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# EFFECT OF CROSSING ON THE PERFORMANCE OF LOCAL STRAINS

## 4. Blood Hematology and Biochemical Traits and Some Organs Relative Weights of Chicken Cocks

**OSAMA M.ALY[1], ABD-EL-HAMID, E.A[2] AND WAGDY Z. ALY[1]**

[1] Anim. Prod. Res. Institute, Ministry of Agric., Egypt
[2] Animal and Poultry Dept., Fac. of Agric. (Damanhour), Alex. Univ. Egypt
E-mail: osmali2002@yahoo.com

## ABSTRACT

**Two local strains of chickens [Bandara (B) and Gimmizah (G)] were used in reciprocal crossing to determine the effects of different genotypes on blood hematology and biochemical traits, body weight and relative organs weights of cocks.**

**Results showed significnat differences among all genotypes studied concerning all blood hematology traits, while the BxG cross had the highest values of packed cell volume and mean cell hemoglubin. Both BxG and its reciprocal cross had significnatly a highest and equal averages of hemoglubin and mean cell volume concentration while G strain had the highest red blood cells count comapred to the other genotypes.**

**Concerning blood biochemical traits, both pure strains (G and B) had nearly significnatly similar averages of serum protein, while G strain had the highest serum albumin average and B strain had the highest content of cholesterol. However, both crosses (BxG and GxB) had the highest average of alanine amino transaminase (ALT) overall genotypes. Cocks of B and GxB cross were significnatly heaviest weights compared to the other genotypes. Liver relative weight of BxG cocks was the heaviest while B cocks had the heaviest relative weights of tests and pancrease. The G cocks had the heaviest spleen**

**relative weight, but no significant effects of crossing on thymus relative weight were found.**

**It could be concluded that heterotic effects of crossing between Bandara and Gimmizah and their reciprocal crosses were positive in most blood hematological traits, body weight and testes relative weights at 16 weeks of age. Negative estimates of heterotic effects for all biochemical blood traits were found except for serum alanine amino transaminase (ALT) when Gimmizah strain was used as a sire. Also, negative heterotic effects were found concerning relative weights of most organs studied.**

**Key words:** The crossing, heterosis, blood hematology and biochemical, local chicken cocks.

## INTRODUCTION

Crossbreeding of chickens plays an important role in the improvement of the native strains in Egypt (Aly and Abou El-Ella, 2006). Aly *et al.*, (2005) reported that crossing between Gimmizah and Bandara local strains improved body weight, and some carcass traits. The immediate favorable effect of crossing on body weight was reported by Fairfull *et al.* (1988), and Sato *et al.* (1992).

Physiological and immunological traits are good indicator to predict performance of chickens. The available studies of the effect of crossing on blood parameters were few. Significnat differences between some local strains in blood parameters were found (El-Kaiaty and Hassan, 2004). Hematological parameters of chickens were studied by Elnaggar *et al.* (2001), El-Kaiaty and Hassan (2004), El-Tahawy (2005) and Abd El-Aziz (2006).

Moreover, Dowidar *et al.* (1999) found significant differences ($P<0.05$) in most biochemical criteria (total protein, albumin, cholesterol, triglycerides, and GPT) between local three strains of chickens (i.e. Fayoumi, Dandrawi, and Golden Montazah) and in quails (Korshom *et al*., 1993). On the other hand, Genedy *et al.* (1999) found no significant strain difference in Mandarah and Gimmizah regarding the previous biochemical criteria. On the contrary, Fathi *et al.* (2005) and Nazmi *et al.* (2006) found no significnat differences

among genotypes for plasma total protein, albumin, globulin and relative weight of liver.

Lymphoid oragan weights reflect body's ability to provide lymphoid cells during an immune response (Heckert *et al.,* 2002). Primary and secondary lymphoid organs weights provide the site for maturation lymphocytes, and for the interaction between lymphocytes and antigens. The bursa, thymus glands and spleen are the important lymphoid organs involved in the development and differentiation of T or B lymphocytes ( Eerola *et al*., 1987; Toivanen *et al.,* 1987; Nazmi, *et al*., 2006).

