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Carcass Characteristics and Internal Organs of Broilers Fed Varying Levels of Full Fat Palm Kernel Meal

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Abstract
This study was conducted to evaluate the proximate composition of Full Fat Palm Kernel Meal (FFPKM) and the effect of feeding diets with graded level of FFPKM on the carcass characteristics of broiler chickens. A total of 144 day old broiler chicks of Anak breeds were assigned to 4 experimental diets in a completely randomized design. The birds were fed graded levels (0, 5.0, 7.50 and 10.20 % at starter and 0, 7.0, 9.50 and 14.30 % at the finisher) of FFPKM in partial replacement of maize and palm kernel cake. Data were recorded on feed intake and weekly weight changes. On day 56 of the experiment, nine birds per treatment were randomly selected from each of the replicates, starved overnight and slaughtered to evaluate carcass characteristics. The proximate analysis showed that Full Fat Palm Kernel meal is rich in protein (11.50 %) and fat (50.70 %). Although there was no significant difference ($p>0.05$) in carcass yield and cut parts, birds fed diet 4 with the highest inclusion level of FFPKM recorded the highest values in dressing percentage and thigh cut, indicating better performance. There were significant differences ($p<0.05$) in the weights of crop, gizzard and kidney. Thus, FFPKM can replace maize and palm kernel cake up to 14.30 % in broiler diets without any deleterious effects on carcass quality and internal organs like the liver.
Keywords: full fat palm kernel meal, proximate composition, broilers, carcass, internal organs.

1. Introduction

The full potential of poultry products as a panacea to insufficient animal protein intake of Nigerians has not been achieved principally because of inadequate feed. Feed constitutes about 70 - 80 % of the total cost in poultry production (Durunna *et al.,* 2005). The bulk of the feed cost arises from energy and protein concentrates such as maize, soybean, fishmeal and groundnut cake. However, the increasing cost of these energy and protein concentrates due to competition between humans and animals has necessitated research into non-conventional feedstuffs such as agricultural waste and agro-industrial by-products so as to reduce feed cost (Okeudo *et al.*, 2005; George and Sese, 2012; Sese *et al*., 2014). The most prominent by-products of plant origin in use today as enumerated by Bello (1984) are mainly of oil seed cake, or meals and brewing wastes. The main oil seeds used in farming systems in Nigeria include oil palm fruits, cotton seeds, sesame seeds, bambara nuts, groundnuts, melon seeds, coconuts, rubber seeds, soybeans and sun flower seeds. These can be served in their full-fat or partly expressed forms as both energy and protein sources for extensive and intensive poultry systems.

Oil palm (*Elaeis guineensis jacq*.) trees are grown in abundance in South South rain forest zone of Nigeria. The oil palm tree is a versatile tree crop with almost all its parts being useful and of economic value. Due to its economic importance as a high yielding source of edible and industrial oils, the oil palm is grown as a plantation crop in most countries with high rainfall (minimum 1600 mm/yr) in tropical climates. The oil palm bears its fruits in bunches varying in weight from 10 – 40kg. The individual fruit which weighs between 6-20 g are made up of an outer skin (exocarp), a pulp (mesocarp) containing the palm oil in a fibrous matrix, a central nut consisting of a shell (endocarp) that protects the seed and the seed (kernel) which itself contains an oil, quite different from palm oil, resembling coconut oil (Agunbiade *et al.,* 1999).The steps involved in the processing of palm fruits are fruit fermentation to loosen fruit base from spikelets; bunch chopping to facilitate manual removal of fruits; removal and sorting of fruits from spikelets; sterilizing/boiling to expose oil cells; fruit pounding/digestion to separate fibre from nuts, opening up oil-bearing cells for easy flow of oil; pressing of the mash to expel palm oil; oil purification; mash/fibre-nut separation, fibre pressing and nut drying. Many a by-product rich in oil/oil residues are obtained from the processing of palm fruit. These include full fat palm kernel meal (FFPKM), palm oil effluent, palm oil sludge, oil-rich fibrous residue and palm kernel cake (PKC). FFPKM is the whole palm nut (endocarp) and the kernel without oil extraction. FFPKM is different from Palm kernel cake (PKC), which is a by-product of mechanically expelled palm kernel oil extraction (Okeudo *et al.,* 2005). Palm oil sludge is the material that remains after decanting the palm oil mill effluent.

FFPKM is a concentrated source of energy than PKC, containing 46 – 54 % DM of oil with metabolizable energy content of 6400 Kcal/kg (Oruwari *et al.,* 1996; Sese *et al.,* 2014). The oil present in FFPKM is useful in reducing the dustiness of feed. Addition of FFPKM to broiler diets based on soybean meal and maize have increased the metabolisable energy levels of the diets (Vargas and Zumbado 2003). FFPKM is also a rich source of crude fibre (13.38 %) and crude protein (11.26 %) (Sese *et al.,* 2014) and can thus replace palm kernel meal PKC in animal diets. PKC has been included in broiler diets up to 28 – 35 % without any deleterious effect on carcass yield, internal organs characteristics and organoleptic properties of broilers meat

(Onwudike, 1986; Okeudo *et al.,* 2005). In the same vein, Sese *et al.* (2014) also included 5 – 9 % FFPKM in the diets of broilers with no deleterious effect on growth and carcass characteristics. These authors also reported a reduction in feed cost as the level of FFPKM in the diets increased.There is dearth of information on the nutritional value of FFPKM. The objective of this work therefore was to determine the proximate composition of FFPKM and to determine the effect of replacing maize and PKM with graded levels of FFPKM on the carcass characteristics and internal organs of broilers.

