THE INTERACTION EFFECT OF HEAT STRESS AND GENOTYPE ON SOME PRODUCTIVE AND REPRODUCTIVE TRAITS IN JAPANESE QUAIL

By

A.A. El-Fiky, G.M. Gebriel, A.A. Enab, F.H. Abdou and M.K. Harfoush

Dept. of Poultry Production, Faculty of Agric, Minufiya University

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Abstract: *Three lines of Japanese quail, control (CL), high body weight (HBW) and high egg number (HEN), were selected for five generations. In the sixth generation, a total of 1164 chicks at hatch from the three selected lines (CL, HBW and HEN) were taken for heat stress experiment. Chicks of each line were divided into two groups based on full sibs. The first group was exposed to constant heat stress at 38°c from hatch to 90-d of egg laying, while the second group was kept under natural condition without exposure to heat stress during autumn season in order to study the interaction effect of different environmental temperatures and genotypes on some productive and reproductive traits.*

The obtained concluded that birds exposed to constant heat stress (38°c) has heavier body weight at all ages studied, earlier age at sexual maturity, higher egg number at 90-d of laying and higher hatchability percentage of fertile eggs than untreated birds with significant differences between treatments.

On the other hand, the HEN line had lower body weight at all ages studies, earlier age at sexual maturity, lower egg weight, higher egg number at 90-d of laying and higher hatchability percentage of fertile eggs than that of CL and HBW lines with highly significant differences. The interaction between heat stress treatments and line (Hs x L) was significant ($P \leq 0.05$) or highly significant ($P \leq 0.01$) in body weight at all ages studied and productive traits, which explain the possibility for selecting tolerant line for heat stress.

These results suggest the highest activity of thyroid gland at heat stress and heat stressed birds had the ability to maintain a rather uniform temperature of their internal organs.

INTRODUCTION

Recently, quail farming offers a viable and practical solution to the problem of animal protein deficiency. There has been increasing activity in the production of Japanese quail in developing countries, since quail breeding offers an opportunity for diversification and early marketing age ***(Mukherjee, 1993)***. They require less space and low initial investment and have good export potential.

For many years, researchers have been investigating the effect of high environmental temperature on the performance of different poultry species, including young chickens ***(Henken et al., 1983)***, broiler breeders ***(McDaniel et al., 1995)***, turkeys ***(McKee and Sams, 1997)*** and laying hens ***(Emery et al., 1984; Muiruri and Harrison, 1991; Whitehead et al., 1998)*** They have found that high environmental temperatures have deleterious effects on productive performance. In laying hens, heat stress depresses body weight ***(Scott and Balnave, 1988)***, egg production ***(Muiruri and Harrison, 1991; Whitehead et al., 1998)***, egg weight ***(Balnave and Muheereza, 1997)***, and shell quality ***(Emery et al., 1984; Mahmoud et al., 1996)***. Such a depression was generally accompanied by a marked suppression of feed intake, which could be the cause of the decline in production. **Larbier et al., (1993)**. Found that chronic heat exposure significantly decreased protein digesion. ***Bonnet et al., (1997)*** reported that the feed digestibility of the protein, fat and starch in diet also were decreased with exposure of broiler chickens to high temperature. Body weight and feed consumption were significantly reduced in hens in the heat stress group ***Mashaly et al., (2004)***.

However, ***Emery et al., (1984)*** reported that high temperature did not affect egg production. Furthermore, ***Muiruri and Harrison (1991)*** found that heat stress did not significantly affect egg weigh or feed conversion. Moreover, ***Koelkebeck et al., (1998)*** indicated that acute heat stress had no adverse effects on dietary amino acid digestibility in laying hens. The differences in the above results could be due to differences in e hart stress treatments, type of birds used and/or genetic variations in responses to heat stress treatments among lines of birds.

It is interested that certain breeds or strains of poultry appears to tolerate heat stress more successfully than others. ***Etches et al., (1995)*** reported that jungle fowl survive under heat stress more successfully than normal commercial strains of chicken, indicating a genetic component in this tolerance. The performance of the Japanese quail lines during growing and laying periods had no stability in marked body weights, growth rate, egg production traits, fertility and hatchability and rectal temperature ***(Durgum and Kestin, 1997 and El-Nabarawy, 1997)***. Therefore, the interaction between genotype and constant heat stress (38°c) effect on some productive and reproductive traits in Japanese quail would provide the basis for future genetic manipulation of the heat tolerance.

