Egypt Poult. Sci. Vol (25) (II): (333-350)

EFFECT OF DURATION OF FEED WITHDRAWAL VERSUS *AD LIBITUM* FEEDING DURING HIGH ENVIRONMENTAL TEMPERATURE ON BROILER CHICKEN PERFORMANCE

By

M. El-Sagheer and M.N. Makled

Department of Animal and Poultry Production, Faculty of Agriculture, Assiut University, Assiut, Egypt.

Received: 23/ 04/ 2005 **Accepted: 16/ 05 /2005**

Abstract: *This experiment was conducted to investigate the effect of duration of feed withdrawal and full-feeding during high environmental temperature condition on broiler chicken performance and mortality rate. One hundred and twenty one-day old brown Shaver broilers were used in this study. The experiment consisted of four groups, each group included three replicates of 10 chicks each. The broilers were full-fed ad libitum in the control group 1 (FFC) while feeders were removed for three (at 9.00 a.m. and return it at 12.00 p.m.), six (at 9.00 a.m. and return it at 3.00 p.m.) or nine (at 9.00 a.m. and return it at 6.00 p.m.) hours per day in groups 2, 3 and 4, (FW3, FW6, and FW9) respectively from 2 to 7 weeks of age. The average indoor temperature was 26-38 °C. The obtained results could be summarized as follows:*

No significant differences in the final body weight, feed consumption and cumulative feed conversion ratio were observed between full-fed and all restricted broilers. The broilers of all restricted-fed groups had fewer deaths than that of the control group. The mortality rate was 13.3, 10.0, 0.0 and 10.0% for groups 1, 2, 3, and 4, respectively.

No significant differences in carcass weight, its percentage, as well as the percentage of femurs, breast, wings, blood, feet & shank, heart, liver, gizzard, giblets, intestine, drumsticks & femurs fat, and total fat weight were found among all groups. However, significant (P≤0.05) differences were detected in the percentage of head, back, skin, proventriculus, spleen, gallbladder, abdominal fat, subcutaneous fat and breast fat of the groups. The broilers of all restricted-fed groups had significantly lower (P≤0.05) percentage of drumsticks & femurs as compared with that of FFC. It could be observed that, the FFC group had significantly higher (P≤0.05) neck fat as compared with all restricted groups, while it had significantly lower (P≤0.05) heart fat. The FW6 birds had insignificantly lower total fat than that of FFC birds. All restricted fed broilers (groups 2, 3 and 4) increased *economical efficiency by 13, 99 and 2%, respectively as compared with FFC broilers. The FW6 group had the best economic efficiency (EE) value.*

It could be concluded that, the most suitable feeding regime during high environmental temperature is the withdrawal of feed for 6 hours per day at 9.00 a.m. and return it at 3.00 p.m. from 2 to 7 weeks of age because it was best economically efficient than other feed restriction regimes. Also, using this regime was associated with a reduction in fat deposition and with no mortalities.

INTRODUCTION

High temperature condition adversely affects production and reproduction in poultry (Marsden *et al.,* 1987). Such condition is one of the main causes of low productivity of chickens under upper Egypt conditions where the prevailed ambient temperature fluctuates from lower than 10 °C in winter to higher over 40°C in summer months. High environmental temperature imposes certain physiological stresses on poultry that reduce their performance (MacLeod, 1984; Austic, 1985). Heat stress increased mortality, reduced both feed intake and feed conversion ratio (Suk and Washburn, 1995). Also, Dawoud (1998) reported that the low growth occurred in summer season was due to high ambient temperature (30-36 °C) which had a direct effect on central nervous system to reduce metabolic rate and feed consumption.

Feed withdrawal during the hottest hours of the day has become a common practice in many broiler producing areas. Short-term feed withdrawal can lower the bird's body temperature and increase its ability to survive acute heat stress. Smith and Teeter (1988) studied the influence of fasting intervals beginning 3-6 hours prior to heat stress initiation and totaling up to 12 hours daily during heat stress (37 ºC). The authors reported a significantly reduced mortality. One practice in use is to remove feed at 8.00 a.m. and return it at 8.00 p.m. Fasting may reduce weight gain and thus one would have to compromize between the importance of a more rapid growth versus a greater mortality risk.

McGovern et al., (1999) found that 40-day body weight of ad libitum birds were significantly greater than those of feed restricted birds. However, Zhong *et al.,* (1995) reported that no differences were observed between body weights means of full and restricted feed. Saleh *et al.,* (1996) reported that final body weight did not differ among birds restricted to 20% or 40% and those fully fed, as well as the abdominal fat percentage decreased with increasing feed restriction. Palo *et al.,* (1995) showed that feed-restricted of broilers increased in body weight at 48 days of age. It was found that the best feed conversion was achieved as the results of eight-hour feed removal per day between 5 and 37 days of age (Anonymous, 1997). Payawal (1996) reported that feed removal improved feed conversion efficiency and had no effect on carcass composition. Plavink *et al.,* (1986) noted that feed restriction from first week of age for male broilers would produce essentially the same amount of meat at market age and significantly less abdominal fat. Therefore, the objective of this study was to compare the duration of feed withdrawal with ad libitum feeding during high environmental temperature condition and their effect on broiler performance and mortality rate.

