
The effect of feed restriction at the starter phase on performance of broiler chickens

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Abstract

Two hundred and twenty five day old straight run broiler chicks were utilized in completely randomized design to test the effect of restricting feed intake of four groups of chicks to 92.5%, 85.0%, 77.5% and 70.0% of the unrestricted (control) group in the starter phase and following ad libitum feeding for all groups in the finisher phase. The treatments were simply designated as A, B, C, D, and E. The starter phase in which the restriction was carried out lasted 28 days and the finisher phase 42 days. Parameters evaluated during the starter and finisher phases included: growth rate, feed conversion ratio and mortality rate. Results show gain in weight among all groups while the group fed diet B and the control had comparable weight gain at the starter phase. The percentage weight difference between the control and each of the other dietary groups was: 4.4%, 8.4%, 8.6% and 10.4% for the treatments B, C, D, and E respectively. Feed: gain ratio improved as the level of restriction became stricter. Following ad libitum feeding of all groups at the finisher phase, the feed restricted groups at the starter phase voraciously increased their feed intake, thus, producing comparable performance values with the unrestricted (control) group in weight gain in the 8th week of the study. Although birds in all groups averaged more than 2000g final live weight in 10 weeks, significant differences exist between groups that were fed diets C, D, and E that were restricted at the starter phase, an indication that complete compensatory growth was not obtainable. Feed: gain ratio improved for restricted groups. Mortality rate did not show any trend attributable to levels of feed restriction. This study shows that broiler chicks fed restricted levels of balanced diet at the starter phase but later fed ad libitum at the finisher phase could attain a finished weight of about 2000g or more at a market age of 10 weeks (70 days) with an improvement in feed: gain ratio.

Key Words: Feed restriction, weight gain, feed: gain ratio, compensatory growth, mortality rate, broilers.

Introduction

At certain times in the course of poultry production, some small scale farmers do practice feed restriction, especially, if feed is not prepared 'on farm' but have to be purchased from feed merchants. In layer production, it is good management practice to underfeed, especially, the heavy breeds during their growing period to

point of lay to minimize early fat deposit and perhaps to reduced production cost. In broiler production however, birds are fed *ad libitum* in order to enhance attainment of early market weight (1.8kg). Therefore, lack of feed at any phase of broiler production is consider a poor management practice. However, evidence is accumulating, that, when feed restriction is

carried out on broilers at an early age and adequate feeding ensues thereafter, the restricted chicks grow fast enough to compensate for the early weight depression in time for market age (8-10 weeks).

Wilson and Osbourn (1960) reported that when a group of animals of similar weights is underfed for a period of time and later given good feeding as their counterparts, they will grow at a faster rate than their full fed counterparts. Following this observation, Plavnik and Hurwitz (1985) fed maintenance diet (40 Kcal) per chick per day from 6 day post hatch to 12 days of age. The restricted group had grown fast and by day 52 or 56 had caught up with the unrestricted control group and had better feed efficiency. Calvert *et al* (1989) reported that broiler chicks fed 40 Kcal per bird from 6 to 12 days starting at 6 day post hatch had body weight gain similar to the unrestricted control group from 21 to 56 days of age. The phenomenon of growth of restricted groups put up by Plavnik and Hurwitz (1985; 1986) and Calvert *et al.* (1989) are at variance. Plavnik and Hurwitz (1985) and other workers (Wilson and Osbourn 1969; Plavnik *et al.*; 1986), seem to suggest completed compensatory growth, with restricted group equaling the final body weight of the restricted groups. Calvert *et al.* (1986) and other workers (Pinchasov and Jensen 1989; McMurtry *et al.*; 1988; Mollison *et al.* 1984 and Beane *et al.*; 1979) suggest that, although, there is compensatory growth, of the restricted groups which at certain periods may equal that of the unrestricted control, the final body weight of the restricted groups never catches up with that of the unrestricted (control) group.

Age at which restricted feed intake is initiated (Palo *et al.*; 1995 and Deaton, 1995) and the duration of restriction (Balley *et al.*; 1992) have effects on whether restricted birds grow to "catch

up" or equal the final weight of the control birds. Dietary dilution using high fiber diet (oat hulls) as a means of restricting energy intake (Zubair and Leesón, 1994) produced beneficial (catch up) effect 25 days following realimentation on control diet. Age at marketing and the severity of intake restriction are the factors that may be considered in early feed restriction program.

It is because there is dearth of information on the performance response of chicks whose feed was restricted during the starter and/or finisher phases that this trial was embarked upon. Furthermore, the inconsistency observed in the various research findings on the subject matter also need to be clarified.

