

EGG QUALITY CHARACTERISTICS OF LAYER HENS FED VARYING LEVELS OF YELLOW COCOYAM CORM MEAL (*Xanthosoma sagittifolium*) AS ENERGY SOURCE

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ABSTRACT

This experiment was carried out to determine the effect of sun-dried cocoyam corm meal (SDCCM) on the performance and egg quality characteristics of layer hens. Poultry industry in Nigeria is faced with numerous challenges among which is the scarcity and high cost of poultry feed fueled by high cost of energy and protein feed feedstuffs such as maize, sorghum, oat, millet etc. Cocoyam corm meal has been discovered as cheaper energy source than grains such as maize or wheat and was used to formulate layer hens' diets as energy source at 0.0%, 10.0%, 15.0% and 20% levels of inclusion respectively. These were used to feed a batch of one hundred and twenty (120) Isa brown pullets starting at their point of lay for a fifty-six (56) days feeding trial. The birds were grouped into four treatments of 30 hens per group and replicated three times with 10 birds per group in a Completely Randomized Design (CRD). Proximate composition of the experimental material was evaluated while the laying hens performance and egg quality characteristics were determined. The results obtained showed no treatment effect ($P>0.05$) for all the performance characteristics except for feed cost and hen – day egg production which were significantly reduced ($P<0.05$) in the test diets at 20% dietary levels. Similarly, all the external egg quality characteristics measured in this study were similar ($P>0.05$) in all the treatments means except for egg shell weight which was reduced significantly ($P<0.05$) in T₄ (20% DCCM). However, all the treatment groups retained similar ($P<0.05$) egg shell thickness and were within the range of 0.30 – 0.36mm reported for egg shell thickness. However, for internal egg quality characteristics, results obtained in all the treatment means were similar ($P>0.05$). Albumen height and haugh unit values were, 7.19, 7.36, 7.13, and 7.23cm and 83.75, 83.79, 82.53 and 83.80 respectively. It was therefore concluded that dried cocoyam corm meal is an ideal feed ingredient in layer hen's diets at 20% inclusion level.

Keywords: Performance, egg quality characteristics, layer hens and sun-dried cocoyam corm meal.

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INTRODUCTION

Poultry production remains the fastest means of providing animal proteins to countries whose protein demand are still high. In Nigeria poultry products such as meat and egg are still in high demand due to the fact that there are no religious or social constraints to these products. However, animal protein intake in Nigeria is absolutely low at 4.59/day/caput USDA, (2013) as against 28g/day/caput recommended by FAO, (2000). The low per caput consumption of animal products in Nigeria is reflected by the low food-production and imports to meet the demands for the rapid growing population (FAO, 2000). FAO, (2001) indicated that if the high production of animal products is achieved through the use of alternative or unconventional feedstuffs that the high prices for grains for livestock and their production will fall and with this per caput consumption of meat and egg will increase. Okonkwo, *et al.*, (2014) indicated that the use of unconventional energy sources for poultry feed as alternative to conventional energy sources is sequel to the ever-increasing prices of the conventional energy feed ingredients such as maize grains, wheat, oat etc.

Cocoyam (*Xanthosoma spp.*) are cultivated in many parts of Nigeria and West Africa in general. Cocoyam corms and its other parts are cheaper energy sources than most grains and with substantial amount of vitamins, minerals and proteins contents (Boakye, *et al.*, 2016 and 2017). Opara (2003), observed that cocoyam corms meal can be regarded as one of the sources of dietary energy, proteins and vitamins. It is said to be also high in potassium, zinc and nicotinic acid as well as a low inhibitor of trypsin compared to other edible aroids.

Matikiti, A. (2017), outlined the proximate composition of cocoyam in the range of 65-78% moisture, 2-5% ash, 0.2-1.10% fat, 2-5% fibre, 14-23% carbohydrates, 390-460mg/100g potassium, 24-43mg/100g calcium, 79-91K/Cal energy, 4.8% crude protein and 79-110mg/100g magnesium. Cocoyam is high in carbohydrates because it contains digestible starch.

Boakye, *et al.*, (2017), observed that high calcium oxalate affects the corm palatability conferring acidity and bitter astringent taste. It also contains other anti-nutritional and toxic properties such as phytate and tannin which cause health hazard for humans and poultry if not well processed (Sefa-Dedeh and Agyir-Sackey, 2004).

Eyasu *et al.* (2019), in a study with *Xanthosoma sagittifolium*, observed that the proximate, mineral and anti-nutrients content of the green and purple varieties of *Xanthosoma sagittifolium* (L.) Schott were as follows, 61.91 and 63.53% moisture contents, crude protein (10.10%) and (8.48%), fibre, 2.66% and 2.14%, fat contents 0.85 and 0.22% respectively for green and purple varieties of *Xanthosoma sagittifolium* respectively. However, they also observed carbohydrate and gross energy values (Kcal/100g) of green and purple *Xanthosoma sagittifolium* to be 85.36% and 378.47Kcal/100g and 84.76% and 380.27Kcal/100g, ash contents, 3.25 and 2.27% respectively.

