GROWTH PERFORMANCE, CARCASS RESPONSE AND COST BENEFIT ANALYSIS OF COCKEREL FED GRADED LEVELS OF CASSAVA (*MANIHOT ESCULENTA*) GRIT SUPPLEMENTED WITH MORINGA (*MORINGA OLEIFERA*) LEAF MEAL

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ABSTRACT

A sixteen week trial was conducted to assess the effect of replacing cassava grit supplemented with Moringa leaf meal (MLM) for maize on the performance of 120 "day old" Harco cockerel chickens. Four experimental cockerel starter and finisher diets were formulated with diet 1 formulated to contain 0 % cassava grit while diet 2, 3 and 4 were formulated to contain cassava grit at 33.3, 66.6 and 100 % replacement for maize with 5 % of Moringa leaf meal inclusion in diets 2, 3 and 4 respectively. Chicks were randomly assigned to the four treatment diets in a completely randomized designed (CRD). Growth performance at finisher phase revealed that average live weight was significantly (p<0.05) highest 2.17 kg/bird in birds fed 66.6 % CGM. Weekly weight gain was also significantly (p<0.05) highest 0.86kg/bird among birds placed on 66.6 % CGM. Feed conversion ratio and protein efficiency ratio were also significantly (p<0.05) affected by the treatment diets. The cost benefit analysis at finisher phase cost of fed consume (₦171.83/bird) was also highest in birds fed 66.6 % CGM. Cost of feed per kilogram weight gain has comparable values of (₦93.67 and ₦93.21/bird) among birds fed diet 2 and 3. Total cost of production was least (₦640.74/bird) in birds fed 66.6 % CGM. Net profit (₦859.26) was highest in birds fed 66.6 % CGM. From this study, it is concluded that cassava grit can replace maize up to 66.6 % inclusion level with 5 % moringa leaf meal supplement in cockerel diet for optimum performance as well as good economic returns

Keywords: Cockerel, Cassava grit, *Moringa* leaf meal, Biological performance, Cost-benefit

INTRODUCTION

A major developmental challenge facing most developing countries like Nigeria in Africa is food insecurity due to the high population growth in Africa and growing income, the demand for eggs and poultry meat has significantly increased in recent years across large parts of the continent (WHO, 2010). Energy feed sources like maize, sorghum and millet are expensive feedstuff which constitute about 50 – 55 % of every formulated poultry diet.

Maize as a major component of livestock feed in Nigeria is expensive and its productivity has become very low due to the insurgency crisis in the north-eastern part of the country and the recent maize worm devastation recorded in some southern state have further increase the demand-supply gap in this energy feed resource. The livestock producers appear most hit in terms of high cost of feed brought about by exorbitant cost of feed ingredients. Poultry production still remains one of the veritable ways of achieving sustainable and rapid production of high quality animal protein to meet the increasing demand of the Nigerian learning populace (Apata and Ojo, 2000). Limitation imposed by scarcity of maize and competition from human consumption have forced many farmers into employing alternative sources of energy feedstuffs for poultry feed of which cassava is an example.

Cassava (*Manihot esculenta*) is consumed in West African countries as a cheap source of carbohydrate food for man and livestock (Oyewumi, 2013). The metabolizable energy value of cassava root meal is about (3,870 kcal/kg) which is higher than that of maize (3,430 kcal/kg) (Tion and Adeka, 2000). However, the low protein content (Salcedo *et al.,* 2010) and the dustiness of the feed (Ukachukwu, 2005; Ojewola *et al.,* 2006; Kana *et al.,* 2015) are among the limiting factor in cassava utilization. It is essential therefore that a good quality protein has to be incorporated in the diet containing cassava root so that its Amino acid profile can be improved.

