

Performance, carcass and blood indices of broiler chickens fed graded levels of sun-dried raw wild cocoyam (*Colocasia esculenta* (L.) Schott) corms as partial substitutes for maize

R. Olajide

Department of Animal Science and Production, Joseph Ayo Babalola University, Ikeji-Arakeji, P.M.B. 5006, Ilesa, Osun State, NIGERIA
+2348035199681; rotbos97@yahoo.com



Abstract

*The suitability of graded levels of sun-dried raw wild cocoyam (*Colocasia esculenta* (L.) Schott) corms as partial replacement for maize in the diet of finishing broiler chickens was carried out in a feeding trial that lasted for four weeks. One hundred and twenty (120) four weeks old broilers were used. The birds were assigned into four dietary treatments of three replicates each. The experiment was carried out using the completely randomized design. Each diet represented a treatment. Diet 1 as the control treatment was devoid of the test ingredient. The remaining three (3) diets were formulated on 10, 20 and 30% substitution levels of raw wild cocoyam corms for maize on a weight for weight basis. The diets and clean drinking water were provided ad libitum throughout the period of the study. Data were collected on performance, carcass, haematology, serum metabolites, and economy of production. Results revealed that the weight gain, feed conversion ratio, cost per kilogramme feed and carcass characteristics were significantly ($P < 0.05$) affected by the dietary treatments. Among the serum metabolites and haematological parameters monitored, only cholesterol was significantly ($P < 0.05$) affected by the graded levels of the test ingredients in the diets. It was concluded that maize can be replaced with 20% of raw wild cocoyam corms without deleterious effects on performance, carcass, serum biochemistry and haematology of broiler chickens.*

Keywords: Finishing broilers, performance, Haematology, serum metabolites, raw wild cocoyam corms

Introduction

The growing demand for animal protein resulting from rapid growth of the world population calls for increased supply of food of animal origin. This is particularly so for the developing countries. Reports had indicated falls in animal protein consumption of Nigerians in the last four decades (Oyenuga, 1973; Idufueko, 1984; FAO, 1994; Akinmutimi and Onwukwe, 2002). Poultry which would have been a panacea to this inadequate protein of animal origin has suffered from the rising costs of

both the imported feed ingredients and locally produced energy feed resources especially maize. The problem is exacerbated by intense competition for the limited available energy feed ingredients by man and industry leaving small quantities for livestock sector. There is the need to look for alternatives in the area of those resources that are not conventionally employed in feed production and which are not keenly consumed by man. This is likely to reduce the cost of poultry production directly through availability at reduced cost and indirectly by reducing the cost of maize

since competition for the latter would be reduced. This is bound to increase the profitability of the poultry producers who may embrace the feed ingredient as alternatives to maize. The alternatives could be sourced from root and tuber crops including corms of cocoyam and their wild cultivars. These alternatives are readily available but always confronted with the problem of anti-nutritional factors (ANFs) which may limit their use in livestock feeds. Reports have confirmed the presence of ANFs in different corms of cocoyam (Agwunobi *et al.* 2002., Sefa-dede and Agyir-sackey, 2004). One of the methods recommended for detoxification of roots and tubers is sun-drying (Sonaiya, 1995). This study evaluated the effects of feeding graded levels of sun-dried raw wild cocoyam (*Colocasia esculenta* (L.) Schott) corms (RWCC) as partial replacement for maize on growth performance, carcass, serum metabolites and haematology of hybro broiler finisher chickens.

Materials and methods

The processing, nutrient and anti-nutritional contents of the raw wild cocoyam (*Colocasia esculenta* (L.) Schott) corms (RWCC) were as by Olajide *et al.*, (2011). The unpeeled RWCC were thoroughly washed, and sliced to about one centimeter thick and sun-dried for 6 days to constant moisture content.

Experimental diets

Four (4) experimental diets were formulated with partial replacement (weight for weight) of maize with RWCC. Diet 1 contained no RWCC and served as the control. Diets 2, 3 and 4 contained 10, 20 and 30% RWCC as partial replacement for maize in the diets. Each of the diets represented a treatment.

