Responsed to Genetic Improvement and Heritability of Egg Production and Egg Quality Traits in Japanese Quail (Coturnix coturnix japonica)

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Abstract

A study was conducted to determine the egg production, egg quality traits, response to genetic improvement of the egg traits and heritability of the traits in the Japanese quail. The birds used were about 470 chicks purchased at day 14 to serve as foundation stock. They were sexed at day 21 and the females were caged in 28 cages each contain 15 quails constructed in dimension of 60cm x 45cm x 45cm (length x breath x weight). Three birds from each caged were randomly picked at day 35, 42, 49 and 56 in each generation base (G_s), first (G_1) and second (G_2) and the data obtained were subjected to analyses of variance and realized heritability were obtained as appropriate from the following traits: live body changes in female sexual maturity, body weight gain, egg production, egg quality traits, reproductive traits, realized h^2 for the egg traits and egg production in the Japanese quail.

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The result shows that selection base on high body weight led to the traits to differed significantly (P< 0.05) and (P < 0.01) by generations, age and sex of quails and significantly affects egg production for base, first and second generations. There were more egg production in first generation than base and second generations. The advances in age for a set of generation led to increase in weekly egg production, selection for body weight for the first generation base on average weekly egg production which was lower than the base and second generation and also as the bird's advances in age there was improvement in egg traits at day 35, 42, 49 and 56. The percentage death in shell, percentage death in egg and percentage infertility responded positively to selection base on high body weight. The realized h^2 of egg number and age at sexual maturity in female quail was very low 0.05 in egg number and 0.23 in age at sexual maturity. There was also low realized h^2 values observed in egg width, yolk width, albumen length, shell weight and shell thickness and egg production (0.01 - 0.07). Apart from the age at sexual maturity which h^2 is moderate and implies that response to selection for high body weight may be rapid while the low realized heritability obtained for egg number and egg quality traits implies that response to selection for the traits could be slow.

Key words: Body Weight Improvement; Productive Performance; Egg Quality; Realized Heritability.

1. Introduction

The Japanese quail is now a well-established animal model in biology and a bird used for intensive egg and meat production [1]. Studies in quails have been aimed at increasing meat and egg production. Egg production is of critical importance in birds not only for their reproduction but also for human consumption as the egg is a highly nutritive and balanced food, the egg can be used for vaccine production. Consequently, laying in poultry has been improved through selection to increase the total number of eggs laid per hen. Production performance of the Japanese quails can be improved by increasing their genetic potential and favorable management conditions. Short-term experiments can be used to estimate the magnitude of the initial rates of response to selection [2].

[3] stated that in turkeys, selection for increased body weight resulted in decreased egg production, intensity of lay. [4] observed improvement in indigenous chickens through selective breeding. The finding of the studies conducted to [5] and [6] improvement egg yield of Desi generation- chickens in comparison to their parents shows that Birth

weight in first generation was lower than the base and second generations. The improvement of egg size and its components are influenced by number of genetic and non-genetic factors [7]. Reference [8] reported that egg production decreased depending on selection for increased body weight of quails. A lot of authors [9-14] reported that egg weight continuously increasing with increasing in age. Shell thickness decrease with advance in age of the quail [15].

Selection for high body weight influences the generation of egg traits in Japanese quail positively [16 , 17]. References [18 , 19] reported 72.20% and 73.20%, respectively for hatchability percentage in Japanese quail in second generation.

References [20 - 22] reported h^2 estimates for egg number to also be high. The heritability estimates for egg weight in laying Japanese quail was reported to range between 0.35 – 0.62 as stated by [23 – 25]. Similarly, variable h^2 estimates were reported by a number of scientists regarding egg weight [26 – 28] recorded the h^2 estimates 0.31, 0.25, 0.54, 0.49 and 0.52 – 0.91, respectively.

Literature on h^2 for egg production in quail was dearth, other investigator stated that in turkey little or no association between egg production and body weight was observed in earlier selection studies during the first few generations of selection for either increased egg production [29 – 30] or increased body weight [31 - 32] estimated genetic relationship between bodyweight and egg production.

