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Performance and Feed Cost Benefit of Laying Birds Fed Diet Containing Fermented Cassava Peel Meal Blended with Palm Oil Sludge

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Abstract

This study investigated the performance of laying birds fed diet containing Fermented Cassava Peel Meal (FCPM) mixed with Palm Oil Sludge (POS). The fermented cassava peel meal was obtained by putting the fresh cassava peels in an air tight polyethene bag for four days to enhance the fermentation process after which it was sundried until the weight becomes constant. Then, the fermented cassava peels were milled to obtain fermented cassava peel meal. The mixing of FCPM with POS gave rise to a new product called FCPM+POS. Eight- Four (84) days feeding trial was conducted using one hundred and 120 Isa brown strain of laying hens of twenty-four weeks old was procured from a reputable poultry farm that were raised in a deep liter system. On the day one of the study, the birds were weighed and randomly separated into three groups of forty (40) birds each. Each group was further subdivided into four replicates of ten (10) birds each. Three diets were formulated with diet 1 as the control diet while diet 2 (FCPM), 3 (ECPM+POS) had a 20% replacement level of maize with cassava peel meal each. At the end of the trial, the layer performances, economics of production and egg quality were estimated. There were significant differences ($P < 0.05$) in feed intake, final body weight and feed conversion ratio among the treatment groups. The dietary levels of the test material in laying hens ration reduced cost of producing one kilogram of feed and this was reflected in cost of egg (₦/kg) produced. There were no significant differences ($P > 0.05$) among the treatment groups in oblong circumference, egg weight and shell weight, but the horizontal circumference recorded significant difference ($P < 0.05$) among the group in horizontal circumference. Haugh unit were not significantly ($P > 0.05$)

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affected by the treatment. The albumin index, yolk index, yolk Colour values among the groups were not significantly different (P > 0.05).There were significant differences (P < 0.05) among the treatment groups in the 11th week of the experiment for hen day egg production. It was concluded that 20% processed cassava peel meal mixed with palm oil sludge could replace maize without adversely affecting the overall layer performances, economics of production and egg quality.

Introduction

Developing countries have continued to increase in population resulting in increased demand for protein in human and animal origin [1]. Energy is a critical component of poultry rations, which is essential for life along with other major nutrient classes [2]. Since protein from the animal source is rich in the essential amino acid, minerals and vitamins that the body requires, therefore there is need to increase the production of animal products so as to bridge the animal protein gap in Nigeria. In Nigeria, the high cost of conventional source of energy and protein is largely responsible for the present high price of finished feeds. Also, competition between man and animal for the conventional energy feedstuffs leading to scarcity of feed ingredients also poses problem of proper feeding of livestock species [3]. Therefore, there is an urgent need to explore the available and less competitive non-conventional feed ingredients. Such alternatives are cassava peels and palm oil sludge. The two farm wastes are locally available and underutilized but hold much agronomic potentials. The studies in cassava peel and palm oil sludge in Nigeria and elsewhere in the world have shown its potentials in supplying good quality food energy for livestock [4]. Cassava plants and palm trees are indigenous to Nigeria and are readily available particularly around the southern part of Nigeria. Thus, with emerging technologies of drying, grating and preserving cassava peels, it holds the key to providing a readily available and sustainable source of feeding for domestic animals [5]. Cassava peels are rich in energy, therefore can be used as source of energy in poultry diets. The limited usage of cassava peel in Nigeria made it non-conventional feedstuffs of choice for poultry industry and other farm animals. Like most tropical crops, the utilization of cassava peels for good growth and performance of poultry species may be limited due to the presence of anti- nutritional factors such as hydrogen cyanide, tannin, phytate and saponin [6]. Hence, the need for processing through various methods sun drying and fermentation which exerts beneficial effects by reducing or destroying the inherent anti-nutritional factors [7]. Effective reduction of levels of anti-nutritional factors present in formulated rations and the quality of the feed therefore was determined by the effectiveness of the processing methods employed. The aim of this study therefore was to investigate the effect of feeding inclusion levels of ensiled cassava peel mixed with palm oil sludge based diets on the layer performances, economics of production and egg quality.

