

Effects of 5-hour wetting of sun-dried cassava tuber meal on the HCN content and dietary value of the meal for young broiler chicks

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Abstract

The efficacy of wetting sun-dried cassava tuber meal as a method of reducing its hydrocyanide (HCN) content and improving its nutritive value for broilers was investigated. Cassava tubers were peeled, chopped into pieces, sun-dried and then milled. Part of the sun-dried cassava tuber meal was soaked in water at the rate of 5 parts of water to 4 parts of the meal, thinly spread on the floor for 5 hours and then taken out and spread by the side of the tarred road and sun-dried again. The raw cassava tuber meal (RCTM), sun-dried cassava tuber meal (SCTM) and wetted sun-dried cassava tuber meal (WSCTM) were analysed for cyanide content. Five diets were made such that diet 1 (control) contained no cassava tuber meal; in diets 2 and 3, 75% of the maize in diet 1 was replaced with SCTM and WSCTM, respectively, while in diets 4 and 5, 100% of the maize was replaced with SCTM and WSCTM, respectively. Each diet was fed to a group of 30 one-week old broiler chicks for 4 weeks. Blood was collected from the birds at the end of the feeding trial and haematological constituents determined. RCTM contained 800ppm HCN, SCTM contained 50ppm and WSCTM contained 10ppm. At 100% replacement of dietary maize with SCTM, growth performance of the birds was significantly ($P < 0.05$) depressed. HB, PCV, RBC and WBC were also depressed at that level. Wetting sun-dried cassava tuber meal appeared to be a simple and effective way of processing cassava for use as energy feed for broiler production.

Key words: wetted, sun-dried cassava tuber meal, HCN, broilers.

Introduction

Maize has been playing a key role as a source of energy in poultry diets. However, in view of the fact that it is also used as a major human food and various industrial raw material, its demand outstrips its supply. This invariably has contributed to the high cost of poultry feeds in the country with concomitant increase in the cost of poultry products. There is the need, therefore, for exploitation of other energy sources as alternatives to maize if poultry enterprise in the country is to be sustained.

One alternative energy source is cassava (*Manihot esculenta*). Nigeria is the largest producer of cassava in the world. It is estimated that in 2004 cassava production in the country was about 38.179 million metric tons (FAO, 2005). Cassava is capable of providing very high yields of energy per hectare, about 13 times more than maize or guinea corn (Oyenuga, 1961; Omole, 1977; Oke, 1978). With the current Federal Government's promotional emphasis on cassava, it is expected that its production in the country may double in the

next few years. It therefore has a very high potential as an alternative to maize as a source of energy in poultry diets even though it is very low in protein and other essential nutrients when compared with maize (Asaolu, 1988; Odukwe, 1994; Udedibie *et al*, 2004).

One serious draw-back in the use of cassava as feedstuff for non-ruminants is its content of cyanogenic glucosides, linamarin and lotaustralin, which on hydrolysis produce hydrogen cyanide (HCN) which is highly toxic. Although various methods have been devised for its detoxification, including, sun-drying (Odukwe, 1994), cooking (Okeke *et al*, 1985), use of additives (Obioha *et al*, 1984, personal communication) and fermentation (Udedibie *et al*, 2004), live animal trials conducted using processed cassava tuber meal have given contradictory results. Recent study at our station (Udedibie *et al*, 2004) has shown that fermentation is better than sun-drying as a method of processing cassava for inclusion in poultry diets.

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 and makes the meal very safe for human consumption. The study herein reported was designed to test the efficacy of the wetting method as a means of processing cassava tubers for inclusion in broiler diets as a source of energy.

Materials and Methods

Source And Processing of Cassava Tubers

The tubers of bitter cassava (variety TMS 30572) used for the trial were bought from Owerri market in Imo State of Nigeria. They were peeled, cut

into slices and spread in the sun to dry to crispy form and then milled to produce sun-dried cassava tuber meal (SCTM). The meal was divided into 2 batches. One batch was then soaked in water at the rate of 5 parts of water to 4 parts of the meal and thinly spread on the floor at room temperature and left for 5 hours as recommended by Bradbury (2004). At the end of the 5 hours, it was brought out and thinly spread by the side of tarred road, sun-dried, milled and sieved (to remove strings) to produce wetted sun-dried cassava tuber meal (WSCTM).

