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EFFECT OF PARTIAL REPLACEMENT OF SOYBEAN WITH MORINGA OLEIFERA (MORINGA) LEAF AND IPOMEA BATATA (SWEET POTATO) LEAF MEAL MIXTURE ON THE GROWTH PERFORMANCE AND BLOOD PROFILE OF BROILER CHICKEN

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Abstract:

This study was conducted to evaluate the effects of the mixture of graded levels of *Moringaoleifera* and *Ipomea batata Leaves Meal* (MOIBLM) on the growth performance, carcass quality as well as haematology and serum biochemical indices of broiler chickens. A total of one hundred and eighty (180) day old Arbo acre broiler chickens were randomly allotted into four dietary treatments of forty five (45) birds each in a Completely Randomized Experimental Design (CRD). Each treatment had three replicates with 15 birds per replicate at MOIBLM inclusion level of 0%, 2.5%, 5%, 7.5% respectively. Data were collected on feed intake, weight gain and feed conversion ratio, carcass quality, haematology and serum chemistry. The birds were raised in a battery cage system where feeds and water were provided *ad-libitum*in an experiment which lasted for fifty-six (56) days. Data collected on Growth performance and blood parameters were subjected to analysis of variance and means were considered at $p<0.05$. The result revealed significant ($p<0.05$) differences in feed intake and weight gain of broiler chickens fed the experimental diet with experimental animals fed 2.5% inclusion level (T2) having higher weight gain and feed conversion ratio than others. There were also significant differences in the packed cell volume, heamoglobin, red blood cell, white blood cell, albumin, globulin and total protein across the treatments, but all are within the normal range for the experimental animal. Generally, the MOIBLM did not have any negative effect on the experimental animals throughout the period of the experiment. The study concluded that MOIBLM improved the growth performance and feed conversion efficiency of broiler chickens especially at 5% inclusion level. Therefore, it can be utilized by broiler chicken as partial replacement for soybean basal diet without adverse effect on their growth performance, heamatology and serum biochemical indices. It further recommended that MOIBLM meal at inclusion level of 5% and 7.5% would be beneficial for the health, and growth performance of broiler chicken. Further research is also recommended on the potentials of these test ingredients in animal feed formulation.

Keywords: Moringa leaf, sweet potato leaf, broiler chicken, performance, blood profile

1.INTRODUCTION

There has also been an increase in competition among ingredients used in the manufacture of livestock feed and consequently a great need for alternatives that can supply in the high demands for such ingredients, in particular for soya meal (Chisoro, 2015). Garba *et al*. (2010) suggested partial or complete replacement of expensive and conventional feed ingredients with cheaper non-conventional substitutes.

Soybean is the dominant protein source for livestock and human nutrition; it constitutes the largest volumes of both plant protein meal, and feed ingredient resources available in the world. These demands have made soybean highly competitive. One of the ways of reducing the cost of production and making protein available to people in cheaper prices especially in developing countries is by the use of agricultural by-products and tropical plants (leaf meal) which are not directly used by humans as food to feed livestock (Dey *et al*., 2013). For instance, *Moringa olifera* and *Ipomea batatas* leaves are found to be loaded with vitamins and amino acids (Francis *et al*., 2005). Fahey (2009) stated that the high bioavailability of moringa leaves and stems make them an excellent feed for livestock, it also an excellent source of sulphur containing amino acids, cysteine and methionine, which are often limiting in most feedstuff used for feeding animals (Olugbemi *et al*., 2010).

Moringa leaves contains 27.51% crude protein, 19.25% crude fibre, 2.23% crude fat, 7.13% ash, 76.53% moisture, 43.88% carbohydrate and 1296.00 Kj/g calories (Oduro *et al*., 2008).Sweet potato (*Ipomoea batatas*) is a dicotyledonous plant that belongs to the bindweed or morning glory family (Convolvulaceae). Its large, starchy, sweet-tasting, tuberous roots are a root vegetable. The young leaves and shoots are sometimes eaten as greens and have also been found to be rich in several bioactive chemicals or phytochemicals (alkaloids, flavonoids, tannins, saponins, terpenoids, phenols etc.) Buragohain (2016); Alagbe and Oluwafemi (2019) which performs multiple biological activities such as antimicrobial, antifungal, antiviral, antioxidants, hypolipidemic, anti-allergic and neuroprotective (Oluwafemi et al., 2020; Shittu et al., 2020; Olafadehan et al., 2020).

