

PERFORMANCE OF LAYING HENS FED GRADED LEVELS OF DRIED YELLOW COCOYAM CORM MEAL (*Xanthosoma sagittifolium*) AS PARTIAL REPLACEMENT FOR MAIZE

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ABSTRACT

Yellow cocoyam (*Xanthosoma sagittifolium*), a tropical root crop is presently underutilized as energy feedstuff in poultry diets. The objective of this experiment was to evaluate the effects of dried cocoyam corm meal as partial replacement for maize on egg laying and haematological parameters of layer hens. Fifty-six (56) days feeding trial was conducted using one hundred and twenty (120) Isa brown layer hens of twenty weeks (20 weeks) old. Sample of the cocoyam corm meal used for this study was analyzed in the laboratory to determine its proximate nutrient composition. Results showed moisture content 79%, ash 4%, fat 1.1%, fibre 5.5%, carbohydrate 24%, protein 8.05% and energy 3160.05kcal/kg DM. The cocoyam corm meal was used to formulate layer hens' diets: T₁, T₂, T₃, and T₄ at 0%, 10%, 15% and 20% inclusion levels respectively. The experimental layer hens were divided into four treatment groups of thirty (30) hens each which was further replicated three times, ten (10) birds per replicate in a Completely Randomized Design (CRD). Each group of the experimental birds was subjected to one of the experimental diets for the period of 56 days and drinking water was also provided regularly. At the expiration of the experiment, three (3) birds were selected from each group for haematological parameters evaluation. Average daily feed and total feed intake showed no significant ($P>0.05$) difference though T₄ was higher ($P<0.05$) among the treatments and T₁ was the least ($P<0.05$). Total body weight gained was significantly ($P<0.05$) higher at T₄. T₂ was significantly ($P<0.05$) the lowest among other treatments. T₁ had a significant ($P<0.05$) highest hen day egg production followed by T₂ and T₃ which were statistically the same ($P>0.05$) while T₄ had the lowest ($P<0.05$) among the treatments. T₂ had the heaviest ($P<0.05$) egg weight of 65.40g while T₁ had the lowest ($P<0.05$) (61.76g) though still within the same category of large in USDA (2000) egg weight rating. Feed efficiency of feed/g egg weight was higher at T₂ (1.27). T₄ (1.38) had the lowest ($P<0.05$) feed conversion efficiency with no significance ($P>0.05$) difference among values obtained from other treatments. T₁ had the highest pack cell volume ($P<0.05$). Red blood cell, count, haemoglobin and white blood cell count values which did not differ significantly ($P>0.05$) among the values of T₂, followed by T₃. Results obtained in the haematological parameters evaluated showed significant difference ($P<0.05$) recorded in some values; T₃ had the highest haemoglobin (20.46 pg) followed by T₄ (20.34 pg), T₁ had the least (19.80 pg) but still within the recommended range for layer hens for optimal

performance. It is concluded that dried cocoyam corm meal (Xanthosoma sagittifolium) is an ideal ingredient in layer hens diets up to 15% inclusion level for good performance.

Key words: Egg production, growth, haematology, proximate composition.

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INTRODUCTION

Steady increase in cost of conventional poultry feedstuffs in Nigeria has led to search and utilization of alternative feed sources for poultry (Obidimma, 2009; Esiegwu and Okonkwo, 2018). Inadequate production of maize which is the major conventional energy feed source to meet the energy requirements for man, livestock and raw material for industries Anyaehie, (2006), created the need to look for cheaper, readily available and alternative sources of energy feedstuff for poultry such as yellow cocoyam corm known as “ede uhie” in Igbo (Ndimantang *et al.*, 2006).

Cocoyam is a collective name for species of *Colocasia* and *Xanthosoma* genera from family of *Aracea* (Opara, 2003, Ramanatha *et al.*, 2010). Cocoyam is a herbaceous annual and perennial crop with underground roots known as corms which contains high amount of starch (Ramanatha *et al.*, 2010).

Xanthosoma sagittifolium is very nutritious and highly productive and yet it's corms and cormels are being under utilized as energy feed resources (Onu *et al.*, 2006, Owusu-Darko *et al.*, 2014, Eyasu *et al.*, 2019).

The cocoyam corm can be processed into fufu and the cormels can also be used in soup thickening or serve as portage with vegetables in Igbo land (Onu *et al.*, 2006). It is also a source of dietary energy, proteins, vitamins and as well high in potassium, zinc and nicotic acid (Aboubakar *et al.*, 2008).

