GENETIC PARAMETER ESTIMATES FOR GLUTATHIONE PEROXIDASE AND SOME BLOOD CONSTITUENTS AND THEIR ASSOCIATION WITH SOME GROWTH TRAITS IN JAPANESE QUAIL

By

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Abstract:*Glutathione peroxidase (GPX) play a vital role in scavenging oxidative radicals and are considered as markers for evaluation of oxidative stress and in maintaining the health, productivity and reproductive characteristics of the animals. Reliable estimates of heritability and correlations are necessary to predict the direct and indirect selection responses. Therefore, the present study was conducted to estimate the heritability, genetic and phenotypic correlation coefficients of body weights (BW), shank length (SL) recorded at different ages, growth rates (GR) calculated during different growth periods, GPX, hemoglobin (Hb), red blood cells count (RBCs),white blood cells (WBCs), platelet count (PC), haematocrit (Ht), lymphocyte (Lymph), heterophils (Hetero), total protein (TP), albumin (Alb), globulins (Glob), calcium (Ca), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) under prevailing conditions of Egypt. The previous parameters needed to determine the effective selection criteria for future genetic improving in Japanese quail refine the breeding goal into a broader perspective and consider changes in immunological and physiological traits in the breeding program.*

The obtained results indicated that:

1. The corresponding values of BW at two, four and six weeks of age for combined sexes were 46.61, 108.02 and 158.14 g, respectively. Females were significantly heavier than males at two, four and six weeks of age.

2. The fastest growth rate was shown during the period 2-6 weeks of age

whereas; the slowest rate was obtained during the period 4-6 weeks of age (109.4 vs 38.82%) for the combined sexes. Sex significantly influenced GR favoring males during all periods.

3. *The corresponding values of SL at two, four and six weeks of age for combined sexes were 25.21, 28.29 and 37.44 mm, respectively. Sex had significant effect on SL at two and four weeks of age where female had longer SL than males.*

4. *Sex insignificantly affected all studied hematological parameters except for GPX and TP, where, females had significant higher values than males.*

5. *Heritability estimates for BW and SL ranged from low to high (0.22 and 0.95) regardless of the estimation method. BW, SL and GR had higher dam component heritability than sire heritability estimates.*

6. *Heritability estimates of GPX based on sire, dam and sire+dam variance components were 0.45, 0.55 and 0.51, respectively.*

7. *Regardless of estimation method, heritability estimates of blood constituents at six weeks of age ranged from 0.25-0.76. Also, heritability estimates of GPX and most blood constituents based on maternal being considerably larger than the paternal heritability estimate.*

8. *The phenotypic correlations between BW, GR_{2-4} and SL were positive and high in magnitude.*

9. *GPX enzymes activity and most of blood constituents are genetically and phenotypically correlated with each other with high and significant values.*

10. *Positive phenotypic and genetic correlations estimates were found between GPX enzymes activity and Lymph at 6 weeks of age with each of BW_2, BW_4, BW_6, GR_{2-4}, SL_2, SL_4 and SL_6 whereas, they negatively correlated with GR_{4-6}.*

11. *Each of Hb, WBCs, PC, Hetero, Ht, MCV, MCH and Ca are positively correlated with GR_{4-6} and negatively correlated with BW_2, BW_4, BW_6, GR_{2-4}, SL_2, SL_4 and SL_6.*

It could be concluded that most of these parameters had high heritability's values and are genetically and phenotypically correlated with each other with high

and significant values. These results should emphasize the importance of the shank length in the genetic manipulation of the structural material of the body, precisely to avoid any unfavorable reduction in the body skeletal support like what happened in broiler chickens. Also, either BW or SL can be used as criteria of selection to improve growth performance and immunological and physiological traits of Japanese quail since they had considerably higher heritability, genetic and phenotypic correlations with growth rate, GPX enzymes activity and some blood constituents. Correlation among previous blood parameters and GPX enzymes activity indicated that, estimate of one of these parameters could be used as a good indicator to the other parameters based on the high correlation values which obtained in the results.

INTRODUCTION

Quail industry has been developed in many countries for both meat and egg production (**Risse, 1980**). Also, quail is considered a good economical source for producing animal protein (**Singh *et al.*, 1981**). Nowadays, Japanese quail become widely distributed in Egypt as a source of meat production since their meat and eggs have become highly popular to the consumers.

According to many authors, recent breeding work that focused on improving production parameters is inversely correlated to some physiological parameters in poultry. Thus, to prevent undesirable side effects of selection in quail, like those that have occurred in broilers, we must refine the breeding goal into a broader perspective and consider changes in immunological and physiological traits in the breeding goal. So that, the sciences of genetics and physiology provide the basic knowledge required creating efficient genetic change in production and health traits therefore, these disciplines are key components in developing improved breeding programs. The physiological and hematological parameters are good indicator to predict and estimate productive and reproductive performance (**Emmerson, 2003**). Several investigations were conducted to relate chicken performance with some parameters of blood (**Attia, 2002 and Alm El Dein *et al.*, 2008**).

Glutathione peroxidase (EC 1. 11. 1. 9.) is a selenoenzyme, which is part of the biological antioxidant defence mechanism. It plays an important role in limited or preventing free radical initiated peroxidative damage by catalysing the reduction of hydrogen peroxide and a wide range of lipid hydroperoxides (**Arthur, 2000**). Glutathione peroxidase (GPX) scavenging

oxidative radicals and are considered as markers for evaluation of oxidative stress and in maintaining the health, productivity and reproductive characteristics of the animals **(Spurlock and Savage, 1993)**. There are some observations about the correlation of antioxidant enzymes activities and body weight, weight gain, growth rate and meat quality in chickens and rabbits **(Mézes *et al.,* 1994; Farahat *et al.,* 2008 a and b and Ragab *et al.,* 2010).** Blood biochemical traits could be important as indicator traits in breeding for high productivity. A wide range has been reported in Japanese quail for some blood constituents **(Avci *et al.,* 2007 and Bahie El Deen *et al.,* 2009).**

Commercial poultry breeding has amongst its objectives, the improvement of production potential and disease resistance. Over the years there has been much emphasis on growth improvement that is negatively associated with some aspects of immunological performance of poultry as reported by **Yunis *et al.,* (2000) and Cheema *et al.,* (2003).** Existence of any significant relationship between blood biochemical features related to health such as antioxidant enzymes activities and blood constituents with performance are needed for the design of breeding programs aimed to improve the balance between production and health traits. Estimation of genetic parameters is primordial to the establishment of strategies to be used in animal breeding programs because with the study of these parameters, the evaluation of response to selection for a trait and genetic associations among traits become possible. Genetic correlations have an importance to animal breeders because they represent the correlation between the breeding values of two traits. A genetic correlation between traits will result in a correlated response to selection **(Falconer, 1989).** A wide range of heritability estimates for body weight has been cited by many researchers **(Caron *et al.,* 1990, Abdel Fattah *et al.,* 2006 and Saatci *et al.,* 2006).** These studies normally used body weight at different ages and often used different methods to estimate the heritability. The success of the breeder or experimenter in changing the characteristics of the population can be predicted only from knowledge of heritability. Although a few commercial breeding programs have recently been initiated to develop Japanese quail lines with rapid rates of growth, selection responses for growth in Japanese quail will be viewed primarily from the results of experiments designed to provide an understanding of the inheritance of body weight and rate of gain and blood biochemical traits.