MATERAILS AND METHODS

The present work was carried out at the Research Poultry Farm of Animal and Poultry Production Department, Faculty of Agriculture, Assiut University from 21st of July to 7th of September 2004. One hundred and twenty one-day old brown Shaver broilers were used in this study. All chicks were wing banded and individually weighed. The experiment consisted of a control and 3 treatments groups. Each group included three replicates of 10 chicks each. The birds were housed in floor pens. Each replicate was kept in a partition of 2 square meter provided with litter of wheat straw (3 cm depth). The groups were as follows: (1) Full-fed control birds (FFC) which were fed *ad libitum* throughout the experiment period (from 1 to 49 days of age), (2) Removal of feed for 3 hours per day (at 9.00 a.m. and return it at 12.00 p.m.) from 2 to 7 weeks of age (FW3), (3) Removal of feed for 6 hours per day (at 9.00 a.m. and return it at 3.00 p.m.) from 2 to 7 weeks of age (FW6), (4) Removal of feed for 9 hours per day (at 9.00 a.m. and return it at 6.00 p.m.) from 2 to 7 weeks of age (FW9). Broilers of groups 2, 3, and 4 were fed *ad libitum* from day 1 to day 7. The chicks were maintained under continuous lighting with water available all the time. The birds received starter diet till two weeks of age; grower diet from three to five weeks of age; and finisher diet from six to seven weeks of age. The composition and proximate analysis of the experimental diets are shown in Table 1. The indoor temperature was recorded daily every 3 hours during the experimental period and then the average minimum and maximum indoor temperature was calculated weekly as shown in Table 2. The following parameters were studied:

Body weight (BW) and feed consumption (FC): Birds of each replicate were weighed individually every week. Also, FC of each replicate was calculated weekly.

Feed conversion ratio (FCR): Mean FCR was calculated weekly by dividing total feed consumed in a pen by the total gain in BW of the birds in that pen.

Carcass criteria: At 49 days old, 6 birds per treatment were chosen around the average weight of the group and sacrificed. After slaughter, the internal organs were removed from the body. The heart, liver, empty gizzard, proventriculus and spleen were weighed. The empty gastrointestinal tract including the pancreas was weighed. The head was removed at the occipital bone, feet and shanks were removed at the hock joints, wings were removed at shoulder joints, neck was removed close to the shoulder and then all parts were individually weighed. Breast, femurs and drumsticks were weighed as separate carcass parts. The back was separated from breast along the vertebral column. The breast included the bones of sternum and ribs was weighed. Carcass yield and carcass parts (Carcass weight, blood, feet & shank, head, neck, drumsticks, femurs, drumsticks & femurs, breast, wings, back and skin) were calculated as percentage of live body weight, while body organs (Heart, liver, gizzard, giblets, proventriculus, spleen, gallbladder and intestine) were calculated as percentage of carcass weight. The fat contents were calculated as percentage of carcass weight therefore, abdominal, gizzard, neck, drumsticks & femurs, heart, breast and subcutaneous fats were removed and weighed.

Mortality rate (MR): *Number of d*ied birds were recorded daily, and MR was calculated for each treatment.

Economic efficiency (EE): Feed cost per bird (starter, grower and finisher diets) was calculated by multiplying mean FC per bird by the cost of 1 kg of diet. Bird price was calculated by multiplying mean bird weight by price of 1 kg of live weight. Net revenue was calculated by subtracting bird price from total feed and depreciation costs. Economic efficiency (EE) was estimated by dividing net revenue by total feed and depreciation costs.

Statistical analysis: Data collected were subjected to ANOVA by applying the General Linear Models Procedure of SAS software (SAS institute, version 6.12, 1996). Duncan (1955) was used to detect differences between means of the different groups.

RESULTS AND DISCUSSION

1. Body weight (BW): Data of the BW are presented in Table 3. At day – old and first week of age, there were no significant differences in BW between all the restricted-fed groups and FFC group. At 2 weeks of age, broilers of all restricted-fed groups had similar BW, but were significantly

($P \leq 0.05$) lesser than FFC group. At 3 weeks of age, the control group had significantly higher ($P \leq 0.05$) BW than those of groups 2 and 3, but there were no significant differences among groups 1 and 4. At 4 weeks of age, there were no significant differences in BW among all restricted-fed groups, but the broilers of FFC had significantly higher BW than that of FW6 group. At age 5, 6 and 7 weeks of age, there were no significant differences in BW between all restricted-fed groups and FFC group. However, at 7 weeks of age, all restricted-fed groups resulted in lower BW than that of the FFC group. Such reduction in BW was 7.4, 7.3 and 2.0% for birds in FW3, FW6 and FW9 groups, respectively as compared to FFC group. These results are in agreement with previous finding of Beane *et al.,* (1979), Mollison *et al.,* (1984), McMurtry *et al.,* (1988), Pinchasov and Jensen, (1989), and Fontana *et al.,* (1993).

The reduction of growth may be due to the decrease in feed consumption. It was expected, based on previously reported studies (Palo *et al.,* 1995; Zubair and Leeson, 1996; Cooper *et al.,* 1998; Vo *et al.,* 1998; McGovern *et al.,* 1999) that the feeding regime would result in a decrease in body weight because of the feed removal. Decreasing the meal length in feed removal groups resulted in poorer body weight (Plavnik *et al.,* 1986). Petek, (1999) found that full-fed group had significantly ($P \leq 0.05$) heavier average body weights throughout the experiment period, and the final body weights of the full-fed significantly increased ($P \leq 0.05$) than those of 3-hour feed removal and 6-hour feed removal groups. In contrast, Saleh *et al.,* (1996) reported that there were no effects of feed restriction or feed removal on body weight.

2. Body weight gain (BWG): Results in Table 4 show that, at 2 and 3 weeks of age, no significant differences were observed in BWG among all restricted-fed groups, but the broilers of FFC group gained significantly more ($P \leq 0.05$) weight than those of FW3 and FW6 groups at 2 weeks of age and FW6 group at 3 weeks of age. From 4 to 7 weeks of age and overall mean of BWG, no significant differences were found among all groups. Similar results were observed by Plavnik and Hurwitz (1985).

