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GROWTH PERFORMANCE AND BLOOD INDICES OF BROILER CHICKENS FED LYE-PROCESSED MORINGA *(Moringa oleifera)* SEED MEAL

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ABSTRACT

A 56-day feeding trial was conducted to determine the effect of lye processed Moringa seed meal (LMSM) on performance and blood indices of broiler chicken. A total of 150 one- day-old cobb breed broiler chicks were randomly allotted to five (5) dietary treatments replicated three times with ten chicks per replicate. The experimental diets were formulated with LMSM at inclusion levels of 0%, 5%, 10%, 15% and 20% designated as T_1, T_2, T_3, T_4 and T_5 respectively. Data were generated for final body weight, total feed intake, daily feed intake (DFI), total weight gain, daily weight gain (DWG), feed conversion ratio and blood indices. Data obtained were subjected to Analysis of Variance (ANOVA). The result of the performance showed significant ($P<0.05$) influence of LMSM on final weight gain, weight gain, daily feed intake and feed conversion ratio at both phases. Birds on diet 0%, 5% and 10% recorded the highest weight gain while birds on 15% and 20% LMSM obtained the least value in the starter phase. Birds on control diet and 5% LMSM recorded the highest feed intake while the lowest was obtained on 20% diet. The best FCR was observed in birds fed control diet, 5% and 10% LMSM diet. Finisher broiler fed control diet, 5% and 10% recorded higher final weight and weight gain. Birds fed control diet recorded the highest feed intake while birds on 15% and 20% LMSM recorded the lowest. Birds fed control diet, 5% and 10% LMSM obtained better FCR. The feed cost per gain was cheaper when fed LMSM irrespective of the inclusion level. Heamatology and serum chemistry results revealed that all measured parameters showed no significant ($P>0.05$) influence of LMSM treatments on the birds except packed cell volume (PVC), Hemoglobin (Hb) and White blood cell, Glucose and ALP. Broiler chickens could be fed up to 10% LMSM at starter phase and 15%LMSM of finisher phase.

Keywords: Broiler chickens, *Moringa oleifera* seed, lye processing method, performance and Blood indices

INTRODUCTION

Competition for the limited resources between man and livestock production are great challenges facing the once prospered poultry industry. Hence, to break through the production cycles of the poultry birds with feed resources that have high protein value for poultry birds which are not necessarily consumed by human being will be of great importance to poultry industry. This therefore, necessitated the search for alternative locally feed resources for livestock with minimal competition by man and without any deleterious effect on performance and health of the animal (Adetunji, *et al.,* 2020). One of the alternatives is the use of unconventional plant by-products such as *Moringa oleifera* seed.

Moringa oleifera is a highly qualitative plant and cherished due to its multipurpose functions such as medicinal uses, growth promoter, antimicrobial and antioxidant effects (Moyo *et al.*, 2011; MbiKay, 2012; Idris and Jami, 2016). All parts of the plants are edible and have long been consumed by man (Fashey, 2005).

Moringa oleifera seed have been reported as a good source of edible proteins, vitamins and essential amino acids in poultry nutrition (Olugbemi *et al.*, 2010). Akangbe (2022) reported that the proximate composition of *Moringa oleifera* seed contained 36.90% crude protein, 9.0% crude fibre, 16.2% ether extract, 12.0% ash, 95.3% dry matter, 0.43 mg calcium, 0.40 mg phosphorus, 0.95 mg potassium, 0.54 mg magnesium and 188.30 ppm iron. However, *Moringa oleifera* seed has been found to contain some anti-nutritional factors such as protease inhibitors, hemaglutinins, tannins and cyanogenic glycosides which may interfere with the digestion and utilization of dietary protein and carbohydrates and even alters the availability of some minerals (Ahaota *et al.,* 2013). Various methods have been explored in a way to reduce the anti-nutritional factors in this by-product although with little success. Among the methods used includes the earlier works of Makkar and Becker (2009), Ogbe *et al.* (2012) and Akangbe (2022) who reported that Moringa seeds soaked in water above 30 minutes recorded increased crude protein but recommended inclusion levels not beyond 5% in poultry diets. Taiwo *et al.* (2015) reported that the defatted seed is better because of the low anti-nutritional factors. High inclusion up to 20% depressed final body weight, weight gain, feed intake and poor carcass in broilers chickens fed Moringa seed subjected to the cold press processing method (Afolayan *et al.*,2020) Processing methods like soaking, de-hulling and roasting has been reported to improve the nutritional and functional properties of plants seeds to some extent (Yagoub and Abdalla, 2007). Hence, there is need to explore lye processing method on which information is scarce and perhaps may be appropriate to reduce the anti-nutritional factor in order to increase the level of inclusion in broilers diet for better performance without negative effects on health of the birds.

