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Growth performance and carcass traits of broiler breeder cocks fed varying levels of dietary protein in tropical environment

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Abstract

This study was carried out to investigate the effect of graded levels of dietary protein on the growth performance and carcass traits of broiler breeder cocks. A total of two hundred and forty broiler breeder cocks were randomly assigned to four treatment groups in a completely randomized design. The experimental diets T1, T2, T3 and T4 contained protein level of 18%, 16%, 14%, and 12%. The experiment lasted for 8 weeks. Parameters studied include: initial weight, final weight, total weight gain, feed intake, feed conversion ratio and mortality rate. The results obtained for growth performance and carcass traits, with the exception of the thigh, liver, and spleen weight, revealed that the performance and carcass traits were optimized in the birds fed on 14% dietary protein level. The study, further suggested that the fed dietary protein levels could be reduced to 14% at finisher stage with no harmful effect on broiler breeder performance and carcass traits.

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Introduction

The ever increasing shortage of animal protein in the diets of an average Nigerian as reported by FAO (1997) requires a logical solution like increasing the rate of production and intake of poultry and its products. Poultry production has been described as one of the fastest means to achieving appreciable improvement in the nutritional standard of the Nigerian populace because of its prolificacy, little generation interval, high rate of turnover and relatively small capital venture (Smith, 2001; Ani and Okeke, 2011). However, to achieve maximum health and performance of poultry, birds must be supplied with adequate and nutritionally balanced diets. Research studies have proved animals as richer sources of protein, vitamins, and minerals than plant sources. That is one reason why studies or ventures aimed at improving on the nutrient availability to man via animal sources are always welcomed and encouraged.

One wildest means of meat production is poultry production; it is liable to management practices, quality of feed, and source of day old chicks used. The production cycle could take 8-10 weeks and as such, farmers can produce five batches in a year (Gefu *et al.*, 2002). Poultry production however remains one of the potential avenues to achieve sustainable and rapid production of high quality protein to meet the demand for animal protein (Akpata and Ojo, 2000). To cope with the market demand for protein (meat), modern broilers are reaching market age sooner each year (Kleyn and Chrystal, 2008). Consequently, improvements in genetics and nutrition will be essential to safeguarding this speedy growth attainment and maintaining sustainable broiler production.

According to Renema and Robinson (2004), modern broilers are the results of genetic selection focused on a high growth rate, extensive muscle development and relatively low feed consumption. The birds reach their slaughter weight of 2.0kg in 5-6 weeks while they are still juvenile. The high cost of feed is blamed on the competition between man and his livestock for available grains which account for 70-85% cost of poultry production (Sanni and Ogundipe, 2005).

This trend has accounted for low protein intake as a result of high cost of feeds. Poultry production has been identified as one major means of solving problem of low animal protein intake in Nigeria (Aletor *et al.*, 2000, Makinde *et al.*, 2013). Growth in broiler chickens and its productivity are greatly influenced by dietary protein levels (Bregendahl *et al.*, 2002) within the rearing period. Subsequently proteins have numerous functions in the living organism, it is very essential to provide adequate protein level in the diet to guarantee optimum animal performance.

Maintenance of broiler breeder cocks for reproductive performance and good carcass quality is a substantial production cost, in the breeder segment of the poultry industry. According to Sexton (1983), the estimated production cost per roaster was $30 in the year (1986), there were about 3.4 million breeders males in the US. Assuming the present day cost of breeder males if still remained the same as that of the year 1983, the overall cost of maintaining breeder cocks would be approximately 100 million dollars today. Thus, research is focused at reducing the production cost of breeder males while maintaining its good reproductive performance and carcass quality is necessary. The well-organized growth performance and reproductive fitness in breeder cocks are negatively related to production traits (Siegal and Dunnington, 1985). As a result, real management of commercial breeder flock cannot be negotiated. The sustained genetic improvements in feed efficiency, rapid growth and high breast meat yield in the broiler requires a constant adjustment to the broiler breeders and nutrition to prevent overweight of cocks and the associated negative inputs on fertility and reproductive efficiency. The limitation of the body weight gain must be sustained throughout the life live time of the breeder birds by controlling feed intake to minimize poor reproductive efficiency in adult birds (Richard *et al.,* 2010). It has been found that often time breeder cocks often become too heavy at certain stages of growth due to overweight condition which renders cocks less efficient during servicing due to inability to mount hen. Consequently, the objective of

this research study was to decide the effect of varying levels of dietary protein on the growth and carcass qualities of broiler breeder cocks.