3. Feed consumption (FC): Effect of time of feed withdrawal on FC is presented in Table 5. It is clear that, at 2 and 7 weeks of age, broilers of groups 2 and 3 consumed significantly ($P \leq 0.05$) lesser feed than those of groups 1 and 4. At 1, 3, 4, 5, 6 weeks of age and overall mean of FC, no significant differences were observed among all groups, however the overall mean of FC in FW3 and FW6 groups were decreased by about 7.8 and 11.4%, respectively as compared with that of FFC group, the opposite was true with FW9 group it increased by about 3.6%.

4. Feed conversion ratio (FCR): The data of FCR are presented in Table 6. It is clear that at 5 weeks of age, birds of FW6 group had significantly (P≤0.05) better value of FCR than that of birds in FFC group, but there are no significant differences among all restricted-fed groups. At 2, 3, 4, 6, 7 weeks of age and cumulative FCR, no significant differences were observed among all groups, however birds in FW3 and FW6 groups had better cumulative FCR by about 2.2 and 2.7%, respectively than that of birds of FFC group.

The effect of feed removal in improving FCR seems to be in agreement with the works of Plavink and Hurwitz, (1985), Plavink *et al.,* (1986), Rosenbrough *et al.,* (1988), Payawal, (1996) and Urdaneta-Rincon and Leeson (2002) which showed that restricted feeding or feed removal improved FCR. Petek, (1999) found that the broilers in FW6 had better feed conversion ratios than those of FW3 and FCC. Plavnik and Hurwitz (1985) reported that the specific energy needs for maintenance may be decreased during feed restriction. Compensatory feed efficiency was observed in feed restricted groups after returning to the full feeding. In contrast, Elliot and Edwards (1994) and Zhong *et al.,* (1995) did not observe any effect on FCR when chicks were deprived of feed 8 hours each day.

5. Carcass criteria: The data of carcass yield and carcass parts weights as percentage of live body weight are shown in Table 7. No significant differences were found in carcass weight, carcass percentage, the percentage of femurs, breast, wings, blood and feet & shank among all groups. However, there were significant (P≤0.05) differences in the percentage of head, back, and skin of the groups. The broilers of group 4 had significantly lower (P≤0.05) percentage of neck as compared with groups 1, 2, and 3. However, the broilers of all restricted-fed groups had significantly lower (P≤0.05) percentage of drumsticks and drumsticks & femurs as compared with control group.

The data of body organs weights and fat contents as percentage of carcass weight are presented in Table 8. It is clear that, feed restriction had no significant effect on heart, liver, gizzard, giblets, intestine, abdominal fat, drumsticks & femurs fat, total fat weight as percentage of carcass weight. However, there were significant (P≤0.05) differences in the percentage of proventriculus, spleen, gallbladder, abdominal fat, subcutaneous fat and breast fat of the groups. The percentage of proventriculus of birds of FW9 group increased significantly (P≤0.05) than those of the birds of FFC group and other restricted groups. Cherry and Siegel (1978) showed that chickens with heavier gut weights had slower gastro-intestinal clearance than those with lighter digestive tracts. They also found that, a slower clearance of feed from the intestinal tract allows the nutrients greater exposure to the absorptive cells and consequently improves the efficiency of feed utilization. Lilia *et al.,* (1985) reported that an increase in the size of the digestive organs improved the capacity of the chickens to ingest and digest feed. Others (Nir *et al.,* 1987; Katanabaf *et al.,* 1989) have also shown that a greater weight and length of crop and oesophagus increases the capacity of these organs to retain and control the evacuation of feed from the crop.

It could be noticed that, the FFC group had a significantly ($P \leq 0.05$) increased neck fat as compared with all restricted groups, while it had a significantly ($P \leq 0.05$) decreased heart fat. The birds of FW6 group had insignificantly lower percentage of total fat by about 18.8% than that of FFC group. Rosebrough *et al.,* (1986), found that the activities of the lipogenic enzymes were depressed during the period of feed restriction.

Payawal (1996) and Saleh *et al.,* (1996), found that the feed removal during the day had no effect on dressing percentage. In contrast, Petek, (1999) found that the broilers in the 6-hours feed removal group had greater percentages of carcass, liver, heart and gizzard weights than those in the 3-hours feed removal and full-fed groups. He also found that abdominal fat was higher in full-feeding group than the 3-hours feed removal and 6-hours feed removal groups. These findings are the same as the previous findings of Plavnik and Huwitz (1985), Plavink *et al.,* (1986), McMurtry *et al.,* (1988), Arce *et al.,* (1989) and Khontabrab *et al.,* (1997). No significant difference for abdominal fat was found by Summers *et al.,* (1990), Palo *et al.,* (1995), and Fontana *et al.,* (1993).

6. Mortality rate (MR): Data of MR are shown in Table 9. It is clear that broilers of all restricted-fed groups had fewer deaths than those of FFC group. The MR was 13.3, 10.0, 0.0 and 10.0% for groups 1, 2, 3, and 4, respectively. Similar results were observed by Urdaneta-Rincon and Leeson (2002) when feed was restricted to 95, 90, or 85% of the feed consumed *ad libitum* from 5 to 42 day of age. Also, Shlosberg *et al.,* (1991) and Acre *et al.,* (1992) reduced mortality by using feed restriction in broilers. Bowes *et al.,* (1988) and O'Sullivan *et al.,* (1992) reported that a lower rate of mortality caused by Sudden Death Syndrome in broilers restricted to 75% of the feed intake of control birds from 5 to 39 days of age

7. Economic Efficiency (EE): Results in Table 9 indicate that birds of groups 1 and 4 had heavier body weight than those of groups 2 and 3. Also, birds of groups 1 and 4 consumed more feed than those of groups 2 and 3 thus it had the highest feed cost. Groups 1, 2 and 4 had the highest depreciation costs as mortality was increased. Net revenue per bird was calculated by subtracting total feed and depreciation costs from bird price. It was observed that all restricted fed groups had the best net revenue per bird but FFC group had the lowest value. All restricted-fed groups (groups 2, 3 and 4) increased economical efficiency by 13, 99 and 2%, respectively as compared with the control group. The FW6 group had the best EE value as compared with other restricted-fed groups because it had no mortalities throughout the entire experimental period.

