PERFORMANCE CHARACTERISTICS OF BROILER CHICKENS FED COMPOSITE LEAF MEAL AS ALTERNATIVE PREMIX

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ABSTRACT

This study produced composite leaf meal from five vegetables to replace commercial premix in broiler diets. Fresh moringa, African basil, cassava, fluted pumpkin and bitter leaves were harvested, air-dried and milled separately and were later mixed in equal proportion (ratio 1:1:1:1:1) into a composite meal and used to replace broiler commercial premix at 0, 1, 2, 3, 4 and 5 % in place of 0, 20, 40, 60, 80 and 100 % reduction levels of commercial premix, respectively. Three hundred day-old broilers were randomly allotted at 50 chicks per treatment of 5 replicates using performance and cost implication as response criteria. All the growth parameters measured were not significantly influenced (p>0.05) by the dietary treatments. The highest final weights (2.71 kg/bird) and best feed conversion ratio was recorded in Diet II birds. Highest dress and eviscerated weights (88.15 and 77.07 %) were recorded in Diet I birds, while lowest dress weight (86.62 %) was recorded in Diet VI birds and lowest eviscerated weight (73.77 %) occurred in Diet V birds. The heart, lung, pancreas and belly fat weights were influenced (p<0.05) by the dietary treatments among measured organs. The average price realized/bird and average price gained/bird were highest in Diet II birds (₦2660.00 and ₦1906.07). Generally, the percentage cost reduction increased as the level of the composite meal inclusion increased. Conceivably, within the limit of this study the replacement of commercial broiler premix with CLM could help to stem over dependence of broiler farmers on importation of premix.

Keywords: Broiler, Leaves, Composite leaf meal, Premix, Performance, Cost

INTRODUCTION

The search for least-cost formulations has long involved the replacement of expensive feed stuffs with cheaper alternatives in the formulation of poultry rations. In intensive poultry enterprise, feed is the major component cost and the ultimate challenge is to reduce cost of input to a minimum without compromising the quality of the products (Ziggers, 2011). Thus, adequate knowledge of poultry nutrition and of course micro-nutrients (vitamins and minerals) in alternative feed ingredients like leaves is imperative for good ration formulation (Adegbenro *et al.,* 2012). Feed formulation involves combining different ingredients (i.e. protein and energy sources, vitamins and minerals) in proportions necessary to provide the animal with proper amounts of nutrients needed at a particular growth stage. From market survey as at April – May, 2016, it was discovered that 1.0 kg of commercial broiler premix cost about ₦ 700 which when calculated in tons will translate to ₦ 700,000 per ton. This could be reduced to a reasonable level if alternative but locally available feed ingredients are judiciously used in place of these commercial premixes. This will significantly reduce the cost of producing monogastric diets and in turn increase meat and egg production in

Africa. Vegetable-based feeds are a rich source of essential plant amino acids, vitamins and minerals. Furthermore, it has been established that green vegetable leaves are the cheapest and most abundant source of proteins because of their ability to synthesize amino acids from a wide range of available primary materials such as water, carbon dioxide and atmospheric nitrogen (Agbede and Aletor, 2004; Fasuyi, 2006). Thus, in the course of world clamour for sustained food security through organic farming enhancement, the combination of cassava (*Manihot esculenta*), moringa (*Moringa oleifera*), fluted pumpkin (*Telfairia occidentalis*), bitter leaf (*Vernonia amygdalina*) and African basil (*Ocimum gratissimum*) leaves could be as a replacer for the expensive commercial premix often used in poultry diets production. This thus forms the main focus of the compendium of studies reported herein. Hence, this study examined the nutritive potentials of composite leaf meal from five leaves available locally as alternative premix in broiler chicken diets.

MATERIALS AND METHODS

Experimental Site: The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, The Federal University of Technology, Akure, Nigeria, (Latitude 7018''N and Longitude 50 10''E) which falls within the rainforest zone of the humid tropics which is characterized by hot and humid climate. The mean annual rainfall is 1500 mm and the rain period is bimodal with a short break in August. The altitude is about 350.52 m above sea level, the mean annual humidity is 75 % and that of temperature is 27^{o}C.

Composite Leaf Meal Production: Leaves from cassava, moringa, fluted pumpkin, basil and bitter leaves were harvested and air-dried to a constant weight to prevent loss of some vital nutrients. The air-dried leaves were milled using hammer mill and stored in plastic container separately prior to use. Thereafter, the leaves were mixed together in the ratio of 1:1:1:1:1 weight:weight to produce the CLM.