Materials and methods

Experimental Site

The research work was conducted at the Delta State University farm Asaba Campus. Asaba Delta State, Nigeria. Asaba is located at latitude 06°49'East and 60°12' North of the equator. Asaba has its rainy season from March to November, with a mean annual rainfall of 1800-300mm while maximum day temperature range from 27.5 – 30.90 (Federal Ministry of Aviation; Department of meteorological Services Asaba, 2018).

Experimental Birds, Design and Their Management

Two hundred and forty day - old broiler breeder cocks were used for the experiment. The birds were checked, and given anti-stress medication on arrival. During the brooding period, the birds were fed with a commercial broiler starter diet containing 16.5% crude protein and 2,650 kcal/kg M .E. *ad-libitum*. Clean drinking water was made available always. Heat and ventilation were properly monitored to prevent adverse effects. All prophylactic medications and scheduled vaccinations for broiler were carried out. Gomboro and New castle diseases vaccines were administered as scheduled in the vaccination programme while coccidiostat were given as at when due. To ensure proper intake of the vaccines, the birds were starved of water for some hours in the morning before the vaccines were given. All vaccinations were through oral. At the end of 4 weeks, the broilers chicks were randomly distributed into four (4) treatments groups and it was further divided into three (3) replicates of twenty birds in a completely randomized design (CRD). The weight of birds was taken on replicate basis every week. Ethical permit was approved, and the research work were done in accordance with ethic guidelines.

Preparation of Experimental Diets

The diets were formulated in accordance with the established recommendations for dietary energy and protein in broiler chickens raised in warm wet climates (Obioha, 1992, Oluyemi and Roberts, 2000).

Performance Parameters

The growth performance indices measured included feed intake, weight gain, feed conversion ratio and mortalities. Weight of the birds and feed offered the broilers each morning using a 5kg scale. Feed intake was determined by deducting the surplus feed from feed offered. Feed conversation ratio was calculated as kilogram of feed consumed per week divided by weight gained in that week.

Slaughtering Process and Carcass Cutting Appraisal.

Twenty (20) birds per treatment were arbitrarily nominated and slaughtered, at the end of the experimental trial, for carcass evaluation Tougan *et al.* (2013a). The birds were made to fast for 12 hour. Subsequently, the birds were sacrificed by cutting the jugular vein. Thereafter, the birds were scaled in hot water, Defeathered manually. Head were removed from the neck very close to the scull at the occipital joint and shank at the hock joint, and then eviscerated. The evisceration was carryout by posterior ventral cut and carefully removed completely of the visceral organs (gizzard, liver, hart and spleen) and weighed. Abdominal fat which comprises of the fat adjoining gizzard and liver were carefully removed and weighed together. The dressed carcass, breast, thighs, wings and back or drumsticks were weighed plus the bones. The wings were carefully removed by cutting along the shoulder joint of the proximal end of humerus. The thigh and back quotas were acquired by cutting through joint between the femur and ilium bone of the pelvic girdle. Back was detached from the thigh by a cut through the joint formed by the femur, fibula and tibia as describe by Dessie *et al.* (2017). Dressing percentage was designed as weight of the carcass excluding the neck, head, feathers, feet and visceral organs and divide by live bodyweight multiplied by 100. The cut parts, including the organs were weighted with a 5kg kitchen scale and a sensitive electronic salton (1kg) scale.

Data Collection

The following data were collected during the period of the research: initial body weight final body weight, feed intake, weight gain, feed conversion ratio and mortality using the replicate as the investigational component.

Statistical Analysis

Data collected were subjected to analysis of variance using the SPSS (version 22, 2016) statistical software. Significantly different means were separated with the Duncan multiple range Test of the same statistical package.

Results and discussion

The performance characteristics of the broiler parent cocks fed different level of protein in their diet are presented in Table 2. Highly significant (P<0.05) differences were observed among the four treatment group in the initial body weight and at 8 weeks of age. Bird in treatments 1 and 2 were significantly Superior in weight at 4 weeks of age compared to those of bird in treatment 3. Bird in treatment 4 had the least body weight. At 8 weeks of age, the bird in treatments 1,2and 3 attained an average body weight of 3870.00, 3880.00 and 3858.50g, respectively which were higher (p<0.05) than those of birds in treatment 4 (3758.00g).

