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Effect of Feed Restriction on Growth Performance Characteristics of Broiler Chickens

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ABSTRACT

Feed restriction is one of the methods used in commercial treatment in poultry breeding industry to reduce the cost of production. This study was carried out to examine the effect of feed restriction on growth performance characteristics of broiler chickens. A total of sixty Anak broiler chicks were used. The birds were allotted into four dietary treatments in a Completely Randomized Design (CRD). Each treatment was replicated three times with five birds per replicate. The dietary treatments were identified as T_1, T_2, T_3 (which was commercial diet from Vital feed industry) and T_4. The study lasted for a period of 8 weeks which includes 2 weeks of acclimatization prior to the starting of experiment. Birds on T_1 were on ad libitum feeding throughout the experimental period, T_2 were on 70% ad libitum for the first 21 days followed by ad libitum feeding for the last 21 days, T_3 were on 70% ad libitum throughout the experimental period and T_4 were on 70% of commercial diet + 30% sun-dried maize sievette throughout the experimental period. Analysis of data showed that the final body weight of T_1 and T_4 were significantly difference among other treatments ($p<0.05$). Feed intake values of T_1 and T_4 were significantly ($p<0.05$) higher than T_2 and T_3. Feed efficiency did not differ between treatments. Result on carcass quality revealed that there was a significant difference between the slaughtered weight of T_1 and other treatments. But similarities existed between T_2 and T_4. No significant differences were found between T_1, T_2 and T_4 for the breast, drum stick/thigh, wing and gizzard weight but T_3 remains the lowest among the treatments. From the result, birds on T_1 had the highest feed intake followed by T_4, T_2 and T_3. T_3 had the least net return. Based on this experiment, T_4 was found to be of more economic value.

Introduction

Poultry feeding has changed more than the feeding of any other species. Originally, it was strictly a backyard enterprise, the mother hen did her own incubating and raised her young, and the farmer's wife fed the chickens on table scraps and the unaccounted-for grain from the crib (Ensminger, 1991). Reproduction was confined to the spring months when green feeds, insects and sunshine were all available to contribute to nutrition of baby chicks (Ensminger, 1991). Feeding was largely an art rather than a science and as such commercial feeds were sold largely "secret formula and patented portion" but all these have changed. Today, the vast majority of commercial poultry is produced in large units where the maximum of science and technology exist (Crouch *et al.*, 2000).

Poultry (broiler chicken) nutrition is more critical than that of other farm animals with regard to a number of factors (Crouch *et al.*, 2000). This is so because birds are quite different from four footed animals, their digestion is more rapid, their respiration and circulation are faster, their body temperature is 8 to 10 degree higher (about 107^0F), they are more sensitive to environmental influences, growth takes place at a fast rate and birds mature at an earlier age (Crouch *et al.*, 2000). The economic importance of poultry feeding becomes apparent when it is realized that 65% to 75% of the total production cost of poultry is from feed (Austic, 1985). For this reason, the efficient use of feed is extremely important to the poultry producer (Austic, 1985). Furthermore, confinement production is common place and well balanced rations containing adequate source of all known nutrient materials are fed for maximum production (Lilbum, 1997). The current trend in poultry production is towards controlled environment, which usually results in lowered consumption. Under such condition, the daily feed consumption must be taken into consideration and the nutrient content of the feed (energy, amino acids, vitamins and minerals) increased so as to compensate for the reduced feed intake and meet the requirements (Lilbum, 1997).

It is clear that the performance of poultry has improved dramatically over the last decade and potential for similar improvements over the next decade exists (Yahav, 2000). Whether they are corrected to actual level of performance will however depend very much on whether to adjust standard of control over the environment, disease control and most importantly nutrition and practice of feeding to keep pace with the next work of the geneticist (Yahav, 2000).

Feed restriction is becoming a more common commercial treatment employed in poultry breeding industry to reduce the cost of production (Zhan *et al*., 2007). Several methods of feed restriction among broiler breeders have been reported. They include skip-a-day feeding, diet deficient in protein, or amino acids, quantitative feed restriction, use of distasteful chemicals

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in diet, high fiber diets and combination of these methods (Nester *et al.*, 1981).

