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Response of Broilers to Feeding Manipulations

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Abstract: The study investigated the response of broilers to different feeding manipulations. Six groups of day old Anak broilers were randomly assigned to either one of the following feeding methods from day old to 3 weeks; *Ad libitum* feeding, Skip-a-day feeding, 50% of *ad libitum* feeding, 6 hours of light and 18 hours of darkness per day, 3% dietary ammonium sulphate or diet containing 18% protein and 2800 kcal/kg ME. Broilers were thereafter fed the same finisher diet to market age. Results at market age showed that feed intake was significantly reduced by all but one of the feed restriction methods investigated ($P< 0.05$, $P<0.01$). Weight gains were comparable among broilers regardless of the feeding method ($P>0.05$, $P>0.01$). Feed to gain ratio was significantly reduced in broilers placed on 50% of *ad libitum* feeding ($P<0.05$, $P<0.01$). Feeding methods did not affect broilers liveability ($P>0.05$, $P>0.01$). Cost to benefit ratio of broiler production was significantly reduced by skip-a-day and 50% of *ad libitum* feeding methods ($P<0.05$, $P<0.01$). Also abdominal fat pad, a factor that downgrades carcass value was significantly reduced by skip-a-day and 6 hours of lighting per day feeding methods ($P<0.05$, $P<0.01$). It was concluded that for both cost and abdominal fat reduction, skip-a-day feeding method for 3 weeks would offer the best alternative to the usual *ad libitum* feeding in broilers.

Key words: Feeding manipulations, feed intake, weight gain, feed gain ratio, abdominal fat

Introduction

Several approaches, both qualitative and quantitative have been employed to restrict nutrient or caloric intake in broilers in order to reduce cost of feeding, improve feed efficiency and reduce excessive abdominal fat deposition and carcass fat among other problems associated with *ad libitum* feeding. However, investigations so far have shown considerable variations concerning early life restrictions, compensatory growth and fat deposition (Griffiths *et al*., 1977; Oyedeji *et al*., 2003a; Oyedeji and Atteh, 2003).

A number of factors have been suggested as influencing birds' response to a period of restriction. These include, nature, severity and duration of the restriction, the pattern of refeeding, the stage of growth during restriction as well as sex and the genotype of the population (Wilson and Osbourn, 1960; Plavnik and Hurwitz, 1989).

In addition to these factors, environmental factors such as seasons of the year and temperature also exert some influence on feed intake and subsequent fat deposition in broilers (Kubena *et. al.,* 1972). The present study was designed to investigate response of broilers to either one of five methods of feed restriction.

Materials and Methods

Three hundred and sixty day old Anak broiler chicks were randomly allocated to either one of groups 1, 2, 3, 4, 5, or 6, representing *ad libitum* feeding (control), Skip-A-Day feeding for 3 weeks, 50% of *ad libitum* feeding for 3 weeks, 6 Hours Light - 18 Hours darkness per day for 3 weeks, 3% Dietary ammonium sulphate for 3 weeks or 18% protein 2,800 kcal/kg diet for 3 weeks respectively. Chicks were housed in electrically heated battery brooders. Each of the six groups was replicated thrice with 20 birds per replicate. Broilers in groups 1, 2, 3 and 4 were fed on diet 1 (Table 1) for 3 weeks in line with the nature of each treatment, while those in groups 5 and 6 received diets 2 and 3 (Table 1) respectively for three weeks. Water was supplied to satisfaction for broilers in each group. Weekly records of feed intake and weight gain were taken. At the end of 3 weeks, broilers were finished up to market age on diet 4 (Table 1).

A metabolic study was conducted at the 2nd week of the experiment. Weighed quantities of feed were supplied and faecal samples collected over a 72-hour period, using total collection method. The faecal samples collected were oven dried at 60^{o}C for 24 hours, weighed and ground prior to chemical analysis.

The proximate analyses of the faecal samples and the feed samples were carried out using the method of (AOAC, 1980).

At the end of eight weeks, 5 broilers were randomly selected from each replicate pen, weighed and slaughtered by exsanguination. Carcass weights were taken after evisceration. The adipose tissues surrounding the gizzard and intestine, extending within the ischium and surrounding the cloaca, bursal of fabricius and adjacent abdominal muscles were collected and weighed as the abdominal fat.

