EFFECT OF FEEDING BROILER BIRDS WITH FATTY ACIDS RICH PLANTS (JUTE MALLOW AND WATERLEAF) ON THE HAEMATOLOGY AND SERUM BIOCHEMISTRY OF BROILER CHICKENS

Abubakar, A. E., Olorunsanya, A. O. Egbewande, O. and Lawal, M.
Department of Animal Production, Faculty of Agriculture,
Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria
Corresponding email: mohdlawal@ibbu.edu.ng

ABSTRACT

This study evaluated the effect of feeding broiler birds with fatty acid-rich plants on broiler chickens' haematology and serum biochemistry. The birds were fed diets containing varying levels of jute mallow, waterleaf and their combination. Four diets tagged as T1, T2, T3 and T4 were formulated such that T1 contained 0% of jute mallow and 0% waterleaf; T2 – 10% jute mallow, 0% waterleaf; T3 – 0% jute mallow, 10% waterleaf; T4 – 5% jute mallow and 5% waterleaf, respectively. The diets were fed to the broiler for seven (7) weeks, and their effects on the haematology and serum biochemistry were compared. One hundred and sixty broiler chicks were randomly assigned to the treatments; each treatment had four experimental units (replicates). At the end of the feeding trial, 4 birds per treatment were selected and blood collected from their wing vein for sample analysis. No significant difference ($p>0.05$) was recorded in almost all the parameters of haematology except for eosinophils, where treatment 3 was significantly different ($p<0.05$) from treatment 4 but similar to treatment 1 and 2. No significant difference ($p>0.05$) was recorded in all the indices for serum biochemistry. The study indicated that including jute mallow and waterleaf in broiler diets did not affect broiler chickens' haematology or serum biochemistry.

Keywords: Jute mallow, Waterleaf, Omega3 Fatty Acids, Haematology and Serum Biochemistry

INTRODUCTION

INTRODUCTION

Fatty acids, particularly essential fatty acids, are becoming of more importance in poultry feeding systems not only because they improve the health and productivity of birds, but because of the health-conscious society that prefers appropriately balanced diets to decrease adverse health issues (Cherian, 2015). Amongst various fatty acids, omega-6 (ω-6) and omega-3 (ω-3) fatty acids prove essential in a properly maintained ratio for several physiological, biological (Simopoulos, 2011), developmental (Kalakuntla *et al.,* 2017), reproductive (Feng *et al.,* 2015), and favourable health functions (Lee *et al.,* 2019). Sufficient supplementation of poultry diets with new and beneficial feed additives or supplements is gaining interest as it significantly improves general poultry production and performance as well as ensures good health of birds (Dhama *et al.,* 2014). In human diets, ω-3 and ω-6 are essential fatty acids. Nevertheless, considerable alteration in dietary patterns has resulted in alterations of the consumption of such fatty acids, with a subsequent increase in the consumption of ω-6fatty acids and an obvious decrease in the consumption of ω-3 fatty acids. This alteration has led to an imbalance in the ω-6/ω-3 ratio, which is at 20:1 which now differs considerably from the original ratio of (1:1).

Therefore, dietary supplement of foodstuffs such as eggs and meat are ways of improving the daily consumption of ω-3 to meet the recommended doses (Baiao *et al.,* 2005).

