LAYING PERFORMANCE AND EGG QUALITY OF HENS FED BOILED UNRIPE PLANTAIN (*Musa paradisiaca c*v. cadava) PEEL FLOUR DIETS

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ABSTRACT
The laying performance and egg quality of hens fed diets containing Boiled Unripe Plantain Peel Flour (BUPPF) as a replacement for maize offal was studied for a period of 6 weeks. One hundred and fifty-six 18-weeks old ISA Brown laying hens were randomly divided into 3 dietary treatments, with 4 replicates of 13 birds each. A total of 52 birds were in a treatment group. Dietary treatment groups were: 0% BUPPF (control), 10% BUPPF (T1) and 20% BUPPF (T3) in a completely randomized design. Data were collected on hen day egg production, Average Daily Intake (ADI), feed conversion, Albumin Weight (AW), Yolk Weight (YW), Shell Plus Membrane Weight (SPMW), Yolk Index (YI) and Yolk Colour (YC). All data collected were analysed by one-way analysis of variance (ANOVA). The results showed that laying hens fed BUPPF diets had significantly higher ADI (p=0.001) and SPMW (p=0.0005) than those fed control diet. Eggs from hens fed control diet had the highest AW (p=0.0003), YI (p= 0.013) and best YC (p<0.001). Conclusively, boiled unripe plantain peel had adverse effects on yolk index and yolk colour. Therefore, boiling may not be a suitable method for processing unripe plantain peel as there were no improvement in laying performance and egg quality of hens fed boiled unripe plantain peel diets.
Key-words: laying performance, hens, boiled unripe plantain peel flour, yolk and egg quality

INTRODUCTION

Plantain wastes (peels) pose to be potential sources of nutrients for production of animal feeds, and their use for this purpose should be encouraged, as this will also help to decrease menace of plantain waste in the environment ((Okareh *et al.,* 2015)) and reduce cost of poultry production. However, the use of plantain peels in poultry has been limited because of possible deleterious effects arising from the presence of tannins (Blandon *et al.,* 2015) and fibrousness (Akande and Agbetuyi, 2019). It has been reported that tannins content in dry banana peels reduces from 1.2g/100g to 0.46g/100g after soaking in boiling water (Blandon *et al*. (2015). The present study evaluated the effects of boiled unripe plantain (*M. paradisiaca* cv. cadava) peel flour diets on laying performance, external and internal quality of eggs laid by hens.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at layer Unit, Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso, Oyo State Nigeria.

Source and processing of Unripe Plantain Peels

Unripe plantain (*M. paradisiaca* cv. cadava) peels were sourced from plantain chips processing enterprise in Ogbomoso, Oyo State. The peels were boiled at 100°C for forty minutes in a cooking pot and sun-dried to a constant weight. The dried peels were ground using hammer mill with sieve size of 0.5mm to reduce the particle size to obtain Boiled Unripe Plantain Peel Flour (BUPPF).

Management of Experimental Birds and Diets

One hundred and fifty-six, 18-weeks old pullets of Isa Brown strain of layers were used for the experiment. The pullets were purchased at 12 weeks of age from a reputable farm, fed grower mash feed for 6 weeks until they reach sexual maturity and attain 20% egg production before feeding them experimental diets. At eighteen weeks of age, the birds were randomly divided into three Dietary treatment groups of 4 replicates each with 13 birds in each replicate and 52 birds per treatment in a completely randomized design experiment. The experimental birds were kept in two-tier battery cage system for a period of 6 weeks of study. Feed and water were offered *ad libitum* to the birds. Routine management practices and vaccination programme were administered as at when due. Three

Experimental diets were formulated for the study. Diets contained 0, 10 and 20% boiled unripe plantain peel flour in Control, Treatment 1 and Treatment 2, respectively (Table1).

Table 1: Ingredient Composition of the Experimental Layer Diets

Ingredients	Control	T1 (10% BUPPF)	T2 (20% BUPPF)	Grower mash
Maize	44.30	44.30	44.30	38.00
Maize offal	20.00	10.00	-	31.00
BUPPF	-	10.00	20.00	-
Wheat offal	-	-	-	12.70
Soybean meal	22.00	22.00	22.00	12.00
FM (72% CP)	3.00	4.00	4.00	2.00
Methionine	0.20	0.20	0.20	0.10
**Fixed ingredients	10.50	10.50	10.50	10.50
Crude Protein*	16.90	17.05	17.35	15.85
M.E (kcal/kg))	3020.90	3040.88	3014.48	2689. 00