MATERIALS AND METHODS

This experiment was carried out at the Poultry Research Farm, Faculty of Agriculture at Shebin El-kom, Minufiya University, Egypt, through three successive years from November, 1999 to October, 2002, in order to study the interaction between constant heat stress (38°c) and genotype on some productive and reproductive traits in Japanese quail.

(1) Flock development:

A total of 1679 chicks of Japanese quail *(Coturnix coturnix japonica)* at hatch were used to develop three lines. First line was taken at random as a control line (CL). The second line was selected for high egg number (HEN). The third line was selected for high body weight (HBW). Selection method of independent culling levels was applied to select the two selected lines (HEN and HBW). The selection criterion was, approximately, the general average of the population plus one standard deviation for five generations.

(2) Experimental design and heat stress treatments:

In the sixth genration, a total of 1164 chicks at hatch from the control and the two selected lines (HEN and HBW) were taken for heat stress experiment. Chicks of each line were divided into two groups based on full sibs. The first group was exposed to constant heat stress (38°c) during both growing and laying periods from hatch to 90-d of egg laying, mean while the second group was brooded at a starting temperature of 37°c for the first week, then decreased 2-3°c weekly to reach the natural condition after 4 weeks, then kept under natural condition without heat stress during autumn season at an average of 25°c and 39.22% relative humidity (Table 1) during the experimental period for one generation. The experimental design and number of birds at different ages are given in Table (2).

(3) Flock management:

The mating system was in ratio of one male with two females in cages avoiding full or half-sibs mating. Pedigreed fertile eggs were collected from each dam for 10-d period, then hatched in optimal condition. The chicks were wing banded at hatch and brooded and reared in floor for 4-wk. 4-wk of age when all birds were sexed according to plumage colour and pattern, then transformed to the laying cages at 7-wk of age. Feed and water were available *ad libitum*. Diet contained 28% crude protein and 2886 ME kcal/kg was used until 4-wk of age, then introduced ration contained 21% crude protein and 2835 ME kcal/kg to the end of egg production period.

(4) Studied traits:

The following traits were studied in the control (CL) and the selected lines (HEN and HBW) for one generation as follows:

4.1. Body weight (g) at hatch, 2, 4, 6 and 8-wk of age (BW, g).

4.2. Growth rate was calculated at bi-weekly intervals from hatch to 8-wk of age using the formula given by Brody (1945) as follows:

$$\text{Growth rate (\%)} = \frac{W_2 - W_1}{0.5\,(W_2 + W_1)} \times 100$$

Where: W_1= first weight, W_2= second weight

4.3. Productive traits

4.3.1. Age at sexual maturity (SM, days), age at first egg in days.

4.3.2. Egg weight (g): Average weight of first five eggs at sexual maturity (EW_{SM}, g) and average weight of five eggs during 12-13 wk of egg production (EW_M, g).

4.3.3. Egg number during the first 90-d of laying (EN_{90}, egg).

4.4. Fertility and hatchability percentages.

4.5. Rectal temperature determined by an electronic thermometer at 1, 3, 5 and 7-wk of age.

(5) Statistical analysis:

Analysis of variance for data was calculated using SAS, general linear models procedure ***(SAS institue, 1996)***. Duncan's new multiple range test was used to test the differences among the means **(Steel and Torries,**

1980). Percentages of growth rate, fertility and hatchability were converted to the corresponding arcsin prior to statistical analysis.

RESUTLS AND DISCUSSION

(1) Body weight during the growing period:

Averages body weight (Mean ± S.E) at hatch, 2, 4, 6 and 8-wk of age for the control and two selected lines (High body weight, HBW and high egg number, HEN lines) constant heat stress (HS) at 38°c or those kept without heat stress (WHS) are given in Table (3). It clearly appears that HS group (38°c) had heavier body weight than non treated one (WHS at all ages studied. The statistical differences between treatments were highly significant ($P \leq 0.01$). Body weight values as WHS vs HS groups were 32.79 vs 37.46 g, 76.19 vs 80.69 g, 113.43 vs 118.60 g and 145.64 vs 152.41 g at 2, 4, 6 and 8-wk of age respectively. However, body weight for stressed and non treated groups was progressively increased with the advance of age. Also, high body weight line (HBW) had heavier body weight at all ages studies (2, 4, 6 and 8-wk of age) than that of control and HEN lines (Table 3). The statistical differences among lines were highly significant ($p \leq 0.01$). The interaction between the heat stress treatments and livers was significant ($P < 0.05$).

