Available online at www.worldscientificnews.com

World Scientific News

WSN 56 (2016) 45-55 EISSN 2392-2192

# Growth performance and haematology of broiler chickens fed diets with graded sweet potato (*Ipomoea batatas*) leaf meals

**C. R. Unigwe**[1,*], **C. E. Ononogbu**[1], **A. D. Adejuyigbe**[1] and **F. O. Abonyi**[2]

[1]Federal College of Animal Health and Production Technology, Ibadan, Nigeria

[2]Department of Veterinary Animal Health and Production, University of Nigeria, Nsukka, Nigeria

*E-mail address: robinsonunigwe@gmail.com

**ABSTRACT**

A total of 60 Russ 2011 two weeks old broiler chicks with an average weight of $215.33 \pm 4.55$g were fed with diets compounded with sweet potato leaves (SPL) for 56 days. The diets consist of $T_1$ (0% SPL), $T_2$ (5% SPL), $T_3$ (10% SPL) and $T_4$ (15% SPL). The proximate composition of the SPL was determined in the laboratory. The birds were randomly allocated to four treatments using completely randomized design (CRD). Each treatment was subdivided into three replicates of five chicks each. At the end of the experiment, all data collected were subjected to one way analysis of variance and difference in means was separated using Duncan's New Multiple Range Test. The results showed no significant difference ($p>0.05$) in the average body weight gain, feed intake, feed conversion ratio (FCR) and protein efficiency ratio (PER). However, birds on $T_2$ (32.77g) had the best daily body weight gain followed by $T_4$ (30.36g), $T_3$ (30.06g) and $T_1$ (29.21g) while in terms of daily feed intake, $T_4$ (98.20g) consumed most followed by $T_2$ (98.17g) and $T_3$ (96.59g) whereas, $T_1$ (92.38g) consumed the least feed. The birds on $T_2$ (3.00) demonstrated the best FCR followed by $T_1$ (3.16), T3 (3.21) and $T_4$ (3.23). Also $T_1$ (1.59) showed the best PER closely followed by $T_1$ (1.53), $T_3$ (1.46) and $T_4$ (1.43). There was, however, a significant difference ($p<0.05$) in Hb concentration when $T_2$ (11.62g/dl) and $T_3$ (12.48g/dl) were compared with $T_1$ (10.34g/dl) and $T_4$ (10.21g/dl). In the PCV, a statistical difference ($p<0.05$) also was observed between T1 (24.73%) and others ($T_2$ (28.18%), $T_3$ (28.97%)and $T_4$ (27.14%)) while similar trend ($p<0.05$) was seen in the RBC count when $T_4$ ($9.72 \times 10^6$/ul) was compared with $T_1$ ($10.21 \times 10^6$/ul), $T_2$ ($10.81 \times 10^6$/ul) and $T_3$ ($11.43 \times 10^6$/ul) and no significant difference ($p>0.05$) among all the treatments with respect to WBC ($T_1$ ($21.23 \times 10^3$/ul), $T_2$ ($19.18 \times 10^3$/ul), $T_3$ ($21.26 \times 10^3$/ul) and $T_4$ ($22.63 \times 10^3$/ul)). Although the haematological parameters fell within normal physiological ranges, there was a gradual increase in these values as the inclusion levels progressed till $T_3$ (10% inclusion) and then a decrease. It is therefore recommended that inclusion of SPL up to 5% in the diet of broilers is good for enhanced body weight gain, FCR and PER and up to 10% for enhanced haematological parameters.

***Keywords*****:** Broilers; FCR; growth; haematology; PER; sweet potato leaf meal

## 1. INTRODUCTION

Vegetables serve as an indispensable constituent of the human diet supplying the body with minerals, vitamins and certain hormone precursors, in addition to protein and energy (Oyenuga and Fetuga, 1975). They are allowed to waste and sometime constitute to health hazard through the stench that exude from their decomposing heaps, as well serving as unending source of pathogenic organisms to animals and humans.