Haematological components of blood are valuable in monitoring protein quality of feed (Atansuyi *et al.*, 2021). Feed toxicity most especially that of feed constituents that affect the formation of blood (Oyawoye and Ogunkunle, 1998). The serum chemistry and haematological components are influenced by the quantity, quality and the level of anti-nutritional factors present in the feedstuff (Akinmutimi, 2004). This research therefore, evaluated the effect of lye processed Moringa seed meal (LMSM) on the growth performance and blood parameters of broiler chickens.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Poultry Unit, Livestock Teaching and Research Farm, Federal University Dutse, Jigawa State. Dutse is located on longitude 9.34°E and Latitude 11.76°N and has an elevation of 431.36 meters above sea level (Encarta, 2007). There is usually a hot diurnal temperature and comparatively cooler at nights during the last 2-3 months of the dry season which is followed by a wet season between the months of June and September (Weather and Climate, 2020).

Processing of test ingredient

Moringa seeds were purchased in Dutse ultra-modern market, Jigawa State. The seeds were cleansed by winnowing and hand picking to remove stones and debris. The processing methods adopted for the Moringa seeds is described below:

Lye-water method

Ash was sieved to remove charcoal and other impurities; hot water was poured over ash in a barrel and a brown liquid dripped at base of container which represents the lye water. Moringa seeds was placed in a muslin cloth and soaked in the lye water for 18 hours, thereafter, it was removed, sun-dried for seven days, crushed and left to be incorporated in the formulation (Akande *et al.*, 2011).

Experimental design and animal management

One hundred and fifty (150) day-old Cobb breed broiler chicks were randomly allotted to five (5) dietary treatments comprising three replicates and ten chicks per replicate. The experimental diets were formulated with lye processed Moringa seed meal (LMSM) used to replace soyabean meal in the diets of broilers at inclusion levels 0% (control diet), 5%, 10%, 15% and 20% designated as T_1, T_2, T_3, T_4 and T_5 respectively. Feed and clean water were supplied *ad libitum.* The birds were reared intensively on deep litter (dried wood shavings) housing system. Routine vaccination program and medication schedule were strictly adhered to.

Experimental diets

Five experimental diets were formulated for both starter (Table 1) and finisher (Table 2) phases of the study. The experimental diets were formulated to meet the NRC (1994) nutrient requirements for broiler chickens. The chicks were allocated to the five different treatments designated. The proximate compositions of the experimental diets were determined using the methods of AOAC (2012) and are presented in Tables 1 and 2. The energy value ME was calculated using the formula of Pauzenga (1985) as follows: ME (kcal/kg) = 37x % CP+81x % EE +35.5 x % NFE.

Data collection and parameters measured

The birds were weighed at the beginning of the experiment and the initial weight was obtained. The final weight was taken at the end of the experiment. Total weight gain was determined by subtracting the initial weight from the final weight. Daily feed intake was determined by the difference between daily feed offered and daily feed leftover and the total feed intake was obtained by cumulative addition of the daily feed intake. Feed conversion ratio (FCR) was computed by dividing daily feed intake by daily weight gain. .