Cocoyam corms contains anti-nutritional factors such as tannins, hydrocyanid, oxalates, anti-trypsin inhibitor (Okereke, 2012; Hand and Binh, 2013). The anti-nutritional factors in the cocoyam corms could be removed through drying, fermentation, cooking and toasting to make the product safe for human and livestock consumption (Ndimantang *et al.*, 2006, Eyasu *et al.*, 2019).

Ndimantang *et al.* (2006), Aboubakar *et al.* (2008), Akinmutimi *et al.* 2006), Chandra Subhash *et al.* (2012) observed that *Xanthosoma sagittifolium* corm meal proved to serve as good food for both man and livestock with its appreciable nutritional profile and higher productivity. Ndimantang *et al.* (2006) went further to say that cocoyam corm flour (*Xanthosoma sagittifolium*) contains about 132 calories in a cup of dried and ground corms of 135 grams, 0.347mg copper, 0.32mg of vitamin B6, 31.9gm of carbohydrates, 8.07mg of potassium, 1.32mg of iron, 1.131mg of vit. B1, 0.257mg of manganese and 9.74% protein.

Owusu – Darko, *et al.* (2014), evaluated the potentials of cocoyam corms and cormels and expressed dismay for an under utilization and under exploitation of this arable crop by consumers. However, Iwuoha *et al.* (1995), Sheila (1999), Dosumu, *et al.* (2012), Zhu, *Journal of the Faculty of Agriculture and Veterinary Medicine, Imo State University Owerri* website: www.ajol.info/index.php/jafs

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(2016) reported some anti-nutritional factors in cocoyam corms and cormels especially calcium oxalate and physico-chemical properties which can hinder their utilization as food if not well processed. In other to proffer solutions to these problems posed by these anti-nutritional factors of cocoyam corms and cormels, Sefa *et al.* (2004), observed that calcium oxalate, tannin, hydrocyanid etc could be removed through good processing methods such as drying, soaking or cooking and could make the corm meal safe for consumption and for other industrial uses.

Matikiti, (2017), observed that the proximate nutritional composition of cocoyam were in the range of 65–78% moisture 2–5% ash, 0.2–1.10% fat, 2.5–5% fibre, 14-23% carbohydrates, 390-460mg/100g potassium, 24-43mg/100g calcium, 79-91kcal/cal energy, 4.8% protein and 79-110mg/100g magnesium.

The study was therefore targeted to investigate the performance and haematological parameters of laying hens fed cocoyam corm meal (*Xanthosoma sagittifolium*) as partial replacement for maize in their diets.

MATERIALS AND METHODS

This research was conducted at the Teaching and Research Farm, Imo State University Owerri, located within the South-East agro-ecological zone of Nigeria. Owerri lies between latitude 5^o29' North and longitude 7^o20' East, 91m above sea level with temperature and humidity ranging from 20.0 – 27.5^oC and 75-90% and rainfall annually ranging from 1,500mm to 2,200mm, (AccuWeather, 2015).

The corms of *Xanthosoma sagittifolium*, used for this experiment were bought from Umucheke Okwe in Onuimo Local Government Area of Imo State. The corms were peeled, washed, cut into pieces and sundried for 15 days so that it could be crispy while milling using a hammer mill. The dried cocoyam corm meal (DCCM) was taken to the laboratory for proximate analysis according to AOAC, (2010). Four layer diets; T₁ (control), T₂, T₃ and T₄ were formulated in which dried cocoyam corm meal was added to partially replace maize at 0%, 10%, 15% and 20% respectively. The experimental diets and their calculated nutrients composition are shown in Table 1.

One hundred and twenty (120), 20 weeks old Isa brown pullets at point of lay were bought from a reputable dealer in Ibadan and were used for the experiment. The birds were separated into four treatment groups of 30-layer hens and each group was further subdivided into three replicates of 10-layer hens each housed in a pen measuring 2.4m x 1.5m x 1.8m (H x L x W). The birds were fed commercial layer mash for one week for stabilization after which the groups were assigned to the four experimental diets in a Complete Randomized Design (CRD) and the initial weights of the birds recorded. Feed and water were provided adlibitum and other routine management of laying hens was also observed, (Opara, 2003). Egg were collected three times a day, morning, afternoon and evening, and recorded.

