Economics Benefits, Growth Performance, Carcass and Meat Characteristics of Broiler Chicken Fed High Fibre Diet

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ABSTRACT

Aims: The effects of high fibre diet fed to broilers chicken on growth, carcass performance sensory evaluation, primal cuts and meat characteristics were carried out in a eight weeks feeding trials.

Methodology: A total of two hundred and forty, day old broiler chicks of Arbor Acer breed obtained from a commercial hatchery was used for the trial. An average (33±0.12g body weight) were weighted individually and randomly divided into three (3) Treatment with ten replicate per treatment and eight birds per replicate using a completely randomized design. The diet contained T1= 8.70% fibre; T2= 13.10% with enzyme and T3= 13.10% fibre without enzyme. Parameters measured are daily feed consumption, weekly body weights, weight gain and feed conversion ratio were properly recorded. Carcass performance parameters were measured and recorded for both the external and internal organs, primal cuts, sensory evaluation, cooking loss and yield using a standard procedure. Data were analysed using descriptive statistic and ANOVA at $\alpha_{0.05}$.

Results: There were no significant difference ($P<0.05$) for weight gain and feed conversion ratio while Treatment 3 had the highest daily feed consumption and weekly body weights with least daily feed consumption, and weekly body weights in Treatment 1. The result shows that there was no differs in carcass performance, external organs weight as well as internal organs weight. There was no significant difference ($P<0.05$) observed in the primal cuts and sensory evaluation. The cooking loss was significantly higher ($P>0.05$) in Treatment 1(control with 8.7% fibre) 33.36% with least cooking loss in Treatment 3 containing 13.10% (21.54%). Treatment 3 had the highest cooking yield (78.46%) compared to other treatment.

Conclusion: broiler chicken can be fed with 13.10% fibre diet without enzyme without any adverse effect on the growth, carcass performance, enhances better cooking yield and lower cooking loss.

Keywords: Growth performance, carcass performance, high fibre diet, primal cuts, cooking loss, cooking yield, sensory evaluation

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1. INTRODUCTION

The aim of farmers is to ensure high productivity and profitability. Due to the high competition for conventional feeding stuff such as maize between human and animal to meet their energy requirement which has led to high cost of production and in turns reduce the profits [1]. Farmers have adopted the use of alternative feeding materials that are less or not consumed by humans and yet meet the energy requirement of animals such as broiler chickens. Such feeding materials are fibres from cereals such as rice, corn, wheat and oat.

Fiber content of diets is mainly more important in ruminants; however, there are good results with fiber content in non-ruminants such as pigs and poultry [2]. Fiber provides health benefits, with several physiological functions [3]. Also, fiber in feed ingredients may affect cecal microbial population, nutrient digestibility, and volatile fatty acid production. Interactions of these effects can affect bird performance and meat qualities [4]

Meat quality is greatly affect7ed by the diet fed to the farm animal [5]. Diet is an important aspect of animal production, and different bird species or lines have different nutrient requirements depending on age, genetic background and environment as well as the health status of the birds. Thus, nutritionists are faced with a challenge of formulating diets with the available feed ingredients, but also having to mitigate the resulting diet effects to achieve optimum bird production [4].

Use of feed ingredients high in dietary fiber in poultry nutrition has generally been discouraged due to the negative effects exerted on nutrient utilization and performance such as decrease in body weight gain and feed conversion [4]. It is important to note that fibre in monogastric diets is mainly utilized in the hind gut (i.e. ceca, rectum and the colon). Feeding animals diets high in dietary fiber, particularly soluble fiber alters the rate of fecal passage, microbiota, metabolites, and efficacy of digestion [6].

Thus, this study is designed to investigate the Influence of high fibre diet fed to broiler chickens on growth, carcass performance, sensory evaluation and meat characteristics

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2. MATERIAL AND METHODS

2.1 Experimental site

The experiment was conducted at Poultry Unit Division of National Veterinary Research Institute, Vom Plateau State, Nigeria.

