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SELECTION AND CORRELATED RESPONSE FOR IMPROVING FEED CONVERSION FOR EGG PRODUCTION TRAIT IN MANDARAH STRAIN OF CHICKENS

By

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Abstract: *The present selection experiment was carried out over four successive generations with two linens (selected and control), which had been developed of Mandarah strain of chickens. The first line was selected for improving feed conversion for egg production till 40 weeks of age in Mandarah strains of chickens using individual selection and the second line was the control line.*

The results obtained indicated that, feed conversion of egg production till 40 weeks of age for males was 4.12 kg feed/kg eggs for selected line and 5.54 kg feed/kg eggs for control line in three generations. Morever, females consumed 4.71 kg feed/kg eggs for selected line and 5.54 kg feed/kg eggs for control line in four generations. Selection differentials mean of male was -0.84 kg/kg in two selected generations. The corresponding mean for females was, -0.79 kg feed/kg eggs. The realized and expected responses, were -0.52 and -0.30 for males, and were -1.49 and -0.42 for females over three generations, respectively.

Body weight at 8, 12, 16 and 40 weeks of age as well as at sexual maturity were different correlated with selection to improve feed conversion for egg production. After three generations of selection, the realized response for growth rate had a negative value (-1.1 and -4.1) for 8-12 and 12-16 weeks of age, respectively. However, the selection to improve feed conversion causes turning of body measurements at 8 and 16 weeks of age. Moreover, the selected line pullets significantly matured earlier than those of the control line –8.1 days in the three generations. Moreover, the realized response of age at sexual maturity was –1.7 days in the same generations, while the cumulative responses were –1.7 days. Selection for feed conversion increases egg number, egg weight, egg mass and the duration *period of the first ten eggs. Moreover, the cumulative responses for these traits were 1.5 eggs, 2.4g, 127.9g and 0.9 days, respectively.*

The realized heritability mean estimated for feed conversion for egg production based on sire plus dame component of variance in three generations was 0.18. The genetic correlations from full sibs between feed conversion till 40 weeks of age and egg production traits resulted in positive correlations with age at sexual maturity and egg weight, while negative correlations were found with body weight at sexual maturity, duration of the first 10 eggs, egg number and egg mass till 40 week of age.

It could be concluded that selection for feed conversion for egg production till 40 weeks of age in Mandarah strain of chickens increase egg number, egg weight as well as improved egg mass and duration period of the first 10 eggs. Also, reduced age at sexual maturity

INTRODUCTION

Feed conversion during laying period can be calculated as the amount of feed consumed (kg) to produce one-kilogram egg. Native breeds less convert feed to eggs, there are many attempts to improve this trait by selection indirectly. It is difficult for genetic improvement of this trait because this character expressed in a ratio and compound. Feed conversion of laying birds is affected by several factors such as: breed, age, activity, production and other environmental factor.

Egg production is the yield of overall performance of a bird concerning many variables such as egg number, egg weight as well as egg mass and age at sexual maturity. These variables are correlated with egg production and with each other in the positive or negative trends.

Selection is the first major method for improving productive traits. Few investigators have attempted to utilize the advantage of local breeds of chickens in Egypt such as Mandarah, El-Salam. Gimmizah, Bandara, Inshas, Dokki-4, strains...etc, by means of selection procedures and breeding programs. Many breeders (Abd El-Gawad *et al.*, (1983), Mahmoud *et al.* (1982), El-Hossari and Ragab, (1970), Bakir *et al.* 2002) have succeeded to improve some strains of standard breeds like Rhode Island Red and Leghorn chickens as medium and light breeds for egg production.

Local varieties of chickens are expected to be more adapted to the unfavorable local conditions, they could be utilized in the process of establishing a local hybrid for meat or egg production with foreign breeds. However, the productivity of these local strains of chickens is still inferior compared with the imported commercial hybrids. Although, these local strains of chickens contributed to national egg and meat production, they consumed more feed compared to foreign strains and showing poor feed conversion.

However, local breeds have lower growth traits (body weight and growth rate). Therefore, it is very important to develop such breeding programs to improve the productivity of specific local strains through which the national poultry production would be increased. Furthermore, the improved local strains and/or their hybrids could find a hopeful place in the African poultry market.

The present study is a part of the breeding program of the Animal Production Research Institute (APRI), for improving the productivity of the local Egyptian strains of chickens through selection. The specific aim of the study is apply to individual selection for feed conversion for egg production till 40 weeks of age in Mandarah strain of chickens. Moreover to estimate of some genetic parameters such as heritability coefficients, genetic and phenotypic correlations coefficients and others are also a job.

MATERIALS AND METHODS

The experimental work was conducted in Sakha Research Station, Kafr El-Sheikh, Animal Production Research Institute, Ministry of Agriculture, Egypt. The study started in December 2002 and was terminated in June 2006.

Management and Selection:

A total of 1000 day old Mandarah chicks were randomly selected at hatch from the flock of the station. All chicks were wing-banded to keep their pedigree and weighed to the nearest gram at hatch and until 20 weeks of age. On weighing days, the birds were fasted until weighting. The birds were vaccinated at hatch against Mark's disease and reared under conventional open-sided houses until they reached 20 weeks of age. The pullets were transferred to individual laying cages while, cockerels were moved to individual cages in cock's house until 40 weeks of age. During the first 6 weeks of age the birds received a starter ration containing 19.3 % protein and 2868 kcal/kg M.E. From 6 to 20 weeks of age, the birds received a grower ration containing 15.2 % protein and 2690 kcal/kg M.E. From 20-40 weeks of age, the birds received a layer ration containing 17.2 % protein and 2710 kcal/kg M.E. All the other nutritional requirements were covered for each age according to NRC (1995). The number of tested as well as selected sires and dams for each line during various generations are shown in Table (1).

