Feeding Full Fat Palm Fruit Meal Diets with Enzymes to Broiler Chickens: 2. Carcass Characteristics and Internal Organs

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Abstract
Previous work reported that feeding broiler chickens with up to 14.30% of Full Fat Palm Fruit Meal (FFPFM) with fibre degrading multienzymes had no deleterious effect on growth performance and economics. There was also no effect of enzymes supplementation compared to earlier work done with no enzymes. The focus for this particular study was on the effect of feeding FFPFM diets with fibre degrading multienzymes on the carcass characteristics as well as the internal organs of broiler chickens. One hundred and forty four one-day-old broiler chicks of Arbor Acre breeds were randomly allocated to 16 units of 4 experimental diets in a completely randomized design. The four experimental diets had graded levels of FFPFM (0, 5.0, 7.50 and 10.20% at starter stage; and 0, 7.0, 9.50 and 14.30% at finisher stage) with one level of fibre degrading multienzymes, maxigrain (from Polchem Laboratories Ltd, India with each gram containing cellulase, 10000IU; beta-glucanase, 200IU; xylanase, 10000IU and phytase, 2500FTU) added at 100g/tone of feed to T2, T3 and T4. Data were recorded daily on feed intake and weekly on weight changes. On day 56 of the experiment, eight birds per treatment were randomly selected from each of the replicates, starved overnight and slaughtered to evaluate carcass characteristics and internal organs. There was no significant difference ($p>0.05$) at starter and finisher phases in carcass yield and cut parts. Results were also comparable across treatments on all parameters for internal organs. Additionally, no effect of enzymes supplementation was recorded. Thus feeding broiler chickens with up to 14.30% of FFPFM with or without enzymes resulted in no deleterious effects on carcass characteristic and internal organs parameters.
Keywords: full fat palm fruit meal, enzymes supplementation, broiler chickens, cellulose digestion, carcass characteristics
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1. Introduction

Increasing popularity in the use of fibre degrading enzymes coupled with the exploration of cellulose as a low cost energy source, and most abundant natural renewable resource in the world have implication on the use and improvement of nutritive value of palm based products and by products in poultry nutrition (Zhang and Zhang, 2013; Adrizal *et al*., 2011; Beauchemin *et al*., 2003; Asmare, 2014). Finding alternative cheaper energy sources is expected to ameliorate competition for maize in human and animal nutrition (Okeudo *et al.,* 2005; George and Sese, 2012; Sese *et al.,* 2014).

Palm based meals are potential poultry feed ingredients in palm oil producing regions where high feed prices become a major production problem for small farmers (Adrizal *et al.,* 2011). Palm fruit (*Elaeis guineensis*) derived from palm tree is a rich source of cellulose, hemicellulose and lignin and are abundant in the South South rain forest zone of Nigeria. Two types of oil namely, palm oil from fleshy mesocarp; and palm kernel oil from the endosperm are derived from ripe palm fruits (Agunbiade *et al.,* 1999). Phenolic acids, flavonoids, antioxidants, vitamin E (30% tocopherols, 70% tocotrienols), fat, carotenoids and phytosterols have been reported as components of palm fruits (Sundram *et al*., 2003). Additionally, processed palm fruits yield byproducts such as palm kernel meal (PKM), palm oil effluent, palm oil sludge, oil-rich fibrous residue and palm kernel cake (PKC). Unlike Palm fruit meal (PFM) or palm kernel cake (PKC), which are respective by-products of mechanically expelled palm oil or palm kernel oil extraction, full fat palm fruit meal (FFPFM) is obtained from crushing the whole palm fruit, including the kernel (exocarp, mesocarp and endocarp) without oil extraction (Okeudo *et al*., 2005). In previous work FFPFM has been included up to 10.2% at starter and 14.30% at finisher levels with no reported deleterious effect on broiler growth performance, carcass characteristics and economics of broiler chickens (Ekanem *et al*., 2016). Conflicting conclusions in appropriate levels of inclusion for PKM for broilers and laying hens have been reported and reasons for this have been attributed to perhaps the fibre content, degree of grittiness and amino acid digestibility of PKM (Adrizal *et al*., 2011). Although not much has been reported in these areas on FFPFM, the presence of the cellulose, hemicelluloses and lignin may warrant the use of fibre degrading enzymes to help in nutrient extraction.

