EFFECT OF SWEET POTATO LEAF MEAL ON GROWTH, HAEMATOLOGY AND MEAT QUALITY OF BROILER CHICKEN

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ABSTRACT

This study was conducted to assess the efficacy of sweet potato leaf meal (SPLM) as an alternative feed ingredient in broiler chicken ration using growth, haematology and meat quality parameters as criteria. One hundred and eight (108) started chickens were divided into four treatments with three replicates/ treatment and nine birds/ replicate in a completely randomized design. SPLM was included in their feed at 0(control), 5, 10 and 15 %. Data on body weight and feed intake were taken during the experiment. Blood parameters and meat quality were assessed at the end of the trial. Results showed that weight gain (WG), feed intake and feed conversion ratio (FCR) were significantly influenced ($p<0.05$) by SPLM treatments. Broiler chicken fed 5 % SPLM diet had 1.18 kg WG, which was statistically same as control whereas those on 15 % SPLM diet had the least value of 0.76 kg. Values for FCR increased progressively with increasing inclusion of SPLM, chickens on 0 % had a value of 2.79 and those on 15 % had 4.66. Inclusion of up to 15 % SPLM did not have any detrimental effect on blood profile and meat quality of the chickens. It was concluded based on growth performance that the use of SPLM in broiler chicken diets should not exceed 5 %.

Keywords: Potato leaves, Broiler chickens, Alternative feed resource, Cooking loss, Meat palatability

INTRODUCTION

Sweet potato (*Ipomoea batatas*) belongs to the family Convolvulaceae and is widely grown in many parts of the world. The plant grows fast (Abonyi *et al*., 2012) and the leaves can be harvested up to four times during a cycle. Hence, the availability of sweet potato leaves can be assured throughout the year. Also, not many people consume sweet potato leaves. Most times, the leaves are left as wastes after harvesting the tubers or used to feed ruminants.

There is the need to increase the supply of animal protein to the populace for health and vitality mostly in the tropics; and rearing of poultry could help achieve this easily. Meat from broiler chickens is highly enjoyed by both young and old people. Poultry production requires less water and has less negative impact on the environment than other animal species (Farrell, 2010) but the shortage and high cost of feed ingredients needed by the chickens have been a major obstacle to expansion of the poultry industry (Adebayo and Adeola, 2005). Feeds compounded and given to domesticated animals should also have the attributes of maintaining their health and improving the quality of their products. Thus, it is essential to continue exploring the potentials of other materials which can be used as feed ingredients for poultry and are not in stiff competition with man for food and industrial use.

Sweet potato leaf meal (SPLM) has been used in broiler diets (Mmereole, 2009; Tsega and Tamir, 2009). According to Heuzé *et al.* (2013), dried sweet potato leaves increased the yellow colouration of broiler skin and egg yolk. Sweet potato leaf is rich in protein, iron and vitamins which make it a useful haematinic. However, there is dearth of information on the influence of SPLM on meat quality. Thus, the study was conducted to assess the effect of SPLM on growth performance, haematology and meat quality of broiler chickens (Marshall Breed).

MATERIALS AND METHODS

Experimental Site: This study was carried out at the Poultry Section of the Teaching and Research Farm and Department of Animal Production and Health laboratory of the Federal University of Technology, Akure (FUTA), Ondo State, Nigeria. The institution is geographically located between latitude 7°5″N and longitude 5°15″E at an altitude of 370 m above sea level (Oyinloye, 2013). The experiment lasted for 4 weeks.

Collection of Test Ingredient: Sweet potato leaves were harvested fresh from areas within Ondo and Osun States, Nigeria. These leaves were identified (Hutchinson and Daziel, 1954) and authenticated by a botanist in the Department of Forestry and Wood Technology, FUTA, where voucher specimen (DFWTH - 0321) was deposited in FUTA herbarium. The leaves were shade-dried for few days until crispy with their greenish colouration intact, milled and stored pending use.

Toxicity and Antinutritrive Factors Assay of Sweet Potato Leaves: The toxicity and antinutritrive values used for this study were adopted from the studies of Almazan (1995), Jiru and Urga (1995), Antia *et al*. (2006) and Mwanri *et al*. (2011).