There has been interest in the utilization of Moringa (*Moringa oleifera*) commonly called horse radish tree or drum stick tree, as a protein source for livestock (Sarwatt *et al.,* 2002; Kakengi *et al.,* 2007; Nuhu, 2010). *Moringa* leaves have quality attributes that makes it a potential substitute for soyabean meal or fish meal in non-ruminant diet (Okosun and Oyedeji, 2016). Several authors have reported the success stories of some agro by-products, root crops and other industrial by-products as replacement for maize. Onuh (2006) reported that agro by-products could be included at 10 % in poultry diet without any adverse effect. Tion and Adeka (2000) also demonstrated the beneficial effect of using cassava root meal to replace maize up to 30 % in broiler diet. Nwokoro *et al.* (2000) showed that cockerel starter bird could tolerate only 28 % level of cassava sievate in their diet. Cassava root meal and its by-product have being used in various forms and levels but there is a dearth of information on its combined (cassava + peel) supplementation with moringa leaf meal in poultry feeding.

This study was designed therefore to look into the growth performance and cost benefit analysis of cockerel fed cassava grit supplemented with moringa leaf meal.

MATERIALS AND METHODS

The experiment was carried out at the Poultry Unit of the Livestock Section, Teaching and Research Farm, Ambrose Alli University, Ekpoma for a period of sixteen (16) weeks. Cassava *(Manihot esculenta)* for the feeding trial was purchased from a reputable farm in Ekpoma, Esan West Local Government Area of Edo State, Nigeria. The woody part was chopped off, and the cassava was thoroughly washed to reduce the silica level to near zero. It was then grated without peeling and screw pressed for about 48 hours to reduce the hydrogen cyanide level to the barest minimum. It was mixed with palm oil to further encapsulate the cyanide in the milled whole cassava. It was thereafter oil-fried air dried and bagged into product known as the cassava grit which was used in formulating the experimental diets. The moringa leaf meal (MOLM) was air-dried at room temperature for 7 days until a constant weight was obtained and stored in air tight plastic pending use.

In a complete randomized design, one hundred and twenty (120) day old Harco cockerels were divided into four groups of thirty chicks containing three replicates of ten chicks each. The replicates were housed in floor pens measured 2.4 m^2 with the floor covered with wood shavings as liter material. A plastic trough and drinker were provided in each pen. The birds were vaccinated against gumboro at 2 and 4 weeks, Newcastle at 3 and 5 weeks, fowl cholera at 6 weeks and fowl pox disease at 9 weeks of age. Four isonitrogenous and isocaloric diets (1, 2, 3 and 4) were formulated to contain 21 and 18 % crude protein and 2650 and 2250 kcal/kg energy in the chicks and grower mashes respectively (Tables 1 and 2). Cassava grit was included in both the chick and grower mashes at 0.00, 33.30, 66.60 and 100 % replacement of maize in diets 1 (control), 2, 3 and 4 respectively, while moringa leaf meal after grinding was included at 5 % level in all the treatment diets except the control diet.

Table 1: Percentage compositions of cockerel starter diets

Ingredients	CGM1 0.00	CGM2 33.30	CGM3 66.60	CGM4 100
Maize	40.71	27.13	13.75	0.00
Cassava grit	0.00	13.57	27.14	40.71
Soya bean meal	29.25	29.84	32.84	36.33
Moringa leaf meal	0.00	5.00	5.00	5.00
Fish meal	0.50	0.50	0.50	0.50
Wheat offal	25.72	19.35	16.66	13.88
*DCP	2.00	2.00	2.00	2.00
Lime stone	1.20	1.99	1.49	0.96
Premix	0.30	0.30	0.30	0.30
Salt	0.32	0.32	0.32	0.32
Total	100.0	100.0	100.0	100.0
Calculated analysis				
Crude protein (%)	21.00	21.00	21.00	21.00
ME (Kcal/Kg)	2650	2650	2650	2650

