PHYSIOCHEMICAL NATURE AND NUTRITIVE VALUE OF DRIED CASSAVA *FUFU* MEAL FOR LAYING HENS

A.B.I. UDEBIBIE*, G. E. ENYENIHI, M. J. AKPAN, O. L. OBASI and I. P. SOLOMON

Department Of Animal Science, University of Uyo, Uyo. Nigeria.
*Permanent Address: Federal University Of Technology, Owerri. Nigeria
E-mail: abiu-futo@yahoo.com; +2348037111043

ABSTRACT
Sun-drying of cassava *fufu* was investigated as a method of processing cassava to eliminate its cyanide content, dusty nature, increase its shelf life and to improve its feeding value as a source of energy in the diets of laying hens. Cassava tubers were prepared in the traditional way into *fufu* and dried in the sun by flattening it in bits on polyethylene sheets. The dried flakes when milled, resulted in small hard pellets devoid of cyanide and whose proximate composition, appearance, smell and texture in 8 months of storage in porous sacs remained unchanged. Feeding trial with laying hens in which dietary maize was replaced with the dried cassava *fufu* meal (DCFM) at 100% indicated no significant difference in body weights, feed intake, egg production, egg weight, feed conversion ratio, egg quality and the haematological indices of the hens (P>0.05). Dietary DCFM significantly (P<0.05) increased weight of gizzard while the weights of other internal organs (liver, heart and kidney) as well as abdominal fats remained unaffected by the treatments (P<0.05).

Key Words: Dried cassava *fufu* meal, nutritive value, laying hens.

INTRODUCTION
Maize has been playing key role as source of energy in poultry feeds in Nigeria. However, because it is a major human food and also used as raw material for various industries, its demand outstrips its supply, leading to more than 2000% increase in its price within the last 20 years (Udedibie, 2007). This has 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 other sources of energy that could be used in poultry feeds to reduce the pressure on maize.

Cassava which is the major source of calories for Nigerians could also serve as alternative to maize in livestock feeds. FAO (2005) estimated cassava production in Nigeria in 2004 at 38.2 million metric tons. By that figure, Nigeria has become the largest producer of cassava in the world. The figure is expected to possibly double within the next few years as a result of the current Federal Government emphasis on its production.

Attempts to use cassava as a source of energy in poultry diets as replacement for maize have, however, yielded conflicting results. This is so because cassava tuber contains potentially toxic levels of cyanogenic gluocside, linamarin. Linamarin is deglycosylated by the enzyme, linamarase (also in the tuber), yielding acetone cyanohydrins, which spontaneously converts into deadly hydrogen cyanide (HCN) once it is ingested (Sayre, 2007). Different methods have been employed in attempt to detoxify cassava tuber so as to render it utilizable as food for humans and feed for livestock. These include sun-drying (Odukwe, 1994), cooking (Okeke *et al*, 1985), use of additives (Obioha *et al*, 1984) and fermentation (Udedibie *et al*, 2004), with fermentation proving to be the most effective. Recent studies in Australia (Bradbury, 2004) have demonstrated that wetting sun-dried cassava tuber meal for 5 hours before use reduces the cyanide content of the meal to about one-third of its previous level. Feeding trials with the meal so produced showed that it could completely and safely replace maize in the diets of broilers (Udedibie *et al*, 2007) but depressed feed intake and egg production of laying hens at 100% replacement of maize (Enyenihi, 2008).

Another drawback in the use of cassava tuber as a feedstuff is the powdery nature of the meal and its very short shelf life. The powdery nature of the meal renders poultry feeds very dusty, making feed intake of the birds difficult (Anyaegbu, 2001; Tewe and Bokanga, 2001). The powdery meal easily gets infested with weevils that render it useless, unless it is sealed in polyethylene bags.

This paper reports the development of a non-dusty, cyanide-free and storable cassava tuber product and its feeding value as source of energy in the diet of laying hens.

MATERIAL AND METHODS

The study was carried out at the Teaching and Research Farm of University of Uyo, Uyo-Nigeria. Uyo is the Capital of Akwa Ibom State of Nigeria. It is one of the States that make up the Niger Delta region of Nigeria. It lies between latitude $4^0 4^1$ and $5^0 0^1$ and longitude $7^0 45^1$ and $8^0 5^1$ with an average annual rainfall of 200mm and temperature range of 23 to 30°C (Multinational Diaries, 2008).

