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REPLACEMENT VALUE OF FERMENTED WILD COCOYAM [*Colocasia esculenta* (L.) SCHOTT] CORM MEAL FOR MAIZE IN BROILER FINISHER DIETS

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ABSTRACT

A feeding trial was conducted using 120 Hybro broiler chickens (four-weeks old) with average initial weight of (710.08g/b) arranged in a completely randomized design, to evaluate the feeding value of fermented wild cocoyam corms (FWCC) as a partial replacement for maize. The FWCC was used at 0 (control), 10, 20 and 30% in the dietary treatments. The four treatments were replicated three times with 10 birds per replicate. The trial lasted for 28 days. The experimental birds were fed ad libitum. Performance, carcass, and haematology of the birds fed the experimental diets were investigated. Average daily feed intake was not significantly ($P > 0.05$) affected by the dietary treatments. Weight gain showed an initial increase from 43.50g/b/d (0% FWCC) to 43.93g/b/d (10% FWCC), then declined to 41.38g/b/d (20% FWCC) and 35.73g/b/d (30% FWCC). Feed conversion ratio was 2.56, 2.53, 2.71 and 3.15 at 0, 10, 20 and 30% FWCC. Albumin: globulin ratio, packed cell volume and mean corpuscular haemoglobin concentration were significantly ($P<0.05$) affected by the dietary treatments. Cost per kg feed (CPKF) decreased ($P < 0.05$) from ₦50.01 (control) to ₦38.39 (10% FWCC), ₦36.78 (20% FWCC) and ₦35.17 (30% FWCC) respectively. Results indicate that FWCC can safely and economically replace 30% of maize in broiler finisher diets.

Keywords: fermented wild cocoyam corm; broilers; performance; blood parameters; replacement.

INTRODUCTION

The per caput protein intake of Nigerians and indeed most of the developing countries is below the recommended level (FAO, 1994; Akinmutimi and Onwuke, 2002). Animals with short generation intervals (Carew *et al*., 2003; Atteh, 2004), those with fewer religious or social taboos, high standard protein intake and all essential amino acids (Smith, 2001) plays tremendous roles in ameliorating the protein malnutrition problem in the developing countries. Poultry production readily comes to mind in this respect. High cost of feeds has however marred these benefits of poultry. The use of unconventional feedstuffs could be part of the likely solution to this high cost of feeds. Adeola and Olukosi (2008) defined unconventional feedstuffs as those feedstuffs that can be used for livestock feeding but are under-used or under-exploited. Most of these unconventional feedstuffs do not present direct competition with human food sources and such are more likely to be available for use at a cheaper cost. Cultivar of the wild cocoyam [*Colocasia esculenta* (L.) Schott] corms commonly found on swampy lands along most of the streams in Nigeria and other developing countries could be exploited as one of such unconventional feedstuffs. It has the ability to survive on marginal lands. According to IITA (1982),

cocoyam generally can survive under both water-logged and upland conditions. Its ability to thrive under different conditions otherwise adverse for most crops makes it an ideal subsistence crop for areas where technology is lacking. Its starch grains are very small and easily digestible (Hernando and Leon, 1994). However, due to the presence of anti-nutritional factors (ANFs) in it, there is the need for processing and fermentation has been recommended (Akpan and Umoh, 2004; Olajide *et al.* 2011). Soaking and cooking had also been adopted; and found as appropriate processing methods of corms (Olajide *et al.* 2011). Feeding diets containing above 25% level of taro meal was found to significantly reduce the live weight and dressing percentage of broilers (Anigbogu, 1997). Reddy and Qudratullah (2006) also recommended 10% level of inclusion of cooked taro in poultry diets.

This study investigated the effects of partial substitution of maize with fermented wild cocoyam [*Colocasia esculenta* (L.) Schott] corms (FWCC) on performance, carcass, haematology and serum metabolites of hybro broiler chickens.

MATERIALS AND METHODS

Preparation of the FWCC

The corms were thoroughly washed, grated mechanically, packed into jute bag, then into air-tight polythene bag to exclude air and pressed.

Experimental diets

Four (4) experimental diets were formulated such that FWCC partially replaced maize (weight for weight). Diet 1 (Control) contained no FWCC and designated as T_1. The remaining three (3) diets contained 10, 20 and 30% FWCC designated as T_2, T_3 and T_4 respectively.