Samples of the fresh raw cassava tuber meal, sun-dried cassava tuber meal and the wetted sun-dried cassava tuber meal were analyzed for HCN, using the picrate paper kits method of Bradbury *et al* (1999).

Experimental Diets

Five broiler starter experimental diets were formulated such that the control diet (diet 1) contained 50% maize and no cassava tuber meal. In diets 2 and 3, 75% of the maize in the control diet was replaced with SCTM and WSCTB, respectively. In diets 4 and 5, 100% of the maize was replaced with SCTM and WSCTM, respectively. The diets were balanced to meet the protein and energy requirements of young broiler chicks. Ingredient composition of the diets is shown in table 1.

Experimental Birds and Design

One hundred and fifty one-week old young broiler chicks of Anak strain were divided into 5 groups of 30 birds each and each group randomly assigned to one of the experimental diets in a completely randomized design. Each group was further sub-divided into 3 replicates of 10 birds each and each replicate kept in a compartment measuring 2m x 2m. Each compartment was covered with black polythene sheets for conservation of heat.

Table 1: Ingredient composition of the experimental diets.

Ingredients (%)	Control	75% SCTM*	75% WSCTM**	100 % CTM	100% WSCTM
Maize	50.00	12.50	12.50	0.00	0.00
SCTM	0.00	37.50	0.00	50.00	0.00
WSCTM	0.00	0.00	37.50	0.00	50.00
Soybean meal	30.00	30.00	30.00	30.00	30.00
Fish meal	2.00	3.50	3.50	4.50	4.50
Blood meal	1.50	1.50	1.50	1.50	1.50
Palm kernel cake	6.00	4.50	4.50	3.50	3.50
Wheat offal	6.00	6.00	6.00	6.00	6.00
Bone meal	3.50	3.50	3.50	3.50	3.50
Common salt	0.25	0.25	0.25	0.25	0.25
Vit./TM premix**	0.25	0.25	0.25	0.25	0.25
L – Lysine	0.25	0.25	0.25	0.25	0.25
L – Methionine	0.25	0.25	0.25	0.25	0.25
Calculated Chemical Composition					
Crude protein, %	23.81	23.11	23.11	23.23	23.23
Crude fibre, %	4.22	4.49	4.49	4.58	4.58
Ether extract, %	4.72	4.37	4.37	4.18	4.18
Calcium, %	1.51	1.73	1.73	1.75	1.75
Phosphorus, %	0.84	0.89	0.89	0.88	0.88

* SCTM = Sun-dried cassava tuber meal

** WSCTM = Wetted sun-dried cassava tuber meal

*** To provide the following per kg of feed: Vit. A, 10,000iu; Vit. D₃, 2000iu; Vit. B₁, 0.75 mg; Nicotinic acid, 2.5mg; Calcium panthothenate, 50mg; Vit. B₁₂, 2.5mg; Vit. K₃, 2.50mg; Folic acid, 1.00mg; Choline chloride, 25mg; copper, 8.00mg; Manganese, 64mg; Fe, 32mg; Zn, 40mg; I, 0.8mg; Se, 0.16mg.

Heat was supplied with both electricity and kerosene lantern. Feed and water were provided *ad libitum*. Feed offered and the left-over on the following day were weighed to determine the feed intake of the birds. The birds were weighed at the beginning of the trial and weekly thereafter. All the necessary vaccinations (intraocular Lasota and Gumboro vaccines) were administered at the appropriate time. The trial lasted 4 weeks, from one-week old to 5 weeks old.

Blood Collection and Analysis

At the end of the feeding trial, 5ml of blood was collected from each of 2 birds of a replicate and put into Ethylene Di-amine Tetra Acetic Acid (EDTA) treated Bijou bottles (1mg/ml) for haematological assay. Blood samples were analyzed within 3 hours of their collection for total erythrocyte and leucocyte counts, haematocrit (PCV), haemoglobin concentration (HBC), and differential leucocyte count according to the meth-

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ods described by Hemening (1992). The various red blood indices, corpuscular haemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC), were computed from RBC, HBC and PCV values according to Hemening (1992).

Data Analysis

Data collected were subjected to analysis of variance (ANOVA) as outlined by Snedecor and Cochran (1978). Where significant treatment effects were detected, means were separated using Duncan's New Multiple Range Test as outlined by Snedecor and Cochran (1978).