2. Materials and Methods

The study was conducted at "Hatch your own poultry farms" Ekamba Nsukara Offot, Uyo, Akwa Ibom State, Nigeria. Uyo is located within the tropical rainforest zone which characterizes the South South agro-ecological zone of Nigeria. Uyo is located between latitudes 4˚59´ and 5˚04´ and longitudes 7˚53´ and 8˚00´ E with average rainfall of 1500 mm.

2.1 Experimental Diets

The palm kernel nuts used in this study were sourced from a local palm kernel mill at Ibiono Ibom L.G.A, Akwa Ibom State. The whole palm kernel nut was crushed with the hammer mill, to pass through a 2.5 mm screen and incorporated into a basal diet to replace maize and palm kernel cake, at the rate of 0, 5.0, 7.50 and 10.20 % at the starter level and 0, 7.0, 9.50 and 14.30 % at the finisher level. The ingredients and calculated nutrient composition of the starter and finisher diets are presented in Table 1.

Table 1: Ingredients Composition of Experimental Broiler Diets

Ingredients	**Starter Phase**				**Finisher Phase**			
(%)	**D1**	**D2**	**D3**	**D4**	**D1**	**D2**	**D3**	**D4**
Maize	51.00	50.00	49.00	48.00	55.00	53.00	52.00	50.00
Soybean meal	32.00	32.00	32.00	32.00	26.00	26.00	26.00	26.00
PKC	10.20	6.20	4.70	3.00	14.30	9.30	8.80	5.00
Fish meal	4.00	4.00	4.00	4.00	2.00	2.00	2.00	2.00
FFPKM	0.00	5.00	7.50	10.20	0.00	7.00	9.50	14.30
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vitamins/TM premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrient Composition								
Crude protein	22.60	22.64	22.78	22.90	22.06	20.33	20.62	20.78
Crude fibre	4.16	3.98	3.66	3.81	4.75	4.50	4.42	4.35
Ether extract	8.04	12.92	14.56	17.66	8.56	15.24	17.54	22.15
ME (Kcal/kg)	2881.00	3068.00	3125.50	3254.80	2934.00	3156.50	3246.00	3425.00

*Vitamin premix supplied (per kg diet): vitamin A = 10,000IU; vitamin D_3 = 12,000 I.U.; vitamin E = 20I.U.; vitamin K = 2.5mg; Riboflavin = 3.0mg; Thiamain = 2.0mg; Pyridoxine = 4.0mg; cobalamin = 0.05mg; vitamin B_{12} = 0.01mg; panthotenic acid = 5mg; nicotinic acid = 20mg; folic acid = 0.5mg; choline = 0.2g; manganese = 0.006g; iron = 20mg; copper = 0.006g; zinc = 0.03g; cobalt = 0.25g; iodine = 0.0014g, anti-oxidant = 0.25mg, biotin = 0.08mg; selenium = 0.24mg.
PKC = Palm kernel cake, FFPKM = Full fat palm kernel meal, ME = Metabolizable energy.

2.2 Experimental Birds and Management

One hundred and forty four (144) one-day-old broiler chicks of Anak breed were used. All the pens were thoroughly washed and disinfected prior to the arrival of the birds. The house was partitioned into 16 pens measuring 3 x 3 m each.The concrete floor of all the pens was covered with wood shavings up to a thickness of about 5 cm. The birds were weighed and randomly assigned to four treatment groups, with a total of 36 birds per treatment. The birds were further divided into 4 replicate of 9 birds each. Heat was supplied to the chicks during their first 2 weeks to provide warmth. The birds were subjected to standard broiler chick management procedures, which included routine vaccinations against Newcastle disease and infectious bursal disease (gumboro), which were administered to all the birds within the first three weeks.

2.3 Data Collection

Data were recorded on feed intake. The birds were weighed weekly and weight changes recorded. The feed intake and weight changes were used to calculate the feed: gain ratio. At the end of the feeding trial 1 bird was randomly selected from each replicate and starved overnight, weighed after the fasting, slaughtered by severing

the jugular vein, scalded in warm water for about a minute, de-feathered manually, eviscerated and dressed to determine carcass characteristics. Dressed weight and internal organs were expressed as percentage live weight, while cuts parts were expressed as percentage dressed weight (Ndelekwute *et al.,* 2013).

2.4 Proximate and Statistical Analyses

The proximate composition of the FFPKM was determined by the methods of AOAC (2002). Data collected were statistically analyzed according to the Statistical Analysis System package (SAS, 1999). Significant means were separated using Duncan's Multiple Range Test of the same package.