The principal material problem facing the poultry industry today, particularly the broiler production, remains the high costs of poultry feeds resulting from the soaring costs of grains (Mmerole, 1996; Mmerole, 2008) that supply energy and protein. The grains are known to constitute 60-70% of the poultry feeds (Ekenyem, 2007). The high costs of grains are due to the competition for grains between livestock feeds and other large scale demands such as for human consumption and industrial uses as in the case of breweries and confectionaries (Mmerole, 2009). Sweet potato leaves (SPL) are occasionally used as vegetables in yam and cocoyam porridges in some parts of Nigeria particularly among the Efik-Ibibio people of South-Eastern Nigeria (Eka and Edijala, 1972). Besides being used for human consumption, the leaves serve as fodder for cattle, sheep, goats, pigs and other domestic animals (Antia *et al.,* 2006). For the fact that some of these leaves with high nutritional composition are allowed to waste, there is need to utilize them in poultry and other domestic animal's feeds to help reduce cost of feed and by extension that of production. Many studies have been conducted using various leaf meals as protein sources such as cassava leaf meal (Ng and Wee, 1989), alfalfa (Yousif *et al*., 1994), *Carica papaya* and other leaf meals (Reyes and Fermin, 2003), *Leucaena leucocephala* leaf meal (Bairagi *et al*., 2004) and sweet potato leaf meal (Adewolu, 2008; Wude and Berhan, 2009; Antia *et al*., 2006; Mmerole, 2009).

In the past decades, studies have been carried out to identify alternative and non-conventional feed resources which are cheap and easily available for poultry production (Aduku, 1993; Esonu *et al*., 2003; Ekenyem, 2007; Mmerole, 2009). Sweet potato (*Ipomoea batatas*) belongs to the morning-glory family:- convolvulaceae. It is cultivated in over 100 nations and ranks fifth among the most important food crops in the tropical areas (An, 2004). The leaves of this plant have been used in the tropics as cheap protein sources in ruminant feeds (Adewolu, 2008). Studies have been conducted to determine the nutritive value of SPL. According to Woolfe (1992), Teguia *et al.* (1997), Ishida *et al*. (2000), An (2004), Nguyen and Ogle (2004) and Ekenyem and Madubuike (2006), the leaf meal has a high crude protein content of between 24-33%, with high amino acid content with good mineral profile and vitamins A, B, C and E. Apart from its nutritive value, SPL can be harvested many times throughout the year (Hong *et al*., 2003). One major factor limiting the use of this leaf meal is the presence of anti-nutritional factors (Tacon, 1993) which according to Oyenuga (1968) are the invertase and protease inhibitors and by Antia *et al*. (2006) are cyanide, tannins, oxalate and phytate. However, these substances can be inactivated by various processing methods such as oven or sun-drying, boiling or steaming and grinding prior to inclusion in the feed (Adewolu, 2008). Also the leaves are deficient in an essential amino acid:- lysine, necessitating the inclusion of adequate lysine in poultry diets (Fuller and Chambellain, 1982).

Since there are scanty information on the growth performance effect and haematology of this leaf on broiler considering its relatively high crude protein content and in contrast, some anti-nutritional factors, there is need to evaluate the growth performance of broilers on the leaf meal to ascertain its efficacy or otherwise.

## 2. MATERIALS AND METHODS

### Experimental site, source, processing and proximate analysis of sweet potato leaves

The experiment was conducted at the poultry unit of The Research Farm of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan, Nigeria. The sweet potato leaves (SPL) were bought from Omi market in Ibadan. The leaves were destalked, washed and sun-dried to constant weight for 3-5 days on a plastic sheet laid on concrete floor. Part of the leaves was ground to fine powder using mortar and pestle and sent to the laboratory of Food Science Technology of the same University for proximate composition analysis (AOAC, 1990). The remaining leaves were milled and mixed with other ingredients to compound the feeds

### Source of other ingredients and compounding of diet

Other ingredients including maize, groundnut cake, palm kernel cake, fish meal, wheat offal, lime stone, bone, lysine, methionine, premixes, mycofix and salt were bought from the open market in Ibadan. The above ingredients coupled with processed sweet potato leaves (SPL) were used to compound the starter and finisher diets (Tables 1 & 2) thus:

$T_1$ = conventional diet without SPL,
$T_2$ = Diet with 5% SPL,
$T_3$ = Diet with 10% SPL and,
$T_4$ = Diet with 15% SPL.

In the end of the compounding, each of the diets was subjected to proximate analysis using the method of AOAC (1990).

