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EFFECT OF FEED RESTRICTION ON GROWTH PERFORMANCE, BODY CONFORMATION, CARCASS CHARACTERISTICS AND COST-BENEFIT IN BROILER CHICKENS

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A total of two hundred and seven day-old Arbor Acre commercial hybrid broiler type was used to determine the effects of feed restriction on growth performance, frame size/structure, carcass qualities and profitability in an 8-week trial. Group A birds were fed 24-hour post hatch, and subjected to 4-hour feed removal from the fifth to the sixth week; Group B birds were fed 36-hour post hatch, and subjected to 6-hour feed removal from the fifth to the sixth week while Group C birds were fed 48-hour post hatch, and subjected to 8-hour feed removal from the fifth to the sixth week. The final body weight, average weekly body weight, average weekly feed intake, average weekly body weight gain, feed conversion ratio and percentage mortality were not significantly influenced (P>0.05) by the duration of feed restriction. Apart from neck circumference, which was significantly (P < 0.05) higher in Group C birds, other linear type traits were not affected (P > 0.05) by feed restriction. There were no significant differences in the measured carcass parameters among broilers of the three treatment groups. Total cost of feed (₦) consumed per bird was significantly higher (P<0.05) in group A birds. The gross margin revealed that statistically significant values (₦711.97 versus ₦692.47; P<0.05)) were recorded for birds in Groups C and B compared to those in Group A (₦656.07), It is therefore, suggested that feeding broilers 48-hour post hatch coupled with 8-hour feed removal from the fifth to the sixth week of age could be employed for efficient broiler chicken production.

Key words: broiler chicken, carcass traits, feed restriction, growth parameters, profit margin

Feeding strategy in growing broiler chickens should be to produce animals with maximum lean carcass tissue, highest feed conversion ratio and maximum body weight gain. Continuous genetic selection and improvement have led to a very fast growth rate in modern chicken strains. Feed restriction is usually employed to tackle problems associated with early-life fast growth rate in broilers, such as increased body fat deposition, high incidence of metabolic disorders, increased mortality, and high incidence of skeletal diseases (Saleh *et al*., 2004). Feed restriction is beneficial for improving the feed efficiency and decreasing the breeding cost. Although, early feed restriction reduces growth performance, compensatory growth in the re- feeding period will be attained to accelerate organism growth to reach the regular market weight of animals (Hornick *et al*., 2000). Bozkurt *et al*. (2001) reported that feed restriction did not affect the body weight of birds. Response to feed restriction, however, depends on the duration of the feed restriction, as prolonged feed restriction diminishes the potential of compensatory growth (Leeson *et al*., 2005).

The poultry industry in Nigeria (Yakubu *et al*., 2010a) like elsewhere in the world (Glaser *et al*., 2001) has developed to the level of commercial enterprise involving thousands of birds, with exotic broiler genetic types playing a predominant role in commercial poultry production. The greatest challenge facing the industry is the exorbitant cost of high quality feed; while its expansion depends to a large extent on the manipulation of growth of the birds. There is need therefore, to employ methods of reducing feed intake while ensuring increase in the efficiency of feed utilization, thereby guaranteeing active and sustainable growth and development of the birds. Body weight at a specific age is probably the most frequently used indicator of growth, and is positively correlated with most measures of meat production, such as carcass and meat yield, conformation and skeletal measures among others (Chambers, 1990). However, studies are scanty on the effects of restricted feeding programmes on growth parameters, frame size/skeletal development, carcass characteristics and cost-benefit in commercial broiler chickens in Nigeria, Sub Saharan Africa.

Therefore, the present investigation aimed at determining the effects of temporary feed restriction on body growth through the evaluation of body size/structure, carcass qualities as well as gross margin of broiler chickens under subtropical conditions.

MATERIALS AND METHODS

Location of study

The research was conducted in the Poultry Unit of the Teaching and Research Farm, Faculty of Agriculture, Nasarawa State University, Keffi, Shabu-Lafia Campus. It is located in the guinea savanna zone of North Central Nigeria, and found on latitude 08° 35’ N and longitude 08° 33’ E, respectively. The mean monthly environmental temperature during the study which lasted eight weeks was 31.00 °C, while the monthly relative humidity, rainfall and evaporation were 83.00%, 244.70 mm and 1.75 ml, respectively.

