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# ASSESSMENT OF GROWTH, CARCASS TRAITS, AND SOME PHYSIOLOGICAL PARAMETERS OF BRONZE, AND WHITE TURKEYS (*MELEAGRIS GALLOPAVO*), AND THEIR CROSSES

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**ABSTRACT:** Crossbreeding has the advantage of benefiting from the effect of heterosis. A current crossbreeding experiment was conducted using Black Bronze (BB) and Large White Converter (CC) turkeys. Artificial insemination of 40 mature hens of CC with 6 toms of BB, and 40 mature hens of BB with 6 toms of CC were used to obtain F1 of the two turkey crosses (CB and BC) respectively. A total of 160 poults of the four groups of turkeys were taken in the evaluation in this study. This evaluation included some growth and carcass traits, and some biochemical blood and oxidative profile parameters. It was noticed that the body weight at different ages was higher in the large white turkeys-Converter, CC group, and then the crossbreed BC (BB toms × CC hens) group. The means of daily weight gain (DWG) and feed intake (FI) at different periods of age were highly significant ($P \leq 0.05$) high in CC followed by BC and CB turkeys. Feed conversion (FC) reached the lowest values in CC while the BB genotype was having the highest values. The crosses showed significant values in percentages of carcass/live body weight compared to BB. The hind part of the carcass differed significantly ($P \leq 0.05$) among the four groups of birds regardless of other parts (neck, wing, and chest/carcass). Blood serum protein, glucose, urea, and albumin levels were not significantly affected by the genotype. However, globulin and triglyceride levels were affected significantly ($P \leq 0.05$) by the genotype. Oxidative profile parameters were affected significantly ($P \leq 0.05$) by the genotype. The crossbreeding parameters obtained showed that the additive effect was significant for DWG and FI during the periods from hatching to 24 weeks while it was not significant for FC. The additive effects were not significant for carcass traits, and biochemical blood profile parameters except for glutathione reductase and total antioxidant capacity. The cross effect was significant for DWG during the periods hatching-12, only. The cross effect in FI during the period from hatching to 24 weeks was significant while it was not significant in FC. The cross effects of the two reciprocal crosses were not significant in all carcass parameters and biochemical blood profiles. The oxidative profile was not significantly different in the cross effect except for hydrogen peroxide (HP) and; malondialdehyde. Presumably, the crossbreeding between large white Converter turkeys with Bronze turkeys was to benefit from the effect of heterosis. The crosses have a growth performance and carcass traits higher with a relative growth advantage when the hens were Hybrid Converters. The first generation in crossbreeding could be submitted to selection for the constitution of a synthetic strain.

**Keywords:** Turkeys, crossbreeding, growth traits, carcass traits, physiological parameters.

## INTRODUCTION

The poultry industry is one of the world's largest food sectors, and boosting the growth rate lowers the cost of producing meat. With facing global warming and increasing demand for poultry products due to growing populations and improved living standards, the improvement of poultry production will depend on utilizing and developing local breeds of chicken [Gheyas et al., 2021]. Breeding local poultry breeds are among the farming activities in rural communities and it is known that the local breeds are characterized by high resistance, and are adapted to their local climatic conditions without any loss of productivity in summer, but also their weak prolificacy and their low adult weight qualities [Bogusławska-Tryk et al., 2021]. Body weight is the main concern for producers of chickens for meat [Thorp 2021]. Intensive turkey selection has resulted in significantly lowered age of birds at slaughter and feed conversion ratio (FCR), on the other hand, increased final body weight of birds due to a fast growth rate and increased weight of edible parts in the carcass (Yilmaz et al., 2011). The hybrid large white turkeys replaced the traditional use of Bronze turkeys in low-income countries. However, the fast-growing turkeys are reared exclusively in strictly-controlled conditions of an intensive system that seemed too complex to set up in low-income countries and in Egypt, where the structures were not enough developed. It is else observed they have problems with the osseous system (Zhong et al., 2012), insufficiency of the cardiovascular system (Julian, 2005), and welfare of animals (Fanatico et al., 2008). All these factors combined with increasing demand for poultry products due to growing populations led to increased farmer interest in low-income countries to produce high body weight birds that have not above these problems and can be reared in an un-intensive system.

The crossbreeding between breeds or strains was chosen because that has the advantage of exploiting to profit from the effect of heterosis. Crossbreeding local breeds and commercial meat lines utilized in turkeys such as American bronze and large white turkey (Hybrid Converter) reported by Elibol et al.( 2009) and Bronze and Big 6 turkeys (Damaziak et al., 2015) to assess the growth performances of these parents and their crosses under intensive and semi-intensive management conditions. Stress in birds has induced effects on the body homeostasis and leads to changes in the mobilization of the body, growth, and FCR (Odeh et al., 2003). Intensification of these effects depends on the type of stimulus, as well as on the genotype of the animal. The phenotype of the progeny under stress differs and depends on the value of a given trait transferred by each of the parents. Considering the above, this study aimed to cross local bronze breed with Hybrid Converter turkeys and compare differences in the productive traits and carcass percentage, biochemical blood, and oxidative profile parameters between reciprocal crosses and their parental forms. Another goal of this study was to determine which of the crosses is more suitable for alternative production under natural summer conditions.

## MATERIALS AND METHODS

### Study Location and Ethics

The study was carried out on the research farm, Mahalat Musaa, belonging to the Animal Production Research Institute (APRI), Agricultural Research Center (ARC), located in Kafr El-Shaikh governorate in the north of Egypt. The Institute's ethical rules for animal research were followed and the study plan was approved by the Institute's Research Committee in December 2018 (code no. 020203429). The experiment was carried out between March to October, 2019.

**Experimental design**

Black, Bronze turkeys in Egypt (BB) and Large White turkeys (Converter; CC) were used as pure lines and as their crosses from March to October 2019. In total, 4 different genotypes were included in the experiment: BB, CC, the cross between BB toms and CC hens (BC), and the cross between CC toms and BB hens (CB) to produce F1. Semen was collected by dorso-abdominal massage (Burrows and Quinn, 1937). Thoroughly fresh semen was diluted with a Sodium Chloride solution (NaCl 0.9% w/v) in the ratio of 1:1. All hens were inseminated once a week with 0.05 ml of diluted pooled semen. Eggs were collected two times daily and stored for a maximum of 10 d at 15°C and 60% RH in a storage cabin. The crosses were obtained by artificial insemination (AI) of 40 mature hens of large white turkeys, Converter, (CC) with six toms of Black Bronze (BB), and 40 mature hens of Black Bronze with six toms of large white turkeys. Eggs of all groups were set in the incubator at the same time.

