EFFECT OF EARLY FEED RESTRICTION ON BROILER PERFORMANCE, BLOOD AND CARCASS PARAMETERS UNDER SUMMER CONDITIONS.

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SUMMARY

This research work was designed to study early feed restriction effects on broiler production during Egyptian summer. One hundred ninety eight unsexed Cobb-500 broiler chickens were divided into six experimental treatments with three equal replications. All chicks were free fed starter diet during the first week. In the second week, the chicks in the control group were fed the starter diet ad libitum, but feed intake of the other experimental groups were restricted at levels of 20, 25, 30, 35 and 40%, respectively from the feed intake of the control group. At 2 weeks of age, one bird from each replicate was sacrificed to obtain blood samples. All the experimental chicks were free fed basal grower diet from 14 to 42 days-old. Broiler performance was evaluated by live weight, feed consumed and feed conversion. Carcass parameters and some blood constituents were also measured. The current results showed that feed restriction improved the marketing live body weight, feed utilization and economical efficiency of treated broiler chicks, with no negative effect on either carcass traits or blood parameters. It could be concluded that early feed restriction during the second week of life up to 35% of ad libitum feeding can enhance the marketing weight and improve the feed conversion of broilers as compared to the control treatment under summer conditions in Egypt.

Keywords: Broiler chickens, feed restriction and performance.

INTRODUCTION

Poultry may respond differently to feed restriction (FR) during the post-FR period, thus resulted in a compensatory growth and reached the growth of unrestricted birds (Zhan et al., 2007). They found that restriction of broiler feed for 4 h/day throughout 1 to 21 day-old resulted in no statistical differences among the final body weight of the experimental groups at 63 days of age. Extensive studies in poultry, particularly in broiler chickens, demonstrated inconsistency in the compensatory growth due to strain and age of broilers, FR duration and severity of FR during the post-FR period (Butzen et al., 2015). In the literature, FR was reported to improve feed utilization and decrease the fat deposition and leg problems in broiler chickens (Attia et al., 1995). As feed-restricted for 4 or 6 days throughout starter time (from 7 to 21 day-old), broilers displayed similar growth at marketing age as compared to that of the control group (Netshipale et al., 2012). On the other hand, feed restriction of broilers has been reported to reduce ascites, sudden death and leg problems and metabolic diseases (Santoso, 2002 and Chenxi et al., 2017). In addition, timing of feed restriction reduced the initial growth but achieved an optimal growth performance in broilers (Butzen et al., 2013). This experiment was designed to evaluate early feed restriction effects on broiler performance during summer season in Egypt.

MATERIALS AND METHODS

This experiment was done at Fac. of Agric., Mans. Univ., throughout August and September, 2018. One hundred ninety eight unsexed Cobb-500 broiler chicks (with an average initial live body weight of 47.2±0.15 g) were randomly assigned to six experimental treatments of three replications each. All chicks were fed the starter diet ad libitum during the first week. In the second week, the chicks in the control group were fed ad libitum the starter diet, but feed intake of the other experimental groups was...
restricted at levels of 20, 25, 30, 35 and 40%, respectively form the feed intake of the control group. At 2 weeks of age, one bird from each replicate was sacrificed to obtain blood samples. All the experimental chicks were free fed basal grower diet from 14 to 42 day-old. Diet formulation was performed on the basis of the tabulated data of nutrient composition of feed ingredients published by the (NRC, 1994). Table 1 show feed ingredients and calculated analysis of the diets which used in this experiment.

Broiler performance was evaluated by live weight, feed consumption and conversion efficiency. The chicks were kept in battery cages. The means of minimum and maximum ambient temperature and relative humidity were recorded daily indoor at 12 p.m. and 12 a.m. and the average weekly values are given in Table 2. Throughout the experiment, average live weight, feed consumed and conversion efficiency were determined weekly on a replicate. The feed price/kg gain was evaluated. Feeding economic efficiency (EEF) was determined as following equation:

\[ \text{EEF} = \frac{\text{Sale price of one kg gain} - \text{Feed cost of one kg gain}}{\text{Feed cost of one kg gain}} \]

Where 26 EGP is the price of one kg live weight of broiler chicks at the time of the experiment.

At 2 weeks of age (After feed restriction), one bird from each treatment was sacrificed to obtain blood samples. At 42-day-old, 3 birds/treatment were used to calculate carcass characteristics (percentages of carcass and edible organs). During slaughtering, heparinized blood samples were taken. Blood samples were centrifuged to obtain plasma. Plasma concentrations of total protein; Henry (1964), albumin; Doumas et al. (1971), triglycerides; Tietz (1995), cholesterol; Allain et al. (1974) and high density lipoprotein cholesterol (HDL-C; Sawle et al., 2002) were determined using diagnostic kits. Plasma concentration of low density lipoprotein-cholesterol (LDL-C) was also estimated according the following equation stated by Friedewald et al. (1972):

\[ \text{LDL-C} = \text{Total Cholesterol} - \left( \text{HDL-C} + \text{VLDL} \right) \]

where VLDL are very low-density lipoprotein = plasma triglycerides/5. Plasma globulin was calculated as plasma total protein - plasma albumin.