Management of the experimental birds

This experiment was conducted at the

rearing section of the Poultry Unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. Previously cleaned, washed, disinfected and dried rearing poultry house was allowed to rest for a week after preparations before the birds were distributed into it. Wood shavings of about 20cm thick layer served as the litter and artificial light (electric bulb) provided to encourage the birds to eat in the night. One hundred and twenty (120) finishing Hybro broilers at 4 weeks of age were randomly distributed to four dietary treatments of three replicates each. There were 30 birds of similar average weight per diet. Feed and water were provided *ad libitum*. The birds were weighed weekly and feed intake recorded daily such that the values were subsequently used for the computation of average daily feed intake.

Performance parameters

The performance indices monitored include feed intake, weight gain, feed conversion ratio, cost per kilogramme feed intake, cost per kilogramme weight gain and mortalities. Weights of the birds and feeds were measured using Five Goats scale. Feed intake was determined as the difference between feed supplied and those remaining after a given period. Feed conversion ratio was calculated as kilogramme of feed consumed divided by weight gain in a particular week which eventually was used to calculate the cost per kilogramme weight gain. Cost per kilogramme feed intake was calculated using the prevailing cost of ingredients at the time of purchase during the study.

Carcass analysis

At the end of the feeding trials which lasted for 4 weeks, thirty six (36) birds were randomly selected at the rate of 9 birds per diet for carcass analysis. Carcass evaluation was carried out at the Meat Science Laboratory of the University of Ibadan. The

selected birds were starved overnight and their live weights recorded. The birds were slaughtered by severing the jugular vein, hung upside down for proper bleeding. Each of the carcasses was thoroughly bled, scalded, de-feathered and eviscerated according to the procedures of Jones (1984). The carcass and internal offal (gastro intestinal tract, GIT) were weighed and recorded. The plucked, eviscerated and dressed weights were also taken and expressed as percentages of live weight. The organ weights were calculated and expressed as percentages of carcass weight.

Haematology and biochemical indices

Twenty four (24) birds in all at the rate of 6 birds per dietary treatment were selected at the end of feeding trial and bled by the jugular vein using hypodermic needle with syringe. Blood was drained into two different carefully labeled bottles for haematological and serum metabolite investigation. The blood samples for

haematological parameters were collected into bottles pretreated with ethylene diamine tetra acetic acid (EDTA), an anti-coagulant. Blood samples for biochemical indices were collected into another sample bottles containing no EDTA. Packed cell volume (PCV), red blood cell count (RBC), white blood cell count (WBC) and haemoglobin was determined by Wintrobe's microhaematocrit, improved Neubauer haemocytometer and cyanometahemoglobin methods 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 experimental diets were analysed for proximate chemical composition according

Table 1: Proximate composition, metabolisable energy and anti-nutritional factors of raw wild cocoyam corms

Parameters	RWCC
Dry Matter (%)	88.42
Crude Protein (%)	7.07
Crude Fibre (%)	3.90
Ether Extract (%)	1.10
Ash (%)	2.93
Nitrogen Free Extract (%)	73.42
Metabolisable Energy (Kcal/kg DM)	2957.98
Anti-nutrients:	
Condensed tannins (g/100g DM)	0.28
Hydrolysable tannins (g/100g DM)	0.13
Phytate (g/100g DM)	1.01
Oxalate (g/100g DM)	0.53
Hydrocyanide (mg/kg DM)	17.13
Saponin (g/100g DM)	0.31

RWCC: Raw wild cocoyam corms.