**Management turkeys**

A total of 160 unsexed poults were used in the research with forty turkeys for each genotype. Each genotype was randomly divided into four groups of 10 poults as mixed sex. Initially, flocks were raised in a brooder and at the end of the $8^{th}$ week; the birds were transferred to grow-out houses from 8 weeks of age until the end of the production cycle, which occurred at approximately 24 weeks of age. The sex was determined and equaled during 10 to 24 weeks in each group.

The turkeys were raised on wood shavings and/or rice hulls. The brooder was warmed to 30 °C before the young turkeys arrived and each week the temperature was reduced by about 3–4 °C. The birds were fed ad libitum and had fresh water available during the entire experimental period. The brooder house measured 3.0 m × 3.0 m and the grow-out houses measured 3.0 m × 6.0 m; all houses in the study had these dimensions. All grow-out houses had mesh windows on the sides of the buildings and were equipped with automatic drinkers and manual feeders, and manually controlled ventilation systems. Artificial lighting (incandescent lamps) is used for a total of 23 h of light per day during the brooder stage, 8 weeks of age. Natural light, which entered the house through the windows in grow-out houses, was supplemented with artificial lighting (incandescent lamps) for a total of 23 h of light per day in the first week and subsequently was reduced to 14 h/d till the end of the experiment ($24^{th}$ week). The following vaccination program was applied: Hitchner B1 (HB1) live vaccine against Newcastle Disease (ND) at hatch (intraocular), Rhinotracheitis/Swollen Head Syndrome (TRT/SHS) live vaccine on day 7 (intraocular), Lasota in $7^{th}$ week of life (by drinking water), TRT/SHS second vaccination in week 11, and Lasota second vaccination in weeks 13–14.

The climate of the region where turkeys were grazed can be classified as a semi-arid type of Mediterranean climate, located between 31.11°N and 30.94°E. The region has an altitude of 36 m above sea level.

The nutrient composition of the feed for the different periods used for all turkeys' genotypes is shown in Table 1.

**Collection of data**

***Growth traits***

Body weights (BW, g), duration of fattening period individual bird body weights were recorded at 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, and 24 weeks of age. Daily weight gain (DWG, g) during periods hatch day-12 weeks, 12 to 24 weeks, and hatch day to 24 weeks of age was estimated. Feed intake (FI, g) during periods hatching to 12 weeks, 12 to 24 weeks, and hatching to 24 weeks was recorded. Feed conversion ratio (FCR, g/g) was calculated by dividing average FI by the average DWG and determined for different periods, 0–12 and 12–24 weeks of age.

***Carcass traits***

Four toms turkeys at 16 weeks in each genotype were weighed before the slaughtering after fasting for 12 hours. The birds were slaughtered by cutting the jugular vein and carotid artery on two sides of the neck near the atlantooccipital joint. After bleeding, the carcasses were scalded at 58 ± 2°C for 2 min, handpicked, and manually eviscerated.

Immediately, after the slaughtering, the feathers, feet and heads were removed then the giblets (livers, hearts, and gizzards) were eviscerated and kept. After slaughtering, the slaughter parts included the whole carcass, giblets, and non-edible components were expressed as a percentage of the live body weight. Carcass traits were evaluated by weigh (1) the whole carcass and the carcass was portioned into commercial cuts chest, hind, large muscles, wings, and neck (Edible components). These cuts weighed and were expressed as a percentage of the whole carcass weight (Damaziak et al., 2015). Edible components calculated as % of live body weight (Edible components/Live, %). Then, chest, hind, and large muscles calculated as % of edible components (Chest/Edible components, %), hind/Edible components, %, and Large muscles/Edible components, %), (2) giblets, were calculated as % of live body weight (Giblets/Live, %), and (3) non-edible components that included all the losses during and post-slaughter processing; head, feet, feather, blood, and others were calculated by the difference between the live body weight and the weight of slaughter parts, the carcass, and the giblets. The non-edible components were calculated as % of live body weight (Non-Edible components/Live, %).

***Biochemical blood and oxidative profile parameters***

Blood samples were collected at 16 weeks to get the serum for assaying biochemical blood profile and oxidative profile parameters. Biochemical blood parameters included Protein (g/dl), Globulin (g/dl), Albumin (g/dl), Triglycerides (mg/dl), Glucose (mg/dl), and Urea (mg/dl). Oxidative profile parameters included Hydrogen Peroxide; HP (mmol/ml), Malondialdehyde; MDA (mmol/L), Total Antioxidant Capacity; TAC (mmol/L), and Glutathione Reductase; GR (U/L).

**Statistical analysis**

***Analysis of variance***

Two-way analysis of variance (ANOVA) was used to determine the effects of genotype and mixed-sex groups on traits and parameters under this study using SAS (2002 software's GLM procedure (SAS, Cary, North Carolina, USA). The F-test was used to compare the means, and the differences were considered significant at ($P \leq 0.05$). Duncan's multiple range test procedures in SAS were used to compare differences between means of genotypes. In all analyses, the level of significance was set at P≤0.05. ANOVA estimation of the effect of genotype and groups on traits under this study was performed using the following model: $y_{ijk} = \mu + a_i + b_j + (a\times b)_{ij} + e_{ijk}$. Where; $y_{ijk}$: value for each animal; µ: population mean; $a_i$: effect of $i^{th}$ genotype (Genotype: BB, CC, BC, and CB); $b_j$: effect of $j^{th}$ groups (4 groups); $(a\times b)_{ij}$ : effect of the interaction between $i^{th}$ genotype and $j^{th}$ groups, $e_{ijk}$: random residual error.

***Crossbreeding Parameters***

Direct additive effect (A) and direct heterosis (H) were analyzed by means using Software Package CBE – Crossbreeding Effects, Version 4.0, A universal program for estimating crossbreeding effects (Wolf, 1996) using the model of Dickerson (1969). Direct Additive Effect: (A):½ [(CC ×CC)-(BB × BB)] - [(C ×B) - (B× C)]

Direct Heterosis (H): ½ [(C × B) + (B x C)] – [(C ×C) + (B × B)]

The percentage of each effect (% A, and H) was calculated using a mean estimate of each crossbred effect (additive or heterosis) divided by the mean of the pure line multiplied by 100.