The presence of balanced omega-6: omega-3 fatty acids in poultry diets is essential for normal growth and development and other biological functions (FAO, 2010). Most of the broiler diets include a high level of n-6 fatty acids in their fat sources, which directly affects the omega-6: omega-3 fatty acids ratio (Dela, 2009). Dietary imbalance of omega-6: omega-3 may contribute to the acute inflammatory response and the prevalence of inflammatory-related disorders in broiler chickens (Gonzalez, 2009). Polyunsaturated fatty acids are important constituents of the immune cell structure and eicosanoid formation (Stulnig, 2003). Eicosanoid activity depends on the ratio and content of omega-6 and omega-3 fatty acids (Calder, 1998). Eicosanoids play an essential role in modulating inflammatory response intensity and duration (Stulnig, 2003). They are involved in the increase in vascular permeability and vasodilation, which enhances the production of inflammatory cytokines. Cytokines produced by white blood cells serve as regulators of the whole body by exertion different effects on lymphocytes and other immune cells in response to infection and injury. Omega-6 PUFAs exert pro-inflammatory properties that lead to an increase in inflammatory eicosanoids, cytokine production and immuno-suppression, while omega-3 PUFAs possess anti-inflammatory or less inflammatory properties by decreasing the release of pro-inflammatory eicosanoids and cytokines (Stulnig, 2003). Therefore, dietary supply of omega-3 PUFAs may affect the development of a strong immune system in birds, increase poultry productivity, reduce disease and thereby contribute to increasing economic returns to the poultry industry (Gonzales, 2009). Chekani-Azar et al. (2007) reported that fish oil contains omega-3 fatty acids specifically eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), as being an important factors in the diet for promoting health in humans and animals. Omega-3 (PUFAs) is essential for playing an important role in the prevention of coronary heart disease, hypertension, inflammatory, autoimmune disorders and cancer (ElYamany *et al*., 2008). From the broiler's health aspect, omega-3 PUFAs improve immunity, performance, lipid profile, besides increase marketing weight (Jameel, 2013; Al-Zuhairy and Jameel, 2013; Sahib, 2013). The objective of this study is to assess the effect of feeding the experimental diets on the haematology and serum biochemistry of broiler chickens.

METHODOLOGY

Experimental site

The experiment was conducted at the Poultry Unit of the Niger State Agricultural Mechanization Development Agency (NAMDA) in Maitumbi Minna. Minna is the capital of Niger State and it is located at latitude $9^{0}33$' North and longitude $9^{0}37$' East, with a mean annual rainfall of between 1200mm and 1300mm and mean annual temperature of between 38^{o}C and 42^{o}C. Geographically, Minna is situated in the Southern Guinea Savanna vegetation belt of Nigeria and it is depicted by wet and dry seasons. (Niger State Agricultural Development Project, 2009).

Source of experimental materials

Fresh jute mallow and waterleaf were purchased from Kure Ultra Modern Market, Minna, Niger State, while other feed ingredients were purchased from Alkheri Animal Feeds opposite GidanMatasa, Bosso, Minna, Niger State. Agrited broilers chicks were purchased from Step by Step Poultry Store opposite Kure Ultra Modern Market Minna, Niger State.

Preparation of the test ingredients (jute mallow and waterleaf)

The fresh jute mallow (JM) and waterleaf (WL) were thoroughly washed with clean fresh water to remove dirt (sand and stones). Subsequently, they were air dried at room temperature (29 - 31^{o}C) for two weeks until they were dried and brittle, after which the dried leaves were milled using a hammer mill. The milled jute mallow and waterleaf were packed into different plastic bags and kept till they were to be used. They were eventually used alongside other feed ingredients in the formulation of the experimental diets (Tables 3.1 and 3.2).

Table 1: Gross composition of broiler starter diets containing jute mallow and waterleaf, and their combination

Ingredients	T1 Control	T2 Jute-Mallow (10%)	T3 Waterleaf (10%)	T4 JM/WL (5:5)
Maize	52.06	44.06	44.06	44.06
Soybean meal	12.25	12.25	12.25	12.25
Wheat offal	7.50	7.50	7.50	7.50
GNC	18.99	16.99	16.99	16.99
Fishmeal	5.60	5.60	5.60	5.60
Jute mallow meal	-	10.00	-	5.00
Waterleaf meal	-	-	10.00	5.00
Bone meal	2.10	2.10	2.10	2.10
Vitamin premix	0.80	0.80	0.80	0.80
Lycine	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20
Salt	0.30	0.30	0.30	0.30
TOTAL	100	100	100	100
Crude protein (%)	23.14	23.47	23.32	23.37
M.E (kcal/kg)	2852.01	2729.21	2729.21	2729.21
Ether extract (%)	4.43	4.47	4.39	4.40
Ash (%)	3.41	3.17	3.20	3.19
Crude fibre (%)	4.06	4.67	4.22	4.48
Calcium (%)	1.16	1.17	1.15	1.16
Phosphorus (%)	0.76	0.75	0.73	0.74