Source: Olajide *et al.*, 2011

Table 2: Gross composition of experimental diets fed to finishing hybro broilers

Ingredients	Diets			
	1	2	3	4
	0% RWCC	10% RWCC	20% RWCC	30% RWCC
Maize	50.00	45.00	40.00	35.00
RWCC	0.00	5.00	10.00	15.00
Palm Kernel Cake	8.50	8.50	8.50	8.50
Wheat Offals	12.50	12.50	12.50	12.50
Groundnut Cake	10.00	10.00	10.00	10.00
Soybean 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	89.69	89.62	89.38
Crude Protein	20.45	20.37	20.16	20.02
Crude Fibre	4.36	4.56	4.60	4.74
Ash	5.14	5.30	5.75	6.66
Ether Extract	3.87	3.70	3.58	3.53
Nitrogen Free Extract	55.72	55.76	55.53	54.43
Metabolisable energy (Kcal/kg DM) (Calculated)	3051.28	3035.83	3010.08	2961.76

to the method of AOAC (1995). Nitrogen Free Extract (NFE) was determined by difference and Metabolisable Energy (ME) calculated according to the procedure of Ponzenga (1985) as:

$$\text{ME (kcal / kg DM)} = 37 \times \% \text{ Protein} + 81.8 \times \% \text{ Fat} + 35.5 \times \% \text{ NFE}$$

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 of the same software.

Results

The determined proximate composition and anti-nutritional factors content of raw wild cocoyam (*Colocasia esculenta* (L.) Schott) corms which was used as partial substitutes for maize are in table 1 as reported by Olajide *et al.*, (2011).

Nutrient composition of experimental diets

Table 2 shows the Gross and the determined compositions of the experimental diets. The highest CP (20.45%), EE (3.87%) and the lowest CF (4.36%), Ash (5.14%) was obtained in the control diet. The CP and EE of the diet decreased with increasing

content of RWCC in the diets such that diet formulated on 30% RWCC contained the least CP (20.02%) and EE (3.53%). On the other hand, the least CF (4.36%) and Ash (5.14%) were obtained in the control diet, and these increased with increasing levels of substitution such that diet 4 (30% RWCC-based diet) had the highest CF (4.74%) and Ash (6.66%) respectively.

Performance characteristics of the experimental birds

Results of the performance characteristics (Table 3) revealed that the variations obtained in the average daily weight gain (ADWG), feed conversion ratio (FCR) and cost per kilogram feed intake (CPKF) were significant ($P < 0.05$). Although the average daily feed intake (ADFI) was highest for birds fed the control diet and decreased with replacing levels of RWCC for maize, the variations were however not significant ($P > 0.05$).

The highest ADWG of the birds fed control diet (43.50g) was significantly ($P < 0.05$) higher than 34.15, 33.79 and 29.09g respectively obtained in birds fed 10, 20 and

30% RWCC-based diets. Similar trend was obtained in CPKF. The highest CPKF of N50.01 was obtained for the control diet and this significantly ($P < 0.05$) decreased to N38.28, N36.56 and N34.83 respectively for diets formulated on 10, 20 and 30% RWCC. Mortality was the same for all dietary treatments.

Carcass characteristics of broilers fed raw wild cocoyam corm-based diets

Carcass characteristics including organ weights of hybro broiler finishers fed the experimental diets are presented in table 4. The results indicated that the live weight, bled weight, eviscerated weight, dressed weight, gastro-intestinal tract (GIT), heart and gizzard were significantly ($P < 0.05$) affected by dietary treatments. The highest ($P < 0.05$) live weight (1.97kg), eviscerated weight (72.91%) and dressed weight (64.78%) were obtained in birds fed the control diet. These reduced ($P < 0.05$) to 1.43kg, 68.86% and 59.71% respectively for birds fed 30% RWCC-based diets. The GIT weights, however, increased ($P < 0.05$) from the control (9.19%) to 10.09, 10.78

Table 3: Performance of hybro broilers fed raw wild cocoyam corms as substitutes for maize

Parameters	Diets				SEM	COV
	1 0% RWCC	2 10% RWCC	3 20% RWCC	4 30% RWCC		
Feed Intake (g/b/d)	111.17	110.73	110.51	107.74	0.68	1.23
Weight gain (g/b/d)	43.50 ^a	34.15 ^b	33.79 ^c	29.09 ^d	2.62	14.88
Feed conversion ratio	2.56 ^d	3.24 ^c	3.27 ^b	3.70 ^a	0.24	6.99
Cost /kg feed intake (₦)	50.01 ^a	38.28 ^b	36.56 ^c	34.83 ^d	3.11	15.06
Mortality (%)	1.67	1.67	1.67	1.67	NSA	NSA

^{abcd}Means in the same row with different superscripts differ significantly ($P < 0.05$).