**Results**

***Growth traits***

Figure 1 presents the development of the body weight values of turkeys weekly in different genotypes. The recorded body weight value was significantly (P≤0.05) higher in the large white turkeys-Converter, CC group, and then crossbreed BC (BB toms × CC hens) group (Figure 1).

Monthly body weight (BW) values for turkeys were significantly (P≤0.05) different between genotypes (Table 2). The highest mean BW was achieved by CC (P≤0.05) followed by BC (BB toms × CC hens) and CB (CC toms × BB hens) turkeys for all study periods starting with weight at hatch. Converter, CC, genotype reached highest the body weight (BW) while BB genotype had the lowest value (13324.8 g and 6953.1g) at 24 weeks of age, respectively. The poults that hatched from eggs of local Bronze hens (BB and CB) weighed from 54.9 to 54.2 g regardless of sire genotype, whereas those that hatched from eggs of Converter hens (CC and BC) weighed from 63.4 to 62.8 g. However, a statistically significant (P≤0.05) BW0 d was demonstrated for the BC poults. In the case of crosses, the BW at hatch day was higher in the BC group than CB and this tendency persisted and differences were increasing along with birds' age (Table 2). At the $8^{th}$ week weak of age it was the beginning of significant differences (P≤0.05) between BC and CB genotypes and reciprocal crosses at 12, 16, and 20 weeks, while at 24 weeks, the difference was not significant (P>0.05). The BW during the period 0 –24 weeks of parental forms was attaining extreme values whereas, the lowest was in the BB group and the highest was in the CC group in compared to other breeds (Table 2).

The values of DWG, FI, and FCR during the period from hatch day to 24 weeks were recorded in the four genotypes of turkeys in Table 3. The DWG and FI were significantly different in all the periods among different turkey genotypes.

The DWG and FI were the highest significantly (P < 0.05) achieved by CC followed by BC and CB turkeys for all study periods. The means of the DWG and FI in two crossbreeds were significantly (P<0.05) higher than the means of the Black Bronze (BB) genotype (Table 3). The difference between BC and CB genotypes in DWG was significant while the FI was not significantly different during the period from hatching to 24 weeks.

Feed conversion (FC) reached the lowest values in CC while the BB genotype was having the highest values in compared to the reciprocal crosses (Figure 2). The difference between BC and CB genotypes in DWG was significant while the FI and FC were not significantly different during the period from hatching to 24 weeks. The FC values were reduced by crossing compared to BB while these values were higher than means of CC during different periods from hatching to 24 weeks (Figure 2).

***Carcass traits***

Mean live body weight (g) at slaughtering and percentage non-edible and the carcass as of live body weight parameters for the four genotypes are presented in Table 4. The mean live body weight (g) of toms in CC genotype was heavier significantly than BB (Table 4). The crosses showed significantly improving values in percentages of carcass /live body weight compared to BB (Table 4). Three compositions of carcass (Nike, wing, and chest / carcass) were not different significantly ($P \leq 0.05$) among the four groups of birds, while the hind differed significantly (Figure 3 A). Compared to all other genotypes, the CC group was characterized by the highest percentage of chest and hind followed CB turkey genotype (Figure 3 B).

***Biochemical blood and oxidative profile parameters***

Serum protein, glucose, urea, and albumin levels were not significantly affected by the genotype (Figure 4). However, globulin and triglyceride levels were affected significantly by the genotype (Figure 4). These parameters in the two reciprocal crosses were lower significantly than Converter (CC) and local bronze (BB) genotypes except for the albumin level (Figure 4).

Oxidative profile parameters were affected significantly by the genotype (Figure 5). Hydrogen peroxide level in growing turkey was higher in BB and CC genotype than in the reciprocal crosses. Malondialdehyde (MDA) and total antioxidant capacity (TAC) were high ($P \leq 0.05$) in BB while they were low in CC genotype compared with the two reciprocal crosses. CC genotype had the highest glutathione reductase (GR) level in compared to other genotypes (Figure 5).

***Crossbreeding parameters***

Direct additive, cross effects, and percentage heterosis for DWG, FI, and FC during periods under study and for carcass traits, biochemical blood profile, and oxidative profile parameters are presented in Table 5.

The additive effect was expressed as the difference between the mean of two paternal lines minus the mean of the two reciprocal crosses. The additive effects were significant in DWG and FI during the periods from hatching to 24 weeks while an additive effect in FC was not significant (Table 5). The additive effects were not significant in carcass traits, and biochemical blood profile parameters. There were no significant additive effects in parameters of the oxidative profile except glutathione reductase (GR) and total antioxidant capacity (TAC). The contrast between the two reciprocal is the cross effect. It was significant in DWG during the periods Hatching-12, only. The cross effect in FI during the period from hatching to 24 weeks was significant while it was not significant in FC (Table 5). The contrasts of the two reciprocal cross effects were not significant in all carcass parameters and biochemical blood profiles (Table 5). The oxidative profiles were not significantly different in the cross effect except for Hydrogen Peroxide (HP) and; Malondialdehyde **(**MDA) as shown in Table 5.

Percentage heterosis is the percentage deviation of the mean of the reciprocal crosses from the mean of the parental lines. Percentage heterosis in DWG, FI, and FC reported that mean of the reciprocal crosses was improved by 5.2, 1.3, and 1.0 %, respectively during the period from hatching to 24 weeks. Percentage heterosis in Chest/ Edible components% was high at 4.9 %. Percentage heterosis was high in globulin and triglycerides with more than 86 and 74 %, respectively (Table 5). Percentage heterosis was high in HP and MDA high in with more than 37 and 18 %, respectively (Table 5). A positive sign indicates to these parameters were higher in two reciprocal crosses compared with the parents while the negative sign indicates the opposite.

