

Blood Biochemical Parameters Exploration in Broilers and Local Chickens in Korhogo, Côte d'Ivoire

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Abstract Serum biochemical profile provides valuable information about health and immune status of animals. These biochemical parameters values are influenced by species, age, sex, season, geographic region, nutrition and physiological conditions. The aim of the work is to explore the blood biochemical parameters of broilers and local chickens for consumption in the city of Korhogo. To do this, a venous blood sample was taken from 64 chickens, including 32 local chickens and 32 broiler seemingly healthy chickens for the biochemical tests. The mean values of glucose and phosphorus are within the international reference ranges. In contrast, total protein was higher and uric acid and calcium were below these ranges for both groups of chickens. ASAT (Aspartate aminotransferase) levels were significantly higher in females of local chickens than in males. In contrast, uric acid and phosphorus levels were higher in males than in females in both groups of chicken. Hypocalcemia was observed in all local chickens. Some parameters are within the reference ranges and others are not. They are generally higher in broilers than in local chickens.

Keywords: *biochemical parameters, local chicken, broilers, Korhogo*

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1. Introduction

Biochemical analyzes are crucial importance in the detection, diagnosis and follow-up of patients in both humans and animals. In fact, blood constituents' studies play vital role in assessing the physiological, pathological and nutritional status of an organism. It provides the opportunity to evaluate the presence of several metabolites and other constituents in the body of animals [1]. The serum biochemical profile provides valuable information about health and immune status of animals [2]. The first task is to establish reference values for the relevant population, i.e., the value obtained by observation or measurement on supposedly healthy individuals selected using well-defined criteria [3]. It is well known that, biochemical parameters values are influenced by species, age, sex, season, geographic region, nutrition, and physiological condition [4] and genotype factors in birds [5]. It is therefore desirable to have data in all regions of the world and particularly in Africa where local breeds of chicken are found.

In Côte d'Ivoire poultry production plays an important social and cultural role. Indeed, on the one hand, it represents a large part of subsistence agriculture generating income in rural households, and on the other

hand, modern breeding, mainly of broilers, is an important source of income for a part of the population. In Korhogo, 82% of local chicken production is for both domestic consumption and marketing [6]. However, the sector is experiencing many difficulties, including those of mastery of the reference blood biological parameters. Yet it is known that blood profile data could be used to improve chicken farms [7]. Studies have investigated the biochemical parameters of broilers in other parts of the world and in Africa [8,9] and local chickens [10,11]. To our knowledge, it seems that studies on the biochemical profile of broilers and local chickens have never been conducted in Côte d'Ivoire. The aim of this work is to explore and compare the biochemical blood parameters of broilers and local chickens, intended for consumption in Korhogo, with known reference values. These values could be used for clinical pathological diagnosis and other studies.

2. Methodology

2.1. Experimental Site and Birds

The experiment was carried out from December 2020 to February 2021 in the department of Korhogo situated between 5°16 and 6°16 of longitude West, and at latitude

8°32 and 10°20 North in the northern Côte d'Ivoire. A total of 64 chickens, including 32 local chickens (22 males and 10 females) and 32 broilers (11 males and 21 females) of different ages and apparently healthy, were selected randomly for the study. The average age of the local chickens was 31±9.2 weeks and the broilers 5.4±0.46 weeks. Local chickens were sourced from smallholder poultry farmers from the villages of the Korhogo region. Broilers (Cobb 500) were obtained from several farms in the Korhogo region. This is a descriptive cross-sectional study in chickens intended for consumption at the poultry market in Korhogo.

2.2. Collection and Analysis of Blood Sample

In each bird, a venous blood sample is taken from the jugular vein in dry tubes in the morning between 7:00 and 9:00 am. These blood samples, placed in a cooler with ice, are transported before 12 o'clock on the day of the sampling to the laboratory of Peleforo GON COULIBALY University Health Centre in Korhogo for the performance of biochemical tests. Before they were centrifuged at 3000 rpm for 5 minutes and the serum was aliquoted into micro bowls and was stored at -20°C until further analyses.

Serum parameters including total protein, aspartate amino-transferase (ASAT), uric acid, calcium, phosphorus and glucose were determined by semi auto biochemical analyzer (RAYTO RT-9200) by using standard commercial diagnostic kits.

2.3. Statistical Analysis

For statistical analysis, the data were entered and analysed on STATISTICA software (Windows version 7.1). The mean values of the different biochemical parameters in the birds were compared using the non-parametric Mann Whitney U test. Comparisons of the different proportions obtained of the main blood biochemical parameters were performed by the Loglikelihood ratio test ("G" test) with the statistical software "R" version Windows 2.0.1. The level of significance was reported at less than $P < 0.05$.

