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Chemical composition and nutrient digestibility of umucass 36 cassava root meal by indigenous grower turkeys

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Abstract
This trial was carried out to evaluate the proximate composition and nutrient digestibility of Umucass 36 cassava root meal, generally known as 'gari' in indigenous grower turkey diets under a warm humid tropical condition. A hundred and thirty-five (135) turkey poults were randomly allocated to five (5) treatment diets, with each dietary group having 27 poults that were replicated thrice (9 birds/replicate). The birds were fed and watered ad-libitum for a period of 16 weeks. Two birds per replicate were moved into the metabolic cage by the 14/15th week, thereafter both the feed and the feacal collected were appropriately evaluated. The results showed that Umucass 36 cassava root meal is rich in dietary nutrients but when added to the diets of turkey, it depresses nutrient utilization which in-turn negatively affected the turkey's growth. The results of the nutrient digestibility showed that all the parameters considered were significantly (P<0.05) influenced, only with the exception of the dry matter. The final weights was depressed from 2316.67 (control/T1) to 1850.00 (T5). The implication of this result is that 'gari' should not be substituted for maize beyond 50%. So, 50% substitution level is therefore recommended.

Keywords: Indigenous grower turkey, chemical composition, nutrient digestibility and umucass 36 cassava

Introduction

Maize, a major source of dietary energy in both domestic and commercial poultry nutrition is being daily competed for by humans, livestock producers and several industries. The increasing demand for maize without corresponding increase in its production has led to price instability, inavailability or scarcity and the need to search for comparable alternative if poultry production in Nigeria and some other African countries would be sustained. Cassava (*Manihot esculenta crantz*), which is an energy-dense reserved tuber crop has shown great promise as a comparable maize substitute in poultry nutrition. Cassava remains the most vital food in terms of carbohydrates (Ojo and Akande, 2013) [16] and can be processed into various forms such as "gari", "fufu" and "tapioca" (Okechukwu and Okoye, 2010) [17]. Umucass 36 is a yellow fleshed root cassava variety being propagated in Nigeria and the entire African continent in order to mitigate dietary Vitamin A deficiency. Nigeria, being the largest world producer has been targeting the domestic and international food market (IITA, 2011) [9] with the intention of increasing its production throughout Africa. Cassava root meal has been fed variously without any deleterious effect on bird's performance (Ojewola, 2017) [15], thus ascertaining the suitability of cassava tuber meal as a partial and or complete substitute for maize in poultry diets. Efforts, therefore need be intensified to improve its processing so as to efficiently and profitably exploit its nutritive benefits. Gari, is a widely known and accepted, grated, fermented and toasted food product derived from cassava root meal with potential for meeting human, industrial and livestock needs. It is also pertinent to enlarge the scope of poultry business by looking beyond the production of broiler chickens and laying hens to meet the ever increasing animal protein demands of the Nigerian populace and Africa as a whole. This also becomes necessary, especially now that indigenous turkey production enterprise is gradually receiving reasonable investment attention in most of the African nations.

It is on this premise that efforts were made in this experiment to evaluate the nutritive and anti-nutritive contents of Umucass 36 Cassava variety and its substitutional value for maize in indigenous growing turkey.

Materials and Methods

1. Processing of the Test Material
Umucass 36 cassava root tuber was peeled, washed, grated, bagged and hydraulically pressed between wooden platforms for 3 days to expel excess liquid from the pulp. The de-watered and fermented lumps of the pulp were crumbled with hands while fibrous materials were removed. The remaining mass of cassava was sieved and thereafter toasted in an iron pan over gentle flames of fire for about 10 to 15 minutes. Thereafter, the gari was packed into bags after cooling and thereafter stored in a safe place.

2. Laboratory Evaluation of the Test Material
Samples of the toasted cassava meal were analyzed for their proximate (AOAC, 1984) [2], mineral (AOAC, 1980) [1] and amino acids (AOAC 2006, method 982.30) [3] contents, while the gross energy was determined by the use of the Gallenkamp Ballistic Bomb Calorimeter. The metabolizable energy of the test material was evaluated using the equation described by Jansen (1989) [10].