Experimental Diets: The commercial premix in the basal diet was reduced by 0, 20, 40, 60, 80 and 100 % and replaced with 0, 10, 20, 30, 40 and 50 gkg^{-1} CLM and designated diets I, II, III, IV, V and VI respectively. The gross composition of the experimental diets (starter and finisher phases) were shown in Tables 1 and 2. The proximate composition of the diets was determined according to the method of AOAC (2000).

Experimental Birds and Design: Three hundred (300) Abor Acre day-old chicks were procured from a reputable hatchery in Ibadan, Nigeria. On arrival, the broiler chicks were randomly allotted to six treatments replicated five times with 10 birds per replicate in a Completely Randomized Design. The birds were fed their respective starter diets for a period of four weeks and their finisher diets for the remaining four weeks. Feed and water were supplied *ad libitum* throughout the experimental period. Medication and vaccination were given as at when due. Daily feed consumption and weekly weight changes were monitored. The feed conversion ratio (FCR) was calculated from the values obtained from daily feed consumption and weekly weight changes.

Slaughtering, Carcass and Organs Measurement: At the close of the feeding trial (8 weeks), three birds per replicate were randomly selected and sacrificed. The birds were defeathered and weighed. The eviscerated weight was obtained by removal of the offal and internal organs. Carcass parts and organs were weighed and their weights expressed as percent of live body weight.

Economy of Production: The cost implication and net revenue of replacing the commercial premix with CLM was calculated. Other expenses on drugs, vaccines and litter were common for all the treatments. The calculation of profit per bird for the treatments were calculated by adding factors like cost of day-old chick, cost of experimental diet, cost of feed consumed, average weight gain, cost of drugs and vaccines and average price realized/bird.

Table 1: The gross composition of the broiler-starter experimental diets (g/kg)

Ingredients	Diets					
	I (0 %)	II (1 %)	III (2 %)	IV (3 %)	V (4 %)	VI (5 %)
Maize	503	493.5	479	464.5	455	445.5
Wheat offal	30	30	30	30	30	30
Soybean meal	245	245	245	245	245	245
Groundnut cake	100	100	100	100	100	100
Brewer's dried grain	50	50	50	50	50	50
Fish meal	30	30	30	30	30	30
Bone meal	20	20	20	20	20	20
Oyster shell	10	10	10	10	10	10
*Premix	2.5	2	1.5	1	0.5	0
Composite leaf meal	0	10	20	30	40	50
Methionine	2.5	2.5	2.5	2.5	2.5	2.5
Lysine	2	2	2	2	2	2
Salt	5	5	5	5	5	5
Vegetable oil	0	0	5	10	10	10
Total	1000	1000	1000	1000	1000	1000
Calculated analysis						
Crude protein (g/kg)	236.3	238.3	240.0	241.6	243.8	245.8
Metabolizable energy (MJ/kg)	11.93	11.96	12.11	12.26	12.29	12.33
Calcium (g/kg)	13.80	13.80	13.81	13.81	13.82	13.82
Phosphorus (g/kg)	5.90	5.92	5.95	5.97	6.00	6.02

**Contained vitamins A (8,500,000 IU); D3 (1,500,000 IU); E (10,000mg); K3 (1,500mg); B1 (1,600mg); B2 (4,000mg); B6 (1,500mg); B12 (10 mg); Niacin (20,000 mg); Pantothenic acid (5,000 mg); Folic acid (500 mg); Biotin H2 (750 mg); Choline chloride (175,000 mg); Cobalt (200 mg); Copper (3,000 mg); Iodine (1,000 mg); Iron (20,000 mg); Manganese (40,000 mg); Selenium (200 mg); Zinc (30,000 mg); and Antioxidant (1,250 mg) per 2.5 kg*

Table 2: The gross composition of the broiler-finisher experimental diets (g/kg)