1.1 Justification of study

This research was conducted to determine response to genetic improvement and heritability of egg production and egg quality traits in Japanese quail towards estimating genetic parameters for improving the egg production, egg quality traits, meat traits.

2. The Specific objectives

The research was to determine the egg production, egg quality traits, response to genetic improvement of the egg traits and heritability of the traits in Japanese quail.

3. Materials and Methods

3.1 Experimental Site:

The study was conducted at the Poultry unit of Animal Science Department, Faculty of Agriculture, Ahmadu Bello University, Samaru –Zaria. Zaria is within Northern Guinea Savannah zone of Nigeria, latitude 11' 12°N and longitude 7' 33°E at an altitude of 610M above sea level. The climate is relatively dry, with mean annual rainfall of 700-1400mm, occurring between the Month of April and September. The dry season begins around the middle of October, with dry cold weather that ends in February. This is followed by relative hot, dry weather from March to April, when the rain begins. The mean minimum and maximum daily temperature is about 14° and 24°C during the cool season and 19° and 36°C during the hot season. The relative humidity varies between 19% in the dry season and between 63% and 80% in the wet season as stated by [33].

3.2 Mating Plan

Artificial selection was carried out on the birds at day 35, 42, 49 and 56 after weighing all the birds. Those with the highest weight were chosen for breeding consisting of 28 males and 84 females (1:3) in constructed caged of 10cm x 10cm x 10cm to determine the birth weight sex of birds, Body weight, egg production and egg quality traits in generations of the quails while mating ratio in separate caged of 1:1 was used to determine Age at sexual maturity in females, egg quality and egg production in the two generations. For the study that utilized mating ratio 1:1 and 1:3, all the birds were wing banded in accordance with the families and 1500 fertile eggs

were hatched from eggs collected about 3weeks for those mated to ratio 1:3 and 150 for 1 weeks from birds mated 1:1.

3.3 Management of Fertile Egg

Eggs were collected daily after the birds had reached maturity, for each of day 35, 42, 49 and 56 days of age for each generation. Eggs were identified by their sire families in 28 cages for those mated to a ratio of 1:3 and weeks and for 50 cages for those mated individually for ratio 1:1, the eggs were collected for 3 weeks, stored at room temperature lower than 20°C and 65% relative humidity (RH) for a week, and then disinfected with tetra hydroxyl (TH4) mixed with 1 liter of water for spraying on egg surface. Pedigreed eggs were set in the setting trays, depending on their sire families and arranged in a forced draft incubator with temperature of 37.5°C and 65% RH. Eggs were turned automatically every three hours. At the end of the 14th day of incubation, eggs were transferred into pedigree hatching baskets and moved into the hatcher where the temperature was 37.5°C and RH was 70%.

3.4 Incubation and Hatching of Fertile Eggs

Pre-incubation of the fertile egg collected was made by storing them at a temperature of 15°C. Fumigation was done 12 hours before placing them in the incubator. When eggs were set in the incubator, temperature requirement was put at 37.5°C with humidity of 60% and turning of eggs was at an angle of 45° for 4-6 times a day and the chicks were hatched at day 18 of incubation and the %hatchability, %fertility, %death in shell, %dead in egg, %infertility were determined.

3.5 Experimental Birds and their Management

Four hundred and seventy Japanese quails at 14 days of age were purchased from National Veterinary Research Institute (NVRI), Vom, Plateau State which served as foundation stock. The management of the young chicks included the provision of supplementary heat for 4 weeks under 24 hours lighting, and thereafter 9 to 12 hours light and 6 to 8 hours dark cycle. Indoor air temperature for the chicks was 36°C. Birds were allowed *ad libitum* access to food and water. They were fed with starter and grower diet containing 24% crude protein (CP) and 2904ME, Kcals/kg between 1-35 days of age. Thereafter a breeder diet containing 23% CP and 2800, Kcals/kg ME was fed. The same diets were provided to birds on the selection process across various generations. The minerals and vitamins were adequately supply to cover the requirements according to [34].