ME (Kcal/kg) = 38.55 x Dry Matter-394.59 x Tannic Acid.

The Hydrogen cyanide (HCN), tannic and phytic acids were respectively determined using the non-laborious spectrophotometric method of Bradbury *et al*. (1999) [4], Maya (1982) [13] and Markkah *et al*. (1993) [12].

3. Nutritional Study
Five diets were respectively formulated for the starter and grower phases. The well processed Umucass 36 cassava meal (garri) was included in the diets as substitute for maize at 0, 25, 50, 75 and 100% respectively at both the starter and the grower phases. Starter phase lasted 8 weeks (0-8weeks), while the finisher phase was between the 8th and 16th week. A hundred and thirty five turkey poults raised on deep litter were randomly allocated to the five dietary treatments in a Completely Randomized Design (CRD), with each dietary group having 27 poults replicated thrice, the birds were fed and watered *ad libitum* for a period of 16 weeks. The percent nutrient digestibility of each of the diets were thereafter evaluated.

At the end of the 14th week, 2 birds were randomly picked from each of the dietary replicates and were transferred into the well prepared metabolic cages without disrupting the experimental design. They were kept in the cages for the first 7 days (14-15weeks) to enable them acclimatize to the new environment while being fed same diet throughout. Between the 15th and the 16th week, records of feed intake and feacal output were taken. The feacal output were collected daily, dried in the oven for 24 hours 105^{0}C and were stored until the experiment was terminated. Thereafter, both the dietary and feacal samples were evaluated for their proximate composition using the procedure described by AOAC (1984) [2].

4. Data Analysis
Data obtained from the nutrient digestibility of growing turkey poults fed graded levels of gari meal were subjected to analyses of variance in a Complete Randomized Design according to Steel and Torrie (1980) [19] using SPSS version 20.0 and the differences between the treatment means were compared using the Duncan Multiple Range test (1955) [5].

Results and Discussion
The results of the laboratory evaluation of the proximate composition, gross energy, mineral, anti-nutrients of the test material and percent nutrient digested when the test material was fed to growing indigenous turkey poults are herein presented in tables 1, 2, 3 and 4 respectively. The dietary tables for the starter and grower phases are presented in tables 5 and 6, while the nutrient utilization table is presented in table 7.

Table 1: Proximate composition and gross energy of processed Umucass 36 cassava root meal

Test material	CP (%)	EE (%)	CF (%)	Ash (%)	Moisture (%)	CHO (%)	GE (Kcal/kg)
"Garri"	2.23	3.54	1.40	1.88	10.77	80.20	3520

Table 2: Determined mineral composition of Umucass 36 cassava root meal

Parameter	Gari
Na (%)	0.06
K (%)	0.11
Mg (%)	0.08
P (%)	0.15
Ca (%)	0.05
Fe (mg/kg)	45.65
Zn (mg/kg)	11.55

Table 3: Determined amino acids profile of Umucass 36 cassava root meal

Parameter (%)	Gari
Alanine	0.86
Arginine	2.65
Aspartic acid	1.41
Cysteine	1.07
Glutamic acid	3.51
Glycine	2.41
Histidine	0.82
Isoleucine	1.06
Leucine	2.17
Lysine	0.70
Methionine	0.13
Phenylalanine	2.51
Proline	1.70
Threonine	1.10
Tryptophan	0.52
Tyrosine	2.49
Ornithine	0.09
Cysteine	0.60
Serine	0.54
Valine	3.01

Table 4: Determined anti-nutrient composition of Umucass 36 Cassava root meal

Parameter (%)	Gari
Saponin	0.12
Tannin	0.0020
Phytate	0.0048
Oxalate	0.0025
HCN (mg/kg)	2.37

Table 5: Percent composition of Indigenous Turkey starter diets showing quantitative replacement of maize with Umucass 36 Cassava root meal