Maize processing waste (sievette) variously called in Nigeria as 'Esususoka' in Igbo, 'Dusa' in Hausa and 'Eeriogi' in Yoruba is the waste from 'akamu' (pap) production. The waste is relatively available in large quantities both in rural and urban communities in Nigeria. This can be used to increase bulk as in qualitative feed restriction and increase the fiber content of feed. It is very cheap and available at all time. Most of the backyard poultry farmers use it as a source of feed. Therefore, the objectives of this study were to evaluate the growth performance and carcass quality of broiler chicks placed on different levels of feed restriction, the efficiency of utilization of dietary treatments and also to determine the economy of production under the different feeding regimes.

Materials and Methods

Location and duration of the study

The experiment was carried out at the poultry unit of the department of Animal Science and Fisheries Ebonyi State University, Abakaliki located at 6^0 $15^'$N and 8^0 $05^'$ E. The study lasted for a period of 8 weeks.

Experimental diet

The feed used was commercial broiler starter and finisher mashes from Vital feed industry. Proximate Analysis of the feed was done. The starter mash was fed from day-old to 5 weeks and finisher mash was given from 5 to 8 weeks.

Table 1. Proximate Analysis of Vital Feed and Maize Sievette (Yellow maize) according to Banigo *et al.*, 1974.

Feed component	Starter feed (%)	Finisher feed (%)	Maize sievette (%)	Starter diet + Maize sievette (%)	Finisher diet + Maize sievette (%)
Crude fiber	5.00	5.40	7.00	6.50	6.60
Crude protein	21.00	19.00	13.90	17.40	16.40
Ash	2.90	3.50	4.92	4.41	4.50
Moisture	2.00	2.50	9.75	3.50	2.10
NFE	60.50	61.0	63.20	63.00	64.40
Ether extract	8.5	8.6	1.22	5.00	5.80

Experimental chicks and procedures

A total of sixty Anak day old broiler chicks with an average initial weight of 42.50g were used. The birds were obtained from Ebonyi State Poultry Farm Nkaliki. The birds were acclimatized for 2 weeks prior to the starting of experiment. The birds were allotted to four dietary treatments in a Completely Randomized Design (CRD). Each dietary treatment was replicated three times with five birds per replicate. The dietary treatments were identified in Table 2.

Sanitation measures/medication

Strict sanitary measures were adhered throughout the period of the study and disinfectant was always available in the foot dip at the entrance to the pen. Drinking troughs were washed with detergent daily and faeces removed from the feeders. The litter was kept dried throughout the experimental period. Necessary vaccinations were given to the birds according to schedule/prescription. Proximate analyses of the diets were done. Vitamin (vitalyte) and antibiotics were given via drinking water to enhance growth at intervals according to the manufacturer's description.

Table 2. Dietary treatments

Treatment	Description
T_1	*ad libitum* feeding throughout the experimental period
T_2	70% *ad libitum* for the first 21 days followed by *ad libitum* feeding for the last 21 days
T_3	70% *ad libitum* throughout the experimental period
T_4	70% of commercial diet + 30% sundried maize filtrate waste (got from pap sellers) throughout the experimental period.

Data collection

The average day old weights of the birds were determined on arrival of the birds to the farm. Subsequent body weight measurement of individual bird/replicate was taken weekly and daily feed intake was taken by differences between the quantity of feed given and the quantity left using nutri-scale weighing balance of error margin of 0-10gram. Also data collection on the carcass quality was collected. At the end of the experiment, weekly body weight gain was calculated by the following formula:

$$\frac{Final\ body\ weight - initial\ body\ weight}{Number\ of\ weeks}$$

Where:

Initial body weight = weight of bird at 14^{th} day when the study began

Number of weeks = number of weeks when dietary treatment was given.

Feed efficiency/bird was determined by dividing average weight gain by average feed consumed.

