

Nutrient Retention, Carcass and Organ Characteristics of Finisher Broilers Fed Palm Press Fibre Meal

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Abstract

The quest for ways to solve the present soaring cost of chicken has led to the exploration into the use of Palm Press Fibre (PPF) to substitute maize in feeding broiler birds. PPF is a high fibre agricultural waste product and high fibre feed ingredients are known to exert negative consequences on the carcass and organ characteristics of broiler birds. This research therefore understudied the nutrient retention, carcass and organ characteristics of finisher broilers fed different substitution rates of maize with Palm Press Fibre Meal (PPFM). A total of 240 ROSS 308 breed of finishing broilers of 28 days post hatch were used for the experiment following a Completely Randomized Design (CRD). Each treatment group had sixty broiler birds that were replicated three times to obtain twenty birds per replicate. The control diet (T₁) contained no PPFM, while T₂, T₃ and T₄ diets contained 10%, 20% and 30% PPFM respectively which represents 16.67, 33.33 and 50% substitution rates of maize. The birds were managed under deep litter system and fed ad libitum for 28 days. After which, the 3 broilers were slaughtered for carcass and organ assessment while another set of 3 broilers were put in a metabolic cage for nutrient retention assessment. Result of the proximate composition showed PPFM contained 12.61% Crude protein, 7.21% Crude fibre, 3.32% Ether extract and 6.87% Ash. The live weight of the broilers were significantly bigger for control and T₂ but reduced for T₃ and T₄. The eviscerated weight in percentage live weight was similar (P > 0.05) for T₁, T₂ and T₃ groups but reduced for T₄ group. Also, the thigh and drumstick (%lw) had the highest value for the control which was similar (P > 0.05) with T₂ but differed (P < 0.05) from T₃ and T₄ while the value for T₃ and T₄ were same (P > 0.05) with that of T₂. There was a progressive increase in the gizzard size as inclusion rate of PPFM increased in the diets. Crude protein retention was significant (P > 0.05) reduced at T₄. It was concluded that substitution of maize with PPFM can cause increase in gizzard size, not toxic to the broilers and protein retention can be reduced when the inclusion rate increases to 50%.

Keywords: Carcass; Diet; Finisher Broilers; Palm Press Fibre; Nutrient Retention; Organ

Introduction

The quest for reduction in cost of feeding poultry which takes 60 - 80% [1] of production cost has led to the exploration into utilization of wide range of agricultural waste products so as to use them to substitute to the conventional feed ingredient whose high cost resulted to the high cost of feeding poultry. One of these agricultural waste products is Palm Press Fibre (PPF) which is the fibrous residue obtained after extraction of oil from palm nut. PPF is abundantly generated in Nigeria especially in the tropical rain forest region as Nigeria is ranked fourth largest producer of palm oil in the world, accounting for 3% of global production [2]. Presently, heaps of PPF are seen around most mills within the areas where palm fruit is processed. This could become an environmental problem since the delayed use of PPF has been reported to result

in bioconversion to methane, which directly contributes to greenhouse gas emissions [3]. Palm press fiber has no value in human food, since it is largely fiber but may contain important amount of residual palm oil. The cheap and readily availability of palm press fiber make it an attractive material for studying and the prospect of it substituting other relatively scarce energy source. The chemical composition of PPF ranges from 6.50% moisture content, 93.91% dry matter, 3.6 - 7.5% crude protein, 33.18-35.73 % carbohydrate, 5.56 - 40.13% of fat and 14.6% crude fiber depending on the method of the oil extraction from the oil palm fruit [4]. These values showed that PPF is quite high in energy, thus giving it an edge as an alternative ingredient for poultry feeding, though it is high in fibre. Feeding has been reported to exert immense influences on the development of carcass, organs and muscles in broilers [5]. The

breast muscle of broilers is a vital part of carcass quality and has the highest significant economic impact in broiler value [6] while examination of organs like the liver gives an insight into the toxicity level of the diet to which the bird was fed, as enlarged liver has been attributed to high toxicity level of diet consumed by the bird during its life time [7]. This study therefore, assessed the effect of substituting maize with palm press fiber on the nutrient retention, carcass and organ characteristics of finisher broilers.