According to Onimisi *et al*. (2007); Olatunji et al. (2015), Moringa leaf meal can be included up to 30% in rabbit diet without any adverse effect on the growth performance. It can also be included up to 20% in the diets of laying birds without any adverse effect on their production and performance (Ayssiwede *et al*., 2011). Some leaves have proven to contain nutritional properties that can be beneficial if incorporated into animals feed (Chisoro, 2015). Therefore, this experiment was conducted to evaluate the effects of the mixture of graded levels of *Moringaoleifera* and *Ipomea batata Leaves Meal* (MOIBLM) on the growth performance, carcass quality as well as haematology and serum biochemical indices of broiler chickens.

2.MATERIALS AND METHODS

2.1 EXPERIMENTAL SITE

The study was carried out at the poultry section of the Teaching and Research Farm of the Faculty of Agriculture University of Abuja, Abuja Nigeria. The study territory exist in the Southern Guinea Savanna ecological zone of Nigeria, geographically situated within latitude $08^0$25′ and $9^0$20′N and longitude $06^0$45′ and $07^0$39′E.

2.2PRE-EXPERIMENTAL OPERATIONS

Deep litter poultry house was used for the experiment, damaged parts in the poultry house was repaired, swept, cleaned and well disinfected with Cid 2000, feed and water troughs was also washed. The electrical fittings (bulb) 200 watts were properly fixed, foot bath was put in place for proper biosecurity and a vaccination programme was designed before the commencement of the study.

2.3COLLECTION AND PROCESSING OF MORINGA OLEIFERA AND IPOMEA BATATA LEAF

Fresh and healthy *Moringa oleifera* and *Ipomea batata* leaves were harvested at the University Teaching and Research farm, Gwagwalada, Abuja. The harvested leaves were air dried separately on a concrete floor for 2 weeks to maintain the bioactive chemicals in the plant. The dried leaves were then hammer milled to produce *Moringa oleifera* and *Ipomea batata* leaf meal and mixed in the ratio of 1:1 to produce (MOIBLM). It was later stored in an air tight labeled container and kept for further analysis.

2.4EXPERIMENTAL ANIMALS AND MANAGEMENT

A total of one hundred and eighty (180) one-day old (Arbo-acre) broilers birds of mixed sex were obtained from a commercial hatchery (chi) in Ibadan. The chicks were weighed individually at the beginning of the experiment. Anti-stress was added in the drinking water of the birds. They were randomly allocated into four dietary treatments (T1, T2, T3 and T4); each treatment replicated three times with 15 birds per replicate making a total of 45 birds per treatment. The birds were allowed two (2) weeks to acclimatize within which they were given antibiotics and vitamins. The light (electric bulb) was continuous and the initial brooding temperature was 34^oC for the first week of age and it was gradually reduced by 2^oC per week. Vaccines were given according to the prevailing vaccination schedule in the environment. Clean feed and water was administered *ad libitum* and other routine management were strictly adhered to.

2.5EXPERIMENTAL DIET AND DESIGN

Four (4) experimental diets (treatments) were formulated to meet the nutritional requirements of birds according to NRC (1994). Treatment 1(T1) was designated to serve as the control with no MOIBLM. All other

treatments (T2, T3 and T4) contained MOIBLM replacing soybean meal at 2.5%, 5%, and 7.5% respectively; the experimental design was a Completely Randomized Design (CRD).

2.6MEASUREMENTS

Proximate compositions of experiment diet were determined by using official method of analysis by AOAC (2000).

2.7PERFORMANCE RECORD

Feed intake was recorded daily and body weight gain was recorded weekly, feed conversion ratio was calculated by dividing the total feed intake by weight gain, mortality was also recorded as it occurs.

