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Effects of Treated Banana Peel Meal on the Feed Efficiency, Digestibility and Cost Effectiveness of Broiler Chickens Diet

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Abstract

The study was conducted to investigate effect and the nutritive value of treated banana peel meal at substitutionary levels for maize and other ingredients on the feed efficiency, digestibility and cost effectiveness on broiler chickens diet. A total of one hundred and eighty (180) Arbor Acres broilers were randomly distributed into four treatment groups of 0%-control, 10, 20 and 30% inclusion of treated banana peel meal as T_0, T_{10}, T_{20} and T_{30} treatments respectively. Each treatment had 45 broiler birds with three replicates of 15 birds per replicate and the experiment lasted 4 weeks. The rations were made isonitrogenous and isocaloric. The birds were randomly distributed in a completely randomized design and Duncan multiple range test was used to separate means having significant differences ($p < 0.05$). The results showed that the final liveweight was significantly highest at T_0 (1997.80g) compared to 1896.22g and 1841.83g in T_{20} and T_{30} respectively. The daily weight gain was lowest ($p < 0.05$) in T_{30} with a value of 44.87g compared to T_0 and T_{10} which were same statistically though numerically different. The feed efficiency ratio decreased as the level of peel meal inclusion increased from T_0, T_{10}, T_{20} to T_{30} (0.36, 0.34, 0.32 and 0.29). The dry matter and crude protein digestibility were significantly highest (87.21% and 87.52%) at T_0 compared to 81.63% and 79.38% recorded at T_{30} respectively. The cost of feed per kilogramme of diet was significantly highest at the T_0 (N105.54) compared to N97.50 in T_{30} treatment. The feed cost savings was significantly highest at T_{30} (N9.32) with the lowest value of N4.85 recorded in T_{10}. It was concluded that banana peel meal can be added up to 10% in broiler chicken diet without any adverse effect on the performance of the birds thus enriching the poultry productions business.

Keywords: Isonitrogenous; Alternative feedstuffs; Pericarp; Digestibility; Isocaloric

Introduction

Banana (*Musa sapientum*) is a monocotyledonous plant that originated from the South–East Asian countries with two main species, *Musa acuminata* and *Musa balbisiana* from Malaysia and India respectively [1-3]. There were different banana types, genomes and hybrids which had been widely cultivated [4,5]. Banana, widely cultivated in Africa is very rich in potassium and calcium but low in sodium content [1,6,7]. It had a medicinal use in people with high blood pressure and stroke [8,9], and also reported to help to stimulate the production of hemoglobin and also have hypolipidemic effects [10,11]. The pulp of banana is used for food or feed however; less work had been done on the nutritive value of banana peel meal as alternative feedstuffs in poultry production [10,12].

In poultry production business, feeding is the most expensive singular input, it accounts for between 65 - 70% of the total cost of production [13-15]. Banana peel is an alternative feedstuff for animal feeding which can be sourced from local banana market stands and banana processing industry [11,16]. Banana is rich in potassium and low in sodium thus highly recommended for people with high blood pressure [3,17]. Banana pericarp (peel) had been treated for poultry use in order to remove or lower the anti-nutritional factors, this includes using different treatment techniques like addition of ash and covering for 3-5 days, sun drying for 4-5 days, oven dried for 2hrs at 100 °C and use of different alkali and sodium hydroxide amongst others [2,18]. The inclusion of waste banana fruit in the ration of swine had been reported [19,20] while other authors had reported the use of banana peel meal in broiler chickens [5,11,16,18,21]. The banana pericarp contains some anti-nutritional factors like tannins, oxalate and phytate amongst others which could induce adverse effects like depressive growth, reduced feed efficiency and vital organs damage in the body which may ultimately lead to mortality in birds and great losses in poultry enterprise if good processing techniques to detoxify these anti-nutritional factors are not carried out [22,23]. Banana peel contains higher crude fibre, ash and low crude protein compared to the mesocarp (pulp) and this makes it a good alternative feedstuff for animal feeding [24,25]. Therefore, the aim of this research is to evaluate the nutritive value of treated banana peel meal (TBPM) in broiler chickens diet.

Materials and Methods

Banana Collection, Processing and Storage

Ripened banana peels were collected at the popular local banana stand of Oshodi main market. The banana peels were sorted and washed with clean water to remove the dirt and stones. They were later spread openly on jute bags over cemented floor under high sun intensity for 4-5 days. When a high dehydration had been achieved, they were transferred to the cabinet tray drier and dried at 125 °C for 25 minutes. Cooling and air-drying was done to obtain a well dried crispy banana peel which was packaged for onward milling using Apex® Hammer Mill. The banana peel meal was later subjected to proximate analysis for the study. Chemical analysis was done [26-28] and the determined moisture content was <10% to enable a good and longtime storage. The crude protein and crude fibre analysis results for the banana peel meal was 1.93 and 26.68% respectively.