In general, the obtained results for body weight in Japanese quail are in agreement with the results obtained by ***El-Nabarawy (1997)*** who reported that body weight of Japanese quail kept from one to seven wk of age under 38°c had heavier body weight in all ages studied than control. Also, ***Bahie El-Deen and El-Sayed (1999)*** reported that the interaction between lines and locations in body weight was highly significant ($P \leq 0.01$) at 2 and 4-wk of age.

These results concluded that Japanese quail exposed to constant heat stress (38°c) had heavier body weight than untreated treatment. This finding may be due to the highest activity of thyroid gland at heat stress and its association with body fat, nervous system, thermogenesis and metabolic rate. In this respect, ***John and George (1978)*** stated that thyroid activity was the lowest in winter months. Also, ***Bowen and Washburn (1985)*** noted that the decreasing response of the thyroid activity was associated with heat tolerance. In addition, ***El-***Nabarawy ***(1997)*** found that triiodothyronine (T3) in Japanese quail under heat stress (38°c) at 7-wk of age reached to 2.80 µg/100 ml serum and was higher than that of control (2.56 µg/100 ml serum).

(2) Growth rate percentage during the growing period:

Data in Table (4) illustrate the growth rate at different ages in the control and two selected lines (HBW and HEN) of Japanese quail exposed to constant heat stress (38°c) or without heat stress. The results show that growth rate was higher for HS group during the periods of 0-2 wk and 6-8 wk of age than those of WHS group, which were134.82 vs 131.63% and 24.93 vs 24.56%, respectively. Also, the tabulated data show that HBW-line had higher growth rate during the periods of 0-2, 4-6 and 0-8 wk of age than control and HEN lines. The interaction between lines and heat stress (LXH) was insignificant.

In this respect, ***Bahie El-Deen and El-Sayed (1999)*** reported that the interaction between locations and lines for growth rate was highly significant ($P \leq 0.01$) at 0-2 and 4-6 wk of age.

(3) Productive traits during the laying period:

Data presented in Table (5) show some productive traits during the laying period for the control and the two selected lines (HBW and HEN) of Japanese quail kept under two different environmental temperatures. It was clear that the group exposed to constant heat stress at 38°c had earlier age at sexual maturity (58.98 vs 60.80 d), heavier body weight at sexual maturity (174.73 vs 169.88 g), heavier body weight at maturity (205.35 vs 200.24 g), and higher egg number at 90-d of laying (59.14 vs 58.20 eggs) than those of WHS group, respectively. Almost similar trends were found in HS and WHS groups in egg weight at sexual maturity and egg weight at maturity.

However, high egg number line (HEN) had earlier age at sexual maturity (58.03 vs 59.04 and 62.37 d), lower body weight at sexual maturity (158.60 vs 172.18 and 185.74 g), lower body weight at maturity (190.57 vs 190.36 and 234.06 g), lower egg weight at sexual maturity (8.75 vs 10.03 and 10.17 g), lower egg weight at maturity (10.22 vs 11.31 and 12.21 g) and higher egg number at 90-d of laying (66.82 vs 56.64 and 53.05 eggs) as compared to than that of control and high body weight (HBW) lines, respectively. The statistical differences among lines for all traits studied were highly significant ($P \leq 0.01$). The interaction between (L x HS) was significant ($P \leq 0.05$) or highly significant ($P \leq 0.01$) in most of the productive traits.

In this respect, increased of age at sexual maturity in HBW line than control and high egg number line (HEN) was as a result of selection for high body weight line and its positive correlation with high growth rate ***(Marks, 1979)***.

El-Nabarawy (1997) studied the effect of constant heat stress (38°c) on some productive traits in Japanese quail. She found that heat stress had no significant effect on egg number, which agrees with the present study.