Experimental design

A total of two hundred and seven day-old Arbor Acre commercial hybrid broiler type was used for the investigation. The birds were leg banded, individually weighed and randomly assigned to three initial feeding regimens (fasting for 24, 36 and 48 hours post hatch) in a completely randomized design. Birds in Group A received water, but were fed 24 hours post hatch; Group B birds received water, but were fed 36 hours post hatch while birds in Group C received water, but were fed 48 hours post hatch. Each treatment group was replicated three times with 23 birds per replicate. The allocation of birds, reared on deep litter in a standard poultry house, was based on minimizing the variations in initial bodyweights between replicate pens. Afterwards, all birds were fed *ad libitum* commercial starter ration, “Vital Feed” (21.00% crude protein, 2,800 kcal/kg ME, 8.50% fat, 5.00% crude fibre, 1.20% calcium and 0.45% phosphorus) obtained from a reputable commercial feed mill [Grand Cereals and Oil Mills Ltd. (Subsidiary of UACN), Jos, Plateau State, Nigeria] until the fifth week. At the beginning of the fifth week, birds were subjected further to feed restriction. Group A, Group B and Group C birds were subjected to 4-hour (9.00 a.m. – 1.00 p.m.), 6-hour (9.00 a.m. – 3.00 p.m.) and 8-hour (9.00 am – 5.00 pm) daily feed withdrawal programmes until the end of the sixth week (2-week daily feed withdrawal). Afterwards, the birds were fed *ad libitum* commercial broiler finisher ration, “Vital Feed” (19.00% crude protein, 2,900 Kcal/kg ME, 8.60% fat, 5.40% crude fibre, 1.20% calcium and 0.41% phosphorus) until the end of the eight week, which the experiment lasted. The reason for adopting the initial feed restriction programmes in the present study is that vast majority of the day-old chicks that are reared in northern Nigeria are obtained from hatcheries located in the southern parts of the country. It most times, depending on the location of the farms, takes a day or two for such birds to eventually arrive at their destinations in the northern axis of the country. Hence, group A birds in the present study was used as the control group.

Routine vaccination and other management practices were strictly adhered to. The day-old birds were given intraocular vaccination against Newcastle disease. At days 10 and 21, Gumboro vaccines were administered on the birds while Newcastle Disease Vaccine (Lasota) was orally administered when the birds were 27 days old. Antibiotics that contain some vitamins as constituents (Neofuramycine Plus) were provided in the drinking water from day 1 to 7, and from day 14 to 16, respectively. However, Vitalyte™ Extra (a combination of vitamins, electrolytes and amino acids) were given to the birds on days 11, 20 and 29 to 32, respectively. Oral administration of coccidiostat (Amprolium) was done on days 23 to 25 and 36-38, respectively.

The response parameters taken were body weight, measured individually on a weekly basis; feed consumption was recorded on a pen basis daily by finding the difference between the amount offered and the left over collected the following day (this was later expressed on a weekly basis); body weight gain was determined weekly while feed conversion ratio was calculated by dividing feed intake by weight gain. Mortality was recorded on a daily basis.

At 8 weeks of age, eight body conformation characteristics were measured, namely body length (BL), length between the tip of the *Rostrum maxillare* (beak) and that of the Cauda (tail, without feathers); shank length (SL), distance from the shank joint to the extremity of the *Digitus pedi*s; neck length (NL), distance between the occipital condyle and the cephalic borders of the coracoids; wing length (WL) taken from the shoulder joint to the extremity of the terminal phalanx, digit 111; thigh length (TL); thigh circumference (TC) taken as the circumference at the widest point of the thigh, breast circumference (BC), taken under the wings at the edge of the sternum and neck circumference (NC), measured at the widest point of the neck. The anatomical reference points were as earlier described (Teguia *et al*., 2008; Yakubu *et al*., 2009). Similarly, three morphological indices, namely massiveness (MAS) (the ratio of live body weight to body length × 100); stockiness (STK) (the ratio of breast circumference to body length × 100); and condition index (CND) (the ratio of live body weight to wing length × 100) were measured on each broiler chicken. Carcass data were also collected from four randomly selected birds per treatment group. The birds were individually weighed using a 5-kg scale. They were then slaughtered by severing the carotid arteries and jugular veins and blood drained under gravity; scalded to facilitate plucking and eviscerated. The carcasses were then divided into the following parts as described by Kleczek *et al*. (2007):

Head – obtained by cutting off between the occipital condyle and the atlas;

Neck – obtained by cutting along the line joining the cephalic borders of the coracoids;

Shank – obtained by cutting off through the hock-joint (sesmoid);

Wing – obtained by cutting through the shoulder joint;

Thigh – obtained by cutting through the hip joint (from the pubic process, through the groin towards the back, and then along the backbone, starting from the anterior border of the pelvis);

Breast – obtained by a double cut through the cartilaginous junctures of the ribs, from the inferior border of the backbone towards the coracoids;

Back – dorsal-lumbar quarter (the remaining part of the carcass).