**DCP: Dicalcium phosphate*

Table 2: Percentage compositions of cockerel finisher diets

Ingredients	CGM1 0	CGM2 33.3	CGM3 66.6	CGM4 100
Maize	22.53	15.02	7.51	0.00
Cassava grit	0.00	7.51	15.02	22.53
Soya bean meal	16.56	16.45	16.94	18.06
Moringa leaf meal	0.00	5.00	5.00	5.00
Palm oil	0.00	0.00	0.00	0.09
Wheat offal	50.01	50.05	50.57	50.54
*DCP	1.50	1.50	1.50	1.50
Lime stone	3.78	3.64	2.85	1.66
Premix	0.30	0.30	0.30	0.30
Salt	0.32	0.32	0.32	0.32
Total	100.0	100.0	100.0	100.0
Calculated analysis				
Crude protein (%)	18.00	18.00	18.00	18.00
ME (Kcal/Kg)	2250	2250	2250	2250

**DCP: Dicalcium phosphate*

The diet and clean drinking water were provided *ad-libitum* throughout the 16 weeks of the experiment. The chick mash was fed for the first 8 weeks of age and the finisher mash for the remaining 8 weeks of the experiment.

The proximate composition of cassava grit, moringa leaf meal and all dietary ingredients were analyzed based on the procedures described by AOAC (2000). Weight of cockerels and feed consumption were recorded weekly for all the treatments while, feed conversion and protein efficiency ratio was calculated accordingly.

Mortality among the birds during the experimental period was recorded and the causes were ascertained by detailed autopsy.

On the last day of the feeding trial, three (3) birds were selected based on the overall average from each treatment group making a total of 27 cockerels from the entire experiment. The cockerels were starved for 12 hours of feed, but drinking water was provided. Each bird was tagged and weighted before and after slaughtering to determine the live and bled weights respectively. The slaughtered cockerels were dipped in hot warm water for about two minutes and the feathers were plucked. The plucked weight was also recorded. The plucked chickens were eviscerated and the dressed weights estimated. The dressed weight refers to the weight of the birds being partially butchered, removing all the internal organs. The carcass was thereafter cut into parts, Such as head, neck, drumstick, shank, breast, back, lungs and gizzard and were. The weights of the parts were recorded and measured relative to the eviscerated weight. The dressing percentage was calculated as: Dressing percentage = dressed weight (g) ÷ live weight (g) x 100. The percentage relative organ weight was calculated as: Percentage relative organ weight = weight of organ (g) ÷ eviscerated weight (g) x 100.

The economic cost-benefit of raising cockerels up to 16 weeks of age with cassava grit was calculated as production cost = seed cost + feed cost + management cost for the respective dietary types.

All the data collected were subjected to analysis of variance (ANOVA) and differences between treatment means were separated using Duncan's multiple range test (DMRT) at 5 % level of probability. All statistical procedures were done with the aid of SAS (1999).

RESULTS

The analyzed nutrient composition of cassava grit (CG) and *Moringa oleifera* leaf meal (MOLM) are shown in Table 3.

Table 3: Analyzed nutrient composition of cassava grit and moringa leaf meal

Nutrients (%)	Cassava Grit	*Moringa* Leaf Meal
Dry Matter (DM)	88.03	94.60
Crude Protein (CP)	2.05	28.00
Crude Fibre (CF)	3.85	7.10
Ether Extract (EE)	2.32	5.90
Ash	1.24	12.20
Nitrogen Free Extract (NFE)	78.50	46.80
ME* (Kcal/kg)	3050	3175

**Metabolizable energy value was calculated using the method 37x %CP + 81x % EE + 35.5 x % NFE for poultry (Fisher and Boorman, 1986)*

Cassava grit had 88.03 % dry matter (DM), 3,402 kcal/kg metabolizable energy (ME), 2.05 % crude protein (CP), 3.85 % crude fibre (CF), 2.32 % ether extract (EE), 1.24 % ash and 78.57 % nitrogen free extract (NFE), while moringa leaf meal had 94.60% DM, 28.00 % CP, 7.10 % CF, 5.90 % EE, 12.20 % ash and 46.80 % NFE.