(4) Fertility and hatchability:

Data presented in Table (6) show the percentages of fertility and hatchability of fertile eggs for the control and the two selected lines (HBW and HEN) of Japanese quail kept under two different environmental temperatures. It was found that fertility and hatchability percentages of fertile eggs in the heat stressed group were higher (78.98 and 69.22%) than those of non treated group (77.35 and 58.89%), respectively. However the statistical differences between the environmental temperatures were not significant in this respect.

Fertility for the HBW, HEN and control lines were 67.16, 81.37 and 85.97%, while, hatchability of fertile eggs recorded 59.45, 70.77 and 61.95%, respectively. The statistical differences among lines in either fertility or hatchability (%) were highly significant ($p \leq 0.01$). It clearly appears that the heat stress treatment did not significantly affect the fertility and hatchability percentages. Meanwhile the HBW line recorded the greatest fertility percentage and the Hen line had the highest hatchability percentage (Table 6). The interaction between the effect of heat stress and the line of quail as not significant ***El-Nabarawy (1997)*** showed that fertility percentage was decreased under heat stress and hatchability of fertile eggs was increased.

(5) Rectal temperature:

Means of rectal temperatures (RT) at 1, 3, 5 and 7-wk of age for the control and the two selected lines (HBW and HEN) of Japanese quail kept under two different environmental temperatures are given in Table (7). Rectal temperatures ranged from 40.98 to 42.42°c for the non-heat stressed group and from 39.94 to 42.49°c for heat stressed (38°c) one. The results also show the rectal temperature was increased with the advance of the age of birds in both heat stressed (38°c) group as well as non-heat stressed group. The statistical differences between treatments were significant ($p \leq 0.05$) at 1, 3 and 7-wk of age and insignificant at 5-wk of age.

In general, the group exposed to constant heat stress (38°c) had lower rectal temperature than the non-treated group at 1-wk of age (39.94 vs 40.98°c), and 5-wk of age (42.37 vs 42.42°c). Opposite trend was found at 3-wk of age (41.75 vs 41.17 °c) and 7-wk of age (42.49 vs 42.39°c).

Regardless the lines of the Japanese quail birds, of the HBW line had higher rectal temperature at 1, 3 and 5-wks of age than control and HEN lines. The statistical differences among lines were significant (P ≤ 0.05). But the interaction between (L x HS) was not significant.

This results explain that the heat stressed birds had the ability to maintain a rather uniform temperature of their internal organs. Similar results for the present finding in Japanese quail have been reported by ***Durgum and Keskin (1997)***. Also, ***El-Nabarawy (1997)*** reported that means of body temperature were lower in constant heat stressed line (38°c) than control line.

Table (1): Average ambient temperature (°c) and relative humidity (%) during the experimental period (autumn season) in Shibin El-Kom.

Time	Ambient temperature (°c)	Relative humidity %
08.00	22.02 ± 0.68	48.67 ± 1.52
14.00	29.52 ± 1.32	25.67 ± 2.43
20.0	23.43 ± 1.22	43.33 ± 2.09
Average	24.99 ± 0.99	39.22 ± 2.63

Table (2): The experimental design and number of birds of Japanese quail at different ages for each line.

Treatments (1)	***Lines*** (2)	***Number of birds at***			
		4-wks[3]	**8-wk**[3]	**SM**[4]	**90-dp**[5]
WHS	HBW	166	154	74	67
	HEN	181	156	81	75
	CL	213	198	96	94
	Total	560	508	251	236
HS (38°c)	HBW	146	112	68	57
	HEN	159	124	64	48
	CL	145	125	77	70
	Total	450	361	209	175

1- WHS= without heat stress and HS= Heat stress.
2- HBW= High bodyweight line, HEN= High egg number line and CL= control line
3- Combined sexes at 4 and 8 wk of age.
4- Number of pullets at sexual maturity.
5- Number of layers at 90-d of laying.