Site of the experiment

The study was carried out at the Poultry Unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria.; located at $7^0$27'N and $3^0$45'E at altitude 200-300m above sea level; with mean annual temperature of 25-30^0 C and the average annual rainfall of about 1255mm (Babayemi and Bamikole, 2009).

Management of the experimental birds

The rearing house was washed, disinfected, and allowed to dry and rest before the birds were moved in from brooder section. The litter (wood shavings) of about 20cm thick, of good absorbent quality was used. Artificial light (electric bulb) provided to encourage the birds to eat at night. One hundred and twenty (120) 4-weeks old Hybro broiler chicks were used for this study. The birds were previously raised on broiler starter diets containing 3041.63 - 3095.88 kcal/kg ME and 22.66 - 23.98% CP. They were randomly distributed to four dietary treatments of three replicates each. There were 30 birds of similar average weight per treatment at the rate of 10 birds per replicate. Feed and water were provided *ad libitum*. Feed intake and weights of the birds were recorded weekly. These were used to compute the average daily feed intake and weight gain.

Carcass analysis

Carcass evaluation was carried out at the Meat Science Laboratory, University of Ibadan, Nigeria. Thirty six (36) birds at the rate of 9 birds per treatment were randomly selected at the end of 8th week for carcass evaluation. The birds were deprived feed for 12 hours overnight, but allowed access to water. The fasted live weights were recorded and the birds were slaughtered by severing the jugular vein; and hung upside down for proper bleeding. Well-bled carcasses were scalded, de-feathered and eviscerated. The weights were adequately recorded at each of the processing stages and organs (kidney, lungs, heart, liver and gizzard) weights were recorded. The intestine and abdominal fat were also weighed and recorded. Carcass weights (plucked, eviscerated and dressed weights) were calculated as percentages of

live weight. The organ weights were calculated as percentages of carcass weight. The weights were measured with AB-200 Mettler Toledo® sensitive scale calibrated in grams.

Haematology and biochemical indices

Six (6) birds per treatment (24 birds in all) were bled by the jugular vein using hypodermic needle with syringe. Blood was drained into two different carefully labeled bottles for haematological and serum metabolite investigations. The blood samples for haematological parameters were collected into bottles pretreated with ethylene diamine tetra acetic acid (EDTA) as anti-coagulant. Blood samples for biochemical indices were collected into another sample bottles containing no anti-coagulant. Packed cell volume (PCV), red blood cell count (RBC), white blood cell (WBC) and haemoglobin were determined by Wintrobe's microhaematocrit, improved Neubauer haemocytometer and cyanometaemoglobin respectively. Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated as described by Jain, (1986). Serum biochemical indices investigated include total protein, globulin, albumin, albumin: globulin ratio, cholesterol and glucose.

Chemical analysis

The nutrient and anti-nutritional factors' contents were determined according to standard methods. The experimental diets were analysed for proximate chemical composition according to the method of AOAC, (1995). Nitrogen Free Extract (NFE) was determined by difference and Metabolisable Energy (ME) calculated according to the procedure of Pauzenga, (1985) as: ME (kcal / kg) = 37 x % Protein + 81.8 x % Fat +35.5 x % NFE

Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) using SAS Statistical Package (SAS, 1999). The means were separated using Duncan multiple range test.

RESULTS AND DISCUSSION

Processing, nutrient and anti-nutritional factors' contents of the fermented wild cocoyam [*Colocasia esculenta* (L.) Schott] corms were the same as presented (Olajide *et al.* 2011). The dry matter (87.90%), crude protein (7.44%), crude fiber (3.45%), ether extract (0.88%), ash (2.63%), NFE (73.50%) and ME (2956.51kcal/kg DM) of the fermented wild cocoyam were according to Olajide *et al.* (2011). These authors also reported 0.16g/100g DM, 0.04 g/100g DM, 0.05 g/100g DM, 0.14 g/100g DM, 0.18 g/100g DM and 7.20 ppm respectively for condensed tannins, hydrolysable tannins, phytate, oxalate, saponin and hydrocyanide.