## DISCUSSION

The Converter birds exhibited fast-growing traits, as was observed with the highest body weights and their weights in the present study were similar to the findings of (Yilmaz et al., 2011). The body weights of the Converter were observed at 8.507 and 11.172 kg at 12 and 15 weeks of bird age, respectively (Yilmaz et al., 2011). Also, the weights of the Converter and the crossings were close to the findings of Elibol et al. (2009). The weights of the Converter poults at 16 and 18 weeks of age of the birds were 14.24 and 17.06 kg respectively (Roberson et al., 2003) which were heavier than reported in the present study being 7.82 and 9.98 kg at 16 and 20 weeks of age respectively. Differences in body weights between this study and literature data have due to different genotypes and feeding and growing conditions, management, etc. Different weights and the growth of reciprocal crosses depend mainly on the applied genetic material and differences between the parents. High weights of the BC genotype that hatched from eggs of CC compared to the CB genotype that hatched from eggs of BB are in harmony with the results of Damaziak et al. (2015). The present results support the finding of Damaziak et al. (2015) who pointed out that a great maternal effect is noticed on the growth of crosses. Also, Nestor et al. (2005) achieved high BW at 16 weeks in the crosses of turkeys whereas the dam was a heavy line and low when the dam was from the light line. Many studies provided evidence that BW at hatching day depends most of all on egg weight, and thus directly on the genotype of the dam (Oblakova et al., 2008; Lilburn and Antonelli, 2012). This explained the higher BW on the hatching day of CC and BC turkeys compared to the BB and CB birds. Sire, CC genotype, could be had an impact on the growth curves of the CB genotype, immediately after hatching, which was indicated by significantly faster growth at 4, 8, and 12 weeks (Table 2).

The highest DWG and lowest FC in the CC genotype was, probably, linked with a decreasing value of this parameter in commercial lines as a result of selection. Compared to the average of the Bronze turkey, the CB and BC genotypes have a growth performance higher by approximately 47.7 and 28.9 %. This resulted in the crossbreeding that was to profit from their complementarity and the effect of heterosis. Feed efficiency is important to animal production because feed cost is a large component of the overall cost in all production settings. A study by Havenstain et al. (2007) demonstrates that since 1966 the value of FC in turkey toms at 20 weeks of age has decreased by 20 to 50%. Results obtained in our experiment regarding the FC values (BB < BC < CB < CC) are similar to data reported by Damaziak et al. (2015) in their study on the reciprocal crosses of slow-growing Bronze turkeys (sg) and fast-growing Big 6 turkeys (fg). The results obtained for FCR in this study were consistent with the values of 2.96 and 2.32 and they were close to results obtained by Sarica et al. (1991) and Anonymous (2006) for American Bronze and Large White turkeys that ranged from 3.18 to 2.51, respectively. The value of 2.63 was obtained in FCR by Havenstein et al. (2007) for male turkeys at 20 weeks of age. In the experiment of Elibol et al. (2009), the Hybrid Converter × Bronze turkey demonstrated intermediate values of FC compared to pure lines. Also, Elibol et al. (2009) demonstrated that the FC values were strongly correlated with the growth rate of birds.

It is clear that the key criterion for producers of live turkey material is the final BW of birds at slaughtering. But for further distributors and retailers, significant will be the weight of the carcass and the percentage content of edible elements in the carcass, particularly of the largest muscles. Our data of carcass, percentages averaged 75.8 % for CC and 74.8% for BB turkeys for males at 16 weeks turkeys. In crosses, carcass percentages averaged 80.4 and 81.4 and they were higher than the parents. Also, the carcass% in CB and BC genotypes increased by approximately 7.5 and 8.8% compared to the local Bronze. In the literature data of carcass percentages averaged 82.7 % for large white turkeys and 74.0 % for Bronze turkeys for males at 18 weeks (Isguzar, 2003). In literature data on breast muscle percentages per carcass in males, the Bronze at 18 weeks was 28.5% (Isguzar, 2003) and 31.1% (Sarica et al., 1991) and in males, the White turkeys at 18 weeks were 39.0% (Isguzar, 2003) and 15.1 % (Lesson and Summers, 1997). Our values for the hind/carcass percentage were higher values for Bronze and Large White turkeys in the findings of Isguzar (2003) which were 29.1 and 27%, respectively. Furthermore, researchers reported that the average percentage of chest and hind was 54.2 for heavy White turkeys for males at 18 weeks (Salmon, 1979) and 52.7% for Bronze turkeys for males at 24 weeks (Aksoy, 1996). The average percentages of wings were 13.1 % for Bronze turkeys for males at 18 weeks (Sarica et al., 1991b); 8.6 % for Buta turkeys at 17 weeks (Araba and Mireles, 1993). Significant differences appeared in the percentage of leg muscles per carcass and the percentage of the carcass per live weight in crosses in comparison to the parents (Figure 3). This is similar to Nestor et al. (2001) who stated that heterosis in the weight of the leg muscles was higher than that of parents. The difference between BC and CB toms was small and not significant but BC was higher than CB toms in the percentage of the chest while the hind was the opposite. Compared to the BB group, the BC and CB groups were characterized by the higher percentage of chest and hind.

The increased in triglyceride concentration in the serum blood of birds may be linked with the enhanced mobilization of fat to produce the metabolic rate (Damaziak et al., 2017). In our study, triglyceride concentration in the blood of crosses was similar level. Interesting is also that both BC and CB turkeys were similar to the BB turkeys. Except for globulin content that was significantly higher ($P \leq 0.05$) in serum samples of the CC compared to the birds of the BC line. Also, no significant differences were found in globulin in the blood of the crosses (Figure 4). There are no studies reported in the literature that would explicitly indicate that stress modifies concentrations of individual fractions of globulin in the blood of birds.

Heat stress increased lipid peroxidation because of increased free radicals generated from hydrogen peroxide. The rise of lipid peroxidation resulted in increased Malondialdehyde (MDA) in blood and tissues (Espinosa-Diez et al., 2015). Antioxidant enzymes such as catalase (CAT) and

Glutathione Reductase (GR) play a vital role in protecting cells from the harmful effects of the free radical (Gopcevic et al., 2013). Synthesizing these enzymes is an important regulation, in terms of animal response to stress conditions. This explained high Malondialdehyde (MDA) and total antioxidant capacity (TAC) were high in BB (Figure 5) and that could support the local breed to be more tolerant to heat stress. Compared with CC there was increasing the TAC in two reciprocal crosses (Figure 5) may be indicted to they are more tolerant of heat stress than the CC genotype.

The literature lacks data on the crossbreeding of heavy commercial lines of turkeys with local breeds. A positive sign in the additive effects indicated to these parameters were significantly higher in the parents compared with the two reciprocal crosses while the negative sign indicate the opposite. Presumably, this may be result in differences between the pure lines of parents (Damaziak et al., 2015) that were high between Local Bronze and Converter. In the crossing effects, a negative sign indicated to the parameters were significantly higher in the CB genotype than in BC. The present results indicated a great effect of maternal effect through the first 12 weeks of the growth curve compared to the sire effect in BC genotype turkeys.

