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GENETIC RESPONSE OF BODY WEIGHT, SECONDARY SEXUAL CHARACTERS AND HATCHABILITY OF GIMMIZAH CHICKENS SELECTED FOR BREAST CIRCUMFERENCE

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ABSTRACT: This experiment was conducted to study the effect of long term selection for breast circumference (BC) of Gimmizah (GM) chickens on some body measurements of males at 12, 25 and 45 weeks of age such as body weight (BW), BC, shank length (SL), and secondary sexual characters as comb length (CL) and wattle length (WL), besides fertility with hatchability and their genetic parameters. Two hundred and twenty GM hens with twenty males were randomly chosen and considered as base population (G_0). Chicks produced from G_0 were selected for BC at 12-wk of age and selected through additional five generations. The results revealed that selection for BC significantly increased BW at 12-wk of age for selected line compared to control one among 4 and 5th generations. Comb length for selected lines had significantly increased compared to control lines for CL_{12} in G_4 and G_5. Wattle lengths for selected lines were increased ($p<0.05$) in the last three generations compared to the rest ones among all the experimental ages. There were a significant improvement of fertility and hatchability of fertile eggs percentages among the subsequent selected generations. Most of heritability (h^2) estimates for CL and WL were considered high and ranged between 0.50 and 0.78. Low estimates of h^2 were recorded for which ranged between 0.02 to 0.14 and for hatchability of fertile eggs between 0.02 and 0.05. Furthermore, CL represented high genetic correlation with fertility among the bird's ages and generations. In conclusion, body circumference could be used as selection tool for improving body weight and secondary sexual characters without detrimental effect on fertility, besides suggesting other body measurements as shank, comb and wattle lengths could be included in selection index.

Key words: Selection-Breast circumferences - Heritability- Comb

INTRODUCTION

Egyptian developed breeds were subjected to different programs of selection for improving the productive and reproductive traits. Gimmizah breed was developed by crossing between Plymouth Rock and Dokki4 (Mahmoud et al., 1982). Relationships among measurements could be applied in selection, besides these will help the breeders to organize the breeding programs to achieve the combination for maximizing the economic return (Okon et al., 1997). Chambers (1990) stated that there was genetic relationship between growth and skeletal dimensions. The external characteristics of chest width and shank score for male broiler breeders have been proposed as methods of evaluating reproductive potential (Ruth, 2002). The most important dimensions usually measured are body circumference, shank length and keel length for local strain (Abou EL-Ella et al., 2005). Many of body conformation measurements such as shank and keel lengths may be used as good indicators for skeletal size also, Dudgeon (2010) mentioned that length of shank is better measure for the genetic of size than body weight. Skeletal development in the early period of chicken production is influenced by early growth as normal skeletal is important in terms of obtaining high level of fertility, as shank length is highly correlated with fertility (Nordskog, 1976). Selection of males with good shank length will result in having good body circumference during life and also will increase male fertility and males with a good balance of shank length, keel length and breast width had a high fertility rate (Gao et al., 2010).

As a rule, hatchability decline with selection for body weight but this is not always true (Maioney et al., 1963). Fertility problems were partially attributed to selection for increased body weight (Ogasawara et al., 1963) and modified breast size (Carte and Leighton, 1969). Relationship between body weight and reproduction traits as fertility and hatchability are of interest as they affect the rate of genetic progress (Savegnago et al., 2011). The degree of development of the secondary sexual character such as comb and wattle could affect the reproductive potential (McGary et al., 2002).

This study was undertaken to study the effect of selection for breast circumferences in Gimmizah chickens at twelve weeks of age on some body measurements such as body weight, shank length, comb length, wattle length, fertility and hatchability beside estimation of genetic parameters for the previous studied traits.

MATERIALS AND METHODS

The present experiment was conducted on Gimmizah (GM) chickens at EL-Sabahia Poultry Research Station, Agriculture Research Center. Two hundred and twenty GM hens beside twentytwo males grown on litter were randomly chosen from the flock and considered as base population(G_0) composing 22 pen's families (10 hens for each male / pen). Chicks produced from G_0 were wing-banded and selected for breast circumference (BC) within families at 12-wk of age. Birds were selected as the parents of the next generation and continued throughout five selected generations. Average selection proportion of about 40-45% for hens and 5% for cocks were applied in each generation. One hundred and twenty hens besides 12 cocks were selected to produce the next generation. Control family consisted by random mating of one male from each sire family to a non-related ten females for each one of the studied generations.

A total number of 6750 hatching GM eggs produced from chickens aged between 45-50 wks and representing the six experimental generations were used for determining the hatching trials. Eggs were individually numbered and marked by sires for each generation and incubated in Egyptian-made incubator at 99.5° F and 55% relative humidity (RH) during setting phase and 98.60° F with 65% RH during hatching phase. Eggs were randomly distributed in trays as replicates in the incubator. On the 18th day of incubation, eggs for each generation were candled and those with evidence of living embryos were transferred to the hatcher with the same experiential design: The infertile eggs were macroscopically evaluated to demine apparent infertility by necked eyes. Macroscopic fertility was calculated as a percentage of fertile eggs relative to total eggs set. Hatchability of fertile eggs was calculated as the percentage of sound chicks that hatched from fertile eggs.