Housing and Treatment

The study was carried out in the deep litter section of the Epe Poultry Farms in Lekki Area of Lagos State, Nigeria for a period of 4 weeks (5^{th} to 8^{th} week of bird's age). The housing was well ventilated with a concrete flooring system and wire nettings on either side for proper ventilation. The pen was open sided for easy and proper ventilation while the wood shaving was used as litter material. The housing was fumigated with Enlol® E.C, 5mls per 100 liters of water, two weeks before the arrival of the birds and locked up for two days. It was opened and washed with clean water, four days prior to stocking with birds and ventilated. The feeders and drinkers were washed and clean water for drinking was provided *ad libitum*. The birds were randomly distributed and used for the study.

Birds, Diet and Health

One hundred and eighty day old *Arbor Acres* broiler chicks were used for the study. The birds were assigned to four dietary treatments following a completely randomized design (CRD). The four test diets designated as T_0, T_{10}, T_{20} and T_{30} were formulated to contain 0, 10, 20 and 30% of treated banana peel meal (TBPM) to replace maize and other ingredients. The feed compounded were made isonitrogenous and isocaloric (Table 1). Proper medication and vaccination programs were strictly carried out and good bio-security measure was maintained.

The broiler chicks collected at day old were weighed on arrival at the farm and weekly thereafter. The chicks were brooded for two weeks and fed for another two weeks making the four weeks of the starter phase. Data collection started from the fifth week to the eight week of the study (finisher phase). The experimental birds were weighed at the end of the starter phase and this marked the initial weight of the birds for the commencement of the study and data collection at the finisher phase. The birds were then randomly allotted according to the bodyweight uniformity for the different treatments which were replicated thrice. Birds were given 24 hours of free access to clean water (*ad libitum*) daily while lighting regimen of 22hrs of light and 2 hrs of dark was maintained.

The diets were formulated to meet the requirement of the broiler chickens according to the National Research Council [29].

Data Collection and Analysis

The data collected were on feed efficiency, digestibility and cost evaluation at the finisher phase of growth from the 5^{th} to the 8^{th} weeks of age.

Feed Efficiency (Growth performance)

The feed efficiency (growth performance) was monitored daily and weekly thereafter. The feed intake was measured by subtracting the feed remaining from that supplied the previous day. The birds were also weighed daily for one week at the starter phase and weekly (for four weeks) thereafter using Camry® electronic digital scale 0.01g. Initial weight was subtracted from the final weight to get the weight gain. The feed efficiency ratio (FER) was obtained by dividing the average weight gain (g) by the feed intake (g) for the growth performance analysis. Mortality was also monitored for any death in the flock within the data collection period. No bird was culled.

Digestibility Analysis

This was done using the total collection method where three birds per treatment were selected and put into the digestibility cage having a flat aluminum tray for easy collection of excreta materials. The birds were acclimatized to the digestibility cage for three days followed by four days total collection of excreta samples. Feather and feed were prevented from falling inside the collecting tray of the excreta materials. Collection of the excreta was done twice daily, they were weighed and stored at 4 °C in a refrigerator and it was later pooled and analyzed. The proximate compositions of the feed and collected excreta droppings was estimated to determine content of the dry matter, crude protein, crude fiber, ether extract, ash and nitrogen-free extract [26].

Feed Cost Analysis

The feed cost (₦) was calculated by adding the sum of the total feed ingredients costs used in the composition of the diet. The cost of feed per kg weight gain was computed by the multiplication of the cost with the feed conversion ratio. The feed cost savings was calculated as initial (control) cost minus final cost divided by initial cost multiplied by hundred.

$$\text{Feed cost savings} = \frac{\text{Initial cost} - \text{Final Cost}}{\text{Initial Cost}} \times 100$$

The cost of daily feed intake per bird (₦) was arrived at by multiplying the cost of feed/kg by the quantity (g) of feed taken daily

Cost of daily feed intake per bird = Cost of feed/kg X Quantity of daily feed intake