Average daily weight gain (g) = weight gain (g) ÷ number of experimental days (g)

2.8HAEMATOLOGICAL AND SERUM BIOCHEMICAL ANALYSIS

Blood samples were collected very early in the morning from the wing vein from three (3) randomly selected birds per replicate into a 5 ml sterile syringe using 23 gauge needles and transferred into an ethylene diamine tetra acetic acid (EDTA) bottle. Haematological parameters: pack cell volume (PCV), red blood cell (RBC), haemoglobin (Hb), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), mean corpuscular volume (MCV), white blood cell (WBC) and its differentials were analyzed using an automated machine (Sysmex, Model KU-30 HG, India).

Serum analysis was carried out using bottles free from EDTA, blood were analyzed for total protein, albumin, globulin, glucose, cholesterol, creatinine, alanine transaminase (ALT) and aspartate transaminase (AST) were assayed using diagnostic kit manufactured by Merck India Ltd (Model PS-09R) as described by Alagbe *et al*. (2020).

2.9STATISTICAL ANALYSIS

All data were subjected to one -way analysis of variance (ANOVA) using SPSS (18.0) and significant means were separated using Duncan multiple range tests (Duncan, 1955). Significant was declared if $P \leq 0.05$.

Table 1: Composition (%) of experimental (Starter diets 1-4 weeks)

Ingredients	Treatments			
	1	2	3	4
Maize	50.55	50.55	50.55	50.55
G/cake (GNC)	09.00	09.00	09.00	09.00
Soya cake	27.00	26.98	26.95	26.93
Fish meal (65%)	02.00	02.00	02.00	02.00
Palm oil	03.00	03.00	03.00	03.00
Bone meal	05.00	05.00	05.00	05.00
Limestone	02.50	02.00	02.00	02.00
Salt	00.30	00.30	00.30	00.30
Vit	00.20	00.20	00.20	00.20
Lysine	00.25	00.25	00.25	00.25
Methionine	00.20	00.20	00.20	00.20
MOIBLM	00.00	02.50	05.00	07.50
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
ME/Kcal/kg	2998.4	2990.5	2970.4	2960.8
CP%	21.40	21.20	21.10	20.90
CF%	02.61	02.72	02.88	03.00
EE%	07.42	07.35	07.28	07.21
Ly%	01.24	01.17	01.10	01.03
Meth%	00.55	00.53	00.51	00.50
Ca%	01.43	01.46	01.48	01.50
Phos%	00.71	00.71	00.72	00.73

[1]Premix supplied per kg diet :- Vit A, 10,000 I.U; Vit E, 5mg; Vit D3, 3000I.U, Vit K, 3mg; Vit B2, 5.5mg; Niacin, 25mg ; Vit B12, 16mg ; Choline chloride, 120mg ; Mn, 5.2mg ; Zn, 25mg ; Cu, 2.6g ; Folic acid, 2mg ; Fe, 5g ; Pantothenic acid, 10mg ; Biotin, 30.5g ; Antioxidant, 56mg

Table 2: Composition (%) of experimental (Finisher diets 5-8weeks)

Ingredients	Treatments			
	1	2	3	4
Maize	55.55	58.55	58.55	58.55
G/cake (GNC)	09.00	09.00	09.00	09.00
Soya cake	23.20	20.80	18.30	15.80
Fish meal local	01.00	01.00	01.00	01.00
Palm oil	03.00	03.00	03.00	03.00
Bone meal	04. 70	03.20	03.20	03.20
Limestone	02.50	02.50	02.50	02.50
Salt	00.30	00.30	00.30	00.30
Vit	00.20	00.20	00.20	00.20
Lysine	00.25	00.25	00.25	00.25
Methionine	00.20	00.20	00.20	00.20
MOIBLM	00.00	02.50	05.00	07.50
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
ME/Kcal/kg	3084	3074	3064	3054
CP%	21.40	21.20	21.10	20.90
CF%	03.79	03.94	04.08	04.23
EE%	07.42	07.35	07.28	07.21
Ly%	01.24	01.17	01.10	01.03
Meth%	00.55	00.53	00.51	00.50
Ca%	01.33	01.56	01.78	02.00
Phos%	00.71	00.71	00.72	00.73