SEM = standard error of the means, COV = coefficient of variation, NSA = not statistically analysed

and 11.82% respectively for birds fed 10, 20 and 30% RWCC-based diets. The heart weight (0.56%) obtained in birds on control diet was lower ($P < 0.05$) than 0.76, 0.81 and 0.85% respectively obtained in birds fed 20, 30 and 10% RWCC-based diets. There were no significant differences ($P > 0.05$) in birds fed 10-30% RWCC-based diets for the gizzard. However, these values were higher ($P < 0.05$) than the control.

Serum metabolites of broilers fed raw wild cocoyam corm-based diets

Table 5 revealed that out of all serum biochemical indices monitored, only cholesterol was significantly ($P < 0.05$)

affected by the dietary treatments. The highest ($P < 0.05$) cholesterol (134.54mg/dl) was obtained in birds fed the control diet. This decreased to 125.70, 118.81 and 113.16mg/dl respectively for birds fed 10, 20 and 30% RWCC-based diets. Variations obtained in the total protein, albumin, globulin, albumin: globulin ratio and glucose were not significant ($P > 0.05$).

Haematology of broilers fed raw wild cocoyam corm-based diets

All haematological parameters investigated (Table 6) vis-a-vis red blood cells (RBC), white blood cells (WBC), packed cell

Table 4: Carcass characteristics of broilers fed raw wild cocoyam corm-based diets

Parameters	Diets				SEM	COV
	1 0% RWCC	2 10% RWCC	3 20% RWCC	4 30% RWCC		
Live weight, LW (kg)	1.97 ^a	1.78 ^b	1.67 ^c	1.43 ^d	0.16	17.97
Bled weight (% LW)	96.94 ^{ab}	97.09 ^a	96.82 ^{ab}	95.32 ^b	0.50	1.02
Plucked weight (% LW)	88.43	86.70	90.47	84.79	2.28	5.19
Eviscerated weight (% LW)	72.91 ^a	72.01 ^b	69.74 ^c	68.86 ^d	1.92	5.42
Dressing Percentage (% LW)	64.78 ^a	63.00 ^b	61.16 ^c	59.71 ^d	1.96	6.29
Gastro intestinal tract (% LW)	9.19 ^b	10.09 ^{ab}	10.78 ^{ab}	11.82 ^a	0.10	18.96
Abdominal fat (% LW)	2.03	1.74	1.64	1.46	0.26	30.55
Organ (% of carcass)						
Kidney	0.96	0.96	1.04	1.70	0.24	41.33
Lungs	0.87	0.90	0.95	1.13	0.11	21.66
Heart	0.56 ^d	0.85 ^a	0.76 ^c	0.81 ^b	0.10	25.56
Liver	3.35	3.23	3.69	4.76	0.65	34.32
Gizzard	2.75 ^b	3.30 ^a	3.34 ^a	3.43 ^a	0.27	16.69

^{abcd} Means in the same row with different superscripts differ significantly ($P < 0.05$).

SEM = standard error of the means, COV = coefficient of variation

Table 5: Serum metabolites of broilers fed raw wild cocoyam corm-based diets

Parameters	Diets				SEM	COV
	1	2	3	4		
	0% RWCC	10% RWCC	20% RWCC	30% RWCC		
Total Protein (g/dl)	6.13	6.12	6.53	6.59	0.36	11.42
Albumin (g/dl)	2.29	2.30	2.23	2.26	0.09	7.97
Globulin (g/dl)	3.83	3.82	4.30	4.33	0.31	15.29
Albumin: Globulin Ratio	0.60	0.60	0.53	0.53	0.04	11.79
Cholesterol (mg/dl)	134.54 ^a	125.70 ^b	118.81 ^c	113.16 ^d	5.73	9.32
Glucose (mg/dl)	133.06	130.58	128.68	129.31	5.54	8.50

^{abcd} Means in the same row with different superscripts differ significantly ($P < 0.05$).