GENERAL CONCLUSION

From the results obtained in this experiment, it may be concluded that although full-feeding regime resulted in higher BW, it was economically less efficient than all feed restriction regimes. The most suitable feeding regime during high environmental temperature condition was the removal of feed for 6 hours per day from 2 to 7 weeks of age; because it was the best economically efficient than those of the other feed restriction regimes. Also, usage of this regime was associated with no mortalities and reduced fat deposition.

Table 1. Composition and calculated analysis of the experimental diets.

Ingredients, %	Starter	Grower	Finisher
Ground yellow corn	61.35	69.15	74.40
Soybean meal (44% CP)	25.85	21.00	18.15
Broiler concentrates*	10.43	9.30	6.30
Dicalcium phosphate	0.37	0.50	0.75
Salt	--	0.05	0.15
Limestone	--	--	0.25
DL-methionine	1.00	--	--
Lysine	1.00	--	--
Calculated analysis:**			
ME, Kcal/Kg	2920	3044	3017
Crude Protein, %	22.26	20.23	17.88
Crude fiber, %	3.45	3.24	3.09
Crude fat, %	2.79	3.02	3.12
Ca, %	1.03	0.97	0.90
P (Available), %	0.51	0.50	0.45

**Calculated on dry matter basis and according to NRC (1994).

*** The broiler concentrate contains:** *Crude protein, 52%; Crude fiber, 2%; Crude fat, 2.4%;Ca, 7.6%;P (Available), 2.6%; Methionine, 1.7%; Lysine, 2.5%; Salt, 2%; ME,2650 Kcal/Kg.* **Each kilogram of broiler concentrate contains the following levels of vitamins and minerals:** *Vit A, 120000 IU; vit D3, 22000 IU; vit E, 10000 mg; vit K, 2000 mg; B1, 1000 mg; B2, 5000 mg; B6, 15000 mg; B12, 10 mg; Biotin, 50 mg; Dicalcium phosphate, 1000 mg; Pantothenic acid, 120 mg; Folic acid ,20 mg; Niacin, 450 mg; Chorine chloride, 3600 mg; Fe, 300 mg; I, 10 mg; Mn, 1000 mg; Cu, 1000 mg; Se, 2 mg; Co, 1 mg; Zn, 600 mg.*

Table 2. Average of indoor temperatures during the experimental period.

Week	Temperature (°C)									
	9AM	0PM	3PM	6PM	9PM	0AM	3AM	6AM	Minimum	Maximum
1	31.3 ±0.6	33.1 ±0.5	34.7 ±0.5	36.1 ±0.3	35.7 ±0.3	34.9 ±0.4	33.9 ±0.4	33.7 ±0.3	29 ±0.2	37 ±0.2
2	31.4 ±0.7	33.1 ±0.6	34.9 ±0.8	36.6 ±0.6	35.1 ±0.7	33.9 ±0.9	32.6 ±0.8	31.4 ±0.8	29 ±0.3	38 ±0.3
3	29.9 ±0.3	32.7 ±0.4	34.7 ±0.5	35.9 ±0.6	33.4 ±0.4	32.0 ±0.4	30.6 ±0.5	29.6 ±0.5	28 ±0.3	37 ±0.3
4	29.6 ±0.3	32.4 ±0.4	34.9 ±0.5	35.6 ±0.3	33.4 ±0.4	32.0 ±0.4	30.6 ±0.3	29.7 ±0.4	29 ±0.3	36 ±0.3
5	28.5 ±0.4	31.2 ±0.6	33.0 ±0.6	33.5 ±0.5	32.2 ±0.6	31.0 ±0.4	29.8 ±0.4	28.5 ±0.3	27 ±0.3	36 ±0.3
6	27.1 ±0.4	29.9 ±0.4	32.4 ±0.4	32.8 ±0.3	30.8 ±0.2	29.8 ±0.2	28.5 ±0.2	27.3 ±0.1	26 ±0.3	34 ±0.3
7	27.0 ±0.3	30.0 ±0.3	32.6 ±0.3	32.9 ±0.1	31.6 ±0.4	30.7 ±0.4	29.3 ±0.3	27.6 ±0.4	26 ±0.3	33 ±0.3

Values are given as means ± standard error.

Table 3. Effect of duration of feed withdrawal on live body weight (g).

Age (in weeks)	Feeding Regime			
	FFC	FW3	FW6	FW9
Day-old	42.4±0.5	42.2±0.6	42.4±0.7	42.7±0.5
1	112.0±2.3	109.9±1.2	111.2±1.3	109.4±1.6
2	213.9±5.8^{a}	186.0±6.8^{b}	177.9±7.9^{b}	194.3±7.1^{b}
3	352.7±11.2^{a}	306.0±15.5^{bc}	274.9±15.0^{c}	315.9±13.4^{ab}
4	496.9±14.7^{a}	450.0±24.1^{ab}	426.5±20.4^{b}	460.4±21.6^{ab}
5	691.4±23.6	659.1±32.0	652.1±26.5	690.4±25.5
6	938.1±32.3	902.3±38.9	901.2±33.7	910.6±30.0
7	1197.7±43.5	1109.6±40.3	1109.4±41.9	1174.2±40.6

$^{a---d}$ Means ± standard error in the same row with different superscripts are significantly different ($P \leq 0.05$). FFC= Full-fed control.

FW3= Feed withdrawal for 3 hours per day from 2 to 7 weeks of age.

FW6= Feed withdrawal for 6 hours per day from 2 to 7 weeks of age.