[1]Premix supplied per kg diet :- Vit A, 7,000 I.U; Vit E, 5mg; Vit D3, 3000I.U, Vit K, 3mg; Vit B2, 5.5mg; Niacin, 25mg; Vit B12, 16mg ; Choline chloride, 120mg ; Mn, 5.2mg ; Zn, 25mg ; Cu, 2.6g ; Folic acid, 2mg ; Fe, 5g ; Pantothenic acid, 10mg ; Biotin, 30.5g ; Antioxidant, 56mg

3.RESULTS AND DISCUSSION

3.1PROXIMATE COMPOSITION OF MOIBLM

Table 3 reveals the proximate composition of MOIBLM. The proximate components revealed the presence of crude protein (38.41 %), crude fibre (15.44 %), ether extract (2.91 %), ash (10.44 %), dry matter (90.45 %) and energy (2006.7 kcal/kg). The crude protein, crude fibre, ether extract values obtained in this experiment were higher than those reported by Madubuike and Ekenyem (2006) for Ipomoea asarifolia leaf meal. Shittu et al. (2019) reported an energy value of 3236.1 Kcal/kg in Ipomoea asarifolia leaf meal. Significant protein level was recorded in MOIBLM; it is an indication that the material can be used as a protein supplement for livestock feed (NRC, 1994). Ash content is an indication of the amount of minerals present in a particular sample which are important in many biochemical reactions functioning as co-enzyme and help physiological processes in the body (Ojewuyi et al., 2014; Alagbe, 2019). The ether extract (EE) value obtained is contrary to the findings of Fagbohun et al. (2012) who reported EE of 10.21 % in Urena lobata leaves.

Table 3: Proximate Composition of *Moringa oleifera* and *Ipomea batatas* leaf meal

Parameters	Composition
Dry matter (%)	90.45
Crude protein (%)	38.41
Crude fibre (%)	15.44
Ether extract (%)	2.91
Ash (%)	10.44
Energy (kcal/kg)	2006.7

3.2GROWTH PERFORMANCE OF BROILER CHICKS FED DIFFERENT LEVELS OF MOIBLM

The performance characteristic of broiler chicks given different levels of MOIBLM is shown in Table 4. Initial body weight (IBW), final live weight (LW), weight gain (WG) and average daily gain (ADWG) range between 40.05 – 41.80 g, 1589.1 – 2300.7 g, 1548.1 – 2258.9 g and 27.64 – 40.34 g respectively. The weight gain was highest in T4, intermediate in T2 and T3 and lowest in T1 (P<0.05). The result obtained is in agreement with the findings of Olatunji et al. (2005); Alagbe and Oluwafemi (2019). Similar result was obtained by Sadeghi et al., 2012; Fascina et al. (2017) when phytogenic additives were fed to broiler chickens. The high weight observed in T4 could be attributed to the presence of phytochemicals in MOIBLM. According to Hyun et al. (2018), phytochemicals in plant ensures optimum animal performance and nutrient availability; their composition or concentration vary according to the plant, parts of the plant, geographical origin, harvesting seasons, environmental factors, processing techniques and storage conditions (Chen et al., 2000).

Total feed intake (3945.0 - 3940.0 g) and average daily feed intake (70.36 - 70.44 g) were not (P>0.05) influenced by the treatments. Mortality was highest in T1 (5.1 %), none was recorded in the other treatments (P<0.05). Musa et al. (2020) reported than inclusion of phytochemicals in the diets alters and stabilizes the intestinal microbiota (eubiosis) and reduces microbial toxic metabolites in the gut, due to their direct antimicrobial properties on various pathogenic bacteria. For instance, saponins, flavonoids and tannins have been suggested to involve in antimicrobial, antiviral, antioxidant and anti-inflmmatory activities (Atamgba et al, 2015). It could also be one of the possible reasons why mortality was not recorded in T2, T3 and T4 compared to T1 where 5.1 % mortality was recorded.

