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Profile of Serum Metabolites and Proteins of Broiler Breeders in Rearing Age

ABSTRACT

The excellence of modern broiler production is based on the genetic improvement of broiler strains for high growth rate and high egg production, associated with technological developments in nutrition, management, and health. Over the last decades, the clinical biochemistry of broilers has been studied to determine serum biochemical component values; however, there are still many knowledge gaps on factors that determine changes in these values. In this study, the serum lipid and protein profiles of 4-week-old male and female Cobb broiler breeders were evaluated. Blood samples were collected on a commercial farm located in the city of Uberlândia, MG, Brazil. The following parameters were evaluated: total protein, albumin, globulin, albumin to globulin ratio (A/V), uric acid, urea, cholesterol, and triglyceride levels using an automatic analyzer. The results showed sex-specific biochemical patterns for most blood parameters evaluated. Moreover, the obtained values were different from those obtained in many published studies with broilers and commercial layers, stressing the need to develop further studies with chickens of different ages.

INTRODUCTION

The Brazilian poultry industry has significantly developed in recent years, and today is one of the most important economic activities in that country. Its outstanding productivity is based on recent progresses in poultry production, which is today characterized by high competitiveness and advanced technological standards (Silva, 2000).

In order to maximize the production potential of poultry, body functions need to be in perfect balance, known as homeostasis. In this context, the knowledge of the levels of some blood parameters provides important information to determine body balance status, reflecting the requirements of metabolic processes.

Blood biochemical analysis is widely used to assist the diagnosis and characterization of diseases in most animal species, but it is seldom used in avian species. However, it is an important tool, as some metabolic disorders are difficult to detect only by clinical signs (Andreasen *et al.*, 1996). It can also assist the monitoring of poultry health, the diagnosis and treatment of diseases, and to assess their health status (Schmidt *et al.*, 2007).

The aim of this study was to determine the profile of serum proteins, lipids, and metabolites of Cobb broiler breeders, so that it could be used as a benchmark for a comparative analysis between males and females in a commercial breeding system, at the age of four weeks.



MATERIAL AND METHODS

Birds, management, and diets

All the procedures applied in this study were conducted in accordance with the standards of the Ethics Committee on the Use of Animals of the Federal University of Uberlândia, and approved under protocol CEUA/UFU 004/16.

The study was conducted on a commercial broiler breeder farm, located in Uberlândia, state of Minas Gerais, Brazil, in April of 2016.

In total, 13,500 female and 1,755 day-old male Cobb breeders were housed in a 2800-m² house. The house was equipped with nipple drinkers, automatic trough feeders, air conditioning system with exhaustion fans, and evaporative cooling pads. During the first three days, a photoperiod of 23 h of light was applied, after which it was gradually decreased and stabilized at 9 h of light from the third week on. The light intensity was 4 lux, and controlled by black/silver curtains.

During the four first weeks of age, the broilers were fed a starter diet based on corn and soybean meal, containing 20.5% crude protein and 2950 kcal metabolizable energy/kg. Feed intake was daily monitored for body weight control.

Blood sampling and weight of broilers

At 28 days of age, 15 birds of each gender were individually weighed on digital scale (1g accuracy), and then blood samples were collected by puncture of the ulnar vein, using sterile syringes and needles after 6 h of fasting. An aliquot of 3mL of blood was collected and transferred to sterile tubes without anticoagulant. The collected blood samples were submitted in insulated boxes to the Clinical Laboratory of the Veterinary Hospital of the Federal University of Uberlândia. Upon arrival, samples were centrifuged at 720xg for 10 minutes. The obtained sera were transferred to microtubes and stored under refrigeration (2° to 8° C) for 24 hours until serum biochemical analyses.