Semen quality for each cockerel was conducted two weeks before starting the experiment. Random mating was applied in the control lines. Artificial Insemination was used according to Lake and Steuart (1978) during the production season by assigning about five to six females to each male.

Eggs were collected for incubation during ten days, kept in the storage room before setting in the incubator. Diets and water were supplied *ad libitum* during the study period, all birds were kept and reared under the same environmental conditions.

Selection was based on females of Mandarah were selected according to feed conversion for egg production till 40 weeks of age, which calculated as kg feed/kg egg mass during interval periods after maturation (period=4 weeks) till 40 weeks of age. Individuals selected of this strain that lower the overall mean, while males were selected according to performance of their mothers that have lower than mean in feed conversion for egg mass at 40 weeks of age. Therefore, in the base population selection in Mandarah strain were carried out in females only. The 20 selected males were mated with no attempted assorted mating, to the lowest 137 females from the selected line using about five to six females for each male. The only restriction was no full or half sib matings. All the hens were caged. At the same time about 500 eggs from the base flock were set with the eggs of the selected line to use as contemporary controls. The control chicks were reared intermingled with the selected line.

All management practices were the same as far as possible, within and between lines and generations. All the females were kept to study age at sexual maturity, body and egg weights at sexual maturity, number of days required to lay first 10 eggs, egg production, egg weight and feed conversion for egg production until 40 weeks of age. Body weight was recorded individually to the nearest gram for all birds at 8, 12, 16, and 40 weeks of age, growth rates were calculated biweekly at 8-12 and at 12-16 weeks of age for both sexes (Broody, 1945). Body measurements (shank length, keel length, and body circumferences were measured at 8 and 16 weeks of age to the nearest millimeter (mm).

All the previous measurements were obtained from all the hens of the selected and control lines every generation.

Selection differential (S) was calculated as the difference between the average of the selected birds as parents for a certain trait and the average of their population (Falconer, 1983).

Intensity of selection (I) was estimated according to Falconer (1983)

I = S / sd (S = is the selection differential & sd = is the standard deviation).

Density of selection (V) was calculated by the following equation.

V= Number of selected parents / Total number of parents population.

The realized direct and correlated responses were estimated according to the numerator of the following equation after Guill and Washburn (1974) for estimating realized heritability.

R=(Progeny selected – Parent selected) – (Progeny control – Parent control).

The expected response to selection (ER) was calculated according to the general equation (Falconer, 1983).

ER= Selection differential (S) x heritability (h^2).

Statistical analysis was using by Harvey program (1990) and statistical model was used as follows:

$$Y_{ijkl} = \mu + G_i + L_j + S_k + (GxL)_{ij} + (LxS)_{jk} + (GxS)_{ik} + (GxLxS)_{ijk} + e_{ijkl}$$

Where: Y_{ijkl}=an observation; μ=overall mean; G_i=effect of generation; L_j=effect of line; S_k=effect of sex; $(GxL)_{ij}$=interaction between generation and line; $(LxS)_{jk}$=interaction between line and sex; $(GxS)_{ik}$=interaction among generation and sex; $(GxLxS)_{ijk}$=interaction among generation, line and sex, e_{ijkl}= random error

The statistical analyses for egg production traits under study was as follows:

$$Y_{ijk} = \mu + G_i + L_j + (GxL)_{ij} + e_{ijk}$$

Where: Y_{ij}=an observations; μ=overall mean; G_i=effect of generation; L_j=effect of line; $(GxL)_{ij}$=interaction between generation and line; e_{ijk}= random error

The heritability, genetic and phenotypic correlations estimates were performed according to the following equation (Harvey, 1990).

$$Y_{ijk} = \mu + G_i + S_{ij} + D_{ijk} + e_{ijk}$$

Where: Y_{ijk}=an observations; μ=overall mean; G_i=fixed effect of i^{th} generation; S_{ij}=random effect of the j^{th} sire within i^{th} generation; D_{ijk}=random effect of the k^{th} dam within i^{th} sir, within j^{th} generation; e_{ijk}=random error.

RESULTS AND DISCUSSION

Selection differential:

Selection differential (S) and selection intensity (I) are presented in Table (2). As regard to females, it could be noticed that selection intensity (I) in the base generation was 0.64 and increased in the first and second generations being 0.87 and 0.80, respectively. However, the values of selection differential (S) was gradually decreased from the base to the end generation. This could be explained through the decrease of the variation as a result of selection. Selection usually exploits a large amount of variation in the first generations specially when the strain was not under selection.

Selection density (V) mean was 54.03 in three generation. The corresponding values for realized response for feed conversion till 40 week of age was -0.50 kg/kg,. Moreover, expected response to selection was -0.14 kg/kg in three generation.

Concerning males showed be noticed that selection intensity (I) in the first generation was 2.20 slightly decreased in the second generation to 2.15 due to the increasing of the present of selected parents (V). However, the values of selection differential (S) were gradually decreased (-0.90 and -0.77 kg/kg) from the first to second generation. This could be explained through the decrease of the variation as a result of selections.

Selection density mean was 3.7 in two generations. The corresponding value mean for realized response for feed conversion till 40 week of age was -0.26 kg/kg. Moreover, expected response mean to selection was -0.15 kg feed/kg eggs in two generation.

These results indicated that, the selection density for the males is higher than the females. However, the realized and expected response to selection is lower for the males than those the females, due to the fact that the males were taken the half of genetic values from their mothers. However, the direct selection for feed conversion of egg production for males cannot directly calculated by the males, so this trait was calculated for males as their mothers of the previous generation.

Selection response

Data in Table (2) showed that average of feed conversion till 40 weeks of age in three generations was 4.12 kg/kg for selected line and 5.54 kg/kg for control line for males, while females had 4.71 kg feed/kg eggs of selected line and 5.54 kg/kg for control line in four generations. Moreover, highly significant differences ($p \leq 0.001$) among generations and between lines and their interaction ($p \leq 0.01$) were found. These results may be due to the variations of genetic basis, which indicate that increasing egg mass and decreasing feed intake because this trait had a moderate heritability coefficient.