The weights of the thigh, breast and back were taken as the carcass weight, which was later expressed as percentage of the final live body weight. Similarly, the relative weights of the cut parts (head, neck, shank, wing, thigh, breast and back), the organs (liver, heart, lung, kidney, gizzard, pancreas) as well as the abdominal fat (fat surrounding the gizzard, extending to the ischium and surrounding the bursa of fabricus, cloaca and adjacent abdominal muscles) were determined as earlier described (Yakubu *et al*., 2010b). The length of both the small and large intestines was also estimated.

The prevailing farm gate price of broiler finisher feed was used to calculate cost of feed per kg diet (₦). Feed intake per bird for the 8-week experimental period was used to multiply the cost/kg of feed to obtain the cost of feed consumed by a bird. The cost/kg weight gain was calculated using the procedure of Ukachukwu and Anugwa (1995) and adopted by Yakubu *et al.* (2010b) by taking the product of cost/kg feed and feed conversion ratio of birds. The cost of production was estimated as the product of cost/kg weight gain and mean total weight gain, while revenue was calculated as price of meat (₦/kg) multiplied by mean total weight gain. The gross margin

(₦) was estimated as the difference between revenue and cost of production.

Statistical analysis

The data were analyzed by one-way analysis of variance to evaluate the fixed effect of feed restriction on the growth parameters, biometric measures, carcass qualities and cost-benefit investigated. Statistical analysis was run on the SPSS (2010). The separation of means was effected using Duncan's Multiple Range Test (DMRT) method while statements of significance were based on P < 0.05.

RESULTS

The effect of feed restriction on the growth performance of broiler chickens is presented in Table 1. The final body weight, average weekly body weight, average weekly feed intake, average weekly body weight gain, feed conversion ratio of birds fed 24-hour post hatch with 4-hour feed withdrawal from 5th-6th week were not significantly (P>0.05) different from their counterparts fed 36-hour post hatch with 6-hour feed withdrawal from 5th-6th week and those fed 48-hour post hatch with 8-hour feed withdrawal from 5th-6th week, respectively.

The descriptive characteristics of body measurements of broiler chickens are presented in Table 2. Apart from neck circumference which was significantly higher (P < 0.05) in group C birds, there was no effect of feed restriction on, shank length, neck length, wing length, body length, breast circumference, thigh circumference, thigh

Table 1. Effect of feed restriction on the growth performance (Mean ±SE) of broiler chickens

Parameters	Feed restriction		
	Group A	Group B	Group C
Final body weight (kg)	2.01±2.05^a	2.02±0.05^a	2.09±0.04^a
Average weekly body weight (g)	874.62±238.79^a	893.72±242.72^a	891.54±249.46^a
Average weekly feed intake (g)	743.43±138.38^a	724.08±130.52^a	720.22±128.04^a
Average weekly body weight gain (g)	245.24±48.86^a	246.53±44.14^a	255.31±50.90^a
Feed conversion ratio	3.01±0.26^a	2.87±0.14^a	2.85±0.27^a
Mortality rate (%)	18.84±6.31^a	10.15±3.83^a	15.94±3.83^a

SE: Standard error of means.
Group A: Birds fed 24-hour post hatch with 4-hour feed withdrawal from 5th-6th week.
Group B: Birds fed 36-hour post hatch with 6-hour feed withdrawal from 5th-6th week.
Group C: Birds fed 48-hour post hatch with 8-hour feed withdrawal from 5th-6th week.
Means in the same row bearing the same superscript do not differ significantly (P>0.05).