SEM = standard error of the means, COV = coefficient of variation

volume (PCV), haemoglobin, mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular haemoglobin (MCH) were not significantly ($P > 0.05$) affected by the dietary treatments.

Discussion

Results of the composition of the RWCC as reported by Olajide *et al.* (2011) served as evidence that the corms contained an array of anti-nutritional factors (ANFs). Similar results indicating the presence of ANFs in different corms of cocoyam have been reported (Esonu *et al.* 2000., Agwunobi *et al.* 2002., Preeti, 2003., Sefa-dede and Agyir-sackey, 2004).

The trends obtained in the determined composition of the experimental diets were reflections of the original nutrient contents of the raw wild cocoyam (*Colocasia esculenta* (L.) Schott) corm which replaced maize. The diets were, however, formulated

to meet the nutrient and energy requirements of broiler finishers under the tropical environmental conditions where the experiment was carried out as recommended by Olomu (1995).

The non-significant values of the ADFI of the birds among all dietary treatments was an indication of better ability of these birds (finishers) to tolerate the ANFs in RWCC. This agrees with the findings of Bedford (2006) and Panda (2006). The highest ADWG of the birds fed control diet could be explained by absence of ANFs in maize. Progressive reductions in this parameter with increasing content of RWCC in the diets

could also be linked to the contents of residual ANFs. Similar depressed weight gains have been reported with HCN (Montgomery, 1980., Aletor and Fetuga, 1984), tannin (King *et al.*, 2000) and phytate (Tanveer *et al.*, 2000). Decnyperre *et al.* (1992) observed that slight increase in

Table 6: Haematology of broilers fed raw wild cocoyam corm-based diets

Parameters	Diets				SEM	COV
	1	2	3	4		
	0%	10%	20%	30%		
	RWCC	RWCC	RWCC	RWCC		
Red Blood Cells (mm ³ x 10 ⁶)	3.12	3.13	3.33	3.28	0.26	15.70
White Blood Cells (mm ³ x 10 ³)	19.55	20.60	20.92	21.90	1.65	15.87
Packed Cell Volume (%)	27.67	28.00	27.00	27.33	0.50	3.64
Haemoglobin (g/100ml)	9.27	9.40	9.30	9.17	0.14	2.97
Mean Corpuscular Volume (μ)	91.15	90.23	87.15	83.32	8.69	19.75
Mean Corpuscular Haemoglobin Concentration (%)	33.49	33.57	34.47	33.54	0.36	2.14
Mean Corpuscular Haemoglobin (μg)	30.54	30.29	29.79	27.95	2.77	18.70

Means in the same row with different superscripts differ significantly ($P < 0.05$).

SEM = standard error of the means, COV = coefficient of variation

dietary protein levels under hot and humid tropical conditions were beneficial for growth rate and feed efficiency in broilers. Zaczek *et al.* (2003) observed that increasing concentration of fibre in diets have a negative linear effect on body weight. The lowest FCR obtained in birds fed the control diet was as a result of better utilization of nutrients in it due to absence of ANFs. The values of FCR of broilers on control and those on all RWCC-based diets were lower than values reported (Adetunji and Ologhobo, 1999., Ojewola *et al.* 2002)., but higher than the value of 2.25-2.70 obtained by Tion *et al.* (2005) for broilers raised in tropical environment. The differences may have been caused by diets

fed and breed of birds. The FCR in this study, however, compares favourably with the values obtained by (Adejinmi *et al.* 1997 and Akpodiete *et al.* 1997).