The body measurements were determined on Gimmizah males at 12, 25 and 45 weeks of age. The measurements were body weight (BW, gm), breast circumference (BC, cm) around the deepest region of the breast, shank length (SL, cm), as distance from the shank joint to the extremity of the digit us pedis, comb length (CL, cm) as distance between the point of attachment of the comb to the head and its highest point and wattle length (WL, cm). All body linear measurements were determined using caliper, but BC measurement was determined using tailor's tape rule.

Statistical Methods

The results for the traits (fertility percent, hatchability of fertile eggs percent, BW, SL, BC, CL, and WL) were analyzed by ANOVA with the general linear model (GLM) procedure of pc SAS (SAS institute, 2016).

$Y_{ik} = \mu + s_i + e_{ik}$

Where

Y_{ik} = the phenotypic measurements for the individual from Kth sire.

μ = general mean for the measurement.

s_i = effect common to all individual from ith sire.

e_{ik} = the experimental error.

Differences among means were done according to Duncan (1955).

In this process, the individuals sires which don and which do not contribute to the information for variance component estimation, i.e. individuals without records and a pedigree link to at least one other individual are replaced with an "unknown" code and eliminated from the list of the pedigree records (Meyer, 2006). The first step, the mixed model was defined to analyze the data, get the Restricted Maximum Likelihood (REML) estimates of the variance and covariance components. These estimates were used in the prediction equations of the additive values of all birds as directed by Sorensen and Kennedy (1984). The following animal model shown in matrix notation was used to estimate genetic parameters for the fertility %, hatchability of fertile eggs %, BW, SL, BC; CL, and WL as well as means of all traits. REML co variance components were estimated by series of multivariate animal models (allowing to estimate correlations among traits) using WOMBAT software (Meyer, 2006).

The model can be represented in matrix terms by

$Y = Xb + Za + e$

Where, y is the vector of observations; X is the incidence matrix of fixed effects; b is the vector of fixed effects (generation); Z is the incidence matrix of random effects; a is the vector of random effects; e is the vector of residuals. Single-trait analyses were used to obtain estimates additive and heritability's, and these estimates were then used in a multiple-trait analysis of all different traits to obtain genetic correlations among traits

Genetic correlations were estimated using biraviate analyses with the same fixed effects in univariate models (Yavarifard et al., 2015).

Heritability was computed according to Boldman et al., (1995) as:

$$h^2 = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_e^2}$$

Where σ_a^2 and σ_e^2 are variances due to effects of direct additive genetic and random error, respectively.

RESULTS AND DISCUSSION

Data of Table 1 showed some body males measurements and hatchability of Gimmizah chickens selected for breast circumference (BC) among consequtive generations. Selection for BC significantly increased body weight (BW) at 12-wk of age for selected line compared to those for control among G_0, G_4 and G_5, while, G_1, G_2 and G_3 did not represent any statistical change. Sixth generation (G_5) represented significant ($p<0.05$) increase of BW_{12} and BW_{45} for selected line compared to those for the rest generations, while, BW_{25} represented the same changes for selected and control lines among the studied generations. Also, selected line for BW_{25}represented significant increase compared to control among G_2, G_3, G_4 and G_5. While, selected lines for 45-wk of age showed significant increase of BW among all studied generations compared to control ones. Selected lines represented significant increase of BC at 12, 25 and 45 weeks of age compared to those for controls among the studied generations except that for BC_{12} in G_1 and BC_{45} in G_2. Also, the significant increase of BC in selected lines were observed in G_5 for all studied ages (BC_{12}, BC_{25} and BC_{45}) compared to those for the rest studied generations.

Shank lengths (SL) for the selected lines represented significant increase compared to control lines in the last four experimental generations (G_2, G_3, G_4 and G_5) among all studied ages except that for SL_{45} in G_2 which did not represent any statistical changes. Moreover, SL had increased through selected lines among generations with statistical increase in G_4 and G_5 compared to the rest generations. Comb lengths (CL) for selected lines had increased ($p<0.05$) compared to control lines for CL_{12} in G_4 and G_5, while this statistical increase had been observed for CL_{25} and CL_{45} in the last four studied generations. Data of this table demonstrated ranking increase of CL in selected lines among the subsequent generations with statistical increase in the last generations for all studied ages. The selected lines for the last four generations demonstrate significant increase of WL compared to those for control among all studied ages (WL12, 25 and 45 week). Wattle lengths for selected lines had significantly increased in the last three generations compared to the rest ones for all experimental bird ages. Furthermore, fertility percentage was significantly increased for selected lines compared to control among third, fourth and fifths generations. Apparently, there was significant improvement of fertility coincided with the subsequent selected generations. Also, data of Table 1 represented significant increase in hatchability of fertile eggs % for selected line compared to control in G_2 and G_5 while, this increase was numerically detected for selected line among the other generations. Besides, fifth generation represented significant increase of hatchability of fertile eggs% compared to those for other generations. Respectable to fertility and hatchability in the current results, fertility percentage had significantly increased for selected line compared to control for the 4, 5, 6th generations, but was not detected in the first three generations, while hatchability improvement was observed only for the sixth generation of selection. Besides there was ranking increase for fertility and hatchability in the selected line among the progressed generations. The current results regarding the significant increase of selected body weight compared to control over the generations are keeping with those previously reported by Abou El-Ghar and Abd El-Karim (2016) and Abuzaid et al. (2019) for local chickens. Different research-workers supported our results regarding the significant increase of SL for selected line compared to control and over the generations as Abdellatif (1999) reported that select line had longer SL compared to control line after five generations of selection for body weight in Dandrawi breed. Moreover, Ramadan et al. (2014) mentioned that shank lengths of the selected line were significantly longer than those of the control one. The significant increase of SL for selected line compared to control over generations are in harmony with those previously detected by Abou El-Ghar and Abd El-Karim (2016) who mentioned that selected line had longer SL than the control line over generations. Results of the significant increase of WL for the selected line compared to control among the studied generations are in accordance with those previously reported by Abdellatif (2002) and Saleh et al. (2008).