2.2 Experimental animals and management:

A total of two hundred and forty, day old broiler chicks of Arbor (DOC) Acer breed were obtained from a commercial hatchery was used for the trial. An average (33.00±0.12g body weight) were weighted individually and randomly divided into three (3) Treatments with ten replicates per treatment and eight birds per replicate. The brooding temperature was kept at an average of 26.5^{0}C from the first to second week of age. Thereafter, the temperature was lowered to 22^{0}C for the rest of experimental period. Wood shaving was used as litter material. At DOC (Day Old Chick) and anti-stress were given to the birds for three days. From week two to three, first and second Infectious Bursal Disease Vaccine (IBDV) was administered. Then, at week four and five Anticocidial drug and Newcastle Disease Vaccine Lasota were given to the birds respectively. The experiment was conducted for the period of eight weeks. The daily feed consumption, weekly body weights, weight gain, feed conversion ratio, economic benefit and cost of production which was calculated using (feed intake and economic benefit) were properly recorded. Carcass performance parameters was measured for both the external and internal organs.

2.3 Experiment diet

Three experiment diets were formulated with high fibre content as shown in Table 1.

Table 1: Feed composition

Ingredients	T1	T2	T3
Lysine	0.35	0.35	0.35

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Methionine	0.20	0.20	0.20
Premix	0.45	0.45	0.48
Salt	0.37	0.37	0.37
Curpail Enzyme	0.03	0.03	-
Toxin Blinder	0.02	0.02	0.02
GNC	27.90	27.90	27.90
Maize Bran	25.00	60.00	60.00
Rice Bran	7.50	7.50	7.50
Bone Meal	2.40	2.40	2.40
Lime Stone	0.60	0.60	0.60
Oyatozyme	0.20	0.20	0.20
Maize	35.00	-	-
	100.016	100.016	100.016
Total Percentage	***100***	***100***	***100***

Nutrients Composition of Diets			
Metabolizeable energy (Kcal/Kg)	3197.00	2984.00	2716.00
Crude Protein %	18.16	18.50	17.83
Crude Fat %	7.40	9.15	9.15
Crude Fibre %	8.70	13.10	13.10
Ash %	5.20	6.24	6.24
Calcium %	1.50	1.50	1.22
Available Phosphorus %	0.67	0.72	0.42
Methionine %	0.49	0.46	0.46
Lysine %	0.95	1.00	0.96
Methionine + Cystine %	0.77	0.76	0.74

T1= Control (8.7% Fibre); T2= 13.10% Fibre with enzyme T3= 13.10% Fibre without enzyme

2.4 Sensory evaluation

The nine-point hedonic scale was used by twenty panelists who were trained individuals aged between 20 and 40 years were used to determined two replicate of the prepared sausage to assess colour (1-4 dark, 5- intermediate, 6-9 light), tenderness (1-4 tough, 5-intermediate, 6-9 tender), juiciness (1-4 dry, 5- intermediate, 6-9 juicy), and overall acceptability, OA (1-4 low, 5- intermediate, 6-9 high) [7].

2.5 Cooking loss

Cooking loss was determined according to the procedure described by [7]. Meat samples from each treatment and major primal cuts were taken, weighed before cooking for 10

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minutes after the water in the cooking pot had boiled. Cooked samples were allowed to cool then weighed. Cooking loss was calculated using:

$$\text{Cooking loss \%} = \frac{\text{weight of sample before cooking} - \text{weight of sample after cooking}}{\text{weight of sample before cooking}} \times 100$$

2.6 Experimental design

Completely randomized design was used.

2.7 Statistical Analysis

Data obtained were subjected to analysis of variance using [8]. The means were separated using Duncan's Multiple Range Test of the same procedure.

3. RESULTS AND DISCUSSION

The economic benefit of feeding broilers with high fibre diet is shown in Figure 1 and cost of production is shown in figure 2. Feed production cost was higher in T1 = 114.09 naira per kg, T2 = 97.03 naira per kg while least feed cost at T3 = 92.62 naira per kg. The growth performance was shown in Table 2. The fiber had no effect on both the weight gained and feed conversion ratio among the treatments. The feed intake /week/ replicate was higher statistically in Treatment 3 with least values in Treatment 1. Furthermore, the feed intake/bird/week was also higher in both Treatments 2 and 3. In agreement with previous reports [9], [10], and [11], broiler chicks' body weight gain was reduced at higher concentrations of high fiber dietary ingredients which was in line with the findings of the study. A possible explanation for the reduced performance could be that inclusion of high fibre source in broiler diets.

