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Replacement value of palm kernel meal for maize on growth, egg quality, and economic parameters of local duck hens

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Abstract

A research was conducted to evaluate the effect of replacing maize with palm kernel meal (PKM) in the diet on the performance of duck hens. Five treatment diets were formulated in which PKM replaced maize at 0, 25, 50, 75 and 100% using a completely randomized design in three replications. The study lasted 8 weeks during which growth performance was evaluated from 16 to 20 weeks of age and economics of production and egg quality traits assessed from 20 to 24 weeks of age of the ducks. With the exception of mortality, significant differences (P<0.05) occurred in other growth parameters examined. The average daily weight gain of birds fed 0% PKM were significantly higher (P<0.05) than others. There was insignificant difference (P>0.05) in the feed intake of ducks fed 0, 25, and 50% PKM, which were higher (P<0.05) than 75% PKM, and that of 100% PKM was the least (P<0.05). The feed conversion efficiency of birds fed 100% PKM was not significantly different (P>0.05) from that of 0% and 75% PKM but was better than 25% and 50% PKM. The cost per egg produced was least in 50% PKM (₦ 9.17) but highest in 100% PKM (₦20.63/g). The gross marginal profit of ducks fed 50% PKM (₦ 445.87/hen) was not significantly different (P>0.05) from that of 25% PKM (₦ 359.20/hen) but was significantly higher (P>0.05) than others. There was no significantly difference (P>0.05) in the hen day egg production, egg weight, egg length, egg width, yolk width and albumen height of birds fed all the treatment diets. The shell thickness and yolk height of buds feed 25% PKM and 50% PKM were not significantly different (P>0.05) from each other but that of 50% PKM was higher (P<0.05) than others. From 16 to 20 weeks of age, duck hens can be fed with diets in which PKM replaces maize up to 100% whereas for the laying period (21-24weeks), diets with replacement of maize with 50% PKM were most satisfactory.

Key Words: *Palm Kernel Meal, Maize, Duck, Replacement.*

Introduction

Nigerian poultry industry has been facing an age long serious setback due largely to high cost of feed occasioned by high cost of maize and other major sources of energy in the feeds [1, 2]. Maize constitutes staple food for Nigerians and it is a good source of energy for livestock animals [3, 4] hence there is competition between man and livestock for maize in the country. This competition and the consequent high demand for maize result to high cost of livestock feeds. Maize accounts for about 50 percent of the total feed ingredients used in poultry feed in Nigeria [5]. Scarcity of maize due to its low level of production in Nigeria also contributes to high cost of the ingredient [6]. Consequently the prices of poultry products such as meat and eggs are high, making them unfavorable to the average Nigerians [7, 8]. This situation adversely affects the profit margin of our poultry farmers. Animal protein intake of the

average Nigerian (g/caput/day) is far less than that recommended (35g/head/day) [9].

If the efforts in the country for accelerated livestock production in order to meet the animal protein needs of Nigeria are to be successful, cheaper and more readily available feedstuffs need to be evaluated and be used as alternatives for conventional but costly feed ingredients such as maize.

Agro-industry by-products such as palm kernel meal (PKM) have considerable potentials to serve as alternatives to maize in ration formulation. Palm kernel meal is produced in abundance in Nigeria and its nutritive value makes it to double as energy and protein feedstuff. It could serve as a replacement for maize in poultry diets. Palm kernel meal has a crude protein content of 19-21% and metabolizable energy value of 2640-2700kcal/kg feed [10,11]. Its grittiness and fibrous nature can be ameliorated by the high residual oil content [12].

Broiler and laying chickens have been the focus to address the issue of low animal protein intake of Nigerians, but it makes good sense that the production of other poultry species such as ducks be increased in order to achieve this objective.

Ducks are water birds but are more economically raised intensively in pens with litter floors [13]. Local ducks, which closely resemble the Khaki Campbell breed are good for commercial egg production, laying more and larger eggs (120 eggs per bird per year) than local domestics fowls [14]. Ducks are raised for egg and meat purposes, although its products are yet to be fully acceptable to Nigerian consumers [15].

