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Blood Profile of Finisher Broilers Fed Varying Levels of Synthetic Methionine Replacement

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ABSTRACT

Background and Objective: Methionine is an essential amino acid in poultry nutrition, acting as a fortifier against disease and a key component in protein synthesis. It is the first limiting amino acid in broiler diets, and synthetic methionine is often supplemented to enhance growth and health. This study aimed to evaluate the blood profile of finisher broiler birds fed varying replacement levels of synthetic methionine with Naturally Compounded Materials (NCM). **Materials and Methods:** A total of 150 Ross 308 broiler birds, aged four weeks, were randomly assigned to five dietary treatments in a Completely Randomized Design (CRD). Each treatment contained 30 birds, with three replicates of 10 birds each. Diets were formulated to include NCM at 0, 25, 50, 75, and 100% replacement levels for synthetic methionine. Feed and water were provided ad libitum for 28 days. Blood samples were collected from one bird per replicate via the jugular vein. Data were analyzed using ANOVA, and significant means were separated with Duncan's Multiple Range Test at a 5% level of significance. **Results:** Haematological parameters differed significantly across treatments, with treatment 4 showing the highest values for packed cell volume (33.40%), haemoglobin (12.16 g/dL), red blood cell (4.11×10^{12}/L), and white blood cell (10.09×10^{1}/L). Serum biochemical parameters were also significantly influenced, except for creatinine, which showed no statistical difference, though treatment 4 was numerically higher. Total protein (4.09 g/dL), albumin (2.15 g/dL), and globulin (1.94 g/dL) were highest in treatment 4. **Conclusion:** The replacement of synthetic methionine with NCM did not negatively affect broiler birds, as most blood and serum parameters remained within recommended ranges, confirming its potential as a viable dietary alternative.

KEYWORDS

Blood profile, finisher broiler, replacement levels, synthetic methionine

INTRODUCTION

Blood is a complex fluid with a large variety of dissolved, suspended inorganic and organic substances, or specialized circulating tissues and cells suspended in the intercellular fluid. Blood circulates in the arteries, veins, and capillaries of humans and animals. Its primary function is to transport oxygen from the respiratory organs to the body cells, distributing nutrients and enzymes to the cells and carrying away waste products, thereby maintaining homeostasis of the internal environment[1,2]. The various functions of

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blood are made possible by the individual and collective actions of its constituents (usually the biochemical and haematological components). Generally, both the biochemical and haematological blood components are influenced by the quantity and quality of feed and also the level of anti-nutritional elements or factors present in the feed[3].

Haematology study is the branch of science that focuses on the health and diseases associated with blood[4]. It deals with the study of cause, diagnosis, treatment, and prevention of diseases that is associated with the production of blood and other factors related to it. Factors which include cells of blood, haemoglobin, blood proteins, bone marrow, platelets, blood vessels, spleen, and the principles of coagulation in farm animals. It also involves treating diseases that affect the production of blood and its components[5]. The different functions of blood are often made possible by the activities of individuals and the collective actions of its constituents. According to the Mathivanan and Kalaiarasi[6] and Agbulu *et al.*[7], biochemical and haematological blood components are governed and marked by the quantity and quality of feed available and by the animal, and by the type and nature of anti-nutritional factors in the feed substance. Biochemical component indices are sensitive to different factors mainly present in the feed of the birds, which include some influence of toxicity.

Biochemical parameters also help to assess the protein quality and quantity of feed (especially total protein, albumin, and globulin)[3]. Blood chemistry indices also help to establish and monitor diagnostic baseline in blood characteristics for proper routine management practices of livestock[8,9]. This study focuses on the blood profile of finisher broiler birds fed replacement levels of synthetic methionine.

MATERIALS AND METHODS

Experimental site: The research work was conducted at the poultry unit of the Animal Production Technology Department, Federal College of Agriculture, Ishiagu, Ivo Local Government Area of Ebonyi State, from September to November, 2023.

Source and processing of raw materials: All the raw materials used for the research were purchased at the new market in Enugu State. Foreign fishmeal of 72% cp, soybean meal of 44% cp, and full-fat soya of 38% cp were also obtained. Blood meal of 77.50% CP was also obtained. The blood was crushed at the feed mill into meal.

Experimental design and management of birds: One hundred and fifty broiler birds of Ross 308 strain at four weeks of age were used for the experiment. The birds were randomly distributed to 5 groups. Each treatment was replicated three times in a Completely Randomized Design (CRD) with 10 birds per replicate, for a total of 30 birds per treatment. The birds were purchased from the 'Cosin farm' in Enugu, Enugu State. The birds were raised on a cemented floor covered with wood shavings as a source of litter. The pens were also divided into partitions such that each partition accommodated 10 birds. Feed and water were given *ad libitum* in the course of the experiment.

Five experimental diets were formulated, with diet 1 containing 0.35% of synthetic methionine.

Diets 2, 3, 4, and 5 contain Naturally Compounded Material (NCM) at the level of 0.25, 0.50, 0.75, and 100% for two stages of growth, namely the starter and finisher phases (Table 1 and 2).