Total antioxidant capacity (TAC) and malondialdehyde (MDA) were determined according to Koracevic et al. (2001) and Mihara & Uohiyama (1978), respectively. Plasma alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were estimated by diagnostic commercial kits (Reitman &Frankel, 1957). Corticosterone concentration in blood plasma was determined (Jezová et al., 1994). One-way analysis of variance using Statgraphics (Rockville, 1991) was used to analyze the obtained data. The significance level of 0.05 was used to consider the differences among treatments were significant (Duncan, 1955). The following statistical model was used: \( Y_{ij} = \mu + F_i + e_{ij} \). Where: \( Y_{ij} = \) observed traits; \( \mu = \) the overall mean; \( F_i = \) effect of feed restriction; \( e_{ij} = \) experimental random error.
Table (1): Components and calculated analyses of broiler experimental diets.

| Components                  | Starter % | Grower % |
|-----------------------------|-----------|----------|
| Yellow corn                 | 64.5      | 70.7     |
| Soybean meal (44%)          | 10.7      | 9.2      |
| Dicalcium phosphate         | 1.8       | 1.8      |
| Limestone                   | 2.0       | 1.8      |
| Corn gluten meal (60%)      | 19.8      | 15.5     |
| Common salt                 | 0.3       | 0.3      |
| Vit. & min. Premix*         | 0.3       | 0.3      |
| L-Lysine HCl                | 0.6       | 0.4      |
| Total                       | 100       | 100      |

Air-dried calculated analysis**

|                | Starter | Grower |
|----------------|---------|--------|
| Metabolizable energy Kcal/Kg | 3157    | 3165   |
| Crude protein %             | 23.03   | 20.04  |
| EE %                        | 3.3     | 3.15   |
| CF %                        | 2.43    | 2.40   |
| Ca %                        | 1.18    | 1.10   |
| P %                         | 0.69    | 0.67   |
| Av. P %                     | 0.44    | 0.44   |
| Lysine%                     | 1.13    | 0.90   |
| Methionine%                 | 0.48    | 0.41   |
| Methionine+Cystine%         | 0.88    | 0.77   |
| EGP/kg diet                 | 6.0     | 6.0    |

* Each 3 kg premix contains: Vit. A,12,000,000 IU; Vit. D₃, 2,500,000 IU; Vit. E, 10 g; Vit. K₂, 2.5 g; Vit. B₂, 5 g; Vit. B₆, 1.5 g; Vit. B₁₂, 10mg; Biotin, 50mg; Folic acid, 1.0g; Nicotinic acid, 30mg; Pantothenic acid, 10g; Antioxidant, 10g; Mn, 60g; Cu, 10g; Zn, 55g; Fe, 35g; I, 1.0g; Co, 250mg and Se, 150mg.

** Calculated according to NRC (1994).

Table (2): Ambient temperature (AT) and relative humidity (RH) throughout the experimental period.

| Experimental weeks | AT, °C Minimum | Maximum | RH, % Minimum | Maximum |
|--------------------|----------------|---------|---------------|---------|
| 1                  | 30.0           | 36.4    | 50.3          | 81.0    |
| 2                  | 28.3           | 36.9    | 50.0          | 85.0    |
| 3                  | 28.0           | 35.6    | 54.3          | 82.9    |
| 4                  | 25.6           | 34.4    | 55.7          | 80.7    |
| 5                  | 26.7           | 35.9    | 52.1          | 80.7    |
| 6                  | 26.0           | 34.3    | 57.1          | 83.6    |

RESULTS AND DISCUSSION

Live body weight:

Table (3) shows the effect of quantitative feed restriction (FR) on the weekly body weight of Cobb500 broiler chicks. Live body weight of chicks was not affected by feed restriction in the first and fourth weeks of the experimental period. Significant differences were detected among the different treatments in bird's weight in the second, third, fifth and sixth week-old. At the second week of study, the feed restricted groups (T2, T3, T4 and T5) recorded significantly lower live body weights compared with the control group. At the third week of experiment, live body weights of the experimental groups subjected to 30 or 35% FR were not significantly different from the control chicks; however, the other groups (20, 25 or 40% FR) had significantly lower live body weights. At the fifth week of experiment, birds subjected to 30% FR displayed significantly higher live body weight compared with other experimental groups. Feed restriction at levels of 20, 25, 30 and 35% led to a significant improvement in live body weights of chicks at the sixth week of study compared with other experimental groups.
Our results agree with those of Gous and Cherry (2004), who found that early feed restriction caused a rapid growth in broiler chicks. The positive effect of FR on growth rate of chickens may be an improvement in the efficiency of feed utilization by birds (Lippens et al., 2000). In addition, Morais et al. (2017) found that feed restriction had improved the final body weight due to improvement in feed conversion. Teimouri et al. (2005) reported that levels of dietary dilution from 8 to 14 day-old positively affect broilers weight. Attia et al. (2017) found that feed restriction produced a compensatory growth in broiler chickens throughout the period from 15 to 35 days of age. Chenxi et al. (2017) found that body weight of restricted broilers was higher than the control counterparts.

On the contrary, Mahmood et al. (2007) illustrated that the broiler chickens reared under feed restriction for 3, 5 and 7 hours daily from the 8th to 28th day had lighter body weights than those reared under free feeding. Similarly, Njoku et al. (2012) reported that feed-restricted birds gained less weight than fully-fed birds.