Materials and Methods

Location of experiment

The research was conducted at the Teaching and Research Farm, Akanu Ibiam Federal Polytechnic, Unwana, Afikpo North, Local Government Area, Ebonyi State. Unwana is in tropical rain forest zone of Nigeria.

Collection and preparation of palm press fiber (PPF)

The palm press fiber used in this research was collected from a local palm oil mill at Ogwuma Edda in Afikpo South, Local Government Area, Ebonyi State. The PPF was sun dried to crispiness and was taken to a hammer mill for milling to obtain the Palm Press

fiber Meal (PPFM). Proximate composition of the PPFM was obtained according to [8] to determine the crude protein, crude fiber, fat, ash and energy.

Experimental birds and design

A total of 240 ROSS 308 breed of finishing broilers of 28 days post hatch were used for the experiment following a Completely Randomized Design (CRD). Each treatment group had sixty broiler birds that were replicated three times to obtain twenty birds per replicate. The weight of the birds per replicate groups was adjusted to give near uniform initial weights to all the groups. The broiler birds were managed under deep litter adopting strict ethical standard. Water and feed were given *adlibitum*. The feeding period lasted for 28days.

Experimental diets

Four experimental diets were formulated for the research. Diet T₁ which was the control contained 0% PPFM. In T₂ diet, PPFM substituted maize at 16.67% (10% added), while in T₃ and T₄, PPFM supplemented maize at 33.33% (20% added) and 50% (30% added) respectively. The palm press fiber was added on weight-to-weight basis. The ingredient composition of the diet is represented in table 1.

Ingredients	Treatment Levels (%)			
	T ₁ (0.00PPFM)	T ₂ (10.00PPFM)	T ₃ 20.00PPFM)	T ₄ 30.00PPFM)
Maize(9%CP)	60.00	50.00	40.00	30.00
PPFM	0.00	10.00	20.00	30.00
GNC	9.00	9.00	9.00	9.00
SBM	8.00	8.00	8.00	8.00
BDG	12.00	12.00	12.00	12.00
Fish meal	3.00	3.00	3.00	3.00
Blood meal	3.00	3.00	3.00	3.00
Bone meal	4.00	4.00	4.00	4.00
*Vit. Premix	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated nutrient composition of the diets				
Crude protein (%)	20.46	20.88	21.24	21.60
Crude fibre (%)	3.96	4.41	4.86	5.31
Calcium (%)	0.15	0.47	0.79	0.11
Phosphorus (%)	0.42	0.75	0.08	0.41
Fat (%)	4.61	4.53	5.49	4.37
Ash (%)	6.96	7.53	8.07	8.63
Met. Energy (kcal/kg)	2985.63	2957.04	2935.51	2897.45

Table 1: Ingredients and calculated nutrient composition of the experimental diets.

To provide the following per kilogram of feed; Vit A 10,000IU; vit D3 1500 IU; Vit. E 2mg; riboflavin 3mg; pantothenic acid 10mg; nicotinic acid 2.5mg; choline 3.5mg; folic acid 1mg; magnesium 56mg; lysine 1mg; iron 20mg; zinc 50mg Cobalt 1.25mg.

Data collection

At the end of the 28 days feeding period, 3 broilers were randomly selected from each replicate and tagged for carcass and organ analysis while another set of 3 broilers per replicate were transferred to metabolic cages for nutrient retention assessment.

Carcass and organ assessment

The broilers were starved of feed for a period of 12 hours while water was given to them. They were weighed to obtain the live weight. The broilers were then slaughtered strictly in compliance to the recommended ethical standard by severing the jugular vein with a sharp knife. Slaughtered broilers were dipped in hot water at a temperature of about 70°C to pluck off the feathers after which the dressed weight was weighed and recorded. The dressed broilers were also eviscerated, weighed recorded. The carcass was then cut into parts while the internal abdominal content were separated for the internal organs assessment adopting the method of [9]. The recorded weights of the parts were expressed as percentage of the live weight while the intestinal length was measured with tape and recorded in cm. The weight of the following parts were assessed and recorded; breast muscle, thigh and drumstick, back, neck, head, wing, vent, shank. The following internal organs were also examined, weighed and their weights expressed as percentage of the live weight: heart, liver and gull bladder, gizzard and proventriculus.