Feed intake was recorded daily and was determined by weighing the quantity of feed offered and the left over the following day, the difference between the two values was the daily feed intake. The body weight gain was observed by weighing the birds every week with electronic

digital scale to determine their body weight change. The feed conversion ratio of the birds was determined on the weight of the egg laid by dividing the total feed intake by the total egg weight.

Hen day egg production was also determined by dividing the total number of eggs laid per day by the total number of birds alive and multiple by hundred:

$$\frac{\text{Total number of egg laid/ day}}{\text{Number of birds alive}} \times \frac{100}{1}$$

(Brown *et al.*, 2000, Anyaehie, 2006).

All eggs collected from each group were weighed daily with electronic digital scale to determine the average egg weight. Blood samples were collected from three (3) birds per treatment at the end of the experiment from their wing web using syringe and needle. The blood samples collected were poured into specimen bottles containing EDTA (Ethylene diamine tetra acetic acid) for haematological analysis according to Dacie *et al.* (1984) and Merck Manual, (2012).

All data collected were subjected to analysis of variance according to AOAC (2003), using SPSS, (2012) and significantly different means were separated using Duncan's New Multiple Range Test (DNMRT) of the same software.

RESULTS AND DISCUSSION

Table 2 shows the proximate analysis of dried cocoyam corm meal (*Xanthosoma sagittifolium*) used for this study. The crude fibre, crude protein, ash, ether extract moisture, dry matter, nitrogen free extract and metabolizable energy are: 5.56%, 8.05%, 4.00%, 4.5%, 79%, 80.05%, 48.0% and 3160.05kcal/kgDm respectively. These values were in line with the values obtained by Sarla *et al.* (2012) and Makikiti, (2017).

The result of the performance of layer hens fed dried cocoyam corm meal are shown in Table 3. Feed intake increased as the levels of dried cocoyam corm meal increased in the diets though there were no significant ($P > 0.05$) difference among the treatment groups, T₄ had the highest ($P < 0.05$) feed intake among other groups while T₁ had the least ($P < 0.05$). The results of feed intake obtained in this study are in agreement with observations of Esonu (2000^a and 2000^b), Ndimetang *et al.* (2006) who reported that cocoyam corm meals were very rich in nutrients and very palatable and therefore increases its acceptability in poultry diets. On body weight gain, hens placed on diets 2 (T₂) had significance ($P < 0.05$) least weight gain among the treatment groups, T₁ group and T₃ were the same ($P > 0.05$) while T₄ had the highest ($P < 0.05$) weight gain among other groups. This obviously implies that cocoyam corm meal (*Xanthosoma sagittifolium*) improved adequate weight gain that are required for maximum egg production. This is in agreement with Kekeocha and Okonkwo (2012) who stated that growth require synthesis of new body tissues and the raw materials for growth have to be provided through feed and feedstuffs that are adequate for it. In laying hens that are reared for other purposes, production however is influenced by growth which has to be attained to a

particular point (1.5 to 2kg). On hen day egg production, the layer hens fed 0% dried cocoyam corm meal (T₁) had the highest egg production (72.02%) which was significantly (P<0.05) higher than T₄ (57.03%), T₂ and T₃ had same (P>0.05) number of eggs (67.26%) which was closer to T₁. Egg production reduced as cocoyam corm meal increased the diets, this could be attributed to higher weight gain observed at higher level inclusion of cocoyam corm meal in the diets of layer hens. This inference affirmed the claim of Ikpe *et al.* (2019) who stated that too much weight in layer hens resulted to low egg production. Moreso, higher feed intake of T₄ hens did not match the egg production value recorded in this study. On egg weight, T₂ (10%DCCM) was significantly (P<0.05) higher than other groups with an average weight of (65.40g) followed by T₃ (64.36g), T₁ (control) had the lowest (61.76g) (P<0.05) which was significantly the lowest (P<0.05) among other groups on egg weight. This experiment showed that 15% inclusion of cocoyam corm meal supported egg production, egg weight and feed efficiency more than 20% inclusion (T₄). On feed conversion efficiency, T₂ had the highest (P<0.05) (1.27) among other groups followed by T₁ (1.31) and then T₄ (1.38) which had the lowest (P<0.05), though there were no significant (P>0.05) difference among the treatment groups on feed conversion ratio. This is in line with Iheukwumere *et al.* (2008) and Esonu, (2000b) who stated that layer hens' diets should be adequate with regard to essential nutrients to improve feed efficiency and feed utilization. Also, Effiong *et al.* (2015), Singh *et al.* (2015) reported positive influence on hen day production, egg weight and feed efficiency on hens fed adequate diets in terms of quality and quantity. All the eggs obtained in this study were within the same category as stated in the United States, Department of Agriculture (2000 and 2013) as standard for egg weight and hen day production. It is important to state here that as at the time this experiment was carried out, very little information was available on the inclusion of yellow cocoyam corm meal *Xanthosoma (sagittifolium)* as feed ingredient in layer hens' diets.

