Research Article

Evaluation of Production and Reproductive Traits of Mamourah Egyptian Local Chicken and Crossbreed Tanta G-1

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Abstract | This experiment was conducted to study the progress in productive performance of Tanta G-1 selected for high body weight at 8 weeks of age compared with the Mamourah local strain. The selection was applied for three generations. Body weight at sexual maturity (BWSM), age at sexual maturity (ASM), and egg production traits (EP) from 36 - 42 weeks of age were also applied. Our results showed that the average body weight for Tanta G-1 and Mamourah chicken strains was 866.45 grams and 558.75 grams in the first generation. In the second generation, the Tanta G-1 line's body weight was 1006.50 grams against 555.10 grams for the Mamourah strain, while in the third generation the average body weight in the Tanta G-1 line was 1068.93 grams versus 551.25 grams in the Mamourah strain at the age of 8 weeks. This difference between the two lines was significant (P≤0.05). Body weight at sexual maturity was 3155.16 g,1525.00g for males and females in generation one, 3137.35g,1526.24g in generation two, and 3119.91g,1526.83g in generation 3 respectively for Tanta G- 1 and Mamourah chickens strain respectively. In the first generation age at sexual maturity for Tanta G- 1 was 172 days, while it was 157 days for the Mamourah strain. The weight of the first egg weight was (45.46g) for Tanta G- 1, while it was 34.84g for the Mamourah strain (34.84g). The overall mean fertility percentage for Tanta G-1 female egg was 87.92 %, while it was 88.94 % for the Mamourah strain and the difference was significantly different (P≤0.05). The overall mean hatchability percentage was 76.15% and 75.03%, for Mamourah and Tanta G- 1 line respectively.

Keywords | Local strain, Selection, body weight, Correlated response, productive performance, Reproductive performance.

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INTRODUCTION

Native strains of chickens play an important role to produce meat and eggs. Native strains of chickens have low body weight and slow growth rate and need more time to reach marketing weight. (Sopannarath and Bunchasak, 2015; Jaturasitha et al., 2016). The future success of the broiler industry depends on the bird being able to continue to perform at present levels but with minimized negative effects on fitness traits, which reduces the management resources required (Pollock, 1999). Information on phenotypic and genetic parameters for production traits and traits related to health is needed for the design of breeding programs aimed at improving the balance between production and health traits (Zerehdaran, 2005). Live Body weight (LBW) and carcass traits were under intensive selection for more than half a century, and are considered the most important economic traits in broiler breeding programs. Progress in rapid growth has been accompanied by an increase in abdominal fat deposition in broilers (Baéza et al., 2012; Crossley and Altimiras, 2012).

The genetic control of growth, in chickens, will provide an opportunity for genetic enhancement of production performance and physiology (Li et al., 2005). However, improving the body weight of native chickens by genetic selection is a slow and time-consuming practice. Therefore, crossbreeding is a better option to obtain birds with a faster growth rate that are adapted to local environmental conditions (Segura-Correa et al., 2004).

Crossbreeding in chickens is a technique for producing superior hybrid to improve body weight, egg production traits, and reproductive performance through independent culling level (Nassar, 2017), and fitness. To take advantage of hybrid vigor, crossbreeding is regarded as an effective strategy for the generation of commercial stocks in the chicken business. A two-way hybrid between a commercial breed and an enhanced local breed is usually used in cross-breeding, to combine greater production features with hardiness. (Debes, 2017; El-Tahawy, 2020). The current study aimed to improve the productivity of the local strains by improving body weight and egg production traits.

MATERIALS AND METHODS

Ethical approval

The present study has been conducted in accordance with the guidelines of the Ethics Committee of the Faculty of Agriculture of Cairo University.

This experiment was conducted at Animal Production Research Institute, Agriculture Research Center to develop a new synthetic local broiler breeder male line. Local Egyptian strain Mamourah females (Abd_ElGawad et.al., 1979) were housed individually and artificially inseminated with grandparent male line male Indian River strain (Aviagen, 2018). Pedigreed eggs for each sire and dam were collected to obtain the base generation named the Tanta line. Hatched chicks were wing banded, pedigreed for sir and dam, sexed, and weighed individually.

An inter-C-mating system with no full or half-sibs mating was applied. Two hatched chicks were taken. The first hatch considered the selected line named Tanta G-1 line while the second hatch served as a random-bred control line (Mamourah strain). Feed and water are provided ad libitum from hatch until 8 weeks of age. The light was provided 24 hours per day. The selection procedure for high body weight at 8 weeks was applied for the next generation in the Tanta G-1 line.

