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Original Research

Growth performance and haematological indices of broiler finisher chickens fed diets containing *Calopogonium mucunoides* leaf meal supplemented with yeast

[1*]Anyaegbu, B. C., [2]Daniel-Igwe, G. & [3]Ogbonna, A. C.

[1]Department of Animal nutrition and Biochemistry, [2]Department of Veterinary Medicine, [3]Department of Animal Production and Livestock Management, Michael Okpara University of Agriculture, Umudike, Umuahia, Abia State, Nigeria

*Corresponding author: batoanyaegbu@gmail.com, +2347089842243

ABSTRACT

A total of 150 four-week-old Anak finisher broiler chickens were used to determine the growth performance and haematological indices of broiler finisher chickens fed diets containing *Calopogonium mucunoides* leaf meal supplemented with yeast. They were randomly grouped into 5 treatments with each consisting of 30 broiler chickens. Each treatment group was replicated thrice with equal number of birds (10) per replicate. Five experimental diets were formulated; control diet contained basal diet and soyabean meal which was quantitatively replaced with sun dried *Calapogonium mucunoide* leaf meal supplemented with yeast at 10, 15, 20 and 25% in other diets. The experiment was laid out in Completely Randomized Design (CRD). The blood of the experimental birds was collected and analysed for packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), Haemoglobin Concentration (Hb), Mean Cell Haemoglobin (MCH) and Mean Cell Volume (MCV) at the end of 4 weeks. Data obtained were subjected to one way analysis of variance. The results of the study showed that inclusion of yeast significantly ($P < 0.05$) influenced the feed intake, final liveweight gain, weight gain, feed conversion ratio, red blood cells (RBC) and MCH (Mean Corpuscular Haemoglobin) of the finisher broiler chicken. All parameters tended to improve with increased dietary level of *Calopogonium mucunoides* leaf meal supplemented with yeast in diets of broiler finisher chickens. *Calopogonium mucunoides* leaf meal supplemented with yeast did not significantly ($P > 0.05$) influence PCV (Packed Cell Volume), HBg/dl, WBC (White Blood Cells) and MCHC. It was concluded in this study that *Calopogonium mucunoides* leaf meal supplemented with yeast could be included at 25% to improve body weight gain, feed conversion ratio and red blood cell of finisher broiler chickens.

Keywords: Broiler chickens, *Calopogonium mucunoides*, growth Performance, haematological indices.

INTRODUCTION

The high cost of conventional feed ingredients has led to increase in the prices of poultry products (Adejinmi *et al.*, 2007). Cost of feed accounts for up to 60–80% of the total cost of production in intensive poultry production (Tewe, 1997). Therefore, high cost of feeds can be reduced via feed formulation with non-conventional alternatives that are cheap, readily available and possess relatively similar nutrient composition with conventional energy and protein sources (Onyimonyi & Okeke, 2005). One possible source of cheap feed resources is the leaf meal or green leafy products of some tropical legumes and browse plants. *Calopogonium mucunoides* leaf meal-supplemented with yeast can be used as an alternative protein source for broiler chickens. *C. mucunoides* is widely cultivated as a forage and pasture legume, green manure and cover crop. It is also commonly planted as a pioneer species, for fodder/animal feed, forage and as a nitrogen fixing species to reduce erosion and improve soil fertility in tropical and sub-tropical region (Cook *et al.*, 2005). On the basis of its nutritive value, *in-vitro* digestibility of leaf DM ranges from 58 to 66% depending on the age of regrowth and level of hairiness. Crude protein (CP) content of top growth ranges from 16 to 24% with lower values for older growth. Ndelekwule *et al.* (2021) reported that cassava peel meal could be improved with 40% *Calopogonium mucunoides* leaf meal in the diets of broiler chickens. Aderinola *et al.* (2021) also reported that incorporation of *Centrosema pubescens* up to 20% inclusion level gives results similar to the control while incorporation of *Calopogonium mucunoides* leaf meal up to 10% resulted in satisfactory result.