Statistical analysis

Data collected on growth performance traits viz: (final body weight, average weekly body weight gain), average weekly feed intake, feed efficiency and carcass characteristics, were analyzed using a one way ANOVA (Analysis of Variance) in a Completely Randomized Design (CRD) while the means were separated using Duncan's New Multiple Range Test.

Economic analysis

A cost benefit (Gross margin) analysis was carried out for the four groups to ascertain whether the restriction applied had some economic benefits. The cost of production included the cost of feeding, procurement of birds, labour and medication. The revenue was based on 5.26 USD per kg live weight of broilers during the time of the experiment. The following parameters were obtained.

(i)Feed cost (USD)/g feed consumed/bird/treatment = $\frac{Total\ cost\ of\ feed\ (USD)}{Total\ feed\ consumed\ (g)}$

(ii)Feed cost (USD/g) weight gain/bird/treatment = $\frac{Total\ cost\ of\ feeding\ (USD)}{Total\ weight\ gain\ (g)}$

(iii) Total revenue generated = final body weight x number of birds x cost per g live weight.

Results

Growth performance traits viz; (initial body weight, final body weight, weekly weight gain), average weekly feed intake and feed efficiency

The results as presented in Table 3 indicated no significant difference ($p>0.05$) among the treatments for initial body weights while the final body weight for T_1 and T_4 were significantly ($p<0.05$) higher than T_3. However, T_2 and T_3 were similar for final body weight. The average weekly weight gain for T_1 and T_4 were significantly ($p<0.05$) higher than T_2 and T_3. The values of average weekly feed intake for T_1 and T_4 were ($p<0.05$) higher followed by T_2 and T_3. There was no significant difference ($p>0.5$) among treatments in feed efficiency.

Table 3. Main effects of treatment on growth performance of broiler chickens

Parameters	Treatments				
	T_1	T_2	T_3	T_4	SEM
Initial body weight (g/bird)	320	290	310	320	0.03
Final body weight (g/bird)	2220^a	1890^{bc}	1830^c	2060^{ab}	0.06
Average weekly weight gain (g/bird)	320^a	250^b	250^b	290^a	0.01
Average weekly feed intake (g/bird)	930^a	770^b	680^c	850^a	0.23
Feed efficiency	0.37	0.39	0.41	0.36	0.01

[a,b,c] Means on the same row followed with different superscripts are significantly different (p<0.05) SEM: Standard error of mean

Carcass quality of broiler chickens

The results of the mean values of carcass quality are presented in Table 4. The results showed that the slaughtered and defeathered weights for T_1 were significantly difference ($p<0.05$) among the treatments while similarity existed between T_2 and T_4 but T_3 remain the lowest. Furthermore, the value of dressed carcass for T_1 was higher ($p<0.05$) than T_2 and T_3 but similarity existed between T_1 and T_4 in the same trait. The values pertaining to drum stick/thigh and wing weight were significantly higher among T_1, T_2 and T_4 when compared to T_3. The abdominal fat weight of T_1 and T_4 were greater than T_2 and T_3.

Table 4. Main effect of Treatment on Carcass Quality of Broiler Chicken

Parameters	Treatments				
	T_1	T_2	T_3	T_4	SEM
Slaughtered weight (g/bird)	1950^a	1780^b	1480^c	1800^b	0.04
Defeathered weight (g/bird)	1730^a	1560^b	1340^c	1590^b	0.04
Dressed carcass weight (g/bird)	1290^a	1130^{bc}	1080^c	1220^{ab}	0.04
Breast muscle weight (g/bird)	350^a	320^a	290^b	350^a	0.01
Drum stick and thigh weight (g/bird)	180^a	180^a	160^b	180^a	0.00
Wing weight (g/bird)	90^a	80^a	70^b	90^a	0.00
Gizzard weight (g/bird)	50^a	40^a	30^b	40^a	0.00
Abdominal fat weight (g/bird)	67^a	30^b	20^b	60^a	0.04
Dressing %	58	60	59	59	

[a,b,c] Means on the same row followed with different superscripts are significantly different (p<0.05) SEM: Standard error of mean

Economics of production

Cost of feed/kg weight gain per bird ranges from T_4 = USD 0.88, T_3 = USD 1.05,

T_2 = USD 1.12 and T_1 = USD 1.16. T_1 was higher among treatments on feed intake, total cost of feeding and total feed consumed/g/bird and while T_4 has the highest net returns (USD) per bird.

