EFFECTS OF EARLY FEED RESTRICTION ON THE PERFORMANCE OF BROILERS

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Summary

An experiment was conducted to compare the effects of early feed restriction on the performace and abdominal fat deposition in broilers. The treatments consisted of providing feed *ad libitum* (Full-fed) and three feed restriction treatments of restricting feeding between 8-21 days of age (DOA) either for a duration of 7 days or 14 days. The three feed restriction treatments were Restrict 8-14 DOA, Restrict 8-21 DOA and Restrict 15-21 DOA.

Liveweights and feed consumption were obtained at weekly intervals. Samples of both male and female broilers broilers were taken at 43 DOA to determine the weight of abdominal fat, liver and gizzards.

Feed efficiency was generally improved by feed restriction, but a compensatory gain was not observed in the restricted groups. Broilers on restricted feeding also had lower mortality as compared to the full-fed broilers. There is no effect of early feed restriction on the weight of the abdominal fat and the dressing percentages but the weights of the liver and gizzard were affected by restriction. Also there was an effect of sex on the weights of the abdominal fat, the liver and gizzard of the males and females.

(**Key Words** : Broiler Chicken, Feed Restriction, Growth, Broiler Performance)

Introduction

The increased in the preference of consumers for leaner meat had stimulated interest in reducing abdominal fat deposition in broilers. Meat-type chickens have traditionally been fed as much as they will eat and this principle of encouraging broilers to increase feed consumption is applied rigorously in broiler production of straight-run flocks by feeding nutrient dense diets in a highly palatable form. On the other hand, the practice of nutrient or feed restriction during the early life of the chick could reduce the abdominal fat by reducing the subsequent deposition of fat by delaying hyperplasia, hypertrophy of adipocytes, or both (March and Hansen, 1977; Plavnik and Hurwitz, 1985; Plavnik et al., 1986).

Several methods, both quantitative and qualitative nutrient or feed restriction, have been tried in attempts to reduce carcass fat in broilers by several researchers with varying degrees of success. These methods include restricting feed intake (Beane et al., 1979; Mollison et al., 1984), reducing the calorie : protein ratio (Griffith et al., 1977) and early feed restriction (Cabel and Waldroup, 1990; Pinchasov and Jensen, 1989; Plavnik and Hurwitz, 1985; Plavnik et al., 1986; Summers et al., 1990 and Yu et al., 1990) and these studies were mainly on the response of either the male or female broilers to various degrees of restriction. There is a lack of information concerning the response of mixed-sex flocks to feed restriction, therefore the following experiment was conducted to compare the effects of early-life feed restriction programs in a mixed flock on broiler performance and the deposition of abdominal fat.

Materials and Methods

Animals and management

A total of 1,200 day-old straight-run broilers (Avian) were randomly distributed into 12 pens at a density of 0.11 m^2 per chick. The chicks were housed in a conventional broiler house with galvanized wire netting walls partitioned into twenty pens (3.0 m × 3.6 m). Only twelve of the pens were used. The chicks were brooded for two weeks by the use of electric heaters. Wood

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shaving was used as bedding material with approximately 10 cm in depth. All chicks were fed a crumbled starter diet of 22% crude protein and 12.13 MJ, ME/kg for the first three weeks, from day 1 to day 21. On day 22 a finishing pelleted diet, containing 19% crude protein and 12.55 MJ, ME/kg was fed until 42 days of age. The feeds were obtained from a commercial feedmill. All groups were fed once daily using three hanging tube feeders (pan diameter of 42 cm). Water was provided by automatic bell-shaped drinker.

Feeding regimes

The four feeding treatments were: (1) FULL FED ; *ad libitum* feeding during the entire 42 days experimental period ; (2) RESTRICT 8-14 DOA; feed restricted to approximately 75% of *ad libitum* consumption during the second week, 8-14 days of age (DOA) ; (3) RESTRICT 8-21 DOA ; feed restricted to approximately 75% of *ad libitum* consumption during the second week, 8-14 days of age and continued feed restriction to approximately 50% of *ad libitum* consumption during the third week, 5-21 days of age (4) RESTRICT 15-21 DOA ; feed restricted to approximately 50% of *ad libitum* consumption during the third week, 15-21 days of age. Three replicate pens with 100 broilers per pen were utilized per treatment.

Traits measured and analyses

The birds were weighed on a per pen basis and feed consumption was recorded at weekly intervals. Feed conversion was calculated as feed/gain for the six weeks. At the conclusion of the study, 8 males and 8 females from each treatment were selected at random, slaughtered and processed. The carcasses were then eviscerated and the abdominal fat pads removed as described by Cabel et al. (1987). The carcasses, the abdominal fat pads, the liver and gizzard were weighed, and expressed as a percentage of total body weight (grams per 100 g).