Table (3): Effects of feed restriction on weekly body weight of broiler chicks.

| Treatment | Age in week | Initial wt, (g) | 1 | 2 | 3 | 4 | 5 | 6 |
|-----------|-------------|----------------|---|---|---|---|---|---|
| T1        |             | 47.1           | 132| 275a| 561a| 915| 1300a| 1833a|
| T2        |             | 47.3           | 130| 236bc| 527b| 897| 1347b| 1916ab|
| T3        |             | 46.5           | 130| 245b| 522b| 877| 1295bc| 1899ab|
| T4        |             | 47.3           | 132| 236bc| 549ab| 953| 1390b| 1981a|
| T5        |             | 47.4           | 134| 227a| 532ab| 880| 1315bc| 1915ab|
| T6        |             | 47.6           | 133| 203c| 486c| 843| 1265c| 1874bc|
| SEM       |             | 0.36           | 2.55| 5.24| 10.4| 27.04| 23.13| 25.88|
| Significance |        | NS             | NS | ** | NS | * | * | |

SEM = Standard error of the means; NS=Not significant; *=Significant at P≤0.05; **= Significant at P≤0.01

Weight gain:

Table (4) shows no differences among treatments of chicks in daily gain throughout the 1st, 3rd, 4th, and 6th weeks-old. Significant differences were found among the experimental broilers throughout the 2nd and 5th weeks of age and total experimental period (1-6 weeks of age). During 2nd week of study, ad libitum feeding (T1) caused significantly higher (P≤0.01) daily body weight gain than the other experimental groups. Feed restriction had a beneficial effect on daily weight gain of chicks in the fifth week of study compared with ad libitum feeding (the control group). During the whole experimental period, feed restriction at levels of 20, 30 and 35% led to a positive effect in daily gain of chicks comparing with other experimental groups suggesting that growth compensation occurred. In this connection, Zubair and Leeson (1996) indicated that decreasing live body weight during early feed restriction in chickens could be recovered by compensatory growth during 20-25 days after re-feeding period.

In agreement with the obtained results, Butzen et al. (2013) showed that feed restriction had a compensatory growth in broiler chickens. Cristiano et al. (2013) reported that increasing levels of feed restriction up to 40% reduced body weight gain on broiler chickens. In addition, Omosebi et al. (2014) found that broiler chickens kept under feed restriction (40 % for 6 weeks) had superior feed gain ratio compared with the control group. Kouki and Bergaoui (2016) found that broilers chickens reared under restricted feeding from 35 to 49 days of age had significantly higher weight gain during the re-feeding period comparing to the control.

On the contrary, David and Subalini (2015) revealed that feed restriction (3, 5 and 7 hours daily) did not significantly affect body weight gains of broiler chickens. Similarly, Chodová and Tůmová (2017) found that feed restriction (65-80%) had no significant effect on daily body weight gain of broilers.
Table (4): Daily gain (g) of broiler chicks as affected by feed restriction.

| Treatment | 1      | 2      | 3      | 4      | 5      | 6      | 1-6     |
|-----------|--------|--------|--------|--------|--------|--------|---------|
| T1        | 12.08  | 26.71  | 36.86  | 50.64  | 55.00  | 76.19  | 42.53   |
| T2        | 11.80  | 14.94  | 38.19  | 52.88  | 64.29  | 81.33  | 44.49   |
| T3        | 11.88  | 16.49  | 36.07  | 50.67  | 59.76  | 86.33  | 44.11   |
| T4        | 12.08  | 15.06  | 41.29  | 57.76  | 62.38  | 84.46  | 46.05   |
| T5        | 12.40  | 13.46  | 40.29  | 49.71  | 62.14  | 85.76  | 44.47   |
| T6        | 12.19  | 9.91   | 37.55  | 51.02  | 60.24  | 86.95  | 43.48   |
| SEM       | 0.37   | 2.38   | 1.34   | 3.09   | 1.36   | 2.96   | 0.62    |

Table (4): Daily gain (g) of broiler chicks as affected by feed restriction.

| Treatment | Week of study |
|-----------|---------------|
| T1        | 15.66         |
| T2        | 12.57         |
| T3        | 11.48         |
| T4        | 25.76         |
| T5        | 12.19         |
| T6        | 24.27         |

SEM = Standard error of the means; NS = Not significant; *= Significant at P≤0.05; **= Significant at P≤0.01

Feed intake:

Data of Table (5) show daily feed intake of Cobb500 broiler chicks reared under feed restriction. Feed restriction had a significant effect on feed consumption throughout the 2nd and 5th weeks-old and total experimental period (1-6 weeks of age). Feed restriction had no effect on daily feed intake of broilers during of 1st, 3rd, 4th and 6th week-old. The control birds had significantly higher daily feed intake than the other experimental groups at the second week of age. At the 5th week of age, chicks subjected to 20% FR consumed significantly more feed than that of the control birds but other groups were not significantly different from the control. During the total experimental period, daily feed intake of chicks subjected to 40% FR was significantly lower than that of the control birds.

In agreement with the present results, Hassanien (2011) reported that birds kept under higher levels of feed restriction consumed a little feed. Omosebi et al. (2014) found that broiler reared under restriction (40% for 6 weeks) had significantly reduced feed intake. Adeyemi et al. (2015) reported that broiler chicks kept under feed restricted (80-75%) decreased daily feed intake.

However, Khetani et al. (2009) illustrated that feed restricted broilers led to an increase in feed intake. Also, Lanhui et al. (2011) found a higher feed consumption by control birds compared to feed-restricted groups. Jananpour et al. (2013) reported that broiler exposed to early feed restriction had an increased feed intake. Attia et al. (2017) found that feed restriction during the 7-14 d of age consumed feed without significant differences in feed intake. Novele et al. (2008) reported that feed intake was significantly reduced by feed restriction.