Eyasu *et al.* (2019), also observed that aroids are group with the neglected and under-utilized crops which over the years have received little research attention. However, they are important tuberous root crops that play significant role in the livelihood of millions of relatively poor people in developing countries. The most important aroids are from *Journal of the Faculty of Agriculture and Veterinary Medicine, Imo State University Owerri*
website: www.ajol.info/index.php/jafs

Colocasieae and *Caladieae*, that is taro (*Colocasia esculentu* (L.) Schott and *Colocasia Xanthosoma sagittifolium* (L.) Schott.

However, to overcome all these health hazards caused by the anti-nutritional factors content of cocoyam corm, different processing methods could be used which sundrying is one while others include: cooking, soaking in water for hours, fermentation etc. <https://www.ncgi.nim.nih.gov>pmc>. There is therefore need to employ the services, of one or more than one method of processing cocoyam corm in order to enhance the breakdown of these anti-nutritional factors content of the corm so as to make the material safe as poultry diet.

The study therefore was aimed at evaluating the performance and egg quality characteristics of layer hens fed cocoyam corm meal (*Xanthosoma sagittifolium*) as energy source in their diets.

MATERIALS AND METHODS

This study was carried out at the Poultry Unit of Imo State University Teaching and Research Farm, Owerri, Imo State, which is located within the South-Eastern agro-ecological zone of Nigeria. Owerri lies between latitudes, 5^o.29'N, and longitudes 7^o20' E at 91m above the sea level. The area has an annual rainfall of 1,500mm to 2,200mm, temperature of 20 – 27.5^oC, relative humidity of 75-90% (Accumulator, 2015).

The cocoyam corms used for this experiment were bought from Umuchoke Okwe Market in Onuimo Local Government Area of Imo State. The corms were peeled, washed sliced and sun-dried for 14 days (two weeks) to a moisture level of 79% and milled with hammer mill. The sample of the milled cocoyam corm meal was sent to laboratory for proximate nutrients composition analysis according to AOAC, (2010). Layer hen diets were formulated incorporating the cocoyam corm meal at 0.0%, 10.0%, 15.0% and 20.0% as T₁, T₂, T₃ and T₄ respectively.

The ingredients and nutrients composition of the experimental diets are shown in Table 1. One hundred and twenty (120), Isa brown layer hens at their points of lay were used and the hens were purchased from a reputable source. The birds were randomly divided into four treatment groups of 30 hens per group. Each group was assigned to one of the treatment diets in a Completely Randomized Design (CRD). Each group of 30 hens was further replicated three times, with ten(10) hens in each replicate and housed in a pen measuring 1m x 1m. Feed and water were provided ad libitum, vaccination and sanitation measures were carried out when necessary. Data were collected on feed intake, feed conversion, ratios, egg weights, hen-day egg production, internal and external egg quality characteristics, such as albumen height, yolk height, shell weight, haugh unit values etc.

All data collected were subjected to analysis of variance using SPSS software (2012) where as significant treatment effects means were compared using the Duncan's New Multiple Range Test (DNMRT) SPSS (2012).

RESULTS AND DISCUSSION

The proximate compositions of dried cocoyam corm meal (DCCM) are shown in Table 2. The crude protein (CP %, Dry Matter), crude fibre (CF), moisture content, ether extract (EE), ash and nitrogen free extract (NFE) were close and some above the values reported by Matikit, (2017), crude protein 4.8%, fibre 3%, Ether extract 1.1, moisture 78%, ash 4%, carbohydrates 22%, energy 79-91k/cal, magnesium 98%/100g. Ndimentang *et al.*, (2016) also observed other nutritional profile of *Xanthosoma sagittifolium* to further contains 132 calories in a cup of 135grams of dried and ground *Xanthosoma spp.*, 0.347gm of copper, 0.32mg of vitamin B6, 31.9gm of carbohydrate, 8.07mg of potassium, 1.32mg of iron and protein 9.74%. These variations could result due to climatic condition, soil factors, processing method used as well as laboratory and analytical processes involved; (Esiegwu, *et al.*, 2018).

The external egg quality characteristics of the layer hens fed the varying levels of yellow cocoyam corm meal (DCCM) are shown in Table 3. The results obtained on the external egg quality parameters measured in this experiment such as egg weight, egg size/length, width, shell weight and percentage shell thickness were similar ($P>0.05$), this showed that the dried cocoyam corm meal even at higher level of 20% did not negatively affect the external egg quality characteristics. This equally indicated that sun-drying, actually removed the high calcium-oxalate contained in cocoyam corms as Boakye *et al.*, (2016) rightly said that high calcium oxalates and other anti-nutritional factors in cocoyam corms affect the corm palatability conferring acidity and other bitter astringent taste which cause health hazards to human beings and poultry if not well processed. Egg weight and size has been reported by Iposu *et al.* (2000), Obidinma, (2009 and Barkye, 2017) as one of the most important measures that determines the consumer's choice of eggs. Consumers and other industrial egg users are seriously concerned with good quality eggs and freshness of eggs. However, the egg weight obtained in this study was within the recommended average of 60-65gm (Iposu, *et al.*, 2000, Obidinma, 2009).