Moreover, the results in this table revealed that selection for BC increased the fertility and hatchability combined with the selection progress, besides the eggs produced from the selected birds represented significant increase of fertility and hatchability compared to control especially for the fourth and fifth generations of selection. These results are keeping with the findings of McGary et al. (2003) who mentioned that external characteristics such as chest width, keel length, shank length and comb height of male breeders have been proposed as methods of evaluating reproductive potential. Most of the fertility problems in the literature with the increased skeletal structure could be due to reduction of mating ability (McGary et al., 2001).

It is concluded from data of this table that selection for BC had a significant influence on BW for selected birds compared to control allover all selected generations, while fertility improvement requires three generations of selection or more to achieve the desired outcome.

Genetic additive (V_A) estimates of BW, BC, SL, CL and WL besides fertility and hatchability for Gimmizah chickens among five generations of selection for BC are shown in Table 2. Data of V_A for BW_{12} ranged between 1.02 for G_5 to 13.9 for G_0 and G_4, but for BW_{25}, it ranged between 1.01 for G_4 to 6.65 for G_0. Regarding BW_{45}, minute change of V_A had been observed between the experimental generations. Moreover, the genetic additive estimates of BC_{12}ranged between0.12 for G_1 to 1.40 for G_3. Also, the variation of BC was detected for

BW_{25} as highest one was estimated for G_4 (39.98) and lowest one was 0.12 for G_0. Genetic additive estimates of SL varied between 0.17for SL_{12} in G_0 to 85.47 for SL_{25} in G_4. Furthermore, the range of variation for CL was estimated between 0.13 for G_0 to 129.90 for CL_{25} in G_4. Wattle length did not represent highly variation estimates between the generations for each chicken age or between the generations for each bird's age. Also, highest estimate of V_A for fertility was recorded for G_4 (1.85) and lowest one was detected for G_3 (0.51). while, highest estimate of V_A for hatchability of fertile eggs was recorded for G_3 (32.37) and lowest one was 1.36 for G_4.

The genetic additive estimates of BW did not represent any statistical change between the studied ages except that for BW_{12} at G_0 and G_4. The reported estimates herein were lower than previously reported by Iraqi (2000) on Dokki chickens. Also, similar estimates of genetic additive for BC were documented by Ragaa and Ashour (2014), while the same authers reported less estimates of SL than those reported herein but nearly close that reported in G_4 and G_5 especially for CL_{12}. In harmony with our results, Harrison (2017) stated that genetic additive among lines were similar but they mentioned that this relationship decreased as selection progressed. There is little information pertaining the genetic additive of fertility and hatchability due to selection of breast circumference.

Heritability estimates (h^2)for male's body measurements besides fertility and hatchability of fertile eggs are given in Table 3. Most of h^2 estimates for BW among the studied ages (12, 25 and 45 weeks) represented 0.50 value except that for BW_{12} at G_0 (0.68) and G_4 (0.97) and BW_{25} represented 0.65 at G_0. Most of h^2 estimates for BC for ages among the studied generations could be considered high as averaged 0.50 with little exceptions at G_4 and G_5. Also, SL represented high estimates of h^2 as the highest one was 0.78 for SL_{12} at G_1, G_4 and G_5 and SL_{45} at G_5, whereas of the lowest estimates represented 0.50 for the most ages and generations. Moreover, all estimates of GL and WL were high and ranged between 0.50 and 0.78 except 0.01 for WL_{25} at G_4. Furthermore, low estimates of h^2 were recorded for fertility as ranged between 0.02 to 0.14 and for hatchability of fertile eggs between 0.02 and 0.05. The heritability estimates of BW among the studied ages and generations could be considered moderate to high as ranged between 0.05 to 0.98 and these results added credence to those reported by Niranjan et al. (2011) and Ragaa and Ashour (2014). Also, the outcome of h^2 results for BC_{12} among the generations due to selection correspond the previous reports by Shemeis et al. (2007) and Ragaa and Ashour (2014). Moreover, the findings of the estimates of SL and CL in the current results generally agree with the previous data reported by Ramadan et al. (1974), and Shemeis et al. (2007). The low values of heritability for fertility and hatchability were paralleled by those of Hartmann et al.(2002) and Sapp et al. (2004).