Variations obtained in the CPKF showed the differences in cost of maize and RWCC which are the variable ingredients. However, despite the lower ADWG and higher FCR of the birds fed RWCC-based diets than the control, the lower CPKF of RWCC than that of maize was such that cost of feed per kilogramme weight gain (CPKWG) at 10 and 20% RWCC were lower (more economical) than control. Low mortality values obtained across all dietary treatments was an indication that contents

of ANFs in RWCC at 10-30% was not poisonous to have resulted in outrageous mortalities.

The quality of carcass is very critical to the determination of profit obtainable from broiler production. The good performance depicted by highest live weight of the birds fed the control diet was an evidence of better utilization of nutrients in it (control). Onimisi *et al.* (2010) recommended quality protein maize to improve broiler production and make more meat available. Obun *et al.* (2011) linked improved performance of broilers fed honey-flavoured diets to improved palatability and reduced dustiness of feed. Lower eviscerated and dressed weights of the birds on graded levels of RWCC-based diets than the control could have been caused by the dietary treatments. Carcass yield and dressing percentage are known to be influenced by dietary quality (Johnson and McNabb, 1983). Variations in the size of gut have been associated with the amount of fibre consumed by birds in the process of meeting their energy requirement. Increases in the weights of the GIT and the gizzard obtained with increase in contents of RWCC in the diets could be explained by increase in dietary fibre. Fibres have been found to lower the digestibility of nutrients (Alokan, 2000). The non-digestible part of the feed is left in the GIT and that would have added to its (GIT) weight. Olajide *et al.* (2009) reported that the digestibility of nutrients by hybro broilers was affected by contents of anti-nutritional factors in wild cocoyam (*Colocasia esculenta* (L.) Schott) corms. Indirectly, contents of ANFs which affected digestibility could also influence the size of GIT and gizzard. Summers and Leeson (1986) reported an increase in gizzard size with fibre intake. Akinola and Abiola (1999) recorded similar increased weights of gizzard and intestines of

cockerels with fibres in melon husk-based diets. The trend obtained in the heart was not particular to be attributed to effect of dietary treatments. Olajide *et al.* (2009) found no histopathological lesions in organs (proventriculus, lungs, heart, liver, kidney and GIT) of hybro broilers fed 10-30% RWCC-based diets.

The highest cholesterol of the birds fed control diet and its decreasing with increasing RWCC in the diets could be linked to the ANFs especially saponin in the diets. Saponins are known to assert physiological effect of lowering the level of plasma cholesterol concentrations in experimental animals (Oakenfull 1981 and Michael 2005). Although dietary fibres have been implicated (Hale *et al.* 1986) in this respect, Donnica (2000) identified soluble dietary fibre (β -glucans) as capable of achieving this. The non-significant values of the total protein, albumin and sera glucose was an indication that the contents of anti-nutritional factors in RWCC-based diets did not precipitate inadequacy of nutrients which could create an anaemic condition. The blood volume (percentage of body weight) obtained for all dietary treatments falls within 2.5-6.6% of the body weight recommended for normal chickens (Mitruka and Rawnsley, 1977).

The lower WBC obtained in birds fed the control diet than those obtained in birds fed RWCC-based diets could be explained by an increased need to challenge the foreign body in form of anti-nutritional factors in the diets formulated with graded levels of RWCC. The increased concentrations of ANFs with increasing RWCC would have elicited responses of increased WBC (antibodies) for defence.

Conclusion

It was concluded that maize could be replaced with RWCC up to 20% on a weight

for weight basis without deleterious effect on performance and carcass quality.

