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Effect of Sex and Genotype on Blood Serum Electrolytes and Biochemical Parameters of Nigerian Indigenous Chickens

Research Article

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ABSTRACT

The effect of genotype and sex of Nigerian indigenous chickens (dwarf, Fulani ecotypes, neck, frizzle and normal feathered) on blood serum electrolytes and biochemical parameters were investigated using 40 chickens. The collected data were subjected to analysis via a 2 way ANOVA. The results revealed serum levels of sodium, potassium, chloride, uric acid, glucose, total protein, creatinin, albumin and globulin were 145.23±27.18 mmoi/L, 8.05±2.39 mmoi/L, 106.33±11.27 mmoi/L, 3.57±1.47 mg/µL, 44.87±17.57 mg/dL, 72.20±8.42 g/L, 74.50±12.98 µmoi/L, 38.30±4.84 g/L and 33.30±5.95 g/L respectively. Creatinin in the female birds was significantly higher than in males (P<0.05). The serum chloride, potassium, globulin, glucose and uric acid were also significantly different across the genotype. Serum chloride and glucose were higher in dwarf chickens, whilst potassium was higher in neck chickens and higher globulin levels were observed in frizzle chickens compared to the other four genotypes. The study revealed a significant effect of sex on creatinin and genotype on various physiological characters of Nigerian indigenous chicken.

KEY WORDS chicken, electrolyte, serum biochemistry, sex and genotype.

INTRODUCTION

Intensive poultry production has been identified as one of the means of attaining sufficiency in the supply of animal protein in the diet of the average Nigerian. Local chickens are small bodied mongrels raised on free range (village system) and back yard systems (Lul, 1990). They have diverse uses and benefits which play an important role in human nutrition and as income sources. They are characterized by survival traits such as small body size, slow growth, late maturity and hardiness (Ibe, 1993). Hardiness and small body size are thought to be an adaptation to the harsh tropical environment they inhabit (Ezekwe and Machiebe, 2004). The genetically unimproved local chickens remain predominant in African villages despite the introduction of exotic and cross-bred types (Adedokun and Sonaiya, 2001).

It is assumed that there is only one type of local chicken in Nigeria even though the Hausas and Fulani settlers in Northern Nigeria recognized by name at least 15 varieties of local chickens (Ibrahim and Abdu, 1992). Their wide spread distribution in the villages demonstrates the importance of these small and easily managed farm animals. For any meaningful progress on the local chickens to take place, there is a real need for the improvement in the characteristics of the local chicken including their body and egg sizes (Ndofor *et al.* 2006). An important requirement for this improvement is an appropriate breeding method for bringing about rapid genetic changes. However, major genes of chicken are believed to confer not only adaptability to the tropical climate, but also resistance to diseases (Haunshi *et al.* 2002). Reports on the influence of major genes such as naked neck, frizzle, slow feathering and dwarfism have been evaluated for their influence on immune competence in chicken (Bacon *et al.* 1986).

The potential use of biochemical blood parameters as predictors of health status, genetic disease resistance, meat quality and performance traits depend on a better understanding of the causes of quantitative variation in these characteristics. Most of the investigated blood parameters have been associated with diseases resistance, meat quality or performance trials (Just *et al.* 1983; Martin and Lumsden, 1987). For proper management, breeding, feeding, prevention and treatment of diseases, it is desirable to know the normal physiological values in the Nigerian normal environment (Islam *et al.* 2004). The present research was undertaken to investigate key serum biochemical values and to determine the influence of sex and genotype on these values in indigenous Nigerian chickens.

MATERIALS AND METHODS

Description of the study area

The experiment was conducted at the poultry unit of the Livestock Teaching and Research Farm, Kano University of Science and Technology, Wudil. The site is situated on latitude 12˚ 58N andn longitude 8˚ 25E. The range of annual temperature and relative humidity is about 38-43 ˚C and 40-51% respectively. It has mean annual rainfall ranges of 850-870 mm from May-October with a peak in August. Three distinct seasons are however, recognized dry cold (October-January), dry hot (February-May) and wet (June-September).