Discussion

Effect of treatment on growth performance traits

The results pertaining to the effect of treatment on growth performance traits as presented in Table 3 indicated that both restriction-realimentation protocols resulted in decreased growth rates (compared with control) during the restriction period. The average mean values of the final body weight shows that there was no significant difference between birds in T_1 and those in T_4. This may be due to the addition of maize sievette in T_4 which added bulk to the feed.

Table 5. Economics of production

Parameters	1	2	3	4
Total feed consumed (g/bird)	5580	4640	4130	5120
Total cost of feeding (USD/bird)	2.13	1.77	1.57	1.53
Total cost of bird/(USD)	0.99	0.99	0.99	0.99
Feed cost (USD)/g commercial feed consumed	0.38	0.38	0.38	0.38
Labour and exigencies (USD)/bird	0.66	0.66	0.66	0.66
Total cost of production (USD)/bird	3.76	3.41	3.22	3.17
Total weight gain/g/bird	1840	1590	1500	1740
Feed cost (USD)/g weight gain/bird	1.16	1.12	1.06	0.88
Revenue (USD)/bird	9.67	8.35	7.88	9.18
Net returns (USD)/bird	5.89	4.93	4.67	6.00
Cost/benefit ratio	0.64	0.69	0.69	0.53

Cost per 25000g of feed based on 9.54 (USD)
Cost per 1000g of maize sievette based on 0.11 (USD)
Cost per 1000g live weight based on 5.26 (USD)

The result of the final body weight is in accordance with the observations made by Willis *et al.,* (2007) in mushroom extract fed broiler chickens. The values of the weekly weight gain of T_2 and T_3 were reduced during the restriction period. The result coincided with the findings of (Tolkamp *et al.,* 2005) who suggested that it could be as a result of time/duration or severity of restriction. During this time, the chicks were also affected by coccidiosis. The studies of Zhan *et al*., (2007) and Willis *et al.,* (2007) also observed that restricted birds are prone to coccidiosis during their early period of life. Furthermore, feed restriction also resulted in accelerated growth and at the age of 8^{th} week, the daily weight gain of T_4 and T_1 birds were comparable. The T_2 and T_3 groups produced consistently, the lowest of total weight gain. This could be as a result of 70% feed restriction, duration, severity and timing of the birds (Yu and Robinson, 1992). Also compensatory growth resulted in a minimization of difference in the final body weight between T_4 and T_1 birds at 8 weeks of age. The observation made is in accordance with those of Zhan *et al*., (2007) who observed compensatory growth of birds restricted from feed at their early age.

Table 3 elucidates that feed intake values for T_1 and T_4 were significantly ($p<0.05$) higher than those in T_2 and T_3. This could be as a result of different types of feed restriction applied to the birds. Furthermore feed utilization by restricted birds was better than full fed ones.

Effect of treatment on carcass quality viz: slaughtered weight, dressed carcass, defeathered weight, breast muscle weight, drum stick and thigh, wing weight, gizzard and abdominal fat weight

Table 4 shows the main effects of treatment on carcass quality of broiler chickens. The treatments resulted in a slight increase ($p<0.05$) in slaughtered weight and defeathered weight of birds. There was significant difference between the slaughtered and defeathered weights of T_1 and other treatments. This may be as a result of *ad libitum* feeding which the birds in T_1 were not subjected to any feed restriction. However, the birds in T_2 and T_4 are comparable in the two traits while the birds in T_3 were the least. The similarity observed in T_2 and T_4 could be as a result of compensatory growth in T_2 following feed restriction, defined as sustained accelerated growth in refed birds compared with T_4 (Lee and Leeson, 2001). There was a progressive increase in abdominal fat weight for T_1 and T_4 compared with others. This finding is in accordance with those reported by (Lee and Leeson, 2001).