### Experimental birds, design, management and duration

A total of sixty RUSS 2011 broiler chicks aged 2 weeks with average weight of 215.33$\pm$4.55g were used for the research. The birds were randomly allocated to four treatments using completely randomized design (CRD). Each treatment was subdivided into three replicates of five chicks each, making a total of 12 replicates and sixty birds. The poultry house was cleaned and washed with disinfectant solution, allowed un-stocked for two weeks. The poultry equipments were also cleaned and disinfected. Wood shavings were poured on the floor two days before the arrival of the chicks. On arrival, clean water with glucose and vitalyte was served as anti-stress. The initial weights were taken and recorded on arrival and sources of heat put on in the brooder house. They were fed twice daily, in the morning by 7am and evening by 5.30pm. All vaccination schedule was observed, the litter materials were replaced after the brooding stage and the sanitary/biosecurity was also maintained. They were dewormed using levamisol solution and given multivitamins during stress periods like vaccination and as well were given coccidiostat (Embazin forte$^{R}$). The experiment lasted for 8 weeks.

**Data collection**

Weekly weight gain:-This was collected weekly through weigh back mechanism.
Feed intake:- The daily feed intake was got through weigh back mechanism too.
Feed conversion ratio:- This was obtain by dividing the average total feed intake by average total weight gain.
Protein efficiency ratio:- This is the ratio of body weight gain to the crude protein intake in the feed.
Haematological study: At the end of the feeding trial, two broilers were selected from each replicate group, 5 ml of blood sample was taken with a sterile syringe and was put into a bijoh bottle containing ethylene diamine tetracetic acid (EDTA) as an anticoagulant for haematological analysis using methods of wintrobe microhaematocrit and cyanomethaemoglobin (Ghai, 1993) respectively. Red blood cell (RBC) and white blood cell counts (WBC) were determined using the haemacytometer method (Dacie and Lewis 1984).

**Statistical analysis**

All the data were subjected to one way analysis of variance and statistical difference in means was separated using New Duncan's Multiple Range Test (Obi, 2002).

## 3. RESULTS AND DISCUSSIONS

**Perfomance of broilers fed diets with sweet potato leaf meal**

Table 4 shows the performance characteristics of broiler birds fed diet compounded with 0%, 5%, 10% and 15% of SPL. There was no significant difference ($p>0.05$) in the average initial body weights among $T_1$ (210.67g), $T_2$ (221.33g), T3 (213.33g) and $T_4$ (216.00g) treatments. There was however a significant difference ($p<0.05$) when the average final body weight of birds in $T_1$ (1846.67g) was compared to $T_2$ (2056.67g), $T_3$ (1896.67g) and $T_4$ (1916.67g) but no significant difference ($p>0.05$) when $T_2$, $T_3$ and $T_4$ were compared. The average total body weight gain of $T_1$ (1636g), $T_2$ (1835.34g), $T_3$ (1683.34g) and $T_4$ (1700.67g) were however not statistically different ($p>0.05$) when compared. This study contradicts the findings of Teguia *et al*. (1993) and Wude and Berhan (2009) who reported statistically lower body weight gain beyond 10% inclusion of SPL but it is in tandem with the results of Amha (1990) and Adewolu (2008) who reported that birds assigned to 5%, 10% and 15% dried SPL diets gained approximately similar body weights as in this experiment. This trend of gradual increase in average body weight gain as the SPL increased could be due to some growth promoting principles in the leaf.

This can be corroborated by the fact that the previous works of Woolfe (1992), Teguia *et al*. (1997), Ali *et al*. (1999), Ishida *et al*. (2000), An (2004), Nguyen and Ogle (2004) and Ekenyem and Madubuike (2006) on SPL meal revealed high crude protein content of between 24-33%, high amino acid content, good mineral profile and vitamins A, B, C and E. Although the leaf contains anti-nutritional factors (Tacon, 1993) like invertase and protease inhibitors (Oyenuga, 1968), cyanide, tannins, oxalate and phytate (Antia *et al*., 2006), they can be inactivated by various processing methods like sun-drying, boiling and grinding prior to inclusion (Adewolu, 2008). The average total feed intake of $T_1$ (5173.16g), $T_2$ (5497.34g), $T_3$ (5403.82g) and $T_4$ (5499.43g) showed a significant difference ($p<0.05$) when $T_1$ was compared to other treatments but not so ($p>0.05$) when $T_2$, $T_3$, and $T_4$ were compared.