Nutrient retention

The broilers in the metabolic cages were given 3 days to stabilize before the data collection commenced. The broilers were fed 90% of their daily feed intake and fecal output collected within every 24 hours. The collected fecal output were dried in an oven, weighed and recorded. The data collection lasted for 4 days. The daily collections were pooled, mixed and sample collected for analysis. The fecal waste from the treatment groups and the samples of the treatment diets were taken to the laboratory for proximate analysis. The results obtained from both, were used in determining the nutrient retention level of the diets by the broilers.

$$\text{Nutrient retention} = \frac{\text{Nutrient in feed} - \text{Nutrient in feces}}{\text{Nutrient in feed}} \times \frac{100}{1}$$

Data analysis

The data obtained from the study which was subjected to statistical analysis using analysis of variance (ANOVA) procedure and computed with IBM SPSS version 22. Significant difference (p < 0.05) means were separated using Duncan Multiple Range Test [10].

Results and Discussion

Proximate composition of PPFM

The result of the proximate analysis of the PPFM as presented in table 2. showed that PPFM contained 12.61% crude protein. The crude fiber content was 7.21%, the ether extract 3.32%, ash contained 6.87% and carbohydrate contained 60.78% respectively.

The chemical composition of the PPFM obtained in the present research had a higher level of crude protein compared to report of [11,12]. The difference in the chemical composition could be as a result of the difference in the processing of the palm press fiber. [13-15] reported that the chemical composition of palm press fiber varies considerably depending on source, the methodology of the oil extraction, the proportion of the endocarp remaining and the efficiency of oil extraction from the fiber. This could have contributed to the discrepancy in the values of the nutrients obtained in the present research.

Nutrient	Percentage Levels (DM)
Moisture Content	9.24
Dry Matter	90.76
Crude Protein	12.61
Crude Fiber	7.21
Ether Extract	3.32
Ash	6.87
Carbohydrate	60.78
Metabolizable energy (Kcal/kg)	2,891.16

Table 2: Proximate composition of PPFM.

Source: Field Report, 2021.

Carcass characteristics of the broilers fed different levels of PPFM

The result of the carcass characteristics of the finisher broilers fed different inclusion levels of PPFM as presented in table 3 showed that the live weight of broilers in the control group (2966.67g) was similar (P > 0.05) with the live weight of broilers in treatment 2 group (2750.00g) but significantly (P < 0.05) bigger than T₃ and T₄. The live weight of T₂ was however similar (P > 0.05) with T₃ but significantly bigger than T₄ which had the smallest value of 1950.00g. There was no difference in the values obtained for dressed weight. The eviscerated weight had a significant result. The eviscerated weight of the broiler in the control group was the same with those in T₂ and T₃ groups but significantly (P < 0.05) higher than the broilers in T₄ group. Broilers in T₂, T₃, and T₄ groups were however the same when compared among selves. There was no significant difference in values obtained for the breast muscle. The percentage live weight of thigh and drumstick for the broilers in control group was significantly highest in value (25.70%), which was similar (P > 0.05) with T₂ (23.87%) but differed from T₃ (20.83%) and T₄ (20.53%) while among T₂, T₃ and T₄, they had similar (P > 0.05) values. There was no significant difference (P > 0.05) among the treatment groups for the wing, the head, the neck, vent and shank.