Experimental measurements

In each generation, chicks were weighed individually bi-weekly. Also, body weight at sexual maturity (BWSM), age at sexual maturity (ASM), egg production numbers (EN), and egg weight (EW) were recorded for (Tanta G-1) line and Mamourah strain. Fertility and Hatchability percentage was also recorded.

Statistical analysis

Analysis of variance was carried out using, the General Linear Model procedure of the (X L stat, 2014). Significant differences were separated by Duncan's multiple range test (Duncan, 1955). The significance level was set at 5%. The following model was used in each generation:

$Y_{ijk} = \mu + L_i + S_j + LS_{ij} + e_{ijk}$ Where:

Y_{ijk} = the K^{th} observation of the j^{th} sex within the i^{th} line.

μ = the overall mean.

L_i = the effect of the i^{th} line.

S_j = the effect of the j^{th} sex

LS_{ij} = the interaction between the i^{th}

e = the random error.

RESULTS AND DISCUSSION

Body weight and growth performance

After three generations of selection for high live body weight, the Tanta G-1 line increased significantly ($P \leq 0.05$) in body weight at 8 weeks of age compared with the Mamourah strain. The average body weight of Tanta G-1 and Mamourah strain at 8 weeks of age were 1172.25g *and* 618.50g respectively (Table 1). These results agreed with Rashid et al. (2012) reported that body weight at 6 weeks of age was 485 g and 396 g for males and females of the Cairo B2 line selected for high live body weight respectively. Also, Nassar (2013) reported that body weight at 6 weeks of age for Cairo B-2 and the random-bred control lines were 1085 and 700g respectively, in the seventh generation of selection for high live body weight.

Also, our results indicate that the body weight of the Tanta G-1 line increased significantly ($p<0.05$) at different ages after three generations of selection compared with the control line Mamourah strain. These results agreed with Joseph et al. (2005), Schmidt et al. (2006), Nassar (2017), Ramadan et al. (2014), and Ramadan (2019). Joseph et al., (2005), Schmidt et al. (2006), and Nassar, (2013) reported that selection for high body weight in broiler breeders includes maternal effects which have a positive association with the live body weight of its progenies after hatch. Also, Nassar (2017) reported that body weight for the Giza M-2 line increased significantly ($p < 0.05$) at different ages compared with the control line.

Also, our results agreed with many authors whose recorded breed and strain differences in body weight (Taha et al., 2012), Omer (2012), Ajayi and Ejiofor, (2009), and Ramadan (2019). The typical LBW via the creation of Giza M-2 and RBC (Random bred control) LINE lines 862 g compared 550 g at 6 weeks of age (983 g vs. 625 g), and 983 g vs. 625 g (G5), with substantial differences, respectively for the two lines (Nassar, 2017). In the same direction, El-Tahawy (2020) reported that at 0, 4, 8, and 12 weeks of age, the bird's body weight was 35.3 g, 226.1 g, 560.2 g, and 924.6 g, respectively.

Soliman et al. (2020) reported that for all variables tested, genotype comparisons revealed statistically significant differences. When compared to the commercial Lohmann strain (LL) and other crossbreds, the Alexandria (AA) strain produced significantly higher body weight at 8 weeks of age (AL and LA). In body weight at sexual maturity, however, the commercial strain (LL) greatly outperformed the local strain (AA) and both crossbreds (AL and LA) (1829.25 vs. 1669.16, 1649.72, and 1563.74 g, respectively).

Tanta G-1 males exhibited considerably higher LBW than Mamourah males over all generations and at all ages, according to the findings. Furthermore, at hatch, 14 days, 28 days, 42 days, and 56 days of age, Tanta G-1 males had significantly (P≤0.05) larger LBW than Mamourah males (Figure 1). At 8 weeks of age, the average LBW of Tanta G-1 males and Mamourah males' lines were 921.50 g vs. 612.16 g (G1), 1074.24 g vs. 619.83 (G2), and 1172.25 g vs. 618.50 g (G3), respectively.