Furthermore, utilization of leaf meals such as *Gliricidia sepium* (Tewe, 1997), cassava plant (Onyimonyi & Okeke, 2005), wild sun flower (Esonu *et al.*, 2004), mimosa leaf meal (Sulhattin & Mustafa, 2017), *Calopogonium mucunoides* etc. as sources of protein and/or energy has been recommended for livestock nutrition largely due to their abundant availability especially during rainy season and high cost of conventional feedstuff. Leaf meals do not only serve as protein source but also provide some necessary vitamins, minerals also some oxycarotenoids and xanthophylls, which causes yellow coloration of broiler skin, shank and egg yolk (Esonu *et al*., 2004; Sulhattin & Mustafa, 2017). Leaf meals have been used as sources of nutrient in the diets of poultry, pigs and rabbits, because of the ability of rabbits to handle crude fibre. These leaf meals are particularly useful for rabbit feeding. However, level of use in the diets of these animals should be restricted to 10 – 20% for poultry and pigs and may be up to 25 – 30% for rabbits (Olomu, 2011). The anti-nutrients present in *Calopogonium mucunoides* leaf meal are tannin (1.24%), phytate (0.82%), oxalate (0.81%) and saponin (0.44%) (Obua *et al.,* 2012). (Adebayo et al., 2019) reported *Calopogonium* leaf meal having tannin content of 2.96%, phytate 0.94%, oxalate 2.77% and saponin 0.85%. These anti-nutrients are detoxified by several processing methods such as soaking, germination, thermal or heat treatment, fermentation, genetic manipulation, and other processing methods (Soetan, 2008). Supplementation of diets containing *Calopogonium mucunoides* leaf meal with yeast would appear to be efficient to partially replaced soyabean meal in the diets of broiler finisher chickens. This research was carried out to evaluate the growth performance and haematological indices of finisher broiler chickens fed diets containing *Calopogonium mucunoides* leaf meal supplemented with yeast (*Saccharomyces cerevisiae*).

MATERIALS AND METHODS

EXPERIMENTAL SITE

The study was carried out at the Poultry Unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State in Nigeria. The area is located on latitude 05º 21`N and longitude 07º 33`E with an elevation of about 112 m above the sea level. The location has an annual rainfall of 177 – 2000 mm per annum from April to October and a short period of dry season from November to March with a relative humidity of about 50 – 90% and monthly temperature range of 17 – 36 °C (NRCRI, 2019).

PROCUREMENT AND PROCESSING OF FEED INGREDIENTS

Calopogonium mucunoides leaves were collected around the premises of the Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The leaves were sun dried till about 10% moisture content was achieved and then grounded to powdery form. This was done to reduce the Anti-Nutritional Factors (ANF) present in the forage legume, other feed ingredients like maize, wheat offal, fishmeal, soyabean meal, bone meal, premix, lysine, methionine, salt etc. were bought from Jocan Livestock Services, Umuahia, Abia State. The yeast additive (*Saccharomyces cerevisiae*) was brought from a reputable supermarket in Umuahia, Abia State.

EXPERIMENTAL BIRDS AND MANAGEMENT

A total of 150 four weeks old Anak broiler chickens were used for the study. They were divided into five experimental treatment groups. Each treatment group contained thirty (30) finisher broiler chicks. Then, each treatment group was divided into three replicates of 10 birds each. The floor of the pen was covered with wood shavings. Each group was randomly assigned to an experimental finisher broiler diet in a completely randomized design (CRD) and was fed for four weeks. Feed and water were supplied *ad-libitum*.