2.4. Ethics

Experimental procedures and protocols used in this study were approved by ethical committee of Health Sciences, University Peleforo Gon Coulibaly (Korhogo/Côte d'Ivoire). These guide lines were in accordance with the internationally accepted principles for laboratory use and care. Then, this study was approved by the Ministry of Animal Production and Fishery Resources in the Republic of Côte d'Ivoire.

3. Results

3.1. Mean Values of Biochemical Parameters

The mean values of the different biochemical parameters associated with the standard error on mean (ESM) are presented in [Table 1](#) and [Table 2](#).

Glucose: The mean concentration of glucose in broilers and in local chickens was 2.77±0.06 and 2.22±0.09 g/L with extremes ranging from 1.96 to 3.19 and then 0.74 to 3.11, respectively. This concentration was higher in broilers than in local chickens with a very significant difference ($P < 0.001$). It was higher in males than in females of broilers and, in contrast, in females of local chickens than in males with no significant difference in both cases.

Total protein: The mean total protein values were 6.16±0.58 and 5.22±0.64 g/dL in local and broilers, respectively, with extremes of 2 to 16 g/dL and then 1 to 15 g/dL. It was higher in males than in females without significant difference in all birds.

Aspartate amino transferase: The mean concentrations of ASAT were 87.80±14.97 and 68.06±10.93 IU/L in local and broilers, respectively. Extreme values in local chickens were 5.60 to 320.3 IU/L. Mean values were higher in females than males with a very significant difference ($P < 0.01$). However, it was higher in males than in females in broilers without significant difference. Extreme values for these were 0.6 to 250.3 IU/L.

Uric acid: The mean value was 1.34±0.21 and 1.58±0.19 mg/dl in local and broilers, respectively. These mean values were smaller than the minimum reference values. Extreme values in local chickens ranged from 0.12 to 5.28 mg/dl. Mean values were higher in males than in females, with a very significant difference ($P < 0.01$). However, it was higher in females than in males of broilers with no significant difference. Extreme values for these were 0.47 to 5.08 mg/dl.

Calcium: The mean calcium concentration which was 3.95±0.50 mg/dl in local chickens and 6.37±0.62 mg/dl in broilers. It was higher in broilers with a highly significant difference ($P < 0.001$), extremes ranged from 0.25 to 8.03 mg/dl and 1.28 to 10.97 mg/dl in local chickens and broilers, respectively. These means were higher in male local chickens compared to females, in contrast, higher in females than in male broilers without significant difference.

Phosphorus: The mean value was 5.40±0.03 and 5.43±0.05 mg/dl in local and broilers, respectively. Extreme values in broilers were 4.86 to 5.70 mg/dl. Mean values were higher in males than in females, with a very significant difference ($P < 0.001$). Similarly, it was higher in females than in males of local chickens with no significant difference. Extreme values for these were 5.01 to 5.69 mg/dl.

3.2. Proportion of Blood Biochemical Parameters

The distribution of biochemical parameters of all chicken according to international reference standards is presented in [Table 3](#).

Hypoglycaemia was more observed in local chickens (21.88%) than in broilers (3.13%) with a very highly significant difference ($P < 0.001$). Hyperglycaemia occurred only in broilers (28.12%). Hyperprotidemia was 50% in broilers and 40.62% in local chickens. The hypoprotidemia of 37.5% in broilers was higher than in local chickens (12.5%) with a very highly significant difference ($P < 0.001$).

Table 1. Mean values of biochemical parameters in local chicken

Biochemical parameters	Total population n=32			Male n=22			Female n=10			P value	Reference values [12,13]
	Mean ± SEM	Min	Max	Mean ± SEM	Min	Max	Mean ± SEM	Min	Max		
Glucose (g/L)	2.22±0.09	0.74	3.11	2.15±0.12	0.74	3.11	2.39±0.10	1.97	2.91	0.2132 (NS)	1.97-2.99
Total protein (g/dL)	6.16±0.58	2.00	16.00	6.68±0.81	2.00	16.00	5.00±0.26	4.00	6.00	0.3730 (NS)	3.3-4.5
ASAT (UI/L)	87.80±14.97	5.60	320.3	56.38±11.74	5.60	228.8	163.14±31.39	33.9	330.3	0.0056 (S)	<230
Uric acid (mg/dl)	1.34±0.21	0.12	5.28	1.63±0.27	0.18	5.28	0.70±0.19	0.12	2.21	0.0116 (S)	1.9-12.5
Calcium (mg/dl)	3.95±0.50	0.25	8.03	3.64±0.65	0.25	8.03	4.60±0.74	2.10	7.53	0.4395 (NS)	8.1 - 12
Phosphorus (mg/dL)	5.40±0.03	5.01	5.69	5.37±0.03	5.01	5.60	5.45±0.08	5.01	5.69	0.1080 (NS)	5-7

n: Total number of each subjects group; ASAT: Aspartate amino-transferase; SEM: Standard error of mean; Min: Minimum; Max: Maximum; S: Statistically different for P value < 0.05; NS: Not statistically significant for p value > 0.05.