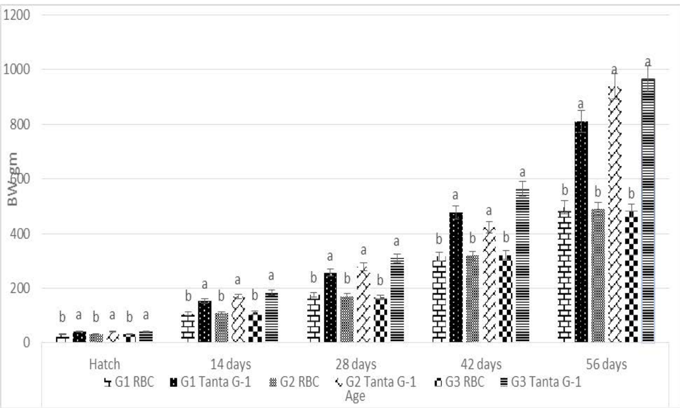

Figure 1: Live body weight (g) at different ages, from generation1 (G1) to generation 3 (G3) of both Tanta G-1 and RBC lines as combined sex.

Tanta G-1 females exhibited considerably higher LBW than Mamourah females over all generations and at all ages, according to the findings). Tanta G-1 females had considerably (P≤0.05) higher LBW at hatch, 14 days, 28 days, 42 days, and 56 days of age compared with the Mamourah female line (Figure 1). The average LBW of Tanta G-1 females and Mamourah females' lines by generation at 8 weeks of age were 811.37 g *vs.* 464.33 g (G1), 938.73 g *vs* 490.16 (G2) and 965.62 g *vs.* 484.00 g (G3), respectively.

Faruque et al. (2017) discovered that intensive management system selection improved the BW of indigenous chickens in the second generation, with weight gains of 107.34, 175.95, and 150.70g for ND, HI, and NN genotypes at 8 weeks of age, and BW increases of 202.91, 337.36, and 72.82 g for ND, HI, and NN genotypes at 40 weeks of age. Nassar (2017) also indicated a positive reaction in LBW and egg productivity in the Giza M-2 line as a result of the breeding effort.

Significant sexual dimorphism, in body weight, was apparent at all ages studied except at hatch. From the second week of age until the 6 weeks of age, males had significantly (P≤0.05) higher body weight than females Table (2). At 4 and 8 weeks of age, sex had a significant impact on body weight. At all ages, males were substantially heavier than females (Soliman et al., 2020).

Sultana et al. (2021) found that the mean BW of Non-descript deshi (ND), Hilly (HI), and Naked Neck (NN) hens grew from 349.99, 380.07, 340.43 g in G0 to 609.09, 704.15, and 591.39g in G7 at 8 weeks of age, and from 1240.71, 1448.30, 1218.34g in G0 to 1530.82, 1901.43, and 1511.66 g in G6 at 40 weeks of age. Over the seven generations of selection, ND, HI, and NN gained 259.10, 324.08, and 250.96 g at 8 weeks of age, and 290.11, 453.13, and 293.32 g at 40 weeks of age, respectively. As a result, the effect of generations of selection on body weight (p≤0.001) was highly significant. Sultana (2019) discovered that at both 8 and 4 weeks of age, generation of selection increased the body weight. Intensive management system selection enhanced the BW of indigenous chickens in the second generation, according to Faruque et al. (2017).

Age and body weight at sexual maturity

Body composition plays a crucial role in sexual development, and the connection between LBW and reproduction in restricted-fed broiler breeder females is not straightforward (Bornstein et al., 1984). However, because LBW is a primary predictor of both of those factors, it is commonly assumed that high uniformity reduces variability in ASM and EW (Wilson, 1991; Hocking, 2004). To achieve optimal reproductive performance in broiler breeder pullets, maintaining a high level of LBW homogeneity is a primary goal during the raising stage (Hocking, 2004).

Results indicated that the Tanta G-1 line had significantly higher body weight at sexual maturity (BWSM) for the first three generations in comparison to those of the Mamourah line (Table 3). This may be due to the selection

Table 1: Live body weight (g) LSM and SE at different ages of the 3rd generation of both the Tanta G-1 line and the Mamourah strains.

Trait	**Age(day)**				
S.O.V	**Hatch (gm)**	**14dys (gm)**	**28 days (g)**	**42 days (g)**	**56 days(g)**
Strain					
Tanta G-1	41.13[a]	189.00[a]	331.06[a]	644.60[a]	1068.93[a]
Mamouraha	31.47[b]	115.50[b]	188.00[b]	366.75[b]	551.25[b]
SE	0.07	1.37	1.98	2.95	3.49
Sex					
Male	36.39[a]	157.37[a]	281.93[a]	568.37[a]	895.37[a]
Female	36.21[a]	147.12[b]	237.12[b]	442.37[b]	724.81[b]
SE	0.072	1.372	1.988	2.955	3.942
Strain*Sex					
Tanta G-1 ♂	41.16[a]	194.25[a]	352.87[a]	724.75[a]	1172.25[a]
Tanta G-1♀	40.08[a]	183.75[b]	309.25[b]	563.25[b]	965.62[b]
Mamourah ♂	31.60[b]	120.50[c]	211.00[c]	412.00[c]	618.50[c]
Mamourah ♀	31.35[b]	110.50[d]	165.00[d]	321.50[d]	484.00[d]
SE	0.11	1.94	2.814.17	4.17	5.24
Probabilities					
Strain	0.00001	0.00001	0.00001	0.00001	0.00001
Sex	0.0878	0.00001	0.00001	0.00001	0.00001
Strain*Sex	0.00001	0.00001	0.00001	0.00001	0.00001