3. Results

The proximate composition of FFPKM used for the experiment is shown in Table 2.

Table 2: Proximate composition of Full fat Palm Kernel Meal (FFPKM) used in formulating the Diets.

Parameters (% DM)	Composition
Dry Matter	90.5
Crude Protein	11.50
Ether Extract	50.70
Crude Fibre	14.00
Ash	4.00

Table 3: Carcass yield of broiler chickens fed Full fat Palm Kernel Meal

Parameters	D_1	D_2	D_3	D_4	SEM
Fasted live weight (g)	2400.00	2233.33	2250.00	2261.11	12.80
Dressed weight (g)	1697.56	1574.67	1595.89	1636.00	9.00
Dressing percentage (%)	70.73	70.51	70.93	72.36	0.14
Breast cut (%)	31.20	31.24	32.87	31.51	0.42
Thigh (%)	17.12	17.32	17.23	18.67	0.41
Drumstick (%)	13.94	15.11	14.17	14.37	0.33
Back cut (%)	26.24	24.34	24.55	23.62	0.49
Wing (%)	11.50	11.99	11.25	11.77	0.21

SEM = standard error of the means. D1= 0 % FFPKM, D2= 7.0 % FFPKM, D3= 9.50 % FFPKM, D4= 14.30 FFPKM.

The carcass parameters of the broiler birds fed varying levels of FFPKM are shown in Table 3.

Table 4: Effect of Full Fat Palm Kernel Meal (FFPKM) on internal organs of Broiler Chickens (% of live weight)

Parameters	T_1	T_2	T_3	T_3	SEM
Crop (%)	0.59^{ab}	0.69^{b}	0.48^{a}	0.45^{a}	0.03
Proventriculus (%)	0.24	0.21	0.26	0.18	0.01
Gizzard (%)	2.75^{ab}	2.97^{b}	2.71^{ab}	2.56^{a}	0.06
Liver (%)	1.72	1.78	1.88	1.81	0.06
Heart (%)	0.46	0.55	0.48	0.49	1.32
Pancreas (%)	0.19	0.18	0.21	0.20	0.01
Kidney (%)	0.64^{b}	0.66^{b}	0.49^{a}	0.57^{ab}	0.03
Spleen (%)	0.14	0.13	0.16	0.13	0.01
Abdominal (%) fat	1.41	0.97	1.26	1.04	0.12
Small Intestine (%)	2.29	2.37	2.13	1.87	0.09
Large Intestine (%)	0.47	0.53	0.50	0.46	0.03
Caecum (%)	0.48	0.54	0.54	0.59	0.03

^{abc} means along the same row with different superscripts are significantly different ($P < 0.05$). SEM = standard error of the means. T1= 0 % FFPKM, T2= 7.0 % FFPKM, T3= 9.50 % FFPKM, T4= 14.30 FFPKM

The effect of graded levels of FFPKM on the internal organs of broilers is shown in table 4.

4. Discussions

As indicated in Table 2, the crude protein (11.50 %) and crude fibre (14.00 %) agreed with the reports of Akpanbiatu *et al.* (2001) and Sese *et al.* (2014), while the ether extract and ash content agreed with Sese *et al.* (2014).

4.1 Effect of FFPKM on Carcass Yield of Broiler Chickens

As shown in Table 3, there was no significant difference ($p>0.05$) in the carcass cuts of broilers, birds on diet 4

(14.30 % FFPKM) recorded highest dressed and thigh weights than the control as well as 7.00, 9.50 and 14.30 % FFPKM inclusions. This is however in variance with previous researchers who reported significant differences in the carcass characteristics of broilers with higher dietary levels of energy (Olerede and Alayande, 1999; Okeudo *et al.,* 2005; Sese *et al.,* 2014).

4.2 Effect of FFPKM on Internal Organs of Broiler Chickens

As shown in table 4, feeding of Full Fat Palm Kernel Meal (FFPKM) has significant effect ($P< 0.05$) on the weights of crop, gizzard and kidney (Table 4).

The weights of the gizzard (2.97, 2.71 and 2.51 %) and crop (0.69, 0.48 and 0.45 %) decreased with increasing level of FFPKM in the diets. This may be due to slow passage and digestibility rate occasioned by the increased crude fibre contents of FFPKM. There were no significant differences ($p>0.05$) in the weights of other internal organs including the liver. This showed that FFPKM had no toxic effect on the liver. Although there was no significant difference ($p>0.05$) in the percent of abdominal fat, it was observed that the tissue of the slaughtered birds fed varying levels of FFPKM were soft and oily as also reported by Sese *et al.* (2014). The soft and oily tissues of the broiler birds was likely due to the increased energy (fat) supplied by the FFPKM.

5. Conclusion

Full fat palm kernel meal is rich in oil and can thus supply energy to the birds. FFPKM can be included up to 14.30 % in broilers ration for better weight gain and with no deleterious effect on the liver or other internal organs.

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