Statistical analyses

Analysis of Variance (Statgraphics®) was used to determine differences in treatment means and significance was assessed at the 0.05 level. When significance was found, means within treatments were separated using the Least Significance Difference test.

Results

Body weight

The weekly liveweights of the broilers are shown in table 1. Regardless of the week and duration of quantitative feed restriction, broilers in the three feed restriction treatments were significantly lighter in body weight after the restriction period compared to the full-fed broilers. In all restricted groups, growth in absolute terms was lower than the full-fed broilers. However, growth rate of the restricted groups exceeded that of the full-fed broilers for two weeks after refeeding. The accelerated growth rate was not significantly high to compensate entirely for the growth lost during the period of restriction, so that the final body weight was lower especially for the broilers restricted for two weeks. At 6 weeks of age, this body weight difference varied from 140.8 g (broilers restricted for 1 week) to 213.3 g (broilers restricted for 2 weeks). The restricted broilers did not exhibit any compensatory growth until 6 weeks of age.

TABLE 1. INFLUENCE OF TIMING OF FEED RESTRICTION ON BODY WEIGHTS OF BROILER CHICKS

Age (Weeks)	*Ad libitum*	Restricted 8-14 DOA	Restricted 8-21 DOA	Restricted 15-21 DOA
0	42.6[a] ± 0.33	42.8[a] ± 0.76	41.5[a] ± 0.53	41.6[a] ± 0.29
1	160.8[a] ± 0.83	155.8[a] ± 3.63	156.8[a] ± 5.63	153.3[a] ± 9.12
2	375.0[a] ±15.07	305.2[b] ± 5.17	297.3[b] ± 17.42	393.9[a] ± 4.41
3	735.0[a] ±10.41	685.0[b] ± 8.66	453.3[d] ± 5.46	494.2[c] ± 5.46
4	1,139.3[a] ±22.52	1,122.5[a] ±26.26	914.2[b] ±23.82	949.2[b] ±20.73
5	1,608.3[a] ±73.28	1,529.2[a] ±15.30	1,369.2[b] ±19.17	1,387.5[b] ±16.65
6	1,983.3[a] ±47.0	1,842.5[b] ±34.5	1,770.0[b] ±35.0	1,842.5[b] ± 7.2

[abcd] Mean ± SEM in a row with no common superscripts differ significantly ($p < 0.05$).

Feed consumption and feed conversion

A summary of the effects of early feed restriction on broiler performance is shown in table 2. The duration of the restriction had an effect on the liveweight and total feed intake as reflected in broilers restricted for 14 days (table 2) whereby the liveweight was significantly lower than the full-fed control and the two other groups on restricted feeding. The overall feed consumption was reduced by 17.1% than the full-fed when restriction of 7 days was imposed at the third week (15-21 DOA) and only by 12% when restriction was imposed for 14 days at the second and third week (8-21 DOA). While the broilers

that was restricted for 7 days during week 3 (15-21 DOA) showed a significant advantage in feed conversion as compared to the other two restricted groups and the full-fed broilers.

TABLE 2. EFFECTS OF EARLY RESTRICTED FEEDING ON THE PERFORMANCE OF BROILERS, DURATION OF 42 DAYS

Variable	*Ad libitum*	Restricted 8-14 DOA	Restricted 8-21 DOA	Restricted 15-21 DOA
Final liveweight (g/b)	1,983.3[a] ± 47.0	1,842.5[b] ± 34.5	1,770.0[b] ± 35.0	1,842.5[b] ± 7.2
Liveweight gain (g/b/d)	46.2[a] ± 1.12	42.9[b] ± 0.82	41.2[b] ± 0.82	42.9[b] ± 0.17
Total feed intake (g/b)	3,381.4[a] ±110.8	3,363.2[a] ±100.4	2,974.7[b] ±146.0	2,804.5[b] ±54.1
Feed intake (g/b/d)	80.5[a] ± 2.6	80.1[a] ± 2.4	70.8[b] ± 3.5	66.8[b] ± 1.3
FCR (Feed/Gain)	1.74[a] ± 0.055	1.87[a] ± 0.072	1.72[ab] ± 0.062	1.56[b] ± 0.023
Mortality (%)	10.26[a] ± 1.66	6.39[a] ± 3.57	6.36[a] ± 0.91	6.07[a] ± 2.15

[ab] Means ± SEM in a row with no common superscripts differ significantly ($p < 0.05$).

Mortality

The overall mortality was low for the restricted groups (an average of 6.27%) as compared to the full-fed broilers (10.26%) although the difference was not significant.

Abdominal fat, liver and gizzard weights

The effects of early feed restriction on the weights of the abdominal fat, liver and gizzards are shown in table 3. There was no significant effect of feed restriction on dressing percentages and the weights of the abdominal fat between the full-fed and restricted broilers but there was an effect of feed restriction on liver and gizzard weights. The weights of the abdominal fat, liver and gizzard of the females were significantly heavier than the males.