## CONCLUSION

Presumably, the crossbreeding between Hybrid Converter turkeys with Bronze turkeys was to benefit from the effect of heterosis. Compared to the averages of the Bronze turkeys, the crosses have a growth performance and carcass traits higher with a relative growth advantage when the hens were Hybrid Converters. The crosses do not seem to be more sensitive to the summer conditions than the local Bronze turkeys. The first generation in crossbreeding could be submitted to selection for the constitution of a synthetic strain that can be considered a good step in improving turkeys in Egypt. This suggestion has the advantage of exploiting and it does not require a complex scheme and a complex structure to be sited up in Egypt.

**Table (1):** Starter and growing experimental diet composition and nutrient levels (% as fed-basis).

| Components | Starter1(0-8W) | Starter2(8-16W) | Grower(16-24W) |
|---|---|---|---|
| **Ingredient (%)** | | | |
| Yellow corn | 50.00 | 60.00 | 69.00 |
| Soybean meal (44%) | 39.00 | 29.00 | 20.00 |
| Broiler concentrates (52 | 10.00 | 0.00 | 0.00 |
| Fish meal (65%) | 0.00 | 10.00 | 10.00 |
| Di-calcium phosphate | 0.25 | 0.10 | 0.10 |
| Ground Limestone | 0.00 | 0.30 | 0.30 |
| DL-methionine | 0.10 | 0.10 | 0.10 |
| L-Lysine | 0.15 | 0.15 | 0.15 |
| Premix* | 0.25 | 0.10 | 0.10 |
| Salt (Sodium chloride) | 0.25 | 0.25 | 0.25 |
| Total | 100.00 | 100.00 | 100.00 |
| **Nutrient composition**[2] | | | |
| Metabolizable energy | 2931 | 2995 | 3057 |
| Crude protein [1] | 26.76 | 24.32 | 21.37 |

Provided the following per kilogram of diet: Vitamin A, 6000 IU; Vitamin D3, 500 IU; Vitamin E, 20 IU; Vitamin K3, 0.50 mg; Vitamin B1, 2.1 mg; Vitamin B2, 3.0 mg; Vitamin B6, 3.5 mg; Vitamin B12, 0.01 mg; pantothenic acid, 10 mg; niacin, 15 mg; biotin, 0.15 mg; folic acid, 0.45 mg; choline chloride, 500 mg; Fe, 80 mg; Cu, 7 mg; Mn, 60 mg; Zn, 65 mg; I, 0.35 mg; and Se, 0.23 mg.

**Table (2):** Means and standard errors for body weight values of turkeys monthly in different genotypes.

| Body Weight at: | Turkey genotypes* | | | | SEM | P value |
|---|---|---|---|---|---|---|
| | BB | CC | BC | CB | | |
| Hatch day | $54.9^{b}$ | $63.4^{a}$ | $62.8^{a}$ | $54.7^{b}$ | 0.56 | <.0001 |
| 4 week | $362.6^{c}$ | $1262.1^{a}$ | $714.4^{b}$ | $649.1^{b}$ | 38.9 | <.0001 |
| 8 week | $1251.5^{d}$ | $3113.2^{a}$ | $2700.4^{b}$ | $2014.5^{c}$ | 70.9 | <.0001 |
| 12 week | $2138.2^{d}$ | $5069.7^{a}$ | $4119.6^{b}$ | $3029.1^{c}$ | 110.0 | <.0001 |
| 16 week | $3775.1^{c}$ | $7821.6^{a}$ | $5877.2^{b}$ | $4300.5^{c}$ | 261.4 | <.0001 |
| 20 week | $4779.5^{c}$ | $9980.7^{a}$ | $6655.3^{b}$ | $5306.5^{c}$ | 330.2 | <.0001 |
| 24 week | $6953.1^{c}$ | $13324.8^{a}$ | $10269.6^{b}$ | $8982.2^{b}$ | 506.6 | <.0001 |

*Turkey's genotypes: BB= Local Bronze, CC = Converter; reciprocal crossbreed: BC (BB toms × CC hens); CB (CC toms × BB hens).
a, b, c, d means within each raw with different superscripts are significantly different (P<0.05).

**Table (3):** Means and standard errors (SEM) for daily weight gain (DWG) and feed intake (FI) in the genotypes of turkeys during the different periods from hatching to 24 weeks of age.

| Parameters | Turkey genotypes* | | | | SEM | *P* value |
|---|---|---|---|---|---|---|
| | BB | CC | BC | CB | | |
| **DWG during the period:** | | | | | | |
| Hatch day -12 week | $22.9^{d}$ | $55.6^{a}$ | $45.0^{b}$ | $32.9^{c}$ | 0.17 | <.0001 |
| 12 to 24 week | $53.8^{d}$ | $91.7^{a}$ | $68.3^{b}$ | $66.1^{c}$ | 0.57 | <.0001 |
| Hatch day to 24 week | $38.4^{d}$ | $73.6^{a}$ | $56.7^{b}$ | $49.5^{c}$ | 0.31 | <.0001 |
| **FI during the period:** | | | | | | |
| Hatch to 12 week | $68.5^{d}$ | $118.6^{a}$ | $101.8^{b}$ | $85.6^{c}$ | 3.42 | 0.001 |
| 12 to 24 week | $150.2^{c}$ | $224.1^{a}$ | $186.0^{b}$ | $185.4^{b}$ | 4.41 | 0.0002 |
| Hatching to 24 week | $111.6^{d}$ | $171.6^{a}$ | $144.0^{b}$ | $135.6^{b}$ | 3.90 | 0.001 |

*Turkey genotypes: BB – Local Bronze, CC – Converter; reciprocal crossbreed: BC (BB toms × CC hens); CB (CC toms × BB hens).
a, b, c, d means within each raw with different superscripts are significantly different (P<0.05).

**Table (4):** Means of live body weight (Kg) and percentage carcass traits per live weight toms for the four genotypes.

| Parameters | Means for turkey genotypes | | | | SEM | *P* value |
|---|---|---|---|---|---|---|
| | BB | CC | BC | CB | | |
| Live body (Kg) | $8.4^{b}$ | $13.9^{a}$ | $11.8^{a}$ | $11.4^{ab}$ | 980.2 | 0.0243 |
| Carcass /Live% | $74.8^{b}$ | $75.8^{ab}$ | $80.4^{ab}$ | $81.4^{a}$ | 1.764 | 0.0710 |
| Giblets/Live% | 3.5 | 3.0 | 2.8 | 3.5 | 0.31 | 0.3848 |
| Non-Edible/Live % | $25.2^{a}$ | $24.2^{ab}$ | $19.6^{ab}$ | $18.6^{b}$ | 1.76 | 0.071 |

SEM: standard error of means, Turkey genotypes: BB – Local Bronze, CC – Converter; reciprocal crossbreed: BC (BB toms sires × CC hens dams); CB (CC toms sires × BB hens dams).
a, b, c, d means within each raw with different superscripts are significantly different (P<0.05).

