EVALUATION OF BLOOD LIPIDS IN TWO MAJOR NIGERIAN INDIGENOUS CHICKENS, KUROILER AND THEIR CROSSBREDS

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ABSTRACT

This study evaluated the blood lipids (total cholesterol, triglycerides, and lipoprotein). In the study, 18 chickens each of Naked Neck (NN), Normal Feather (NF), Kuroiler (KR) and their crossbreds were used. They were reared under the same environment and management. Chickens were slaughtered and blood samples were taken at 24 weeks of age, the serum was harvested by centrifugation, and then the total cholesterol (TCH), triglycerides (TG) and high-density lipoprotein (HDL) were assayed using an enzymatic kit, Low-density lipoprotein (LDL) were determined using the Friedwald equation. The results obtained indicated that genotype significantly differed (p<0.01) in TCH, TG and HDL levels. Sexwisely, males had significantly higher (p<0.01) levels of TCH (96.99 ± 8.78 mg/dL), TG (102.98 ± 11.15 mg/dL) and LDL (52.11 ± 2.12 mg/dL) in all the genotypes than its female counterpart. Furthermore, NN progenies recorded the lowest values in all parameters studied, TCH (61.44 ± 5.09 mg/dL), TG (61.23 ± 19.46 mg/dL), HDL (26.84 ± 4.04 mg/dL) and LDL (32.55 ± 14.10 mg/dL). The TCH and TG were low in both NN and NF chickens but the HDL and LDL were very low in NN birds while the level of cholesterol and fat was high in the pure exotic breed and low in the crossbred progenies. The reported lower serum cholesterol and triglyceride concentrations are reflected in their concentrations in blood and protect human beings from atherosclerosis. Therefore, estimation of blood lipid in these birds is recommended for future study.

Keywords: Nigerian indigenous chicken, Kuroiler, Blood cholesterol, Low-density lipoprotein, High-density lipoprotein

INTRODUCTION

Cholesterol plays a major role in human heart health which can be good and bad. High-density lipoprotein (HDL) is good cholesterol and low-density lipoprotein (LDL) is bad cholesterol. In contrast, high cholesterol in serum is a leading risk factor for human cardiovascular disease such as coronary heart disease and stroke (Norata *et al*., 2012). Excess cholesterol in the bloodstream can form plaque (a thick, hard deposit) in artery walls. The cholesterol or plaque build-up causes arteries to become thicker, harder and less flexible, slowing down and sometimes blocking blood flow to the heart. When blood flow is restricted, angina (chest pain) can result. A heart attack will result when blood flow to the heart is severely impaired

and a clot stops blood flow completely (Tabas, 2002; Lada and Rudel, 2003).

Lipids constitute a very important group of organic substances in plant and animal tissue since lipids include fats, and other compounds that resemble each other in physical properties. Lipids are an essential component of the homeostatic function of the animal body. The lipids vary in blood like other constituents and occur as fats, fatty acids, phospholipids, cholesterol and cholesterol esters (Ahmed *et al*., 2023). Research by Rajkumar *et al*. (2010) found that the total cholesterol concentration in serum was significantly lower in Naked Neck (NN) chickens, while Peters *et al.* (2002) showed that the Normal Feather (NF) birds had higher serum cholesterol value than NN.

It is widely acknowledged that there is an urgent need to return to a balanced fatty acid diet by decreasing the intake of cholesterol and saturated fats (Evans *et al.,* 2002). Chicken meat is low in fat and cholesterol and is usually considered healthier than other animal protein sources, especially red meats of mammalian origin (Shah *et al*., 2013). Despite these efforts to develop novel strategies to produce meat with lower cholesterol and saturated fatty acid contents, there is still a need for more information regarding production alternatives to achieve this important goal. Therefore, this study aims to determine the lipoproteins, triglyceride and cholesterol concentrations in two major Nigerian indigenous chickens and their crossbreds.