Table 1: Gross composition of experimental finisher diets

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4
Maize	50.00	45.00	40.00	35.00
FWCC	0.00	5.00	10.00	15.00
PKC	8.50	8.50	8.50	8.50
Wheat offal	12.50	12.50	12.50	12.50
Groundnut Cake	10.00	10.00	10.00	10.00
Soy bean Meal	12.00	12.00	12.00	12.00
Palm Oil	0.40	0.40	0.40	0.40
Fish Meal (72%)	3.00	3.00	3.00	3.00
Bone Meal	1.50	1.50	1.50	1.50
Oyster Shell	1.35	1.35	1.35	1.35
Salt	0.20	0.20	0.20	0.20
*Premix	0.25	0.25	0.25	0.25
Methionine	0.15	0.15	0.15	0.15
Lysine	0.15	0.15	0.15	0.15
Total	100.00	100.00	100.00	100.00
Determined Nutrient Composition (%)				
Dry Matter	89.54	89.51	89.59	89.54
Crude Protein	20.45	20.38	20.24	19.86
Crude Fibre	4.36	4.47	4.55	4.63
Ash	5.14	5.24	5.29	6.55
Ether Extract	3.87	3.62	3.55	3.43
Nitrogen Free Extract	55.72	55.80	55.96	55.07
ME (kcal/kg DM)	3051.28	3031.08	3025.85	2979.32

FWCC: Fermented wild cocoyam corms, PKC: Palm Kernel Cake

**Composition of Premix: 2.5kg of premix contains: Retinol acetate (10000000iu), Vit. D3 (2000000iu), Vit. E (15000iu), Vit. B (3000mg), Niacin (15000mg), Vit. B6 (3000mg), Vit. B12 (10mg), Vit. K3 (2000mg), Biotin (20mg), Folic Acid (500mg), Calcium pantothenate (800mg), Chlorine Chloride (250000mg), Manganese (75000mg), Iron (25000mg), Copper (5000mg), Zinc (70000mg), Selenium (150mg), Iodine (1300mg), Magnesium (100mg), Ethoxyquine (500g), BHT (700g).*

The gross composition of the experimental diets is presented in Table 1. The ME, crude protein (CP) and ether extract (EE) decreased while the crude fibre (CF) and ash increased as the replacement level of FWCC increased in the experimental diets. This can be attributed to the levels of ME, CP, EE, CF and ash in FWCC compared to maize. The diets were formulated based on specifications of 2300-3500ME kcal/kg DM and 15.3-23.3% CP; 4-5% CF recommended by Olomu, (1995) and NRC, (1994) respectively.

Table 2: Performance characteristics of hybro broilers fed FWCC as substitutes for maize

Parameters	Diet 1 (0% FWCC)	Diet 2 (10% FWCC)	Diet 3 (20% FWCC)	Diet 4 (30% FWCC)	SEM
Feed intake (g/b/d)	111.17	110.90	112.09	112.51	0.68
Weight gain (g/b/d)	43.50[b]	43.93[a]	41.38[c]	35.73[d]	0.46
FCR	2.56[b]	2.53[b]	2.71[b]	3.15[a]	0.15
Cost per kg feed(₦)	50.01[a]	38.39[b]	36.78[c]	35.17[d]	3.05
Cost of feed per kg weight gain (₦)	127.86[a]	97.00[d]	99.67[c]	110.67[b]	6.80
Mortality (%)	3.33	3.33	0.00	0.00	-

[a,b, c, d] Means in the same row with different superscripts differ significantly ($P < 0.05$)
FWCC: Fermented wild cocoyam corms. SEM = standard error of the means