Highly variations among generations for females (from base population to the third generation) in selected line for feed conversion values were -1.59 kg/kg (5.82 and 4.23). The corresponding figures of males (from first generation to the third generation) were –0.38 kg/kg (4.34 and 3.96), while the control line for two sexes were -0.1 kg/kg (5.56 and 5.46), respectively (Table 2). This result may be due to the selection differential among generations. These results are in agreement with those findings by Ghanem, (1995) and Younis and Abd El-Ghany (2003) whose reported that improve feed conversion for egg production by selection for egg number in Silver Montazah strain and it ranged from 4.0 to 6.5 kg/kg, and with Saleh *et al.,* (2006) and Abd Ella, (2007) who reported similar findings of feed conversion on local strain under Egyptian condition.

Generally, the results pronounced that the realized response to selection (-0.52 for males and -1.49 for females) for feed conversion for egg production till 40 weeks of age for three generations in Mandarah strain as a local strain of chickens was higher than the expected response by using direct individual selection (Table 2). This result indicates that the direct individual selection gave greater improvement for feed conversion till 40 week of age and may be due to the large additive genetic variation among individuals of Mandarah population which needs continuous genetic improving and selection program to exploit the additive genetic effects nicking in the future.

Correlated response:

Body weight

Data presented in Table (3) showed that significant and highly significant differences among generations, lines and sexes were observed at 8, 12, 16 and 40 weeks of age, and at sexual maturity. Moreover, selected line had heavier body weight than control line for all ages during base, first, second and third generations. Significant differences ($p \leq 0.05$) were found between males and females at all ages during growing period and at 40 week of age.

Genetic improvement of feed conversion in laying hens has been realized mainly as a correlated response to selection for higher egg production level and through de liberate reduction of maintenance requirements by selection for a low adult body weight. According to their information, our results were similar to those reported by Enayat (2006), who found that after two generations of selection for part record egg production (egg weight and egg number) in two locales strains of chickens, body weight at 12 and 40 weeks of age were not change with selection for egg number, but it increased with selected for egg weight. The differences between selected and control lines over generations of selection may be revealing that, selection for feed efficiency means slightly change in body weight at different ages. Selection for egg number caused negative effect on body weight in males and females (Soltan, 1991).

The realized response for these traits had positive values (44.9, 45.1, 7.0 and 11.3 g) for 8, 12, 16 and 40 weeks of age, respectively. Moreover, it was negative value (-75.8 g) for body weight at sexual maturity, after three generations of selection for feed conversion (Table 4). These significant differences between selected and control lines over generations of selection may reveal that this local strain can compensate effectively the difference in growth at later ages.

Generally, body weight at different ages was different correlated with selection to improve feed conversion for egg production, because the feed conversion for egg production included some subject traits such as, egg mass (egg weight, egg number) and feed consumption, so body weight were negative response with egg number, but it is positive with egg weight and feed consumption.

Growth rate

Results presented in Table (5) showed that highly significant differences among generations and lines (selected and control), significant differences were found for the interaction between generation, line and generation, sex from the period 8-12 weeks of age. However, there were significant differences among generations and their interaction, but there were no differences among lines and sexes from the period 12-16 weeks of age. These results indicate that direct selection to improve feed conversion for egg production had an effect on growth rate during period 8-12 weeks of age in the present study. These results were inagreement with Enayat (2006) who indicated that selection for improve egg production till 40 wks of age had an effect on growth rate during the growing periods in Inshas and Silver Montazah strains.

After three generations of selection for feed conversion for egg production, the realized response for growth rate had negative values (-1.1 and -4.1) for 8-12 and 12-16 weeks of age, respectively, Table (4).

Body measurements

Table (6) shows body measurements (Shank length (SL), Keel length (KL) and Breast circumference (BC) of males and females as well as combined sexes in both selected and control lines during growing period (8 and 16 weeks of age) in different generations. SL, KL and BC measured at 8 and 16 week of age were affected by generation where as highly significant ($p \leq 0.001$) were observed, but these traits were not significant between selected and control lines except KL at 8 week of age. The results appear that highly significant ($p \leq 0.001$) between sexes for SL and KL at 8 week of age, and for KL at 16 week of age. Moreover, the males had significantly higher ($p \leq 0.001$) values than females at all ages except SL at 8 week of age. Positive correlations between egg mass and Shank length, Keel length and Breast width were reported by Hamdy *et al.,* (2002).

In general, selection to improve feed conversion for egg production till 40 weeks of age in Mandarah strain as a local strain caused turning of body measurements at all ages after three generations of selection. The means of body measurements in the present study are in agreement with those reported by Rizkalla *et al.,* (2002), El-Wardany *et al.* (1994), El-Wardany (1999a, b) and Enayat (2006).

Age at sexual maturity (ASM)

The pullets of the third generation were significantly ($p \leq 0.001$) matured earlier than base population, first and second generations (Table 7).

These results agreed with those reported by Shebl (1991) and Abd Ella (2007), who found the first generation matured earlier than the base generation. In the present experiment, the realized response for ASM were different from generation to generation in the selected line, being -6.4 (1^{st} generation), 7.0 (2^{nd} generation), -2.3 (3^{rd} generation) and -1.7 days (cumulative response), Table (4).

Refining to the effect of line the means of ASM for four generations were 167.7 days for the selected line 175.13 days for control line. It could be seen that the selected line pullets significantly ($p \leq 0.001$) matured earlier than those of the control line by 7.43 days in three generations. Average of age at sexual maturity was similar with those finding by Ghanem *et al.,* (2007) with Mandarah strain (170.0 days), Kosba *et al.,* (2002a and 2006) and Abd Ella (2007) with Bahij strain (167.8 days).