References

- Adejinmi, O. O., Adeleye, I. O. A. and Oladega, O. 1997.** Performance of broilers fed on graded levels of soldierfly larvae meal (*Hermetia illucens*). Proceedings 2nd Ann. Conf. ASAN, Lagos, Nigeria. (Eds: Ologhobo, A.D; Iyayi, A.E; Adeshinwa, A.O.K and Bamgbose, A.M.)
- Adetunji C.A. and Ologhobo, A.D. 1999.** Utilization of full fat sunflower seed in the diets of broiler chicken. *Tropical Journal of Animal Science*, 2(2):61-66.
- Agwunobi L. N., Angwukam P. O., Cora O. O. and Isiaka M. A. 2002.** Studies on the use of *Colocasia esculenta* (Taro Cocoyam) in the diets of weaned pigs. <http://www.springerlink.com,lapp/home/contribution.asp?wasp=d97028a32ec14c,2785....103008,1/4/80>.
- 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.
- Akinola, S. O. and Abiola, S. S. 1999.** Blood chemistry and carcass yield of cockerels fed melon husk diets. *Tropical Journal of Animal Science*, 2 (2): 39-44.
- Akpodiete, O. J., Ologhobo, A. D. and Ayoade, O. G. 1997.** Replacement value of maggot meal for fish meal in broiler chicken diets. Proceedings 2nd Ann. Conf. ASAN, Ikeja.
- Aletor, V. A. and Fetuga, B. L. 1984.** The effect of varying levels of raw lima bean (*Phaseolus lunatus*) on the rat's pancreatic and intestinal trypsin (EC.3.4.21.4) and chymotrypsin (EC. 3.4.21.1) activity. *Nutritional Report International*, 29 (3): 565-570.
- Alokan, J.A. 2000.** Evaluation of Water Parri (*Azolla pinnata*) in the diet of growing rabbits. *Proceedings of the 25th Annual NSAP Conf. 19-23, March, Umudike, 311-312.*
- Association of Official Analytical Chemist AOAC, 1995.** Official Methods of Analysis. 17th Edition. Washington D. C, pp. 69-89.
- Bedford, M. R. 2006.** Phytate as An Anti-Nutrient-Challenges in Quantification of the Nutrient Value of Phytase. Syngenta Animal Nutrition Technical Symposium, Multi-State Poultry Feeding & Nutrition Conf. pp. 25-27.
- Obun, C. O., M. S. Yahaya, O. A. Olafadehan, A. S. Kehinde, O. A. Adeyemi, I. U. Farouk and D. S. Allinson 2011.** Effect of honey-flavoured diets on the performance and relative organ weights of finisher broiler chickens. *Nigerian Journal of Animal Production* 38 (1): 64-72.
- Cockerel, I., Halliday, D. and Morgham, D. J. 1987.** Quality control in the animal feedstuff manufacturing industry. Tropical Institute, London, pp 74-94.
- Donnica Moore, M. D. 2000.** Lower Your Cholesterol and Triglycerides. <http://www.drdonnica.com/toptips/00000400.htm>
- Decynpere, E., Buyse, J. Van Isterdael, J., Michael, H. and Hermans. A. 1992.** Growth, feed conversion and carcass quality in broiler chickens in hot and humid tropical conditions. Proceedings, Vol 2 XIX World's Poultry Congress, Amsterdam, The Netherlands 20-24 Sept. Ponsler and 100ijev Wageningen, pp. 97-99.