Genetic correlations between fertility with some body males measurements of Gimmizah chickens selected for BC throughout consecutive selected generations are shown in Table 4. Data of this table revealed that there are low positive values of correlations between fertility and BW among studied ages and generations. Also, positive moderate correlations were detected between fertility and BC especially for G_4 and G_5 among the studied ages, besides high correlations for G_3 with BC_{12} and BC_{25}. The genetic correlations between fertility and SL among the studied ages through the experimental generations ranged between 0.19 for G_0 in SL_{45} to 0.46 for SL_{25} at G_4 and SL_{45} at G_5. Comb length showed positive increase of genetic correlations with fertility for the studied ages through progressing generations. Furthermore, CL represented high genetic correlation among the bird's age and generations started from 0.3 for CL_{12} at G_0 to 0.77 for CL_{25} in G_3. Genetic correlations between hatchability with some body males measurements of Gimmizah chickens selected for BC throughout consecutive generations are shown in Table 5. The genetic correlations between hatchability and BC are low in the first two generations like BW but this relation tended to increase through the last generations of selection from 0.10 to around 0.2 to 0.3. These results provide evidence that selection of BC in Gimmizah chickens at 12 weeks of age could be used without detrimental influence on hatchability trait and could be consider as better area of improvement more than body weight. Shank length represented higher genetic correlation with hatchability more than that for BC and less values than that between hatchability and CL. Moreover, highly positive genetic correlations between hatchability and WL were detected especially for the advanced ages (WL_{45}) among the experimental generations. This outcome means that highly fertility of the birds tends to have a high hatchability of that eggs and the relation is close as fertility improvement would bring better results of hatchability. Also, data of this table revealed highly positive genetic correlation between fertility and hatchability among the studied generations.

The observed notice of the high positive correlation between fertility and comb length is keeping with that previously mentioned by McGary et al. (2002) who found that male broiler breeders with larger combs within specific strains were likely to have a higher fertility. Also, McGary et al. (2003) mentioned that genetic correlations between fertility and WL revealed that males with greater WL tended to have a higher fertility. Furthermore, Cavero et al. (2011) added credence to the reported results of highly genetic correlation between fertility and hatchability.

Therefore, the increase of the genetic correlation between the both studied traits namely CL and WL is good indicator for increasing male fertility and consequently, hatchability traits.

IN CONCLUSION,

body circumference could be used as selection tool for improving body weight and secondary sexual characters without detrimental affect on fertility and hatchability besides suggesting that other body measurements such as shank, comb and wattle lengths could be included in selection index.

Table (1): Some body male measurements and hatchability of Gimmizah chickens selected for breast circumference among generations

Generation (G) / Traits			**G_0** $\overline{X}$ ± S.E	**G_1** $\overline{X}$ ± S.E	**G_2** $\overline{X}$ ± S.E	**G_3** $\overline{X}$ ± S.E	**G_4** $\overline{X}$ ± S.E	**G_5** $\overline{X}$ ± S.E
Body weight (BW, gm)	BW$_{12}$ (12-wk)	Selected	1105.18±3.92 $^{A c}$	1187.39±4.97 ^{b}	1125.39±5.48 ^{c}	1198.90±20.90 ^{b}	1202.5±5.18^{Ab}	1748.78±15.04^{Aa}
		Control	1058.78±2.04 $^{B d}$	1183.0±3.50 ^{b}	1109.44±15.33 ^{c}	1188.43±21.89 ^{b}	1174.16±6.10^{Bb}	1590.74±57.59^{Ba}
	BW$_{25}$ (25-wk)	Selected	1373.37±3.8 ^{c}	1436.00± 10.59 ^{b}	1431±5.80 ^{Ab}	1433.56±22.65 ^{Ab}	2432.22±21.26^{Aa}	2411.74±14.15^{Aa}
		Control	1386.82±16.82 ^{c}	1435.00± 8.10 ^{b}	1324.04±8.13 ^{Bd}	1305.0±20.15 ^{Bd}	1905.75±17.76^{Ba}	1937.95±50.53^{Ba}
	BW$_{45}$ (45-wk)	Selected	2514.20±36.01 $^{A c}$	2503±10.05 ^{Ae}	2593.94±16.83^{Ab}	2642.67±22.44^{Ad}	2775.15±14.3^{Ad}	2891.85±12.03^{Aa}
		Control	2079.73±34.61 $^{B d}$	2309.20±12.50 ^{Bb}	2253.22±36.24$^{B a}$	2215.00±20.51^{Bc}	2255.00± 0.15^{Bc}	2357.08±73.41 ^{Bab}
Breast circumference (BC, cm)	BC$_{12}$ (12-wk)	Selected	27.92±0.03A^{c}	28.51±0.05 ^{b}	28.32±0.03 ^{Ab}	26.59±0.09 ^{Ad}	27.79±0.05 ^{Ac}	31.81±0.22 ^{Aa}
		Control	27.31±0.17^{Babc}	28.50±0.05 ^{a}	28.02±0.10 ^{Bab}	26.15±0.18 ^{Bc}	26.80±0.08 ^{Bbc}	24.27±1.07 ^{Bd}
	BC$_{25}$ (25-wk)	Selected	28.38 ± 0.03 $^{A e}$	29.91± 0.03 ^{Ad}	31.47±0.04 ^{Ac}	28.94±0.14^{Af}	35.44±0.13^{Ab}	35.95±0.07^{Aa}
		Control	27.29 ± 0.08 $^{B c}$	29.10±0.02 ^{Bb}	29.13±0.96 ^{Bb}	26.00±0.09^{Bd}	33.39±0.14^{Ba}	33.88±0.21Ba
	BC$_{45}$ (45-wk)	Selected	32.70±0.12 $^{A d}$	32.15±0.07^{Ae}	32.26±0.09 ^{e}	33.83±0.14 ^{Ac}	36.60±0.02^{Ab}	38.06±0.11 ^{Aa}
		Control	31.97±0.11 $^{B c}$	30.50±0.03^{Bd}	32.13±0.09 ^{c}	29.20±0.08 ^{Be}	34.20±0.11 ^{Bb}	36.91±0.64 ^{Ba}
Shank length (SL, cm)	SL$_{12}$ (12-wk)	Selected	11.01±0.01^{d}	10.07±0.02 ^{e}	11.53±0.02 ^{Ac}	11.34±0.12 ^{Ac}	11.88±0.03$^{A b}$	12.38±0.04$^{A a}$
		Control	11.00±0.01 ^{a}	10.20±0.01 ^{c}	11.08±0.03$^{B a}$	10.67±0.10 ^{Bb}	10.38±0.02$^{B c}$	11.03±0.14$^{B a}$
	SL$_{25}$ (25-wk)	Selected	11.59±0.01 ^{d}	11.37±0.03 ^{d}	11.99±0.02$^{A c}$	11.84±0.04 $^{A c}$	12.85±0.09$^{A a}$	12.98±0.03 $^{A a}$
		Control	11.28±0.07 ^{b}	11.40±0.03 ^{a}	11.26±0.03$^{B b}$	10.90 ±0.03 $^{B e}$	11.13±0.04$^{B d}$	11.18±0.03 $^{B d}$
	SL$_{45}$ (45-wk)	Selected	11.70±0.04$^{A c}$	11.69±0.05 ^{c}	12.10±0.05 ^{b}	12.20±0.06$^{A b}$	13.39±0.08$^{A a}$	13.48±0.04$^{A a}$
		Control	11.40±0.01$^{B d}$	11.70±0.02 ^{c}	12.04±0.02 ^{b}	11.50±0.05 $^{B b}$	12.30± 0.04$^{B b}$	12.98±0.04^{Ba}