Performance Characteristics of Cockerel Chickens Fed Varying Levels of Cassava Grit with *Moringa* Leaf Meal Supplementation: The growth performance of cockerel starter and finisher fed cassava grit with moringa leaf meal supplement are shown in Tables 4 and 5. The dietary treatments at starter phase significantly influenced ($p<0.05$) the average weekly feed intake and average weekly weight gain. Protein efficiency ratio and feed conversion ratio were however not significantly affected ($p>0.05$) by the dietary treatments. Average weekly feed intake was highest among birds fed 66.6 % CGM compare to other treatment diets. Average weekly weight gain was significantly high ($p<0.05$) for birds maintained on 66.6 % CGM inclusion level compare to birds placed on the other treatment diets. Protein efficiency ratio and feed conversion ratio values recorded for birds placed on 0, 33.3, 66.6 and 100 % CGM inclusion level did not statistically differ ($p>0.05$) from one another.

At finisher phase, final live weight, weekly weight gain, feed conversion ratio and protein efficiency ratio were all significantly affected ($p<0.05$) by the dietary treatments, while weekly feed intake was not significantly influenced ($p>0.05$) by the dietary treatment. Birds fed diet containing 66.6% CGM had a higher live weight compare to other birds on other treatment diets. Average weekly weight gain was highest in birds fed 66.6 % CGM compare to other treatment diets. Cockerels fed the control diet had the best feed conversion ratio compare to other treatment diets. For protein efficiency ratio, birds fed diets 1, 2 and 3 had similar values of 0.04 and as such were better protein converter than birds on 100 % CGM.

The highest comparable mortality was recorded in birds fed diets 2 and 4, and then similar mortality value was recorded for birds fed the control and diet 3. However, the mortality rate was low and evenly spread among birds fed the test diets, ranging from 3.33 – 6.67 % and occurred at the finishing phase of the experiment.

Relative Carcass Quality of Cockerel Chicken Fed Varying Levels of Cassava Grit with *Moringa* Leaf Meal Supplementation: The carcass characteristics of cockerel revealed that live weight, plucked weight, eviscerated weight, dressing percentage and back were all significantly influenced ($p<0.05$) by the dietary treatment, while relative weight of head, neck, breast muscle, thigh muscle, drum stick, shanks and wings were not affected significantly ($p>0.05$) by the dietary treatment (Table 6). Average live weight was however numerically higher (2.17 kg/bird) in birds fed diet 3 (66.6 % CGM), followed by those fed the control diet (1.83 kg/bird). The least value (1.63 kg/bird) was recorded for birds fed 100 % CGM based diet. Plucked weight and eviscerated weight recorded were numerically higher in birds fed 66.6 % CGM based diet (2.08 and 2.00 kg/bird), followed by (1.73 and 1.63 kg/bird) recorded in birds fed the control diet (0 % CGM) and similar

Table 4: Performance characteristics of cockerel starter fed varying levels of cassava grit with moringa leaf meal supplementation

Parameters	Diets			
	1	2	3	4
Inclusion levels of CGM (%)	0	33.3	66.6	100
Average initial body weight (g/bird)	50.1 ± 0.03	50.01 ± 0.02	50.00 ± 0.02	50.00 ± 0.02
Average weekly feed intake (Kg/bird)	2.65 ± 0.01^{a}	2.10 ± 0.05^{b}	2.79 ± 0.01^{a}	2.44 ± 0.02^{b}
Average weekly weight gain (kg/bird)	0.39 ± 0.01^{a}	0.19 ± 0.01^{c}	0.42 ± 0.02^{a}	0.30 ± 0.01^{b}
Protein efficiency ratio	2.24 ± 0.02	1.76 ± 0.03	2.55 ± 0.02	0.30 ± 0.04
Feed conversion ratio	9.55 ± 0.02	10.06 ± 0.01	9.72 ± 0.01	8.22 ± 0.02