Ingredients	Diets					
	I (0 %)	II (1 %)	III (2 %)	IV (3 %)	V (4 %)	VI (5 %)
Maize	595	584	574.5	564.5	550	540.5
Soybean meal	185.5	185.5	185.5	185.5	185.5	185.5
Groundnut cake	70	70	70	70	70	70
Brewer's dried grain	50	50	50	50	50	50
Fish meal	5	5	5	5	5	5
Bone meal	25	25	25	25	25	25
Oyster shell	10	10	10	10	10	10
Premix	2.5	2	1.5	1	0.5	0
Composite mix	0	10	20	30	40	50
Methionine	2	2	2	2	2	2
Lysine	2	2	2	2	2	2
Salt	5	5	5	5	5	5
Vegetable oil	48	49.5	49.5	50	55	55
Total	1000	1000	1000	1000	1000	1000
Calculated analysis						
Crude protein (g/kg)	182.2	184.1	186.2	188.2	189.9	192.0
Metabolizable energy (MJ/kg)	13.49	13.56	13.60	13.64	13.79	13.83
Calcium (g/kg)	13.90	13.90	13.91	13.91	13.92	13.92
Phosphorus (g/kg)	5.60	5.62	5.64	5.67	5.70	5.72

**Contained vitamins A (8,500,000 IU); D3 (1,500,000 IU); E (10,000mg); K3 (1,500mg); B1 (1,600mg); B2 (4,000mg); B6 (1,500mg); B12 (10 mg); Niacin (20,000 mg); Pantothenic acid (5,000 mg); Folic acid (500 mg); Biotin H2 (750 mg); Choline chloride (175,000 mg); Cobalt (200 mg); Copper (3,000 mg); Iodine (1,000 mg); Iron (20,000 mg); Manganese (40,000 mg); Selenium (200 mg); Zinc (30,000 mg); and Antioxidant (1,250 mg) per 2.5 kg*

Statistical Analysis: Data collected were subjected to one-way analysis of variance (ANOVA) using SPSS version 13 package (SPSS, 2006) and significant means were separated using Duncan Multiple Range Test of the same package.

RESULTS

Performance Characteristics: Table 3 showed the influence of CLM on the performance of broiler chickens. The final body weight (FBW), total weight gain (TWG), total feed intake (TFI) and feed conversion ratio (FCR) of the birds fed the control diet were not significantly different (p>0.05) from those fed the CLM diets. However, the FBW of birds fed on 1 % CLM diet were numerically higher (2.71 kg/bird) than the rest experimental birds (2.54 – 2.69 kg/bird). Similar trends were observed for TWG. Also, the highest TFI (5.37 kg/bird) was observed in birds fed 5 % CLM diet, while the lowest TFI (5.02 kg/bird) was recorded in birds fed 2 % CLM diet. The least feed conversion ratio (1.99) was observed in bird fed Diet II while the highest feed conversion ratio was recorded in bird fed Diet VI.

Carcass Characteristics: Table 4 showed the carcass characteristics of broiler chicken finishers fed CLM-based diets. The percentage dressed weights and the relative weights of back, chest, drumstick, thigh, wing, neck and head (g/kg body weight) were not significantly influenced (p>0.05) by the dietary treatments. The percent eviscerated weight of birds fed the control diet (77.07 ± 1.17 %) was significantlyhigher (p<0.05) than those fed 4 % CLM diet (73.77 ± 0.31 %), but similar to those fed the 1, 2, 3 and 5 % CLM diets which ranged from 74.78 ± 0.78 – 76.57 ± 0.86 %. Also, the shank weight was significantly influenced (p<0.05) by the dietary treatments. Broiler chickens fed 3 % CLM diet had the highest value for thigh (101.99 ± 5.88 g/kg), while the least for thigh (86.01 ± 1.87 g/kg) was recorded in birds fed 2 % CLM diet. Also, birds fed Diet containing 3 % CLM had the highest shank weight (40.16 ± 2.54 g/kg) while least was recorded in diet III (30.72 ± 1.81 g/kg). In general, the eviscerated and shank weights did not follow any particular trend. The relative weights of drumstick ranged from 80.24 ± 1.90 – 93.46 ± 3.86 g/kg and chest weight ranged from 179.39 ± 8.90 – 200.85 ± 4.80 g/kg.