Economic parameters considered were determined

Table 1: Percentage composition of starter and finisher diets used in the experiment

	Starter diets			Finisher diet
Ingredient	1	2	3	4
Yellow Maize	47.00	47.00	40.00	60.00
Soybeans	31.57	31.57	17.00	17.47
Brewers Dry Grain	4.00	4.00	16.22	6.27
Maize Offal	5.00	5.00	12.45	10.45
Blood Meal	3.00	3.00	3.00	2.94
Palm Oil	3.00	3.00	1.91	--
Bone meal	2.55	2.55	2.95	1.94
Oyster shell	0.28	0.28	0.10	0.33
Salt	0.25	0.25	0.25	0.25
-DL - Methionine	0.10	0.10	0.10	0.10
*Vit. Min. Premix	0.25	0.25	0.25	0.25
$(NH_4)_2SO_4$	--	3.00	--	--
Grit	3.00	--	5.77	--
TOTAL	100.00	100.00	100.00	100.00
Analysed nutrient content				
Dry matter%	95.60	95.30	95.98	95.14
Protein%	22.31	22.43	17.26	17.20
Crude Fat%	4.20	4.30	3.71	1.70
Fibre%	4.50	4.50	4.58	4.42

*Provide per kg of diet, Vitamin A (8000IU); Vitamin D_3 (1200IU); Vitamin E (3IU); Vitamin K_3 – Kastab (2mg); Vitamin B_2 - Riboflavin (8mg); Vitamin B_3 Nicotinic acid (10mg); Vitamin B_5 – Pantothenic acid (150mg); manganese (Mn), (80mg); Zinc (Zn) (50mg) Copper (Cu) (2mg); Iodine (I) (1.2mg); Cobalt (Co) (0.2mg); Selenium (Se) (0.1mg).

using the prevailing market prizes of ingredients used in the diets, cost of medication and that of broilers on live weight basis.

The Data collected were subjected to the analysis of variance as described by Steel and Torrie,(1980) for a completely randomized design. Significant differences in means were tested at 1 and 5%, using Duncans Multiple Range Test (1955).

Results

The effects of restriction methods on the feed intake, weight gain and feed to gain ratio of broilers during the restriction period (0-3 weeks) and after the restriction period (4-8 weeks) are shown in Table 2. During the 3 weeks of feed restriction, all the methods applied significantly reduced feed intake of broilers ($P<0.05$, $P < 0.01$) with the lowest feed intake of 392g recorded in broilers on 3% dietary ammonium sulphate as against 809g recorded for broilers fed *ad libitum*.

Weight gain was also significantly reduced during this period ($P<0.05$, $P<0.01$), except for broilers on 6 hours of light and 18 hours of darkness per day which had a comparable weight gain with those on *ad libitum* feeding ($P>0.05$, $P>0.01$). Generally, feed to gain ratio was comparable among birds regardless of treatments ($P>0.05$, $P>0.01$).

During the period of realimentation (4-8 weeks), feed intake was significantly lower in broilers placed on Skip-A-Day, 50% of *ad libitum* feeding and 3% dietary ammonium sulphate feeding manipulation methods ($P<0.05$, $P<0.01$). All other treatments had comparable feed intake with the control at this period ($P>0.05$, $P>0.01$). Weight gain and feed to gain ratios were generally comparable among broilers regardless of treatments ($P>0.05$, $P>0.01$).

Table 3 shows the effect of feed restriction methods on the performance, economic parameter and abdominal fat of broilers at market age. Total feed intake was significantly reduced in all but one of the feed restriction methods applied ($P<0.05$, $P<0.01$). The lowest feed intake was recorded among broilers subjected to 50% of *ad libitum* feeding 3433g as compared with 4271g for broilers on *ad libitum* feeding. Broilers placed on 18% dietary protein and 2,800kcal/kg metabolizable energy had comparable feed intake with those of the control fed *ad libitum* ($P>0.05$, $P> 0.01$).

Weight gains at market age and feed/gain ratio were comparable among broilers subjected to one form of feed restriction or the other when compared with unrestricted birds ($P>0.05$, $P>0.01$). However, broilers subjected to 50% of *ad libitum* feeding for 3 weeks had a significantly lower feed to gain ratio (2.30) as compared with those on *ad libitum* feeding (2.72) ($P<0.05$, $P<0.01$). Percentage mortality of broilers was not significantly affected by any of the restriction methods compared with full feeding ($P>0.05$, $P>0.01$).