Results obtained for the performance of the birds (Table 2) show that weight gain (WG), feed conversion ratio (FCR), cost per kg feed (CPKF), cost of feed per kg weight gain (CFPKWG) were significantly ($P < 0.05$) affected by dietary treatments. Average daily feed intake was similar ($P > 0.05$) across all dietary treatments. The WG showed an initial increase from 43.50g/b/d (0% FWCC) to 43.93g/b/d (10% FWCC) and declined to 41.38g/b/d, 35.73g/b/d for birds fed 20 and 30% FWCC respectively. The FCR of 2.56, 2.53 and 2.71 for birds fed 0, 10, and 20% FWCC respectively were not significantly ($P < 0.05$) different from one another. However, these were significantly ($P < 0.05$) lower than 3.15 for birds fed 30% FWCC. The CPKF (cost per kg feed) consistently decreased from ₦50.01 for control diet to ₦35.17 for diet four (30% FWCC). The CFPKWG of all birds fed 10 to 30% FWCC – based diets were lower ($P < 0.05$) than control, with values of ₦127.86, ₦97.00, ₦99.67 and ₦110.67 for birds fed 0, 10, 20 and 30% FWCC – based diets respectively. The non significant variations obtained in feed intake across all dietary treatments could be due to the fact that the ANFs in FWCC have been reduced to minimal level as a result of fermentation process. Fermentation is recommended as a processing technique to detoxify root and tuber crops including corms of cocoyam (Nnanyalugo *et al.*, 2002). The best performances indicated in terms of WG and FCR obtained for birds fed 10% FWCC could be the level at which the birds utilize the nutrients in FWCC. Beyond this level, these performance parameters declined. It could be that, at 20 and 30% FWCC levels of substitution the ANFs impaired the digestion

and absorption of nutrients. This probably explains why WG and FCR at these levels were not as good as for the control and 10% FWCC. Similarly, reduced digestibility, availability, utilization of nutrients and lower ME of diets with ANFs have been reported by King *et al.* (2000) and Baidoo *et al.* (2003). All the treatment diets had lower CPKF than the control diet because FWCC was cheaper than maize. Birds fed 10% FWCC – based diets had the least feed intake, FCR; but however, had highest WG. Also, birds fed 20 and 30% FWCC – based diets had the lowest CFPKWG. Feeding 10 – 30% FWCC, therefore offer cheaper alternative to maize in broiler finisher production. This agrees with the findings of Ezieshi and Olomu, (2004) that feed costs per kg live weight gain of broilers on unconventional alternative energy sources to maize were lower. The mortality rate of 3.33% obtained for the control and 10% FWCC was lower than 6.67-8.89% obtained by Inaku *et al.* (2011) from other broiler studies in the tropics. The zero mortality obtained at 20 and 30% FWCC showed that mortalities at 0 and 10% FWCC were not related to or caused by dietary FWCC levels.

Table 3: Carcass characteristics of broiler birds fed fermented wild cocoyam corm-based diets

Parameters	Diets				SEM
	0% FWCC	10% FWCC	20% FWCC	30% FWCC	
Live weight Kg)	1.97^{a}	1.85^{ab}	1.74^{ab}	1.69^{b}	0.09
Bled weight (%)	96.94^{ab}	97.85^{a}	95.30^{b}	95.11^{b}	0.72
Plucked weight %	88.43	85.36	88.13	86.13	2.14
Evis. weight (%)	72.91^{a}	74.73^{a}	69.04^{b}	66.19^{b}	2.12
Dressed weight %	64.78^{a}	66.42^{a}	61.05^{b}	58.30^{c}	2.03
GIT (%)	9.19^{b}	8.74^{b}	12.05^{a}	12.79^{a}	1.07
Abd. fat (%)	2.03	1.91	1.61	1.38	0.24
Organ weight (% of carcass)					
Kidney	0.96	1.00	1.07	0.99	0.11
Lungs	0.87	1.00	0.85	1.00	0.10
Heart	0.56^{d}	0.66^{c}	0.70^{b}	0.76^{a}	0.05
Liver	3.35	2.75	3.65	3.62	0.44
Gizzard	2.75^{b}	2.96^{ab}	3.63^{ab}	3.87^{a}	0.37

FWCC: Fermented wild cocoyam corms; GIT: gastro-intestinal tract; Abd. : abdominal
^{a,b,ab,c} Means in the same row with different superscripts differ significantly ($P < 0.05$)

