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GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF FINISHER BROILER CHICKENS FED PALM KERNEL MEAL DIETS SUPPLEMENTED WITH CELLULASE

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ABSTRACT

A total of 96 broiler chickens, aged 28 days were fed palm kernel meal (PKM) diets supplemented with cellulase at the finisher phase. The birds were allotted to four diets, each replicated three times, with 8 birds per replicate in a Completely Randomized Design. Final weight decreased (1740.04g-973.00g) with PKM level. However, 20%PKM birds (1000.09g) were similar to 30%PKM (973.00g). Daily weight gain (60.41g-23.83g) and daily feed intake (120.25g-54.56g) followed similar trend as final weight. Feed conversion ratio was best (P<0.05) in 0% PKM group (2.00) and poorest in 20% PKM birds (2.37). Bled weight was significantly affected (P<0.05), birds fed 0%PKM (1616.75g) and 10%PKM (1608.38g) were similar but different from 20%PKM (1325.05g) and 30%PKM (1290.05g). De-feathered weight decreased (1563.36g-1221.73g) with level of PKM. Eviscerated weight (1345.09g-1078.31g) and dressing percentage (74.39-70.67) showed similar trend of variation as live-weight. Head, neck, leg, drumstick, thigh, back, wing, breast, intestine and gizzard varied significantly (P<0.05). Drumstick and thigh were highest in birds fed 10%PKM (11.07g/11.57g) and lowest in birds fed 20% PKM (9.58g/10.84g). Back declined (14.53-12.59) with PKM level. Highest wing percentage was in 30%PKM (8.29) and least in 20%PKM (7.81). Highest breast percentage was in 20%PKM (20.98) and least in 0%PKM (19.90). Intestine was highest in 0%PKM (11.58) and least in 10%PKM (9.53). The gizzard increased (5.55-6.96) with PKM. Heart and liver were not affected (P>0.05). PKM with cellulase supplementation could be fed to finisher broiler chickens up to 10% for improved growth response and carcass yield.

Keywords: Cellulase, Enzyme, Palm Kernel Meal, Performance, Carcass characteristics, Broiler chickens.

INTRODUCTION

A critical aspect of broiler production is the provision of quality feed which should enhance utilization and eventual growth. Unfortunately, the production of the needed quality feed for broilers is currently being hampered in this part of the world by high costs of energy and protein feedstuffs. However, there are abundant deposits of relatively cheap agro-industrial by-products such as wheat offal (WO), rice bran (RB), brewer's dried grain (BDG), palm kernel meal (PKM) and maize milling by-product (MO) (Esuga *et al*., 2008).

Palm kernel meal (PKM) is derived from oil processing mill, and possesses great nutritive value for livestock feeding. It is fibrous and has medium grade protein (Pickard, 2005). Sathitkowitchai *et al*. (2018) reported 14-18% crude protein and 10.6 MJ/kg DM energy for PKM. PKM is coarse-textured and has high viscosity, which may result in decreased nutrient absorption (Ojediran *et al*., 2020). The β-mannan and non-starch polysaccharide (NSP) present in PKM possess anti-nutritional properties that impede the full utilization of the nutrients in pigs (O'Shea *et al*., 2014; Oladokun *et al*., 2016). However, reports revealed that PKM can sustain maintenance and moderate growth in poultry, and can be used as partial substitute to maize and soybean in poultry diet (Alshelmani *et al.*, 2017). The nutritive value of PKM for monogastrics have been enhanced through solid-state fermentation (Mirnawati *et al*., 2011; Alshelmani *et al*., 2017) and enzyme supplementation (Kononenko and Gorkovenko, 2011) among others.

The addition of enzymes that digest the β-mannan in PKM, can improve an animal's weight gain and feed efficiency (Adeola and Cowieson, 2011). Mannanase enzyme aids in the hydrolysis of linear mannans, resulting in increased digestion of NSPs, improved nutrient utilization and decreased intestinal viscosity of digesta (O'Shea *et al*., 2014; Ojediran *et al*., 2020). The use of an enzyme to improve the digestibility in poultry, might enhance not just the growth performance of poultry, but the health and immune status of the animals, as reflected in haematological and serum biochemical parameters (Stephenson *et al.*, 2014; Zuo *et al*., 2015), as well as the feed conversion (Esuga *et al*., 2008).

