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EFFECT OF CROSSING BETWEEN NATIVE AND A COMMERCIAL CHICKEN STRAIN ON EGG PRODUCTION TRAITS.

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Abstract: *This experiment was conducted at Maryout Research Station, Desert Research Center. Two local strains Mandarah (M), Golden Montazah (G) and commercial meat type strain, Kosmos (K) were used in a full 3×3 diallel crosses design. The results of this study showed that:*

Significant differences (P<0.01) among the three pure strains also, among the reciprocal crosses were found in all egg production traits. Reciprocal crosses surpassed both their parents and strain crosses. Overall means were 1943, 1704 and 1792 g, respectively, for body weight at sexual maturity (BWSM); 2085, 1889 and 18389 g for mature body weight (MBW); 54.7, 47.0 and 37.4 egg number per hen housed during the 90 day; 3337, 2712 and 2128 egg mass/ hen/ 90 day; and 0.60, 0.52 and 0.41% egg/ hen/day for the aforementioned genetic groups, respectively.

Overall means of early egg weight (EEW) of the crosses and the reciprocal crosses were the highest (P<0.01, e.g. 51.3 and 52.56 g) compared to that for their parents (47.03g). Kosmas pullets consumed (p<0.01) the highest amount of ration per day and per 90 day compared to those of the local strains, and the overall mean of the reciprocal crosses was significantly the highest and that of the crosses was the lowest while feed intake (FI) of the parent had intermediate value. The overall mean of feed conversion (FC) for the parents was the best (3.24). kosmos strain had significantly double (10%) mortality rate of pullets throughout laying period compared to the local strains (5% each). Reciprocal crosses had significantly the lowest mortality (4.16%).

Eggs of both M and G strains had the highest (p<0.01) fertility (F %) (92.0 And 92.8%) compared to the K one (80.0%) and both overall mean of the parents and the reciprocal crosses had significantly *nearly equal and the highest F % (88.3 and 88.4%). Reciprocal crosses had the highest hatchability for total eggs (HTE %) or for fertile eggs (TFE %) ;(74.1 and 84.3 %), respectively, compared to the others. While Kosmos egg had the highest final embryonic mortality percentage (FEM %); (14.2%) and total egg loss (TEL %); (20.7%), reciprocal crosses decreased the two traits to be (6.43% and 15.76%) respectively.*

Estimates of heterosis percentages of strain crosses and reciprocal crosses were positive in most egg production traits, ranged from -0.5 to 25.8% for BWSM, from -4.42 to 21.04% for MBW, -2.6 to 0.96 % for ASM, -30.40 to 46.00% for EN, -31.29 to 41.89% for EM, -31.3 to 45.5% for RL, -25.4 to 36.6% for FI / hen /day and -50.0 to Zero%. All heterosis percentages of EEW, MEW and FC were positive and they were in range (4.60 - 18.98 %), (0.08 - 8.69%), and (18.7 – 26.4%), respectively.

Heterosis percentages of crosses and reciprocal crosses of hatch traits varied in values , signs and in range(-9.3 to 3.7% for F%, -10.6 to 19.4% for FTE%, -3.7 to 3.1% for HFE%, -18.1 to 48.3% for EM%, -38.5 to 41.4%, for LM%, -44.6 to 31.5% for FEM% and -16.00 to 17.6% for total egg loss %). These results demonstrate the presence of non-additive genetic variations causing heterotic effects on egg production traits. Most of hatch traits were toward Mandarah and Golden Montazah local parents while heterotic effects had a tend to the heavy parent (Kosmos) concerning body weight at sexual maturity , mature body weight and egg weight.

INTRODUCTION

Standard foreign breeds of chickens play an important role in improvement of economic traits of native strains in Egypt (Zatter, 1994 and Mohamed, 2003). Strain crosses in poultry industry are considered an effective method for the production of hybrid vigor commercial stocks. During the past 40 years, more than 15 local Egyptian strains of chickens have been developed, through crossing native and standard breeds.

Many investigators confirmed the superiority of crossbreds over the purebreds regarding reproductive and some economic traits (Abd El-Gawad, 1981; Farghaly and Saleh, 1988; Abdou, 1992; Fairfull. 1990; Nawar and Abdou, 1999; Khalil *et al.* (2004); Aly *et al.* (2005). Mating between native Egyptian breeds, and foreign strains had performed better than pure strains (Sabra, 1990; Shebl *et al.*, 1990; Khairy, 1997; Nawar and Abdou, 1999). High and positive heterosis % for body weight at different ages among crossbreds and reciprocal crossbreds were obtained in chickens (Abd Alla, 1978; Atallah, 1989; Farghaly., 1989; Mandour *et al.*, 1992 and 1996 and El-Gendy 2000).

The objectives of this research were to study the heterotic effects on egg production performance and hatch traits due to crossing between Mandarah and Golden Montazah local strains and the commercial meat strain (Kosmos), also, heterosis percentages were estimated and discussed.

MATE RIALS AND METHODS

This experiment was conducted at Maryout Research Station, Desert Research Center, Ministry of Agriculture, through the period from 2005- 2006.Two local strains, Golden Montazah (G), and Mandarah (M) and commercial meat type strains; Kosmos (K) were used. The local strains were obtained from the Poultry Improvement Project (Ferhash, Behaira Governorate), while the standard one was from the General Poultry Company, Cairo- Egypt. Flocks were vaccinated and medicated against the common diseases (according to the vaccination program, in the corresponding centers).

Mating plan: Mature cocks (36) and (180) pullets from each of the above populations were used in a full 3×3 design. Cocks and hens were assigned randomly to cages and hens were artificially inseminated after 2 wks preliminary adaptation semen collection period (Mohamed, 2003). They were provided with 16 hrs light and feed and water were provided ad libitum. Pedigreed eggs (630 eggs) per cock and hen parental stocks were collected and stored at 15°C and 85% RH and set weekly in a forced air incubator (after being fumigated).

Hatched chicks were wing banded for each genotype, and brooded in conventional floor brooder. At 8 wks of age, birds were sexed and pullets were reared separately. Chicks were fed a commercial starting diet (up to 8 wks) of 21% CP and 2700 kcal/ kg, grower (8-20 wks) diet of 18% CP and 2700 kcal/kg, and a layer (20 wks-up) diet of 16% CP and 2700 kcal/kg. The birds were housed in pens at 20 weeks of age. Pullets of each strain and their crosses were divided at random into 9 groups. Each group is composed of 4 pens (five pullets and one cock each).

