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Response of Laying Hens to total Dietary Replacement of Maize with Cassava.

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Abstract

The response of Isa Brown laying hens during 77 – 85 weeks of age to peeled unfermented cassava root meal (CRM) as total substitute for maize in diet was examined. Eighty (80) hens were assigned to four dietary treatment groups (T_1, T_2, T_3, and T_4) in a completely randomized design. The control diet (CD) contained 40% maize while the proportion of maize in the CD was replaced with 100, 110 and 120% CRM amounting to 40, 44 and 48% of cassava in diet for T_2, T_3 and T_4 respectively. All diets were isocaloric and isonitrogenous. The CRM diets produced statistically significant ($p<0.05$) improvements by leading to lower feed intake, better feed conversion and increased hen-day production (HDP) with increasing levels of CRM in diet. Although the eggs obtained from birds fed the CD had significantly higher yolk weight than those from the CRM, there was no significant difference ($p>0.05$) in egg weight in all treatment groups. The best overall performance was achieved from birds fed 48% (120% replacement) cassava diet.

Key words: Laying hen, maize, cassava root meal, egg quality.

Introduction

Maize (*Zea mays*) is the major source of energy in poultry diets. Its proportion in diets for monogastrics in the tropics ranges from 50 to 70%, PAN, (1985). It also serves as the major staple foodstuff for a good proportion of Nigerians. Thus, its ever-increasing demand for human consumption, livestock feed and industrial uses have continuously raised its market price thereby increasing the cost of animal feed. Consequently, the primary aim of producing quality meat and eggs at minimal cost by poultry farmers have been hampered due to man's keen competition with his animals over grains (Ademosun and Eshiett, 1980; Ijaiya *et al*, 2002). This has been the major obstacle in developing the poultry industry in Nigeria.

Over the decades, alternative feedstuffs have been developed to replace the expensive conventional ones. One of such alternative is cassava. Cassava is the most promising of the tubers providing very high yields of energy per hectare. Its ease of cultivation, tolerance to drought and poor soil condition, lower cost of production, stable market price and all year round availability makes it preferable to maize. Thus, a well processed dry cassava meal stands as a ready alternative to maize in Nigerian livestock feeds (Eruvbetine and Adejobi, 2000; Tewe, 1982).

Several works which used cassava products have been reported (Sekoni *et al*, 1998; Salami and Odunsi, 2003). Using brewers dried yeast to blend cassava, Oruwari *et al*, (2003) stated that with proper protein balance, cassava meal could completely replace maize in broiler diets.

Unlike broiler and rabbit production, there is apparent paucity of information on total replacement of maize with cassava products in layer feeds. This study therefore evaluates the response of laying hens to the complete replacement of maize with cassava root meal (CRM) in layer diet.

Materials and Methods

Source and production of CRM:
A local variety (TMS-30572) of peeled unfermented dry cassava tubers were bought from a nearby market. The dry tubers were milled in a hammer mill to Cassava Root Meal (CRM) and were subjected to hydrogen cyanide (HCN) test (0.15mg HCN/gm) using the method of AOAC, (1975) and proximate analysis (crude protein 1.7%, fat 0.7% and crude fibre 2.6%). using the method of AOAC, (1990). The CRM was used to compound isocaloric and isonitrogenous layer diets (Table 1). The Table also shows the chemical composition of diets.

Diets and management of birds:
Four experimental diets were formulated. Diet T_1 contained 40% maize and had no cassava root meal. It served as the control diet. The proportion of maize in T_1 was gradually replaced by 40, 44 and 48% CRM representing 100, 110 and 120% replacement of maize with cassava for T_2, T_3 and T_4 respectively. Eighty Isa Brown laying hens were randomly divided equally to four (4) groups. Each group had 5 replicates of 4 hens each. The Californian type battery cage placed in an open sided poultry house was used to accommodate the experimental birds. Two birds were housed in each compartment of the cage measuring 30 x 38 x 48 cm for breath, length and height, respectively. The birds were given the experimental diet and water *ad libitum* throughout the experimental period. Coccidial and bacterial treatments that served as part of the bird routine management continued within the period with the administration of wormazine.

Experimental schedule and data collection:
The experiment lasted for 56 days. Individual birds were weighed at the commencement of the experiment to obtain the initial weight of birds. Subsequent weight data were taken weekly for computation of mean body weight of birds. Feed consumption was measured by calculating the difference in the quantity of feed offered daily and the quantity left. This was used to compute the mean daily feed intake and feed conversion ratio (kg feed per dozen egg). Egg production and egg weight were recorded daily while the mean hen-day production (HDP) was computed weekly from the egg production records. Birds were closely observed for mortality to effect adjustment in feed calculation. Two freshly laid eggs, free of cracks were randomly sampled from each replicate for weekly measurement of egg quality.