Experimental Diets: SPLM was included in broiler finisher feeds at 0, 5, 10 and 15 % to make four (4) experimental diets; 0% inclusion was the control. The gross compositions of the experimental diets are shown in Table 1.

Experimental Birds and Management Practices: The ethical guidelines for the use of animals in research adopted in this study were those of NENT (2018). One hundred and eight (108) 4-weeks old broiler chickens (Marshall Breed) were randomly allocated to the four dietary treatments. Each treatment was replicated thrice and there were 9 birds per replicate in a completely randomized design. The experiment was approved after due presentations to the research protocol team of the Department of Animal Production and Health, FUTA. Birds were reared on deep litter and managed under good hygienic conditions throughout the experimental period. Experimental diets and potable water were supplied *ad libitum*. Newcastle disease and Gumboro vaccines were administered orally before the chickens were 4 weeks old (1st doses on day 6 and 15 respectively).

Growth Performance and Feed Conversion Ratio: Data on initial body weights (which is a reflection of weights after termination of starter phase), weekly body weights and feed intake were recorded during the trial. Weight gain was calculated as difference between final body weight and initial body weight. Feed conversion ratio was calculated as feed intake divided by weight gain (Kalia *et al*., 2017).

Haematological Study: Blood samples were collected for haematological studies into ethylene diamine tetra-acetic acid (EDTA) bottles from three birds per replicate at the end of the trial when the birds were 8 weeks old. The bottles were capped and inverted repeatedly for about a minute to prevent clotting of blood samples. Blood was drawn into micro-haematocrit capillary tubes, sealed at one end and left to stand vertically for 1 hour to determine the erythrocyte sedimentation rate (ESR). Packed cell volume (PCV) was measured with haematocrit reader. Absolute values; mean corpuscular haemoglobin concentration (MCHC), mean corpuscular haemoglobin (MCH) and mean corpuscular volume (MCV) were then calculated (Odunitan-Wayas *et al*., 2018).

Table 1: Composition of diets for broiler-chicken finishers fed sweet potato leaf meals

Ingredients (kg)	Control	5%	10%	15%
Maize	52.50	51.30	48.20	44.50
Sweet Potato Leaf Meal	0.00	5.00	10.00	15.00
Wheat offal	13.00	8.00	6.50	6.00
Soyabean meal	15.00	15.00	14.60	14.10
Groundnut cake	13.90	15.10	15.10	14.80
Others*	5.60	5.60	5.60	5.60
Total	100	100	100	100
Calculated analysis				
ME (Kcal/Kg)	2989.62	3092.37	3152.89	3200.89
Crude protein (%)	19.79	20.54	21.01	21.42
Crude fibre (%)	3.83	3.85	4.05	4.30
Ether extract (%)	4.11	4.12	4.08	4.03
Calcium (%)	1.03	1.08	1.13	1.18
Phosphorus (%)	0.50	0.54	0.58	0.63

**Vegetable oil- 2.00%; Bone meal- 2.40; Oyster shell- 0.20; Lysine - 0.20; Methionine- 0.25; Premix- 0.25; Salt- 0.30, **2.5kg premix contains Vitamin A (8,000,000 I.U);Vitamin D3 (2,000,000 I.U); Vitamin E (5,000mg), Niacin (15,000mg); Vitamin B1 (1,500mg); Vitamin B2 (8,000mg); Vitamin B6 (1,500mg), Vitamin B12 (10mg); Vitamin K3 (2,000mg); Calpan (5,000mg); Biotin (20mg); Folic acid (500mg); Antioxidant (125,000mg); Choline chloride (200,000mg); Cobalt (200mg); Copper (5,000mg); Iodine (1,200mg); Iron (40,000mg); Manganese (80,000mg); Selenium (200mg); Zinc (60,000mg)*

Meat Quality Assessment

Cooking loss: The meat samples were weighed (initial weight) and carefully put into well labeled polythene bags. These bags were then cooked in boiling water for 35 minutes. Thereafter, the meat samples were removed, drained and allowed to cool to room temperature. The cooked meat samples were reweighed (final weight) and cooking loss obtained as: Cooking loss (%) = Initial weight of meat – Final weight of meat / Initial weight of meat x 100 / 1 (Adesua and Onibi, 2014).

