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The use of sun-dried cassava tuber meal, Brewers' dried grains and palm oil to simulate maize in the diet of laying hens

A.B.I. Udedibie, O.J. Chukwurah, Glory, E. Enyenihi, Helen O. Obikaonu and I.C. Okoli*

Department of Animal Science and Technology, Federal University of Technology, P.M.B. 1526 Owerri, Nigeria

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Sun-dried cassava tuber meal, brewers' dried grains and palm oil were weighed out and mixed at the ratio of 6:3:1 to produce an energy product similar to yellow maize meal and referred to as CBP-mix. An experiment was conducted to determine the effects of completely replacing maize with CBP-mix in the diet of laying hens. The control diet (diet 1) contained yellow maize as the major source of energy, while in diet 2, CBP-mix was used to completely replace the maize as the major source of energy. Each diet was fed to a group of 40 laying hens for 12 weeks. Each group was sub-divided into 4 replicates of 10 birds each and each replicate housed in a 1.5 x 2 m compartment. The layers on the CBP-mix diet performed significantly ($p<0.05$) better than those on control diet in terms of egg production, feed conversion ratio and cost of egg production. Egg quality indices (albumen index, yolk index and Haugh unit) as well as egg shell thickness were not affected by the treatments ($p>0.05$). Egg yolks of both treatments had scores of 6 and 5, respectively on Roche egg yolk color chart. The weights of the internal organs (liver, heart, gizzard, kidney) were not affected by the treatments ($p>0.05$), but the birds on CBP-mix diet developed significantly ($p<0.05$) more abdominal fat. Hematological indices were not affected by the treatments ($p>0.05$).

Key words: Poultry feed, cassava tuber meal, brewers' dried grains, palm oil, maize

Introduction

Maize has been playing a key role as a source of energy in poultry diets in Nigeria. However, because it is a major human food and also used as industrial raw material in the country, its demand outstrips its supply, leading to over 2000% increase in price within the last 25 years. This has invariably contributed to the high cost of poultry feeds with concomitant increase in the prices of poultry products. There is the need therefore to search for alternatives to maize to reduce the demand pressure on it.

* Corresponding author: I.C. Okoli; e-mail: dr_charleso@yahoo.com

Cassava tuber meal appears to be a good source of carbohydrates but it has some drawbacks: it is dusty, contains very low crude protein and high content of cyanogenic glucoside, linamarin, which produces hydrogen cyanide that is highly toxic. These factors render its nutritive value much less than that of maize (Odukwe, 1994; Udedibie *et al.*, 2004; Udedibie *et al.*, 2008; Enyenihi *et al.*, 2009).

Maize sorghum brewers' dried grains, the by-product of the brewing industry, is relatively high in crude protein (about 28%) and crude fiber (about 12%) but low in digestible carbohydrates (Uchegbu and Udedibie, 1998). Palm oil is very rich in energy (about 8.2 Mcal/kg ME) and can serve as a stabilizing agent to reduce the dustiness of feeds. With the characteristics of sun-dried cassava tuber meal, brewers' dried grains and palm oil described above, it might be possible to develop a product that could simulate maize in laying diets based on their appropriate proportions. Recent trial at the University of Uyo-Nigeria (Udedibie *et al.*, 2009) has shown that such a mixture, which was called CBP-mix, could completely replace maize in broiler finisher diets.

This paper reports the effects of CBP-mix as replacement for maize in the diet of laying hens.

Materials and methods

The trial was carried out at the Poultry Unit of the Teaching and Research Farm of the Federal University of Technology, Owerri-Nigeria.

Sources and processing of test materials: The fresh cassava tubers (bitter variety) used for the study were bought from a local market close to the University. They were peeled, chopped into small pieces and sun-dried until they became crispy. The sun-dried chips were then milled and sieved to produce sun-dried cassava tuber meal. Wet brewers' grains was bought from the Consolidated Brewery, the brewers of 33© lager beer at Awo-Omama, Imo State-Nigeria, sun-dried and milled to break the lumps. Palm oil was bought from the local market mentioned above. The sun-dried cassava tuber meal was analyzed for HCN content using the picrate paper method of Bradbury *et al.* (1999).

Production of CBP-mix and the experimental diets: The sun-dried cassava tuber meal, brewers' dried grains and palm oil were weighed out at the ratio of 6:3:1 and thoroughly mixed to produce a product that somehow looked like yellow maize meal. In other words, to produce 100 kg of the product, the three items were mixed at the rate of 60 kg cassava tuber meal; 30 kg brewers' dried grains and 10 liters of palm oil. The product (CBP-mix) was subjected to proximate analysis according to AOAC (1995) and HCN analysis according to Bradbury *et al.* (1999).

Two diets were made such that diet 1 (control) contained yellow maize as the major source of energy, while in diet 2, CBP-mix was used to completely replace maize. Each of the 2 diets contained the same amounts of the other ingredients. Both diets were subjected to proximate and HCN analysis as stated above. Ingredient and chemical composition of the diets are shown in table 1.