FW9= Feed withdrawal for 9 hours per day from 2 to 7 weeks of age.

Table 4. Effect of duration of feed withdrawal on body weight gain (g/bird/day).

Age (in weeks)	Feeding Regime			
	FFC	FW3	FW6	FW9
1	10.0±0.3	9.7±0.2	9.8±0.2	9.5±0.2
2	14.6±0.7^{a}	11.5±0.8^{b}	10.4±1.0^{b}	12.8±0.8^{ab}
3	19.8±1.3^{a}	17.1±1.6^{ab}	13.9±1.3^{b}	17.4±1.3^{ab}
4	19.5±1.2	20.6±1.5	21.7±2.0	20.3±1.6
5	28.5±2.0	29.8±1.7	32.2±1.2	31.3±1.7
6	35.2±2.7	34.8±1.8	35.6±1.6	31.5±1.6
7	36.2±1.9	32.6±3.8	34.9±2.1	37.7±2.3
Overall mean	22.9±0.9	22.4±0.9	22.7±0.9	22.6±0.9

a----d Means ± standard error in the same row with different superscripts are significantly different (P≤ 0.05). FFC= Full-fed control.
FW3= Feed withdrawal for 3 hours per day from 2 to 7 weeks of age.
FW6= Feed withdrawal for 6 hours per day from 2 to 7 weeks of age.
FW9= Feed withdrawal for 9 hours per day from 2 to 7 weeks of age.

Table 5. Effect of duration of feed withdrawal on daily feed consumption (g/bird).

Age (in weeks)	Feeding Regime			
	FFC	FW3	FW6	FW9
1	14.6±0.3	14.6±0.4	14.7±0.6	14.3±0.7
2	28.1±0.8^{a}	21.6±0.7^{b}	20.9±0.6^{b}	26.8±2.8^{a}
3	38.8±2.2	39.2±2.9	32.0±0.9	41.1±3.8|
4	50.6±4.1	51.1±6.9	46.8±3.3	51.6±2.2
5	70.1±6.5	65.5±8.5	67.6±2.1	71.0±1.5
6	86.7±2.6	90.5±5.5	83.4±2.7	92.4±8.8
7	98.7±2.6^{a}	74.3±4.2^{b}	77.5±8.9^{b}	103.7±7.9^{a}
Overall mean	55.3±6.5	51.0±6.0	49.0±5.9	57.3±7.0

a----d Means ± standard error in the same row with different superscripts are significantly different (P≤ 0.05). FFC= Full-fed control.
FW3= Feed withdrawal for 3 hours per day from 2 to 7 weeks of age.
FW6= Feed withdrawal for 6 hours per day from 2 to 7 weeks of age.
FW9= Feed withdrawal for 9 hours per day from 2 to 7 weeks of age.

Table 6. Effect of duration of feed withdrawal on feed conversion ratio (Kg feed/Kg gain).

Age (in weeks)	Feeding Regime			
	FFC	FW3	FW6	FW9
1	1.47±0.06	1.62±0.05	1.63±0.06	1.60±0.09
2	1.96±0.18	1.90±0.26	2.02±0.08	2.10±0.21
3	1.96±0.03	2.31±0.17	2.34±0.19	2.39±0.27
4	2.59±0.07	2.45±0.06	2.22±0.20	2.61±0.34
5	2.47±0.12[a]	2.27±0.08[ab]	2.10±0.12[b]	2.28±0.11[ab]
6	2.50±0.25	2.63±0.26	2.35±0.11	2.91±0.14
7	2.72±0.07	2.36±0.22	2.21±0.24	2.78±0.24
Overall mean	2.24±0.10	2.19±0.09	2.18±0.09	2.37±0.12

[a----d] Means ± standard error in the same row with different superscripts are significantly
different (P≤ 0.05). FFC= Full-fed control.
FW3= Feed withdrawal for 3 hours per day from 2 to 7 weeks of age.
FW6= Feed withdrawal for 6 hours per day from 2 to 7 weeks of age.
FW9= Feed withdrawal for 9 hours per day from 2 to 7 weeks of age.

Table 7. Effect of duration of feed withdrawal on carcass yield and carcass parts weights as percentage of live body weight.

Item (%)	Feeding Regime			
	FFC	FW3	FW6	FW9
Live body weight, (g)	1194.3±17.8	1157.5±32.1	1123.5±25.8	1155.0±26.5
Carcass weight, (g)	883.8±20.6	872.4±19.0	849.7±20.8	883.8±20.6
Carcass, (%)	74.0±0.1	75.3±0.9	74.0±0.5	73.6±0.5
Blood	3.3±0.3	4.0±1.1	3.3±0.1	4.0±0.5
Feet & Shank	4.7±0.1	4.9±0.3	4.8±0.3	4.6±0.1
Head	2.9±0.1[ab]	3.1±0.1[ab]	2.8±0.1[b]	3.1±0.1[a]
Neck	7.1±0.3[a]	7.1±0.3[a]	7.0±0.2[a]	6.1±0.2[b]
Drumsticks	11.4±0.3[a]	10.4±0.4[b]	10.5±0.2[b]	10.3±0.2[b]
Femurs	10.1±0.3	9.7±0.3	9.8±0.2	9.6±0.2
Drumsticks & Femurs	21.5±0.4[a]	20.1±0.3[b]	20.2±0.3[b]	19.9±0.3[b]
Breast	16.8±0.3	17.6±0.6	17.5±0.4	17.7±0.1
Wings	9.1±0.2	9.0±0.5	9.5±0.2	9.3±0.2
Back	14.9±1.0[b]	17.1±0.6[a]	14.9±0.5[b]	16.0±0.5[ab]
Skin	6.5±0.5[b]	7.0±0.3[ab]	6.5±0.2[b]	7.7±0.3[a]

[a----d] Means ± standard error in the same row with different superscripts are significantly different (P≤ 0.05). FFC= Full-fed control. FW3= Feed withdrawal for 3 hours per day from 2 to 7 weeks of age. FW6= Feed withdrawal for 6 hours per day from 2 to 7 weeks of age. FW9= Feed withdrawal for 9 hours per day from 2 to 7 weeks of age.