Thaw loss: This was measured after a period of frozen storage of the three muscle types in the freezer. Each frozen sample was removed from the freezer, weighed (initial weight), put into well labeled punctured nylon and placed in the fridge for 24 hours to thaw. After this, the samples were removed from the nylons, mopped and reweighed (final weight). Thaw loss (%) = Initial weight of meat – Final weight of meat / Initial weight of meat x 100 / 1 (Jama *et al*., 2008).

Palatability: The palatability test was done using the thigh muscle after measurement of cooking losses for all treatments. The cooked meat samples were de-skinned, visible fat removed and cut into small pieces. These were coded and evaluated by a 9-member untrained student panel using a 9 point hedonic scale from extremely dislike (1) to extremely like (9) (Wichchukit and O'Mahony, 2015).

Statistical Analysis: All data generated were subjected to one-way analysis of variance (ANOVA). Where significant differences were found, means were compared using Tukey post-hoc test of the Minitab Statistical Package Version 17.

RESULTS

Toxicity and Antinutritrive Factors of Sweet Potato Leaf Meal: *I. batatas* extract had LC_{50} of 120.75 ppm. Sweet potato leaf had tannins (0.21 ± 0.02 mg/100g), oxalate (308.00 ± 1.04 mg/100g) and phytic acid (1.44 ± 0.01 mg/100g) and trypsin and chymotrypsin inhibitors were not detected.

Growth Performance of Broiler Chicken on Sweet Potato Leaf Meal: The final weight (kg/bird), total WG (kg/bird), total feed intake and FCR were significantly influenced ($p<0.05$) by SPLM treatments (Table 2). Broiler chickens fed the control diet had the highest final weight (2.36 ± 0.08 kg/bird) and total WG (1.32 ± 0.03 kg/bird). The weight gained by birds on 5 and

10 % SPLM were statistically ($p>0.05$) the same as control although a decreasing trend was observed with increasing SPLM inclusion. Birds on 15 % SPLM had the lowest WG of 0.76 ± 0.23 kg/bird. FCR increased with increasing levels of SPLM inclusion and was highest for birds fed 15 % SPLM.

Haematological Profile of the Broiler Chicken Fed Diets Containing Sweet Potato Leaf Meal: The PCV, red blood cell (RBC) count, haemoglobin concentration (Hb), erythrocyte sedimentation rate (ESR), mean cell volume (MCV), mean cell haemoglobin (MCH), mean cell haemoglobin concentration (MCHC), lymphocyte and heterophil were not significantly influenced ($p>0.05$) (Table 3). Numerically, values of PCV, RBC and Hb followed an increasing trend with increase in inclusion level of SPLM.

Quality of Meat from Broiler Chickens Fed Diets Containing Sweet Potato Leaf Meal: The palatability score, thaw loss for thigh, drumstick and chest and cooking loss for thigh were not significantly influenced ($p>0.05$) by SPLM inclusion (Table 4). Cooking loss for chest and drumstick were however significantly influenced ($p<0.05$). Cooking loss for both muscle types were highest for birds fed control diet.

DISCUSSION

Phytic acid is the main storage form of phosphorus in plant tissues, contrary to the notion that phosphorus from phytate is poorly utilized by monogastrics because they lack phytase. Tamim *et al*. (2004) reported that effective endogenous phytase activity goes on in the gastrointestinal tract of the animals. Nevertheless, calcium concentrations in their intestines/feed have to be restricted for proper functioning of the enzyme. Despite classifying tannin as antinutrients, Elizondo *et al*. (2010) opined that condensed tannin have antimicrobial activity and prevents bacteria colonization in the intestines of pigs and chickens. Tannins also serve as antidotes for many poisons (Norton, 2000). According to Jiru and Urga (1995), the total oxalate content of this leaf is lesser than that of spinach and there was a marginal decrease in its content when dried (Mwanri *et al*., 2011).