Experimental stock / management

A total of forty matured chickens of five different strains/ecotypes (normal feathered n=8, naked neck n=8, frizzles n=8, dwarfs n=8 and Fulani ecotype n=8) were used; each group comprised 4 males and 4 females. The birds were obtained from smallholder poultry farmers within Kano State; their body weight ranged from 1.3-2.1 kg with a 1:1 ratio of males to females. All birds were quarantined for two weeks, at the end of the quarantine period, they were housed in a deep litter system for six weeks and were fed commercial poultry growers ration containing 15% crude protein *ad libitum*. Clean and fresh drinking water was also given *ad libitum*.

Blood collection

At the end of six weeks of the study period, birds were subjected to 12 hours fasting prior to blood collection. Blood collection was carried out aseptically using a sterile syringe and needle via wing veins. Blood samples were collected into sterile test tubes without anticoagulant (plain parameters). Serum was obtained by centrifugation and the serum samples were stored (at -10 ˚C) until analyzed. The serum was analyzed for glucose (Trinder, 1969).

Total protein was determined by the Kjedahl method as described by Kohn and Allen (1995) and albumin by the method of Doumas (1971). Globulin was obtained by subtracting the albumin content from the total protein. Urea and creatinin were determined according to Harrison (1947). Sodium and potassium were determined by flame photometry (Mouldin *et al.* 1996).

Statistical analysis

All values of serum electrolytes and biochemical values were expressed as mean±standard deviation (SD). Parameters of both sexes and genotype were compared using 2-way ANOVA analyses. The level of significance was reported at (P<0.05).

The statistical model used was

$Y_{ij} = \mu + T_i + S_i + e_i$

Where

Y_{ij}= observation per bird.

μ= general mean.

T_i= effect of genotype.

S_i= fixed effect of sex.

e_i= residual error.

RESULTS AND DISCUSSION

The mean serum electrolytes and biochemical values of Nigerian indigenous chicken are presented in Table 1. The relation of sex and genotype to serum electrolytes and biochemical values in Nigerian indigenous chicken is presented in Tables 2 and 3. It was observed that there was no significant (P<0.05) difference in the sex for mean serum protein values. This result was similar to the findings of Meluzzi *et al.* (1992), Simaraks *et al.* (2004) and Pampori and Iqbal (2007) who studied the serum total protein in broiler, Thai indigenous chicken and the native chickens of Kashmir respectively. Lisano and Quay (1977) reported higher mean total protein value in female than in males turkeys. In female birds, a considerable increase in plasma total protein concentration occurs just prior to egg laying, which could be attributed to an estrogen-induced increase in globulin (Simaraks *et al.* 2004).

It is evident from the present findings that total serum protein differed significantly (P<0.05) among the genotypes (Table 3), with normal feathered birds having the highest value 77.00±5.04 g/L compared to the naked neck 64.50+6.95 g/L. This is similar to the report of Ladokun *et al.* (2008) who reported a higher total serum protein in Normally feathered than in naked neck chickens.

Table 1 Mean blood serum electrolyte and serum protein values for (±standard errors) Nigerian indigenous chicken (dwarf, frizzle, Fulani ecotype, naked neck and normal feathered)