Duration period of the first 10 eggs (PF10)

Highly significant and significant ($p \leq 0.001$ and $p \leq 0.01$) differences were found among generations and lines, where the pullets in the third generation had the lowest days to produce the first ten eggs compared to in the other generations (Table 7).

The realized response was -1.4, 0.9, -0.4 and -0.9 days in the 1st, 2nd, 3rd and cumulative response, respectively Table (4). The selected and control pullets produced the first 10 eggs during 23.1 and 25.3 days (first generation), 22.7 and 24.0 days (second generation) and 22.4 and 24.1 days (third generation), respectively (Table 7). Similar results were find by Kosba *et al.*, (2002a), Ghanem (2003) and Enayat (2006), who found that duration period to produce the first ten eggs ranged from 33.9 to 12.9 days.

Egg number (EN)

The means of egg number were 52.7, 53.9, 54.1 and 56.6 eggs in the base, first, second and third generations, respectively (Table 7). Also, highly significant ($p \leq 0.001$) differences were found among generations and between lines for this trait. Moreover, selection to improve feed conversion for egg production till 40 weeks of age in Mandarah strain affected for egg number trait. It was noticed that means of egg number produced by selected line were higher and highly significant values than control line, where egg number were 56.5 eggs for selected line and 47.6 eggs for control line in the four generations. Average of egg number in the present study was in agreement with reported by Younis and Abd El-Ghany (2004), Abd El-Ghany (2005), and Abd Ella (2007). The realized response for this trait had 2.0, -0.2 and -0.3 eggs for the first, second and third generations and it a appositive value (1.5 eggs) for cumulative response, respectively Table (4). This result was in agreement with Saleh *et al.*, (2006) who found that the realized response for egg number at 40 weeks of age was 15.2 eggs over two generations of selection in Inshas strain of chicken.

In general, selection to improve feed conversion for egg production till 40 weeks of age in Mandarah strain had favorable effect on egg number trait after three generations of selection.

Egg weight (EW)

Average weight of egg produced from pullets of the base generation was lower than those produce by the first, second and third generations and these differences were highly significant ($p \leq 0.001$ and $p \leq 0.01$) among generations, lines and their interactions (Table 7).

The results indicated that third generation had highest egg weight that increased continue by generation for selected line, which suggested that improved feed conversion for egg production. This result for average for egg weight at 40 weeks of age was in agreement with Saleh *et al.,* (2006) who reported that mean of egg weight at 40 wk of production was 43.1 g. for Inshas strains of chickens, also. Abd Ella (2007) in Bahij strain found egg weight from 36-40 weeks of age were 45.6 g.

The realized responses for this trait had positive values and it was harmony with selection for improving feed conversion for egg production till 40 weeks of age in Mandarah strain after three generations, whereas the cumulative response was 2.4 g for egg weight, Table (4).

Egg mass

Highly significantly differences ($p \leq 0.001$) among generations and between lines were observed. Moreover, pullets in the selected line had higher egg mass compared with control line during the four generations (Table 7). The realized response for this trait had a positive value (127.9 g) which led to improve for feed conversion after the three generations of selection till 40 week of age in Mandarah strain (Table 4).

Average of egg mass in the present study was similar with those reported by Younis and Abd El-Ghany (2004), Abd El-Ghany (2005), Enayat (2006), but not in agreement with Abd Ella (2007) who found the lowest egg mass (591.85 g) at 36-40 weeks of age in Bahij strain of chicken.

In general, selection to improve feed conversion for egg production till 40 weeks of age in Mandarah strain could be improve egg mass.

Hertability

The heritability estimates for feed conversion till 40 week of age from in the first, second and third generations were 0.16, 0.20 and 0.18 based on sire plus dame components of variance (Table 8). These estimates are relatively lower than those reported by Younis and Abd El-Ghany (2004) and Saleh *et al.,* (2006), while it was in partial agreement with those reported by Sabri and Abd El-Warith (2000) and Abd Ella (2007).

The heritability estimates for body weight at different ages for the first, second and third generations are shown in Table (8). It was noticed that low estimates of heritability from sire plus dam (h^2s+d) component of variance at 16 and 40 weeks of age in the third generation, while these estimates were moderate at the other ages. The corresponding estimates of body weight for the first generations (0.13, 0.10, 0.22 and 0.21), second generation (0.22, 0.21, 0.36 and 0.13) and third generations (0.26, 0.36, 0.003

and 0.04) at 8, 12, 16 and 40 weeks of age, respectively (Table 8). On contrast, these estimates were lower than those reported by Abd El-Halim, (1999), while, these results were in agreement with Abd El-Ghany (2006) who found that heritability estimates were 0.15 and 0.20 at 8 and 12 weeks of age, respectively, from sire plus dam component of variance after selection for body weight at 12 week of age, while the heritabilities of body weight at sexual maturity for selected line were 0.05, 0.31 and 0.13 for the first, second and third generations, respectively. These results are harmony with those reported by Kosba *et al.,* (1997), Ghanem, (2003), Younis and Abd El-Ghany, (2004) and Abd El-Ghany (2005). In contrary, higher values were reported by Abdellatif (1989) and Shebl (1998), who reported that heritability estimates ranged from 0.78 to 0.89.

Heritability estimates of age at sexual maturity based on sire plus dame components of variance were 0.05, 0.20 and 0.11 for the first, second and third generations, respectively (Table 8). Many investigators found that, the value of heritability ranged from 0.02 to 0.61 for sire plus dame components of variance Kosba *et al.,* (2002), Younis and Abd El-Ghany, (2004), Abd El-Ghany, (2006) and Abd Ella (2007).