EXPERIMENTAL DIETS AND DESIGN

Five experimental finisher broiler diets as shown in Table I were formulated. Diet 1 (Control) did not contain dried *Calopogonium mucunoides* leaf meal and yeast but 25% soyabean meal as the main protein source, while diets 2, 3, 4 and 5 contained 10, 15, 20 and 25% of dried *Calopogonium mucunoides* leaf meal supplemented with yeast probiotic to replace soyabean meal. The design of the study was the Completely Randomized Design (CRD). The statistical model was:

$Y_{ij} = \mu + T_i + e_{ij}$

Where:

Y_{ij} = single observation

μ = Population mean

T_i = Effect of treatment (Diet)

e_{ij} = Random error, assumed to be independently identically and normally distributed at zero mean and constant variance

PROXIMATE ANALYSIS OF RAW AND SUNDRIED *CALOPOGONIUM MUCUNOIDES* LEAF MEAL

Proximate composition of the fresh (raw) and sundried *Calopogonium mucunoides* leaves were determined according to the method of (AOAC, 2003), where dry matter, crude fibre, crude protein, Ether extract, Nitrogen Free Extract and Ash were determined. Gross energy was determined using bomb calorimeter. All analysis was based on 100% dry matter (Table I). Anti-nutrients such as Tannins, oxalate, phytate, saponins, cyanide and alkaloids were also determined according to (AOAC, 2003).

GROWTH PERFORMANCE

The birds were weighed at the beginning of the feeding trial and weekly thereafter. Feed intake was recorded daily by weighing the quantity of feed given and the leftover the following morning. The feeding trial lasted for 4 weeks.

Table 1: Ingredients composition of the experimental diets for finisher broiler chickens

Ingredients	T1 0% CLM	T2 10% CLM	T3 15% CLM	T4 20% CLM	T5 25% CLM
Maize	60.00	60.00	60.00	60.00	60.00
Soyabean meal	25.00	22.50	21.25	20.00	18.75
CLM	0.00	2.50	3.75	5.00	6.25
Palm kernel meal	4.15	4.15	4.15	4.15	4.15
Wheat offal	4.00	4.00	4.00	4.00	4.00
Fish meal (72%)	3.00	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Vit-Min Premix*	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.25	0.25	0.25	0.25	0.25
Yeast	-	0.15	0.15	0.15	0.15
Common Salt	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated nutrients composition of experimental finisher broiler diets					
Crude protein	21.05	20.48	20.19	19.90	19.61
ME Kcal/kg	3148.40	3171.50	3183.05	3194.60	3206.15

CLM = *Calopogonium mucunoides* leaf meal, Yeast additive inclusion rate = 0.15/Kg of diet
*To provide per kg of diet: Vit. A, 2,000000 iu; Vit D3: 4,000iu; Vit E, 80g; Vit. K, 0.49g; Choline, 48.00g; BHT, 32.00g; Manganese, 16.00g; Iron, 8.00mg; Zinc, 72gm; Copper, 0.32g; Iodine, 0.25g; Cobalt, 36.00g; Selenium, 16.00g.

FEED CONVERSION RATIO

This was determined by dividing the average daily feed intake by average body weight gain.

Feed conversion ratio (FCR) = $\frac{\text{Daily feed intake (g)}}{\text{Daily body weight gain (g)}}$

HAEMATOLOGICAL ASSESSMENT

At the end of 28 days, 2 broiler chickens from each replicate within each treatment were randomly selected and blood samples collected for haematological assessment such as Packed Cell Volume (PCV), Red Blood count (RBC), Mean Cell Volume (MCV), Mean Cell Haemoglobin (MCH), Haemoglobin (Hb) and White Blood Cell count. The haematological parameters were determined using the procedure of (Baker and Silverton, 1979). About 5 ml of blood sample was collected for the analysis. The blood sample was collected from the wing vein of the birds using disposable needle and syringe. For hematological analysis, about 2 ml used for analysis was stored in a bottle containing anticoagulant, ethylene diamine tetra acetic acid (EDTA) to prevent clotting and subsequently analyzed to determine the above parameters.