Table (5): Effects of feed restriction on daily feed intake of broiler chicks.

| Treatment | Week of study |
|-----------|---------------|
| T1        | 17.84         |
| T2        | 16.86         |
| T3        | 17.71         |
| T4        | 17.19         |
| T5        | 16.86         |
| T6        | 16.82         |
| SEM       | 0.82          |

SEM = Standard error of the means; NS = Not significant; *= Significant at P≤0.05; **= Significant at P≤0.01

Feed conversion ratio and economical efficiency:

Table (6) shows feed restriction effects on feed conversion of Cobb500 broiler chicks. The feed restriction of broiler chicks did not affect feed conversion ratio during the 1st, 2nd, 3rd, 4th, 5th and 6th weeks of age. However, there was a significant effect of feed restriction on feed conversion of broiler chickens during total experimental period (1-6 weeks of age). Feed restriction at levels of 20, 25, 30, 35
or 40% led to a significant improvement in feed conversion ratio and economical efficiency of feeding of chicks during the entire experimental period comparing to the control. The broiler feed conversion improvement may be due to decreased feed intake and increased growth (Hassanien et al., 2013).

Regarding to our results, Mahmood et al. (2007) and Onbasilar et al. (2009) reported that broilers kept under feed restriction had an improvement in feed utilization. Similarly, Mehmood et al. (2013) found that feed restriction improved feed conversion ratio in broiler chickens. In addition, Omosebi et al. (2014) found that broilers reared under feed restriction (40% for 6 weeks) had improved feed conversion ratio. Furthermore, Adeyemi et al. (2015) found that feed restriction (30%) improved feed conversion ratio of broiler chickens. Additionally, Afsharmanesh et al. (2016) found that feed restriction (50% of ad libitum feed between 6 to 12 days of age) significantly improved feed conversion ratio compared with group fed free during the starter period (1 to 21 day-old). Chenxi et al. (2017) reported that feed conversion of the feed restricted group (10% of energy and protein from 8 to 14 day-old) was significantly better than the control. Similar findings were obtained by Kouki and Bergaoui (2016), who found that broiler chickens exposed to feed restriction had superior feed conversion ratio during the re-feeding period compared to that of the ad libitum-fed group.

However, David and Subalini (2015) revealed that feed restriction (3, 5 and 7 hours daily) did not affect feed conversion of broiler chicks. Chodová and Tůmová (2017) found that feed restriction (65-80%) did not affect feed conversion of broilers.

Our results agree with those of David and Subalini (2015), who found that feed restriction of broiler improved the economical efficiency of broiler chickens.

**Table (6): Effects of feed restriction on feed conversion ratio and economical efficiency of feeding (EEF) for broilers.**

| Treatment | Week of study | EEF |
|-----------|--------------|-----|
|           | 1            | 2   | 3    | 4    | 5    | 6    | 1-6  |
| T1        | 1.48         | 1.70 | 2.14 | 1.91 | 2.10 | 1.93 | 1.95<sup>a</sup> | 1.227<sup>a</sup> |
| T2        | 1.43         | 2.17 | 1.87 | 1.91 | 1.96 | 1.85 | 1.86<sup>b</sup> | 1.326<sup>b</sup> |
| T3        | 1.50         | 1.84 | 1.93 | 1.98 | 1.92 | 1.69 | 1.81<sup>c</sup> | 1.394<sup>c</sup> |
| T4        | 1.43         | 1.88 | 1.83 | 1.78 | 1.95 | 1.78 | 1.79<sup>c</sup> | 1.416<sup>c</sup> |
| T5        | 1.36         | 1.97 | 1.78 | 2.02 | 1.97 | 1.73 | 1.80<sup>c</sup> | 1.403<sup>c</sup> |
| T6        | 1.38         | 2.55 | 1.89 | 1.88 | 1.89 | 1.70 | 1.80<sup>c</sup> | 1.413<sup>c</sup> |
| SEM       | 0.08         | 0.21 | 0.09 | 0.14 | 0.05 | 0.06 | 0.02 | 0.0212 |
| Significance | NS | NS   | NS   | NS   | NS   | NS   | **  | **   |

<sup>a-c</sup>: Means within column with different superscripts are significantly different.

<sup>SEM = Standard error of the means; NS=Not significant; *=Significant at P≤0.05; **= Significant at P≤0.01</sup>

**Blood parameters:**

Blood plasma parameters of Cobb500 broiler chickens at two and six weeks-old are shown in Table (7). No significant differences were found in plasma concentration of total protein, albumin, globulin, triglycerides, cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), very low-density lipoprotein (vLDL), total antioxidant capacity (TAC) and malondialdehyde (MDA). Also, aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were not affected by feed restriction at 2 or 6 weeks of age. There were significantly increase in plasma levels of corticosterone due to feed restriction. The high levels of corticosterone were recorded with the high levels of feed restriction percent (30, 35 and 40% from free feeding) comparing to their control.

