Effects of Divergent Selection for Growth on Carcass Traits in Japanese Quails

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ABSTRACT

Japanese quail has been used as a model for studying the genetics of growth-selected poultry and poultry breeding. The aims of this study were to determine the effects of selection for growth on carcass traits in different lines of Japanese quails. Three lines of Japanese quails were selected (300 birds aged 2 weeks) from the original population including high body weight (HBW), low body weight (LBW) and random bred control (RBC). At 4th week of age, birds were weighed, slaughtered, weighed the carcass, edible giblets and ratio of these organs to the empty body weight were recorded. After the third generation of selection, the selected high line showed significantly higher ($p<0.05$) slaughter, dressing and carcass weights compared to selected low and control lines. The mean carcass weights were 90.95 g in control, 56.12 g in low and 127.05 g in high line. These weights represented approximately 0.76, 0.62 and 0.78 of live body weight at 4th week of age, respectively. Liver, gizzard, spleen and heart weights were significantly increased ($P < 0.05$) in selected high line when compared to low and control lines. The mean of liver, gizzard, spleen and heart weight in selected high line were 5.85, 5.96, 0.40 and 2.54 g, which represented about 0.04, 0.04, 0.002 and 0.02 of live body weight at 4th week of age, respectively. It concluded that selection for high body weight has been improved the carcass traits, including yield and quality.

Key words: selection, growth, carcass, Japanese quails

INTRODUCTION

Japanese quail belongs to order Galiformes, genus Coturnix, and species japonica. Coturnix japonica is the scientific designation of Japanese quail, which differ from Coturnix coturnix (common quail) *(1)*. Japanese quail has been used as a model for studying the genetics of growth-selected poultry and poultry breeding, due to several factors such as; short generation period (3months), with less feed, water and housing requirements, low maintenance costs and short generation interval *(1- 4)*.

Production performance of the Japanese quail can be improved by increasing their genetic potential with better management. Appropriate breeding strategies are used to produce more quail meat at a short period of time through increasing carcass weight and improving carcass quality. More quail meat can be achieved by selection for higher body weight at 4 to 6 weeks of age *(5)*.

Genetic selection may be the quickest and most reliable method for eliminating the harmful character and promoting the desirable traits. Continuous selection and genetic improvement in Japanese quail have been used to improve the meat production traits. Selection studies for improving the growth rate has been performed for Japanese quail to compensate apart of shortage in animal protein *(6)*. Continues genetic improvement of livestock is dependent on the fact that substantial genetic variation exists within

individual breeds allowing them to respond to selection for different traits. The different methods of selection, had been improved the production quantity and quality. The main goal of the breeders is to have a reasonable marketing body weight with less money for the growing bird *(7)*. Therefore, the aim of the present study was to investigate the effects of selection for growth on different carcass traits of Japanese quails.

MATERIALS AND METHODS

Birds and the experimental design

This study was conducted at the poultry Farm, Faculty of Veterinary Medicine, Zagazig University. Three hundred birds of Japanese quail 2nd week of age were wing banded for the experimental work. The birds were collected from experimental unit in Faculty of Agriculture, Zagazig University.

Selection criteria based on the individual body weight at four weeks of age. Three lines of Japanese quails were selected from the base population including high body weight (HBW4, birds which had body weight heavier than the population mean), low body weight (LBW4, birds had body weight lighter than the population mean) and random bred control (RBC, non selected random mating control population). Selection procedures have not changed at any time during the experiment. Each female was mated to a single male and mating between half sibs and/or more closely related individuals were avoided.

After hatching until the end of brooding period (fourth week of age), chicks identified using wing bands according to their families and sex was determined at 4th week of age and were brooded at the floor. At seven weeks of age the selected birds (high and low body weight) and the control line were kept in cages (25x 25x30cm) using one male to one female in one cage forming a sire family, (single pair mating) *(8)*.

Chicks were brooded at the floor. The temperature was 37.5°C at the first week after hatching, and decreased 2-3°C weekly until reached to 26-28°C which continues until the end of brooding period (fourth weeks) *(9)*. The vaccination and/or beak trimming programs had not been done to the breeding stocks. 24 hrs of continues daily light program was allowed during brooding period until the six weeks of age, and then reduced to 14hs light: 10hs dark. For maintaining the maximum egg production and fertility, 14 hrs of light/day/laying period were provided for quails (4watt/m^2). Commercial quail's diet containing (24% protein and 2975.8 K.cal ME/kg) was fed ad libitum throughout the experimental period.

Carcass traits

In the third generation of selection, at 4th week of age, 20 birds from each line were randomly chosen, weighed and then slaughtered after 12 hrs of fasting. Birds were plucked (feathers were removed by the dry method) and the carcass was eviscerated *(10 , 11)*.