This study therefore sought to evaluate the performance and carcass characteristics of finisher broilers fed cellulase enzyme supplemented palm kernel meal diets due to the reported high fibre content of PKM.

MATERIALS AND METHODS

Experimental site

The Deep litter house of the Poultry Unit of the Teaching and Research Farm in the Department of Animal Production, Prince Abubakar Audu University Anyigba, Kogi State Nigeria was used for the feeding trial. The site is located on latitude 7^0 30'N and longitude 7^0 09'E of the Greenwich Meridian (Ifatimehim *et al.*, 2011).

Experimental birds and management

Ninety-six (96), four weeks old broiler chickens were used for the research. Four diets were compounded to contain palm kernel meal (PKM) at 0%, 10%, 20%, and 30% inclusion levels designated as T1, T2, T3 and T4. Diet T1 contained 0% PKM without enzyme, while diets T2, T3 and T4, contained cellulase. . The birds were allocated to the diets in a Completely Randomized Design arrangement of three (3) replicates of eight (8) birds each, and twenty-four (24) birds per dietary group (Table 1). Feed and water were provided *ad-libitum* for twenty-one (21) days of the experiment.

Table 1: Percentage Composition of Cellulase Supplemented Palm Kernel Meal Based Experimental Diets Fed to Finisher Broiler Chickens

PKM Levels	**T1(0%)**	**T2(10%)**	**T3(20%)**	**T4 (30%)**
Ingredients:				
Maize	51.30	44.29	37.29	30.29
Palm kernel meal	0.00	10.00	20.00	30.00
Full-fat soyabean meal	35.00	32.00	29.00	26.00
Fish meal	1.20	1.20	1.20	1.20
Maize offal	8.00	8.00	8.00	8.00
Bone meal	3.50	3.50	3.50	3.50
Salt	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20
Methionine	0.30	0.30	0.30	0.30
Premix	0.25	0.25	0.25	0.25
Cellulase	-	0.01	0.01	0.01
Total	100	100	100	100
Calculated values:				
Crude protein (%)	20.16	20.22	20.28	20.34
Ether extract (%)	8.58	8.46	8.34	8.22
Crude fibre (%)	3.46	4.22	4.98	5.74
Calcium (%)	1.45	1.44	1.43	1.42
Phosphorous (%)	1.00	0.96	0.92	0.88
Lysine (%)	1.05	1.05	1.05	1.05
Methionine (%)	0.34	0.37	0.40	0.43
Cysteine (%)	1.12	1.04	0.98	0.95
Metabolizable energy (Kcal/kg)	3142.66	3075.66	3008.66	2941.66

Data Collection

Initial weight of the birds in each group was taken at the commencement of the feeding trial, while final weight was taken at the end of the experiment. Weight gain was obtained by subtracting initial weight from final weight. Daily weight gain was obtained by dividing weight gain by the number of days used for the feeding trial. Other performance parameters measured were average daily weight gain, daily feed intake and feed conversion ratio. At the end of the experiment, the broiler chickens were starved overnight, after which two birds from each replicate were selected at random, weighed and slaughtered for evaluation of carcass characteristics. Parameters measured were bled-weight, wings, drumstick, leg, thighs, back, head, heart, kidney, liver, intestine and gizzard using digital scale. Dressing percentage was also estimated.

Statistical analysis

All data collected were subjected to Analysis of Variance (ANOVA) using SPSS Computer Statistical Package Version 20. Where significant effects were obtained, means were separated with the aid of the same software using Fisher's Least Significant Difference (LSD) at 5% probability level.