Means in the same row with varying alphabet superscript differ significantly (p<0.05), mean ± standard error of mean, CGM = cassava grit Moringa supplement

Table 5: Performance characteristics of cockerel finisher fed varying levels of cassava grit with moringa leaf meal supplementation

Parameters	Diets			
	1	2	3	4
Inclusion levels of CGM (%)	0	33.3	66.6	100
Average final Live weight (g/bird)	1.83 ± 0.04^{ab}	1.73 ± 0.06^{b}	2.17 ± 0.03^{a}	1.63 ± 0.02^{b}
Average weekly feed intake (Kg/bird)	2.89 ± 0.01	2.72 ± 0.01	3.03 ± 0.02	2.75 ± 0.02
Average weekly weight gain (kg/bird)	0.71 ± 0.12^{b}	0.80 ± 0.08^{ab}	0.86 ± 0.21^{a}	0.48 ± 0.09^{c}
Protein efficiency ratio	0.04 ± 0.16^{a}	0.04 ± 0.15^{a}	0.04 ± 0.12^{a}	0.02 ± 0.08^{b}
Feed conversion ratio	2.65 ± 0.02^{c}	3.21 ± 0.01^{bc}	4.00 ± 0.01^{b}	4.72 ± 0.01^{a}
Mortality rate (%)	3.33	6.67	3.33	6.67

Means in the same row with varying alphabet superscript differ significantly (p<0.05), mean ± standard error of mean, CGM = cassava grit Moringa supplement

Table 6: Relative carcass traits of cockerel fed varying levels of cassava grit with moringa leaf meal supplementation

Parameters	Diets			
	1	2	3	4
Inclusion levels of CGM (%)	0	33.3	66.6	100
Live weight (kg/bird)	1.83 ± 0.04^{ab}	1.73 ± 0.06^{b}	2.17 ± 0.03^{a}	1.63 ± 0.02^{b}
Plucked weight (kg/bird)	1.73 ± 0.06^{ab}	1.62 ± 0.03^{b}	2.08 ± 0.02^{a}	1.53 ± 0.04^{b}
Eviscerated weight (kg/bird)	1.63 ± 0.03^{ab}	1.54 ± 0.07^{b}	2.00± 0.04^{a}	1.43 ± 0.02^{b}
Dressing percentage	89.07 ± 0.14^{ab}	89.40 ± 0.19^{b}	92.16 ± 0.21^{a}	87.73 ± 0.15^{b}
Cut parts (%)				
Head	2.77 ± 0.03	3.00 ± 0.05	2.83 ± 0.02	5.54 ± 0.07
Neck	4.63 ± 0.20	4.40 ± 0.23	4.30 ± 0.16	3.63 ± 0.11
Breast muscles	13.33 ± 0.12	12.17 ± 0.14	14.50 ± 0.09	12.53 ± 0.26
Thighs	7.20 ± 0.32	6.53 ± 0.27	7.27 ± 0.21	6.73 ± 0.19
Back	11.37 ± 0.24^{b}	13.53 ± 0.19^{ab}	12.63 ± 0.07^{b}	14.47 ± 0.12^{a}
Drumsticks	7.50 ± 0.18	7.40 ± 0.24	7.83 ± 0.21	6.50 ± 0.22
Shanks	4.10 ± 0.11	3.67 ± 0.14	3.90 ± 0.12	3.80 ± 0.15

Means in the same row with varying alphabet superscript differ significantly (p<0.05), mean ± standard error of mean, CGM = cassava grit Moringa supplement

values (1.62, 1.54 kg/bird) and (1.53, 1.43 kg/bird) were recorded in birds fed diets 2 and 4 respectively. Dressing percentage followed the same tend as with live weight, plucked weight and eviscerated weight. Back was significantly highest (p<0.05) in birds fed 100 % CGM (14.47), followed by comparable values of 13.53 and 12.63 recorded in birds fed 33.3 and 66.6 % CGM based diets. The least value of 11.37 was recorded in birds fed the control diet. The relative weights of head, neck, breast muscles, thigh muscles, drumsticks and shanks were statistically similar among cockerels fed the treatment diets (Table 6).

