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GROWTH PERFORMANCE, HAEMATOLOGY AND SERUM LIPID PROFILE OF BROILER CHICKENS FED THREE VARIETIES OF RIPE *Solanum melongena* FRUIT MEAL SUPPLEMENTS

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ABSTRACT

The growth, haematological and serum characteristics of Cobb broilers (n = 112) fed inclusions of ripe Solanum melongena fruit meal (SMFM) varieties were incorporated in a 56-day trial. The completely randomized design was employed in assigning day-old chicks to four labeled groups (T1-T4) with four replications. Dietary treatment of SMFM varieties was according to study groups such that T1 had Abia var. Okpokwe, T2 contained Nsukka Ind × Jos, T3 enclosed Nsukka Ind × Nsukka Local, while T4 was control. Daily feed intake and weekly weights furnished the growth assay of the chicks, while their blood assessment was done at the termination of the study. Data analyzed showed T4 to have better ($p < 0.05$) final weights (2740.50 g), feed intake (131.39 g) and weight gain (48.13 g) than SMFM groups. Red blood cell count was highest ($p < 0.05$) in T2 and T3 (10.87×10^6 and 10.88×10^6 mm^3, respectively) and lowly in T1 and T4 (10.04×10^6 mm^3 each). Haemoglobin concentration was highest ($p < 0.05$) in T2 and T3 (8.73, 8.98 g dL^{-}) and lowest in T4 (7.55 g dL^{-1}). Treated birds had better ($p < 0.05$) serum cholesterol and lipoproteins than the control. Triglyceride of T4 (117.75 g dL^{-1}) was different ($p < 0.05$) from T1 and T2 (107.00, 107.67 g dL^{-1}) but similar ($p > 0.05$) to T3 (109.00 g dL^{-1}). The SMFM varieties, mostly Nsukka Ind × Jos (T2), independently promoted superior haematology and serum lipid profile but poor growth of test broilers.

Key words: Cobb, eggplants, poor weight, phytogenic feeding, health status

INTRODUCTION

Discontinued use of antimicrobials, both at therapeutic and sub-therapeutic doses, in animal feeds due to the associated health risks in man and animal has prompted intensive trials in the quest for safe sustainable alternatives (Cheng *et al.,* 2014; Madhupriya *et al.,* 2018). Dietary amendment in animal feeding has shown to be the most plausible strategy of achieving enhanced productive performance (Suganya *et al.,* 2016). In agreement, Millet and Meartens (2011) made an outline of several feed enhancers that has served as bio-mediators in improving the performance of poultry birds to include, but not limited to: binders, emulsifiers, antioxidants, pH control agents, organic acids, enzymes, probiotics, prebiotics, synbiotics, immune-modulators, acidifiers and phytogenics.

Nonetheless, phytogenics are natural botanicals with bio-active ingredients that have appreciably supported improved growth, health and productive performance of poultry birds when used as feed enhancers. The acclaimed output has been logically credited to the apt capacity of these herbal blends in influencing increased digestibility of feed nutrients, enhanced accretion and transformation of growth factors into body tissues, superior immune and gut microbiota (Madhupriya *et al.,* 2018). *Solanum* plants (eggplants) are the traditional culinary *Solanaceae* herb whose medicinal and pharmacological profile has stimulated significant research interest as potential performance modulator in food animals as a result of the nutrient-dense nature of their mesocarp. The fruit is a good source of minerals, vitamins, amide proteins, free reducing sugars, anthocyanin and glyco-alkaloids such as solasodine (Ossamulu *et al.,* 2014a).

Ripening, as it occurs in fruits, is a physiological process that involves the breakdown of chlorophyll leading to the creation and subsequent accumulation of certain pigments such as carotenoids and anthocyanins. The process is associated with changes in fruit composition (from starch to simple sugars), ethylene emissions, and increased rate of respiration (Nwaiwu *et al.,* 2012; Fategbe *et al.,* 2013). Ripening in *Solanum* species increases their radical scavenging ability and antioxidant properties due to the dynamics in their polyphenol contents (Fategbe *et al.,* 2013). The fruits have shown to exert inhibitory effect on the iron and hydrogen peroxide-induced deoxyribose degradation, preventing free radical-induced degenerative diseases such as cancer and diabetes (Fategbe *et al.,* 2013). However,

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ripening in *Solanum* is an economic loss to the farmer (Fan *et al.,* 2016), as ripe fruits are sold at half the price of the unripe (Nwaiwu *et al.,* 2012).