Materials and methods

Experimental site

The research was conducted at the Teaching and Research Farm of the School of Agriculture and Agricultural Technology (SAAT), Federal University of Technology, Owerri (FUTO), Imo State, Nigeria. Owerri is in the Southeastern part of Nigeria, and lies in the humid tropical area of West Africa. According to Obi et al., [8], Owerri is situated between longitude 7° 01' 06" and 7° 03' 00"E and latitude 5° 28' 24" and 5° 30' 00"N, while FUTO is on latitude 05° 29' 06"N and longitude 07° 02' 06"E. The climatic data as summarized by the Ministry of Lands and Survey Atlas of Imo State (1984) shows that Owerri stands at an altitude of 90m, with mean annual rainfall, temperature and relative humidity of 2500 mm, 26.5-27.5°C and 70-80%, respectively. The dry season lasts for three months and mean annual evaporation is 1450 mm. The soil is sandy loam with an average pH of 5.5.

Collection of test material

Cassava peels

Cassava peels that was used for the research was collected from garri processing units within Owerri West Local Government Area. The cassava peels collected was fed into high-density polyethene bags. The bags were compressed to exclude as much air as possible and then tied firmly. The pack was allowed to ferment for four days under ambient condition before sun drying to constant weight. The dry mass was then milled in a hammer mill fitted with 0.2mm sieve. The meal from fermented mass was labelled Fermented Cassava Peel Meal (FCPM).

Palm oil sludge

Palm oil sludge that was used for the research was collected from an oil processing plant at Owerri West Local Government Area, Imo State. The palm oil sludge was mixed with cassava peel meals in the ratio of one (1) litre to ten (10) kg; to produce Fermented Cassava Peel Meal (FCPM) and Fermented Cassava Peel Meal Plus Oil Palm Sludge (FCPM + POS).

Experimental diets

Three experimental diets were formulated according to NRC [9] standard. Diet 1 (control) was containing maize as the major source of dietary energy. In diets 2 and 3, 20 kg of maize was replaced by FCPM, and FCPM + POS respectively. The inclusion level of soybean meal, palm kernel cake, wheat offal, brewers' grain, fish meal, bone meal and supplements was similar in all the treatment groups.

Management of experimental birds and experimental design

One hundred and twenty (120) Isa brown strain of chicken of twenty-four weeks old was procured from a reputable poultry farm. They were kept in a deep litter system and allowed to acclimatize for 2 weeks, then were divided into 3 treatments group of 40 birds each. The 40 birds were further sub-divided into four replicates of 10 birds each and randomly assigned to the three treatment diets in a Complete Randomized Design (CRD).The feeding trial will last for 12 weeks. Routine vaccination, medication and litter management were carried out following the standard procedure and guidelines of the University Training and Research Farm.

Data collection

The birds were weighed individually at the beginning and end of the feeding trial. Weight change was calculated as the difference between the initial and final weights. This was divided by the number of days the trial lasted, to get the mean day weight change. Feed intake was determined on replicate basis by obtaining the differences between the quantity of feed offered and the quantity left over after 24 hours. Egg collection was done in the morning (9.00am), at midday (12.00noon) and

in the afternoon (3.00pm) and number of eggs collected per replicate was recorded accordingly. Feed conversion ratio was determined by dividing the daily feed intake by the average daily egg weight (g feed/g egg). The hen day egg production was determined by dividing the number of eggs produced per day by the number of birds.

Table 1: Pangolin a possible transmitter of covid 19 in humans (universe.byu.edu).

Ingredients	Diet 1	Diet 2	Diet 3
Maize	55.00	35.00	35.00
FCPM	00.00	20.00	00.00
FCPM + POS	00.00	00.00	20.00
Palm Kernel cake	2.00	2.00	2.00
Soybean meal	17.00	17.00	17.00
Wheat offal	9.00	9.00	9.00
Bone meal	6.00	6.00	6.00
Oyster shell	4.00	4.00	4.00
Fish meal	3.00	3.00	3.00
Blood meal	3.00	3.00	3.00
Lysine	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Vit/Premix	0.25	0.25	0.25
	100	100	100
Calculate Chemical Composition of the Experiment Three Diets			
ME (Kcal/Kg)	2750.00	2469.00	2469.00
Crude protein	19.26	18.26	18.26
Crude fibre	3.15	3.95	3.95
Crude fat	3.43	3.79	3.79
Ash	3.05	4.23	4.23
Calcium	3.87	3.86	3.86

To provide the following per kg of feed: Vit. A, 10,000IU; Vit. D_3, 1,500IU; Vit. K, 2mg; riboflavin, 3mg; Pantothenic acid, 6mg; Niacin, 15mg; Choline chloride, 3mg; Vit. B12, 0.08mg; Folic acid, 4mg; Mn, 8mg; Zn, 0.5mg; Iodine, 1.0mg; Co 1.2mg; Cu, 10mg; Fe, 20mg.