Table 8. Effect of duration of feed withdrawal on body organs weights and fat contents as percentage of carcass weight.

Item (%)	Feeding Regime			
	FFC	FW3	FW6	FW9
Body organs				
Carcass weight, (g)	883.8±20.6	872.4±19.0	849.7±20.8	883.8±20.6
Heart	0.40±0.01	0.43±0.03	0.43±0.02	0.40±0.03
Liver	3.07±0.17	3.08±0.13	2.82±0.13	3.00±0.11
Gizzard	2.74±0.09	2.48±0.10	2.62±0.18	2.85±0.16
Giblets	6.20±0.12	5.98±0.23	5.87±0.37	6.26±0.21
Proventriculus	$0.61±0.03^{b}$	$0.57±0.03^{b}$	$0.61±0.03^{b}$	$0.77±0.04^{a}$
Spleen	$0.19±0.03^{ab}$	$0.24±0.01^{a}$	$0.18±0.03^{ab}$	$0.16±0.02^{b}$
Gallbladder	$0.14±0.01^{b}$	$0.14±0.01^{b}$	$0.18±0.03^{ab}$	$0.23±0.02^{a}$
Intestine	5.89±0.43	6.05±0.61	5.87±0.16	6.47±0.21
Fat contents				
Abdominal fat	2.27±0.24	2.55±0.35	2.60±0.25	2.24±0.31
Subcutaneous fat	$0.72±0.22^{ab}$	$0.95±0.16^{a}$	$0.48±0.05^{b}$	$0.90±0.09^{ab}$
Gizzard fat	$1.42±0.20^{ab}$	$1.65±0.31^{a}$	$0.86±0.18^{b}$	$1.49±0.24^{ab}$
Neck	$2.56±0.30^{a}$	$1.74±0.15^{b}$	$1.58±0.17^{b}$	$1.48±0.14^{b}$
Drumsticks& Femurs	0.53±0.06	0.56±0.06	0.52±0.04	0.58±0.09
Heart	$0.03±0.01^{c}$	$0.16±0.02^{a}$	$0.09±0.03^{b}$	$0.07±0.01^{bc}$
Breast	$0.42±0.09^{b}$	$0.69±0.11^{ab}$	$0.87±0.21^{b}$	$0.95±0.19^{a}$
Total Fat	7.95±0.76	8.30±0.75	6.69±0.31	7.95±0.76

[a----d] Means ± standard error in the same row with different superscripts are significantly different (P≤ 0.05). FFC= Full-fed control. FW3= Feed withdrawal for 3 hours per day from 2 to 7 weeks of age. FW6= Feed withdrawal for 6 hours per day from 2 to 7 weeks of age. FW9= Feed withdrawal for 9 hours per day from 2 to 7 weeks of age.

Table 9. Effect of duration of feed withdrawal on mortality rate (%) and economic efficiency.

Item	Feeding Regime			
	FFC	FW3	FW6	FW9
Starter diet cost (LE)	1.15	1.06	0.95	1.16
Grower diet cost (LE)	1.61	1.60	1.53	1.64
Finisher diet cost (LE)	2.28	2.03	1.81	2.42
Total feed costs (LE)	5.04	4.69	4.29	5.22
Mortality Rate (%)	13.3	10.0	0.0	10.0
Depreciation costs (LE)	1.43	1.00	0.0	1.06
Total feed & Depreciation Costs (LE)	6.47	5.69	4.29	6.28
Final bird weight (kg)	1.198	1.110	1.109	1.174
Bird price (LE)	10.78	9.99	9.98	10.57
Net revenue per bird	4.31	4.30	5.69	4.29
Economic efficiency	0.67	0.76	1.33	0.68
Relative economic efficiency (%)	100	113	199	102

FFC= Full-fed control.
FW3= Feed withdrawal for 3 hours per day from 2 to 7 weeks of age.
FW6= Feed withdrawal for 6 hours per day from 2 to 7 weeks of age.
FW9= Feed withdrawal for 9 hours per day from 2 to 7 weeks of age.
Price of 1 kg of starter diet = 2.01 LE, Price of 1 kg of grower diet = 1.91 LE.,
Price of 1 kg of finisher diet = 1.76 LE, Price of 1 kg of live body weight. = 9.00 LE.
LE = Egyptian pound.

REFERENCES

Acre, J.; Berger, M. and Coellio, C.L. (1992). *Control of ascites syndrome by feed restriction techniques. J. Appl. Poult. Res. 1:1-5.*

Anonymous, (1997). *Feeding regimes for broilers. Poult. Int., 36:8, 46.*

Arce, M.J.; Lopez, C.C.; Avilla, G.E. and Tirado, A.J.F. (1989). *Restricted feeding of broilers to reduce mortality from ascites syndrome. Beast CD, 1989-8798.*

Austic, R.E. (1985). *Feeding poultry in hot and cold climates. Pages 123-136 in: Stress Physiology in Livestock. M. Yousef, ed. CRC Press, Boca Raton, FL.*

Beane, W.L.; Cherry, J.A. and Weaver, W.D. (1979). *Intermittent light and restricted feeding of broiler chickens. Poult. Sci., 58:567-571.*

Bowes, V.A.; Julian, N.J.; Leeson, S.L. and Stirtzinger, T. (1988). *Effect of feed restriction on feed efficiency and incidence of sudden death syndrome in broiler chickens. Poult. Sci., 67:1102-1104.*