However, there's limited information from scientific research on the utilization of ripe *Solanum* fruits as phyto treatments in broiler feeding to improve their performance. Enhancing the nutritional performance of broiler chickens is highly significant in poultry keeping as they (broilers) have been postulated by Ebukiba and Anthony (2019) to be strategic in ameliorating the animal protein intake deficiency extant in developing economies of the globe. The authors highlighted the beneficial physiological features of broilers and their lack of consumption barriers to have favored the acclaimed proficiency. Nonetheless, Dim *et al.* (2020) documented the import of haematological indices as clinical indicators of health status and production performance in animal husbandry. Therefore, the present study was designed to evaluate the effect of three varieties of ripe *Solanum melongena* fruit meals on the growth performance, haematological indices and serum lipid profile of broiler chickens.

MATERIALS AND METHODS

Experimental Site, Duration and Ethical Approval

The experiment was carried out at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. The study area lies between 5° 50′, 7° 00′ N and 6° 52′, 7° 54′ E, at an altitude of 500 m asl (Ihedioha *et al.,* 2016). The average temperature of the study area is 28℃ while the relative humidity is within the range of 51-53%. The dry seasons span through Nov. to Mar. whereas the wet seasons are from Apr. to Oct. (Onyenucheya and Nnamchi, 2018). The study was approved by the committee on ethics in the use of animals for biomedical research in the University of Nigeria before commencing the 56-day trial.

Test Varieties

The three selected varieties of ripe *S. melongena* fruits used in the study were; Abia var. Okpokwe (AVO), Nsukka Ind × Jos (NIJ) and Nsukka Ind × Nsukka Local (NINL) (Onyia *et al.,* 2020). The fruits were freshly harvested from the Crop Science Demonstration Farms, University of Nigeria Nsukka after 8 days of post ripening and dried with an improvised solar dryer for 7 days. The dried fruits were ground in a fabricated motor-grinder to produce the *S. melongena* fruit meal (SMFM). The SMFMs were placed in jute bags according to the varieties and stored in a room with dry floors. The proximate composition of the SMFM was carried out according to AOAC (2006) method and presented on Table 2.

Experimental Diets, Birds and Design

The study comprised day-old Cobb chicks (*n* = 112) of approximate weights of 44 g, arranged into four apposite treatment groups (with tags; T1-T4) using the completely randomized experimental design. Each tagged treatment group had replications of seven chicks per replicate. Experimental diets were formulated according to NRC (2012) standard for broiler chickens. The diets had 4 and 8% of SMFM of each variety per 100-kg feed corresponding to birds' starter (0-4 weeks) and finisher (4-8 weeks) growth phases as presented on Table 1. Each variety of SMFM based-diet constituted a treatment corresponding to the four labeled study groups thus; T1 contained AVO, T2 incorporated NIJ, T3 had NINL, and T4 was control.

Table 1: Percentage compositions of experimental diets

Ingredients (%)	Starter				Finisher			
	T1	T2	T3	T4	T1	T2	T3	T4
Maize	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Wheat offal	5.00	5.00	5.00	7.00	9.00	9.00	9.00	14.00
Palm kernel cake	4.00	4.00	4.00	6.00	12.00	12.00	12.00	15.50
SMFM	4.00	4.00	4.00	0.00	8.00	8.00	8.00	0.00
Groundnut cake	18.00	18.00	18.00	18.00	15.00	15.00	15.00	15.00
Fish meal	1.40	1.40	1.40	1.40	1.00	1.00	1.00	1.00
Soy bean meal	22.60	22.60	22.60	22.60	10.00	10.00	10.00	10.00
Bone meal	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin and mineral premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated composition								
Crude protein (%)	23.87	23.90	23.85	23.60	18.94	19.02	18.91	19.35
Crude fiber (%)	3.54	3.51	3.52	4.09	5.15	5.13	5.14	6.27
Metabolizable energy (Mcal kg^{-1})	2.73	2.73	2.73	2.70	2.70	2.70	2.70	2.70

