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**USE OF FERMENTED CASSAVA, PALM KERNEL CAKE
AND DRIED BREWERS' GRAINS TO PRODUCE MAIZE-
FREE LOW-COST DIETS FOR LAYING HENS**

B.C. ANYAEGBU, B.O. ESONU, M.C. UCHEGBU AND A.B.I. UDEDIBIE*Department of Animal Science and Technology,
Federal University of Technology, P.M.B. 1526, Owerri, Nigeria.***Corresponding author:** abiu_futo@yahoo.com

ABSTRACT

An experiment was carried out to determine the performance of laying hens fed maize-free diets based on combinations of fermented cassava tuber meal (FCMT), palm kernel cake (PKC) and dried brewers' grains (DBG) as source of energy. Diet 1 (control) contained maize as the main source of energy while diets 2, 3, 4, 5, and 6 contained FCMT, PKC and DBG at percentages of 30, 20, 20; 35, 15, 20; 35, 20, 15; 25, 20, 25 and 25, 25 and 20, respectively, completely eliminating maize. Each diet was fed to a group of 24 laying hens for 12 weeks, using completely randomized design (CRD). The layers on the maize-free diets tended to consume more feed than those on the control diet. The group on diet 3 (35%: 15%: 20%) recorded significantly ($P<0.05$) higher hen-day egg production (69.50%) than those on the other diets. There were no significant differences ($P>0.05$) in egg weights. The group on the control diet and that on diet 3 recorded significantly ($P<0.05$) superior feed conversion ratios. Haugh unit of the eggs from diet 4 was significantly ($P<0.05$) higher than the others. Diets 3 recorded the lowest feed cost of egg production with the value of N178.67 per kg eggs as against N210.25 per kg eggs from the control. The results of the trial have shown that fermented cassava tuber meal, palm kernel cake and dried brewers' grains can be used to produce maize-free low-cost diets for laying hens if properly combined.

Keywords: fermented cassava, palm kernel cake, dried brewers' grains, maize-free diets, laying hens.

INTRODUCTION

Poultry production has depended on maize as the source of dietary energy. However, cost of maize has been escalating within the late 20 years because of the demand pressure arising from its use as staple food for humans, feed for livestock and raw material for some industries (Udedibie, 2003). This has adversely affected poultry production in the country due to unbearable increase in feed cost and its concomitant effects on the cost of poultry products. There is the need

therefore to look for cheaper alternatives to maize if poultry enterprise in the country must be sustained.

Currently, Nigeria is the largest producer of cassava in the world with production capacity of 38.2 million metric tonnes per annum (FAO, 2005). Although its use as feedstuff is limited by its content of cyanogenetic glucosides, linamarin and lotaustralin (Sayre, 2007), Udedibie *et al.* (2004) have demonstrated that this could be eliminated through

fermentation. It is also low in crude protein (about 3%) but this could be remedied through supplementation with high protein feeds.

Palm kernel cake is the by-product of palm kernel extraction industry and is abundant in many tropical countries including Nigeria. It contains about 20% crude protein and has been shown to support satisfactory egg production at up to 40% dietary inclusion for laying hens (Onwudike, 1988) and body weight gain of broiler (Meremikwu, 2009).

Another by-product that is abundant in Nigeria is dried brewers' grains, the by-product of the breweries. Brewers' grains is 'spent' with regard to its starch content but it contains proportionally more valuable vitamins, minerals, fat, fiber and protein than were contained in the original cereal grains used (Kingsell *et al*, 1979). It is rich in essential fatty acids (Singh, 1988) and crude protein (Udedibie, 1984).

Considering the various attributes of fermented cassava tuber meal, palm kernel cake and dried brewers' grains, it would appear that their appropriate combinations can be used to produce maize-free and cheap diets that can be efficient in promoting performance of laying hens.

This paper reports the performance of laying hens fed maize-free low-cost diets based on various combinations of fermented cassava tuber meal, palm kernel cake and dried brewers' grains.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the poultry section of the Teaching and Research

Farm of the Federal University of Technology, Owerri-Nigeria. Owerri is the Capital of Imo State. It lies between latitude 4° 4' and 6° 3' and longitude 6° 15' and 8° 15'. It has an average annual rainfall of 2500 mm and mean annual temperature range of 26.5 - 27.5 °C. The mean annual humidity range is 70 - 80% with dry season duration of 3 months.

The annual evapotranspiration is 1450 mm and the soil is essentially sandy loam with average pH of 5.5 (Imo State Atlas, 1984).

Sources and Processing of Feed Ingredients

The fresh cassava tubers used in the study were bought from a local market in Ideato North Local Government Area of Imo State. They were washed, cut into pieces and put in vats filled with water and left to ferment under atmospheric temperature for 5 days. Thereafter, they were put in sacs and hand-pressed to remove water and then spread in the sun to dry. The dried fermented cassava tubers were then milled to produce fermented cassava tuber meal (FCTM).

Wet brewers' grains was bought from the Consolidated Brewery Limited, Awo-Omama, the brewers of 33 Export Lager Beer, dried in the sun and milled to homogenize it to produce dried brewers' grains (DBG).