Table 4: Effects of different levels of MOIBLM on the performance traits of broiler chicks

Parameters	T1	T2	T3	T4	SEM
IBW (g)	41.04	40.05	41.00	41.80	0.43
FBW (g)	1589.1^{c}	2097.3^{b}	2209.6^{a}	2300.7^{a}	71.33
Weight gain (g)	1548.1^{c}	2057.3^{b}	2168.6^{a}	2258.9^{a}	20.41
ADWG (g)	27.64^{c}	36.74^{b}	38.73^{b}	40.34^{a}	6.55
TFI (g)	3945.0	3943.7	3940.3	3940.0	10.88
ATFI (g)	70.44	70.42	70.36	70.36	4.81
FCR	2.50	1.92	1.82	1.74	0.08
Mortality (%)	5.1	-	-	-	-

Means in the same row with different superscripts differ significantly (P<0.05)
IBW: initial body weight; FBW: final body weight; ADWG: average daily weight gain; TFI: total feed intake; ATFI: average total feed intake; FCR: feed conversion ratio

3.3EFFECT OF FEEDING MOIBLM ON HEMATOLOGICAL PARAMETERS OF BROILERS CHICKS

Table 5 reveals the values of the hematological parameters investigated; the pack cell volume (PCV) values obtained are 29.81, 30.00, 30.40 and 33.88% for diets 1, 2, 3 and 4 respectively while those of hemoglobin (Hb)values obtained are 8.09, 11.01, 11.33 and 12.09 g/dl for diets 1, 2, 3 and 4. The Red blood cell (RBC) are 1.56, 3.10, 3.60 and 3.91 (10)6mm for diets 1, 2, 3 and 4 respectively while those of MCV are 110.3, 130.1, 147.0 and 156.1fl for diets 1,2,3 and 4 respectively while those of MCH are 37.06, 53.01, 55.78 and 60.22pg for diets 1, 2, 3 and 4 while those of MCHC are 34.71, 36.52, 35.61 and 36.88% for diet 1, 2, 3 and 4 while those of White blood cell (WBC) are 15.08, 22.00, 23.89 and 24.20 $(10)^3$ mm for diets 1, 2, 3 and 4 respectively. The pack cell volume (PCV), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were significantly ($P<0.05$) different among the dietary treatments. The Heterophils values obtained are 3.70, 5.07, 5.00 and 5.10% for diets 1, 2, 3 and 4 respectively while those of monocytes values are 0.70, 0.71, 0.70 and 0.80% for diets 1, 2, 3 and 4. The Lymphocytes values obtained are 6.02, 9.78, 9.94 and 11.44% for diets 1, 2, 3 and 4 respectively while those of Eosinophils values are 0.67, 0.60, 0.61 and 0.60% for diets 1, 2, 3 and 4 respectively while those of Basophils values are 2.11, 2.04, 2.00 and 2.14% for diets 1, 2, 3 and 4 respectively. White blood cell, lymphocytes, monocytes and heterophils were significantly influenced ($P<0.05$) by MOIBLM. However, all values were within the physiological range for broilers reported by Islam et al. (2004); Talebi et al. (2005) and Aldi-Hachesoo et al. (2012).

Table 5: Effect of feeding MOIBLM on hematological parameters of broilers chicks

Parameters	T1	T2	T3	T4	SEM
PCV (%)	29.81^b	30.00^a	30.40^a	33.88^a	1.18
Hb (g/dl)	8.09^c	11.01^b	11.33^b	12.09^a	0.21
RBC ($\times10^6$/µl)	1.56^b	3.10^a	3.60^a	3.91^a	0.05
MCV (fl)	110.3^c	130.1^b	147.0^b	156.1^a	1.20
MCH (pg)	37.06^c	53.01^b	55.78^b	60.22^a	2.11
MCHC (%)	29.71^b	36.52^a	35.61^a	36.88^a	0.04
WBC ($\times10^3$/µl)	15.08^c	22.00^b	23.89^b	24.2^a	0.21
Lymphocytes (%)	6.02^c	9.78^b	9.94^b	11.44^a	0.18
Monocytes (%)	0.20^b	0.71^a	0.70^a	0.80^a	0.02
Heterophils (%)	3.70^b	5.07^a	5.00^a	5.10^a	0.13
Basophils (%)	1.11^b	2.04^a	2.00^a	2.14^a	0.25
Eosinophils (%)	0.27^b	0.60^a	0.61^a	0.60^a	0.01

Means in the same row with different superscripts differ significantly ($P<0.05$)

3.4SERUM BIOCHEMICAL INDICES OF BROILER CHICKS FED DIFFERENT LEVELS OF MOIBLM.