Ingredients	Diet 1 (0%)	Diet 2 (25%)	Diet 3 (50%)	Diet 4 (75%)	Diet 5 (100%
Maize	38	28.5	19	9.5	0.00
Garri	-	9.5	19	28.5	38
P.K.C	8.5	8.5	8.5	8.5	8.5
Soyabean	44	44	44	44	44
Fish meal	5.80	5.80	5.80	5.80	5.80
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
*Vitamin premix	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated Nutrient					
Crude protein %	28.61	28.04	27.47	26.90	26.33
ME (Kcal/kg)	2843.68	2878.45	2913.22	2947.99	2982.76
Calcium	1.29	1.29	1.29	1.29	1.29
Phosphorous	1.00	0.98	0.96	0.94	0.90
Energy: Protein ratio	1:99	1:103	1:106	1:111	1:113
Determined (%)					
Dry matter	82.35	84.98	84.05	85.27	86.68
Crude protein	21.45	23.79	21.48	17.83	16.62
Ether extract	5.26	4.41	4.48	4.25	3.62
Crude fibre	7.88	8.50	8.21	8.16	9.79
Ash	11.26	11.98	11.96	10.62	9.79
Moisture	17.65	15.02	15.95	14.73	13.32
NFE	39.51	36.30	35.37	44.41	45.19
Energy (kcal/kg)	2217.29	2226.49	2206.49	2273.84	2278.56
Calcium	0.98	0.49	0.81	0.57	0.4

*Each 2.5 kg vitamin-mineral premix provided the following: A 8,000,000 iu, D_3 2,000,000 iu, E 5000 mg, K_3 2000 mg, Folic acid 500 mg, Niacin 15,000mg, Calpan 5,000 mg, B_2 8000 mg, B_{12} 10,000 mg, B_1 1,500 mg, B_6 1,500 mg, Biotin 20 mg.

Table 6: Percent composition of indigenous turkey grower diets showing quantitative replacement of maize with Umucass 36 Cassava root meal

Ingredients	Diet 1 (0%)	Diet 2 (25%)	Diet 3 (50%)	Diet 4 (75%)	Diet 5 (100%
Maize	51	38.25	25.5	12.75	0.00
Garri	0.00	12.75	25.5	38.25	51
P.K.C	12.30	12.30	12.30	12.30	12.30
Soyabean	28.00	28.00	28.00	28.00	28.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
*Vitamin premix	0.22	0.22	0.22	0.22	0.22
Total	**100**	**100**	**100**	**100**	**100**
Calculated Nutrient					
Crude protein %	22.91	22.51	21.38	20.62	19.85
ME (Kcal/kg)	2917.87	2964.53	3011.19	3057.56	3104.53
Calcium	1.20	1.20	1.20	1.20	1.20
Phosphorous	0.92	0.89	0.87	0.84	0.82
Energy: Protein ratio	1:127	1:134	1:141	1:148	1:156
Determined (%)					
Dry matter	88.44	87.74	87.76	87.61	86.73
Crude protein	21.97	22.43	20.70	19.99	18.61
Ether extract	1.40	1.32	0.81	0.81	0.53
Crude fibre	7.88	6.10	6.78	7.98	4.93
Ash	5.80	5.71	7.87	7.27	8.39
Moisture	11.56	12.26	12.24	12.39	13.27
NFE	51.39	52.18	51.60	51.56	54.77
Energy (kcal/kg)	2421.54	2455.44	2344.28	2319.92	2339.49
Calcium	4.32	2.04	1.74	1.38	1.68

*Each 2.5 kg vitamin-mineral premix provided the following: A 8,000,000 iu, D_3 2,000,000 iu, E 5000 mg, K_3 2000 mg, Folic acid 500 mg, Niacin 15,000mg, Calpan 5,000mg, B_2 8000mg, B_{12} 10,000 mg, B_1 1,500 mg, B_6 1,500 mg, Biotin 20 mg.

Table 7: Nutrient digestibility of indigenous turkey poults fed graded levels of Cassava root meal.