Cherry, J.A. and Siegel, P.B. (1978). *Selection for body weight at eight weeks of age. 15. Feed passage and intestinal size of normal and dwarf chickens. Poult. Sci., 57: 336-340.*

Cooper, M.A.; Balog, J.M.; Halterman, K.; Kidd, B.; Milliken, L. and Anthony, N.B. (1998). *Effect of feed restriction in broilers raised at simulated high altitude. 1. Ascites incidence and weight gain. Southern Poult. Sci. Soc., 19 Annual Meeting Abstracts. Poult. Sci. Ass., Vol (77): 310.*

Dawoud, A.M. (1998). *Effect of environmental conditions on body compartments of broilers. Ph.D. thesis, faculty of Agriculture Cairo University, Egypt.*

Duncan, D.B. (1955). *Multiple range and multiple tests. Biometrics 11:42.*

Elliot, M.A. and Edwards, H.M. (1994). *Effect of genetic strain, calcium, and feed withdrawal on growth, tibial dyschondroplasia, plasma 1.25 dihydroxy cholecalciferol, and plasma 25-hydroxycholecalciferol in sixteen –day-old chickens. Poult. Sci., 73:570-580.*

Fontana, E.A.; Weaver, W.D.; Denbow, D.M. and Watkins, B.A. (1993). *Early feed restriction of broilers effects on abdominal fat pad, liver and gizzard weights, fat deposition and carcass deposition. Poult. Sci., 72 (2): 243-250.*

Katanabaf, M.N.; Dunnington, E.A.; and Siegel, P.B. (1989). *Allomorphic relationships from hatching to 56 days in parental lines and F1 crosses of chickens selected 27 generations for high or low body weight. Growth, Development and Aging, 52: 11-22.*

Khontabrab, S.; Nikki, T. and Nobukuni, K. (1997). *Effect of restricted feed intake on the growth of muscle and the fat deposition in broiler chicken. Japanese Poult. Sci., 34, 6: 363-372.*

Lilia, C.; Sperber, I. and Marks, H.L. (1985). *Postnatal growth and organ development in Japanese quail selected for high growth rate. Growth, 49:51-62.*

MacLeod, M.G. (1984). *Factors influencing the agreement between thermal physiology measurements and field performances in poultry. Archive Für experimental Veteinärmedizin (Leipzig) 38 (3): 399-410.*

Marsden, A.; Morris, T.R. and Cromatry, A.S. (1987). *The effects of constant environmental temperatures on the performance of laying pullets. British Poult. Sci., 28: 361-380.*

McGovern, RH.; Feddes, J.J.; Robinson, F.E. and Hanson, J.A. (1999). *Growth performance, carcass characteristics and the incidence of ascites in broilers in response to feed restriction and litter oiling. Poult. Sci., 78 (4): 522-528.*

McMurtry, J.P.; Rosebrough, R.W.; Plavink, I. and Cartwright, A.I. (1988). *Influence of early plane of nutrition on enzyme systems and subsequent tissue deposition. Pp. 329-341 in: Biomechanisms regulating growth and development, G.L. Steffens and T.S. Rumsey, ed.*

Mollison, B.; Guenter, W.; and Boycott, B.R. (1984). *Abdominal fat deposition and sudden death syndrome in broilers: The effects of restricted intake, early life caloric (fat) restriction, and calorie: protein. Poult. Sci., 63:1190-1200.*

National Research Council (1994). *Nutrient requirements of poultry. 9th rev. ed National.*

Nir, I.; Nitsan, Z.; Cherry, J.A.; Dunnington, E.A.; Jones, D.E.; and Siegel, P.B. (1987). *Growth-associated traits in parental and F1 populations of chickens under different feeding programs. 2. Ad libitum and intermittent feeding. Poult. Sci., 66:10-22.*

O'Sullivan, N.P.; Dunnington, E.A.; and Siegel, P.B. (1992). *Correlated responses in lines of chickens divergently selected for fifty-six-day body weight. 1. Growth, feed intake and feed utilization. Poult. Sci., 71:590-597.*

Palo, P.E.; Sell, J.L.; Piquer, F.J.; Vilaseca, L.; and Soto-Salonova, M.F. (1995). *Effect of early nutrient restriction on broiler chicken. 2. Performance and digestive enzyme activities. Poult. Sci.. 74 (9): 1470-1483.*

Payawal, S.J.P. (1996). *Feed restriction in broiler chicken: its influence on the growth and development of enzymes for protein digestion. Beast CD 1989-8/98 (PCARRD-Monitor, 24: 5, 7, 10, 13, 14).*

Petek, M. (1999). *The effects of feed removal during the day on some production traits and blood parameters of broilers. Turk. J. Vet. Anim. Sci., 24: 447-452.*

Pinchasov, Y. and Jensen, L.S. (1989). *Comparison of physical and chemical means of feed restriction in broiler chicks. Poult. Sci., 68:61-69.*

Plavnik, I.; and Hurwitz, S. (1985). *The performance of broiler chicks during and following a severe feed restriction at on early age. Poult. Sci., 64: 348-355.*

Plavink, I.; McMurty, J.P. and Rosenbrough, R.W. (1986). *Effects of early feed restriction in broilers. 1. Growth performance and carcass composition. Growth, 50: 68-76.*

Rosenbrough, R.W.; McMurtry, J.P.; Calvert, C.C. and Steel, N.C. (1988). *Energy repletion and lipid metabolism during compensatory gain in broiler chicks. Poult. Sci., 67: (Suppl.1) 146. (Abstr.).*

Rosenbrough, R.W.; Steel, N.C.; McMurtry, J.P. and Plavnik, I. (1986). *Effect of early feed restriction in broilers. II. Lipid metabolism. Growth 50:631-641.*