The use of commercial feed enzymes in feed production offers ample economic and environmental benefits given the scarcity of resources available in feeding animals (Asmare, 2014; Esuga *et al.,* 2008). Fibre degrading enzymes offer substantial prospects for improving utilization of ingredients and animal performance. Even with these prospects, Beauchemin *et al*., (2003) and Asmare, (2014) have reported variability in ruminant and monogastric animal's responses to enzymes. Although Asmare (2014) noted that enzymes are much useful with feeds that have relatively higher levels of fibre in them, it is still not conclusive if enzyme supplementation is required at high levels of PKM inclusion in poultry diets (Adrizal *et al*., 2011). There is a positive attribution to the prospects of using enzymes given the background of increased consumer anxieties relating to the use of antibiotics and growth promoters in animal production (Beauchemin et al., 2003).

2. Materials and Methods

The study was conducted at "HatchYourOwn 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 fruit used in this study were sourced from a local palm plantation at Nsukara Offot. The entire ripe palm fruit 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. Table 1 presents the ingredients and calculated nutrient composition of the starter and finisher diets.

2.2 Experimental Birds and Management

A total of one hundred and forty four (144) one-day-old broiler chicks of Arbor Acre breed were used. 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. The birds were housed after all the pens were thoroughly washed and disinfected prior to the arrival of the birds. Sixteen partitions were created as replicates. Wood shavings to the thickness of 5cm were used to cover the concrete floor of all the pens. On arrival 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 21 days to provide warmth.

Table 1: Ingredients and Nutrients Composition of Experimental Starter and Finisher Broiler Diets

Ingredients	**Starter Phase**				**Finisher Phase**			
(%)	**T1**	**T2**	**T3**	**T4**	**T1**	**T2**	**T3**	**T4**
Maize	51.00	50.00	49.00	48.00	53.00	52.00	51.00	50.00
Soybean meal	30.00	31.00	32.00	33.00	26.00	27.00	28.00	29.00
PKC	10.20	5.20	2.70	0.00	14.30	7.30	4.80	0.00
Fish meal	4.00	4.00	4.00	4.00	2.00	2.00	2.00	2.00
FFPFM	0.00	5.00	7.50	10.20	0.00	7.00	9.50	14.30
Bone meal	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
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	22.13	21.83	21.85	21.86	20.04	19.64	19.62	19.57
Crude fibre	4.50	4.35	4.29	4.23	4.72	4.49	4.44	4.29
Ether extract	8.46	4.90	5.30	5.72	4.18	5.30	5.69	6.45
ME (Kcal/kg)	2866.00	2940.00	2973.00	3008.00	2891.00	3000.00	3032.00	3103.00

*Vitamin premix supplied (per kg diet): vitamin A = 10,000IU; vitamin D_3 = 12,000 IU.; vitamin E = 20IU.; 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, FFPFM = Full fat palm fruit meal, ME = Metabolizable energy.

2.3 Data Collection

Daily data were collected on feed intake while on weekly basis the weights were taken and recorded to determine weight changes. Data on feed intake and weight changes were used to calculate the feed: gain ratio. In order to determine carcass characteristics, 2 birds were randomly selected at the end of the 8 week feeding trial 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. Additionally, 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 Statistical Analyses

Statistical analyses of data collected were carried out 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

Table 2: Carcass yield of broiler chickens fed Full fat Palm Fruit Meal with enzymes

Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**
Fasted live weight (kg)	2.7	2.8	2.9	2.8	0.17
Slaughter weight (kg)	2.0	2.1	2.2	2.2	0.11
Dressed weight (kg)	1.8	1.9	2.0	1.9	0.06