Duck production has not been fully commercialized in Nigeria in spite of its potentials of fast growth, resistance to disease and ability to utilize fibrous feedstuffs such as palm kernel meal. Ducks are able to digest fibre and protein feed relatively more efficiently than chickens [16]. This is an advantage considering recent focus on non-conventional feedstuffs that may reduce cost of feed-inputs in the poultry industry. Therefore, the study was set up to investigate performance of local ducks on diets with PKM as alternative feedstuff.

Materials and Methods

Location and Duration of Study

The study was conducted at the Poultry Unit of the Michael Okpara University of Agriculture Teaching and Research Farm, Umudike. Umudike lies in the co-ordinates of 5^0 North and 7^0 East. It is located within the tropical rain forest zone of South Eastern Nigeria. The climate of the zone is characterized by an average temperature of 28^0C [18].

The duration of the study was 8weeks with two phases within 16 to 24weeks of age of local ducks (16-20 weeks was taken as pre-egg production phase and 20-24weeks as egg production phase).

Experimental Design and Diets

The design of the experiment was a completely randomized design (CRD) having five treatments and three replicates each. Five treatment diets were formulated in which PKM replaced maize at 0, 25, 50, 75 and 100% (Table 1). The replacement method adopted was weight-for-weight (quantitative) replacement where the control diet (0% PKM) was formulated to satisfy the nutrient requirements of ducks and the nutrient requirements of ducks on the other diets were not adjusted correspondingly after replace of maize with PKM.

Table 1: Percentage Composition of Treatment Diets

			Treatment Diets		
Ingredient	**1(0%)**	**2(25%)**	**3 (50%)**	**4 (75%)**	**5 (100%)**
Maize	55	41.25	27.50	13.75	0
Palm kernel meal	0	13.75	27.50	41.25	55
Wheat offal	25	25	25	25	25
Soya bean meal	13	13	13	13	13
Fish meal	3.5	3.5	3.5	3.5	3.5
Bone meal	3	3	3	3	3
Salt	0.25	0.25	0.25	0.25	0.25
Vit/Min. premix	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated					
CP (%)	16.17	17.48	18.75	20.09	21.39
ME(kcal/kg)	2694	2602	2474	2364	2254

Experimental Animals and Management

Seventy-five 16-week-old local growing duck hens with average weight of 992.67g procured from a reputable farm at Owerri, Imo State, Nigeria were used in this study. The birds were randomly allotted to the five treatments and three replicates

The birds were managed on open sided deep litter [22, 23]. The poultry pen was cleaned, washed with a mixture of water and disinfectant and allowed to dry for two weeks before the arrival of the birds. Wood shavings were used as litter materials. The growth performance of the hens was evaluated from 16 weeks to 20 weeks of age and economics of production and egg quality parameters evaluated from 20weeks when birds started to lay. The birds were fed once a day according to the feeding regime of a previous study [24] and water was supplied freely to the birds.

The birds were vaccinated with New Castle disease vaccine (Lasota) via drinking water at 16weeks of age while routine medication with vitamin drugs, antibiotics and anticoccidial drugs was carried out during the study.

Data Collection and Analysis

Growth Performance

Initial, final and weekly weights of the birds were determined by using a scale. Feed intake was determined by subtracting the left over feed from the quantity of feed supplied. Average daily weight gain, average daily feed intake and feed conversion ratio (FCR) were calculated from records of weight and feed intake. Mortality of the birds was calculated as a percentage of initial number of ducks.

Economics of Production

Cost of diets was calculated by summing up the cost of each ingredient that make up 25kg of each treatment diet, which was thereafter reduced to cost in naira per gram of diet. Cost of production of eggs was determined by determining the average cost of feed consumed per hen for laying the eggs for 4 weeks. Cost per egg produced was calculated by dividing the cost of total quantity of feed consumed by the hens per treatment by the weight of the total eggs produced. Revenue generated from the eggs produced per hen in each treatment was determined by multiplying

the number of eggs by the market price ₦25/kg. The difference between revenue and cost of production constituted the gross marginal profit.