**Fixed ingredients: 3% bone meal, 7% limestone, 0.25% salt, 0.25% vitamin-mineral premix.
Note: BUPPF= Boiled Unripe Plantain Peel Flour, FM= Fish Meal, * =Parameters of determined nutrients
ME= Metabolizable energy was calculated using Pauzenga equation,

Data Collection

Laying Performance of the Experimental Birds

i. Hen Day Egg Production (HDEP): During the study, daily egg production was monitored. Hen day egg production was calculated with the formula below;

$$\text{Hen Day Egg Production} = \frac{\text{Number of eggs laid X 100}}{\text{Number of hens X Number of days}}$$

ii. Average Daily Intake (ADI): was calculated by dividing the feed intake by the total number of birds.
iii. Average Egg Weight (AEW): Eggs were weighed on a daily basis. This was calculated by dividing the total weight of eggs laid by number of eggs.
iv. The feed conversion was calculated by dividing the average daily intake by average egg weight.

External and Internal Egg Quality of Laying Hens Fed Boiled Unripe Plantain Peel Flour Diets

From the 2nd week of the study, twelve eggs per treatment of 3 eggs per replicate were used to assess the external and internal egg quality for 5 weeks consecutively. The external egg quality assessed are: egg length, width, egg shape index, egg volume, egg specific gravity, egg weight, shell thickness and its weight. The internal egg quality determined are haugh unit, yolk colour, yolk length, yolk height, and yolk index. Egg length and width were measured with vanier calliper in centimetre (cm). The egg shape index was determined using the ratio of the egg width to the length. The shell weight was estimated after the inner content of eggs had been removed. Shell thickness of individual air-dried shell was measured to the nearest 0.01 mm using a digital micrometer screw gauge. The eggs were broken on a flat surface plate and the internal quality of the eggs were assessed. The internal quality determined were weights of yolk, albumen and yolk colour. Yolk colour was determined by using Roche yolk colour fan. Albumen height was done using a spherometer. Yolk index was assessed by using ratio of width to the height of the yolk.
The Haugh unit was calculated using the formula below:

$$\text{Haugh Unit} = 100 \times \text{Log}(H + 7.57 - 1.7W^{0.37})$$

Where H = Albumen height in millimetre, W = Weight of eggs in grams

Statistical Analysis

All data collected were subjected to one-way Analysis of Variance (ANOVA) using SAS (2004) Software Package, Duncan's option of the same software was used to separate the means. The probability of 5% was considered significant ($P \leq 0.005$).

RESULTS AND DISCUSSION

The laying performance of hens fed boiled unripe plantain peel flour diets presented in Table 2 showed that laying hens fed BUPPF diets had significantly higher average daily intake (P=0.001) than those fed control diet. This result disagrees with the report of Oyedeji *et al.* (2015) who observed that there was no significant difference in the feed intake of broiler chickens fed ripe and unripe plantain peel diets. The differences observed in the feed intake of the experimental animals in the present study and those of earlier authors could be due to differences in

processing method of plantain peels, cultivars and the animals used for the study. The increased average daily intake recorded in hens fed BUPPF diet in the present study may be due to the palatability of the diet. This could be attributed to high vitamin C content in unripe plantain peel flour. It has been reported that unripe plantain peel contains 11.72mg/100g of vitamin C (Akinsanmi *et al*., 2015) which might have enhanced the palatability of the diet. Abudabos *et al*. (2019) observed that the inclusion of vitamin C as much as 200 mg/L in broiler ration when environment's temperature is 32°C showed increase in feed consumption of broiler up to 0.98%. However, the higher ADI for laying hens fed BUPPF diets did not improve egg production of the hens. This could indicate that the hens could utilize the maize offal better than the peel

Table 2: Laying Performance of hens fed boiled unripe plantain peel flour diets

Parameters	CONTROL	T1 (10%BUPPF)	T2 (20%BUPPF)	P-VALUE	SEM
Egg weight (g)	48.26	46.51	45.55	0.219	0.93
HDEP (%)	57.29	62.66	52.01	0.326	4.72
Average Daily Intake(g/bird)	89.18[b]	103.89[a]	98.28	0.001	0.82
Feed Conversion	3.24	3.63	4.26	0.099	0.30

:[a,b,c] : Means along the same row with different superscripts are significantly different (P<0.050)
Note: BUPPF=Boiled Unripe Plantain Peel Flour, HDEP=Hen Day Egg Production