Table 2. Mean values of biochemical parameters in broiler chicken

Biochemical parameters	Total population n=32			Male n=11			Female n=21			P value	Reference values [12,13]
	Mean ± SEM	Min	Max	Mean ± SEM	Min	Max	Mean ± SEM	Min	Max		
Glucose (g/L)	2.77±0.06	1.96	3.32	2.83±0.08	2.41	3.32	2.74±0.08	1.96	3.19	0.7204(NS)	1.97-2.99
Total Protein (g/dL)	5.22±0.64	1.00	15.00	5.64±1.42	2.00	15.00	5.00±0.68	1.00	15.00	0.6290 (NS)	3.3-4.5
ASAT (UI/L)	68.06±10.93	0.6	250.3	88.15±15.22	20.20	181.5	51.06±14.67	0.6	250.3	0.9525 (NS)	<230
Uric acid (mg/dl)	1.58±0.19	0.47	5.08	1.05±0.12	0.47	1.65	1.86±0.27	0.58	5.08	0.0916 (NS)	1.9-12.5
Calcium (mg/dl)	6.37±0.62	1.28	10.97	7.37±1.09	1.72	10.97	5.85±0.75	1.28	10.32	0.1265 (NS)	8.1 - 12
Phosphorus (mg/dL)	5.43±0.05	4.86	5.70	5.55±0.05	5.20	5.70	5.36±0.06	4.86	5.68	0.0145 (S)	5-7

n: Total number of each subjects group; ASAT: Aspartate amino-transferase; SEM: Standard error of mean; Min: Minimum; Max: Maximum; S: Statistically different for P value < 0.05; NS: Not statistically significant for p value > 0.05.

Table 3. Proportions of the main biochemical parameter in all chicken

Biochemical parameters	Local chicken n=32		Broiler chicken n=32	
	n	%	n	%
Glucose (g/L)				
< 1.97	7	21.88	1	3.13***
1.97 - 2.99	25	78.12	22	68.75
>2.99	0	0	9	28.12***
Total protein (g/dL)				
< 3.3	4	12.5	12	37.5***
3.3 - 4.5	15	46.87	4	12.5
>4.5	13	40.62	16	50.0
ASAT (UI/L)				
< 230	28	87.5	31	96.87
>230	4	12.5	1	3.13*
Uric acid (mg/dl)				
< 1.9	23	71.87	14	43.75**
1.9 - 12.5	9	28.13	18	56.25**
>12.5	0	0	0	0
Calcium (mg/dl)				
< 8.10	32	100	20	62.5**
8.10 - 12.0	0	0	12	37.5***
>12.0	0	0	0	0
Phosphorus (mg/dL)				
< 5	0	0	4	12.5***
5 - 7	32	100	28	87.5
>7	0	0	0	0

n: Total number of each subjects group; ASAT: Aspartate amino-transferase; *: Groups with differences were significant at p < 0.05; **: Groups with differences were significant at p < 0.01, ***: Groups with differences were significant at p < 0.001.

The percentage of elevated ASAT was 12.5 and 3.13% in local and broilers respectively with a significant difference (P < 0.05). Hypouricemia was more observed in local chickens (71.87%) than in broilers (43.75%) with

a very significant difference (P < 0.01). Hypocalcaemia was observed in all local chickens. Also 62.5% of broilers had hypocalcaemia. Hypophosphoremia was observed only in broilers.

4. Discussion

It is known that serum biochemical constituents reflect the health, nutrition, climate and management conditions to which the animals are submitted [14]. Exploration of these blood biochemical parameters is most needed in countries where these values are not listed. Among the blood biochemical parameters of the study, mean values of glucose, ASAT and phosphorus are within the international reference ranges. However, total protein, uric acid and calcium are outside these ranges. The values of these blood biochemical parameters do not follow international trends. Thus, the mean value of total protein in both broilers and local chickens was above the upper limit of the reference limits. That of local chickens was higher than the value obtained in the work of [11,15,16,17,18]. Similarly, the mean total protein in this study was higher than that of [16,18,19]. Contrary to the results of these studies, the total protein level was higher in the males of this study.