Genetic studies on Japanese quail in Egypt will enable breeders to design suitable improvement programs for this bird therefore, reliable

estimates of genetic parameters (heritabilities and correlations) are necessary to predict the direct and indirect selection responses. Therefore, the present research was conducted to estimate the heritability, genetic and phenotypic correlation coefficients of body weights (BW) and shank length (SL) recorded at different ages, growth rates (GR) calculated during different growth periods, glutathione peroxidase (GPX) of red blood cells haemolycate, hemoglobin (Hb), red blood cells count (RBCs), white blood cells (WBCs), platelet count (PC), haematocrit (Ht), lymphocyte (Lymph), heterophils (Hetero), total protein (TP), albumin (Alb), globulins (Glob) and calcium (Ca), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) under prevailing conditions of Egypt, which needed to determine the effective selection criteria for future genetic improving in Japanese quail.

MATERIALS AND METHODS

The present experiment was carried out at El-Azab Poultry Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt. A number of 100 sires and 200 dams (two dams were randomly assigned to each sire), were used to produce pedigree progeny [800 chicks (400♂ and 400♀)]. The chicks were marked by wing-banded at hatch day and brooded on floor brooders at a starting temperature of 38^0C for the first week after hatching, and then decreased 2-3^0C each week thereafter. Feed and water were provided *ad libitum*. Diet contained 24.20% crude protein with 2900 ME kcal./kg was fed. No significant changes had been made in feed or management practices throughout the experimental period.

Blood samples were obtained at 6 weeks of age from each experimental bird, about 3 cm^3 of blood from the wing vein of each bird were taken in the morning before feeding (between 8 and 10 o'clock) by dry clean centrifuge tubes containing heparin and immediately centrifuged at 3000 rpm for 20 min. for separating plasma. Plasma samples were prepared, stored at -20^C till time of chemical analysis. Plasma total protein was quantitatively measured based on colorimetric determination as described by **Cannon (1974)**. Albumin concentration was determined according to the method of **Doumas et al. (1977)**. Globulin concentration was estimated by subtraction of albumin concentration from serum total protein value. Calcium concentration was measured by the method of **Jakubowski et al. (1996).** The levels of Hb, RBCs, WBCs, PC, Ht, Lymph and Hetero were

determined by using ABX. Cell counter by Mieros 18. GPX was determined in serum by enzymatic methods using suitable commercial kits.

The following traits studied were:

1- Individual shank length and body weight were recorded at two, four and six weeks of age.

2. Growth rates (GR) during the periods (2-4 weeks), (4-6 weeks) and (2-6 weeks) of age were calculated according to the formula **(Broody, 1945)**:

$$GR = [W_2 - W_1 / \tfrac{1}{2}(W_2 + W_1)] \times 100$$

Where, W_1: the weight at beginning of the period.

W_2: the weight at end of the period.

3. Glutathione peroxidase, Hb, RBCs, WBCs, PC, Ht, Lymph, Hetero, TP, Alb, Glob, Ca, MCV, MCH, MCHC were determined of individual blood samples from experimental birds at 6 wks of age.

Statistical analysis

Data were subjected to one- way analysis of variance to test sex effect using the General Linear Model (GLM) procedure of SPSS User's Guide, **(SPSS, 1999)** according to the following model:

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

where: Y_{ij}: is the observed value of the ith sex on the jth chick, μ: is the common mean, S_i: sex effect (i = 1 and 2) and e_{ij}: is the residual error.

According to **Becker (1985)** data were computerized using the hierarchical analyses of variance and covariance procedure of **SAS (2000)** to compute the heritabilities of the characters (h^2) and genetic (r_g) correlations among them. The following random model was fitted, for all studied traits to calculate the genetic parameters:

$$Y_{ijk} = \mu + S_i + D_{ij} + e_{ijk.}$$

where: Y_{ijk}: expresses the observation of the ijk^{th} bird, **μ:** the overall mean, S_i: the effect of the ith sire, D_{ij}: the effect of the jth dam mated to the ith sire, and e_{ijk}: the error term accounted for the kth bird of the jth dam and i^{th} sire.

Estimation of heritabilities:

Heritabilities estimates were calculated according to **Becker (1985)** as follows:

$$h^2_S \quad = 4\sigma^2_S / \sigma^2_S + \sigma^2_D + \sigma^2_W$$

$$h^2_D \quad = 4\sigma^2_D / \sigma^2_S + \sigma^2_D + \sigma^2_W$$

$$h^2_{S+D} = 2\sigma^2_{S+D} / \sigma^2_S + \sigma^2_D + \sigma^2_W$$

where: σ^2_S: is the sire component of variance, σ^2_D is the dam component of variance, σ^2_W: is the remainder of the genetic variance plus the environmental variance.

Standard errors for heritabilities were calculated as follows:

$$Var (\sigma^2_g) = 2/k2 * \Sigma_g MS_g / f_g + 2$$

$$S.E (\sigma^2_g) = SQRT\ Var (\sigma^2_g)$$

where: **K:** coefficient of the variance component being estimated, MS_g : the gth mean square used to estimated the variance component, f_g : the degrees of freedom of the gth mean square.

Genetic correlations:

Genetic correlation (rg) between any two traits was calculated using combined component of variance and covariance as follows:

$$rg = cov_{xy} / SQRT (\sigma^2_{(x)} * \sigma^2_{(y)})$$

where: **rg**: is the genetic correlation coefficient, cov_{XY} : is the genetic covariance between traits X and Y, σ^2_X : is the variance component of trait X. σ^2_Y : is the variance component of trait Y.

Phenotypic correlations:

Phenotypic correlations (rp) between any two traits were estimated according to **Becker (1985)** as follows:

$$\mathbf{r_p = cov_p /SQRT(\sigma^2_{p(x)} * \sigma^2_{p(y)})}$$

where: $\mathbf{Cov_P}$: the total covariance between x and y traits.

RESULTS AND DISCUSSION

Growth traits:

Least-squares means for two, four and six weeks body weight (BW) and shank length (SL), growth rate (GR) at different periods for females, males and combined sexes of Japanese quail are presented in Table 1.

The corresponding values of BW at two, four and six weeks of age for combined sexes were 46.61, 108.02 and 158.14 g, respectively. These results are in agreement with **Abdel Fattah *et al.*, (2006) and Bahie El Deen *et al.*, (2009)** for BW2, **Abdel Fattah *et al.*, (2006)** for BW4. Higher values for BW6 were reported by **Abdel Fattah *et al.*, (2006) and Bahie El Deen *et al.*, (2009)**. Sex differences in body weight were significant at two, four and six weeks of age, females were significantly heavier than males (Table 1), the same trend was observed in body weights estimated at these ages by **Abdel Fattah *et al.*, (2006) and Bahie El Deen *et al.*, (2009)**. **Caron *et al.* (1990)** indicated that females grow faster and yielded larger muscles and more abdominal fat than males at the same age. Generally, the reported estimates for body weight of Japanese quail recorded at different ages indicate the high efficiency of this bird for growth. However, the observed differences between the various estimates reported in the literature for body weight of Japanese quail recorded at a particular age may be possibly due to the differences in the climatic and managerial conditions under which different flocks were reared and to the possible differences in genetic make up of the different flocks.

The fastest GR was shown during the period 2-6 weeks of age whereas, the slowest rate was obtained during the period 4-6 weeks of age (109.4 vs 38.82) for the combined sexes. Sex significantly influenced GR favoring males during all periods as shown in Table 1. These results agreed with those obtained by **Badawy (2008)**. While, **Shalan (1998)** and **Abdel**

Fattah *et al.* **(2006)** found lower growth rates during 2-4 and 4-6 weeks of age. It seems, however, that growth rate in males and females of Japanese quail should be considered distinct characteristic of population. This matter should be taken into account in any breeding program aiming at improving growth characteristics in Japanese quail.