The value of heritability of duration period to produced the first ten eggs from h^2s+d was 0.09, 0.11 and 0.14 in the first, second and third generations, respectively (Table 8). This result was lower than that finding by Ghanem (2003) and Saleh *et al.,* (2006) who found heritability for this trait were ranged from 0.44 to 0.76 after selection for egg production traits.

Heritability estimates of egg number till 40 weeks of age are shown in Table (8). These estimates in the first, second and third generations were 0.02, 0.22 and 0.29 based on sire plus dame components of variance, respectively. These results are in agreement with those reported by Abd El-Ghany, (2005) and Saleh *et al.,* (2006), and higher than estimated by El-Wardany (1999b) and Abd Ella (2007).

The heritability estimates of egg weight till 40 weeks of age in the first, second and third generations were 0.26, 0.25 and 0.39, respectively (Table 8). Generally, heritability values reported here for egg weight at 40 weeks of age were in agreement with the findings Sabri and Abd El-Warith (2000) and Abdellatif (2001), Abd Ella (2007) reported that heritability of egg weight from sire plus dam components of variance was 0.47.

Heritability estimates of egg mass till 40 week of age were 0.12, 0.19 and 0.25 based on sire plus dame components of variance in the first, second and third generations, respectively (Table 8). Similar values were reported by Kosba *et al.,* (2002) and Ghanem (2003). However, higher values of heritability for egg mass were reported by Abd Ella (2007) who found heritability values ranged from 0.57 to 0.89.

correlations

Genetic and phenotypic correlations between feed conversion for egg production till 40 weeks of age in Mandarah strain and several characters of the three generations from full sibs are presented in Table (8). Negative and positive values were found for genetic and phenotypic correlations between feed conversion and body weight at different ages.

It was noticed that phenotypic correlations between feed conversion with body weight were low value. The genetic correlations were -0.01, -0.02, 0.11 and 0.02 while the phenotypic correlations were -0.04, -0.004, -0.009 and -0.85 for body weight at 8, 12, 16 and 40 weeks of age, respectively (Table 8). There is no clear trend for the genetic and phenotypic correlation estimates, but the positive relationship could be noticed and therefore a reduction in body weight could be expected through reducing the value of feed conversion (improving feed efficiency) through selection.

Negative genetic and phenotypic correlations were found with body weight at sexual maturity. These results were not in agreement with finding by Abd Ella (2007) who founded that the genetic and phenotypic correlations between feed conversion were 0.67 and 0.61. Positive genetic and negative phenotypic correlations between feed conversion and age at sexual maturity were found (0.32 and -0.03). Negative genetic and phenotypic correlations between feed conversion and age at sexual maturity were reported by Abd Ella (2007).

The genetic and phenotypic correlations between feed conversion and duration period of the first ten eggs had negative values (-0.42 and -0.04). Negative genetic and phenotypic correlations between feed conversion and egg number were -0.32 and -0.15 respectively. These results are in agreement with those reported by Abd Ella (2007), and Enayat (2006) who found negative genetic and phenotypic correlations between feed conversion and egg number after two generation of individual selection for egg number.

Egg weight was positive for genetic correlation (0.33) and negative phenotypic correlation (-0.29) with feed conversion. These results are in agreement with those reported by Enayat (2006), while the same results were found by Abd Ella (2007) at all periods of their study.

In the present study, it was observed that negative genetic and phenotypic correlations between feed conversion and egg mass (-0.15 and -0.27) were found. Similar results were reported by Abd Ella (2007).

CONCLUSIONS

Generally, according to the results of the present selection experiment it is clear that selection program should be carried to improve performance of Mandarah strain of chickens for future through selection for feed conversion for egg production till 40 weeks of age. This selected strain could be crossed in future to provide the small holder families with improved local hybrid chicks.

Table (1): Numbers of tested selected and control birds of generations in Mandarah chickens.

Generation	Sex	No. of test birds	Selected	Control
Base	Male		22	7
	Female	210	137	49
	Total	***210***	***159***	***56***
First	Male	412	14	6
	Female	209	94	28
	Total	***621***	***108***	***34***
Second	Male	400	16	8
	Female	210	109	30
	Total	***610***	***125***	***38***

Table (2): Least squares means ± standard errors for feed conversion for the selected and control lines, as well as selection differentials (S), selection intensities (I), selection densities (V), realized responses (R) and expected responses (ER) during the three generations of selection.

Gen.	Selected	Control	S	I	V	R	ER**
	X±S.E	X±S.E	(g)		%	(g)	
Males							
G1	4.34±0.23	5.60±0.58	-0.90	2.20	3.4		
G2	4.06±0.27	5.55±0.27	-0.77	2.15	4.0	-0.23	-0.16
G3	3.96±0.30	5.46±0.26				-0.29	-0.14
CR*						-0.52	-0.30
Females							
G0	5.82±0.12	5.56±0.22	-1.12	0.64	65.2		
G1	4.44±0.15	5.60±0.58	-0.80	0.87	45.0	-1.42	-0.20
G2	4.36±0.14	5.55±0.27	-0.45	0.80	51.9	-0.03	-0.14
G3	4.23±0.12	5.46±0.26				-0.04	-0.08
CR*						-1.49	-0.42

G0=Base generation G1=First generation G2=Second generation G3=Third generation CR*= Cumulative selection response ER**= Expected response= Heritability x selection differential.

Table (3) Least squares means ± standard errors of body weights at different ages of Mandarah strain during growing period as affected by generations, lines and sex.