DATA ANALYSIS

The data collected were subjected to one way analysis of variance (ANOVA) according to (Snedecor & Cochran, 1989), where significant effects were detected from the ANOVA, means were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS

The proximate composition of fresh and dried *Calopognium mucunoides* leafmeal is shown in (Table II). Fresh *Calopognium mucunoides* leaf meal had higher (23.08 ad 25.60%) crude protein and higher crude fibre respectively than 17.75 and 15.30% recorded in dried *Calopogonium* leaf meal.

Table II: Proximate composition of fresh and dried *Calopogonium mucunoides* leaf meal. CLM = *Calopogonium mucunoides* leaf meal

Parameters	Fresh CLM	Dried CLM
Dry matter (%)	84.26	93.06
Moisture (%)	15.74	6.94
Crude protein (%)	23.08	17.75
Ether extract (%)	0.35	1.02
Crude fibre (%)	25.60	15.30
Ash (%)	3.39	0.92
Nitrogen Free Extract (%)	31.84	58.07
Metabolizable Energy (Kcal/Kg)	3181.88	3528.53

FEED INTAKE

The feed intake of the finisher broiler chicken was shown in (Table 3). In the broiler chicken finisher phase significant differences ($P < 0.05$) existed among the various treatment groups. The feed intake of the boiler chicken on treatment 4 and 5 were similar and significantly ($P < 0.05$) higher than those in treatments. The feed intake of the broiler chickens on treatment 2 (10% CLM) supplemented with yeast was significantly (P < 0.05) better than those on treatment 3, 4 and 5 but lower than those on the control diet.

BODY WEIGHT GAIN

The body weight gain of the finisher broiler chicken was shown in (Table 3) significant differences (P < 0.05) existed among the various groups in their body weight gain. The finisher broiler chickens on treatment 5(25% CLM) supplemented with yeast recorded the highest body weight gain which was significantly (P < 0.05) better than those on the control diet. The body weight gain of the finisher broiler chickens on the control diet and treatment 2 were similar and significantly (P < 0.05) better than those on treatment 3 and 4.

FEED CONVERSION RATIO

The feed conversion ratio of the finisher broiler chickens were shown in (Table 3). In the finisher broiler groups significant differences (P < 0.05) existed among the various groups in their feed conversion ratios. The finisher broiler chickens on treatment 5(25% CLM) supplemented with yeast recorded the best feed conversion ratio of 2.80. Generally, the feed conversion ratios of the finisher broiler chickens on diets containing *C. mucunoides* leaf meal supplemented with yeast were improved.

The result of the Packed Cell Volume (PCV) showed that there were no significant differences (P > 0.05) across the treatment groups. There was significant difference (P < 0.05) in RBC (Red Blood Count) across the treatment groups. The value increased with dietary levels of *Calopogonium mucunoides* leaf meal supplemented with yeast.

The result of Haemoglobin (Hb), White Blood Cells (WBC), Mean Cell Volume (MCV) and Mean Cell Haemoglobin concentration (MCHC) showed that there was no significant difference (P > 0.05) across the treatment groups. The Hb values obtained ranges from 7.07 – 7.34 g/dl and were within the normal range of (7.0 – 13.0 g/dl) reported by (Jain, 1993). Haemoglobin concentration of the blood has been associated with availability of nutrients to the animal body (Esonu *et al.*, 2001). The finisher broiler chickens on the control diet recorded the highest MCV of 123.99 fl followed by those in diet 3 (15% CLM and diet 5 25% CLM) (100.64fl) while those on diet 2 (10% CLM) supplemented with yeast recorded the least MCV.

The white blood cell (WBC) result ranges from 15.67 – 19.60 × 10^3/µl. There were no significant differences (P > 0.05) in the White Blood Cells. The values of the white blood cells increased with increase in the level of *Calopogonium* leaf meal supplemented with yeast in the diet.