Processing Of Cassava Tubers

Cassava tubers of bitter variety (Var. TMS 30572) which contained 800ppm HCN according to cassava cyanogens kit colour chart of Bradbury *et al.*, (1999) were processed into *fufu*, using the traditional method. This involved peeling and fermenting the peeled tubers in water for 4 days. The fermented tubers were then sieved into sacs, pressed to remove water to produce fermented cassava paste. This was then cooked and pounded into *fufu*. The *fufu* was taken bit by bit and flattened on polyethylene sheets, using rollers and left in the sun to dry into cakes. The cakes were then milled into dried cassava *fufu* meal (DCFM).

Chemical Analysis

Samples of the dried cassava *fufu* meal were kept in small jute sacs and left in the feed store and periodically observed for physical changes. They were analysed for proximate composition when produce and monthly thereafter, using standard methods (AOAC, 1995). They were also analysed for cyanide content according to Bradbury *et al.*, (1999)

Feeding Trial with laying Hens

Two layers experimental diets were formulated, one based on yellow maize as the major source of energy (control diet) while the other contained DCFM as the source of energy, completely replacing the maize in the control diet. Other ingredients were incorporated in such a way as to make the two diets fairly isonitrogenous. Ingredient composition of the diets is shown in Table 1.

Forty laying hens in their 5th month of laying life were divided into 2 groups of 20 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 5 birds each and each replicate housed in $1^1/_2$m x $1^1/_2$m floor pen and fed the experimental diets for 8 weeks.

Data Collection

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 leftover feed from the weight of the feed offered the previous day. Egg collection was done twice daily. A crate 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).

At the end of the feeding trial, 4 birds were randomly selected from each treatment group (one per replicate) and used for determination of haematological indices and the internal organ weights. Blood (2ml) was collected from the severed neck arteries of the birds into Bijou bottles containing EDTA as anti-coagulant (1mg/ml) and analysed within 3 hours of collection. Indices analysed for included Haemoglobin (Hb) levels, Red Blood Cell (RBC) count, Packed Cell Volume (PCV), White Blood Cell (WBC), Mean Cell Volume (MCV), Mean Cell Haemoglobin Concentration (MCHC), Neutrophils and Lymphocytes, using the methods of Monica (1984).

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

Data Analysis

Data generated were subjected to one-way analysis of variance according to Snedecor and Cochran (1978). Where analysis of variance indicated significant treatment effects, means were compared using least significant difference (LSD) according to Snedecor and Cochran (1978).

Table 1: Ingredient Composition of the Experimental Diets.

Ingredients (%)	Control Diet	DCFM Diet
Maize	50.00	0.00
DCFM	0.00	50.00
Soybean meal	15.00	16.00
Fish meal	2.00	3.50
Blood meal	2.00	3.00
Palm kernel meal	5.00	4.00
Wheat offal	15.00	5.00
Bone meal	5.00	5.00
Oyster shell	4.50	4.50
Common salt	0.25	0.25
TM/Vitamin. Premix	0.25	0.25
l-lysine	0.25	0.25
L –Methionine	0.25	0.25
Calculated composition (% of DM)		
Crude protein	17.66	17.68
Crude fibre	4.53	4.21
Ether extract	3.84	2.58
Ash	3.56	3.48
Calcium	1.86	1.86
Phosphorus	0.82	0.82
ME (Kcal/g)	2.72	2.70

To provide the following per kg of feed: Vit. A, 10,000iu, Vit. D3, 1500iu; Vit. E, 3iu; vit. K, 2mg; Riboflavin, 3mg; panthothenic acid, 6mg; Niacin, 15mg; Vit. B_{12}, 8mg; Choline, 350mg; Folic acid, 4mg; Mg, 56mg; Iodine, 1.0mg; Fe, 20mg; Cu, 10mg; Zn, 0.5mg.

RESULTS AND DISCUSSION

Nature of Dried Cassava *Fufu*

Within 2-3 days of good sunshine, the cassava *fufu* dried to crispy cream coloured, almost odourless cake, different from the original ash-coloured material with characteristic cassava *fufu* smell. When milled using 2mm sieve, the resultant meal consisted of tiny pellets. The cause of the transformation of cassava *fufu* odour is not clear but is believed to be due to formation of cyclodextrins from the cassava starch (Alais and Linden, 1999). Nitrogen-free extract of cassava tuber is 80% starch and 20% sugar. Cyclodextrins from starch act against oxidation and are used for elimination of unwanted taste and odour (Alais and Linden, 1999). As at the time of writing this report, samples of the meal had remained in sacs for 10 months without changes in colour, texture, smell and proximate composition (2.6% CP, 2.3%CF, 0.9% EE, 1.8% Ash and 92% NFE). The meal contained 0.0ppm HCN according to cassava cyanogens kit colour chart of Bradbury *et al* (1999), as against 800ppm HCN scored by the fresh cassava tuber from which the *fufu* was prepared.