Table 1. below shows the proportion of dietary protein level that make up each of the four experimental diets, and their respective computed energy protein contents fed to the birds.

Feed ingredients	Dietary Protein Group			
	1(18%)	2(16%)	3(14%)	4(12%)
Maize	44.00	46.00	48.00	47.00
Fishmeal	3.00	3.00	3.00	3.00
Groundnut cake	10.00	8.00	6.00	4.00
Soybean meal	16.00	13.00	10.00	7.00
Palm Kernel cake	4.50	4.50	4.50	4.50
Wheat offal	16.00	19.00	22.00	28.00
Limestone	4.00	4.00	4.00	4.00
Salt	1.00	1.00	1.00	1.00
Premix	1.00	1.00	1.00	1.00
Methionine	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10
Biotronic	0.10	0.10	0.10	0.10
Calculated Crude protein (%)	21.37	19.37	18.20	16.79
Metabolisable energy (Kcal/kg) feeds	2628	2618	2616	2578

Supplied per kilogram of diet: manganese, 60mg; zinc, 70mg; iron (ferrous sulphate), 55mg; copper, 10mg; selenium, 0.14 mg; chloride, 1.5g; vitamin A, 8,062IU; vitamin E 13IU; vitamin B_{12} 14µg; vitamin K, 3mg

Table 2. Mean performance values of broiler parent cocks fed different level of protein in their diets.

Parameters	Dietary Protein Groups				SEM
	1(18%)	2(16%)	3(14%)	4(12%)	
Initial weight at 4 week (g)	504.30^{b}	489.09^{b}	456,54^{a}	449.82^{a}	14.50
Final weight 8 week (g)	3870.00^{b}	3880.00^{b}	3858.50^{b}	3758.00^{a}	43.83
Total weight gain (g/bird)	1551.80^{b}	1495.93^{b}	1471.98^{b}	1354.92^{a}	38.74
Total feed intake (g/bird)	2688.92^{a}	2798.99^{b}	2797.95^{b}	2798.91^{b}	43.31
Feed conversion ratio (g:g)	1.71^{a}	1.85^{a}	1.90^{a}	2.12^{b}	0.07
Mortality (%)	1.60	2.10	1.70	0.00	

a b: means within a row with different superscripts are significantly (P<0.05) different.

Mean final body weight (3758.00 – 3880.00g/bird) in all the treatment were significantly higher than the reference values of 2468.21- 2758.21g reported by (Nworgu *et al.*, 1999) and (Akanno *et al.*, 2007) at 8 weeks of age and also higher than the final body weights of 1610 -2468g obtained by (Udedibie *et al.*, 2004). Total weight gain and feed conversion ratio were uniform among treatments 1, 2 and 3. These performance traits were improved as the dietary protein levels decreases (P<0.05) up to the 14% dietary protein level (treatment 3) below this level there were no significantly (P>0.05) improvement in performance. These results submitted that the protein requirement of these broiler breeder birds was met by the 14% dietary protein levels of 2616 kcal/kg M E. This were in line with the report of Moran *et al.* (1992) and Zahid *et al.* (2008) who found no significant (P>0.05) difference in weight gain when the dietary protein level was reduced from 23 to 20%. However, Bregendahl *et al.* (2002) and Rezael *et al.* (2004) reported reduced weight gains as the level of protein was decreased during starter phase. Differences in total feed intake (g/bird) were not significant (P>0.05) among birds in treatments 2, 3 and 4, However, birds in these three treatments consumed significantly more feed than those in treatment 1. Birds in treatment 4 were the poorest feed converter as they took more feed and gained less weight when compare with birds in the other treatment groups. Reducing the dietary protein level

did not statistically affect the feed conversion ratio. From the result it was observed that decrease in dietary protein level was not associated with over consumption of feed; hence there was no appreciable increase in feed conversion ratio. It is true from these results that the quantity of feed consumed by the broiler breeder birds to produce 1kg of live weight was not significantly lower on high protein than on low protein diets. These observations were in agreement with the findings of (Rezaei *et al.*, 2004 and Zahid *et al.*, 2008). Birds in treatment 2 recorded the highest mortality, closely followed by those birds in treatments 3 and 1. There was no mortality recorded for treatment 4 throughout the experimental period.