**Table (5):** Additive, and crossbreeding effects and percentage of heterosis for the productive traits, biochemical blood profile, and oxidative profile parameters in the four genetic groups.

| Parameters | Additive Effects | Cross Effects | Percentage heterosis |
|---|---|---|---|
| **DWG during the period:** | | | |
| Hatch day -12 week | (15.9)$^{**}$ | ( 4.0)$^{**}$ | -0.8 |
| 12 to 24 week | (17.7)$^{**}$ | (-0.9)$^{ns}$ | -8.2 |
| Hatch day to 24 week | (16.6)$^{**}$ | (1.5 )$^{ns}$ | -5.4 |
| **FI during the period:** | | | |
| Hatch to 12 week | (24.6)$^{**}$ | (7.4)$^{**}$ | 0.2 |
| 12 to 24 week | (32.5)$^{**}$ | (7.2)$^{**}$ | -0.8 |
| Hatching to 24 week | (28.6)$^{**}$ | (7.2)$^{**}$ | -1.3 |
| **FC during the period:** | | | |
| Hatching to 12 week | (-0.3)$^{ns}$ | (-0.2)$^{ns}$ | -4.9 |
| 12 to 24 week | (-0.1)$^{ns}$ | (0.1)$^{ns}$ | 5.6 |
| Hatching to 24 week | (-0.2)$^{ns}$ | (9.9)$^{ns}$ | 0.9 |
| **Carcass traits:** | | | |
| Live body (g) | (7.1) $^{ns}$ | (1.0)$^{ns}$ | 3.9 |
| Edible components/Live% | (-4.0)$^{ns}$ | (1.4)$^{ns}$ | 0.1 |
| Non-Edible components /Live % | (-1.4)$^{ns}$ | (1.3)$^{ns}$ | -0.5 |
| Chest/ Edible components % | (6.1)$^{ns}$ | (-3.5)$^{ns}$ | 4.9 |
| Hind/ Edible components % | (4.5)$^{ns}$ | (2.1)$^{ns}$ | -5.5 |
| Large muscles/Edible components% | (-4.6)$^{ns}$ | (4.8)$^{ns}$ | 0.2 |
| **Biochemical blood profile :** | | | |
| Protein (g/dl) | (-8.7)$^{ns}$ | (- 0.3) $^{ns}$ | -16.4 |
| Globulin (g/dl) | (-0.1 )$^{ns}$ | (-0.5 )$^{ns}$ | -86.7 |
| Albumin (g/dl) | (5.8 )$^{ns}$ | (0.1)$^{ns}$ | -2.8 |
| Triglycerides (mg/dl) | (-1.2 )$^{ns}$ | (-3.3)$^{ns}$ | -74.5 |
| Glucose (mg/dl) | (-1.2 )$^{ns}$ | (-1.5)$^{ns}$ | -3.5 |
| Urea (mg/dl) | (3.1 )$^{ns}$ | (-0.1)$^{ns}$ | -11.1 |
| **Oxidative Profile[1]:** | | | |
| GR (U/L) | (3.3)$^{*}$ | (-1.7)$^{ns}$ | -1.1 |
| HP (nmol/ml) | (5.4)$^{ns}$ | (-0.1)$^{**}$ | -37.1 |
| MDA (mmol/L) | (-0.6) $^{ns}$ | (-1.7)$^{**}$ | -18.4 |
| TAC (mmol/L) | (-0.1)$^{*}$ | (-2.3)$^{ns}$ | 2.8 |

[1]GR; Glutathione Reductase, HP; Hydrogen Peroxide, MDA; Malondialdehyde, and TAC; Total Antioxidant Capacity.
$^{**}P \leq 0.01$; ns= not significant