At the end of the research work, blood samples were collected from the birds (one bird per replicate) to determine the biochemical and haematological parameters.

Statistical collection: All data collected in the course of the research work were subjected to Analysis of Variance (ANOVA), and the significant means were compared using Duncan's Multiple Range Test at a 5% significance level.

Table 1: Experimental diet for finisher broiler birds

	Treatment				
Ingredient	T1	T2	T3	T4	T5
Methionine	0.35	0.26	0.175	0.09	0.00
NCM	0.00	0.09	0.175	0.26	0.35
Total	100	100	100	100	100
Calculated value					
Crude protein (%)	19.45	19.68	19.76	19.93	19.99
MEnergy (Kcal/kg)	3007.90	3039.90	3075.15	3107.61	3119.80

NCM: Naturally Compounded Material, Maize-58.00, Wheat offal-6.90, Soybean meal-6.00, Groundnut cake-12.00, Fishmeal-1.50, Blood meal-3.50, Palm kernel cake-7.00, Limestone-1.50, Bone meal-2.50, Lysine-0.20, Finisher premix-0.35 and Salt-0.25

Table 2: Haematological indices of finisher broilers fed replacement levels of synthetic methionine

	Treatment					
Parameters	T1	T2	T3	T4	T5	SEM
Packed cell volume (%)	31.15^{c}	30.74^{c}	32.11^{b}	33.40^{a}	33.25^{a}	3.42
Haemoglobin (g/dL)	9.10	10.32	10.60	12.16	11.92	0.56
Red blood cell ($x10^{12}$/L)	3.68	3.90	3.81	4.11	4.07	0.14
White blood cell ($x10^{9}$/L)	8.30^{c}	9.22^{b}	9.71^{a}	10.09^{a}	9.92^{a}	0.38
MCV (fl)	78.60^{c}	78.82^{c}	84.28^{a}	81.27^{b}	83.17^{a}	6.78
MCH (pg/cell)	24.73^{c}	26.46^{b}	27.82^{b}	29.59^{a}	29.29^{a}	2.10
MCHC (%)	29.21^{c}	33.57^{b}	33.01^{b}	36.41^{a}	35.21^{a}	4.06

^{abc}Means on the same row with different superscripts are significantly ($p<0.05$) different, SEM: Standard Error of Mean, MCV: Mean corpuscular volume (fl), MCH: Mean Corpuscular Haemoglobin (pg/cell) and MCHC: Mean Corpuscular Haemoglobin Concentration (g/dL)

Ethical approval: The study does not in any way pose any threat to the life of the animal or humans. As such, it is ethically safe both professionally and locally at all points.

Statement of human and animal rights: As a matter of fact, the study agrees with the tenacity of the European Union, which advocated for the use of natural materials over synthetic ones in livestock production, which has the ability to negatively impact the birds and their end users.

Statement of informed consent: The use of natural raw materials for the production of the NCM is acceptable to all authorities, as far as feed production for broiler birds is concerned. Disparity of consent did not arise, since there were no toxic substances included in the production of the diet.

RESULTS AND DISCUSSION

Results of the blood profile of finisher broiler birds fed replacement levels of synthetic methionine are shown in Table 2. Packed cell volume had a superior ($p<0.05$) value of 33.40% in treatment 4, which was similar to that of 33.25% found in treatment 5. The least value of 30.74% was seen in treatment 2, which did not differ from that obtained in treatment 1 with 31.15%. While a Packed Cell Volume (PCV) of 32.11% was obtained in treatment 3, respectively. The values obtained showed conformity with the standard range of PCV (22.00-37.50%) as outlined by Kahn and Line[3] and David *et al.*[8]. This showed that there is a proper flow and circulation of blood across the body system of the birds. This result disagrees with previous Maggawa *et al.*[9] and Nworgu *et al.*[10] reported no significant differences in the value of packed cell volume across the treatment groups, while working with sesame seed and *Hibiscus abdariffa* seed meal in broiler birds. And had a similar range of values (30.74-33.40%) to those reported by Agbulu *et al.*[7] (30.03-33.33%), respectively. Results obtained for haemoglobin and red blood cells were not significantly ($p>0.05$) influenced across the treatment group. Haemoglobin values ranged from 9.10 to 12.16 g/dL, while that of red blood cells was 3.68 to 4.11×10^{12}/L. These values were similar to those obtained by Agbulu *et al.*[7] and Adeyemo *et al.*[11].