Shank length as indicator of skeletal development for females, males and combined sexes of Japanese quail are presented in Table 1. The corresponding values of SL at two, four and six weeks of age for combined sexes were 25.21, 28.29 and 37.44 mm, respectively. Sex had significant effect on SL at two and four weeks of age where female had longer SL than males as shown in Table 1. These results are in agreement with those reported by **Yannakopoulos** *et al.,* **(1995) and Farahat (1998).**

Glutathione peroxidase and blood constituents:

Least-squares means of GPX activity Hb, RBCs, WBCs, PC, Ht, Lymph, Hetero, TP, Alb, Glob, Ca, MCV, MCH and MCHC are presented in Table 2. Sex had significant influence on GPX and TP, females having higher values than males. The same trend was found by **Godin** *et al.,* **(1995)** that, GPX activity in red blood cells is higher in females than in males of Japanese quail**.** It can be seen that sex insignificantly affected all studied hematological parameters except for GPX and TP (Table 2). Conversely, several investigators reported that males had significantly higher Ht% than females in Japanese quail (**Mihailov** *et al.,* **1999 and Abdel Azeem** *et al.,* **2001**). Sex differences were reported in the literature for TP (**Ragab, 2001 and Abdel Kader, 2003**), Alb, Glob (**Ragab, 2001**). Also, these values of TP were around the range with finding in Japanese quail by **El Ghalid (2005) and Bahie El Deen** *et al.,* **(2009)** while, higher estimate value for Ca was reported in Japanese quail by **El Ghalid (2005) and Bahie El Deen** *et al.,* **(2009).**

Heritability of growth traits:

Heritability estimates for BW, SL and GR obtained from paternal, maternal half-sib and full-sib correlations (h^2_S, h^2_D and h^2_{S+D}, respectively) of Japanese quail at different ages are presented in Table 3. All estimates of heritability for BW, SL and GR showed considerable variations throughout different ages or periods of growth, regardless of estimation method.

Heritability estimates for BW at different ages ranged from low to high (0.34 and 0.95). Generally, the review of the reported estimates for

heritability of body weight recorded at different ages in Japanese quail lead to conclusion that a considerable improvement in this trait could be achieved through efficient selection programs, however selection response for body weight are expected to be large. The body weight at six weeks of age seems to be highly heritable in quails as shown in Table 3. Similar trends are reported by **EL Fiky (1991).**

Heritability estimates during different periods of GR ranged from 0.22 to 0.79 regardless of the estimation method. Growth rates during all studied periods of growth had similar trend to body weight which had higher dam component heritability than sire heritability estimates due to non-additive effects. These estimates are within the range of heritabilities for growth traits estimated by several investigators **(Saatci *et al.*, 2002 and Abdel Fattah, 2006).**

Heritability estimates of SL showed considerable variations throughout different ages of growth, regardless of estimation method. Regardless of estimation method, heritability estimates of SL at two, four and six weeks of age ranged from 0.20-0.70. It can be seen that SL_6 had relatively higher heritability than other ages. The dam component heritability estimates shank lengths were generally higher than those of the sire component heritability estimates, this may be due to non-additive effects, primarily dominance and maternal, which is normally the reason for the maternal (h^2_D) heritability being considerably larger than the paternal heritability estimates (h^2_S), similar trends were reported by **Farahat, (1998).**

Heritability of GPX activity and blood constituents:

Heritability estimates of GPX activity and blood constituents based on sire, dam and sire+dam variance components are presented in Table 4. Heritability estimates of GPX based on sire, dam and sire+dam variance components were 0.45, 0.55 and 0.51, respectively. The larger h^2_D estimates than sire estimates suggested that GPX activity may be due to non-additive effects, primarily dominance and maternal, which is normally the reason for the maternal (h^2_D) heritability being considerably larger than the paternal heritability estimates (h^2_S). **Lingaas *et al.*, (1991)** estimated the heritability for GPX activity in pigs of 0.47, which indicated that, it is possible to increase the levels of GPX in blood plasma of pigs by selection. **Langlands *et al.*, (1980)** have reported a significant variation in the GPX activity both among the breeds of sheep and cattle and among the sires within breeds, the latter resulting in an estimate of the heritability of GPX activity per gram

haemoglobin of RBC haemolycate of 0.5. No available data about the heritability for GPX activity was found for poultry.

Regardless of estimation method, heritability estimates of blood constituents at six weeks of age ranged from 0.25-0.76. Also, heritability estimates of most blood constituents based on maternal being considerably larger than the paternal heritability estimates as shown in Table 4. The present results are in agreement with those obtained in chickens by **Abdel Latif, (2001) and El Dlebshany *et al.,* (2009).** The estimates for heritability of GPX and blood constituents in Japanese quail lead to conclusion that a considerable improvement in this traits could be achieved through efficient selection programs, however selection response for GPX and blood constituents are expected to be large. Based on the obtained heritability estimates, the analyzed traits seemed to be able to respond to selection at variable intensities.

Correlation coefficients between traits:

The phenotypic (r_P) and genetic correlation (r_g) coefficients among different traits are presented in Tables (5-8).

Correlations of growth traits:

The r_P between BW, GR_{2-4} and SL recorded at different ages and for different growth periods studied were positive and high in magnitude (Table 5). Also, the magnitude of the correlation fluctuated with decreasing time intervals between weights. Similar trends were reported by **Bahie El Deen (1994) and Abdel Fattah (2006).** BW_2 had positive significant r_p with each of BW_4, BW_6, SL_2, SL_4 and SL_6, while, the r_p between BW_2 and each of GR_{4-6} and GR_{2-6} was negative. BW_4 was positively correlated with each of BW_6, GR_{2-4} , SL_2, SL_4 and SL_6 and negatively correlated with each of GR_{2-6} and GR_{4-6}. Significant positive r_p correlations estimates were found between BW_6 and GR_{2-4}, SL_2, SL_4 and SL_6 whereas it negatively correlated with GR_{4-6}. GR_{2-4} had positive significant r_p with each of GR_{2-6}, BW_6, SL_4 and SL_6, while, it negatively correlated with GR_{4-6}. GR_{4-6} had significant positive r_p with GR_{2-6}, while, it negatively correlated with SL at all ages. GR_{2-6} was negatively correlated with SL_2, SL_4 and SL_6. Shank length at all ages study was positively correlated with each other as illustrated in Table 5.

The genetic correlations for the same traits followed the same trends as the phenotypic correlations. Most of r_g estimates among body weight

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recorded at different ages and between different growths periods studied were positive and high in magnitude (Table 5). The same trend was reported by **Abdel Fattah (2006).** BW_2 was positively correlated with each of BW_4, BW_6, SL_2, SL_4 and SL_6, while, the r_g between BW_2 and each of GR_{2-4}, GR_{4-6} and GR_{2-6} was negative. Also, BW_4 was positively correlated with each of BW_6, SL_2, SL_4 and SL_6 and negatively correlated with each of GR_{2-4}, GR_{4-6} and GR_{2-6}. Positive r_g correlations estimates were found between BW_6 and SL_2, SL_4 and $SL_6,$ whereas negatively correlated with each of GR_{2-4}, GR_{4-6} and GR_{2-6}. GR_{2-4} had positive r_g with each of SL_2, SL_4 and SL_6, while, it negatively correlated with GR_{4-6} and GR_{2-6}. GR_{4-6} was negatively correlated with GR_{2-6} and SL at all ages. Shank length at all ages study was positively correlated with each other as illustrated in Table 5. These results should emphasize the importance of the shank length in the genetic manipulation of the structural material of the body, precisely to avoid any unfavorable reduction in the body skeletal support like what happened in broiler chickens. It can be concluded that either BW or SL can be used as criteria of selection to improve growth performance of Japanese quail since they had considerably higher heritability, genetic and phenotypic correlations with other traits of growth.