Data analysis

Data generated were subjected to one-way ANOVA using SAS (2012). Significant means at 5% level of probability was separated using Duncan's Multiple Range Test of the same statistical package.

Statistical model

Yij = U+Ti +eij

Where;

Yij = the observed response

U = the overall mean

Ti = the fixed effect of ith treatment (n =0%, 5%, 10%, 15% and 20%)

eij = random residual error

RESULTS

Proximate composition of lye Moringa seed meal is presented in Table 3. The crude protein (34.84%CP) of Lye Processed Moringa seed was higher compared with the raw Moringa seed. Similar trend was observed for dry matter, metabolizable energy of processed which are higher than raw Moringa seed. A reduced crude fibre was obtained for the lye processed Moringa seed meal while raw Moringa seed had higher crude fibre. The Nitrogen free extract of both were similar. Meanwhile, ether extract of the two were at close range.

The growth performance of starter broiler chicks fed lye Moringa seed meal (LMSC) is shown in Table 4. The result revealed there were significant (P<0.05) differences in final weight, weight gain, feed intake, feed conversion ratio and feed cost per kilogram gain. Final weight was best in birds fed control diet, 5% and 10% LMSM while the least similar value was recorded for birds on 15% and 20%. The weight gain decreased with increased inclusion level of LMSC. Meanwhile, better weight gain was recorded for birds on diet 0%, 5% and 10% while the least weight gain was obtained on 15% and 20% LMSM. The feed intake reduced across the treatment with increased inclusion of LMSM. Birds on control diet and 5% LMSM recorded the highest feed intake compared to birds on 10% LMSM while the lowest feed intake was obtained on diets 20%. The FCR was significantly (P<0.05) different across the treatment groups. The best FCR was observed in birds fed control diet, 5% and 10 % LMSM diet. There was significant (P<0.05) decrease in terms of feed cost per kilogram diets in birds fed 5% and 10% LMSM which implies that supplementing LMSM reduced the feed cost per kilogram compared to control diet. However, mortality was high in birds fed 15% and 20% LMSM while others recorded reduced similar values although the values were not significant.

The growth performance of finisher broiler chickens fed LMSM is shown in Table 5. The result showed a significant (P<0.05) difference for final weight, weight gain, feed intake and FCR across the dietary treatments. Birds fed control diet, 5% and 10% recorded higher final weight while birds on 20% recorded the least final weight. The weight gain of birds fed control diet, 5% and 10% were significantly (P<0.05) higher than that of those fed 15% LMSM. Meanwhile the birds fed 15% LMSM had higher (P<0.05) weight gain than those fed 20% who obtained the least weight gain value. The feed intake decrease with increased inclusion level of LMSM. Birds fed control diet recorded the highest feed intake. Closely followed were birds on 5% and 10% while the lowest feed intake was observed on birds fed 15% and 20% LMSM. Birds fed control diet, 5% and 10% LMSM obtained the best statistical similar FCR respectively. The feed cost per gain was cheaper to produce a 1kg when fed LMSM irrespective of the inclusion level in this present study. Mortality trend followed similar pattern observed at the starter phase.

The result of the hematology of the broiler chickens fed LMSC is presented in Table 6. All parameters measured revealed no significant (P>0.05) influence of the treatments on the birds except packed cell volume (PCV), Hemoglobin (Hb) and White blood cell. The PCV and Hb of birds fed control diet, 5%, 10% and 15% LMSM were significantly (P<0.05) higher than those fed 20% LMSM diets. Value of RBC of the birds were similar (P>0.05) across the treatment groups. The white blood cell increases with increased inclusion level of LMSM. Birds on control diet, 5%, 10% recorded lower value of white blood cell compared with birds on 15%nd 20%LMSC. MCV value ranged from 147.26 (20%LMSM) to 142.07(5%LMSM). MCH values were within the same range across the treatment groups. The MCHC value ranged from 26.81g/dl (10% LMSM) to 28.30g/dl (20%LMSM).