Continue Table (1):

Comb length (CL, cm)	CL_{12} (12-wk)	Selected	7.38 ± 0.02^{Bc}	6.95 ± 0.08^{Bd}	7.69 ± 0.08^{b}	6.57 ± 0.18^{e}	7.69 ± 0.07^{Ab}	$8.03\pm0.09A^{a}$
		Control	7.64 ± 0.02^{Aa}	7.80 ± 0.04^{Aa}	7.58 ± 0.05^{a}	6.48 ± 0.20^{b}	6.48 ± 0.06^{Bb}	7.68 ± 0.31^{Ba}
	CL_{25} (25-wk)	Selected	6.48 ± 0.02^{e}	8.11 ± 0.07^{Ad}	$8.12\pm0.06A^{d}$	9.99 ± 0.10^{Ac}	11.82 ± 0.13^{Ab}	14.30 ± 0.11^{Aa}
		Control	6.41 ± 0.01^{e}	6.50 ± 0.05^{Be}	$7.14\pm0.13B^{d}$	7.50 ± 0.10^{Bc}	11.02 ± 0.05^{Bb}	12.04 ± 0.34^{Ba}
	CL_{45} (45-wk)	Selected	11.10 ± 0.03^{e}	12.25 ± 0.12^{d}	12.42 ± 0.16^{Ad}	12.56 ± 0.12^{Ac}	14.26 ± 0.08^{Ab}	16.39 ± 0.16^{Aa}
		Control	11.10 ± 0.01^{d}	12.35 ± 0.09^{c}	12.18 ± 0.09^{Bc}	11.30 ± 0.05^{Bd}	13.30 ± 0.08^{Bb}	13.72 ± 0.90^{Ba}
Wattle length (WL, cm)	WL_{12} (12-wk)	Selected	3.12 ± 0.01^{d}	3.23 ± 0.03^{d}	3.31 ± 0.02^{Ac}	3.38 ± 0.04^{Ac}	3.61 ± 0.03^{Ab}	3.72 ± 0.03^{Aa}
		Control	3.15 ± 0.01^{b}	3.20 ± 0.02^{b}	3.10 ± 0.02^{Bb}	3.12 ± 0.01^{Bb}	3.40 ± 0.04^{Ba}	3.54 ± 0.09^{Ba}
	WL_{25} (25-wk)	Selected	3.51 ± 0.01^{Ae}	3.45 ± 0.03^{d}	3.90 ± 0.03^{Af}	4.10 ± 0.03^{Ac}	5.46 ± 0.09^{Ab}	5.96 ± 0.05^{Aa}
		Control	3.35 ± 0.01^{Bed}	3.60 ± 0.02^{d}	3.65 ± 0.05^{Bd}	3.20 ± 0.03^{Be}	4.50 ± 0.05^{Bb}	5.71 ± 0.11^{Ba}
	WL_{45} (45-wk)	Selected	5.60 ± 0.02^{d}	5.03 ± 0.07^{f}	5.60 ± 0.09^{Ae}	5.90 ± 0.09^{Ac}	6.51 ± 0.06^{Ab}	7.45 ± 0.08^{Aa}
		Control	5.60 ± 0.01^{c}	5.00 ± 0.05^{e}	5.39 ± 0.05^{Bd}	5.30 ± 0.07^{Bc}	6.10 ± 0.05^{Bb}	6.48 ± 0.23^{Ba}
Fertility%		Selected	90.77 ± 1.09^{f}	93.98 ± 0.87^{e}	95.51 ± 0.55^{d}	97.18 ± 1.03^{Ac}	97.40 ± 1.30^{Ab}	98.53 ± 1.11^{Aa}
		Control	90.08 ± 2.73^{e}	93.50 ± 0.54^{b}	93.20 ± 1.47^{c}	94.44 ± 3.15^{Ba}	91.60 ± 3.81^{Bd}	94.41 ± 2.19^{Ba}
Hatchability Of fertile eggs%		Selected	91.18 ± 0.23^{c}	90.50 ± 1.07^{d}	92.52 ± 0.14^{Ab}	91.42 ± 2.28^{b}	91.27 ± 0.28^{c}	94.82 ± 1.77^{Aa}
		Control	90.01 ± 0.57^{b}	90.15 ± 3.84^{b}	90.44 ± 0.38^{Bb}	90.19 ± 4.77^{b}	90.26 ± 0.78^{b}	91.22 ± 3.25^{Ba}