Ingredients	T_0	T_{10}	T_{20}	T_{30}
Maize	564.00	507.60	451.20	394.80
Soybean Meal	159.00	160.00	168.00	171.00
Groundnut cake	120.00	124.00	119.00	116.00
Brewers Dry Grain	15.00	15.00	10.00	20.00
Wheal Offal	70.00	65.00	60.00	44.00
Treated Banana Peel Meal (TBPM)	0.00	56.40	112.80	169.20
Palm oil	5.00	5.00	12.00	18.00
Fish Meal	25.00	25.00	25.00	25.00
Bone Meal	28.00	28.00	28.00	28.00
Oyster Shell	7.00	7.00	7.00	7.00
Lysine	2.00	2.00	2.00	2.00
Methionine	1.00	1.00	1.00	1.00
Premix	2.00	2.00	2.00	2.00
Salt	2.00	2.00	2.00	2.00
TOTAL	**1000**	**1000**	**1000**	**1000**
Determined Analysis%				
Dry Matter (DM)	91.45	91.25	90.62	89.58
CP	19.34	19.21	19.25	19.16
CF	4.34	4.69	5.74	6.20
Ether Extract	4.69	4.97	5.31	5.28
Ash	5.63	5.81	6.49	6.89
NFE	57.45	56.57	53.83	52.08
Calculated Analysis				
ME: Protein ratio	153.42	152.30	151.26	150.45
Calcium	1.11	1.13	1.15	1.16
Phosphorus	0.53	0.52	0.53	0.53
Methionine	0.41	0.45	0.45	0.39
Lysine	1.17	1.21	1.16	1.15
MJ/KG	12.42	12.25	12.19	12.07

*provided g kg^{-1} of diet- Vitamin A (12,000IU); Vitamin D_3 (2.500IU); Vitamin E (30,000IU);Vitamin K_3 (2,000mg); Vitamin B2-Riboflavin (3mg); Vitamin B3-Nicotinic acid (10mg);VitaminB5(15mcg)-Pantotheni cacid(15,000mg);Manganese(80,000mg);Zinc(50mg); Copper(5mg); Iodine(1,000mg); Cobalt (Co) (0.2mg); Selenium (Se) (0.1mg)),Folic acid (1,500mg),Biotin (50 mcg); Choline chloride (300,000mg)

Table 1: Composition of experimental diets (g kg^{-1})

Statistical Analysis

The data collected were subjected to a one way analysis of variance (ANOVA) in a completely randomized design arrangement. The means that were significantly different were compared using the Duncan's Multiple Range Test (DMRT) procedure [30].

Results and Discussion

The results obtained for the processed treated banana peel meal (TBPM) analysis showed that the crude protein (1.93%) was a higher than 0.09% reported by Duwa *et al* [19] while the crude fiber value of 26.68% was lower than 31.70% reported by the same author. This could be due to the quality of banana peel processed and the different processing and analytical techniques used.

The results of the growth performance (Table 2) showed that the final live weight decreased significantly ($p < 0.05$) as the level of inclusion of the TBPM increased. The final live weight value of 1997.80g in T_0 was significantly highest ($p < 0.05$) compared to 1933.17g, 1896.22g and 1841.83g in T_{10}, T_{20} and T_{30} respectively. The decreasing weight gain trend which had also been reported [18] could be due to the effect of the increasing levels of the banana peel meal inclusion in the diet and the poorer feed efficiency ratio (FER) observed especially in T_{30} with 0.29 FER compared to 0.36 in T_0 treatment. The daily feed intake increased ($p < 0.05$) as the level of inclusion of TBPM increased; it was highest ($p < 0.05$) in T_{30} with a value of 149.71g compared to 141.32, 140.63 and 146.44g in T_0, T_{10} and T_{20} respectively. Birds eat to satisfy the energy requirements and this could be responsible for the high feed intake in T_{20} and T_{30} in contrast to others [5,31].

The mortality was significantly highest ($p < 0.05$) in the T_{20} with a value of 3.25% while the lowest value of 1.32% was recorded in T_{10}. The post mortem examination after the veterinary examination and diagnosis showed feed impaction in the tracheal region which could suggest tracheal blockade as a result of higher feed impaction during feed ingestion. A mild bacterial infection was diagnosed especially in the fifth week where the few birds showing signs like sleeping and staying away from the feeders were culled and treated symptomatically and since there was no death, after four days they were returned to their pen.