In agreement with our results, Kumar et al. (2015) reported that feed regimen had no negative effect on activity of liver enzymes (AST and ALT) or protein metabolism at 14 (end of restriction period) and 35 days of age. Similarly, Adeyemi et al. (2015) found that serum concentrations of total protein, albumin and globulin were not affected by 15 or 30% feed restriction. Afsharmanesh et al. (2016) found that blood levels of total cholesterol, HDL, LDL and triglycerides of broilers were not influenced by feed restriction at a level of 50% from day 6 to day 12. Chenxi et al. (2017) reported that feed restriction had no effect on the plasma total protein, albumin or globulin of broilers.

On the other hand, Nassef et al., (2015) found that, broilers subjected to feed restriction by 20% from 7 to 21 days had significantly low blood content of triglycerides, but the blood concentration of...
cholesterol, HDL, vLDL, ALT, AST, total protein, albumin and globulin were not differ from the control group. Jahanpour et al. (2015) found that feed restriction (4 h per day from 7 to 21 days of age) significantly increased plasma concentration of albumin but decreased plasma levels of cholesterol, glucose and triglyceride of broilers. In addition, Attia et al. (2017) found that feed restriction significantly increased plasma albumin but decreased total cholesterol while plasma levels of total protein, globulin, total antioxidant capacity (TAC) and malondialdehyde (MDA) were not affected. Increased corticosterone concentration in broiler plasma may be depend on condition of stress and the metabolic effect of feed restriction, as corticosterone is involved in regulation of blood glucose levels (Hoching et al., 1996; De Jong et al., 2002 and Mench, 2002).

### Table (7): Feed restriction effects on blood plasma constituents of broiler chickens at 2 and 6 weeks of age.

| At two weeks old | Treatment | T1 | T2 | T3 | T4 | T5 | T6 | SEM | SL |
|------------------|-----------|----|----|----|----|----|----|-----|----|
| Total protein g/dl |           | 4.37 | 4.25 | 4.74 | 4.87 | 4.67 | 5.02 | 0.20 | NS |
| Albumin g/dl      |           | 2.32 | 2.32 | 2.53 | 2.63 | 2.57 | 2.68 | 0.10 | NS |
| Globulin g/dl     |           | 2.06 | 1.93 | 2.20 | 2.24 | 2.10 | 2.35 | 0.12 | NS |
| Cholesterol mg/dl |           | 141.7 | 147.2 | 138.3 | 153.5 | 153.5 | 140.7 | 6.96 | NS |
| Triglycerides mg/dl |        | 117.1 | 119.9 | 120.1 | 122.4 | 117.1 | 108.8 | 5.34 | NS |
| HDL mg/dl         |           | 38.6 | 44.5 | 44.3 | 45.9 | 45.9 | 44.1 | 46.0 | 4.86 |
| vLDL mg/dl        |           | 23.4 | 24.0 | 24.0 | 24.5 | 23.4 | 21.8 | 1.07 | NS |
| LDL mg/dl         |           | 79.8 | 78.7 | 69.9 | 83.2 | 85.9 | 73.0 | 6.01 | NS |
| AST U/l           |           | 63.6 | 51.8 | 62.0 | 74.8 | 70.4 | 75.1 | 6.05 | NS |
| ALT U/l           |           | 17.3 | 18.5 | 19   | 21.1 | 17.4 | 17.9 | 1.37 | NS |
| TAC mM/ml         |           | 1.21 | 1.28 | 1.14 | 1.26 | 1.10 | 1.11 | 0.06 | NS |
| MDA nmol/ml       |           | 19.8 | 17.7 | 19.7 | 22.5 | 21.2 | 23.6 | 1.42 | NS |
| Corticosterone nm/dl |       | 1.23 | 1.42 | 1.93 | 2.19 | 3.45 | 3.54 | 0.25 | ** |

| At six weeks old  | Treatment | T1 | T2 | T3 | T4 | T5 | T6 | SEM | SL |
|------------------|-----------|----|----|----|----|----|----|-----|----|
| Total protein g/dl |           | 3.92 | 4.35 | 4.23 | 4.33 | 4.31 | 4.28 | 0.25 | NS |
| Albumin g/dl      |           | 2.04 | 2.17 | 2.31 | 2.17 | 2.22 | 2.19 | 0.12 | NS |
| Globulin g/dl     |           | 1.88 | 2.18 | 1.92 | 2.16 | 2.09 | 2.09 | 0.14 | NS |
| Cholesterol mg/dl |           | 177.1 | 164.6 | 165.0 | 155.4 | 161.7 | 156.0 | 8.03 | NS |
| Triglycerides mg/dl |       | 130.8 | 117.5 | 120.8 | 120.6 | 134.2 | 123.3 | 5.41 | NS |
| HDL mg/dl         |           | 61.7 | 55.2 | 56.7 | 58.1 | 55.7 | 50.9 | 4.39 | NS |
| vLDL mg/dl        |           | 26.2 | 23.5 | 24.2 | 24.1 | 26.8 | 24.7 | 1.08 | NS |
| LDL mg/dl         |           | 89.3 | 85.9 | 84.1 | 73.2 | 79.2 | 80.5 | 7.93 | NS |
| AST U/l           |           | 83.8 | 77.4 | 79.3 | 76.3 | 86.0 | 72.1 | 4.93 | NS |
| ALT U/l           |           | 19.2 | 18.4 | 21.4 | 20.6 | 23.5 | 22.9 | 1.48 | NS |
| TAC mM/ml         |           | 1.41 | 1.34 | 1.53 | 1.43 | 1.39 | 1.19 | 0.12 | NS |
| MDA nmol/ml       |           | 22.3 | 27.2 | 26.7 | 32.2 | 29.5 | 31.6 | 2.13 | NS |
| Corticosterone nm/dl |       | 3.63c | 4.38abc | 4.11bc | 4.54ab | 4.88c | 4.96c | 0.22 | ** |

a-c: Means within column with different superscripts are significantly different.