[1]Premix: A – 12,000,000IU; Vitamin B_1 – 2,000mg; Vitamin B_6 – 3,500mg; Vitamin B_{12} – 20mg; Vitamin D_3 – 3,000,000IU; Vitamin E – 30,000mg; Vitamin K_3 – 2,500mg; Antioxidanrt – 125,000mg, Biotin – 80mg; Calpan – 10,000mg, Choline Chloride – 200,000mg; Cobalt – 250mg, Copper – 8,000mg, Folic acid – 1,000mg; Iodine – 1,200mg; Iron – 40,000mg; Manganese – 70,000mg; Niacin – 40,000mg; Selenium – 250mg; Zinc – 60,000mg.

Key:

ME= Metabolizable energy

T1 = control no jute-mallow and waterleaf

T2 = contains 10% of jute-mallow and 0 waterleaf meals

T3 = contains 0 % jute-mallow and 10 % of waterleaf meals

T4 = contains 5% jute-mallow and 5% waterleaf meals

Table 2: Gross composition of broiler finisher diets containing jute mallow and waterleaf, and their combination

Ingredients	T1 Control	T2 Jute-Mallow (10%)	T3 Waterleaf (10%)	T4 JM/WL (5:5)
Maize	54.66	46.66	46.66	46.66
Soybean meal	10.34	10.34	10.34	10.34
Wheat offal	10.00	10.00	10.00	10.00
GNC	17.40	15.40	15.40	15.40
Fishmeal	4.00	4.00	4.00	4.00
Jute mallow meal	-	10.00	-	5.00
Waterleaf meal	-	-	10.00	5.00
Bone meal	2.10	2.10	2.10	2.10
Vitamin premix	0.80	0.80	0.80	0.80
Lycine	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20
Salt	0.30	0.30	0.30	0.30
TOTAL	100	100	100	100
Crude protein (%)	21.07	21.37	21.37	21.37
M.E (kcal/kg)	2855.34	2727.57	2789.13	2811.37
Ether extract (%)	4.32	4.39	4.27	4.36
Ash (%)	2.95	2.76	2.98	2.81
Crude fibre (%)	4.10	4.62	4.97	4.87
Calcium (%)	1.05	1.07	1.06	1.05
Phosphorus (%)	0.71	0.7	0.72	0.69

[1]Premix: A – 12,000,000IU; Vitamin B_1 – 2,000mg; Vitamin B_6 – 3,500mg; Vitamin B_{12} – 20mg; Vitamin D_3 – 3,000,000IU; Vitamin E – 30,000mg; Vitamin K_3 – 2,500mg; Antioxidanrt – 125,000mg, Biotin – 80mg; Calpan – 10,000mg, Choline Chloride – 200,000mg; Cobalt – 250mg, Copper – 8,000mg, Folic acid – 1,000mg; Iodine – 1,200mg; Iron – 40,000mg; Manganese – 70,000mg; Niacin – 40,000mg; Selenium – 250mg; Zinc – 60,000mg.

Key:

ME= Metabolizable energy
T1 = control no jute-mallow and waterleaf
T2 = contains 10% of jute-mallow and 0 waterleaf meals
T3 = contains 0 % jute-mallow and 10 % of waterleaf meals
T4 = contains 5% jute-mallow and 5% waterleaf meals

Experimental design

A total of one hundred and sixty (160) day-old Agrited broiler chicks were used for the study. The birds were randomly allotted into four treatment groups T1, T2, T3 and T4, respectively. Each treatment had four replicates. There were ten birds per replicate, making a total of 40 birds per treatment. A complete randomized design was used. T1 (control) contained 0% jute mallow and waterleaf, T2 contained 10% jute mallow and 0% waterleaf, T3 contained 0% jute mallow and 10% waterleaf, while T4 contained 5% jute mallow and 5% waterleaf, as indicated in Tables 3.1 and 3.2.

Experimental birds and management

The birds were reared in a deep litter system, where they were uniformly cared for and managed. The experiment lasted for seven weeks. Feed and clean wholesome drinking water were provided for the chicks *ad-libitum* throughout the experimental trial period. The birds were housed in an open-sided wall house to provide proper cross ventilation, while in the evening, when the temperature normally drops, the open sides were covered using tarpaulins to provide warmth. This was done both at the starter and finisher phase.