Wherease, there were no significnat differences among genotypes for relative weight of both spleen and thymus (Fathi *et al.*, 2005, Nazmi *et al.,* 2006). Different estimates of heterosis were reported by (Saleh and Farghaly, 1988; Mandour *et al.,* 1996; Aly *et al.,* 2005) concerning body weight at different ages. Positive heterosis estimates for spleen and pancreas weights were recorded by (Wall and Anthony, 1995). While other studies reported that crossbreeding did not improve edible weight (Salah-Eid, 1977, and El-Turky, 1981). In addition, intermediate values between the two parental lines were recorded (Hathaway *et al.,* 1953; Aggarwal *et al.,* 1978).

The objective of this study was to determine the effect of crossing between Gimmizah and Bandara strains and their reciprocals cross on blood hematology (red blood cell count, packed cell volume, mean cell volume, mean cell hemoglobin and mean cell hemoglobin concentration), biochemical (total serum protein, albumin, golbulin, cholesterol, aspartate amino transaminase (AST), alanine amino transaminase (ALT), organs and gland relative weights.

## MATERIALS AND METHODS

The present experiment was carried out at El-Sabahiah Research Station, Animal Production Research Institute, Agriculture Research Center. The experiment started on 2003, two local strains of chickens [Bandara (B) and Gimmizah (G)] were used to have crossbreds and their reciprocals. Management conditions were similar as possible throughout the whole experiment. Number of chicks obtained per strains and crosses were 370 , 301 , 483 and 388 for B, G, B x G and G x B, respectively, (the first parent is the sire). The

chicks were fed *ad libitum,* a starter ration containing 19.7 % crude protein and 2875 Kcal ME/Kg. At 8 weeks of age, the ration was changed to a grower ration containing 15.6 % crude protein and 2720 Kcal ME/Kg. At 16 weeks of age, randomly five cocks from each breeding group were weighed, slaughtered and liver, spleen, pancreas, thymus and testes were removed and weighed to the nearest 0.1 g. Relative organs weights were calculated as a percentage of live body weight.

Blood samples were obtained after slaughtering (5 birds from each genotype) at 16 weeks of age. Heparin was used as anticoagulant but in part of the samples, it was withheld to obtain serum. Plasma and serum were obtained by centrifugation of blood at 3000 rpm for 20 min, and stored at – 20 $^{o}$C until the chemical analysis. Red blood cells (RBCs) were counted on an AO Bright line hemocytometer using a light microscope at 400x magnification (Seiverd, 1964). Hemoglobin (Hg) concentration was determined by the cyanomethemoglobin procedure (Eilers, 1967). Wintrobe hematocrit tubes were used for determination of hematocrit value (HV).

The mean cell volume (MCV) , mean cell hemoglobin (MCH), and the mean cell hemoglobin concentration (MCHC) were referred as absolute values. These values were calculated from the results of red blood cell count, hemoglobin concentration and hematocrit value, respectively.

**Mean cell volume (MCV):**

$$\textbf{MCV} = \frac{\textbf{\% Hematocrit X 10}}{\textbf{Number of RBC}} \quad \textbf{(micron}^{3}\textbf{ / red blood cell).}$$

**Mean cell hemoglobin (MCH):**

$$\textbf{MCH} (\mu\text{ug}) = \frac{\textbf{Hemoglobin concentration (g/dl) X 10}}{\textbf{Number of RBC million/mm}^{3}}$$

**Mean cell hemoglubin concentration (MCHC):**

$$\textbf{MCHC} = \frac{\text{Hemoglobin (g/dl)}}{\text{\% of hematocrit}} \text{ X 100 (\%)}$$

Serum total cholesterol (mg/100ml) was determined according to the method of Watson (1960). Serum total protein was measured by the Biuret method as described by Armstrong and Carr (1964). Albumin concentration was determined according to the method of Domuas *et al*. (1977). Globulin concentration was estimated by subtraction of albumin concentration from serum total protein value according to Coles (1974). The serum activites of aspartate amino transaminase (IU/L) and alanine amino transaminase (IU/L) enzymes were assayed by the method of Reitman and Frankal (1957).

**Statistical analysis**

Data obtained in percentages were converted to angles using arcsine transformation prior to statistical analysis. The data was subjected to one way analysis of variance and Duncan's multiple range test using General Linear Model (GLM) of statistical analysis program (SAS, 2001).