3.6 Data collection

Three generations namely base population (G_0), generation one (G_1) and generation two (G_2). The following data were collected on each generation:

3.7 Egg traits

Four hundred and twenty birds were used to study the birth weight (g), egg production traits, egg quality traits of

the birds. The birds were housed in 28 cages, and each cage housed 15 quails. The dimension for the cages was 60cm × 45cm × 45 cm (length × breath × height). Eggs were picked at day 35, 42, 49 and 56 morning and evening daily in each generation G_0, G_1, G_2 and recorded, three eggs from each caged were picked and egg quality determined.

3.8 Sexual Maturity

Fifty females were put individually in a constructed caged size 5cm × 2.5cm × 2.5cm to monitor sexual maturity using 50 females each in the constructed caged and monitoring started at day 35. They were monitored for females, when they dropped the first egg and body weight as at that time known. Monitoring was from 07.00 to 11.00am and 01.00 to 05.00pm (8 hours) daily and an age at sexual maturity traits was determined.

3.9 Egg Production Traits:

Four hundred and twenty females quails were distributed in to 28 cages constructed 60cm × 45cm × 45 cm (length × breath × height) to study the number of eggs produced in the morning and afternoon. The eggs produced in the morning were picked at 10.00am and afternoon at 4.00pm daily and result recorded per week. The following were determined:

3.10 Egg production/day/week

Determined by collecting and recording the egg collected morning and afternoon daily and summing the total weekly. Number of egg laid (n): Total number of eggs produced by the birds in a given period in a given generation.

3.11 Egg Quality Traits

Three eggs from each of the 28 cages housing 15 females each were randomly picked on a specific day of the week to determine the egg quality traits for each of base generation, first and second generation at day 35, 42, 49 and 56. Three eggs from each of the eggs picked was broken into a known weight of clean smooth paper that does not absorb liquid immediately and the following measurements obtained: Egg weight (g): Weight of egg, known using digital weighing machine after breaking up. Egg length (cm): Measured to the nearest 0.01mm, using vernier caliper. Egg width (cm): Determined using vernier caliper corrected to the nearest 0.01mm. Yolk weight (g): Obtained by separating the yolk from the albumen and weight of yolk obtained using digital weighing machine. Yolk length (cm): Obtained by using vernier caliper, corrected to 0.01mm. Yolk height (cm): determined using venier caliper, corrected to the nearest 0.01mm. Albumen Weight (g): By separating the albumen from the yolk and weight of albumen obtained by using digital weighing machine. Albumen Length (cm): Vernier caliper was used to obtain the length, corrected to 0.01mm. Albumen Width (cm): was obtained by using vernier caliper across the yolk, corrected to 0.01mm. Shell + Membrane Weight: The shells alone with membrane of each egg were collected and air dried for one hour and weight of each was determined. Shell + Membrane Thickness: Micrometer screw gauge was used to determine the thickness of the dried shell +membrane corrected to 0.01mm.

3.12 Reproduction Traits

About 1500 fertile eggs were collected from mated birds of 1:3 male to female ratio in a cage from groups of 28 families on daily basis for 21 days for G_0, G_1 and G_2 and about 150 fertile eggs were collected from mated birds of 1:1 male to female ratio in a cage from groups of 28 families on daily basis for 7 days for G_0, G_1 and G_2. The collected eggs were stored in a cool room before setting them for hatching. The following measurements were obtained out of 420 females Japanese quail for each of G_1 and G_2 from the set eggs: Fertility, hatchability, number of dead in shell and dead embryos.

The following measurements were made: Egg set: Total number of eggs set in an incubator

3.12.1 Fertility

Total number of eggs those were fertile from the set egg
$$\textbf{Fertility } \% = \frac{\text{Number of hatched chicks}}{\text{Number of fertile eggs}} \times 100$$

3.12.2 Hatchability

= Total number of eggs that were hatch from the fertile egg

$$\textbf{Hatchability } \% = \frac{\text{Number of eggs hatched}}{\text{Total number of eggs set}} \times 100$$

Number of Dead in shell: number of fertile eggs that just started the process of development but immediately died in shell. Dead embryo: The number of mature chicks that failed to hatch Infertile egg: Number of eggs that did not hatch and after breaking showed no sign of development.