MATERIALS AND METHODS

Experimental Site: The experiment was carried out at the Poultry Unit of Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Ogbomoso is situated in the derived savannah zone of Nigeria on longitude 4°15' east and latitude 8°15' northeast of the Greenwich meridian. The altitude is between 300 and 600 m above sea level. The mean annual rainfall and temperature are 1247 mm and 27 °C (Ewetola *et al*., 2015).

Birds and their Management: The experimental birds were matured cocks and hens of NF (6 cocks, 30 hens), KR (10 cocks, 16 hens) and NN (10 cocks, 30 hens) were obtained from the existing stock at the Poultry Unit of Teaching and Research Farm, Ladoke Akintola University of Technology Ogbomoso. 118-day-old chicks were generated: NN 25(female 12, male 13), NF 18(male 6, female 12), Kuroiler x Naked Neck (KNN) 25(male 16, female 9), Kuroiler x Normal Feather (KNF) 35(male 28, female 17) and KR 15(male 10, female 5).

The brooder pen was covered all around with a sack to prevent the penetration of rodents from attacking the chicks and to prevent the escape of warmth from the brooder. The pen was washed with Lysol a week before the arrival and also washed again three days before the arrival of the chicks. Wood shavings were spread on the floor of each pen. Coal pots containing charcoal were placed at one side in each pen to warm the brooder house before the introduction of the day-old chicks. A thermometer was used to monitor the temperature.

Feed and water were placed in each brooder pen. Lasota vaccine was administered to day-old chicks intraocularly (I/0) after which the chicks were introduced into the pen and the temperature monitored. The chicks were monitored and taken care of for four weeks. After four weeks the sack used was rolled up to allow fresh air from the environment to come into the brooder pen. The chicks remained on deep litres throughout the 12 weeks.

Feed and Feeding of the Chicks: Feed and Feeding of the Chicks: The hens were fed *ad-libitum* with commercial layer mash (Animal Care, Nigeria Limited) containing 16.0% crude protein and 2800 Kcal metabolizable energy, while the cocks were fed with commercial grower mash (Animal Care, Nigeria Limited) containing 15.0% crude protein and 2500 Kcal metabolizable energy. Clean water was given *ad libitum*. Medications and vaccinations were given as required.

A total number of ninety (90) chickens were slaughtered; NF (9 males and 9 females), NN (9 males and 9 females), KR (9 males and 9 females), KNN (9 males and 9 females), KNF (9 males and 9 females) and 45 chickens for male and female each. The selected chickens were weighed and bled after 12 hours of deprived water

and feed. The chickens were slaughtered, and 5 ml of blood was collected into a vacutainer tube containing ethylene diamine tetra-acetic (EDTA) without anti-coagulant from each bird for the serum analysis.

Specimen Collection and Handling: Collection of blood early in the morning into a glass tube such as a red top Vacutainer blood collection tube. The blood was allowed to stand for 45 minutes at room temperature to allow complete clotting and clot retraction. A shorter period may result in incomplete clotting and secondary clots may form later. During the clotting period, the collection tube was sealed. The samples were centrifuged at 1,500 rpm for 30 minutes at 4°C. The samples were later placed into an ice bath immediately after centrifuging and maintained at 2 – 4 °C thereafter.

Data Collection: The blood lipid profiles analyzed in these samples were; total cholesterol (TC) triglycerides (TG), HDL, and LDL. TC in serum was estimated employing the chemistry auto-analyzing kit AUTOPAK, using enzymatic (cholesterol esterase, cholesterol oxidase and peroxidase). The endpoint and the results were expressed as mg/dL (Roeschlau *et al.*, 1974). TG in the serum was estimated employing the chemistry auto-analyzing kit using enzymatic (lipoprotein lipase, glycerol kinase, glycerol-3-phosphate oxidase, peroxidase, 4-amino antipyrine and ATP) and colourimetric method (Tietz, 1990) and the results were expressed as mg/dL of serum. The HDLs in serum were estimated employing a chemistry auto-analyzing kit (AUTOPAK) using the phosphotungstate method. The results were expressed as mg/dL of serum and the LDL was estimated as the LDL = Total Chol – HDL-Chol, LDL-Chol = Total Chol-(Chol + HDL-Chol) using the precipitation method (NCEP, 2001).