The results of haematological analysis of layer hens fed dried cocoyam corm meal are shown in Table 4.

Haematological parameters such as haemoglobin, packed cell volume, red blood cell volume tend to decrease as the levels of cocoyam corm meal increased in the diets but did not follow a definite order.

Moreso, all the values obtained were within the normal range for hens which were in line with Merck, (2012). The mean cell haemoglobin concentration increased (P<0.05) for hens fed high inclusion levels of cocoyam corm meal in their diets. T₃ had the highest (P<0.05) cell haemoglobin concentration (20.46pg) followed by T₄ (20.34pg) which differed significantly (P<0.05) from T₁ (19.80pg). The white blood cell count values did not differ significantly (P>0.05) among the treatment groups and all the values obtained are within the recommended range for avian specie also in line with Merck, (2012). Other blood parameters evaluated include; Eosinophil, Monocytes, Rasophil showed no significant (P>0.05) difference among the treatment groups. These indicate the normal body functions of hens and the absence of infection in all the treatment groups. This is in line with Awuyobi *et al.* (2002), (Ewuola *et al.*, 2004), Iheukwumere *et al.* (2006) who stated that haematological parameters are an index and reflection of the effects of dietary treatment on the animal in *Journal of the Faculty of Agriculture and Veterinary Medicine, Imo State University Owerri* website: www.ajol.info/index.php/jafs

terms of type quality and quantity ingested to meet the physiological, biological, biochemical and metabolic necessities of the body.

In this study, none of the haematological parameters evaluated had any adverse effect on the layer hens as well as egg production, and an indication that the dried cocoyam corm meal is an ideal feed ingredient and could replace maize in layer hen's diets up to 15% level in their diets without any deleterious effect on the overall performance.

CONCLUSION AND APPLICATION

It was concluded that:

1. Feeding layer hens with dried cocoyam corm meal (*Xanthosoma sagittifolium*) based diets improved feed intake, body weight gain, egg weight and feed conversion efficiency.
2. Hen day egg production of hens placed on 15% cocoyam corm meal was close to the value obtained from the control (T₁) which was the highest.
3. For poultry farmers and poultry nutritionists whose target is primarily on improvement of feed efficiency and egg weight of laying hens, the result of this study showed that 10% dried cocoyam corm meal replacement of maize will meet that need, hence, it is recommended.
4. Finally, on a general note, the result of this study showed that 15% of cocoyam corm meal (*Xanthosoma sagittifolium*) could be included in the diets of layer hens without any adverse effects on the performance and blood parameters.

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APPENDIX

Table 1: Ingredient and Calculated Nutrient Compositions of the experimental diets

Ingredients	T₁ (0.0%)	T₂ (10%)	T₃ (15.0%)	T₄ (20.0%)
Maize	50.0	40.0	35.0	30.0
Cocoyam corm meal	0.0	10.0	15.0	20.0
Soya bean meal	16.0	16.0	16.0	16.0
Fish meal	3.0	3.0	3.0	3.0
Blood meal	1.0	1.0	1.0	1.0
Wheat offal meal	10.0	10.0	10.0	10.0
Palm kernel cake meal	10.25	10.25	10.25	10.25
Bone meal	9.0	9.0	9.0	9.0
Salt	0.25	0.25	0.25	0.25
Vit. Premix	0.25	0.25	0.25	0.25
L- Lysine	0.15	0.15	0.15	0.15
DL – Methionine	0.10	0.10	0.10	0.10

Calculated Nutrient Composition of Experimental Diets

Crude protein (%)	17.96	17.55	17.35	17.22
Crude fibre (%)	4.14	4.10	4.04	4.00
Ether extract (%)	3.70	3.56	3.45	3.25
Calcium (%)	3.55	3.60	3.68	4.00
Phosphorus (%)	1.00	1.06	1.08	1.12
Lysine (%)	0.92	0.95	1.00	1.12
Methionine (%)	0.38	0.39	0.45	0.48
Metabolizable Energy Kcal/kg	2705.06	2650.05	2625.00	2575.98