The high feed intake could be due to the anti-nutritional components of SPL which probably bound the nutrients and made them unavailable to absorption no wonder they ate more to meet their energy requirements (Hill and Danskey, 1954; Sahlotaut, 1987; Blaxter, 1989; Coop and Kyriazakis, 2001; Unigwe, 2011). This also gives credence to the fact that the feed even at 15% inclusion of SPL was palatable enough to the birds. This might be due to the processing technique (drying and grinding) employed in this study. This might have reduced the anti-nutrients in SPL as well increased its palatability to the birds. This is in conformity with the findings of Fagbenro (1999), Francis *et al*. (2001) and Siddhuraju and Becker (2003) who found that reduction in anti-nutrients by different processing techniques resulted in better palatability and growth in fish.

Although the nutritional quality of SPL as elucidated by daily body weight gains, FCR and protein efficiency ratio of broilers was highest in $T_2$ (5% SPL), there was no significant difference ($p>0.05$) among other treatments. This could be due to lower anti-nutrients $T_2$ diet compared to those of $T_3$ and $T_4$. It is also most probable that due to its higher metabolisable energy and crude protein content compared to the $T_1$ (0% SPL), it did better relatively. This agrees with the findings of Grimmes *et al*. (1997) and Okonkwo *et al*. (1995) that as the level of the fibrous ingredient such as SPL increases in the broiler diet, the growth performance characteristics start to decline. It also exonerates the work of Farrell *et al*. (2000) who reported no significant difference ($p>0.05$) in FCR by broilers fed 0, 4, 8, 12 and 16% sweet potato vine. Also corroborates Teguia *et al.* (1993) who included dried SPL up to 20% without any detrimental effect on body weight gain and FCR. But for the fact that there was no significant difference ($p>0.05$) among these performance characteristics, it agrees with Okoye (2001) who observed no inferior performance of broilers fed cassava leaf meal when compared to those fed 100% maize diets so long as the inclusion does not exceed 10%, beyond which performance traits start to decline.

**Haematology of broilers fed diets containing sweet potato leaf meal**

Table 5 shows a significant difference($p<0.05$) in haemoglobin (Hb) concentration between $T_1$(10.34g/dl)/$T_4$(10.21g/dl) and $T_2$(11.62g/dl)/$T_3$(12.48g/dl) while in packed cell volume (PCV), there was a significant difference ($p<0.05$) when $T_1$(24.73%) was compared with $T_2$(28.18%), $T_3$(28.97%) and $T_4$(27.14%). In the same vein, the red blood cell count (RBC) showed that there was a significant difference ($p<0.05$) when $T_1$ ($10.21x10^6/\mu l$), $T_2$ ($10.81x10^6/\mu l$) and $T_3$ ($11.43x10^6/\mu l$) were compared with $T_4$ ($9.72x10^6/\mu l$). There was no significant difference ($p>0.05$) among $T_1$ ($21.23x10^3/\mu l$), $T_2$ ($19.18x10^3/\mu l$), $T_3$ ($21.26x10^3/\mu l$) and $T_4$ ($22.63x10^3/\mu l$) in respect of white blood cell (WBC) count.

The general increase in PCV, RBC, WBC, and Hb of broilers fed diets that contained graded levels of SPL particularly as the level increased from 5% to 10% shows that the leaf may contain blood forming factors that may have stimulated more blood production by the broilers. The high crude protein (24.21%) and ash (11.05%) contents as demonstrated by the proximate analysis (table 3) could also be pointed at, as being contributory to the elevated haematological indices since Brown and Clime (1991) opined that increased haematological parameters could be associated with high quality protein. In the same vein, Unigwe and

Nwakpu (2009) demonstrated increase in Hb, RBC and PCV due to increased mineral content of feed which is an indispensible factor of erythropoesis. The gradual rise in WBC as the inclusion levels increased could suggest that SPL might have helped in boosting the immune system of the broilers. These haematological parameters fall within the normal physiological ranges as established by Mitruka and Rawnsley (1977), Ross *et al*. (1978) and Mmerole (1996).