Genotype	Sex	Sodium (mmoi/L)	Potassium (mmoi/L)	Chlorine (mmoi/L)	Total / protein (g/L)	Globulin (g/L)	Albumin (g/L)	Creatinin (µmoi/L)	Uric acid (mg/dL)	Glucose (mg/dL)
Dwarf	M	153.67± 5.04	9.50± 2.21	115.33± 1.76	75.33± 5.70	34.67± 3.33	40.67± 2.40	82.00± 2.89	3.93± 0.42	64.67± 2.67
	F	154.67± 8.01	8.47± 0.41	110.00± 5.77	71.67± 2.03	33.00± 1.73	38.67± 1.76	78.67± 14.10	4.43± 0.73	61.00± 10.69
Frizzle	M	154.33± 2.73	6.77± 1.05	113.67± 5.67	76.67± 0.88	39.33± 1.20	37.33± 1.86	66.67± 7.67	3.27± 0.66	56.33± 7.84
	F	109.00± 47.52	6.73± 1.12	110.00± 5.29	73.67± 4.84	36.00± 1.55	37.67± 3.84	90.00± 4.00	3.57± 1.82	25.67± 4.48
Fulani ecotype	M	144.67± 4.81	6.50± 0.86	107.60± 4.36	67.67± 0.88	29.67± 1.45	38.67± 2.00	70.33± 1.45	3.57± 0.15	30.33± 1.18
	F	152.67± 4.05	6.03± 0.49	111.33± 4.33	74.00± 3.76	31.33± 3.18	42.67± 0.67	67.33± 2.03	3.93± 1.64	53.67± 0.88
Naked neck	M	145.00± 14.64	11.03± 1.80	97.33± 10.73	64.67± 5.81	30.00± 5.29	34.67± 0.67	70.67± 6.64	2.63± 0.35	33.33± 16.13
	F	150.33± 7.17	7.63± 1.01	96.00± 11.24	64.33± 8.09	28.00± 3.06	37.00± 5.51	74.33± 1.76	4.03± 1.20	39.67± 0.88
Normal feathered	M	137.67± 1.86	10.10± 1.56	98.00± 1.15	74.67± 4.37	32.33± 5.04	42.33± 2.96	59.00± 6.93	3.57± 0.13	30.00± 3.61
	F	150.33± 6.85	7.73± 1.01	104.67± 3.71	79.33± 5.70	38.67± 3.71	34.00± 2.00	86.00± 4.00	2.77± 0.53	54.00± 7.23
Overall		145.23± 27.18	8.05± 2.39	106.33± 11.27	72.20± 8.42	33.30± 5.95	38.30± 4.84	74.50± 12.98	3.57± 1.47	44.87± 17.57

M: male; F: female.

Table 2 Effect of sex on serum electrolytes and plasma protein of Nigerian indigenous chicken

Parameters	Sex	
	Males (n=20)	Females (n=20)
Sodium (mmoi/L)	147.07±3.26	143.40±9.54
Potassium (mmoi/L)	8.78±0.75	7.32±0.40
Chloride (mmoi/L)	106.27±2.99	106.40±2.93
Total protein (g/L)	71.80±2.02	72.60±2.38
Globulin (g/L)	33.20±1.69	33.40±1.43
Albumin (g/L)	38.60±1.07	33.40±1.43
Creatinin (µmoi/L)	69.73±2.93^{b}	79.27±3.39^{a}
Uric acid (mg/dL)	3.39±0.73	3.75±0.51
Glucose (mg/dL)	42.93±5.03	46.80±4.09

The means within the same row with different letter, are significantly different (P<0.05).

Table 3 Effects of genotype on blood serum electrolytes and serum protein level (±standard errors) of five Nigerian indigenous chicken

Parameters	Genotypes				
	Dwarf	Frizzle	Fulani Ecotype	Naked Neck	Normal Feathered
Sodium (mmoi/L)	154.17±6.53	131.67±25.13	148.67± 4.43	147.67± 10.91	144.00± 4.36
Potassium (mmoi/L)	8.99± 1.31^{ab}	6.75 ± 1.09b^{c}	6.27 ± 0.68^{c}	9.36± 1.41^{a}	8.92± 1.29^{ab}
Chloride (mmoi/L)	112.67±3.77^{a}	111.84±5.47^{a}	109.17±4.35^{ab}	96.67±10.99^{b}	101.34±2.43^{ab}
Total protein (g/L)	73.50±3.87^{ab}	75.17±2.86^{a}	70.84±2.32^{b}	64.50±6.95^{c}	77.00±5.04^{a}
Globulin (g/L)	33.84±2.53^{ab}	37.67±1.38^{a}	30.50±2.32^{b}	29.00±4.18^{b}	35.50±4.38^{ab}
Albumin (g/L)	39.67±2.08	37.50±2.85	40.67±1.34	35.84±3.09	38.17±2.48
Creatinine (µmoi/L)	80.34±8.50	78.34±5.84	68.83±1.74	72.50±4.20	72.50±5.47
Uric acid (mg/dL)	4.18±0.58^{a}	3.42±1.24^{b}	3.75±0.90^{ab}	3.33±0.78b	3.17±0.33^{b}
Glucose (mg/dL)	62.84±6.68^{a}	41.00±6.16^{b}	42.00±2.03^{b}	36.50±2.25^{b}	42.00±5.42^{b}

The means within the same row with at least one common letter, do not have significant difference (P>0.05).