SEM = standard error of the means. T1= 0 % FFPFM, T2= 7.0 % FFPFM, T3= 9.50 % FFPFM, T4= 14.30 FFPFM

Table 3: Growth performance of finisher broiler chickens fed full fat palm fruit meal with enzyme

Parameters (%)	T_1	T_2	T_3	T_4	SEM
Dressed weight	66.96	66.91	68.74	66.62	0.52
Breast cut	33.93	34.14	33.87	32.79	0.60
Thigh	17.62	18.19	17.69	19.39	0.65
Drumstick	14.93	14.44	15.01	14.60	0.29
Back cut	22.87	22.64	23.38	22.05	0.49
Wing cut	10.79	10.60	10.04	11.17	0.28

SEM = standard error of the means. T1= 0% FFPFM, T2= 7.0% FFPFM, T3= 9.50% FFPFM, T4= 14.30% FFPFM.

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

Parameters (%)	T_1	T_2	T_3	T_3	SEM
Heart	0.49	0.48	0.49	0.51	0.03
Liver	2.09	2.05	1.92	1.93	0.07
Proventriculus	0.40	0.66	0.49	0.51	0.05
Large Intestine	0.38	0.36	0.38	0.56	0.02
Small Intestine	3.05	2.88	2.77	3.24	0.13
Abdominal fat	1.36	2.17	1.73	1.69	0.40
Spleen	2.00	1.86	2.10	1.82	0.09
Caecum	0.12	0.12	0.11	0.15	0.01
Pancreas	0.62	0.61	0.63	0.62	0.06
Lungs	0.22	0.24	0.18	0.25	0.02
Gizzard	0.43	0.52	0.60	0.56	0.03

SEM = standard error of the means. T1= 0 % FFPFM, T2= 7.0 % FFPFM, T3= 9.50 % FFPFM, T4= 14.30 FFPFM

4. Discussions

The following section discusses the results presented in section 3 above. Levels of FFPFM did not affect any of the parameters for carcass yield and internal organs.

4.1 Effect of FFPFM on Carcass Yield of Broiler Chickens

As shown in Table 2, there was no significant difference (P>0.05) in the dressed weight of the control diet compared to all other treatment diets. The slaughter weight showed a slow but stable pattern of increment from T1 to T4.

Results in Table 3, show no significant difference (P>0.05) in any of the parameters (dressing percentage, breast cut, thigh, drumstick, back cut and wing cut) across all treatments. However, T3 provided higher numeric values for dressed weight, drumstick and back cut, even if there was no particular trend in the treatment values for thos parameters. This is however in variance with previous researcher on PKM and enzymes (Esuga *et al*., 2008) who reported significant differences in the carcass yield such as dressed weight, neck, liver, lungs, kidney, abdominal fat, pancrease, spleen and length of intestines across treatments. Esuga *et al*., (2008) also reported significant effect on the breast, thigh and heart. Adrizal *et al*., (2011) found comparable results on with or without enzymes in trials with laying hens.

4.2 Effect of FFPFM on Internal Organs of Broiler Chickens

Table 4 shows that there was no significant difference (P>0.05) in internal organ parameters (heart, liver, proventriculus, large intestine, abdominal fat, spleen, caecum, pancrease and gizzard) across all treatments. This showed that FFPFM had no toxic effect on the liver and other internal organs.

5. Conclusion

Although there are mixed responses with various researchers on the effects with or without enzymes, the use of full fat palm fruit meal diets presents a viable alternative energy source for broiler chickens production. This study shows that FFPFM with enzymes could be supplemented up to 14.30% in broilers ration for comparable carcass yield and internal organs as those fed with 0% of FFPFM with no enzymes. Therefore, FFPFM can be included up to 14.30% in broilers ration with or without enzymes with no deleterious effect on the liver or other internal organs.

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