Table (3): Means ± S.E. of body weight (g) at different ages for lines of Japanese quail reared under two different environmental temperatures

Age	*Lines*	*Treatments*		*Overall means*
		WHS	*HS (38°c)*	
Hatch	HBW	7.45 ± 0.10	7.02 ± 0.07	7.28 ± 0.05b
	HEN	6.06 ± 0.08	7.13 ± 0.08	6.56 ± 0.07a
	CL	6.32 ± 0.15	7.20 ± 0.08	6.68 ± 0.06a
	Average	6.57 ± 0.05b	7.14 ± 0.04a	6.83 ± 0.04
2-wk	HBW	36.55 ± 0.59	40.71 ± 0.56	38.50 ± 0.42b
	HEN	30.70 ± 0.52	37.05 ± 0.56	33.67 ± 0.42a
	CL	31.64 ± 0.55	34.67 ± 0.46	32.87 ± 0.39a
	Average	32.79 ± 0.34b	37.46 ± 0.32a	34.88 ± 0.25
4-wk	HBW	82.26 ± 1.72	83.79 ± 1.15	82.98 ± 0.79c
	HEN	75.82 ± 1.21	80.09 ± 1.13	77.82 ± 0.84a
	CL	71.76 ± 1.05	78.23± 1.09	74.36 ± 0.98b
	Average	76.19 ± 0.67b	80.69 ± 0.65a	78.20 ± 0.48
6-wk	HBW	128.67 ± 1.63	133.12 ± 1.37	130.66 ± 0.89 c
	HEN	101.86 ± 1.05	106.92 ± 1.28	104.16 ± 0.83a
	CL	110.58 ± 1.18	116.13 ± 1.42	112.77 ± 0.92b
	Average	113.43± 1.08b	118.60± 0.95a	115.65 ± 0.62
8-wk	HBW	163.72 ± 1.56	170.82 ± 2.03	166.71 ± 1.26c
	HEN	132.08 ± 1.13	139.51 ± 1.54	135.37 ± 0.95a
	CL	142.28 ± 1.46	148.70 ± 1.51	144.76 ± 1.08b
	Average	145.64± 0.99b	152.44± 1.19a	148.46 ± 0.77

a,b,c values having similar superscripts in the same column (among lines) or the same raws (between treatments) were not significant

HBW= High body weight line, HEN= High egg number line, CL= control line

WHS= without heat stress, HS= heat stress

Table (4): Mean ± S.E. of growth rate (%) at different ages for lines of Japanese quail reared under two different environmental temperatures

Age	lines	Treatments		Overall means
		WHS	HS	
0-2 wk	HBW	130.77 ± 0.87	139.78 ± 0.77	134.98 ± 0.64c
	HEN	132.49 ± 1.12	134.27 ± 0.86	133.32 ± 0.72b
	CL	131.57 ± 0.89	130.42 ± 0.86	131.10 ± 0.63a
	Average	131.63 ± 0.56	134.82 ± 0.51	133.05 ± 0.39
2-4 wk	HBW	77.12 ± 0.86	68.75 ± 1.20	73.21 ± 0.76a
	HEN	84.43 ± 1.04	73.42 ± 0.95	79.28 ± 0.77b
	CL	77.85 ± 1.19	76.73 ± 0.96	77.40 ± 0.73b
	Average	79.76 ± 0.59	72.97 ± 0.62	76.74 ± 0.44
4-6 wk	HBW	44.95 ± 0.68	46.47 ± 0.83	45.63 ± 0.53c
	HEN	27.89 ± 0.87	27.32 ± 0.86	27.63 ± 0.62a
	CL	42.30 ± 0.62	38.80 ± 1.32	40.92 ± 0.65b
	Average	38.67 ± 0.52	37.43 ± 0.71	38.14 ± 0.43
6-8 wk	HBW	23.36 ± 0.69	24.45 ± 1.15	23.82 ± 0.63a
	HEN	25.[illegible] ± 0.66	25.76 ± 0.74	25.42 ± 0.46b
	CL	25.02 ± 0.70	24.54 ± 0.95	24.83 ± 0.57a
	Average	24.56 ± 0.40	24.93 ± 0.54	24.71 0 ± 0.32
0-8 wk	HBW	182.48 ± 0.19	183.79 ± 0.24	183.03 ± 0.16c
	HEN	182.35 ± 0.28	180.18 ± 0.23	181.39 ± 0.20a
	CL	182.90 ± 0.20	181.36 ± 0.23	182.23 ± 0.10b
	Average	182.60 ± 0.13	181.71 ± 0.16	182.23 ± 0.10

a,b,c values having similar superscripts in the same column within each age were not significant
HBW= High body weight line, HEN= High egg number line, CL= control line
WHS= without heat stress, HS= heat stress

Table (5) Means ± S.E. of some productive traits for lines of Japanese quail reared under two different environmental temperatures