*Each 2.5 kg of Starter premix contains: vit. A, 10000000 IU; vit. D_3, 2000000 IU; vit. E, 23000 mg; vit. K_3, 2000 mg; vit. B_1, 1800 mg; vit. B_2, 5500 mg; Niacin, 27500 mg; pantothenic acid, 7500 mg; vit. B_6, 3000 mg; iodine, 1000 mg; iron, 20000 mg; manganese, 40000 mg; selenium, 200 mg; zinc, 30000 mg; antioxidant, 1250 mg. One tonne of Finisher feed contains: vit. A, 10.00 g; vit. D_3, 5.00 g; vit. E, 50.00 g; vit. K, 3.00 g; vit. B_1, 2.00 g; vit. B_2, 6.00 g; vit. B_6, 3.00 g; vit. B_{12}, 15.00 mg; biotin, 0.12 g; nicotinic acid, 50.00 g; folic acid, 1.50 g; choline, 0.35 g; methionine, 2514.00 g; threonine, 361.00 g; lysine, 1779.00 g; iodine, 1.00 g; selenium, 0.35 g; iron, 40.00 g; molybdenum, 0.50 g; manganese, 100.00 g; copper, 15.00 g; zinc, 100.00 g. SMFM - *Solanum melongena* fruit meal, T1 - Abia var. Okpokwe, T2 - Nsukka Ind × Jos, T3 - Nsukka Ind × Nsukka Local, T4 - control

Management of Experimental Birds

Before the arrival of the birds, the experimental pens (1.5 m × 2.0 m) were cleaned and disinfected with soap and disinfectants after which coarse wood shavings were spread abroad as bedding material. The pens were pre-heated a day before the arrival of chicks with bulbs and lanterns to ensure a good brooding environment. For adequate ventilation in the production house, the experimental pens had low walls that partitioned the different replications. Upon arrival, the chicks were given lasota intraocular vaccination. Also, glucose and vitamin supplement (Vitalyte®) were included to chicks' drinking water at manufacturer's prescrition as anti-stress to ameliorate the negative effect of transportation on the birds. However, the birds had lasota and gumboro intraocular vaccinations at 7 and 14th day of study. Broilers were fed measured quantity (in grams) of feed twice daily (morning and evening) following routine inspection to assess chicks' health status. Feeding and drinking troughs were amply provided and properly cleaned daily before feeding.

Data Collection

Broilers were weighed at the start of the experiment and weekly intervals using an Avery® weighing balance till the end of the study. The average daily weight gain (ADWG) was calculated as the difference in the birds' weekly body weights per day. The average daily feed intake (ADFI) was deduced as the difference in the quantity of feed supplied to a replicate bird in a day and the remnant (in grams) the next morning. Feed conversion ratio (FCR) was calculated as the ratio of daily feed intake to corresponding weight gain per bird.

Haematological and Serum Lipid Assay

At the end of the study, two birds per replicate were randomly selected for sample collections. Blood samples (2.5 ml) were collected from the wing vein using sterile syringes into plain tubes and ethylenediamine tetra-acetic acid bottles for serum and haematological examinations, respectively. Separate syringes were used per collection to avoid contamination of samples while ice packs in an enclosed chest served to cool the sampled bottles till analysis within the hour of collection. Plasma was readily harvested by centrifuging at 3000 rpm for 15 min. Packed cell volume (PCV) determination was by the micro haematocrit method, while the red and white blood cell counts (RBC and WBC) were conducted in line with the haemocytometer method (Thrall and Weiser, 2002). The haemoglobin concentration (Hb) was determined following the cyanomethemoglobin method (Higgins *et al.,* 2008). The enzymatic method of Richmond (1973) was used to estimate cholesterol concentration of samples. The triglycerides were determined according to the enzymatic colorimetric method of Bucolo and David (1973). The low- and high-density lipoproteins were determined using commercial diagnostic kits (number-72201-04), Qualigens India, Pvt., Ltd.

Statistical Analysis

Data from the study were analyzed in a one-way analysis of variance using SPPS version 22.0. Treatment means that were significantly different were separated using the Duncan's new multiple range test at 5% probability level.