The result of the serum biochemistry of the broiler chickens fed LMSC is shown in Table 7. The result revealed no significant (P>0.05) differences for all the parameters measured except for Glucose and ALP. Total protein values ranged from 40.32–39.22 g/dl (15% and 10%). Albumin values ranged from 18.49 to 16.48 g/dl (15% and 5%) while globulin values ranged from 23.39 (0%)-21.83 g/dl (15%). Birds fed 0% recorded significantly (P<0.05) higher Glucose value compared to similar values obtained in birds fed MOSM diets regardless the inclusion levels. Birds fed 20% LMSC diet obtained increased ALP when compared to their counterparts on LMSM diets with similar ALP Values. The Uric Acid of birds fed 20% LMSM numerically recorded higher value while birds on 15% recorded the least value. Creatinine value ranged from 21.45 (0%) to 20.46 (10%). Uric acid, AST and ALT values were statistically similar across the dietary treatment groups.

DISCUSSION

The high crude protein (34.84% CP) of Moringa seed portrays it as efficient protein source for poultry birds. This corroborated the earlier work of Taiwo *et al.* (2015) who reported that *Moringa oleifera* seed is a good source of protein and essential minerals. The crude protein in this present study was higher than values (32.49 and 23.42%) reported by Afolayan *et al.*

(2020) and Bridgemohan (2014) for cold pressed and untreated *Moringa oleifera* seed respectively. Similar CP was observed by Akangbe (2022) who reported the proximate composition of *Moringa oleifera* seed soaked in water to contained crude protein of 36.90%, crude fibre 9.0%, ether extract 16.2%, ash 12.0% and dry matter 95.3 % respectively. Report have shown that processing methods increased the crude protein as well reduce the phytochemical content (Makkar and Becker, 2009; Ogbe *et al.*, 2012 and Akangbe, 2015). The crude fibre (CF) of (8.6%) and ME (3454.72 Kcal/kg) reported are in line with the findings of Akangbe (2015) who reported (9.0%) of crude fibre and Afolabi *et al.* (2020) reported (3304.39kcal/kg) of ME respectively. The 94.86% dry matter reported in this study was at consonant with the observation of Akangbe (2022).

The performance characteristics of broilers fed LMSM revealed that the final weight of birds on LMSM diets up to 10% inclusion levels showed improved final weight as birds on control diet at both phase. This could be attributed to the ability of the birds to utilize the Moringa seed effectively probably due to the processing method adopted which could have drastically reduced the anti- nutrient factors present in Moringa seed. Also, the lower crude fibre and high protein content could have improved digestion which resulted in appreciable weight gain translating to better final live weight observed. Reports have shown that processing methods increased the crude protein as well reduce the phytochemical content (Makkar and Becker, 2009; Ogbe *et al.*, 2012 and Akangbe, 2022). This finding was at variance with Afolayan *et al.* (2020) who reported reduced final weight above 5% LMSM inclusion level in broiler’s diet. The decrease in weight gain as LMSM inclusion level increases could be attributed to the anti-nutritional factors, such as protease inhibitors, tannins and cyanogenic glycosides which might have interfered with the digestion and reduced utilization of dietary protein and carbohydrates resulting in inefficient utilization of the nutrient (Ahaota *et al.*, 2013). Similar finding was reported by Afolayan *et al.* (2020) who observed general decrease in final weight, weight gain and feed intake as inclusion level of Moringa increased across the treatment. Meanwhile, similar better weight gain recorded for birds on diet 0%, 5% and 10% LMSM suggested that LMSM could sustain life for improve performance up to 10% for starter and 15% for finisher broiler respectively. Similar finding was noted by Oyedele *et al.* (2013) who reported increased weight gain and better feed conversion ratio following replacement of fish meal with Moringa seed. This observation differs from the report Afolayan *et al.* (2020) who observed drastically reduction in weight gain at 10% inclusion level of LMSM using cold press processing method fed to broiler chickens. The reduced feed intake for treatments above 10% LMSM with increase inclusion of LMSM could be linked to the low weight gain observed at the starter phase. However, increased feed intake of birds on control diet and 5% LMSM which was at close range with birds on 10% LMSM at both starter and finisher phases could be attributed to the processing method employed on LMSM was able to degrade the nutrients present for increase bulkiness (M.E) that culminated to better and efficient use of the feed. The amount of feed consumed by an animal is a reflection of the organoleptic properties of the feed such as palatability and nutrient composition. Palatability of feed is an important factor that influences voluntary feed intake in broiler chickens (Diaz-Sanchez *et al*., 2015)