Traits	Treatments	Lines			Overall means
		HBW	HEN	Control	
SM	WHS	63.19 ± 0.65	58.90 ± 0.43	60.56 ± 0.72	60.80 ± 0.37
	HS	61.47 ± 0.71	56.92 ± 0.68	58.49 ± 0.76	58.98 ± 0.43
	Average	62.37 ± 0.47b	58.03 ± 0.39a	59.64±0.53a	59.97 ± 0.28
BWSM	WHS	187.64 ± 1.67	154.38 ± 1.51	169.28±1.50	169.88±1.21
	HS	183.68 ± 1.86	163.94 ± 1.75	175.81±1.91	174.73±1.19
	Average	185.74 ± 1.25c	158.60± 1.21a	172.18±1.20b	172.09±0.87
EWSM	WHS	10.63 ± 0.10	8.96 ± 0.07	9.67 ± 0.12	9.72 ± 0.07
	HS	9.66 ± 0.09	8.49 ± 0.08	10.47 ± 0.08	9.60 ± 0.07
	Average	10.17 ± 0.08b	8.75 ± 0.06a	10.03±0.08b	9.67 ± 0.07
EN90	WHS	49.91 ± 1.03	66.37 ± 0.62	57.61 ± 0.98	58.20 ± 0.67
	HS	56.74 ± 1.13	67.52 ± 1.08	55.34 ± 1.07	59.14 ± 0.75
	Average	53.05 ± 0.82a	66.82 ± 0.56c	56.64±0.73b	58.60 ± 0.50
BWM	WHS	237.93 ± 1.74	188.62 ± 1.45	187.67±1.51	202.24±1.72
	HS	229.50 ± 2.05	193.62 ± 2.28	193.74±1.82	205.35±1.72
	Average	234.06 ± 1.37b	190.57±1.26a	190.26±1.18a	203.57±1.23
EWM	WHS	12.52 ± 0.17	10.47 ± 0.10	11.20 ± 0.17	11.34 ± 0.10
	HS	11.86 ± 0.16	9.82 ± 0.13	11.46 ± 0.16	11.14 ± 0.11
	Average	12.21 ± 0.12c	10.22 ± 0.08a	11.31±0.12b	11.26 ± 0.08

a,b,c values having similar superscripts in the same row were not significant
EWSM, Age at sexual matrurity, BWSM and BWM= Body weight sexual maturity and maturity
EN90= Egg number at 90-d of laying

Table (6) Means ± S.E. of fertility and hatchability (%) of fertile eggs for lines of Japanese quail reared under two different environmental temperatures

Traits	*Treat.*	Lines			Overall means
		HBW	HEN	Control	
Fertility	WHS	66.27 ± 5.16	81.90±4.01	83.89±7.37	77.35±3.98
	HS	68.06 ± 3.67	80.83±3.63	88.05±3.67	78.98±3.45
	Average	67.16 ± 4.61^{a}	81.37±4.02^{b}	85.97±5.11^{c}	78.17±3.66
Hatchability	WHS	50.93±5.24	65.74±6.69	60.00±6.00	58.89±7.45
	HS	67.96±4.54	75.79±5.51	63.89±6.70	69.22±7.90
	Average	59.45 ± 4.93^{a}	70.77±5.83^{b}	61.95±6.61^{a}	64.06±7.62

Table (7): Mean ± S.E. of rectal temperature (°c) at different ages for lines of Japanese quail reared under two different environmental temperatues