External and internal quality of eggs from laying hens fed boiled unripe plantain peel flour diets shown in Table 3 revealed that there were significant differences in the egg shell plus membrane (P=0.003), albumin weight (P=0.008), yolk weight (P=0.028), yolk length (P<0.0001), yolk index (P=0.013) and yolk colour (P<0.001) of eggs laid by the hens. Egg shells plus membrane from hens fed 20% BUPPF diets were heavier with longer yolk than eggs from hens fed control and those fed 10% BUPPF diets. The yolk weight of eggs laid by hens fed plantain peel flour diets were heavier than those fed control diet. Highest albumen weight (66.36%), yolk index (0.49) and better yolk colour were recorded in eggs laid by hens fed control diet. The heavier shell plus membrane weight of eggs laid by hens fed 20%BUPPF could be attributed to high calcium and phosphorus content of the peel. Okareh *et al*. (2015) reported that plantain waste (peels) is rich in calcium, phosphorus and iron and could be good source of these minerals. Heavier yolk weight observed in eggs from hens fed boiled unripe plantain peel flour diets shows that the eggs may be richer in lipids than those laid by hens fed control diet

Table 3: External and Internal Egg Quality of Laying Hens Fed BUPPF diets

Parameters	Control	T1 (10%BUPPF)	T2 (20%BUPPF)	P-Value	SEM
Egg shape index	0.78	0.78	0.77	0.280	0.000014
Yolk weight (%)	21.81[b]	22.75[a]	22.61[a]	0.028	0.27
SPMW (%)	11.83[b]	12.48[b]	12.98[a]	0.0005	0.20
Albumen weight (%)	66.36[a]	64.77[b]	64.41[b]	0.0003	0.34
Haugh unit	94.50	92.90	93.56	0.269	0.70
Yolk length (cm)	3.48[c]	3.53[b]	3.59[a]	<0.0001	0.02
Yolk height (cm)	1.69	1.66	1.69	0.381	0.02
Yolk Index	0.49[a]	0.47[b]	0.47[b]	0.013	0.01
Specific gravity (g/cm^3)	1.06	1.05	1.05	0.433	0.01
Shell thickness (cm)	0.35	0.35	0.36	0.329	0.01
Yolk colour	5.79[a]	4.63[b]	4.29[b]	<0.001	0.17
Yolk albumin ratio	0.35	0.35	0.36	0.648	0.01

[a,b,c] : Means along the same row with different superscripts are significantly different (P<0.050)
Note: BUPPF=Boiled Unripe Plantain Peel Flour, SPMW=Shell Plus Membrane Weight
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Highest yolk index of 0.49 (49%) was noticed in eggs laid by hens fed control diet. However, the yolk index of 0.47(47%) observed in eggs from hens fed BUPPF diet fell within the normal range reported by other authors for fresh egg. Garba *et al.* (2010) reported a yolk index range of 44 to 47% for fresh egg. Oyewole *et al*. (2018) observed that the yolk index of eggs laid by hens fed graded levels of sweet orange fruit peel meal ranged from 46.62 to 56.16%. The yolk index obtained in the present study implied that dietary BUPPF had no adverse effect on the freshness of egg. Better yolk colour of eggs laid by hens fed control diet than those fed BUPPF diet might be due to the reduction in the carotenoid content of the peel during boiling. Carotenoid is an effective pigment for egg yolk colour. Ngoh *et al*. (2018) reported that α-carotenoid and β-carotenoid content in unripe plantain pulps

with peels decreases from 511.67 to 360.94 µg Eq.β-carotene/100g fresh weight and 460.06 to 308.42 µg Eq.β-carotene/100g fresh weight respectively after boiling in water (at 100˚C) for 40 minutes. Also, α-carotenoid and β-carotenoid content in unripe plantain pulps without peels respectively reduces from 511.67 to 428.94 µg Eq.β-carotene/100g fresh weight and 460.06 to 308.42 µg Eq.β-carotene/100g fresh weight after boiling in water (at 100˚C) for 40 minutes (Ngoh *et al*., 2018).

CONCLUSION AND RECOMMENDATION

It was concluded that eggs laid by hens fed control diet had higher albumen weight, yolk index and better yolk colour than those fed boiled unripe plantain peel flour diets. This implies that internal egg quality of eggs laid by hens fed boiled unripe plantain peel flour diets was adversely affected. It is therefore recommended that other processing methods should be used to process unripe plantain (*M. paradisiaca* cv. cadava) peel to enhance its use in layer diets.

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