Eggs were weighed using a mettler electronic balance while the length and width were obtained by measuring the long and widest axes with a vernier caliper. The eggs were carefully broken at the middle to keep the yolk intact and emptied into a petri-dish. Individual yolk was separated from the albumen and weighed. Yolk height was recorded and the diameter was taken as the maximum cross-sectional diameter with a pair of vernier caliper. Albumen heights were also obtained by measuring the widest expanse of the thick albumen between the yolk edge and the external edge of the thick albumen. Individual

Table 1: Ingredients and chemical composition of experimental layer diets

Ingredients (%)	*Treatments*			
	T_1	T_2	T_3	T_4
Maize	40	-	-	-
Cassava	-	40	44	48
Palm kernel cake	19	13	7.4	2.6
Soya bean meal	15	26	29	31
Fish meal	2.25	2.25	2.25	2.25
Wheat bran	12	6.6	5.0	4.0
Palm oil	1.0	1.0	1.2	1.0
Vit/Trace mineral	0.25	0.25	0.25	0.25
Limestone	6.0	6.0	6.0	6.0
Bone meal	4.0	4.0	4.0	4.0
D-L Methionine	0.05	0.25	0.25	0.25
Salt	0.4	0.4	0.4	0.4
Lysine	0.05	0.25	0.25	0.25
Composition of nutrient (%/kg)				
Crude Protein (analyzed)	19.34	19.22	19.23	18.82
ME (calculated, kcal/kg)	2516.65	2514.99	2539.55	2552.39
Fat (calculated)	5.23	3.32	3.15	2.64
Fat (analyzed)	4.90	3.40	3.00	2.40
Crude fibre (calculated)	5.35	6.82	6.54	6.35
Crude fibre (analyzed)	4.81	5.10	4.90	5.20
Lysine (calculated)	0.87	1.18	1.22	1.23
Methionine (calculated)	0.38	0.53	0.94	0.93
Calcium (calculated)	3.89	3.88	3.87	3.86
Phosphorus (calculated)	1.21	1.06	1.01	0.97
Moisture (analyzed)	8.70	8.60	9.00	8.40

Trace minerals for each Kg contain: Mn 40g, Fe 20g, Zn 18g, Cu 0.8g, I 0.62g, Co 0.09g and Se 0.04g.

The vitamins for each kg contain: Vit. A 5,000,000 I.U, Vit. D_3 1,100,000 I.U, Vit. K 0.8g, Vit. B_1 10.6g and Vit B_2 2.4g, nicotinic acid 14.0g, calcium D-pantothenate 4.0g, Vit B_6 1.4g, Vit B_{12} 8.0g, folic acid 0.4g, biotin 0.02g, Vit C 10.0g, choline chloride 120.0g, Zinc bacitracin 8.0g, methionine 80.0g, Avatec 36.0g.

egg shell was carefully washed, air-dried for 24 hours and weighed. The shell thickness was measured using a micrometer screw gauge. The albumen weight was estimated by subtracting the yolk and shell weight from the egg weight. Egg index, yolk index and yolk to albumen ratio were computed from the egg quality measurements. All the data collected were subjected to analysis of variance (ANOVA) using the completely randomized design of Steel and Torrie, (1980) and treatment means were separated by using the multiple range test of Duncan (1955).

Results

Effect of diets on the performance of laying hens. The performance of laying hens fed the various dietary inclusion of peeled unfermented cassava

root meal (CRM) throughout the 56 day experimental period are presented in Table 2. The initial and final weight of birds in the various treatments did not differ significantly (P>0.5) from each other.

The mean daily feed intake (MDFI) of birds over the experimental period differed significantly (P<0.05) among the dietary treatments with the birds on the control diet (CD) being significantly (P<0.05) higher than those on the CRM diets. Within the birds on the CRM diets, MDFI of birds were also significantly different (P<0.05) from each other with a decreased level of intake as the level of CRM in diet increased.

Effect of diets on feed conversion:
The mean feed conversion ratio were significantly (P<0.05) different with birds on the CRM diets having better feed utilization. Bird on the highest CRM diets (48%) had the best feed conversion when compared to the control, but was not significantly (P >0.05) higher than those on 44% CRM.

The dietary treatment had an overall improvement on mean hen-day production (HDP) attributable to all levels of the CRM diets when compared to the control. Laying hens fed 48% CRM had significantly (P <0.05) higher HDP than those fed 40% CRM but was not different from those fed 44% CRM. Similarly the HDP of birds fed 40% and 44% CRM were not significantly (P >0.05) different from each other. No mortality was recorded throughout the experimental period.

Egg quality parameters of layers fed with peeled unfermented cassava root meal for the 8 weeks experimental period are given in Table 3.

