Laying performance of Japanese quails divergently selected for body weight under different rearing and lighting systems

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أداء وضع البيض فى السمان اليابانى المنتخب لوزن الجسم فى إتجاهين تحت أنظمة متباينة من التربية والإضاءة

رسالة علمية

مقدمة إلى الدراسات العليا بكلية الطب البيطرى – جامعة الاسكندرية
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تخصص

التربية والإنتاج الحيوانى

مقدمة من

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لجنــــة الإشــــــــراف

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Presented to

my Parents, brothers,

Wife

and my lovely son

Eyad

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Introduction

Because of shortage in animal protein supplementation for human nutrition, quails are considered as a good economical source to compensate this shortage.

Due to tremendous reproductive potential of Japanese quails, they used as pilot animals to replace chickens and turkeys in research of poultry genetics. Body weight, egg production, egg weight; fertility and hatchability are interesting traits to be studied in Japanese quails

Development of commercial poultry lines has been largely based on selection for traits related to economic performance. Changes in the growth pattern could be a result of a single trait long-term selection for body weight at a given age. It was confirmed in experimental lines of Japanese quails selected for body weight at 28 days of age on adequate or stressful nutrition.

System of housing to be used depends on the type and size of the quail enterprise. There are three basic housing systems available for quail farming, aviary (ornamental and exotic quail), floor and cage systems.

Growing of replacement layer pullets in cages rather than floor environments is the current system in the egg industry because of the reduced housing, labor, and equipment costs. Differences between the pullet's growth in these two environments were examined.

Few studies have dealt with the effects of different light periods on the growth parameters in quails. During rearing, the light periods affect the growth rate by direct influencing the duration of daily feeding. When birds offered long light periods, their feed consumption increased in proportion to the duration of light leading to increased market weight.

This study aimed to investigate the effect of divergent selection for four weeks body weight of Japanese quails reared under cage and floor systems. Utilizing different lighting systems on the parameters of laying performance and other related traits (egg production, egg weight, age at sexual maturity, fertility and hatchability). Genetic parameters of the studied traits were also estimated.

Materials and Methods

This experiment was conducted on Japanese quail (Coturnix coturnix Japonica) at the Department of Animal Husbandry and Animal Wealth Development, Alexandria University throughout the period from January 2007 to March 2009.

I. Experimental Flock Management:

I.1. First experiment (cage versus floor rearing)

I.1.1. Base generation

I.1.1.1. Source of birds.

A total of 500 quail chicks (10 days of age) were obtained randomly from commercial quail farms at Kafre El- Sheikh Province.

I.1.1.2. Brooding Managements

I.1.1.2.1. warming

Birds were wing banded and reared on floor. Quail chicks were floor brooded under gas heater throughout the first four weeks of age. Ambient temperature was 36 º C in the first week at their farm, and then lowered by 3 º C weekly to reach 21 º C at about 6 weeks of age.

1.1.1.2.2. Feeding

Birds were fed ad libtium on diet containing 24% crude protein and 2975.8 Kcal ME/kg of feed during brooding period. Ingredients and chemical analysis are in Table 1.

I.1.1.3. Selection Procedures

Individual selection, for high and low body weight at four-week body weight and arranged according to selection procedures on cages and floor from 28 days.

The high and low body weight selected according to the mean weight of the flock. Selected high weight sire families were $\overline{X} + {}^{1}/_{2}$ SD and selected low weight sire families were $\overline{X} - {}^{1}/_{2}$ SD. Total birds selected, used as parents of the first generation for high body weight were 104 birds arranged randomly as 15 sire families on cages (HC) single pair mating (15 males and 30 females) and (36 females and 12 males) on floor (HF).

Table (1): Ingredient composition and chemical analysis (%) of the basal diets used during growing and laying periods of Japanese quail (NRC. 1994).

Ingredients	Growing %	Laying%
Yellow corn, ground	59.95	63.95
Soybean oil meal (44% CP)	29	21
Fish meal (72% CP)	8.5	7.3
Ground limestone	0.9	5.5
Dicalsium phosphate	1.0	1.6
Common salt	0.4	0.4
Premix	0.25	0.25
Chemical analysis		
Crude protein	24.10	20.05
Ether extract	3.36	3.33
Crude fiber	3.05	2.99
Nitrogen free extract	51.61	51.98
Ash	5.96	9.81
Calcium	0.843	2.67
Available phosphorus	0.508	0.578
Lysine	1.479	1.189
Methionine	0.488	0.418
ME (Kcal/kg diet)	2975.8	2894.66
Calorie/protein ratio	123.48	144.37

The premix used was Hermox produced by Heropharm and composed of (per 2.5 kg) vitamin A 12000000 IU, vitamin D3 2500000IU, vitamin E 1000 mg, vitamin K3 2000 mg, vitamin B1 1000mg, vitamin B2 5000 mg, vitamin B6 1500 mg, vitamin B12 10 mg, niacin 30000 mg, bioten 50 mg, folic acid 1000 mg, pantothenic acid 10000 mg, manganese 60000 mg, zinc 50000 mg, iron 30000 mg, copper 4000 mg, iodine 300 mg, selenium 100 mg and cobalt 100 mg.