A, B Means in the same column within each trait with different superscripts are significantly different ($p<0.05$)

a, b... and f means in the same row among generations with different superscripts are significantly different ($p<0.05$)

Table(2): Genetic additive estimates (V_A)of some body male measurements and hatchability of Gimmizah chickens selected for breast circumference among generations

Traits	Generation (G)	G_0 V_A± S.E	G_1 V_A± S.E	G_2 V_A± S.E	G_3 V_A± S.E	G_4 V_A± S.E	G_5 V_A± S.E
Body weight (BW)	BW_{12} at 12-wk of age	13.9±12.6	1.08±0.74	1.16±0.08	1.08±0.29	13.90±12.7	1.02±0.24
	BW_{25}at 25-wk of age	6.65±0.52	1.02±0.20	1.08±0.19	1.08±0.37	1.01±0.61	1.02±0.21
	BW_{45} at 45-wk of age	1.0±0.10	1.21±0.16	1.01±0.42	1.03±0.22	1.01±0.10	1.03±0.27
Breast circumference (BC)	BC_{12} at 12-wk of age	0.206±0.04	0.14±0.09	1.02±0.18	1.42±0.26	0.62±0.76	1.02±0.21
	BC_{25} at 25-wk of age	0.12±0.05	1.01±0.21	1.95±0.46	16.10±2.66	39.98±4.7	1.58±0.47
	BC_{45} at 45-wk of age	1.0±0.61		1.01±0.42	1.08±0.52	3.94±0.16	1.62±0.39
Shank length (SL)	SL_{12} at 12-wk of age		0.17±0.06	1.02±0.18	1.02±0.75	0.41±0.19	0.43±0.13
	SL_{25} at 25-wk of age		1.01±0.20	1.01±0.87	1.08±0.51	85.47±27.9	18.51±0.30
	SL_{45} at 45-wk of age	1.0±0.50		1.01±0.86	1.48±0.40	2.78±0.25	17.02±0.09
Comb length (CL)	CL_{12} at 12-wk of age	0.181±0.21	0.70±0.26	1.01±0.18	1.02±0.26	1.30±0.22	2.29±0.70
	CL_{25} at 25-wk of age	0.13±0.09	1.01±0.20	1.01±0.18	31.51±7.69	129.90±26.3	2.83±1.17
	CL_{45} at 45-wk of age	9.0±0.42	0.18±0.09	1.74±0.62	1.08±0.30	2.76±0.20	46.18±2.26
Wattle length (WL)	WL_{12} at 12-wk of age		0.25±0.11	1.02±0.18	1.08±0.50	2.56±1.08	0.13±0.08
	WL_{25} at 25-wk of age		1.01±0.20	1.01±0.42	1.08±0.50	0.14±0.05	0.50±0.22
	WL_{45} at 45-wk of age	1.0±0.42	0.50±0.15	1.01±0.52	1.08±0.50	1.50±0.17	1.82±0.48
Fertility			0.84±0.43	1.18±2.42	0.51±0.11	1.85±0.52	1.83±0.42
Hatchability of fertile eggs			1.40±0.24	1.79±0.48	32.37±6.98	1.36±0.33	1.92±0.24

Table(3): Heritability estimates (h^2)of some body male measurements and hatchability of Gimmizah chickens selected for breast circumference among six generations