Studied traits

Egg production was recorded daily starting from sexual maturity up to 40 weeks of age. Ages at sexual maturity were estimated in days from hatching up to the day at which pullets in each breeding group of pullets within each breeding pen reached 50% of egg production. Body weight at sexual maturity and mature body weight were recorded for random samples containing 40 pullets for each studied strain or crossbred. A total of 100 eggs chosen randomly at sexual maturity and at the end of study were weighed individually to the nearest gram. Egg number per hen housed was calculated for each pen by dividing the total number of eggs produced during the period (90 days) by the number of hens housed at start of lay. Egg mass was calculated by multiplying the number of eggs per pullet by the mean egg weight in gram during the experimental period. .Settable eggs were sanitized and stored in an egg cooler at approximately 13°C and 70% RH .Eggs were incubated for 18 day at 37.7°C and 60 % RH and then transferred into a hatch operating at 37.2°C and 65 %RH. All eggs that failed to hatch after 21 day incubation were broken, open and age at embryonic dead was determined. All unhatched eggs were categorized to early embryonic mortality (the number of embryos dead during the first week of incubation), late embryonic mortality (the number of embryos dead during the second week of incubation), and final embryonic mortality (internal and external pip embryos). Percentage for each category was calculated for fertile eggs. Fertility was estimated by the number of fertile eggs in percent of total number of eggs set. Hatchability was estimated by number of healthy chicks in percent of total number of eggs (HTF %) and of fertile eggs (HFE %). Total egg loss was estimated by the number of unhatched eggs and infertile eggs. Mortality of pullets was estimated by the percentage of dead pullets from the age of sexual maturity till the end of study period (about 10 months).

Statistical analysis:

Analysis of variance was applied according to Snedecor and Cochran (1981). Data of the traits under study were analyzed using the following model:

$Y_{Ink} = \mu + H_i + G_j + e_{ijk}$

Where:

Y_{ijk} = the observation of the ijk pullet,

μ = the overall mean,

H_i= the fixed effect of the i^{th} hatch,

G_j= the fixed effect of the j^{th} genotype group,

and e_{ijk} = the remainder error.

Duncan`s multiple range test was used to compare every two means (Steel and Torries, 1980). All percentage data were transformed to the corresponding arcsin angles prior to statistical analysis. Also, heterosis percentages estimated based on the mid-parents (MP) were determined according to equation given by Sinha and Khanna (1975) as follows:

$$H\% = (F - MP) / MP * 100$$

F = mean of crosses   MP = mid-parents

RESULTS AND DISCUSSION

Egg production traits:

Results of body weight at sexual maturity (BWSM), mature body weight (MBW), age at sexual maturity (ASM), egg number (EN) and total egg mass at 90 d (EM), early (EEW) and mature egg weight (MEW) of Golden Montazah (G), Mandarah (M), and Kosmos (K) chicken and their reciprocal crosses are presented in Table (1). Kosmos chicken had significantly ($P<.05$) the highest BWSM (1894 g) and MBW (2056g) compared to the two local strains. Using K strain as a dam improved ($P<0.01$) BWSM and MBW. The MK and GK crosses were the heaviest (2213 and 2010 g) and (2350 and 2170 g), for the two traits, respectively, where their weights surpassed the mid parents tends to the heavy parent (Kosmos) while means of crosses were approximately equal to the mean of mid-parents. Significant differences among the pure strains or among the different genotypes reported herein are in agreement with those found by Abdou (1985), Nawar and Abdou (1994), El-Tahawy (2000) and Nawar and Bahie El-Deen (2000). The superiority of strain crosses over the pure strains in body weights was confirmed by several reports (Ali, 1979; Kosba *et al.*, 1981; Farghaly et al; 1989; Zatter, 1994; Mandour *et al.*, 1996 Mohamed, 2003) in chickens and Sharaf *et al.*, 2006) in quails. Working on the same strains, Amin; (2007) found that Kosmos strain maintained its significant highest body weight at 24 weeks (2030.4g), while Golden Mantazah had the lightest body weight (1790.6g) at the same age. Reciprocal crossbreds on the average had the heaviest body weight while overall mean body weight of purebred was the lowest. Crossing Mandarah cocks to Kosmos hens produced heavy weight chicks up to 24 wks of age.

Considering the age at sexual maturity (ASM), Kosmas matured sexually later ($P<.05$) by 11 and 16 days than M pullets (179.2 d) and G one (184.2 d Table 1). Means of ASM of the reciprocal crosses ranged from 182 to 191 d. It was noted that MK cross expressed the latest ASM (191.d) compared to all strain crosses and their reciprocals, then followed by GK, KM, and KG (189, 189.2, and 187.21 d), respectively. Means of ASM for MG (182.0d) and GM (185d) pullets were approximately equal to their mid parents, no heterotic effects were found. Similar results were reported by Nawar (1995), Nawar and Abdou (1999) and El-Tahawy (2000).

Mandarah and Golden Montazah pullets laid significantly ($P<0.05$) the highest egg number per hen housed / 90 d (EN) (55 and 52 eggs), respectively, while Kosmos chicken had the lowest one (34 eggs), Table (1). Mating between Mandarah cocks and Kosmos pullets improved ($P<0.01$) eggs number. The MK cross expressed the highest eggs number (65egg), followed by GK cross (59egg), while pullets of KG, MG or GM laid nearly equal EN. Generally, results indicated that overall mean of the reciprocal crosses was significantly different and had the highest EN (54.7eggs) compared to overall mean of crosses and pure strains. Wang and Pirchner (1992) and Nawar, Abdou (1999) and Nawar and Bahie El-Deen, (2000) reported that the strain crossing increased rate of lying.

Significant differences between pure strains were found in egg mass (EM) (g/hen/90day). It was noticed that Mandarah pullets had significantly ($P<0.05$) the highest egg mass (3084g) followed by G pullets (2813g) while Kosmos pullets had the lowest EM (2240 g). Also it noticed that using M males in a MK cross improved significantly egg mass (4254 g). The GK cross had the 2nd rank (3585 g). Generally, reciprocal crosses had the highiest overall mean (3337 g) ($P <.0.01$), while that of crosses was the lowest (2128 g) and pure lines had an intermediate one (2712g). These results agreed with those reported by Nawar and Abdou (1999) and Nawar and Bahie El-Deen (2000) and Khalil *et al*. (2004).

As for the early and late eggs weights, Kosmos eggs were significantly the heaviest (53.7 and 64.59), respectively. No significant differences were found between the two pure strains M and G which were 42.1 g and 45.3 g for the early and 56.2 g and 54.49 for the late eggs, respectively. Crossing improved early and late egg weights compared to the pure local strains where MK reciprocal strain cross had the heaviest eggs 56.4 and 65.6 g of both the early and late eggs, respectively, compared to other reciprocal crosses, while egg weights of crossing between the two local strains (MG or GM) were nearly equal to that of mid-parent (49.5 g and 48.6 g, respectively), where no heterotic effect was observed. The EW means of the other crosses ranged from 54.9 g to 59.89 g for the mature eggs. These results are in agreement with those reported by Nawar *et al.* (1997), Nawar and Abdou (1999), Nawar and Bahie El-Deen (2000) and Khalil *et al*. (2004).