Gen.	Line	Sex	Body weight at			
			8-week	**12-week**	**16-week**	**40-week**
G0		Male	535.6±30.5	913.5±34.4	1102.6±36.9	1630.3±48.1
		Female	468.8±11.7	815.7±13.2	1013.9±14.2	1492.6±18.4
		Av.	**502.2±16.3**	**864.6±18.4**	**1058.2±19.8**	**1561.4±25.7**
G1	**S**	Male	603.6±37.6	871.1±42.4	1142.3±47.3	1859.1±62.9
		Female	604.0±14.5	817.1±16.4	1057.6±17.6	1502.7±21.5
		Av.	**603.8±20.2**	**844.1±22.7**	**1099.9±25.2**	**1680.9±33.3**
	C	Male	516.7±57.4	858.3±64.8	1087.5±85.2	1686.7±85.2
		Female	493.2±26.6	846.4±30.0	1021.7±32.8	1523.0±43.1
		Av.	**504.9±31.6**	**852.4±35.7**	**1054.6±45.6**	**1604.9±47.7**
G2	**S**	Male	584.8±35.2	849.6±39.7	1088.8±42.6	1849.4±52.2
		Female	582.6±13.5	816.2±15.2	1041.6±16.3	1604.4±20.1
		Av.	**585.7±18.8**	**832.9±21.3**	**1065.2±22.8**	**1726.9±28.0**
	C	Male	561.3±49.7	910.0±56.1	1100.0±60.3	1773.7±73.8
		Female	533.2±25.7	807.8±28.9	1054.3±31.1	1471.1±39.5
		Av.	**547.2±28.0**	**858.9±31.6**	**1077.2±33.9**	**1622.4±41.9**
G3	**S**	Male	616.1±22.0	880.4±24.8	1107.8±26.6	1802.3±37.5
		Female	590.7±9.71	866.5±11.0	1079.9±11.8	1596.1±14.5
		Av.	**603.4±12.0**	**873.4±13.6**	**1093.9±14.5**	**1699.2±20.1**
	C	Male	598.8±49.7	838.8±56.1	1112.5±60.3	1778.0±93.4
		Female	518.3±25.7	817.8±29.0	1061.3±31.1	1597.9±39.5
		Av.	**558.5±28.0**	**828.3±31.6**	**1086.9±33.9**	**1687.9±50.7**
Significances						
Generation (G)			**	*	**	**
Line (L)			*	*	*	*
Sex (S)			*	*	**	***
G x L			NS	*	NS	*
G x S			*	*	NS	NS
L x S			*	*	NS	*
G x Lx S			NS	NS	NS	NS

G0=Base generation G1=First generation G2=Second generation G3=Third generation S=Selected & C=Control line *=Significant at 5% level of probability **=Significant at 1% level of probability ***=Significant at 0.1% level of probability NS = No significant

Table (4) Realized correlated response for unselected traits in the selected line by generation.

Traits	Generations			Total
	First	Second	Third	
Body weight at 8-wks (g)	98.9	-60.4	6.4	44.9
Body weight at 12-wks (g)	-8.3	-17.7	71.1	45.1
Body weight at 16-wks (g)	45.3	-57.3	19.0	7.0
Body weight at 40-wks (g)	76.0	28.5	-93.2	11.3
Growth rate 8-12 wk (%)	-17.9	12.1	4.7	-1.1
Growth rate 12-16 wk (%)	4.3	-1.0	-7.4	-4.1
Body weight at sexual maturity (g)	23.3	5.3	-104.4	-75.8
Age at sexual maturity (d)	-6.4	7.0	-2.3	-1.7
Duration of the first 10 eggs (d)	-1.4	0.9	-0.4	-0.9
Egg number for 40 wks of age	2.0	-0.2	-0.3	1.5
Egg weight for 40 wks of age (g)	1.9	1.7	-1.2	2.4
Egg mass for 40 wks of age (kg)	-121.2	46.4	202.7	127.9

Table (5) Least squares means ± standard errors of growth rate in Mandarah strain during growing period as affected by generations, lines and sex.

Generation	Line	Sex	Growth rate 8-12	Growth rate 12-16
G0		Male	53.5±4.43	27.5±3.60
		Female	52.9±1.70	31.8±1.38
		Av.	**53.2±2.37**	**29.6±1.93**
G1	S	Male	30.9±5.45	32.8±4.60
		Female	37.8±2.10	19.2±1.71
		Av.	**34.4±2.92**	**26.0±2.45**
	C	Male	51.8±8.33	25.0±6.77
		Female	52.7±3.85	18.4±3.19
		Av.	**52.3±4.59**	**21.7±3.74**
G2	S	Male	40.5±5.10	30.3±4.14
		Female	37.6±1.95	20.9±1.59
		Av.	**39.1±2.73**	**25.6±2.22**
	C	Male	47.6±7.21	17.6±5.86
		Female	42.4±3.72	26.9±3.03
		Av.	**44.9±4.06**	**22.3±3.30**
G3	S	Male	36.6±3.19	23.6±2.59
		Female	39.0±1.41	22.7±1.14
		Av.	**37.8±1.74**	**23.2±1.41**
	C	Male	32.3±7.21	28.2±5.86
		Female	45.4±3.72	26.5±3.03
		Av.	**38.9±4.06**	**27.3±3.30**
Significances				
Generation (G)			***	*
Line (L)			***	NS
Sex (S)			NS	NS
G x L			*	*
G x S			*	*
L x S			NS	*
G x Lx S			NS	NS

G0=Base generation G1=First generation G2=Second generation G3=Third generation S=Selected & C=Control line *=Significant at 5% level of probability **=Significant at 1% level of probability ***=Significant at 0.1% level of probability NS = No Significant.

Table (6): Least squares means ± standard errors of body measurements at different ages of Mandarah strain during growing period as affected by generation, line and sex.