Two feed restriction methods, that is, skip-a-day for 3 weeks and 50% of *ad libitum* feeding significantly

Table 2: Effect of nutrient restriction methods on the performance of broilers

Feeding method	Restriction period (0-3 weeks			post restriction period (4-8 Weeks)		
	Feed Intake (g)	Weight gain (g)	Feed/gain ratio	Feed Intake (g)	Weight gain (g)	Feed/gain ratio
Ad libitum feeding (Control)	809[a]	437[a]	1.87[bc]	3462[a]	1133[ab]	3.06[ab]
Skip-A-Day (SAD)	414[e]	159[d]	2.65[a]	3092[b]	1215[a]	2.55[b]
50% of *Ad libitum*	461[d]	282[c]	1.64[c]	2972[b]	1214[a]	2.45[b]
6 HrL : 18 HrD	644[c]	398[ab]	1.62[c]	3226[ab]	990[b]	3.26[a]
3% $(NH_4)_2$ SO_4	392[e]	203[d]	1.94[bc]	3060[b]	1167[ab]	2.62[b]
18% P, 2800kcal/kg ME	758[b]	358[b]	2.13[b]	3405[a]	1026[ab]	3.32[a]
S E M	167.07	104.20	0.39	225.30	153.30	0.52
Significance	*	*	*	*	*	*

*Means within column followed by different superscripts differ significantly (P<0.05, P<0.01)

Table 3: Effect of nutrient restriction methods on the performance, Cost/benefit ratio and abdominal fat pad of broilers at market age

Feeding method	Performance Characteristics (0 - 8 weeks)					Abdominal Fat % of carcass fat
	Feed Intake (g)	Weight gain (g)	Feed/gain ratio	Mortality %	Cost / benefit ratio	
Ad libitum feeding (Control)	4271[a]	1570	2.72[ab]	7.53	0.76[a]	2.53[a]
Skip-A-Day (SAD)	3506[c]	1374	2.55[bc]	4.62	0.58[b]	1.01[c]
50% of *Ad libitum*	3433[c]	1496	2.30[c]	0.00	0.57[b]	1.66[abc]
6 HrL : 18 HrD	3870[b]	1388	2.80[ab]	0.00	0.72[a]	1.28[bc]
3% $(NH_4)_2$ SO_4	3452[c]	1370	2.52[bc]	4.62	0.76[a]	1.73[a]
18% P, 2800kcal/kg ME	4163[ab]	1384	3.01[a]	4.62	0.71[a]	2.46[a]
SEM	379.25	110.81	0.27	1.90	0.08	0.79
Significance	*	NS	*	NS	*	*

*Means within column followed by different superscripts differ significantly (P<0.05, P<0.01)

reduced cost/benefit ratio of broiler production compared with the *ad libitum* feeding (P<0.05, P<0.01).Other feeding methods had comparable values for this economic parameter (P>0.05, P>0.01).

The abdominal fat pad was significantly reduced in broilers subjected to skip-a-day feeding (1.01%) and broilers subjected to 6 hour light and 18 hours of darkness per day (1.28%) when compared with broilers on full feeding (2.53%) (P<0.05, 0.01). Other feed restriction methods had comparable abdominal fat values with the birds on *ad libitum* feeding (P>0.05, P>0.01).

The effect of feed restriction methods on nutrient utilization is shown in Table 4. Protein retention, and fibre availability were comparable among broilers regardless of feeding methods (P>0.05, P>0.01). However, fat utilization was significantly reduced in broilers subjected to 3% dietary ammonium sulphate and 6 hours lighting per day (P<0.05, P<0.01).

Discussion

Virtually all but one of the feeding manipulation methods investigated in this study reduced feed intake in broilers. The feed intake reduction was achieved by different mechanisms. Subjecting broilers to 50% or half of *ad libitum* feeding daily or fasting birds every other day as in the skip-a-day method expectedly reduced the feed intake of broilers. This is in line with previous reports (Plavnik and Hurwitz, 1989; Oyedeji *et al.*, 2003a).