Table 2: Growth Performance of Duck Hens Fed Treatment Diets

	Treatment Diets					
Parameters	**1(0%)**	**2(25%)**	**3 (50%)**	**4 (75%)**	**5 (100%)**	SEM
Initial weight (g/bird)	1010.00	976.67	967.33	1003.33	1010.00	25.14
Final Weight	1350.00^{a}	1226.67^{c}	1210.33^{c}	1256.00^{b}	1251.33^{b}	26.25
Av. Daily weight gain (g/bird)	6.07^{a}	4.46^{b}	4.41^{b}	4.51^{b}	4.31^{b}	0.47
Av. Daily feed intake (g/bird)	80.20^{ab}	84.87^{a}	88.53^{a}	71.00^{b}	52.20^{c}	3.01
Feed conversion Ratio	13.21^{bc}	19.03^{ab}	20.07^{a}	15.74^{abc}	12.11^{c}	2.07
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00

^{abc} *means in the same row with different superscripts are significantly different (P<0.05) from one another. (0) – (100): percentage replacement of maize with PKM*

Table 3: Economics of Production of Duck Hens Fed Treatment Diets

	Treatment Diets					
Economic indices	**1(0%)**	**2(25%)**	**3 (50%)**	**4 (75%)**	**5 (100%)**	**SEM**
Cost of diets (₦/g)	0.064^{a}	0.059^{b}	0.052^{c}	0.047^{d}	0.041^{e}	0.001
Cost of production of egg (₦ /hen)	287.53^{a}	278,30^{a}	256.63^{a}	187.10^{b}	120.00^{c}	13.45
Cost per egg production (₦/g)	15.03^{b}	10.97^{bc}	9.17^{c}	14.80^{b}	20.63^{a}	1.46
Revenue (₦ /hen)	480.00^{b}	637.50^{a}	702.50^{a}	324.67^{c}	147.50^{d}	24.64
Gross margin (₦ /hen)	192.67^{b}	359.20^{a}	445.87^{a}	137.90^{b}	27.50^{c}	30.77

^{abc} *means in the same row with different superscripts are significantly different (P<0.05) from one another. (0) – (100): percentage replacement of maize with PKM*

Table 4: Egg Quality of Duck Hens Fed Treatment Diets

	Treatment Diets					
Economic indices	**1(0%)**	**2(25%)**	**3 (50%)**	**4 (75%)**	**5 (100%)**	SEM
Hen-day Egg prod. (%)	90.32	91.19	93.34	84.95	82.48	3.28
Egg weight (g)	56.80	59.65	61.54	56.70	56.67	2.39
Egg length (cm)	5.58	5.66	5.84	5.39	5.24	0.19
Egg width (cm)	3.60	3.80	3.87	3.43	3.37	0.16
Shell thickness (mm)	0.24^{c}	0.27^{ab}	0.29^{a}	0.24^{bc}	0.23^{c}	0.01
Yolk height (cm)	1.83^{ab}	2.03^{ab}	2.27^{a}	1/70b	1.67b	0.15
Yolk width (cm)	4.33	4.43	4.53	3.90	3.80	0.28
Albumen height (cm)	0.93	1.00	1.03	0.87	0.87	0.05

^{abc} *means in the same row with different superscripts are significantly different (P<0.05) from one another. (0) – (100): percentage replacement of maize with PKM*

Egg Quality

Average daily percentage of the eggs produced per treatment was calculated. Electronic scale was used to measure the weight of the eggs. Egg length and width were determined with the aid of Vernier

caliper. Shell thickness was determined with the shell membrane intact using micrometer screw gauge [25]. The height and width as well as thick albumen heights were measured using spherometer.

Statistical Analysis

The data collected were subjected to one-way analysis of variance (ANOVA) [26]. Mean separation was carried out where significance difference occurred using Duncan's Multiple Range Test [27]. Computer package for Social Sciences (SPSS) Windows 10.0 (2012) was used for data analysis.