Correlations of GPX activity and blood constituents:

Little or no reported values were available for correlations between each of GPX enzymes activity and blood constituents in Japanese quail.

GPX enzymes activity showed significant positive r_p (P≤0.01) with LYMP, whereas significant negative r_p (P≤0.01) with Hb, WBCs, PC, Hetero, Ht, MCV, MCH and Ca were found as shown in Table 6. Significant positive r_p (P≤0.01) was found between Hb concentration and each of RBCs, WBCs, PC, Hetero, Ht, MCV, MCH and Ca (Table 6). Red blood cells were significant positive correlated with each of WBCs, PC, Hetero and Ht, while the r_p were negative with LYMP. White blood cells positively correlated with PC, Hetero, Ht, MCV, MCH and Ca, while, the r_p is negative with LYMP. Significant positive r_p (P≤0.01) were found between PC and each of Hetero, Ht, MCV, MCH and Ca, however, it negatively correlated with LYMP (Table 6). Highly negative r_p estimates were found between Heteroand LYMP, while the values are positive with each of Ht, MCV, MCH and Ca as indicated in Table 6. Significant positive r_p was found between Ht and each of MCV and MCH. MCV had significant (P≤0.01) positive r_p with each of MCH and Ca. MCH had significant positive r_p with Ca (0.33, P≤0.05). Total protein positively correlated with

each of Alb and Glob (0.89, P≤0.01 and 0.30, P≤0.05). Similar trend of correlation coefficients among some blood parameters in chickens were reported by **El Safty et al. (2004) and Abdel Azim and Farahat (2009).**

GPX enzymes activity had positive r_g with LYMP, whereas negative r_g with Hb, WBCs, PC, Hetero, Ht, MCV, MCH and Ca were found. Hb concentration was positively correlated with each of RBCs, WBCs, PC, Hetero, Ht, MCV, MCH, TP, Alb, Glob and Ca, while negatively correlated with LYMP and GPX enzymes activity (Table 6). Red blood cells were positively correlated with each of WBCs, PC, and Ht, TP, Alb, Glob and Ca while the r_g was negative with other parameters. White blood cells positively correlated with PC, Hetero, Ht, MCV, MCH, TP and Ca, while, the r_g is negative with LYMP, Alb and Glob. Positive r_g was found between PC and each of Hetero, Ht, MCV, MCH, TP and Ca, however, it negatively correlated with LYMP, TP and Glob (Table 6). Negative r_g estimates was found between Hetero with LYMP and Alb while the values are positive with each of other parameters as indicated in Table 6. Positive r_g was found between Ht and each of MCV and MCH. MCV had positive r_g with each of MCH and Ca. MCH had positive r_g with Ca (0.33, P≤0.05). Total protein positively correlated with each of Alb and Glob.

It could be concluded that GPX enzymes activity and most of blood parameter are genetically and phenotypically correlated with each other with high and significant values. Correlation among previous blood parameters and GPX enzymes activity indicated that, estimate of one of these parameters could be used as a good indicator to the other parameters based on the high correlation values which obtained in our results. Also, this highly correlation values may be attributed to the pleiotropic effects and consequently performing selection in any of the two traits may lead to an improvement in the other trait, but further research is needed to support that hypothesis.

Correlations between GPX enzymes activity and blood plasma constituents with growth traits:

The phenotypic correlations between GPX enzymes activity and blood plasma constituents with growth traits at 6 wks of age are presented in Table 7.

Significant (P≤0.01) positive r_p correlations estimates were found between GPX enzymes activity and Lymph at 6 weeks of age with each of BW_2, BW_4, BW_6, GR_{2-4}, SL_2, SL_4 and SL_6 whereas, they negatively correlated with GR_{4-6} (Table 7). Each of Hb, WBCs, PC, Hetero, Ht, MCV,

MCH and Ca are positively correlated (P≤0.01) with GR_{4-6} and negatively correlated (P≤0.01) with BW_2, BW_4, BW_6, GR_{2-4}, SL_2, SL_4 and SL_6. Significant negative r_p correlations estimates were found between TP and Alb at 6 weeks of age with BW_2 and BW_6 as shown in Table 7. Similar trend of significant phenotypic correlation coefficients between GPX enzymes activity and blood plasma constituents with growth traits in chickens were reported by **Abdel Azim and Farahat (2009).**

The genetic correlations between GPX enzymes activity and blood plasma constituents with growth traits at 6 wks of age are presented in Table 8. Positive r_g correlations estimates were found between GPX enzymes activity and Lymph at 6 weeks of age with each of BW_2, BW_4, BW_6, GR_{2-4}, SL_2, SL_4 and SL_6 whereas, they negatively correlated with GR_{4-6} (Table 8). Each of Hb, WBCs, PC, Hetero, Ht, MCV, MCH and Ca are positively correlated (P≤0.01) with GR_{4-6} and negatively correlated (P≤0.01) with BW_2, BW_4, BW_6, GR_{2-4}, SL_2, SL_4 and SL_6.

The high correlations values between GPX enzymes activity and blood plasma constituents with growth traits are of interest because they indicate which measurements may be useful as genetic markers in breeding programs.

From the current results, it could be concluded that GPX enzymes activity and blood constituents can be done as prediction indicators to increase and improve growth traits and can be also used in selection programs to improve production and immunological traits of Japanese quail. Also, the highly heritability, genetic and phenotypic correlation values obtained may be attributed to the pleiotropic effects and consequently performing selection in any of the two traits may lead to an improvement in the other trait. This finding indicates that these parameters are useful and important with potential use in breeding programs as early predictors for indirect selection or crosses which associated with disease resistance, highly tolerance to oxidative stress and performance traits of Japanese quail.

Table 1. Actual means and standard errors for body weight, growth rate and shank length traits recorded for males, females and combined sexes of Japanese quail.

Item	Males	Females	Combined sexes
BW_2 g	$42.14^b \pm 0.60$	$53.54^a \pm 0.79$	46.61 ± 0.53
BW_4 g	$101.66^b \pm 1.37$	$117.89^a \pm 1.33$	108.02 ± 1.04
BW_6 g	$150.23^b \pm 1.42$	$170.41^a \pm 1.70$	158.14 ± 1.16
GR_{2-4}%	$81.81^a \pm 1.00$	$75.07^b \pm 1.35$	79.17 ± 0.82
GR_{4-6}%	$40.24^a \pm 1.04$	$36.61^b \pm 0.85$	38.82 ± 0.71
GR_{2-6} %	$112.78^a \pm 0.83$	$104.17^b \pm 1.22$	109.4 ± 0.72
SL_2 mm	$24.89^b \pm 0.17$	$25.72^a \pm 0.20$	25.21 ± 0.13
SL_4 mm	$27.85^b \pm 0.17$	$28.96^a \pm 0.18$	28.29 ± 0.13
SL_6 mm	37.17 ± 0.15	37.85 ± 0.11	37.44 ± 0.10

[a,b,] :Means within the same raw had different superscripts are significantly different (P≤0.05). BW_2: body weight at two weeks of age, BW_4: body weight at four weeks of age, BW_6: body weight at six weeks of age, GR_{2-4}: growth rate from two-four weeks of age, GR_{4-6}: growth rate from four-six weeks of age, GR_{2-6}: growth rate from two-six weeks of age, SL_2: shank length at two weeks of age, SL_4: shank length at four weeks of age, SL_6: shank length at six weeks of age.

