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Effect of graded levels of cassava peel meal in the diet of layers on performance, haematology and economics of production

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Abstract Results showed significant differences (P<0.05) in the values obtained for final weight, weight change, hen day production, hen house production, number of eggs, egg weight and mortality. Daily feed intake and feed conversion ratio were not significantly (P>0.05) influenced by the treatments. Final weight ranged between 1530.67g (10%CPM) and 1614.00g (5%CPM), weight change ranged from -126.67g (10%CPM) to -12.00g (0%CPM), daily feed intake was between 74.33g and 75.33g, feed conversion ratio was from 3.40 to 2.90. HDP was between 53.33 and 63.00, while HHP was between 53.33 and 62.67. Number of eggs ranged between 83.00 and 97.00, egg weight 57.00g to 59.33g. All haematological indices evaluated were not significantly (P>0.05) influenced by the dietary treatments. The observed PCV, Hb, RBC, WBC, MCV, MCH, MCHC, neutrophil and lymphocytes values ranged from 32.33% to 35.00%, 10.77g/dl to 11.67g/dl, 2.47 x 10^{12}/l to 2.64 x 10^{12}/l, 212.33 x 10^{9}/l to 225 x 10^{9}/l, 129.00fl to 132.33fl, 43.00pg to 45.33pg, 33.17g/dl to 33.90g/dl, 3.67% to 5.00%, 95.00 to 97.00%, respectively. All the economic parameters evaluated were significantly (P<0.05) affected by the treatments except feed cost/dozen eggs. Feed cost/kg declined linearly as CPM level increased in the diet. Feed cost/bird (FC/B) followed similar pattern as feed cost/kg. Cost saving from feed due to inclusion of CPM varied from ₦271.37 (5%CPM) to ₦843.92 (20%CPM). Feeding CPM to layers did not adversely affect feed intake and feed conversion ratio. However, CPM caused reduction in egg number, while promoting economic indices by reducing feed cost, cost of dozen eggs, while enhancing profitability.

Keywords: Cassava peel meal, Diet, Graded levels, Haematology, Layers, Performance

Introduction

Poultry is one the sources of protein in the form of meat and egg all over the world. Chicken egg is the most popular among the poultry specie. World production of table eggs is put at over 86.67 metric tonnes in 2020 (Shahbandah, 2022). Nigeria has the highest annual egg production, about 650 metric tonnes, and second largest poultry population in Africa (Sanusi *et al*., 2019; CSIRO,

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2022). According to CSIRO (2022), Nigeria's local egg production can cater for only 30% of local egg demand. Obviously, there is a huge potential and market for the egg production enterprise in Nigeria, to enhance nutritional and health security, as well as contributing to household and economic growth of the populace. Unfortunately, of recent the enormous prospect for the chicken egg enterprise is being hampered by poultry feed crisis, arising from the astronomic rise in the price of conventional feedstuffs such as maize. Maize is the major source of energy in poultry feed production, a tone of which sells for about ₦255,000 ($365). However, the use of maize has been limited because of competitive uses among men, the beverage industry and for production of other livestock (Iji, 2010). The proportion of maize used in poultry diets ranges from 50%-70% (Salami *et al.,* 2003). In recent times, low production of maize due to reduction in arable land, land fertility, insecurity, farmers and herdsmen clashes among others have resulted in further increase in the cost of maize, and consequently feed cost.

Continuous use of maize will result in perpetual increase in the price of livestock as well as livestock products. Salami *et al.* (2003) advocated the use of alternative energy source in feed production. One of such alternatives for potential replacement of maize in animal feed may be cassava peel meal (CPM). Nigeria produces 59million tonnes of cassava tuber, which generates about 15million tonnes of wet peels annually (All-about-feed, 2022). In most cassava processing areas, the peels are heaped together thereby constituting environment menace. Burning these heaps of cassava peels will likely result in air pollution due to methane production. Consequently, the most productive way of disposal is feeding the peels to livestock. However, the use of cassava peel as feed for non- ruminant animals is limited by its high-fibre content and hydrocyanic acid which is deleterious to their growth and development (Tewe, 2004). Therefore the utilization of cassava peels depends very much upon the development of improved processing technologies and improved products that can meet the changing needs of poultry farmers (Midau *et al.,* 2011). The feeding trial sought to determine the effect of different levels of cassava peel meal on production performance, economics and haematology of layers offered graded levels of cassava peel meal.