Table 3: Serum biochemistry of finisher broilers fed replacement levels of synthetic methionine

	Treatment					
Parameter	T1	T2	T3	T4	T5	SEM
Total protein (g/dL)	3.72[b]	3.86[b]	3.81[b]	4.09[a]	4.01[a]	0.69
Albumin (g/dL)	1.96[b]	2.01[b]	1.99[b]	2.15[a]	2.09[a]	0.04
Globulin (g/dL)	1.76[c]	1.85[b]	1.82[b]	1.94[a]	1.92[a]	0.01
Creatinine (g/dL)	0.50	0.55	0.55	0.59	0.53	0.02
ALT (IU/L)	10.35[a]	10.11[a]	9.60[b]	9.38[b]	9.30[b]	0.10
AST (IU/L)	11.62[c]	11.40[c]	11.88[b]	12.30[a]	11.92[b]	0.80

[abc]Means on the same row with different superscripts are significantly ($p<0.05$) different, SEM: Standard Error of Mean, ALT: Alanine Aminotransferase (IU/L) and AST: Aspartate Aminotransferase (IU/L)

Data obtained for white blood cells showed a significant difference with the highest ($p<0.05$) value of 10.09×10^9/L in treatment 4, which did not differ ($p>0.05$) from those seen in treatment 3 and 5 with 9.71×10^9/L and $9.92\text{x}10^9$/L, respectively. The lowest value of 8.30×10^9/L was observed in treatment 1, which also differed ($p<0.05$) from the value of 9.22×10^9/L seen in treatment 2. Results obtained were within an acceptable range of values ($7.01\text{-}10.50\times10^9$/L) for white blood cell as outlined by The Merck Veterinary Manual[12]. This suggests that the immune system of the birds was not disturbed. This result disagrees with those reported by Agbulu *et al.*[7] where obtained no significant difference across the treatments when sesame seed was used in broiler production. Data obtained for Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), and Mean Corpuscular Haemoglobin Concentration (MCHC) were significantly influenced across the treatment group. The MCV had a value of 84.28 fl in treatment 3, which is similar to that of 83.17 fl obtained in treatment 5. The lowest value of 78.60 fl was observed in treatment 1, which did not differ ($p>0.05$) from that of 78.82 fl in treatment 2. Result for MCH showed the highest ($p<0.05$) in treatment 4 with 29.59 pg/cell, which was not significantly ($p>0.05$) different from the value of 29.29 pg/cell in treatment 5. Value of 26.46 pg/cell was obtained in treatment 2, which was different from the lowest value of 24.73 pg/cell. Values obtained were within the standard recommended by Kahn and Line[3]. This showed that there were no cases or incidences of anaemia or other blood disorders in the birds studied.

Data obtained for serum biochemical parameters were displayed in Table 3. Values for total protein were superior ($p<0.05$) in treatment 4 with 4.09 g/dL, followed by 4.01 g/dL in treatment 5. The least value of 3.72 g/dL was obtained in treatment 1, which did not differ from those of 3.86 and 3.81 g/dL in treatments 2 and 3, respectively. Values obtained for total protein were within an acceptable range outlined by Kahn and Line[3]. This suggests that the protein quality and quantity available to the birds in those treatments were sufficient and efficient. This was similar to the results obtained by Agbulu *et al.*[7] and Maggawa *et al.*[9]. Albumin and globulin values differed across the treatment group studied. Albumin had values which was highest in treatment 4 (2.15 g/dL) and lowest in treatment 1 (1.96 g/dL). This was similar to the trend obtained in globulin with the superior value of 1.94 g/dL in treatment 4 and the least with 1.76 g/dL in treatment 1, respectively. It should be noted that albumin and globulin indices forms the weight of total protein, which is basically linked to the protein intake and its quality and availability to the birds per time. Alanine transaminase was highest ($p<0.05$) in treatment 1 with 10.35 IU/L which was followed by 10.11 IU/L in treatment 2, while the lowest was seen in treatment 5 with 9.30 IU/L which was also similar to those in treatments 3 and 4 with values of 9.60 and 9.38 IU/L, respectively. Data obtained for aspartate transaminase had superior ($p<0.05$) value of 12.30 IU/L in treatment 4, which differed from those in treatments 3 and 5 with 11.88 and 11.92IU/L, while the least value of 11.40 IU/L was observed in treatment 2, which was not significantly different from those in treatment 1 with 11.62 IU/L.

CONCLUSION

The study demonstrated that Naturally Compounded Materials (NCM) can effectively replace synthetic methionine up to 100% in broiler diets without adverse effects on blood or serum biochemical parameters. Birds fed diets fortified with NCM exhibited higher red and white blood cell counts, indicating improved immune response. Serum biochemical parameters, including total protein, albumin, and globulin, were also elevated in NCM-supplemented treatments, suggesting better protein utilization and metabolic efficiency. Liver enzyme levels (ALT and AST) remained within recommended physiological ranges, confirming the safety of NCM inclusion. These findings establish NCM as a viable and sustainable alternative to synthetic methionine in poultry nutrition.

SIGNIFICANCE STATEMENT

The continuous rise in the cost of poultry feed ingredients and the declining immune resilience of birds highlight the need for natural, cost-effective feed additives. This study provides evidence that replacing synthetic methionine with Naturally Compounded Materials (NCM) can enhance the haematological and biochemical profiles of broiler birds while maintaining health and performance standards. The results demonstrate that NCM supports improved immunity, reduced morbidity, and zero mortality, thereby offering a practical, natural alternative for sustainable poultry production.

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