Experimental birds and design: Eighty laying hens in their 8th month of laying life were divided into 2 groups of 40 birds each and each group randomly assigned to one of the experimental diets, using completely randomized design. Each group was further sub-divided into 4 replicates of 10 birds each and each replicate housed in 1.5 x 2m floor pen and fed the experimental diet for 12 weeks.

Table 1. Ingredient and chemical composition of the experimental diets

Ingredients (%)	Diet 1 Control	Diet 2 CBP-mix
Yellow maize	50.00	0.00
CBP-mix	0.00	50.00
Soybean meal	15.00	15.00
Fish meal	2.00	2.00
Blood meal	2.00	2.00
Palm kernel meal	5.00	5.00
Wheat offal	15.00	15.00
Bone meal	10.00	10.00
Vit./Trace mineral premix*	0.25	0.25
Salt	0.25	0.25
L- lysine	0.25	0.25
L - methionine	0.25	0.25
Chemical Composition (% dm)		
Crude Protein	18.32	18.46
Crude fiber	5.06	8.14
Ether extract	4.82	7.43
Ash	4.62	4.76
Nitrogen-free extract	67.18	61.34
ME (Mcal/kg) (calculated)	2.76	2.84

To provide the following per kg of feed: Vit. A, 10,000 iu; Vit. D_3, 1500 iu; Vit. E, 3 iu; Vit. K, 2 mg; Riboflavin, 3mg; Panthothenic acid, 6 mg; Niacin, 15 mg; Vit B_{12}, 8 mg; Choline, 350 mg; Folic acid, 4 mg; Mg, 56 mg; Iodine, 1.0 mg; Fe, 20 mg; Cu, mg; Zn, 0.5 mg.

Data collection and analysis: The birds were weighed at the beginning and end of the feeding trial to determine their body weight changes. Feed and water were provided *ad libitum*. Daily feed intake was determined by subtracting the weight of left-over feed from the weight of the feed offered the previous day. Egg collection was done twice daily. A create of eggs from each group was weighed each week to determine average egg weights. Feed conversion ratio

was determined as kg feed/kg eggs laid. Egg quality indices were determined accordingly: egg yolk index according to Funk (1948), albumen index according to Heiman and Carver (1936) and Haugh unit according to Haugh (1936) as modified by Brant *et al.* (1951). Egg yolk color was determined using the Roche yolk color fan developed by Vuilleumier (1969).

As the end of the feeding trial, 4 birds were randomly selected from each treatment group (one per replicate) and used for determination of hematological indices and the internal organ weights. Blood (2ml) was collected from the severed neck blood vessels of the birds into Bijou bottles containing EDTA as anti-coagulant (1 mg/ml) and analyzed within 3 hours of collection. Indices analyzed included hemoglobin (HB) levels, red blood cell (RBC) count, packed cell volume (PCV), white blood cell (WBC), mean cell volume (MCV), mean cell hemoglobin concentration (MCHC), heterophils, lymphocytes and eosinophils, using the methods of Monica (1984).

The slaughtered birds were de-feathered, eviscerated and their internal organs (liver, gizzard, kidney and heart) as well as abdominal fat weighed.

Data analyses: Data generated were subjected to one-way analyzed of variance according to Snedecor and Cochran (1978). Where analysis of variance indicated significant treatment effects, means were compared using Least Significant Difference (LSD) method according to Snedecor and Cochran (1978).

Results and discussions

Physico-chemical composition of CBP-mix and the experimental diets: The sun-dried cassava tuber meal used for the study contained 50 ppm HCN. This is in agreement with recent reports by Udedibie *et al.* (2008) and Enyenihi *et al.* (2009) that sun-drying of cassava tuber could not completely eliminate HCN from it. However, the CBP- mix diet contained 25 ppm HCN. This was understandably so because of the dilution of the HCN from cassava tuber meal with the other dietary ingredients. The CBP-mix looked somehow like yellow maize meal, thereby making the 2 experimental diets look somehow similar.

CBP-mix contained 10.24% CP, 5.31% CF, 12.12% EE, 4.36% ash and 67.97% NFE. The proximate composition of the 2 experimental diets is shown in Table 1. The CBP-mix diet was relatively higher than the control diet in all the components except in NFE.

Performance of the experimental birds: Data on the performance of the experimental laying hens are presented in Table 2.

Table 2. Performance of the Experimental Birds

Parameters	Control	CBP-mix	SEM
Av. initial body wt. (kg)	1.78	1.73	0.04
Av. final body wt. (kg)	1.87	1.92	0.07
Av. body wt. change (kg)	0.09[b]	0.19[a]	0.002
Av. feed intake (g/day)	115.73	112.08	2.14
Feed conversion ratio (kg feed/kg eggs)	3.76[b]	3.22[a]	0.03
Av. hen-day egg prod. (%)	62.76[b]	70.86[a]	1.46
Av. egg wt. (g)	58.02	58.03	0.02
Cost of feed (₦/kg)	74.90	72.10	
Cost of prod. (₦/kg eggs)	281.16	232.16	

[ab]Means with a row with different superscripts are significantly different ($p<0.05$)

Feed intake and body weight changes: The group on CBP-mix diet gained significantly ($p<0.05$) more body weight than the group on the control diet. This contradicts the reports by Udedibie *et al.* (2008) and Enyenihi *et al.* (2009) on body weight changes of laying hens fed cassava tuber meal-based diets.