Relative Organs Measurement: The relative weights of liver, kidney, spleen, gizzard and proventriculus were not significantly affected (p>0.05) by the treatments but that of heart, lung, pancreas and belly fat were significantly affected by levels of CLM in the diets (Table 5). The relative weight of the heart of the birds fed the control diet (3.87 ± 0.29 g/kg body weight) was similar (p>0.05) to those fed the 1, 3, 4 and 5 % CLM diets but higher (p<0.05) than those fed 2 % CLM diet (3.08 ± 0.28 g/kg body weight). Similarly, the relative weight of the lungs of the birds fed the control diet (4.15 ± 0.39 g/kg body weight) was similar (p>0.05) to those fed 1, 3, 4 and 5 % CLM diets but higher (p<0.05) than those fed 2 % CLM diet (3.63 ± 0.47 g/kg body weight). The relative weight of the pancreas of the birds fed control diet (1.50 ± 0.18 g/kg body weight) was significantly lower (p<0.05) than those fed 4 % CLM diet, but similar (p>0.05) to those fed 2 and 5 % CLM diets and was equally higher (p<0.05) than those fed 1 and 3 % CLM diets (1.18 ± 0.08 and 1.44 ± 0.10 g/kg body weight). In addition, the relative weights of the belly fat were significantly (p<0.05) affected by the dietary treatments. The birds fed the control diet had higher (19.28 ± 3.45 g/kg body weight) than those fed CLM diets (12.66 ± 2.98 – 18.43 ± 1.66 g/kg body weight). The reduction was progressive as the level of CLM inclusion increases.

Economy of Production: The economics of broiler chickens fed CLM-based diets were presented in Table 6. Highest cost of experimental diet, cost of feed consumed and total cost of production were recorded in birds fed Diet I (₦92.70/kg, ₦357.98/kg and ₦757.98/kg) and lowest cost of experimental diet (₦88.66/kg) was recorded in birds fed Diet VI, while lowest cost of feed consumed and total cost of production were recorded in birds fed Diet III (₦326.58/kg and ₦726.58/kg, respectively).

Table 3: Performance of broiler chickens fed composite leaf meal-based diets

Parameters	Diets					
	I (0 %)	II (1 %)	III (2 %)	IV (3 %)	V (4 %)	VI (5 %)
Initial weight (g/bird)	40.81±0.19	41.27±0.02	41.48±0.03	41.38±0.03	41.38±0.03	41.59±0.12
Final weight (kg/bird)	2.69±0.41	2.71±0.33	2.54±0.29	2.64±0.30	2.64±0.37	2.68±0.26
Total weight gain (kg/bird)	2.65±0.27	2.66±0.35	2.50±0.29	2.60±0.36	2.60±0.33	2.64±0.24
Total feed intake (kg/bird)	5.31±0.41	5.29±0.45	5.02±0.50	5.22±0.49	5.17±0.36	5.37±0.32
Daily weight gain (g/bird)	47.29±3.44	47.58±5.52	44.60±2.61	46.38±4.38	46.33±3.58	47.17±2.54
Daily feed intake (g/bird)	94.65±5.75	94.39±3.02	89.68±4.04	93.15±5.92	92.39±3.86	95.85±2.75
Feed conversion ratios	2.01±0.03	1.99±0.04	2.01±0.03	2.01±0.03	2.00±0.03	2.03±0.04

Table 4: Carcass characteristics of broiler chickens fed composite leaf meal-based diets

Parameters	Diets					
	I (0 %)	II (1 %)	III (2 %)	IV (3 %)	V (4 %)	VI (5 %)
Dress weight (%)	$88.15±1.01^{a}$	$86.92±1.14^{a}$	$87.92±1.34^{a}$	$88.00±0.87^{a}$	$86.77±0.34^{a}$	$86.62±0.98^{a}$
Eviscerated weight (%)	$77.07±1.17^{a}$	$75.88±1.08^{ab}$	$76.31±0.96^{ab}$	$76.57±0.86^{ab}$	$73.77±0.31^{b}$	$74.78±0.78^{ab}$
Back (g/kg body weight)	$141.16±4.24^{b}$	$139.39±4.58^{c}$	$145.03±6.14^{a}$	$142.15±5.58^{b}$	$141.66±7.39^{b}$	$126.61±6.51^{d}$
Chest (g/kg body weight)	$200.85±4.80^{a}$	$180.30±9.82^{d}$	$186.21±6.82^{c}$	$195.81±6.94^{b}$	$196.18±3.92^{b}$	$179.39±8.90^{d}$
Drumstick (g/kg body weight)	$83.66±6.20^{d}$	$93.46±3.86^{a}$	$86.29±4.35^{c}$	$92.46±3.92^{a}$	$80.24±1.90^{e}$	$89.76±4.14^{b}$
Thigh (g/kg body weight)	$98.13±2.86^{b}$	$94.30±4.87^{c}$	$86.01±1.87^{e}$	$101.99±5.88^{a}$	$89.81±7.61^{d}$	$97.04±5.95^{b}$
Wing (g/kg body weight)	$70.71±2.27^{d}$	$76.08±3.48^{a}$	$70.47±2.27^{d}$	$74.26±3.41^{b}$	$68.64±1.81^{e}$	$73.43±1.76^{c}$
Neck (g/kg body weight)	$44.12±4.31^{c}$	$46.36±2.27^{a}$	$43.72±2.11^{c}$	$42.02±1.10^{d}$	$41.61±4.06^{d}$	$45.59±2.09^{b}$
Head (g/kg body weight)	$21.93±1.64^{a}$	$22.01±1.54^{a}$	$18.52±0.98^{d}$	$21.38±0.58^{b}$	$22.11±2.57^{a}$	$20.94±1.10^{c}$
Shank (g/kg body weight)	$35.88±2.54^{ab}$	$38.63±2.94^{ab}$	$30.72±1.81^{b}$	$40.16±2.54^{a}$	$33.73±2.61^{ab}$	$37.49±2.40^{ab}$