Feeding is pivotal to achieving profit in poultry farming. The direct impact of feeds given to animals can be easily noticed in their growth rate (Puerta-Fernandez, 2017). As seen in the results of this study, the broiler chicken WG and FCR were influenced by SPLM inclusion. Decrease in values of these parameters with increase in SPLM inclusion was observed. This reduction may be attributed to high fibre content of the leaf meal and presence of protease inhibitor in it (Oyenuga, 1968). According to Kagya-Agyemang *et al*. (2008) feed intake and WG were significantly depressed by SPLM addition at 10, 20 and 30 % in broiler chicken ration and at 20 and 30 % particularly, FCR was depressed. According to Tsega and Tamir (2009), daily WG of broiler chicken reduced drastically at 15 and 20 % inclusion levels of SPLM. These authors attributed the reduction in WG to reduced feed intake and possibly due to reduced protein quality. In contrast, Unigwe *et al*. (2014) did not observe any significant difference in WG and FCR of broilers fed sweet potato leaf (SPL) diets and therefore concluded that up to 5 % SPL numerically enhanced WG of broiler chickens. Differences in breeds of chickens used and probably number of birds per treatment could be responsible for variance in results obtained. Also contrary to results of this study, Tsega and Tamir (2009) considered 10 % SPLM inclusion in broiler finisher diet as a good level with less negative effects. Mmereole (2009) reported that SPLM used at 20 % replacement of maize had adverse effect on broiler chicken but on adding exogenous enzyme (Roxazyme G) at this level, growth and cost of feed per kg body weight were better than those of the other treatments.

Assessment of haematological parameters is a practical means of monitoring changes in body functioning and overall health of animals (Etim *et al*., 2013). It is used to evaluate the effect of food, environment and pathogens on the animal (Elagib and Ahmed, 2011). Changes in haematological parameters can be safely compared with values obtained for the control group in research studies (Bollige and Everds, 2012).

Table 2: Growth performance of broiler finishers fed diets containing sweet potato leaf meal

Level of SPLM inclusion (%)	Initial weight (kg/bird)	Final weight (kg/bird)	Total weight gain (kg/bird)	Total feed intake (kg/bird)	Average weight gain (g/bird/day)	Average feed intake (g/bird/day)	Feed conversion ratio
0	1.04 ± 0.11^{b}	2.36 ± 0.08^{c}	1.32 ± 0.03^{b}	3.68 ± 0.08^{b}	48.88 ± 1.21^{b}	136.29 ± 2.85^{b}	2.79 ± 0.09^{a}
5	0.76 ± 0.05^{a}	1.94 ± 0.15^{b}	1.18 ± 0.10^{b}	3.31 ± 0.09^{a}	43.66 ± 3.68^{ab}	122.43 ± 3.26^{a}	2.81 ± 0.16^{a}
10	0.67 ± 0.10^{a}	1.74 ± 0.10^{ab}	1.08 ± 0.18^{ab}	3.62 ± 0.05^{b}	39.92 ±6.68^{ab}	133.98 ± 1.67^{b}	3.42 ± 0.58^{ab}
15	0.62 ± 0.01^{a}	1.38 ± 0.23^{a}	0.76 ± 0.23^{a}	3.29 ± 0.05^{a}	27.97 ± 6.68^{a}	121.75 ± 1.79^{a}	4.66 ± 1.56^{b}

SPLM = sweet potato leaf meal; Mean ± Standard deviation; ^{abc}Means with different superscripts along the same column are significantly different (p<0.05)

Table 3: Haematological profile of broiler finishers fed diets containing sweet potato leaf meal