The serum biochemical parameters of the experimental animals are presented in Table 6. The Albumin values obtained are 2.22, 2.30, 2.02 and 2.16 (g/dl) for diets 1, 2, 3 and 4 respectively while those of Globulin values obtained are 1.23, 2.00, 2.01 and 2.00 (g/dl) for diets 1, 2, 3 and 4 respectively. The total protein values obtained are 3.47, 4.30, 4.03 and 4.16 (g/dl) for diets 1, 2, 3 and 4 respectively. Creatinine values obtained are 0.43, 0.40, 0.41 and 0.42 (mg/dl) for diets 1, 2, 3 and 4 respectively. Cholesterol values obtained are 101.1, 100.8, 98.10, 85.44 (mg/dl) for diets 1, 2, 3 and 4 respectively. Urea values obtained are 1.66, 1.57, 1.40 and 1.31 mg/dl for diets 1, 2, 3 and 4 respectively. ALT values obtained are 141.6, 110.1, 97.70 and 88.31 (iu/l) for diets 1, 2, 3 and 4 respectively. AST values obtained are 91.51, 87.39, 77.04 and 60.40 (iu/l) for diets 1, 2, 3 and 4 respectively. Albumin, globulin, total protein, cholesterol, urea, ALT and AST were significantly different ($P<0.05$) while creatinine was not significantly ($P>0.05$) influenced by different inclusion of *Moringa oleifera* and *Ipomea batata* leaf meal mixture. Serum protein may be used as an indirect measurement of dietary protein quality (Alikwe *et al*. 2010). Globulin play a significant role in fighting infections, hormone carrier as well as blood clotting process because of the presence of

antibodies and enzymes in them (Vivian *et al.*, 2015). However, all within the physiological range reported for birds by Livingston *et al.* (2020). Cholesterol level decrease with increase in MOIBLM, this clearly removes the risk of cardiovascular disease and ensures that the meat of the animal is safe for consumption (Alagbe *et al.*, 2020). The non-significant difference in creatinine and urea values ($P > 0.05$) is an indication that the integrity of the kidney is not compromised, similar report was observed by Alikwe et al. (2010). AST and ALP values in T4 reduced as the level of MOIBLM inclusion increased, this reveals that the test material is non toxic. This result is in agreement with the findings of Iyayi (1994).

Table 6: Serum biochemical indices of broiler chicks fed different levels of MOIBLM.

Parameters	T1	T2	T3	T4	SEM
Albumin (g/dl)	2.22^{a}	2.30^{a}	2.02^{b}	2.16^{b}	0.06
Globulin (g/dl)	1.23^{b}	2.00^{a}	2.01^{a}	2.00^{a}	1.22
Total protein (g/dl)	3.47^{b}	4.30^{a}	4.03^{a}	4.16^{a}	1.40
Creatinine (mg/dl)	0.43	0.40	0.41	0.42	0.05
Cholesterol (mg/dl)	101.1^{a}	100.8^{a}	98.10^{b}	85.44^{c}	3.03
Urea (mg/dl)	1.66^{a}	1.57^{a}	1.40^{b}	1.31^{c}	0.07
ALT (iu/l)	141.6^{a}	110.1^{a}	97.70^{b}	88.31^{b}	1.31
AST (iu/l)	91.51^{a}	87.39^{a}	77.04^{b}	60.40^{c}	3.01

Means in the same row with different superscripts differ significantly ($P<0.05$)
AST: Alanine serum transaminase
ALT: Alanine aminotransferase
SEM: standard error of mean

4.CONCLUSION

Results obtained in this study have shown that *Moringa oleifera* and *Ipomea batata* leaf meal can be utilized by Broiler chicken as fed supplement in soybean meal basal diets without adverse effects on their growth performance, hematological profile and serum biochemical indices at low level.

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6.CONFLICTS OF INTEREST: The authors declare no conflict of interest.

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