3. 13 Estimation of Genetic Parameters

3.13.1 Realized heritability

The Realized heritability (h^2) is response to selection over selection differential. Therefore response to selection is formulated as R $=$ P_1 – P_0 Where: R$=$ Response to selection, P_1 =Mean body weight of offspring, P_0 =Mean body weight of parents (unselected) generation. The Selection differential(S): S= P_s – P_0 where: S= selection differential, P_s = Mean body weight of selected from population, P_0 = Mean body weight of population.

3.13.2 Statistical analysis

Percentage fertility and hatchability were transformed to the corresponding arc sine values according to [35]. Statistical analysis was done by the aid of SAS software [36] according to the following Statistical models:

$$Y_{ijklm} = \mu + G_i + H_j + S_k + GH_{ij} + GS_{ik} + e_{ijklm}$$

Where: Y_{ij}= the observation of ijklm[th] bird, μ = overall mean, G_i = effect of ith generation (I = 0, 1, 2), H_j=

effect of jth hatch (j = 1, 2), S_k= effect of kth sex (k = male and female), A_l= effect of lth age, GS_{ik}= Interaction between i^{th} generation and k^{th} sex, e_{ijklm}= random error. Significant differences between means were ranked by using Duncan's Multiple Range Test [37].

4. Results and Discussion

4.1 Results

The effect of selection for high body weight on egg traits is shown in Table 1. Egg number significantly affects the generations (P< 0.01) while egg weight and birth weight differed significantly (P< 0.05) in generations. The egg weight, egg numbers and birth weight in generation selected (G_S) were higher than G_1 and G_2 while G_2 has higher values than G_1.

Table 1: Effect of generations on egg production and body weight

Traits	Sex	Generations			LoS
		G_s	G_1	G_2	
Egg weight (g)	Females	12.4^a	10.7^c	10.8^b	*
Egg Number (n)	Females	3706^a	3418^c	3692^b	**
Birth $_{Weight}$ (g)	Combined Sex	8.80^a	7.40^c	7.90^b	*

means of each traits within each generation with different superscripts differ*= (P< 0.05), **=(P< 0.01); LoS = least of significant,, G_S= Base population, G_1= generation of selected one, G_2= generation of selected two.

Table 2 show the least square means for egg production and weight traits in Japanese quail by age. The result of the egg production and weight traits differed significantly (P< 0.01) by age, except egg weight in generation selected (G_S), generation one (G_1) and generation two (G_2) that differed significantly (P< 0.05) as birds advance in age. There was improvement in weekly egg production in generations selected, G_1 and G_2 from day 35, 42, 49 and there- after reduces slightly at day 56. The body weight for females generation selected Gs are higher than generation one (G_1) and generation two(G_2) While generation two (G_2) was higher than generation one (G_1). The egg weight for generation selected (Gs) where higher than generation one (G_1) and generation two (G_2) While generation two (G_2) was higher than generation one (G_1).

The least square mean for egg quality of traits in Japanese quail in generation and age is shown in Table 3.The result of the egg quality traits differed significantly (P< 0.05) in generations, except egg weight and egg width which differed significantly (P< 0.01) in generation. The effect of age on egg quality differed significantly (P< 0.05) and no significant difference in yolk width. The generation selected (Gs) values are higher than G_1 and G_2, while values in G_2 are more than G_1.