Results and Discussion

Hydrogen Cyanide Content

Fresh raw cassava tuber meal contained 800ppm HCN; sun-dried cassava tuber meal contained 50ppm HCN while 5-hour wetted sun-dried cassava tuber meal contained 10ppm HCN. This meant about 94% reduction in HCN by sun-drying and about 99% reduction when wetting process was applied. This result tends to confirm the observation of Bradbury (2004) that wetting

sun-dried cassava tuber meal as described above is a simple method that reduces cyanide content of the meal to about one third of the previous level. The reduction observed in this study was to one fifth of the previous level.

Performance of the Experimental Birds

Data on the performance of the experimental birds are presented in Table 2. At the replacement level of 100% of the dietary maize with sun-dried cassava tuber meal (100% SCTM), daily weight gain of the birds significantly ($P<0.05$) declined relative to the control group. Wetted sun-dried cassava tuber meal produced no adverse effect when 100% dietary maize was replaced with it. It therefore seems to follow that cyanide content of 50ppm in the cassava tuber meal can still constitute a nutritional problem for young growing broilers if its dietary inclusion is up to fifty percent. Both sun-dried and wetted sun-dried cassava tuber meal did not affect feed intake and feed conversion ratio of the birds. One mortality each was recorded in the control, 75% WSCTM and 100% SCTM groups. Post-mortem examination of their carcasses did not reveal any clear cause of their

Table 2: Performance of the experimental birds

Parameters	Experimental Diets					SEM
	Control	75% SCTM	75% WSCTM	100% SCTM	100% WSCTM	
Av. Initial Body Wt. (g)	95.00	97.00	96.50	98.00	95.60	1.17
Av. Final Body Wt. (g)	994.40	970.50	1004.80	967.50	997.10	13.16
Av. Body Wt. Gain (g)	899.40 ^a	873.5 ^{ab}	908.30 ^a	864.50 ^b	901.60 ^a	9.64
Av. Daily Wt. Gain (g)	32.12 ^a	31.20 ^{ab}	32.44 ^a	30.88 ^b	32.20 ^a	0.74
Av. Daily Feed Intake(g)	54.77 ^b	59.13 ^{ab}	62.62 ^a	58.26 ^{ab}	60.60 ^a	1.55
Feed/Gain Ratio	1.71	1.92	1.93	1.89	1.85	0.06
Mortality (%)	3.33	0.00	3.33	3.33	0.00	-

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

Table 3: Haematological indices of the experimental birds

Blood Indices	Experimental Diets					SEM
	Control	75% SCTM	75% WSCTM	100% SCTM	100% WSCTM	
Haemoglobin (HB) g/100ml	10.80 ^a	10.35 ^a	9.90 ^{ab}	9.40 ^b	9.95 ^{ab}	0.35
PCV (%)	35.45 ^a	34.15 ^{ab}	32.70 ^{ab}	31.40 ^b	32.85 ^{ab}	1.08
RBC (x 10 ⁶ /ul)	4.23 ^a	4.12 ^a	3.98 ^{ab}	3.70 ^b	3.95 ^{ab}	0.18
WBC (10 ³ /ul)	30.80 ^a	29.40 ^{ab}	28.15 ^{ab}	27.55 ^b	29.20 ^{ab}	0.57
MCV (%)	84.10	83.07	83.63	84.88	83.51	1.19
MCH (%)	25.61	25.17	25.01	25.40	25.28	0.32
MCHC (%)	30.46	30.30	30.28	29.93	30.27	0.18
Neutrophils (%)	55.50	56.00	57.50	59.50	58.50	1.81
Eosinophils (%)	2.50	2.50	2.50	1.00	1.00	0.02
Basophils (%)	0.00	0.00	0.00	0.00	0.00	0.00
Lymphocytes (%)	39.00	39.50	39.00	37.00	37.50	1.67

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

^{ac} Means within a row with different superscripts are significantly different (P<0.01)

death. Cassava tuber meal was therefore not suspected as the cause since the control diet also recorded mortality.

Haematological Indices

Data on the haematological indices of the experimental birds are presented in Table 3. 100% SCTM had a significant effect (P<0.05) on haemoglobin (Hb), PCV (%), RBC, and WBC. At 100% replacement level of dietary maize with sun-dried cassava tuber meal, these haematological constituents were significantly (P<0.05) reduced. Haemoglobin count (HBC), MCV, MCH, MCHC, neutrophils, eosinophils, basophils and lymphocytes were not affected by the treatments (P>0.05). The values for monocytes followed no trend.