Table 2. Actual means and standard errors for glutathione peroxidase activity and blood parameters recorded for males, females and combined sexes of Japanese quail at six weeks of age.

Item	Males	Females	Com. sexes
GPX gm	12.73 [b] ±0.12	13.74[a] ±0.34	13.15±0.19
Hb g/dl	11.05±0.60	11.71±0.52	11.44±0.39
Ht %	33.47±1.64	34.24±1.34	33.93±1.03
RBCs 10^6/ml	2.63±0.10	2.84±0.13	2.75±0.09
WBCs 10^6/ml	10.12±1.39	10.59±1.04	10.40±0.83
PC 10^6/ml	43.04±6.24	50.28± 4.81	47.38±3.81
Hetero%	23.04± 1.55	25.17± 1.34	24.32± 1.02
Lymph %	68.33±1.47	66.64±1.33	67.32±0.99
MCV μ^3	127.81 ±4.00	128.38 ±2.60	128.15 ±2.21
MCH µµg	42.61±1.84	40.84±1.15	41.55±1.01
MCHC %	32.93±0.53	35.51±1.20	34.48±0.76
TP g/dl	3.76[b]±0.10	4.08[a]±0.05	3.95±0.06
Alb g/dl	2.34 ±0.10	2.57±0.05	2.48±0.04
Glob g/dl	1.42±0.04	1.50±0 .04	1.47±0.04
Ca mg/dl	8.43±0.14	8.36±0.10	8.39±0.08

[a,b] :Means within the same raw had different superscripts are significantly different (P≤0.05). Glutathione peroxidase (GPX) of red blood cells haemolycate, hemoglobin (Hb), red blood cells count (RBCs), white blood cells (WBCs), platelet count (PC), haematocrit (Ht), lymphocyte (Lymph), heterophils (Hetero), total protein (TP), albumin (Alb), globulins (Glob) and calcium (Ca), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC).

Table 3. Heritability estimates±SE of body weight (BW), growth rate (GR) and shank length (SL) for combined sexes based on paternal (S), maternal half-sibs (D) and full-sib (S+D) correlations in Japanese quail.

Trait	h^2	2 weeks	4 weeks	6 weeks
	S	0.48±0.09	0.62±0.08	0.34±0.08
BW	D	0.93±0.08	0.69±0.08	0.95±0.07
	S+D	0.70±0.06	0.64±0.06	0.70±0.05
	S	0.22±0.12	0.21±0.09	0.65±0.05
SL	D	0.65±0.05	0.68±0.07	0.71±0.08
	S+D	0.50±0.06	0.55±0.05	0.70±0.05
		2-4 weeks	4-6 weeks	2-6 weeks
	S	0.27±0.14	0.28±0.14	0.72±0.11
GR	D	0.22±0.17	0.23±0.19	0.79±0.13
	S+D	0.35±0.18	0.36±0.21	0.74±0.11

Table 4. Heritability estimates ± SE of glutathione peroxidase activity and blood parameters for combined sexes based on paternal (S), maternal half-sibs (D) and full-sib (S+D) correlations in Japanese quail at six weeks of age.

Item	S	D	S+D
GPX gm	0.45 ± 0.13	0.55 ± 0.18	0.51 ± 0.16
Hb g/dl	0.34 ± 0.12	0.44 ± 0.12	0.38 ± 0.15
Ht %	0.35 ± 0.25	0.45 ± 0.25	0.39± 0.19
RBCs 10^6/ml	0.25 ± 0.17	0.33 ± 0.22	0.28± 0.20
WBCs 10^6/ml	0.35 ± 0.12	0.55 ± 0.18	0.43 ± 0.17
PC 10^6/ml	0.25 ± 0.21	0.55 ± 0.21	0.40± 0.15
Hetero%	0.27 ± 0.11	0.47 ± 0.14	0.35 ± 0.19
Lymph %	0.39 ± 0.15	0.48 ± 0.15	0.42 ± 0.20
MCV μ^3	0.38 ± 0.16	0.58 ± 0.19	0.41 ± 0.16
MCH μμg	0.45 ± 0.15	0.55 ± 0.15	0.48 ± 0.18
MCHC %	0.44 ± 0.19	0.54 ± 0.21	0.48 ± 0.22
TP g/dl	0.65 ± 0.15	0.76 ± 0.18	0.71 ± 0.25
Alb g/dl	0.52 ± 0.12	0.68 ± 0.09	0.59 ± 0.15
Glob g/dl	0.66 ± 0.13	0.75 ± 0.19	0.70 ± 0.20
Ca mg/dl	0.36 ± 0.11	0.45 ± 0.17	0.41 ± 0.17

Glutathione peroxidase (GPX) of red blood cells haemolycate, hemoglobin (Hb), red blood cells count (RBCs), white blood cells (WBCs), platelet count (PC), haematocrit (Ht), lymphocyte (Lymph), heterophils (Hetero), total protein (TP), albumin (Alb), globulins (Glob), calcium (Ca), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC).

Table 5. Coefficients of genetic correlations (below diagonal) and phenotypic correlations (above diagonal) between body weight, growth rate and shank length of Japanese quail.

Trait	BW_2	BW_4	BW_6	GR_{2-4}	GR_{4-6}	GR_{2-6}	SL_2	SL_4	SL_6
BW_2 g		0.73**	0.65**	-0.03	-0.69**	-0.82**	0.74**	0.70**	0.37*
BW_4 g	0.90		0.90**	0.63**	-0.93**	-0.32*	0.68**	0.94**	0.56**
BW_6 g	0.85	0.89			-0.69**	-0.12	0.63**	0.85**	0.67**
GR_{2-4}%	-0.50	-0.30	-0.25		-0.60**	0.45**	0.14	0.55**	0.42**
GR_{4-6}%	-0.64	-0.47	-0.59	-0.55		0.44**	-0.64**	-0.88**	-0.43**
GR_{2-6} %	-0.45	-0.53	-0.75	-0.47	-0.30		-0.54**	-0.35*	-0.10
SL_2 mm	0.65	0.53	0.50	0.35	-0.62	-0.43		0.70**	0.46**
SL_4 mm	0.37	0.61	0.43	0.72	-0.52	-0.37	0.68		0.58**
SL_6 mm	0.54	0.65	0.64	0.32	-0.39	-0.25	0.62	0.42	

BW_2: body weight at two weeks of age, BW_4: body weight at four weeks of age, BW_6: body weight at six weeks of age, GR_{2-4}: growth rate from two-four weeks of age, GR_{4-6}: growth rate from four-six weeks of age, GR_{2-6}: growth rate from two-six weeks of age, SL_2: shank length at two weeks of age, SL_4: shank length at four weeks of age, SL_6: shank length at six weeks of age.

Table 6. Coefficients of genetic correlations (below diagonal) and phenotypic correlations (above diagonal) between glutathione peroxidase activity and blood parameters in Japanese quail.