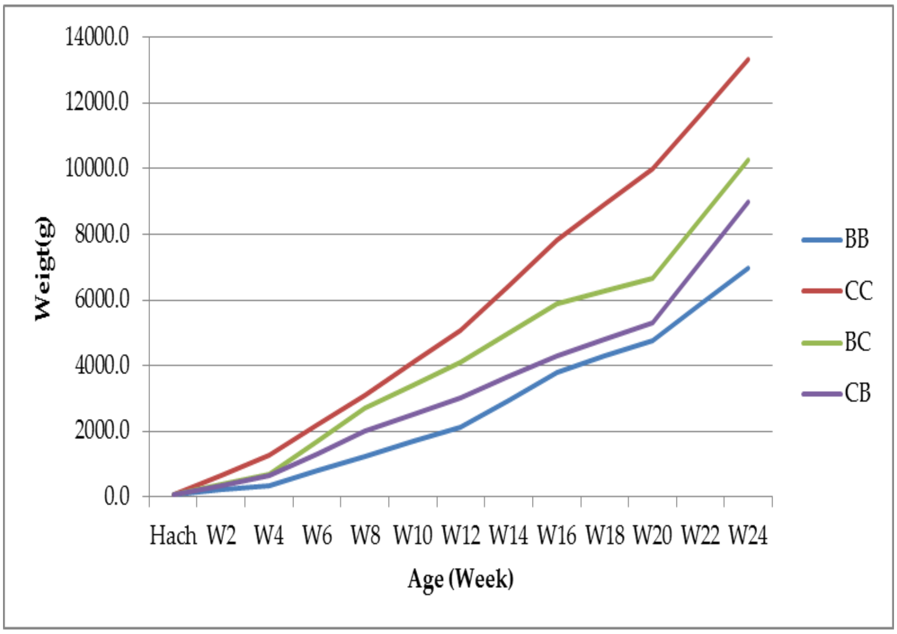



**Figure (1):** Body weight values of turkeys weekly in different genotypes.

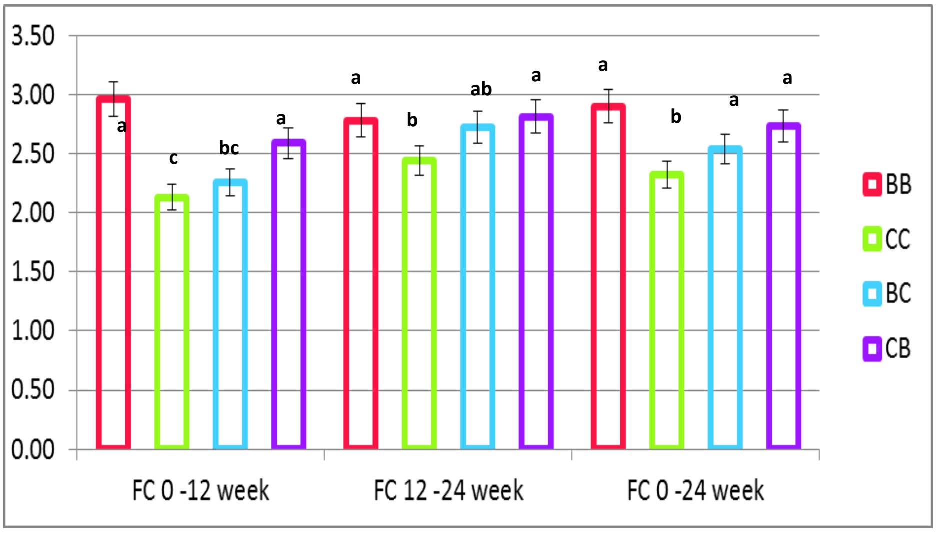



**Figure (2):** Mean the feed conversion (FC) in the four genotypes of turkeys during the different periods

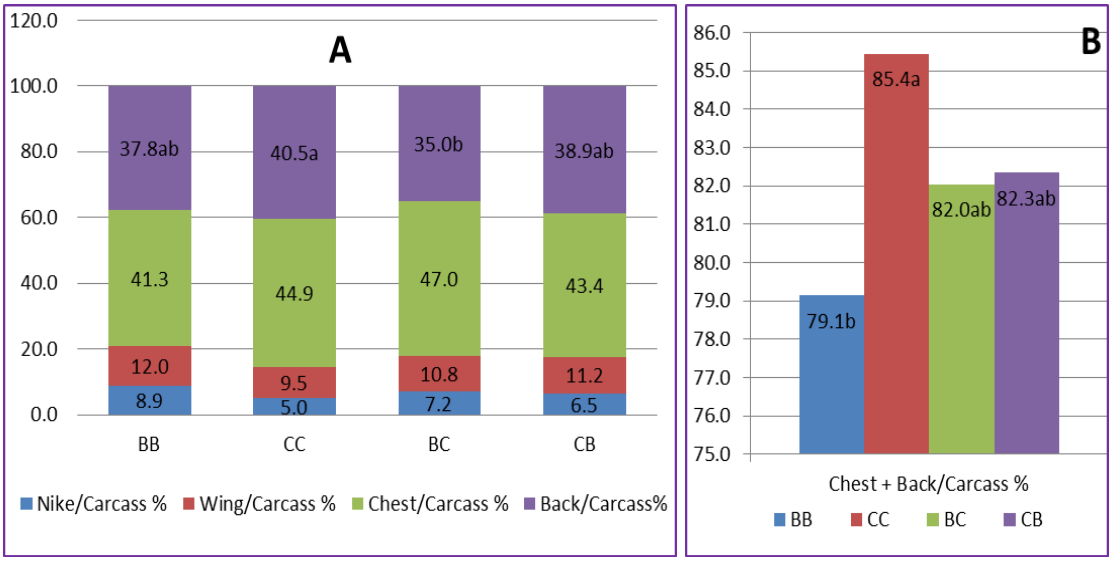



**Figure (3):** Means of the carcass component traits as percentage values for the four

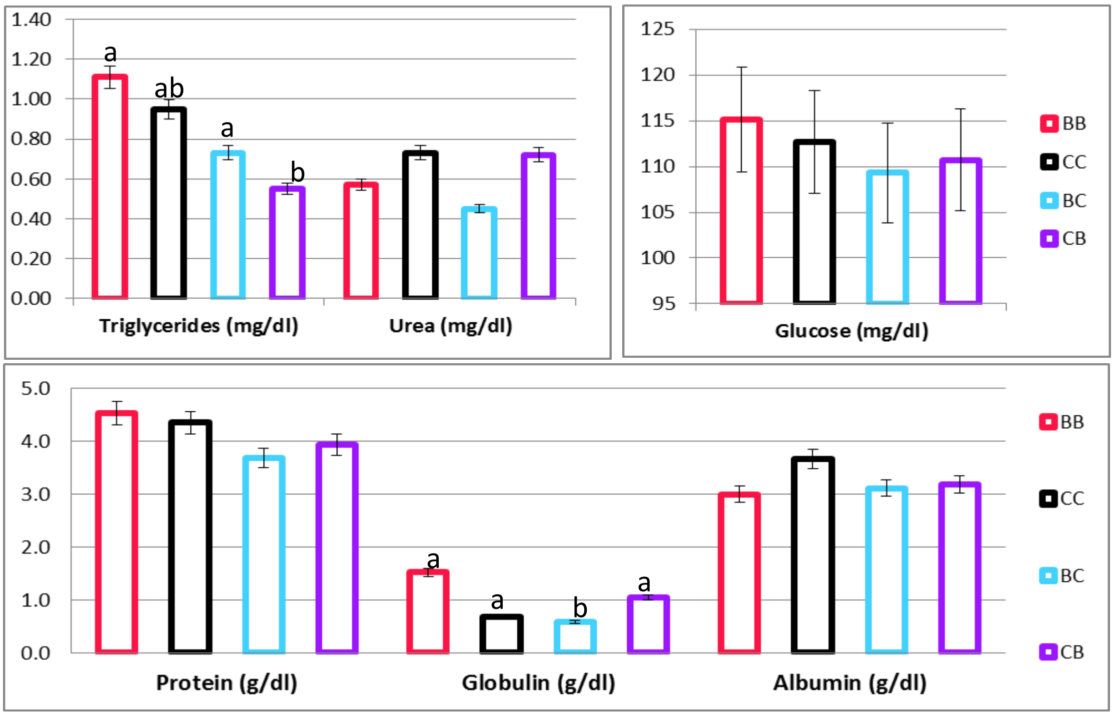
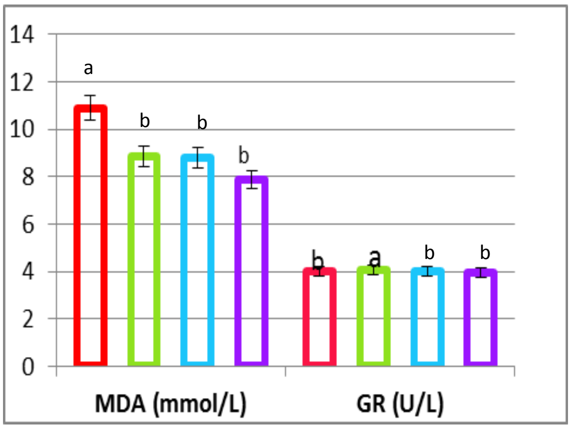
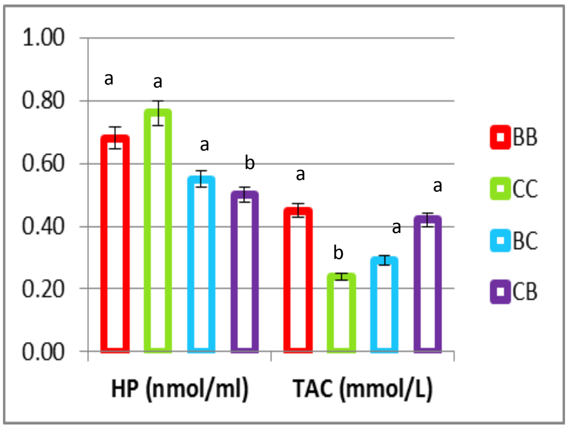