Table 7: Relative organ weight of cockerel chickens fed varying levels of cassava grit with moringa leaf meal supplementation

Parameters	Diets			
	1	2	3	4
Inclusion levels of CGM (%)	0	33.3	66.6	100
Spleen	0.15 ± 0.03^{a}	0.15 ± 0.04^{a}	0.13 ± 0.01^{ab}	0.07 ± 0.02^{b}
Gizzard	3.00 ± 0.23	3.50 ± 0.20	3.00 ± 0.29	3.10 ± 0.09
Heart	0.28 ± 0.01	3.00 ± 0.02	0.34 ± 0.02	0.40 ± 0.01
Liver	2.43 ± 0.08	0.34 ± 0.06	2.33 ± 0.04	2.27 ± 0.03
Pancreas	1.00 ± 0.04	2.33 ± 0.09	0.90 ± 0.03	1.00 ± 0.04
Bursa	1.43 ± 0.05	0.90 ± 0.02	1.40 ± 0.06	1.37 ± 0.03

Means in the same row with varying alphabet superscript differ significantly (p<0.05), mean ± standard error of mean, CGM = cassava grit Moringa supplement

Relative Organ Weight of Cockerel Chickens Fed Varying Levels of Cassava Grit with Moringa Leaf Meal Supplementation: The dietary treatment had no significant effect (p>0.05) on the relative weights of gizzard, heart, liver, pancreas and bursa (Table 7). However, the spleen was significantly influenced (p<0.05) by the treatment diets. Cockerels placed on diet 1, 2, 3 and 4 had a similar values of 3.00, 3.50, 3.00 and 3.10 respectively. Relative weights of heart and liver were 0.28 and 2.43 in diet 1, 0.32 and 2.43 in diet 2, 0.34 and 2.3 in diet 3, 0.40 and 2.27 in diet 4 respectively. Pancreas and bursa weights were 1.00 and 1.43 %, 1.07 and 1.47 %, 0.90 and 1.40 %, and 1.00 and 1.37 % for cockerels placed on diet 1, 2, 3 and 4 respectively. Relative spleen values of 0.15, 0.15, 0.13 and 0.07 with a mean standard error of 0.03 were respectively recorded for cockerels maintained on treatment 1, 2, 3 and 4 (Table 7).

Cost benefit Analysis of Cockerel Chickens Fed Varying Levels of Cassava Grit with Moringa Leaf Meal Supplementation: The cost-benefit of feeding cassava grit with MOLM as replacement for maize in cockerel chickens at the starter phase indicated that the costs of day old chick was ₦ 60/bird. Cost of feed consumed (₦/bird) was highest in birds maintained on diet 3 (₦158.91) and lowest (₦121.37) in diet 2 (Table 8). The least cost of feed per kg weight gain was recorded in birds fed dietary treatment 2 (₦16.99). At the finisher phase, cost of feed consumed (₦/bird) was still highest on birds maintained on diet 3 (₦171.83), followed by ₦170.74 in diet 1, ₦156.77 in Diet 2 and least ₦153.10 in diet 4. The least cost of the feed per kg weight gain was obtained in birds fed diet 4 (₦54.73), Total cost of production was highest in birds fed treatment diet 1 (₦738.00), and least cost of production was obtained (₦640.74) in birds fed treatment diet 3. Net profit was least in diet 4 (₦300.93, followed by diet 2 (₦511.86), diet 1 (₦762.00) while highest net profit was obtained in dietary treatment 3 (₦859.26) (Table 8).