Birds selected as parents of the first generation for low body weight were 104 birds arranged on cages as 12 sire families (LC) (single pair mating) 12 males and 24 females, 29 females and 15 males on floor (LF).

Control group was divided randomly and arranged in 12 sire families on cages (CC) (single pair mating) as well as 30 females and 16 males on floor (CF).

Breeding birds were fed on layer diet containing 21% crud protein and 2894.66 kcal ME/kg of feed. Minerals and vitamins were adequately supplied to cover the requirements of NRC (1994). Ingredients and chemical analysis are in Table 1.

I.1.2. Birds of the first and second generation

Quail chicks were wing banded at hatch according to their sire families for all lines that reared on cages. Chicks of floor groups were wing banded according to their groups.

Brooding and feeding management controlled as those of the base generation to provide the optimum requirements of the quails.

Within family selection procedure was used for HC and LC for divergent selection for four-week body weight. Individual selection was used for floor lines as performed with base generation.

I.2. Second experiment (16 hr light versus natural light program)

I.2.1. Base generation

A total of 500 quail chicks (10 days of age) were obtained randomly from commercial quail farms at Kafre El- Sheikh Province.

Brooding and feeding managements were done as those of the first experiment to provide optimum requirements of the quails.

I.2.1.1. Selection Procedures

Individual selection $\overline{X} + {}^{1}/_{2}$ SD was performed for high and low body weight at four-week body weight and arranged according selection procedures on two lighting programs (16L: 8D) versus natural lighting system from 28 days.

Total birds selected used as parents of the first generation for high body weight were 102 birds arranged randomly as 15 sire families on cages with (16L: 8D) as 15 males and 30 females as well as 15 sire families on cages supplemented with natural light.

Birds selected used as parents of the first generation for low body weight was 102 birds arranged randomly as 15 sire families on cages with (16L : 8D) as 15 males and 30 females as well as 15 sire families on cages supplemented with natural light.

The control group was divided randomly and arranged in 12 sire family on cages supplemented with 16L: 8D as well as 12 sire family on cages supplemented with natural light.

I.2.2. Birds of the first and second generation

Brooding and feeding managements were done as those of the first experiment to provide optimum requirements of the quails.

Lines of natural light failed to reach complete sexual maturity, only few females of high body weight line gave eggs at about 73 days of age then stopped egg production, other females of low and control light failed to give eggs till the end of the base generation studying. Thus make difficulty to obtain progenies from the base generation, and the experiment continued to evaluate the new established light program which is supplementation of Japanese quail by 16 hrs of light and 8 hrs dark after divergent selection for four-week body weight.

Within family selection procedures were used for all lines of high and low body weight that supplemented with (16l : 8D); the divergent selection at four-week body weight done according to the mean of progeny of each sire family as $\overline{X} \pm {}^{1}/_{2}$ SD.

1.3. Fertile egg management

After all females reached sexual maturity in both two experiments, eggs collected daily and numbered according to their sire families then stored at 18 º C for 8 days. Eggs were fumigated using formaldehyde gas (mixing 20 g of KMNO4 with 40 C.C of formalin 40% for each three cubic meters of the cabinate space) for about 20 minutes then the gas expelled.

Pedigreed eggs were set in the setting trays according to their sire families in a forced draft incubator at 37.5 º C and 60-70% relative humidity (RH). Eggs were turned automatically every three hours. At 14th day of incubation eggs were set in pedigree baskets and transferred to the hatcher, where the temperature was 37.5 º C and RH was 70%.

Selection intensity was measured as: $\mathbf{i = ½ \ (i_m + i_f)}$ as shown in Table (2 and 3).

Where:

i = intensity of selection.

$\mathbf{i_m}$ = intensity of selection for males (no. of selected males/ total no. of birds).

$\mathbf{i_f}$ = intensity of selection for females (no. of selected females/ total no. of birds).

Table (2): Proportion of selected males and females per generation as well as selection intensity across two generations of divergent selection for body weight in Japanese quails under cage versus floor systems.

Generation	Line	High body weight			Line	Low body weight		
		Proportion of selected males	Proportion of selected females	Selection intensity		Proportion of selected males	Proportion of selected females	Selection intensity
Base	HC	0.08	0.19	1.65	LC	0.10	0.16	1.64
	HF	0.08	0.19	1.65	LF	0.10	0.16	1.64
First	HC	0.10	0.20	1.58	LC	0.13	0.22	1.49
	HF	0.09	0.22	1.58	LF	0.07	0.22	1.64
Second	HC	0.12	0.20	1.54	LC	0.09	0.22	1.49
	HF	0.09	0.18	1.63	LF	0.14	0.16	1.56

HC = high body weight reared on cages.
HF = high body weight reared on floor.
LC = low body weight reared on cages.
LF = low body weight reared on floor.