The statistical model describing all parameters included was as following:

$Y_{ij} = \mu + G_i + e_{ij}$

Where:

$Y_{ij}$ = Observed on cocks,

$\mu$ = Overall mean,

$G_i$ = Effect of the $i^{th}$ genotype,

$e_{ij}$ = Experimental error

Heterosis percentage (H%) was determined according to equation given by (Lasely, 1978) as follows:

$$H\% = \frac{\text{Average of crossbred - average of 2 lines}}{\text{Average of 2 lines}} X\,100$$

## RESULTS AND DISCUSSIN

**Blood hematology traits**

Results presented in Table (1) showed significnat ($P<0.05$) differences between the four genotypes concerning all blood hematological traits. The Bandara (B) x Gimmizah (G) cross had the highest vlaues of packed cell volume (PCV%) (48.7%), mean cell

hemoglobin (MCH) (42.3) and both BxG and GxB crosses had signficiantly the highest and equal averages of hemoglobin. (11.0%) and mean cell volume (166.8) concentration while G strain had the highest red blood cells count (3.46x $10^3$/$mm^3$) compared to the other genotypes.

In crossbreds, heterosis percentages (H%) of the parental line cross B x G were the highest and positive for PCV% and MCV (13.79% and 52.43%) and negative (-9.19) for RBC compared to the maternal line one (Table 1). Mean cell volume concerning (MCHC %), heterosis percentage of G x B was positive and higher comapred to the B X G crossbred (38.35 vs 19.42). Estimates of heterosis H% for Hg% and MCV with respect to B x G and the reciprocal cross were equal (3.91% and 27.82%), respectively.

Estimates of red blood cells are in the range which found by Elnaggar *et al.*, (2001) in broiler while they are less than those reported by Abd El-Aziz (2006). Packed cell volume estimates of this study are higher comapred to those of Elnaggar *et al.*, (2001) and Abd El-Aziz (2006), estimates of hemoglobin concentration Hg% are less than reported by the same authors. Indication, no significnat differences between the different Bandara transgenic groups were found concerning Hg% (El-Tahawy, 2005; Abd El-Aziz, 2006). There are wide differences between averages of MCV reported in this study and the range which found by Abd El-Aziz (2006). (80.4 to 80.9).

**Blood biochemical traits**

It was noticed from Table (2) that both G and B strains had significnatly ($P<0.05$) and nearly similar averages of serum total protein (STP) averages (5.80 and 5.85 g/dL, respectively) comaped to their crossbred and reciprocal. While G strain had the highest serum total albumin (STA) average (2.50 g/dL) the highest one of serum cholesterol (SC) contnet was found in B strain (99.4 mg/100 ml) comapred with the other genoytpes studied. However, both BxG and GxB crosses had the highest average of serum alanine amino transaminase (ALT) (19.2 and 20.3 μ/L), respectively. Results reported herein concerning STP, STA and SC are less than that reported by Ahmed (1999), (3.79 g/100 ml, 2.06 g/100 ml and 121.04 mg/100 ml), respectively.

The highest STP level determined in G and B strains was close to those estimated by Raghib *et al.* (1975) that STP of Rhode Island Red (RIR), Dokki-4 (Dok), and Fayoumi (Fay) chickens were 5.54, 5.72 and 4.83 gm/dl, respectively.

On the other hand, Raghib *et al.* (1975) did not detect any significant variations in STP and serum total globulin (STG) values, among different crossbreds of native ( Fay, and Dok) and standard (RIR) chicken breeds, but these values were higher than those of the corresponding purebreds. While estimates of STP and STG in this study were higher than those reported by Ghanem (1990) (4.42 and 2.159 g/dL), average of STA was nearly similar (2.262 g/dL).

Abd El-Kader (2003) found significant differences between local strains (Fay, G and Silver Montazah) in GPT of either vaccinated or non- vaccinated groups. Similer results were recorded by Mossad *et al.* (1995) and Dowidar *et al.* (1999), that there were significant differencs ($P<0.05$) in most biochemical criteria (total protein, albumin, cholesterol, triglycerides, and GPT) between local strains of chickens and in quails (Korshom *et al*., 1993). In contrast, Genedy *et al*. (1999) found no significant chicken strain differences [Mandarah (Man) and G] regarding the previous biochemical characteristics.