Before the arrival of the birds, the poultry pen was rigorously scraped, scrubbed and swept, after which it was then washed and disinfected. Old newspapers were spread on the floor as litter material during the brooding stage charcoal stoves were used as the heat source. On arrival, they were carefully emptied from the cartons and immediately served water containing vitalyte to help cushion the effects of transportation stress. Feed and clean water were subsequently made available, and this continued *ad libitum*. The vaccination routine was carried out as follows:

2^{nd} week - Lasota 1^{st} dose
3^{rd} week - Gumboro 1^{st} dose
5^{th} week - Lasota 2^{nd} dose

Medication was also administered via drinking water. Vitalyte was often served to prevent stress and improve appetite. Virucine and Pox Proline were used for the control and treatment of fowl pox. Amprolium was administered to prevent coccidiosis.

Blood analysis

At the end of the experiment, 4 birds per treatment were bled through the wing vein for blood sample analysis, using a sterilized syringe and needle. About 5 ml of blood was collected from each bird, and 3 ml was transferred into a labelled sterile universal bottle containing EDTA (Ethylene Diamine Tetra-acetic Acid) to determine the haematological indices, while 2 ml was transferred into a sterile universal bottle without EDTA and then allowed to coagulate to determine the serum biochemical indices. All the samples were taken to the Laboratory for analysis.

Statistical analysis

All the data obtained were subjected to one-way analysis of variance (ANOVA) using Statistical Analysis System (SAS, 2010) and significant means were separated using Duncan's Multiple Range Test (Duncan, 1955).

Table 3: Proximate composition of jute mallow (*C. olitorius*) and waterleaf (*T. triangulare*)

Nutrients%	Jute mallow	Waterleaf
Moisture content	5.65	11.20
Crude fibre	17.95	8.19
Crude protein	13.15	13.06
Ash	6.9	7.87
Lipid	4.79	1.90
Nitrogen free extract	51.65	57.76

RESULTS

Heamatological parameters of the broiler chickens fed the experimental diets

Table 4 below shows the blood haematology of broiler chickens fed diets containing test ingredients. In all, only the values of eosinophils recorded significant ($p<0.05$) differences. Haemoglobin (Hb), packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), neutrophils, lymphocytes and monocytes recorded no significant ($p>0.05$) differences. For eosinophils treatment 3 was significantly higher than treatments 4, while treatments 1 and 2 were similar to both treatments 3 and 4.

Table 4:Heamatological parameters of the broiler chickens fed the experimental diets

PARAMETER	T1	T2	T3	T4	SEM (±)
Hemoglobin (g)	9.02	9.52	9.42	9.55	0.16
Packed cell volume (%)	26.50	28.00	27.75	28.00	0.50
Red blood cell (10^6µl)	3.22	3.37	3.30	3.17	0.04
White blood cell(10^4µl)	16.32	16.12	15.17	14.67	0.40
Neutrophils(10^3µl)	34.75	37.00	36.75	35.75	0.92
Lymphocytes(10^3µl)	59.75	56.50	56.75	58.25	0.95
Monocytes (10^3µl)	1.50	2.75	2.25	2.50	0.30
Eosinophils(10^3µl)	4.00^{ab}	3.75^{ab}	4.25^{a}	2.25^{b}	0.32

Serum biochemistry parameters of the broiler chickens fed the experimental diets

Table 5 below shows the serum biochemistry of broiler chickens fed diets containing test ingredients. There were no significant ($p>0.05$) differences in the values for all the parameters.