Table 2. Mean (±SE) of the morphological traits of broiler chickens as affected by feed restriction

Traits	Feed restriction		
	Group A	Group B	Group C
Body length	39.18 ± 0.36^a	39.11 ± 0.23^a	39.11 ± 0.23^a
Neck length	11.12 ± 0.12^a	11.07 ± 0.10^a	11.27 ± 0.09^a
Wing length	19.44 ± 0.26^a	19.25 ± 0.22^a	19.33 ± 0.26^a
Shank length	8.08 ± 0.07^a	8.15 ± 0.06^a	8.25 ± 0.05^a
Thigh length	12.81 ± 0.17^a	12.81 ± 0.17^a	12.95 ± 0.14^a
Thigh circumference	15.04 ± 0.24^a	14.65 ± 0.22^a	14.88 ± 0.19^a
Breast circumference	32.67 ± 0.71^a	33.40 ± 0.60^a	34.41 ± 0.56^a
Neck circumference	10.27 ± 0.12^c	10.87 ± 0.14^b	11.28 ± 0.12^a
Massiveness	5.08 ± 0.09^a	5.11 ± 0.10^a	5.30 ± 0.08^a
Stockiness	82.39 ± 1.34^a	85.24 ± 1.24^a	85.88 ± 1.81^a
Condition index	10.27 ± 0.15^a	10.46 ± 0.17^a	10.72 ± 0.16^a

SE: Standard error of means.
Means in the same row bearing the same superscripts are not significantly different (P > 0.05).

Table 3. Means (±SE) of the carcass traits of broiler chickens as affected by feed restriction

Traits	Feed restriction		
	Group A	Group B	Group C
Carcass yield (% FBW)	42.70 ± 1.35[a]	45.53 ± 1.28[a]	44.13 ± 1.74[a]
Cut-up parts (% FBW)			
Head	2.12 ± 0.08[a]	2.30 ± 0.09[a]	2.27 ± 0.12[a]
Neck	5.01 ± 0.26[a]	4.64 ± 0.17[a]	4.63 ± 0.37[a]
Wing	4.12 ± 0.15[a]	4.04 ± 0.19[a]	4.34 ± 0.18[a]
Thigh	11.24 ± 1.05[a]	11.08 ± 0.48[a]	10.46 ± 0.29[a]
Breast	18.82 ± 2.06[a]	21.12 ± 0.97[a]	19.41 ± 1.03[a]
Back	12.64 ± 0.16[a]	13.34 ± 0.54[a]	14.36 ± 0.75[a]

FBW: Final body weight.
SE: Standard error of means.
Means in the same row bearing the same superscripts are not significantly different (P >0.05).

Table 4. Means (±SE) of the viscera organs and abdominal fat (%FBW) of broiler chicken as affected by feed restriction

Traits	Feed restriction		
	Group A	Group B	Group C
Liver	1.81 ± 0.14[a]	2.08 ± 0.12[a]	1.94 ± 0.16[a]
Heart	0.20 ± 0.01[a]	0.30 ± 0.06[a]	0.29 ± 0.02[a]
Kidney	0.46 ± 0.02[a]	0.49 ± 0.03[a]	0.42 ± 0.04[a]
Gizzard	2.10 ± 0.16[a]	2.27 ± 0.12[a]	2.15 ± 0.19[a]
Pancreas	0.20 ± 0.02[a]	0.14 ± 0.02[a]	0.15 ± 0.02[a]
Small intestine (cm)	180.00 ± 4.53[a]	185.00 ± 8.54[a]	197.25 ± 13.55[a]
Large intestine (cm)	29.25 ± 1.89[a]	28.25 ± 3.17[a]	34.50 ± 2.75[a]
Abdominal fat	0.66 ± 0.13[a]	1.06 ± 0.09[a]	1.12 ± 0.25[a]

SE: Standard error of means.
Means in the same row bearing the same superscripts are not significantly different (P > 0.05).

length, massiveness, stockiness and condition index, respectively among the treatment groups.

There were no statistical significant differences (P > 0.05) in the relative weights (%) of the carcass and cut-up parts (head, neck, wing, thigh, breast, back) of birds under the three feeding regimes (Table 3).

The viscera organs (pancreas, kidney, liver, heart, gizzard) as well as the abdominal fat of birds under the three feed restriction programmes were also similar (P > 0.05) (Table 4).

The effect of feed restriction on cost-benefit of broiler chicken production is presented in Table 5. Total cost of feed consumed per

Table 5. Effect of feed restriction on the cost-benefit (mean ±SE) of broiler chicken production

Parameters	Feed restriction		
	Group A	Group B	Group C
Cost of feed per kg diet (₦)	88.00	88.00	88.00
Total cost of feed consumed per bird (₦)	523.37±2.54[a]	509.75±3.56[b]	507.02±4.06[b]
Cost of feed per kg body weight gain (₦)	265.04±22.79[a]	252.78±12.62[a]	250.69±23.79[a]
Cost of production (₦)	519.98±4.59[a]	498.53±7.30[a]	512.00±8.69[a]
Revenue (₦)	1176.00±10.39[a]	1182.00±17.32[a]	1224.00±20.78[a]
Gross margin (₦)	656.07±5.85[b]	692.47±5.02[a]	711.97±12.09[a]