SEM = Standard error of the means; NS=Not significant; *=Significant at P≤0.05; **= Significant at P≤0.01

### Carcass parameters:

In Table (8), carcass parameters of Cobb500 broiler chicks at 6 week-old as affected by feed restriction. Carcass traits were not significantly affected by feed restriction. Feed restriction did not affect relative weights of carcass traits, total edible parts (TEP) or inedible parts (IEP) of broiler chickens.

Our results agree with those of Cristiano et al. (2013) who found that carcass and breast percentage were not affected by feed restriction of broilers. Similar results were found by David and Subalini (2015) who reported that feed restriction (3, 5 and 7 hours daily) had no effect on carcass characteristics of broiler chickens. Furthermore, Kouki and Bergaoui (2016) reported that carcass yield of chicken was not affected by feed restriction when compared with ad libitum-fed group. Recently, Saber (2016) found that carcass traits of feed restricted broilers were not significantly affected.

In disagreement with the obtained results, Tumova et al. (2002) mentioned that broiler carcass weight was increased in response to feed restriction. Saleh et al. (2005) found that feed restriction significantly
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reduced carcass percent of broilers. In addition, Onbasilar et al. (2009) reported that broiler reared under feed restriction had significantly lower heart weight compared with those fed control diet. Similarly, Boostani et al. (2010) found that the feed restriction reduced weights of breast and abdominal fat of broiler chicks as comparing to the control. Jalal and Zakaria (2012) reported that broiler chickens kept under feed restriction exhibited significant differences in dressing percentage when compared with chicks fed ad libitum. Additionally, Mirshamsollahi (2013) reported that chickens reared under feed restriction displayed significantly higher carcass weight and lower abdominal fat pad weight as compared to the control group.

Table (8): Feed restriction effects on carcass traits of 42-day-old broilers.

| Treatment | LBW (g) | Carcass % | Liver % | Gizzard % | Heart % | Giblets % | TEP % | IEP % |
|-----------|---------|-----------|--------|-----------|--------|-----------|-------|-------|
| T1        | 2000    | 71.6      | 1.71   | 1.46      | 0.47   | 3.64      | 75.21 | 24.79 |
| T2        | 1997    | 72.6      | 1.82   | 1.72      | 0.51   | 4.05      | 76.67 | 23.33 |
| T3        | 2043    | 73.4      | 1.82   | 1.76      | 0.48   | 4.05      | 77.43 | 22.57 |
| T4        | 2068    | 71.8      | 1.95   | 1.62      | 0.49   | 4.06      | 75.85 | 21.15 |
| T5        | 2051    | 72.5      | 1.81   | 1.67      | 0.48   | 3.96      | 76.48 | 23.52 |
| T6        | 2040    | 73.7      | 1.88   | 1.79      | 0.48   | 4.15      | 77.88 | 22.12 |
| SEM       | 41.2    | 1.36      | 0.08   | 0.08      | 0.02   | 0.12      | 1.35  | 1.35  |
| Significance | NS    | NS        | NS     | NS        | NS     | NS        | NS    | NS    |

**TEP**: Total edible parts, **IEP**: Inedible parts.
**NS**=Not significant

CONCLUSION

It could be concluded that early feed restriction during the second week of life up to 35% of ad libitum feeding can enhance the marketing weight and improve the feed conversion and economical efficiency of broiler chickens comparing with their control under summer conditions in Egypt.

REFERENCES

Adeyemi, O. A., Njoku, C. P., Odunbaku, O. M., Sogunle, O. M. and Egbeyale, L.T. (2015). Response of Broiler Chickens to Quantitative Feed Restriction with or without Ascorbic Acid Supplementation. Iranian Journal of Applied Animal Science 5(2), 393-401

Afsharmanesh, M., Lotfi, M., and Mehdipour, Z. (2016). Effects of wet feeding and early feed restriction on blood parameters and growth performance of broiler chickens. Animal Nutrition, 2: 168-172.

Allain, C. A., Pon, L. S., Chang, C. S. G., Richmond, W., and Fu, P. C. 1974. Enzymatic determination of total serum cholesterol. Clinical Chemistry, 20, 470-475.

Attia Y. A., Abd-Elhamid E. Abd-Elhamid, Mustafa M., Al-Harthi, M. A. and Muhammad Mai (2017). Response of slow-growing chickens to feed restriction and effects on growth performance, blood constituents and immune markers. Rev Mex Cienc Pecu; 8(2):175-184

Attia, Y. A., Osman, Mona, Abou-Egla, El-Samra, and El-Deek A. A. (1995). Response of growth, feed conversion and characteristics of broiler chicks to feed restriction methods, time and diet quality. Mansoura Univ. J AgricSci; (20):3261-3282.

Boostani, A., Mahmoodian F. H. R. and Kamalzadeh (2010). Comparison of the effects of several feed restriction periods to control ascites on performance, carcass characteristics and hematological indices of broiler chickens. Brazilian Journal of Poultry Science. 12(3): 171 – 177.
Butzen, F. M., Ribeiro, A. M. L., Vieira, M. M., Kessler, A. M., Dadalt, J. C., and Della, M. P. (2013). Early feed restriction in broilers. I—Performance, body fraction weights, and meat quality. The Journal of Applied Poultry Research. (22): 251-259.