Levels of total protein (biuret method), albumin (bromocresol green method), globulins (calculated as the difference between the total protein and albumin), uric acid (Trinder enzymatic method), urea (ultraviolet kinetic enzymatic method), total cholesterol, and triglycerides (Trinder enzymatic method) were determined in individual samples in an automatic analyzer (Chemwell®, Megazyme, Wicklow, Ireland), and using commercial kits (Labtest Diagnóstica S.A, Lagoa Santa, Brazil). The automatic analyzer was

previously calibrated with caliber 1 and measured with the control serum Qualitrol 1H, both manufactured by Labtest Diagnóstica®.

Statistical Analysis

Data were analyzed according to a completely randomized design, with 15 sampling units per gender to evaluate the effect of the gender of 4-week-old broilers on blood chemical profile.

Data normality was tested by the Kolmogorov-Smirnov test at 5% significance levels, which showed that presented normal distribution. Data were submitted to analysis of variance, and the test of Tukey was applied to determine possible difference between genders, at 5% significance levels. The software GraphPad Prism 5.1 was used for statistical analyses.

RESULTS

Body weight

Average body weights of 538.33±14.10 g and 686.80±23.16 g were determined for females and males, respectively, and were statistically different ($p<0.05$) (Table 1).

Table 1 – Mean and standard deviation values of the body weight and serum biochemical parameters of 4-week-old female and male broiler breeders.

Parameter	Females	Males
Body weight (g)	538.33a ± 14,10	686.80b ± 23.16
Total protein (g/L)	28.00b ± 4.30	24.60a ± 4.20
Albumin (g/L)	13.70b ± 1.90	10.60a ± 1.90
Globulins (g/L)	14.30 ± 2.60	14.00 ± 2.80
A/G ratio	0.97b ± 0.11	0.77a ± 0.13
Uric acid (mmol/L)	3.71a ± 1.50	5.03b ± 1.40
Urea (mmol/L)	6.50 ± 2.21	7.34 ± 3.75
Cholesterol (mmol/L)	3.44b ± 0.53	2.80a ± 0.43
Triglycerides (mmol/L)	0.57a ± 0.21	1.25b ± 0.22

A/G ratio = Albumin / Globulin ratio

Mean followed by different letters in the same row differ by the Tukey test ($p<0.05$).

Serum biochemical parameters

Comparing the serum biochemical parameters between males and females, it was observed that females presented significantly higher serum concentrations of total protein, albumin, A/G ratio, cholesterol, uric acid, and triglycerides than males ($p<0.05$), while the serum concentrations of globulin and urea were similar ($p>0.05$) for males and females (Table 1).



DISCUSSION

Body weight

The genetic improvement of broilers for fast growth, high-meat yield, and good feed conversion ratio entails the selection of broiler breeders with these characteristics. However, when broiler breeders are fed *ad libitum*, they present excessive body weight and fat accumulation, which compromises their productive and reproductive performance. Therefore, it is essential to control their body weight, mainly during the rearing period, to allow them to achieve sexual maturity with adequate body weight and at the desired age (Vieira *et al.*, 1995).

The body weight recommended by the genetic company (Cobb, 2013) for 4-week-old breeders of the evaluated strain is 540g for females and 690g for males. In the present study, body weights of 538.33g and 686.80g were determined in females and males, respectively, corresponding to variations of -0.31% and -0.46% from the recommended values, respectively. These values are very close to those recommended for this strain, and therefore, indicate that the body development of the evaluated birds complied with the recommended standard.

Serum biochemical parameters

There are few studies available in literature (Schmidt *et al.*, 2007) on the blood biochemical profile of poultry.

Serum proteins are mainly synthesized in the liver, and, among other functions, maintain blood volume through the colloidal osmotic effect, buffer blood pH, transport hormones and drugs, participate in cell coagulation, catalyze chemical reactions (enzymes), regulate the metabolism (hormones), and participate in the body defense against foreign agents (Melillo, 2013).