DISCUSSION

The proximate composition of fresh and dried *Calopogonium mucunoides* leaf meal is shown in (Table II). Fresh *Calopogonium mucunoides* leaf meal had higher (23.08 and 25.60 %) crude protein and higher crude fibre, respectively than 17.75 and 15.30% recorded in dried *Calopogonium mucunoides* leaf meal. The crude protein obtained was similar to 24.65% reported by (Obua *et al.*, 2012). Obua *et al.* (2012) also reported higher crude fibre of (21.69%) and ash (9.79%) probably due to soil type, stage of growth and season of the year. The values obtained for crude protein, ether extract, crude fibre, moisture content, ash and metabolizable energy fell within the ranges obtained by previous studies (Aduku, 1993; Ikhimioya *and* Olagunju 1996; Tewe, 1997; Bamigboye and Oluwarinde, 2017).

The feed intake of the finisher broiler chickens improved significantly (P < 0.05) as the level of *Calopogonium mucunoides* leaf meal supplemented with yeast increased in their diets (Table 3). The feed intake of the finisher broiler chickens on diets 4 and 5 were similar and significantly (P < 0.05) higher than those in diets 2 and 3. The inclusion of yeast improved feed intake by improving palatability (Gao et al., 2008; Ignacio, 1995). The body weight gain of the finisher broiler chickens improved significantly (P < 0.05) as the level of *Calopogonium mucunoides* leaf meal

Table III: Growth performance of finisher broiler chickens fed diets containing *Calopogonium mucunoides* leaf meal supplemented with yeast

Parameters	T1 (Control)	T2 10% CLM	T3 15% CLM	T4 20% CLM	T5 25% CLM	SEM
Initial body weight (g)	922.42	814.25	829.84	871.81	841.12	15.10
Final body weight (g/bird)	2215.29^{a}	2123.93^{ab}	1944.69^{b}	2020.34^{b}	2778.70^{a}	32.25
Body weight gain (g/bird)	1292.87^{ab}	1289.68^{ab}	1114.85^{bc}	1148.53^{bc}	1937.58^{a}	27.09
Daily body weight gain (g/bird/day)	46.17^{a}	46.06^{a}	39.82^{b}	41.02^{ab}	69.20^{ab}	0.97
Daily feed intake (g/bird/day)	217.04^{a}	208.85^{ab}	187.40^{c}	194.80^{bc}	193.73^{bc}	2.33
Feed conversion ratio	4.71^{ab}	4.53^{b}	4.71^{ab}	4.75^{a}	2.80^{c}	0.15

abc means in a row with different superscripts differ significantly at (P < 0.05)
SEM = Standard Error Mean; CLM = Calopogonium mucunoides leaf meal

Table IV: Haematological indices of finisher broiler chickens fed diets containing *Calopogonium mucunoides* leaf meal supplemented with yeast

Parameters	Diet 1 0% CLM	Diet 2 10% CLM	Diet 3 15% CLM	Diet 4 20% CLM	Diet 5 25% CLM	SEM	
PCV (%)	30.83	28.00	27.33	27.83	29.33	0.56	NS
HB (g/dl)	7.07	7.34	7.23	7.15	7.12	0.09	NS
RBC (× 10^6/ml)	2.50[b]	2.87[a]	3.10[a]	2.82[ab]	2.92[a]	0.07	SD
WBC (× 10^3/ml)	15.67	17.47	18.80	18.80	19.60	1.39	NS
MCV (fl)	123.99	97.60	109.42	99.31	100.64	4.91	NS
MCH (Pg)	28.41[a]	25.68[ab]	23.34[b]	25.45[ab]	24.41[b]	0.60	SD
MCHC (g/dl)	23.00	26.42	26.49	25.74	24.30	0.57	NS

[abc] Means on the same rows with different superscripts differ significantly at P < 0.05; SEM: Standard Error of the Mean, RBC: Red Blood Cell; PCV: Packed Cell Volume, Hb: Haemoglobin; WBC: White Blood Cell, MCV: Mean Cell Volume; MCH: Mean Cell Haemoglobin, MCHC: Mean Cell Haemoglobin Concentration CLM: *Calopogonium mucunoides* leaf meal.
NS: Not significant; SD: Significantly different

supplemented with yeast in their diets increased. The finisher broiler chickens on diet 5 (25% CLM) supplemented with yeast recorded the highest body weight gain which was significantly (P < 0.05) better than those on the control diet. Earlier researchers have attributed part of the growth promoting properties of yeast to its ability to stimulate feed intake by improving palatability (Gao et al., 2008; Ignacio, 1995).