Materials and Methods

Two hundred and twenty five unsexed day old broiler chicks were purchased from livestock merchant and utilized in a Completely Randomized Design to test the effects that feed intake restrictions at 92.5% , 85%, 77.5%, and 70%, of the full fed (control) would have on finishing broiler chickens. The various restriction levels (in percentages) accounted for the five treatment groups. Weekly feed intake of each chick was calculated as determined by Dafwang and Ogundipe, (1987) and North (1978). They stated that a broiler chick required 20g feed per day in the first week, 30g in the second week, 48g in the third week and 64g in the fourth week respectively. The feeding method was the "skip a day" whereby the total feed for two days was determined according to the level of restriction and was served at once to last for two days before another serving was effected (Smith, 1990). In this way, each chick in each treatment had ample opportunity of eating enough feed required in at least the 24 hours of the 48 hour feed allotted. Chicks were brooded on deep litter and each pen measured 2.75 x 1.85m². Heat was supplied by kerosene stoves and bush lamps provided light

especially at night. There were five treatments and each treatment had three replicate pens. Chicks were assigned at random to each pen and each pen had 15 chicks such that each treatment had 45 chicks. Water was provided *ad libitum*.

Chicks were weighed individually every week throughout the study. At the end of intake restriction, all chicks were fed finisher feed *ad libitum*. The composition of the experimental diets is provided in table 1. The experiment terminated when all restricted groups had attained a mean weight of 2000g. Data collected were summarized and analyzed statistically, using ANOVA of the Completely Randomized Design and, where appropriate, mean separation was done using Duncan's New Multiple Range Test as outlined by Steel and Torrie (1980).

Results and Discussions

Starter phase

At the end of the four week feed intake restriction, the control group and the group that received diet B did not differ ($P>0.05$) in feed intake, weight gain and feed: gain ratio. Chicks fed restricted diets (B, C, D, and E) did not differ ($P>0.05$) in weight gain but differed ($P<0.05$) in feed intake which continued to diminish as the restriction levels became stricter as expected. Feed-to-gain ratio did not differ ($P>0.05$) between the control, and diets B and C. There was improvement in feed-to-gain which resulted in significant improvement in the ratios between diets E, D and the other lesser restricted diets.

Table 1: The composition of the diets.

Feedstuff	Starter diet	Finisher diet
	% of diets	
Maize	36.00	50.00
Soyabeans (fullfat)	50.00	41.00
Cassava root meal	-	3.50
Rice offal	9.90	1.30
Bone meal	3.40	3.50
Premix *	0.25	0.25
Salt	0.25	0.25
Methionine	0.20	0.20
	100.00	100.00
Determined analysis (DM basis)		
Crude protein (%)	23.2	19.96
Crude fibre (%)	5.5	4.36
Ether extract (%)	6.50	5.81
Ash (%)	8.30	5.54
ME (Kcal/kg)**	3023	3209
Calculated analysis		
Calcium (%)	1.30	1.36
Phosphorus (% total)	1.08	1.00
Methionine + Cystine (%)	0.92	0.76
Lysine (%)	1.32	1.10

*Agricare premix (Pfizer) at the rate of incorporation in the diet supplied the following additional nutrients per kg of diet
 Vits- A 10,000 IU; D 2000 IU; E 20 IU; K 3mg; B12 0.05mg, Riboflavin 6mg, Pantothenate 15mg, Nicotinic acid 35mg, Folicin
 1mg, cholin chloride 500mg, Se 0.15mg, Cu 12mg, Mn 55mg, Fe55mg

**After Pauzenga (1985) ME Kcal/kg = $(37 \times \% CP - 81.8 \times \% \text{tare} - 35.5 \times \% \text{NFE})$ as cited by Oduguwa *et al.* (2004)

The effect of feed restriction on performance of broiler finishers

The full fed chicks received 41g (122 kcal ME) per chick per day on the average over the entire starter period. Calvert *et al.*, (1989) described 40 Kcal energy per day intake in the second week as maintenance requirement. Chicks in this study appear to have consumed more than the maintenance requirement and even the 70% intake restricted diet (E) supplied 63 Kcal ME per chick per day. It is probable that all groups of chicks were in productive state but at varying degrees of growth production. Plavnik and Hurwitz (1985) restricted intake of two week old broilers to only 40 Kcal per day which they considered to be severe restriction, and meant for maintenance. They found that the chicks even at this level of energy restriction, gained about 4 g per day and even in the third week of restriction, these broiler chicks continued to gain but the average daily gain dropped to 2g per day. Differences between the restricted groups expressed as percentages of the full fed control was minimal, 4.4% for diet B, 8.4%, for diet C, 8.6%, for the diet D, and 10.4% for diet E respectively. The restricted groups continually scratched the litter for food. Perhaps chicks extracted some energy from the litter materials consumed to further augment the energy requirement for growth. Pond *et al* (1985) demonstrated such a phenomenon in pigs.