The following carcass traits were recorded (g):

1- Body weight at slaughter age (after bleeding).
2- Dressing weight (after bleeding and plucking).
3- Eviscerated carcass weights (empty carcass weight).
4- Weight of the edible giblets (heart, liver spleen and empty gizzard).
5- Ratios of carcass traits to the empty body weight relative to 4th week body weight.

Statistical analysis

Statistical analysis on the mean time taken to land was carried out using PASW Statistics (SPSS version 16.0 for Windows) *(12)*. The following statistical model was used:

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

Y_{ij}: carcass trait.

L_i: effect of i^{th} line.

eij: unexplained source (error).

RESULTS AND DISCUSSION

Our results revealed significant increase (P<0.05) in the absolute weights of slaughter, dressing, carcass, liver, gizzard, spleen and heart, compared to low and control lines after the third generations of selection (Table 1). Similar results were recorded previously *(10)*. They demonstrated that the highest carcass weight was in the high line, while the lowest was in the low body weight line. Short term selection for 4-week body weight caused improvement in carcass traits. Also, the carcass weight of Japanese quail was increased at 4th week of age in the high selected line (70 % of live weight) than the control line (62 % of live weight) *(11 ,13)*. The superiority of carcass yield for selected high line could be explained as the heavier body weight, the greater carcass yield produced *(14)*.

Table 1. Least square means ± Standard deviations (LSM ± SD) of absolute weights (g) for carcass traits at 4th week of age across third generation of selection for body weight in different lines of Japanese quails (high & low and control).

Traits	Absolute weights (g)		
	Control	Low	High
Live body wt	121.52 ± 19.12^b	90.40 ± 1.53^c	167.33 ± 23.77^a
Slaughter wt	116.22 ± 17.66^b	85.10 ± 1.03^c	161.91 ± 23.17^a
Dressing wt	109.54 ± 32.27^b	70.95 ± 0.00^c	152.40 ± 17.16^a
Carcass wt	90.95 ± 12.36^b	56.12 ± 0.00^c	127.05 ± 18.42^a
Liver wt	3.33 ± 0.78^b	2.48 ± 0.29^c	5.85 ± 1.08^a
Gizzard wt	3.61 ± 1.07^b	2.70 ± 0.16^c	5.96 ± 0.96^a
Spleen wt	0.27 ± 0.13^b	0.10 ± 0.00^c	0.40 ± 0.00^a
Heart wt	1.70 ± 0.41^b	1.06 ± 0.35^c	2.54 ± 0.26^a

Means of different variables within the same row having different superscripts are significantly different at level (p < 0.05).

We found that the relative values (%) of slaughter, dressing, carcass, liver, gizzard, spleen and heart weights were significantly increased (P<0.05) in the selected high line than in the low and control line after the third generations of selection (Table 2). On the other hand, relative values of dressing, carcass, spleen and heart weights were increased non significantly (p> 0.05) in the selected high line compared to control line. Similar trend was demonstrated between selected low lines and control one for liver and gizzard values.these results confirmed those obtained in India **(15).** They found that, selection for 4-week body weight was associated with an increase in dressing, evisceration and giblets percentages, but with a decrease in visceral organ weights.

Table 2. Least square means ± Standard deviations (LSM ± SD) of relative values for carcass traits at 4th week of age across third generation of selection for body weight in different lines of Japanese quails (high & low and control).

Traits	Relative values		
	Control	Low	High
Slaughter wt	0.96 ± 0.02^{b}	0.94 ± 0.00^{c}	0.97 ± 0.00^{a}
Dressing wt	0.90 ± 0.23^{a}	0.79 ± 0.02^{b}	0.94 ± 0.21^{a}
Carcass wt	0.76 ± 0.12^{a}	0.62 ± 0.01^{b}	0.78 ± 0.19^{a}
Liver wt	0.03 ± 0.00^{b}	0.02 ± 0.00^{b}	0.04 ± 0.00^{a}
Gizzard wt	0.03 ± 0.01^{b}	0.02 ± 0.01^{b}	0.04 ± 0.00^{a}
Spleen wt	0.002 ± 0.00^{a}	0.001± 0.00^{b}	0.002 ± 0.00^{a}
Heart wt	0.01 ± 0.00^{a}	0.01 ± 0.00^{b}	0.02 ± 0.00^{a}

Means of different variables within the same row having different superscripts are significantly different at level ($p < 0.05$).