RESULTS AND DISCUSSION

Proximate Compositions of Three Varieties of Ripe *Solanum melongena* Fruit Meal

The proximate analysis of three varieties of ripe *S. melongena* fruit meal (Table 2) showed significant differences ($p < 0.05$) in their contents of crude protein (CP), ether extracts, moisture, nitrogen free extracts (NFE) and ash. The crude fiber (CF) and energy contents of the test varieties were not significantly ($p > 0.05$) different among treatment groups. Kandoliya *et al.* (2015) and Khan *et al.* (2015) reported *S. melongena* fruits to have high nutritive value when compared with other vegetables, linking the nutritional value to their protein contents. In the current study, the CP of T2 (9.41%) differed significantly ($p < 0.05$) from T3 (8.10%) but similar ($p > 0.05$) to T1 (8.54%). However, T1 had the same ($p > 0.05$) CP with T3. The crude protein fractions of the test varieties were higher than the values (2.10-5.97%) reported by Oyebamiji and Ayeni (2018) but lower than values of 18.48% by Wakili *et al.* (2015) for *S. melongena* fruits. Meanwhile, Hussain *et al.* (2010) had reported ash content of vegetables as an index of the mineral fractions of plant samples. The ash content of T3 (6.50%) was higher ($p < 0.05$) than T1 (4.00%), while that of T2 (5.50%) was similar ($p > 0.05$) to T3 and T1. The present ash values were slightly higher than those recorded by Agoreyo *et al.* (2012) for *S. melongena* fruits (1.96-3.15%).

Nonetheless, low fat contents of eggplants poised them as potent in abating risks of cardiovascular diseases and atherosclerosis (Showemimo and Olarewaju, 2004). Among the test varieties, T1 and T2 recorded similar ($p > 0.05$) ether values (4.00%) that were higher ($p < 0.05$) than T3 (2.50%). Present ether values were higher than the values of 1.65-2.13% reported by Agoreyo *et al.* (2014) for varieties of *S. melongena* fruits. On the other hand, carbohydrate can also be used for other biochemical reactions asides energy metabolism in the body (Kandoliya *et al.,* 2015). In this study, NFE of T1 (70.31%) and T3 (69.50%) were similar ($p > 0.05$) but higher ($p < 0.05$) than T2 (64.29%). However, these values were astronomically higher than the lowly figures (2.42-4.14%) reported by Edeke *et al.* (2021) for *S. melongena* fruits. On the other hand, African eggplants are fleshy vegetables known for their very high moisture content and low calorific value (Nwodo *et al.,* 2011; Kandoliya *et al.,* 2015). From the existing study, moisture content of T1 (90.00%) and T3 (89.50%) were similar ($p > 0.05$); however, higher ($p < 0.05$) than T2 (86.00%). Moisture contents of sampled varieties were within the range documented by Nimenibo-uadia and Omotayo (2017) for *S. melongena* fruits. The high moisture content of test varieties suggests the beneficial role they could play in facilitating efficient gastrointestinal tract secretions that will translate to enhance performance in the animal. The energy values of test SMFM varieties were similar to the values of 2.70-3.0 MCal kg^{-1} reported by Silva *et al.* (2021) for the mesocarp of *S. melongena* fruits. Notably, the fiber compositions of *S. melongena* fruits have been associated with several pharmacological properties (Sanchez-mata *et al.,* 2010). In comparison with relevant subsisting literature, the CF values from the current study were lower than the values of 11.8-12.74% documented by Jimenez *et al.* (2018) for *S. melongena* fruits meals but within the range (2.00-2.28%) in print by Wakili *et al.* (2015) for *S. melongena* fruits.