The FCR observed at both starter and finisher phases across the treatments with LMSM portrays that the feed was properly utilized at all levels of inclusion probably because the birds have adjusted to the diet as a result of age which increased the ability of the birds to tolerate more fibrous feed with high feed efficiency that reflected in finisher broiler feed intake. Furthermore, the lye processing method employed on the LMSM could have probably reduced the effect of anti-nutritional factors to minimal level thereby neutralized the stringent taste in order to improve its acceptability to the birds for better consumption. This could be contributory to the better final weight, FI and FCR obtained at the finisher phase of the experiment as LMSM increased. The work attested the finding of Obadire *et al.* (2019) who reported better final weight, FI and FCR in broilers chickens following inclusion of mixed vegetable up to 15% level. In contrast with Olugbemi, *et al.* (2010) who observed depressed performance in broiler chicken fed above 5% Moringa leaf. Feed conversion ratio is considered as a leading quality parameter and its progress or development is generally associated with feed efficiency in poultry production. The reduced mortality rate observed showed the processing method employed have positive influence to have drastically reduced the anti-nutritional factors present in LMSM which posed no threat on digestion and absorption of the available nutrient which could cause any breakdown in the immune system that will reduce survivability.

Blood parameters are good indicators of physiological, pathological and nutritional status of an animal and changes in values have the potential of being used to elucidate the impact of nutritional factors (Odunsi *et al*, 1999; Kurtoghu *et al.*, 2005). The increased values of PCV and Hb observed in bird fed 5%, 10% and 15% LMSL as compared to birds on control diet (0%

LMSM) and the non-significance of RBC of the birds' diets is an indication that the birds were adequately nourished and not anemic and the dietary protein is of good quality. It is a reflection of the nutritional profile of the diets which was good enough for high oxygen carrying capacity in supporting life. Isaac *et al.* (2013) reported that animals with good blood composition will likely demonstrate improved performance. In addition, Chineke *et al.* (2006) reported that high PCV is an indication of either increase in RBC or reduction in circulating plasma volume. Consequently, Guluwa *et al.* (2017) reported that haemoglobin concentration within the normal range for healthy chicken indicates improved oxygen carrying capacity. Muneer *et al.* (2021) reported that packed cell volume, HB and mean corpuscular heamoglobin are major indices for evaluating circulatory erythrocytes and are significant in the diagnosis of anemia and also serve as useful indices for bone marrow capacity to produce red blood cells like in human being.

Furthermore, the white blood cells increased with increased inclusion levels of LMSM. The high WBC recorded is a reflection of a way to fight disease. Hence, birds with low white blood cells are exposed to high risk of disease infection meanwhile those with high counts have high degree of resistance to disease and enhanced adaptability to local environmental and disease prevalent condition (Afolayan *et al.,* 2020). This observation was at variance with the report of Annongu *et al.* (2015) who reported decrease in WBC, MCV and MCH with increasing levels of MOSM. The report is in accordance with work of Seotan (2013), Isaac *et al.* (2013) and Afolayan *et al.* (2020). The authors recorded high white blood cell when fed Moringa seed meal to broiler chickens.