The higher total protein concentration determined in the serum of females compared with males is attributed to their higher albumin values, as globulin values were statistically similar (Table 1). According to Harr *et al.* (2002), serum total protein values of broilers tend to be lower than those of mammals, ranging from 25.00 to 45.00 g/L.

Albumin values were higher in females than in males (Table 1), although males consumed a greater amount of feed and protein. Using the same diet, with intake of grams/broiler/day higher by males, the difference in values may suggest a higher protein intake by them, in order to meet the demand for higher body development. Ross *et al.* (1978) determined albumin

values of 10.80-16.10 g/L in broilers, whereas Barbosa *et al.* (2011) found 11.40-12.10 g/L in commercial layers during lay. The main functions of albumin are the transport of several molecules and the maintenance of blood oncotic pressure (Melillo, 2013).

The similar globulin values determined in males and females suggest that both genders presented the same health status at the age studied. Kudair & Al-Hussary (2010) showed increased globulin levels of in broilers submitted to vaccination (against infectious bronchitis, Newcastle disease and infectious bursal disease), with values ranging between 10.00-11.90 g/L in non-vaccinated birds and 16.30-19.20 g/L in the vaccinated ones.

The A/G ratio values of females were higher than those of males due to the higher albumin concentration in females. When this ratio is reduced, there may be hypoproteinemia, and may indicate acute or chronic inflammatory processes due to the elevation of globulins (Lumeij, 1997).

Higher uric acid values were determined in males than in females. Uric acid is the main product of protein nitrogen and purine metabolism in poultry. Approximately 90% of the uric acid is secreted by the proximal convoluted tubules in healthy broilers (Harr, 2002). The highest values found in males may reflect their protein metabolism rate at this age, as they have a higher body growth rate than females. According to Benez (2004), the values found in broilers ranged between 0.12 and 0.89 mmol/L. Ross *et al.* (1978) obtained an average serum uric acid levels of 0.46 mmol/L in broilers. Serum uric acid levels are influenced by the diet, hydration status, and species (Lumeij, 2008).

Serum urea levels were not influenced by gender. The urea values determined in the present study are consistent with those found by Batina *et al.* (2005) for broilers, ranging between 6.5 and 7.76 mg/dL.

Serum cholesterol levels were higher in females than in males. According to Peebles *et al.* (2004), the levels of LDL and VLDL, which are lipoproteins associated with the transport of cholesterol, are much lower in males than in females, compared to HDL levels, responsible for the reduction of serum cholesterol. Cholesterol levels can also be influenced by age, diet, and reproductive activity (Harr, 2002; Alonso-Alvarez, 2005). Ross *et al.* (1978) reported cholesterol values of 1.86-3.37 mmol/L in broilers.

Triglycerides are synthesized in the intestinal mucosa and in the liver from the digestion of dietary components and the absorption of fatty acids. Serum



triglyceride levels of poultry are influenced by sex, diet, and hormonal factors (Hochleithner, 1994). In the present study, the triglyceride levels of males were higher compared to females. On the other hand, Musa *et al.* (2007), in a study with 12-week-old chickens of the Anka and Rugao breeds, did not find significantly different levels of triglycerides between males e females. In the study of Evans *et al.* (1977), the serum triglyceride values in broilers ranged between 1.54 and 1.88 mmol/L, when a diet with around 3,000 kcal metabolizable energy/kg was fed. Comparing serum triglycerides levels between two commercial strains of broilers at 36 days of age reared under the same conditions, Osorio *et al.* (2012) obtained values of 0.28 mmol/L and 0.23 mmol/L, with a feed containing 18% crude protein and 3150 kcal metabolizable energy/kg.

CONCLUSIONS

The body weight of the broiler breeders evaluated in this study was within the recommended weight range for the genetic strain.

Most values of serum biochemical constituents evaluated were statistically different between females and males, suggesting a different pattern for each gender.

Further studies are required to evaluate the blood biochemical profile of broiler breeders, considering gender and age.

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