Estimates of H% ranged between -20.29 and 17.79% for blood biochmeical traits in crossbred B x G and between -22 and 24.54% in the reciprocal cross except that of AST where estimate of both crossed were equal -0.88 (Table 2). Results reported herein are less than those reported by Abd El-Kader (2003), who found that Man x G and Fay x Man crossbreds had the highest positive heterosis percentage for STP (36.11 and 35.06%) and STG (74.2 and 68.5%), respectively. Fay x G crossbred rised to H% (11.3 – 18.2%) compared to the other genotypes studied as well as the crossponding purelines.

**Body weight and relative organ weights**

Results in Table (3) showed the effect of crossing between G and B strians on body weight and relative weights of liver, testes, pancrease, thymus and spleen glands. Cocks of GxB crossbred was significnatly heaviest compared to the other genotypes. Liver of BxG, cocks was the heaivest (1.94%) while B ones had the highest relative weights of testes (0.698%) ($P<0.001$) and pancrease (0.207%) ($P<0.05$). Concerning the lymphoid organs (Thymus and spleen), no significnat differences were found between different genotypes for

thymus gland while G cocks had the highest (P<0.01) relative weight of spleen (0.258%) comapred to the other genotypes.

Similar results were obtained by Mossad (1994), Nawar (1995); Nawar *et al*., (1997) and Aly *et al*. (2005) where significnat differences between genotypes were found. On the other hand, estimates of body weight reported herein were higher comapred with those reported by Mossad (1994) for G (1309.6 g) and B (1262.9 g) males.

In contrast, resutls of Mossad (1994) showed no signficiant effect of strain on the relative weight of liver, she reported higher estimates (2.01 and 2.12%) comapred to those reported in this study for relative weights of G and B males, respectively. In addition, Nazmi *et al* (2006) found the same results that no significnat effect of genotype on liver, spleen and thymus relative weights.

The results reported hearin concerning thymus relative weight may be related to that age of cocks being late to determine the effect of crossing on thymus weight because involution of thymus occur with the on set of sexual maturity (Toivanen *et al*., 1987).

Table (3) showed that H% effect for body weight at 16 weeks of age for B x G was negative and lower (-6.38) than that of the G x B cross (10.53). Estimates of H% of the relative weights of organs were in range (-25.66 to 24.51%). As for lymphoid organs, all estimates of heterosis H% were negative, higher for B x G (-11.89 and -39.57) than those for the reciprocal one (-6.33 and -25.66) for both thymus and spleen relative weight. Gowe and Fairfull (1982) reproted that heterosis for some traits is affected by age during early growth and over production cycles. In addition, heterosis for body weight increases from about zero at hatch to range of 2-10% by slaughter age 6-16 wk (Fairfull, 1990).

The crossbred of RIR and Dok 4 reported by Saleh and Farghaly (1988) was positive heteratic effects on eight week body weight while negative heterotic effects were in 4 and 8 weeks body weight in White Leghorn and RIR. The results reported in this study were in the range that found by Mandour *et al.,* (1996), they reported that dialle crossing of Silver Montazah with Alexandria strain had the highest positive H% (16.37%) for live body weight. On the contrary, crossing Matrouh strain to the last one gave negative H% (-2.78%). While results of this study showed negative heterotic. Wall and Anthony (1995). Recorded positve

heterosis for spleen and pancreas weights in F1 of cross between Giant Jungle fowl and broiler breeders. On the opposite, crossbreeding did not improve edible weight (Salah-Eid, 1977; El-Turky, 1981). The last author attributed the negative heterosis to have non-additive genetic variance for the native breeds. Moreover, some investigators reported that adible weights of crossbreds were intermediate between those two parental lines (Hathaway *et al.*, 1953, Aggarwal *et al.*, 1978). Z chromosome genes has no effect of disease mechanisms, maternal effects are not generally considered important (Bernon and Chambers, 1985). The superiority of the reciprocal cross (low line x high line) body weight reflected large maternal effects (Li *et al.*, 2001).

Generally, heterotic effects of crossing between Bandara and Gimmizah and their reciprocal crosses were positive in most blood hematological traits, body weight and testes relative weights at 16 weeks of age. Negative estimates of heterotic effects for all biochemical blood traits were found except for serum alanine amino transaminase (ALT) when Gimmizah strain was used as a sire. Also, negative heterotic effects were found concerning relative weights of most organs studied.