DISCUSSION

The cassava grit used in this study had 2.05 % crude protein. This value was in consonance with the value reported by Oyewumi (2013) in cassava grit basal diet trial on laying birds. The *Moringa oleifera* leaf meal used in this study had 28.00 % crude protein and was slightly higher than that reported by Gupta *et al.* (1989) and Oduro *et al.* (2008) who reported levels of 25.1 and 26.4 % respectively, but similar to value reported by Nuhu (2010). This high value recorded for crude protein may be influenced by the stage of harvesting, processing and the agro climatic condition prevailing in the study area. The observed significant difference (p<0.05) in the final live weight revealed that 66.6 % CGM fed cockerels had highest weight gain comparable to the control than those on diets 2 and 4. This is because birds from these lower weight gain diet (CGM 2 and CGM 4) consumed less of the feed which might be due to its relative dusty nature. The inclusion of *Moringa oleifera* leaf meal at 5 % had no significant effect (p>0.05) on feed intake (Kakengi *et al.,* 2007) beyond the 66.6 % cassava grit replacement of maize in cockerel rearing.

Table 8: Economic analysis of cockerel chicken fed varying levels of cassava grit with moringa leaf meal supplementation

Parameters	Diets			
	1	2	3	4
Inclusion levels of CGM (%)	0	33.3	66.6	100
Starter phase				
Cost of day old chicks (₦/bird)	60	60	60	60
Cost of feed consumed (₦/bird)	157.47	121.37	158.91	135.97
Cost of feed/kg weight gain (₦)	46.45	16.99	50.45	30.59
Finisher phase				
Cost of feed consumed (₦/bird)	170.74	156.77	171.83	153.10
Cost of feed/kg weight gain (₦)	90.50	93.67	93.21	54.73
Total cost of production (₦/bird)	738.00	688.14	640.74	699.07
Income (₦/bird)	1500	1200	1500	1000
Net profit (₦ /birds)	762.00	571.86	859.26	300.93

It does means that the (CGM-maize) mixed ratio in diet formulated to contain 66.6 % tend to reduce dustiness in the feed which probably might have increase the palatability of the feed leading to increase in feed consumption. This is in agreement with the findings of Okereke (2012) who reported that cassava root meal can replace up to 30 % maize without detrimental effect on performance of poultry. Growth rate and feed conversion ratio of the birds fed the control diet and those fed 66.6 % CGM were statistically similar. However, the feed conversion of birds fed the control diet performed better than those fed CGM-maize mixed diet. This is in agreement with the findings of Okpanachi *et al.* (2014). Protein efficiency ratio did not vary in the birds fed treatment diet at the starter phase. However, at the finisher phase, protein efficiency ratio varied with the treatment diets, although there were similar values recorded in diet 1, 2 and 3. This could be adduced to the isonitrogenious nature of the diet which led to the optimal utilization of protein at both phases. This lends support from the report of Kakengi *et al.* (2007) that *M. oleifera* can be optimally utilized in poultry feeding.

Cockerels fed 66.6 % CGM had higher average live weight which translated to higher average plucked and eviscerated weights. This could be attributed to the fact that the experimental animal performed well on diet formulated with 66.6 % CGM inclusion level as well as the control.

This findings is in consonance with the earlier reports of Duruna *et al.* (2006) reported difference on the live weight, eviscerated weight and dressing percentage of broilers fed varying levels of *Anthronata macrophyla* seed meal. The dressing percentage in this study was highest in birds fed 66.6% CGM. This value was however similar to that obtained from the control. The choice part of chicken (breast muscle, drumstick) did not differ between the dietary treatments. This report on dressing percentage was in tandem with the earlier report of Tesfaye *et al.* (2013) who reported a significant difference in the breast muscle of broilers fed cassava root chips. However, report from this study on thigh muscle and drumstick negates his findings. The highest value recorded for the birds back of bird fed 100% CGM could be adduced to the fact that the birds laid more bone at the back than flesh compare to other birds fed treatment diets 1, 2 and 3 respectively. Head, neck, thigh, muscle, shank and wing weights of birds did not differ among the treatment diets. The result showed that inclusion of CGM up to 66.6% had no adverse effect on carcass quality. These comparable weights of the cut part of cockerel on all the diet support the assertion that at various level of inclusion of CGM the birds can perform well without any deleterious effect on performance, since dressed weight of cut part is suggested to be relative value of dressed salable carcass for maximum profit in cockerel chicken (Ojo, 2003; Aboki *et al.,* 2013). It is therefore obvious from the study that the inclusion of CGM up to 66.6