Table 5: Serum biochemistry parameters of the broiler chickens fed the experimental diets

PARAMETER	T1	T2	T3	T4	SEM (±)
Glucose (mg/dl)	3.27	3.30	4.07	4.12	0.22
Cholesterol (mmol/l)	1.60	1.92	2.37	2.40	0.15
Alanine aminotransferase (IU/L)	35.60	35.77	33.95	33.25	4.57
Aspartate aminotransferase (IU/L)	15.45	20.82	24.62	24.45	2.66
Total protein (g/dl)	17.70	18.12	17.50	17.55	0.11

DISCUSSION

Blood haematology of broiler chickens fed diets containing test ingredients revealed that the diets had no effects on the values for packed cell volume, haemoglobin, red blood cell, white blood cell, neutrophils, lymphocytes and monocytes. Values of eosinophils vary significantly ($p<0.05$) but fall within the normal ranges for healthy chickens, as was reported by Campbell *et al.* (2003) in a related work. The mean values for packed cell volume (PCV), haemoglobin (Hb), white blood cell (WBC), red blood cell (RBC), neutrophils, lymphocytes and monocytes were not significantly ($p>0.05$) influenced by the treatment diets. The non-significant variation in almost all the haematological indices of broilers could be ascribed to the quality of the test diets. As noted by Omoikhoje*et al.* (2018), it implies that the test diets were by no means inferior to the control diet.

An excessive increase of eosinophils in the blood would be a response to either a viral or bacterial attack, as eosinophils are multifunctional leukocytes implicated in the pathogenesis of numerous inflammatory processes, including parasitic helminths, bacterial and viral infections, tissue injury, tumour immunity, and allergic diseases.

For serum biochemical indices, no significant ($p>0.05$) differences were observed in all the parameters measured, which were glucose, cholesterol, alanine aminotransferase, aspartate aminotransferase and total protein. It was, however, within the normal range (16-34g/dl) as reported by Kwari *et al.* (2011) for broiler chickens in a related experiment. Total protein is usually a reflection of the protein quality fed, and so maintaining the normal range, as in this study, is the best evidence that the protein level in the blood of the birds was adequate in proportion.

CONCLUSION AND RECOMMENDATION

No significant ($p>0.05$) difference was recorded in the haematological parameters except for eosinophils. Serum biochemistry of the broiler chicken resulting from the experiment was not statistically different. The test ingredients could be included in broiler feed, as they were able to maintain the same levels as the control diets. Further research should be carried out on the test ingredients.

REFERENCES

Al-Zuhairy, M.A.; Jameel, Y.J. (2014). Effect of ND vaccine, multivitamins AD3E, and omega-3 on performance and immune response of broilers. *Mirror Res. Vet Sci. Anim*. 2014, 3, 42–50

Baiao, N.C.; Lara, L.J.C. (2005) Oil and fat in broiler nutrition. *Braz. J. Poul. Sci.* 2005, 7, 129–141. [CrossRef]

Campbell, J.R., Kenealy, M.D. and Campbell, K.L. (2003). Anatomy and physiology of farm animals. In: *Animal Sciences. The biology, care and production of domestic animals.* 4th Edition. McGraw Hill Company Inc. New York. Pp. 179-202.

Cherian, G. (2015) Nutrition and metabolism in poultry: Role of lipids in early diet. J. Anim. Sci. Biotechnol. 6, 28. [CrossRef] [PubMed]

Deton, L. (1997) A review of Corchorus olitorius in Nigeria. In: Schippers R, Budd L (eds) Workshop on African indigenous vegetables. Limbe, Cameroon, January 12–18, 1997, pp 25–30. Workshop papers. ODA

Dhama, K.; Tiwari, R.; Khan, R.U.; Chakraborty, S.; Gopi, M.; Karthik, K.; Saminathan, M.; Desingu, P.A.; Sunkara, L.T. (2014). Growth promoters and novel feed additives improving poultry production and health, bioactive principles and beneficial applications: The trends and advances—A review. *Int. J. Pharmacol*.10, 129–159.

