.07	5.43 ± 0.93
Creatinine (mmol/l)	73.6 ± 12.2	70.54 ± 13.2
Ca (mmol/l)	3.7 ± 0.73	4.17 ± 0.93
Total protein (g/l)	64.7 ± 13.0	68.07 ± 12.65
Albumin (g/l)	30.79 ± 7.1	34.26 ± 9.60

3.2.11.1. Method

The method/procedure and calculation of results obtained is as described on the user manual of the Randox creatinine test kit used for the analysis.

3.2.12. Calcium test (Colorimetric method)

For the quantitative in vitro determination of calcium in serum.

3.2.12.1. Method

The method/procedure and calculation of results obtained is as described on the user manual of the Randox calcium test kit used for the analysis.

3.2.13. Total protein test (Biuret method)

Used for quantitative in vitro determination of total protein in serum/plasma.

3.2.13.1. Method

The method/procedure and calculation of results obtained is as described on the user manual of the Randox total protein test kit used for the analysis.

3.2.14. Albumin test (Bromocresol green)

For quantitative in vitro determination of albumin in serum.

3.2.14.1. Method

The method/procedure and calculation of results obtained is as described on the user manual of the Randox albumin test kit used for the analysis.

3.3. Statistical analysis

The haematological and biochemical data obtained from the samples were compared statistically on the basis of the different breeds of fowl used (broiler and jungle fowls) using analysis of variance procedure for completely randomized design.

4. RESULTS

The results obtained from the study on the haematological and biochemical indices of the two different breeds of fowl are shown in Table 1 and 2. Table 1 represents the results gotten from the different haematological parameters of the two fowl breeds while Table 2 represent the result of the different biochemical parameters carried out on the two breeds. Table 3 represents the different mean and standard deviation of all the results for all parameters. The results of the biochemical parameters were obtained by dividing the absorbance of the sample by the absorbance of the standard then multiply by the standard concentration.

5. DISCUSSION

From the above results of the haematological parameters, the platelet cell count of the broilers were observed to be higher than those of the jungle fowl (43.8 ± 4.6µl and 34.5 ± 3.80µl) which suggest that the broilers would likely have blood clot faster in event of any sustained injury, this is because the platelets are involved in haemostasis, leading to blood clot formation. The WBC count was also significantly ($p \leq 0.05$) higher in the broilers than the jungle fowl (25.88 $\times 10^3$ ± 3.4µl and 17.42 $\times 10^3$ ± 0.6µl), which implies that the broilers would have a stronger immune system than the jungle fowl because WBC helps defend the body against infectious diseases and pathogens. The PCV of the jungle fowl was slightly higher than that of the broilers (30.6 ± 1.43% and 30.4 ± 2.8%), indicating that the jungle fowls have more red cells (haemoglobin) which is

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an oxygen carrier than the broilers. The genotype of the broilers revealed 80% inheritance of normal (AA) haemoglobin gene while the jungle fowls had 20%. The result indicates that the jungle fowl stands greater risk of having sickle cell anaemia because on sickle mutation, the homozygote state will be (SS) while the broilers stands lesser risks (20%). For the biochemical parameters of the fowl breeds, variations in mean chloride concentration in broilers were observed to be significantly ($p \leq 0.05$) higher than that of the jungle fowls (Table 3). Parameters such as Na, HCO_3, Cl, urea and creatinine concentrations revealed slight variations with those of the broilers slightly higher than the jungle fowls (Table 3). But in K, Ca, total protein and albumin concentrations, the jungle fowls had values which were slightly higher than those of the broilers (Table 3). Variations in the concentrations of electrolytes, urea, total protein, albumin, calcium and creatinine may be due to the difference in nutritional status as a result of their feeding pattern.

SUMMARY OF RESEARCH

1. In other to have an insight into the impact of the general status of fowls raised, their haematological and biochemical indices as well as analytical study were conducted.
2. The parameters studied in this research, play a role in ascertaining the level of natural resistance and adaptation of the individual fowl breed.
3. The findings from this research work will enhance the knowledge of domestic poultry owner and feed producing industries on how best to improve productivity.

FUTURE ISSUES

1. Other breeds should be studied to obtain more information on domesticated chickens globally.
2. There is need for further investigation on how the genetic defects affects the red jungle (Hamburg) fowl breed.

DISCLOSURE STATEMENT

There is no financial support for this research work from the funding agency.

ACKNOWLEDGMENTS

Much thanks to our guide for his constructive criticism, and assistance towards the successful completion of this research work.

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