To provide; Vitamin k = 2.5gm, Thiamine B1 = 1.5g, Riboflavin B₂ = 5g, Pyriboflavin B₆ = 1.5g, vitamin B12 = 10mg, Biotin = 20mg, Niacin = 15gm, Pantothenic acid = 5mg, folic acid = 0.6gm, Manganese = 75gm, zinc = 50gm, Iron = 25gm, copper 5gm, Iodine = 1gm, Selenium = 100gm, Cobalt = 300mg, chlorine chloride = 150gm.

Source: Agrited, (2007).

Table 2: Proximate Composition of Cocoyam Corm Meal (*Xanthosoma sagittifolium*)

Nutrient % DM	Composition
Crude fibre	5.56
Crude protein	8.05
Ash	4.00
Ether extract	4.5
Moisture	79
Dry matter	80.05
Nitrogen Free Extract	48.00
ME (Kcal/kg)	3160.05kcal/kgDM

Table 3: Performance of layer hens fed sun dried cocoyam corm meal (DCCM)

Parameters	Dietary Treatment				SEM
	T ₁ (0%)	T ₂ (10%)	T ₃ (15%)	T ₄ (20%)	
Initial body weight(g)	1710.00	1733.33	1710.00	1693.33	10.50
Total body weight gain(g)	96.67 ^b	66.67 ^c	96.67 ^b	100.00 ^a	11.12
Final body weight(g)	1806.67 ^a	1800.00 ^b	1806.67 ^a	1793.33 ^c	16.18
Av. daily feed intake(g)	113.50 ^d	114.00 ^c	114.50 ^b	1150.01 ^a	0.25
Total feed intake(g)	3405 ^d	3420 ^c	3435 ^b	3450.3 ^a	0.36
Hen day egg production(%)	72.02 ^a	67.26 ^b	67.26 ^b	57.03 ^c	1.11
Av. NO. of eggs/bird within 56 days	45.20	41.10	41.10	40.02	0.05
Av. Egg weight(g)	61.76 ^d	65.40 ^a	64.36 ^b	62.36 ^c	2.57
Total egg weight(g)	2606.272	2687.94	2581.48	2495.65	0.04
Feed conversion ratio (gfeed/g egg wt)	1.31	1.27	1.33	1.38	0.03

Means in the same row having different superscripts are significantly different (P<0.05)

SEM: Standard error of mean

DCCM: Dried cocoyam corm meal

gfeed/g egg wt: Gram feed per gram egg weight

Table 4: Haematological parameters of layer hens fed sun-dried cocoyam corm meal

Parameters	T₁ (0%)	T₂ (10%)	T₃ (15%)	T₄ (20%)	SEM
Haemoglobin (g/dl)	13.20 ^a	12.97 ^{ab}	12.40 ^b	12.57 ^{ab}	0.13
Packed Cell Volume (%)	43.33 ^a	41.33 ^{ab}	38.00 ^c	39.00 ^{bc}	0.73
Red blood cell (x10 ¹² /L)	13.33 ^a	13.07 ^{ab}	12.13 ^b	12.36 ^{ab}	0.20
Mean Cell Volume (fl)	132.50	131.17	131.33	131.27	0.23
Mean Cell Haemoglobin (pg)	19.80 ^c	19.86 ^b	20.46 ^a	20.34 ^{ab}	0.12
Mean Cell Haemoglobin Concentration (g/dl)	30.50 ^b	31.40 ^{ab}	32.67 ^a	32.57 ^a	0.34
White blood cell Concentration (X10 ⁹ /L)	11.93 ^a	11.77 ^{ab}	11.43 ^b	11.63 ^{ab}	0.07
Heterophils (%)	53.00	53.33	53.33	52.33	0.44
Basophil (%)	00.00	00.00	00.00	00.00	0.00
Monocyte (%)	1.67	1.63	1.67	1.67	0.15
Lymphocytes (%)	44.00	43.67	45.67	45.00	0.34
Eosinophil (%)	1.33	1.67	1.33	1.00	0.14
ESR (mm ³ /hr)	16.67	23.33	33.33	26.67	2.89

Means in the same row having different superscripts are significantly different (P<0.05)