Trait	GPX	Hb	RBCs	WBCs	PC	Hetero	Lymph	Ht	MCV	MCH	TP	Alb	Glob	Ca
GPX gm		-0.52**	-0.12	-0.55**	-0.52**	-0.54**	0.51**	-0.40**	-0.63**	-0.52**	-0.13	-0.12	-0.04	-0.30*
Hb g/dl	-0.42		0.65**	0.85**	0.82**	0.81**	-0.82**	0.84**	0.69**	0.57**	0.14	0.10	0.10	0.30*
Ht %	-0.11	0.55		0.38**	0.43**	0.43**	-0.44**	0.47**	0.10	-0.01	0.11	0.12	-0.02	0.06
RBCs 10^6/ml	-0.42	0.64	0.22		0.78**	0.80**	-0.84**	0.69**	0.73**	0.79**	0.06	0.07	-0.02	0.34*
WBCs 10^6/ml	-0.39	0.75	0.31	0.57		0.77**	-0.72**	0.63**	0.77**	0.60**	0.15	0.09	0.13	0.38**
PC 10^6/ml	-0.41	0.52	0.25	0.63	0.46		-0.96**	0.64**	0.75**	0.67**	0.11	0.05	0.13	0.36*
Hetero%	0.52	-0.22	-0.21	-0.55	-0.53	-0.71		-0.66**	-0.70**	-0.69**	-0.11	-0.07	-0.08	-0.33*
Lymph %	-0.31	0.36	0.31	0.63	0.53	0.43	-0.48		0.51**	0.44**	0.07	-0.05	0.27	0.23
MCV µ³	-0.41	0.39	-0.07	0.59	0.46	0.52	-0.52	0.34		0.83**	0.21	0.15	0.13	0.46**
MCH µµg	-0.34	0.31	-0.06	0.46	0.44	0.39	-0.57	0.42	0.57		0.09	0.10	-0.02	0.33*
MCHC %	0.13	0.05	0.13	0.11	-0.13	0.09	0.13	-0.13	0.11	-0.14		0.89**	0.30*	0.20
TP g/dl	-0.11	0.11	0.07	-0.14	0.02	-0.10	0.14	0.10	0.09	0.07	0.72		-0.16	0.26
Alb g/dl	0.13	0.12	-0.01	-0.15	-0.10	0.08	-0.02	0.14	0.03	-0.01	0.21	-0.02		-0.11
Glob g/dl	-0.44	0.27	0.05	0.22	0.28	0.31	-0.21	0.11	0.28	0.23	0.15	-0.10	0.10	

** Correlation is significant at P≤0.01 level. * Correlation is significant at P-0.≤0.05 level. Glutathione peroxidase (GPX) of red blood cells haemolycate, hemoglobin (Hb), red blood cells count (RBCs), white blood cells (WBCs), platelet count (PC), haematocrit (Ht), lymphocyte (Lymph), heterophils (Hetero), total protein (TP), albumin (Alb), globulins (Glob), calcium (Ca), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC).

Table 7. Coefficients of phenotypic correlations between growth traits and glutathione peroxidase activity and blood parameters of Japanese quail.

rait	BW2	BW4	BW6	GR2-4	GR4-6	GR2-6	SL2	SL4	SL6
GPX gm	0.41**	0.58**	0.52**	0.40**	-0.56**	-0.20	0.37*	0.54**	0.35*
Hb g/dl	-0.51**	-0.64**	-0.56**	-0.41**	0.64**	0.28	-0.45**	-0.60**	-0.38**
Ht %	-0.21	-0.16	-0.16	-0.01	0.14	0.16	-0.14	-0.14	-0.21
RBCs 10^6/ml	-0.50**	-0.69**	-0.57**	-0.48**	0.71**	0.28	-0.45**	-0.63**	-0.33*
WBCs 10^6/ml	-0.54**	-0.76**	-0.67**	-0.52**	0.75**	0.26	-0.49**	-0.70**	-0.39**
PC 10^6/ml	-0.56**	-0.72**	-0.65**	-0.46**	0.70**	0.28	-0.52**	-0.67**	-0.36**
Hetero%	0.52**	0.67**	0.57**	0.45**	-0.66**	-0.26	0.44**	0.62**	0.28
Lymph %	-0.42**	-0.52**	-0.41**	-0.34*	0.57**	0.27	-0.48**	-0.49**	-0.38**
MCV μ^3	-0.59**	-0.79**	-0.71**	-0.50**	0.76**	0.30*	-0.48**	-0.76**	-0.31*
MCH $\mu\mu g$	-0.51**	-0.67**	-0.57**	-0.42**	0.67**	0.29*	-0.37*	-0.66**	-0.30*
MCHC %	-0.35*	-0.24	-0.30*	0.02	0.15	0.20	-0.13	-0.26	-0.02
TP g/dl	-0.30*	-0.18	-0.31*	0.02	0.13	0.19	-0.11	-0.21	-0.01
Alb g/dl	-0.14	-0.13	-0.21	-0.01	0.06	0.05	-0.04	-0.12	-0.05
Glob g/dl	-0.17	-0.41**	-0.36*	-0.45**	0.41**	-0.04	-0.14	-0.37*	-0.30*

BW_2: body weight at two weeks of age, BW_4: body weight at four weeks of age, BW_6: body weight at six weeks of age, GR_{2-4}: growth rate from two-four weeks of age, GR_{4-6}: growth rate from four-six weeks of age, GR_{2-6}: growth rate from two-six weeks of age, SL_2: shank length at two weeks of age, SL_4: shank length at four weeks of age, SL_6: shank length at six weeks of age Glutathione peroxidase (GPX) of red blood cells haemolycate, hemoglobin (Hb), red blood cells count (RBCs), white blood cells (WBCs), platelet count (PC), haematocrit (Ht), lymphocyte (Lymph), heterophils (Hetero), total protein (TP), albumin (Alb), globulins (Glob), calcium (Ca), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC).

Table 8. Coefficients of genetic correlations between growth traits and glutathione peroxidase activity and blood parameters of Japanese quail.

Trait	BW2	BW4	BW6	GR2-4	GR4-6	GR2-6	SL2	SL4	SL6
GPX gm	0.39	0.45	0.57	0.38	-0.48	-0.30	0.32	0.44	0.31
Hb g/dl	-0.43	-0.54	-0.55	-0.33	0.51	0.17	-0.39	-0.64	-0.33
Ht %	-0.22	-0.17	-0.19	-0.11	0.16	0.19	-0.20	-0.24	-0.25
RBCs 10^6/ml	-0.40	-0.50	-0.57	-0.55	0.64	0.30	-0.36	-0.44	-0.23
WBCs 10^6/ml	0.45	-0.45	-0.41	-0.44	0.53	0.31	-0.25	-0.30	-0.41
PC 10^6/ml	-0.60	-0.80	-0.45	-0.22	0.58	0.29	-0.41	-0.38	0.23
Hetero%	0.32	-0.56	0.50	0.32	-0.53	-0.30	0.20	0.29	0.16
Lymph %	-0.52	-0.54	-0.45	-0.22	0.44	0.19	-0.23	-0.29	-0.22
MCV μ^3	-0.47	-0.68	-0.55	-0.56	0.63	0.26	-0.52	-0.50	-0.26
MCH $\mu\mu g$	-0.41	-0.59	-0.44	-0.33	0.48	0.25	-0.21	-0.20	-0.16
MCHC %	0.15	-0.25	-0.20	-0.12	0.11	0.10	0.10	0.36	0.10
TP g/dl	0.22	-0.11	-0.28	-0.09	0.09	0.18	0.19	0.19	-0.11
Alb g/dl	- 0.16	-0.09	-0.22	-0.11	-0.05	-0.10	0.13	0.09	0.10
Glob g/dl	-0.22	-0.33	-0.46	-0.33	0.36	-0.10	-0.06	-0.21	-0.19

BW_2: body weight at two weeks of age, BW_4: body weight at four weeks of age, BW_6: body weight at six weeks of age, GR_{2-4}: growth rate from two-four weeks of age, GR_{4-6}: growth rate from four-six weeks of age, GR_{2-6}: growth rate from two-six weeks of age, SL_2: shank length at two weeks of age, SL_4: shank length at four weeks of age, SL_6: shank length at six weeks of age Glutathione peroxidase (GPX) of red blood cells haemolycate, hemoglobin (Hb), red blood cells count (RBCs), white blood cells (WBCs), platelet count (PC), haematocrit (Ht), lymphocyte (Lymph), heterophils (Hetero), total protein (TP), albumin (Alb), globulins (Glob), calcium (Ca), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC).