Finisher phase

Following realimentation on *ad libitum* feeding in the finisher phase, restricted chicks consumed feed voraciously and this translated into improved weight gain for chicks that were previously fed diets B and C which caught up with the full fed (control) group in week 6. Chicks that were previously fed diet D caught up with the full fed (control) group in week 7. By 8 week, all the feed restricted groups had caught up with the fully fed (control) group in weight gain (Table 3). However at week 10, the weight gains of chickens fed diets C and E were again inferior ($P<0.01$) to that of the control. Although weight gain was similar in all groups in week 8, total weight differed significantly ($P<0.05$) (Table 4). The birds earlier fed diet B had caught up with the control group (diet A) from week 8 through 10. The birds fed diets C, D and E did not "catch up" with the control group in cumulative weight. This study and those of many other workers have shown that rapid growth of earlier restricted groups which Bohman (1955) described as "compensatory" takes place during period of realimentation.

The control group and those previously restricted to 92.5% feed intake (diet B), did not differ ($P>0.05$) in total weight. The 92.5% group

Table 2: The effect of feed restriction on the performance of broiler starter chicks (28 days of age).

Level of restriction:		Parameter	
% of <i>ad libitum</i>		Feed intake (g)	Feed: grain ratio
100.0	A	1143 ^a	1.85 ^a
92.5	B	1050 ^{ab}	1.79 ^a
85.0	C	963 ^{bc}	1.72 ^a
77.5	D	879 ^{cd}	1.57 ^b
70.0	E	795 ^d	1.45 ^c
SEM		30.75	0.04

a,b,c,d. mean within a column with different superscripts differ ($P<0.05$).

SEM = Standard Error of Means

Table 3: The effect of feed restriction at the starter phase on weight gain of broiler finisher chickens.

<i>Level of feed restriction:</i>		<i>(age in weeks)</i>					
<i>% of ad libitum</i>		5	6	7	8	9	10
100.0	A	212 ^a	265 ^a	285 ^b	295 ^{ab}	315 ^a	345 ^a
92.5	B	190 ^b	280 ^a	310 ^a	320 ^a	325 ^a	335 ^a
85.0	C	185 ^{bc}	230 ^b	260 ^b	290 ^b	290 ^b	315 ^{bc}
77.5	D	170 ^{bc}	240 ^b	270 ^b	300 ^{ab}	235 ^c	325 ^{ab}
70.0	E	166 ^c	220 ^b	260 ^b	285 ^b	240 ^c	300 ^c
SEM		6.76	6.32	7.80	7.85	5.63	7.19

a, b, c, means within a column with different superscripts differ ($P < 0.05$)
SEM = Standard Error of Means.

Table 4: The effect restriction on cumulative weights (g) at the age broiler are usually finished.

<i>Level of restriction:</i>		<i>(age in weeks)</i>		
<i>% of ad libitum</i>		8	9	10
100.0	A	1710 ^a	2025 ^a	2370 ^a
92.5	B	1720 ^a	2045 ^a	2380 ^a
85.0	C	1565 ^b	1845 ^b	2160 ^b
77.5	D	1580 ^b	1815 ^b	2170 ^b
70.0	E	1520 ^c	1760 ^c	2060 ^b
SEM		8.47	14.20	38.30

a, b, c, means within a column with different superscripts differ ($P < 0.05$)
SEM = Standard Error of Means.

Table 5: The effect of feed restriction at the starter phase on feed conversion ratios of broiler finisher chickens.

<i>Level of feed restriction:</i>		<i>(Age in weeks)</i>					
<i>% of ad libitum</i>		5	6	7	8	9	10
100.0	A	2.36 ^a	2.66 ^a	2.72 ^a	2.86 ^a	2.88 ^a	3.10 ^a
92.5	B	2.41 ^a	2.45 ^b	2.68 ^a	2.75 ^b	2.80 ^a	2.92 ^{ab}
85.0	C	2.05 ^b	2.51 ^{ab}	2.56 ^{ab}	2.62 ^c	2.68 ^a	2.75 ^b
77.5	D	1.76 ^c	2.28 ^c	2.32 ^{bc}	2.30 ^d	2.45 ^{bc}	2.50 ^c
70.0	E	1.65 ^c	2.01 ^d	2.15 ^c	2.15 ^e	2.25 ^c	2.35 ^c
SEM		0.06	0.06	0.08	0.03	0.07	0.07

a, b, c, means within a column with different superscripts differ ($P < 0.05$)
SEM = Standard Error of Means.