[a…d] Means, within age and source of variation (S.O.V), with different superscripts, are significantly different (Duncan, 1955).

Table 2: Sexual dimorphism of the Tanta G-1 line and Mamourah strain from generation 1(G1) to generation 3 (G3).

	Sex	**Generation**		
		G1	**G2**	**G3**
Mamouraha				
8 week LBW (g)	Female	496.33	490.16	484
	Male	621.16	619.83	618.5
Sex differences		110.13	135.5	206.63
TantaG-1				
8 week LBW (g)	Female	811.37	938.75	965.62
	Male	921.5	1074.25	1172.25
Sex differences		124.83	129.67	134.5
Lines different		307.7	451.4	517.68
Lines different (%)		35.51	44.85	48.43

for high LBW at 8 weeks of age in the Tanta G-1 line. A major objective of the genetic selection in the Tanta G-1 line has been to increase LBW at earlier ages and this strategy has changed LBW at different points along the growth curve including BWSM. On the other hand, there were significant differences between the Tanta G-1 and the (MAMOURAH) strain in ASM in the first three generations compared to the Mamourah strain Soliman et al. (2020) When compared to the commercial strain (LL), the local strain (AA) laid the first egg significantly later (182.78 vs. 151.40 d). However, when compared to the native strain (AA), the crossbred (LA) lay much earlier (172.83 vs. 182.78 d) The results of Soliman et al. (2020) agreed with the results found in our study. Debes (2017) found that the Silver Montazah (SM) strain was the heaviest ($P \leq 0.05$) at sexual maturity (1550.76g) when compared to the other pure strains, but the two-way hybrid (SM X LSL) had a higher BWSM (1553.22 g) than (MT XLS) (1479.91g). This could be owing to the genetic differences between these breeds. According to Iraqi et al. (2016), the body weight at sexual maturity in the line Benha chickens (Line B) was 1742 g.

Table 3: Weight at sexual maturity, age at sexual maturity, egg number during first 36-week of age, average egg weight for the eggs produced during the first 36 weeks of age, the weight of the first egg (LSM ± SE) of the Tanta G-1 line and Mamourah strain in the generation's studies.

Generation	Traits	BWSM (g)	ASM (days)	EN90	EW (g)	FEW (g)
G1	Mamouraha	1525.66^b±37.16	154.1^b±0.54	58^a±0.35	51.36^b±0.21	35.03^b±0.25
	Tanta G-1	3155.16^a±18.58	172.72^a±0.1	58^a±0.17	60.41^a±0.10	45.61^a±0.11
G2	Mamouraha	1526.24^b±20.44	156.6^b±0.23	58^a±0.25	51.58^b±0.19	34.84^b±0.16
	Tanta G-1	3137.35^a±12.43	172.0^a±0.20	58^a±0.16	60.21^a±0.12	45.42^a±0.13
G3	Mamouraha	1526.83^b±8.80	159.26^b±0.19	58^a±0.15	51.80^b±0.13	34.65^b±0.10
	Tanta G-1	3119.91^a±6.28	171.79^a±0.14	58^a±0.15	60.08^a±0.09	45.37^a±0.07

BWSM= body weight at sexual maturity, ASM= age at sexual maturity, EN= egg number, EW= egg weight, FEW= weight of first egg.,

* Means within traits, with different superscripts are significantly different (P≤0.05).

Table 4: Fertility and hatchability percentage of Tanta G-1 line and Mamourah strain for the first three generations combined data.

Lines	Fertility (%)	Hatchability (%)
Mamourah	88.94^a	76.1500^a
Tanta G-1	87.92^b	75.0375^b
SE	0.158	0.1456
Probability	<0.0001	<0.0001

$^{a..b}$, means within traits, with different superscripts are significantly different (P≤0.05).