- Esonu B. O., Iwu P. E., Opera C. C. and Bamgbose A. M. 2000.** Evaluation of partial replacement of maize with cooked wild variegated cocoyam corm meal (*Caladium hortulanum*) in broiler starter diet. *Tropical Journal of Animal Science*, 3 (1): 85-89.
- FAO, 1994.** Tropical root and tuber crops: Production, perspectives and future prospect. Food and Agricultural Organization (FAO) plant production and protection paper 126. FAO, Rome, Italy.
- Hale, O. M., Newton, G. L. and Haydon, K. D. 1986.** Effects of diet and exercise on performance, carcass traits and plasma compositions of growing-finishing barrows. *Journal of Animal Science*, 62 (3): 665-671
- Idufueko, A. O. 1984.** Nigeria's move towards self-sufficiency in animal protein production. Paper presented at the Seminar of Nigeria Veterinary Medical Association, Lagos, August, 1984.
- 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.
- Jones, R. 1984.** A standard method of dissection of poultry for carcass analysis. West of Scotland Agricultural College, *Technical Bulletin No. 222. Agr. Scotland*.
- 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. Davidson, 2005.** Saponin. <http://Micro.Magnet.Fsu.Edu/Phytoc hemicals/Page/Saponin/html>.
- Mitruka, B. M. and Rawnsley H. M., 1977.** Clinical biochemical and hematological reference values in normal experimental animals. Masson Publishing USA Inc. New York.
- Montgomery, R. D. 1980.** Cyanogens in toxic constituents of plant foodstuffs. Academic Press New York, pp. 143-153.
- Oakenfull, D. 1981.** Saponins in Food- A Review. *Food Chemistry* 6: 19-28.
- Ojewola, G. S., Amaefule, K. U., Abasiokong, S. F., Akinmutimi A. H., Lawal, A. S. and Anyanwu, K., 2002.** Response of broiler finishers to dietary methionine and or lysine supplementation. *Tropical Journal of Animal Science* 5 (1): 189-196.
- Olajide, R., A. O. Akinsoyinu., K. D. Afolabi and J. T. Ogunlade 2009.** Histopathological parameters of internal organs of broilers as affected by anti-nutritional factors of wild cocoyam (*Colocasia esculenta* (L.) Schott) corm-based diets. Proceedings 34th Ann. Conf. NSAP, Uyo, Nigeria, pp. 102-105.
- Olajide, R., A. O. Akinsoyinu., Afolabi, K. D., Owosibo, A. O., Fakolade, P. O. and 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. and 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.
- Onimisi, P. A., Dafwang, I. I., Omage, J. T., Bawa, G. S. and J. E. Onyibe 2010.** Performance of broiler chickens fed diets containing normal maize and quality protein maize (Obantapa). *Journal of Applied Agricultural Research* 2: 69-74.
- Oyenuga, V. A. 1973.** Foods and feeds of Tropical Africa. Proceedings of the International Symposium on Animal production in the Tropics, held at the University of Ibadan, Nigeria. pp. 26-29.
- Panda, A. K. 2006.** Phosphorus: The Essential Mineral. *Feed-Mix*, 14 (1): 16-17. www.AGRIWORLD.NL
- Pauzenga, U. 1985.** Feeding Parent Stock. *Zootecnica International*, December 1985, pp. 22-24.
- Preeti Hemant, 2003.** The taro root: a versatile tuber. preeti@29-pool3.ras10.ilchi.alerondial.net
- SAS Institute, 1999.** SAS START R Users Guide: Statistics. Version 9 Edition. SAS Institute, Inc., Cary, North Carolina, USA.
- Sefa-dede, S. and Agyir-Sackey, E. K. 2006.** Chemical composition and effect of processing on oxalate content of cocoyam *Xanthosoma sagittifolium* and *Colocasia esculenta* corms. *Food Chemistry* 85, (4): 479-487.
- Sonaiya, E.B. 1995.** Feed resources for smallholder poultry in Nigeria. *World Animal Review*. 85: 1. <http://www.fao.org/docrep/V4440T/v4440T0a.htm>
- Summers, D., Leeson, S. 1986.** Influence of nutrition density on feed composition, weight gain and gut capacity of broiler, leghorns and turkey reared to 26 days of age. *Animal Feed Science and Technology* 16: 124-129.
- Tanveer, A., Shahid, R., Muhammed, S., Ahsan-ul, H. and Zia-ul, H. 2000.** Effect of Microbial Phytase produced from a fungus *Aspergillus niger* on bioavailability of phosphorus and calcium in broiler chickens. *Animal Feed Science and Technology*, 83 (2): 103-114.
- Tion, M. A., Orga, M. T. and Adeka, I. A. 2005.** The effect of calorie to protein ratio of practical diets on performance and carcass quality of broiler chickens. *Nigerian Journal of Animal Production*, 32 (2): 253-260.
- Zaczek, V., Jones, E. K. M., Makloed, M. G. and Hocking, P. M. 2003.** Dietary fibre improves the welfare of female broiler breeders. *British Poultry Science*, 44: 530.

Received: 13th July, 2011

Accepted: 9th October, 2012