The result of this experiment shows that there was no difference between the dressed carcass weights of T_1 and T_4. This finding is in line with the observations made by Lee and Leeson, (2001) who reported that broiler chickens may be switched to a less nutrient-dense grower diet or qualitative feed restriction in which T_4 undergone and still gave good growth performance and carcass yield. The values pertaining to the breast muscle, drum stick and thigh, wing and gizzard weights are comparable among T_1, T_2 and T_4 but T_3 remains the lowest among the treatments. This could be as a result of treatment effect during the experimental period. The results of this study are comparable to those of Yu and Robinson, (1992) who reported that timing or period of feed restriction has significant effect on growth performance and carcass quality of broiler chickens.

Economics of production

Table 5 depicts the effect of feed restriction on the economics of production. Cost of feed/g weight gain per bird ranges from USD 0.88 to USD 1.16, with birds on T_1 having the highest total cost of feed consumption followed by T_2 and T_3 while the lowest was T_4. Total feed cost was lower for the restricted groups than *ad libitum.* The cost of production existed in the same way for the cost of feed consumed per bird. The net returns (gross margin) were found to be as: T_1 = USD 5.89, T_2 = USD 4.93, T_3 = USD 4.67 and T_4 = USD 6.00. Although higher feed cost/kg was observed in T_1 than other treatments but the gain/bird was higher in T_4 than other treatments due to the introduction of maize sievette which is cheap and available. Furthermore, it may be as a result of qualitative method of feed restriction known as full feeding of deficient diets (Friedman and Sklam, 1989). Similarly, qualitative feed restriction of nutrient intake by appropriate dietary dilution of appetite suppression, with free access to food, has been reported to be less stressful and more profitable (Tolkamp *et al*., 2005). The information in Table 5 also bespeaks that the type of feed restriction of broiler chickens had significant effects in the cost of production. According to Zhan *et al*., (2007) suggested that early feed restriction of birds and later returned to *ad libitum* made higher profit. However, in this present study it could be as a result of 70% feed restriction and duration. Furthermore, T_4 had higher revenue than other treatments and this is an indication that qualitative feed restriction or nutrient dilution provides more profit margins and least cost of production.

Summary and Conclusion

Summary

The results shown in the Table 1, 2, 3, 4 and 5 were obtained from the experiment which was the effect of feed restriction on growth performance characteristics of broiler chickens. Sixty 2 weeks old of Anak broiler randomly assigned to four treatments identified as T_1 = *ad libitum* feeding throughout the experimental period, T_2 = 70% *ad libitum* for the first 21 days followed by *ad libitum* feeding for the last 21 days, T_3 = 70% *ad libitum* throughout the experimental period and T_4 = 70% *ad libitum* + 30% sun-dried maize sievette throughout the experimental period which lasted for a total of 8 weeks while the feed used was Vital feed.

The parameters measured were final body weight, average weekly weight gain, weekly feed intake, feed efficiency, initial body weight, carcass quality and economy of production. There was no significant difference between the final body weight and weight gain of T_1 and T_4. But similarity existed between T_2 and T_3. Data collected were analyzed using one-way ANOVA in CRD.

Conclusion

From the result, birds on T_1 had the highest feed intake followed by T_4, T_2 and T_3. T_3 had the least net return. Based on this experiment, T_4 was found to be more economic value. The method of feed restriction both quantitative and qualitative methods have great influence on growth performance characteristics of broiler chickens. In addition there is need for addition of maize sievette in a little amount to reduce cost of production. As feed restriction is a common practice in the poultry industry, it is necessary to understand its effect especially on the performance characteristics of broiler chickens. It will also enable the broiler producers to exploit the advantages associated with feed restriction for much improved production of broiler chickens and as well reduce the hazardous effect of feed restriction to birds.

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