Parameter 0%	T1	T2	T3	T4	T5	S.E.M
	Control 0%	25%	50%	75%	100%	
Feacal moisture	70.62^{b}	74.30^{ab}	70.49^{b}	74.25^{ab}	81.10^{a}	1.49
Dry matter	66.75	60.78	59.68	55.93	52.62	2.13^{NS}
Crude protein	57.73^{a}	47.77^{ab}	47.82^{ab}	47.03^{ab}	28.74^{c}	3.40
Crude fibre	58.76^{a}	22.23^{b}	13.50^{bc}	13.50^{bc}	3.25^{d}	6.23
Ether extract	84.25^{a}	76.82^{ab}	44.21^{c}	44.21^{c}	38.94^{d}	5.67
Ash	82.24^{a}	54.78^{b}	32.05^{c}	32.05^{c}	17.28^{d}	7.58
NFE	78.16^{a}	68.01^{ab}	64.21^{b}	64.21^{b}	62.28^{b}	1.95
Met. Energy(Kcal/kg)	3390.00^{b}	2662.00^{c}	2745.00^{bc}	2745.00^{bc}	2741.00^{bc}	171.0

a-d(means treatment in a row with different superscripts are significantly different; $P<0.05$).

The determined percent protein value of gari is 2.23. This is numerically higher than 0.7% reported by Ngiki *et al.* (2014) [14] in root tubers, but lower than 10% crude protein content reported for maize by Gil and Butrago (2002). This may be the reason why cassava-based poultry diets need be supplemented with protein sources that can provide adequate supply of some of the essential amino acids. According to Gomes *et al.* (2005). The high fat content of 3.54% obtained could be attributed to the processing method, while 1.4% crude fibre and 1.77% moisture fall within the recommended level prescribed by Gil and Buitrago (2002) [6] and Igbeka (1987) [8]. The ash contents value (1.88%) was higher than 1.7% reported. The gross energy value (3.52kcal/kg obtained was lower than 3.84kcal/kg obtained by Oyenuga (1968) [18]. The results of the mineral composition and amino acids profile of the Umucass 36 Cassava root meal showed that the test material has a conglomerate of nutrients to contribute when added to poultry diets, either partially or completely. The various differences obtained could be attributed to one or combination of the following parameters, which includes species of cassava, soil type and available nutrients, age at harvesting, processing method and other factors such as intensity of rainfall, ambient temperature and storage type and duration.

Animal functions at their best when their requirements for dietary essentials (energy, proteins, minerals and vitamins) are met. These essentials must also be biologically available and efficiently utilized within the confine of suitable environment. Furthermore, it is also important to recognize the fact that emphasis should not be placed just on meeting the minimum requirement but on having continuous relationship between intake and the animal's performance. The result presented on table 7 showed significant ($P<0.05$) difference on all the parameters considered, only with the exception of the dry matter content. Percent crude protein, crude fibre, ether extract, ash and nitrogen free extract were depressed ($P<0.05$) as the dietary inclusion of gari in the grower turkey diets increased from 0 to 100% substitution level. This agrees with the report of Khempaka *et al.* (2009) [11]. Cassava is low in protein, which oftentimes could hardly be sufficiently ameliorated by supplementation with expensive synthetic amino acids (Tables 5 and 6) coupled with increasing hard- to-digest dietary crude fibre and residues of hydrocyanide which hinders the digestion and utilization of some other dietary nutrients. The effects of the graded substitution of maize with cassava on the bird's live weight at 16 weeks (Table 8) showed a numerically consistent depression as the level of substitution increased from 0% to 100%.

Table 8: Final live weight of indigenous grower turkeys fed graded levels of Umucass 36 cassava root meal

Parameter (g)	T1	T2	T3	T4	T5	S.E.M
	0%	25%	50%	75%	100%	
Initial weight	49.00	50.67	48.85	49.39	48.70	0.29^{NS}
Final live weight	2316.67	2183.33	2233.33	1916.67	1850.00	71.88^{NS}

From the foregoing, it is important to know that Umucass 36 cassava root meal gari is rich in some nutrients and we can take advantage of these nutrients by including it in starter and grower indigenous turkey diets up-to-50% wherever maize is not available in sufficient quantity and or very expensive. It is therefore recommended.

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