Traits	Generation (G)	G_0	G_1	G_2	G_3	G_4	G_5
Body weight (BW)	BW_{12}at 12-wk of age	0.68±0.06	0.50±0.01	0.50±0.01	0.50±0.01	0.97±0.06	0.50±0.01
	BW_{25} at 25-wk of age	0.65±0.01	0.50±0.01	0.50±0.01	0.50±0.01	0.50±0.01	0.50±0.01
	BW_{45} at 45-wk of age	0.50±0.06		0.50±0.01	0.50±0.01	0.50±0.01	0.50±0.01
Breast circumference (BC)	BC_{12} at 12-wk of age	0.69±0.11	0.56±0.09	0.40±0.02	0.48±0.01	0.49±0.09	0.32±0.07
	BC_{25} at 25-wk of age		0.50±0.01	0.50±0.01	0.58±0.36	0.35±0.06	0.67±0.15
	BC_{45} at 45-wk of age	0.50±0.07		0.50±0.01	0.50±0.01	0.58±0.02	0.68±0.13
Shank length (SL)	SL_{12} at 12-wk of age		0.78±0.12	0.50±0.01	0.71±0.09	0.78±0.13	0.78±0.15
	SL_{25} at 25-wk of age		0.50±0.01	0.50±0.01	0.50±0.01	0.74±0.25	0.77±0.08
	SL_{45}at 45-wk of age	0.50±0.05		0.50±0.01	0.73±0.08	0.68±0.06	0.78±0.23
Comb length (CL)	CL_{12} at 12-wk of age	0.79±0.11	0.79±0.18	0.50±0.01	0.50±0.01	0.79±0.11	0.79±0.16
	CL_{25} at 25-wk of age	0.79±0.10	0.50±0.01	0.78±0.24	0.78±0.24	0.72±0.38	0.78±0.21
	CL_{45} at 45-wk of age	0.50±0.05	0.73±0.12	0.60±0.01	0.77±0.14	0.61±0.05	0.59±0.22
Wattle length (WL)	WL_{12} at 12-wk of age		0.78±0.24	0.74±0.20	0.50±0.01	0.54±0.28	0.79±0.14
	WL_{25} at 25-wk of age		0.50±0.01	0.77±0.21	0.73±0.21	0.50±0.02	0.77±0.23
	WL_{45} at 45-wk of age	0.50±0.05	0.78±0.18	0.77±0.18	0.75±0.26	0.76±0.08	0.78±0.19
Fertility			0.14±0.08	0.02±0.07	0.02±0.01	0.05±0.01	0.05±0.08
Hatchability of fertile eggs			0.05±0.08	0.05±0.01	0.02±0.01	0.05±0.01	0.05±0.04

Table (4): Genetic correlations between fertility and some body male measurements of Gimmizah chickens selected for breast circumference among generations

Traits	Generation (G)	G0	G1	G2	G3	G4	G5
Body weight (BW)	BW12 at 12-wk of age	0.10±0.02	0.10±0.04	0.10±0.01	0.10±0.03	0.06±0.02	0.10±0.03
	BW25 at 25-wk of age	0.10±0.01	0.10±0.01	0.10±0.01	0.10±0.02	0.10±0.01	0.10±0.01
	BW45 at 45-wk of age	0.10±0.01	0.10±0.01	0.10±0.01	0.10±0.01	0.10±0.01	0.10±0.01
Breast circumference (BC)	BC12 at 12-wk of age	0.05±0.01	0.15±0.03	0.14±0.01	0.80±0.20	0.10±0.01	0.30±0.01
	BC25 at 25-wk of age	0.16±0.03	0.14±0.05	0.12±0.02	0.98±0.01	0.28±0.08	0.45±0.21
	BC45 at 45-wk of age	0.18±0.03	0.25±0.06	0.08±0.01	0.15±0.07	0.13±0.02	0.32±0.11
Shank length (SL)	SL12 at 12-wk of age		0.20±0.02	0.32±0.19	0.23±0.01	0.20±0.02	0.25±0.06
	SL25 at 25-wk of age		0.20±0.01	0.37±0.21	0.38±0.01	0.46±0.12	0.32±0.11
	SL45 at 45-wk of age	0.19±0.11	0.30±0.01	0.33±0.01	0.37±0.02	0.37±0.04	0.46±0.01
Comb length (CL)	CL12 at 12-wk of age	0.21±0.04	0.20±0.04	0.21±0.15	0.23±0.01	0.25±0.01	0.23±0.05
	CL25 at 25-wk of age	0.20±0.18	0.20±0.01	0.30±0.01	0.37±0.15	0.32±0.01	0.42±0.02
	CL45 at 45-wk of age	0.21±0.09	0.10±0.01	0.22±0.04	0.42±0.11	0.35±0.03	0.39±0.01
Wattle length (WL)	WL12 at 12-wk of age		0.10±0.02	0.17±0.04	0.20±0.21	0.37±0.05	0.40±0.11
	WL25 at 25-wk of age		0.10±0.01	0.27±0.02	0.23±0.01	0.47±0.27	0.48±0.09
	WL45 at 45-wk of age	0.55±0.35	0.30±0.01	0.31±0.06	0.48±0.14	0.41±0.03	0.47±0.02

Table (5): Genetic correlations between hatchability with some body male measurements and fertility of Gimmizah chickens selected for breast circumference among generations