There was improvement base on age for the egg traits at day 35, 42, 49 and 56d, except egg width and yolk width which improved at day 49 and 56. Albumen length value shows no improvement in day 35 and 42 but

shows

Table 2: Least square means for egg production and weight traits in Japanese quail by age

Traits			Age $_{(d)}$				LoS
			D_{35}	D_{42}	D_{49}	D_{56}	
Average weekly egg production G_s			266 ± 2.29^d	915 ± 48.88^c	1318 ± 3.95^a	1197 ± 4.06^b	**
Average weekly egg production G_1			165 ± 7.19^d	952 ± 1.92^c	1382 ± 3.23^a	1221 ± 3.67^b	**
Average weekly egg production G_2			242 ± 6.15^d	870 ± 4.86^c	1219 ± 27.70^a	1162 ± 9.86^b	**
Body Weight female G_s			159.1 ± 2.34^d	188.9 ± 3.32^c	231.6 ± 2.94^b	262.9 ± 3.52^a	**
Body Weight female G_1			135.9 ± 1.59^d	160.1 ± 1.65^c	184.6 ± 1.79^b	212.9 ± 2.37^a	**
Body Weight female G_2			148.5 ± 1.63^d	180.6 ± 1.73^c	202.5 ± 2.31^b	223.8 ± 2.84^a	**
Egg Weight G_s			8.4 ± 1.02^d	9.6 ± 0.91^c	10.2 ± 0.96^b	11.9 ± 1.17^a	*
Egg Weight G_1			6.7 ± 0.81^d	7.6 ± 1.04^c	9.2 ± 0.97^b	9.6 ± 0.80^a	*
Egg Weight G_2			7.8 ± 0.67^d	8.8 ± 0.97^c	10.0 ± 0.97^b	11.3 ± 1.34^a	*

means of each traits within each generation with different superscripts differ*= ($P< 0.05$), **=($P< 0.01$); LoS = least of significant,, G_s= Base population, G_1= generation of selected one, G_2= generation of selected two, N= number of birds observed.

Table 3: Least square mean for egg quality of traits in Japanese quail in generation and age

Traits	N	Generations			LoS	Age(g)				LoS
		G_s	G_1	G_2		D_{35}	D_{42}	D_{49}	D_{56}	
Egg weight(g)	56	12.5 ± 1.22^b	8.3 ± 1.21^c	10.2 ± 1.23^a	**	7.5 ± 0.61^d	8.7 ± 0.82^c	10.1 ± 1.32^b	10.9 ± 0.17^a	*
Egg length(cm)	56	3.8 ± 0.18^b	2.9 ± 0.11^c	3.4 ± 0.22^a	*	2.8 ± 0.14^d	3.1 ± 0.08^c	3.6 ± 0.11^b	3.9 ± 0.13^a	*
Egg width(cm)	56	2.9 ± 0.18^b	2.4 ± 0.18^c	2.6 ± 0.24^a	**	2.3 ± 0.21^c	2.5 ± 0.31^b	2.3 ± 0.09^c	3.1 ± 0.15^a	*
Yolk weight(g)	56	5.1 ± 0.26^b	3.7 ± 0.25^c	4.4 ± 0.23^a	*	3.1 ± 0.32^d	3.8 ± 0.24^c	4.5 ± 0.21^b	4.8 ± 0.31^a	*
Yolk length (cm)	56	1.6 ± 0.21^a	1.3 ± 0.12^b	1.3 ± 0.13^a	*	1.3 ± 0.12^d	1.4 ± 0.21^c	1.6 ± 0.32^b	1.7 ± 0.11^a	*
Yolk width (cm)	56	2.3 ± 0.13^a	2.2 ± 0.13^b	2.3 ± 0.14^a	*	2.2 ± 0.13^b	2.3 ± 0.22^a	2.2 ± 0.14^b	2.3 ± 0.13^a	*
Albumen weight	56	3.6 ± 0.12^b	3.2 ± 0.12^c	3.3 ± 0.13^a	*	3.0 ± 0.11^d	3.2 ± 0.34^c	3.4 ± 0.14^b	3.5 ± 0.13^a	*
Albumen length	56	0.3 ± 0.15^b	1.0 ± 0.22^a	0.3 ± 0.09^b	*	0.3 ± 0.02^b	0.3 ± 0.12^b	0.3 ± 0.11^b	1.2 ± 0.17^a	*
Albumen width	56	3.1 ± 0.13^b	3.0 ± 0.04^c	3.3 ± 0.22^a	*	2.5 ± 0.04^d	2.9 ± 0.23^c	3.5 ± 0.22^a	3.4 ± 0.13^b	*
Shell weight(g)	56	0.5 ± 0.02^a	0.4 ± 0.02^a	0.3 ± 0.09^b	*	0.4 ± 0.51^a	0.4 ± 0.11^a	0.3 ± 0.02^b	0.3 ± 0.05^b	*
Shell thickness	56	0.2 ± 0.02^b	0.3 ± 0.04^a	0.2 ± 0.04^b	*	0.4 ± 0.04^a	0.3 ± 0.02^a	0.2 ± 0.04^b	0.1 ± 0.02^c	*