TABLE 3. THE EFFECTS OF EARLY RESTRICTED FEEDING AND SEX ON DRESSING PERCENTAGE (%), ABDOMINAL FAT, LIVER AND GIZZARD WEIGHTS (g/100 g) OF BROILERS AT 43 DAYS SLAUGHTER AGE

Treatment	Dressing (%)	Abdominal Fat	Liver	Gizzard
Feeding				
Ad libitum Regimen	72.37 ±0.45	3.68 ±0.18	2.16[ab] ±0.09	1.17[a] ±0.06
8-14 DOA[A]	71.37 ±1.28	3.88 ±0.18	2.30[b] ±0.09	1.22[ab] ±0.08
8-21 DOA[A]	70.78 ±0.53	3.41 ±0.18	2.21[a] ±0.09	1.38[b] ±0.06
15-21 DOA[A]	72.49 ±0.84	3.63 ±0.18	2.16[ab] ±0.07	1.36[b] ±0.08
Sex				
Male	72.06	3.46[a]	2.12[a]	1.20[a]
Female	71.44	3.84[b]	2.29[b]	1.37[b]
SEM	0.60	0.13	0.58	0.05

[A] Feed restriction on indicated days.
[ab] Mean ± SEM within a treatment and column with no common superscripts differ significantly ($p < 0.05$).

Discussion

In this study, a full compensation for the weight retardation during feed restriction was not obtained within a growth period of 6 weeks. The reduced market weight (6 weeks) of broilers due to feed restriction is in agreement with those as reported by Fontana et al. (1992), Mollison et al. (1984), Pinchasov and Jensen (1989), Robinson et al. (1992) and Yu et al. (1990). This observation does not agree with the results reported by Plavnik et al. (1986) and Plavnik and Hurwitz (1985, 1988). Some of the reasons for the discrepancy have been discussed by Yu and Robinson (1992) and includes the severity, the duration, and the timing of the feed restriction, the length of time allowed for refeeding, and sex and strain of bird. In this study, the reduced liveweight at 6 weeks could be attributed to the severity and duration of the feed restriction especially for the birds restricted for two weeks and a feed restriction of 50% of the full-fed birds at the third week.

The weight of the restricted flocks was reduced from the full-fed controls by 7.10-10.8% in a mixed-sex flocks. Pinchasov and Jensen (1989) observed that the response of males and females to identical levels of feed restriction as compared to the full-fed controls is different by 9.2% in females and 4.5% in males.

The liveweight gain of restricted broilers was

significantly lower than the full-fed broilers and this affected the feed efficiency whereby the broilers restricted for one week during the third week showed the best feed conversion ratio and this is consistent with other findings (Fontana et al., 1992; Pasternak and Shalev, 1983; Plavnik and Hurwitz, 1985, 1988; Plavnik et al., 1986). If ever early feed restriction is adopted, a 7 days feed restriction at three weeks would be an advantage because of the better feed conversion among restricted groups and comparable liveweight at 6 weeks with the broilers restricted during the second week. Although not significant, early feed restriction decreased mortality (table 2) and this is consistent with the finding of Fontana et al. (1992).

Perhaps the most controversial aspect of early feed restriction programmes has been the lack of a consistent effect on abdominal fat pad or total carcass fat. In this study, there was no difference in abdominal fat pad size between restricted and unrestricted broilers as shown in table 3. This is consistent with the findings of Pinchasov and Jensen (1989), Summers et al. (1990), Yu et al. (1990) and Fontana et al. (1993) but does not agree with other findings (Plavnik and Hurwitz, 1985; Plavnik et al. 1986) in which the abdominal fat pad could be reduced by restricting the quantity of diet offered. An explanation for the apparent contradiction could be due to the effects of early feed restriction on fat deposition and a corresponding metabolic shift in nutrient partitioning (Fontana et al. 1993). Results from this study indicated no significant difference in fat deposition in the abdominal fat pad in restricted and full-fed broilers. However, these gross measurements may not accurately reflect the rates of metabolism of the restricted broilers. With reference to sex differences, a significantly heavier abdominal fat was measured in female broilers at 43 days when compared with male broilers. These results are not surprising, as female broilers are known to have higher levels of carcass fat (Kubena et al., 1974).

The gizzard weight of broilers with feed restriction at three weeks of age were heavier than the other two groups, whereas the liver weight was heavier in broilers restricted at two weeks of age. This is not consistent with the finding by Fontana et al. (1993) in which the liver and gizzard weights were minimally affected by the early feed restriction.

Conclusions

Short-term feed restriction does have a potential application in broiler chicken production provided the reduction in final body weight is not excessive. Restriction in feed intake during the third week reduced the total loss of broilers but improved slightly the feed efficiency.

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