NB: FCPM: Fermented Cassava Peel Mea; FCPM + POS: Fermented Cassava Peal Meal plus Palm Oil Sludge

Exterior and interior egg characteristics

The eggs collected on the 7th day of each week were used for external and internal egg characteristics studies. Four (4) eggs per replicate whose weight are closest to the mean of each replicate, were used to determine the, horizontal and oblong circumferences, yolk and albumen heights and widths, shell thickness and yolk color. The egg weights were measured with an electronic weighing balance (Model: EK5055) with sensitivity of ± 0.001g. The horizontal and oblong circumferences were measured using an inelastic thread and well-calibrated plastic meters rule, respectively. The yolk and albumen heights, were measured using a spherometer while diameters were determined using a Venier caliper. The average of short and long diameters were calculated and recorded. The height of the thick albumen was measured from the chalazae. The yolk and albumen indices were calculated as shown in equations below.

$$\text{Yolk index} = \frac{yolk\ \text{height}}{yolk\ \text{width}}$$

$$\text{Albumen index} = \frac{albumen\ \text{height}}{albumen\ \text{width}}$$

The percentage shell was calculated by dividing the shell weight by the egg weight and then multiplied by 100. The shell thickness was obtained using a micrometer screw gauge (DIN - 863/11) with sensitivity 0.01mm after removing the membrane at three points on the shell (peripheral, centre and narrow ends). Yolk Colour was determined using Hoffman La Roche Colour fan scale. The Haugh unit was calculated by substituting the albumen height and egg weight in the equation outlined by Oluyemi and Robert [10]:

$Hu = 100 \log (H + 7.57 - 1.7w^{0.37})$

Where:

Hu= Haugh Unit

H= Observed albumen height in mm

W= Egg weight in (g)

Or

$$Hu = 100 \log H - \sqrt{\frac{a\ (30W^{0.37} - 100 + 1.9}{100}}$$ Where:

Where:

Hu= Haugh Unit

H= Observed albumen height in mm

A= The gravitational constant 32.2

W= Observed weight of the egg in

Results and discussions

Performances, economics of production and egg quality characteristics of laying hens Performance of laying hens fed processed cassava peels.

The results of the performances of laying hens were shown in Table 2.

Feed intake

There were significant differences ($P < 0.05$) in feed intake among treatment groups. The average feed intake values were 138.14g, 144.27g and 146.57g for 0%, 20% FCPM and 20% FCPM+POS. The feed intake of the group on 20% FCPM+POS dietary level were significantly ($P < 0.05$) higher than other groups. It recorded highest ($P < 0.05$) feed intake (146.57g) while group on the control recorded least ($P < 0.05$) feed intake (138.14g). This agreed with the findings of Ijaiya et al., [11] on higher intake of feed, which contained CPM in rabbit diets. The increased feed intake observed in the group of birds fed 20% FCPM be because it contained more fibre compared to maize which tend to increase the fibre content of the diets containing it thereby diluting the other nutrients especially energy. The birds therefore had to eat more to meet their energy needs to sustain growth and development. This is in agreement with Salami and Odunsi, who reported that increase in crude fibre decreases Metabolizable Energy (ME) thereby leading to increased feed intake to meet ME requirements.

Final body weight

There were significant differences (P < 0.05) in final body weight among the treatment groups. The final body weight values were 1891.5g, 1665.00 and 1620.00 for 0 %, 20% FCPM and 20% FCPM+POS respectively. The birds on the control diet has the highest (P < 0.05) final body weight (1891.5g) while those on 20% FCPM and 20% FCPM+POS were similarly significant in final body weight but lower than the control.