Means of rate of laying (RL) followed the same trend of egg number. The M and G pullets had the highest (P<.01) (RL) 0.61% and 0.57%, respectively, while Kosmos pullets had the lowest one (0.38 %) (Table 2).

The MK cross surpassed the other genotypes in this traits, while it had the highest values in RL (0.72%) followed by GK cross (0.66 %). The means of RL of the other reciprocal crosses ranged from 0.34 to 0.45 %. Generally, there were significant differences between overall means of RL of pure strains and crosses and it's reciprocal. Reciprocal crosses had significantly the highest RL (0.60%) followed by pure strains (0.52%), while crossbreds had the lowest one (0.41%).These results agree with those reported by Nawar *et al.* (1997); Nawar and Abdou (1999) ; Bahie El-Deen et al, (1998) and Khalil *et al*. (2004).

It was clear that G and M pure pullets consumed daily the least amount of feed (107.2 g) and (103.0 g), respectively, while Kosmos pullets consumed the highest amount (116.4 g). The MK and GK cross pullets consumed daily the highest amount of feed (150 and 140.4 g), respectively, and these means are more than that of mid parent. MG cross decreased this trait than their mid parents. Pullets of the other crosses consumed daily feed ranged from 81.9 g to 104.6 g. Similar results were reported by Abdou and Kolstad (1986) and Nawar (1995).

Concerning feed intake / hen / 90d, pullets consumed the lowest amount of feed (9288 g) than both of G and K pullets (9648 and 10476 g), respectively. The reciprocal crosses means take the same trend as of feed intake/hen/day. Generally, overall mean of FI for cross strains was the lowest (8374 g) while the reciprocal crosses had the highest (12536 g).

Feed conversion (FC) averages were 3.01, 3.26 and 3.42 for M, G and K strains, respectively. Generally it was noticed that all genotypes of crosses or reciprocal crossbreds were higher than mid parent averages ranged from 3.61 and 4.22. These results are in agreement with that found by several authors (Nawar, 1995; Nawar and Abdou, 1999; Bahie El-Deen et al., 1998; and Khalil *et al*., 2004) who reported that crossbreeds differed significantly in their feed utilization.

It was noticed that Kosmos pullets had the highest mortality percentage (M %) (10%), while Mandarah and Golden Montazah had the least one and equal value (5%). Moreover, (MK, GK and MG) crosses had the same percentages. Using G as a sire in crossing with M pullets decreased mortality of pullets (2.5%). While mated Kosmos with the M or G local strains increased M% where KM and KG had equal and the highest values (7.5%). These results agreed with that found Nawar and Bahie El-Deen (2000) and Khalil *et al*. (2004).

Hatch traits

Results of fertility, hatchability from total eggs (THE %) and from fertile eggs percentages (HFE %), early (EM %) and late (LM %) and final (FM %) embryonic mortality percentages and total egg loss percentages for the pure strains (G, M and K) and their reciprocal crosses are presented in Table (3). It was noticed that eggs of the local pure strains (G and M)-had significantly the highest fertility percentages (F %) (92.0% and 92.8%), respectively, while Kosmos eggs had the least value (80.0%). Reciprocal crosses improved fertility, where averages of (MK, GK and GM) crosses surpassed mid-parent averages while mating kosmos males with M and G females decreased F% than their parents. Similar results were reported by Zatter (1994) Nawar (1995), Nawar and Abdou (1999), Nawar and Bahie El-Deen (2000) and Khalil et al. (2004).

Eggs of the pure local strains G and M had the highest THE% (74.83 and 77.68%, respectively), while Kosmos eggs had the lowest mean (63.41%). Reciprocal crosses improved fertility of Kosmos pullets by about 10% compared to the pure parent THE% (i. e 73.63 , 72.10 and 75.80 %, for MK, GK and GM crosses, respectively,) In general, overall means of the reciprocal crosses and pure strains were significantly the highest (THE%) (74.21 And 71.97%, respectively), while strain crosses had the least one (66.34%).

Egg produced from the Mandarah pullets had the highest HFE% (85.40%) followed by Golden Montazah (81.64%), while Kosmos pullets had the least one (79.25 %). Considering the crosses, the same trend as in THE% was found where crossbreds MK, GK, GM and MG had significantly the highest HFE% (84.53 , 83.62 , 84.53 and 82.66 %, respectively,) while crosses KM and KG had the lowest percentages (79.26 and 78.75% , respectively,) . Statistical analysis showed that overall means differed significantly where reciprocal crossbred pullets had the highest HFE% (84.22%) while no significant differences between crosses and pure strains were noticed in HFE% (80.22 and

82.09 % . respectively,) This finding may be due to high adaptation of local purebred lines to the local environment. It was also noticed that some crosses had slight increases in fertility and hatchability over purebred parents, indicated the possibility of improving fitness traits by proper breeding programs and also by crossing between different breeds to obtain hybrid vigor (Shawer and Khalifah 1976), Mohammad, (1997). and Khalil et al. 2004).

Infertility and embryonic mortality rates are of a great economic importance for the commercial chickens industry because they are major components of hatchability. No significant differences were noticed among overall means of pure strains, crosses and reciprocal crosses in early and late embryonic mortality percentages. While Mandarah pullets had the least final embryonic mortality percentage (FM %) (4.2%), Kosmos pullets had the highest one (14.2%) followed by Golden Montazah (8.2%). The KG pullets had the highest FM% (14.4 %) followed by KM (14.5%), while MG, MK, GK and GM pullets had the least percentage, (4.1, 5.7, 6.02 and 7.4%, respectively,). Similarly, Kosmos and Golden Montazah strain had the highest total egg loss percentages (TEL% 20.7 and 18.35%, respectively). Mandarah strain had the least percentage (14.5%). Also, KM, KG and MG strain crosses pullets had the highest TEL% (20.7, 21.24 and 17.33%, respectively), while reciprocal crosses (MK, GK and GM) had the least percentages (15.45, 16.4 and 15.5%, respectively). Similar results were reported by Zatter (1994) and Nawar (1995).

Heterosis for egg production traits:

Heterosis percentages (H %) of egg production traits are presented in Tables 4 and 5. The estimates of direct H% for egg production traits indicated that crossing between Mandarah or Golden Montazah cocks and Kosmos pullets were associated with positive heterotic effects, where MK cross had the highest values in most traits, followed by GK cross and means of the two genotypes were higher than mid-parents mean. The KM and MG crosses had negative and equal H% (- 0.5 each) while the KG cross and the three reciprocal crosses had positive H%. Wide range was found (0.04 to 25.8%).