Materials and methods

The study was conducted at the Poultry Unit of the Teaching and Research Farm of Kogi State University, Anyigba, which is located on latitude $7^0$30'N and longitude $7^0$09'E of the Greenwich Meridian (Ifatimehim *et al.,* 2011). Cassava peel meal was obtained from Cassava Peel Meal Processing Unit

Cottage Industry Ejule, Kogi State. At the Unit fresh stump and dirt free cassava peels were collected, grated and subjected to hydraulic press for dewatering. The dewatered cassava peels were then pulverized prior to sun-drying for 2-3days. The crispy product was milled and then sieved to obtain fine but coarse mash which was incorporated in the experimental diets. Seventy five Nera Black birds (29 weeks old) were selected from the flock on the farm to be used for the feeding trial.

The birds were randomly assigned in a Completely Randomized Design to five dietary treatments coded as T1, T2, T3, T4, and T5 (Table 1). Each treatment had fifteen birds, which was split into three replicates of five birds each. Diets T1, T2, T3, T4 and T5 contained 0%, 5%, 10%, 15%, 20% cassava peel meal respectively. The feeding trial was conducted in battery cage. The experimental diets and drinking water were offered *ad-libtum* to the birds during the period of the feeding trial. Performance indices measured were final weight, weight change, feed intake and feed conversion ratio (Johnson and Farrel, 1984; Oyewole *et al*., 2019). Egg production parameters evaluated were egg weight, egg number, hen-day production and hen-house production. Economic indices measured were feed cost/kg, cost of feed consumed, cost of feed/dozen eggs, revenue from eggs, profit and cost saving due to CPM inclusion. At the end of the feeding trial, blood samples were taken from two birds per replicate across the treatments into bijou sample bottles containing EDTA for haematological evaluation. Haematological parameters evaluated were packed cell volume (PCV), red blood cell count (RBC), white blood cell count (WBC), haemoglobin (Hb), neutrophils, lymphocytes, mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC), and mean corpuscular haemoglobin (MCH) (Jain, 1993).

Statistical analysis

All collected data were analysed using One Way Analysis of Variance (ANOVA) with the aid of computer software, Statistical Package for Social Sciences (SPSS) version.16.0. Significantly different means were separated by Duncan's multiple range test using the same software at 5% confidence level.

Results

The production performance of birds fed graded levels of cassava peel meal (CPM)

The production performance of birds fed graded levels of cassava peel meal (CPM) is presented in Table 2. Results obtained showed significant differences (P<0.05) in the values obtained for final weight, weight change, hen day production (HDP), hen house production (HHP), number of eggs, egg weight and mortality. Daily feed intake and feed conversion ratio were not significantly (P>0.05) influenced by the treatments. Final weight ranged between 1530.67g (10%CPM) and 1614.00g (5%CPM), weight change ranged from -126.67g to -12.00g, daily feed intake was between 74.33g and 75.33g, feed conversion ratio was from 3.40 to 2.90, HDP and HHP were between 53.33 and 63.00, and 53.33 and 62.67 respectively. Number of eggs ranged between 83.00 and 97.00, egg weight 57.00g to 59.33g, and mortality 0% to 6.67%.

Table 1. Gross composition of cassava peel meal based layer diets (%)

	%CPM				
Ingredients	0	5	10	15	20
Maize	50.00	44.50	39.00	33.50	28.00
Full fat soybean	30.00	30.00	30.00	30.00	30.00
Cassava peel meal	0.00	5.00	10.00	15.00	20.00
Wheat offal	9.50	9.50	9.50	9.50	9.50
Bone meal	4.50	4.50	4.50	4.50	4.50
Limestone	5.00	5.00	5.00	5.00	5.00
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Vitamin/ mineral premix	0.25	0.25	0.25	0.25	0.25
Palm oil	0	0.50	1.00	1.50	2.00
Total	100	100	100	100	100

CPM- Cassava peel meal

Table 2. Production performance of layers fed cassava peel meal based diets

	%CPM						
Parameter	0	5	10	15	20	SEM	LOS
Initial weight (g)	1631.33	1626.00	1657.33	1663.67	1625.33	17.29	NS
Final weight (g)	1608.00^{a}	1614.00^{a}	1530.67^{b}	1623.33^{a}	1539.33^{b}	23.03	*
Weight change (g)	-23.33^{a}	-12.00^{a}	-126.67^{c}	-40.33^{a}	-85.33^{b}	28.51	*
DFI (g)	74.67	74.67	74.33	75.33	75.33	0.16	NS
FCR	2.90	3.01	3.20	3.40	3.20	0.50	NS
HDP	62.67^{a}	57.33^{b}	63.00^{a}	53.33^{c}	58.00^{b}	1.75	*
HHP	62.67^{a}	57.33^{cd}	58.00^{bc}	53.33^{d}	58.00^{bc}	2.05	*
Number of eggs	97.00^{a}	89.00^{b}	90.00^{b}	83.00^{c}	90.00^{b}	2.71	*
Egg weight (g)	57.00^{c}	59.33^{a}	58.00^{b}	58.33^{b}	58.00^{b}	0.52	*
Mortality (%)	0^{b}	0^{b}	6.67^{a}	0^{b}	0^{b}	1.33	*