The serum glucose obtained for birds fed LMSM in this study slightly reduced compared with control diet but values were within normal range for healthy birds. It shows energy availability for the birds were adequate. Adebisi (1997) reported that serum glucose level is used to sustain normal function. The total protein, serum albumin, serum globulin values observed across the treatment were within the normal range for healthy animals. It is a strong indication that the protein of the diets was efficiently utilized. The result differs from Annongu *et al.* (2015) who reported reduced serum total protein, albumin and globulin with graded levels of untreated Moringa seed meal. Total protein, serum albumin, serum globulin is indication of the protein retained in the animal body (Akinola and Abiola, 1999 and Esonu *et al.*, 2001). A low albumin concentration is a reflection of poor health and indicator of bad result (Kastow, 2009).

The non-significances observed in serum uric acid and creatinine across the dietary treatment is a proof that the protein in the LMSM was properly and efficiently utilized by the birds. The report disagreed with Annongu *et al.* (2015) who observed increased levels of creatinine and uric acid in response to higher untreated MOSM levels in broiler chickens fed diets and Aregheore (2002) reported drastically reduction in the blood parameters measured when fed animals with high level of MOSM. The liver enzymes ALT and AST were within normal range across the dietary treatment groups regardless the diet type. Blood plasma transaminase enzymes activity (alanine aminotransferase and aspartate aminotransferase) are the most important indicators of liver cells activity where increasing concentration of these enzyme indicates the tissue activity are being destroyed (Molander *et al.*, 1957). Normal enzyme level in serum is a reflection of a balance between synthesis and their release as a result of the different physiological process in the body (Zilva and Pannall, 1984). The enzymes were produced by the liver and the amount present in the blood is indicative of the integrity of the liver. Thus the normal values of these liver enzymes is a reflection of good health in the birds' liver and reflects that the anti-nutritional factors present in LMSM have been drastically reduced to pose no threat to liver function. Meanwhile, the ALP obtained for birds fed LMSM in this study slightly increased but within normal range for healthy birds. This could be as a result of the processing method employed on MOSM which have reduced the anti-nutritional factor present which does not elicit pronounced negative effect on these enzymes to be utilized. Furthermore, reduced level of liver enzymes could be attributed to high level of anti-nutritional factors in poultry feed. Consequently, such threat or damage to the liver could have caused leakage of these enzymes which will possibly results to increased level in the blood stream. This finding was at variance with the work of Annongu *et al.* (2015) who observed reduced activities of AST, ALT and ALP in birds fed untreated MSOM.

CONCLUSION

It could be concluded that feeding broiler chickens up to 10% LMSM at starter phase and 15%LMSM of finisher phase did not have any negative effect on growth performance and blood indices measured. Meanwhile, the reduced growth performance consistently recorded for 20% LMSM might be due to the high concentration of anti-nutritional factors contained in LMSM which could be eliminated for efficient utilization if probably supplemented with probiotics. Therefore, further research should be carried out by supplementing with probiotic for better utilization since Moringa seed is rich in protein but impaired.

Table 1: Proximate composition of Moringa Seed Meal

Parameters	Raw LMSM	Lyed LMSM
Metabolizable Energy (kcal/kg)	3314.30	3454.72
Crude Protein (%)	32.78	34.84
Dry Matter (%)	94.16	94.86
Ash (%)	3.78	3.84
Crude Fibre (%)	9.87	8.60
Ether extract (%)	16.40	16.40
Nitrogen free extract (%)	31.33	31.22

Table 2: Composition of experimental Lye Moringa seed meal (LMSM) fed starter broiler chickens (0-4 weeks)

Ingredient (%)	0	5	10	15	20
Maize	51.00	51.00	51.00	51.00	51.00
Fish meal	2.60	2.60	2.60	2.60	2.60
Soya bean meal	25.00	20.00	15.00	10.00	5.00
Lye Moringa LMSM	-	5.00	10.00	15.00	20.00
G/nut meal	9.00	9.00	9.00	9.00	9.00
Wheat offal	8.00	8.00	8.00	8.00	8.00
Bone meal	1.80	1.80	1.80	1.80	1.80
Oyster shell	1.50	1.50	1.50	1.50	1.50
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.3	0.3	0.3	0.3	0.3
Premix	0.30	0.30	0.30	0.30	0.30
Salt	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated Analysis					
ME	2,929.00	2,954.00	2,979.00	3004.00	3029.00
CP	23.40	23.08	22.78	22.50	22.18
EE	3.87	4.62	4.82	4.91	4.97
CF	3.46	3.45	3.48	3.50	3.53
Cal	1.16	1.16	1.16	1.16	1.16
P	0.42	0.41	0.41	0.41	0.41
Lysine	1.43	1.43	1.42	1.42	1.41
Methionine	0.60	0.61	0.61	0.61	0.61