The H% of mature body weights for all the strain crosses were negative and ranged from -4.42% to -1.07%, where MBW means of KM and KG were equal or less than mid-parents. On the other hand, positive estimates of H% (21.04 and 12.99, respectively), were observed for MK and GK reciprocal cross while negative value (-3.9%) was found for GM cross. These results demonstrate the presence of non-additive genetic variations causing heterotic effects on body weight at sexual maturity and mature body weight toward Kosmos parent. Aly *et al.* (2005) using cross of Gimmizah (G) and Bandarah (B) local strains found that dominance tend Bandarah strain was found in the cross B X G for body weight at hatch, 4 ad 16 wks of age.

Regarding age at sexual maturity, data cited in Table 4, revealed that estimates of H% in the crosses and their reciprocals were positive (0.05 to 1.8%) except KM cross was negative (-.26%), means for all crosses were approximately equal to mid-parents mean except GM cross which matured sexually later than their parents. Fairfull *et al.* (1985 and 1987) reported that heterosis for mature BW ranged from -3 to 6%, but was normally in range of 2 to 5 percent. As for sexual mutuality, heterosis for BW deviates from expectations resulting from dominance in F_2s. Although dominance in the major genetic mechanism for BW heterosis, additive-x additive epitasis influences heterosis for mature BW in Leghorn crosses.

Concerning egg number pre hen housed throughout the 90 days of production, (30.4, -6.96 and -23.4%) were observed for KM, KG and MG crosses where their means were lower than their mid-parents. The estimates of heterosis percentages of egg number per day of all strain cross and reciprocals were approximately equal and had the same sign, estimates of H% were -1.3, -7.5 and -23.7 for KM, MG, respectively, while H% estimates were 45.5, 38.9 and -25.4% for the aforementioned reciprocal crosses, respectively. Heterosis for egg production in Leghorn crosses involves both dominance and epistasis (Fairfull *et al.*, 1985 and 1987) ranged from – 3 to 30 % (in two-way crosses). They found maternal heterosis for early egg production significant in hen-houses production and rate lay, but insignificant for other egg production traits and for sexual maturity (0 to -9 %) and closely approximates expectations resulting from dominance in three– and four crosses equal to that of two-way crosses Fairfull (1990) respect that . Aly *et al.* (2005) reported that different Egyptian strains are good combiners for egg production traits.

Regarding total egg mass H% take the same trend as of EN where H% were negative for the three crosses, KM, KG and MG (-31.29, -8.92 and -3.78%), respectively, for GM cross (-26.26%) and positive for MK (59.8%) and GK (41.89%). Means of crosses which had negative values were low compared to their mid-parents.

Heterasis for egg weight cited by Fairfull *et al.*, 1985, 1987 was lower (-2 to 5 %) and conforms closely to expectations that would result from dominance alone. In contrast, no linear relationship exists between heterosis and parental performance for egg weight (Fairfull *et al.*, 1983 and Mohammad, 1997).

As for the early egg weight, estimates of H% were positive for KM (9.91%), KG (5.65%) and MG (14.6%), also for their reciprocals (18.98, 6.64 and 12.5, respectively). Crosses between the three strains studied enhanced this trait in all the reciprocal crosses. In respect to mature egg weight, negative heteresis percentages for KM (-3.72%), KG (-3.28%) and GM (-0.72%) were found while positive estimates of H% were observed for MG, MK and GK crosses.

Regarding feed intake per day, data presented in Table 5 revealed that H% estimates were negative and approximately equal for strain crosses when FI were estimated per day or per 90 days. As for the reciprocal crosses, all genotypes had negative values of H% except that for GM cross which had positive one. Estimates of H% of feed conversion were positive for KM and KG, negative for their reciprocal and the opposite was found for MG and it's reciprocal. Heterosis for BW is not desirable in layers as in commonly feed conversion by increasing the maintenance requirements. Feed conversion in broilers exhibits considerable heterosis (7 to 16 % Fairfull *et al.,* 1985, 1987).

Estimates of heterosis of pullets viability were zero in the three crosses indicating no heterotic effect while for reciprocal crosses, H % were negative (- 50.0 to – 33.2 %) and this indicates heterotic effect toward the local parents. Fairfull (1990) reported that one component of hen-housed egg production is viability, thus, the large reciprocal effect for egg production often may result partially from differences in viability, especially as the reciprocal effect for sexual maturity is normally much lower. Reciprocal effects for egg mass and feed conversion are substantial in chickens, but generally lower than crossponding heterosis. Reciprocal effects for sexual maturity and egg weight and mature body weights are of about the same magnilude as heterasis effects. Reciprocal differences are substantial for viability (1 to 15%) and hen housed egg production (0 to 19 %) in chicken (Fairfull, 1990).

Heterosis for hatch traits

Heteresis values of fertility percentage were negative (- 8.2 and – 9.3) for KM and KG respectively, positive for MG (3.7). Opposite signs were found with respect their reciprocal crosses (2.4, 1.9 and – 3.7), respectively,

Estimates of heteresis for both HTE % and HFE % were negative in the strain crosses and ranged from – 10.6 to 3.8 for HTE % and from – 3.7 to – 1.02 % for HFE % , while they were positive in all reciprocal genotypes, except that of GM cross of HTE % which had negative value (-0.6 %).In contrast of this results A hybrid embryo exhibits no heteresis. A hybrid dam exhibits heteresis for fertility, but a hybrid sire seems to have little effect (Fairfull *et al*., 1987 and Mohammad, 1997).Moreover , there is heterosis for hatchability made passible by a hybrid embryo (Fairfull *et al*., 1987) and the dams genotypes expresses heteresis the sir's genotype has little effect on heteresis for hatchability.

Estimates of H% varied in values and signs concerning early embryonic mortality (-18.1 to 11.7 %) for the crosses and (5.2 to 48.3 %) for the reciprocals. Regarding the late embryonic mortality, wide ranges of H % for crosses (- 23.2 to – 33.8 %) and for reciprocals (-4.2 to 41.4 %) were found.

Heterosis estimates of the final mortality % ranged from –33.9 to 31.5% for the crosses and – 44.6 % to 19.4 % for their reciprocals. As for total egg loss, heteroses percentages were positive (5.5 – 17.6 %), negatives (- 16.0 to – 5.0 %) for the crosses and reciprocals, respectively.

The positive effect of crossing agrees with those findings by Mohammad, (1997), Mohamed (2003) in chicken and Sharaf *et al.* (2006) in quails. The vigor of crossbred depends on the quality of the parental line used in the cross. A wide range of heterotic percentages of these traits has been reported by Farghaly and Saleh (1988), Nawar and Abdou (1999) , El Tahawy (2000), El-Gendy (2000) in chickens and El-Gendy (2000), Aly et al. (2005), Amin (2007) and Bahie El Deen *et al.* (1998) in quail. Changes in heterosis have been found with respect to location, nutritional treatment (Gowe and Fairfull, 1982).