## 4. CONCLUSION

It can be concluded that 5% sweet potato leaf (SPL) meal in the diet of broilers enhance growth performance, feed conversion ratio and protein efficiency ratio without any deleterious effect while 10% of SPL increases blood parameter indices better than other lower inclusions.

**Table 1.** Composition of the experimental starter diets.

| Ingredient | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
|---|---|---|---|---|
| SPL | 0 | 5 | 10 | 15 |
| Maize | 45 | 45 | 45 | 45 |
| GNC | 25 | 25 | 25 | 25 |
| PKC | 21 | 16 | 11 | 06 |
| Fish meal | 3 | 3 | 3 | 3 |
| Wheat offal | 2 | 2 | 2 | 2 |
| Lime stone | 0.9 | 0.9 | 0.9 | 0.9 |
| Bone meal | 2 | 2 | 2 | 2 |
| Lysine | 0.25 | 0.25 | 0.25 | 0.25 |
| Methionine | 0.20 | 0.20 | 0.20 | 0.20 |
| Broiler premix | 0.25 | 0.25 | 0.25 | 0.25 |
| Mycofix | 0.10 | 0.10 | 0.10 | 0.10 |
| Salt | 0.30 | 0.30 | 0.30 | 0.30 |
| Total | 100 | 100 | 100 | 100 |
| Crude protein (%) | 21.56 | 21.91 | 22.23 | 22.61 |
| ME (kcal/kg) | 2731.80 | 2760.40 | 2789.01 | 2817.65 |

**Table 2.** Composition of the experimental finisher diets.

| Ingredient | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
|---|---|---|---|---|
| SPL | O | 5 | 10 | 15 |
| Maize | 45 | 45 | 45 | 45 |
| GNC | 18.10 | 18.10 | 18.10 | 18.10 |

| | | | | |
|---|---|---|---|---|
| PKC | 25 | 20 | 15 | 10 |
| Fish meal | 3 | 3 | 3 | 3 |
| Wheat offal | 5 | 5 | 5 | 5 |
| Lime stone | 0.8 | 0.8 | 0.8 | 0.8 |
| Bone meal | 2 | 2 | 2 | 2 |
| Lysine | 0.25 | 0.25 | 0.25 | 0.25 |
| Methionine | 0.20 | 0.20 | 0.20 | 0.20 |
| Broiler premix | 0.25 | 0.25 | 0.25 | 0.25 |
| Mycofix | 0.10 | 0.10 | 0.10 | 0.10 |
| Salt | 0.30 | 0.30 | 0.30 | 0.30 |
| Total | 100 | 100 | 100 | 100 |
| Crude protein (%) | 19.72 | 20.07 | 20.42 | 20.77 |
| ME (kcal/kg) | 2633.60 | 2662.24 | 2690.84 | 2719.44 |

Key:- SPL = Sweet potato leaf, GNC = Groundnut cake, PKC = Palm kenel cake, ME = Metabolisable energy

**Table 3.** Proximate chemical composition of sweet potato leaf.

| Nutrient | Composition (%) |
|---|---|
| Moisture | 4.07 |
| Crude protein | 24.21 |
| Crude fibre | 7.74 |
| Crude fat | 3.88 |
| Ash | 11.05 |
| Nitrogen free extract | 49.05 |
| Dry matter | 81.78 |
| Metabolisable energy (kca/kg) | 2668.36 |

**Table 4.** Growth performance characteristics of broilers fed sweet potato leaves diet.

| Parameter | $T_1$ | $T_2$ | $T_3$ | $T_4$ | SEM |
|---|---|---|---|---|---|
| Av. initial bwt (g) | 210.67 | 221.33 | 213.33 | 216 | 7.42 |
| Av. final bwt (g) | $1846.67^{b}$ | $2056.67^{a}$ | $1896.67^{a}$ | $1916.67^{a}$ | 85.40 |
| Av. total bwt gain (g) | 1636 | 1835.34 | 1683.34 | 1700.67 | 85.14 |
| Av. daily bwt gain (g) | 29.21 | 32.77 | 30.06 | 30.36 | 1.46 |