Statistical Analysis: Data generated were subjected to a one-way analysis of variance (ANOVA) using the procedures of the General Linear Model of SAS (2003). The model employed is as shown below: $Y_{ij} = \mu + G_i + S_j + e_{ij}$, where; Y_{ij} = Individual effect within the i^{th} genotype, μ = Overall mean, G_i = Fixed effect of the i^{th} genotype (1, 2, 3, 4, 5), S_j = fixed effect of j^{th} sex (1, 2) and e_{ij} = Experimental error which is evenly distributed.

RESULTS

The least-square mean values of blood lipids in two Nigerian indigenous chickens and their crossbred indicated that the genotype had a significant effect ($p<0.05$) on cholesterol, triglycerides, and LDL in all chicken genotypes studied (Table 1).

Table 1: Least Square Mean values of blood lipids in two Nigerian indigenous chickens, Kuroiler and their crossbreds

Genotype	Number	TCH (mg/dL)	TG (mg/dL)
NF	18	89.26 ± 12.95^{b}	85.71 ± 16.70^{b}
NN	18	61.44 ± 05.09^{a}	61.23 ± 19.46^{a}
KR	18	131.52 ± 15.09^{d}	117.06 ± 19.23^{c}
KN	18	100.60 ± 10.15^{c}	166.67 ± 16.70^{d}
KNF	18	120.21 ± 12.95^{e}	95.83 ± 16.70^{b}
Sex			
Male	45	104.22 ± 8.76*	107.62 ± 12.29*
Female	45	96.99 ± 8.78	102.98 ± 11.15
Genotype	**Number**	**HDL (mg/d)**	**LDL (mg/dL)**
NF	18	26.28 ± 1.07	45.88 ± 12.10^{c}
NN	18	26.84 ± 4.04	32.55 ± 14.10^{a}
KR	18	26.02 ± 4.94	85.10 ± 14.52^{e}
KN	18	26.16 ± 3.47	39.11 ± 12.19^{b}
KNF	18	26.98 ± 3.87	74.19 ± 12.11^{d}
Sex			
Male	45	24.16 ± 2.35	58.55 ± 8.19*
Female	45	24.23 ± 2.05	52.11 ± 2.12

*^{abcde} Means along the same column with different letter superscripts differed significantly ($p<0.05$), * = significant mean at $p<0.05$ for pairwise comparison using t-test, NF = Normal Feather, KNN = Kuroiler × Naked Neck, KNF = Kuroiler × Normal Feather, KR = Kuroiler, CHO = cholesterol, TG = Triglycerides, HDL = High-density lipoprotein, LDL = low-density*

The progenies of KR chickens had the highest value of cholesterol and LDL of values 131.52 ±

15.09 mg/dL and 85.10 ± 14.52 mg/dL respectively. Furthermore, NN progenies recorded the lowest values in all parameters studied, cholesterol (61.44 ± 05.09 mg/dL). Triglycerides (61.23 ± 19.46 mg/dL), HDL (26.84 ± 4.04 mg/dL) and LDL (32.55 ± 14.10 mg/dL). There was no significant effect ($p>0.05$) of genotype on HDL, the values did not statistically differ ($p>0.05$) for all the genotypes. There was a significant effect ($p<0.05$) of sex on triglycerides and LDL. Male chickens had the highest values of cholesterol (104.22 ± 8.76 mg/dL), triglycerides (107.62 ± 12.29 mg/dL) and LDL (58.55 ± 8.19 mg/dL).