REFERENCES

Abdel Azeem, F.; Ibrahim, F.A. and Ali, N.G. (2001). *Growth performance and some blood parameters of growing Japanese quail as influenced by different dietary protein levels and microbial probiotics supplementation. Egypt. Poult. Sci. 21: 465-489.*

Abdel Azim , A. M. and Farahat, G. S. (2009). Breed differences and phenotypic correlations of antioxidant enzymes activities, some physiological parameters and productive traits of chicken. 2. Phenotypic correlations. *Egypt Poult. Sci. 29: 645- 666.*

Abdel Fattah, M.H; El-Full E.A.; Farahat, G.S; Hatba N.A. and Khalifa, M.A. (2006). *Inheritance of body weight, growth rate and fitness traits in Japanese quail. Egypt. Poult. Sci.26: 1195-1215.*

Abdel Kader, I. A. (2003). *Effect of dietary levels of methionine and lysine on performance of Japanese quail. M. Sc. Thesis, Fac. Agric., Fayoum, Cairo Univ., Egypt.*

Abdel Latif, H. A. (2001). *Inheritance of certain plasma constituents and their association with some economic traits in Dandarawi and Golden Montazah hens. M.Sc. Thesis, Fac. of Agric., Cairo Univ., Egypt.*

Alm El Dein, A. K.; Abd El-Ghany, F.A.; Awaden, N.B. and Soliman, M.M. (2008). *Prediction of productive performance of laying* blood plasma constituents, body weight, genetic parameter, chickens 477 *hens by measurement of some blood constituents. Egypt. Poult. Sci., 28:849 – 866.*

Arthur, J. R. (2000). *The glutathione peroxidases. Cell. Mol. Life Sci. 57: 1825-1835.*

Attia, N.A.M. (2002). *Genetic study of some plasma constituents and their association with some growth traits in Dandarawi and Golden Montazah chickens. M.Sc. Thesis, Fac. of Agric., Cairo Univ.(Fayoum), Egypt.*

Avci, M.; Denek, N. and Kaplan, O. (2007). *Effects of humic acid at different levels on growth performance, carcass yields and some biochemical parameters of quails. J. Anim. Vet. Adv., 6(1):1-4.*

Badawy, A.Y. (2008). *Divergent selection in Japanese quail for body weight under subtropical conditions. M.Sc. Thesis, Fac. of Agric.,Suez Canal.Univ., Egypt.*

Bahie El Deen, M. (1994). *Selection indices and crossing as a tool for improvement meat and egg production in Japanese quail. Ph. D. Thesis, Fac. of Agric. Alexandria. Univ., Egypt.*

Bahie El Deen, M.; Kosba, M.A. and Soliman, A.S.A. (2009). Studies of some performance and blood constituents traits in Japanese quail. *Egypt. Poult. Sci. 29:* 1187-1208.

Becker, W. A. (1985). *Manual of quantitative genetics. First reprinting. Academic enterprises, Pullman, USA.*

Broody, S. (1945). Bioenergetics and growth. Reinhold pup. Crop. N. Y., U.S.A.

Cannon, D.C. (1974). *In clinical chemistry- principles and techniques, 2nd Ed., Edited by R. J. Henry, Harper and Row, Hagerstwon, MD, USA.*

Caron. N.; Minvielle, M. D. and Poste, L.M. (1990). *Mass selection for 45-day weight in Japanese quail: selection response carcass composition, cooking properties and sensory characteristics. Poult. Sci. 69:1037-1045.*

Cheema, M.A.; Qureshi, M.A. and G.B. Havenstein, G.B. (2003). *A comparison of the immune response of a 2001 commercial broiler with a 1957 randombred broiler strain when fed representative 1957 and 2001 broiler diets. Poult. Sci. 82:1519-1529.*

Doumas, B.T.; Watson, W. and Biggs, H.G. (1977). *Albumin standards and the measurement of serum albumin with bromocresol green.Clin.Chem.Acta.,31 :87 – 96.*

El Dlebshany, A.E.; El Tahawy, W.S. and Amin, E.M. (2009). *Inheritance of some blood plasma constituents and its relationship with body weight in chickens. Egypt. Poult. Sci. 29: 465-480.*

El Fiky, F. A. (1991). *Genetic studies on some economic traits in Japanese quail. Ph.D. Thesis, Fac. Agric. Al Azhar Univ., Cairo, Egypt.*

El Ghalid; O.A., (2005). *Estradiol effects on blood profile and performance of Japanese quail at different stages of production. Ph. D. Thesis, Fac. of Agric. Alexandria. Univ., Egypt.*

El Safty, S.A. (2004). *Stepwise regression analysis for ultrstructural measurements of eggshell quality in two local breeds of chicken. Egypt. Poult. Sci. 24: 189-203.*

Emmerson, D. A. (2003). *Breeding objectives and selection strategies for broiler production. Pages 113-126 in Poultry Genetics, Breeding and Biotechnology. W. M. Muir and S. E. Aggrey, eds. CABI Publishing, Wallingford, UK.*

Falconer, D. S. (1989). Introduction to Quantitative Genetics. 3rd Ed, Longman Group, Essex, England.

Farahat, G. S. (1998). *Estimation of some genetic and phenotypic parameters for growth and reproductive traits of Japanese quail. M.Sc. Thesis, Fac. Agric., Fayoum, Cairo Univ., Egypt.*

Farahat, G.S.; Eissa, E.A. and Mézes, M. (2008a). *Effect of genotype, heterosis and sex on body weight and red blood cell haemolysate and blood plasma glutathione peroxidase activity at the age of sexual maturity in chickens. J. Poult. Sci. 45:180-185.*

Farahat, G.S.; Eissa, E.A.; Balogh, K. and Mézes, M. (2008b). *Glutathione peroxidase activity in different breeds and sexes of chickens during embryonic development up to peak of egg production. J. of Anim, and Feed Sci. 17: 588–599.*

Godin, D.; Garnett, M.; Cheng, K. and Nichols, C. (1995). *Sex-related alterations in antioxidant status and susceptibility to atherosclerosis in Japanese quail. Can. J. Cardiol. 10: 945-951.*

Jakoubowski, Z.; Kabata, J.; Kalinowski, L.; Szczepanska-Konkel, M. and Angielski, S. (1996). *Badania laboratoryjne w codziennej praktyce. MAK med Gdańsk.*

Langlands, J. B; **Donald, G.**; **Chang, T. S.; Evans, R.; Hearnshaw, H. and Post, T.B. (1980).** *Genotype as a source of variation in selenium concentration and glutathione peroxidase activity of whole blood from grazing sheep and cattle. Australian J. of Agricultural Res. 4: 839-848.*

Lingaas,F.; Brun, E. and Froslie, A. (1991). *Estimates of heritability for selenium and glutathione peroxidase levels in pigs. J. Anim. Breed. Genet. 108:48-53.*

Mézes, M.; Eiben, Cs. And Virág, Gy. (1994). *Determination of glutathione peroxidase enzyme activity in blood plasma, red blood cells and liver of rabbits. Correlation between the enzyme activity and some production traits (In Hungarian). In. Zs. Szendrő (Editor). Proceedings of the 6th Rabbit Breeding Day, PATE, Kaposvár, pp. 121-126.*