CPM- Cassava peel meal, DFI: Daily feed intake, FCR: Feed conversion ratio, HDP: Hen day production, HHP: Hen house production. ^{abc} =means with different superscript along the same row show significant difference at P<0.05, NS= Not significantly different at P>0.05, SEM= Standard error of mean, LOS= level of significance

Haematology of layers fed cassava peel meal based diets

The haematology of layers fed cassava peel meal-based diets is shown in Table 3. All haematological indices evaluated were not significantly (P>0.05) affected by the dietary treatments. The observed PCV, Hb, RBC, WBC, MCV, MCH, MCHC, neutrophil and lymphocytes values ranged from 32.33% to 35.00%, 10.77g/dl to 11.67g/dl, 2.47 x 10^{12}/l to 2.64 x 10^{12}/l, 212.33 x 10^{9}/l to 225 x 10^{9}/l, 129.00fl to 132.33fl, 43.00pg to 45.33pg, 33.17g/dl to 33.90g/dl, 3.67% to 5.00%, 95.00 to 97.00%, respectively.

Table 3. Haematology of layers fed cassava peel meal based diets

	%CPM						
Parameter	0	5	10	15	20	SEM	LOS
PCV (%)	34.33	32.33	35.00	33.33	32.33	2.03	NS
Hb (g/dl)	11.43	10.80	11.67	11.13	10.77	1.67	NS
RBC (x10^{12}/l)	2.58	2.49	2.64	2.58	2.47	0.50	NS
WBC(x10^{9}/l)	212.33	225.70	217.33	219.67	219.00	15.87	NS
MCV (fl)	132.33	129.00	132.00	129.00	130.33	5.01	NS
MCH (pg)	45.33	44.33	43.33	43.00	43.33	2.11	NS
MCHC (g/dl)	33.90	33.33	33.33	33.17	33.33	1.02	NS
NEU (%)	4.00	3.00	3.67	5.00	4.66	0.84	NS
LYM (%)	96.00	97.00	96.33	95.00	95.33	2.33	NS

CPM- Cassava peel meal, PCV= Packed cell volume, Hb=Haemoglobin, RBC= Red blood cell, WBC= White blood cell, MCV= Mean cell volume, MCHC= Mean corpuscular haemoglobin concentration, MCH= Mean corpuscular haemoglobin, NEU= Neutrophils, LYMP= Lymphocytes ^{abc}=means with different superscript along the same row show significant difference at P<0.05, NS= Not significantly different at P>0.05, SEM= Standard error of mean, LOS= level of significance

Economics of production of layers fed diets containing graded levels

The economics of production of layers fed diets containing graded levels of cassava peel meal is presented in Table 4. All the economic parameters evaluated were significantly (P<0.05) affected by the treatments except feed cost/dozen eggs. Feed cost/kg declined linearly (₦280.38 to ₦237.70) as CPM level increased in the diet. Feed cost/bird (FC/B) followed similar pattern as feed cost/kg. FC/B varied from ₦17.92 to ₦20.94, total feed cost ₦2989.58 to ₦3833.50, revenue from eggs ₦5126.70 to ₦5820.00, and revenue less total feed cost ₦1777.90 to ₦2128.70. Cost saving from feed due to inclusion of CPM varied from ₦271.37 to ₦843.92.

Table 4. Economics of production of Layers fed graded levels of cassava peel meal (₦)

	%CPM						
Parameter	0	5	10	15	20	SEM	LOS
Feed cost/kg	280.38^{a}	272.60^{a}	262.53^{abc}	248.63^{bc}	237.70^{c}	11.97	*
Feed cost/bird	20.94^{a}	20.36^{ab}	19.51^{abc}	18.74^{bc}	17.92^{c}	0.92	*
Total feed cost	3833.50^{a}	3563.13^{b}	3414.92^{c}	3421.58^{c}	2989.58^{d}	6.20	*
Feed cost/dozen eggs	466.04	464.42	445.23	455.66	422.92	36.19	NS
Revenue from egg	5820.00^{a}	5340.00^{b}	5400^{b}	5126.70^{b}	5253.30^{b}	164.40	*
Revenue - TFC	1986.50^{a}	1777.90^{c}	1985.10^{ab}	1841.40^{b}	2128.70^{a}	92.50	*
Cost saving due to CPM	-	271.37	418.58	411.92	843.92		