Means for each trait within generations and ages with different superscripts differ*= ($P< 0.05$),**=($P< 0.01$); LoS= Level of significance, G_0=Generation of unselected parent; G_1=Generation one, Generation two N=number of birds observed.

increases at day 49 and decreases at day 56. Shell weight increases as from day 35 by 11.2 then decreases at day 49 while same values are recorded at day 49 and 56. Shell thickness shows continuous decrease with increase with advance in age.

Response to selection in hatchability performance in generations of Japanese quail is shown in Table 4. The result indicated negative response in percentage fertility and hatchability while percentage death in shell, death in egg and infertility shows positive response. The percentage fertility and hatchability in second generation (G_2) where higher than first generation (G_1) while percentage death in shell, death in egg and infertility where lower in G_2 than G_1.

Table 4: Response to selection in hatchability performance in Japanese quail

Traits	Generations		Response to selection
	G_1	G_2	
% Fertility	86.33	91.36	-5.49
% Hatchability	56.91	76.60	-25.70
% Death in shell	13.54	8.09	67.37
% Dead in Egg	15.88	9.67	64.22
% infertility	13.67	9.22	48.26
G_1= generation of selected one, G_2= generation of selected two			

Table 5: shows the realized heritability of egg number and age at sexual maturity in female Japanese quail and it was observed that heritability was high. The response to selection mean and percentage values were negative in egg numbers while response to selection in age at sexual maturity in females mean and percentages were higher than selection differential mean and percentage values which are negative.

Table 5: Realized heritability of egg number and age at sexual maturity in females Japanese quail

	Response to Selection		Selection Differential		Realized h^2
	Mean	%	Mean	%	
Egg number (n)	-14	0.38	-288	0.42	0.05
Age Sexual maturity female	0.32	0.75	-1.36	-3.32	0.23

The realized heritability of egg traits in Japanese quail is shown in Table 6. The result indicated that realized h^2 values were low in most of the traits except albumen weight, albumen width that are moderately high while egg weight, egg length, yolk weight, yolk length that are high. The response to selection mean values of albumen length, shell weight, shell thickness is negative. The response to selection mean values for egg length, egg width, yolk weight and percentage values for egg width, albumen thickness were higher than selection

differential mean and percentage verse vassal.

Table 6: Realized heritability of egg traits in Japanese quail

Traits	Response to Selection		Selection Differentials		Realized h^2
	Mean	%	Mean	%	
Egg weight	2.0	19.61	4.2	34.40	0.48
Egg Length	0.5	14.71	0.9	23.68	0.55
Egg width	0.5	17.24	0.2	7.69	0.07
Yolk weight	0.7	15.91	1.4	27.45	0.50
Yolk Length	0.3	18.75	0.4	23.53	0.74
Yolk width	0.1	4.35	0.1	4.35	0.02
Albumen weight	0.1	12.12	0.4	11.11	0.25
Albumen Length	-0.2	66.67	0.2	66.67	0.01
Albumen width	0.1	3.23	0.3	9.09	0.33
Shell weight	-0.1	33.33	0.1	20.00	0.01
Shell thickness	-0.1	50.00	0.1	33.33	0.01

The realized heritability of egg production in Japanese quail is shown in table 7. The result indicated that h^2 for traits were high except egg at day 49d. The response to selection mean values were negative for egg at day 42, 49 and 56d while for selection differential for egg at day 42 and 49d. The percentage values for egg at day 35 and 56d were lower than those of the selection differential.