Sodium is present in the extracellular fluid and is primarily responsible for determining the value of the extracellular fluid and its osmotic pressure. Serum sodium levels in the Nigerian indigenous chicken did not differ significantly between male and females (Table 2). This agrees with the work of Homswat *et al*. (1999) who found no differences between sexes. The value 147.07+3.26 (mmoi/L) in the present study falls within the normal range of serum sodium in mature birds 130-150 mmoi/L (Sturkie, 1965), however Simaraks *et al*. (2004) have previously reported higher values in females.

Serum chloride levels in Nigerian indigenous chicken were not significantly different between the sexes (Table 2) in agreement with Siller and Wight (1997) and Simaraks *et al.* (2004) findings in pheasant and Thai indigenous chicken. However, serum chloride level in the Nigerian indigenous birds were significantly ($P<0.05$) different, with the dwarf chicken having the highest value 112.67+3.77 mmoi/L and the naked neck recording the least 96.67±10.99 mmoi/L in the present study. The serum chloride level was not different from the reference range 108-124 mmoi/l. In birds, uric acid is a major product of the catabolism of nitrogen; age, species and diet may influence the concentration of blood uric acid. (Lumeij, 1997; Simaraks *et al*. 2004). Serum uric acid in the present study did not show any significant difference with sex ($P>0.05$).

This is contrary to the findings of Sturkie (1965) and Simaraks *et al*. (2004) who reviewed that serum uric acid of mature female birds was higher than that of male chickens. Across genotypes, there is a statistical difference ($P<0.05$) with respect to uric acid .All the uric acid values were within the reference value 1.9-12.5 mg/dL of Clinical diagnostic division (1990).

Creatinin contents have been shown to depend on the quantity and quality of dietary protein (Eggum, 1970; Iyayi and Tewe, 1998; Awosanya *et al*. 1999 and Esonu *et al*. 2001). The values for creatinin recorded in the present study differed significantly among the two sexes, with the female recording higher values 79.27±3.39 µmoi/L and the male 69.73±2.93 µmoi/L. Serum creatinin is a waste product found in muscle from a high energy storage compound, creatinin phosphate is also an indication of higher muscle mass (Ladokun *et al*. 2008).Variation due to genotype did not occur in the present study. This observation disagrees with the findings in earlier studies in other species of birds (Olayemi *et al*. 2006).

The mean values of albumin and globulin contents of the two sexes were not significantly influenced as previously identified by Shimidt *et al*. (2007) and Ladokun *et al.* (2008) in ring-naked pheasant and Nigerian indigenous chicken. The overall mean values of albumin in this study were 38.60+1.07 g/L and 38.00+1.44 g/L and the globulin values were 33.20+1.69 g/L and 33.40+1.43 g/L in male and female Nigerian indigenous chicken respectively. The increase in protein values recorded in the current study was reflected both in the albumin and globulin values separately. It is evident that globulin in the present study shows significant ($P<0.05$) difference with frizzle chickens recording higher values than the other four genotypes 37.67+1.38 g/L.

The variation in the genotype values of globulin recorded in this study were similar to the reports of Homswat *et al.* (1999) and Simaraks *et al*. (2004). However, the serum glucose level in male and female chicken did not show any difference. Mary-Priya and Gomathy (2008) reported that blood glucose increases until maturity and then subsequently decrease gradually throughout the bird's life. Across the genotype, a significant difference ($P<0.05$) was observed. Dwarf chickens had a greater glucose level 62.84$\pm$6.68 mg/dL compared to frizzle, Fulani ecotype, naked neck and normal feathered birds (Table 3). The higher glucose level in dwarf is an indication of breed difference.

CONCLUSION

In conclusion, we found that creatinin significantly differed in accordance with sex while biochemical parameters (potassium, chloride, total protein, globulin, uric acid and glucose) significantly differed in accordance with genotype, which could be utilized within cross breeding programmes since it is necessary to generate quantitative and qualitative data to understand and support the local chicken production. The present study in Nigerian indigenous chicken has added information towards the goal of understanding local chicken physiology in order to produce individuals that are fit and more productive.

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