Vitamin/Minerals premix supplied per kg diet; vita, 8,000iu; vit D3,1440iu; VitE,21.6mg; VitK3,2.7mgVitB1,1.8mg; VitB2,3.6mg: VitB6,2.7mg; Niacin,21.6mg; VitB12,0.018mg; FolicAcid,0.54mg; Pantothenic acid,9.0mg; Biotin,0.036mg; Choline chloride,270mg; Zinc,27mg; Mn,108mg; Fe,18mg; I2,0.72mg; Se,0.072mg; Cu,1.44mg; Co,0.14

Table 3: Composition of experimental Lye Moringa seed meal (LMSM) fed finisher broiler chickens (0-4 weeks)

Ingredient (%)	0	5	10	15	20
Maize	58.35	58.35	58.35	58.35	58.35
Fish meal	1.00	1.00	1.00	1.00	1.00
Soya Bean Meal	25.00	20.00	15.00	10.00	5.00
Lye Moringa LMSM	-	5.00	10.00	15.00	20.00
G/nut meal	3.60	3.60	3.60	3.60	3.60
Wheat offal	8.00	8.00	8.00	8.00	8.00
Bone Meal	1.50	1.50	1.50	1.50	1.50
Oyster Shell	1.50	1.50	1.50	1.50	1.50
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Premix	0.30	0.30	0.30	0.30	0.30
Salt	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated Analysis					
ME	2,978.20	3,003.20	3,028.20	3,053.20	3,078.20
CP	20.40	20.20	19.90	19.60	19.50
EE	3.67	4.42	5.17	5.92	5.67
CF	3.28	3.31	3.33	3.36	3.38
Cal	1.11	1.11	1.11	1.11	1.11
P	0.40	0.40	0.40	0.40	0.40
Lysine	1.26	1.25	1.25	1.24	1.24
Methionine	0.56	0.56	0.57	0.57	0.57

Vitamin/Minerals premix supplied per kg diet; vita, 8,000iu; vit D3,1440iu; VitE,21.6mg; VitK3,2.7mgVitB1,1.8mg; VitB2,3.6mg: VitB6,2.7mg; Niacin,21.6mg; VitB12,0.018mg; FolicAcid,0.54mg; Pantothenic acid, 9.0mg; Biotin, 0.036mg; Choline chloride,270mg; Zinc,27mg; Mn,108mg; Fe,18mg; I2,0.72mg; Se,0.072mg; Cu,1.44mg; Co,0.14

Table 4: Growth Performance of starter broiler chickens fed Lye Moringa seed meal (LMSM) (0-4 weeks)

Parameter	T1	T2	T3	T4	T5	SEM
Initial weight (g/b)	45.63	45.63	45.63	45.63	45.63	0.12
Final weight (g/b)	1169.67^{a}	1110.66^{a}	1108.44^{a}	1066.66^{b}	1046.03^{b}	11.12
Weight gain (g/b)	1124.04^{a}	1065.03^{b}	1062.81^{b}	1021.03^{c}	1006.04^{c}	9.10
Feed intake (g/b)	1620.33^{a}	1590.00^{a}	1556.76^{b}	1545.77^{c}	1520.44^{d}	33.25
FCR	1.44^{b}	1.43^{b}	1.46^{b}	1.52^{a}	1.52^{a}	0.03
Feed cost (N/kg)	118.00	105.00	106.00	110.00	112.00	0.18
Feed cost/gain (N/kg)	188.68^{a}	162.60^{c}	166.20^{c}	170.20^{bc}	174.00^{b}	3.50
Mortality	0.00	0.33	0.33	0.67	0.67	0.25