a-b: mean within rows having different superscripts are significantly different (p<0.05)

Table 5: Organ weights of broiler chickens fed composite leaf meal-based diets (g/kg body weight)

Parameters	Diets					
	I (0 %)	II (1 %)	III (2 %)	IV (3 %)	V (4 %)	VI (5 %)
Liver	15.35±0.79^{a}	15.29±0.56^{a}	14.83±0.51^{bc}	14.01±0.55^{d}	14.57±0.34^{c}	15.02±0.67^{ab}
Kidney	4.83±0.48^{ab}	4.59±0.38^{abc}	4.02±0.25^{d}	4.27±0.23^{cd}	4.93±0.46^{a}	4.39±0.44^{bcd}
Heart	3.87±0.29^{b}	4.10±0.26^{b}	3.08±0.28^{a}	3.99±0.13^{b}	3.63±0.30^{ab}	3.96±0.13^{b}
Lung	4.15±0.39^{ab}	4.42±0.27^{ab}	3.63±0.47^{a}	4.73±0.31^{b}	4.42±0.29^{ab}	4.25±0.20^{ab}
Pancreas	1.50±0.18^{bc}	1.18±0.08^{a}	1.56±0.05^{bc}	1.44±0.10^{ab}	1.77±0.07^{c}	1.68±0.06^{bc}
Spleen	1.05±0.12^{b}	1.14±0.14^{ab}	0.87±0.12^{c}	1.11±0.13^{ab}	1.25±0.14^{a}	1.15±0.10^{ab}
Gizzard	12.52±0.56^{c}	14.44±0.65^{a}	12.49±0.81^{c}	13.66±0.64^{b}	13.22±0.72^{b}	14.48±0.89^{a}
Belly fat	19.28±3.45^{b}	18.43±1.66^{b}	16.53±2.23^{ab}	15.18±2.26^{ab}	13.32±2.12^{a}	12.66±2.98^{a}
Proventriculus	3.22±0.15^{ab}	3.15±0.15^{ab}	3.06±0.28^{b}	3.15±0.26^{ab}	3.33±0.33^{ab}	3.37±0.21^{a}

a-c: mean within rows having different superscripts are significantly different (p<0.05)

Table 6: Economics of broiler chickens fed composite leaf meal-based diets

Parameters	Diets					
	I (0 %)	II (1 %)	III (2 %)	IV (3 %)	V (4 %)	VI (5 %)
Cost of day-old chicks (₦)	150.00	150.00	150.00	150.00	150.00	150.00
Cost of experimental diet (₦/kg)	92.74	91.93	90.97	90.06	89.62	88.66
Total feed consumed (kg/bird)	5.31	5.29	5.02	5.22	5.17	5.37
Cost feed consumed (₦/bird)	357.98	353.93	326.58	339.53	335.18	348.43
Weight gain (kg)	2.65	2.66	2.50	2.60	2.60	2.64
Cost of drugs/vaccine (₦)	250.00	250.00	250.00	250.00	250.00	250.00
Total cost of production (₦)	757.98	753.93	726.58	739.53	735.18	748.43
Average price realized/bird (@ 1000/kg)	2650.00	2660.00	2500.00	2600.00	2600.00	2640.00
Average price gained/bird (₦)	1892.02	1906.07	1773.42	1860.47	1864.82	1891.57
Net profit/bird (₦)	713.97	716.57	709.37	715.57	717.24	716.50
% Cost reduction	-	0.87	1.91	2.89	3.36	4.40