This difference can be explained by the environment and the conditions of experimentation. These conditions according to [20] vary the blood biochemical parameters in birds. Total protein levels were very high in this study [21] reported in their work that total protein levels were highest in older broiler during fattening, which would explain this level in this study.

However, a fractionation of protein types in plasma would locate on the hyperprotidemia of the study. Indeed, the work of [22] and [23] have indicated that electrophoresis is one of the most important methods for evaluating any

changes in the serum protein concentrations, in particular in cases of hyperprotidemia, by describing the distribution of the protein fractions and distinguishing the polyclonal increase (inflammatory) gamma globulins and protein. Generally, dehydration in birds is one of the causes of the increase in total protein. The storage conditions for chickens before sale still do not meet the same conditions as the farms from which these animals come, which can cause permanent dehydration of birds.

The average glucose level of all chickens is within the reference values. It is known that glucose and triglycerides are the main metabolites which are closely related to the sustainability of the energy supply for the implementation of the physiological and biochemical functions of the organism [24].

The mean value within the reference values is indicative of good glucose intake in the chickens of the study to achieve these physiological and biochemical functions. However, this value is significantly higher in broilers compared to local chickens. In addition, hypoglycaemia was significantly higher in local chickens. Local or domestic chickens receive nutrients only from the ration consumed and the amount of this ration depends on several factors such as gender, age, food energy level and ambient temperature [25]. Broilers have unfettered access to high-energy food, while local chickens search around the concessions for their daily rations. They not only have difficult access to food but spend more energy searching for food. In addition, the traditional way of raising poultry, characterized by the rambling of poultry, also exposes them to a quantitative and qualitative food shortage, especially when the immediate environment is poor in agricultural or domestic food debris [26]. This difference in access to food would explain the differences in the glucose status of the study chickens. In addition, [27] showed that glucose levels were influenced by the interaction between collection period, sex, and lighting conditions in broilers. Furthermore, the method of sampling and storage influences the value measured as demonstrated by [28].

The mean of ASAT obtained in this study is lower than that obtained by [29] and [30] in Nigeria and then [31] in Malaysia. Aspartate amino transferase is a sensitive indicator of liver disease in birds. Although not specific, it is the best measure of liver disease in birds [32].

[33] indicated that aspartate aminotransferase activity may be used as an indicator of functional and/or morphological liver damage in chickens. The elevated ASAT in the local chickens in the study was significantly higher. This could be caused by liver and/or muscle disorders. The determination of creatine phosphokinase (CPK) would have located the cause of the increase in ASAT in local chickens in this study.

The mean value of uric acid in both types of chicken in the study is below the lower limit of the reference values. It is also lower than that obtained by [34] in Brazil and [35] in South Africa. According to the literature, A high level of uric acid is usually obvious in female birds due to ovulatory activities [36]. In contrast, mean uric acid was significantly higher in males than in females of local chickens in this study. The average age (31 ± 9.2 weeks) of the local chickens would be the main cause, since females do not lay eggs at this age. Females in broilers, on the

other hand, had higher uric acid levels than males without any significant difference. Age, sex and diet of birds are known to influence the amount of uric acid [36].

The hypocalcaemia observed in all local chickens indicates low serum calcium levels in them. Dietary components are known to influence mineral balance by affecting blood calcium levels [37]. The diet of local chickens, which is not pre-defined, would explain this low serum calcium level. This average is lower than that obtained in the work of [18] in Nigeria, by [17] in India in native chickens. Serum calcium was higher in broilers compared to local chickens with a very significant difference. Yet, calcium plays pivotal roles in metabolism, blood clotting, enzyme activation, neuromuscular function, muscle contraction, cell adhesion, and intracellular signalling [38] Although maximum bone mineralization during growth increases dietary calcium requirements [39], a calcium supplement should be provided to the local chicken feed.

In contrast to [11] work, serum phosphorus was higher in local chickens than in broilers and was significantly different by sex in broilers.

5. Conclusion

At the conclusion of the study, it should be noted that the mean values of glucose, uric acid, calcium and phosphorus are higher in broilers than in local chickens with a significant difference in glucose and calcium. Conversely, total protein and ASAT levels are higher in local chickens than in broilers without any significant difference. These values differ for most international reference values. A study of a higher sample, particularly in local chickens, should be considered to establish biochemical reference standards for blood.

Contribution of Authors

All the authors contributed equally. They read the final version, and approved it for the publication.

Conflict of Interest

The authors declare that they do not have conflict of interest.

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