Table 3 shows carcass characteristics of broiler birds fed fermented wild cocoyam corm-based diets. The plucked weight, abdominal fat, kidney, lungs and liver were not significantly ($P > 0.05$) affected by dietary treatments. The live weight reflected the performance of birds on experimental diets. The blood volume represented by the bled weight falls within the standard range of 2.50-6.50% reported by Mitruka and Rawnsley, (1977) for normal chickens. Highest ($P < 0.05$) eviscerated and dressed weights were obtained in birds fed 10% FWCC – based diets. These were superior though not significant ($P > 0.05$) to the control. The lower values of eviscerated and dressed weights at 20 and 30% FWCC levels could be as a result of lower CP, ME, EE; and higher CF and contents of ANFs. Similar lower weight and carcass yield have been attributed to reduce CP (Cecil, 1981), ME (Gardiner, 1971) and fibre concentration in diets (Zaczek *et al.,* 2003). Dietary quality has been identified to influence dressing percentage or carcass yield (Johnson and McNabb, 1983). Increase in gastro intestinal tract weight with increasing level of FWCC could be as a result of undigested feeds still left in the tract . Evidence abounds that residual ANFs lower digestibility of nutrients (Cherbut *et al.*, 1998; Safari *et al.,* 2005; Olajide *et al.,* 2009). The lowest heart weight obtained in the control and subsequent increase in its weight with increasing level of FWCC could be as a result of extra workload imposed by stress of handling ANFs such as digestibility. This is in line with the submission of Carew *et al.* (2003) that consistent enlargement of heart muscle may represent extra workload imposed by stress or disease. There was increase in gizzard weight with increasing levels of FWCC which could be as a result of physical activity of handling relatively higher fibre in this FWCC- based diets; i.e fibrousness of the diets. Gizzard is affected by nutrition and physical activity (Encyclopedia Britanica, 2010). Such an increase was also linked to extra muscular or secretory work required to process the diets which were relatively higher in fibre compared with the control (Carew *et al.* 2003; Atteh, 2004).

Table 4: Serum metabolites and haematology of broilers fed fermented wild cocoyam corm-based diets

Parameters	Diet 1 (0% FWCC)	Diet 2 (10% FWCC)	Diet 3 (20% FWCC)	Diet 4 (30% FWCC)	SEM
Total Protein (g/dl)	6.13	5.80	6.53	6.41	0.37
Albumin (g/dl)	2.29	2.02	2.21	2.08	0.11
Globulin (g/dl)	3.83	3.78	4.32	4.33	0.33
Alb:Glob. Ratio	0.60^{a}	0.55^{ab}	0.53^{ab}	0.42^{b}	0.04
Cholesterol (mg/dl)	134.54	129.75	125.00	120.40	7.35
Glucose (mg/dl)	133.06	133.13	133.04	129.43	4.49
RBC, $mm^3x\ 10^6$	3.12	3.12	3.03	3.00	0.23
WBC,$mm^3x\ 10^3$	19.55	19.63	19.85	20.18	1.53
PCV (%)	27.67^{a}	25.00^{c}	25.00^{c}	26.33^{b}	1.00
Hb (g/100ml)	9.27	9.47	9.43	9.30	0.14
MCV (µ)	91.15	80.70	83.32	89.20	5.89
MCHC (%)	33.49^{d}	38.16^{a}	37.94^{b}	35.36^{c}	1.63
MCH (µ µg)	30.54	30.85	31.80	31.66	2.51

FWCC: Fermented wild cocoyam corms; RBC: red blood cells; WBC: white blood cells; PCV: packed cell volume; Hb: haemoglobin; MCV: mean corpuscular volume; MCHC: mean corpuscular haemoglobin concentration; MCHb: mean corpuscular haemoglobin.

^{a,b,ab,c,d}Means in the same row with different superscripts differ significantly ($P < 0.05$)

SEM = standard error of the means

Most of the serum metabolites investigated were similar and unaffected ($P > 0.05$) by FWCC inclusion in the diets except the albumin: globulin ratio as indicated in Table 4. The numerical (P > 0.05) increase in globulin with increasing level of FWCC in the diets was as a result of the need for the birds' defense mechanism to ward off external invasion (foreign bodies) depicted by residual ANFs in FWCC. Cholesterol level in the serum decreased (P > 0.05) numerically with increasing level of FWCC in the diets. This could be linked to the presence of saponin in FWCC. Akpodiete