^{abc} Means on the same row having different superscripts are significantly different (P<0.05)

Table 5: Growth Performance of finisher broiler chickens fed Lye Moringa seed meal (LMSM) (5-8 weeks)

Parameter	T1	T2	T3	T4	T5	SEM
Initial weight (g/b)	1129.66	1129.66	1129.66	1129.66	1129.66	29.56
Final weight (g/b)	2390.52^{a}	2382.26^{a}	2371.44^{a}	2263.40^{b}	2249.72^{c}	11.12
Weight gain (g/b)	1260.86^{a}	1252.60^{a}	1241.78^{a}	1133.74^{b}	1120.06^{c}	11.10
Feed intake (g/b)	2454.84^{a}	2438.33^{b}	2421.77^{b}	2370.34^{c}	2379.01^{c}	33.25
FCR	1.95^{b}	1.95^{b}	1.95^{b}	2.09^{a}	2.12^{a}	0.03
Feed cost (N/kg)	126.77	120.40	120.96	122.40	125.88	0.18
Feed cost (N/kg)	233.81^{a}	211.46^{b}	216.20^{b}	217.18^{b}	220.48^{b}	4.16
Mortality	0.00	0.33	0.33	0.67	0.67	0.25

^{abc} Means on the same row having different superscripts are significantly different (P<0.05)

Table 6: Heamatology parameter of finisher broiler chickens fed Lye Moringa seed meal (LMSM)

Ingredient (%)	0	5	10	15	20	SEM
PVC (%)	39.60^{a}	38.62^{a}	38.05^{a}	36.78^{a}	30.72^{b}	0.71
Hb (g/dl)	12.64^{a}	12.51^{a}	11.96^{a}	11.84^{a}	10.16^{b}	0.63
RBC ($x10^{12}$/L)	2.93	2.83	2.97	2.86	2.82	0.28
WBC ($x10^{9}$/L)	5.18 ^{b}	5.82^{b}	5.83^{b}	6.17^{a}	6.32^{a}	0.17
MCV (fl)	146.65	142.07	146.03	147.03	147.26	1.76
MCH (pg)	40.08	40.37	40.64	40.66	40.42	2.26
MCHC (g/dl)	27.13	27.28	26.81	27.96	28.30	2.16

^{abc} Means on the same row having different superscripts are significantly different (P<0.05), PVC- packed cell volume (%), Hb- Haemoglobin, RBC- Red blood cells, WBC- White blood cells, MCV- Mean corpuscular volume, MCH- Mean corpuscular haemoglobin, MCHC – Mean corpuscular haemoglobin concentration

Table 7: Serum chemistry of finisher broiler chickens fed Lye Moringa seed meal (LMSM)

Parameters	0	5	10	15	20	SEM
Total Protein (g/dl)	40.15	39.59	39.22	40.32	39.87	0.44
Albumin (g/dl)	16.76	16.48	16.89	18.49	17.59	0.22
Globulin (g/dl)	23.39	23.11	22.33	21.83	22.28	0.49
Glucose (mg/dl)	184.78^{a}	178.33^{b}	177.01^{b}	174.13^{b}	171.50^{b}	5.70
ALT (u/l)	51.50	50.62	51.01	51.59	52.13	1.93
ALP (u/l)	31.48^{b}	31.05^{b}	31.39^{b}	32.01^{b}	33.69^{a}	1.56
AST (U/l)	97.84	97.94	98.02	98.08	98.13	7.89
UricAcid mmol/L	4.42	4.43	4.60	4.58	4.59	0.19
Creatinine mmol/l	21.45	20.51	20.46	21.40	20.50	1.13

^{abc} Means on the same row having different superscripts are significantly different (P<0.05), ALT- Alanine aminotransferase **AST-** Aspartate aminotransferase

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