Discussion

One of the methods of processing cassava tubers for human consumption is sun-drying. Unfortunately, the traditional sun-drying method

leaves a large amount of linamarin remaining in the cassava flour, amounting to 25 – 50% retention of cyanide (Bradbury, 2004). The WHO safe standard for cyanide is 10ppm. However, the WHO safe standard of 10 ppm can only be achieved by sun-drying roots of sweet cassava. This trial has shown that sun-drying cassava tubers of the bitter variety can only reduce the cyanide content to 50ppm which appears much higher than the WHO safe standard. Wetting the sun-dried cassava tuber meal for 5 hours reduced the cyanide level to 10ppm, confirming the wetting method developed by Bradbury (2004) as a simple and effective method for reducing cyanide in sun-dried cassava flour. This, however, works only when there is sufficient linamarase present in the flour, and pre-supposes that drying should not be done at high temperatures that may destroy the residual linamarase in the flour (Bradbury, 2004).

The performance of the experimental birds showed that sun-dried cassava tuber meal containing 50ppm cyanide is detrimental to young broiler chicks at 50% dietary level. At that dietary level, the cyanide content of the diet was 25ppm. On the other hand, wetted sun-dried cassava tuber meal containing 10ppm cyanide would raise the cyanide content of the diet to only 5ppm at inclusion level of 50 percent.

Haematological constituents usually reflect the physiological responsiveness of the animal to its external or internal environments and thus serve as a veritable tool for monitoring animal health. The present results of haematological parameters are indications that total replacement of dietary maize with wetted sun-dried cassava tuber meal had no serious deleterous effect on the internal physiology of the birds. The results also tend to reaffirm earlier observations at our station (Udedibie *et al.*, 2004) that sun-dried cassava tuber meal could not replace 100% of the dietary maize in broiler diets without deleterous effects.

Conclusion

It is concluded that dietary maize could be completely replaced with wetted sun-dried cassava tuber meal in broiler diets provided that the diet is balanced for crude protein in view of the disparity in crude protein content between maize and cassava tuber meal.

References

- Asaolu, V.O. 1988. Utilization of cassava peels and *Gliricida sepium* in the diet of West African Dwarf sheep. M. Phil. Thesis, Obafemi Awolowo University, Ile-Ife, Nigeria.
- Bradbury, J. H. 2004. Wetting method to reduce cyanide content of cassava flour. *Cassava Cyanide and Diseases Network News*, 4: 3 – 4.
- Bradbury, M.E., Egan, S. V. and Bradbury, J. H. 1999. Picrate paper kits for determination of total cyanogens in cassava roots and all forms of cyanogens in cassava products. *J. Sci. Fd. Agric.*, 79: 595–601.
- F.A.O. 2005. Food and Agricultural Organization of the United Nations Statistics (FAOSTAT Database results). Production Year Book, FAO, Rome.
- Hemening, D.A. 1992. *Clinical Hematology of Homeostasis* (2nd edn.). E. A. Davis Co., Philadelphia.
- Odukwe, C. A. 1994. The feeding value of composite cassava root meal for broiler chicks. Ph.D. Thesis, University of Nigeria, Nsukka, Nigeria.
- Oke, O. L. 1978. Problems in the use of cassava in animal feeding. *Anim. Fd. Sci. Tech.*, 3: 345 – 380.
- Okeke, G.C., Obioha, F.C. and Udogu, A.E. 1985. Comparison of detoxification of cassava-borne cyanide. *Nutr. Report Intl.*, 32: 139 – 147.
- Omole, T. A. 1977. Cassava in the nutrition of layers. Proc., Workshop on cassava as animal feed, held at University of Gualph, Ontario, Canada, 18th – 20th April, 1977, by B. Nestle and M. Graham (eds.), pp 29 – 36.
- Oyenuga, V. A. 1961. Nutritive value of cereals and cassava diets for growing fattening pigs in Nigeria. *Brit. J. Nutri.*, 115 : 327 – 338.
- Snedecor, G.W. and Cochran, W. E. 1978. *Statistical Methods*. Iowa State University Press Ames – Iowa, 6th edn.

Udedibe, A. B. I., Auyaegbu, B. C., Onyechekwa, G. C. and Egbuokporo, O. C. 2004. Effect of feeding different levels of fermented and unfermented

cassava tuber meals on performance of broilers. *Nig. J. Anim. Prod.*, 31: 211 – 219.

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