DISCUSSION

The lipids metabolites in the chicken blood, including the level of triglycerides, total cholesterol and lipoprotein are sensitive indicators of fat metabolism intensity in the organism and its widely accepted that the values of these parameters in exotic and indigenous chickens depend on several factors such as age, sex, genetic type, environmental and feeding conditions (Meluzzi *et al.,* 1992). In this study, the NN genotype had a significant lower cholesterol level than other genotypes. The plasma triglycerides, total cholesterol, HDL and LDL are good indicators of total body lipids.

This study revealed lesser triglycerides concentration in NN compared to NF, KR and their crossbreds substantiating the findings on triglycerides, a similar study conducted on broilers by Diktaş *et al.* (2015) had claimed no difference in triglycerides levels. Therefore, it can be postulated that the NN chickens had fewer subcutaneous fat depots and this may be as a result of better temperature tolerance of NN chickens which can be attributed to its lower triglycerides. The results on blood lipids profile contrasted with those of Ladokun *et al.* (2008) who reported a non-significant effect of phenotype, arguing that plumage colour is of traditional significance instead of genetic. The non-genetic factors affecting blood biochemistry may be the nutrition, environmental conditions, stress level, behavioural activities and overall physiological status of the birds (Etim *et al.,* 2014).

This study revealed that the concentration of HDL was very low in NN chicken when compared to other genotypes. NN has the lowest values of HDL and the lowest value of LDL. The NN genotype had significantly lower HDL and dense LDL levels than the broiler chickens (Griffin *et al.,* 1982). This may be because NN was leaner than KR, NF and their crossbred. Lipoprotein can be both good and bad. HDL is good cholesterol and LDL is bad cholesterol.

The result obtained in this study revealed that the concentration of cholesterol was highest in KR and its crossbred. This observation corroborates with many findings of Gunes *et al.* (2002), Al-Aqil and Zulkifli (2009) and Diktaş *et al.* (2015) who reported higher levels of cholesterol in KR chicken when compared to any other indigenous birds. Disparity in cholesterol levels in KR and their crossbred has been attributed to their genetic makeup (Silva *et al.,* 2013). The serum cholesterol of NN chicken was lower than the reference range of most birds (129 – 297 mg/dL) (CDD, 1990) and in broilers (140 mg/dL) (Meluzzi *et al.,* 1992). Lower content of cholesterol may be as a result of high body activity and a high need for energy in NN, as well as low level of cholesterol in NN chickens; which makes it a beneficial source of animal protein to human beings (Bogusławska-Tryk *et al.*, 2016).

The level of concentration of total cholesterol, triglycerides, and HDL was very low in female chickens. The LDL and HDL are two types of lipoproteins that circulate in the blood. The amount of cholesterol in the blood is influenced by the amount of cholesterol synthesized (Huff *et al.*, 2023). Quaresma *et al.* (2022) suggested that LDL cholesterol plays a role in providing the body tissues with a major career for cholesterol from the liver to body tissues so that the levels of LDL in the blood are influenced by the concentration of cholesterol. On the other hand, HDL is a lipoprotein that maintains the balance of cholesterol in order not to accumulate inside the cell, the balance is managed by the transport of sterols of the membrane at a rate equal to the amount of cholesterol is synthesized to the liver (Dietschy, 2003).

Fanatico *et al.* (2005) concluded that female chickens had leaner meat than males based on a significantly higher force (N) value in females when compared to males. Therefore, the -density HDL was high in female chickens since developing oocytes have been identified as a characteristic of fat deposition in females. High plasma levels of lipids in female chickens reflect the significant demand for lipids by the growing oocytes. In addition, the LDL particles in meat-type broiler chickens occur in much smaller proportions, with LDL exceeding HDL. Kokore *et al.* (2021) noted that the plasma concentrations of HDL in female birds are depressed 2- to 3-fold compared to males. In chicken, females appear to lose the ability to assemble LDL correctly; therefore, the LDL level increased in serum. Similar results were also reported by Aberra (2011) that LDL cholesterol was almost 20% higher in obese compared to lean chickens in both sexes because the metabolism of adipose tissue in the post-obese state is known to differ compared to the subjects who have constantly been lean.