**Table (1): Effect of crossing between Gimmizah and Bandara strains on blood hematology traits**

| Genotypes / Traits | G | B | BxG | H% | GxB | H% | Prop. |
|---|---|---|---|---|---|---|---|
| **PCV(%)** | 45.3±0.89$^{ab}$ | 40.3±0.90$^{c}$ | 48.7±1.87$^{a}$ | 13.79 | 41.7±1.74$^{bc}$ | -2.57 | ** |
| **Hg(%)** | 8.08±0.57$^{b}$ | 8.53±0.93b$^{b}$ | 11.0±1.06$^{a}$ | 3.91 | 11.0±1.06$^{a}$ | 3.91 | ** |
| **RBC ($10^3$/mm$^3$)** | 3.46±0.35$^{a}$ | 2.20±0.52$^{b}$ | 2.57±0.80$^{b}$ | -9.19 | 2.70±0.15$^{b}$ | -4.59 | ** |
| **MCV** | 130.5±5.37$^{b}$ | 130.5±5.37$^{b}$ | 166.8±2.35$^{a}$ | 27.82 | 166.8±3.1$^{a}$ | 27.82 | ** |
| **MCH** | 25.4±1.86$^{b}$ | 30.1±1.16$^{b}$ | 42.3±4.68$^{a}$ | 52.43 | 29.1±1.87$^{b}$ | 4.86 | * |
| **MCHC(%)** | 19.6±1.41$^{c}$ | 21.6±1.63b$^{c}$ | 24.6±1.48$^{ab}$ | 19.42 | 28.5±1.64$^{a}$ | 38.35 | ** |

* Significnat at 0.05, ** Significant at 0.01,

a-c Means in the same row having different letters are significnatly different (P<0.05),

PCV = Packed cell volume, Hg = Hemoglobin concentration, RBC = Red blood cells, MCV = Mean cell volume, MCH = Mean cell hemoglobin, MCHC = Mean cell hemoglobin concentration, H %= Heterosis percentage

**Table (2): Effect of crossing between Gimmizah and Bandara strains on blood biochemical traits**

| Traits \ Genotypes | G | B | BxG | H% | GxB | H% | Prop. |
|---|---|---|---|---|---|---|---|
| **Protein (g/dl)** | 5.80±0.48$^{a}$ | 5.85±0.55$^{a}$ | 4.86±0.40$^{b}$ | -16.57 | 4.60±0.06$^{b}$ | -21.03 | * |
| **Albumin (g/dl)** | 2.50±0.12$^{a}$ | 2.32±0.13$^{ab}$ | 2.13±0.24$^{bc}$ | -11.62 | 1.95±0.02$^{c}$ | -19.09 | ** |
| **Globulin (g/dl)** | 3.30±0.47 | 3.50±0.36 | 2.71±0.17 | -20.29 | 2.65±0.02 | -22.06 | NS |
| **Cholesterol (mg/dl)** | 87.79±2.18$^{b}$ | 99.4±4.69$^{a}$ | 81.1±0.39$^{b}$ | -13.35 | 84.2±0.27$^{b}$ | -10.04 | ** |
| **AST (U/L)** | 40.1±0.40 | 39.2±0.35 | 39.3±0.78 | -0.88 | 39.3±0.26 | -0.88 | NS |
| **ALT (U/L)** | 15.7±1.37$^{b}$ | 16.9±0.46$^{b}$ | 19.2±0.26$^{a}$ | -17.79 | 20.3±0.24$^{a}$ | 24.54 | ** |

* Significnat at 0.05, ** Significant at 0.01, NS = Not significant

a-c Means in the same row having different latters are significnatly different (P<0.05),AST = Aspartate amino transaminase, ALT = Alanine amino transaminase.

H %= Heterosis percentage.