Butzen, F. M., Vieira, M. M., Kessler, A. M., Arístimuñha, P. C., Marx, F. R., Bockor, L., and Ribeiro, A. M. L. (2015). Early feed restriction in broilers. II: Body composition and nutrient gain. J Appl Poult Res: (24):198-205.

Chenxi Xu, Haiming Y., Zhiyue W, Yan W, Banghong H and Chuan L (2017). The effects of early feed restriction on growth performance, internal organs and blood biochemical indicators of broilers. Animal and Veterinary Sciences, 5(6):121-125.

Chodová, D., and Tůmová, E. (2017). Feed restriction and muscle fiber characteristics of pectoralis major in broiler chickens (2017). Scientia Agriculturae Bohemica, 48, (1): 8–12.

Cristiano, B., Müller, J. I. F., Paulo, J. C., Jacob, T. G., Gonçalves, A.F.E. and Karen P. (2013). Quantitative feed restriction from 35 to 42 days of age for broiler chickens. Rev. Bras. Saúde Prod. Anim., Salvador, 14(4):778-784.

David, L. S., and Subalimi, E. (2015). Effects of Feed restriction on the growth performance, organ size and carcass characteristics of Broiler chickens. Sch J Agric Vet Sci; 2(2A):108-111.

De Jong, I.C., van Voorst, S., Ehlhardt, D.A. and Blokhuis, H.J. (2002). Effects of restricted feeding on physiological stress parameters in growing broiler breeders. Br. Poult. Sci. 43, 157–168.

Doumas, B. T., Watson, W. A. and Biggs, H. G. (1972). Albumin standards and the measurement of serum albumin with bromocresol green. Clin. Chim. Acta, 31, 87-96. https://doi.org/10.1016/0009-8981(71)90365-2

Duncan, D.B. (1955). Multiple ranges and multiple f-test, Biometrics 11: 1-42.

Friedewald, W.T., R.I. Levy and D.S. Fredrickson (1972). Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clinical Chemistry, 18(6): 499-502.

Gous, R. M. and Cherry, P. (2004). Effects of body weight at, and lighting regimen and growth curve to, 20 weeks on laying performance in broiler breeders, British Poultry Science 4(4): 452–454.

Hassanien H.H.M. (2011). Productive performance of broiler chickens as affected by feed restriction systems. Asian J. Poult. Sci. 5(1): 21-27.

Hassanien H. H. M., Abdel-Wareth A. A. A. and El-Deek A. A. (2013). Interaction effects between feed physical form and feed restriction on performance and carcass characteristics of broilers. Egypt. J Anim Prod; 50:19-26.

Henry, R. J. 1964. Clinical Chemistry: Principles and Techniques. Harper and Row Publishers, NewYork.

Hocking, P.M., Maxwell, M.H. and Mitchell, M.A. (1996). Relationships between the degree of food restriction and welfare indices in broiler breeder females. Br. Poult. Sci. 37, 263–278.

Jahanpour, H., Seidavi, A., Qotbi A.A.A., and Carreira R. P. (2013). Effects of Two Levels of Quantitative Feed Restriction for a 7- or 14- Days Period on Broilers Blood Parameters. Acta Scientiae Veterinariae. 41: 1-11.

Jahanpour H, Seidavi A, Qotbi AAA, Van Den Hoven R, Rocha e, Silva S, Laudadio V. and Tufarelli V (2015). Effects of the level and duration of feeding restriction on carcass components of broilers. Arch Anim Breed; 58: 99-105.

Jalal, M. A. R. and Zakaria, H. A. (2012). The effect of quantitative feed restriction during the starter period on compensatory growth and carcass characteristics of broiler chickens. Pakistan Journal of Nutrition 11 (9): 719-724.

Jezová, D., Guillame, V., Juránková, E., Carayon, P. and Oliver, C. (1994). Studies of the physiological role of ANF in ACTH regulation. Endocr. Regul. 28, 163–169.

Khetani, T. L., Nkukwana, T. T., Chimonyo, M. and Muchenje, V. (2009). Effect of quantitative feed restriction on broiler performance, Tropical Animal Health and Production 41:379–384.
Sherif and Mansour

Koracevic, D., Koracevic, G., and Djordjevic, V. (2001). Method for the Measurement of Antioxidant Activity in Human Fluids. Journal of Clinical Pathology, 54, 356-361. http://dx.doi.org/10.1136/jcp.54.5.356

Kouki, C., and Bergaoui, R. (2016). Interest of the use of quantitative feed restriction in the production of heavy broilers. Journal of new sciences, Agriculture and Biotechnology, 35(4), 196-1968

Kumar Sunil, Dutta Narayan, Balian S, Pattanaik AK and Singh SK (2015). Effect of feed restriction on nutrient metabolism, metabolic profile and excretion of nutrients in goats. Anim Nutr Feed Technol; 15: 361-374.

Lanhui L., Zhao G., Ren Z., Duan L., Zheng H., Wang J. and He Y. (2011). Effects of early feed restriction programs on production performance and hormone level in plasma of broiler chickens. Front. Agric. China. 5, 94-101.