Age	*Lines*	*Treatments*		*Overall means*
		WHS	*HS (38°c)*	
1-wk	HBW	41.47 ± 0.10	39.84 ± 0.09	40.65 ± 0.11^{b}
	HEN	40.73 ± 0.08	39.83 ± 0.08	40.28 ± 0.08^{a}
	CL	40.76 ± 0.10	40.15 ± 0.09	40.45 ± 0.07^{a}
	Average	40.98 ± 0.09^{b}	39.94 ± 0.09^{a}	40.46 ± 0.05
3-wk	HBW	41.37 ± 0.10	41.81 ± 0.08	41.59 ± 0.07^{b}
	HEN	40.98 ± 0.10	41.53 ± 0.08	41.25 ± 0.07^{a}
	CL	41.18 ± 0.08	41.90 ± 0.12	41.54 ± 0.08^{b}
	Average	41.17 ± 0.09^{a}	41.75 ± 0.06^{b}	41.46 ± 0.04
5-wk	HBW	42.59 ± 0.05	42.52 ± 0.08	42.55 ± 0.04^{c}
	HEN	42.43 ± 0.06	42.38 ± 0.05	42.40 ± 0.04^{b}
	CL	42.24 ± 0.07	42.22 ± 0.05	42.23 ± 0.04^{a}
	Average	42.42 ± 0.05	42.37 ± 0.03	42.39 ± 0.04
7-wk	HBW	42.55 ± 0.08	42.29 ± 0.05	42.42 ± 0.05
	HEN	42.50 ± 0.06	42.50 ± 0.07	42.50 ± 0.04
	CL	42.11 ± 0.08	42.68 ± 0.05	42.39 ± 0.05
	Average	42.39 ± 0.04	42.49 ± 0.03	42.44 ± 0.03

a,b,c values having similar superscripts in the same column were not significant
HBW= High body weight line, HEN= High egg number line, CL= control line
WHS= without heat stress, HS= heat stress

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تأثير التفاعل بين الاجهاد الحرارى والتركيب الوراثى على بعض الصفات الانتاجية والتناسلية فى السمان اليابانى

عبد المنعم عبد الحليم الفقى، جودة محمد جبريل، أحمد عبد الوهاب عنب، فاروق حسن عبده، محمد كمال حرفوش

قسم إنتاج الدواجن – كلية الزراعة بشبين الكوم – جامعة المنوفية

تم انتخاب ثلاثة خطوط من السمان اليابانى، الأول خط المقارنة (CL) والثانى الخط العالى فى وزن الجسم (HBW) والثالث الخط العالى فى عدد البيض (HEN)، وذلك لمدة خمسة أجيال. وفى الجيل السادس، استخدم ١١٦٤ كتكوت عند الفقس من الخطوط الثلاثة (HEN, HBW, CL) فى تجربة الاجهاد الحرارى حيث قسمت الكتاكيت فى كل خط إلى مجموعتين بناء على الاخوة الأشقة. المجموعة الأولى تعرضت للاجهاد الحرارى على درجة ٣٨°م من الفقس حتى عمر ٩٠ يوم من وضع البيض، بينما حفظت المجموعة الثانية لمدة أسبوع على درجة ٣٧°م ثم خفضت ٢-٣°م أسبوعياً إلى أن وصلت إلى الظروف الطبيعية بدون اجهاد حرارى خلال موسم الخريف بهدف دراسة تأثير التفاعل بين درجات الحرارة المختلفة والتركيب الوراثى على بعض الصفات الانتاجية والتناسلية.

أوضحت النتائج أن مجموعة الطيور التى تعرضت للاجهاد الحرارى (٣٨°م) كانت أكبر فى وزن الجسم عند كل الأعمار التى درست، مبكرة فى العمر عند النضج الجنسى، أعلا فى عدد البيض عند عمر ٩٠ يوم من الوضع، وفى نسبة فقس البيض المخصب عن مجموعة الطيور الغير معاملة، وكانت الفروق بين المعاملات معنوية.

من جهة أخرى، كانت طيور الخط العالى فى عدد البيض (HEN) أصغر فى وزن الجسم عند كل الأعمار التى درست، مبكرة فى العمر عند النضج الجنسى، أصغر فى وزن البيضة، أعلا فى عدد البيض عند عمر ٩٠ يوم من الوضع، وفى نسبة فقس البيض المخصب عن كل من طيور خط المقارنة (CL) والخط العالى فى وزن الجسم (HBW) وكانت الفروق بين الخطوط عالية المعنوية. وجد أن التفاعل بين معاملات الإجهاد الحرارى والخطوط (HS x L) كانت معنوية أو عالية المعنوية بالنسبة لوزن الجسم عند كل الأعمار التى درست والصفات الانتاجية والتى توضح إمكانية انتخاب خط مقاوم للاجهاد الحرارى.

هذه النتائج تفسر النشاط العالى لغدة الثيرويد Thyroid عند التعرض للاجهاد الحرارى، كما أن الطيور التى تعرضت للاجهاد الحرارى تمتلك القدرة على حفظ درجة حرارتها متماثلة فى الغدد الداخلية.