Conclusion: In this study, there were significant statistical differences observed between serum triglyceride, cholesterol, HDL and LDL levels in local chickens, KR and their crossbreds. Mean triglycerides and LDL values were higher in males than in females' chicken with a very highly significant difference.

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REFERENCES

ABERRA, M. (2011). Performance and physiological responses of naked-neck chickens and their F1 crosses with commercial layer breeds to long-term high ambient temperature. *Global Veterinaria*, 6(3): 272 – 280.

AHMED, S., SHAH, P. and AHMED, O. (2023). Biochemistry, Lipids. *In:* StatPearls [Internet]. StatPearls Publishing, Treasure Island, Florida, United States. https://www.ncbi.nlm.nih.gov/ books/NBK525952/

AL-AQIL, A. and ZULKIFLI, I. (2009). Changes in heat shock protein 70 expression and blood characteristics in transported broiler chickens as affected by housing and early age feed restriction. *Poultry Science*, 88(7): 1358 – 1364.

BOGUSŁAWSKA-TRYK, M., PIOTROWSKA, A., SZYMECZKO, R., BURLIKOWSKA, K. and GŁOWIŃSKA, B. (2016). Lipid metabolism indices and fatty acids profile in the blood serum of broiler chickens fed a diet with lignocellulose. *Brazilian Journal of Poultry Science*, 18(3): 451 – 456.

CDD (1990). *Veterinary Reference Guide.* Clinical Diagnostic Division, Eastman Kodak Company, Rochester, USA.

DIETSCHY, J. M. (2003). How cholesterol metabolism and transport present novel targets for lipid treatment. *Advanced Studies in Medicine*, 3(4 C): S319 – S323.

DIKTAŞ, M., ŞEKEROĞLU, A., DUMAN, M. and YILDIRIM, A. (2015). Effect of different housing systems on production and blood profile of slow-growing broilers. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi*, 21(4): 521 – 526.

ETIM, N. N., WILLIAMS, M. E., AKPABIO, U. and OFFIONG, E. E. (2014). Haematological parameters and factors affecting their values. *Agricultural Science*, 2(1): 37 – 47.

EVANS, M., ROBERTS, A. and REES, A. (2002). The future direction of cholesterol-lowering therapy. *Current Opinion in Lipidology*, 13(6): 663 – 669.

EWETOLA, E. A., OWOADE, F. M. and OLATUNJI, O. O. (2015). Assessment of degradation status of soils in selected areas of Ogbomoso, Oyo State, Nigeria. *International Letters of Chemistry, Physics and Astronomy*, 59: 17 – 25.

FANATICO, A. C., CAVITT, L. C., PILLAI, P. B., EMMERT, J. L. and OWENS, C. M. (2005). Evaluation of slower-growing broiler genotypes grown with and without

outdoor access: meat quality. *Poultry Science*, 84(11): 1785 – 1790.

GRIFFIN, H. D., WHITEHEAD, C. C. and BROADBENT, L. A. (1982). The relationship between plasma triglyceride concentrations and body fat content in male and female broilers – a basis for selection? *British Poultry Science*, 23(1): 15 – 23.

GUNES, N., POLAT, U. and PETEK, M. (2002). Investigation of changes in blood biochemical parameters of hens raised in alternative housing systems. *Uludag University Journal of the Faculty of Veterinary Medicine (Turkey)*, 21: 39 – 42.

HUFF, T., BOYD, B. and JIALAL, I. (2023). *Physiology, Cholesterol. In:* StatPearls [Internet]. StatPearls Publishing, Treasure Island, Florida, United States. https://www.ncbi.nlm.nih.gov/books /NBK470561/

KOKORE, A. B., KAMAGATE, S., OUATTARA, H., YAO, J. and YAPO, A. P. (2021). Study of lipid profile in broilers and local chickens in Korhogo, Côte d'Ivoire. *IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS)*, 16(5): 25 – 29.