The other ingredients (PKC, maize, local fish meal, blood meal, wheat offal, soyabean meal, salt, vitamin/trace mineral premix, lysine and methionine) were bought from a local dealer. The FCTM, PKC, DBG, local fish meal were subjected to proximate analysis according to AOAC (1995). Fresh cassava tubers and the FCTM were analyzed for HCN according to Bradbury *et al.* (1999).

Experimental Diets

Six experimental diets were formulated such that the control diet (diet 1) contained maize as the main source of energy while diets 2, 3, 4, 5 and 6 contained FCTM, PKC and DBG at the following percentages: 30%, 20%, 20%; 35%, 15%, 20%; 35%, 20%, 15%; 25%, 20%, 25% and 25%, 25%, 20%, respectively, completely replacing maize. Other ingredients remained the same for the diets (Table 1).

Experimental Birds and Design

A total of 144 laying hens of Isa Brown breed at 10 months of laying life were divided into 6 groups of 24 birds each and each group randomly assigned to one of the experimental diets in completely randomized design. Each group was replicated 3 times and each replicate of 8 birds housed in a pen measuring 1.5 x 2 m. Wood shavings were used as litter material.

The birds were weighed at the beginning and end of the trial to determine their body weight changes. Feed and water were provided *ad libitum*. The trial lasted for 12 weeks.

Data Collection and Analysis

Data collected included initial body weight, final body weight, feed intake, feed conversion ratio, egg production, egg weight and egg quality indices.

Feed intake was determined by subtracting the weight of the left-over feed from the weight of the feed fed the previous day.

Eggs were collected twice daily. At the end of each week, the eggs collected from each pen were weighed to determine the average egg weights. Feed conversion ratio (FCR) was determined by dividing daily feed intake by daily egg weight (g feed/g egg). Hen-day egg production was determined by dividing total egg production by the number of layers multiplied by 100.

At the end of the trial, six eggs were randomly selected from each treatment and used to determine egg quality indices. Egg quality indices determined included egg shell thickness, yolk index, albumin index and Haugh unit. Egg shell thickness was determined with a micrometer screw gauge after the membrane from each egg was removed.

Measurements were taken from three points on each egg shell. The shell thickness value of the egg was the average of the 3 measurements. Egg yolk index was determined according to Sharp and Powell (1930) as modified by Funk (1948). Albumin index was determined according to Haiman and Carver (1936), while Haugh unit was determined according to Haugh (1937), as modified by Brant *et al.* (1951).

The data collected were subjected to one-way analysis of variance (ANOVA), according to Snedecor and Cochran (1978). Where ANOVA indicated significant treatment effects, means were compared using Duncan's New Multiple Range Test (Steel and Torrie, 1980).

Table 1: Ingredient Composition of the Layer Experimental Diets

Ingredients (%)	Experimental Diets					
	Diet 1 (control)	Diet 2	Diets 3	Diets 4	Diets 5	Diets 6
Maize	50.00	0.00	0.00	0.00	0.00	0.00
FC TM*	0.00	30.00	35.00	35.00	25.00	25.00
Palm kernel cake	15.00	20.00	15.00	20.00	20.00	25.00
Brewers' dried grains	5.00	20.00	20.00	15.00	25.00	20.00
Soyabean meal	10.00	10.00	10.00	10.00	10.00	10.00
Wheat offal	4.00	4.00	4.00	4.00	4.00	4.00
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00
Blood meal	3.00	3.00	3.00	3.00	3.00	3.00
Bone meal	9.00	9.00	9.00	9.00	9.00	9.00
Vit./TM premix**	0.25	0.25	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25	0.25	0.25
L-lysine	0.25	0.25	0.25	0.25	0.25	0.25
L-methionine	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Nutrient Composition of the Experimental Layer Diets (% of DM)						
Crude protein	17.45	17.05	17.25	16.15	17.95	17.85
Crude fibre	4.41	7.59	7.97	8.93	7.80	7.76
Ether extract	3.89	3.55	2.45	2.42	2.46	2.77
Ash	3.11	4.05	3.92	3.69	4.19	4.19
Calcium	3.43	3.54	3.53	3.51	3.53	2.53
Phosphorus	1.99	2.04	2.04	1.99	2.08	2.07
Metabolizable energy (Kcal/g)	2.67	2.64	2.62	2.63	2.55	2.58

* Fermented cassava tuber meal

** To provide the following per kg of diet: Vit. A, 2000,000iu; Vit. D₃ 100iu, Vit. E; 8g; Vit. K, 0.4g; B₁, 0.3g; Vit. B₂, 1.0g; Vit. B₆, 0.6g; Folic acid, 0.2g; Biotin, 8.0mg; Choline, 48.0g; BHT 32.0g; Iodine, 2.5mg; Cobalt, 3.6mg; Vit. C, 2.4mg; Vit. B₁₂, 4.0mg; Mn, 1.6mg; Fe, 8.0mg; Zn, 7.2mg; Copper, 3.2mg; Selenium 1.6mg.