More so, the shell thickness obtained were similar ($P>0.05$) and were within the recommended range of 0.30mm – 0.36mm reported by (Oluyemi and Roberts, 2007). Eggs with thick egg shell help to reduce shell cracking during egg collections and transportation, (Olabode, 2015) and this has some serious economic implication in egg production and marketing.

The internal egg quality characteristics results for layer birds fed dried cocoyam corm meal as energy source are shown in Table 4. The albumen length increased ($P<0.05$) as cocoyam corm meal increased in the diet. However, there was no significant difference ($P>0.05$) on the albumen heights. Albumen widths and the haugh unit of the eggs from all the groups measured except the yolk width which increased ($P<0.05$) as the level of dried cocoyam corm meal increased in the diets. The values of the internal egg quality characteristics obtained in this experiment were indicators that the eggs obtained were of good quality and were within the recommended ranges as observed by Oluyemi and Roberts, (2007), Obidinma, (2009) and Owusu Darko *et al.*, (2014). This showed that the dried cocoyam corm meal can serve as

energy source in layer hen's diets since it had no deleterious effect on the external and internal egg quality characteristics.

CONCLUSION AND RECOMMENDATION

It was concluded that for external and internal egg quality measures and for good quality egg production, up to 20%, dried cocoyam corm meal (*Xanthosoma sagittifolium*) could be included in the laying hens' diets since it did not show any defect in the external and internal egg qualities of the experimental hens. Therefore, it was recommended that dried cocoyam corm meal should be used as an alternative energy source in the laying hens diets up to 20% inclusion level because it was supportive to the external and internal egg qualities at this level.

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APPENDIX

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

Ingredients	Dietary corn meal T ₁ (0.0%)	Levels of (<i>Xanthosoma</i>) T ₂ (10%)	Dried of (<i>sagittifolium</i>) T ₃ (15.0%)	Cocoyam T ₄ (20.0%)
Maize	50	40	35	30
Cocoyam corn meal	0	10	15	20
Soya bean meal	16	16	16	16
Fish meal	4	4	4	4
Wheat offal meal	12.0	12.0	12.0	12.0
Palm kernel cake meal	8.7	8.7	8.7	8.7
Bone meal	8.5	8.5	8.5	8.5
Salt	0.30	0.30	0.30	0.30
Vit. Premix (layer 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
Total	100.00	100.00	100.00	100.00
Calculated Nutrient Composition of Experimental Diets				
Crude protein (%)	17.96	17.45	17.20	16.91
Crude fibre (%)	4.14	4.12	4.00	3.97
Ether extract (%)	3.67	3.42	3.39	3.38
Calcium (%)	3.05	3.07	3.09	3.08
Phosphorus (%)	1.15	1.16	1.14	1.12
Lysine (%)	1.22	1.23	1.20	1.19
Methionine (%)	0.55	0.50	0.51	0.53
Metabolizable				
Energy Kcal/kg	2677.05	2653.58	2625.57	2598.95

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

Nutrient % DM	Composition
Crude protein	8.05
Crude fibre	5.50
Ash	4.00
Ether extract	4.50
Moisture	79.00
Dry Matter	86.05
Nitrogen Free Extract	48.00
ME (Kcal/kg)	3160.05kcal/kgDM

Table 3: External egg quality Characteristics of layer hens fed cocoyam corm meal (*Xanthosoma sagittifolium*)

Parameters	Dietary Treatment				SEM
	T ₁ (0%)	T ₂ (10%)	T ₃ (15%)	T ₄ (20%)	
Egg Weight (g)	61.75	65.40	64.36	62.36	1.11
Egg length (cm)	4.25	4.24	4.35	4.30	0.04
Egg width (cm)	2.95	3.08	2.96	2.97	0.03
Egg shell weight (g)	5.65 ^a	5.30 ^{ab}	5.66 ^a	5.13 ^b	0.08
Egg shell percentage	9.15 ^a	8.11 ^c	8.86 ^{ab}	8.22 ^b	0.19
Egg shell thickness (mm)	0.30	0.33	0.31	0.32	0.19

abcd: Means in the same horizontal row having different superscripts are significantly (P<0.05) different.

Table 4: Internal egg quality characteristics of laying hens fed cocoyam corm meal (*Xanthosoma sagittifolium*)

Parameters	Dietary Treatment				SEM
	T ₁ (0%)	T ₂ (10%)	T ₃ (15%)	T ₄ (20%)	
Albumen height (cm)	7.19	7.39	7.13	7.23	0.04
Albumen length (cm)	7.67 ^{ab}	7.35 ^b	8.23 ^a	8.37 ^a	0.16
Albumen width (cm)	6.44	6.16	6.63	6.36	0.09
Yolk height (cm)	1.99 ^{ab}	2.09 ^a	1.97 ^{ab}	1.93 ^b	0.03
Yolk width (cm)	3.98 ^a	3.78 ^b	4.04 ^a	4.02 ^a	0.04
Haugh unit	83.75	83.79	82.53	83.80	0.41

abcd: Means in the same horizontal row having different superscripts are significantly (P<0.05) different.