It could be concluded that mating between males of Mandarah and Golden Montazah local parents with pullets of the commercial meat strain (Kosmos) causing positive heterotic effects on egg production traits, most of hatch traits toward Mandarah and Golden Montazah local parents while positive heterotic effects tend the heavy parent (kosmos) concerning body weight at sexual maturity, mature body weight and egg weight.

Table (1): Means ± standard errors for body weight at sexual maturity, mature body weight, age at sexual maturity, egg number and, egg mass pre hen housed per 90 day and early and mature egg weight for Mandarah (M), Golden Montazah (G), and Kosmos (K) strains of chicken and their reciprocal crosses

Traits / Genotype	Body weight at sexual maturity, G	Mature Body weight, g	Age at sexual maturity, d	Total egg number (pre hen housed per 90 day)	Total egg mass (g /hen / 90 day)	Early egg weight ,g	Mature egg weight ,g
Pure strains							
M	1625±7.1^{y}	1827±16.5^{y}	184.2±1.3^{y}	55±1.0^{x}	3084 ±126^{x}	42.1±1.2^{y}	56.2±1.4^{y}
G	1586±10.2^{y}	1785±8.1^{z}	179.2±1.3^{y}	52±1.4^{x}	2813±135^{y}	45.3±1.3^{y}	54.4±1.3^{y}
K	1894±4.0^{x}	2056±17.2^{x}	195.2±1.1^{x}	34±1.6^{y}	2240±109^{z}	53.7±1.4^{x}	64.5±1.2^{x}
Overall mean	1791.2±6.5^{B}	1889±15^{B}	186.2±1.1	47.0±1.9^{B}	2712±125^{B}	47.03±1.1^{B}	58.4±1.9
Strains cross							
KM	1750±16.2^{c}	1890±17.4^{c}	189.2±1.6^{a}	31±0.7^{d}	1829±71^{d}	52.1±1.1^{b}	58.1±1.8^{bc}
KG	1764±7.5^{c}	1900± 8.1^{c}	187.2±0.1^{ab}	40±2.2^{c}	2301±142^{c}	52.3±1.1^{b}	57.5±0.8^{bcd}
MG	1598±5.6^{e}	1726± 6.1^{d}	182.0±2.0^{cd}	41±0.6^{c}	2256±83^{c}	49.5±1.8^{c}	55.5±1.61^{cd}
Overall mean	1704±15.3^{C}	1838.±16^{B}	186.1±1.3	37.4±1.1^{C}	2128±104^{C}	51.3±1.12^{A}	57.03±1.4
Reciprocal cross							
MK	2213±31.6^{a}	2350±34.9^{a}	191.0±2.02^{a}	65 ±1.7^{a}	4254±149.5^{a}	56.4±0.1^{a}	65.6±0.70^{a}
GK	2010±31.1^{b}	2170±69.3^{b}	189.0±0.77^{ab}	59±1.6^{b}	3585±184^{b}	52.7±1.5^{b}	59.8±1.46^{b}
GM	1606±11.1^{d}	1734±12.0^{d}	185±1.30^{bc}	40±1.6^{c}	2174±106^{cd}	48.6±1.1^{c}	54.9±0.69^{d}
Overall mean	1943±26.3^{A}	2084.7±30^{A}	188.3±1.7	54.7±1.3^{A}	3337±150^{A}	52.56±0.9^{A}	60.1±1.3
Sig of strains	**	**	**	**	**	**	**

The first parent of each cross was the sire. ** Significant at $P < 0.01$ level.
X –Z = different litters between pure strains are significant ($P<0.05$).
a –e = different litters between crosses and reciprocal crossbred genotype are significant ($P<0.01$).
A – C=different litters between overalls genotypic means within each trait are significant ($P<0.05$).

Table (2): Means ± standard errors for egg number (egg / hen /day), feed intake (g/hen/day),feed conversion (Kg. feed/Kg. egg mass) and mortality rate through laying period (90 day) for Mandarah (M) Golden Montazah (G), and Kosmos (K) strains of chicken and their reciprocal crosses

Traits / Genotype	Rate of lay (egg /hen /day)	Feed intake (g./hen /day)	Feed intake (g./hen / 90day)	Feed conversion (Kg.feed/Kg. egg mass)	Mortality rate through laying period %)
Purebreds:					
M	0.61±1.11^{x}	103.2±1.06^{y}	9288±96.09^{y}	3.01±0.12^{y}	5.0^{y}
G	0.57±1.57^{x}	107.2±4.18^{y}	9648±376.9^{x}	3.26±0.40^{y}	5.0^{y}
K	0.38±1.83^{y}	116.4±3.07^{x}	10476±276^{x}	3.42±0.79^{x}	10^{x}
Overall mean	0.52±1.2^{B}	108.1±4.0^{B}	9804±35.3^{B}	3.24±0.21^{B}	6.66^{A}
Strains cross					
KM	0.34±7.51^{d}	81.9 ±3.03^{e}	7312±274.39^{e}	4.00±1.22^{ab}	7.5^{a}
KG	0.44±2.25^{c}	104 ± .24^{bcd}	9446±652.60^{cd}	4.22±1.41^{a}	7.5^{a}
MG	0.45±6.08^{c}	92.4± 1.43^{de}	8366±124.62^{de}	3.72±1.04^{ab}	5.0^{b}
Overall mean	0.41±1.1^{C}	92.8±2.21^{C}	8374±122.2^{C}	3.98±0.31^{A}	6.66^{A}
Reciprocal cross:					
MK	0.72±1.91^{a}	150 ±4.9^{a}	16130±342.8^{a}	3.80±0.12^{ab}	5.0^{b}
GK	0.66±1.77^{b}	140.4 ±5.4^{a}	13602±658.6^{b}	3.81±0.10^{ab}	5.0^{b}
GM	0.44±1.77^{c}	104.6±1.6^{bcd}	7876±458.14^{e}	3.61±0.14^{b}	2.5^{c}
Overall mean	0.60±1.5^{A}	131.66±3.8^{A}	12536±350.1^{A}	3.74±1.01^{A}	4.16^{B}
Sig of strains	**	**	**	*	*

The first parent of each cross was the sire.
* Significant at P< 0.05 level, ** Significant at P< 0.01 level
X –Z = different litters between pure strains are significant (P<0.05)
a –e = different litters between crosses and reciprocal crossbred genotype are significant (P<0.01)
A – C=different litters between overalls genotypic means within each trait are significant (P<0.05)

Table (3) Means ± standard errors for fertility percentage , hatchability from total eggs percentage ,hatchability from fertility eggs percentage, early, late and final Mortality embryonic percentage and total egg loss percentage from the crossing for Mandarah (M) Golden Montazah (G), and Kosmos (K) strains of chicken and their reciprocal crosses