RESULTS AND DISCUSSION

Hydrocyanide and Proximate Composition of the Cassava Tubers and FCTM

Data on the HCN and proximate composition of the fresh and fermented cassava tuber meals are presented in Table 2. The HCN content of the fresh cassava tuber meal was 800 ppm as against zero value obtained from FCTM. This is in agreement with the report of Udedibie *et al.* (2004) that fermentation is a very effective means of detoxifying cassava tubers.

Earlier reports by Okeke *et al.* (1985) and

Odukwe (1994) showed that sun drying, cooking or addition of palm oil are not quite as effective as methods of processing cassava for use as animal feed.

There were not much differences in the proximate composition of the 2 samples on dry matter basis. The very high values of nitrogen-free extract of the samples is an indication that cassava tuber meal is essentially an energy feed.

Table 2: Cyanide and Proximate Composition of Fresh and Fermented Cassava Tuber Meals (DM Basis)

Parameters	Fresh Tuber Meal	Fermented Tuber Meal
Cyanide (ppm)	800.0	0.00
Crude protein	2.51	2.46
Crude fibre	2.31	2.06
Total ash	1.62	2.11
Ether extract	0.84	1.20
Nitrogen-free extract	92.17	92.72

Performance of the Laying Birds

The layers on all the experimental diets gained weight during the trial. However, the layers on diet 4 gained significantly ($p < 0.05$) more weight than those on diets 5 and 6, possibly because of the relatively low energy content of the two diets (2.55 Mcal/kg ME and 2.58 Mcal/kg ME).

In terms of egg production, the layers on diet 3 produced significantly ($P < 0.05$) more eggs than those on diet 5. It also numerically produced more eggs than those on the control and the rest of the maize-free diets. This therefore means that 35%: 15%: 20%

is the optimal combination of the 3 products for egg production. Cyanide cannot be blamed for the poor performance of the groups on diet 5 and 6 because fermentation eliminated the cyanide in the cassava. According to Udedibie *et al.* (2004), and Enyenihi *et al.* (2009), sun-dried cassava tuber meal at 50% maize replacement is not detrimental for egg production or broiler performance. Egg weights were not affected by the treatments ($P > 0.05$). The feed intake of the layers on the control diet compared favourably with that of the layers on diet 3 and same was the feed conversion ratio ($P > 0.05$). Diet 3 also recorded the lowest feed cost of

egg production with the value of N178.67 per kg eggs as against N210.25 per kg eggs from the control.

Egg Quality Indices

Data on egg quality indices of the layers are presented in Table 4. Egg shell thickness, yolk index and albumen index of the eggs

were not affected by the treatments ($P>0.05$). The group on diet 4 had significantly ($P<0.05$) higher value of Haugh unit relative to the groups on diets 2, 5 and 6. The values are, however, within the range considered adequate for good quality eggs (Oluyemi and Roberts, 2000).

Table 3: Performance of the Experimental Laying Hens

Parameters	Diet 1 (control)	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	SEM
Av. initial body wt. (kg)	1.32	1.38	1.27	1.32	1.37	1.35	0.02
Av. final body wt. (kg)	1.52	1.58	1.49	1.60	1.55	1.47	0.05
Av. body wt. gain (kg)	0.19ab	0.20ab	0.22ab	0.28a	0.18b	0.12b	0.008
Hen-day egg prod. (%)	64.40ab	65.08ab	69.50a	67.05ab	63.04b	64.79ab	1.85
Av. daily feed intake (g)	110.23b	137.14ab	120.26b	140.04a	140.13a	140.17a	6.51
Av. egg wt. (g)	63.27	59.66	58.66	58.44	59.67	59.64	1.85
Feed conversion ratio (kg feed/kg eggs)	3.24b	4.12a	3.46b	4.21a	4.42a	3.97a	0.12
Cost of feed (N/kg)	64.89	50.14	51.64	50.89	49.39	45.64	-
Cost of production (N/kg eggs)	210.25	206.58	178.67	214.25	218.30	181.19	-
Mortality	1	2	1	-	1	-	-

^{ab}Means within a row with different superscripts are significantly different ($P<0.05$)

Table 4. Effects of the Experimental Diets on Egg Quality Indices of the Laying Hens

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	SEM
Egg weight	62.12	62.71	57.47	59.51	60.85	59.66	1.61
Eggshell thickness (mm)	0.43	0.47	0.46	0.43	0.42	0.44	0.01
Yolk index	0.47	0.41	0.42	0.44	0.41	0.43	0.03
Albumen index	0.13	0.13	0.12	0.14	0.12	0.10	0.02
Haugh unit	92.15b	93.29ab	89.74bc	97.96a	88.23bc	85.36c	1.64

^{abc} Means within a row with different superscripts are significantly different ($P<0.05$)

CONCLUSION

The results of the trial have shown that fermented cassava tuber meal, palm kernel cake and dried brewers' grains can be used to produce low-cost maize-free diets for laying hens if appropriately combined and the most efficient combination from this study is 35%, 15% and 20%. It is therefore recommended that in the event of scarcity and/or high cost of maize, the three products can be used to completely replace maize in the diets of laying hens, using the combination.

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