Table 7: Realized heritability for egg production

Day(d)	Response to Selection		Selection Differentials		Realized h^2
	Mean	%	Mean	%	
Egg 35d	77	31.82	101	37.97	0.76
Egg 42d	-82	9.43	-37	4.04	0.45
Egg 49d	-163	13.37	-64	4.86	0.03
Egg 56d	-59	5.08	98	60.20	0.60

4.2 Discussion

4.2.1 Egg Production

Selection for increased body weight for egg production significantly affects base, first and second generations as 3706, 3418 and 3692, respectively as indicated in table 1. There was more egg production in first generation than the second and base generation. The finding suggested that selection for body weight lead to decrease in egg number. This is similar to finding [3] who have stated that in turkeys, selection for increased body weight resulted in decreased egg production, intensity of lay. [38] stated that in Japanese quail, selection for increased

body weight under different nutritional environments resulted in decreased egg production. This is contrary to finding of [39 – 40]. Reference [4] observed improvement in indigenous chickens through selective breeding. The finding of the earlier studies conducted by indicated significant (P< 0.01) improvement in egg yield of Desi generation- chickens in comparison to their parents as stated [5 – 6]. The Birth weight was lower in first generation (7.40g) than the base (8.80) and second (7.90) generations. This suggested that selection for body weight positively affects Birth weight. This possibly may be maternal effects improvement as a result of selection that may have brought about better birth weight at day old chick. Therefore the development of village chicken through pure breeding and selection could be undertaken for poultry improvement. References [4] observed that through natural selection, the population preserves and accumulates traits that are beneficial and rejects those that are detrimental in their prevailing environments. The surviving populations are able to contribute more genes associated with beneficial traits for increased fitness to subsequent generations.

Effect of Body Weight Egg Traits

The egg production and weight trait in Japanese quail is shows in Table 2 as they advance in age. The results indicated that advances in age for a set of generations led to the average weekly egg production increased. While selection for body weights for the first generations base on average weekly egg production was lower than the base and second generation. The improvement in egg weight as bird advances in age is as a result of increased in body weight as birds also advances in age. The improvement of egg size and its components are influenced by number of genetic and non-genetic factors, this agrees with findings of [7]. Increase in body weight lead to decreased in egg number in this study. Contrary reports [42- 44] stated that egg production was not affected by body weight. However, References [45 , 46] found that body weight was positively related to egg production. [8] reported that egg production decreased depending of selection as to body weight of quails increased.

The strong and positive genetic relationships as observed between egg traits at various ages could mean that the same genes are controlling egg traits at different ages. The low egg number obtained in second generation might be as a result of delay in sexual maturity especially during the later months of selection experiment. Another factor that may have contributed to the variable response achieved from generation to generation may also be due to laying season of hatching across generations (hatching could be during the hot dry, rainy or cool dry hamattan period).

4.2.2 Egg Quality Traits

The least square mean for egg quality of traits n Japanese quail as shown in table 1 indicated that there was improvement base on age for the egg traits at day 35, 42, 49 and 56d. The improvement means that egg quality traits were affected by the age of the quails, except egg width and yolk width, albumen length, shell weight and shell thickness which were affected by increased and decreases in size and weight. A lot of authors [9 – 14] reported that egg weight continuously increasing with increasing in age. Shell thickness in this research finding shows continuous decrease with advance in age of the quail which is similar to the finding of [15].

The egg quality traits value on generation one is lower than the base and second generations. This shows that

selection for high body weight influence the generation of egg traits positively. This is similar to other researchers who stated that there was improvement in traits of Japanese quail [16 and 17]**.**.