Growth Response of Broilers Fed Three Varieties of Ripe *Solanum melongena* Fruit Meal

The growth performance of broiler chickens fed three varieties of ripe *S. melongena* fruit meal showed significant differences ($p < 0.05$) in the birds' final body weight (FBW), ADWG, ADFI and FCR (Table 3). The control group (T4) had the highest FBW (2740.50 g) and ADWG (48.13 g) that differed significantly ($p < 0.05$) from other treatments groups, while T3 recorded the least ($p < 0.05$) values of 1600.00 and 27.80 g for FBW and ADWG, respectively. However, T1 and T2 had comparable ($p > 0.05$) FBW (2240.10 and 2080.50 g) and ADWG (39.19 and 36.38 g) that were also higher ($p < 0.05$) than T3. The ADFI of T4 (131.39 g) differed significantly ($p < 0.05$) among treatments while T3 had the least ($p < 0.05$) value of 58.10 g even as T1 and T2 had similar ($p > 0.05$) ADFI values. Nonetheless, FCR was superior ($p < 0.05$) in *Solanum* treated groups (T1, T2, and T3) and inferior in T4 (2.73) regardless of the similarity ($p > 0.05$) between the treated groups.

It is obvious from the current study that birds on the control group (T4) guzzled more feed than any other treatment group. Kadi (2012) had stated that feed intake of animals should cover for their nutritional needs so as to externalize their inert growth potentials. Consequently, the increased ADFI of T4 translated into better FBW and ADWG than the *Solanum* treated groups. However, reduced feed intake observed for SMFM treated groups can be attributed to the nutrient nature of *Solanum* fruits. Ossamulu *et al.* (2014b) reported the fruits of eggplants to be nutrient-dense, thus increases satiety when consumed. It follows that the birds on the dietary treatments consumed less feed to attain satiety. Nevertheless, asides from the reduced ADFI playing out as a factor, the reduced body weight of birds on *Solanum* treatment could be associated to the phytochemical constituents of the SMFM. Nwozo *et al.* (2018) reported very high concentrations of phytochemicals, especially flavonoids and alkaloids in extracts of *S. melongena* fruits. Rondanelli *et al.* (2016) reviewed the effects of various phytochemicals on muscle growth and health, supporting Bonaldo and Sandri (2013) that protein synthesis and degradation in the muscles are modulated by indicator-metabolic pathways that are mostly affected by dietary factors. Therefore, it could be suggested that the dense nature of the innate phytochemicals of SMFM exerted inhibitory effects on the key mechanisms that control yield of contractile proteins and organelles in muscle tissues. Impairment of these metabolic provisions was reported to reduce muscle mass deposition and carcass yield (Bonaldo and Sandri, 2013). Thus, this suggested reduction in muscle mass accretion probably affected the body weight of treated broilers adversely. Similar findings were in the reports of Nwozo *et al.* (2018) who illustrated weight reduction potential of *S. melongena* fruits using overweight New Zealand rabbits fed high fat diets.

Table 2: Proximate compositions of three varieties of ripe *Solanum melongena* fruit meal

Proximate fractions (%)	T1	T2	T3	SEM
Crude protein	8.54±0.12^{ab}	9.41±0.06^{a}	8.10±1.18^{b}	0.60
Crude fiber	3.15±0.33	2.80±0.06	2.90±0.20	0.09
Ash	4.00±0.17^{b}	5.50±0.04^{ab}	6.50±1.50^{a}	0.15
Ether extract	4.00±0.36^{a}	4.00±0.12^{a}	2.50±0.20^{b}	0.27
Nitrogen free extract	70.31±1.76^{a}	64.29±1.17^{b}	69.50±0.89^{a}	3.06
Moisture	90.00±0.81^{a}	86.00±0.57^{b}	89.50±0.45^{a}	2.07
Metabolizable energy (kcal kg^{-1})	3000.00±10.12	3001.00±9.91	3008.00±12.00	204.43

a b - treatment means on the same row that are significantly different at 5% probability level, SEM - standard error of mean,
T1 - Abia var. Okpokwe, T2 - Nsukka Ind × Jos, T3 - Nsukka Ind × Nsukka Local

Table 3: Growth performance of broiler birds fed three varieties of ripe *Solanum melongena* fruit meal