and Okagbare, (2002) and Michael, (2005) linked reduced serum cholesterol to presence of saponin in the diets. The glucose levels were not adversely affected by dietary treatments. Out of all the haematological indices investigated, only PCV and MCHC were significantly ($P < 0.05$) affected by dietary treatments. Although the PCV (26.33%) at for birds fed 30% FWCC was higher than 25.00% obtained at 10 and 20% FWCC level of inclusion, this was however, lower ($P < 0.05$) than 27.67% for the control. Similarly, MCHC decreased with FWCC in the diets and the least MCHC was obtained in the control. The trends for these parameters (PCV and MCHC) were not so definite especially as it relates with the control. So, the trends cannot be linked to dietary inclusion of FWCC in the diets. The PCV values obtained in the present study compares favourably with the values range of 26.00 – 45.20% and 24.90 – 40.70% respectively for normal male and female chicken (Mitruka and Rawnsley, 1977). The RBC, WBC, Hb, MCV and MCH were similar and not significantly ($P < 0.05$) affected by dietary treatments. This may suggest adequacy of nutrients for the birds on all experimental diets.

CONCLUSION

It was concluded that:

1. Weight gain of birds fed 10% FWCC was highest and FCR increased with increasing replacement levels of FWCC; while cost per kg feed and cost of feed per kg weight gain of all FWCC-based diets were lower than control.
2. Serum metabolites and haematological parameters were not adversely affected by residual contents of ANFs in FWCC.
3. The numerical decrease in serum cholesterol and abdominal fat obtained with increasing FWCC in the diets are desirable and could be a panacea to scare associated with these metabolites.
4. Maize can economically and safely be replaced with 30% FWCC as a cheaper alternative energy source in the diets of broiler finishers.

REFERENCES

Adeola, O. and Olukosi, O. A. (2008) Opportunities and challenges in the use of alternative feedstuffs in poultry production. *Nigerian Poultry Science Journal* 5 (4): 147-155.

Akinmutimi, A. H. and Onwukwe, C. C. (2002) Effect of cooking with various concentrated potash on nutrient composition of Lima beans. *Journal of Agricultural Biotechnology and Environment*, 1: 1-13.

Akpan, E. J. and Umoh, I. B. (2004) Effect of heat and tetracycline treatments on the food quality and acridity factors in cocoyam (*Xanthosoma sagittifolium* (L.) Schott). *Pakistan Journal of Nutrition* 3 (4): 240-243.

Akpodiete, O. J. and Okagbare, G. O. (2002) Haematological and biochemical indices of meat and egg-type chickens fed maggot meal. *Tropical Journal of Animal Science 5(1):* 175-180.

Anigbogu, N.M. (1997) Effect of replacing corn with taro (Colocasia esculenta Linn.) Meal on the liveweight,dressing percentage and cut-up yield of broiler chicks. Proceedings 2nd Ann. Conf. ASAN, Lagos, Nigeria, pp.90-95

Association of Official Analytical Chemist, AOAC (1995). Official Methods of

Analysis. 17th Edition. Washington D. C, pp. 69-89.

Atteh, J. O. (2004) Critical review of the activities of feed enzymes in Nigeria. Paper presented at the Bio-ingredients (Nig.) Ltd. Seminar, 21st May, 2004 at Airport Hotel, Ikeja, Lagos.

Babayemi, O.J and Bamikole, M.A. (2009) Nutrient value and invitro gas production of African wild cocoyam (Colocasia esculentum). *African Journal of Food Agriculture Nutrition and Development,* 9 (1): 593-607

Baidoo, S. K., Yang, Q. M. and Walker, R. D. (2003) Effects of phytase on apparent digestibility of organic phosphorus and nutrients in maize soya bean meal based diets for sows. *Animal Feed Science and Technology* 104 (1-4): 295-304.

Carew, L. B., D. Hardy., J. Weis., F. Alster., S. A. Misehler., A. Gernat and E. I. Zakrewska (2003) Heating raw Velvet beans (*Mucuna pruriensis*) reverse some anti-nutritional effects on organ growth, blood chemistry and organ histology in growing chickens. *Trop. and Sub Trop. Agrosystems* 1: 267-275.

Cecil, H. C. (1981) Effect of dietary protein on body weight and reproductive performance of male turkeys. *Poultry Science* 60: 1049-1055.

Cherbut, C., Barry, J. L., Wyers, M. and Delort-Laval, J. (1998) Effect of dietary fibre on transit time and faecal excretion in the growing pig. *Animal Feed Science and Technology* 45 (1): 65-79.

Encyclopedia Britanica (2010).