Traits / Genotype	Fertility percentage	Hatchability from total eggs %	Hatchability from fertile eggs%	Early embryonic mortality%	Late embryonic mortality %	Final embryonic mortality %	Total egg loss %
Purebreds							
M	92.0±0.6^{x}	77.7±0.1^{x}	85.4±0.1^{x}	2.87±0.9^{x}	7.5±1.1^{x}	4.2±0.1^{z}	14.5±1. 4^{z}
G	92.8±0.7^{x}	74.8±1.2^{x}	81.6±0.1^{yz}	4.11±1.3^{x}	5.5±0.1^{xy}	8.2±1.1^{y}	18.4±1.2^{y}
K	80.0±0.6^{y}	63.4±0.1^{z}	79.3±0.1^{z}	1.77±1.0^{x}	4.4±0.7^{y}	14.2±0.1^{x}	20.7±1. 6^{x}
Mean	88.3±1.2^{A}	71.1±1.2^{A}	82.0±0.2^{B}	2.91±1.1	5.8±0.2	8.1±1.3^{B}	17.1±1.1^{AB}
Strains cross							
KM	79.0±0.6^{b}	63.0±1.2^{b}	79.3±1.1^{b}	1.90±1.2	6.1±1.1^{ab}	12.1±1.3^{b}	20.7±1.61^{a}
KG	78.4±0.1^{b}	62.6±1.1^{b}	78.8±0.1^{b}	2.99±0.1	3.8±1.2^{c}	14.5±1.9^{a}	21.2±1.0^{a}
MG	89.0±1.6^{a}	73.3±1.5^{a}	82.7±0.1^{a}	3.90±1.2	8.7±0.1^{a}	4.1±1.1^{c}	17.4±1.1^{a}
Mean	82.2±0.8^{B}	66.4±0.1^{B}	80.3±0.6^{B}	2.93±0.2	6.2±1.1	10.3±1.8^{A}	19.8±1.2^{A}
Reciprocal cross							
MK	88.0±0.8^{a}	73.6±0.5^{a}	84.5±1.1^{a}	3.44±0.5^{a}	5.9±1.4^{abc}	5.7±0.6^{b}	15.4±1.4^{b}
GK	88.0±0.6^{a}	72.1±0.6^{a}	83.6±0.1^{a}	3.77±0.1^{a}	7.0±1.2^{abc}	6.20.7^{b}	16.4±0.1^{b}
GM	89.0±0.7^{a}	75.8±0.6^{a}	84.5±1.1^{a}	4.02±0.6^{a}	4.0±0.6^{bc}	7.4±1.3^{b}	15.5±1.5^{b}
Mean	88.4±0.9^{A}	74.1±1.3^{A}	84.3±1.3^{A}	3.74±0.1	5.6±1.5	6.43±0.8^{B}	15.76±1.5^{B}
Sig of strains	**	**	*	ns	*	ns	*

The first parent of each cross was the sire.
* Significant at P< 0.05 level, ** Significant at P< 0.01 level, ns: non significant.
X –Z = different litters between pure strains are significant (P<0.05)
a –e = different litters between crosses and reciprocal crossbred genotype are significant (p<0.05)
A – C=different litters between overalls genotypic means within each trait are significant (p<0.05)

Table (4) : Heterosis percentage (H%), for body weight at sexual maturity, mature body weight, Age at sexual maturity, egg number and, egg mass pre hen housed per 90 day and early and mature egg weight for Mandarah (M), Golden Montazah (G), and Kosmos (K) strains of chicken and their reciprocal crosses

Traits / Genotype	Body weight At sexual maturity	Mature Body weight	Age at sexual maturity	Total egg number (pre hen housed per 90 d)	Total egg mass (g /hen / 90 day)	Early egg weight	Mature egg weight
Strains cross KM	-0.53	-2.65	-0.26	-30.40	-31.29	9.91	-3.72
KG	1.40	-1.07	0.05	-6.97	-8.92	5.65	-3.28
MG	-0.50	-4.42	0.16	-23.40	-23.78	4.60	0.36
Reciprocal cross MK	25.80	21.04	0.68	46.00	59.80	18.98	8.69
GK	15.50	12.99	0.96	37.20	41.89	6.64	0.59
GM	0.03	-3.90	1.80	-25.20	-26.26	11.50	-0.72

The first parent of each cross was the sire.

Table (5): Heterosis percentage (H%) egg number (egg / hen /day),feed intake (g/hen/day),feed conversion (Kg. feed/Kg .egg mass) and mortality rate through laying period (90 day) for Mandarah (M) Golden Montazah (G), and Kosmos (K) strains of chicken and their reciprocal crosses

Traits / Genotype	Rate of lay (egg /hen /day	Feed intake (g./hen /day)	Feed intake (g./hen / 90day)	Feed conversion (Kg .feed /Kg. egg mass)	Mortality rate through laying period
Strains cross KM	-31.3	-25.4	-26.5	24.4	0.0
KG	-7.4	-6.1	-6.1	26.4	0.0
MG	-23.7	-12.2	-11.7	18.7	0.0
Reciprocal cross MK	45.5	36.6	63.3	18.2	33.4
GK	38.9	25.6	35.2	14.0	-33.2
GM	-25.4	-0.3	-16.8	15.2	-50.0

The first parent of each cross was the sire.

Table (6) : Heterosis percentage (H%) for fertility percentage , hatchability from total eggs percentage ,hatchability from fertility eggs percentage, early, late and final Mortality embryonic percentage and total egg loss percentage from the crossing for Mandarah (M) Golden Montazah (G), and Kosmos (K) strains of chicken and their reciprocal crosses

Traits / Genotype	Fertility percentage	Hatchability from total eggs	Hatchability from fertile eggs	Early embryonic mortality	Late embryonic mortality	Final embryonic mortality	Total egg loss
Strains cross KM	-8.2	-10.6	-3.7	-18.1	2.5	31.5	17.6
KG	-9.3	19.4	-2.1	1.7	-23.2	29.5	8.78
MG	3.7	-3.8	-1.02	11.7	33.8	-33.9	5.50
Reciprocal cross MK	2.4	4.4	2.7	48.3	-0.84	-38.5	-12.2
GK	1.9	5.6	3.1	28.2	41.4	-44.6	-16.00
GM	-3.7	-0.6	1.2	15.2	-38.5	19.4	-5.60

The first parent of each cross was the sire.