Gen.	Line	Sex	8 wks of age			16 wks of age		
			SL	KL	BC	SL	KL	BC
G0		1	5.5±0.06	6.7±0.06	17.4±0.15	7.7±0.09	9.3±0.08	27.0±0.48
		2	4.9±0.12	7.1±0.12	19.5±0.32	8.6±0.19	9.5±0.18	25.8±0.19
		Av.	**5.2±0.07**	**6.9±0.07**	**18.9±0.18**	**8.1±0.10**	**9.4±0.10**	**26.4±0.26**
G1	1	1	5.6±0.07	7.0±0.07	19.3±0.17	8.2±0.09	9.8±0.10	26.9±0.21
		2	5.5±0.06	6.7±0.06	17.7±0.16	7.5±0.10	9.4±0.10	25.3±0.23
		Av.	**5.5±0.05**	**6.7±0.05**	**18.0±0.14**	**8.6±0.08**	**9.6±0.08**	**25.4±0.31**
	2	1	5.7±0.15	7.3±0.11	19.2±0.30	9.3±0.54	9.3±0.17	27.7±1.41
		2	5.5±0.06	6.7±0.36	17.3±0.93	7.7±0.17	9.2±0.17	26.1±0.39
		Av.	**5.6±0.06**	**6.6±0.06**	**18.3±0.16**	**8.7±0.09**	**9.4±0.09**	**26.5±0.02**
G2	1	1	6.4±0.14	7.4±0.14	19.8±0.37	8.9±0.10	10.3±0.21	27.9±0.23
		2	5.1±0.07	6.2±0.07	18.4±0.18	8.6±0.21	9.9±0.10	27.3±0.48
		Av.	**5.9±0.11**	**6.8±0.11**	**19.4±0.30**	**8.6±0.17**	**10.4±0.17**	**27.5±0.03**
	2	1	5.7±0.25	6.6±0.25	19.1±0.66	8.7±0.38	9.6±0.38	26.7±0.86
		2	5.1±0.13	5.6±0.13	17.5±0.34	8.4±0.20	9.4±0.20	26.3±0.45
		Av.	**5.5±0.06**	**6.4±0.06**	**18.7±0.17**	**8.6±0.10**	**9.5±0.10**	**26.4±0.31**
G3	1	1	6.3±0.11	7.3±0.11	19.9±0.29	8.8±0.17	10.6±0.17	27.8±0.38
		2	5.7±0.05	6.5±0.05	18.5±0.13	7.9±0.07	8.7±0.07	27.1±0.17
		Av.	**6.0±0.06**	**7.1±0.01**	**18.8±0.02**	**8.0±0.04**	**9.1±0.05**	**27.3±0.11**
	2	1	5.8±0.25	6.7±0.25	19.5±0.66	8.9±0.38	9.5±0.38	26.5±0.86
		2	5.5±0.13	6.1±0.13	18.6±0.34	7.8±0.20	7.9±0.20	26.2±0.45
		Av.	**5.6±0.07**	**6.3±0.12**	**18.8±0.22**	**8.1±0.19**	**8.2±0.17**	**26.4±0.21**
Significances								
Generation (G)			***	***	***	***	***	***
Line (L)			NS	**	NS	NS	NS	NS
Sex (S)			***	***	NS	NS	***	NS
G x L			*	***	NS	**	NS	NS
G x S			NS	***	***	***	***	***
L x S			***	**	NS	NS	NS	NS
G x L x S			**	**	NS	*	NS	*

G0=Base generation G1=First generation G2=Second generation G3=Third generation *=Significant at 5% level of probability **=Significant at 1% level of probability ***=Significant at 0.1% level of probability Line 1=Selected line. Line 2=Control line Sex 1=males Sex 2=females NS=No Significant SL=Shank Length KL=Keel Length BC=Breast Circumference.

Table (7): Least squares means ± standard errors of body weight at sexual maturity (WSM), age at sexual maturity (ASM), duration of the first 10 eggs (PF10), egg number (EN), egg weight (EW) and egg mass for 40 week of age in Mandarah selected and control lines over 4 generations.

Gen.	Line	No.	WSM (g)	ASM (days)	PF 10 (days)	EN 40 (eggs)	EW 40 (g)	Egg mass (g)
G0	Selected	137	1400.7±12.4	175.3±1.23	25.4±0.87	54.7±1.04	41.0±0.31	2250.4±49.1
	Control	49	1398.8±20.7	180.9±2.06	26.2±1.52	47.1±1.77	40.6±0.52	1516.8±83.2
G1	Selected	94	1393.1±15.0	165.0±1.48	23.1±1.04	56.3±1.24	42.5±0.44	2405.6±58.2
	Control	28	1367.9±27.4	177.0±2.72	25.3±1.91	46.7±2.27	40.2±0.82	1793.2±106.6
G2	Selected	109	1361.5±14.0	166.8±1.38	22.7±0.97	56.1±1.15	43.1±0.42	2448.8±54.3
	Control	30	1331.0±26.5	171.8±2.63	24.0±1.84	46.7±2.19	39.1±0.79	1790.0±103.0
G3	Selected	90	1240.1±15.3	163.5±1.52	22.4±1.07	58.9±1.26	45.0±0.46	2569.6±59.5
	Control	30	1314.0±26.5	170.8±2.63	24.1±1.85	49.8±2.19	42.2±0.79	1708.1±103.0
Significances								
Generation (G)			***	***	**	***	***	***
Line (L)			NS	***	***	***	***	***
G x L			*	*	**	*	**	*

G0=Base generation G1=First generation G2=Second generation G3=Third generation *=Significant at 5% level of probability **=Significant at 1% level of probability ***=Significant at 0.1% level of probability NS=No Significant

Table (8): Estimates of heritability from sir plus dam (h2S+D) of the study traits and the genetic ± standard error (rG±SE) and phenotypic correlations (rP) between feed conversion and the other traits for three generations in Mandarah strain of chickens