| | | | | | |
|---|---|---|---|---|---|
| Av. total feed intake (g) | $5173.16^{b}$ | $5487.34^{a}$ | $5403.82^{a}$ | $5499.43^{a}$ | 160.06 |
| Av. daily feed intake (g) | $92.38^{b}$ | $98.17^{a}$ | $96.50^{a}$ | $98.20^{a}$ | 2.83 |
| Feed conversion ratio (FCR) | 3.16 | 3.00 | 3.21 | 3.23 | 0.12 |
| Protein efficiency ratio (PER) | 1.53 | 1.59 | 1.46 | 1.43 | 0.11 |

ab: Means on the same row with different superscripts are significantly different ($p<0.05$)

**Table 5.** Haematology of broilers fed diets containing sweet potato leaf meal

| Parameter | $T_1$ | $T_2$ | $T_3$ | $T_4$ | SEM | *NORMAL |
|---|---|---|---|---|---|---|
| Haemoglobin(g/dl) | $10.34^{b}$ | $11.62^{a}$ | $12.48^{a}$ | $10.21^{b}$ | 1.28 | 8-15 |
| PCV(%) | $24.73^{b}$ | $28.18^{a}$ | $28.97^{a}$ | $27.14^{a}$ | 2.64 | 22-30 |
| RBC($x10^6/\mu l$) | $10.21^{a}$ | $10.81^{a}$ | $11.43^{a}$ | $9.72^{b}$ | 4.14 | 8.5-17 |
| WBC($x10^3/\mu l$) | 21.23 | 19.18 | 21.26 | 22.63 | 2.33 | 18-30 |

Ab; Means on the same row with different superscripts are statistically different ($p<0.05$)
* Mitruka and Rawnsley (1977)

## References


[1] Adewolu, M.A. (2008). Potentials of sweet potato (*Ipomoea batatas*) leaf meal as dietary ingredient for *Tilapia zilli* fingerlings. *Pak. J. Nutr.* 7(3): 444-449.

[2] Aduku, A.O. (1993). Tropical Feed Stuff Analysis Table. Ahmadu Bello University, Saaru, Zaria, Nigeria.

[3] Ali, M.A., Tageldin, T.H. and Solaiman, E.M. (1999). Effect of sweet potato tops or roots in growing rabbit diets on growth performance, digestibility, carcass traits and economic efficiency. *Egypt J. Rabbit Sci*. 9: 13-23.

[4] Amha, K. (1990). Evaluation of the nutritive and supplementary values of noug seed meal (*Guizotia abyssinica*) in commercial broiler chicks' ration. MSc thesis submitted to School of Gradute Studies, Alemaya University.

[5] An, L.V. (2004). Sweet potato leaves for growing pigs-Biomass yield, digestion and nutritive value. Doctoral thesis, Swedish University of Agricultural Science.

[6] Antia, B.S., Akpan, E.J., Okon, P.A. and Umoren, I.U. (2006). Nutritive and Anti-Nutritive Evaluation of Sweet Potato (*Ipomoea batatas*) Leaves. *Pak. J. Nutr*. 5(2): 166-168.

[7] Association of Official Analytic Chemist (AOAC) (1990). Official Method of Analysis. 15th Ed., Washington DC.

[8] Bairagi, A.K., Sarkar, G., Sen, S.K. and Ray, A.K. (2004). Evaluation of the nutritive value of *Leucaena leucocephala* leaf meal inoculated with fish intestine bacteria-

*Bacillus subtilis* and *Bacillus circulans* in formulated diets for rohu, Labeo rohita (Hamilton) fingerlings. *Aquaculture Res*. 35: 436-446.

[9] Blaxter, K.L. (1989). Energy metabolism in animal and man. Cambridge press, 336.

[10] Brown, J.A. and Clime, T.R. (1991). Comparative haematology of rabbit on forage and graded concentrares. *J. Anim. Sci.* 35: 211-218.

[11] Coop, R.L. and Kyriazakis, I. (2001). Influence of host nutrition on the development and consequences of nematode parasitism in ruminants. *Trends Parasitology* 17: 325-330.

[12] Dacie, F.F. and Lewis, S.M. (1984). *Practical Haematology*. 6th Ed. Churchill Livingston, New York.

