

A COMPARATIVE ANALYSIS OF SERUM BIOCHEMICAL AND HAEMATOLOGICAL PARAMETERS IN ARBOR ACRES AND MARSHALL BROILER STRAINS AT THE STARTER PHASE

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Abstract: This study evaluated and compared serum biochemical and haematological parameters of two commercial broiler strains (Arbor Acres and Marshall) during the 28-day starter phase. A total of 180 day-old unsexed chicks (90 per strain) were randomly assigned and reared under uniform deep-litter conditions. Blood samples were collected from 12 birds (6 per strain) on day 28. Results showed no statistically significant differences ($p > 0.05$) in serum biochemical indices such as triglycerides, cholesterol, lipoproteins, total protein, albumin, and globulin. Similarly, haematological indices and leukocyte differentials were comparable between strains. All measured values fell within established normal ranges for healthy broilers. The findings suggested that under identical management conditions, both strains exhibited similar physiological health during the starter phase. Therefore, strain selection for commercial production may be based on performance traits such as growth rate and carcass yield rather than baseline health metrics.

Keywords: Broiler Strains, Serum Biochemistry, Haematology, Starter Phase, Health Status.

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Introduction

Broiler chickens play a crucial role in global poultry production, a fact underscored by genetic and nutritional advances that have led to a dramatic increase in their growth rate and feed conversion efficiency over the past 50 years (Zuidhof *et al.*, 2014). The starter phase, spanning the first four weeks of life, is critical for physiological development, immune system establishment, and organogenesis (Gonzalez and Morales, 2020). During this period, stressors such as handling and vaccination may disrupt homeostasis, which can be reflected in blood parameters (Toghyani *et al.*, 2010).

Blood analysis is a reliable diagnostic tool for assessing internal physiological status. Serum biochemical parameters offer insights into nutritional adequacy, liver and kidney function, and lipid metabolism (Kaneko *et al.*, 2008). Haematological indices, on the other hand, reflect oxygen transport capacity, immune competence, and potential pathologies (Bah *et al.*, 2022). These parameters may vary with genetic background, including strain differences (Szabó *et al.*, 2005).

In Nigeria, Arbor Acres and Marshall strains are widely used in commercial broiler production. Understanding their physiological responses during the starter phase is essential for informed strain selection. This study aimed to compare the serum biochemical and haematological profiles of these strains under identical management conditions.

Materials and Methods

Experimental Site and Bird Management

The experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Ekiti State University, Ado-Ekiti. A total of 180 day-old unsexed chicks (90 Arbor Acres and 90 Marshall) were obtained from a certified hatchery. Birds were housed on deep litter for 28 days and provided *ad libitum* access to feed and water. The starter diet contained 24% crude protein and 2900 kcal/kg metabolizable energy. Standard brooding, vaccination, and medication protocols were followed. Experimental Design and Blood Collection

A completely randomized design was used, with two treatments (strains) and three replicates per treatment. Each replicate contained 30 birds. On day 28, two birds per replicate were

randomly selected for blood sampling, totaling 12 birds (6 per strain). Blood for serum biochemical analysis was collected into plain tubes, while samples for haematology were collected into EDTA-coated tubes.

Laboratory Analysis

Serum biochemical parameters such as triglycerides, total cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL), total protein, and albumin were analyzed using commercial enzymatic kits. Total protein was measured via the Biuret method, and albumin via the bromocresol green method. Globulin was calculated by subtracting albumin from total protein.

Haematological parameters including packed cell volume (PCV), haemoglobin (Hb), red blood cells (RBC), white blood cells (WBC), and platelets were determined using standard methods (Mitruka and Rawnsley, 1977). Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC) were calculated. Leukocyte differentials were assessed using Giemsa-stained blood smears.

Statistical Analysis

Data were analyzed using one-way ANOVA in SPSS version 20. The fixed effect was strain. Where significant differences occurred, means were separated using Duncan’s Multiple Range Test with significance set at $p < 0.05$.

Results

The results for serum biochemical parameters as presented in Table 1 showed no significant differences ($p > 0.05$) between the Arbor Acres and Marshall strains for any of the parameters measured. Similarly, the haematological indices (Table 2) and white blood cell differentials (Table 3) showed no significant ($p > 0.05$) variations between the two strains.

Discussion

The absence of significant differences in the serum biochemical and haematological parameters between Arbor Acres and Marshall broilers indicated a remarkable similarity in their fundamental physiological status when managed under identical conditions. The lipid profile, comprising triglycerides, cholesterol, low and high-density lipoprotein, was consistent between strains. For broilers, normal serum cholesterol levels typically range from 120 to 180 mg/dL, while triglycerides can vary from 50 to 130 mg/dL depending on diet and age (Alagawany *et al.*, 2017; Madhupriya *et al.*, 2020). Cholesterol is a precursor for steroid hormones and bile acids, and its levels are influenced by dietary intake and hepatic synthesis. Elevated levels (hypercholesterolemia) can be associated with high-energy diets, metabolic disorders, or liver dysfunction, while low levels may indicate malnutrition or malabsorption (Kaneko *et al.*, 2008).