The result of the carcass and organ characteristic evaluation of the finisher broiler Parent cocks fed different dietary protein levels is presented in Table 3. There were significant ($P < 0.05$) differenced in the various parameters measured except, thigh, liver and spleen weights. The live weight gain decreased gradually with decreasing level of dietary protein from 3.36kg to 2.97kg (Ijaiya and Fasanya, 2004). The dressing percentage and the mean weights of body cuts which include of thighs, wings, breast, back, neck, head, spleen, liver, gizzard, abdominal fat and heart are shown in Table 3. Dressing percentage ranged from 62.37% for treatment 3 to 65.78% for treatment 1, with no significant ($P > 0.05$) differences among treatment groups. Mean weight values of thigh, spleen and liver did not differ significantly ($P > 0.05$) among groups, thereby signifying no dietary protein level effect on them. This observation is similar to the observations of Fasanya and Ijaiya, (2002) and Ijaiya and Fasanya, (2004), that bones form the major portion of the weight of most of the parts mention above, may not have contributed much to total weight change of these parts. Weights of thigh and breast ranged from 1243.97 g for treatment 4 to 1353.14g for treatment 1 and 297.38g for treatment 4 to 305.43g for treatment1 respectively. There were no significant ($P > 0.05$) differences among the dietary treatment groups, which mean that variation in dietary level of protein did not significantly alter the growth of thigh and Breast in treatment 1, 2 and 3 except treatment 4. Contrarily, mean weights of back were affected significantly ($P < 0.05$) by the varying levels of protein. The different levels of dietary protein had no significant ($P > 0.05$) effect on the weights of the liver, spleen and gizzard abdominal fat in treatment 1, 2 and 3 except treatment 4. This can be explained with the observations of Wallace, (1998) and Palson and Verges (2000) in goats, that the liver, being a vital organ, attained most of its mature weight during development of the foetus. Therefore, varying levels of protein do not significantly change liver weight in the later stages of growth. These observations are similar to those by Aduku *et al.* (1986) and Sankhyan *et al.* (1991), they reported average dressing percentages and weights of body slices of rabbits fed varying levels of dietary protein and energy were not significant.

Table 3. Carcass and Organ Characteristics of Breeder Cocks Fed Graded Levels of Dietary Protein.

Traits	Dietary protein groups			
	1(18%)	2(16%)	3(14%)	4(12%)
Live weight (kg)	3.36± 0.22^{a}	3.28± 0.20^{a}	3.23± 0.32^{a}	2.97± 0.25^{b}
Dressing percentage	65.78	63.42	62.37	63.46
Thigh (g)	1353.14± 44.62	1306.15± 23.21	1308.54 ±28.34	1243.97 ±55.91
Wings (g)	1226.77± 99.30^{a}	1077.27± 20.38^{b}	1077.74± 26.81^{b}	966.63± 64.50^{b}
Breast (g)	305.43± 41.80^{a}	304.56± 11.58^{a}	301.455 ±13.56^{a}	297.38.± 12.18^{b}
Back (g)	301.33± 21.70^{a}	298.41± 20.11^{b}	289.55± 18.12^{b}	245.38± 20.13^{c}
Neck (g)	303.31± 19.20^{a}	295.07± 16.24^{a}	239.00± 19.93^{b}	276.28± 8.63^{b}
Head (g)	396.64± 11.29^{a}	351.93± 14.12^{b}	343.75± 7.29^{b}	325.81± 18.64^{b}
Liver (g)	18.42± 0.93	17.92± 1.21	19.72± 1.45	18.42± 1.23
Spleen (g)	10.60± 2.94	8.87± 1.12	9.05± 1.53	8.75± 1.73
Gizzard (g)	48.30± 1.69^{a}	46.96± 2,98^{a}	42.97± 2.33^{a}	37.93± 1.17^{b}
Abdominal fat (g)	45.85± 1.22^{a}	44.84± 2.30^{a}	42.97± 2.33^{a}	37.93± 1.17^{b}
Heart (g)	12.02± 0.03^{a}	11.58± 0.02^{a}	10.34± 0.01^{b}	10.42± 0.01^{b}

a,b,c: means within rows with different superscripts are significantly different ($P< 0.05$)

Conclusion

The study showed that the fed dietary protein levels to breeder parent cocks had no adverse effects on the growth performance and carcass trait.

On the whole, the result of this present study suggested that the fed dietary protein levels could be reduced to 14% at finisher stage with no harmful effect on broiler breeder's performance. Though, additional study is required to determine the lowest level after which the performance will suffer.

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