The experimental diet based on the DCFM had similar appearance and texture as the control diet based on yellow maize.

Performance of the Experimental Birds

Data on the effects of DCFM on the experimental laying hens are presented in Table 2. The final body weights, feed intake, hen-day egg production, egg weights and feed conversion ratio of the 2 groups were not affected by the treatments ($p>0.05$). The results confirm the superiority of DCFM over sun-dried or wetted sun-dried cassava tuber meal as sources of energy in laying diets as earlier observed by Enyenihi (2008). No mortality occurred during the experimental period.

The egg quality indices (Haugh unit, yolk and albumen indices) as well as eggshell thickness were not affected by the treatments ($P>0.05$). Haematological indices of the birds (HB, RBC, WBC, PCV, MCV, MCHC, neutrophils and lymphocytes) were also not affected by the treatments ($P>0.05$). The values were similar to those earlier reported as normal for poultry (Orji *et al*, 1987) and confirm recent observations by Udedibie *et al*. (2007) and Enyenihi (2008) on broilers and laying hens fed cassava-based diets.

Haematological 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. The results of the haematological parameters are indications that total replacement of dietary maize with DCFM had no serious deleterious effect on the internal physiology of the birds.

Table 2: Effects of Dried Cassava *Fufu* Meal on the Experimental Laying Hens.

Parameters	Control Diets	DCFM DIET	SEM
Av. initial body wt. (kg)	1.54	1.53	0.10
Av. final body wt.	1.65	1.59	0.05
Av. body wt. change (kg)	0.11	0.06	0.002
Av. feed intake (g/d)	125.8	126.00	2.14
Av. hen-day egg prodtn. (%)	71.04	71.56	2.38
Av. egg wt. (g)	61.08	61.21	1.03
Fed conversion ratio (kg feed/kg eggs)	2.88	2.88	0.07
Mortalities (%)	0.00	0.00	0.00
Egg Quality Indices			
Haugh unit	35.44	32.30	2.26
Egg yolk index	0.42	0.44	0.009
Albumen index	0.10	0.11	0.002
Shell thickness (mm)	0.34	0.34	0.001
Internal Organs (% of live wt.)			
Liver	1.60	1.71	0.02
Gizzard	1.72^a	2.02^b	0.08
Kidney	0.12	0.09	0.017
Heart	0.42	0.46	0.035
Abdominal fat	1.14	1.31	0.04
Haematological Indices			
HB (g/dl)	10.10	9.00	0.13
WBC (mm^3)	3150.0	2975.0	142.0
RBC ($x 10^{12}$)	3.85	3.48	0.1×10^6
PCV (%)	29.12	28.33	1.08
MCV (fl)	80.10	82.36	4.22
MCHC (g/100ml)	33.41	33.35	1.04
Neutrophils (%)	54.6	55.16	2.12
Lymphocytes (%)	48.5	48.62	1.86

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

Cassava fufu meal in laying hens' diets

With exception of the gizzard, the weights of internal organs of the birds (liver, heart and kidney) as well as the abdominal fat were not significantly different ($p>0.05$). The birds on DCFM diet developed significantly ($p<0.05$) heavier gizzards. The reason for this is yet to be determined. Absence of significant differences in liver weights was an indication that the livers of the birds were not subjected to any serious toxicity.

CONCLUSION

Processing cassava tuber into dried cassava *fufu* meal appears to offer solution to the three major problems associated with cassava as poultry feed ingredient. It not only totally eliminates its HCN content and dusty nature, but also prolongs its shelf-life. Although the process may appear labourious and expensive, it is hoped that technology can be developed that will make it commercializable. The product appears to have the potential of being the form in which cassava can be imported or exported as livestock feed.

The fourth limitation of cassava tuber which is its low crude protein content demands that cassava-based diets need to be supplemented with high-protein feeds in view of the disparity in crude protein content between maize and cassava.

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