The observed values for cholesterol and triglycerides in this study fell within the normal range, suggesting balanced lipid metabolism and adequate energy status in both strains. Additionally, the high high-density lipoprotein (HDL) values relative to low-density lipoprotein (LDL) are typical in birds and are considered a normal aspect of avian lipid physiology, with HDL being the primary carrier of cholesterol (Hermier, 1997; Beaufrère, and Ammersbach, 2020).

Table 1: Serum biochemical parameters (mean ± SEM) of broiler chickens at the starter phase

Parameters	Arbor Acres	Marshall
Triglyceride (mg/dL)	93.15 ± 1.71	92.87 ± 1.53
Cholesterol (mg/dL)	121.67 ± 2.32	119.98 ± 2.43
LDL (mg/dL)	16.87 ± 2.90	17.67 ± 3.45
HDL (mg/dL)	96.78 ± 2.23	95.84 ± 2.19
Total Protein (g/dL)	3.60 ± 0.83	3.64 ± 0.67
Albumin (g/dL)	2.10 ± 0.24	1.98 ± 0.53
Globulin (g/dL)	1.50 ± 0.59	1.66 ± 0.14

Table 2: Haematological indices (mean ± SEM) of broiler chickens at the starter phase

Parameters	Arbor Acres	Marshall
Packed Cell Volume (%)	28.27 ± 0.72	28.33 ± 0.44
Haemoglobin (g/dL)	10.42 ± 0.24	10.11 ± 0.15
Red Blood Cells (x10 ⁶ /μL)	1.84 ± 0.75	1.86 ± 0.04
White Blood Cells (x10 ³ /μL)	69.00 ± 1.93	69.10 ± 1.73
Platelets (x10 ³ /μL)	7.93 ± 0.23	7.31 ± 0.23
Mean Cell Volume (fL)	125.50 ± 0.47	124.02 ± 0.56
MCHC (g/dL)	33.10 ± 0.64	32.96 ± 0.49

Table 3: White blood cell differentials (%) (mean ± SEM) of broiler chickens

Parameters	Abor Acres	Marshall
Heterophils	61.00 ± 0.70	61.17 ± 0.62
Lymphocytes	31.00 ± 1.05	30.05 ± 0.85
Monocytes	3.33 ± 0.32	3.48 ± 0.34
Eosinophils	3.67 ± 0.40	3.98 ± 0.32

The values for total protein, albumin, and globulin were also comparable and within the documented normal range for broilers at this age, which is approximately 2.5–4.5 g/dL for total protein (Bah *et al.*, 2022; Kokore *et al.*, 2021). Total protein is a key indicator of nutritional status and liver function. Hypoproteinemia (low total protein) can result from protein malnutrition, malabsorption, or chronic liver and kidney diseases, leading to edema and impaired immunity (Thrall *et al.*, 2012). Hyperproteinemia is less common but often indicates dehydration or chronic inflammatory conditions. Albumin, synthesized by the liver, is the main determinant of plasma oncotic pressure. A low albumin level (hypoalbuminemia) is a sensitive marker of chronic liver insufficiency, protein-losing enteropathies, or renal disease (Kaneko *et al.*, 2008). The comparable albumin and globulin levels between strains suggest similar liver synthetic function and protein turnover.

The haematological profile provides a snapshot of the oxygen transport system and immune capacity. The Packed Cell Volume (PCV) and haemoglobin (Hb) values observed in this study are within the expected range for 4-week-old broilers, which is often reported as PCV 25–35% and Hb 8–12 g/dL (Bah *et al.*, 2022; Solomon, 2016). A low PCV (anaemia) can be caused by nutritional deficiencies (e.g., iron, folic acid), parasitic infections (e.g., coccidiosis), or chronic disease, resulting in reduced oxygen-carrying capacity and poor growth. A high PCV (polycythemia) is rare in poultry but could indicate dehydration or chronic respiratory disease. The non-significant difference in these parameters confirmed that both strains maintained similar erythropoietic activity and oxygen transport efficiency.

The Red Blood Cell (RBC) count is consistent with avian physiology, where erythrocytes are nucleated and fewer in number than in mammals. The calculated Mean Corpuscular Volume (MCV) and Mean Corpuscular Hemoglobin Concentration (MCHC) values further confirmed that the erythrocytes from both strains are normocytic and normochromic, showing no signs of morphological abnormalities indicative of nutritional deficiencies (Kokore *et al.*, 2021).

The total White Blood Cell (WBC) count fell within the broad normal range for young broilers, which can be highly variable ($20\text{--}80 \times 10^3/\mu\text{L}$) and is sensitive to stress and infection (Gross and Siegel, 1983; Ribeiro *et al.*, 2024). Leukocytosis (high WBC) is a common response to infection, inflammation, or stress. Conversely, leukopenia (low WBC) can occur during overwhelming infections or due to certain toxins, leading to immunosuppression. The leukogram, specifically the heterophil-to-lymphocyte (H:L) ratio, is a well-established indicator of stress in poultry. The H:L ratio in this study was approximately 1.97 for both strains, which is below the threshold of 2.0 often associated with significant physiological stress (Gross and Siegel, 1983). This suggested that the management conditions were adequate and did not induce a differential stress response between the strains. A high H:L ratio is a hallmark of a stress response mediated by corticosteroids, while a low ratio indicates a predominance of the adaptive immune system (lymphocytes) and a less-stressed state.

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