SE: Standard error of means.
Means in the same row bearing different superscript differ significantly (P<0.05).

bird was significantly higher (P<0.05) in birds fed 24-hour post hatch with 4-hour feed withdrawal from 5^{th}-6^{th} week (Group A) (523.37±2.54) compared to their counterparts fed 36-hour post hatch with 6-hour feed withdrawal from 5^{th}-6^{th} week (Group B) (509.75±3.5) and those fed 48-hour post hatch with 8-hour feed withdrawal from 5^{th}-6^{th} week (Group C) (507.02±4.06). Cost of feed per kg body weight gain was similar in the three treatment groups (265.04±22.79 versus 252.78±12.62 versus 250.69±23.79). Cost of production (519.98±4.59 versus 498.53±7.30 versus 512.00±8.69) was also not significantly (P>0.05) different among the three groups. Although revenue was equally not significantly (P>0.05) different among the three groups, there appeared to be an increasing linear trend from Group A to Group C. However, significantly (P<0.05) higher gross margin (711.97±12.09 versus 692.47±5.02 versus 656.07±5.85) was recorded for birds in Groups C and B compared to birds in Group A.

DISCUSSION

The present findings are comparable to the reports of Zhan *et al*. (2007) where final body weight, average daily body weight gain and average daily feed intake of feed-restricted birds at 63-day of age remained as *ad libitum* birds. Similar submission was made for overall weight gains between 9 and 42 days of age of broiler chickens by Demir *et al*. (2004). In their own findings, Benyi *et al*. (2010) reported that overall, daily feed removal reduced feed intake and improved feed efficiency in all feed-restricted birds, and the longer the period of feed removal the better the efficiency of utilization, but it had no effect on weight gain and market weight. In a related study however, Mahmood *et al*. (2005) reported that birds kept off feed from 9.00 a.m. to 7.00 p.m. gained significantly more weight (1275g) and utilized their feed more efficiently than those of the control group. It is suffice to say that in the present experiment, near full compensatory growth (growth faster than normal after a period of nutrient restriction) was attained especially by broiler chickens fed 48-hour post hatch with 8-hour feed withdrawal from 5^{th}-6^{th} week. This could be attributed to the fact that birds that have been subjected to the stress of feed restriction generally have the potential to efficiently utilize feed (Bruno *et al*., 2000). An animal whose growth has been retarded exhibits, when the restriction is removed, a rate of growth greater than that which is normal in similar animals of the same chronological age. Until recently, it was assumed that the broiler, with its relatively short commercial life cycle, would have insufficient time to capitalize from growth compensation in contrast to animals with more prolonged growth periods, such as ruminant and turkeys. The last two weeks of *ad libitum* feeding in the present study could have been enough to warrant compensatory growth.

Gous and Cherry (2004) reported that a period of slow growth for birds subjected to feed restriction is usually followed by a period of rapid growth when the birds approach the final stages of their growth. According to Mendes *et al*. (2007), body mass index (a function of body weight and body length), appeared to be similar from the 22^{nd} day of rearing till the period the birds attained market age. Similarly, Demir *et al*. (2001) reported that overall weight gains between 9 days and 42 days of age were not affected by feed restriction. Contrary to the present findings, Bhanja *et al*. (2009) reported that birds that were fed within 24 hour post hatch gained significantly higher body weight at five weeks of age compared to those that received feed between 32 and 48 hours. This is due to the fact that there were no statistical differences in the final body weights of birds among the three treatment groups. Similar observation was made by Tumova *et al*. (2002) where broiler chickens were believed to have compensated for growth during the period of realimentation. The fast rate of body weight gain compensates for the delayed growth that occurred during the early stage of feed restriction. This translates into reduced maintenance costs as well as improved feed utilization potential of the birds (Lippens *et al*., 2000). However, Khetani *et al*. (2008) reported no evidence of compensatory growth in the restricted groups of birds reared for 42 days.