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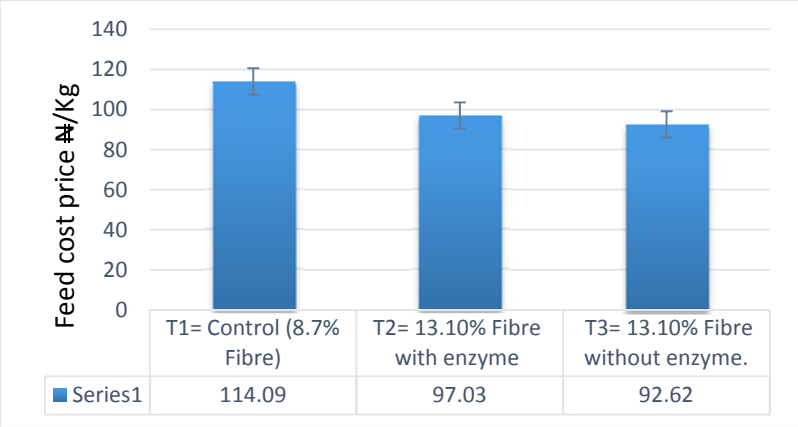

Figure 1: Economics benefits

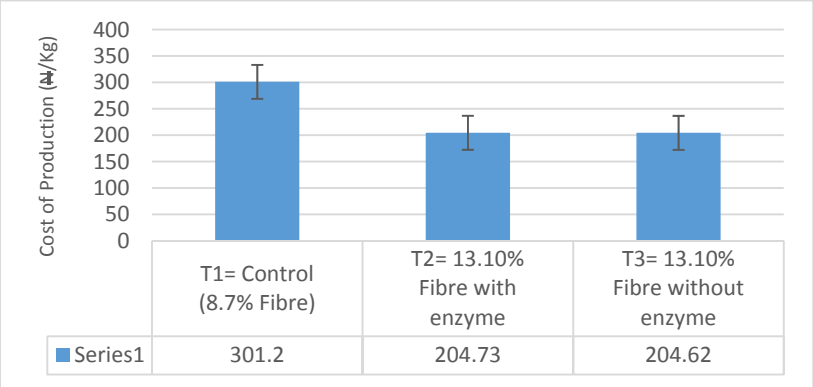

Figure 2: Cost of Production as affected by high fibre diet fed broilers chicken

Table 2: Growth performance of broiler chicken fed high fibre diet

Parameters	T1	T2	T3	SEM
Initial weight	39.78	39.7	39.75	0.24
Final weight	1478	1850	1633.33	83.56
wgt gain/wk	239.84	271.2	265.6	12.15
FI/WK/REP	8077.39^{b}	9999.97^{a}	10111.31^{a}	374.27
FI/Bird/wk	479.18^{b}	566.23^{a}	561.74^{a}	16.68
FCR	2.64	2.11	2.21	0.22

^{a,b,c} Means across rows with different superscripts differ significantly at P<0.05; wgt: Weight; wk: Week; FI; Feed Intake; F.C.R: Feed Conversion Ratio;. S.E.M: Standard Error of the Mean

T1= Control (8.7% Fibre); T2= 13.10% Fibre with enzyme T3= 13.10% Fibre without enzyme.

Table 3: Carcass performance as affected by high fibre diet

Parameters	T1	T2	T3	SEM

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Live Weight	2.12	2.30	2.30	0.07
Bled Weight	2.02	2.21	2.22	0.07
Defeathered weight	1.95	2.11	2.12	0.07
Evicerated Weight	1.71	1.84	1.83	0.06
Dressed Weight	1.44	1.58	1.57	0.06
Dressed percentage	68.29	68.78	68.31	0.18

T1= Control (8.7% Fibre); T2= 13.10% Fibre with enzyme T3= 13.10% Fibre without enzyme.

Table 4: External organs of broilers as affected by high fibre diet

Parameters	T1	T2	T3	SEM
Head	56.00	57.00	56.67	1.24
Neck	90.00	100.00	101.33	2.93
Shank	87.00	94.33	93.33	2.22
Abdominal fat	14.67	21.67	26.67	3.17

T1= Control (8.7% Fibre); T2= 13.10% Fibre with enzyme T3= 13.10% Fibre without enzyme.