In the present study, though there was a reduction in live weight of the broilers at 33.33 and 50% substitution levels of maize with PPFM, but the reduction did not affect the values obtained for dressed weight, breast muscle, head, neck and shank as their values were similar with control. Only the eviscerated weight and thigh & drumstick had a significant result. The percentage live weight of the eviscerated weight was highest for the broilers whose diet did not contain PPFM, which was maintained at 16.67 and 33.33% substitution rate but reduced significantly at 50% substitution level. The reduction in eviscerated weight of T₄ broilers as obtained in this research could be as result of the reduced live weight of the broilers in this group. [16] reported that heavier birds produces heavier eviscerated yield. The percentage live weight of the thigh

and drumstick was also highest for broilers whose diet did not contain PPFM and similar with broilers on 16.67% substitution rate but reduced significantly when the substitution rate increased to 33.33% and 50.00%. However, the value of the thigh & drumstick was the same at 16.67, 33.33 and 50.00% substitution rate when compared without the control. Thigh/drumstick and Breast muscle are the most valuable portions of the carcass with high significant economic impact in the market [6,17]. The breast muscle of the broilers in the present research was not affected by the different rates of substitution, but only the thigh and drumstick which reduced from 33.33% substitution of maize with PPF. The reduction however was not much as the values at 16.67% substitution rate was the same as the value obtained at 33.33 and 50.00% substitution rate.

Parameters	Treatment levels (%)				SEM
	T ₁ (0.00PPFM)	T ₂ (10.00PPFM)	T ₃ (20.00PPFM)	T ₄ (30.00PPFM)	
Live weight (g)	2966.67 ^a	2750.00 ^{ab}	2416.67 ^b	1950.00 ^c	95.01
Dressed (%lw)	90.07	87.10	87.73	87.07	2.37
Eviscerated (%lw)	82.33 ^a	77.77 ^{ab}	79.90 ^{ab}	74.97 ^b	2.87
Breast muscle (%lw)	24.60	25.70	23.87	20.53	2.56
Thigh & drumstick (%lw)	25.70 ^a	23.87 ^{ab}	20.83 ^b	20.53 ^b	1.91
Head (%lw)	1.90	2.37	2.17	2.07	0.31
Neck (%lw)	4.07	4.37	4.63	4.50	0.36
Vent (%lw)	3.33	2.13	2.90	2.67	0.69
Shank (%lw)	3.07	3.60	4.33	3.83	0.57

Table 3: Carcass characteristics of finisher broilers fed varying levels of Palm Press Fiber Meal (PPFM)

Note: Mean within row with different superscript differ significantly (p < 0.05). Without superscript = not significant. SEM = Standard Error Mean. %LW = Percentage Live Weight.

Internal organs characteristics of the broilers fed different levels of PPFM

The internal organ characteristics of the finisher broilers fed different levels of palm press fiber as presented in table 4. showed no significant difference in the percentage live weight of the liver/gull bladder, the heart and the vent while the gizzard and proventriculus and the caecum had a significant effect. The gizzard and proventriculus of the broilers in the control group had the least value which progressively increased as the inclusion rate of PPFM increased. The increase in weight with increasing level of PPFM in the diets may be due to the slow digestibility rate occasioned by the increased crude fiber content of the diets as inclusion rate of PPFM increased (see table 1). Increased gizzard size has been associated with increased fibre in the diet which puts more pressure on the gizzard resulting to increase in the gizzard size [18,19] asserted that increased fibre in a diets of poultry. [20] asserted that large particle size of feed makes the feed to last longer in the gizzard, im-

proves gizzard development and favors digestion. The size of gizzard that will become detrimental needs further research. Though there was a significant effect in the length of the caecum, but the caecum of the broilers in the control group was similar (P > 0.05) with the broilers in all the treatment group. Thus an indication that substitution of maize with PPFM at up to 50% may not have affected the caecum. In the present research, the liver, which is the most voluminous gland present in animal body that plays a fundamental role in the digestion of nutrients, through the production of bile, liver enzymes, in the metabolism of sugar, proteins, and fats [21], had no significant effect. Increased liver size in poultry has been associated with the presence of anti-nutritional factors and toxicity in their diet [22-24]. The non significant effect obtained from the liver and gallbladder in the present research is an indication that substitution of maize with PPFM at up to 50% may be devoid of anti-nutritional factor and did not impose toxicity to the broilers.