Parameters	T1	T2	T3	T4	SEM
Initial body weight (g)	45.50±0.28	43.50±0.43	43.0±0.31	45.00±0.48	0.99
Final body weight (g)	2240.10±34.28^{b}	2080.50±44.07^{b}	1600.00±30.00^{c}	2740.50±56.68^{a}	260.00
Average daily weight gain (g)	39.19±0.86^{b}	36.38±0.76^{b}	27.80±0.70^{c}	48.13±0.79^{a}	3.94
Average daily feed intake (g)	80.71±1.20^{b}	76.40±1.25^{b}	58.10±1.17^{c}	131.39±1.12^{a}	4.62
Feed conversion ratio	2.06±0.01^{b}	2.10±0.01^{b}	2.09±0.02^{b}	2.73±0.04^{a}	0.02

a b c - treatment means on the same row that are significantly different at 5% probability level, SEM - standard error of mean,
T1 - Abia var. Okpokwe, T2 is Nsukka Ind × Jos, T3 is Nsukka Ind × Nsukka Local, T4 - control

Haematology of Broilers Fed Three Varieties of Ripe *Solanum melongena* Fruit Meal

The haematological evaluation of broiler chickens fed three varieties of SMFM showed significant ($p < 0.05$) differences among treatments for PCV, Hb, RBC and WBC (Table 4). The *Solanum* treated groups were of similar ($p > 0.05$) PCV values (T1, 32.00; T2, 33.25; T3, 33.75%) that were higher ($p < 0.05$) than T4 (29.75%). The RBC of T2 and T3 were significantly ($p < 0.05$) higher than T1 and T4 even with their shared similarity ($p < 0.05$). The WBC of *Solanum* treated broilers was similar ($p > 0.05$) yet higher ($p < 0.05$) than the control group. Furthermore, Hb of T2 (8.73 g dL^{-1}) and T3 (8.98 g dL^{-1}) were higher ($p < 0.05$) than other treatment groups, while T4 had the least ($p < 0.05$) Hb of 7.55 g dL^{-1}. Also, Hb of T2 (8.72 g dL^{-1}) and T3 (8.98 g dL^{-1}) were similar ($p > 0.05$) even as T1 and T4 recorded comparable ($p > 0.05$) Hb values of 8.20 and 7.55 g dL^{-1}. The haematological values from existing study fell within normal physiological range published by Banerjee in 2009 for Cobb broilers. Nevertheless, the better haematological indices of *Solanum* treated birds than the control group could be an indication that test SMFM varieties furnished valuable biological functions that limited cellular damage (anti-oxidation) and probably encouraged immunogenesis in the broilers. Some authors have ascribed the antioxidant potentials of *Solanum* fruits to their constituent phytochemicals which act to inhibit hydrogen peroxide-induced deoxyribose degradation (Stommel and Whitaker, 2003; Fategbe *et al.,* 2013). Thus, more blood cells of *Solanum* treated birds were salvaged from extant oxidative damage resulting to better cellular indices of haematology than the control. Our finding supports literature evidence on the anti-oxidative qualities of *Solanum* fruits (Nisha *et al.,* 2009; Akanitapichat *et al.,* 2010).

Serum Lipids of Broilers Fed Three Varieties of Ripe *Solanum melongena* Fruit Meal

The serum lipid profile of broilers fed three varieties of ripe *S. melongena* fruit meal revealed significant ($p < 0.05$) differences in the birds' values for all the parameters profiled (Table 5), including high-density lipoproteins (HDL), low-density lipoprotein (LDL), cholesterol and triglycerides (TAG). The HDL records of treated broilers (T1, T2 and T3) were comparable ($p > 0.05$) but higher ($p < 0.05$) than the control group. The serum LDL and cholesterol of broilers on the test varieties (T1, T2 and T3) were found to be similar ($p > 0.05$), although lower ($p < 0.05$) than the control. The TAG of T4 differed significantly ($p < 0.05$) from T1 and T2, but similar ($p > 0.05$) with T3. Nevertheless, T1 and T2 had similar ($p > 0.05$) TAG values with T3. Increased HDL of birds on the SMFM treatments suggests the probability of *S. melongena* being remedial to atherosclerosis, which is traditionally associated with cholesterolemia as a result of increased serum levels of LDL. From the current study, it was observed that the SMFM decreased LDL content, justifying the claims that atherosclerosis could be reduced via supplementation of the test ingredient in the feed of chickens. There is proof of literature on the hypolipidemic properties of *S. melongena* fruits (Guimaraes *et al.,* 2000). Interestingly, Sudheesh *et al.* (1997) had linked the hypolipidemic effect of *Solanum* fruits extracts to their flavonoid contents. Nwozo *et al.* (2018) reported very high amounts of flavonoids in extracts of *Solanum* fruits. Even so, Shen *et al.* (2005) made reports on solanoflavone as a biflavonal glycoside from *S. melongena* with anti-inflammatory and lipidemic potentials.