Table 5: Internal organs of broilers as affected by high fibre diet

Parameters	T1	T2	T3	SEM
Liver Weight	2.01	1.90	2.13	0.08
Heart Weight	0.53	0.51	0.49	0.03
spleen weight	0.20	0.17	0.13	0.02
bile weight	0.05	0.13	0.10	0.02
Gizzard Weight	2.57	1.91	2.40	0.14
Empty gizzard	1.65	1.41	1.68	0.09
Intestine weight	5.23	4.79	4.53	0.21
Intestine length	11.18	10.10	8.28	0.61
Proventriculus	0.29	0.31	0.35	0.03

T1= Control (8.7% Fibre); T2= 13.10% Fibre with enzyme T3= 13.10% Fibre without enzyme.

Tables 3, 4 and 5 showed that treatments had no significant effect ($P<0.05$) on both the external and internal organs such as weights of necks, heads, shanks, abdominal fat, livers, hearts, spleens, bile, gizzards, empty gizzards, intestinal weight, intestinal length and proventriculus, as these parameters did not show differences across the diets. The results obtained could be due to the inclusion of higher total intake of high fiber feed ingredients in the broiler chicks resulting in reduced both the internal and external organs.

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Table 6 shows the primal cuts of broilers chicken fed high fibre diet. Comparing the thigh, drumsticks, back, breast meat and wings across the treatment shows no significant difference (P<0.05). Besides, the colour, aroma, flavor, juiciness, tenderness, texture and overall acceptability examined under sensory evaluation shows no difference (P<0.05) among the treatment as shown in Table 7. Similar result was obtained by [12], who compared chicken groups fed high fibre. The cooking loss and yield of meat from broiler chickens fed high fibre diet were presented in Table 4. The cooking loss of breast meat from broiler chickens fed control (8.70% fibre) had the highest cooking loss. While Treatment 3 had the highest cooking yield with lowest cooking yield in Treatment 1. Meanwhile both the cooking loss and yield for drumstick and thigh shows no significant difference. The result obtained could be due to ability of the high fibre to hold water within the muscle of the broilers chicken.

Table 6: Primal cuts of broilers chicken fed high fibre diet.

Parameters (g)	T1	T2	T3	SEM
Thigh	266.67	286.67	263.67	14.19
Drumstick	209.33	222.67	231.33	8.26
Back	277.00	312.33	335.67	14.69
Breast	511.33	569.00	554.00	22.63
Wings	161.67	173.67	173.33	5.49

T1= Control (8.7% Fibre); T2= 13.10% Fibre with enzyme T3= 13.10% Fibre without enzyme.

Table 7: Sensory evaluation of meat from broilers chicken fed high fibre diet

Parameters	T1	T2	T3	SEM
Colour	5.10	4.80	4.80	0.29
Aroma	3.60	2.10	3.50	0.38
Flavour	3.60	3.30	3.50	0.29
Juiciness	5.30	4.00	4.00	0.36
Tenderness	5.00	5.10	5.00	0.29
Texture	4.30	4.40	4.50	0.29
Overall acceptability	4.30	3.50	3.10	0.34

T1= Control (8.7% Fibre); T2= 13.10% Fibre with enzyme T3= 13.10% Fibre without enzyme.

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Table 8: Cooking loss and yield of meat from broilers chicken fed high fibre diet

Parameters	Primal cuts	T1	T2	T3	SEM
Cooking loss	Breast	33.36[a]	24.74[b]	21.54[b]	2.16
	Drumstick	28.17	21.15	19.62	2.93
	Thigh	29.29	24.48	22.42	2.11
Cooking yield	Breast	66.64[b]	75.26[a]	78.46[a]	2.16
	Drumstick	71.83	78.85	80.38	2.93
	Thigh	70.71	75.52	77.58	2.11

[a,b,c] Means across rows with different superscripts differ significantly at P<0.05
T1= Control (8.7% Fibre); T2= 13.10% Fibre with enzyme T3= 13.10% Fibre without enzyme

4. CONCLUSION

In conclusion, broiler chickens can be fed with 13.10% fibre diet without enzymes have no adverse effect on the growth and carcass performance. However, it enhances better cooking yield and lowers cooking loss with a minimal cost of feed production. The most important theory that this work seems to suggest that the higher the fiber content of broiler diet, the less the cost of production holding the enzyme constant.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

Author SCE designed the study, Author ODO Author NCE, and Author UA performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author ODO and Author NCE managed the analyses of the study. All authors read and approved the final manuscript.

Ehical:

As per international standard Informed written ethical approval has been collected and preserved by the author(s).

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