The average price realized/bird and average price gained/bird were highest in birds fed Diet II (₦2660.00 and ₦1906.07) followed by birds fed Diet I (₦2650.00 and ₦1892.02) with lowest values recorded in birds fed Diet III (₦2500.00 and ₦1773.42). Generally, the percentage cost reduction increased as the level of the CLM inclusion increased (0.87 - 4.40 % for finisher diets).

DISCUSSION

This current study showed that the FBW, TWG, TFI and FCR of the birds fed the control diet were not significantly different (p>0.05) from those fed the CLM diets. However, the best FCR was recorded in birds fed 1 % leaf composite meal diet, which indicated that the birds fed 1 % CLM diet utilized their feed better than other test diets. In general, the growth parameters measured during this trial for birds fed the control diet and those fed the CLM diets were identical, thus suggestted the nutritional adequacy of the CLM in replacing the commercial premix in broiler diet in sub-tropical Africa where these leaves are abundant. Thus, in the course of world clamour for sustained food security through organic farming enhancement, the combination of these leaves could be used as a cheaper replacer for commercial premix in broiler diets.

Carcass has been shown to be an instrumental in determining the relationship between the whole sale or process birds (Groen *et al.,* 1998). Quality of product output for the system is fixed by a predetermined amount of kilogram carcass of final product of broilers finished by a commercial grower (Groen *et al.*, 1998). The result on dressed weight was not significantly different among the treatment mean values but numerically higher in birds fed the control diet. Birds fed Diet II (1 % CLM diet) had the highest live weight per bird. This observation therefore implied that the dressed weight of chicken may not necessarily be directly proportional to the performance traits. A high weight gain value does not imply a concomitant increase in dressed weight as a percent of live weight (Fasuyi, 2000).

On the other hand, the percentages of the eviscerated weight were significantly higher (p<0.05) in birds fed the control diet than those fed Diet V but similar to those fed other test diets. The result indicated that the diets promoted the development of identical eviscerated weight percent. The values for eviscerated weight in this study ranged from 73.77 – 77.07 % which surpassed the normal range of 65 – 70 % reported for broiler chicken (Oluyemi and Robberts, 1979).

Organs on the other hand are body parts, composed of several types of tissues, capable of carrying out specialized function (Sarojini, 2005). The weight of organs in broilers according to Atteh, 2004 reflects the anatomical response of birds to the type of diet consumed. The relative organs weight measured in this study were comparable in all the dietary treatments except the heart, lungs, pancreas and belly fat. Though there were significant different (P<0.05) in the value obtained for heart and lungs, the chickens fed the control diet had similar values with 1, 3, 4 and 5% CLM diet, suggesting that the diets were not detrimental even though the leaves may have contained some anti-nutritional factors. The presences of anti-nutritional factors have been associated with abnormal enlargement of organs such as liver and pancreas due to detoxifying activities (Adeyemi, 2003). The significant variation among the treatment mean values of heart, lungs and pancreas did not follow a particular pattern in relationship with the dietary treatments. The result apparently may not have any relationship with the treatment diets, as other factors order than the CLM could be responsible. It could be generally be surmised that the control diet and the test diets enhanced identical organ development. More so, the pancreas though showing a significant different among the treatment diets did not have a particular trend. Also, the variation observed might not be due to the CLM inclusion as both birds fed the control and CLM diets did not show pancreatic hypertrophy.

However, the mean weight values for the belly fat were significantly different (p<0.05) among the treatments. The reduction in values for the belly fat was progressive as the level of CLM inclusion increased, thus indicating the potential of the leaf meals to reduction of fat deposition in the muscle and therefore could help in the prevention and reduction of neurodegerative diseases associated with lipid-rich diets (Upadhyay, 1990; Oforjindu, 2006).