Carcass traits had highly significant positive phenotypic correlation with the body weight at different ages (2nd, 4th and 6th weeks of age) which ranged between 0.59 - 0.91 (Table 3). Compatible results were detected in previous studies *(10)*. They mentioned that, the carcass traits were highly correlated with the body weight. There was high positive correlation between 4-, weeks body weight and carcass traits (0.85-0.97) *(11,13)*. Therefore, they suggested that early BW4 can be used as a selection criterion for improving carcass traits in Japanese quails. On the contrary, the phenotypic correlations between body weight and carcass traits in quails were positive and small in magnitude *(16)*. Also, the correlation between body weight and percentage of body and carcass components was non significant low estimate *(17)*.

Table 3. Pearson correlation coefficients of body weight (g) at 2nd, 4th and 6th week of age with carcass traits at 4th week of age across third generation of selection for body weight in Japanese quails.

Traits	Body weight		
	2nd weeks	4th weeks	6th weeks
Slaughter wt	0.67**	0.87**	0.65**
Dressing wt	0.67**	0.84**	0.59**
Carcass wt	0.72**	0.91**	0.71**
Liver wt	0.60**	0.85**	0.62**
Gizzard wt	0.62**	0.84**	0.59**
Spleen wt	0.67**	0.82**	0.75**
Heart wt	0.66**	0.88**	0.64**

** Correlations are significant at the level ($p < 0.01$).

CONCLUSION

Selection is an efficient tool in improving the body weight and carcass traits in Japanese quails, which will compensate the shortage of animal protein. The HBW line had the best carcass traits than the LBW and the RBC lines. Therefore, selection produces more quail meat at a short period of time through increasing the carcass weight and improving carcass quality and quantity.

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الملخص العربي

تأثير الإنتخاب المتفرع للنمو على صفات الذبيحة فى السمان اليابانى

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يستخدم السمان الياباني كنموذج فى الدراسة الجينية للدواجن المنتخبة لوزن الجسم و لتربية الدواجن .إستهدفت هذه الدراسة قياس تأثيرات الإنتخاب المتفرع للنمو على صفات الذبيحة في خطوط السمان الياباني المختلفة.وقد إشتملت الدراسة على ثلاثة أجيال من الإنتخاب وقد تم تكوين ثلاثة خطوط إحتوت على خطين منتخبين احدهما لصفة وزن الجسم العالى عند عمر أربعة أسابيع والأخر لصفة وزن الجسم المنخفض عند عمر أربعة أسابيع أيضا والثالث غير منتخب يستخدم كمجموعة ضابطة . اشتملت هذه التجربة بعد الجيل الثالث من الإنتخاب على صفات الذبيحة المختلفة وتشمل وزن الذبيحة عند عمر أربعة أسابيع ، وزن الكبد، وزن المعدة والطحال والقلب ونسبتهما إلى الوزن الكلى.

وجدت فروق معنوية ($p<0.05$) للخط المنتخب لوزن الجسم العالى عند عمر أربعة أسابيع مقارنة بالخط المنتخب لوزن الجسم المنخفض عند عمر أربعة أسابيع و الخط الضابط فى صفات الذبيحة. وكانت متوسطات وزن الذبيحة بعد ثلاثة أجيال من الإنتخاب عند عمر أربعة أسابيع هى ٩٠،٩٥ جرام فى الخط الضابط، ٥٦،١٢ جرام فى الخط المنتخب لوزن الجسم المنخفض و١٢٧،٠٥ جرام فى الخط المنتخب لوزن الجسم العالى على التوالى. وأيضا متوسطات صفات الذبيحة فى صورة نسبة من وزن الجسم بعد ثلاثة أجيال من الإنتخاب عند عمر أربعة أسابيع هى 0.76 فى الخط الضابط، 0.62 فى الخط المنتخب لوزن الجسم المنخفض 0.78 فى الخط المنتخب لوزن الجسم العالى على التوالى.

سجلت فروق معنوية ($p<0.05$) للخط المنتخب لوزن الجسم العالى عند عمر أربعة أسابيع مقارنة بالخط المنتخب لوزن الجسم المنخفض عند عمر أربعة أسابيع و الخط الضابط لكلا من وزن الكبد، وزن المعدة ، وزن الطحال ووزن القلب. وكانت متوسطاتهم بعد ثلاثة أجيال من الإنتخاب فى الخط المنتخب لوزن الجسم العالى عند عمر أربعة أسابيع هى 5.85، 5.96، 0.40 و 2.54 جرام على التوالى. والتى تمثل بأوزان نسبية هى 0.4 ، 0.4 ، 0.002 و 0.02 على التوالى.

من النتائج السابقة من الممكن أن نستخلص أن الإنتخاب المتفرع لصفات النمو ووزن الجسم العالى فى السمان الياباني يساهم بصورة مباشرة فى تحسين صفات الذبيحة من حيث الكمية والجودة.