Therefore, it is logical to suggest that high concentrations of flavonoids and alkaloids in the SMFM stimulated the birds' central nervous system (CNS) to initiate inhibition of hepatic bile-synthase such that the test broilers had less accretion of fats in their blood serum. Hence, the blood lipid profiles of broiler chickens on the test varieties of SMFM were augmented better than the control. Interestingly, our postulation was validated by the report of Das and Barua (2013), which highlighted the fat reducing effects of *Solanum melongena* fruits as significant and inimitable to the plant. Nonetheless, in conformation with present results, the works of Odetola *et al.* (2004) and Edijala *et al.* (2005) demonstrated reduced LDL, cholesterol and triglycerides in birds fed *Solanum* supplements.

Table 4: Haematological indices of broiler birds fed three varieties of ripe *Solanum melongena* fruit meal

Parameters	T1	T2	T3	T4	SEM
PCV (%)	32.00±2.27^{a}	33.25±8.28^{a}	33.75±2.71^{a}	29.75±4.12^{b}	4.09
RBC (×10^{6} mm^{3})	10.04±0.06^{b}	10.87±0.12^{a}	10.88±0.07^{a}	10.04±0.14^{b}	0.97
WBC (×10^{3} mm^{3})	9200.00±373.02^{a}	9325.00±390.63^{a}	9425.00±420.48^{a}	8775.00±366.39^{b}	220.50
Hb (g dL^{-1})	8.20±0.35^{b}	8.73±0.64^{a}	8.98±0.51^{a}	7.55±0.54^{c}	0.44

a b c - treatment means on the same row that are significantly different at 5% probability level, SEM - standard error of mean, PCV - packed cell volume, RBC is red blood cell, WBC is white blood cell, Hb - haemoglobin concentration, T1 - Abia var. Okpokwe, T2 - Nsukka Ind × Jos, T3 - Nsukka Ind × Nsukka Local, T4 - control

Table 5: Serum lipid profile of broilers fed three varieties of ripe *Solanum melongena* fruit meal

Parameters (g dL^{-1})	T1	T2	T3	T4	SEM
High density lipoproteins	76.00±1.74^{a}	77.25±9.20^{a}	69.00±4.95^{a}	30.50±3.46^{b}	6.33
Low density lipoproteins	14.25±0.07^{b}	18.50±0.90^{b}	16.00±0.06^{b}	51.00±4.12^{a}	3.08
Cholesterol	87.50±9.20^{b}	91.25±0.75^{b}	81.25±0.57^{b}	105.00±0.89^{a}	8.67
Triglycerides	107.00±8.26^{b}	107.67±9.73^{b}	109.00±6.24^{ab}	117.75±8.55^{a}	10.20

a b - treatment means on the same row that are significantly different at 5% probability level, SEM - standard error of mean, T1 - Abia var. Okpokwe, T2 - Nsukka Ind × Jos, T3 - Nsukka Ind × Nsukka Local, T4 - control

CONCLUSION

From a critical evaluation of present results, birds on the control group ate more feed to satisfy for their better final weight values than the birds on SMFM treatments, irrespective of the varieties sampled. However, the blood cell features of birds on SMFM were found to be better than the control group especially with respect to PCV, WBC and Hb concentrations. More so, SMFM inclusion in the diets of the study birds decreased their serum LDL, cholesterol and TAG values. Hence, it can be asserted that the inclusion of ripe SMFM (at the inclusion levels and varieties sampled) in the diets of broilers should be used as a therapeutic phyto-additive in cases of observed atherosclerosis (because of its ability to trim serum fats), rather than as a growth promoting additive. This assertion was drawn from performance records of the present study, depicting the insignificant role played by the test ingredient in improving the weights of the under-studied birds. So we construed that SMFM varieties, mostly Nsukka Ind × Jos (T2), independently promoted superior haematology and serum lipid profile but poor growth of the test broilers.

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