The economy of production revealed that the cost of feed per kilogram of feed and cost of feed per gain were affected by the dietary treatments. These cost indicators were highest in the control diet and lowest in the 5 % CLM diet, which suggested plausible economic benefit of this inclusion level in broiler production. As a result of an increase in percentage cost reduction as the level of the CLM inclusion increased, it may be economically safe to completely replace commercial broiler premix with CLM as this would help lower cost of production and increase broiler meat affordability by the resource poor. For instance, the complete replacements of commercial premix with CLM at 5 % inclusion level led to ₦4.00 reduction. This translates to a colossal savings of ₦40,000 for the diet per tonne by farmers. Also, from the results which shows an increased in the revenue in the output of products from birds fed CLM-based diets which is directly related to an increase in chicken cutting performance. It shows that inclusion level of CLM can be done without any effect on the performance of broiler chickens. These findings were in agreement with the findings of Madiya *et al.* (2004) and Yadav *et al.* (2014). This observation could encourage broiler farmers especially the backyard poultry farmers in their quest for large scale expansion.

Conclusion: The replacement of commercial broiler premix in broiler chicken diets with CLM from the leaves under study could help to stem over dependence of broiler farmers, especially the low holding backyard farmers, on importation of commercial premix in developing countries thus leading to reduction in the cost of feeding and subsequently making poultry product (meat) available to the resource populace.

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REFERENCES

ADEGBENRO, M., AYENI, A. O., OLOWOYEYE, J., BANKOLE, O. M., AGBEDE, J. O., ONIBI, G. E. and ALETOR, V. A. (2012). Leaf composite mix as alternative premix to commercial premix in broiler finisher diets. Pages 1 – 4. *In: Conference on International Research on Food Security, Natural Resource Management and Rural Development*. Organised by Georg-August Universität Göttingen and University of Kassel-Witzenhausen, September 19 – 21, 2012.

ADEYEMI, F. A. (2003). Effect of enzyme supplemented cassava root sievet (CRS) in cassava-based diets on some visceral organs of pullet chicks. Pages 25 – 27. *In*: *Proceedings of the 8th Annual Conference of Animal Science Association of Nigeria*. September 16 – 18, 2003, Federal University of Technology, Minna.

AGBEDE, J. O. and ALETOR, V. A. (2004). Chemical characterization and protein quality evaluation of protein concentrates from *Gliricidia sepium* and *Leucaena leucocephala. International Journal of Food Science and Technology,* 39(3): 253 – 261.

FASUYI, A. O. (2000). Biochemical, Nutrition and Socio-Economic Aspects of Cassava Leaf Utilization. *PhD Thesis, The Federal University of Technology*, Akure, Nigeria.

FASUYI, A. O. (2006). Nutritional potentials of some tropical vegetable leaf meals: chemical characterization and functional properties. *African Journal of Biotechnology*, 5(1): 049 – 053.

GROEN, A. F., JIANG, X., EMMERSON, D. A. and VEREIJKAN, A. (1998). A deterministic model for the economic evaluation of broiler production systems. *Poultry Science*, 77(7): 925 – 933.

MADIYA, A. T., MCCRINDLE, C. M. E. and VEARY, C. M. (2004). The use of dried bakery products in a free-choice feeding method for small-scale broiler production. *Journal of the South African Veterinary Association,* 74(4): 111 – 116.

OFORJINDU, O. (2006). The toxicity of graded levels of neem (*Azadirachta indica*) leaf meal. *B. Agricultural Technology Project Report*, Federal University of Technology, Owerri, Nigeria.

OLUYEMI, J. A. and ROBERTS, F. A. (1979). *Poultry Production in Warm Wet Climates*. Macmillan Press Limited, London.

SAROJINI, T. R. (2005). *Modern Biology.* 3rd Edition, Africana First Publisher Limited, Nigeria.

SPSS (2006). *Statistical Package for Social Sciences*. SPSS Base 15.0 User's Guide, Chicago, USA.

UPADHYAY, C. (1990). The medicinal properties of neem (*Azadirachta indica*) tree. *In: Animal Pharmacology*. Second Edition, Longman, England.

YADAV, D. S., SHRIVASTAVA, M., SINGH, J. P. and MISHRA, A. K. (2014). Effect of replacement of maize with bakery waste in broiler ration. *International Journal of Agricultural Sciences and Veterinary Medicine*, 2(1): 28 – 33.

ZIGGERS, D. (2011). Optimising nutrient density in a volatile market. *All About Feed*, 2(3): 18 – 20.