Egg number and Egg weights

In comparison to the Mamourah strain, the Tanta G-1 line had considerably greater FEW, and EW than the Mamourah strains (P≤0.05) (Table 3). Table 3 shows the EN of the Tanta G-1 and Mamourah strains for the first 36 weeks of age. The number of eggs produced, by the first three-generation, during the first 90 days of production, is presented in Table 3. The egg production means for the first three-generation female was 58 eggs for both lines. This number was found to be within the range of 27 to 69 eggs reported for the local Egyptian.

The increase in EN in the Mamourah strains until 42 weeks is due to the high age of sexual maturity of the Tanta G1 strain compared to the Mamourah strain. Therefore, we must focus on future generations on through independent culling levels to improve egg production for the selected line compared to the control line. And also, may be due to the negative correlation between high body weight and reproductive performance (Luo et al., 2007) Nassar (2017) reported that in comparison to the RBC line, the EN, FEW, and EW of the Giza M-2 line were significantly greater (P0.05). The EN of Giza M-2 and RBC lines are shown for the first 36 weeks of age. The increase in EN in the Giza M-2 line is attributable to our decision to raise EN (via independent culling levels) in all generations of the Giza M-2 line. Furthermore, when compared to the RBC line, Giza M-2 had a much greater FEW. In addition, the Giza M-2 line showed a greater EW throughout the first 36 weeks of age than the RBC line. Soliman et al. (2020) although both crossbreds (AL and LA) lay significantly more eggs than the local strain (AA) (53.14 and 52.29 g vs. 47.47 g), they consistently weighed less than the commercial strain (LL) (57.55 g). The egg mass followed the same pattern. The crossbreds (AL and LA) deposited significantly more eggs (2452.69 and 2231.51 g) than the local strain (1630.67 g), while the local strain (1630.67 g) laid significantly more eggs. They were not as numerous as the commercial strain (3394.82 g). Also, Nassar (2017) also found that the Giza M-2 line had considerably greater EN and FEW than the RBC line (P0.05). According to Younis et al. (2014), the average egg number for the base, first, and second generation over the first 90 days of laying was 43.9, 52.7, and 61.9 eggs for the selected line, and 43.6, 44.8, and 46.1 eggs for the control line, respectively.

Fertility and hatchability percentage

The overall mean fertility of Tanta G-1 chicken eggs was 87.92 percent (Table 4), whereas the fertility of Mamourah chicken eggs was 88.94 percent. This difference was significantly statistical. Overall mean hatchability across total incubated and viable eggs were determined to be 76.15 and 75.03 percent, for Mamourah and Tanta G-1 respectively, as shown in Table 4. Also, this difference was significantly statistical this difference between the two lines due to the negatively correlated between high body weight and reproductive performance (Nassar 2017, Luo et al., 2007) Sapkota et al. (2020) Fertility and hatchability traits play an important role in overall profitability. Fertility of Sakini chickens Fertility, hatchability, and survivorship all improved significantly (p0.05) in chosen generations when compared to the base population, but no significant differences were found within the different populations. Thus, indigenous Sakini chicken in this experiment fared better in terms of survivorship, fertility, and hatchability in subsequent generations, indicating that there is plenty of room for selective breeding within the indigenous population to boost Sakini chicken productivity in Nepal. Sapkota et al. (2020).

CONCLUSION

This study's findings the production performance (live weight at various weeks) and reproductive traits such as age at first laying, weight at first laying, egg number, egg weight, and egg production. The results clearly showed that the Tanta G-1 chickens outperformed Mamourah chickens in terms of growth, but that Mamourah chickens outperformed Tanta G-1 in terms of fertility and hatchability in subsequent generations, indicating that there is a lot of variation for selective breeding within the indigenous population to improve these economically important traits. Finally, to produce commercially hybrid lines, better adapted to the volatile climate changes in Egypt's environmental conditions and more resistant to endemic poultry diseases we suggested used Tanta G-1 males in crossing with other female lines.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

AUTHORS CONTRIBUTION

Conceptualization: Gomaa Said Ramadan, Omer Sayed Rashed; investigation: Gomaa Said Ramadan, Ossama el-WeshAhy; resources: Ahmed Rezk, Alaa Abdo, Omer Sayed Rashed, Osamaa El -Weshahy; analysis: Gomaa Said Ramadan; writing—original draft preparation: Gomaa Said Ramadan; writing-review, and editing: Gomaa, Said Ramadan, Omer Sayed Rashed. All authors have read and agreed to the published version of the manuscript.

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