Parameters	Level of SPLM Inclusion (%)			
	0	**5**	**10**	**15**
Packed cell volume (%)	27.13 ± 3.04	27.78 ±2.91	28.44 ± 2.13	29.33 ± 1.87
Red blood cell count (106 mm^3)	2.24 ± 0.56	2.26 ± 0.49	2.47 ± 0.36	2.56 ± 0.26
Haemoglobin concentration (g/100 ml)	9.05 ± 1.01	9.26 ± 0.99	9.49 ± 0.71	9.77 ± 0.63
Erythrocyte sedimentation rate (mm/hr)	5.00 ± 2.27	4.11 ± 2.21	3.44 ± 1.51	2.89 ± 1.27
Mean cell haemoglobin concentration (%)	33.36 ± 0.06	33.31 ± 0.11	33.36 ± 0.08	33.29 ± 0.08
Mean cell haemoglobin (pg)	41.65 ± 5.88	41.95 ± 5.40	38.78 ± 2.51	38.34 ± 1.59
Mean cell volume (μ^3)	124.82 ± 17.66	125.94 ± 16.37	116.24 ± 7.53	115.17 ± 4.82
Lymphocyte (%)	59.38 ± 3.58	60.00 ± 3.61	61.78 ± 2.28	61.00 ± 2.12
Heterophil (%)	23.13 ± 1.89	22.67 ± 2.65	23.11 ± 2.09	22.00 ± 2.65

SPLM = sweet potato leaf meal; Mean ± Standard deviation; Means were not significantly different (p>0.05) based on one-way ANOVA

Table 4: Palatability, cooking loss and thaw loss of meat from broilers chickens fed diets containing sweet potato leaf meal

Level of SPLM Inclusion (%)	Palatability Score	Cooking loss (%)			Thaw loss (%)		
		Thigh	**Drumstick**	**Chest**	**Thigh**	**Drumstick**	**Chest**
0	6.44 ± 1.67	33.19 ± 1.66	29.55 ± 1.82^{b}	29.67 ± 2.09^{b}	1.09 ± 0.58	1.23 ± 0.42	3.53 ± 1.74
5	5.89 ± 3.02	31.88 ± 1.64	25.94 ± 1.42^{ab}	30.74 ± 4.76^{b}	0.93 ± 0.74	0.48 ± 0.45	0.84 ± 0.70
10	7.67 ± 1.23	30.47 ± 1.69	26.22 ± 1.99^{ab}	25.87 ± 5.92^{ab}	2.21 ± 1.73	0.93 ± 0.57	2.09 ± 1.34
15	7.56 ± 1.81	30.21 ± 2.91	24.96 ± 2.20^{a}	21.90 ± 1.65^{a}	2.46 ± 0.74	1.40 ± 1.01	2.10 ± 1.75

SPLM = sweet potato leaf meal; Mean ± Standard deviation; ^{ab}Means with different superscripts along the same column are significantly different (p<0.05)

In this study, PCV, RBC count, Hb, ESR, MCV, MCH, MCHC, lymphocyte and heterophil values did not differ from the values of the control group. The PCV and Hb values, which helps to diagnose anaemia (Turkson and Ganyo, 2015) also, fell within the ranges described by Mitruka and Rownsley (1977) and Ross *et al.* (1978) for normal chickens, although, an increasing trend was observed in the PCV, Hb and RBC values of the broiler chicken fed the dietary treatments. The non-significance in the haematological values obtained suggests that SPLM did not pose any health threat (Ayuk and Essien, 2009) to the birds even at up to 15 % inclusion levels. The result of this study was in line with results obtained by Ayuk and Essien (2009) where no significant difference in the blood parameters of broilers fed SPL meal was observed. The differences obtained in values stated by these authors and those obtained in this result might have been influenced by strain, gender, age (Olaniyi *et al*., 2012) or management practices (Etim *et al*., 2014) in addition to other factors highlighted above.

The palatability scores showed that the normal taste of thigh cuts from the chickens was not altered as all values recorded tended towards "like" on the scale. No specific trend was also observed in relation to levels of test ingredients fed. Cooking loss is proportional to shrinkage of meat cuts and it affects size, juiciness and texture (Sheard, 2002) of such cuts. Cooking loss was significantly highest for drumstick and chest of chickens fed control diet although values for most treatments were statistically similar to control. It can be deduced that the values obtained for cooking loss across the treatments were still satisfactory as the overall acceptability of meat was not jeopardized. The values for thawing loss for the thigh, chest and drumstick did not also follow any particular trend in relation to the treatments.

Conclusion: Although up to 15% SPLM did not have any negative impact on haematology and meat quality of broiler-chicken finishers, inclusion level of this leaf meal in their feed should not exceed 5%.

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