**Table (3):** Effect of crossing between Gimmizah and Bandara strains on body weight and relative organs weights

| Traits \ Genotypes | G | B | BxG | H % | GxB | H% | Prop. |
|---|---|---|---|---|---|---|---|
| **Body weight (g)** | 1838.0±194.0$^{b}$ | 2016.0±254.0$^{a}$ | 1804.0±217.0$^{b}$ | -6.38 | 2130.0±144.0$^{a}$ | 10.53 | * |
| **Liver (%)** | 1.57±0.03$^{b}$ | 1.67±0.03$^{b}$ | 1.94±0.08$^{a}$ | 19.75 | 1.53±0.06$^{b}$ | -5.56 | * |
| **Testes (%)** | 0.171±0.04$^{b}$ | 0.698±0.07$^{a}$ | 0.323±0.05$^{b}$ | -25.66 | 0.541±0.05$^{a}$ | 24.51 | *** |
| **Pancreas (%)** | 0.148±0.02$^{b}$ | 0.207±0.01$^{a}$ | 0.143±0.01$^{b}$ | -19.44 | 0.148±0.02$^{b}$ | -16.62 | * |
| **Lymphoid organs:** | | | | | | | |
| **Thymus (%)** | 0.195±0.02 | 0.200±0.03 | 0.174±0.01 | -11.89 | 0.185±0.02 | -6.33 | NS |
| **Spleen (%)** | 0.258±0.01$^{a}$ | 0.159±0.01$^{b}$ | 0.126±0.01$^{b}$ | -39.57 | 0.155±0.01$^{b}$ | -25.66 | ** |

* Significnat at 0.05, ** Significant at 0.01, NS = Not signficiant,

a-b Means in the same row having different letters are significnatly different (P<0.05).

H %= Heterosis percentage.

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# الملـخص العـربى
# تأثير الخلط على اداء السلالات المحلية
# 4. صفات الدم الفيزيقية و الكيموحيوية و الوزن النسبى لبعض الاعضاء فى ذكور الدجاج

**اسامة محمود على[1]، عبد الحميد السيد عبد الحميد[2] ، وجدى ذكريا على[1]**
[1] معهد بحوث الإنتاج الحيوانى – وزارة الزراعة - مصر - الدقى، [2] كلية الزراعة (دمنهور) - جامعة الإسكندرية

استخدم فى هذه الدراسة نوعين من السلالات المحلية (بندرة و جميزة) حيث تم دراسة تأثير الخلط و الخلط العكسى بين السلالتين على صفات الدم الفيزيقية و الكيموحيوية ووزن الجسم و الوزن النسبى لبعض الاعضاء فى ذكور الدجاج.
اهم نتائج هذه الدراسة:

- وجدت إختلافات معنوية بين المجاميع الوراثية التى تمت دراستها فى صفات الدم الفيزيقية بينما اعطى خليط بندرة X جميزة اعلى قيمة فى PCV, MCV و قد حقق كل من الخليط و الخليط العكسى بندرة X جميزة ، جميزة X بندرة قيم متساوية و كانت الاعلى معنوياً بالنسبة لمحتوى هيموجلوبين الدم، MCV .
- سلالة الجميزة اعطت أعلى عدد فى كرات الدم الحمراء مقارنة بالتراكيب الوراثية الاخرى.
- كانت متوسطات بروتينات السيرم لكل من سلالة البندرة، الجميزة متساوية تقريباً و تختلف معنوياً عنها فى الخليط و الخليط العكسى
- متوسط الالبيومين الدم فى سلالة الجميزة كان الأعلى
- سلالة البندرة كانت الأعلى فى محتوى الدم من الكوليستيرول مع ذلك كل من الخليط و الخليط العكسى (بندرة X جميزة، جميزة X بندرة) كانت الاعلى فى محتوى الدم من الإنزيمات الناقلة لمجموعة الأمين ALT مقارنة بمحتوى السلالتين الاصلين.
- وجد أن ديوك البندرة، خليط جميزة X بندرة كانت الاثقل مقارنة بالمجموعات الوراثية الاخرى.
- الوزن النسبى للكبد فى ذكور خليط البندرة X الجميزة كان الاعلى بينما كان الوزن النسبى للخصية و البنكرياس فى ذكور البندرة الاعلى مقارنة بالتراكيب الوراثية الاخرى. الوزن النسبى للطحال فى ذكور الجميزة هو الاعلى.
- لم يشاهد تأثير معنوياً للخلط على الوزن النسبى للغدة التيموسية و يمكن القول بأن تأثير قوة الخلط و الخلط العكسى بين سلالتى الجميزة، البندرة كان موجباً فى معظم صفات الدم الفيزيقية و سالبة بالنسبة لجميع صفات الدم الكيموحيوية ما عدا الإنزيم الناقل لمجموعة الامين ALT حيث كانت قيم قوة الخلط موجبة عندما استخدمت سلالة الجميزة كأباء.
- وجد تأثير سلبى للخلط و الخلط العكسى على الوزن النسبى لمعظم صفات الأعضاء المدروسة.