Feed conversion ratio (g/feed/g egg)

There were significant differences (P < 0.05) in feed conversion ratio among the treatment groups. The feed conversion ratios were 2.75, 3.11, and 3.00 for 0%, 20% FCPM and 20% FCPM+POS respectively. The group on 20% FCPM dietary level recorded significantly (P < 0.05) better-feed conversion ratio (3.11) than other groups. The control group recorded poorest (P < 0.05) feed conversion ratio (2.75).

Economics analysis of layers

The dietary levels of the tested material in laying hens ration reduced cost of producing one kilogram of feed and this was reflected in cost of egg (₦/ kg) produced Table 3. Based on the economy of producing 1.0 kg of egg the 20 % FCPM + POS based diet has the lowest cost of production (₦359.73) The control diet was the most expensive diet (₦393.00).

Egg quality characteristics

External characteristics

The data on egg quality characteristics were shown on Table 4 and 5. There were no significant differences (P > 0.05) among the treatment groups in oblong circumference. The values were 16.43, 16.21 and 17.32 for 0%, 20% FCPM and 20% FCPM+POS respectively. The highest (P > 0.05) value was recorded by the group on 20% FCPM+POS (17.32cm) while the group on.

Table 2: Performances of laying hens fed processed cassava peel.

Parameters	Control	FCPM	FCPM+POS	SEM
Initial weight (g)	1816	1707.5	1802.5	0.421
Final weight (g)	1891.50^{a}	1665.00^{b}	1620.00^{b}	0.002
Ave feed intake (g/day)	138.14^{b}	144.27^{a}	146.57^{a}	0.002
Average hen day production (%)	81.45	74.23	77.55	0.145
Feed conversion ratio(g feed/ g egg)	2.75^{b}	3.11^{a}	3.00^{ab}	0.079
Average weight (g)	50.25	46.33	49.15	0.22

^{a,b,c} means with different superscripts within a row are significantly different (p<0.05).

Table 3: Economics analysis of laying hens fed fermented cassava peel meal.

Parameters	Control	FCPM	FCPM+POS
Feed cost (₦/kg)	142.91	119.91	119.91
Feed cost savings	-	23.00	23.00
Feed cost(/kg) egg produced	393	372.92	359.73

20% FCPM (P > 0.05) value (16.21cm). The values were not in agreement with the report range of 14.92-15.36 by [12]. This might be due to the species differences and feed constituents.

The egg weight and shell weight also showed no significant differences (P > 0.05), but the horizontal circumference recorded significant difference (P < 0.05) among the group in horizontal circumference. The values were 14.22, 14.19 and 14.55 for 0 %, 20 % FCPM and 20 % FCPM+POS respectively. Birds on 20% FCPM+POS recorded the highest (P < 0.05) value (14.55) while the group on 20% FCPM recorded the least (P < 0.05) value (14.19). The values were slightly above the reported standard range of 13.10-13.50 [12].

Internal egg characteristics

Haugh Unit

Haugh unit were not significantly (P > 0.05) affected by the treatment (Table 5). The values were 85.84, 86.16 and 86.17 for 0%, 20% FCPM and 20% FCPM+POS respectively. The values obtained for the group were within the standard reported range for normal eggs of 75.50 - 95.67 [13].

Shell thickness

The shell thickness values were comparable among the groups and showed no significant differences (P > 0.05). The values were 0.33, 0.35 and 0.35 for 0%, 20% FCPM and 20% FCPM + POS respectively. The shell thickness values recorded were within the standard reported range of 0.33-0.36 [12].

Effect of proceed cassava peel on external egg quality traits of laying hens were shown on Table 4. The decreased in egg weight was in line with [14]. Egg weight is the most important quality trait not only to the consumers but also to the egg producers [15]. The heaviest eggs were obtained at the last week of the experiment. Significant increase was observed in egg weight with age of the birds is consistent with the reports of Johnson [16] who observed heavier egg in older birds likewise [17] corroborated the report. The findings of this study however was in line with the average egg shell thickness values of 0.30 and 0.35mm for Nigerian local breed [14]. The egg volume also increased with the hen's age. Furthermore, the external egg quality traits considered in this study, it was only the egg horizontal circumference was significantly (P < 0.05) affected.

Table 4: Effect of processed cassava peel meal on the external qualities characteristics of egg.