Lippens *et al*. (2000) reported that there was a slight trend towards reduced mortality in food-restricted broiler chickens, and went ahead to submit that a mild restriction may offer some economic advantages over *ad libitum* feeding regimen, mainly by reducing mortality. Al-Aqil *et al*. (2009) reported no significant difference in the mortality rate of broiler chicks as a result of feed restriction. However, it should be noted that the effects of feed restriction depend on many factors such as market age, intensity and duration of restriction, sex and strain of broiler chickens

The result obtained on the body structure of broiler chickens is similar to that reported for rabbits by Yakubu *et al*. (2007), although there is dearth of information in literature to justify the higher neck circumference of group C birds. It is however, in contrast with the findings of Ingram and Hatten (2001), where feed restriction affected shank and keel length, respectively in varying degrees. Bruno *et al*. (2000) reported that food restriction reduced bone length and width but did not affect bone weight. It is worthy of note that the category of birds, age, pattern and duration of feed restriction could have been responsible for the differences between our own findings and those reported by earlier workers. Body length, shank length, neck length and wing length are measurements almost independent of the environment; therefore, they usually indicate inherent size. The treatment groups were similar in massiveness and stockiness which, are used to assess musculature development, and are also traits for solidity of the body. Likewise, the condition index (body weight corrected for body size), which gives a better indication of a bird's ability to meet its present and future energy requirements, than using body weight alone. This is of physiological importance because standard measures of metabolic activities are frequently expressed as a function of body size, and it is often useful to examine the relationship of structures or organs relative to overall body size. The present results on body morphology have indicated that broiler chickens not under too long and severe feed restriction might still attain the growth potential of their morphometric traits during the period of re-feeding. This information could be employed in breeding and selection schemes if the goal is to improve body conformation.

The non-significant differences in carcass qualities observed among the three treatment groups are reflections of the similarities in the final body weights of the broiler chickens. This is consistent with the findings of Urdaneta-Rincon and Leeson (2002) that the breast meat yield of broiler chickens was not significantly affected by feed restriction. According to Saleh *et al*. (2005), breast, leg and wing yields expressed as a percentage of the carcass were not significantly affected by feed restriction. Onbasilar *et al*. (2009) also reported that the carcass characteristics of broiler chickens were not affected by the treatment applied.

The present results are consistent with that by Palo *et al*. (1995) where considerable differences were not observed in the gizzard, small intestine, liver and pancreas of birds fed *ad libitum* and those which feeding was restricted. However, Yang *et al*. (2009) submitted that there was a significant effect of fasting for 72 hours on small intestine weight and length, liver, heart and pancreas weight. They went further to report that the maximum fasting period should not exceed 60 hours post hatch, and the feasible feeding time should be within 36 hours. Conflicting results concerning body fat deposition have been observed in literature. Birds subjected to feed restriction have been shown to have higher carcass fat content at market age (Zhan *et al*., 2007). Feed restriction had no effect on the total carcass fat content of broiler chickens (Lippens *et al*., 2000, Benyi *et al*., 2009). Although excess fat is reported to constitute health hazards, Mendes *et al*. (2008) reported that restricted feeding resulted in increased fat content in the breast area while decreasing fat content in the rump area. According to them, increasing the fat content in the breast, which has little or no fat, improves taste, and decreasing the fat in the rump, which has a high fat percentage, improves the health value of the meat. These varying reports on fat deposition might not be unconnected with the strain and age of birds, the duration and severity of the feed restriction programme. It implies that the degree and duration of feed restriction used in the present trial was insufficient to reduce adipocyte proliferation; and according to Attia *et al*. (1998), if such effect did occur, was nullified by adipocyte hypertrophy when adequate amounts of feed were offered during the realimentation period.

In smallholder poultry production systems in the tropics, feed cost is so exorbitant as to threaten the sustainability of these enterprises. The present lower cost of feed of birds fed 48-hour post hatch with 8-hour feed withdrawal from 5^{th}-6^{th} week might not be unconnected with the relatively lower quantity of feed taken. Urdaneta-Rincon and Leeson (2002) postulated that compensatory growth and associated reduction in maintenance feed requirements provide a promising method of reducing feed cost of broiler chickens. The higher gross margin recorded especially for birds fed 48-hour post hatch with 8-hour feed withdrawal from 5^{th}-6^{th} week not be unconnected with lower cost and better utilization of feed. It was quite difficult to compare our present findings on cost-benefit with others as most work on feed restriction emphasized more on growth parameters.

CONCLUSION

The results of the present investigation have shown that birds not under too long and severe feed restriction could still perform well in terms of growth, linear body measurements, carcass characteristics and profitability. Therefore, it is suggested that feeding broilers 48-hour post hatch coupled with 8-hour feed removal from the fifth to the sixth week of age could be employed for efficient broiler chicken production, especially in periods of scarcity of commercial feed in the tropics or as a cost saving device.

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