Mihailov, R.; Lasheva, V. and Lashev, L. (1999). Some hematological values in Japanese quail. Bulga. J. Vet. Med. 2: 137-139

Ragab, M. S. (2001). *A study of substituting yellow corn and soybean meal by sorghum grain and raw sunflower on the performance of Japanese quail. Ph. D. Thesis, Fac. Agric., Fayoum, Cairo Univ., Egypt.*

Ragab, M. S.; Magda, R.A and Farahat, G.S. (2010). *Effect of molukhyia or parsley feeding on carcass characteristic, glutathione peroxidase enzyme activity and meat quality of two broiler strains. Egypt. Poult. Sci. 30: 353-389.*

Risse, J. (1980). *Guinea fowl and quail as poultry meet. In: Mead G.C. and B.M. freeman (EDS). Meat quality in poultry and game Birds, PP. 193-197.*

Saatci, M.; Dewi, I.A.; Aksoy, A.R.; Kirmizibayrak, T. and Ulutas, Z. (2002). *Estimation of genetic parameters for weekly live weights in one to one sire and dam pedigree recorded Japanese quail. Proceedings of the 7th World Congress on Genetics Applied to Livestock Production, Montpellier, France, August, 2002.*

Saatci, M.; Omed, H. and Dewi, I. A. (2006). *Genetic Parameters from Univariate and Bivariate Analyses of Egg and Weight Traits in Japanese Quail. Poult. Sci. 85:185-190*

SAS (2000). *SAS/STAT Users Guide: Statistics. Version 8.1, SAS Institute Inc., Cary, NC.*

Shalan, H.M. (1998). *lndependent culling levels selection and crossing for improving meat and egg production in Japanese quail. Ph. D. Thesis, Fac. oF Agric., Alexandria. Univ., Egypt.*

Singh, R.P.; Panda, B.; Ahaja, S.D.; Agarwal, S.K.; Prakash Babu, M.; Shrivastava, A.K. and Butta, O.P. (1981). *Development of quails for meat and egg. Central avian Res. Inst. Izatnagar.*

SPSS (1999). *User's Guide: Statistics. Version 10. SPSS Inc., Chicago, IL, USA.*

Spurlock, M.E. and Savage, J.E. (1993). *Effects of dietary protein and selected antioxidants on fatty hemorrhagic syndrome induced in Japanese quails. Poult. Sci., 72: 2095-2105.*

Yannakopoulos, A. L.; Christaki, F. and Paneri, P.F. (1995). *Effect of age and carcass composition on the onset of sexual maturity in quail under normal feeding regimens. Br. Poult. Sci. 36: 771-777.*

Yunis, R.; Ben-David, A.; Heller, E.D. and Cahaner, A. (2000). *Immunocompetence and viability under commercial conditions of broiler groups differing in growth rate and in antibody response to Eschirichia coil. Poultry Sci. 79:810-816.*

الملخص العربي

تقدير المقاييس الوراثية لنشاط إنزيم الجلوتاثيون بيروكسيديز وبعض صفات الدم وعلاقتهم بصفات النمو في السمان الياباني

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يعتبر إنزيم الجلوتاثيون بيروكسيديز مكون هام في النظام البيولوجي لمقاومة مخاطر الأكسدة والحفاظ على الحالة الصحية والإنتاجية للطيور. تم إجراء هذه التجربة بهدف تقدير العمق الوراثى ومعاملات الارتباط الوراثى والمظهري لنشاط إنزيم الجلوتاثيون بيروكسيديز وبعض صفات الدم وعلاقتهم بصفات وزن الجسم ومعدل النمو وطول قصبة الأرجل في السمان الياباني وذلك لإضافة صفات انتخابية جديدة يمكن استخدامها للتحسين الوراثى في السمان الياباني تأخذ في الاعتبار الصفات الفسيولوجية و المناعية.

وتتلخص أهم النتائج المتحصل عليها فيما يلي:

١.كانت قيم المتوسطات لوزن الجسم عند أعمار 2، 4، 6 (46.61 -108.02- 158.14 جرام على التوالي) وكانت الإناث اعلي معنويا في الوزن عن الذكور عند كل الأعمار.

٢.كان اعلي معدل نمو في الفترة من 2-6 أسابيع واقلها في الفترة من 4-6 (109.4 مقابل 38.82) وكانت الذكور اعلي معنويا في الوزن عن الإناث عند كل الأعمار.

٣.كانت قيم المتوسطات لطول قصبة الأرجل عند أعمار2، 4 ، 6 (23.21-28.29-37.44 مم على التوالي) وكانت الإناث اعلي معنويا عن الذكور عند عمر2و4 أسبوع.

٤.كان تأثير الجنس معنوي لصالح الإناث بالنسبة لنشاط إنزيم الجلوتاثيون بيروكسيديز والبروتين الكلى وغير معنوي لباقي صفات الدم المدروسة.

٥.أظهرت قيم المكافئ الوراثى لصفات وزن الجسم و معدل نمو و طول قصبة الأرجل مدى واسع من الاختلاف بقيم تتراوح من (0.95-0.22) بغض النظر عن طريقة التقدير والاتجاه العام لقيم المكافئ الوراثى المقدر من مكون تباين الأم اعلي من المقدر من قيم مكون تباين الأب.

٦.كانت قيمة قيم المكافئ الوراثى المحسوب لنشاط إنزيم الجلوتاثيون بيروكسيديز من مكون تباين الأب، الأم والاثنين معا (0.51-0.55-0.40 على التوالي) و كانت القيم المقدرة من مكون تباين الأم اعلي من المقدر من قيم مكون تباين الأب.

٧.أظهرت قيم المكافئ الوراثى لصفات الدم المدروسة مدى واسع من الاختلاف بقيم تتراوح من (0.76-0.25) بغض النظر عن طريقة التقدير والاتجاه العام لقيم المكافئ الوراثى المقدر من مكون تباين الأم اعلي من المقدر من قيم مكون تباين الأب لمعظم صفات الدم.

٨.سجلت قيم معاملات الارتباط المظهري والوراثي بين وزن الجسم و طول قصبة الأرجل ومعدل النمو في الفترة من 2-4 أسابيع قيم مرتفعة وموجبة.

٩.أظهرت قيم معاملات الارتباط المظهري والوراثي لنشاط إنزيم الجلوتاثيون بيروكسيديز وبعض المقاييس الفسيولوجية قيم مرتفعة ومعنوية.

١٠.ارتبط نشاط إنزيم الجلوتاثيون بيروكسيديز ونسبة الخلايا الليمفاوية ارتباط وراثي ومظهري موجب مع وزن الجسم و طول قصبة الأرجل عند كل الأعمار ومعدل النمو في الفترة من 2-4 أسابيع وسالب مع معدل النمو في الفترة من 4-6 أسابيع.

١١. ارتبطت معظم المقاييس الفسيولوجية ارتباط وراثي ومظهري سالب مع وزن الجسم و طول قصبة الأرجل عند كل الأعمار ومعدل النمو في الفترة من   2-4 أسابيع و موجب مع معدل النمو في الفترة من 4-6 أسابيع.

والخلاصة أن قيم المكافئ الوراثى ومعاملات الارتباط الوراثي والمظهري بين إنزيم الجلوتاثيون بيروكسيديز ومعظم المقاييس الفسيولوجية و الصفات الإنتاجية كانت مرتفعة و انه يمكن استخدام هذه الصفات بطريقة مناسبة في برامج التربية والانتخاب المختلفة لإنتاج سلالات مقاومه لمخاطر الأكسدة وتحسين الصفات المناعية و الإنتاجية.