[13] Eka, O.U. and Edijala, J.K. (1972). Chemical composition of some traditionally prepared Nigerian foods. *J. Boil. Appl. Chem*., 6: 177-180.

[14] Ekenyem, B.U. (2007). Effect of dietary inclusion of *Ipomoea ascarifolia* leaf meal on the performance of carcass and organ characteristics of grower pigs. *Adv. Sci. Technol.,* 1: 87-91.

[15] Ekenyem, B.U. and Madubuike, F.N. (2006). An assessment of *Ipomoea ascarifolia* leaf meal as feed ingredient in broiler chick production. *Pak. J. Nutri*., 5: 46-50.

[16] Esonu, B.O., Iheukwumere, F.C., Iwuji, T.C., Akanu, N. And Nwugo, O.H. (2003). Evaluation of *Microdesmis puberula* leaf meal as a feed ingredient in broiler starter diets. *Nig. J. Anim. Prod.,* 30: 3-7.

[17] Fagbenro, A.O. (1999). Comparative evaluation of heat-processed winged bean (*Psophocarpus tetragonalobus)* meal as partial replacement of fish meal in diets for African catfish (*Clarias gariepinus*). *Aquaculture*, 170: 297-305.

[18] Farrell, R.D., Jibril, J., Maldonada, H. and Mannion, P. (2000). A note on comparison of the feeding value of sweet potato vines and lucerne meal for broiler chicks. *J. Anim. Feed sci. Technol.,* 85: 145-150.

[19] Francis, G., Makkar, H.P.S. and Becker, K. (2001). The anti-nutritional factors present in plant-derived alternative fish feed ingredients and their effects in fish. *Aquaculture,* 119: 197-207.

[20] Fuller, M.F. and Chambelain, A.G. (1982). Protein requirements of pigs. Ed. W. Haresign. In: Recent Advances in Animal Nutrition, Butterworth, London, 176.

[21] Ghai CL (1993). A textbook of Practical Physiology. 4th edn. Jaypee Brother Medical Publisher Ltd .

[22] Grimmes, G.L., Perked, P.R. and Ground, A.N. (1997). Enzyme supplementation on broiler and turkey diets to enhance wheat utilization. Proceedings of the Alltech's 13th Annual Symposium, Nottingham University Press, Nottingham, 131-138.

[23] Hill, F.W. and Danskey, L.M. (1954). Studies on energy requirements of birds:- The effect of dietary energy levels on growth and feed consumption. *Poultry Sci.,* 33: 119-122.

[24] Hong, N.T.T., Wanapat, M., Wachirapakorn, C.K.P. and Rowlinson, P. (2003). Effect of timing of initial cutting and subsequent cutting on yields and chemical composition of cassava hay and its supplementation on lactating dairy cows. *Asian-Australian J. Anim. Sci*., 16: 1763-1769.

[25] Ishida, H., Suzuno, H., Sugiyama, N., Imami,S., Tadokoro, T. and Meakawa, A. (2000). Nutritive value on chemical components of leaves, stalks and stem of sweet potato (*Ipomoea batatas Poir*). *Food Chem*., 68: 359-367.

[26] Mitruka, B.M. and Rawnsley, H.M. (1977). Clinical, biochemical and Haematological Reference Values in Normal Experimental Animals. Mason Publishing Company, New York, 35-50.

[27] Mmereole, F.U.C. (2009). Evaluation of dietary inclusion of sweet potato (*Ipomoea batatas*) leaf meal (SPLM) with and without enzyme treatment in broiler diets. *Pak. J. Nutr*. 8: 841-844.

[28] Mmerole, F.U.C. (1996). The study of haematological parameters in the Nigerian local chicken. *Nig. J. Anim. Prod*., 1: 94-97.

[29] Mmerole, F.U.C. (2008). Effects of replacing groundnut cake with rubber seed meal on the haematological and serological indices of broilers. *J. Polut. Sci*., 7: 622-624.

[30] Ng, W.K. and Wee, K.L. (1989). Thr nutritive value of cassava leaf meal in pelleted feed for Nile tilapia. *Aquaculture*, 83: 45-58.

[31] Nguyen, T.T. and Ogle, B. (2004). The effect of supplementing different green feed (water spinach, sweet potato leaves and duck weed) to broken rice based diets on performance, meat and egg yolk color of Luong Phuong chickens. Doctoral thesis, Department of Animal Nutrition and Management, Sweden University.