Traits	Heritability			Correlations	
	First generation	Second generation	Third generation	r_G	r_P
BW 8	0.13±0.09	0.22±0.14	0.26±0.07	-0.01±0.12	-0.04
BW 12	0.10±0.20	0.21±0.04	0.16±0.06	-0.02±0.08	-0.004
BW 16	0.22±0.14	0.36±0.08	0.003±0.06	0.11±0.51	-0.009
BW 40	0.21±0.10	0.13±0.09	0.04±0.09	0.02±0.19	-0.85
WSM	0.05±0.09	0.31±0.14	0.13±0.07	-0.22±0.20	-0.04
ASM	0.05±0.09	0.20±0.14	0.11±0.07	0.32±0.81	-0.03
PF10	0.09±0.50	0.11±0.06	0.14±0.10	-0.42±0.23	-0.04
EN	0.02±0.14	0.22±0.09	0.29±0.06	-0.32±0.27	-0.15
EW	0.26±0.12	0.25±0.11	0.39±0.10	0.33±0.10	-0.29
EM	0.12±0.18	0.19±0.21	0.25±0.15	-0.15±0.16	-0.27
FC	0.16±0.05	0.20±0.07	0.18±0.17		

BW8=Body weight at 8 wks of age BW12=Body weight at 12 wks of age BW16=Body weight at 16 wks of age WSM=Body weight at sexual maturity BW40=Body weight at 40 weeks of age ASM=Age at sexual maturity PF10=Duration of the first 10 eggs EN=Egg number EW=Egg weight EM=Egg mass FC=Feed conversion for egg production

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الملخص العربي

الانتخاب والاستجابة المرتبطة لتحسين الكفاءة التحويلية لإنتاج البيض في سلالة المندرة من الدجاج المحلي

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قسم إنتاج الدواجن - كلية الزراعة - جامعة كفر الشيخ

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اجريت [illegible]اسة بمحطة بحوث الانتاج الحيوانى بسخا-وزارة الزراعه خلال اربعه اجيال متعاقبه (٢٠٠٢/٢٠٠٦) لدراسة الاستجابه المباشره للانتخاب لصفة الكفاءه التحويليه لانتاج البيض (كجم علف / كجم بيض) حتى ٤٠ اسبوع من العمر في سلالة المندره والاستجابة المرتبطه [illegible]ت وزن الجسم ، معدل النمو ، عمر النضج الجنسى ، المده اللازمة لانتاج الـ١٠ بيضات الاولى ، عدد ووزن البيض ، كتلة البيض و تقدير المكافئ الوراثي للصفات المختلفة والارتباط الوراثي والمظهري للصفات المدروسة.

وكانت اهم النتائج المتحصل عليها كالأتي :

١- متوسط الكفاءة التحويلية (كجم علف / كجم بيض) لانتاج البيض حتى ٤٠ اسبوع من العمر في الذكور ٤.١٢ كجم علف / كجم بيض فى ثلاثة اجيال بينما في الإناث ٤.٧١ كجم علف/ كجم بيض فى اربعة اجيال فى الخط المنتخب. بينما في ذكور الكنترول ٥.٥٤ و في الاناث ٥.٥٤ كجم علف / كجم بيض ووجد هناك فروق عالية المعنويه بين الاجيال و الخطوط وكذلك التداخل بينهم.

٢-- الفارق الانتخابي للكفاءة التحويلية لانتاج البيض لكل من الذكور - ٠.٩٠، - ٠.٧٧ و الاناث - ١.١٢ ، - ٠.٨٠ ، - ٠.٤٥ جم و الاستجابة المحققة للانتخاب في الذكور - ٠.٢٣، - ٠.٢٩

و الإناث - ١.٤٢ ، - ٣٠.٠٣، - ٤٠.٠٤ جم بعد ثلاث أجيال من الانتخاب.

٣- الانتخاب للكفاءه التحويليه لانتاج البيض حتى ٤٠ اسبوع من العمر حقق تغير فى وزن الجسم فى الاعمار المختلفة وهذه الفروق عالية المعنوية بين الاجيال والخطوط وكذلك بين الذكور والاناث والتبكير في عمر النضج الجنسى كما ادى الى زيادة عدد و وزن البيض وبالتالي زيادة كتلة البيض حتى ٤٠ اسبوع من العمر و ايضا الفتره اللازمة لانتاج العشرة بيضات الاولى، وكانت الاستجابه الكليه لهذه الصفات هي - ١.٧ يوم و ١.٥ بيضه و ٢.٤ جم و ١٢٧.٩ جم و ٠.٩ يوم على التوالى.

٤- المكافئ الوراثي لصفة الكفاءه التحويليه لانتاج البيض فى الجيل الاول و الثاني و الثالث كان ٠.١٦و..٠.٢٠ و ٠.١٨ على اساس مكونات كل من الاب والام معا على التوالى. بينما كانت لصفات عـــدد و وزن البيض و كتلة البيض والكفاءة التحويليـ لانتـــاج البيض حتى ٤٠ اسـبوع من العمر و المـده اللازمه لانتـــاج العشرة بيضات الاولي بعد ثلاث أجيال من الانتخاب هو ٠.٢٩ و ٠.٣٩ و ٠.٢٥ و ٠.١٨ و ٠.١٤ و على التوالي.

٥- الارتباط الوراثي لصفة الكفاءة التحويلية لانتاج البيض حتى ٤٠ اسبوع من العمر موجبا مع صفات (العمر عند النضج الجنسي و وزن البيض.) بينما كان سالبا مع صفات (وزن الجسم عند النضج الجنسي وعدد و وكتلة البيض و الفتره اللازمة لانتاج العشرة بيضات الاولى) . بينما كان الارتباط المظهرى موجبا مع جميع الصفات.

من الواضح بصفه عامة من خلال هذه التجربة هو امكانية حدوث تحسين فى صفة الكفاءه التحويليه لانتاج البيض حتي ٤٠ اسبوع من العمر عند استخدام الانتخاب الفردى في سلالة المندره مما يوصي بالاستمرار في برنامج الانتخاب لتحسين الصفات الإنتاجية في السلالات المحلية مستقبلا.