RESULTS

The growth performance of birds as influenced by the experimental diets is presented in Table 2. The Results obtained revealed that palm kernel meal inclusion had significant (P<0.05) influence on the values obtained for various performance parameters. Final weight decreased linearly with increased PKM despite cellulase supplementation. Daily weight gain and daily feed intake followed similar pattern of variation as final weight. Feed conversion ratio was best (P<0.05) in 0%PKM group but poorest with birds fed 20 % PKM. Table 3 shows the effect of feeding palm kernel meal diets supplemented with cellulase enzyme on the carcass characteristics of the birds. Results showed significant differences (P<0.05) among the treatments in the live weight and bled weight. Birds fed diets 0%PKM and 10% PKM were similar but different from those fed 20%PKM and 30% PKM De-feathered weight declined linearly as level of PKM increased except that 0%PKM was similar to 10% PKM. Eviscerated weight and dressing percentage followed similar pattern of variation as live weight. Head, neck, leg, drumstick, thigh, back, wing, breast, intestine and gizzard varied significantly (P<0.05) with treatment. For head, the highest percentage was observed in 30%PKM and the lowest in 0% PKM. Birds on the 0%PKM had the highest neck percentage and 30% the least. Percentage of leg was highest in10%PKM and lowest in 30%PKM. Drumstick and thigh were highest in 10%PKM and lowest in 20%PKM. Percentage back declined as the inclusion level of PKM increased in the diet. Highest wing percentage was observed in birds fed 30%PKM and least in 20%PKM. Highest breast percentage was observed in 20%PKM and least in 10%PKM. Percentage of intestine was highest in 0%PKM and least in 10%PKM. Percentage of gizzard increased linearly as inclusion of PKM in the diet increased. Heart and liver were not significantly different (P>0.05).

Table 2. Growth Performance of Finisher Broiler Chickens Fed Varied Inclusion Levels of Palm Kernel Meal in the Diets with Cellulase Supplementation

PKM Levels: Parameters	T1(0%)	T2(10%)	T3(20%)	T4 (30%)	SEM
Initial weight (g)	471.33	469.00	469.33	471.67	0.53
Final Weight (g)	1740.04^{a}	1500.08^{b}	1000.09^{c}	973.00^{c}	111.21
Weight gain (g)	1268.76^{a}	1031.00^{b}	530.67^{c}	500.33^{c}	111.20
Daily weight gain (g)	60.41^{a}	49.10^{b}	25.27^{c}	23.83^{c}	5.30
Daily feed intake (g)	120.25^{a}	103.27^{b}	59.80^{c}	54.56^{c}	11.70
Feed conversion ratio	2.00^{a}	2.10^{b}	2.37^{d}	2.29^{c}	0.02

^{a,b,c} Means with different superscripts along the same row show significant difference at P<0.05, SEM= Standard error of the mean

Table 3. Carcass Characteristics of Broilers Fed Diets Containing Varied Levels of PKM Supplemented with Cellulase Enzyme

PKM Levels: Parameters	T1(0%)	T2(10%)	T3(20%)	T4 (30%)	SEM
Live weight (g)	1641.73^{a}	1630.06^{a}	1326.76^{b}	1313.43^{b}	30.07
Bled weight (g)	1616.75^{a}	1608.38^{a}	1325.05^{b}	1290.05^{b}	29.79
Defeathered weight(g)	1563.36^{a}	1531.71^{a}	1305.05^{b}	1221.73^{c}	29.14
Eviscerated weight (g)	1345.09^{a}	1358.33^{a}	1145.03^{b}	1078.31^{c}	11.17
Dressing percentage (%)	74.39^{a}	73.98^{a}	70.74^{b}	70.67^{b}	0.61
Head (%)	2.98^{c}	3.27^{b}	3.26^{b}	3.60^{a}	0.12
Neck (%)	6.45^{a}	6.23^{a}	5.86^{b}	5.54^{c}	0.10
Leg (%)	4.58^{a}	4.90^{a}	4.29^{b}	4.09^{b}	0.12
Drum stick (%)	10.75^{b}	11.07^{a}	9.58^{c}	10.80^{b}	0.16

Thigh (%)	11.08[b]	11.59[a]	10.84[b]	11.57[a]	0.16
Back (%)	14.53[a]	13.64[b]	13.03[b]	12.59[c]	0.26
Wing (%)	7.81[b]	8.24[a]	7.23[b]	8.29[a]	0.15
Breast (%)	19.90[c]	20.95[a]	20.98[a]	20.41[b]	0.27
Heart (%)	0.46	0.47	0.34	0.60	0.19
Liver (%)	3.70	3.41	3.65	3.77	0.40
Intestine (%)	11.58[a]	9.53[c]	11.55[a]	10.10[b]	0.19
Gizzard (%)	5.55[b]	5.67[b]	6.96[a]	6.96[a]	0.04