TFC= Total feed cost, CPM- Cassava peel meal, *abcd =means with different superscript along the same row show significant difference at P<0.05, NS= Not significantly different at P>0.05, SEM= Standard error of mean, LOS= level of significance

Discussion

The observed result for final weight in the study is higher than the range 1489.25g-1589.22g reported by Sogunle *et al.* (2009) for layers aged 60 weeks and 1413.33g-1500.00g for 30 weeks old layers (Oyewole *et al.*, 2019). Observed values were also higher than 1520g reported by Oyewole *et al.* (2011), but lower than values reported by Salami and Odunsi (2003)**.** The observed DFI range of 74.33g-74.67g is lower than 103.97g- 110.31g reported by Oyewole *et al*. (2011) for Nera black layers fed orange peel-based diets and reared on deep litter, but higher than 63.21g-75.35g for cage reared layers in the same location reported by Oyewole *et al.* (2019). The DFI appear adequate because the observed values for CPM groups are comparable to that of birds on the control diet. Salami and Odunsi (2003) had reported 99.00g-125g as DFI. The observed feed conversion ratio may suggest better utilization of the control diet by the birds for egg production than the CPM based diets. The observed values of HDP and HHP are however higher than 33.81-46.01 and 28.79-33.32 reported by Oyewole *et al.* (2011) and Oyewole *et al.* (2019) respectively, but close to the range 52.18 - 64.79 reported by Anyanwu *et al.* (2008). The age and strain of birds might be responsible for these differences besides the differences nutritional management. The hen day production values ranged from 53.33 - 63.00. The highest value obtained was at 10%CPM. The range obtained in this study compares favourably with the range 55.10-64.80 reported by Salami and Odunsi (2003). The production performance indices may indicate that CPM in laying hen diets does not affect egg production adversary even at 20% inclusion.

Blood is an important index of physiological, pathological and nutritional status in the organism (Olorode *et al*., 2007). While Aletor (1989) and Aletor and Egberongbe (1992) had opined that blood indices most consistently affected by diet include RBC, PCV and plasma protein. Observed packed cell volume (PCV) was within the physiological range of 27.0%-45.5% for normal and healthy birds reported by Jain (1993) but higher than 29.00%-30.67% reported by Oyewole *et al.* (2022) for broilers. According to Oyawoye and Ogunkunle (1998), abnormal PCV level points to the presence of a toxic factor which has a drastic effect on blood formation. Haemoglobin (Hb) observed in this study is lower than 9.60g/dl-10.20g/dl obtained by Oyewole *et al.* (2022) for broilers. The observed RBC values are higher than reported values of 2.08×10^{12}/l - 2.17×10^{12}/l (Oyewole *et al.*, 2022). The non-significance of all haematological parameters evaluated may suggest that CPM based diets furnished the birds with sufficient nutrients such as vitamins and minerals for haematopoiesis. The inclusion of CPM therefore did not impair the utilization of the necessary minerals and vitamins required for blood formation. Furthermore, it may also indicate that the processing method employed in the preparation of the CPM used in the diets was adequate, thereby making it nutritionally safe for the birds, even at 20% inclusion level. Consequently, the diets containing CPM were not toxic to the birds.

The observed values for feed cost/kg of feed indicated a progressive decline in the cost of producing a kilogramme of feed as the inclusion level of CPM increased in the diet. This is most likely due to the lower cost of CPM relative to that of maize which it was meant to substitute. Oftentimes, non-conventional feedstuffs have been found to be cheaper than their conventional counterparts. The trend of feed cost/bird was determined by the product of respective feed consumed and the cost of the corresponding diets. The costliest feed cost was incurred with birds on the control, while the cheapest with those fed 20% CPM. This observation is similar for total feed cost. Feed cost/dozen eggs appeared to decline (P>0.05) with the inclusion of CPM in the diet. At 20% inclusion of CPM about ₦43.12 (9.25%) was conserved from the cost due to feed in producing a dozen eggs. Revenue from sale of eggs was higher in the control group than others. This is due to the larger number of eggs produced by the birds in this group. Hence revenue from eggs is directly proportional to the quantity of eggs laid. Since the price of an egg was the same for all groups. Where all other costs are held constant except feed cost, the highest income (revenue from eggs less feed cost) showed 20%CPM inclusion as the highest, while the control was the least. During the feeding trial a cost reduction due to feed of between ₦271.37 (7.08%) and ₦843.92 (22.01%) was achieved.

Feeding CPM to layers even at 20% did not adversely affect the acceptability of the diet as indicated by feed intake and feed conversion ratio. However, CPM did result in reduction in egg number, while promoting economic indices by reducing feed cost, cost of dozen eggs and enhancing profitability index.

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