DiNicolantonio, J.J.; O'Keefe, J.H. (2018). Importance of maintaining a low omega-6/omega-3 ratio for reducing inflammation. Open Heart 2018, 5, e000946. [CrossRef] [PubMed]

Ezekwe, M. O, Besong, S. A. and Igbokwe, P. E. (2001), Beneficial influence of Purslane and waterleaf supplement to Humans. *FASEB Journal*, 16, A639. https://eurekamag.com/research/034//476/034476071.php

Feng, Y.; Ding, Y.; Liu, J.; Tian, Y.; Yang, Y.; Guan, S.; Zhang, C. (2015). Effects of dietary omega-3/omega-6 fatty acid ratios on reproduction in the young breeder rooster. BMC Vet. Res. 11, 73. [CrossRef]

Ibrahim T.A., Fagbohun E.D. (2011) Physicochemical properties and in vitro anti-bacterial activity of Corchorus olitorius Linn. Seed oil. *Life Sci Leafl* 15:499–505

Ibrahim, D.; El-Sayed, R.; Khater, S.I.; Said, E.N.; El-Mandrawy, S.A.M. (2018) Changing dietary n-6: n-3 ratio using different oil sources affects performance, behavior, cytokines mRNA expression and meat fatty acid profile of broiler chickens. *Anim. Nutr.* 2018, 4, 44–51.

Kalakuntla, S.; Nagireddy, N.K.; Panda, A.K.; Jatoth, N.; Thirunahari, R.; Vangoor, R.R. (2017). Effect of dietary incorporation of n-3 polyunsaturated fatty acids rich oil sources on fatty acid profile, keeping quality and sensory attributes of broiler chicken meat. *Anim. Nutr*. 2017, 3, 386–391. [CrossRef]

Kwari, I.D., Diarra, S.S., Saleh, B. Bovoa, P.R., Ramat, O.A. and Tochukwu, D. (2011). Growth, haematology and serology of broiler chickens fed different cultivars of sorghum as replacement for maize in the semi arid zone of Nigeria. *Agric. Biol. J. North America.* 1:326-329.

Matsufuji, H., Sakai S., Chino M., Goda Y., Toyoda M., Takeda, M. (2001) Relationship between cardiac glycoside contents and color of Corchorus olitorius seeds. *J Health Sci* 47:89–93

Mazen, Ama., (2004) Accumulation of four metals in tissues of Corchorus olitorius and possible mechanisms of their tolerance. Biol Plant 48(2):267–272

Merlier H (1972) Synthe`se des Etudes Phe´nologiques des Espe`ces de Jache`re du Centre Se´ne´gal. Centre National de RecherchesAgronomiques de BAMBEY. Republique du Se´ne´gal. Ministe`re du De´veloppement Rural. Institut de RecherchesAgronomiquesTropicales et des Cultures Vivrie`res.

Ndlovu J. and Afolayan A.J. (2008) Nutritional analysis of the South African wild vegetable Corchorus olitorius L. *Asian J Plant Sci* 7:615–618

Nemb, A.R., Emadak, A., Mouzong, G.C., Nemba, C.E., (2011). Qualitative and quantitative assessment of mineral elements in the leaves of Corchorus facicularis and Corchorus olitorius harvested in Cameroon. J Curr Chem Pharm Sci 2:17–23. www.sadgurupublications.com

Nemb, A.R., Emadak, A., Mouzong, G.C., Nemba, C.E., (2011). Qualitative and quantitative assessment of mineral elements in the leaves of Corchorus facicularis and Corchorus olitorius harvested in Cameroon. J Curr Chem Pharm Sci 2:17–23. www.sadgurupublications.com

Omoikhoje, S.O., Oduduru, O. and Eguaoje, S.A. (2018). Blood constituent of broiler chickens as affected by biscuit waste based diets. *Nigerian Society for Animal Production,* 45(2): 201-208.

Opabode, J.T., and Adebooye, O.C., (2005) Application of biotechnology for the improvement of Nigerian indigenous leaf vegetables. *Afri J Biotechnol* 4:128–142. http://www. academicjournals.org/AJB

Richardson, A.J. (2006) Omega-3 fatty acids in ADHD and related neurodevelopmental disorders. *Int. Rev. Psychiatry* 2006, 18, 155–172.

Simopoulos, A.P. (2011). Importance of the omega-6/omega-3 balance in health and disease: Evolutionary aspects of diet. *World Rev. Nutr. Diet*. 2011, 102, 10–21.

Swanson, D.; Block, R.; Mousa, S.A. (2012) Omega-3 fatty acids EPA and DHA: Health benefits throughout life. Adv. Nutr. 2012, 3, 1–7. [CrossRef] [PubMed]