Saleh, K.; Attia, X.A.; and Younis, H. (1996). *Effect of feed restriction and breed on compensatory growth, abdominal fat and some production traits of broiler chicks. Beast CD 1989-8/98 (Achiv-furgeflugelkunde. 60, 4, 153-159).*

SAS (1996). *SAS User's Guide, statistics (6.2th ed.) Cary NC: SAS Institute Inc.*

Shlosberg, A.; Berman, E.; Bendheim, U. and Plavnik, I. (1991). *Controlled early feed restriction as a potential means of reducing the incidence of ascites in broilers. Avian Dis. 35:681-684.*

Suk, Y.O. and Washburn, K.W. (1995). *Effects of environmental temperature on growth, efficiency of feed utilization, carcass fatness and their association. Poult. Sci., 74: 285-296.*

Summers, J.D.; Spratt, D. and Atkinson, J.L. (1990). *Restricted feeding and compensatory growth for broilers. Poult. Sci., 69:1855-1861.*

Urdaneta-Rincon, M.; and Leeson, S. (2002). *Quantitative and qualitative feed restriction on growth characteristics of male broiler chicken. Poult. Sci., 81:679-688.*

Vo, K.V.; Burgess, C.H.; Adefope, N.A.; Wakefield, T. and Cattin, C. (1998). *Effect of feed restriction for various duration on stress response and compensatory growth of commercial broilers.*

Southern Poult. Sci. Soc., 19th Annual Meeting Abstracts. Poult. Sci. Ass., Vol. 77:111.

Zhong, C.; Nakaue, H.S.; Hu, C.Y. and Mirosh, L.W. (1995). *Effect of full feed and early feed restriction on broiler performance, abdominal fat level, cellularity and fat metabolism in broiler chicken. Poult. Sci., 74: 1636-1643.*

Zubair, A.K. and Leeson, S. (1996). *Changes in body composition and adiposity cellularity of male broilers subjected to varying degrees of early-life feed restriction. Poult. Sci., 75 (6): 719-728.*

الملخص العربى

تأثير طول وقت منع التغذيه بتأثير التغذيه حتى الشبع اثناء درجات الحراره العاليه علي الأداء الإنتاجي لكتاكيت اللحم

محمد الصغير محمد – محمد نبيل مقلد
قسم الإنتاج الحيواني والدواجن - كلية الزراعة - جامعة أسيوط

أجريت هذه الدراسة على مائه وعشرون كتكوت تسمين من سلاله شيفر البنى بغرض مقارنه طول وقت منع التغذيه والتغذيه حتى الشبع اثناء درجات الحراره العاليه علي الأداء الإنتاجي لكتاكيت اللحم ومعدل النفوق. قسمت الكتاكيت إلي أربع مجاميع: كونترول, ٣معاملات, وكل مجموعه اشتملت على ٣ مكررات وكل مكرره اشتملت على ١٠ كتاكيت. المجموعة الأولي تم فيها تغذية الكتاكيت إلي حد الشبع من عمر يوم حتى عمر ٤٩ يوم والمجماميع الثانية , والثالثه , والرابعه سحب الغذاء لمده ٣ , ٦ , ٩ ساعات كل يوم من عمر ٢ حتى ٧ اسابيع على التوالى. وكان متوسط درجه حراره العنبر من 26-٣٨°م. أمكن تلخيص النتائج المتحصل عليها كالتالي:

لا توجد اى اختلافات معنويه فى وزن الجسم النهائى, الغذاء المستهلك, وكفاءه التحويل الغذائى بين طيور المجموعه المغذاه حتى الشبع وطيور كل مجاميع التحديد الغذائى.ووجد ان معدل النفوق كان أقل فى كل مجاميع تحديد الغذاء عن المجموعه الكونترول, وكان معدل النفوق ١٣,٣ , ١٠,٠ , ٠,٠ , ١٠,٠% للمجاميع ١ , ٢ , ٣ , ٤ على التوالى.

لا توجد اى اختلافات معنويه بين المجاميع فى وزن الذبيحه والذبيحة, ونسب كل من الفخذ, الصدر, الجناحين, الدم, الاقدام والقصبه, القلب, الكبد, القونصه, الحوائج, الامعاء, دهن الفخذ والدبوس, الدهن الكلى. ولكن وجدت اختلافات معنويه بين المجاميع فى وزن الرأس, الجلد, المعده الغديه, الطحال, الصفراء, دهن البطن, دهن تحت الجلد, ودهن الصدر. ووجد ان كل مجاميع التحديد الغذائى لها نسبه فخذ ودبوس اكبر معنويا عن طيور المجموعه الكنترول.

هذا وتبين أن دهن رقبه طيورالمجموعه الكنترول أزداد معنويا عن كل مجاميع التحديد الغذائى, بينما نقص معنويا دهن القلب, وانخفض الدهن الكلى فى طيور المجموعه الثانيه بدرجه غير معنويه عن طيور المجموعه الكنترول.

ومن دراسه الجدوى الاقتصاديه, وجد ان الكفاءه الاقتصاديه زادت فى كل مجاميع تحديد الغذاء (الثانيه, الثالثه, الرابعه) بحوالى ١٣, ٩٩, ٢% على التوالى عن المجموعه الكنترول, وكانت المجموعه الثانيه أكفأ من الناحيه الاقتصاديه عن مجاميع تحديد الغذاء الاخرى.

بصفة عامة نستخلص أن انسب برنامج لتحديد الغذاء اثناء ارتفاع درجه الحراره هو منع الغذاء لمده ٦ ساعات فى اليوم من عمر ٢ الى ٧ اسابيع لانه يكون أكفأ اقتصاديا عن برامج تحديد الغذاء الاخرى, هذا إلى جانب أنه يؤدى الى انخفاض ترسيب الدهن وانعدام النفوق.