Table 6: The effect of feed restriction at the starter phase on cumulative performance of broiler finisher chickens reared to 70 days of age.

Trait	Level of feed restriction: % of <i>ad libitum</i>					SEM
	100.0 (A)	92.5 (B)	85.0 (c)	77.5 (D)	70.0 (E)	
Feed intake (g)	5935 ^a	5810 ^a	4946 ^b	4399 ^c	3927 ^d	57.35
Weight gain (g)	2330 ^a	2340 ^a	2120 ^b	2130 ^b	2020 ^b	38.70
Total wt (g)	2370 ^a	2380 ^a	2160 ^b	2170 ^b	2060 ^b	38.30
Feed: gain (ratio)	2.55 ^a	2.48 ^a	2.33 ^a	2.07 ^b	1.96 ^b	0.06
Mortality (%)	6.67	8.87	6.67	4.44	13.33	-

a, b, c, d, means within a column with different superscripts differ ($P < 0.05$)
SEM = Standard Error of Means.

(diet B) lost 4.4% weight during the 4 week restriction period. The 85% restriction group (diet C) lost 8.8% and 77.5% group (diet D) lost 8.6% while the 70% group (diet E) lost 10.6% of their weight when compared to the control (diet A) at 4 weeks of age. These percent differences caused significant weight losses of finishing broilers (Table 6). Deaton (1995) restricted intake for 7 days at 80% or 60% of the control. He reported that chicks that had lost more than 17% weight following restriction were unable to compensate and equal the weight of the control. Birds that had lost only 8% of their weight had compensated adequately at 41 days of age. The findings in this study are at variance with that of Deaton (1995) since only the 4.4% loss of body weight recovered fully. Those of 8.8% and 10.6% weight loss could not compensate fully even at 70 days of age. This may be due in part to the extended period of intake restriction. Balley *et al* (1992) showed that age at initiation and duration of restriction, both affect final body weight. Other authors (Fontana, 1992; Calvert *et al*, 1989; Pinchasov and Jensen 1989; McMurtry *et al*, 1988, Millision *et al*, 1984 and Beane *et al*, 1979) also reported that the restricted chicks could not fully compensate for growth to equal that of the control group.

Weight gain of all restricted groups caught up with the control group from 7 to 8 weeks but

could not maintain this “catch up” gain to termination of the study (Table 3) Fontana *et al* (1992) suggested that since restricted broilers could not fully overcome weight loss, the term “accelerated growth” rather than compensatory growth should be used to describe this growth phenomenon. In this country, finished broilers are not sold by weight measures but by uniform price for each bird in the batch. The more acceptable weight preferred by consumers is 1.8kg or better. The group of chicks that were restricted the most (diet E) was able to reach the weight of 2000g in 10 weeks along with the other groups.

Feed Efficiency

At the end of intake restriction, feed: gain ratio did not differ significantly ($P > 0.05$) between the control, diets A, B, and C. Diets C and D also did not differ ($P > 0.05$) and diets D and E also did not differ ($P > 0.05$) (Table 2). After realimentation on the finisher diet, the feed: gain ratio of the control diet A and diet B continued to be poorer, while the diet E had the most improved efficiency. Cumulative feed -to - gain ratio (Table 6) also followed a similar trend. Feed to gain ratio of the restricted broilers continued to improve as the level of restriction became stricter. Deaton (1995) restricted intake to 90%, 75% or 60% of *ad libitum* control and reported improved feed efficiency with decreasing level of intake. Many workers

(Plavnik and Hurwitz, 1985; Plavnik *et al.*, 1986, McMurtry *et al.* 1988, Pinchasov and Jensen, 1989) reported similar findings.

Mortality Rate

Mortality occurred and was highest in diet E (13.33%), followed by diet B (8.87%). The lowest mortality (4.44%) occurred in diet D (Table 6). Mortality did not follow a definite pattern to suggest restriction level as a factor.

Conclusion

This study has demonstrated that when broiler chickens are underfed at any point during the starter phase but are subsequently offered a nutritionally balanced unrestricted finisher diet, they do undergo compensatory growth to attain the required market weight within 10 weeks of production.

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