In terms of feed conversion ratio, the finishers broiler chickens on diet 5 (25% CLM) supplemented with yeast recorded the best feed conversion ratio of 2.80 which was significantly (P < 0.05) better than others. The inclusion of yeast improved better utilization of the diets containing *Calopogonium mucunoides* leaf meal and improved the feed conversion ratios (Adejumo et al., 2005).

Haematological indices of finisher broiler chickens fed diets containing *Calopogonium mucunoides* leaf meal supplemented with yeast was showed on (Table IV). Packed Cell Volumes (PCV) obtained was within the normal ranges of 22 – 35% reported by (Jain, 1993). Higher than normal numbers of RBC may be due to congenital heart diseases, dehydration (severe diarrhea, low blood oxygen levels (hypoxia), polycythemia etc. When an animal moves to a higher altitude the RBC count increases for several weeks. Lower than normal numbers of RBCs may be due to anaemia, bone marrow failure (example, from radiation, toxins or tumour), erythropoietin deficiency, haemolysis, haemorrhage, malnutrition, nutritional deficiencies of iron, copper, folate, vitamin B_{12}, Vitamin B_6, over-dehydration, etc. The MCH of the finisher broiler chickens were within the normal ranges of 27.2 – 28.9 for the domestic chickens (Etim et al, 2014). According to (Njidda *et al.*, 2006), MCV, MCH and MCHC are used in diagnosing anaemic conditions and therefore are important morphological characteristics of anaemia (Campbell, 1988). Perhaps, this is an indication that the broiler chickens were not anaemic.

The result of Haemoglobin (Hb), White Blood Cells (WBC), Mean Cell Volume (MCV) and Mean Cell Haemoglobin concentration (MCHC) showed that there was no significant difference (P > 0.05) across the treatment groups. The Hb values obtained ranges from 7.07 – 7.34 g/dl and were within the normal range of (7.0 – 13.0 g/dl) reported by (Jain, 1993). Haemoglobin concentration of the blood has been associated with availability of nutrients to the animal body (Esonu *et al.,* 2001). The finisher broiler chickens on the control diet recorded the highest MCV of 123.99 fl followed by those in diet 3 (15% CLM and diet 5 25% CLM) (100.64fl) while those on diet 2 (10% CLM) supplemented with yeast recorded the least MCV. There was no significant difference (P > 0.05) in MCV across the treatment groups. The MCV obtained was within the normal ranges of (90 – 130fl) as reported by (Mitruka *et al.*, 1997).

The white blood cell (WBC) result ranges from 15.67 – 19.60 × 10^3/µl. There were no significant differences (P > 0.05) in the White Blood Cells. The values of the white blood cells increased with increase in the level of *Calopogonium* leaf meal supplemented with yeast in the diet. The values obtained in WBC fell within the normal reference values reported for birds by (Cole, 1980). The WBC of the finisher broiler chickens fall within the normal range, it means that the diets did not affect the immune system. There were no significant differences in MCHC of the finisher broiler chickens. The result of the feeding trial showed that the diet did not have any negative effect on the finisher broiler chickens because the result was in line with the normal range of haematological values for broiler chickens recommended by Cole (1980) and Mitruka *et al.* (1997). There was significant difference (P < 0.05) in RBC (Red Blood Count) across the treatment groups. The value increased with dietary levels of *Calopogonium mucunoides* leaf meal supplemented with yeast.

CONCLUSION

It was concluded from this study that *Calopogonium mucunoides* leaf meal supplemented with yeast could be included at 25% to improve body weight gain, feed conversion ratio and red blood cell of finisher broiler chickens.

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