% level supported the improvement in carcass yield of cockerels. The gizzard weights in all the treatments were similar. The gizzard is the centre of digestion in poultry. The similarity in weight may be attributed to the non-fibrous and the gritty nature of feed particles which aided the bulk movement of the feed through the gut of the birds. Aderemi (2004) reported no difference in relative gizzard weight of broilers fed diet containing whole cassava root meal fermented with rumen filtrate. The varying levels of cassava grit and moringa meal supplementation did not change the weight of the heart and liver in the latter stages of growth. The comparable weights obtained for pancreas and bursa may be due to the balance of nutrients in all the diets. Omoikhoje *et al.* (2005) reported comparable values of pancreas and bursa for broilers fed varying levels of cooked Bambara groundnut meal. Spleen weights differed significantly with the values decreasing with an increasing inclusion of cassava grit with moringa supplementation this could be due to the higher solubility and easy flow of cassava grit in aqueous milieu of the gastro intestinal tract. This lend support from the report of Agbabiaka *et al.* (2012) who reported a significant difference on the weight of spleen of broiler fed 50 % inclusion level of tigernut (*Cyprus esculentus*).

Feed intake value recorded was highest in birds fed 66.6 % CGM and this could have translated to the highest total cost of feed consumed and cost of feed/kg weight gain recorded from birds fed 66.6 % CGM replacement level. This lend support from the findings of Omoikhoje *et al.* (2008) who reported that the inclusion of 30 % level of unpeeled cassava waste meal in the diets of rabbits led to reduction in the cost of feed, cost of feed/kg weight gain, cost of production and improvement in the profit margin. In the same vein, the total cost of production was least in birds fed the same treatment diet 3 (66.6 % CGM) this could be due to the cheap nature of the basal diet that reduced the cost of formulating the diet per kilogram. This is also in tandem with the report of Omoikhoje *et al.* (2008). The least cost of feed consume recorded in birds fed 100 % CGM could be as a result of the cheap cost of cassava grit used in formulating the diet compare to diet 1 and 2 that has some inclusion of maize which was relatively high. This is lend support from the report of Nworgwu *et al.* (2000) who stated that there is need for dietary incorporation of unconventional feed ingredient as alternative, non-competitive, readily available and cheap ingredients so as to reduce the cost of production and in the long run increase profit margin. However, highest income was generated from birds maintained on 66.6 % CGM based diet compare to other birds on diet 1, 2 and 4. Net profit follows the same trend but the poor net profit from birds on CGM 4 was not surprising as cassava grit has never being reported as an alternative to totally replace maize in ration formulation. Zahari and Alimon (2006) had earlier reported improvement in the feed efficiency through the accelerated use of local feed stuff in other to reduce high production cost thereby increasing profit. The low mortality record from this study shows that the dietary treatment has no significant ($p>0.05$) on the health status of the birds. The observation suggested that the health status of the birds were not compromised when cassava grit was supplemented with 5% Moringa leaf meal. The cause of mortality recorded in this study according to post mortem assessment was not clear since all the organs observed in the birds were normal.

Conclusion: The result of the study revealed that cassava grit at 66.6 % replacement level for maize with 5 % moringa leaf meal incorporation for maize improves the biological performance of cockerel chickens. This level of substitution also gave better economic returns when compared with the control maize based ration in cockerel production.

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