Lippens, M., Room, G., De Groote, G. and Decuyper, E. (2000): Early and temporary quantitative food restriction of broiler chickens. 1. Effects on performance characteristics, mortality and meat quality, British Poultry Science 41:343–354.

Mahmood, S., Mehmood, S., Ahmad, F., Masood, A. and Kausar, R. (2007). Effects of feed restriction during starter phase on subsequent growth performance, dressing percentage, relative organ weight and immune response of broilers, Pakistan Veterinary Journal 27:137-141.

Mehmood, S., Sahota, A.W., Akram, M., Javed, K., Hussain, J., Sharif, H., Haroon, S., and Jatoi, A.S. (2013). Influence of feed restriction regimes on growth performance of broilers with different initial weight categories. The J. Anim Plant Sci., 26 (3): 1522-1526.

Mench, J.A., 2002. Broiler breeders: feed restriction and welfare. World Poultry Sci. J. 58, 27–33.

Mihara, M., and Uchiyama, M. (1978). Determination of malonaldehyde precursor in tissues by thiobarbituric acid test. Anal. Biochem., 86(1):271-278. https://doi.org/10.1016/0003-2697(78)90342-1

Mirshamsollahi A. (2013). Effect of different food restriction on performance and carcass characteristics of Arian and Ross broiler chickens. International Journal of Agriculture: Research and Review. 3(3): 495-501.

Morais, B. C., Netto, D. A., Alves, J. R. and Lima, H. J. D. (2017). Effect of early feed restriction on body weight and compensatory growth in Label Rouge broiler chickens. Acta Agronómica. 66 (4):606-611.

Nassef, E.; Shukry, M. and Kamal, T. (2015). Effect of feed restriction on growth performance, sudden death syndrome and some blood parameters in broilers chickens. Assiut Vet. Med. J. 61 (147): 204-209.

Netshipale, A. J., Benyi K., Baloyi J. J., Mahlako K. T., and Mutavhatsindi T. F (2012). Responses of two broiler chickens strains to early-age skip-a-day feed restriction in a semi-arid subtropical environment. African J Agr. Res.; (7): 6523-6529.

Njoku, C.P., Aina A.B.J., Sogunle O.M., Adeyemi O.A. and Oduguwa O.O. (2012). Influence of feed quantity offered on growth performance, carcass yield,organ weight and back fat composition of finishing pigs. Nigerian J. Anim. Prod. 39(2),96-106.

Novele, D.J., Ng’ambi, J.W., Norris, D., and Mbajiorgu, C.A. (2008).Effect of sex, level and period of feed restriction during the starter stage on productivity and carcass characteristics of Ross 308 broiler chickens in South Africa. International Journal of Poultry Science 7 (6): 530-537.

NRC. 1994. Nutrient requirements of poultry. 9th rev. ed. National Academy Press, Washington DC

Onbasilar, E. E., Yalcin, S., Torlak, E. and Ozdemir, P. (2009): Effects of early feed restriction on live performance, carcass characteristics, meat and liver composition, some blood parameters, heterophile lymphocyte ratio, antibody production and tonic immobility duration, Trop. Anim. Health and Production 41:1513-1519.

Omoreibe, D.J., Adeyemi, O.A., Sogunle, M.O., Idowu, O.M.O., and Njoku, C.P. (2014). Effects of duration and level of feed restriction on performance and meat quality of broiler chickens. Arch. Zootec. 63 (244): 611-621.
تأثير تحديد الغذاء المبكر على الأداء الانتاجي ومقاييس الدم وصفاث الذبيحة لدجاج اللحم تحت ظروف الصيف

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أجريت هذه الدراسة لتقييم تأثير تحديد الغذاء المبكر على أداء دجاج اللحم خلال فصل الصيف في مصر. تم استخدام مادة ثنائية أنتهاء، وهو نمط من كنافة اللحم سلالة 500 Cobb غير المجندة، وتوزيعها عشوائياً لاستمالة مجمعات تجريبية كل منها في ثلاثة مجموعات. تم تعذيب جميع الكتاكيت بحرية على العلبة أواءا في الأسواق الأول. في الأسبوع الثاني تم تغذية الكتاكيت في المجموعة الكثيرة على العلبة أواءا بحرية. بينما غذى بقية المجمعات التجريبية الأخرى على العلبة المبكرة بيعدين 20، 30، 35 و 40٪ على التوالي من الماكولات بواسطة المجموعة الكثيرة. عند عمر أسبوعين، تم إزالة فوق واحد من كل مكروا بالعلاقة للحصول على عيان الدم. تم تغذية جميع الكتاكيت بحرية على العلبة الواحدة عن طريق دجاج اللحم من معاكيا خلاص وزن الجسم الحي، والفاكهة من العلبة ومعامل النقل الغذائي. كما تم قيام الجودة وبعض معاييس الدم في نهاية التجربة.

أظهرت النتائج الحالية أن تحديد الغذاء أدى إلى تحسين وزن الجسم الحي في الصيف، ومع وجود تأثير ملحوظ على معاكيا النقل، أي معيى. يمكن استنتاج أن تحديد الغذاء المبكر خلال الأسبوع الثاني من العمر بنسبة تصل إلى 35٪ من الماكولات بحرية يمكن أن يحسن الأداء التروبيزي ويحسن معامل النقل الغذائي لدجاج اللحم مقارنة بالجميعة الكثيرة تحت ظروف الصيف في مصر.