The use of photo regimen, where broilers were exposed to only 6 hours of lighting per day as against the usual 12 hours of lighting, invariably reduced the feeding time of broilers, hence reduction in feed intake. Guhl (1953), noted that chicks will not eat at a light intensity below one foot candle. Since birds depend extremely on sight for food seeking, the visual organs are well developed and strategically placed. Other possible reason for such feed intake reduction could be physiological. Rosety (1980) reported that visual cells of avian retina have glycogen bodies in the cytoplasm adjacent to the photoreceptors which disappears when birds are placed in darkness over a prolonged period and reappear when turned to light. Forbes and Injidi (1979) reported that exogenous melatonin depresses feed intake and accounts for lower feed intake of chicken that has been exposed to darkness. The robust rhythms associated with darkness have been those associated with the production of melatonin in such a way that melatonin

Table 4: Effect of feed restriction methods on nutrient utilization by broilers

Feeding method	Protein %	Fat%	Fibre%
Ad libitum feeding (Control)	69.14	83.20[a]	39.26
Skip-A-Day (SAD)	64.39	80.72[ab]	41.00
50% of Ad libitum	68.59	81.49[ab]	40.23
6 HrL : 18 HrD	62.63	73.47[bc]	39.16
3% $(NH_4)_2$ SO_4	63.54	69.56[c]	42.01
18% P, 2800kcal/kg ME	62.86	79.60[ab]	40.68
SEM	4.22	6.10	2.63
Significance	NS	*	NS

*Means within column followed by different superscripts differ significantly (P<0.05, P<0.01).

levels are high during scotophase (darkness) and low during photophase (Light period).

Dietary ammonium sulphate, a feed intake suppressant reduced feed intake of broilers presumably because of palatability problem. Chickens are sensitive to taste (Moran, 1982). Sibald and Cave (1976), observed that a number of salts could cause a dose dependent reduction in feed intake and that ammonium sulphate was the most potent. Ammonium sulphate as feed intake suppressant may be distasteful to birds. Oyedeji *et al.* (2003b), reported a dose dependant reduction in feed intake using ammonium sulphate in broilers diet when compared with birds fed *ad libitum*. Presumably, because of palatability problem associated with ammonium sulphate based diet, broilers had no appetite for it even when feed was presented to them *ad libitum*.

Reduction in dietary protein and energy did not reduce feed intake, this may have to do with birds' attempt to satisfy their energy needs.

The nutrients in the diets especially protein and fat were comparably or even better utilized by broilers, especially those on 50% of *ad libitum f*eeding. It is then not surprising that at market age comparable body weight gains and feed efficiencies were recorded for all methods of feed restriction with those fed *ad libitum*. It has been postulated that live-weight gain is mainly the deposition of protein, fat or water (Boekholt *et al.*, 1994). It is also to be noted that broilers earlier subjected to one form of feed restriction or the other, compensated at market age for the initial weight depression during the 3 week of feed restriction. This phenomenon is compensatory growth. This is defined as the rate of growth faster than normal growth exhibited by birds earlier subjected to feed restriction, but later returned to normal feeding. This perhaps has to do with the fact that, birds earlier restricted efficiently utilized their feed, while still not consuming more than the unrestricted birds. It is encouraging to observe that, the birds subjected to 50% of *ad libitum* feeding recorded an improved feed utilization over those fed *ad libitum*.

Plavnik and Hurwitz (1991) reported compensatory growth in broilers subjected to early feed restriction, while Washburn and Bondari (1978) did not observe such phenomenon. Explaining the reasons for compensatory growth, Forsum *et al.* (1981), opined that feed restriction lowers the maintenance requirements by reducing the loss of metabolic energy (total heat of production), the basal metabolic rate and the specific dynamic action of feed.

None of the methods of feed restriction studied affected broilers liveability. It is interesting to note that even in skip-a-day feeding where one would have expected some form of cannibalism which could result in high mortality among broilers, was not detrimental. Once water is provided to satisfaction, feed restriction would not be detrimental to the survival of broilers.

On the economic parameter; all the feed restriction methods compared favourably with the usual *ad libitum* feeding but it is shown in this study that 50% of *ad libitum* feeding for 3 weeks and skip-a-day feeding for 3 weeks offered better economic gains than the usual *ad libitum* feeding.

Two of the feed restriction methods namely, skip-a-day feeding for 3 weeks and 6 hours of light and 18 hours of darkness per day for 3 weeks, significantly reduced the abdominal fat of broilers. Nutrient restriction during the early life of birds has been assumed to reduce the subsequent deposition of fat by delaying hyperplasia or hypertrophy or both (Plavnik and Hurwitz, 1988).