[32] Obi, I.U. (2002). Statistical Methods of detecting differences between treatment means and research methodology issues in laboratory and field experiments, AP Express Publishing Company, Limited, 13-19.

[33] Okonkwo, A.C., Wamagi, I.T., Okon, B.I. and Umoh, B.I. (1995). Effects of *Leucaena leucocephala* seed meal on the performance and carcass characteristics of broilers. *Nig. J. Prod*., 22: 44-48.

[34] Okoye, F.C. (2001). Replacement of cassava leaf meal for maize as energy source in the diet of broiler chicks. Proceedings of the 26$^{th}$ Annual Conference of the Nigerian Society for Animal Production, Cornell University, New York, 289-290.

[35] Oyenuga, V.A. (1968). Nigerian food and feeding stuffs- their chemistry and nutritive value. 3$^{rd}$ ed. University Press, Ibadan, Nigeria.

[36] Oyenuga, V.A. and Fetuga, B.L. (1975). First national seminar on fruits and vegetables. In: Proc. and Recom. papers,NIHORT, Ibadan.

[37] Reyes, O.S. and Fermin, A.C. (2003). Terrestrial leaf meals or freshwater aquatic fern as potential feed ingredients for farmed abalone *Hallotis asinine* (Linnaeus 1758). *Aquaculture Res*., 34: 593-599.

[38] Ross, J.D., Christie, G., Holiday, W.G. and Jones, R.M. (1978). Haematological indices in chicken on range management. *Vet Record*, 102: 29-31.

[39] Sahlotaut, B.P. (1987). Nutritional needs and feeding of German Angora rabbits. *Int. Appl. Rabbit Res*., 10(3): 11-14.

[40] Siddhuraju, P. and Becker, K. (2003). Comparative nutritional evaluation of differentially processed mucuna seeds (*Mucuna pruriens L var utilis*) on growth performance, feed utilization and body composition in Nile tilapia (*Oreochromis niloticus L). Aquaculture,* 34: 487-500.

[41] Steel, R.G.D. and Torrie, J.N. (1980). Principles and Procedures of Statistics. McGraw Hill co. Inc. New York.

[42] Tacon, A.G.J. (1993). Feed ingredients for warmwater fish and other processed feedstuffs. FAO Fisheries Circular No 856, FAO, Rome, 64.

[43] Teguia, A., Niwe, R.M. and Nguekouo, F.C. (1997). Effect of replacement of maize with dried leaves of sweet potato (*Ipomoea batatas*) and perennial peanuts *(Arachis glabratas*) on the performance of finishing broilers. *Anim. Feed Sci. and Technol.*, 66: 283-287.

[44] Teguia, A., Tchoumboue, J., Mayaka, B.T. and Tankou, C.M. (1993). The growth of broiler chicks as affected by the replacement of graded levels of maize by sweet potato leaves (*Ipomoea batatas). Animal Feed Science and Tech*., 40: 233-237.

[45] Unigwe, C.R. and Nwakpu, P.E.(2009). Effect of Ingestion of Garcinia kola Seed on Erythrocytes in Rabbits. *Continental J. Vet. Sci.*, 3: 7-10.

[46] Unigwe, C.R. (2011). Effect of graded levels of *Hibiscus sabdariffa Linn* (Rosella) calyx extraction on growth performance and haematology of broiler chickens. *Global Res. J. Sci*., 1: 78-81.

[47] Woolfe, J.A. (1992). Sweet potato- an untapped food resource. Cambridge University Press, Cambridge, 643.

[48] Wude, T. and Berhan, T. (2009). The effect of increasing levels of dried leaves of sweet potato (*Ipomoea batatas*) on dry matter intake and body weight gain performance of broiler finisher chickens. *Livestock research for rural dev*. 21(2): 1-6.

[49] Yousif, O.M., Alhadhrami, G.A. and Passaraki, M. (1994). Evaluation of dehydrated alfalfa and saltbush (Atriplex) leaves in diets for tilapia (*Oreochromis aureus* L.). *Aquaculture,* 126: 341-347.

( Received 20 September 2016; accepted 04 October 2016 )