Traits	Generation (G)	G0	G1	G2	G3	G4	G5
Body weight (BW)	BW12 at 12-wk of age	0.10±0.01	0.10±0.01	0.10±0.01	0.10±0.02	0.10±0.01	0.10±0.01
	BW25 at 25-wk of age	0.10±0.01	0.10±0.01	0.10±0.01	0.10±0.01	0.10±0.01	0.10±0.01
	BW45 at 45-wk of age	0.10±0.01	0.10±0.01	0.10±0.01	0.10±0.01	0.10±0.01	0.10±0.01
Breast circumference (BC)	BC12 at 12-wk of age	0.23±0.05	0.10±0.01	0.30±0.10	0.32±0.16	0.32±0.01	0.33±0.03
	BC25 at 25-wk of age	0.10±0.01	0.10±0.01	0.20±0.05	0.18±0.01	0.15±0.06	0.15±0.01
	BC45 at 45-wk of age	0.28±0.25	0.11±0.01	0.13±0.01	0.18±0.01	0.12±0.02	0.22±0.04
Shank length (SL)	SL12 at 12-wk of age		0.05±0.01	0.15±F	0.10±F	0.12±0.02	0.06±0.01
	SL25 at 25-wk of age		0.40±0.08	0.68±0.28	0.68±0.07	0.62±0.13	0.68±0.02
	SL45 at 45-wk of age	0.44±0.05	0.35±0.05	0.35±0.18	0.36±0.08	0.25±0.04	0.40±0.04
Comb length (CL)	CL12 at 12-wk of age	0.36±0.01	0.42±0.02	0.56±F	0.71±F	0.56±0.02	0.65±0.02
	CL25 at 25-wk of age	0.31±0.01	0.35±0.07	0.30±0.08	0.77±0.03	0.55±0.18	0.67±0.20
	CL45 at 45-wk of age	0.47±0.02	0.48±0.09	0.49±0.15	0.53±0.19	0.58±0.08	0.51±0.18
Wattle length (WL)	WL12 at 12-wk of age		0.26±0.04	0.33±0.15	0.34±F	0.39±0.19	0.34±0.01
	WL25at 25-wk of age		0.35±0.12	0.32±0.02	0.60±0.28	0.67±0.24	0.66±F
	WL45 at 45-wk of age	0.29±F	0.30±0.15	0.30±0.2	0.65±0.15	0.63±0.01	0.65±0.04
Fertility		0.33±0.04	0.45±0.04	0.40±0.01	0.54±0.07	0.51± 0.01	0.62±0.04

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الملخص العربي

الاستجابة الوراثية لوزن الجسم وصفات الجنس الثانوية والفقس لدجاج الجميزة المنتخب لمحيط الصدر

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أجريت هذه التجربة لدراسة تأثير الانتخاب لفترة طويلة لمحيط الصدر لدجاج الجميزة على بعض مقاييس الجسم للذكور عند أعمار ١٢، ٢٥، ٤٥ أسبوع من العمر مثل وزن الجسم، محيط الصدر وطول الساق وبعض صفات الجنس الثانوية مثل طول العرف، طول الدلايات إضافة للخصوبة والتفريخ وبعض المقاييس الوراثية لهذه الصفات. تم اختيار عدد مائتان وعشرون دجاجة مع عشرون ديك عشوائيا من سلالة الجميزة واعتبرت كجيل أساس (G0). الكتاكيت الناتجة من جيل الأساس تم الانتخاب فيها لمحيط الصدر عند عمر ١٢ أسبوع. لخمسة أجيال أخرى إضافية.

أوضحت النتائج أن الانتخاب لمحيط الصدر أدى إلى زيادة معنوية في وزن الجسم عند عمر ١٢ أسبوع للخط المنتخب مقارنة بخط الكنترول في الأجيال المنتخبة ٤، ٥. وزاد طول الساق في الخط المنتخب معنويا مقارنة بالخط المقارن (الكنترول) في الأجيال الأخيرة من التجربة لكل الأعمار تحت الدراسة ماعدا طول الساق في عمر ٤٥ أسبوع للجيل الثاني. وأيضا زاد طول العرف معنويا في الخط المنتخب مقارنة بخط الكنترول عند عمر ١٢ أسبوع في الجيل الرابع والخامس. وزادت أطوال الدلايات معنويا للخط المنتخب مقارنه بالكنترول في المواسم الثلاثة الأخيرة لكل الأعمار المدروسة. وحدثت زيادة معنوية في نسب الخصوبة والفقس مع الانتخاب المتكرر لمحيط الصدر. وسجلت قيم الجينات المضيفة (V_A) للخصوبة اعلي قيم في الجيل الثاني (٧.١٨) واقل قيمه تم تسجيلها في الجيل الثالث (٠.٥١). وكانت معظم قيم المكافئ الوراثي لوزن الجسم ومحيط الصدر للأعمار المدروسة في الأجيال المختلفة هي ٠.٥٠.

وسجلت أطوال العرف والدلايات اعلي قيم للمكافئ الوراثي وتراوحت بين ٠.٥٠ – ٠.٧٨. وسجلت اقل قيم للمكافئ الوراثي لصفة الخصوبة حيث تراوحت بين ٠.٠٢ – ٠.١٤. وسجلت صفة الفقس للبيض المخصب قيم تراوحت بين ٠.٠٢ – ٠.٠٥. وسجل طول العرف اعلي قيمة للارتباط الوراثي مع الخصوبة لكل الأعمار المدروسة خلال الأجيال المنتخبة.

ومن ذلك يمكن استنتاج أن الانتخاب لمحيط الصدر قد يستخدم كأداة لتحسين وزن الجسم وصفات الجنس الثانوية بدون أثر سلبي على صفة الخصوبة وكذلك يمكن اقتراح عمل دليل انتخابي يحتوي على بعض مقاييس الجسم الأخرى مثل طول الساق وطول العرف.