In summary, this study has revealed that in terms of the economics of broiler production, 50% of *ad libitum* feeding for 3 weeks or skip-a-day feeding for 3 weeks started at day old would provide a better alternative to the usual *ad libitum* feeding.

Also, either skip-a-day feeding for 3 weeks or exposing broilers to only 6 hours of light daily for 3 weeks starting at day old, would improve carcass quality and reduce sudden death syndrome often associated with birds fed *ad libitum*.

References

Association of official Analytical Chemists (AOAC), 1980.13th Ed., Washington, D.C. PG., 21-47.

Boekholt, H.A., P.H. Vandergrintein, V.V.A.M. Schervrs, M.J.N. Los and C.P. Leffering, 1994. Effect of dietary energy restriction on retention of protein, fat and energy in broilers chickens. Br. Poult. Sci., 35: 603-614.

Duncans, D.B., 1955. Multiple range and multiple F tests. Biometrics, 11: 1-42.

Forbes, J.M. and M.H. Injidi, 1979. Feeding and sleeping in chickens following melatonin and triodothyronine injections. J. Physiol., 296: 57-58.

Forsum, E.P., E. Hillman and M.C. Nesheim, 1981. Effect of energy restriction on total fat production, basal metabolic rate and specific dynamic action of food in fats. J. Nutr., 111: 1691-1697.

Griffiths, I., S. Leeson and J.D. Summers, 1977. Fat deposition in broilers, effects of dietary energy on protein balance and early life caloric restriction on productive performance and abdominal fat pad. Poult. Sci., 56: 638 -646.

Guhl, A.M., 1953. Social behaviour of the domestic fowl. Kansas Agric. Expre. Stat. Tech. Bul., 73.

Kubena, I.F., B.D. Loit, J.N. Deaton, F.N. Freece and J.D. Amy, 1972. Body composition of chicks as influenced by environmental temperature and selected dietary factors. Poult. Sci., 51: 517-522.

Moran, E.T. Jr., 1982. Comparative nutrition of fowl and swine. Gastrointestinal System. Published by E. T. Moran (Jr.) Canada, pp: 79-82.

Oyedeji, J.O. and J.O. Atteh, 2003. Response of broilers to 3 weeks feed restriction initiated at different time periods. Nig. J. Anim. Prod., 30: 157-162.

Oyedeji, J.O., J.O. Atteh and S.A. Adedeji, 2003a. Response of broilers to skip a day (SAD) feeding. Nig. J. Anim. Prod., 30: 163 – 172.

Oyedeji, J.O., J.O. Atteh and O.O. Ogbonini, 2003b. Effects of dietary ammonium sulphate (AS) on the performance and abdominal fat of broilers Nig. J. Anim. Prod., 30: 9-14.

Plavnik, I. and S. Hurwitz, 1989. Effect of dietary protein, energy and feed pelleting in the response of chick to early feed restriction. Poult. Sci., 68: 1118-1125.

Plavnik, I. and S. Hurwitz, 1991. Response of broiler chickens and turkey poults subjected to feed restriction of varied severity during early life. Br. Poult. Sci., 32: 343 -352.

Plavnik, I. and S. Hurwitz, 1988. Early feed restriction in chicks effect of egg laying, duration and sex efficiency and body composition. Poult. Sci., 67: 1407-1413.

Rosety, M., 1980. Influence of light on development of glycogen bodies in visual cells of the ovian retina. An experimental study. Mortol normal Y Pato. Log, A4: 323.

Steel, R.G.D. and H.Z.H. Torrie, 1980. Principles and procedures of statistics. Biomedical approach Mc. Graw Hill Book. Co. Inc. New York Toronto London pp: 101-123.

Sibald, I.R. and N.A. Cave, 1976. The response of chicks to ammonium, calcium, magnesium and sodium sulphate and to ammonium and potassium carbonates. Poult. Sci., 55: 2209-2213.

Washburn, K.W. and K. Bondari, 1978. Comparison of the effects of severity and duration of restriction feeding on growth, feeding consumption and feed conversion of broilers grown in individual cages and floor pens. Poult. Sci., 27: 1148-1154.

Wilson, P.W. and D.F. Osbourn, 1960. Compensatory growth after undernutrition in mammals and birds. Biol. Rev., 35: 325-363.