Statistical analysis of the external qualities of eggs revealed that there were no significant differences (P > 0.05) between the treatment groups with regard to egg weight, egg length,

Table 2: Performance of laying hens fed peeled unfermented cassava root meal

Performance Parameters	*Dietary Treatments* T_1	T_2	T_3	T_4	*SEM (±)*
Initial weight (kg/bird)	1.76	1.80	1.71	1.78	0.053
Final weight (kg/bird)	1.85	1.84	1.79	1.84	0.047
Feed intake (g/bird/day)	138.43^{a}	130.32^{b}	127.03^{c}	123.33^{d}	0.35
Feed conversion (kg feed/doz. egg)	2.66^{a}	2.40^{b}	2.31^{bc}	2.21^{c}	0.053
Hen-day production (%)	62.41^{c}	65.09^{b}	65.98^{ab}	67.05^{a}	0.30
Mortality	-	-	-	-	-

a, b, c - Means within the same row with different superscripts are significantly different from one another (P < 0.05).

Table 3: Egg quality parameters of laying hens fed Peeled unfermented cassava root meal

Egg quality	*Dietary*	*Treatments*			
Parameters	T_1	T_2	T_3	T_4	*SEM (±)*
Egg weight (g)	70.20	70.17	69.60	69.44	0.530
Egg length (cm)	6.09	6.08	6.09	6.06	0.037
Egg width (cm)	4.51	4.46	4.42	4.42	0.096
Egg index	0.306	0.306	0.305	0.303	0.002
Yolk weight (g)	17.18[a]	16.34[b]	16.18[b]	16.13[b]	0.10
Yolk height (cm)	1.26	1.22	1.24	1.23	0.032
Yolk diameter (cm)	4.12	3.99	4.07	4.06	0.071
Yolk index	0.306	0.306	0305	0.303	0.0015
Yolk: Albumen ratio	0.38	0.36	0.36	0.35	0.019
Albumen weight (g)	45.63	46.08	45.85	45.80	0.64
Albumen height (mm)	32.00	32.50	31.30	32.2	0.37
Shell weight (g)	7.91	7.75	7.58	7.15	0.18
Shell thickness (mm)	0.29	0.29	0.29	0.27	0.013

a, b, c – Means within the same row with different superscripts are significantly different from one another ($P < 0.05$).

egg width, egg index, shell weight and shell thickness.

The mean yolk weight of eggs from the CD were significantly ($p<0.05$) higher than those from the cassava based diets. The dietary treatments did not significantly ($P > 0.05$) affect yolk height, yolk diameter, yolk index, yolk: albumen ratio, albumen weight and albumen height.

Discussion

The observed similarity in the final weight of birds which did not differ significantly from those in the control indicated that the birds could conveniently tolerate total replacement of maize with CRM in diet up to 120% (48% CRM). This could be certified by the isocaloric and isonitrogenous feed in all the treatments and the uniformity in the age of the laying hens. However, this finding disagreed with the reports of (Esonu and Udedibie, 1993; Eruvbetine *et al*, 1996 and Salami, 2000) that replacement levels beyond 50% of maize in diet of grower cockrels, weaner rabbits and layers may lead to reduction in weight gain.

Layers on the control diet (CD) recorded significantly higher feed intake than those on the CRM diets with more reduction in feed consumption as the level of CRM in diet increased. This observation tallied with the report of Oruwari *et al*, (2003) who observed significantly higher feed intake of broiler birds on the CD compared to those on the cassava / brewers dried yeast blend (cassayeast). It is also in accordance with the report by Salami and Odunsi (2003) who reported higher feed consumption of layers on the CD than those on cassava peel meal (CPM) with an observed

declining reduction in consumption as the level of CPM increased irrespective of the processing method employed.

Feed conversion ratio showed better improvement with the use of CRM diets. Birds on diet T_4 (48% CRM) were the best converters when compared to the control and other diets. The improvement in feed conversion observed seemed to be spectacular since the analyzed crude fibre levels in all the CRM diets were equivalent to the level in the CD. It is thus noteworthy that the use of CRM to completely replace maize in diet for laying hens has a place in formulated feeds for layers, especially in areas where there is surplus cassava.

The HDP of birds on the CRM diets were significantly better than those on the CD. The superior HDP of birds on diet T_4 (48% CRM) being the highest CRM inclusion showed that laying hens could tolerate up to 120% replacement of maize with cassava root meal. This supported earlier report by Durunna *et al,* (1999) who observed that there was no deleterious effect utilizing sun-dried cassava tuber based rations for egg and broiler meat productions.

The result obtained from the external qualities of eggs and some internal qualities such as yolk height and diameter, yolk index, yolk: albumen ratio, albumen weight and height which were not significantly different in all treatments were expected since all the birds were mature and of the same age. This supported the finding by Abdullah *et al,* (2003) who reported that the age of the hen strongly influenced the egg size and the proportion of its components. Although the yolk weight of egg on the CD was significantly higher than those from the CRM, it did not give any significant difference in the weight of eggs in the CRM treatments.

Conclusion

The result of this study revealed that CRM is capable of totally replacing maize in diet for laying hens. The 48% CRM diet equivalent to 120% replacement of maize with CRM in this study was found to produce the best result. However, it is not known how much higher level of CRM would be tolerated to support egg production.

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