REFERENCES

Abd-Alla, .A.M. 1978. *Genetic studies in poultry. A comparative study of five breeds of chickens under certain plans of nutrition. Ph.D. Thesis, Fac . Of Agric., Minia Univ., Egypt.*

Abd El-Gawad, E.M. (1981). *The "Mandara" a new breed of chickens Egypt. Poult. Sci. 1:16-22.*

Abdou, F.H. (1985). *Improving indigenous chickens in developing countries; experience from Egypt. Proc. 12th Annual Scientific Conference of Tanzania Society of Animal Production, Arusha, Tanzania.*

Abdou, F.H. (1992).*A working panel to improve Menofyia chickens through developing the new strain of (Norfa). Menofyia. Agric.Res. 17(1992)No.2:980-982.*

Abdou, F.H. and N.Kolstad (1986). *Improving indigenous chickens in developing countries Preliminary selection results from the Norwegian Egyptian project for improving chickens in Egypt. Paper presented at the Sci. Conf. of Tanzania society of Anim. Prod .Arusha.*

Aly, O.M; R.S. Abou El-Ghar, Nazla. Y. Abou El-Ella and W.Z. Aly, (2005). *Using potency Ratio to interpret hybrid vigor in crossing between two local strains of chickens. Egypt. Poult. Sci. 25: 413-428.*

Ali, M.A. (1979). *Genetic studies in poultry. Comparative study of Dandarawy, Phode Island Red, S.C.W. leghorn and Dokki- 4 breeds of chicken and their crosses. M.Sc. thesis, Alex. Of Agric. Univ. of Alexandria, Egypt.*

Amin, E.M. (2007). Effect of diallel crossing on growth performance and viability of standard and two native Egyptian chicken breeds. Egypt. Poult. Sci., 27: 1151-1173.

Atallah, G.A.M. (1989). *Evalution of single crosses among four lines of Alexandria chicken for growth traits. M. Sc. Thesis, Fac. of Agric., Alex. Niv. Egypt.*

Bahie El-Deen, M.; M.K. Shebl and A.M. El-Raffa, A.M. (1998). *Heterosis, maternal and direct genetic effects for growth and egg production traits in quail crosses. Egypt. Poult. Sci. 18(I): 153-165.*

El-Gendy, E.A. (2000): *Heterosis in reciprocal crosses between two lines of chickens divergently selected short term for heat tolerance, with an approach to genetic distance between these selected lines. Egypt. poult. Sci. 20:25-48.*

El-Tahawy, W.S. (2000). *Genetically improvement of some Productive and reproductive traits in local chicken. M. Sc. Thesis, Fac. of Agric. Alex. Univ Egypt .*

Fairfull R.W. (1990). *Heterosis. Poultry breeding and genetics, R.D., Crawford (Ed). Elsevier, Amsterdam, Page 913:933.*

Fairfull, R.W.; R.S.Game and J.A Nagai (1983). *Diallel cross of six long term selected Leghorn strain with emphasis and heterosis and reciprocal effects. Brit. Poult. Sci.24:113.*

Fairfull, R.W.; R.S. Gowe and J.A. Nagai. (1985). *Heterosis in White Leghorn strain crosses. Proc. Brit. Poult . Breeders Roundtable (Edinburgh).*

Fairfull, R.W.; R.S. Gowe and J. Nagai. (1987). *Dominance and epistasis in heterosis of White Leghorn strain crosses. Can. J. Anim.Sci. 67:663-680.*

Farghaly, M and K. Saleh (1988). *The effect of crossbreeding on egg Traits in laying hens. Egypt. Poult. Sci. 8:376-391.*

Farghaly, M. (1989). *Combining ability analysis in a diallel cross involving four lines of Alexandria chicken. J. Agric. Sci. Mansoura Univ., 14: 161-168.*

Gowe, R.S. and R.W Fairfull, (1982). *Hetrossis in egg-type chickens. Proc.2nd world Cong. Appl. Livestock Prod (Madrid) 6:228-242.*

Khairy, M. (1997). *Improvement of some Egyptian strains of chickens by crossing with egg-type commercial breeders. Second Hungrian Egyptian Poult. Conf. 16-19 September, 1997; Part I, 171-178.*

Khalil, M.K; A.H.Al-Homidan and I.H Hermes (2004). *Crossbreeding components in age at first egg and egg production for crossing Saudi chickens with White Leghorn Livestock Research for rural Development 16(1) 2004.*

Kosba, M.A.; Mahmoud, T.H.; Kalil, A.Z.; and, G.M Abd-Alla. (1981). *A comparative study of four breeds of chickens and their Fl crosses. Agric. Res. Rev., Cairo, 59: 93-103.*

Mandour, M.A.; G.A. Abd-Allah and M.M. Sharaf. (1996). *Effect of crossbreeding in some carcass traits of native and standard breeds of chickens. Egypt. poult.Sci. 16 (1): 171-185.*

Mandour, M. A.; M.M. Sharaf; M.A. Kosba and N.M. El- Naggar (1992) . *Estimation of combining ability and heterosis for some economic traits strains of chickens from a diallel cross. Egypt. Poult. Sic. 12: 57-78.*

Mohamed, A.A. (2003); *Effect of diallel crosses on poultry performance. M. .Sci. Thesis, Fac. of Agric. Alexandria University.*

Mohammad, Kh.A. (1997). *Improvement of some Egyptian strains of chickens by crossing with egg-type commercial breeds. Second Hungarian. Egyptian Poult. Conf. 16-19 September 1997, Godollo, Hungare part I. Page 171-178.*

Nawar, M.E. (1995). *A comparative study of some productive traits between some native and foreign breeds of chickens. Ph. D. Thesis, Univ. of Minufiya, Egypt.*

Nawar, M.E. and F.H. Abdou. (1999). *Analysis of heterotic gene action and maternal effects in crossbred Fayoumi chickens. Egypt Poult. Sci. 19 (III): 671-689.*

Nawar, M.E and M. Bahie El-Deen; (2000) *Acomparative study of some economic traits on seven genotypes of chicken under intensive production system. Egypt. Poult. Sci. 20 (IV): (1031-1045).*

Sabra, Z.E.A. (1990). *Estimation of heterosis and combining ability for some economic traits in chickens. M.Sc. Thesis, Moshtohor, Zagazig Univ., Egypt.*

Sharaf, M.M; M.A. Mandour, and A.E. Taha (2006). *Effect of diallel crossing on same growth performance, carcass traits and immune response against Newcastle disease virus vaccine of Japanese quails. Egypt. Poult. Sci. 3 :1451-1470.*

Shawer, M .F and M .M. Khalifah (1976). *Fertility and hatchability performance and heritability under selections in Alexandria cross lines. J. Agri. Sci. Mansourah University1 (1):1-12.*

Shebl, M.K.; Mervat A. Ali; Magda M. Balat and T.H. Tag El- Din (1990). *Evaluation of combining ability for some body size traits and feathering in a diallel cross of chickens. Egypt. Poult. Sci. 10: 159-177.*

Sherif, B.T. (1991). *Improving of some economic traits in chickens. Ph. D.Thesis, Univ. Minufiya, Egypt.*

Sinha, S.K and R. Khanna (1975). *Phyiological biochemical and genetic bases of heterosis. Advan. Agron. 27:123-174.*