Ezieshi, E. V. and Olomu, J. M. (2004) Comparative performance of broiler chickens fed varying levels of palm kernel cake and maize offal. *Pakistan Journal of Nutrition,* 3 (4): 254-257.

FAO, (1994) Tropical root and tuber crops: Production, perspectives and future prospect. Food and Agricultural Organization (FAO) plant production and protection paper 126.

Gardiner, E. E. (1971) Relationship between energy phosphorus and breed on growing and laying periods on early egg weight and egg components. *Poultry Science* 74 (1): 50-61.

Hernando, B. J. E. and Leon, J. (1994) Neglected crops: 1492 from a different perspective. Plant production and protection series No. 26, FAO, pp. 253-258.

IITA, (1982). Tuber and root crop production manual. Manual Series No.9, pp 193-203.

Inaku, E. N., Bawa, G. S., Olugbemi, T. S. and Buba, W. (2011) Nutritive value of yam peel meal (ypm) in broiler diets. Proceedings 36th Ann. Conf. NSAP, Abuja, Nigeria, pp.414-417.

Jain, W. C. (1986) Scham's Veterinary Haematology. 4th Ed. Lea and Febiger. Philadelphia. pp: 149-162.

Johnson, G. and McNabb, J. M. (1983) Grassmeal as ingredients in diets for broiler chickens. *British Poultry Science,* 24: 361-369.

King, D., Fan, M. Z., Ejeta, G., Asem, E. K., and Adeola, O. (2000) The effects of tannins on nutrient utilization in the white pekin duck. *British Poultry Science,* 41 (5): 630-639.

Michael, W. D. (2005) Saponin.

http://Micro.Magnet.Fsu.Edu/Phytochemicals /Page/Saponin/html. Retrieved in 2007

Mitruka, B. M. and Rawnsley, H. M. (1977). Clinical biochemical and hematological reference values in normal experimental

animals. MassonPublishing USA Inc. New York.

Nnanyalugo, D. O., Okeke, E. C., and Ibeanu, V. (2002) Knowledge, attitude and usage patterns of fermented and germinated complementary foods in Nigeria. *Plant Foods and Human Nutrition* 58 (1): 41-51.

NRC, (1994) National Research Council. Nutrient Requirements of Poultry. 9th rev. ed; National Academy Press, Washington USA.

Olajide, R., A. O. Akinsoyinu., Afolabi, K. D., Owosibo, A. O., Fakolade, P. O., Akinleye, S. B. (2009) Digestibility of nutrients by hybro broilers as affected by contents of anti-nutritional factors in wild cocoyam corm-based diets. Proceedings 14th Ann. Conf. ASAN, Ogbomoso, Nigeria, pp.202-205.

Olajide, R., Akinsoyinu, A. O., Babayemi, O. J., Omojola, A. B., Abu, A. O., Afolabi, K. D. (2011) Effect of processing on energy values, nutrient and anti-nutrient components of wild cocoyam (*Colocasia esculenta* (L.) Schott) corm. *Pakistan Journal of Nutrition,* 10 (1): 29-34.

Olomu, J. M. (1995) Monogastric Animal Nutrition, Principle and Practice. A Jachem publication, pp. 1-5.

Pauzenga, U. (1985) Feeding Parent Stock. *Zootecnica International*, December 1985, pp. 22-24.

Reddy, C.V. and Qudratullah, S. (2006) Strategic feeding supplementation through locally available resources. World poultry Congress.

Safari Sinegani, A. A., Emtiazi, G., Hajrasuliha, S., Shariatmadari, H. (2005) Biodegradation of some Agricultural Residues by Fungi in Agitated Submerged Cultures. *African Journal of Biotechnology* 4 (10): 1058-1061.

SAS Institute, (1999) SAS START R Users Guide: Statistics. Version 9 Edition. SAS Institute, Inc., Cary, North Carolina, USA.

Smith A.J. (2001) Poultry: In the Tropical Agriculturist. Revised Edition. Published by Macmillan Education Limited, London and Oxford, p. 123.

Zaczek, V., Jones, E. K. M., Makloed, M. G., Hocking, P. M. (2003) Dietary fibre improves the welfare of female broiler breeders. *British Poultry Science*, 44: 530.