Parameters	Treatment Levels (%)				SEM
	T ₁ (0.00PPFM)	T ₂ (10PPFM)	T ₃ (20.00PPFM)	T ₄ (30.00PPFM)	
Gizzard and Proventriculus (%lw)	2.30 ^c	3.30 ^b	3.83 ^{ab}	4.43 ^a	0.39
Liver and Gall bladder (%lw)	1.77	2.00	1.80	1.77	0.20
Heart (%lw)	0.39	0.49	0.40	0.33	0.05
Small Intestine (cm)	231.33	239.33	236.67	223.33	11.47
large Intestine (cm)	9.67	11.67	10.00	10.00	1.90
Caecum (cm)	18.67 ^{ab}	19.67 ^a	20.00 ^a	15.67 ^b	1.58

Table 4: Internal organ characteristics of finisher broilers fed different levels of PPFM.

Note: Mean within row with different superscript differ significantly (p < 0.05). Without superscript = not significant. SEM = Standard Error Mean.

Nutrient retention of the finisher broilers fed different levels of PPFM

The result of the nutrient retention of the finisher Broilers fed different substitution levels of PPFM to maize as presented in table 5. showed that there was no significant difference (P > 0.05) in all the nutrients except in crude protein. The crude protein of the control group retained 87.27% and was similar (P > 0.05) with T₂ and T₃ groups which retained 86.96% and 86.69% respectively but significantly (P < 0.05) higher than T₄ group which retained least protein (81.23%). The similarity among the groups in retaining nutrient is an indication that the broilers in these treatment groups retained nutrients at par except crude protein whose retention in T₄ was reduced. The reduced retention of crude protein as obtained

in the present research could be as a result of the higher crude fibre of treatment 4 diet (see table 1). [25] asserted that insoluble materials in diet could increase the viscosity of intestinal digesta, leading to reduced retention and absorption of nutrients. A similar result was obtained in the work of [29,30] using Palm Kernel cake (PKC) in which crude protein retention was found to decrease with increased inclusion level of palm kernel cake in broiler’s diet. The result obtained from crude protein in the present research, confirm with this assertion. Also, the finding of the present research showed that, at up to 20% inclusion rate of PPFM, the retention of crude protein by the broilers was not affected but reduces when the inclusion rate gets to 30%. This was contrary to the work with PKC in which 15% inclusion rate causes significant reduction in retention of nutrients [29,30].

Parameters (%)	Treatment Levels (%)				SEM
	T ₁ (0.00PPFM)	T ₂ (10.00PPFM)	T ₃ (20.00PPFM)	T ₄ (30.00PPFM)	
Dry Matter	89.47	90.21	90.67	88.31	3.26
Crude protein	87.27 ^a	86.96 ^a	86.49 ^a	81.23 ^b	1.41
Crude fibre	57.03	51.22	50.86	56.43	4.92
Ether extract	81.07	86.14	81.59	86.29	2.37
Ash	53.90	43.48	45.29	44.56	4.73

Table 5: Nutrient retention of finisher broilers fed varying levels of Palm Press Fiber Meal.

Note: Mean within row with different superscript differ significantly (p < 0.05). Without superscript = not significant. SEM = Standard Error Mean.

Conclusion

From the findings from this research the following conclusions were drawn

- Though there was difference in live weight of broilers fed different inclusion levels of PPFM, but the difference did not show in the breast muscle while the thigh & drumstick that reduced at 3.33 and 50% substitution rate were still comparable with the value obtained at 16.67% which was similar with the control.
- There was increase in size of gizzard as the inclusion level of the PPFM increased.
- Inclusion of PPFM at up to 50% substitution rate did not affect the liver size which is an indication of non-toxicity of the diets.
- Retention of nutrients were not affected except crude protein retention which was reduced at 50% substitution rate.

It is recommended therefore that substitution of maize with Palm press fiber meal at up to 50% may not impact on the carcass and organ characteristics of the finisher broilers but at 50% substitution rate retention of crude protein reduce.

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Conflict of Interest

We declare that no conflict of interest exists in this research. Runs contrary to the hypothesis proposed by Hetland, *et al.* (, **) that coarse particles accumulate in the gizzard and are retained for longer causing the gizzard to become relatively distended.

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