Table (3): Proportion of selected males and females per generation as well as selection intensity across two generations of divergent selection for body weight in Japanese quail under 16 hours of light and 8 hours of dark.

Generation	High body weight			Low body weight		
	Proportion of selected males	Proportion of selected females	Selection intensity	Proportion of selected males	Proportion of selected females	Selection intensity
Base	0.09	0.17	1.65	0.10	0.16	1.64
First	0.17	0.23	1.41	0.11	0.23	1.52
Second	0.11	0.25	1.49	0.11	0.20	1.56

II. Studied traits and Estimations

II.1. Body weight

Body weight was recorded to the nearest gram at hatch, 2 and 4 weeks for all birds.

II.2. Relative growth rate

Relative growth rate was calculated according to **Broody (1945).**

$$\text{Relative Growth rate \%} = \frac{(W_2 - W_1)}{\frac{1}{2}(W_1 + W_2)} x100$$

Where:

W1 = is the weight at any week.
W2 = is the weight at the next week.

II.3. Fertility Percentage

It was recorded for each sire family and also for floor collected eggs by the following formula:

$$\text{Fertility \%} = \frac{\text{Number of fertile eggs}}{\text{Total number of eggs setted}} x100$$

II.4. Hatchability Percentage.

It was recorded for each sire family and also for floor collected eggs by the following formula:

$$\text{Hatchability \%} = \frac{\text{Number of hatched chicks}}{\text{Number of fertile eggs}} x100$$

II.5. Livability percentage.

It was recorded for each sire family and also for floor reared chicks up to the age of sexual maturity and expressed as percentage.

II.6. Age at sexual maturity (Age at the first egg).

Expressed in days from hatching day till the day of the first egg for all females of all lines of two experiments (floor females examined daily until complete sexual maturity).

II.7. Egg production

Were recorded for each sire family of all lines for the first 45 days after sexual maturity for base, first and second generation **(Bahie El-Dean, 1991)**. Mass production recorded for floor reared hens for the same period.

II.8. Egg weight

Were recorded in grams during the period of the first 30 days after sexual maturity for base, first and second generation **(Omran, 1993)**. Mass weight recorded for floor reared hens.

II.9. Egg quality.

Recorded for all lines in the second generation and calculated for each sire family in two experiments; mass egg quality recorded for floor lines. The following parameters of egg quality were recorded:

II.9.1Egg weight. It was measured to the nearest gram.

II.9.2. Albumen percentage. By dividing albumen weight on the total egg weight.

II.9.3. Yolk pecentage. By dividing yolk weight on the total egg weight.

II.9.4. Shell and shell membranes pecrentage. By subtracting total albumen and yolk weight from egg weight then dividing it on total egg weight.

II.9.5. Yolk index. It was obtained by dividing yolk height on yolk width.

III. Selection procedures and genetic parameters

III.1. Selection differential ″ S ″

- Actual selection differential calculated according to **(Becker, 1985).**

III.2. Response to selection ″ R″

Response to selection is equal to the differences between mean of the progenies of the selected parents and the mean of the population from which the parents were selected **(Becker, 1985).**

III.3. Heritability

III.3.1. Expected heritability estimates

Heritability was calculated in each generation from variance components as:

$$h^2 = \frac{4\sigma^2{}_s}{\sigma^2{}_s + \sigma^2{}_w}$$

Where:

$\sigma^2 s$ = variance of sire.

$\sigma^2 w$ = variance of error.

III.3.2. Realized Heritability

Realized heritability is calculated by dividing the selection response by selection differential**.**

$$h^2 = R/S$$

Where:

R = Actual selection response.
S = Actual selection differential.

IV. Statistical analysis

All percentage data were transformed to the corresponding arcsines according to **Snedecor and Cochran (1981).**

Statistical analyses were done by the aid of **SAS soft ware (2002)** according to following models.

Chi-square test used for analysis livability significance between cage and floor lines in the first experiment.

IV. 1. Statistical models

IV.1.1. First experiment

$$X_{Ijkl} = \mu + G_i + L_j + R_k + e_{ijkl}$$

Where:

X_{ijkl} = the X th observation of the i th generation and jth line.
μ = overall mean.
G_i = effect of I th generation (i = 0, 1, 2).
L_j = effect of the j th body weight line (j = 1, 2, 3).
R_k = effect of rearing system cage and floor (k = 1, 2).
e_{ijkl} = random error.

Used for traits (fertility, hatchability, age at sexual maturity, egg production, egg weight and egg quality)

IV.1.2. second experiment

$$X_{ijkl} = \mu + G_i + L_j + R_k + e_{ijkl}$$

Where:

X_{ijkl} = the X th observation of the i th generation and jth line**.**
μ = overall mean.
G_i = effect of i th generation (i= 0, 1, 2).