4.2.3 Response to Hatchability in Japanese quail

The response to selection base on high body weight and the effects on hatchability on Japanese quail is shown in table 4. The % dead in shell, % dead in egg and % infertility responded positively. The increase in hatchability and fertility could be attributed to improvement in incubating conditions over generations. The values reported for the two traits are below the range reported in the literature especially study by [18] and [19] reported 72.20% and 73.20%, respectively for hatchability percentage in Japanese quail in second generation but low 56.91% in this finding. Furthermore, Reference [47] reported a wide range for this traits (68.20 -78.50) during three consecutive generations while low ranges of 45.50 and 50.80% were reported by [8]. The wide differences in reported values for fertility and hatchability could be attributed to water loss during incubation and other environment differences. Water loss is a normal process during incubation; usually 11.32% of water is lost in quail eggs. However, too low or too high water loss influences embryo development and consequences, egg hatchability [48].

4.2.4 Realized Heritability of Egg number and Age at Sexual Maturity in Female Japanese quail

The realized heritability of egg number and age at sexual maturity in female Japanese quail shown in table 5 indicated that realized heritability was very low 0.05 in egg number and 0.23 in age at sexual maturity. The realized h^2 values obtained for age at sexual maturity in the present research was lower than the finding of [20] which h^2 estimates was 0.48. The low h^2 values obtained in this research appear that additive genetic effects were more important in affecting egg number and age at sexual maturity than do environmental and non-additive genetic effects.

4.2.5 Realized Heritability of Egg Traits Japanese quail

The realized heritability of egg traits in Japanese quail shown in table 6 indicated that h^2 values are low in egg width, yolk width, Albumen length, Shell weight and Shell thickness as 0.07, 0.02, 0.01, 0.01 and 0.01, respectively. The h^2 values reported on shell weight in this research was lower than the 0.25 reported by [24]. There was moderate realized for albumen weight and albumen width as 0.25 and 0.33, respectively. [24] reported h^2 value to be 0.35, 0.31 and 0.25 which is similar to this finding. However, h^2 values were obtained in egg weight, egg length, yolk weight, yolk length to be 0.48, 0.55, 0.50 and 0.74, respectively. Reference [22] reported h^2 values in yolk weight to be 0.68 which is similar to the present finding. The heritability estimates for egg weight in laying Japanese quail was reported to range between 0.35 – 0.62 as stated by [23 - 25]. Similarly, variable h^2 estimates were reported by a number of scientists regarding egg weight [2, 26, 27, 22, 28] recorded the h2 estimates 0.31, 0.25, 0.54, 0.49 and 0.52 – 0.91, respectively.

The lower h^2 values in some of the traits in the present study might be due to decrease in additive genetic variance. While the moderate to high h^2 values might be because of some environmental factors and some non additive genetic affects that causes and continuous selection might remedy the situation for better productivity.

4.2.6 Realized Heritability for Egg Production

The realized h^2 for egg production in Japanese quail showed in table 7 were high except egg at day 49 (0.03). The high realized h^2 may likely be as a result of some environmental factors and management. Literature on h^2 for egg production in quail was dearth, other investigator stated that in turkey little or no association between egg production and body weight was observed in earlier selection studies during the first few generations of selection for either increased egg production or increased body weight [31]. Reference [32] estimated genetic relationship between bodyweight and egg production.

5. Conclusion and Recommendations

5.1 Conclusion

Selection for increased body weight for egg production and advances in age led to lower egg production in the base and second generation than first generation. The realized h^2 in egg number was low (0.05), age at sexual maturity in female (0.23) and lower h^2 was obtained for most of the egg quality traits (0.01 – 0.07). Apart from the age at sexual maturity which h^2 is moderate the low realized heritability obtained for egg number and egg quality traits implies that response to selection for the traits that are low could be slow for the traits.

5.3 Recommendations

The study was limited to short term selection, therefore form a foundation study for long term selection on body weight on generations of Japanese quail. It is recommended in this study that selection for high body weight to improve on the traits is a slow process therefore selection to improve on the traits may occur over time because the same genes are controlling the traits positively.

Acknowledgments

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