The cost evaluation analysis (Table 3) showed that the cost of feed/kg of diet was highest ($p < 0.05$) in T_1 with a value of ₦105.54 while T_2, T_3 and T4 had ₦100.42, ₦98.59 and ₦95.70 respectively. The lowered costs in T_2 - T_4 is as a result of cheap (free) sourcing of the alternative feedstuff (TBPM), as it replaced that of maize in the respective diet. Abel *et al* [13,14] had also reported that there is lowered feed cost when an alternative feed ingredient is used in place of the conventional feedstuffs. The cost of daily feed intake per bird was highest ($p < 0.05$) in the T_1 (₦14.49) as against (₦14.32) in T_4. The cost of feed/kg weight gain was significantly ($p > 0.05$) highest in T_4 with a value of ₦317.71 while the lowest cost of ₦293.40 and ₦292.22 was recorded in T_1 and T_2 respectively. This was due to the lower weight gain recorded in T_4 and a bad feed conversion ratio value.

The feed savings cost analysis showed that T_4 had the highest ($p < 0.05$) cost savings of ₦9.32 compared to ₦4.85, ₦6.59 in the T_2 and T_3 treatments respectively, this increment in feed savings cost is attributable to the low cost of the treated banana peel meal at the point of sourcing as an alternative feed source compared to the conventional maize in the control.

Parameters	T_0	T_{10}	T_{20}	T_{30}	SEM
Initial liveweight (g/bird)	579.43	578.65	586.43	585.59	2.11
Final liveweight (g/bird)	1997.80^a	1933.17^{ab}	1896.22^b	1841.83^c	11.52
Daily weight gain (g/bird)	50.66^a	48.38^a	46.79^b	44.87^c	0.74
Daily feed intake (g/bird)	141.32^b	140.63^b	146.44^a	149.71^a	1.75
Feed Efficiency Ratio (FER)	0.36^a	0.34^b	0.32^b	0.29^c	0.08
Daily protein intake (g/bird)	27.33	27.02	26.65	26.23	1.24
Protein efficiency ratio (PER)	1.85^a	1.79^a	1.76^b	1.71^c	0.07
Mortality (%)	1.47^b	1.32^b	3.25^a	1.43^b	0.09

[abc] Means within same row with different superscripts differ significantly ($P < 0.05$)
SEM- Standard Error of Means; TBPM-Treated Banana Peel Meal

Table 2: Effect of TBPM on the growth performance of broiler diet

Parameters	T_0	T_{10}	T_{20}	T_{30}	SEM
Cost of feed/kg of diet (₦)	105.54^a	100.42^b	98.59^{ab}	95.70^b	7.26
Cost of daily feed intake/bird (₦)	14.49^a	14.12^c	14.44^a	14.32^b	4.31
Cost of feed/kg weight gain (₦)	293.40^b	292.22^b	307.61^a	317.71^a	11.06
Feed cost savings (%)	-	4.85^b	6.59^b	9.32^a	0.09

[abc] Means within same row with different superscripts differ significantly ($P < 0.05$)
SEM- Standard Error of Means; TBPM-Treated Banana Peel Meal

Table 3: Effect of TBPM on the cost evaluation and economic analysis of broiler diet

The effects of the treated banana peel meal on the digestibility co-efficients of the broiler diet are presented in Table 4. The dry matter digestibility was significantly highest in T_0 with a value of 87.21% compared to the lowest value of 81.63% in T_{30}. The crude protein digestibility was significantly highest in T_0 (87.52%) and lowest value of 79.38% in T_{30}, this could be attributed to the increasing levels of the treated banana peel meal in the respective diets [7,9,18]. The T_{10} and T_{20} treatments recorded 86.49% and 81.81% respectively. The lowering value in the parameters could be due to the inability of the birds to digest the nutrients therein in the feed and also, increasing inclusions of the treated banana peel meal [5,16,17,23]. The ether extract digestibility was highest ($p < 0.05$) in the T_{10} with 93.39% compared to 90.78% in T_{20} treatment.

Parameters	T_0	T_{10}	T_{20}	T_{30}	SEM
Dry matter Digestibility	87.21[a]	86.45[a]	84.84[a]	81.63[b]	1.18
Crude Protein Digestibility	87.52[a]	86.49[a]	81.81[a]	79.38[b]	2.04
Crude Fibre Digestibility	76.36	73.54	74.43	71.09	2.38
Ether Extract Digestibility	91.43	93.39	90.78	92.01	3.17

[abc] Means within same row with different superscripts differ significantly ($P < 0.05$)
SEM- Standard Error of Means; TBPM-Treated Banana Peel Meal

Table 4: Effect of TBPM on the digestibility co-efficient of broiler diet

Conclusion

It is hereby concluded that the treated banana peel meal can be included in the broiler finisher feed up to 10% inclusion without any adverse effect on the growth performance of the broiler birds. It also positively leads to cost reduction in feed purchase thus a lowered cost of production and a better feed conversion ratio.

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