[a,b,c,d] Means with different superscripts along the same row show significant difference at $P<0.05$, SEM= Standard error of the mean

DISCUSSION

Growth performance of broiler chickens fed diets containing varied levels of PKM supplemented with cellulase enzyme

The trend observed in final body weight indicates that increase in the inclusion of PKM with cellulase supplementation decreased body weight. Final weight values obtained ranged from 973.00 g - 1740.04 g. The higher final weight obtained in broiler chickens fed the control diet may suggest better digestibility and utilization of the feed. Pickard (2005) reported that despite high in nutrients in PKM; the ingredient is highly fibrous, which makes its utilization low. Furthermore, Alshelmani *et al*. (2017) reported lower weight of 1474.50g when PKM was included up to 30% whereas 2035.66g was obtained for the control in broiler experiment. Adeola and Cowieson (2011) reported that broiler chickens body weight increased from 1.82kg to 2.10kg upon feeding 30% PKM with addition of enzyme. Ugwu *et al*. (2008) reported body weights ranging from 1.70kg to 1.84kg for broiler chickens at 8weeks with fed palm kernel cake, bambara offal and rice husk diets. The workers recommended that the 20% PKM can effectively replace maize for the finisher phase of broilers. Total weight gain values obtained ranged from 500.33-1268.76g. For daily weight gain, obtained values ranged from 23.83g to 60.41g. Daily feed intake value ranged from 54.56g to 120.25g. Feed intake values may indicate that PKM depressed birds' appetite, perhaps due to the higher fibre level in PKM-based diets and body size of the birds. Observed feed intake range is lower than 83.90g-134.55g for broilers at 6 weeks fed PKM (Bello *et al*., 2012). Conversely, Mirnawati *et al*. (2011), reported an increase in feed consumption by broilers fed higher PKM inclusion levels, attributing it to the energy dilution in PKM, which encouraged chickens to consume adequate feed to meet their energy requirements. Higher feed intake values of 109.50g-122.00g were reported by Fasuyi *et al*. (2014), who opined that further degradation of diet increased intake and hence weight gain of the birds.

Carcass characteristics of broiler chickens fed diets containing varied levels of PKM supplemented with cellulase enzyme

Live weight ranged from 1313.43g -1642.73g and varied between birds fed control diet (0% PKM) and those fed 10%PKM with cellulase enzyme. But, lower values were obtained when PKM increased in the diet to 20% and inclusion with the same level of cellulase enzyme supplementation. The variation in broiler live weight could be due the poor utilization of the PKM-based cellulase supplemented diets. Highest values of 1641.73g and 1630.06g were obtained for the birds fed 0%PKM and 10%PKM with cellulase enzyme supplementation. Mardhati *et al*. (2011) had reported reduction in live weight at slaughter of birds fed higher inclusion of PKM (40%). Wan-Zahari and Alimon (2003) reported a significant steady decreasing live weight at slaughter with PKM inclusion. However, Pushpakumara *et al*. (2017) reported that PKM did not affect the live weight of the birds even at 15%. Similar pattern of weight distribution was observed in the bled, defeathered and eviscerated weights and dressing percentage. Observed dressing percentage values are higher than 69.55% reported by Mardhati *et al*. (2011) for birds fed 30% PKM. Variations in dressing percentage may be attributed to different ration types, nutrient content, birds breed/strain, environmental conditions, processing, and management conditions. Other primal cuts varied among experimental birds. Alshelmani *et al*. (2016) reported similarities in the weights of breasts, wings and thighs fed PKM diets. There was no difference observed in the internal organs like heart, liver and intestine weight except for the gizzard that enlarged with inclusion of PKM. The increase in gizzard size could be due to the high fibre content of PKM (Jimenez- Moreno *et al*., 2009). This is in line with findings by Zanu *et al*. (2012) who reported that the gizzard of laying chickens increased with 15% inclusion level of PKM. The heart was not under any stress to pump oxygenated blood. The liver seemingly was not under any stress to perform its usual function even at 30%PKM, hence the similarity in size.

CONCLUSION

Based on the findings of this research, inclusion of PKM with cellulase enzyme in the diets of finisher broiler chickens compromised performance and carcass characteristics when fed beyond 10%. PKM utilization with other enzymes and combinations of enzymes may be evaluated.

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