**Figure (4):** Means of biochemical blood profile parameters in the four genotypes at 16 weeks of age.




HP; Hydrogen Peroxide, MDA; Malondialdehyde, TAC; Total Antioxidant Capacity, GR; Glutathione Reductase

**Figure (5):** Means oxidative profile parameters in the four genotypes at 16 weeks of age.

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## الملخص العربى

# تقييم صفات النمو والذبيحة وبعض المعايير الفسيولوجية للرومى البرونزى و الرومي الأبيض وخليطهما

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تكمن ميزة الخلط بين السلالات فى الاستفادة من تأثير قوة الهجين. تم إجراء تجربة خلط باستخدام سلالة الرومى البرونز الأسود (BB) وسلالة الرومى الأ بيض عريض الصدر، كونفيرتر (CC). تم استخدام التلقيح الاصطناعي لـ ٤٠ دجاجة ناضجة من سلالة الرومى عريض الصدر ، كونفيرتر ، (CC) مع ٦ ديوك من البرونز الأسود (BB) ، و ٤٠ دجاجة ناضجة من BB مع ٦ ديوك من كونفيرترCC للحصول على الجيل الاول F1 من الخليط والخليط العكسى للرومى (CB و BC) على التوالي. تم أخذ ١٦٠طائر من مجموعات الطيور الرومى الأربع (النقية والخليطة) في التقييم فى هذه الدراسة. اشتمل هذا التقييم على بعض صفات النمو والذبيحة ، وبعض معايير الدم البيوكيميائية و التأكسدية. لوحظ أن وزن الجسم في مختلف الأعمار كان أعلى في مجموعة الطيور الرومى الأبيض عريض الصدر ، مجموعة CC ، ثم مجموعة الهجين BC (ديوك BB X دجاجاتCC). كانت متوسطات زيادة الوزن اليومية واستهلاك العلف في فترات مختلفة من العمر عالية المعنوية (P <٠.٠٥) في CC تليها الطيورالرومية BC و CB. وصل معدل التحويل الغذائي (FC) إلى أدنى قيم له في CC بينما تميزت مجموعة طيور الرومي البرونزى BB بأعلى القيم. أظهرت الخلطان قيم معنوية في النسب المئوية للذبيحة / وزن الجسم الحي مقارنة بـ BB. اختلف نسبة الجزء الخلفي من الذبيحة بشكل كبير ($P \leq 0.05$) بين المجموعات الأربع من الطيور بغض النظر عن الأجزاء الأخرى (الرقبة ، الجناح ، والصدر / الذبيحة). لم تتأثر مستويات البروتين والجلوكوز واليوريا والألبيومين بشكل كبير باختلاف التراكيب الوراثية. ومع ذلك ، تأثرت مستويات الجلوبيولين والدهون الثلاثية معنويا باختلاف التراكيب الوراثية. تأثرت معايير الدم التأكسدية معنويا باختلاف التركيب الوراثى للطيور. أظهرت تأثيرات الخلط التي تم الحصول عليها أن التأثير الوراثى المضيف كان معنويا على معدل الزيادة اليومية فى الوزن DWG و استهلاك العلفFI خلال الفترات من الفقس إلى ٢٤ أسبوع بينما لم يكن معنويا بالنسبة للكفاءة تحويل الغذاء FC. لم تكن للتأثيرات المضيفة أثر معنوى على صفات الذبيحة ، ومعايير الدم البيوكيميائية باستثناء أثرها على إنزيم الجلوتاثيون ريدوكتاز (GR) والقدرة الإجمالية لمضادات الأكسدة (TAC). كان تأثير الخلط معنوى على معدل الزيادة اليومية فى الوزن DWG خلال الفترة من عمر الفقس إلى ١٢ أسبوع فقط. كان تأثير الخلط معنوى على إستهلاك العليقة خلال الفترة من الفقس إلى ٢٤ أسبوعًا كبيرًا بينما لم يكن معنويًا على كفاءة تحويل الغذاء FC. لم تكن لتأثيرات الخلط للخليطين المتبادلين أثر معنوي على جميع صفات الذبيحة ومعايير الدم البيوكيميائية. لم تختلف معايير التأكسد بشكل كبير بالخلط باستثناء بيروكسيد الهيدروجين (HP) و مالونديالديهيد (MDA). الخلط بين طيور الرومى الأبيض عريض الصدر، كونفيرتر(CC) مع طيور الرومى البرونز كان للاستفادة من تأثير الخلط وقوة الهجين. تمتعت الهجن فى هذه الدراسة بأداء نمو وخصائص ذبيحة أعلى مع ميزة نسبية في النمو خاصة عندما كانت مجموعة الهجين BC (ديوك BB X دجاجاتCC). يمكن اجراء انتخاب فى الجيل الأول الناتج من الخلط لعدة أجيال من أجل تكوين سلالة جديدة. يعتبر ذلك خطوة جيدة في تحسين الرومى في مصر.