Results and Discussion

Growth Performance

The final weight of birds (Table 2) fed 0% PKM was significantly higher ($P<0.05$) than others followed by 75% PKM 4 and 100% PKM whereas those fed 25%PKM and 50%PKM were the least. This could be because of higher energy values of 25% PKM and 50%PKM. The weight gain of birds fed 0%PKM was significantly higher ($P<0.05$) than others while there was no significant difference ($P>0.05$) in the weight gain of ducks fed 25%PKM to 100%PKM. These results could be attributed to the higher energy value of 0%PKM than that of 25%PKM - 100%PKM. The result was the reverse of what was obtained in replacement studies with turkey and broilers [28, 29]. Higher energy values has been The final weight of the ducks fed all the treatment diets fell within the range (1200-1400g/bird) recommended for duck hens at point-of-lay [30].

There was no significant difference ($P>0.05$) in the feed intake of birds fed 0%PKM and that of those fed 25%, 50% and 75%PKM. The feed intake of ducks fed 25%PKM and 50%PKM were significantly higher ($P<0.05$) than those fed 75% and 100%PKM. The theory that birds on lower energy levels eat more to satisfy their energy requirements, [31, 32] was confirmed by ducks fed 25% and 50%PKM but was not the case with birds fed 75% and 100%PKM. This could be due to high content of 75% and 100%PKM with possible higher fibre content. The result of the FCR showed that birds fed 100%PKM were more efficient than others followed by those fed 0%PKM whereas those on 50%PKM were the least. The birds fed 100%PKM ate less feed but gained similar weight with others. This could be due to the higher residual oil content of PKM, which was more in 100%PKM than others. Another contributor to the above observation could be better digestible nutrients reflected the higher crude protein values of diets of 75% and 100%PKM.

Economics of Production

Cost of diets (Table 3) decreased with increase in the level of replacement of maize by PKM. Cost of 0%PKM was significantly higher ($P<0.05$) than other diets and that of 100%PKM was the least. The cost of diet was influenced by low cost of PKM when compared to maize that was erian J. Anim. Sci. 2018, 20 (1): followed similar pattern with cost of diet except that there was no significant difference ($P>0.05$) in cost of producing 0%, 25% and 50%PKM, though 50%PKM was numerically cheaper (256.63 ₦ /hen) than 0%PKM (287.53₦ /hen). The cost per unit weight of egg produced was cheapest in birds fed 50%PKM. It is therefore most economical to produce eggs on 50%PKM. The results in revenue and gross marginal profit of ducks fed 25%PKM and

50%PKM were reportedly significantly higher (P<0.05) than others. Since cost and profit are the economic indices of measuring profitability [37], 50%PKM replacement was preferred.

Egg Quality

There were no significant differences (P<0.05) in hen-day egg production, egg weight, egg length, egg width, yolk width and albumen length of ducks fed all the treatment diets. However, the values in all those parameters for ducks fed 50%PKM were higher than others. Significant differences (P<0.05) were recorded in shell thickness and yolk height. It meant that 50%PKM replacement in which maize and PKM were included in equal proportion supported egg production with minimum feed intake. This was similar to the report of [38] who observed that most egg quality traits did not differ among treatments. The shell thickness of eggs from birds fed 50%PKM was not significantly different (P>0.05) from that of 25%PKM but was significantly greater (P<0.05) than others. This means that the shell of eggs of ducks fed 50%PKM would resist breakage more than others; a quality needed for durability and hatchability [39, 40, 41]. The range of shell thickness obtained here (0.23-0.29mm) was lower than 0.36mm reported for domestic fowl [42]. The egg yolk height of ducks fed 50%PKM though not significantly different (P>0.05) from that of 0% and 25%PKM but was significantly greater (P<0.05) than the yolk weight of birds fed 75% and 100%PKM. This was probably an indication that eggs laid by ducks fed 50%PKM had higher nutrient value than others.

Conclusions and Applications

1. Palm kernel meal may replace maize up to 100% with moderately satisfactory results in the diets of growing ducks.
2. In terms of economics of production and egg quality traits in laying ducks, replacement of maize with PKM at 50% gave the most satisfactory results.

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