LADA, A. T. and RUDEL, L. L. (2003). Dietary monounsaturated versus polyunsaturated fatty acids: which is really better for protection from coronary heart disease? *Current Opinion in Lipidology*, 14(1): 41 – 46.

LADOKUN, A. O., YAKUBU, A., OTITE, J. R., OMEJE, J. N., SOKUNBI, O. A. and ONYEJI, E. (2008). Haematological and serum biochemical indices of naked neck and normally feathered Nigerian indigenous chickens in a sub humid tropical environment. *International Journal of Poultry Science*, 7(1): 55 – 58.

MELUZZI, A., PRIMICERI, G., GIORDANI, R. and FABRIS, G. (1992). Determination of blood constituents reference values in broilers. *Poultry Science,* 71(2): 337 – 345.

NCEP (2001). Executive summary of the third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (adult treatment panel iii). *Journal of the American Medical Association (JAMA)*, 285(19): 2486 – 2497.

NORATA, G. D., PIRILLO, A., AMMIRATI, E. and CATAPANO, A. L. (2012). Emerging role of high-density lipoproteins as a player in the immune system. *Atherosclerosis*, 220(1): 11 – 21.

PETERS, S. O., IKEOBI, C. O. N., OZOJE, M. O. and ADEBAMBO, O. A. (2002). Genetic variation in the performance of the Nigeria local chicken. *Tropical Animal Investigation*, 5: 37 – 47.

RAJKUMAR, U., REDDY, B. L. N., RAJARAVINDRA, K. S., NIRANJAN, M., BHATTACHARYA, T. K., CHATTERJEE, R. N., PANDA, A. K., REDDY, M. R. and SHARMA, R. P. (2010). Effect of naked neck gene on immune competence, serum biochemical and carcass traits in chickens under a tropical climate. *Asian-Australasian Journal of Animal Sciences*, 23(7): 867 – 872.

ROESCHLAU, P., BERNT, E. and GRUBER, W. (1974). Enzymatic determination of total cholesterol in serum. *Zeitschrift fur klinische Chemie und klinische Biochemie*, 12(5): 226 – 230.

SAS (2003). *Statistical Analysis System User's Guide.* 8th Edition, SAS Institute, Cary, North Carolina, United States.

SHAH, A. S., TAN, L., LONG, J. L. and DAVIDSON, W. S. (2013). Proteomic diversity of high-density lipoproteins: our emerging understanding of its importance in lipid transport and beyond. *Journal of Lipid Research*, 54(10): 2575 – 2585.

SILVA, L. S. E., DE MIRANDA, A. M., DE BRITO MAGALHÃES, C. L., DOS SANTOS, R. C., PEDROSA, M. L. and SILVA, M. E. (2013). Diet supplementation with beta-carotene improves the serum lipid profile in rats fed a cholesterol-enriched diet. *Journal of Physiology and Biochemistry*, 69(4): 811 – 820.

TABAS, I. (2002). Cholesterol in health and disease. *The Journal of Clinical Investigation*, 110(5): 583 – 590.

TIETZ, N. W. (1990). *Clinical Guide to Laboratory Tests*. 2nd Edition, W. B. Saunders Company, Philadelphia, United States.

QUARESMA, M. A. G., ANTUNES, I. C., FERREIRA, B. G., PARADA, A., ELIAS, A., BARROS, M., SANTOS, C., PARTIDÁRIO, A., MOURATO, M. and ROSEIRO, L. C. (2022). The composition of the lipid, protein and mineral fractions of quail breast meat obtained from wild and farmed specimens of Common quail (*Coturnix coturnix*) and farmed Japanese quail (*Coturnix japonica domestica*). *Poultry Science*, 101(1): 101505. https://doi.org/10.1016/j.psj.2021.101505