Snedecor, G.W. and W.G. Cochran (1981). *Statistical methods. 7th Ed .The Iowa State University. Press Ames Iowa, USA.*

Steel, R.G.O. and J.H. Torries (1980). *Principles and procedures of statistics. A biometrical approach, 2nd ed. McGraw Hill, New York, N.Y.*

Wang, A.G. F. and F.Pirchner (1992). *Heterosis of feed efficiency and reproductive traits in reciprocal crosses of laying hens. A.B.A., 60:1284.*

Zatter, O.M.M. (1994). *Genetic studies in poultry. Effect of crossbreeding between local strains of chicken on some productive traits .M.Sc. Thesis, Fac. of Agric., Alex. Univ., Egypt.*

الملخص العربي

تاثير خلط الدجاج المحلى مع سلالة دجاج تجارية على صفات إنتاج البيض

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أجريت هذة الدراسة في محطة بحوث مريوط التابعة لمركز بحوث الصحراء في الفترة من٢٠٠٥ ــ ٢٠٠٦ و كان الهدف من الدراسة توضيح اثر خلط سلالة تجارية كزموس مع سلالتين محليتين هما المنتزه الذهبي والمندرة على الاختلافات في صفات أنتاج البيض و تم تقدير قوة الخلط باستخدام الاختلافات في المجاميع الوراثية وكانت أهم النتائج كما يلي:

- وجدت اختلافات معنوية بين سلالات الاباء الثلاث المستخدمة فى الدراسة وكذلك بين الخليط والخليط العكس فى جميع صفات إنتاج البيض. قد تفوقت التراكب الوراثية بالخليط العكس على المتوسط العام بالنسبة للأباء وكذلك بالنسبة للخليط حيث بلغت أوزان الجسم عند النضج الجنسى ١٩٤٣ ، ١٧٠٤ ، ١٧٩٢ جم وكذلك النضج الجسمى ٢٠٨٥، ١٨٩٩ ، ١٨٣٨ جم عدد البيض الناتج خلال ٩٠يوم ٥٤.٧، ٤٧.٠ ٣٧.٤ بيضة وكتلة البيض الناتج خلال نفس الفترة ٣٣٣٧ ، ٢٧١٢ ، ٢١٢٨ جم كما بلغ معدل إنتاج البيض اليومى ٠.٦٠ ، ٥٢.٠، ٠.٤١ %.وكان وزن

البيض الناتج خلال مرحلة الإنتاج المبكرة بالنسبة للخليط والخليط العكس (٥٢.٥٦، ٥١.٣جم) أثقل معنويا بالمقارنة بالمتوسط العام للأباء (٤٧.٠٣جم).

- الاستهلاك اليومى من الغذاء للدجاجات الكوزموس كان أكثر معنويا (P<.01) مقارنة بأستهلاك العلف لدجاجات الأباء المحلية، وكان المتوسط العام لدجاجات الخليط العكس الأعلى معنويا ودجاجات الخليط كانت الأقل استهلاكا للعلف بينما كان متوسط استهلاك دجاجات الأباء ذات قيمة متوسطة بينما ، حققت دجاجات مجموعة الأباء أفضل كفاءة غذائية (٣.٢٤). كما بلغت نسبة النفوق لدجاجات الكوزموس خلال فترة إنتاج البيض ضعف (١٠%) السلالتين المحليتين (٥%) لكلا منهما. بينما بلغ المتوسط العام لدجاجات الخليط العكس أقل نسبة نفوق(٤.١٦%).

- كان البيض الناتج عن دجاجات المندرة والمنتزة الذهبى أكثر خصوبة معنويا (٩٢.٠ و٩٢.٨%) مقارنة بالكوزموس (٨٠.٠%)، وكذلك كان ا لمتوسط العام لسلالات الأباء والخليط العكسى الأعلى مقارنة بالخليط، وأيضا كان المتوسط العام للخليط العكس بالنسبة لنسبة الفقس لكل من إجمالى البيض أو بالنسبة للبيض المخصب الأعلى معنويا (٧٤.١ و ٨٤.٣%) مقارنة بالمجموعتين الأخريتين. كذلك كانت سلالة الكوزموس الأعلى معنويا فى نسبة البيض الكابس وإجمالى البيض الفاقد (١٤.٢ و ٢٠.٧%) بينما كان المتوسط العام للخليط العكسى الأقل فى تلك الصفة مقارنة بمتوسطة الأباء والخليط (٦.٤٣، ٨.١٠ ، ١٥.٧٦%) على التوالى.

- كانت قيم قوة الخلط Heterosis للخليط والخليط العكسى موجبة بالنسبة لمعظم صفات إنتاج البيض حيث تراوحت بين -٠.٥ و ٢٥.٨% بالنسبة لوزن الجسم عند النضج الجنسى ، -٤.٤٢ و ٢١.٠٤ % بالنسبة للوزن الناضج ، -٢.٦ و ٠.٩٦ للعمر عند النضج الجسمي ، -٣٠.٤٠ و ٤٦.٠% لعدد البيض و -٣١.٢٩ و ٤١.٨٩% لكتلة البيض الناتج ، - ٣١.٣ و ٤٥.٤% لمعدل وضع البيض ، -٢٥.٤ و ٣٦.٦% للغذاء المأكول للدجاجة فى اليوم -٥٠.٠٠% و صفر لمعدل نفوق الدجاجات.

- جميع نسب قوة الهجين الخاصة بوزن البيض المبكر والمتأخر والكفاءة الغذ ا نية كانت موجبة (٤.٦ -١٨.٩٨% ، ٠.٠٨ – ٨.٦٩% ، ١٨.٧ – ٢٦.٤%) للصفات السابقة على التوالى.

- تراوحت قيم قوة الهجين بالنسبة لمعظم صفات الفقس بين سالبة وموجبة وتراوحت بين -٩.٣ إلى ٣.٧% لنسبة الخصوبة ، -١٠.٦ و ١٩.٤% لنسبة الفقس للبيض الكلى ، ٣.٧ و ٣.١% لنسبة الفقس للبيض المخصب ، -١٨.١ و ٨٤.٣% لنسبة النفوق المبكر ، -٣٨.٤ و ٤١.٤% لنسبة النفوق المبكر المتأخر، -٤٤.٦ و ٣١.٥% للبيض الكابس ، ١٦.٠٠ و ١٧.٦% لجملة البيض الفاقد.

هذه النتائج تشير إلى وجود قوة الهجين راجعة لسيادة اباء السلالتين المحليتين المندرة والمنتزه الذهبى بانسبة لمعظم صفات إنتاج البيض وصفات الفقس بينما ترجع قوة الهجين لامهات للكوزموس بالنسبة لصفات وزن الجسم ،الوزن الناضج ووزن البيض.