Parameters	Control	FCPM	FCPM+POS	SEM
Egg oblong circumference(cm)	16.43	16.21	17.32	0.186
Egg horizontal circumference(cm)	14.22^{b}	14.19^{b}	14.55^{a}	0.037
Egg weight (g)	62.29	60.79	60.17	0.660
Shell weight(g/egg)	7.33	7.29	7.25	0.968

^{a,b,c} means with different superscripts within a row are significantly different (p<0.05).

Albumin index

The albumin index values among the groups were not significantly different (P > 0.05). The values recorded were 0.15, 0.17 and 0.17 for 0%, 20% FCPM, 20% FCPM+POS respectively. The values were not in line with the reported range of 0.07-0.12 by Emenalom [13].

Yolk index

The yolk index was not significant (P > 0.05) different among the treatment groups. The values were 0.46, 0.47 and 0.48 for 0%, 20% FCPM and 20% FCPM+POS respectively. The values were within the reported standard range of 0.4-0.52 [12]. However, the highest (P > 0.05) values were recorded by the groups on 20 % FCPM + POS (0.48) while the group on 0% CPM had the least (P > 0.05) value (0.46).

Yolk colour

The yolk Colour values were not significantly (P > 0.05) affected by the treatment. The values recorded were 6.04, 5.71 and 6.04 for 0%, 20% FCPM, 20% FCPM+POS respectively. The values were comparable, and fall within the reported range of 4.0-7.5 for yolk Colour [18].

Hen-day egg Production

There were significant differences (P < 0.05) among the treatment groups in the 11th week of the experiment for hen day egg production Table 6. Percentage hen-day egg production decreased with the inclusion of test material. The values were 81.69, 77.67 and 65.35 for 0%, 20% FCPM, 20% FCPM+POS respectively. Birds on the control (0%) diet performed significantly (P > 0.05) better (81.69%) than other groups while those on 20% FCPM+POS recorded the least (P < 0.05) (65.35) in hen-day egg production. This result was in correspondence with the findings of Aina and Fanimo [19], who reported that hen-day egg production, was decreased by cassava meal, whereas egg weight, feed intake, shell thickness, Haugh Unit and feed efficiency were not affected.

Table 5: Effect of processed cassava peel meal on the internal qualities characteristics of egg.

Parameter	Control	FCPM	FCPM+POS	SEM
Yolk height (mm)	1.86	1.96	1.94	0.088
Yolk width (mm)	4.16	3.94	4.09	0.671
Yolk weight (g)	14.38	14.04	14.71	0.058
Yolk Colour	6.04	5.71	6.04	0.173
Albumen height (mm)	1.04	1.15	1.16	0.297
Albumen width(mm)	7.03	6.45	6.94	0.067
Albumen weight (g)	38.08	38.09	39.83	0.136
Shell thickness (mm)	0.33	0.35	0.35	0.481
Shell percentage (%)	11.81	12.02	11.56	0.588
Albumen percentage (%)	60.99	62.21	63.39	0.707
Yolk percentage (%)	23.16	23.18	23.49	0.748
Yolk index	0.46	0.47	0.48	0.315
Albumen index	0.15	0.17	0.17	0.168
Haugh unit	85.84	86.16	86.17	0.696

Table 6: Effect of processed cassava peel meal on the hen - day production.

WEEKS	CONTROL	FCPM	FCPM+POS	SEM
1	83.75	85	86.25	0.773
2	88.84	80.36	84.38	0.186
3	81.69	78.13	83.48	0.230
4	79.47	80.36	81.69	0.889
5	89.29	73.21	83.04	0.024
6	82.59	70.09	79.89	0.12
7	74.98	66.52	78.13	0.234
8	81.25	67.86	76.79	0.138
9	74.55	60.68	69.17	0.162
10	75.89	74.55	70.15	0.635
11	81.69	77.67	65.35	0.014
12	83.45	76.79	72.26	0.139

Conclusion

From the study, it was observed that the feed intake value increased with the addition of the test materials. The birds on dietary treatment recorded higher feed conversion ratio. The inclusion of ECPM+POS reduced the cost of production, showed better external characteristics and albumen index which showed eggs with good qualities for producing other products. Therefore ECPM+POS with 20kg inclusion level gave better quality eggs and has lowest cost of product should be recommended for farmers.

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