The higher body weight gain of the birds on CBP-mix could be due to palm oil and brewers' grains content of the diet. Palm oil contains essential fatty acids and brewers' grains are believed to be rich in unidentified growth factors. Those factors are of great importance in poultry nutrition (Oluyemi and Roberts, 1979; Udedibie, 1984). It followed that 25 ppm HCN which the diet contained had no effect on the birds.

There was no significant difference ($p>0.05$) in feed intake of the groups even though the group on CBP-mix diet numerically consumed less feed (112.08 vs 115.73 g). This could be due to the relatively higher energy density of CBP-mix diet since birds eat to satisfy their energy needs (Oluyemi and Robert, 1979).

Egg production and weight: The hen-day egg production of the CBP-mix group was significantly ($p<0.05$) higher than that of the control group. Similar result was obtained when sun-dried cassava tuber meal was used to replace 75% dietary maize (Enyenihi *et al.*, 2009).

Egg weight was not affected by the treatments ($p>0.05$). Egg weights were also not affected when cassava *fufu* meal or sun-dried cassava tuber meal were used to replace maize in laying diets (Udedibie *et al.*, 2008; Enyenihi *et al.,* 2009).

Feed Conversion Ratio (FCR) and cost of production: The feed conversion ratio of the groups was affected by the treatments. CBP-mix group recorded significantly ($p<0.05$) superior feed conversion ratio than the control group. The costs of the diets (₦/kg) were ₦74.90 and ₦72.10, respectively. It therefore cost ₦281.16 and ₦232.26 (FCR x cost of feed, ₦/kg) to produce a kg of eggs

in the control and CBP-mix groups, respectively. This amounted to about 17% savings in cost of production by using CBP-mix in place of maize.

Egg quality indices and internal organ weights: There were no significant differences in the egg quality indices of the 2 groups (Table 3). The values recorded were within the range regarded as normal for poultry (Mitruka and Rawnsley, 1977; Orji *et al.*, 1987).

Similarly, the weights of the internal organs (liver, gizzard, kidney and heart) were not affected by the treatments ($p>0.05$). However, the group on CBP-mix developed significantly ($p<0.05$) more abdominal fat than the control (Table 4).

Table 3. Egg quality indices

Parameters	Control	CBP-mix	SEM
Haugh unit	52.42	52.65	1.03
Albumen index	0.20	0.19	0.014
Yolk index	0.65	0.67	0.002
Egg shell thickness (mm)	0.38	0.36	0.001
Yolk color	6.0	5.0	—

[ab]Means with a row with different superscripts are significantly different ($p<0.05$)

Similar results had earlier been reported by Udedibie *et al.* (2008) and Enyenihi *et al.* (2009), when cassava *fufu* meal and sun-dried cassava tuber meal were fed to laying hens. Data in table 4 showed that the weight of the abdominal fat recorded in this study was, however, much less than those reported by them. The color of the egg yolk of the control group scored higher on the Roche yolk color fan than that of CBP-mix group (6 vs 5). It showed that the carotene in palm oil can be extracted by the layers for purpose of egg yolk coloration.

Table 4. Internal organ wts (% of live-wt)

Parameters	Control	CBP-mix	SEM
Liver	1.73	1.78	0.02
Gizzard	1.92	2.12	0.08
Kidney	1.14	0.12	0.014
Heart	0.51	0.56	0.041
Abdominal fat	1.16[b]	1.41[a]	0.02

[ab]Means with a row with different superscripts are significantly different ($p<0.05$)

Hematological indices: Hematological constituents usually reflect the physiological responsiveness of the animal to its external and internal

environment and thus serve as a veritable tool for monitoring animal health. There were no significant ($p > 0.05$) differences between the 2 groups in the hematological parameters measured (Table 5). The results were therefore an indication that total replacement of dietary maize with CBP-mix had no deleterious effects on the internal physiology of the birds

Table 5. Hematological indices

Parameters	Control	CBP-mix	SEM
Hb (g/dl)	12.14	11.74	0.17
RBC (x 10^{12})	3.92	3.56	$0.1x10^{6}$
PVC (%)	31.21	29.35	1.22
MCV (fl)	81.32	82.61	4.31
MCHC (g/100ml)	32.43	33.08	1.26
WBC (mm^3)	3476.00	3282.00	122.3
Heterophils (%)	42.62	45.15	2.33
Lymphocytes (%)	44.72	46.24	1.92
Eosinophils (%)	22.30	26.44	1.06

[ab]Means with a row with different superscripts are significantly different ($p<0.05$)

Conclusion

The study has revealed that sun-dried cassava tuber meal, brewers' dried grains and palm oil can be mixed at the ratio of 6:3:1 to make a product (CBP-mix) which could be used to completely replace maize in the diets of laying hens. It is cheaper than maize and enhances egg production performance of laying hens. It is, however, recommended that in using the product, the feed should not be allowed to keep for a long time to avoid spoilage that may occur due to oxidative rancidity of palm oil.

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